Ship Sets for Harbor Ship-to-Shore Service *

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A STUDY of conditions on board fishing trawlers and harbor craft indicates that the radio units must be small in size, rugged in construction and adaptable to remote control. Further, the units must permit operation by non-technical personnel and require a minimum of power for their proper functioning.

The striking similarity between these conditions and those already encountered in the furnishing of radio telephone equipment to aircraft permitted the use with small modification of a radio system already proved by years of use on this country's major airlines.

The ship transmitter, coded the 13-A, has an output of 50 watts. Its size is $13\frac{3}{4}'' \times 18\frac{7}{8}'' \times 10''$, its weight about 34 pounds.

The tube complement comprises a 5-watt audio-frequency amplifier tube, a 5-watt oscillator tube which is controlled by a quartz crystal oscillating at one-half the desired frequency and connected to the grid circuit of the oscillator tube, and a 50-watt screen grid tube as a first radio-frequency amplifier. The coupling from the oscillator is supplied by a radio-frequency transformer which freely passes the first harmonic of the quartz plate to drive the first radio-frequency amplifier. The output stage consists of two similar tubes in parallel to form a second radio-frequency amplifier. The two radio-frequency amplifier stages are coupled by a transformer which also acts as a band-pass filter and freely passes the output frequency. The two radio-frequency transformers are mounted in a single plug-in unit. The audio amplifier modulates the screen bias on the first and second radio-frequency amplifiers, giving substantially one hundred per cent modulation. The filament of each of the three radio-frequency amplifier tubes is in series with a ballast tube to protect them from fluctuations in the power supply.

The quartz crystal oscillator has the recently developed low temperature coefficient cut and the crystal holder is arranged with a heater which operates only should the temperature drop below zero Centigrade. The transmitter is arranged for one, two or three carrier frequencies, each requiring a separate crystal. If more than one frequency is provided, change from one to another is accomplished by a

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single mechanical control. Remote selection of frequency may be by a flexible shaft or by a pull-wire arrangement.

The companion receiver, coded the 12-C, is a compact unit weighing about 16 pounds. It has a superheterodyne circuit employing six tubes and permits a quick shift between two fixed frequencies. High sensitivity and unusual selectivity are obtained. The antenna circuit is series tuned. The beating oscillator and modulator are combined in one tube while a quartz crystal assures the correct beating frequency. It is a plug-in unit similar to that used in the transmitter and ground to the carrier frequency plus the intermediate frequency of 385 kilocycles. Two stages of intermediate radio frequency are used. A duo diode triode tube is used as detector and first stage of audio-frequency amplification. The second audio and output tube is a pentode. Automatic volume control provides uniformity of output signal. A ballast tube protects the filaments against voltage fluctuations in the power supply.

Space is provided for two crystals and remote selection of either frequency may be provided by flexible shaft or pull wire. The controls are tied together through the receiver and transmitter mountings so that the frequency of both may be shifted simultaneously from a remote point.

While in the aircraft system the air pilot has his receiver always in use as he checks periodically on his route, it is obvious that the marine pilot would not require this constant contact with the shore station. To eliminate the necessity of loud speaker monitoring, selective ringing is available. It works from the output of the radio receiver with a conventional type selector which is stepped up in response to the impulses received from a dial actuating the shore transmitter. With this arrangement, any particular boat may be called, a bell announcing the incoming call.

For convenience of installation, the transmitter, receiver and selective ringing unit are mounted in a small metal cabinet. The cabinet provides protection to these units and incorporates the remote frequency change equipment and a junction box. All the connections between the unit mountings in the cabinet are permanent and terminate in the junction box. Provision is made in the base of the cabinet for two cables, one to the control equipment and the other to the power supply. The cabinet is provided with rubber feet which permit its installation in places subject to considerable vibration. One of the features of the installation is the ready access to any of the units for maintenance and test. The top and front of the cabinet may be removed and each unit, being "plug-in" mounted, is easily removable

without disturbing connections. Adequate ventilation is provided as well as protection against direct splashing from above.

The power supply includes 12 volts for the filaments of the transmitter, receiver and selective signaling unit; 200 volts for the plate supply of the radio receiver, and 1,050 volts for plates of the tubes in the radio transmitter. For efficient operation these voltages must be held to reasonably close limits and experience has shown that wide

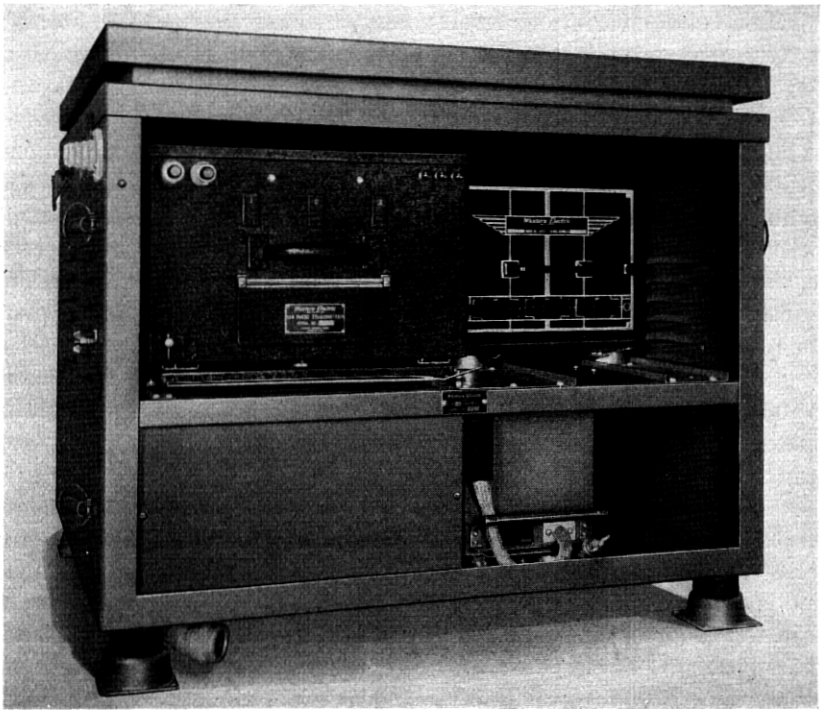

Fig. 1—Cabinet housing radio equipment; front panel removed showing left top radio transmitter, right top radio receiver, ringing unit beneath.

variations in the boat's power supply are to be expected. Therefore, two forms of power supply are generally recommended:

1. Motor generators for both transmitter and receiver;
2. A 12-volt storage battery and charging unit with dynamotors for the plate supply of the transmitter and receiver.

In the case of motor generators, two machines are provided, each consisting of a driving motor and a double winding generator mounted on a common cast iron base. The machines are of splash proof con-

struction. The driving motors depend upon the source of power of each installation. Where the variation of the d-c. supply is greater than ± 3 per cent, a speed regulator is provided.

The generators of the double-voltage type have both a high and a low-voltage winding. One supplies 10 amperes at 13 volts and 0.1 ampere at 200 volts to the receiver; the other 15 amperes at 13 volts and 0.35 ampere at 1,050 volts to the transmitter. The units are equipped with filters to prevent disturbance in the radio equipment.

When voltage variations on shipboard are extreme, a 12-volt storage battery may provide the filament source as well as operate both a 200-volt and a 1,050-volt dynamotor. The battery charger may be of the automatic type or arranged for periodic charging.

The control unit is designed for installation at any convenient location. It provides facilities for remote starting and stopping the radio apparatus. It consists essentially of a single master-control switch, a telephone handset, call bell, a volume control for the receiver in the handset, and an antennæ meter for visual indication of the transmitter operation. A small lamp on the unit indicates when the receiver is in operation. To call or answer a call, one operates the single master-control switch and removes the handset from its hook switch. This controls the power to the radio transmitter. A push button in the handset handle automatically switches from receive to transmit position.

As an adjunct to the two-way radio telephone system, a radio compass has been developed which is essentially composed of a highly sensitive radio receiver and of a loop and "sense-indicating" antenna, and is extremely simple to operate. The accuracy of the arrangement is in the order of one degree when 200 to 300 miles from the marine radio beacon. Taking bearings on marine radio beacons is facilitated by a scale on the receiver calibrated directly in kilocycles and a chart on the receiver panel listing the radio beacons. After tuning, the loop is rotated by a hand wheel until the needle of a center-reading meter points to zero. A unique arrangement of the antenna permits a scale on the shaft of the loop to indicate the azimuth between the ship's heading and the direction of the received radio beacon when the meter reads zero. As the loop is turned to the right or left, the needle on the meter likewise swings to the right or left. There is no doubt as to the "sense" of the bearing as the meter gives positive visual indication when the loop is rotated. By plotting the direction of the boat from two or more radio beacons on the nautical chart, the intersection of these plotted lines determines the ship's position.

The direction-finding receiver employs a superheterodyne circuit,

covering the frequency band from 242 to 515 kilocycles. A single control tunes the entire frequency range providing coverage of all the marine beacon stations and all the ship telegraph frequencies. The power supply for the receiver is the same as that for the other radio units. A loud speaker may be provided for identifying the station and to facilitate tuning. It may also be used for taking a bearing under severe static conditions. The loop assembly consists of a statically shielded loop winding, a supporting pedestal with shaft, a mounting flange, a hand-wheel, an azimuth scale, a compensator, an indicating meter, slip rings, lamp and terminal strip.