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Radio Telephone Service to Ships at Sea *

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The paper discusses the American end of the ship-to-shore radio telephone system and the connecting equipment on board the *Leviathan*. The most suitable wavelengths for this service are in the short-wave range, but the use of these wavelengths complicates the problem, since different wavelengths are required according to the distance of the ship from shore, the time of day, season of year, etc. The problem on shipboard is further complicated by the fact that the transmitting and receiving systems are necessarily near together and special precautions are necessary to take care of interference from the radio telephone transmitter and the radio telegraphic services. In addition to interference from these sources, there is a background of interference in the ships' electrical equipment, all of which necessitates a much more powerful land station than is necessary on shipboard.

In the present system, the shore transmitter has a power rating of 15 kw. and the ship transmitter of 500 watts. The shore transmitting station is located at Ocean Gate, N. J., and the receiving station at Forked River, N. J. At both of these locations, directive antennas are employed which cover the ships' lanes. The stations are connected by wire to the Long Lines toll office in New York, and the over-all control of the circuit is carried out from this point. Both the ship and shore transmitters are crystal controlled. The ship's receiver is highly selective and is of the double-detection type. Communication between the ship and the shore is carried out by use of a pair of frequencies, one for transmission in each of the two directions, separated from each other by about three per cent. Ships of a number of nations are being equipped with wireless telephone apparatus and as the service expands, it will undoubtedly be necessary to formulate a plan in which international agreement is reached on the allocations of frequencies for ship-to-shore telephony and telegraphy, in order that undue interference within the services themselves or between the two services shall not ensue.

IN view of the developments which have recently taken place in the field of ship-to-shore radio telephony, it would appear appropriate to review the state of the science and to discuss the problems which have arisen, the facilities which have been installed, and the general results obtained.

The ship-to-shore radio telephone system, which is here described, was opened for public service between the *Leviathan* and the United States on December 8, 1929. This was the first extension of the public telephone service to a ship at sea and enabled calls to be made between the vessel and any Bell System subscriber. The system as set up is intended primarily for giving telephone service to the larger passenger-carrying vessels as an extension to the wire network, and should be distinguished from the more simple uses which have been made of radio

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telephony in the marine field, such as that of enabling a coastal station operator to talk with coast guard vessels, fishing trawlers, etc.

This paper is concerned with the developments which have been carried out in the United States, including the establishment of transmitting and receiving stations on the New Jersey coast, the equipping of the *Leviathan* and the establishment of service to that ship.

It is significant of the wide-spread interest in this type of service that developments have also gone forward rapidly on the European side where the British, Germans, and French are preparing coastal stations and equipping some of the larger ships for public telephone service. The British have already initiated service to two of the White Star Liners, the *Olympic* and the *Majestic*, and before the summer is over it is likely that half a dozen of the larger transatlantic vessels will be undertaking this service, connecting with both the American and the European networks.[1]

Early Developments

Attempts to apply telephony in the maritime field date back to the pioneer work on radio telephony itself, but it was not until the application of the vacuum tube were developed that radio telephony for any service became finally practicable.

Following the long distance, point-to-point radio telephone experiments of 1915, there was carried out in the following year what is believed to have been the first trial of two-way radio telephony from the wire telephone system to a vessel at sea. This trial was conducted by Bell System engineers in cooperation with the Navy Department. On that occasion the Secretary of the Navy, in his office in Washington, carried on two-way conversations with the captain of the *U. S. S. New Hampshire* off Hampton Roads.

Following the further development of radio telephony during the War, there was undertaken, in the years 1920-1922, an extensive development of ship-to-shore radio telephony, looking toward the linking of ships at sea with the land line telephone network.[2] At that time there was built a coastal radio telephone station at Deal Beach, N. J., and several ships were equipped on a trial basis. Extensive engineering tests were made and a number of demonstrations carried out which proved the physical feasibility of establishing such connections.

While the trials were successful from the technical standpoint, the development was not carried into commercial use because the adverse economic conditions existing in the post-War period did not appear to

[1] Ship-to-shore telephone service is now given (July, 1930) from both U. S. and British shores to the Leviathan, Olympic, Majestic and Homeric.

[2] "Radio Extension of the Telephone System to Ships at Sea," by H. W. Nichols and Lloyd Espenschied, *I. R. E. Proceedings*, Vol. 11, 1923.

justify the initiation of the new service at that time. Furthermore, the waves in the range of 300–500 meters, which had been used in these early trials, were soon thereafter assigned for broadcasting.

In the last few years the whole outlook has changed considerably. The development of short-wave radio systems has greatly increased the message carrying capacity of the radio spectrum and has made it feasible to maintain communication over a greater range of distances than was previously practicable for ships. Transoceanic radio telephone services have been inaugurated, and with the large increase in steamship travel there has arisen a renewed interest in the extension of telephone service to ships at sea.

When it became evident that short-wave transmission might be

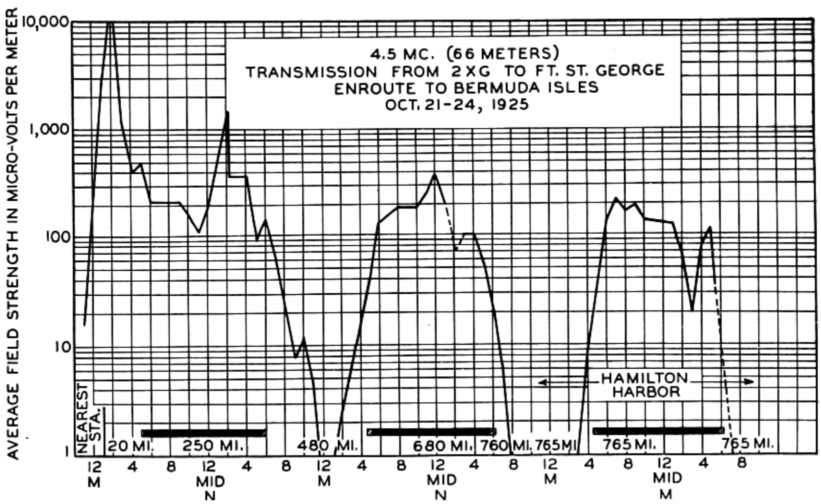

Fig. 1—Received Fields, New York-Bermuda Run 1925.

desirable for ship-to-shore telephone service, there was undertaken a program involving the measurement of the strength of the electric fields received aboard ship from a shore transmitter. This work was part of a general program intended to obtain fundamental data upon short-wave transmission, for purposes of point-to-point, as well as for ship-to-shore telephone services. The tests were first made in 1925 on vessels running between New York and Bermuda. Further measurements were made on other ships in subsequent years.

Fig. 1 is an example of the result of these earlier tests. Transmission was from Deal Beach on 4.5 megacycles (66 meters). The curve shows the relatively weak field which was received as the vessel left dock, due to the considerable stretch of land which intervened in the transmission path, the rise of the field to high values as the ship passed out of the harbor, and the gradual diminution as the vessel continued on her course. It will be observed that transmission on this frequency was effective at night all the way to Bermuda, but that during the daytime the transmission failed for distances greater than a few hundred miles. Corresponding measurements showed that daylight transmission could be secured by means of a higher frequency, such as 9 megacycles (33 meters). Measurements of this kind, supplemented by data obtained for a wide range of distances over land, and for transatlantic distances, have built up a fairly complete set of quantitative data on short-wave transmission over different distances and for various times of the day and year.

Along with this study of transmission conditions, there was carried on the development of short-wave apparatus technique for telephony. The first application was in the field of point-to-point transatlantic operation and the considerable art built up there, including the design of transmitters, receivers, directive antennas, and the working out of two-way operating methods, served as a very useful basis from which to develop the coastal and ship stations for the maritime system.

With this background of development, preparations were made to set up a two-way, short-wave radio telephone system for commercial service. This service was centered upon New York because of the large concentration of ocean-going traffic at that port.

The Technical Problem

One of the most important problems to be solved in the design of a short-wave system is that of determining the frequencies necessary for giving the service involved. The frequencies which are best suited to the different distances, time of day, and season of the year for transmission over the North Atlantic are indicated in the curves of Fig. 2. The curves for the greater distances refer to the transmission which appears to take place in the upper regions of the earth's atmosphere and is usually referred to as sky-wave transmission. Each of the sky-wave curves traces the optimum frequency-distance relation for the time of day and season of the year indicated. The curves merely give a general picture of the frequency relation and do not take account of other effects, such as fading, magnetic storms, etc.

The figure brings out very clearly the necessity for using a variety of wavelengths if the ship lanes are to be adequately covered. Fortunately, there is a considerable band on each side of the curves shown, in which good transmission can be obtained, and this enables one to choose a small number of frequencies in the short-wave range which are adequate to cover the conditions. Actually, it is found that a set of about four frequencies will suffice to cover the North Atlantic. For distances greater than a few hundred miles this characteristic obtains irrespective of whether the transmission is over water or over land, by reason of the fact that the transmission appears to take place in the upper regions of the earth's atmosphere.

Closer in to the transmitting station, however, there is the so-called surface component, the attenuation of which is much less over sea water than over land. It will be seen that the surface wave may be relied upon for distances of the order of 200–300 miles, for frequencies of about 4 megacycles. The transmission of this component is much more stable and reliable than is the transmission of the sky wave. It

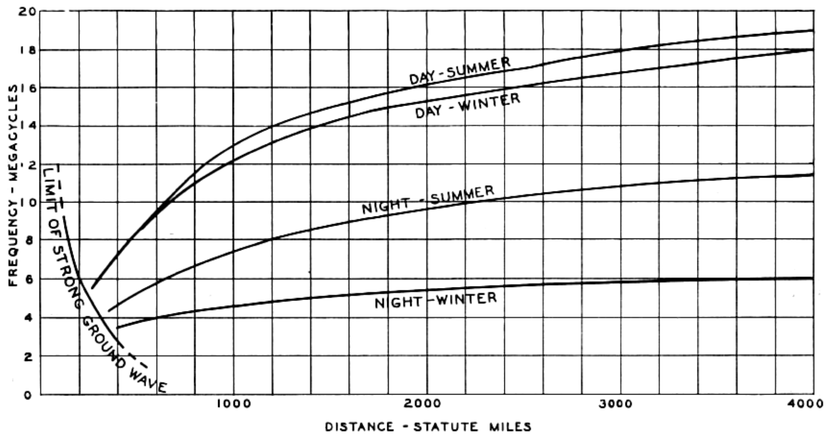

Fig. 2.—Distance-frequency characteristic.

seemed important, therefore, to utilize the surface wave to the maximum extent possible.

With this in mind, a series of transmission measurements was made over a stretch of water between New Jersey, Long Island, and Nantucket for the purpose of more accurately evaluating the effectiveness of the surface wave component, particularly in so far as it bears upon the question of how close to the water front the coastal station need be placed. Transportable transmitting and receiving stations were used in these tests. It was found that as the transmitting or the receiving station was moved away from the water front, the attenuation increased materially. For example, moving either terminal a mile back from the coast line increases the attenuation some 8 decibels at 4.5 megacycles. On the other hand, a narrow stretch of land, such as a sand bar, out a few miles from the coast, introduces relatively little loss.

These results indicate that if full advantage is to be obtained from the more reliable surface-wave component, the coastal station should be immediately upon the seacoast or a salt-water bay.

An important factor in connection with radio reception on shipboard is that of electrical interference. The modern steamship requires for its operation and its service a large amount of electrical machinery. In addition to this, it is equipped with various radio telegraphic services. The operation of all of this electrical equipment produces interference in a receiver which is much in excess of that normally encountered in a shore receiving station which can be so located as to be reasonably free from electrical disturbances. Furthermore, there is on the ship another source of disturbance which is due to

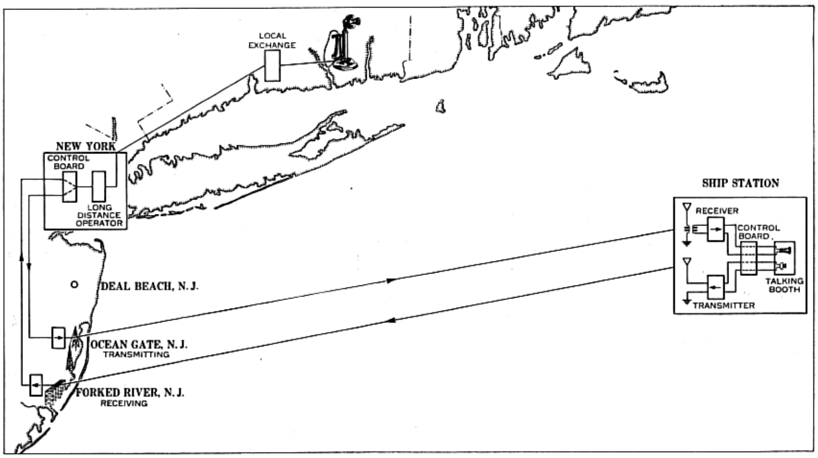

Fig. 3—U. S. coastal station, circuit between New York and ship.

charging and discharging of various parts of the rigging in the strong electromagnetic fields of the various radio transmitters. These various sources of disturbance were found in the earlier shipboard experiments and the high noise levels are, in general, the predominant factor in limiting the communication range. These factors made it desirable to employ at the shore end as powerful a transmitter as was available and to use whatever benefit could be obtained from antennas designed to be roughly directive along the transatlantic ship lanes. A transmitting set of the type used in transatlantic communication, but adapted for the ship-to-shore wavelengths, was therefore employed.

Since the shore receiver can be located in a comparatively quiet situation and since use can also be made of roughly directive receiving antennas, there is no advantage in transmitting as large an amount of

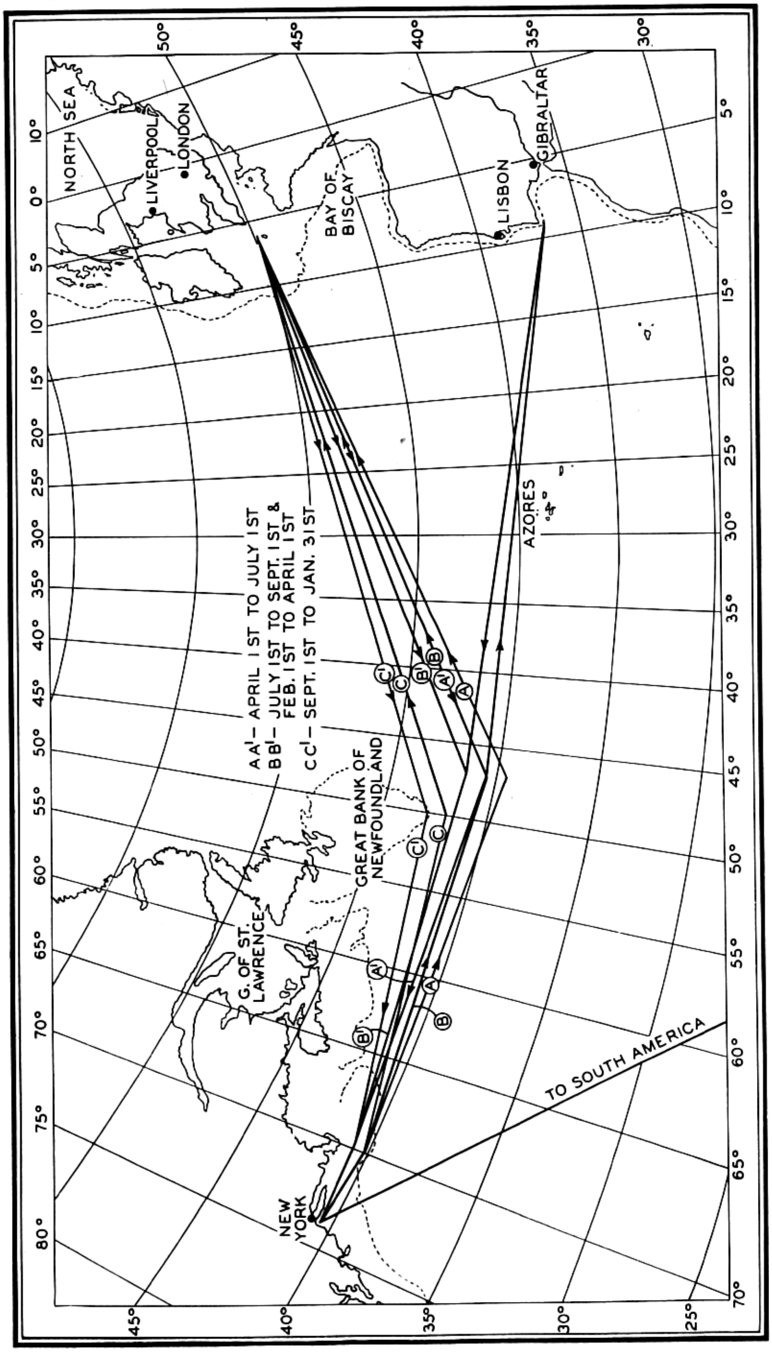

Fig. 4—North Atlantic steamship lanes.

power from the ship as from the shore. The actual power radiated by the *Leviathan's* transmitter is of the order of 500 watts. The shore receiver is of the type used on the transatlantic radio telephone circuits, working with a directive antenna. The arrangement provides a fairly well proportioned system, the channels being substantially equally effective in the two directions.

The Shore System

The general setup of the system is illustrated in Fig. 3. The coastal stations, sending and receiving, are located about 60 miles south of New York on the New Jersey shore, at Ocean Gate and Forked River. The course followed by the transatlantic ships is indicated on the map of Fig. 4. The directional bearing of this course and the directivity

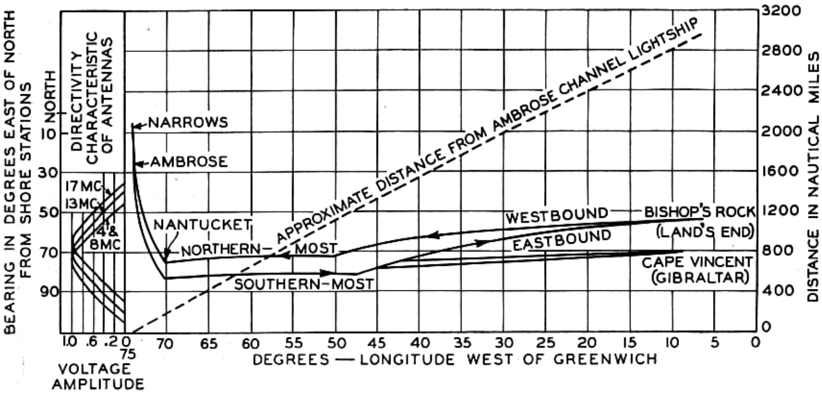

Fig. 5—Directional bearings.

characteristic of the New Jersey shore station antennas are illustrated in Fig. 5. It will be observed that the breadth of the transmitted beam is adequate to take care of the variation of the directional bearing of the course. For steamship routes other than the transatlantic, as for example the coastal route to the South, other antenna arrangements will be required.

In general, the whole coastal station, including the transmitting and receiving units, taken together with the wire line connections and control position in New York, is similar to one end of a transatlantic point-to-point circuit. The transatlantic facilities have been described in previous papers [3] and reference should be made to them for more detail than is given below. The transmitting set has been adapted to cover

[3] Papers on Transatlantic Telephone Service by Messrs. Miller, Bown, Oswald, and Cowan, presented at Winter Convention of the A. I. E. E., New York, N. Y., January 1930. Papers by Messrs. Bown and Oswald, *B. S. T. J.*, Apr. 1930.

the frequency range used in the service. It has a power of 15 kw. output of unmodulated carrier and is capable of delivering 60 kw. peak power. A photograph of a similar transmitter at Deal Beach, which is being used for this service pending the completion of the transmitting station at Ocean Gate, is shown in Fig. 6. The antennas are simpler

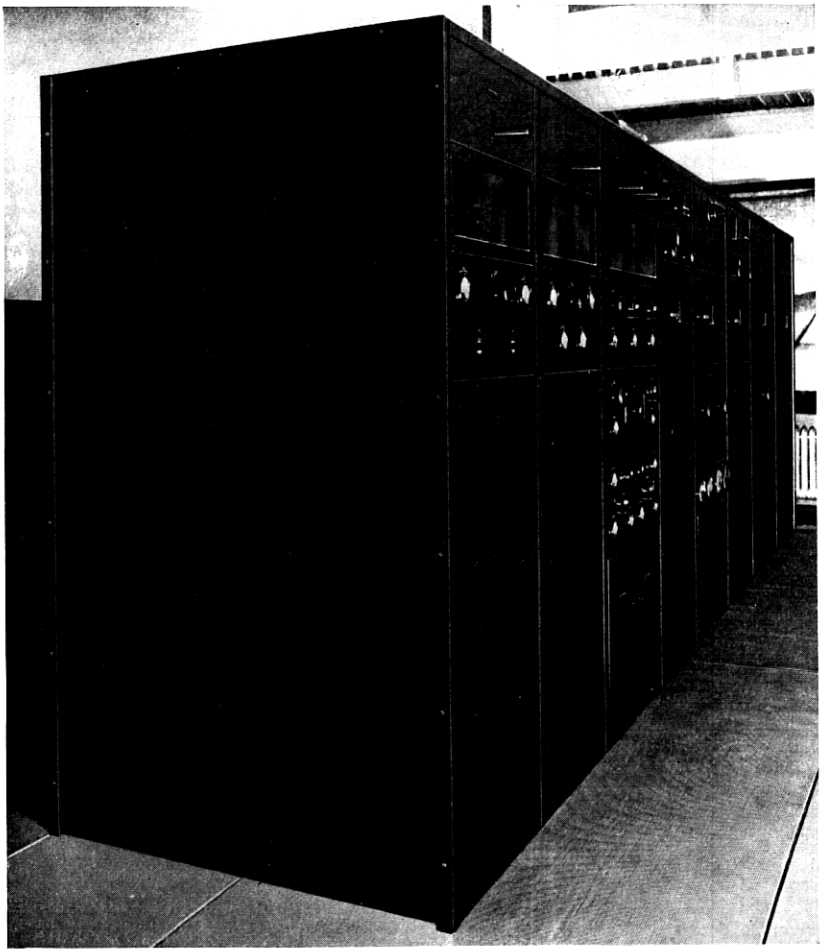

Fig. 6—Deal Beach transmitting set.

and less directional than those employed in the transatlantic circuit, and give a transmission gain of 8 to 10 db as compared with a single half-wave antenna.

The receiving station at Forked River has been in operation since the opening of commerical service last December. A photograph of the receiving set is shown in Fig. 7. The receiver is of the double-detection type, of high gain and selectivity, and employs screen-grid tubes. It is provided with automatic gain control. The apparatus shown includes not only the receiving set proper but also the equipment which is required for monitoring the circuit and for connecting with the wire

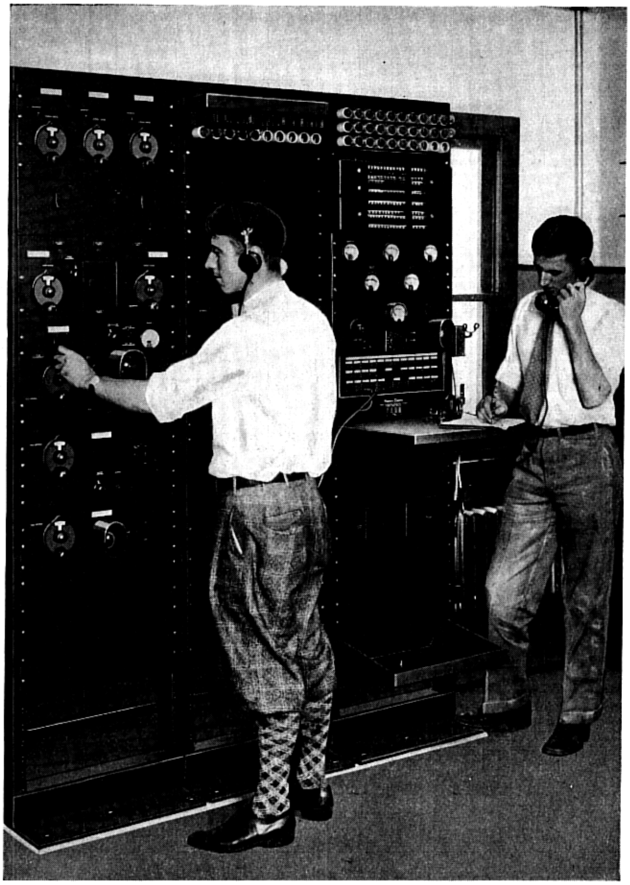

Fig. 7—Forked River receiving set.

line into New York. The receiving antennas are of the same general type as those used in the transatlantic system, which consist of a row of quarter-wavelength verticals connected alternately top and bottom by quarter-wavelength conductors. In the case of the longer wavelengths used in the ship-to-shore service, the vertical conductors are reduced in height and the horizontal links correspondingly elongated. A photograph of the station at Forked River and two of the antennas is shown in Fig. 8.

The control and operating terminal equipment in New York is identical with that in use on the transoceanic radio telephone circuits. The control positions, as they exist in the New York long-distance telephone building for both transatlantic and ship-to-shore circuits, are pictured in Fig. 9. These control positions have associated with them such things as voice-frequency repeaters, indicators of the volume being transmitted and received over the circuit, gain controls, monitoring and testing facilities, and voice-current operated switching devices. The latter prevent the speech received from the ship from being reradiated from the shore transmitting station and permit independent adjustment of amplification in the circuits leading to the transmitting and receiving stations. Thus, the volume sent to the

Fig. 8—Forked River station with antenna.

transmitting station may be kept substantially constant, despite variations in speech volume received from different land line subscribers and full modulation of the transmitter may be obtained for overriding noise on the ship. The function of the technical control operator is that of maintaining the circuit in the correct technical condition for talking. In general, it is the intention that the shore transmitting and receiving stations should function, as far as possible, merely as repeater stations, with the control of the over-all circuit from New York to the ship resting in the New York technical operator.

The circuit terminates as an operating facility before a traffic operator at one of the long-distance telephone boards. In Fig. 10 is shown an illustration of the traffic positions for the transatlantic radio telephone circuits, including, at the right, two positions devoted to the ship-to-shore service. The duty of one of these two girls is confined to the radio circuit itself in that she talks to the ship operator, passes and receives information as to calls, and is generally responsible for completing the connection between the ship circuit and the land line subscriber.

The adjacent operator is concerned more particularly with the land line subscribers, answering inquiries and recording calls outbound to ships and, in turn, getting in touch with and holding land line subscribers for inbound calls.

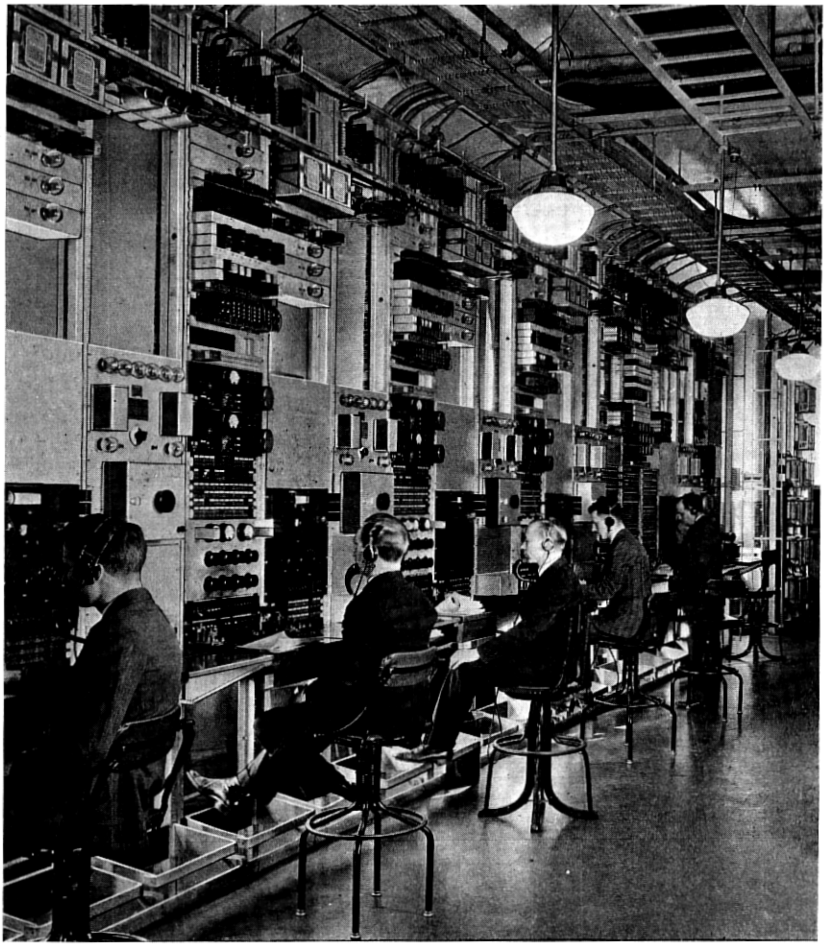

Fig. 9—New York technical control positions.

The Ship Station

The *Leviathan's* radio transmitter was designed to supply about 500 watts, 80 per cent modulated radio frequency power to an antenna at frequencies from 3 to 17 megacycles. To insure satisfactory operating conditions, the carrier frequency stability was made as good as that required for point-to-point service and the transmitter has been designed with the object of holding the frequency within 0.01 per cent. This facilitates the establishment of contact between the ship and shore and obviates the necessity for frequent retuning of the shore receiver. The background noise on the unmodulater carrier, due to commutator ripple, etc., is inappreciable and the audio-frequency characteristics from 200 to 2750 cycles is flat to within $\pm$ 2 db.

In addition to these electrical requirements, the mechanical design must be such as to withstand ship's vibration, permit easy access to the

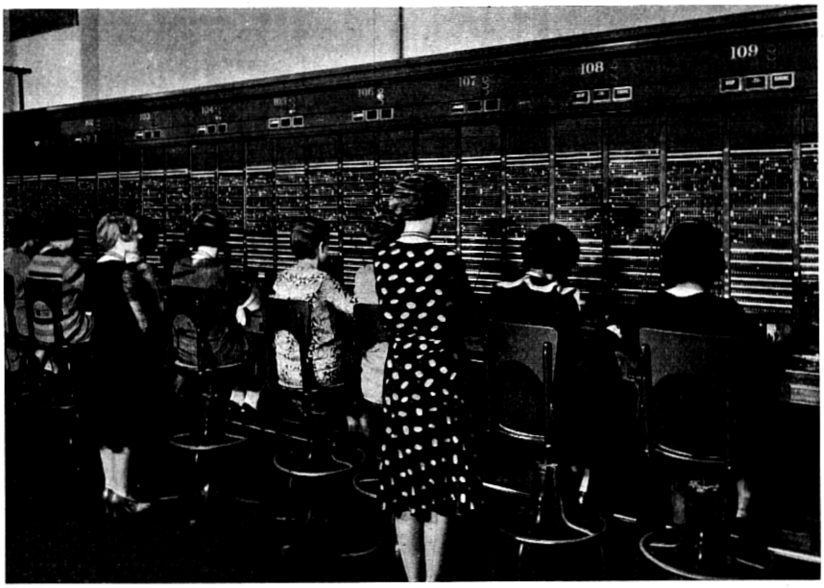

Fig. 10—New York traffic positions.

interior so as to facilitate wave change, and at the same time protect the operators from electrical shock.

The transmitter consists of a crystal oscillator and associated amplifiers. The crystal provides the necessary carrier frequency accuracy and stability and the amplifiers step up the power of the carrier to the desired level. Audio-frequency filters are placed in all voltage supply circuits to eliminate background noise. The modulation system with its associated transformers is designed to produce the requisite audio-frequency quality. A diagram of the circuit is shown in Fig. 11.

Very thorough electrical shielding is necessary between amplifier stages to prevent singing. This shielding makes the changing of coils, which is necessary for the changing of wavelengths, very unhandy, and hence the crystal control and amplifier system, except the last stage is provided in duplicate, one side being used for the longer and the other for the two shorter waves. Wave changing, except for the output circuit of the power stage, is then accomplished by connecting the proper amplifier to the power stage.

The quartz plates used in the crystal control system are circular, being approximately one inch in diameter, and are clamped rigidly in the holder. This clamping serves to prevent any change of frequency with mechanical vibration. The holder with its crystal is mounted in a small oven, the temperature of which is held constant at 50 deg. cent. to better than ± 0.1 deg. cent. The thermal system of this oven is so

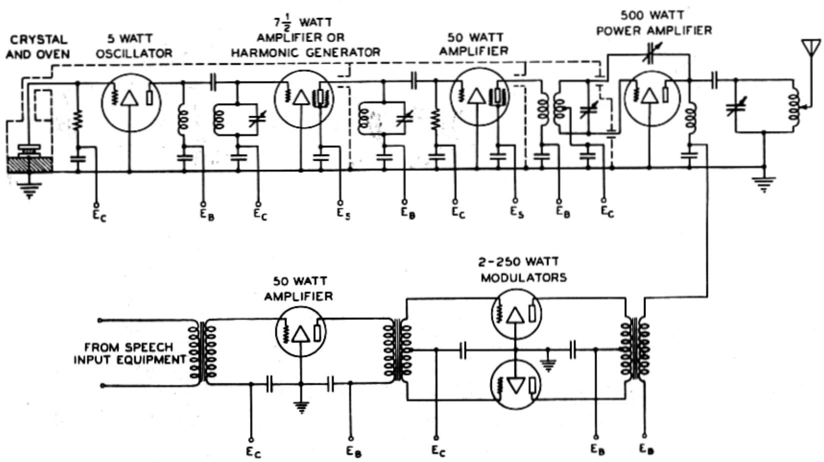

Fig. 11—Ship transmitter's schematic diagram.

designed that the change of internal oven temperature with temperature changes of the surrounding air is negligible.

As shown in the figure, the crystal is connected between the grid and filament of a 5-watt vacuum tube which, together with the parallel resonant circuit connected to the output of this tube, forms the crystal oscillator. The radio-frequency voltage developed by the crystal oscillator is applied directly to the grid of a 7½-watt screen-grid tube which can be used either as an amplifier or a frequency doubler. The output of this tube, except in the case of the higher frequencies, is applied directly to the grid of a 50-watt screen-grid amplifier. For the higher frequencies a second frequency doubler can be switched into the circuit. The output of the 50-watt tube is coupled through a balanced transformer to the final amplifier stage. The amplifier or frequency doubler stages are separately shielded and radio-frequency filters are provided in all power supply leads.

The power amplifier consists of an air-cooled, three-element, one-kilowatt tube. Neutralization is accomplished by the familiar balancing arrangement shown in the figure. The output circuit of this stage consists of a parallel resonant circuit with provision for tapping in the connection to the antenna.

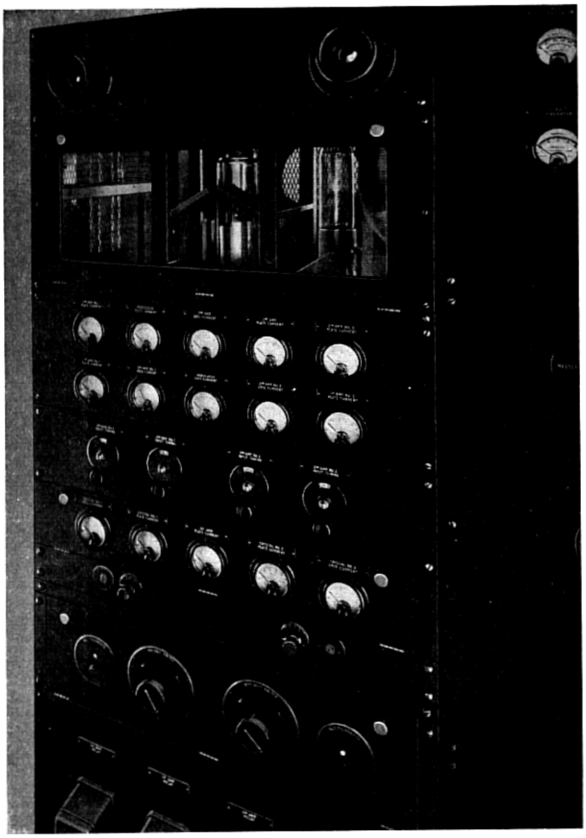

Fig. 12—*Leviathan* transmitter.

Modulation takes place in the plate circuit of the final amplifier stage, the plate current supply being fed through a special transformer, the secondary of which is connected to two 250-watt tubes connected push-pull and fed by a 50-watt amplifier.

The power supply is obtained from motor-generator sets operated from the 110-volt, d-c. ship supply. Protection of the operators and apparatus is provided by means of relays and contactors in the high-voltage supply circuits which prevent the high voltages from being applied if the filament or grid circuits are not closed or if the doors of the transmitter are open.

An illustration of the ship's transmitter is shown in Fig. 12. The picture is somewhat out of perspective owing to difficulty in taking the photograph in the limited space available on shipboard.

The receiving problem on shipboard is complicated by a number of factors. The transmitting and receiving frequencies must be within a few per cent of each other, if the best transmission conditions for the time and place are to be utilized and if the frequencies are to remain in the bands assigned internationally to the mobile services. This requirement, as well as the noise conditions on shipboard, calls for a receiver of high selectivity, which is obtained, in the present instance, by the use of a double-detection set. The over-all selectivity is accomplished both by having a number of highly selective circuits ahead of the first detector and by using tuned circuits in the intermediate frequency stages, the high-frequency selectivity being used primarily to prevent overloading of the first tube and the intermediate frequency circuits being used to obtain the final selectivity required.

A reduction of the disturbances due to stay noises and better discrimination against the transmitted carrier is obtained if the transmitting and receiving antennas are widely spaced. On the other hand, for operating reasons, it is desirable to have the transmitter and receiver located in the same room. In the case of the *Leviathan* installation, the transmitting antenna is located directly above the radio room, between the second and third stacks, and the receiving antenna is placed as far as possible behind the third stack. The receiving antenna is connected through a suitable step-down circuit to a shielded transmission line, the other end of which is connected to the receiver, the receiver itself being very thoroughly shielded to avoid direct interference from the transmitter. On account of limited space, only two antennas are provided to handle the four frequencies, each antenna representing a compromise between the most efficient antennas which could be put up to handle the separate wavelengths.

As stated above, the receiver itself is of the double-detection type, using heater type tubes throughout. Screen-grid tubes are used for the first detector and intermediate frequency amplifiers and three-element tubes in the remaining positions. A photograph of the receiver and associated voice-frequency equipment, as it is installed on the *Leviathan*, is shown in Fig. 13, and a diagrammatic representation of the receiver is shown in Fig. 14. The high-frequency selective system consists of four separately shielded tuned circuits, coupled by small capacities. The use of a screen-grid tube in the detector circuit gives a two fold advantage over the use of a three-element tube in that a higher input impedance is maintained at the higher frequencies and the necessity for neutralizing against the reaction of the beating oscillator on the input circuit is eliminated. The beating voltage is made of the order of 75 to 100 volts for the purpose of reducing the effective tube noise in the detector plate circuit. With this arrangement no d-c. plate voltage is ordinarily required. The screen voltage is 22

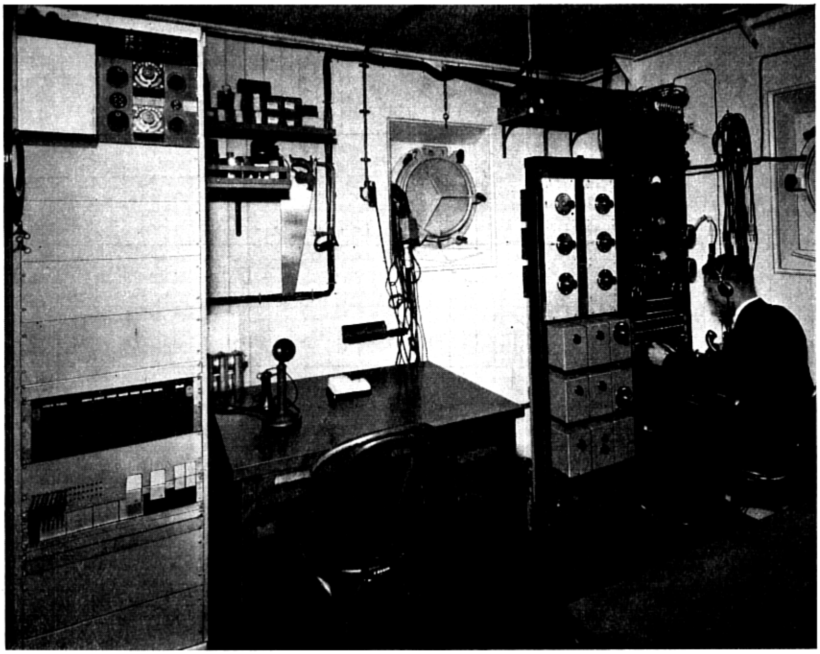

Fig. 13—*Leviathan* receiver.

volts. The output circuit is tuned to the intermediate frequency of 300,000 cycles and connection with the first intermediate amplifier is effected by means of a low impedance transmission line. The intermediate frequency amplifier stages are coupled by means of doubled tuned circuits. The use of properly designed circuits of this type makes it possible to obtain a high degree of selectivity against undesired frequencies while obtaining sufficient band width to maintain ease of tuning and to pass the desired frequencies. The second detector is of the conventional grid bias type. Automatic gain control is provided in which a certain amount of the carrier is taken at the end of the intermediate frequency stages, amplified and rectified. The resulting d-c. current produces a voltage drop across a resistance, which is applied to the grid of the first detector in such a manner that an increase in the intermediate frequency output brings about a reduction in the total set gain and vice versa. Manual gain control for following wide changes in the received fields is accomplished by variation of the voltages applied to the grid and the screen of the first detector.

The voice-frequency equipment, in addition to the desk telephone

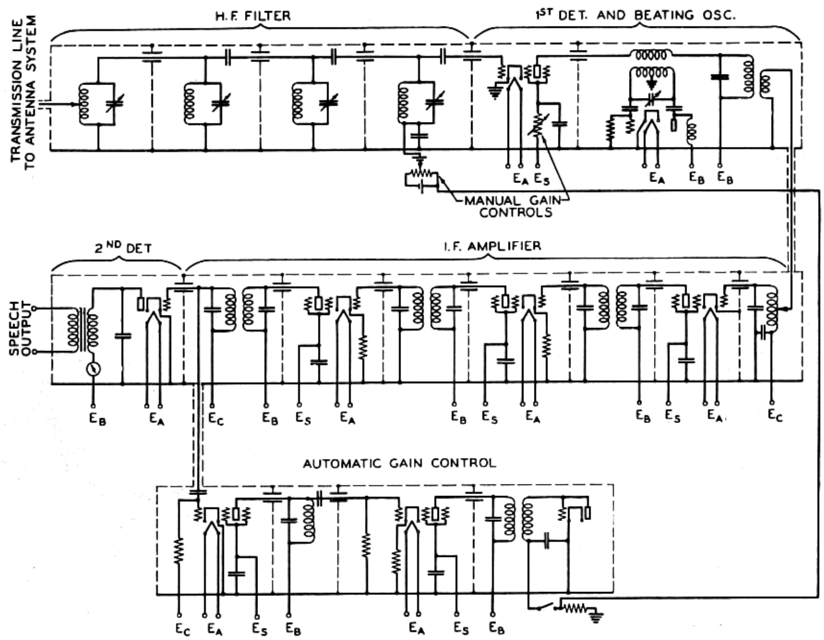

Fig. 14—Ship receiver schematic diagram.

set located in the subscriber's booth, comprises a technical operator's position located adjacent to the ship's receiver, and an attendant's desk located on a lower deck in a room adjacent to the subscriber's booth. The control equipment consists of repeaters, volume control devices, and volume indicators, by means of which the levels of the incoming and outgoing signals can be properly adjusted. Keys are provided which enable the technical operator to talk either over the radio circuit or to the ship subscriber. The booth attendant has facilities by which he can talk either to the subscriber or to the control operator and has a connection with the ship's telephone system for the purpose of locating persons on the ship and calling them to the radio telephone booth.

The subscriber's booth is provided with a desk telephone set having a high-grade transmitter. The outgoing and incoming circuits are shielded from each other and brought separately to the transmitter and receiver of the subscriber's set. An illustration of the subscriber's booth on the *Leviathan* is shown in Fig. 15.

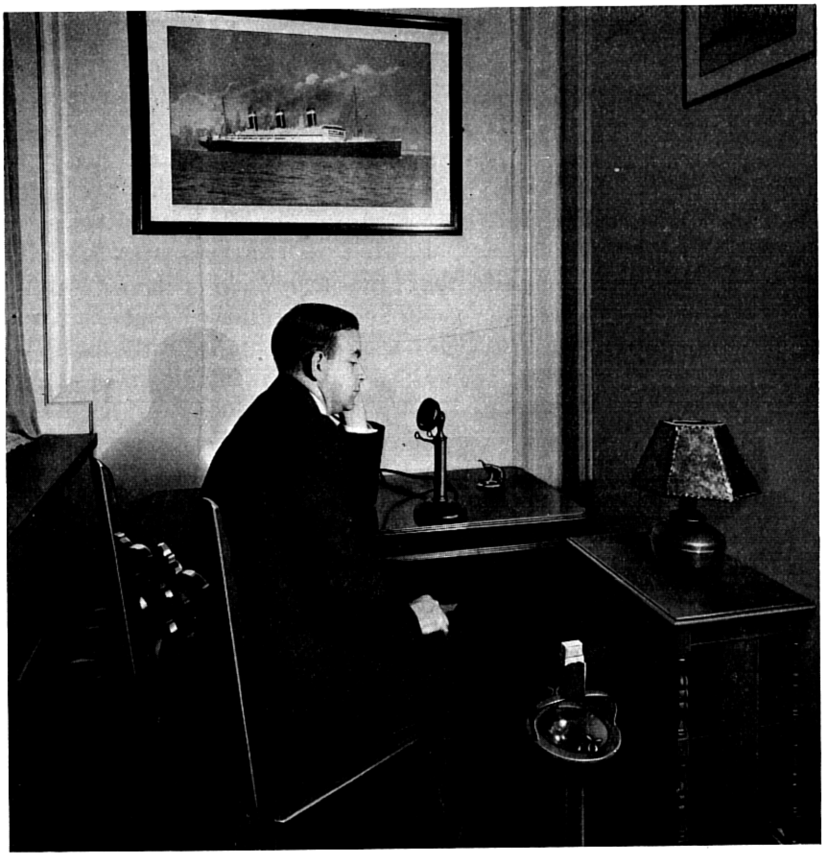

Fig. 15—Subscriber's booth on *Leviathan*.

The Wavelength Situation and Simultaneous Telephone and Telegraph Operation

Communication between ship and shore is carried out by the use of a pair of frequencies, one for transmission in each of the two directions, separated from each other by about 3 per cent. The specific frequencies which were first assigned by the Federal Radio Commission to the shore station and the *Leviathan* were necessarily chosen on more or less of a makeshift basis, in the absence of any comprehensive wavelength plan for this new service. The Commission has recently had under study the setting up of more adequate provisions for ship-to-shore telephone channels, whereby it is hoped a series of frequencies may be designated for telephone service exclusively and whereby there may be established the relation between the telephone and the telegraph frequencies necessary for the avoidance of interference between the two services. Especially is coordination of the two sets of frequencies necessary on the larger vessels, in order that simultaneous telegraph and telephone service may be given without mutual interference. On the larger liners simultaneous use of the radio telephone and radio telegraph service must be provided for. This means that the transmitters of both services must keep accurately on their frequencies and be free of spurious components, and that the receivers must be highly selective. It further entails that the transmitting and receiving frequencies in each of the two cases be so coordinated that the transmission frequency of one service does not lie too near the receiving frequency of the other, and bespeaks a considerable amount of mutual cooperation between the operating agencies involved. Difficulties of fitting in the two services were encountered in the early work on the *Leviathan* and, although the problem has not been worked out to final solution, sufficient progress has been made, in cooperation with the engineers of the Radio Corporation of America, to enable the telegraph and telephone services to be conducted simultaneously without undue interference.

In view of the fact that ships of a number of nations are already preparing to give radio telephone service on the transatlantic routes and with the probability of this service also extending to other parts of the world, it would appear to be a matter of importance that the whole question of marine frequency allocations be worked out in the near future not merely on a national but also on an international basis.

Transmission Results

The transmission results which have been obtained with the *Leviathan* on her first trip of commercial service are summarized in Fig. 16. It will be noted that practically continuous 24-hour communication was maintained for distances within 1000 miles of the shore, corresponding to two days out. The service at greater distances was more intermittent. This was largely due to the fact that during this first trip the effort was concentrated on covering reliably the more important nearer-in distances, and the ship was not prepared to transmit on frequencies above 8 megacycles. The service proved to be much in demand

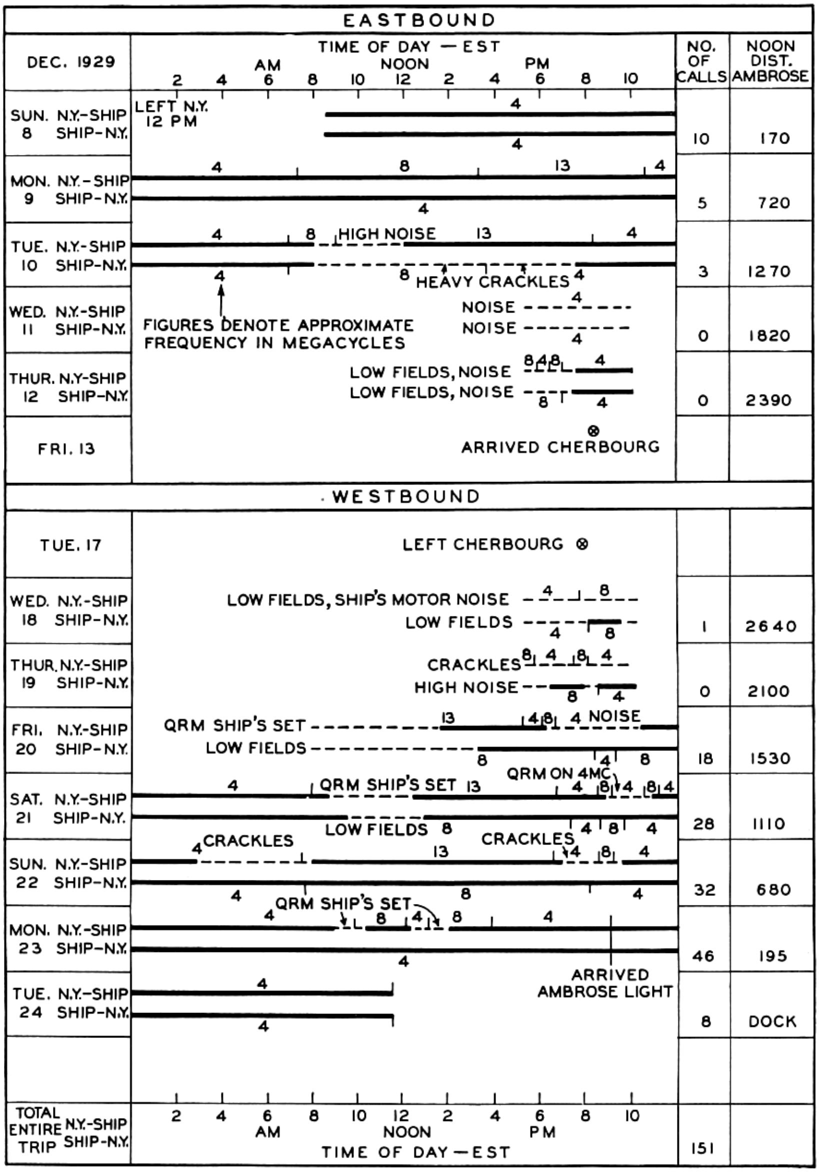

Fig. 16—Transmission results between *S. S. Leviathan* and New York.

by the passengers, as is indicated by the number of calls completed each day, particularly on the return trip. A similar number of test and demonstration calls was made during the voyage. The calls were completed without undue delay, there being only one ship involved, and a fairly high grade of communication was obtained.

In conclusion it will be realized that the solution of the techincal problem of ship-to-shore telephony is now well in hand and has been carried to the point of having proved the practicability of giving this service. Further problems are naturally arising in carrying the development into more general effect, particularly operating problems and those concerned with the international coordination of the service. The indications are that the larger transoceanic ships will be rather generally equipped for telephony and that the service will become one of permanent value in the maritime field.