

THE MARCONI REVIEW

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THE MARCONI REFLECTION SOUNDING DEVICE

Reflection sounding, that is to say the method of determining the depth of water under a ship by measuring the time taken for a disturbance in the water to travel from the bottom of the ship to the bottom of the sea and thence back again to the bottom of the ship, was first proposed many years ago, but has only recently become a practicable proposition.

There are many well known and effective methods of transmitting a suitable disturbance through the water, and also of receiving the reflection on its return, but the problem of measuring accurately the very small interval of time between the transmission of the disturbance and the receipt of the reflection presents considerable difficulties.

These difficulties have been largely overcome in the Marconi Sounding Device, a description of which is given below.

THE velocity with which a compression wave travels through water is well known, and is constant under given conditions of temperature and salinity. For the purposes of navigation this velocity can be taken as 4,900 feet per second, the variations from this velocity being very slight on the high seas. In unusually fresh water, such as the Baltic, or in unusually salt water, such as the Mediterranean, small errors may be found, but these errors are well known and are constant. When using an instrument calibrated for average ocean water, the soundings recorded when in the Baltic would be four per cent. more than the actual truth, and in the Mediterranean they would be one per cent. less than the actual truth. For the ordinary purposes of navigation there is but little interest taken in depths exceeding 100 fathoms, and at this depth the time to be measured is 245 milli-seconds. The time to be measured in, say, 5 fathoms is only 20.5 milli-seconds. These measurements only give the depth of water beneath the instruments, so the depth of the instruments under water has to be added to the depth of water under the instruments to obtain the depth of water measured from its surface, which is the measurement given on the charts.

Next in importance to the problem of the measurement of very small periods of time, comes the problem of avoiding the receipt of false signals, that is to say signals

which are not the true reflection of the original transmission. This problem is analogous to the wireless problem of selective tuning, and the solution must depend upon the nature of the disturbance originally imparted to the water. If this disturbance is rhythmic then the properties of resonance can be made use of to provide some degree of selective tuning, if it is strictly aperiodic the effects of resonance will not be available.

If shallow depths are to be measured, the total period during which each transmission is to last must be very small. A transmission lasting $1/40$ th of a second will hinder the reflection being distinguished from the transmission at any depth less than 10 fathoms (below instruments) because the first waves of the reflection will have reached the receiver before the last waves of transmission have got away. Therefore, the frequency of the transmitted disturbance must be high if sufficient crests are to be made use of to allow the full value of resonance to be obtained.

For instance, if it is required to measure five fathoms below the instruments, and if it is assumed that five crests are sufficient to develop the effects of resonance adequately for selective purposes, the convenient limit of frequency is 400 per second.

In practice there is usually a persistence of comparatively feeble oscillation after the main part of the transmission has ceased, which sets the limit of frequency even higher. Probably about 1,000 per second is the least which is desirable for sea-going purposes, unless the transmitter and receiver are widely separated.

Definite advantages can be gained by increase in frequency, the limit beyond which the frequency cannot profitably be increased being reached when the attenuation of the wave—which increases with its frequency—becomes serious.

The chief advantage of high frequencies for sounding work lies in the fact that directional transmission becomes practicable. The factors which make for directional transmission are naturally proportional to the wave length, and at high frequencies the mechanical dimensions of a directional transmitter become easily manageable. The optimum frequency for this purpose is probably about 40,000 per second, which corresponds to a wavelength through the water of 3.7 centimetres. At frequencies above this figure the attenuation becomes serious, and at substantially lower frequencies the apparatus necessary to produce highly directional effects becomes too large for convenience.

Accuracy of Reflection Sounding.

The degree of accuracy with which soundings can be measured depends upon two things—the certainty with which the velocity of the compression wave through water is known and the accuracy of the chronograph employed.

For all practical purposes, human knowledge of the first of these two is accurate enough. The temperature correction is negligible, and if due regard is paid to what may be called the "Baltic" and "Mediterranean" corrections, errors due to this cause will be less than 1 per cent., an error which is of no account to the navigator.

The Marconi Reflection Sounding Device.

It is impossible to take a sounding by other means with sufficient accuracy to check observations, and errors of 1 fathom in a hundred, or of 7 inches in 10 fathoms, are not very serious.

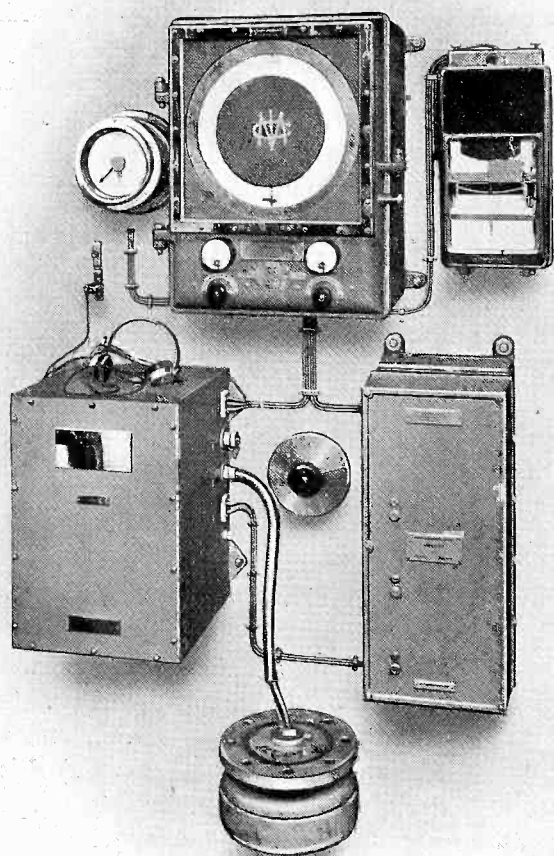


FIG. 1.

impulse of reception. The resulting total error is due to the difference between two periods, both insignificant, and the difference between these two may be properly regarded negligible.

Careful examination of the completed instrument shows that the shortest period of response of the moving parts is not less than 1 milli-second, and that the longest period of response does not exceed $2\frac{1}{2}$ milli-seconds, leaving a maximum possible error of less than 1 fathom. So great an error as this will only occur when sounding in

The accuracy of the chronograph depends upon its construction and on the ease with which its scale can be read under seagoing conditions. The instrument supplied by the Marconi Company is peculiar in the latter respect because its pointer is brought to rest at the sounding as measured and is held there for several seconds, so that no errors can arise in reading the instrument. The accuracy of the chronograph itself is dependent on its own behaviour, that is to say on the constancy with which its moving parts can maintain their speed and on the limitation to some insignificant period of the time taken for it to respond to the impulse received from the transmission or from the reflection. Errors of this nature are further reduced by setting the error due to the time of response to the impulse of transmission, in opposition to the error due to the time of response to the

Operation of Indicator.

The sequence of actions taking place in the indicator is as follows :

In the position of rest the change over relay tongues connect the drive winding in the valve circuit, also the operating coil of the change over and drive relays.

At the moment of transmission there is a surge of current in the anode circuit of the indicator valve. This causes several simultaneous sets of movements.

- (A) The drive magnet seizes the pointer disc, and therefore it begins to rotate.
- (B) The change over relay operates, removing the drive circuit from the valve circuit and replacing it by the brake relay operating coil. It also closes the dimmer contacts.
- (C) The drive relay closes and completes the circuits through its own hold on winding, the drive hold on winding, and the change over relay hold on winding. This keeps the change over relay locked in its new position, and also keeps the disc and pointer locked to the pot magnet on the flywheel. The pointer therefore continues to travel round the scale. The pull of the drive hold on is adjusted by shunting it with a variable resistance. This is a semi-permanent adjustment.

In order that all the above movements shall be quick enough, all the windings are energised at 105 (or 210) volts. The value of the current is kept down to the correct figure by permanent resistances, except in the case of the circuits operated by the anode current of the indicator valve.

As soon as the reflection is received a second surge of current takes place in the anode circuit of the indicator valve, which now includes the operating circuit of the brake relay. The brake relay therefore closes (if the current is sufficient) and the following simultaneous effects are produced.

- (A) The brake relay hold on winding is excited, thus locking the brake relay.
- (B) The brake magnet winding is excited, and kept excited, so that the disc and pointer are captured from the drive magnet, against the attraction of its hold-on, and are held locked until the time comes for the various circuits to be demagnetised.

The distance travelled by the pointer is a measure of the time between transmission and the return of the reflection. As the speed at which a disturbance travels through the body of water (not along its surface) is well known, the scale can be graduated so that the pointer indicates fathoms.

The Marconi Reflection Sounding Device.

Working of Pointer.

The following arrangements are made for working the pointer :—

The pointer is returned to zero by two helical springs pulling round a small drum held to the pointer spindle by a grub screw.

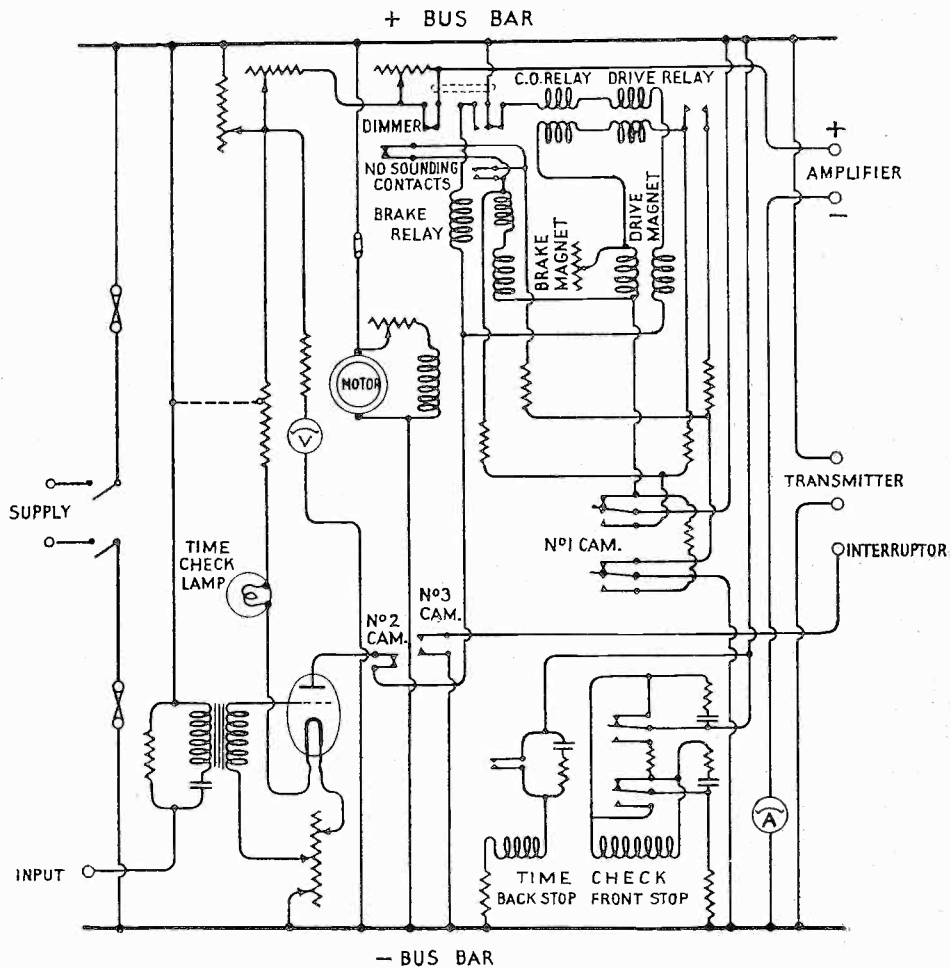


FIG. 4.

The pointer itself is held to the spindle in a similar manner. The position of rest of the pointer is adjustable by means of a screw knob on the right side of the indicator case. This is necessary because the sounding is actually measured from the face of the projector, which is in the bottom of the ship, and the pointer must be set so that it starts from a position on the scale corresponding to the depth of the projector below water—that is to say, the draught of the ship.

The Marconi Reflection Sounding Device.

The pointer spindle also carries a toggle arm which bears against and closes a pair of contacts when the pointer has travelled to the full extent of the scale. These contacts, called the No Sounding contacts, are in parallel with the contacts of the brake relay. When they close the pointer is captured from the drive magnet and held locked at No Sounding, thus indicating that no depth has been measured, and at the same time protecting the pointer mechanism from injury.

Check on Speed of Rotation.

It is obviously necessary that the flywheel should be running at the correct speed. A look-out is kept on this point by a device known as the time check, which operates as follows :—

It consists of a disc having at its centre an axle running in agate bearings, which is kept turned in one direction against a magnetic back stop by the action of a spiral spring. There is a projecting spring leaf on this disc, which is struck a light blow by a projection on the flywheel once in each revolution. This light blow drives the disc round on to another stop, which is also magnetic. This magnetic front stop catches and holds on to a pallett on the disc until such time as the projection on the flywheel reaches a set of contacts which break the circuit through the front stop magnet windings and also demagnetise it by reverse current. At this moment the time check disc is released and the spiral spring on the time check causes its disc to return to the back stop. There is a small hole pierced in the time check disc and there is a window in the edge of the flywheel and another in the scale plate. When these three are in line a ray of light from a small lamp can shine through them all. This lamp is in series with the indicator valve and acts as a telltale for its filament. The time taken for the time check disc to turn far enough from the front stop to bring its hole up into line with the ray of light is sufficiently nearly constant, and if the flywheel is moving at the right speed it will bring its window into line with the ray of light at the same moment as the hole in the time check disc passes across it. In other words, if the flywheel is going at the correct speed the same time will elapse between its projecting striker operating the demagnetising contacts of the time check front stop and its window coming into the ray of light, as elapses between the front stop being demagnetised and the hole in the time check disc coming into the ray of light.

The window in the flywheel is very wide, and its leading and trailing edges are filled in with red and green celluloid, so that if the flywheel is going too fast the ray of light will shine through the red portion of the window and the flash will be red ; if the flywheel is going too slow the flash will be green. The clear centre of the window is so narrow that if the flywheel is making half of a revolution too many per minute there will be a tinge of colour in the flash, and the coloured parts of the window are wide enough to show a flash of the appropriate colour if the flywheel speed is six revolutions per minute wrong.

The Marconi Reflection Sounding Device.

In order to avoid useless mechanical shock, the circuit of the time check back stop is broken just before the projection on the flywheel strikes the spring leaf, the contacts being actuated by a special wedge on the edge of the flywheel.

All the contacts controlling the time check stops (three sets in all) are provided with anti-sparking shunts and condensers. The time check stops are mounted on resilient seatings so as to reduce the noise and shock.

The two arms which carry the time check stops can be moved round their axis, so as to adjust the violence with which the spring leaf on the disc is struck. It is clamped in place at one central and one other point. The blow should only just be sufficient to drive the disc round to the front stop.

The pull of the time check spiral spring can be adjusted by turning a knurled washer carrying the anchor pin for the outer end of the spring. This washer is held by friction washers and will remain wherever it is put.

This disc permits the whole time check mechanism to be adjusted so that the flash will be white when the flywheel is running 68 revolutions per minute.

Operation of Cams.

The set of repeating cams operate as follows. No 1 cam is called the de-mag cam and it operates what is in effect a two-pole two-throw switch. When the cam rollers are riding on the high part of the cam the contacts are made so as to bring the magnet and relay circuits into action at the working polarity. When the cam rollers slip down to an intermediate level the circuits are opened, and as the cam rollers pass over the low level the circuits are momentarily closed at the reverse polarity. A separate set of resistances are used for the "de-mag" current so as to permit of compensation for any variations in the samples of iron in use.

No. 2 cam completes the H.T. circuit of the indicator valve, and opens it again after about $1\frac{1}{2}$ seconds.

No. 3 cam operates the sounding contacts, which are closed at the moment when the sounding is required, and remain closed for about one second.

The setting of the cams is such that the "de-mag" cam contacts close to the working polarity, and the H.T. circuit to the indicator valve is completed at the same moment. The sounding contacts close immediately after.

Minor Controls. Volts Control.

As stated above, the whole outfit is adjusted to work correctly at 105 (or 210) volts, and a rheostat is provided so as to adjust the mains or battery volts available to this figure. This handle is at the left hand lower corner of the indicator, with a voltmeter immediately above it.

There is a tell-tale ammeter which shows the total amplifier current. This should be 0.41 at "bright." There is a semi-permanent resistance in series with the

amplifier to allow of this figure being corrected. If the filament of the P.240 valve in the amplifier has failed, the ammeter will read about 0.25. If the rectifier filament has failed the ammeter will read 0.3 about. If one or other of the S.215 filaments have failed the ammeter will also read about 0.25.

The dimmer resistance which is used to deaden the amplifier during the shock of emission is in series with the amplifier resistance. It is short circuited by the dimmer contacts of the change over relay at the moment when the latter changes over from drive to brake. When in circuit the dimmer resistance should reduce the amplifier current from 0.41 to 0.36 or 0.37.

Time Check Control.

This is simply a field regulator for the motor, and is used to regulate the motor speed in accordance with information given by the colour of the time check flash. If the indicator has been standing for a long time in cold weather it is sometimes necessary to turn the time check control handle as far as it will go to the right before the motor will start.

Main Switch and Fuses.

The mains are brought directly into the terminal board in the back of the indicator case, thence to a double pole switch worked by push buttons in the face of the indicator, thence to a pair of fuses, and thence to distribution bus-bars.

There is a link in the main motor circuit, which can be taken out if it is desired to test the indicator without running the motor.

Indicator Valve Circuit.

The filament is heated directly from the mains through a suitable fixed resistance. The time check lamp is in this circuit immediately on the positive side of the valve filament, and there is an adjustable resistance between the negative side of the filament and the negative bus-bar. The grid connection is taken to a slider on this resistance so as to apply a suitable bias to the grid.

The Marconi Sounding Apparatus is now installed in several trawlers, and is giving a valuable service. Even under the very severe conditions of trawler working the installations are keeping up to the level of performance required, which is "two accurate soundings per minute." The apparatus is designed to operate four times per minute and even under very bad conditions accurate soundings are obtained on average twice a minute, the remaining indications being "No Sounding."

There are occasions when the indicator shows a *false* sounding, but these are isolated and very few in number. They can easily be recognised by their wide departure from the probable depth and are in no way misleading.

J. A. SLEE.

A LOW POWER NAVAL TRANSMITTER

TYPE T.N.5A

The demand for low power transmitters suitable for installation on tugs, naval pickets and motor boats is rapidly increasing and in connection with this the Marconi Company has developed a small transmitter, known as the T.N.5A, which can also be used as an auxiliary set on larger vessels.

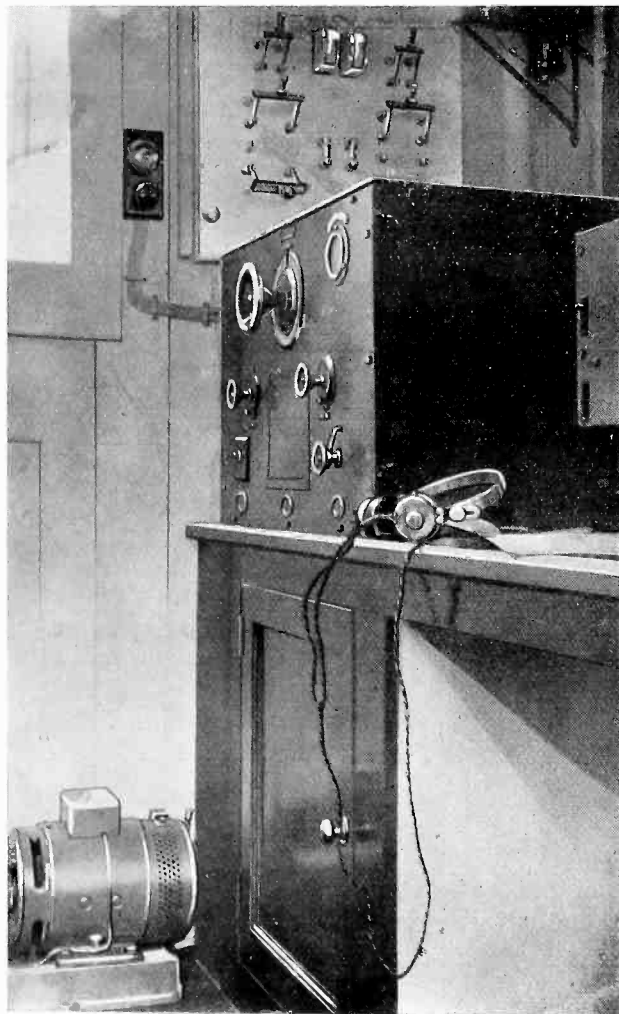
THE type T.N.5A transmitter is designed for signalling by telegraphy only either on the I.C.W. or C.W. systems. A photograph of the transmitter installed in a naval tug is shown and the simplicity and compactness of the design will be

apparent. All the controls are mounted on the front of the transmitter, including a power regulating control, and the component parts are fitted in a rigid iron framework and enclosed by protecting panels.

The transmitter is designed to cover a waverange of from 400 to 1,200 metres, and the working range over sea under ordinary conditions when using full power is of the order of 100 nautical miles.

The transmitter is nominally rated as a 200 watt set, this being the approximate power supplied by the H.T. D.C. generator which is used for supplying the voltage to the anodes of the valves. The standard motor generator supplied with the set delivers a high tension voltage of 800-1,500 volts at 150 m/a, and a low tension voltage of 8-12 volts at 12 amperes.

Alteration of power is



accomplished by increasing or reducing the H.T. voltage and, if necessary, by altering the coupling between the closed circuit and aerial circuit. 2 type M.T.11 valves are used in the transmitter.

Technical Description.

A wiring diagram of the set is given in Fig. 1 and the circuit will be seen to consist of a high frequency oscillator and low frequency modulator for I.C.W.

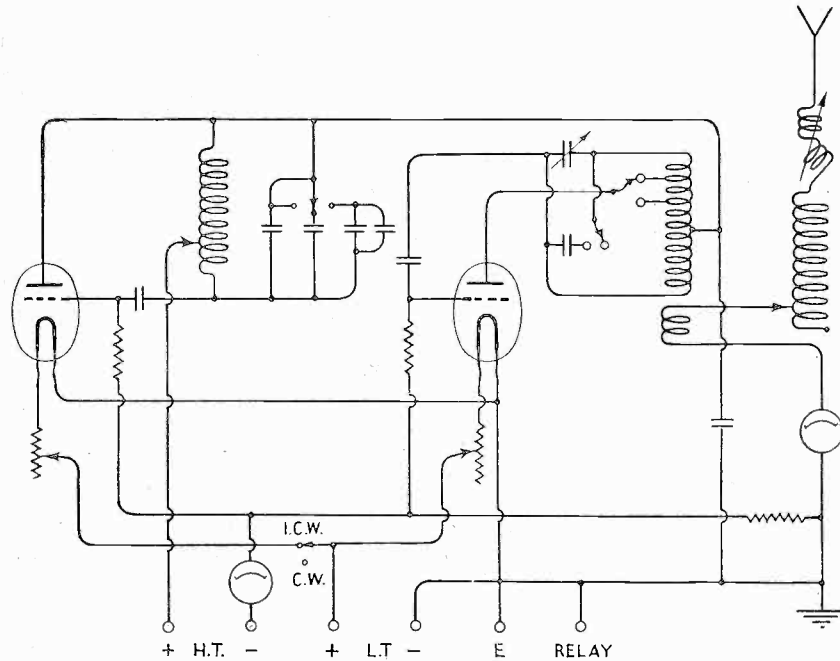


FIG. 1.

signalling. The high frequency valve is fed through a portion of the low frequency tuning inductance and the H.T. supply to the anode of the high frequency oscillator is thus modulated at audio frequency. A choice of 3 notes is provided on the audio frequency oscillator, and the required note may be selected by a switch which connects one of three condensers across the oscillating circuit. Normally the three notes provided are 600, 900 and 1,200 cycles per second.

In the case of continuous wave working the filament of the modulator is switched off and the feed to the high frequency oscillator is then unmodulated. The aerial tuning inductance is provided with a number of tapping points for coarse wavelength adjustment, and a variometer for final adjustment. The aerial circuit is coupled to the closed circuit of the high frequency oscillator which is tuned by means of a variable condenser.

A Low Power Naval Transmitter. Type T.N.5A.

Keying is accomplished by inserting a high resistance in the common lead from the filaments which are earthed to the grids of the two valves and the negative high tension. A relay is provided for this purpose and contacts for "listening through" are also mounted on this relay and switch the aerial from the transmitter to the receiver during "space" periods.

INFLUENCE OF BEAM AERIAL HEIGHT ON SIGNAL INTENSITY

With the increasing use of the Marconi type of Beam Aerial array, the question often arises as to the probable improvement which would result as the height of the aerials in the array were increased.

As an illustration of what might be expected, a case is given below which considers the effect of increasing the height of each aerial from 1λ to $2\frac{1}{2}\lambda$.

IN order to obtain an estimate of the maximum gain that could accrue from using large heights of aerial, the following ideal case may be considered, after which the modifications necessitated by practical requirements can be taken into account.

Consider an array of aerials of n_1 wavelengths horizontal aperture and n_2 vertical aperture isolated in space, and let the receiver be on the line perpendicular to the plane of the array Fig. 1. Then in the limit when n_1 and n_2 are large the amount of power necessary to produce a given signal is inversely proportional to $n_1 n_2$. It therefore follows that in comparing the performance of any two arrays it is the areas of the two that must be compared. A reduction in breadth of the array could be compensated for by an equivalent increase in height.

In this ideal case the gain is occasioned by the fact that all the component parts of the array, whether arranged vertically or horizontally, conspire to produce radiation in the direction OR, and cancel to a greater or less extent by phase opposition in directions other than OR.

A theoretical and experimental check, with regard to the effect of increasing height, on this result has been published in I.E.E. Proceedings* in which an aerial $\frac{1}{4}\lambda$ high was compared with one $\frac{1}{2}\lambda$ high; the theoretical magnification is 1.7 and the observed value 1.6. The approximate theoretical curve is shown in the Fig. 4, in which it appears that the gain of a full wave over half wave uniform aerial is 2/1.

To obtain the whole benefit of the concentration by increasing n_2 , the vertical height, the whole of the energy must be transmitted along OR.

In any actual case we know, chiefly from various impulse and facsimile measurements, that the energy proceeds from the transmitter to receiver by a series of ricochets between the earth and Heaviside layer. This is illustrated in Fig. 2.

*"Design of Transmitting Aerials for Broadcast Stations."

Influence of Beam Aerial Height on Signal Intensity.

The whole energy is by no means carried along the ray OR. The useful rays form a sheaf in the vertical plane containing transmitter and receiver. The magnification in the vertical plane depends on the angular opening θ of this sheaf of rays Fig. 3. Thus, if they deviate but little from the horizontal direction OR practically the full magnification will be obtained. The vertical magnification of the beam depends upon the mode of transmission. This depends on wavelength, distance, etc.

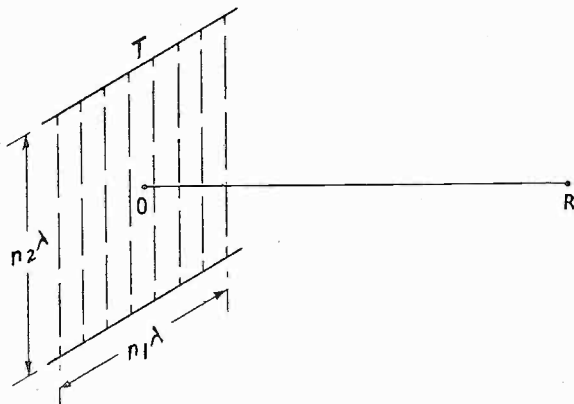


FIG. 1.

Experiments made with a view to determining the angular width of the sheaf of rays by balancing a frame and vertical aerial, which are described in the writer's "Short Wave Wireless Telegraphy," I.E.E. Journal, June, 1927, p. 607, show that for distances of 2,000 km. and more the rays which carry the main energy are confined to a sheaf with a small angle of elevation, i.e., not greater than 20° . For this deviation from the horizontal

(if the direction of propagation of the aerial is slightly elevated) the directive efficiency in the vertical plane is near its ideal value, so that the gain of a 2λ to 2.5λ height aerial over one of $h = \frac{1}{2}\lambda$ is approximately 2 to 2.5 to 1.

Experiments prove therefore that in the majority of cases of medium and long distance transmission the gain of raising the height of the aerial will be nearly in proportion to the height of the aerial, that is for heights of $\frac{1}{2}\lambda$ and more.

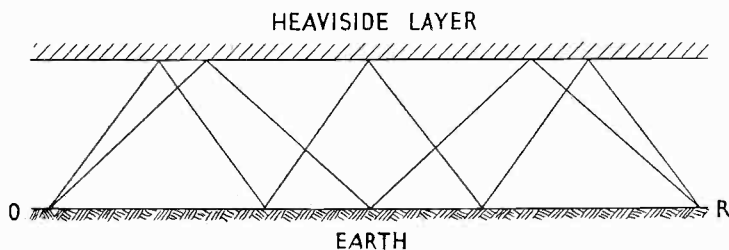


FIG. 2.

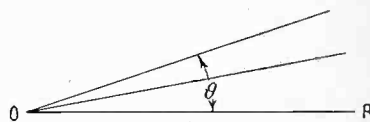


FIG. 3.

Evidence that the gain on raising the height of the aerial is close to its theoretical value is published in a pamphlet of Bell Laboratories on "Short Wave Transatlantic Radio Telephony," where measurements are quoted giving the gain on raising the height of the aerial. Indirect experiments showing the same effect are published in the writer's paper "An Investigation of Short Waves," where it is shown, p. 998,

Influence of Beam Aerial Height on Signal Intensity.

that the E.M.F.'s on two half wavelength aerials stacked vertically are practically equal and additive in phase, thus proving that the main energy of long and medium distance circuits is transmitted along nearly horizontal rays, for which the magnification on raising the aerial vertically approaches its theoretical value.

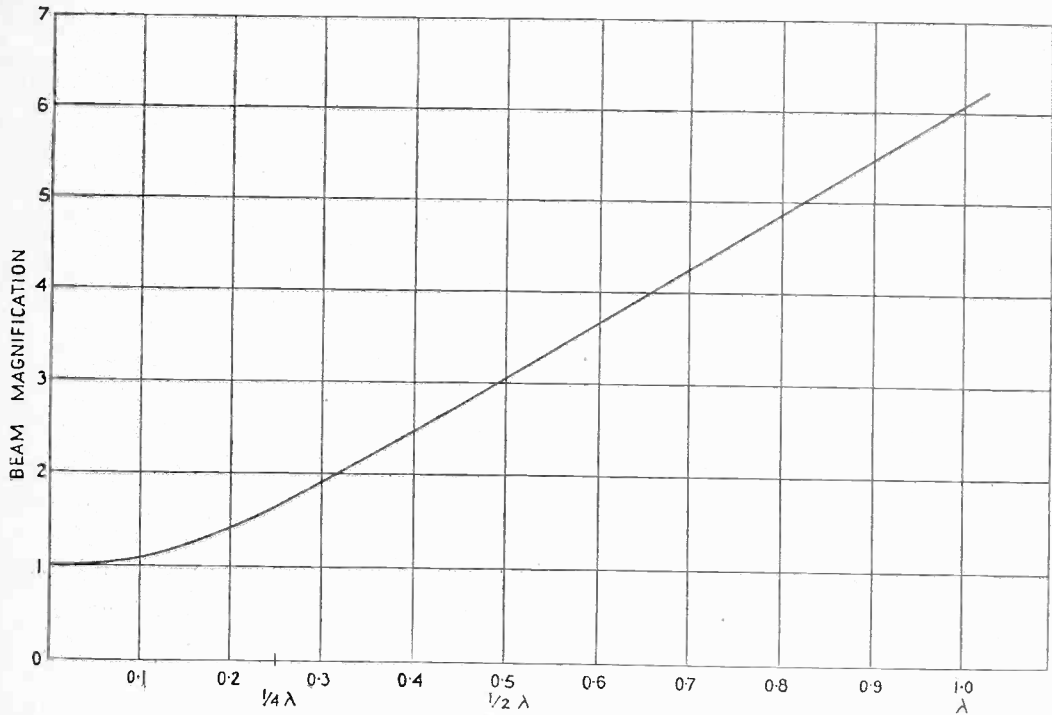


FIG. 4.

In spite of this high angle radiation may be present on the 24 to 29 metre from time to time, but for high speed working it is an advantage to cut out the higher angle rays (by using the vertical directivity of the high aerial) even at the expense of some magnification. The reason for this is that the higher angle rays are delayed and tend to broaden the morse dots, and make such a heavy marking bias that high speed is impossible. For example, a ray at an angle of 60° will arrive $\frac{d}{c} \left(\frac{1}{\cos. 60^\circ} - 1 \right)$ sec. later than the direct signal (where d is the range), *i.e.*, 6.6 milli-seconds, which would spoil working at 150 w.p.m., and probably limit the speeds to less than 100 w.p.m. Such a disturbing ray at 60° would be very largely reduced by using an aerial 2λ to $2\frac{1}{2}\lambda$ high.

As an example, we may state that the theoretical gain of an aerial of 2λ aperture and from 2 to $2\frac{1}{2}\lambda$ high over a single $\frac{1}{2}\lambda$ doublet will be approximately from 4π to 5π , *i.e.*, 12.56 to 15.2, but the theoretical maximum gain will probably only be reached in exceptional cases.

T. L. ECKERSLEY.

THE MARCONI MARINE RECEIVER

TYPE 352

In order that a marine receiver shall be of the greatest service, two points have to be carefully considered:—

1. *It must be compact.*
2. *It must be simple in operation.*

In view of the extended waverange on which marine communication is now carried out, the Marine Receiver type 352 has been designed, together with a note filter which is of great use in separating the desired signal from others not desired, particularly at the longer wavelengths, and a separate heterodyne oscillator for reception of C.W. transmission.

The complete equipment to be described below consists of a two-valve receiver, type 352, a separate heterodyne type 357, and a note filter type 358. The receiver is capable of reception on all wavelengths from 15 metres to 20,000 metres, and the separate heterodyne possesses a wavelength range of from 200 to 22,000 metres.

THE receiver type 352 employs two valves, one as an oscillating detector and one as a low frequency amplifier. A diagram of connections is given in Fig. 1.

Either 2, 4 or 6-volt valves can be utilised as desired, although a 2-volt supply is recommended. The high tension voltage should be of the order of 72 volts.

Tuning is carried out by means of a set of induction coils and a variable condenser. On the short waves, i.e., from 15 to 200 metres, special plug-in inductances are employed, fixed inductance coils being used for the longer waves, the correct coil being selected by means of a switch.

The tuning condenser consists of two parts, one part having a maximum value of .001 mfd. and the other a value of .00015 mfd.

The moving plates of both the parts are connected to the rotating spindle which is earthed. The fixed plates of both parts are connected by way of a special switch to the grid of the detector valve, the appropriate set of fixed plates being connected for either long or short waves.

Reaction control is obtained by means of a variable condenser connected between the plate of the detector valve and a reaction coil, coupled to the grid circuit of the detector valve.

The detector valve output is coupled to the low frequency valve by an L.F. transformer. Low resistance telephones must be employed, a suitable telephone transformer being incorporated in the set, and across the secondary of this trans-

former is connected a high resistance connected as a potentiometer, which provides an effective means of varying the volume of the output.

A three-electrode or pentode valve can be used as the low frequency amplifying valve, a pentode valve being employed only when the service necessitates increased amplification. Normally the output from a triode will suffice, the amplification obtained being enough for ship board requirements. A rejector circuit is incorporated in the aerial circuit, and its function is to reduce interference on 600 and 1,000 metres. This circuit can be shorted by means of a switch when not required.

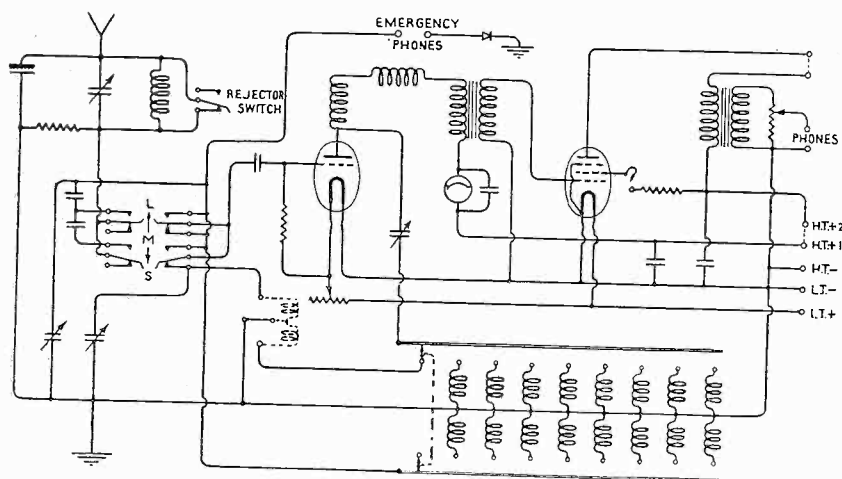


FIG. 1.

Two additional terminals are added to the receiver, and these permit the addition of a note filter, and are normally shorted by means of a link when the note filter is not in use. A milliammeter is connected in the plate circuit of the detector and indicates whether the detector is oscillating or not, and also determines if the detector valve has normal emission. A plug-in type of crystal is provided for emergency requirements.

Operation.

The operation and adjustment of this receiver will be found to be extremely simple. The valves are switched on by means of the "on/off" switch. The position of this switch is shown by an indicator in the small window on the face of the instrument.

The required waverange is selected by means of the multiple switch, or in the case of short waves by the correct plug-in coil. The aerial coupling switch is set to

“ S,” “ M ” or “ L,” according as short, medium or long wave waves are to be received. It should be noted that in the “ L ” or long wave position the switch connects the grid of the detector valve and the .001 tuning condenser to the inductance switch unit, and also connects the .00015 condenser in series with the aerial and the grid of the detector valve.

In the “ M ” or medium wave position the connections of the .001 mfd. tuning condenser and the grid remain the same, but a further .00004 mfd. condenser is placed in series with the .0001 mfd. condenser in the aerial circuit. In the “ M ” position the signal strength will be reduced, but the selectivity increased. For short waves, when the switch is in position “ S,” the grid of the detector valve and the .00015 mfd. variable tuning condenser are connected to the valve holder. On short waves it will be noted that the aerial is not directly connected to the detector grid. Reception is made possible by means of the capacity existing in the switch.

Having placed the aerial coupling switch to a suitable setting, the tuning condenser should be set to the required wave. Next, adjust the reaction condenser until the receiver is in its most sensitive state and keeping the most sensitive adjustment, search for the desired station. The rejector circuit, which covers waves from approximately 300-1,200 metres, is brought into use by the rejector switch, and by manipulating the rejector condenser interference from broadcast or beacon stations can be greatly reduced. It should be noted that after the rejector has been brought into use it is desirable to slightly readjust the tuning and/or reaction condensers.

Adjustment of the L.T. resistance assists in obtaining smooth reaction free from threshold howl, particularly on the short waves. The volume control enables strong signals to be reduced in strength whilst maintaining tuning and reaction adjustments.

Crystal reception can be obtained when the crystal holder is plugged into sockets marked “ crystal ” and the telephones connected to the terminals marked “ Emergency phones.” The crystal contact should be adjusted for best results, and tuning adjustments may have to be modified slightly.

A diagram of connections of the receiver is given in Fig. 1.

Note Filter Type 358.

For the separation of long wave C.W. stations which cannot easily be obtained by high frequency selectivity, a note filter has been designed.

In principle the note filter depends upon the selection of a particular low frequency note, say of 1,000 cycles frequency, in preference to any other low frequency note.

The method of obtaining the low frequency selectivity is by the use of three stages of low frequency transformers, the secondary of the transformer being tuned in each case to the required low frequency note.

The note filter may be tuned to accept any note from approximately 800 to 1,200 cycles.

The note filter is specially designed to be employed in connection with the type 352 receiver described above, and is suitable for working on either 2, 4 or 6-volt valves, the anode voltage being of the order of 72 volts.

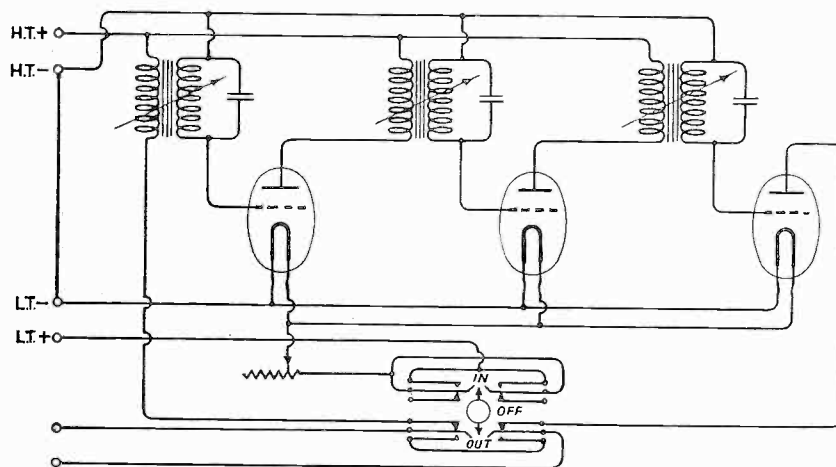


FIG. 2.

Technical Description.

The instrument consists of a front panel together with a base board upon which are mounted the component parts of the three-stage amplifier. The whole fits into a cast aluminium box and is designed to conform in general appearance to the receiver and separate heterodyne which will be described later.

The H.T. and L.T. terminals are on the right hand side of the box. There are no telephone terminals on the note filter as it is unnecessary to remove the telephones from their terminals on the receiver when the note filter is being employed.

A switch is mounted on the front panel of the note filter with three positions marked "in," "off" and "out." When the switch is in the position "in," the note filter follows the low frequency valve of the 352 receiver. In the position "off" the filaments of the valve of the note filter are disconnected from the low tension supply, but there is no through circuit from the receiver via the note filter to the telephones.

In the position "out" the filaments of the valves of the note filter remain disconnected but a through circuit is arranged between the telephones and the receiver.

On the left hand side of the note filter is a filament rheostat which may be used for controlling the amount of amplification, and also the selectivity of the note filter.

The three tuned transformers have impregnated windings of comparatively low resistance together with an iron core choke which may be inserted at any desired distance in the transformer core. A suitable position for the core having been found it may be clamped by means of the three screws provided. The reason for using a variable core is to obtain sharply tuned transformers at the frequency of approximately 1,000 cycles without the use of expensive variable condensers of large

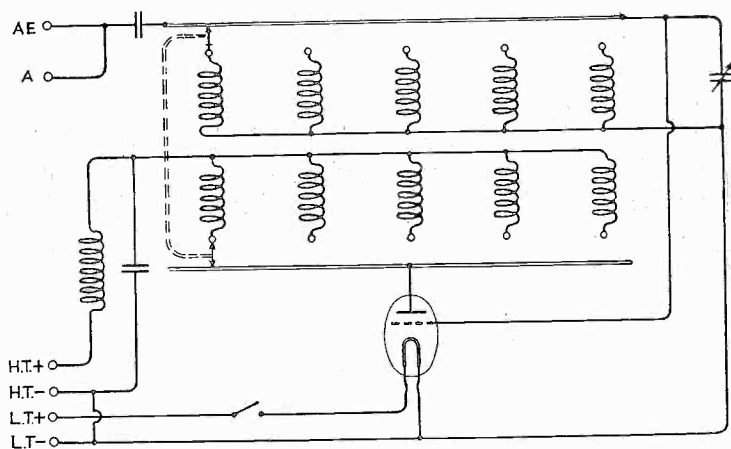


FIG. 3.

capacity. Each circuit may be tuned separately, but the best results are not always obtained until careful adjustments are carried out after approximate tuning has been performed on all three stages. To facilitate movement of the iron cores without disturbance to the valves or to any other part of the note filter, a nut is soldered on to the end of each moveable core. When adjusting the transformers a piece of the correct sized studding about 5 in. or 6 in. long may be inserted in these nuts and helps considerably the fine adjustment of the cores without disturbance of any other part of the note filter.

On the shorter wavelengths, particularly 400 or 500 metres, the note filter may not be found to be of very great help in separation of stations, due to instability on the part of the transmitting station, or of the local oscillator, but on the longer waves it should prove of very great assistance. A diagram of connections of the note filter is given in Fig. 2.

Local Oscillator Type 357.

The separate heterodyne type 357 has been specially designed for use with the receiver type 352. The wave range is from 200 to 22,000 metres. This range is covered in five stages, a multiple switch selects the desired wave-band. Final adjustment of wave length is then obtained by a calibrated variable condenser. Calibration curves are supplied with each heterodyne.

A simple oscillatory circuit is employed, in such a manner that the required amount of energy, for best reception, is transferred to the receiver by means of a coupling capacity. This coupling capacity is located within the heterodyne.

A large high frequency choke is arranged, together with a decoupling condenser, to prevent any back coupling to the receiver via the battery or battery leads.

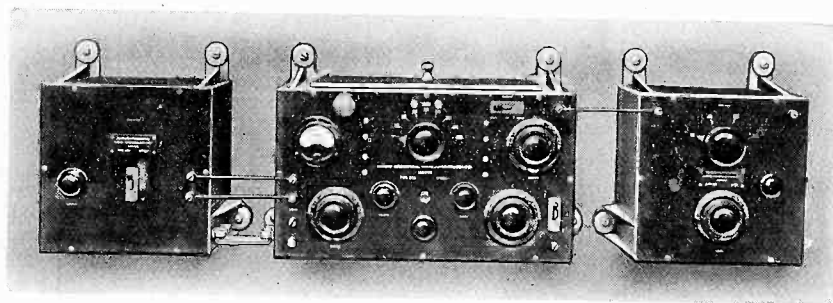


FIG. 4.

An on/off switch is provided so that the heterodyne may be switched off during the reception of spark or I.C.W. transmissions.

Technical Description.

The components of the separate heterodyne are mounted entirely on an aluminium panel, and the complete unit is fitted into a cast aluminium box.

The high tension and low tension terminals project through a slot in the right hand side of the box.

The wave range switch is situated in the upper portion of the box. This switch mounting is of robust construction and of sufficient size to carry the five sets of tuning and reaction coils. The control knob is situated at the top centre of the panel. A pointer attached to the knob indicates the location of the switch, and a device is incorporated in the switch to ensure definite contacts.

The tuning condenser is situated in the centre of the lower half of the panel immediately below the knob controlling the wave range switch.

A shelf, mounted in front of the wave range switch, supports the valve holder and the anti-coupling choke.

The on/off switch is connected in the positive filament lead and fitted in the centre of the panel.

The separate heterodyne is for use on C.W. signals only.

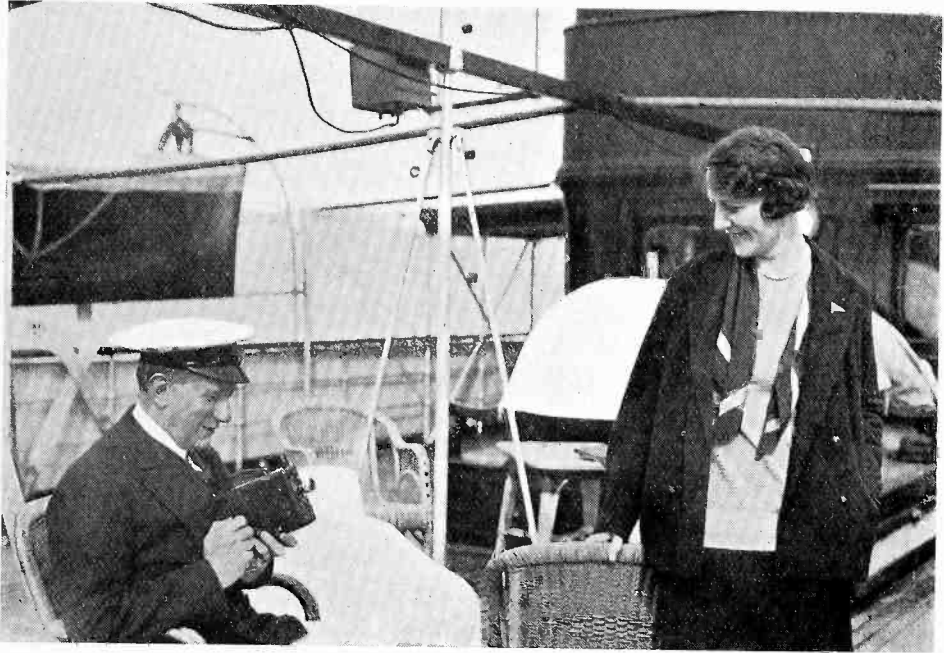
A calibration chart is supplied with each heterodyne. This chart shows five curves corresponding to the five wave ranges on the wave range switch. To obtain any desired wavelength, it is necessary to ascertain first from the calibration chart the position for the wave range switch, and then set the condenser to the value shown on the curve to correspond to the desired wavelength.

The receiver may now be adjusted to the desired wavelength, and as soon as the required station has been tuned in, the filament switch of the heterodyne should be set to the "on" position. If all adjustments are now correct, a heterodyned note should be obtained in the telephones. The reaction condenser on the receiver must therefore be set back just below the oscillation point. A clear C.W. signal should now be heard, and the heterodyne condenser may be varied to give any note which the operator prefers for reading. There are two points on the scale a few degrees either side of the "blind spot" which give this note. Where interference is experienced at one point, the heterodyne should be adjusted to the alternative setting.

A careful readjustment of the reaction condenser on the receiver to a position just below the oscillation point, should now give a very considerable increase in signal strength.

A diagram of connections of the local oscillator type 352 are shown in Fig. 3, and a photograph of the complete installation showing the receiver type 352, the local oscillator type 357 and the note filter type 358, is given in Fig. 4.

MARCONI NEWS AND NOTES
MARCHESE MARCONI'S WIRELESS TELEPHONE
EXPERIMENTS
INTERVIEW BY WIRELESS



Marchese and Marchesa Marconi on board the S.Y. "Elettra." *Photopress*

A NOVEL form of interview was held on April 30th last, when Marchese Marconi on board the S.Y. "Elettra" in the Mediterranean, was interviewed by Mr. Karl Bickel, President of the United Press of America, who was in New York, 4,400 miles away.

The customary form of interview, with questions and replies, was followed, Marchese Marconi speaking to New York through the new short wave telephone transmitter which was in the "Elettra"—described in the last issue of the MARCONI REVIEW. Mr. Karl Bickel was in a studio of the National Broadcasting Company in New York, and the conversation was broadcast throughout the United States of America by the National Broadcasting Company's chain of stations.

In the course of the interview, which was largely concerned with the subject of the international exchange of radio programmes as a means of promoting friendly relations throughout the world, Marchese Marconi said international broadcasting would certainly exert an important influence and should make the possibility of war more remote.

Marchese Marconi, in reply to a question, informed Mr. Bickel that the power used to transmit his conversation from the yacht was taken from a storage battery and was only about 750 watts.

Mr. Bickel, who had already commented on the enormous distance over which the interview was being conducted, remarked : " That scarcely seems possible, does it ? "

In reply to a further question Marchese Marconi stated that he was using a wavelength of 26.7 metres.

Services of New Marconi Stations.

Discussing the reception of foreign programmes in America, Marchese Marconi said : " I am confident that the American public will not be disappointed in their expectations when they receive programmes from Italy. The first short-wave Italian broadcasting station near Rome is practically completed. Its official opening is now only a matter of days. The programmes will consist of music, concerts, opera, as well as descriptions of great Italian events and also, of course, speeches and lectures on a multiplicity of subjects which I have no doubt will be greatly appreciated by the large Italian-speaking and Italian-understanding population of the United States."

Mr. Bickel : " We understand that a short-wave transmitter is being erected for the use of the Vatican. Is it true that His Holiness will use this as a means of addressing the world ? "

Marchese Marconi : " Yes, you are right. A station is being put up under my direction in the State of the Vatican City, and I sincerely think His Holiness the Pope will use the radio as a means of addressing the world, but I am unable at present to state whether he will do so in the near future."

A conversation also took place between the Marchesa Marconi and Mr. David Sarnoff.

Perfect Results over 4,400 Miles.

Despite the distance of 4,400 miles over which the interview was conducted, perfect results were obtained, and at the close of the test an official of the National Broadcasting Company in offering felicitations to Marchese Marconi said : " We are very happy this came over so well. Signals are strong and static is low ; your transmitter is working perfectly. We wish to thank you and we will co-operate with you in any other test."

The National Broadcasting Company telegraphed to Marchese Marconi : " Programme remarkably well received. No fading, no static, fine strength and quality. Programme transmitted coast to coast and Canada through twenty-nine stations. Congratulations and thanks for your fine co-operation from us all."

The success of this interesting interview and broadcast is a further proof of the excellence of the new Marconi telephone equipment.

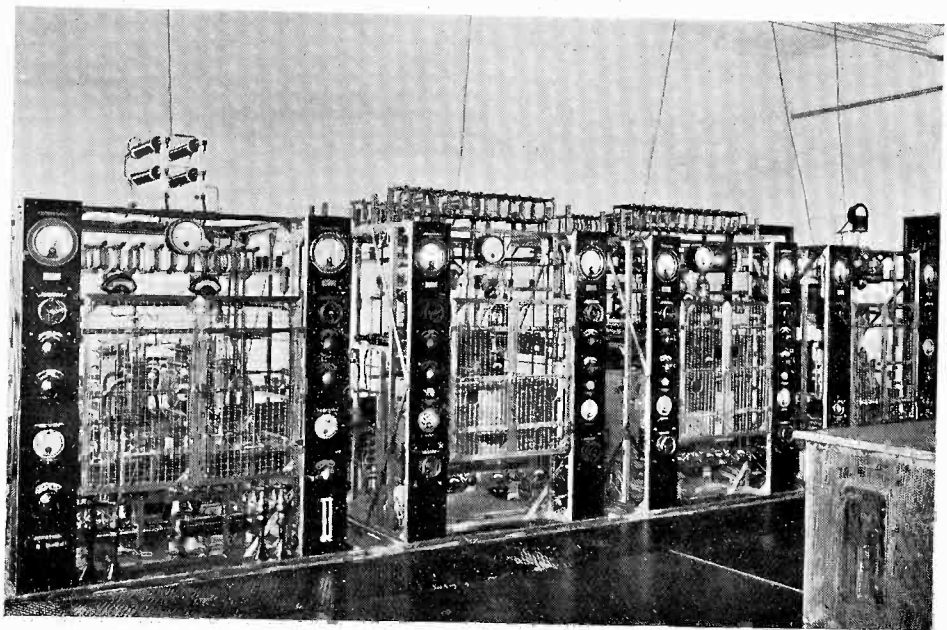
Italian Short Wave Broadcasting Station.

The experience of the Italian broadcasting authorities again demonstrates that the problems of short-wave broadcasting over long distances have been successfully solved by Marconi engineers.

The short wave broadcasting station near Rome which has just been completed by the Marconi Company for the Italian Broadcasting Company enables the Italian programmes to be heard in the Italian Colonies and in distant countries which are outside the range of the broadcasting stations operating on the normal wave band. The successful tests of the station on the wavelength of 25.4 metres were described in the MARCONI REVIEW No. 18.

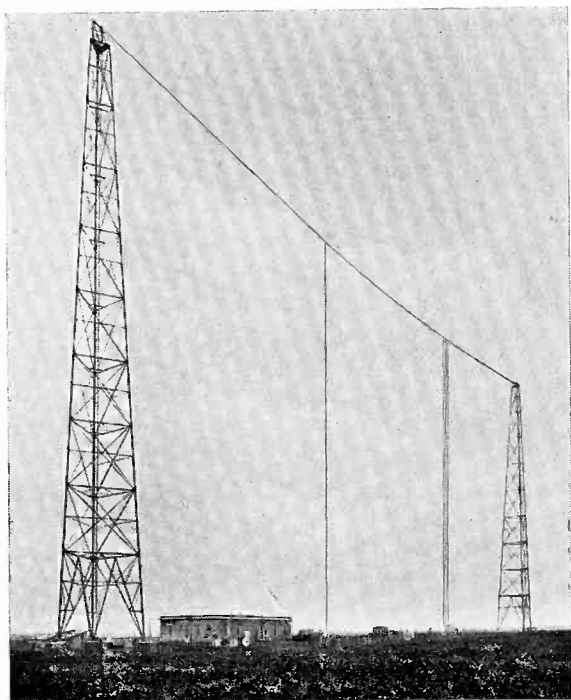
Reports now received of the results obtained on the alternative wavelength of 80 metres show that on this wavelength the station is strongly and clearly received in the important Italian Colonies in Africa and distant countries abroad as well as throughout Italy.

Listeners in the Italian Colonies have reported that these transmissions are strong in intensity and very clear. Tributes to the quality of its performance have been received from Tripoli and Bengasi (North Africa), Rodi (Eastern Mediterranean), Asmara and Massoua (Erythrea) and Mogadiscio (Italian Somaliland), in which the descriptions "good," "clear and strong" have been unanimous. Among the reports



Transmitting panels of the Rome short-wave broadcasting station.

from foreign countries, a Peking (China) listener notes excellent and consistent reception.



Masts and Aerials of the Rome short-wave broadcasting station.

In Italy itself and neighbouring countries the short wave station is also well received on the wavelength of 80 metres, and reports from Genoa, Naples, Milan, Turin, Venice and Sicily indicate the reception of good signals. A listener in Turin remarks that not only was the modulation very good but also the intensity of the signals was equal to that of the 50-kilowatt long wave Rome station—a remarkable performance.

During previous tests on 25.4 metres the station was clearly heard in India, Australia, South Africa, and North America, listeners in these countries remarking on the stability and excellent quality, and the great strength of the Italian transmitter.

Mobile Wireless Stations.

A novel use of the mobility of wireless communication is to be made by the Egyptian State Telegraph Department, which has ordered from the Marconi Company three wireless sets mounted in motor lorries.

These stations will be maintained for use when and where required in areas not supplied by the land telegraph and telephone system, so that practically any point in a wide range of country on either side of the Nile can be linked up at short notice with the main Egyptian telegraph system.

The motor lorries, also of British manufacture, will be of the six-wheel type, fitted with caterpillar attachments so that they will be equally mobile on hard or soft desert country. Each lorry will carry a medium wave $\frac{1}{2}$ kilowatt telegraph transmitter and a small portable short-wave transmitter of 100 watts power. The aerials will be suspended from 70 feet portable masts, and the wavelengths used will

be between 600 and 2,150 metres on the medium wave set, and from 20 to 50 metres on the short-wave set. Self contained power plant will be provided.

Egypt is a country in which, apart from the Delta, the towns and cities with their connecting railway and telegraph communications lie along a narrow strip of land bordering the Nile, with large areas of sparsely inhabited and desert country on either side. In these circumstances the mobile wireless stations will be of particular value in providing special extension of the telegraph system either as a regular service or in times of emergency.

Short Wave Communication.

The remarkable performance of short-wave equipment under favourable conditions has stimulated special interest in short-wave communication.

The Marconi Company was a pioneer in the commercial utilisation of short-waves, and the new Marconi Type A.D.19 transmitter and A.D.20 receiver, operating over the wave band of 40 to 60 metres, have proved very successful both in tests and in commercial operation.

His Royal Highness Prince Purachatra of Siam, Minister of Commerce and Communications, who took two complete sets with him to Siam recently, has given us permission to make use of a report he made to us on their performance during the voyage from England.

Prince Purachatra states that he installed the A.D.19/20 equipment temporarily on the M.S. "Fiona" and that he was successful in communicating with Bangkok with C.W. telegraphy on 46.5 metres when the ship was in the Red Sea and the distance from Bangkok approximately 4,000 miles. From that time he remained in constant communication with Bangkok through this transmitter and receiver.

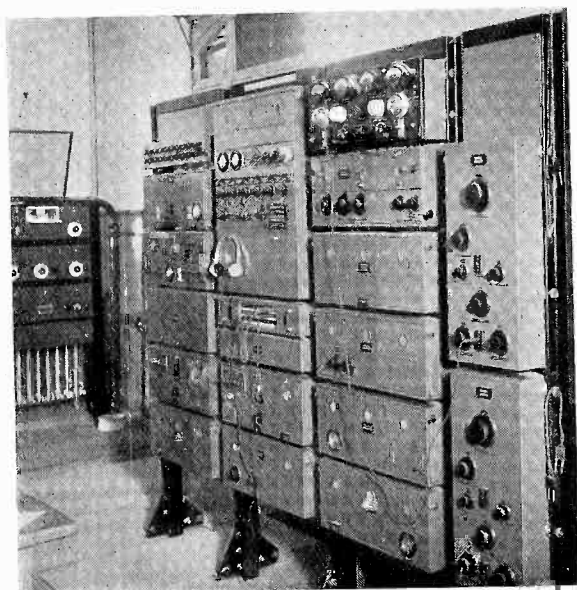
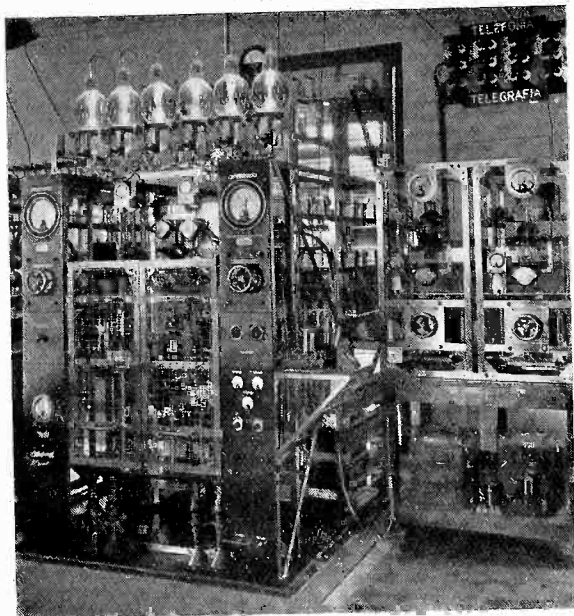
Wireless for Commercial Aviation.

The importance of wireless equipment for commercial aviation, and the supremacy of Marconi apparatus in this sphere, is further demonstrated by the recent decision of the Ad Astra Air Line, Switzerland, to equip its two new machines with Marconi transmitters and receivers. This follows quickly on an order recently received for four Marconi installations for the only other Swiss commercial air line, the Balair Company.

The equipment chosen for the new Swiss air liners is the popular Marconi A.D.6 Type combined transmitter and receiver, which is in daily use on civil, military and naval aircraft in practically every country in the world. The transmitter is of 150 watts power and the set may be used for telephone or telegraph communication.

Airmen Saved by Wireless.

Another instance of life saving by aircraft wireless is reported from Australia.



Marconi short-wave Beam transmitter (above) and receiver (below) installed at the Aranjuez station, Madrid, for the Madrid-Rio de Janeiro telephone service.

On March 31st news was received that Mr. David Smith and Lieut. Shiers, who were attempting to fly from Sydney to England, were forced down in a desolate tract of the mid-Australian desert where the long distance aeroplane "Southern Cross" was lost last year. Fortunately, Mr. Smith and Lieut. Shiers had a wireless transmitter on board their machine which enabled them to issue an SOS message explaining their plight and asking for help. Land and air search parties were immediately organised and the airmen were rescued unharmed.

But for the aid of wireless their position would have been perilous in the extreme, for they were forced to land in a densely wooded hinterland surrounded by mountains and far from the nearest settlement.

Transatlantic Beam Telephone Service.

A Marconi Beam telephone service has now been opened to the public between Madrid and Rio de Janeiro. The first conversations took place between the Spanish Minister of Communications and leading officials in Brazil, all of whom expressed satisfaction with the quality of speech and the efficiency of the service.

The wireless stations conducting the new service in Spain

are of the short-wave Beam type and were erected by Marconi's Wireless Telegraph Company at Aranjuez, near Madrid. In addition to the telephone service, a commercial telegraph service is in operation. For use in these circuits special receivers have been constructed by the Marconi engineers on behalf of Transradio Espanola, the Spanish Company to which these stations belong and which carries out the wireless services between Spain and other countries.

The South American end of the service is controlled by the Companhia Radiotelegraphica Brasileira.

Marconi High Speed Recorder.

The very high speeds of operation reached in modern telegraph services, such as those conducted by the Marconi Beam system, has given an added importance to time-saving devices in wireless telegraph offices. While on slow speed services an interruption of about a minute seemed of small importance, on Beam services operating at speeds of between 100 and 250 words per minute any stoppage, however short, has a more serious aspect.

The necessity for saving seconds has led to the introduction of a new Marconi high speed recorder, Type U.G.6A, which has been developed to eliminate the delay caused when a fresh roll of recording tape has to be brought into use.

The new recorder has two tape drawers, one for the tape in use and the other containing a spare roll of tape, which is so arranged that it can be brought into service immediately the running tape is exhausted. The empty tape drawer is then replenished while the recorder continues with the new supply of tape.

It has been said that progress in the technique of wireless communication lies as much in the improvement of detail as in the production of revolutionary designs, and the Marconi U.G.6A Recorder will strongly appeal to all those who are in charge of high-speed commercial telegraph services, as it eliminates delays which previously were unavoidable.

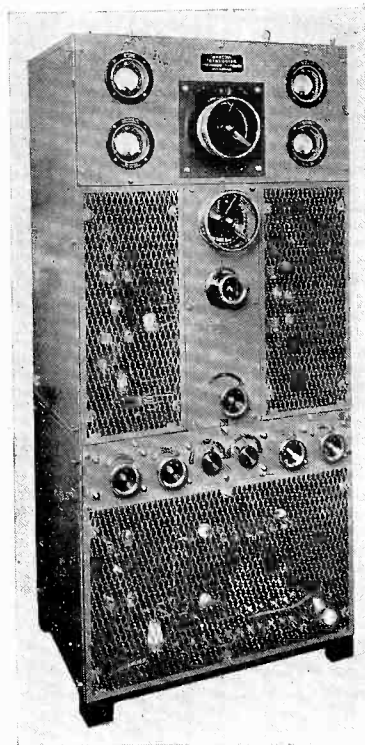
Interchange of Broadcasting Programmes.

In connection with the new Polish broadcasting scheme which was described in *THE MARCONI REVIEW*, No. 12, by means of which alternative programmes on the English model will be made available throughout Poland, it is interesting to learn that the contract obtained by Marconi's Wireless Telegraph Co., Ltd., includes the provision not only of six new broadcasting installations but also of very elaborate equipment of repeaters and correcting apparatus for landlines.

This apparatus will be installed to carry out important improvements in the scheme already in operation for the exchange of high-class broadcasting programmes between Warsaw and Berlin, Prague, Vienna and Budapest.

This international exchange of programmes between these five countries has come into existence, almost unobserved outside the countries concerned, as the result of the activities of the international commission for the exchange of broadcast programmes.

Under the scheme this group of cities broadcasts simultaneously at intervals a high-class musical programme, such as a Viennese opera or Philharmonic concert, provided by the members in rotation. Thus for each programme provided by one country it receives four programmes in return. By this means each country is able to spend more on its special programme than it would otherwise be able to do and each country receives better broadcast entertainment as the result.



Marconi short-wave naval transmitter Type T.N.4, rated at 500 watts.

Wilno and Lwow.

We have received from Poland a request to state that in the map of Europe showing the distribution of Marconi broadcasting stations which appeared on page 26 of the *MARCONI REVIEW* for March, 1930 (No. 18), two Polish towns which were mentioned in their English form as Vilna and Lemberg respectively are known in Poland as Wilno and Lwow.

Marconi Naval Apparatus.

Efficient wireless equipment is of the greatest importance to modern navies, and the following report of the excellent operation of Marconi naval apparatus under actual service conditions is therefore of particular interest.

The officer in charge of the wireless installation on a flotilla leader equipped with Marconi transmitters Type T.N. 2 and T.N. 4 and Marconi naval receivers has submitted the following report after carrying out long and exhaustive tests at sea :

“ The communications have been very good and very regular, the wireless material meeting with the approval of everybody to such an extent that the Commander and the Lieutenant have

nothing but praise for its working. I made a complete demonstration before the Commission of Inspection, tuning in rapidly on the waves they indicated, which I also did before a visiting Captain who went away from

the ship so much interested both with the wireless and the goniometer that he could try it himself after a short explanation."

Naval Receivers and Direction Finders.

"As regards the receivers," continues the officer's report, "I may tell you that there is no limit to the distance, since they have not failed me at any time. News has been received daily from Nauen and Rugby, the Command being well informed of the world's happenings. In the report of communications drawn up by the Command I have seen the good impressions of the Commander with respect to the wireless material with which the ship is equipped."

Of the Marconi Naval Direction Finders on board, the report states that they were used for taking bearings up to 70 miles and gave determination of direction at 1,200 miles.

Island Telephone Service.

The British General Post Office has installed a Marconi wireless telephone transmitter and receiver at the Hartland Point Coastguard station, North Devon, for communication between the mainland and Lundy Island.

Lundy is one of the numerous small islands off the West coast of Britain which, without the service of wireless, are completely out of touch with the mainland during long periods of foggy or stormy weather, the laying and maintenance of cables not being justified by the extent of the communications exchanged. Mr. M. C. Harman, the owner of Lundy Island, has installed a similar Marconi equipment on the island which is being operated in conjunction with the Hartland Point station.

The wireless stations, which take the place of a derelict cable, are to be used principally to enable aid to be sent to ships in distress off Lundy.

The apparatus employed on this service is the Marconi Type X.M.B.1a combined telephone transmitter and receiver of 100 watts power, which does not require skilled operation.