Marine Radio Telephone Service for Boston Harbor *

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THERE has been a constantly increasing interest in an inexpensive service for small harbor and coastal craft such as tugboats, private yachts, coastal passenger ships, merchant craft and fishing vessels. This interest became particularly evident in New England in 1931 and since equipment suitable for the purpose had recently been developed by Bell Telephone Laboratories, the New England Telephone and Telegraph Company undertook the establishment of a marine radio telephone service.

A survey consisting of a comprehensive series of field strength measurements on shipboard and at various points along the coasts of Massachusetts and Cape Cod Bays resulted in selecting Green Harbor as the location for a shore station. Green Harbor is in the town of Marshfield, Massachusetts, about 28 miles southeast of Boston.

A commercial survey indicated that initially the service would be of interest chiefly to the Boston fishing industry. Consequently, boat radio telephone equipment was installed on the trawler "Flow" of the Bay State Fishing Company and the service was opened in June, 1932, on a demonstration basis. As tests with this vessel progressed, it became evident that the radio telephone service would fulfill the communications requirements of the fishing industry. It also became apparent that a complete service of this type should include some means for determining the vessel's position at any time by means of radio. Therefore, the development of such equipment was initiated by Bell Telephone Laboratories as an adjunct to the radio telephone service, and the outcome of tests of an experimental model indicates that the problem of providing suitable radio compass equipment in the price range satisfactory to the fishing fleet owners has been satisfactorily solved.

The radio transmitter is a 400-watt crystal-controlled type similar to those designed for use at aviation ground stations and adjusted to operate at a frequency of 2506 kilocycles. This frequency is maintained within limits of better than 0.025 per cent.

In order to combine the two unidirectional radio channels into a two-way circuit suitable for connection to the ordinary wire circuits in the

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land telephone network, apparatus similar to that provided at the terminals of the transatlantic and high seas ship-to-shore radio telephone circuits has been provided. This apparatus includes controls for adjusting the volume of speech into the transmitter from the receiver to the wire lines and the usual voice operated devices (termed "vodas") provided for the suppression of echoes and singing.

The apparatus mentioned, together with a volume indicator, means for talking, monitoring and signaling, and testing apparatus, is as-

Fig. 1—Installation of control unit on fishing trawler.

sembled on one floor-mounted apparatus bay. This, mounted adjacent to the bay containing the receiver and a noise suppression device, constitutes the operating position. This position is continuously attended by a technical operator who adjusts the controls during the progress of each call, guided by indications of the meters provided, to insure the best possible connection under the conditions obtained at the time. Power for the terminal apparatus is supplied by a motor generator set operating from a 110-volt 60-cycle source.

The noise suppression device, termed a "codan" (carrier operated device anti-noise) is employed in connection with the receiver which introduces a predetermined high loss into the audio-frequency portion of the radio receiver during intervals when there is no incoming carrier, and insures relatively quiet conditions on the receiving line. When a carrier is received, the codan action removes this loss, allowing the speech with which the carrier is modulated to pass from the receiver

Fig. 2—Marine radio compass installed on a trawler.

output to the receiving line. This device makes it possible to deliver higher speech volumes to the telephones on shore since it prevents the operation of the receiving vodas relays on radio noise during the idle intervals. It also prevents the high radio noise which would otherwise result due to the increase in gain inserted by the automatic volume control whenever the carrier is interrupted.

It can be seen from this discussion that the use of the codan presupposes suppression of the carrier of the distant transmitter except when the user wishes to talk. This method of operation has been adopted for this type of marine radio telephone service.

A 10-kw. 220-volt three-phase 60-cycle alternator driven by a Buffalo gasoline engine has been provided to furnish the necessary emergency power supply in case the normal commercial supply fails.

The frequency designated by the Federal Communications Commission for use by ships communicating with the shore through the Green Harbor radio telephone station is 2110 kilocycles. This carrier frequency is maintained within limits of 0.025 per cent.

Two crystals are provided and the circuit arranged so that the receiver may be quickly adjusted to operate on either of two frequencies by means of a local mechanical or an electrically operated remote control. The receiver is so designed as to make possible boat-to-boat conversations on a separate frequency.

The signaling unit which is normally connected to the output of the radio receiver consists of a selector operated under the control of an arrangement of relays which in turn are controlled by incoming signal pulses of 600 and 1500-cycle tones. The bell on each vessel is operated only in response to the particular code of pulses to which the selector is adjusted. Arrangements are also included so that the vessels of any one fleet may be called simultaneously.

A motor generator set operates continuously while the vessel is standing by for the reception of signals and furnishes 12- and 200-volt power for the operation of the radio receiver and signaling unit. A second motor generator set is automatically started when the handset is lifted from the switch hook to place a call or in response to an incoming signal, and furnishes power to operate the transmitter. On several of the smaller boats having 32-volt power supply with wide voltage fluctuations, power supply equipment consisting of two dynamotors operated from a 12-volt battery charged from the vessel's storage battery has been employed successfully.

The control unit for the radio telephone consists of a small panel on which are mounted a switch for turning the set on and off, a meter for indicating antenna current, a manual volume control, pilot lamp

signals and a bell for announcing incoming calls. A special handset with push button completes the control unit assembly.

At Boston, the marine radio telephone traffic is handled at two positions on the outgoing toll board especially modified for this purpose. The wire lines from the Green Harbor station terminate at this point, and calls from vessels can be switched by the operator to any point connected to Bell System facilities. The normal wire lines are three loaded cable pairs. One pair is used for transmission from the shore telephone to a boat, the second conducts speech received from a boat through the toll position to the land line telephone, and the third is employed as an order wire for communication between the operator at the marine position and the technical operator at the Green Harbor station. All of these circuits are duplicated over an alternate route for use in case of trouble on the normal facilities.

The marine operator dials the code assigned to the vessel desired. The dialing operation produces the desired grouping of 600 and 1500 cycle pulses which modulate the radio transmitter carrier frequency of 2506 kilocycles. The signaling unit on the vessel is actuated by these pulses and the bell rings. The captain raises the handset from the switch hook on the control unit, presses the push button in the handle of the handset and announces the name of his vessel. The operator then completes the connection and the conversation takes place.

In placing a call from boat to shore the captain or member of the crew raises the handset from the switch hook and, after listening to ascertain that no conversations are in progress, presses the push button and calls "marine operator." The marine operator who is normally monitoring on the channel ascertains the name of the calling vessel, the shore station desired and other necessary details, and while the calling party holds the line proceeds to call the land line telephone and establish the connection.

When a person on one boat wishes to talk with a person on another boat, the procedure in placing the call and establishing the connection is the same as in the case of a ship-to-shore call, except that when both are prepared to talk, the technical operator at Green Harbor operates a by-pass key which connects the radio receiver output and radio transmitter input without including the voice operated device and other equipment associated with the land circuits. The land line is bridged onto the circuit so that the marine operator may be advised of any difficulties which arise in carrying on the conversation.

During the more than two years that the system has been in experimental service, the transmission results up to distances of 500 miles

from the shore station have been quite satisfactory. Of course, during periods of abnormally heavy static the normal range is somewhat reduced. The service is available at all times, but practically all business is handled between the hours of 8 A.M. and 6 P.M. so that the relatively poor atmospheric conditions usually existing during summer nights do not adversely affect the radio telephone traffic. However, experience has indicated that calls originated during such periods from vessels within the normal range can be handled satisfactorily. During some periods of favorable atmospheric conditions experimental transmissions over distances greatly in excess of the normal range have been successfully conducted.

On fishing vessels the radio telephone equipment is accessible for maintenance work only at the conclusion of trips which are usually of about ten days' duration. It is obvious, therefore, that the equipment must be designed for reliable operation over long periods and experience indicates that these requirements have been well satisfied.

Fishing craft normally make use of the service for reporting the details of the catch, for making arrangements to return to port and for talking with other fishing vessels to locate points where fishing is best. The radio telephone has proved of vital importance on several occasions where engine breakdowns necessitated advice from shore in order to make repairs and having replacement parts available upon the vessel's arrival at port. In several instances of sickness and accidents to members of a crew, medical advice has been obtained or the Coast Guard summoned to remove the injured man for quick transportation to a hospital. In one case of severe damage to a trawler as a result of a collision, the Coast Guard were summoned and the owners were able to keep in constant touch with the situation.