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In this Issue....

SWIMMER OPERATED ECHO SOUNDING EQUIPMENT

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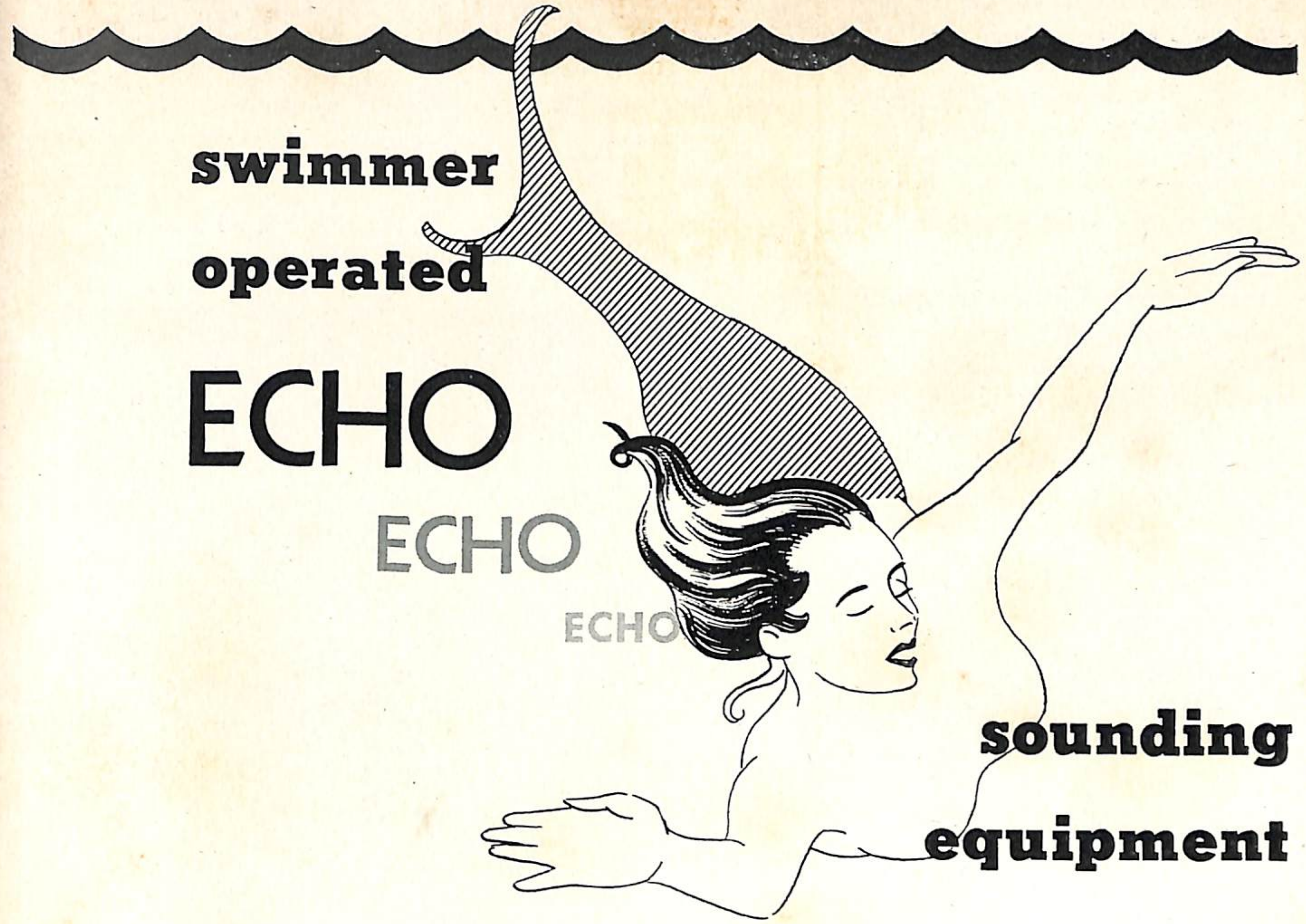
swimmer operated ECHO ECHO ECHO sounding equipment



by
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Introduction

In 1934 the University of California Division of War Research undertook to develop for the amphibious forces an expendable radio fathometer which could be launched from aircraft. The CXKD and lead-line sounding equipments resulted from this project. In July 1945 it was suggested that the Model CXKD expendable echo sounder be mounted on the paddleboard which was proposed for the use of underwater demolition teams. The application was successfully demonstrated at the Navy Combat Demolition Training and Experimental Base on Maui, T. H. Development of the fathometer was carried on after the close of World War II by the U. S. Navy Electronic Laboratory, San Diego, California.

Equipment Developed

Two portable shallow-water fathometer systems have been completed: the Shallow-Water Fathometer (SWF–1) and Swimmer's Telesounder And Radio (STAR) equipment. In both of these systems, the time required for a pulse of sonar energy to travel from the transducer to the bottom and return is displayed as a distance on a cathode-ray oscilloscope (CRO) using an A-scan presentation. This time is proportional to the depth of the water at the buoy. In converting time to depth, the sonar velocity is taken as 4800 ft. per second. The depth of submergence of the transducer, which is fixed at 2½ ft., is accurately taken into account so that true depths are indicated.

Shallow-Water Fathometer (SWF–1)

The Shallow-Water Fathometer (SWF–1) system is a remotely indicating echo sounder consisting of a buoy (towed by a swimmer), and a shipboard receiving station which presents the depth of the water under the buoy. The buoy contains an echo sounder and a continuously operating frequency-modulated (FM) radio transmitter; the shipboard station is a wideband FM radio receiver and a depth indicator unit.

The SWF–1 buoy, shown in Figure 1, is a spar-like cylinder 21 in. long and 7 in. in diameter. It weighs 24½ lb. in air, and floats with 3 in. of the body above water. The radio antenna extends 62 in. from the upper end, and the transducer is freely suspended 13 in. below the lower end. When the buoy is not in use, the antenna is telescoped to a length of 29 in. and the transducer is secured inside the lower end of the buoy.

To put the buoy in operation, the swimmer extends the antenna, releases the transducer, and snaps a switch on the top of the body. Water depths from 5 to 20 ft. may be measured. This information is transmitted to the ship via radio over a line-of-sight range of 6000 yd.

The buoy contains a sonar transmitter, a sonar receiver, and a radio transmitter, all operated from dry batteries with a two-hour life. The sonar transmitter is an electron-coupled, blocked-grid keyed oscillator, the plate load of which is the EP2Z transducer. The transmitter is controlled by a pulse-former circuit which is triggered by a relaxation oscillator (termed the keying-rate oscillator). The pulse-former and keying-rate oscillator circuits are adjusted to produce pulses of 115-kc sonar energy at the rate of 30 pulses per second. Each pulse is of 250 microseconds duration. The sonar receiver, which is capacitively coupled to the transducer, consists of two stages of amplification; its output is rectified to give a nonsymmetrical pulse. This in turn is amplified once before it is applied to the reactance modulator of the FM radio transmitter. The modulator controls the single-tube oscillator-tripler, which has a fundamental frequency of 6.2 Mc and an output frequency of 18.6 Mc. This 18.6-Mc signal is fed to a doubler-driver which supplies the final amplifier with 37.2 Mc. This amplifier is inductively coupled to the buoy antenna. The power input to the final amplifier plate is 2 watts.

The shipboard receiving part of the SWF–1 system consists of a Navy Model RBK–12 radio receiver and a CRO depth indicator unit, arranged as shown in Figure 2. This equipment operates on 117-volt, 60-cps power. An antenna for 37.2 Mc, not shown in Figure 2, is required. The higher it is mounted above the water line the greater will be the radio range.

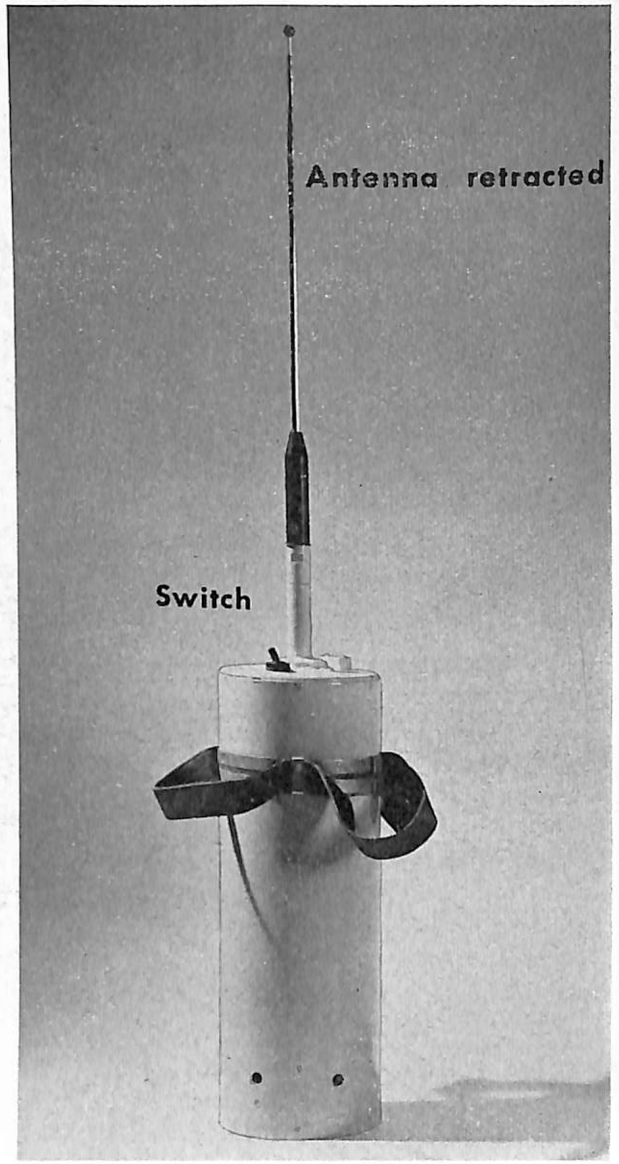
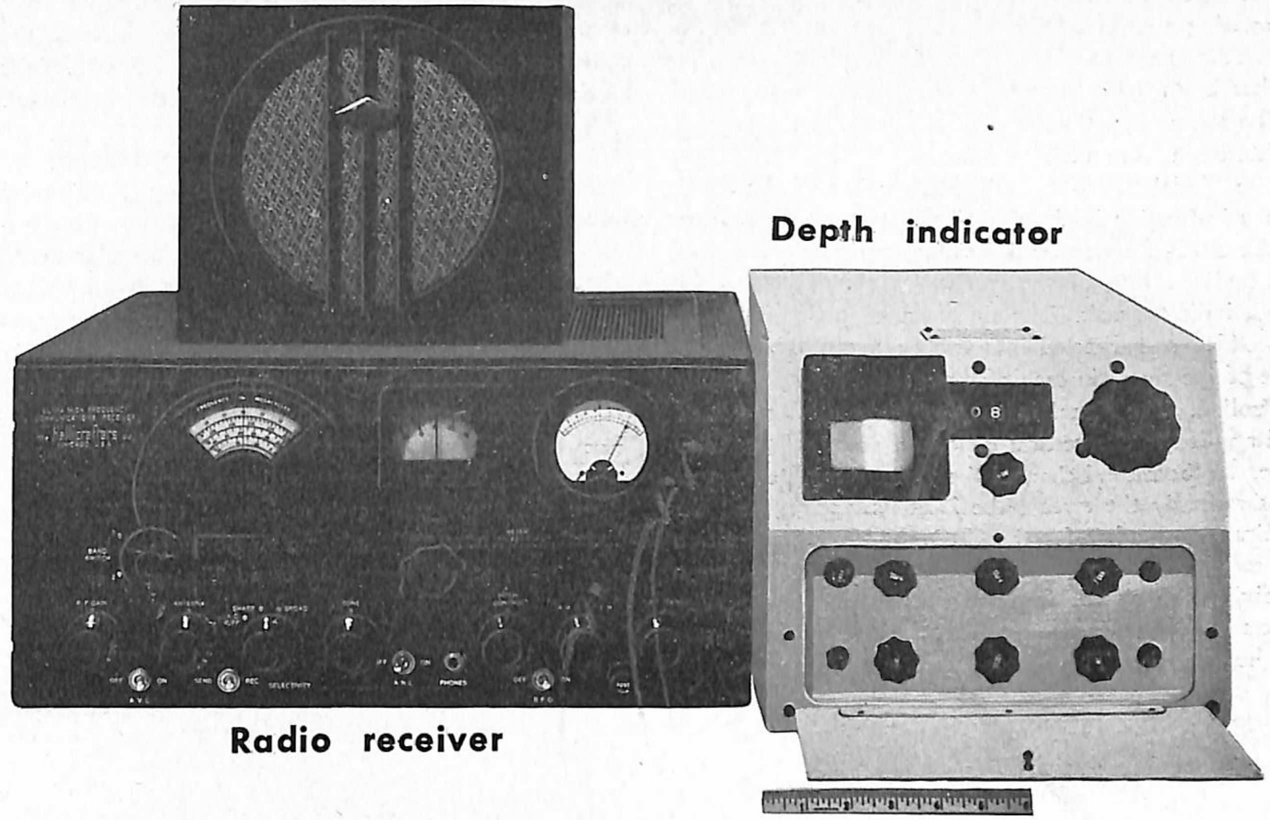


FIGURE 1—SWF–1 swimmer's buoy.

The SWF–1 shipboard equipment indicates the depth of the water under the swimmer's buoy. It receives the 37.2-Mc FM radio signals from the buoy. An audible output aids in tuning and monitoring. The audio signal is fed to the depth indicator, where it serves to synchronize the horizontal sweep on the CRO and supply the vertical marks which identify the outgoing sonar pulse (ping) and the returning echo. A fixed-amplitude verti-

FIGURE 2—SWF–1 shipboard receiving equipment.



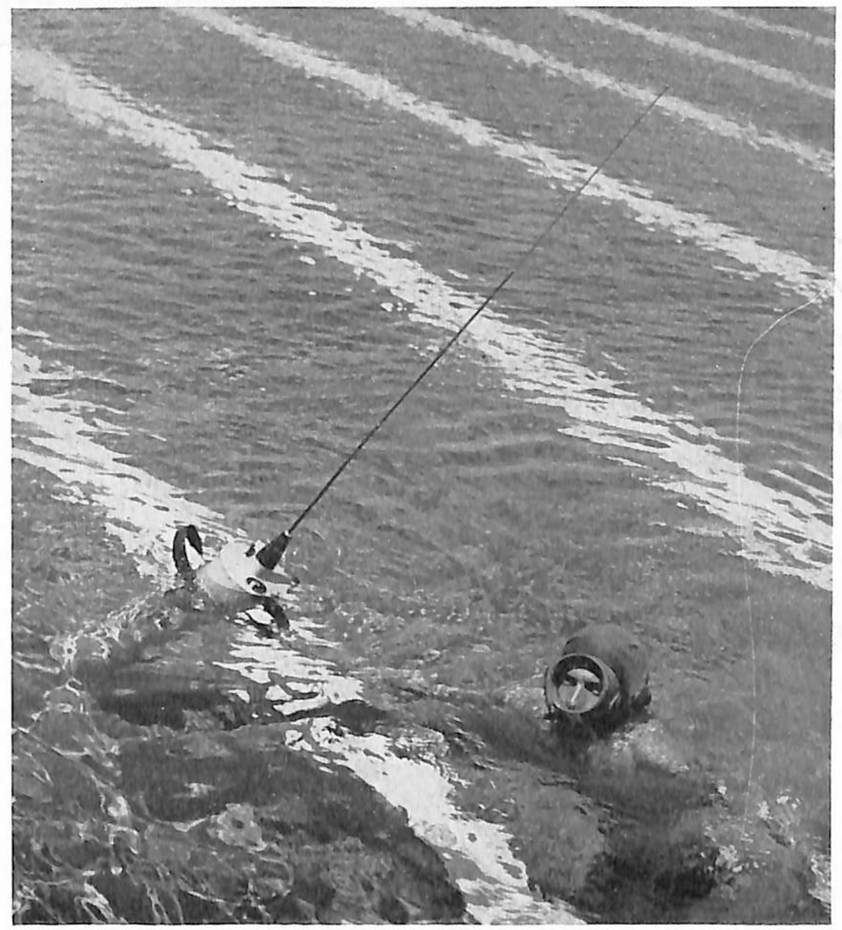


FIGURE 3—Swimmer towing STAR buoy.

cal step marker has been made a part of the trace appearing on the CRO. This marker may be moved along the trace by rotating a control knob which is directly geared to a cyclometer register. When the leading edge of this marker is moved into alignment with the leading edge of the sonar echo, the depth of the water at the buoy is registered in feet on the cyclometer.

The Model RBK–12 radio receiver is well described in the instruction book. Only its immediate application in the SWF–1 system will be discussed here. The normal audio output of the receiver is used to drive the depth indicator unit. The signal entering this indicator is rectified and directed into two channels. The amplitude of the signal in each of these channels is separately controlled. The signal in the first channel is amplified and applied to the vertical deflection plates of the CRO tube. In the second channel the signal is used to trigger synchronously the sweep, the Z-axis blanking, and the vertical-step marker for the CRO. This synchronization is brought about by means of a gas tetrode which, upon receiving the signal, forms a constant-amplitude pulse that actuates the linear-sweep circuit and the vertical-step marker circuit. The linear-sweep circuit controls the Z-axis blanking and also supplies the input to the horizontal amplifier of the CRO. The vertical-step marker circuit regulates the time variable, making possible the coincident adjustment of the step and the echo. The vertical-step marker control is geared to the cyclometer.

Swimmer's Telesounder And Radio (STAR)

The STAR system is a remotely indicating echo sounder in combination with a two-way radio communication system. The buoy, which contains an echo sounder and a two-way radiotelephone, is towed by a swimmer, as shown in Figure 3. The STAR shipboard station consists of a two-way radiotelephone, an indicator control unit, and a CRO. The buoy continuously transmits sonar depth information to the ship, where it is displayed on the CRO. With no interruption to the display of depth information, the swimmer may listen for calls from the shipboard operator or talk to him at will. The entire operation is accomplished on a single radio channel.

The swimmer's buoy, shown in Figures 4 and 5, is a cylinder 30½ in. long and 7 in. in diameter and weighs 35 lb. The antenna protrudes through the top 7 in. when retracted and 54 in. extended. When the transducer is released from its holder in the buoy, it hangs freely 6 in. below the buoy. When the buoy is floating normally, the antenna end of the tank extends 4 in. out of the water. Waterproof microphone and earphone units are each attached to the top of the buoy with 3½ ft. of rubber-covered cable.

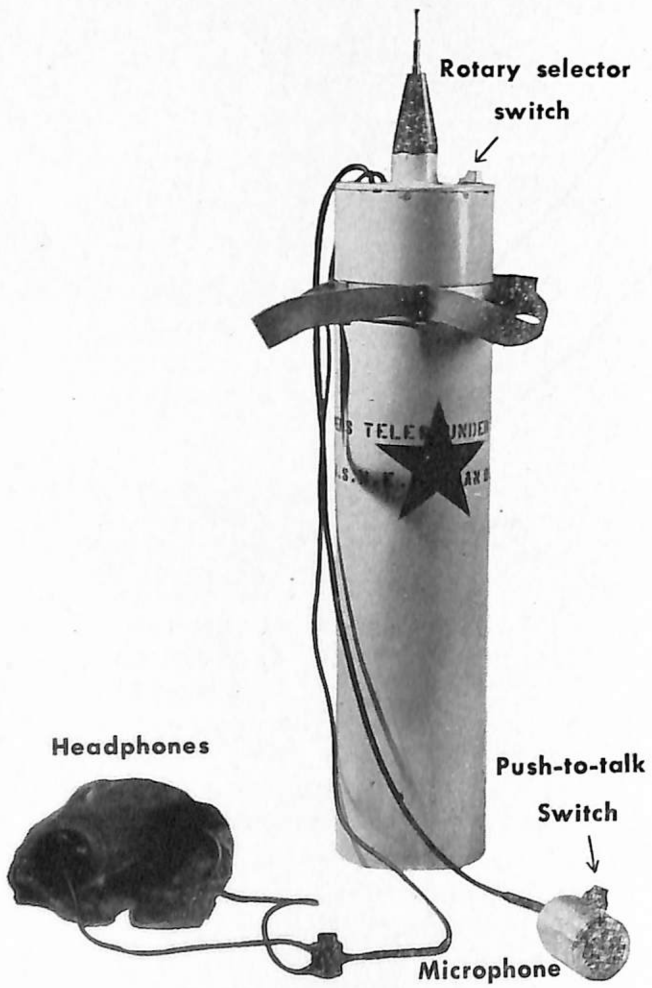


FIGURE 4—STAR swimmer's buoy.

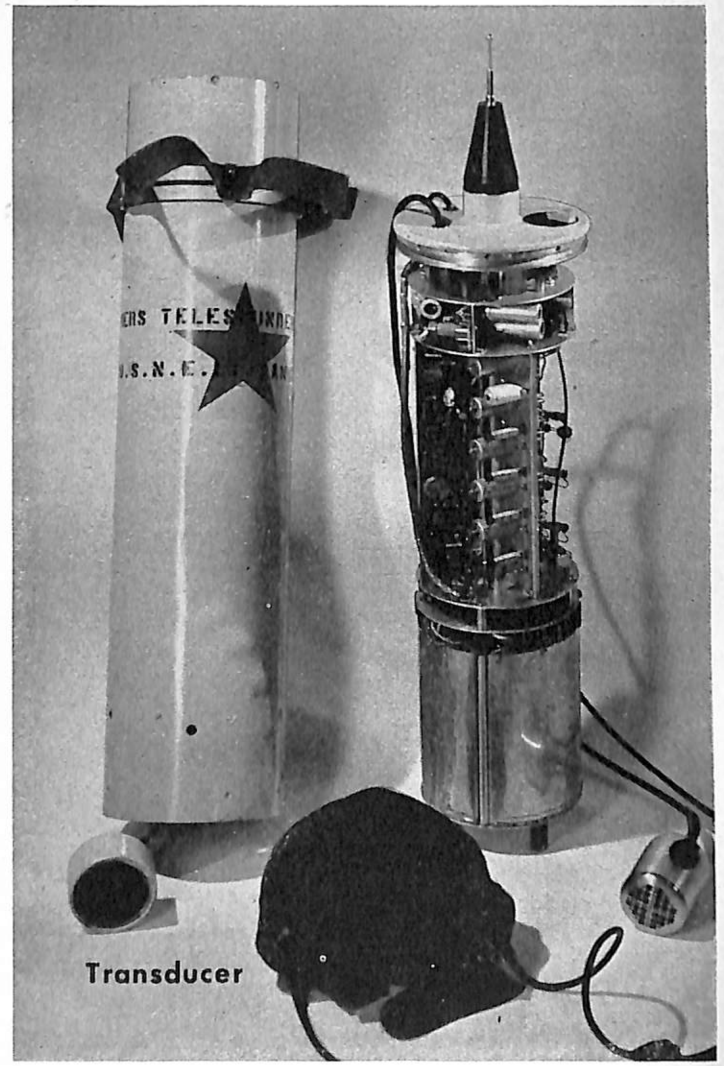


FIGURE 5—STAR swimmer's buoy (disassembled).

The STAR buoy will measure water depths from 5 to 80 ft. and has a line-of-sight radio range of 7000 yd. To put this buoy in operation, the swimmer extends the antenna, releases the transducer, and rotates a selector switch located on the top surface of the body. Refer to Figure 6. This switch has three positions, OFF, ON, and TALK ONLY; and was designed to give positive positioning even when operated with gloved hands. When the switch is in the ON position, swimmer-to-ship or ship-to-swimmer communication may be conducted. Simultaneously—and without interference—sonar depth information will be continuously transmitted. When the switch is in the TALK ONLY position, radio silence may be maintained at the buoy; the swimmer may listen continuously for communication from the shipboard operator and break silence only when replying. In the TALK ONLY position the sonar transmission is inoperative.

These several modes of operation over the single radio channel are controlled electronically. When the rotary selector switch is in the ON position a keyer element exercises automatic control over the sonar functions, the radio transmitter, and the radio receiver. In the TALK ONLY position, the sonar system is inoperative and the radio receiver remains on continuously. The radio transmitter is held in the OFF condition by the keyer; however, facilities for voice transmission from the buoy are continuously available, and are controlled by the push-to-talk button on the microphone.

FIGURE 6—Swimmer sets switch on top of buoy and uses waterproof microphone to communicate with ship.

The keyer consists of a nonsymmetrical multivibrator rate oscillator, a driven-delay timer, and an Eccles-Jordan switching circuit. The functional arrangement of these and the other electronic elements embodied in the STAR buoy is shown in Figure 7. Further circuit details and the pulse characteristics are given in Figure 8. The rate oscillator indicates positive pulses, at t_0, three times per

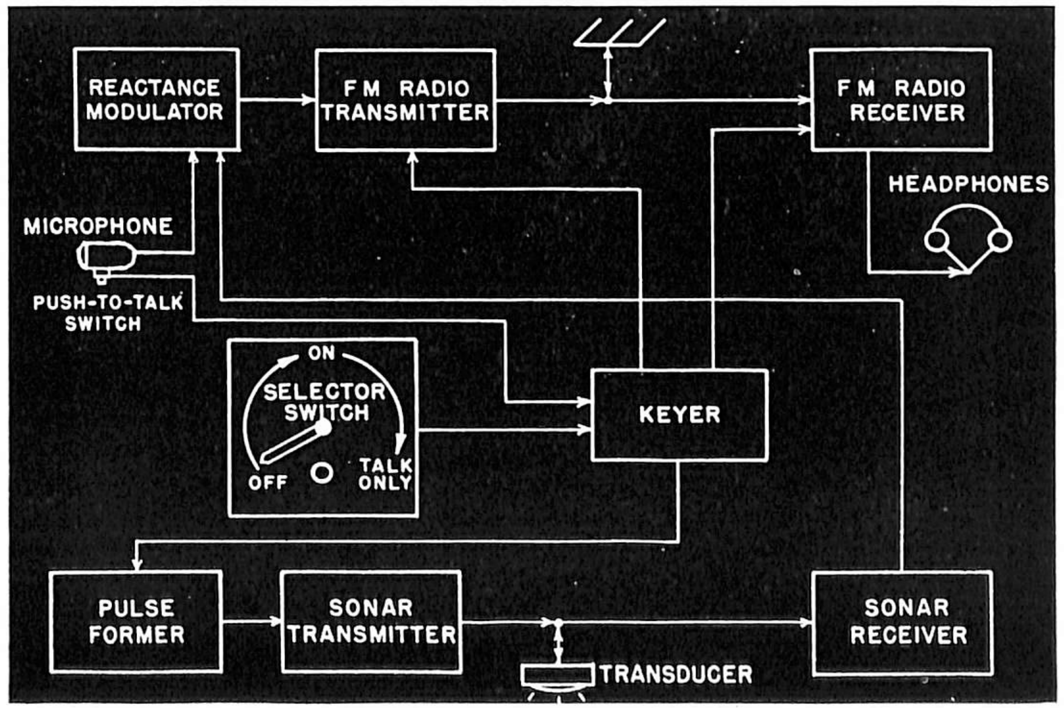


FIGURE 7—STAR buoy block diagram.

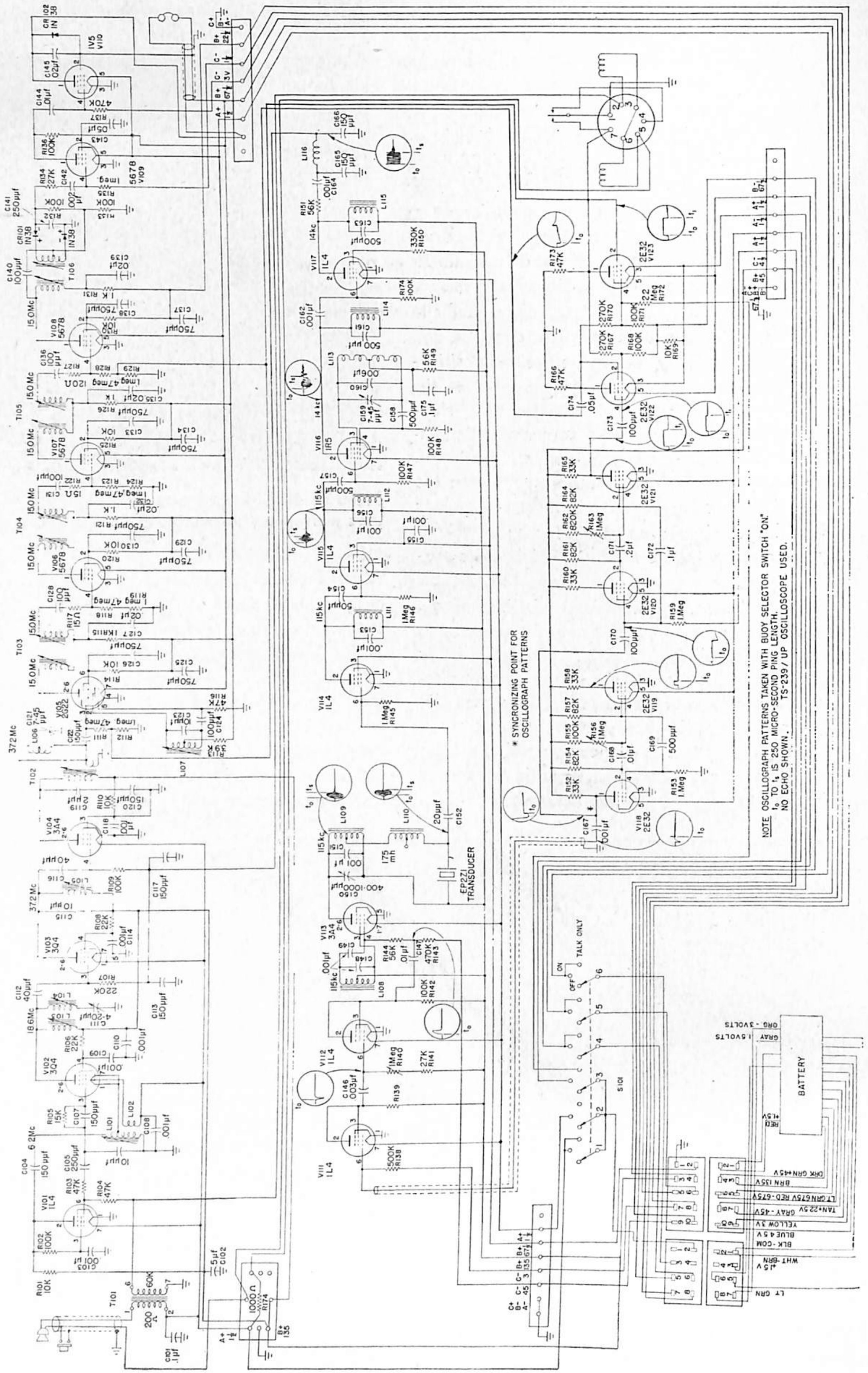
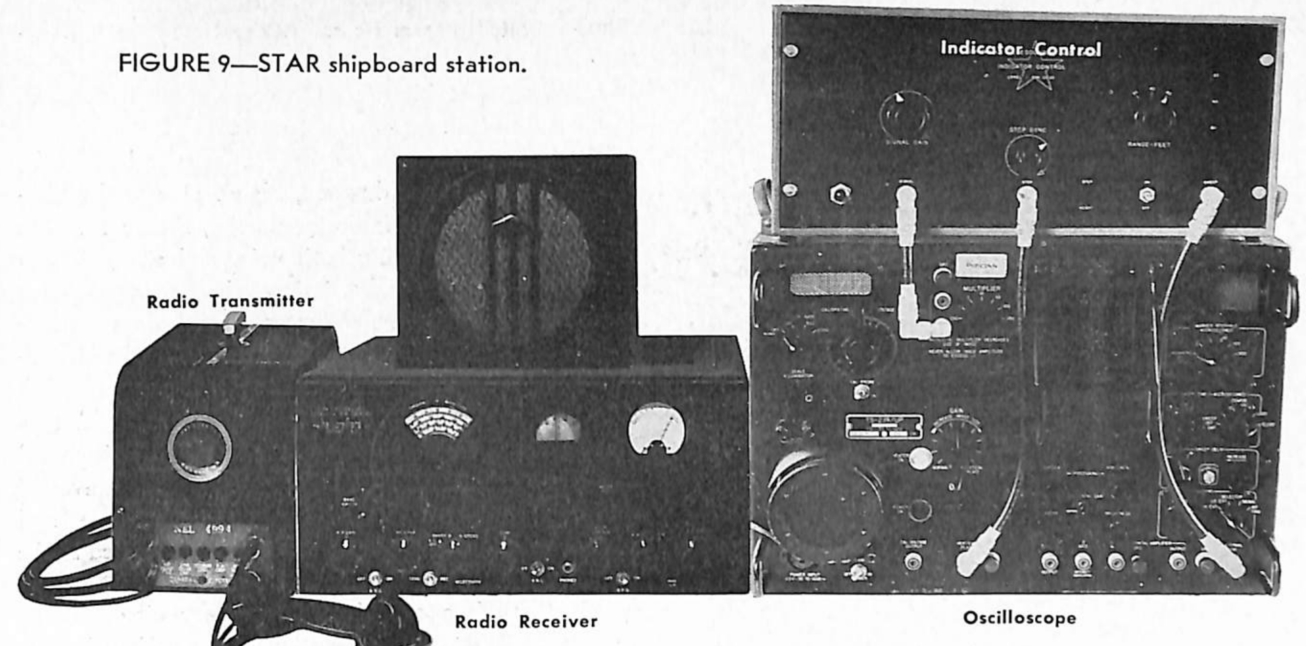


FIGURE 8—STAR buoy schematic diagram.

FIGURE 9—STAR shipboard station.



second. These pulses are used to operate the pulse former of the sonar transmitter and to trigger the driven-delay timer which in turn sets the Eccles-Jordan switch. The initial triggering of the switch keys the radio transmitter on and simultaneously reduces the sensitivity of the radio receiver. After 35 milliseconds, which is the time allowed to obtain the sonar data at 80-ft. depths, the driven-delay circuit "flops" back at t_1 to its original state and triggers the Eccles-Jordan switch to its second stable condition. This cuts the radio transmitter off and restores the radio receiver sensitivity.

The sonar transmitter consists of a pulse former, which receives its excitation from the keyer, and a 115-kc electron-coupled blocked-grid keyed oscillator which is impedance-matched to the EP2Z crystal transducer.

The pulse former supplies a positive pulse which overcomes the fixed-cutoff bias on the oscillator control grid, thus permitting oscillations to take place for a period of 250 microseconds, t_0 to t_8. This pulse length is adjustable.

The sonar receiver accepts input energy from the terminals of the transducer. This energy is amplified by two 115-kc tuned amplifier stages and mixed with 129-kc energy from a local oscillator. The difference signal of 14 kc is then amplified and fed to the radio transmitter.

The radio transmitter is frequency-modulated by the reactance method. The modulating voltages are supplied by the sonar receiver at 14 kc and by the voice microphone at voice-range frequencies. Both modulating voltages are simultaneously present during operations involving the transmission of sonar data and voice from buoy to ship. The reactance-modulated oscillator has a fundamental frequency of 6.2 Mc, which is tripled in the plate circuit of the oscillator tube to 18.6 Mc. The 37.2-Mc sixth harmonic is reduced with a series trap connected in shunt with the 18.6-Mc plate tank circuit. From here the signal is fed to a doubler-driver amplifier that drives the final amplification stage at 37.2 Mc. The final amplification stage is in turn inductively coupled to the antenna tank circuit. The double-driver and the final amplifier are fixed-biased beyond cutoff and are triggered on by either of two methods: (1) by the direct action of the Eccles-Jordan switch in the keyer, which pulses the transmitter on for 35 milliseconds during each cycle of automatic operation, or (2) by the push-to-talk microphone relay, which when held on places the transmitter on continuous operation regardless of the keyer action. The signal is radiated by a vertical antenna of a length slightly less than one-fourth wavelength.

The superheterodyne FM radio receiver operates from the same antenna and at the same frequency as the transmitter and is capacitively coupled to the antenna tank circuit. The signal grid of the first stage and that of the subsequent limiting stage are pulsed negatively by the keyer element at the time the transmitter is automatically keyed on. This momentary desensitization protects the receiving tubes while holding the noise caused by the keying on of the transmitter to a minimum in the earphones. The listening with the radio receiver is effected on a time-shared basis with the transmission of sonar data; the sonar information requires 35 milliseconds and the radio listening approximately 300 milliseconds, together making up the total interval. This distribution of shared time permits the reception of radio communications with satisfactory intelligibility.

The shipboard receiving station, shown in Figures 9

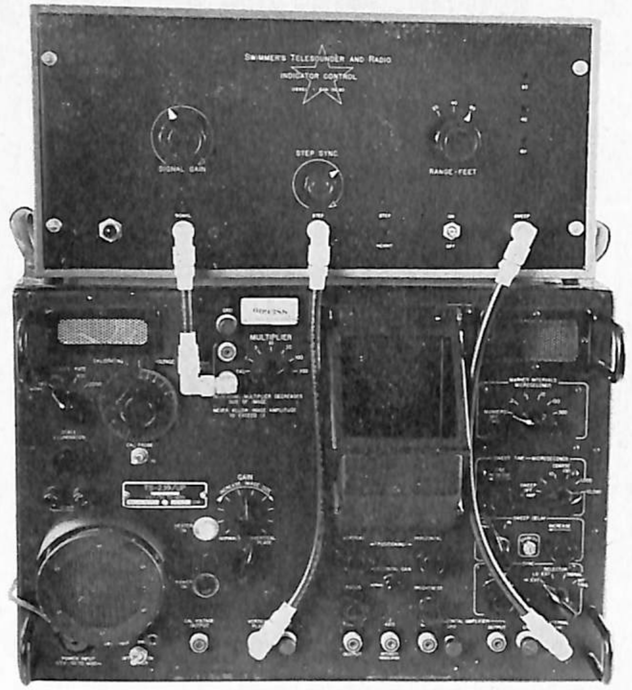


FIGURE 10—STAR indicator control and oscilloscope.

and 10, consists of a standard Navy RBK–12 radio receiver, a standard Navy T5–239/UP oscilloscope, and a special indicator control unit. The transmitter may be any normal FM communications type which can be adjusted to the proper frequency. The antenna should be mounted as high as possible, since the elevation of the antenna is the principal factor governing range. An antenna change-over relay, which may be included as an integral unit in the radio transmitter, is necessary to permit rapid two-way communications. The indicator control is 20 in. by 10 in. by 10 in. and weighs 27 lb. A radio transmitter will usually be found in place on board ship; however, the portable unit used experimentally was a General Electric commercial transmitter.

To insure satisfactory operation, the radio receiver, Model RBK–12, must be carefully tuned to the buoy frequency, 37.2 Mc, with the switches set for FM detection and high-fidelity operation. After being received, the signals are guided to the various elements as shown in Figure 11. The voice reception may be presented either by a speaker or by head-phones. The transmission of sonar depth data does not disturb the voice reception because at 14 kc it is above the range of the audio system and the normal ear response. The superimposed voice and sonar-data signals are applied to the indicator control, where the voice frequencies and much of the random noise are removed. From here, the filtered signal is directed over two separate paths. In one path, it goes directly to the vertical amplifier of the CRO. Over the other path, it reaches the timing selector, where it is used to initiate the driven linear sweep of the CRO and synchronously to trigger the range-step timer. A vertical-step marker, thus generated, appears in the CRO trace and makes it possible to set the sweep correctly for each of the three depth ranges, 20, 40, and 80 ft.

More complete operative details may be learned by referring to the block diagram, Figure 11, and the schematic diagram of the indicator control, Figure 12. The incoming signal carrying both voice and sonar data is taken directly from the discriminator in the radio receiver and introduced into the indicator control via a cathode follower which applies but little load to the discriminator. From the cathode follower the signal passes through a 14-kc bandpass filter and a tuned plate amplifier to a branch point. Over one branch, the signal pulse is passed to the vertical amplifier of the CRO where it is converted into a properly located pattern on the CRO trace and may be read in terms of water depth when applied to the proper scale. Over the other branch the signal pulse travels through a cathode follower to a circuit where full-wave rectification, integration, and amplification are successively applied twice in cascade. The pulse is then differentiated, rectified, and amplified, thus producing a signal to operate the driven sweep of the CRO. The foregoing multiplicity of operations are performed on the incoming signal to insure the selection, from the many possible sporadic pulses, of that particular pulse from the buoy which must be used to trigger properly the CRO driven sweep and the marker step synchronously.

The CRO sweep-triggering is also applied to the input of an inverter stage where it is properly formed and directed into the range step timer. Here it initiates a marker pulse of voltage, the duration of which is determined by one of the three available resistance-capacitance (RC) circuits. The proper RC circuit may be selected by setting the RANGE-FEET switch on the desired range value, 20, 40, or 80 ft. This marker signal, which is of specific duration, is applied directly to the vertical plates of the CRO tube.

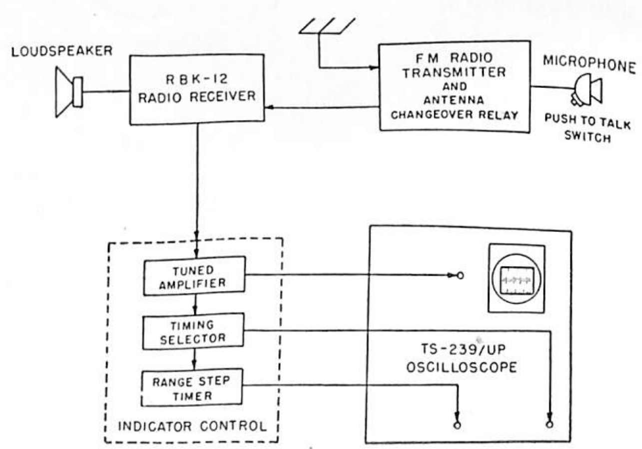


FIGURE 11—STAR shipboard equipment block diagram.

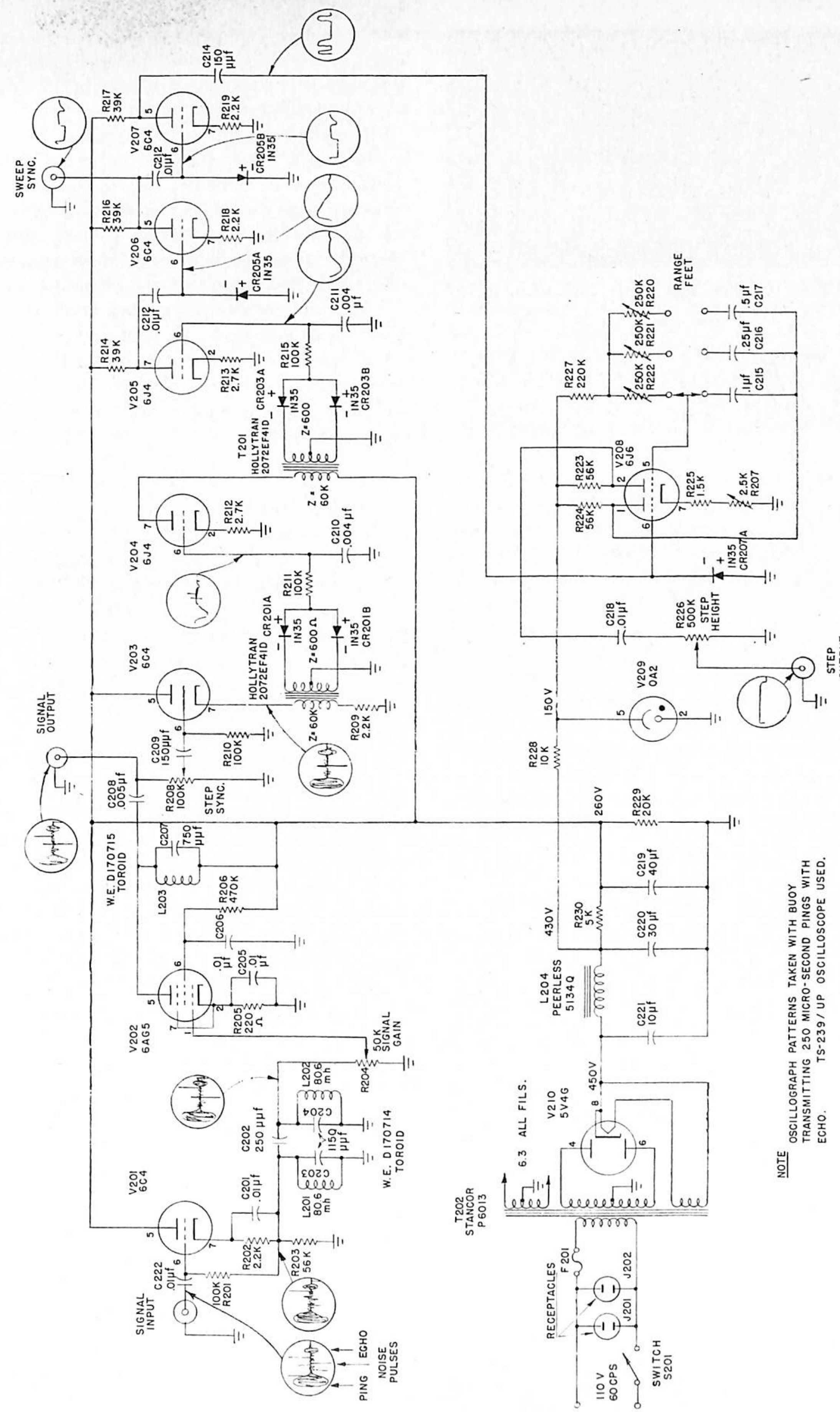


FIGURE 12—STAR indicator control schematic diagram.

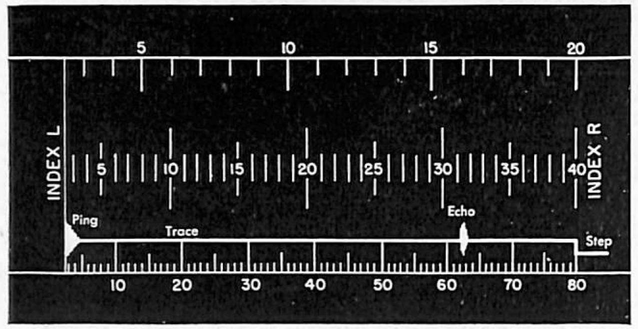


FIGURE 13—Trace showing depth indication of 62 feet on 80-foot scale.

The three scales are shown in Figure 13. By means of indirect lighting, they appear in orange on the CRO face, in contrast to the green trace. The left-hand indexes and the right-hand termini of all scales are common. In operation, a received pulse appears as a vertical trace on the CRO, and if it is the proper pulse from the buoy, it will initiate the horizontal sweep on the CRO while simultaneously applying the marker voltage to the vertical plates. The left edge of the trace thus formed must be aligned with the left index of the scales on the CRO face. It must also be aligned horizontally with the proper scale, and the right edge of the trace marker-step (a sharp downward step formed by the removal of the marker pulse voltage) must be adjusted to the right index line of the selected scale. This selection of step-marker time duration, by setting the range switch and adjusting the length of this step-marked trace to fit the scale, makes it possible to read correctly the depth in feet from the appropriate scale at the left-hand edge of the echo pulse.

Tests

SWF–1

Performance test of the SWF–1 were conducted during the development period to determine the over-all accuracy of depth measurement and adequacy of radio range.

The sonar performance of both the SWF–1 and the STAR were checked at the dock by rigidly mounting the transducer in a fixed position, with its radiating axis horizontal, about 2 ft. beneath the surface of the water. An echo baffle consisting of an aluminum plate 2 ft. square and 1/4 in. thick was rigidly mounted in front of the transducer on and normal to the sonar radiating axis. The range—distance between transducer and baffle—was variable from a maximum of 60 ft. to a minimum at the transducer face. Correction of depth measurements to account for depth of transducer in normal operation is made by adding 2 1/2 ft. The result is the true depth as read on the CRO indicator.

Under these conditions, the accuracy of the SWF–1 equipment was found to be limited by the shipboard operator's ability to align the step and the echo plate. In this test, the alignment allowed readings accurate to within 6 in. of the measured distance. Obviously, full advantage of this accuracy cannot be realized under operating conditions.

The radio performance was checked for range of operation only. This was done by mounting the shipboard antenna 25 ft. above the waterline and obtaining soundings from the buoy at intervals of 500 yd. until a line-of-sight radio range of 6500 yd. had been reached. The test was repeated a number of times on various days, and completely satisfactory results were obtained.

A joint operational test was made with UDT–1 on the Coronado Strand where the receiving equipment was mounted on the beach with antenna height about 25 ft. above sea level. The buoy was taken to sea through the surf by a swimmer who towed the buoy about 1500 yards to seaward from the receiving location and returned. The depth in part of the area covered exceeded 20 ft. and therefore was off the range of the indicator; however, lead-line checks made by the swimmer gave consistent agreement with the readings of the indicator. A second operation on the same day was performed by taking the buoy and a swimmer to sea in a speed boat. Beyond the breaker line the swimmer and buoy were launched from the speed boat while it was traveling at 16 knots. The swimmer then switched on the buoy, and indications of the water depth at the buoy location were received as the swimmer proceeded on his course. Again, lead-line checks were found to agree with the indicator readings. At the conclusion of this operation the swimmer and the buoy were picked up by the speed boat while it was traveling at a speed of 16 knots. Tests were also made at San Clemente Island, off California; and at Bahrein, Arabia, in the Persian Gulf, by UDT–1 during 1948 maneuvers. The reports on these tests indicate that substantial agreement exists between indicated buoy depths and lead-line readings taken simultaneously at the buoy locations.

STAR

The checking procedure for sonar performance of the STAR was the same as that described above for the SWF–1 buoy system. The 20-ft. and the 40-ft. ranges were checked for accuracy throughout, and the 80-ft. range was checked up to the 60-ft value. As with the other system, the limitation of accuracy by this method was found to be the readability of the CRO indication; the magnitude of deviation of reading from the measured value was consistently less than 6 in.

The radio range tests for this buoy were carried out in conjunction with random-noise and interference observations. The shipboard antenna was mounted 50 ft. above water level, and the operation of the system was checked by taking soundings at 500-yd. intervals until a 7000-yd. range was reached. Radio noise observations were made, during both voice and sonar operations for each station, with a Measurements Corp. UHF Radio Noise and Field-Strength Meter Model 58. The response bandwidth of this meter is approximately the same as that of the RBK–12 receiver used as a part of the system under test. These tests, repeated many times and on widely separated days over a period of approximately three months, revealed that the most disturbing noise consisted of high-amplitude pulses of short duration. This character of the noise was evidenced by the large ratio of the peak to average value of noise; for example, peak value would range from 400 to 1000 microvolts, with average values of 20 to 30 microvolts.

In the presence of severe noise and disturbance, the STAR equipment gave entirely satisfactory operation out to and beyond 7000 yd. on both the sonar depth measurements and the two-way voice communications.

Operational trials were conducted to seaward off the Coronado Strand near San Diego. The shipboard equipment was mounted in a truck, with the antenna 25 ft. above sea level. The truck was parked, 250 yd. from the sea, beside a highway on which motor vehicle travel was very heavy (a good source of radio interference). The buoy was taken to sea in a picket boat and put overside for the operational tests, which started near shore in water of 20-ft. depth and extended to sea where the depth exceeded the 80-ft. maximum range of the buoy. The radio ranges were as great as 6000 yd. As a part of the trials, two particular tests were made: one with the buoy located out of sight from shore behind an LST which was 2000 yd. to sea; the other with the buoy behind a second LST located 4000 yd. to sea.

Although the noise originating in the ignition systems of passing motor vehicles became annoying to the shipboard listener at times, it never disturbed the completely satisfactory operation of the STAR system for all depth ranges up to 80 ft. and for radio ranges well over the originally specified 5000 yd. The radio reception at the buoy was the radio-range limiting feature at the longer ranges; it was the only function that did not operate completely satisfactorily in each of the two particular tests when the buoy was located in the radio shadow of the LST's.

Conclusion and Analysis

The SWF–1 system meets the requirement for a swimmer's fathometer where depth only is to be remotely indicated on a ship within radio range. The SWF–1 does not offer ship and swimmer communications and has the disadvantage of having the buoy carrier frequency continuously on the air.

Tests of the STAR system, designed to indicate depths remotely and to provide two-way radiotelephone communication between a swimmer and his command within a 5000-yd. range, have shown the equipment to give entirely satisfactory operation out to and beyond 7000 yd. on both the sonar depth measurements and the two-way voice communications. Evaluations of the accuracy of the STAR depth measurements under controlled conditions revealed that its limitation was the readability of the CRO indication; the magnitude of deviation of observed values from measured values of sonar distances was consistently 6 in. or less. The STAR, on a single frequency, permits continuous radio transmission of sonar information simultaneously with ship and swimmer communications. In addition, it is designed to allow the swimmer, at will, to maintain radio silence. During these periods of radio silence, the sonar transmission is inoperative, and the swimmer may listen for signals from the command ship and, by means of a push-to-talk switch on the microphone, he may break silence at will to reply.

The present STAR equipment, being experimental, is battery-powered for operation in excess of eight hours. Inasmuch as the operational requirement for the equipment will not be in excess of two hours, the capacity of the battery may be greatly reduced, thus making possible a correspondingly substantial reduction in buoy size and weight. The use of all subminiature components and printed circuits, together with potting of some elements, would further improve the equipment.

A new transducer with separate motor elements for transmission and for reception would permit soundings to be made in water as shallow as about 3 ft. instead of 5 ft. minimum now attainable.

The swimmer's microphone should be improved, with special emphasis being placed on providing for satisfactory operation both in air and underwater. The underwater operation would be possible if the swimmer were provided with a diaphragm-equipped helmet or lung. The receiver unit should be improved, and bone-conduction methods employed, if possible, so that the swimmer can readily hear other sounds. The buoy connection for the microphone and the receiving set should be combined into a single plug-in unit which would permit the swimmer to free himself quickly from the buoy and to reconnect with ease either on the surface or while submerged, even while wearing gloves.

An increase in radio range is readily available if the transmitter power output and the receiver sensitivity of the buoy are increased. Application of crystal frequency control to all radio circuits would simplify the operation and field adjustment of the equipment.

Consideration was given to the possibility of providing, for complete subsurface operation, equipment which would transmit depth information, provide two-way communication, and make tracking of the swimmer possible, all by sonar techniques. Although a measure of success has been realized with underwater telephone in the open sea, there is not sufficient quantitative information to insure satsfactory application of sonar techniques for the attainment of the obectives mentioned above. Fragmentary information indicates that attenuation may be as much as ten times greater in shallow water than it is in the open sea. Scattering is known to be very high in rough areas. There is a paucity of data regarding the effects of surf noises. If complete acoustic operation is required, a full investigation of the factors involved should be made before the design or construction of any apparatus is undertaken.

Proposed Auxiliaries

To increase the value of the equipment in tactical operations and to expand its usefulness into other phases of reconnaissance and survey work, it is proposed that several auxiliaries be supplied with the STAR or that they be built directly into an integrated system. The first of these is a means for automatic recording of depths on a paper strip. This would give a continuous contour of the bottom over which the buoy has passed. A standard facsimile recorder using some simple additional electronic controls could be used. Automatic voice recording, on magnetic tape, is recommended to permit the review of an operation or to allow rechecking of various points of importance at a later time. This can be accomplished with existing standard types of magnetic tape recorders which could be used as a part of the over-all system. A third and highly important function, that of tracking the movements of the buoy, could be done by employing a radar-transpondor system which has been developed for use in tracking sonobuoys in anti-submarine warfare. With this addition the buoy could be accurately located and continously tracked without the usual radar interference such as shore and sea clutter.

Proposed Multiple-Unit System

Studies indicate that four buoys, each on a separate carrier frequency, can be integrated into a single system. This would provide a greatly improved system of beach reconnaissance under the control of two operators and one officer. In addition to the individual advantages of the modifications and auxiliaries outlined above, such an arrangement would allow each swimmer to be interrogated and directed at will by the command. This would make possible any on-the-spot alternation of survey plan or the re-survey of any particular region, as well as continuous coordination of swimmers' efforts in event of difficulties or casualties. A complete and continuous time-synchronized record of all courses, depths, commands, and reports would be maintained and could be evaluated without the aid of any swimmer or operator who took part in the maneuver. This would prevent the loss of valuable data in event of casualties.

Equipments embodying the above features are capable of filling the need for channel and harbor sonar-survey apparatus. Four such buoys, each lashed to a small boat, could be propelled at speeds up to five knots or greater to yield a continuous radar-plotted depth survey of a channel. The control ship could follow closely behind the survey, since the captain would have the complete survey records currently before him. Other ships could be guided close behind, thus saving much delay.

The harbor survey application is twofold: first, that associated with the peacetime mapping of bottom contours; second, the task of locating obstructions and sunken hulls in a newly captured harbor so as to make the fullest and quickest use of the harbor facilities. In each of these applications, it is not certain that radar plotting would be fully useful. However, shore-mounted optical plotting methods could certainly be made available and employed to great advantage, along with the continuously recorded depth information and the two-way voice communication facilities.

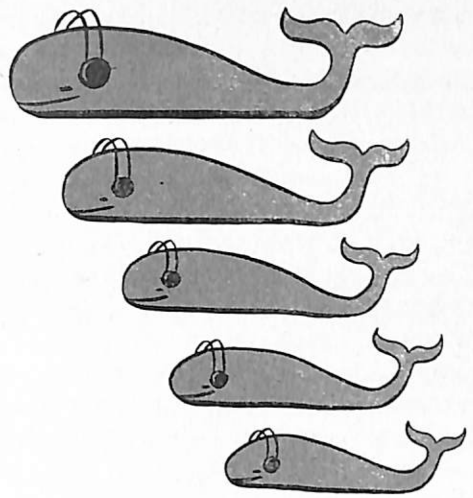
LOW AMPLITUDE RANGE MARKER STEP IN MODEL SS

A frequent complaint from the operators of the Model SS Radar concerns the small size or low amplitude of the range marker step. Providing that the step is still present in some degree, replacement of the 6AC7 tube at position V(1M)2 will restore conditions to normal. Reminiscent of the early days of radar, it may be necessary to try several 6AC7's before one is found that is compatible with its associated components.

In this connection it is pertinent to mention a peculiar condition that exists in some of the SS Instruction Books, SHIPS 335. When the console schematic diagrams for this book were printed some of the "C's" in the 6AC7 designation acquired an appendage that makes them appear like a "G" thus changing the type from 6AC7 to 6AG7. This condition was first encountered by a Western Electric Field Engineer while servicing an SS on board ship. The ship's technician and the field engineer became engaged in a discussion because a 6AG7 was plugged in socket V(1M)2. When the ship's technician presented the schematic in the instruction book the tube designation had all the appearance of a 6AG7. It was only after the field engineer showed him the full scale drawing of the console, with a 6AC7 in the socket, that the technician was convinced and changed the designation on his schematic.

In case of complete loss of the marker step carefully examine resistors R(1L)9, R(1L)125, R(1L)7B and R(1L)11. In case of a defective 6AG7 tube, (usually gassy), at position V(1M)4 these resistors will open or change value. Replacements for R(1L)9 and R(1L)125 should be at least one watt instead of the quarter-watt presently installed. Other causes of range step absence or distortion have been defective capacitors C(1M)7 and C(1L)5A or 5B. —*W. E. Newsletter*

THE SONAR TEAM



Current trends in the mode of submarine warfare place increasing emphasis upon the employment of submarine sonar equipment. The possibility of sonar equipment on board submarines operating with less than maximum efficiency is indicated by repeated inspection reports from Naval Shipyards, the Naval Electronics Laboratory, San Diego, the Submarine Group, San Diego and monthly performance and operational reports from individual submarines. It is desirable that maximum utilization of all available talent be made to insure optimum performance of all sonar equipment installed in submarines.

The Submarine Group, San Diego, has established a "Sonar Team" consisting of an experienced officer and a group of enlisted men technically trained in the art, for the purpose of conducting periodic sonar inspections of submarines in the Group and in addition to assist in the underway training of sonar operating and maintenance personnel. The Commander Submarine Force, U. S. Pacific Fleet indicates that the results which have been obtained by this "Sonar Team" are most gratifying and fully justify the employment of this group of personnel in that manner.

Commander Submarine Force, Pacific Fleet, in requesting that a "Sonar Team" be established by the Submarine Group, Pearl Harbor, listed the following objectives:

1—Conduct periodic inspections of submarines to determine the state of maintenance and upkeep of sonar equipment. Provide on the job instruction to ships personnel in correct maintenance and upkeep procedures.

2—Submit recommendations to the submarine Commanding Officers for the *submission of job orders to correct deficiencies which are beyond the capacity of ship's force.*

3—Provide underway training and instruction in submarine sonar to operating personnel.

4—Conduct periodic inspections of submarines to determine the presence and source of *own ship's noise,* especially extraneous noises caused by superstructure rattles. Make recommendations to the Commanding Officers for correction of defects.

5—Provide instruction to submarine sonar personnel in the correct procedures for the maintenance of logs, records and reports.

6—Submit periodic reports to the Group Commander with copies to the Force Commander and all Squadron Commanders.

7—Utilize to the maximum extent possible the services of the BuShips Field Contract Engineering Group while this group remains in the local area.

This is considered to be a very realistic approach to good performance and maintenance and also results in complete work requests to shipyards..

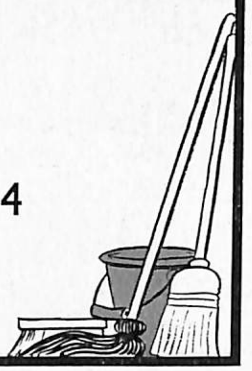
TR TUBES IN THE MARK 25 MOD 2

In at least two cases it has been reported that the TR tubes (1B63A) have been found incorrectly inserted in the duplexer. As is generally known, the end of the tube with the keep-alive terminal faces away from the source of power.

There have been three versions of this tube, the evident changes being in the windows at the ends. In the original design one of the windows was made larger than the other, this window facing away from the hub. It was later found that this was not necessary, so the next version had both windows the same size. The latest version is designed with higher power operation in mind. The window which faces the source of power has a flange of glass moulded around it on the outside, the purpose being to provide a longer break-down path on the outer surface of the window than on the inner.

For all three of the TR tube designs, the tube must be mounted in such a way that the keep-alive terminal is away from the hub of the duplexer, with both tubes facing in the same direction. Failure to assemble them so will result in low transmitter power outside and generally poor performance of the system.—*W. E. Newsletter.*

CLEANING ECHO BOXES *used with* MK 25 *and* MK 34 RADARS



Over a period of time it has been observed that echo boxes used with X-band equipments lose ringtime. Routine tuneup of the equipment fails to restore normal ringtime and substitution of a new echo box is necessary to isolate the real trouble. Further study proved that water was entering the echo box and causing corrosion of the inner surface of the box.

Most of the trouble results from use of the wrong type plug on the end of the RG–9/U coaxial cable or from not tightening the plug securely on the coaxial jack. To the best of our knowledge, either Type UP–21/U or UG–21A/U plug is satisfactory providing it is properly installed on the end of the cable, providing the rubber gaskets are not lost and providing it is properly tightened on the jack. The application of a small quantity of Insulating Compound Stock No. 17–1–39124–3403 Specification AN–C–128A may help to retard moisture leakage.

It has also been found that there is no satisfactory method of reclaiming an echo box when it has once been corroded.

These echo boxes are made from copper-clad steel, welded at the corners. The welded corners are all pressure-tested and all fittings are sealed in with cement. The box is watertight in all respects except for the center conductor of the coaxial jack. There is no standard coaxial jack which is watertight. The only way to seal off this jack is the use of the proper mating plug, and careful tightening of the plug. Any box which is so sealed off, and exposed to rapid changes in temperature, will breathe. Exposure to the sun or stack gasses will heat up the box and the air inside the box. Air will be forced out of the box at the only place where it can get out, the coaxial jack. As the box cools off and the air inside it contracts, air is drawn in through the jack. If the plug is well tightened and is of the correct type, the air may actually be drawn up through the cable from inside the transmitter compartment. Air drawn in through the cable will cause no trouble because the transmitter compartment is dry and the air has low humidity. The trouble comes when air is drawn in around the coaxial fitting on the echo box. If there is water present around the fitting, either salt water splash or rain water, such water will be drawn into the box. Since the water will not be expelled on the next heat cycle, there is a continual accumulation of water inside the box. True, there is probably only a very small amount of water drawn in at each cycle, but there can be several temperature cycles a day. Likewise, breathing around the jack can draw in air of high humidity content and condensation can take place inside the box. Water in the box will result in corrosion of the copper and loss of ringtime.

The boxes are made of copper-clad steel and every precaution was taken to expose a bare minimum of steel on the inner surface of the box when it was assembled. Due to welding of corners and *bosses,* there will be a small percentage of the inner surface which is bare steel. Water will cause corrosion of copper and will cause steel to rust. Rust will work in under the copper and cause the copper to blister. The degree of success we can expect from any attempt at washing out will depend upon the degree of corrosion or rust, and how long we let the box remain in this corroded condition before we wash it out.

The Philadelphia Naval Shipyard has worked out a procedure for cleaning the inside of copper-clad echo boxes, as follows:

"At this activity, four echo boxes from the *U.S.S. Roanoke* and four from as many DD's were in agreement with the above described loss in ringtime because of moisture and corrosion. Cleaning and drying of the echo boxes and fittings resulted in the restoration of ringtime which approached the values for new installations. The demounted echo boxes were cleaned as follows:

The insides of the echo boxes were cleaned with a solution developed by members of the Philadelphia Naval Shipyard Testing Laboratory. This solution is subject of a U. S. Patent issued to Kaplan and Terri. Number of the patent is not presently available. The cleaning solution may be used royalty free on U. S. Naval equipment. Other uses are subject to patent restrictions. About one gallon of dilute sulfuric acid with additions of acetic acid and hydrogen peroxide was introduced into the echo box to be cleaned. The openings were stoppered and the solution slushed around the inside of the box for about ten minutes. The stopper was then removed and the solution drained. Residual acid in the box was neutralized with a quart of 2% sodium carbonate solution which was allowed to remain therein for three to five minutes. Neutralization was tested with litmus paper. Two to three changes of tap water were introduced into the box. Neutralization was again tested with litmus paper. After final rinsing, the echo box was dried out with an air blast. In several of the boxes it was necessary to install new coaxial connectors and associated excitation dipoles.

After echo boxes were reinstalled, normal values of ringtime were observed in all cases.

The patented cleaning solution developed by the Testing Laboratory consisted of the following:

60	fluid ozs. water
6	fl. ozs. concentrated sulfuric acid (95%) specific gravity 1.84
4	fl. ozs. glacial acetic acid
58	fl. ozs. 3% hydrogen peroxide
128	fl. ozs. (1 gallon)

NOTE: *Add in order given"*

The above procedure was presented to the Laboratories for study and they have given us the following comments:

"You will note that one of the objections to this or any other method of cleaning is the possibility of a small amount of the acid solution being entrapped in the crevices associated with the welded seam. To verify this objection we cut open the echo box submitted to us. This box was found to be very badly corroded at some of the seams and around the ⅛" pipe plug. In fact, the corrosion was so bad around the pipe plug that it may have been the chief cause of the leak.

After viewing the condition inside of this box we are convinced that any cleaning solution used in these boxes will, in a majority of the cases, give only temporary results."

The Laboratories also recommended that every effort should be made to seal the plug and jack assembly in the field at the time of installation. They also recommended that the box be dried out periodically with nitrogen.

The above discussion gives a fairly good story but we have a few more comments to add. Be sure that the boxes are properly installed with the right type of coaxial plug and be sure that the plug is well tightened. If you observe that ringtime is falling off, suspect that the box has water in it and that corrosion has started. Don't wait for the corrosion to reach the advanced stage before you do something about it. Get the echo box into the shop and washed out as soon as possible. You may be successful in reclaiming an echo box to usable condition if prompt corrective action is taken. We have no way of knowing how long a box will remain usable after it has been washed out. Much of this will depend on how well the acid has neutralized and how well the box has dried out. It might be a good idea to introduce a nitrogen blast after the box has been dried out with air. We would appreciate reports from the field telling what success you have had in reclaiming echo boxes.

—*W. E. Newsletter*

REPLACING C35 AND Z3 IN THE MARK 25/2 RANGE UNIT

When it becomes necessary to change both the phasing capacitor and the inverter network associated with capacitor C35 in the range unit of the Mark 25/2, the process becomes complicated. Three Western Electric Field Engineers solved this problem with the following method:

It was found that C35 had several spoonfuls of oil in it, and in addition, apparently had a metal chip in the oil which was shorting the capacitor. They next found that network Z3 measured several thousand ohms between terminals, and from terminals to ground. It was decided to replace both of these units, which was done. Lacking necessary alignment equipment, a method was devised which gave satisfactory results. After replacing Z3 and C35 (latter left disengaged from gearing), V4 was removed and terminals 1 and 3 of the socket were strapped together. With the range unit dials (*not* gear unit dials) set at 1000 yards, the rotor of C35 was turned until maximum amplitude was observed at TP5 using the test oscilloscope. This peak is quite broad. This sets the rotor of C35 under sector 3 at 1000 yards (approximately). C35 was next engaged with associated gearing. Since Z3 was taken from spares it required adjustment. To do this, two 6SN7 tubes were modified, the first (tube A) by cutting off pins 1, 2, and 3 (to adjust Inverter 2 on Z3; the second (tube B) by cutting off pins 4, 5, and 6 (to adjust Inverter 1 on Z3). The short between terminals 1 and 3 of socket V4 was removed, tube A was inserted in this socket, and adjustment of Inverter Adj. 2 was made to minimize voltage at TP5. The range is changed in the vicinity of 1000 yards to obtain this minimum also, that is both adjustments were made simultaneously to obtain absolute minimum at TP5. The rotor of C35 is now *exactly* under sector 3, and if the range is not exactly 1000 yards (plus or minus 20) with minimum voltage at TP5, it is necessary to remove the phasing capacitor, rotate the range dials and re-engage the capacitor, then recheck as above and lock the capacitor in place. Replace tube A with tube B, change the range to obtain a reading exactly 500 yards (plus or minus 2) higher than above, and adjust Inverter Adj. 1 for minimum voltage at TP5. This should occur at the same setting. If it is necessary to move the range to a position other than exactly 500 (plus or minus 2) yards above the point where Inverter Adj. 2 gave minimum voltage at TP5, it indicates that Z2 is incorrectly adjusted. Next replace V4 (standard tube with all pins intact) and change range slowly. No voltage variation should be apparent at TP5. If variation is apparent, then either the adjustments were not accurately made, or Z2 (quadrature adjust) is not correctly adjusted (assuming oscillator frequency is correct.

—*W. E. Newsletter*

RADAR

EQUIPMENT MARK 25 MOD 3

The Bureau or Ordnance has been engaged for some time in the development of a major modification of Radar Equipment Mark 25 Mod 2 which is expected to greatly increase its effectiveness as a unit of Gun Fire Control System Mark 37. The change consists principally of the addition of a new high-powered (250-kw peak) transmitter, a modified range unit capable of measuring range out to 100,000 yards, and automatic synchronization of the range unit with designated range. The modification will be accomplished by Field Change No. 25. After completion of the change, the equipment will be identified as Radar Equipment Mark 25 Mod 3.

The main purpose of Field Change No. 25 is to increase the acquisition range capabilities of Gun Fire System Mk 37. Performance reports indicate that Radar Equipment Mk 25 Mod 2 can be expected to accomplish reliable acquisition of a medium-size fighter plane at between 20,000 and 25,000 yards. This acquisition range becomes marginal when planning fire control systems to combat the new jet fighters with speeds of approximately 800 knots. For a target having radar cross-sections less than half that of a fighter and/or having higher speeds, the effective range of the Radar Equipment Mk 25 Mod 2 might be inadequate. For example, a missile the approximate size of Gorgon IV traveling at 800 knots would not permit opening fire until it was in to approximately 5,000 yards. The Mk 25 Mod 3 would increase this opening fire range to approximately 8,500 yards.

The project for the development of a field change kit of parts to convert Radar Equipment Mk 35 Mod 2 was authorized in 1948, with Western Electric Company and its development laboratory, Bell Telephone Laboratories, as the contractors. Two models of the field change kit of parts have just recently been completed and are now undergoing performance and type tests at Bell Telephone Laboratories, Whippany, New Jersey. Upon completion of these tests, one kit of parts will remain installed in the system at the Bell Telephone Laboratories, while the second will be installed in the Gun Director Mk 67 scheduled for installation in the *USS Mississippi (AG–128)*. Delivery of production field change kits is expected in the spring of 1951. The conversion program is arranged so that as funds become available, all Radar Equipments Mk 25 Mod 2 will be converted to Mk 25 Mod 3.

A brief description of each of the new units which are provided by Field Change No. 25 follow:

Transmitter T–259/SPG

The new transmitter-receiver, identified as Transmitter T–259/SPG, uses the high-powered 5780 magnetron which delivers a minimum peak power of 250 kw. The transmitted pulse has a duration of 0.25 microseconds and is transmitted at a repetition rate of 1320 ± 10%.

This new transmitter has several special features not heretofore incorporated in fire control radar transmitters. Special precautions had to be taken in the magnetron cooling system to prevent destruction of the magnetron if the blower failed. This is accomplished by a circuit which opens the high voltage supply of the magnetron when inadequate ventilation is provided. Provision is also made to cut the magnetron power output to approximately 150 kw. if arc-overs occur in the r-f end of the transmitter. Since the duplexer and r-f feed are pressurized, loss of gas in these two sections would result in arc-overs which would make it impossible for the transmitter to operate at 250kw. The reduced power output feature will permit the system to continue to function during emergency conditions, and the duplexer and feed can then be pressurized at a more convenient time. Furthermore, this feature eliminates the need to recycle manually whenever arc-overs do occur, and thus eliminates the time delay interval required in the modulator circuit whenever the system is placed from a STANDBY to OPERATE condition.

The 5780 magnetron is remotely tunable over the frequency range of 8500 to 9500 megacycles. The remote tuning control is located at the Radar Console Mk 5 Mod 1.

Several units and subassemblies in the present transmitter-receiver of Radar Equipment Mk 25 Mod 2 are removed by Field Change No. 25 and are used in the Transmitter T–259/SPG. These units and subassemblies are the converter, i-f preamplifier, local oscillator, AFC unit, crystal meter unit, and radar test unit. Provision

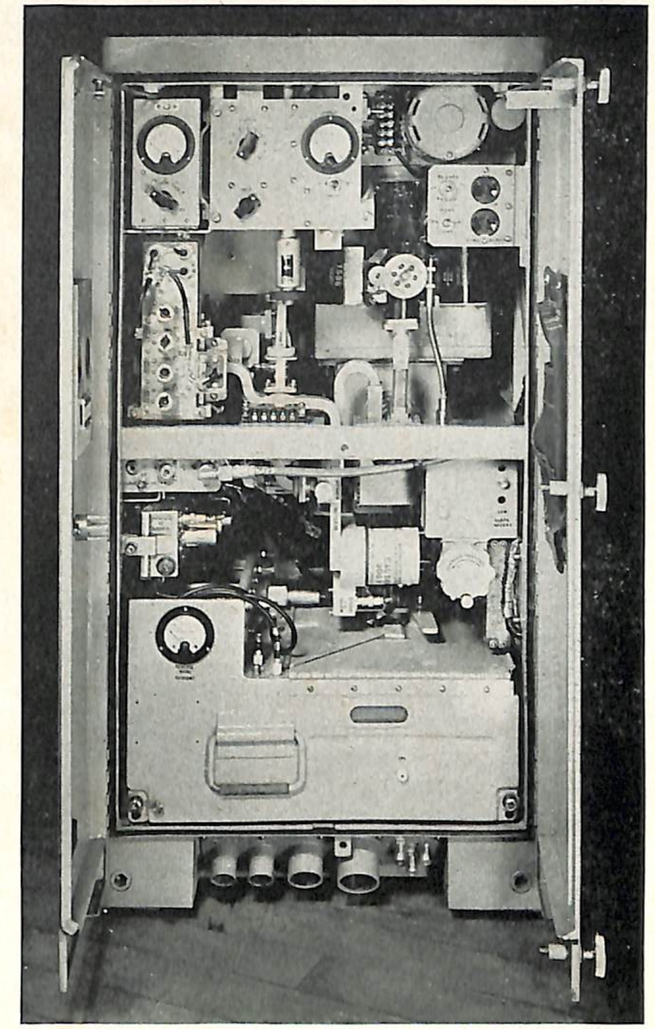


FIGURE 1—Front view of Transmitter T–259/SPG used with Mark 25 Mod 3.

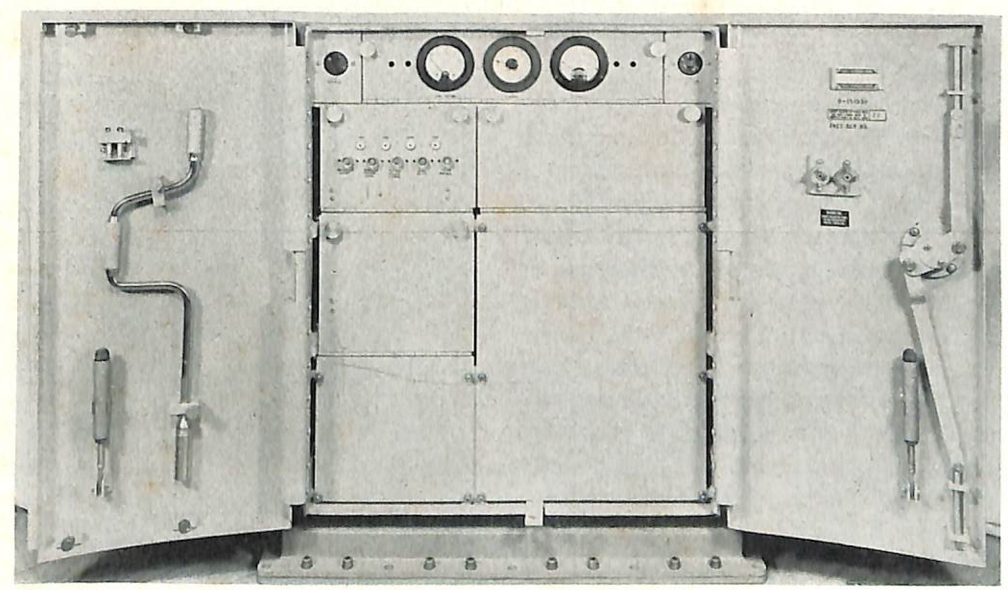


FIGURE 2—View of High Voltage Power Supply PP–572/SPG.

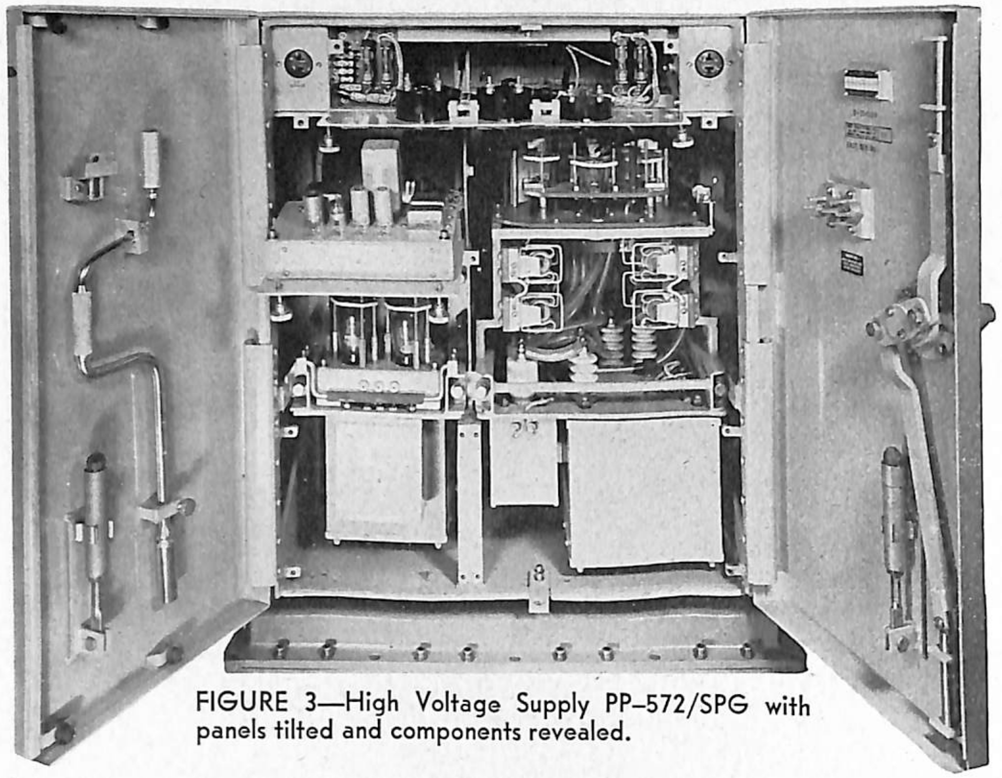


FIGURE 3—High Voltage Supply PP–572/SPG with panels tilted and components revealed.

is made to incorporate a beacon AFC unit which will permit tracking and X-band beacon.

Figure 1 is a view of the Transmitter T–259/SPG with its doors open. The transmitter's over-all dimensions are 22" wide, 20$\frac{1}{2}$" deep, and 40$\frac{3}{4}$" high. The unit's weight is approximately 500 pounds.

Power Supply High Voltage PP–572/SPG

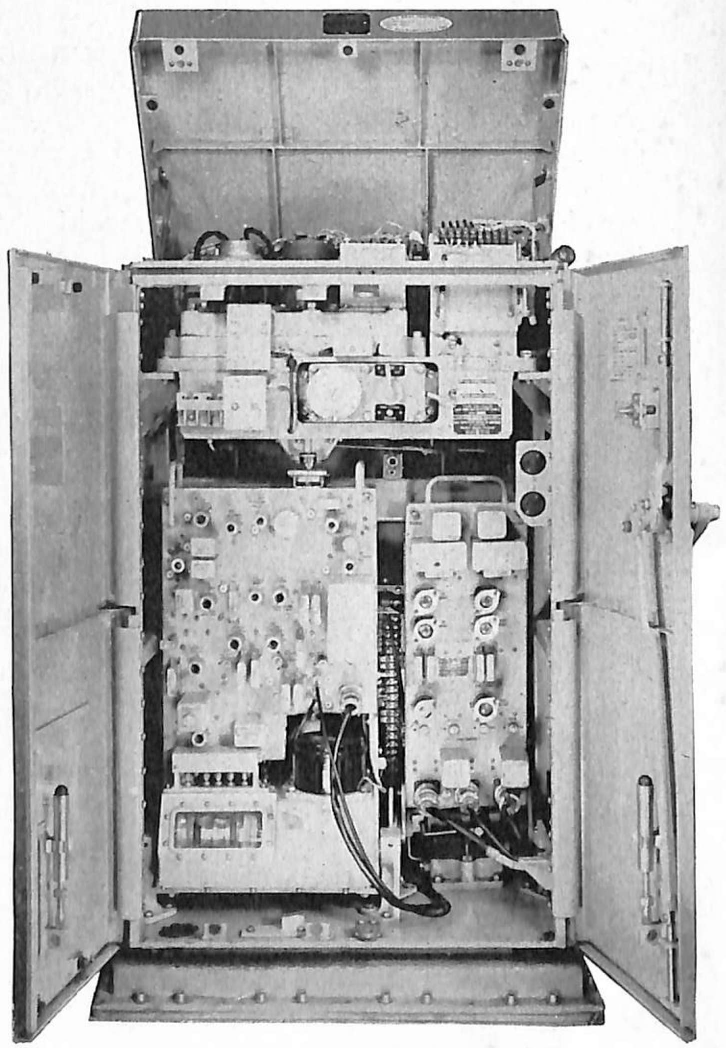
The new Power Supply High Voltage PP–572/SPG, which is located below decks, provides the dc high voltage to the modulator located in the transmitter. It consists primarily of three major chassis: the rectifier and filter chassis, the regulator chassis, and the control chassis. This unit will operate from an unregulated supply which may vary $\pm$ 10%. A control voltage from 0-4 volts regulates the output voltage over a range of approximately 8500 to 3500 volts, respectively, under load conditions from approximately 0 to 100 milliamperes.

Figures 2 and 3 show different views of the Power Supply PP–572/SPG. In these photos, the rectifier and filter chassis is the large unit on the right, the regulator chassis is on the lower left, while the control chassis is located directly above the regulator chassis. This power supply unit is large, containing many bulky components because of the high voltage being generated. The overall dimensions of the Power Supply PP–572/SPG are 29$\frac{9}{16}$" wide, 26$\frac{1}{8}$" deep, and 34$\frac{9}{16}$" high. The weight of the unit is approximately 600 pounds.

Radar Range Unit Assembly Mark 13 Mod 0

Radar Range Unit Assembly Mk 8 Mod 0 is modified to permit range measurement up to 100,000 yards and to provide automatic control of the range unit from desig-

FIGURE 4—Front view of Range Unit Assembly Mark 13 Mod 0 with access doors opened.



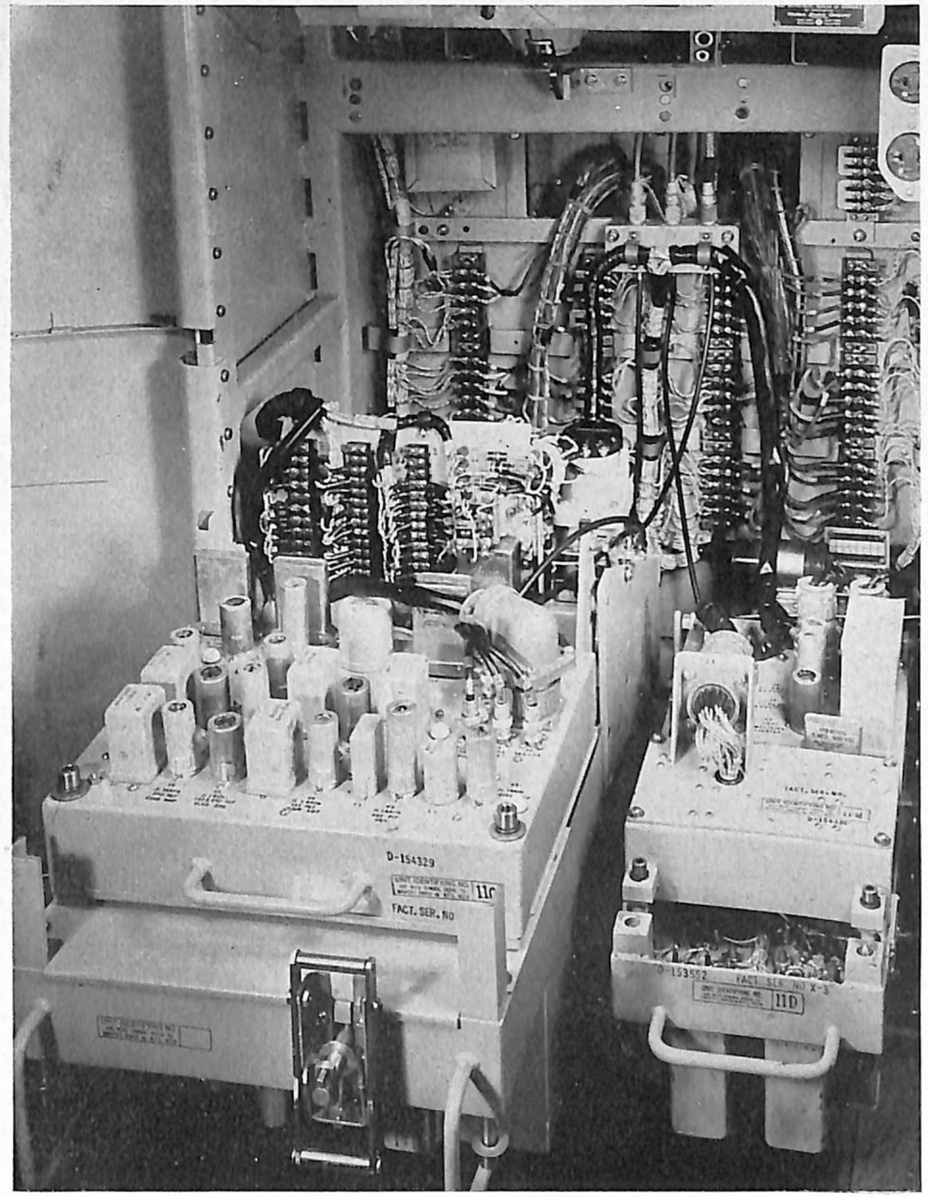


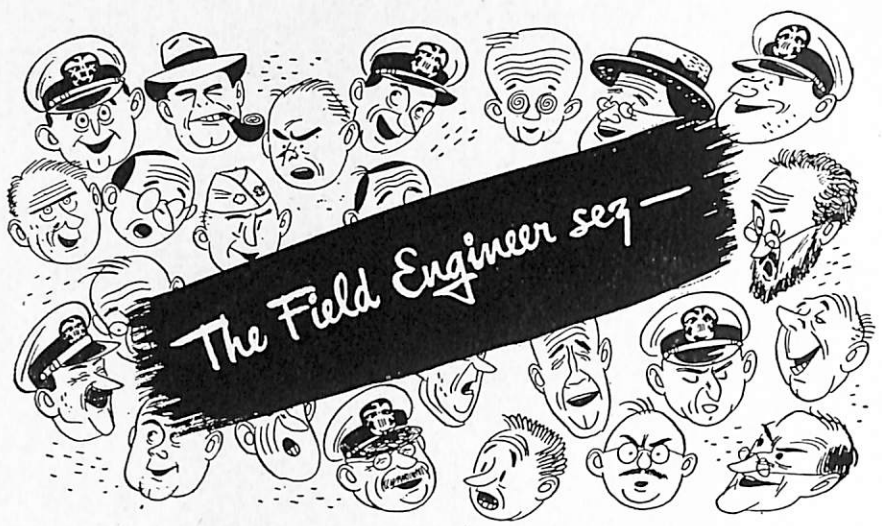
FIGURE 5—Range Unit Assembly Mark 13 Mod 0 with panels tilted forward and down to afford servicing access.

nated range. The modified assembly is identified as Radar Range Unit Assembly Mk 13 Mod 0. The range unit is of the crystal control type and is capable of measuring range to within $\pm$ 10 yards out to 100,000 yards. This conversion increases the automatic tracking speed from a maximum range rate of 500 yards per second to approximately 1,000 yards per second, and also increases the manual range slewing rate from a maximum rate of 6,000 yards per second to 12,000 yards per second. An electric brake is employed in the range unit gear train to provide positive control of the range gate. This feature eliminates the "coasting" condition existing in the old range unit when an operator shifted from the slew rate of 6,000 yards per second.

Automatic synchronization of the range unit with range designation is provided in order to reduce the time required for target acquisition. The circuitry is such that if range designation is accurate to within $\pm$ 50 yards, the range unit will release range designation and begin tracking the target in range automatically. Means are provided to search manually about designated range, with the addition feature of automatically reverting back to range designation as long as range designation is being received. Figures 4 and 5 are views of the range unit assembly showing the new units. Referring to Figure 5, the range unit is the lower left, unit while the unit. mounted on top of the range unit is the synchronizing pulse generator. The lower right hand unit is the amplifier (range servo), a unit of Radar Range Unit Assembly Mk 8 Mod 0, while the top chassis includes all the circuitry required for the range designation feature.

Minor modifications in the units and assemblies of Radar Equipment Mk 25 Mod 2 which are used in the Mod 3 system are also made to permit operation at the higher r-f power level and the increased range.

—*BuOrd Bulletin of Ordnance Information*



MODEL SG-6

U.S.S. Midway (CVB–41)

The *U.S.S. Midway (CVB–41)* reports a very unusual failure in the SG–6 installed in that vessel. Operators observed a complete loss of echoes over two sectors symmetrically located. Close examination of transmitted pulse on PPI showed a rounded extension of the normally circular pulse pattern, with two symmetrical extensions reaching a maximum of about twice the length of the transmitted pulse at bearings of 095 and 275 relative. The loss of echoes coincided with the increased pulse length. Measurement of the standing wave ratio indicated almost complete reflection in the guide twice during each revolution of the antenna. The transmitter would not stay in operation on long pulse, and the magnetron current would fluctuate widely and arcing was indicated in the magnetron or waveguide. The transmitter would stay in operation on short pulse with the effects described above. Fuse F–109 blew occasionally.

It was suspected that the trouble lay in the waveguide rotating joint in the antenna. Upon arrival in port when the SG–6 could be secured and work begun, a wooden staging was constructed on the mast to allow disassembly of the pedestal. It was found necessary to remove the rotating joint, both reflectors, and the selector valve assembly to accomplish repairs.

It was found that a small piece of the waveguide rotating joint assembly immediately above the lower bearing had broken loose where it was brazed to the guide, although it was still in place. The lower bearing in the rotating joint had jammed completely, with the ball race broken, balls jammed, bits of the broken race and about a cubic centimeter of iron dust in the guide below the joint. It is presumed that the bearing failed due to energy leakage from the cracked guide getting into the bearing and causing arcing and pitting, although there is a possibility that it was caused by lack of lubrication since there is no provision for lubrication of this bearing. The jamming of the lower rotating joint bearing caused the rotating joint and the center waveguide to stop, shearing off the lower halves of P–1301, the plastic coupling that transmits the torque to turn the rotating joint. As a result the center waveguide remained stationary while the selector valve assembly waveguide rotated above it, with a complete mismatch reflected back to the transmitter when the two waveguides were at right angles. The coupling P–1301 and the lower bearing were taken from spare parts, and the piece of waveguide that had come loose was brazed in place.

MARK 34 MOD 2

Variation of Receiver Gain With Change In Range

A Western Electric Field Engineer tells about a rather unusual case of trouble where the gain of the receiver varied with changes in range, being very low with the range notch at zero range, and about normal with the notch beyond 20,000 yards. Adjustment of both the "Auto Level" and "AGC" potentiometers failed to give entirely normal AGC action when an echo was gated.

This trouble finally was found to be caused by improper operation of the "Gating Video" tube, due to resistor R351 having changed from its rated value of 1200 ohms to 12 ohms. Replacing the resistor and making the necessary circuit adjustments cleared the trouble.

—*W. E. Newsletter*

MODEL SV

The following troubles and remedies are reported by a Western Electric Field Engineer:

1—Jittery voltage reading on position 7 of the test meter.

2—Variations from 4,000 to 5,000 volts.

3—One of the 371–B tubes showing considerable amount of color.

These troubles were traced and found to be due, in all cases, to a loose plate cap on the 371–B tube. The cap on the carbon plate tubes is soldered to the lead-through wire and this soldered connection is either poor or intermittent when the tube is new or develops this condition with usage.

Occasionally a condition occurs with symptoms of low or intermittent magnetron current in the SV transmitter. When this happens, check R(2)18 which is mounted on the magnetron mounting bracket. In many cases it will be found that this resistor will decrease in value with heat.

When the SV transmitter ON TIME control is adjusted to 170 milliamperes the four 5D21 tubes will start to arc or get too hot. Experience has indicated that before changing tubes or suspecting the modulation network the first thing to do is connect the Simpson test meter in series with R(2)24. Unless a resistance bridge is available this meter shunt is difficult to check because its normal value is 0.625 ohms, 2% tolerance. In one case this meter shunt changed enough to give an error of 35 milliamperes. Since this occurred on the high side it meant that the 5D21's were adjusted to an ON TIME current of 205 milliamperes which was causing the aforementioned arcing or hot 5D21's but is one of the factors that must be considered when this trouble is encountered.

Excessive Modulation Network Current

A Western Electric Field Engineer reports a recent experience in which the modulation network current as read at Position 2 of the transmitter meter switch S3 was off-scale, although other ratings were normal and the equipment appeared normal in all other respects. Investigation disclosed that one wafer of S3, a multiple-wafer type switch, was not rotating with the switch shaft due to excessive wear. Apparently the switch rotor on the defective wafer section had settled between the two contacts in an abnormal fashion and was causing a very high current to flow through the meter on Position 2. The deciding clue was the fact that with the equipment in standby condition, the meter still read 300 milliamperes and only dropped to zero when both auxiliary rectifier tubes were pulled out. This indicated filament current being applied through the meter M2.

—*W. E. Newsletter*

MARK 25 MOD. 2

U.S.S. Roanoke (CL–145)

Transmitter-Receiver D–153345 Unit 3

The transmitter-receiver was checked for operation and a low ring time was disclosed (approximately 500 yards). The TR tubes V(3H)1 & 2 (1B63A's) were replaced from spares. The receiver was retuned but ring time only increased to 1500 yards. However the target echoes appeared normal in all respects. With normal target echoes but low ring time, the echo box was removed for inspection. It was found that the box contained approximately ½-pint of water. Cleaning and drying the echo box was accomplished by the yard test lab. After being re-installed the ringtime was found to have increased to 3050 yards. A new UG–21/U connector was installed on the coaxial cable at the echo box and a watertight seal was made using Glyptol.

U.S.S. Epperson (DDE–719)

Radar Transmitter-Receiver CW–43ACU

Low ring time and low sensitivity were reported for this installation. The low ring time and low sensitivity were corrected by replacing a 1N23B crystal that had a low front-to-back ratio, by cleaning the cavities of both the TR and ATR tubes which had become dirty from arcing, and by replacing the TR tube. The unit was retuned for optimum operation. Ring time was established at 2100 yards. Approximately 10 hours after the above work had been completed, the crystal current fell to a low value and could not be raised by the attenuator. The trouble was eventually traced to a faulty TR tube. Even though in operation a few hours, the tube did not draw the specified normal current and thus the tube did not offer good protection to the crystals. The defective 724B was preplaced and operation returned to normal.

Radar Control Unit (Indicator) CW–23AFZ

While investigating sluggish circle closure, the components of the circuit in this unit were checked for proper values. R–895 (2200-ohm resistor) had changed to 1700 ohms. R–815 and R–818 (100,000-ohm resistors) had changed to 75,000 and 78,000 ohms respectively. All three components were replaced by resistors of the proper value.

Radar Antenna D–152912 Mk 4/1

When the spot senses were checked it was found that the spot did not move in correspondence with the movement of the antenna. Investigation revealed that the 2-phase generator had moved in position due to torque from the sudden starting of the motor. The screws holding the frame of the generator had worked loose and allowed this movement to occur. Readjustment of generator position and tightening of the screws corrected this condition.

Waveguide Switch Lubrication

A previous *W. E. Newsletter* discussed the leakage of transmitted energy into the echo box when the waveguide switch was on the ANTENNA-ONLY position. It was then stated that one part of the cure for the leakage was the lubrication of the waveguide switch with Lubriplate. *Since that time information has been received that the sliding surfaces of the switch should not be lubricated.*

Isolated reports have been received that the fibre washers used as supports for the banana plugs J-2 and J-3 of the magnetron shield have been damaged, apparently by heat. The washers are reported to be cracked and generally deteriorated. In one reported case red fibre washers were found instead of the specified phenol fibre. We have been asked to watch for the existence of any of these damaged washers, and of the above-mentioned red fibre washers, so that remedial action can be taken. If you find any case where the phenol fibre washers are damaged, or where red fibre washers have been used, please contact the nearest Field Engineer activity for further action. —*W. E. Newsletter*

U.S.S. Salisbury Sound (AV-13)

CW-20AFR Power Supply. 3800-volt unregulated source reading low. Trouble found to be an open filament in one 3B24 rectifier. Tube replaced and voltage restored to normal reading.

CW-55AJP D-153506 Radar Indicator Assembly. All indicators in the director were inoperative. Trouble shooting revealed that the 400-cycle crystals had been irreparably damaged by an arc-over in the video transformer T-3 located in the pointers indicator. Replacement of crystals and transformer restored normal operation.

CW-23AJN Control Unit. Intermittent operation of the interlock circuit. Examination disclosed that the sequence relay K-7 was operating erratically. Normal operation restored by replacement of this relay.

—G. E. TRIPLETT, G. J. SEIBERT and D. H. WAGNER, *San Francisco Naval Shipyard.*

U.S.S. Boxer (CV-21)

CW-43ADW Transmitter-Receiver Unit. Transmitter would not fire. Examination revealed that Plug P-30 was improperly installed on cable 65 so that center pin of plug was not making contact with center pin of J-8. Proper assembly of plug corrected trouble.

CW-23AJP Range Unit. Range pulse disappeared at about 35,000 yards. Defective 6SN7GT (V-2) was replaced and operation returned to normal.

CW-55AJP Indicator. Main sweep could not be seen on indicator screen. Replacement of crystals CR-1 and CR-2 (400 cycle) corrected trouble.

System Wiring. +300 volts was found to be missing from angle sweep unit. Jumper was found to be missing between Terminals 72 and 73 of radar unit assembly. Replacement corrected trouble.

System Adjustments. When system was locked on fixed target for first time after adjustments had been completed, the target spot appeared on right-hand edge of bearing presentation. This indicated that antenna was pointing to the left of the target. Radar adjustments were rechecked and found to be correct. Trouble was located by one of the ship's fire controlmen and corrected by adusting a stability control in the train servo amplifier of the Mark 37 Director.

—G. E. TRIPLETT, G. J. SEIBERT and D. H. WAGNER, *San Francisco Naval Shipyard.*

U.S.S. Small (DD-838)

Range Error Detector D-153556. AGC level was found to be somewhat low. R-96 AGC level potentiometer was adjusted and correct operation resulted.

Train and Elevation Indicator D-153558. Average tracking accuracy was obtained without level and cross-level cut into the director (ship tied up to pier) but with level and cross-level cut in, very erratic tracking was observed. Train and elevation error voltages developed at TP-9 and TP-10 with a half-degree off target condition were found to be only 3 volts. Combined angle error gain control R-36 was adjusted for 9 volts at TP-9 and TP-10 which resulted in normal tracking with or without level and cross-level inputs to the Mark 37 Director.

R. A. DALTON, *NOB, Guantanamo Bay, Cuba.*

Range Zero Drift

Several cases have been reported wherein the range zero shifts from 20 to 50 yards over a period of a few hours. Two Western Electric Field Engineers found one cause of this drift was due to faulty 16B3 tubes. First they fed the mod. trigger pulse to the cathode circuit of the first video amplifier stage in the range error detector to simulate a received echo at the mod. trigger time. The system operated for about four hours with no range zero shift, which seemed to indicate to them that the trouble at least was not below decks.

The mod. trigger circuit was returned to normal, and a new 2J51 magnetron was tried in the transmitter. The range drift was the same as before. The modulator tube next was changed. The range zero still drifted. It was observed that noise and other spurious presentations were following the transmitted pulse, so both 16B3 tubes were changed. This corrected the trouble for the system has been operated for several eight-hour periods since with no range zero drift.—*W. E. Newsletter.*

Poor Shape of Range Notch

Recently a Western Electric Field Engineer encountered a condition wherein a small "pip" was present in the notch at all times plus a poor notch shape. When tracking a weak target, it was difficult to determine whether the target had been lost except by watching the tracking lamp. This condition was found to be caused by too short a range gate, and this, in turn apparently was caused by someone inadvertently adjusting the Range Gate Adjustment instead of the Relay Adjustment. After the width of the notch was re-adjusted to 0.4 microseconds the notch trouble was eliminated.

—*W. E. Newsletter*

Securing of Range Unit Dials

It has been reported that the range dials on both the top and bottom of the Mark 25 Mod 2 Radar Range Unit can become loose thus giving wrong range information. These sets of dials are secured by two #4 set screws placed 90° apart, and it is felt that these cannot be tightened enough to make sure the dials won't slip on their shafts. A Western Electric Field Engineer reports this condition can be taken care of by replacing the #4 set screws with #6's. This is the way it should be done. Carefully mark the position of the dials before removing them. Then remove them and drill out the holes with a #29 drill. Tap the holes with an 8/32 tap. and use 8/32 x ¼" Allen set screws. Do not use the type of screws that have a cup at the end because this cup damages the shaft. Use the type with the flat end.

This change is the recommended way of clearing this problem when it arises. No doubt all range units will not have to be modified this way, but if any do, use the #8 set screw method.—*W. E. Newsletter.*

Replacement of R(12D)12

One of the most consistent recurrences of trouble in the Video Amplifier Chassis (Unit 12D) is the overheating and cracking of R(12D)12. Since the subject resistor usually does not open up completely, the only apparent result is reduced amplitude of the "B" video output, causing poor "B" video presentation on the 5" indicators. This trouble has been experienced on about 90% of all Mark 25/2 equipment serviced here. The cause can be attributed to misadjustment of the "B" video bias control. Since it is so frequently encountered, it has become standard procedure to check this resistor before equipment is energized. Although R(12D)39 does not seem to cause as much trouble, several similar burn-outs have been experienced. Both "A" and "B" video bias should be checked frequently and should be set at 0.2 volts. *Under no circumstances should the bias adjustment be used to change the video gain.*

—T. R. TRIPLETT *and* W. S. MCLEAN, *ComServLant*

Failure of R(13A)24 and R(13A)25

Change in value of the +2,000-volt supply can usually be attributed to either an increase or decrease in value of R(13A)24 and R(13A)25. Several such instances have been encountered recently while servicing Mark 25/2 systems. These resistors seem to change value for no apparent reason other than the high value of ambient temperature set up inside the power supply unit during normal operation.

—T. R. TRIPLETT *and* W. S. MCLEAN, *ComServLant*

Oil Level in Tracker Oil Reservoir

Two rather serious cases of over-filling the tracker oil reservoir have been experienced recently. Approximately one quart of oil was taken from each system (normal capacity about 0.5 pint). As a result, oil had been forced into the 6DG synchro units in unit 17B and was found to be dripping out of the end bell on to the cable harness to this unit. Although there was no apparent damage done to either unit (after oil was removed, tracker operated normally) at the time, it is quite possible that subsequent deterioration of soaked leads in both 6DG's and the cable harness might cause serious trouble in the director train and elevation systems. The inspection window in the oil reservoir should be carefully observed while oil is being poured in to avoid over-filling.

—T. R. TRIPLETT *and* W. S. MCLEAN, *ComServLant*

ATI Circuit Not Operating Properly

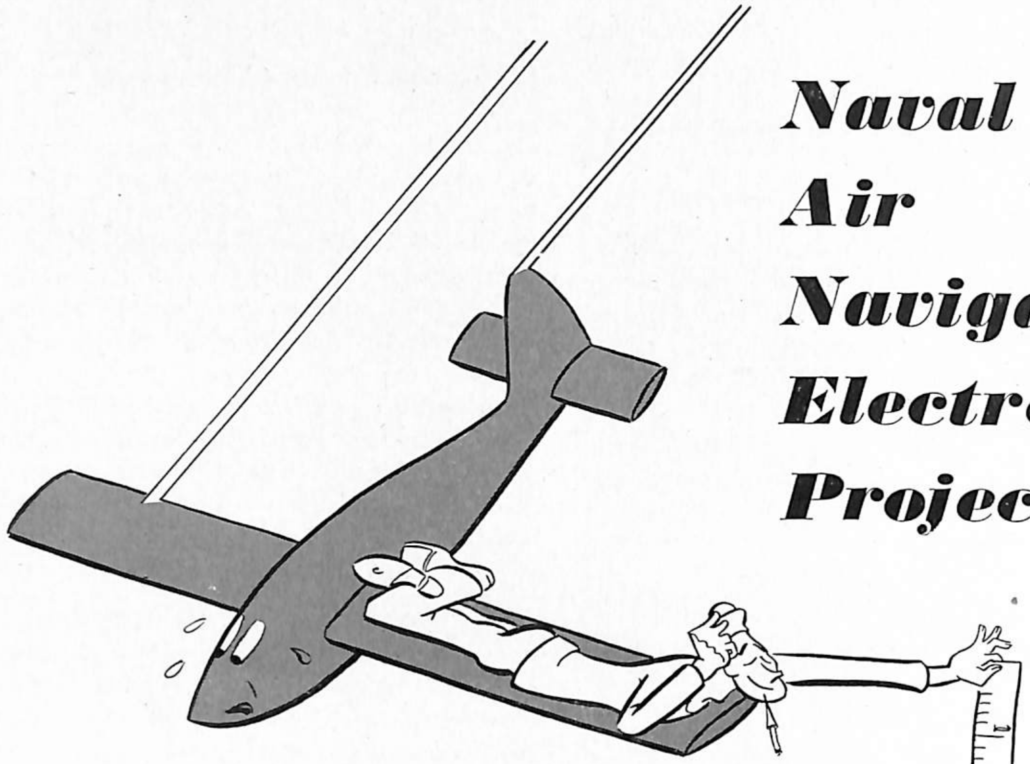
The "track" relay had a tendency to remain closed even with no signal gated. Adjustment of the range error detector seemed to clear up the trouble for a short time. After a few hours operation, the same trouble would re-appear and require another adjustment. This difficulty was observed every two or three days for a period of two weeks. The antenna had a definite tendency to "creep" off the target and run into the upper limit stops for no apparent reason while tracking a target. While investigating the above-mentioned troubles, the signal strength decreased and the angle sweep indicator became jittery.

Readjustment of the R.E.D. circuit several times resulted only in a drift of the balance condition. Changed all tubes in the ATI circuit. Replacement of V(12M)15, range gate amplifier, appeared to have the most effect on correcting the "drift" condition of balance circuits. Found P(12M)32 almost out of J(12M)10. Tightened this plug and the R.E.D. operated normally.

Found that V(17C)13 (6SL7) in the tracker was causing an intermittent condition in the antenna elevation system. Tracker elevation system balanced normally. However any slight vibration of this unit, such as results from gun fire, would cause enough change in balance to drive the elevation servo. Replacement of this tube corrected this condition.

Investigation revealed that the decreased signal strength was caused by a faulty 2K45 local oscillator. Replacement of this tube and also the magnetron (2J51) corrected this condition. Replace V(12F)6 in the angle sweep chassis thereby correcting the jittery elevation sweep on all indicators.

—T. R. TRIPLETT *and* W. S. MCLEAN, *ComServLant*

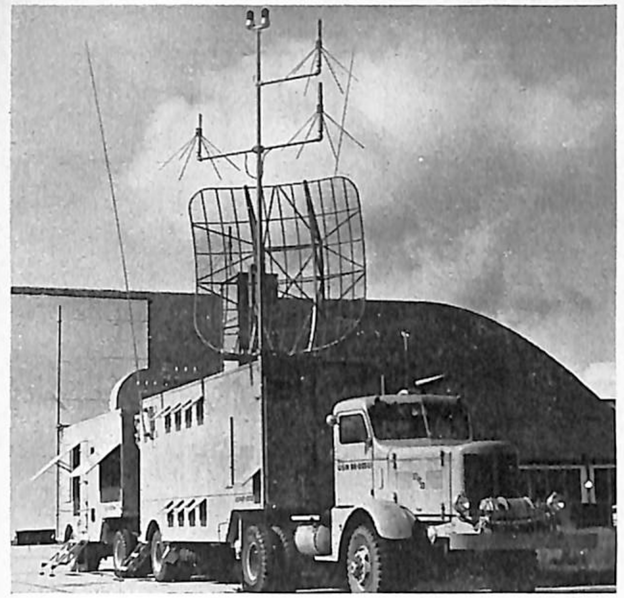


Naval Air Navigation Electronics Project

A consideration of the events leading to the inception of the Naval Air Navigation Electronics Project must necessarily go back to the fall of 1943. At that time, the Bureau of Ships was confronted with the task of developing, testing, and improving the stability and performance of electronic equipment such as the AN/MPN–1A radar set and other aids for the landing of aircraft under poor visibility conditions. The Bureau did not at that time possess any laboratory or field activity where equipment of this nature could be set up, given engineering evaluation, or tested operationally.

To fill this need, in November, 1943 the Bureau of Ships Engineering Project was established at Gainesville, Georgia. Broadly speaking, this Project was a developmental organization concerned with investigation, experimentation, and solution of BuShips problems in the field of electronic navigation. In addition it assisted in training Naval personnel in the installation and operation of laboratory developed equipments. Field engineers trained by the project assisted materially in the original installation of low approach equipment in the Northwestern United States, Alaska, and the Aleutian Islands.

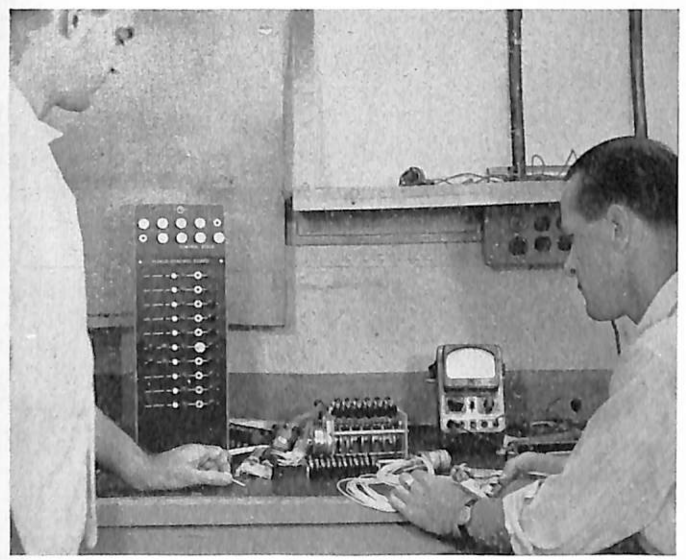
In September, 1944 the name of the facility was changed to Instrument Low Approach Project. The early accomplishments of the Instrument Low Approach Project were very successful. This was due to the recruitment of personnel qualified in handling ground equipment for air navigational aids and to the general administration of the



AN/MPN–5 ground-controlled-approach equipment.

program, aided by a fine spirit of cooperation among the associated Naval personnel.

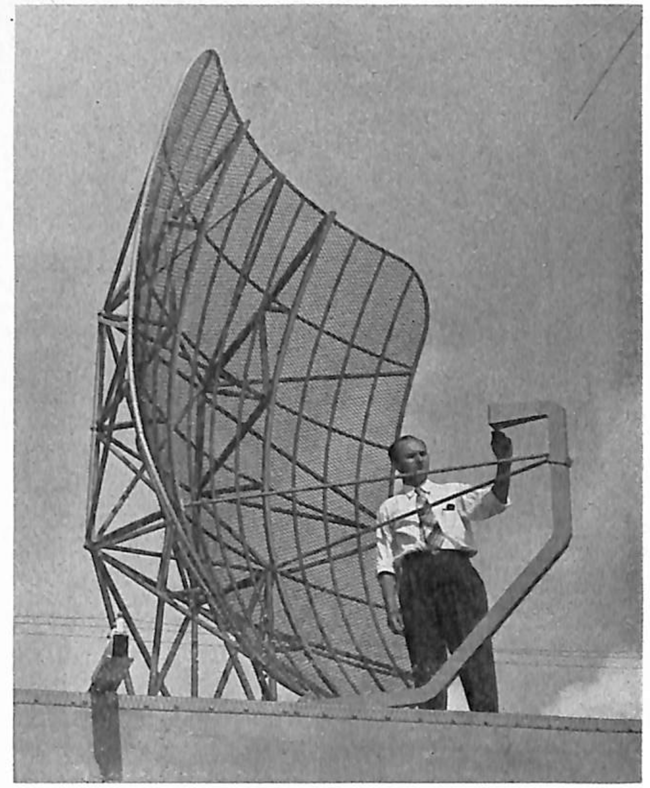
The Bureau of Ships, keeping in mind the possibility of NAS, Gainesville, being placed in an inactive status at termination of the war, considered relocation of the Project. As a result of wide discussion and consideration during conferences attended by representatives of the Chief of Naval Operations and the Bureau of Ships, suitable locations for the Project were subsequently proposed. Two relocation sites were considered: the Naval Air Station, Patuxent River, Md., and the Naval Auxiliary Air Station, Charlestown, Rhode Island. The air station at Charlestown, Rhode Island, was selected for various reasons, one being that test work of the Project could be performed during the frequent inclement



Development of display boards and interval computer for C.C.A.

weather. The Chief of Naval Operations modified the mission of the Naval Auxiliary Air Station at Charlestown to include support of the Project, and transfer orders were made effective immediately.

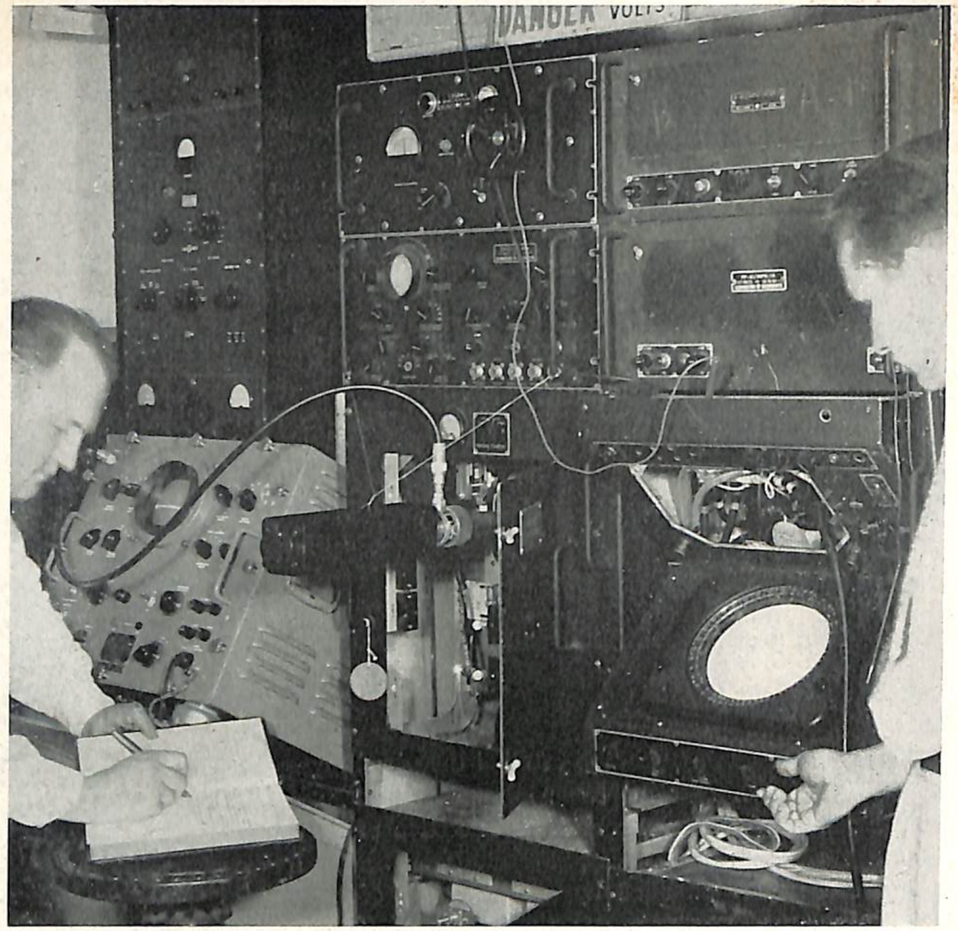
Accordingly, the title of the Instrument Low Approach was formally changed, and the Navy Air Navigation Electronics Project (NANEP) was established on the 23rd of January, 1946, with the mission of performing BuShips assigned problems in connection with the design, development, and test engineering of air navigation electronic aids and air traffic control systems. NANEP became an activity of the First Naval District under the management and technical control of the Bureau of Ships, and under the military control of the



Search antenna of AN/MPN–5.

Naval Air Station, Charlestown, R. I. The complement of the Instrument Low Approach Project had been fourteen officers and twenty-seven enlisted men. However, due to the necessity of the Navy returning to a peacetime status, the complement of NANEP was established at five officers and twenty-nine enlisted personnel.

At the time NANEP officially reported aboard NAAS, Charlestown, a transition period from military to civilian complement of engineers and technicians was conducted. Upon completion of the move, which was executed so as to allow a continuation of the work on technical problems without undue interference, NANEP's mission in the field of design, development, and test engineering of electronic navigational aids was established.



Test rack for development of rotating pulse beacon techniques.

NANEP was housed in several temporary buildings centered about a standard forty by one hundred foot utility hut. Over-all space aggregated 8,000 square feet which was utilized for the establishment of an electronics laboratory, a mechanical laboratory, storage facilities, and as office spaces. Outdoor space was utilized for testing of mobile equipment such as AN/MPN–1A Ground Control Approach, AN/MPN–3, and such other large radar and radio sets undergoing tests at that time.

NANEP was furnished an R4D and Two JRB type aircraft for tests involving flight evaluation. The R4D type aircraft was considered essential for routine work due to its inherent adaptability. It provided sufficient space and carrying capacity to allow an electronics bench installation capable of flight testing many different types of ground installations. This eliminated frequent interchange of airborne equipment. A JRB was chosen as the type most suitable for special work, for flight checking ground installations of electronic equipment, and as a partial fulfillment of the aircraft requirements for conducting special development work at certain air activities where ground equipment was available to the Bureau of Ships.

After spending approximately two years at Charlestown, Rhode Island, NANEP received orders to transfer to NAS, Patuxent River, Md., to become an integral unit within the Electronics Test Division of the Naval Air Test Center. This transfer was directed by Chief of Naval Operations in order to integrate more closely the testing of ship/shore components with the related airborne components of electronic navigation and traffic control systems. In this move it was considered essential that the management control be transferred to the Bureau of Aeronautics and that the Bureau of Ships retain complete technical control inasmuch as the Bureau of Ships is responsible for the research, development and design of all ship and shore based electronic navigational aids. NANEP is the only BuShips activity with flight facilities to conduct engineering tests and field work on this type of equipment. Effective 1 April, 1948, NANEP was located at NAS, Patuxent River in the Electronics Test Division, Naval Air Test Center.

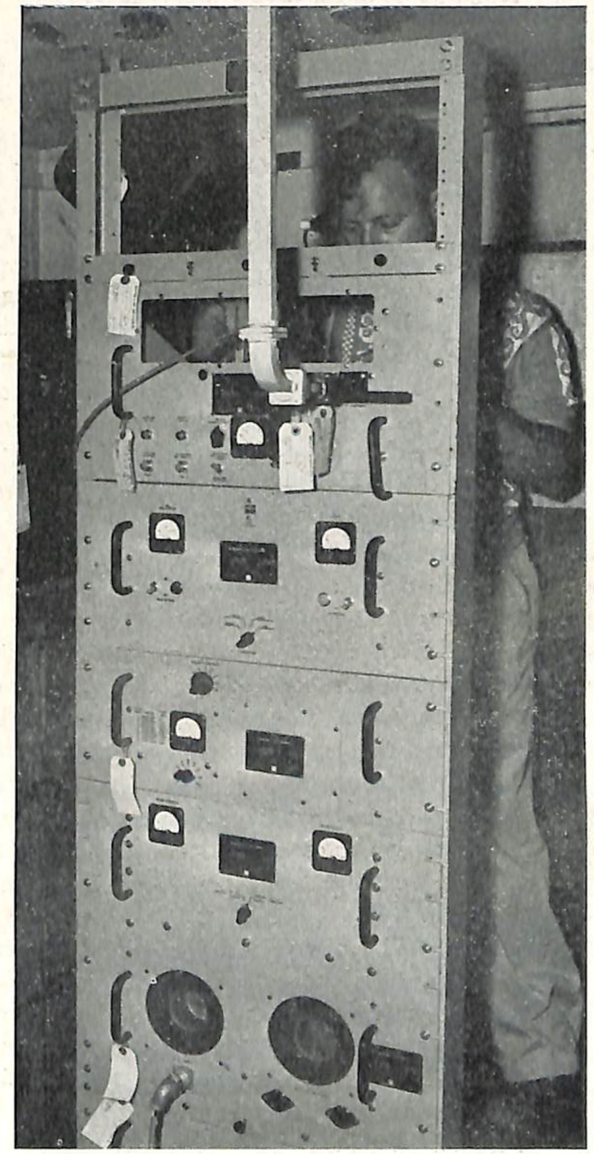
The Senior Officer and Senior Civilian Engineer are responsible for the overall administration and technical work of NANEP, assisted by the Coordinating Division, headed by an officer; and the Clerical Division, headed by a civilian Chief Clerk. The technical work of NANEP is accomplished by the Project Division, which is organized into four functional sections, each under the cognizance of a Section Head: the Engineering Section, the Model Shop Section, the Reports Section, and the Material Section. The prime work is performed by the Engineering Section, whose responsibility involves the making of engineering studies of problems in design and development, and the engineering testing of electronic aids to air navigation and traffic control including Instrument Approach Systems, Automatic Approach Control, Radio Ranges, Homing Beacons, Marker Beacons, Ground Controlled Approach, Carrier Controlled Approach, Radar Beacons, Ship and Shore Based Radar and IFF Equipments, and related special devices for ship or shore installation.

The problems that have been performed by NANEP are many and varied in the field of electronics. Some of the high lights of the projects that NANEP is performing or that have been completed are summarized in the remainder of this article.

Original tests were conducted on a YA Range to determine its accuracy and general operation. Later, simultaneous voice conversion kits were incorporated into the YA Range, and tests were made to determine the effects of and difficulties involved in converting to simultaneous voice operation.

Course bending studies were conducted at NANEP to determine the amount of bending that could be achieved and the difficulty involved in order to meet operational requirements at various locations. Instrument Landing System projects were undertaken, including tests on CRN equipment and course softening techniques for the ILS System, and operational and technical evaluation of such systems as the Sperry Microwave Landing System. A number of projects were concerned with Ground Approach Radar Equipment. Original tests were conducted on the AN/MPN–1A equipment when it was in its early stages of development. More recently, revised sweep circuits have been tested as an improvement to the AN/MPN–1A equipments in the field. The fixed installation, known as the AN/FPN–1 Radar Set at Quonset Point was assigned to NANEP for installation of the equipment and engineering evaluation upon completion of the installation. A new type of evaluation error indicator circuit, developed by NANEP, was applied to the AN/FPN–1 at Quonset Point and resulted in a two-man precision approach system utilizing one talk-down operator who also was the azimuth tracker. The original elevation accuracy was maintained by continuing to use the elevation tracker.

Alignment of experimental rotating pulse beacon transmitting equipment.



Testing of X-band Ramark equipment.

A problem was set up at NANEP for the design of improvements and testing of improvement kits for the GCA's that are in the field. Kits that had been procured by the Bureau of Ships were submitted to NANEP for evaluation before delivery to the actual field units. NANEP investigated the Cross-Talk Problem which existed between the AN/ARC–1 communication equipments in the GCA which as a system had not been evaluated prior to field use. Marker Beacon Receivers were tested at NANEP and a similar problem concerned the pattern measurements of the marker ground installations.

Search and surveillance radar sets, such as the AN/GPN–2, were sent to NANEP for evaluation. The XSG–7 Radar Set was thoroughly evaluated. On all these equipments, NANEP submitted a comprehensive final report to the Bureau of Ships listing all the findings in a full evaluation of the equipment. An AN/TPS–1B Radar Set is currently under evaluation by NANEP. Such direction finder equipments as the DBF and CXGL equipment were evaluated at NANEP to determine the performance capabilities and limitations. *The complete ground terminal equipment for the AEW Relay Link was set up at NANEP for evaluation of the AN/SRR–6. NANEP is currently designing directional antennas for possible use with this AEW System.*

In December of 1948, NANEP issued a comprehensive report on the Engineering Tests of the Civil Aeronautics Administration's VHF Omnidirectional Range. This was followed by a report on the evaluation of the CAA Distance Measuring Equipment as installed with the VHF Omnidirectional Range. Later, similar tests were conducted jointly with the Rho-Theta Evaluation Group. A final report was submitted by NANEP to the Bureau of Ships on an antenna development problem concerned with the installation of VOR,[1] DME,[2] and Racon at the same site. NANEP designed and tested a means by which the Racon Antenna could be mounted coaxially with the DME and VOR Antennas.

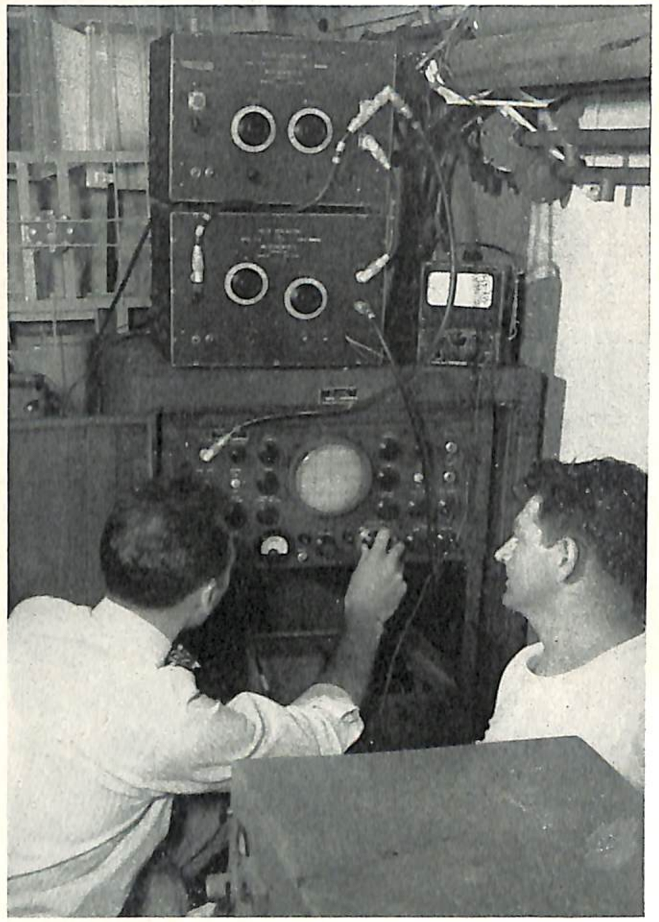
NANEP has been concerned with work aboard aircraft carriers toward all-weather flying. A problem was set up to devise a means by which aircraft could be brought into the carrier controlled approach pattern. *Modified YL equipment, defining a path leading to the destroyer or carrier, was used, together with a holding pattern and a timing computer to space the aircraft at regular intervals in the patern to assure precise desired landing intervals.*

NANEP designed a new CCA radar indicator for installation on board the aircraft carrier *U.S.S. Philippine Sea.* This equipment, known as the AN/SPN–3, is an expanded position indicator (EPI) operated in conjunction with the "B" scope currently in operation on the *U.S.S. Philippine Sea.*

[1] Visual Omnidirectional Range.
[2] Distance Measuring Equipment.

NANEP is testing and evaluating the new CCA equipment known as the AN/SPN–8. *This is an Approach Radar Set for controlled approaches to the carrier. Revised status boards and computers are being designed at the present time by NANEP to facilitate control of the movement and spacing of aircraft from an orbit area into the holding pattern and from there, at timed intervals, to the precision system of the AN/SPN–8. The first of these status boards and computers are now in use on the U.S.S. Coral Sea.*

While numerous projects are in progress concerning evaluations and engineering tests, NANEP is continuing with a development concerned with *rotating pulse beacon techniques in the development of an auxiliary homing system. This development has progressed in design to the point where both bearing and distance information is displayed to the aircraft.*



Experimental rotating pulse beacon receiver.

Various installations and evaluation problems concerning beacons and IFF equipment have been made at NANEP. For example, the AN/APN–63, which is a GCA Assist Beacon, was evaluated by NANEP. An X-Band Beacon concerning possible use with the Precision Approach Radar of GCA was evaluated and showed excellent performance and considerable utility especially with regard to all weather operation where the scopes could at times be considerably cluttered.

A ground installation of the CPX–4 IFF equipment was made in the Electronics Test hanger where NANEP is located. In addition, the AN/APX–6 equipment was installed in the flight test laboratory in the R4D aircraft. Tests were conducted to determine the utility of this equipment in conjunction with the SX Radar available at Electronics Test and the *utility of the IFF equipment in identifying aircraft utilizing the carrier controlled approach pattern developed for use with the modified YL approach equipment.*

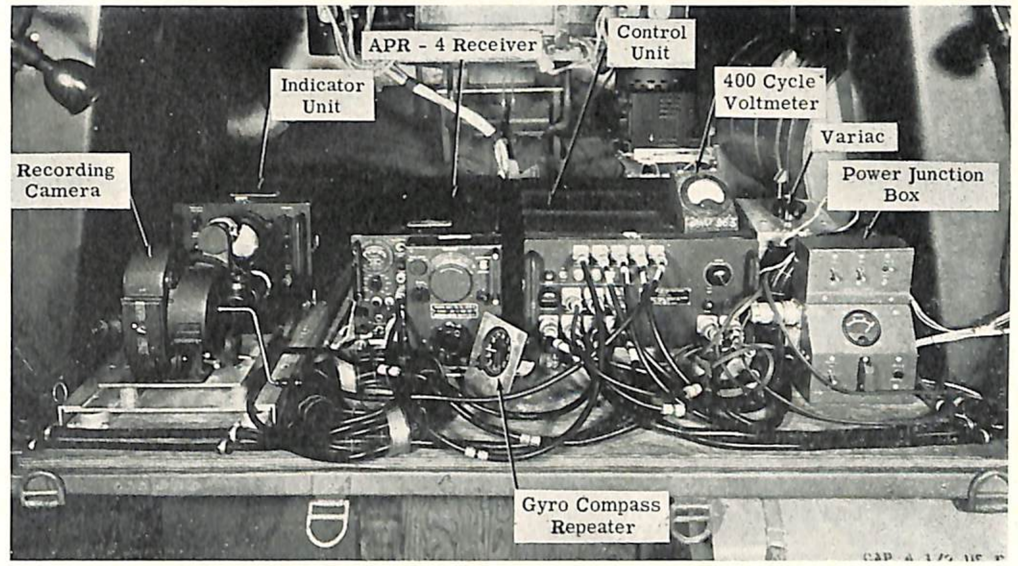
At the present time, NANEP has an authorized complement of forty people. The on-board count at NANEP is thirty-seven, consisting of twenty engineers and technicians with the remaining personnel making up the Reports, Material, and Model Shop Sections.

NANEP now has thirty-two active problems, assigned by the Bureau of Ships. Nine are of "B" priority. Examples of these problems are: the elimination of the cross-talk encountered in the 3 AN/ARC–1 radio equipments installed in the AN/MPN–1A for VHF communications; an evaluation of the CKGL DF equipment as installed in a PB4Y type aircraft, (this equipment utilizes four sector switched antennas each covering a 90° sector); the evaluation of the AN/UPN–7 Radar Beacon in conjunction with the AEW Ground Terminal Equipment; interference tests on the RAMARK equipment; and a complete evaluation of the new GCA equipment, AN/MPN–5.

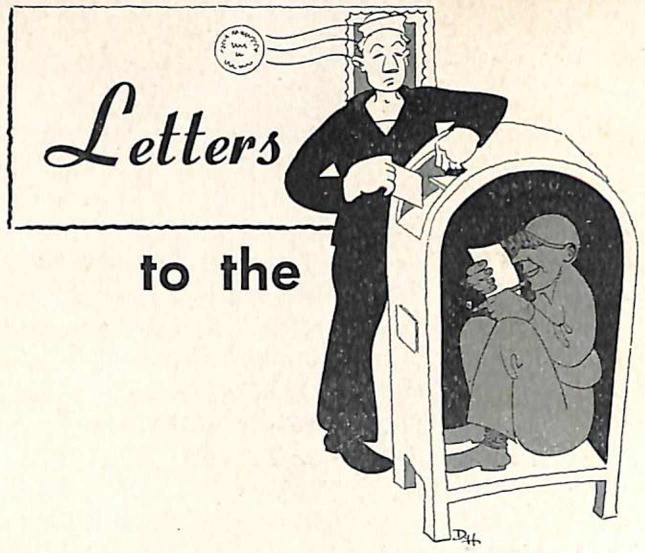
NANEP has fifteen "C" priority projects, typical of which are: the installation of AN/MPN–1A Improvement Kits and the complete test and evaluation of those kits as received from the Bureau of Ships; the development of an auxiliary homing system as a possible replacement for the YE-YG Equipment; the rotating pulse Beacon system described previously; the AEW Terminal Equipment tests and evaluation; *the development of a fixed direction indicator for possible use in amphibious operations in the polar regions;* the installation and flight testing of the Mark V IFF Equipment; *the general study and development of display boards and aircraft interval computers for CCA traffic control, followed by the actual construction of two sets of posting boards and interval timers for installation on board two aircraft carriers;* the evaluation of the AN/TPS–1B System as modified by MTI, and evaluation of a new receiving equipment as well as a new antenna drive system; *the design of two directive antennas for use on AEW equipment;* the technical evaluation of *CCA Approach* Radar Set AN/SPN–8; and the evaluation of an MTI modification kit for Radar Set AN/FPN–1 at Quonset Point, Rhode Island.

On "D" priority, NANEP has been assigned eight projects such as the following: General improvements to the AN/MPN–1A or GCA equipment; a technical evaluation of the SR–6A; a general study of carrier aircraft controlled approach problem, *together with a study of the automatic carrier controlled approach problem;* engineering tests of an ILS installation to be used *for automatic carrier controlled approach studies;* and the development of a fixed GCA type daylight display for control tower use. A study and follow-up problem is assigned to NANEP to keep abreast of development work in automatic GCA by other laboratories.

NANEP, as a comparatively small electronic laboratory, has a very enviable record in that it has completed and submitted to the Bureau of Ships at least one project report a month with the average being approximately sixteen final reports per year for the past three years. In addition, NANEP issues a monthly report on the progress and general status of all problems, as well as a monthly fiscal report giving the status of allotments and the detailed costs charged to each problem assignment.



CXGL control unit and indicator as installed in PB4Y–2 aircraft.



Letters to the EDITOR

Continuing a new, and it is sincerely hoped, a permanent feature of your magazine—ELECTRON. This new feature is the answer to numerous suggestions and requests from fleet and shore personnel for a medium of presenting their individual problems, gripes and questions on electronics matters and obtaining answers to such queries. This section is not to be confused with the FORUM which has been a regular part of the ELECTRON since its inception in 1945. The continuance of this new feature depends entirely on you—the personnel in the field—since we must first receive correspondence from the field before we can search out the answers and print them. As a matter of convenience, it is suggested you write directly to:

The Editor
BuShips Electron
Code 993
Bureau of Ships
Navy Department
Washington 25, D. C.

The following are typical of the type of letters received to date for inclusion in this column:

Editor,
BUSHIPS ELECTRON
Sir:

I have heard that the Bureau is preparing a "handbook" or "manual" as a guide to Electronics Officers in the performance of their duties at various activities. I would appreciate information as to whether such a pamphlet is being prepared and if so when it will be available to Fleet personnel.

Respectfully
G. L. W., Lt. (jg) U.S.N.

The Bureau is preparing an "Electronics Officers Handbook," NavShips 900,160, which is intended for use by Electronics Officers as a guide, not a directive, in the performance of their duties. Publication date of this handbook is indefinite and activities are requested not to request copies of the subject book at the present time.

Editor.

Editor,
BUSHIPS ELECTRON
Sir:

On Page 4 of the September ELECTRON it was stated that if a ship did not have a 234.0 Mc crystal for the TDZ/RDZ on board, the ship should order same from the nearest Electronics Supply Office. I have been informed that this frequency is not correct and would appreciate clarification of this matter.

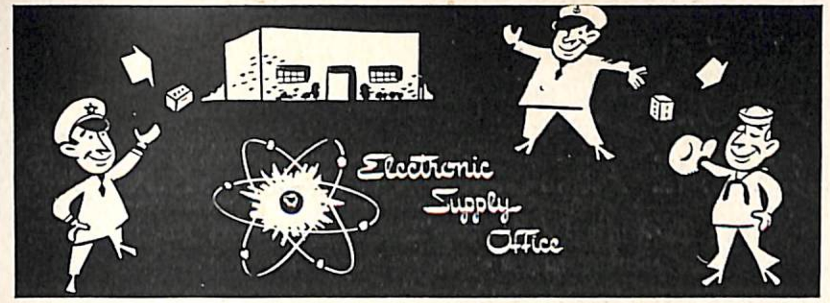
Respectfully
H.H.F., ETC USN

Our face is red, the correct frequency is 243.0 MC.

Editor.

CORRECTION—U-H-F CRYSTAL FREQUENCIES

As stated above, there is no 234.0 Mc. crystal supplied for the TDZ/RDZ. The frequency mentioned in the September ELECTRON should have been 243.0 Mc.



E.S.O. MONTHLY COLUMN

REQUISITION BY MATERIAL CATEGORY

The most efficient shopper has in mind what he wants and where he is going to get it. He classifies his requirements by type desired. If it is groceries, his list will be classified by vegetable requirements, dairy products, meats, etc. By doing this he can save time because the supplier has his store arranged in such groupings.

The same idea may be applied to your requisitions for electronic material. The requisition is your grocery list; the market is your Naval Supply Depot, and in some cases it will be the ESO. Both sources of supply have grouped their commodities and identified them by certain ranges of stock numbers. Stock records and warehousing are set up on such a classification plan.

Your requisition may require screening by technical personnel for the assignment of stock numbers. Certain technical assistants to Supply Officers specialize in various categories of material. A requisition containing items of electron tubes, batteries and resistors may possibly have to be handled by two or more technicians, and be forwarded to two or three separate locations in the Stock Record Card Section of the Supply Department, and that may cause unnecessary delay in its processing.

How much easier it would be for the supplier if you were to submit your requisition by specific category of material! As, for the most part, knowledge of the stock numbers assigned to the groups or items required may not be readily available, you can help by grouping similar electronic items to the best of your ability. In some instances, where doubt exists, it may be advantageous to prepare separate additional requests for each item so that this segregation may be made at the Supply activity.

Section XIII, Paragraph C, of the Electronic Supply Office Inventory Control Manual for Electronic Maintenance Repair Parts, is quoted for guidance:

"All requisitions shall be limited to ten items per request, and each request shall contain only those items within *one* of the weekly categories as set forth in the reporting schedule, Section XII. A blank space equivalent to at least three lines shall be left between items."

If you, as the end users, will follow some of these guide lines for requisitioning, you will find that a more expeditious processing of your requests will result.

FABRICATED REPAIR PARTS

If you've been responsible for an equipment, you've probably wondered who the supermen are who decide what's an electronic maintenance part and how they go about selecting it. Maintenance policies are the responsibility of the Bureau of Ships. The decision regarding which parts are to be considered of a maintenance nature and which are not to be so designated is made when each particular equipment is provisioned. Provisioning meetings are usually conducted at the equipment manufacturer's plant prior to production of the equipment. Representatives from BuShips and the Electronic Supply Office and the manufacturer's engineering department meet there to review the equipment and select the spares.

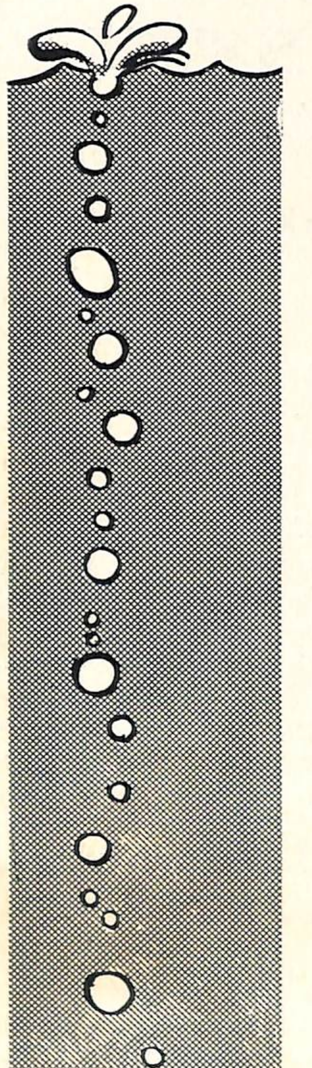
Maintenance parts peculiar are furnished as equipment spares and a quantity is also procured for stock. The former are the responsibility of BuShips and are furnished with the equipment. ESO is responsible for the latter, which are to be binned as bulk for future issues.

During a provisioning meeting, many items are determined to be of such a nature that they can be repaired or fabricated aboard ship or at shore installations. Other parts are deemed to be of longer life than the equipment and, hence, need not be carried for maintenance. Items identified as being in these categories will carry the following note in the parts lists: *"Not furnished as maintenance item. If failure occurs, do not request replenishment unless item cannot be repaired or fabricated."*

Repairable items are thus eliminated from the equipment spares and from allowances. In the past, it was found that many items were supplied unnecessarily in the equipment spares; this resulted in an appreciable waste of material as well as waste of critical stowage space aboard ships.

Such items as simple gaskets, mechanical parts, terminal boards, etc., can usually be fabricated with the raw material and the repair facilities aboard ships. In the event the repaired or fabricated parts are found unsuitable for permanent use, a new part should be requisitioned through the regular supply channels. The maintenance policies outlined above will provide a more efficient supply by enabling better control over the critical maintenance parts.

USN USL notes



SUBMARINE ANTENNA PROGRAM

On Sunday, 18 June, 1950, the Submarine Antenna Branch of the Laboratory's Electronics Section, one of the pioneers in the development field of submarine communication, observed its fifth anniversary. It is significant to note that from a humble beginning in a small boathouse borrowed from the Fishers Island Country Club, which was then under control of the Navy Harbor Defense School, the Antenna Branch has progressed to the extent that it is now housed in Maury Hall, a large completely equipped building on the Laboratory reservation at Fort Trumbull, and has modern facilities at the island field station.

In May 1945, Mr. Cletus M. Dunn, now Section Leader of the Electromagnetics Section on the staff of Dr. John M. Ide, Chief Scientist, was the only Laboratory employee engaged in work other than that of underwater sound, and in collaboration with Mr. Arnold B. Bailey and LCdr Samuel Freedman of the Bureau of Ships, he initiated investigation in field strength measurements of submarine antennas. On 18 June of that year, work was begun on the first authorized problem, which pertained to the "Construction and Installation of Experimental Submarine Antennas."

This problem constituted an important part of the program to develop integrated antenna systems suitable for submarine use. It was the Laboratory's responsibility to "assist the Bureau of Ships in evaluating certain new types of antennas and comparing these with the standard installations now on the submarines."

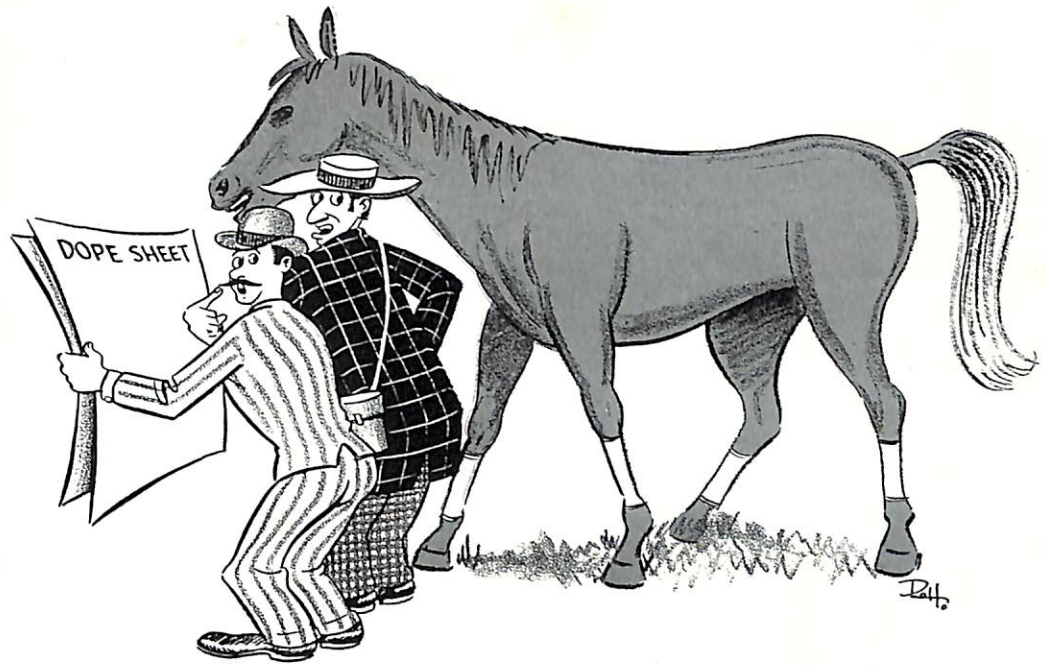
At this time, no suitable facilities were available at Fort Trumbull for conducting this work. Fortunately, the Massachusetts Institute of Technology was conducting operation of their Radiation Laboratory's field station on Fishers Island, and this station was made available to the Navy. Accordingly, in October, the Underwater Sound Laboratory accepted this station on behalf of the Navy, and development of a large-scale submarine antenna program was immediately undertaken. The Fishers Island station is ideally situated for field strength measurements with ships at sea and presents a line-of-sight view to the Laboratory's mainland facilities.

Since field strength measurement equipment, commercially built to the specifications dictated by the scope of the program, was not expected to be delivered for more than a year, a system of polar plotting using cathode-ray tubes was devised on the island. While this test apparatus was being developed, the basic submarine antenna project was assigned to the Laboratory, and a personnel recruitment program was undertaken. In 1947, large portions of installations and equipments from the island station were transferred to the Laboratory proper, at Fort Trumbull.

In the last five years the Antenna Branch complement has grown from a nucleus of three men to twenty engineers and engineering aides, and the value of the equipment used in the vital submarine antenna research program has increased from approximately $1,000 to more than $75,000. The field intensity measurement station on Fishers Island is now on Navy property, as approximately fifty acres were received last year by transfer from the Army's Fort H. G. Wright reservation.

At present, the Antenna Branch is engaged primarily in application engineering and component development for submarine communications antenna systems, and in integrating antennas, systems components, and electronic circuit elements into communications systems which can be employed at periscope depth. In carrying out these responsibilities, it is evident that the Antenna Branch is performing an essential function in the over-all program of the Underwater Sound Laboratory.

Let US *in on the know*



BEING "in the know" at the tracks" *sometimes* helps when picking the "bangtails" but being "in the know" in electronics ALWAYS pays big dividends in efficient operation and maintenance.

YOU can be one of many "tipsters" who provide the Bureau with the latest "inside dope" on operation and maintenance of Navy electronic equipment. This opportunity is afforded Electronics Technicians through the medium of Performance and Operational Reports on electronic equipments such as radio, radar, sonar, countermeasures, etc.

The Bureau utilizes the information contained in these reports when planning prospective corrective actions such as field changes, design modifications, and other improvements in YOUR equipment to the end that over-all improvement in electronic equipment is realized. Thus, you, the originator of these reports benefit directly by the prompt submission of accurate and timely maintenance and operational data. Conversely, inaccurate or useless information serves only to confuse the issue and deter the forward march of electronics improvements.

TO BE A WINNER — submit your Performance and Operational Reports accurately and promptly to:

CODE 983 BUREAU OF SHIPS.

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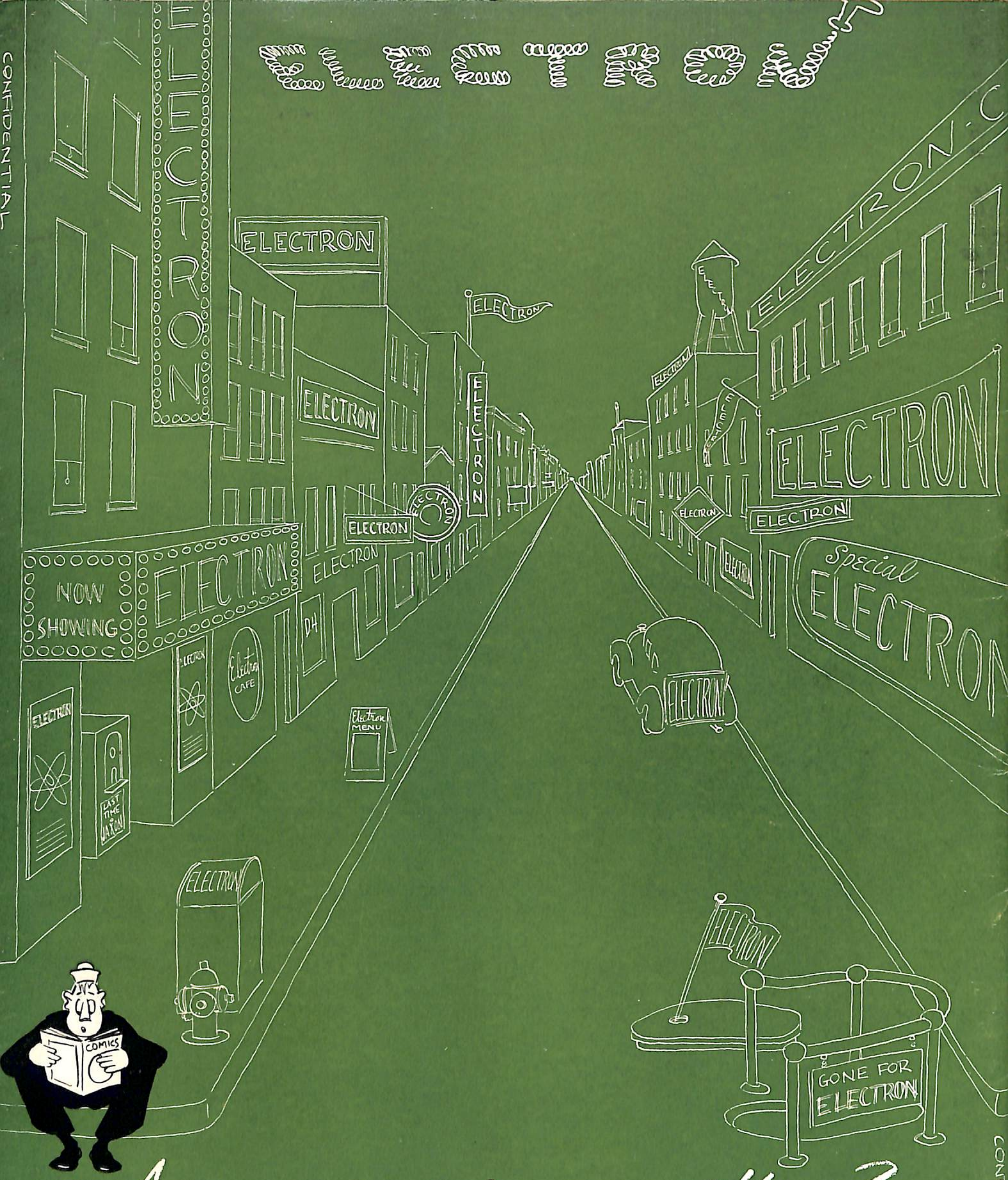

Are you missing something?

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