



## Twelfth Naval District Shore Communication Stations

By G. W. CATTELL

■ The part played by the Twelfth Naval District in the story of shore wireless stations on the Pacific coast is long and full of interest. Mare Island had a hand in the erecting and outfitting of most of the early stations in the Eleventh, Twelfth and Thirteenth Naval Districts and in Alaska.

The first Navy wireless station on Mare Island was a combined transmitting and receiving station consisting of a Slaby Arco open gap spark transmitter together with a Slaby Arco coherer and de-coherer for receiving.

The station was commissioned 21 May 1904. The first message was transmitted to Yerba Buena, approximately twenty air miles distant, by R. B. Stewart now the Senior Electronics Engineer in the Office of the Electronics Officer, Eleventh Naval District. The message was received by a Mr. Carroll, present whereabouts unknown.

In 1921 the Navy established a series of radio direction finder stations along the West Coast. Mare Island originally maintained all the traffic and direction finder stations in the Eleventh and Twelfth Naval Districts and in Alaska and some of the stations in the Thirteenth Naval District. In 1921 the Thirteenth Naval District assumed the maintenance for all stations in that district and in Alaska. In 1924 the Eleventh Naval District assumed the maintenance for their own stations.

About 1920 the Navy started the construction of a series of low-frequency, high-power arc transmitting stations for broadcast schedules to the fleet and for daylight transcontinental and trans-Pacific point-to-point circuits such as Washington, Honolulu, Cavite and Balboa. The Mare Island station was commissioned in 1921 with a 60 kw arc converter with an antenna supported by three 450-foot self-supporting steel towers spaced at the corners of a 1,000-foot triangle.

The method of signalling was to alter frequency slightly, the difference between "mark" and "space" being on the order of between 100 and 500 cycles.

Full advantages of this type of frequency shift keying were not fully appreciated. Walter Fanning of the Twelfth Naval District applied for a patent however, utilizing the principle of using the marking and spacing waves to operate a common polar relay. It was used only to a limited extent.

One of the troublesome disadvantages of the arc transmitter is that it is an inherent generator of severe radio interference covering a continuous band of frequencies from the fundamental upwards. This was known as "arc mush." About 1922 the Federal Telegraph Company, the principal manufacturer of arc converters, invented the nodal-point system of keying which eliminated the spac-



*The Mare Island station as it appeared in 1904.*

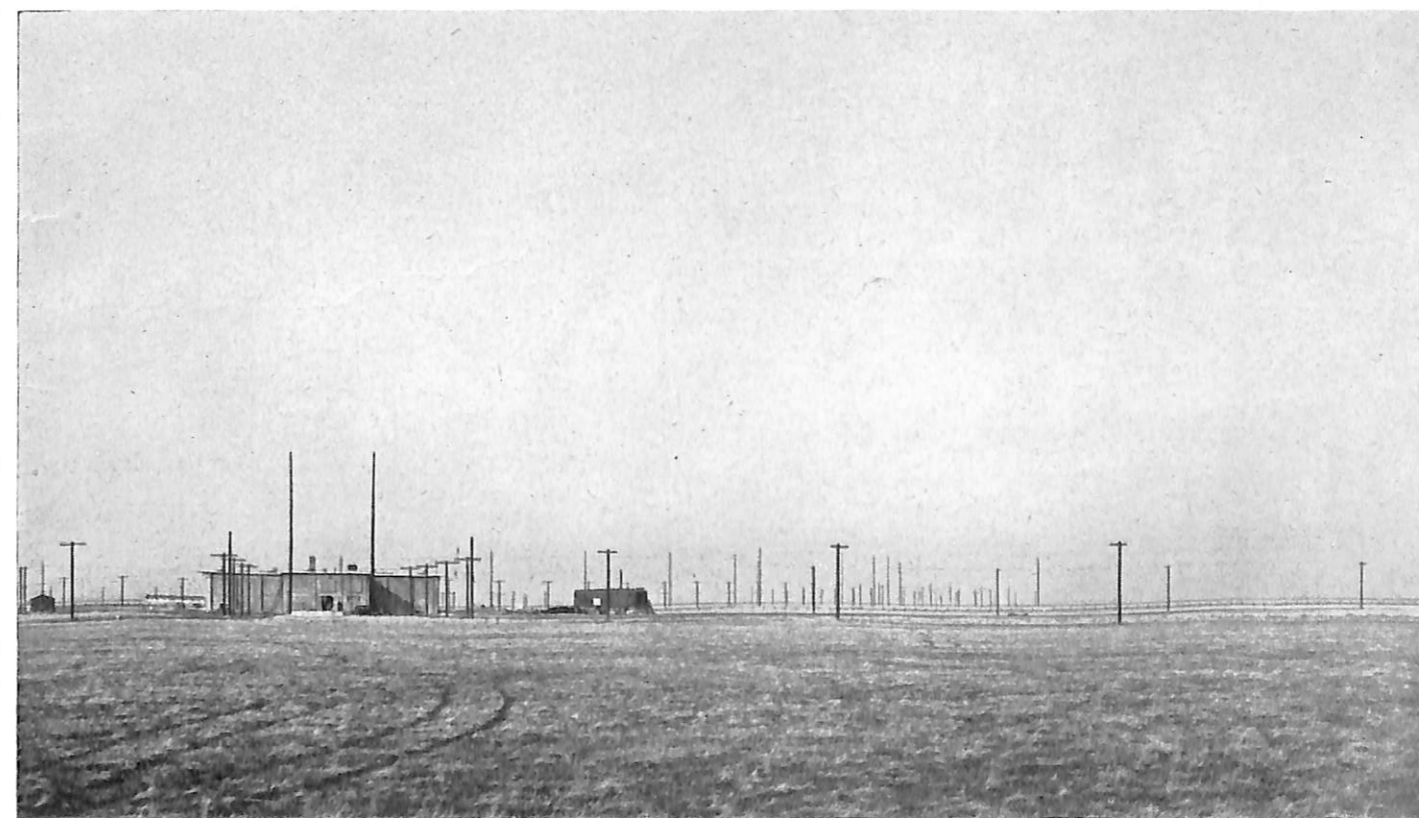
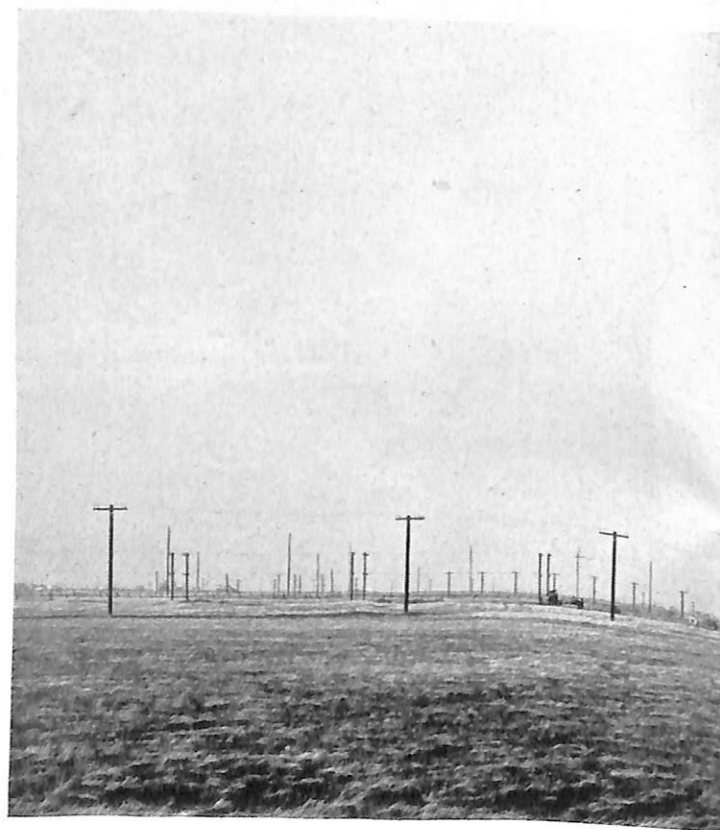


ing wave and effectively reduced the arc mush near the fundamental frequency and to a lesser degree at higher frequencies. About the time radio broadcasting became popular, the Navy became very unpopular for the intense arc mush interference its arc transmitters were causing. Twelfth Naval District personnel developed a low pass filter which when used in connection with suitable shielding was found very effective in reducing arc mush interference on broadcast frequencies to a value where there were no further complaints. This circuit was successfully used by other Navy stations as well as some commercial installations.

Mare Island personnel designed and built the

Navy's first monitor receiving system which was installed at the South San Francisco Radio Station where receiving conditions were good. The signals were "piped" into the control station in San Francisco over wire lines leased from the telephone company. Although this method met with some opposition initially its merit was soon recognized and other installations followed.

Then came the "discovery" of high frequency communication. Isolated cases of very long distance communication using very small power gave rise to many false hopes that it might become the usual thing. It was soon realized that considerable power would be required to obtain thoroughly dependable



*U. S. Naval Communication Station, Dixon, California. Transmitter Building.*



U. S. Naval Radio Station, Skaggs Island, Sonoma, California. Operating Building and 300-foot tower.

results. However, the many advantages of high-frequency communications were soon appreciated and stations sprang up all over the world. New and more-efficient antennas were developed which required larger receiving station sites. The Twelfth Naval District's high frequency receiving developments were transferred to Mare Island, using the same site on the hill which was used for the original Mare Island station. Fading was one of the most troublesome vagaries of high-frequency transmissions. The problem is now understood and effective remedies are available. As the Navy is concerned, Mare Island personnel pioneered diversity reception. Mare Island installed what probably was the first rhombic and certainly the first multiple-wire rhombic receiving antennas used in the Naval Communication Service. Mare Island is believed to be the first to rebroadcast time signals and the first to make practical use of rebroadcasting of traffic by acting as an automatic relay station between Radio Washington and Radio Honolulu. The Twelfth Naval District also pioneered the Navy's use of high-speed Boehme automatic tape transmission and reception.

In the meantime, several high-frequency transmitters had been installed in the High Power station. Because the Hill Receiving Station was only one-mile distant from the High Power transmitting station, the problem of "key clicks" was quite troublesome. Twelfth Naval District personnel satisfactorily solved this problem by developing a diversity-mixer unit incorporating a new circuit which proved effective in eliminating key clicks and all other interference of the impulse type.

Mare Island and the Twelfth Naval District have a tradition of which they are justly proud: whatever it is, it *can* be done; no effort is too great, individual credit is not a motivating factor, and that we all work together on all occasions. Everyone is a member of the same team. Mr. George K. O'Hara, Senior Civilian Assistant to the Electronics Officer, and who has been with this yard for forty years, has played an important role in developing this *esprit de corps*.

#### ACTIVE INSTALLATIONS, TWELFTH NAVAL DISTRICT

To name and describe all the presently active shore electronic activities in the Twelfth Naval District would be beyond the scope of this article. Only a few of the major activities will be discussed briefly.

NCS *Skaggs Island*—Navy Communication Station, Skaggs Island, houses three activities: 1—Receiving Activity, 2—Communications Supple-

mentary Activity and 3—Security Activity. The reservation consists of 3,300 acres of flat and level land surrounded by salt water sloughs and protected therefrom with suitable levees. It is approximately 28 air miles (49 road miles) from the San Francisco Control Station and 8 air miles (29 road miles) from Mare Island Naval Shipyard. The quarters and station maintenance facilities area is in the northeastern corner. The main operating building is located near the geometric center.

The main operating building is of reinforced concrete measuring 80' x 85' and consists of two floors and a basement. It is of splinter-proof construction with no windows below the second floor. It was originally designed and equipped to be a combined major diversity receiving station and complete emergency control station. The lower floor was intended for operating activities. Each room therein is completely shielded with sheet copper. The basement was intended for wireways, conduits and other services. The second floor was intended for offices, storerooms and air conditioning equipment.

The 80' x 30' receiving room was designed to accommodate four rows of single or diversity receivers. The supervisor's desk, audio, radio frequency and power panels as well as the two crystal controlled clocks are located at one end of the room. At the other end of the room are located emergency Boehme positions and ships operating table. Because experience has indicated that it is expedient to have the ship-to-shore operators situated where they can control their own receivers, ships tables (where manual and radio-teletype operators handle this type of circuit) are located adjacent to the wall originally intended for the fourth row of receivers. Receivers and ships tables are above rows of concealed prefabricated holes in the floor which convey wires and cables to a three-tier cable tray slightly to one side of the holes.

The Communication Supplementary Activity occupies the 80' x 35' room originally equipped for control purposes. This activity also occupies additional operating space on the second floor. This activity has sole occupancy of the Special Project Building surrounded by 19 rhombic antennas and the DAJ building which are remotely located. Additions are in the planning stage.

The Security Activity occupies space on the second floor. It is well equipped with a model LAM precision frequency measuring equipment as well as other necessary facilities to measure quickly and accurately any received frequency from the very low to ultra high. Facilities permit of monitoring

several types of transmission including teletype to assist in its program to observe any irregularities in procedure.

The main antenna system consists of three spaced rosette groups of rhombics. Each of three groups was originally of slightly differing design: a—single-wire horizontal, b—3-wire horizontal, and c—single-wire sloping. The intention was to service-test the three types to determine the best. The 3-wire type appears to be most satisfactory.

*NCS Mare Island*—Mare Island is the site for both the Low Frequency Station and the new High Frequency Transmitting Station.

*Low Frequency Transmitting Station*—The original High Power Station was built in 1920 and originally housed one 60 kw arc. During the years that followed, several more arcs were added which in turn were replaced by tube transmitters of various types and descriptions. The two major arcs (100 kw input) were used on frequencies of 28.5 and 42.8 kc up to 1942 when they were replaced by tube transmitters. In the meantime, many high-frequency transmitters were also installed until it was quite apparent that additional space would be required to house the evergrowing number and size of high-frequency transmitters. This station is remotely controlled and essentially unattended, being visited about once per watch.

*High Frequency Transmitting Station*—The High Frequency Station was commissioned in 1940. It is cross-shaped, built of reinforced concrete and having three operating wings and an administrative wing. A splinter-proof operating booth is located at the intersection of the three operating wings. From this booth may be started, stopped, keyed and monitored, any transmitter including those located at the Low Frequency Station one mile away. The transmitters are arranged in four rows and rest over concealed prefabricated holes in the floor which permit the wires and cables to pass into the three-tier wiring trays which follow along beside but under the holes. A three phase enclosed power bus forms a loop circuit entering the three wings. Power taps as heavy as 600 amperes may be taken off every 22 inches without danger to personnel and without interrupting the circuit.

*NCS, Dixon, California*—The high-frequency transmitting station at Dixon is not yet in commission. The station is located approximately 54 air miles (72 miles by road) from San Francisco and approximately 33 air miles (42 miles by road) from Mare Island. It occupies two adjoining sections (1280 acres) of flat and essentially-level land. The entrance is at the north end. The operating building is situated near the geometric center of the property, one mile to the south.

The station was originally intended to be the major high-frequency station in this area. Because of the many changes which have taken place since then, its present status is that of supplementing the High Frequency Transmitting Station at Mare Island. It is understood that the Dixon station will be used, among other purposes, as an experimental station to service-test new ideas such as the development of an unattended, completely remote-controlled transmitting station. Because of the large land area available, it is probable that some antenna development will also be undertaken.

The main features of the operating building are of BuShips design. The building is essentially "tee"-shaped with a small administrative section in front. The transmitter room, approximately 38' x 122', was designed to accommodate ten transmitters.

No specific space has been assigned for additional transmitters other than that now being used as a shop and a relatively small storeroom, which could be made available by the removal of certain partitions. The station is completely air-conditioned to take care of the heat dissipated by the air-cooled transmitters and the excessive temperatures which prevail during the summer months. The floor in the main transmitting room and all administrative areas is of terrazzo construction. Floor trenches are used for electric wiring and cooling water. The main air-conditioning ducts are also in the floor with gratings to allow the flow of cooled air. If appreciable further expansion is deemed necessary, the Bureau has proposed the building of an extension on the other end of the "tee" and construct another transmitter room similar to the one now housing the present transmitters.

There are at least two new and interesting features connected with the Dixon installation. The first twin-rhombic antennas in this area have been constructed at this station. It will be very interesting and instructive to compare them with the standard rhombic and to test the feasibility of using the two halves as separate antennas or the possibilities of horizontal beam steering or beam width control by adjusting the phase relation in the two halves. The two halves of the twin have been brought over separate transmission lines into the building to obtain greater flexibility of utility as well as for greater ease in experimentation. Great care has been taken to keep the transmission lines feeding the two halves as nearly alike as possible.

Another feature which will be tried out is a new system of very flexible radio frequency switching between antennas and transmitters. These switching facilities will comprise two banks of over-

head switch units filling a large portion of the space between opposing rows of transmitters. The new system attempts to approximate the ideal of being able to place any transmitter on any antenna without danger to personnel.

The main power is furnished by the Pacific Gas and Electric Company at 60,000 volts. It passes through Company-owned transformers and Navy-owned switch gear at 2400 volts and then through underground ducts to the operating building about one mile distant. Emergency power is furnished by a 600-kw advance-base-type Diesel engine generator which delivers power through suitable switch gear at 2400 volts.

The antenna field consists of seven twin rhombics and eight single rhombics. Number 6 copperweld wire spaced 12 inches apart is used for outside transmission lines. The same size wire spaced 6 inches apart is used for transmission lines inside the operating building.

*NCS San Francisco*—The San Francisco Control and Teletype Relay stations are located in the Federal Office Building near the San Francisco Civic Center. The radio control room and teletype relay center are located on the third floor. The model UN and single-sideband terminal equipment as well as the two model TDO transmitters are located on the sixth floor. A 150 kw Diesel engine set in the basement furnishes power in case of emergency.

The NTX and radio teletype relay center are considered the best and most efficient in the Naval service. The present arrangement with all its facilities is the result of progressive improvements and a creative imagination.

Some facilities for Boehme transmissions are still being preserved for sending of FOX schedules or where otherwise required.

The radiophoto facilities for the district are located on the sixth floor. Many now famous World War II pictures came over this circuit.

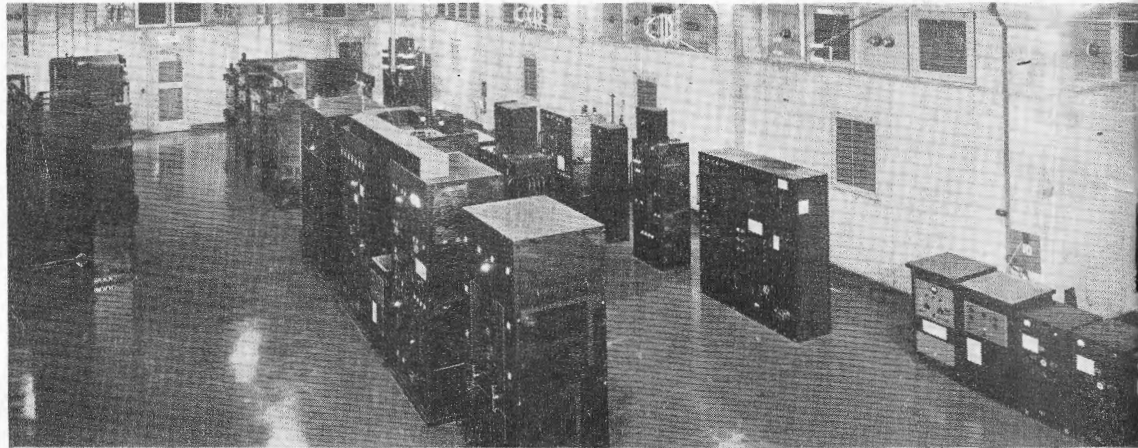
Mare Island transmitters may be controlled from the control station over land lines leased from the Pacific Telephone and Telegraph Company or over the v-h-f communication control links. The radio signals received at the receiving station at Skaggs Island may similarly be transmitted to the control station over the v-h-f communication control links or over Navy-owned cables between Skaggs Island and Mare Island and thence over leased lines to San Francisco. Arrangements have not been completed to permit the use of multi-channel operation over land lines leased from the telephone company.



U. S. Naval Radio Control Station, San Francisco. Teletype Relay Center Tape Monitors.

# H-F TRANSMITTER STATION MARE ISLAND . . . . .

WING "A" FROM ROOF  
OF CONTROL ROOM



WING "B"



WING "C" FROM ROOF  
OF CONTROL ROOM

