MARCONI'S WIRELESS PILOT.

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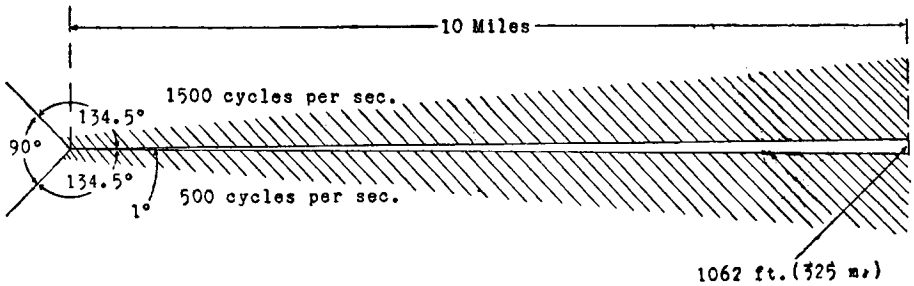
During the last two decades, experiments have been made on several systems of wireless beacons, but these do not seem fully to satisfy navigational requirements in foggy weather, neither do their signals seem to give a direct lead of sufficient reliability into a port. Senator MARCONI has recently perfected a new invention which he demonstrated to an important group of nautical authorities during the trials which took place off Sestri Levante.

The device consists of a beacon situated on the shore, on a rock at Sestri Levante about 300 feet above sea-level, and a receiver fitted to the ship. Two buoys were moored offshore and about 110 yards apart; they represented the mouth of an imaginary harbour. The yacht *Elettra*, on board which the receiver was fitted, left her anchorage at Santa Margarita with the bridge entirely shut in by screens so that neither the Captain nor the Navigating Officer could see anything outside. She was thus navigated completely blind and laid a course for Sestri Levante, about 10 miles away, and, under these conditions, succeeded in passing between the buoys.

The wave-length used is 60 centimetres, chosen as a result of experiments as being the least subject to interference from outside causes. The signals from the radio-beacon are heard in the chart-house by means of a loud speaker and are shown also by a needle which swings over a screen in front of the Navigating Officer. This screen is divided into two parts, one red and the other green. Whenever the ship is on a course which does not take her along the centre-line of the harbour mouth, the needle indicates this situation and, meanwhile, the loud speaker transmits two long notes, one low and the other high, which inform the Officer that he is deviating to right or left respectively of the proper course. Guided by these indications, the Captain alters course until the vessel is making for the centre of the mouth of the port. The Navigating Officer has only to steer the ship so that the indicating needle remains on the central line dividing the red and green of the screen. This may be done from any point of the route.

An appliance which has been added to the beacon allows the distance between the ship and the signal to be determined. This is done by means of the spacing at which the transmitter at regular intervals sends out its signals and, simultaneously, emits an acoustic signal; a special microphone attuned to the signals emitted by the beacon allows them to be received on board ship. When within acoustic range of the station, i. e. at a distance of three or four miles, the operator presses a button as soon as the radio-signal is received, and this converts the head-phone from a radio-receiver to an acoustic receiver; at the same time a stop watch is started; the time which elapses between the reception of the two signals gives the distance.



The apparatus is of very modest dimensions, viz. 6 ½ ft. × 4 ft. It presents a certain analogy with twin searchlights on a single mounting with a dark zone in the centre between them covering an arc of horizon of a few degrees only. Hence the characteristic of this transmission is not based, as might be thought, on the formation of a narrow beam of waves in space but on the formation of a narrow zone of silence in the centre of an intentionally wide beam emitted by the beacon. Thus, two small

aerials fitted with reflectors send out signals at 500 and 1,500 vibrations per second in exactly opposite phases, producing a 1° zone of silence; at 10 miles this silent zone would subtend a band of silence of about 355 yards' width. Each aerial is but a few centimetres long and has a reflector some 90 cm. (3 ft.) high. The reflector is formed of a central part curved in the form of a parabola.

Such a signal, fixed in position, would not be satisfactory, as a navigator might assume he was in the silent zone when a breakdown had occurred; the system is therefore continuously swung from left to right of the centre line of the entrance, the swing having 3° of amplitude on each side of this line. When swinging to the left the beacon sounds a high note, when swinging towards the right it sounds a low note. The change of note takes place when the zone of silence coincides with the line of the entrance of the harbour. The rise and fall of the note therefore has a regular cadence when the ship is exactly on the centre line; if the ship is out of the correct course, one of the notes becomes stronger than the other and the change of note loses its normal cadence. The appliance allows the appreciation of an error within half a degree. The strength of the signals varies approximately as the square of the distance from the source. The two aerials of the transmitter, with reflectors, are mounted at right angles to each other on a platform forming the top of a cylindrical base. The platform and the aerial system swing left and right continuously about 2 inches from the centre line. The transmitting gear is housed in the cylindrical base.

This new type of transmitting station uses two 100-watt special transmitting valves, a loud speaker for the acoustic signal, small motor generators and control panels. The latter are housed in the tower which carries the beacon. The apparatus has satisfied the conditions of working by operating for five months without attention.

The receivers installed on board the ship, on the roof of the navigating house, are on a similar system; they are only a few inches wide and in their structure are incorporated an aerial, a small reflector, the tuning circuits and the receiving valves.

They are mounted on two separate platforms which may be turned in any desired position; the reflector can be oriented in any direction. The angle of reception of these receivers is very wide (about 100°), so that it is only necessary to orient them roughly on the beacon station. With these two receivers, the signals may be received in any position of the ship relative to that of the beacon.

The repeater, situated in the chart-house, consists of a special milliamperemeter and a loud speaker. One side of the dial of the meter is painted green, the other side is red. In response to the radio signal, the needle of the milliamperemeter oscillates continuously from left to right. When on the exact line of entrance, the change of note occurs at the same time as the needle occupies its centre position and the deflection of the needle shows the same amplitude on either side. Any deviation from this normal condition indicates that the ship is too much to the left or right of the line of entrance.

By means of another appliance attached to the same beacon the system of aerials may be made to make one complete revolution each minute; in this case the change of note is produced when the zero line of rotation passes over the true South and the bearing of the ship from the radio-beacon is obtained by measuring with a stop-watch the time which elapses between the change of note and the passage of the zero of rotation over the ship. By this means the *Elettra* was navigated blind according to the signals from the beacon and made to steer a zigzag course about 15 miles from the coast.