BUSHIPS AUGUST 1950

ELECTRON

RESTRICTED

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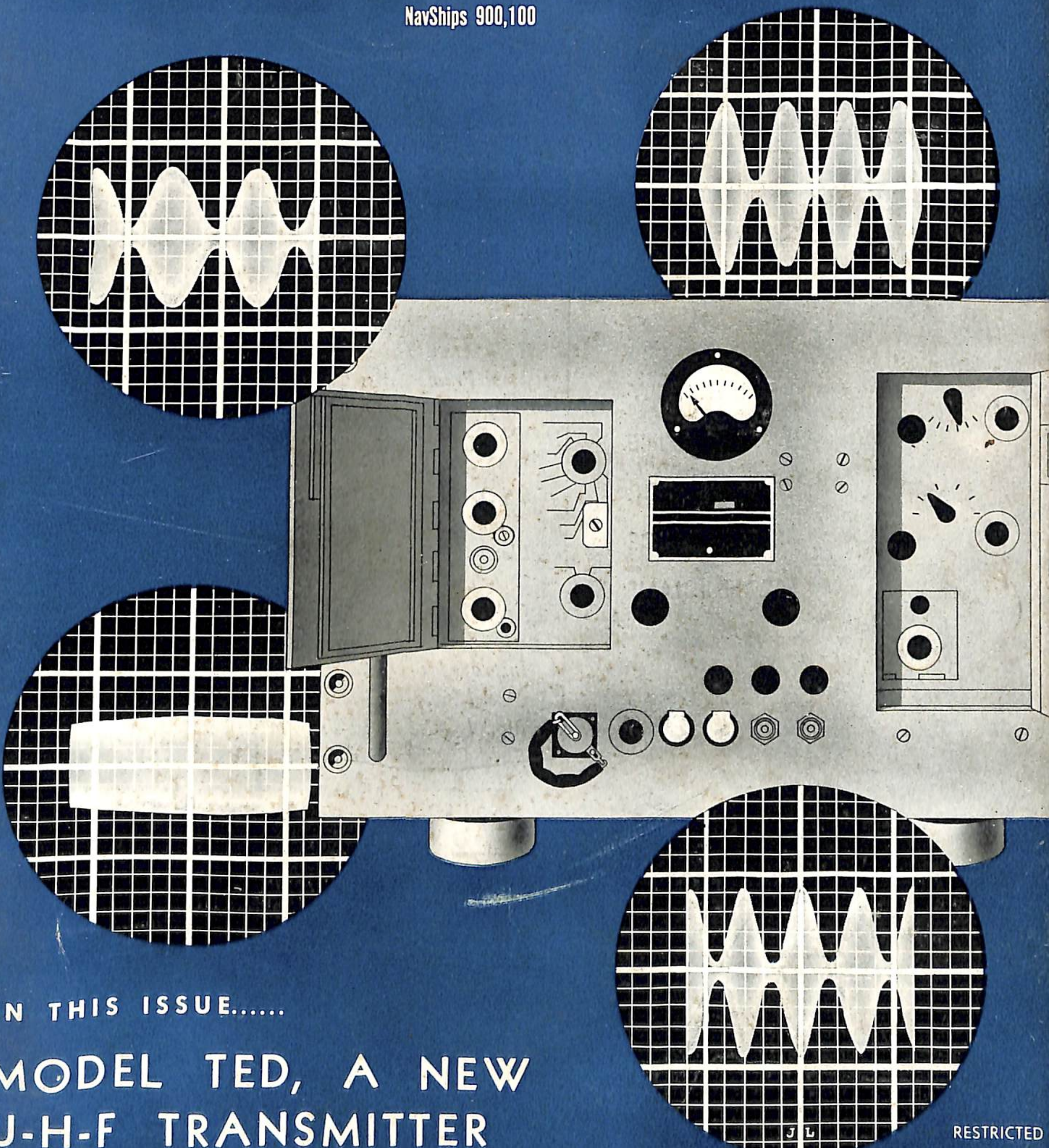

IN THIS ISSUE......

MODEL TED, A NEW U-H-F TRANSMITTER

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BUSHIPS

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THIS ISSUE

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TED *a new u-h-f transmitter*

Been having trouble with your Model TDZ Mac? Do the auto-tunes chew up the gears and spew them all over the deck? Do the 2C39's go off like Roman Candles at a Fourth of July celebration when you try to extract the last microwatt of power? Well be patient because it appears as if relief may be in sight for you and many other technicians who have experienced similar troubles with their u-h-f equipment.

The Operational Development Force has completed tests on a preproduction unit of a new u-h-f transmitter—the Model TED—and all indications are that here is an equipment that is here to stay.

An installation was made in the *U.S.S. Saipan (CVL–40)* and most of the tests were made during a two weeks' cruise from Norfolk to Montreal and Quebec. The Saipan's plane guard destroyer, the *U.S.S. Zellars (DD–777)*, and an F8F fighter aircraft from AirDevRon Three assisted in the tests by forming the other end of the u-h-f communication circuit. The *Zellars* employed a standard shipboard TDZ/RDZ installation while an AN/ARC–12 was used in the aircraft.

The TED is nominally a single-channel, 15-watt transmitter which can be operated on any channel in the 225-400 megacycle frequency range for which crystals are available. Comparing this with the TDZ's ten channels and 30 watts would lead one to believe that the TED is much less desirable. However, the TED mounts four crystals, any one of which can be selected by means of a front panel switch. After the crystal is selected only two controls require touching up and you're on the air—all in less time than it takes for the TDZ's "coffee grinder" to come to a faltering halt. Additionally, a goodly percentage of the TED's 15 watts is pushed into the sidebands where it will do the most good on the receiving end. And here's the pay-off—the transmitter, as received from the factory, was unpacked and installed aboard an aircraft carrier in about two hours; it was operated almost one hundred hours without a single casualty. Six weeks of operation, most of which was at sea, disclosed the equipment to be always as effective as a carefully tuned TDZ and usually more so. In an airplane at 80 miles range, the TED signal was "loud and clear."

by
Cdr. J. H. Allen, USN
Staff ComOpDevFor

Lets examine some of the features of the TED. It is completely self-contained (except microphone and antenna) in a 14″ x 21″ x 7″ cabinet and weighs only 150 pounds. It works into the standard TDZ/RDZ/MAR antenna and can be controlled through the standard shipboard patch panels from Type 23211 or 23500 radiophone units. For shore station installations it may be removed from its cabinet and mounted in a standard 19-inch relay rack. Remote operation over a single pair metallic line is provided for. Only the operating controls are mounted on the front panel. The rest are recessed behind access doors which normally remain closed. The r-f section and audio section may be quickly and easily removed for servicing.

The r-f unit consists of a 12AT7 tube connected as a

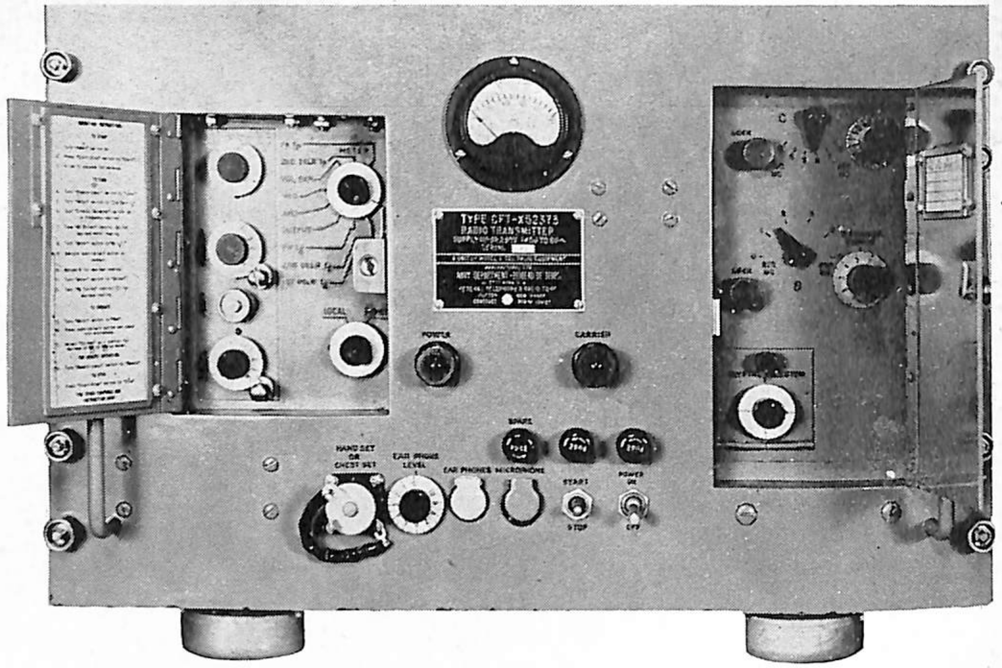

FIGURE 1. Front view of the Model X-TED u-h-f transmitter with front access doors opened.

triode crystal oscillator, with four crystals available on a switchable turret. The oscillator circuit is operated in the frequency range of 18.75 to 33.33 megacycles, and its output is capacity coupled to a 12AT7 tube operated as a frequency doubler. This high frequency output from the oscillator is made possible by use of the new "overtone" type crystals CR24/U. The doubler operating between 37.50 and 67.67 megacycles has insufficient output to drive the 2nd doubler stage, so a stage of class C amplification is inserted. The output of this amplifier is capacity coupled to a Type 4X150A doubler stage which operates between 75.0 and 133.33 megacycles. The output of the second doubler stage is link coupled to the push-pull 4X150A final amplifier stage which triples the frequency of the second doubler to the final output frequency band of 225 to 400 megacycles. The manufacturer rates the 4X150A tubes at 150 watts plate dissipation each. This safety factor should result in almost complete relief from the troubles experienced with the Type 2C39 tubes which are used in the TDZ. All the frequency generating and multiplier stage tuning is ganged on one shaft to a manual control while the power amplifier is tuned separately by another knob. The four position crystal switch is the only other control to manipulate when changing channels. Tuning is accomplished simply by selecting the desired crystal, tuning the multipliers to maximum indication on the front panel meter, switching the meter and tuning the power amplifier for maximum. Could anything be more straightforward? The single meter on the front panel will measure not only all the necessary plate currents but also modulation percentage and relative power output, all with a simple twist of the switch.

The modulator unit, employing push-pull type 807 beam power tetrodes as conventional class AB1 amplifiers is used to amplitude modulate the screen and plate voltages of the 4X150A r-f power amplifiers. The modulator is capable of modulating the carrier 95% in both voice and mcw operation. The unit is designed to work equally well with the standard type remote radiophone units or the special two-wire remote unit designed for the TED. Microphone voltage for the handsets is obtained from a rectifier installed in the power supply section. The modulator chassis contains the following circuits:

1—Modulator Stages
- a—Speech amplifier.
- b—Audio amplifier.
- c—Push-pull amplifiers.
- d—Voice control of modulator (expander circuit)
- e—AVC amplifier.
- f—Clipper.
- g—Modulation indicator.

2—Carrier Relay Control.

3—MCW Oscillator.

The audio section deserves special mention because herein lies most of the secret of the transmitter's effectiveness. The final amplifier screen and plate voltages are amplitude modulated by a conventional class AB1 modulator. Trickery is resorted to, however, between this stage and the microphone, in the form of automatic volume control, a speech clipper (compressor), and a volume expander. The speech amplifier stage can be controlled by the AVC amplifier and rectifier stages by throwing the AVC switch ON, thereby connecting a bias voltage to the grid of the speech amplifier which varies according to the speech level. When the clipper switch is thrown ON, the signal from the speech amplifier is

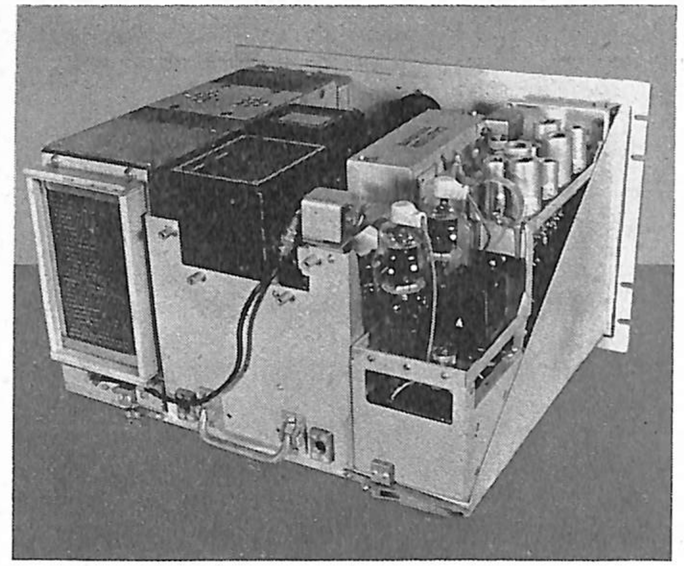

FIGURE 2. Rear view of the Model X-TED u-h-f transmitter removed from its cabinet.

connected to the AVC amplifier and the signal then passes to the clipper stages which are connected as biased diodes on both peaks of the audio signal. The clipping action limits modulation to 90%. To insure identical clipping of both peaks, a "clipping symmetry" control is provided.

The signal next goes to the speech modulator control which controls the level of signal voltage applied to the grid of the audio amplifier stage. In series with the plate voltage lead of the audio amplifier tube is connected a filter which limits the upper frequency response of the stage to 3500 cycles. The output of the filter is connected to another triode audio amplifier stage to further amplify the signal to a sufficient value for driving the 807 modulators to rated value. The driver amplifier cathode is returned through a winding on the modulation transformer for degeneration. To eliminate background noises in the vicinity of the microphone when the press-to-talk switch is closed, an "expander" circuit is included which holds the modulator normally cut-off unless a signal of pre-determined level is introduced into the microphone. The signal from the microphone transformer is connected to the grid of one-half of a multivibrator. The level at this point can be controlled by the "expansion level control" which will determine the amount of signal necessary to cause the one-kick multivibrator to start a complete cycle. When the "expander" circuit is utilized, the bias of the driver amplifier stage is set at —42 volts thereby cutting the tube off. A signal starts the one-kick multivibrator and allows a positive square wave signal to be coupled to the expansion rectifier which will then conduct current and overcome the effects of the fixed bias on the driver amplifier. To eliminate fast action and consequently distortion of speech, the bias to the driver amplifier is applied through a long-time-constant RC circuit so that the amplifier will not follow each brief speech pause.

The mcw oscillator is a triode connected phase shift oscillator operating at approximately 1000 cps. The feedback for the oscillator is obtained by connecting four 45° RC phase shifting networks between the grid and plate of the tube. A slight variation of the frequency of oscillation can be obtained by a small trimmer provided in the feed back circuit. The amplitude of the output signal is controlled by the "modulation lever control" which adjusts the signal fed to the driver amplifier. The mcw oscillator is keyed by controlling a relay whose contact completes the ground circuit for three sections of the phase shifting network.

How about the inevitable servicing? Unlike the "old line" Navy transmitters, the TED is very compact (so much so that forced air cooling is required), but no more so than most of the current airborne equipments. Most of the potentially troublesome components are readily accessible and the unitized construction makes it possible to disassemble the equipment for servicing with a minimum of effort. Although it is realized, to quote the bard, "—one swallow does not a summer make—" it appears that with a fraction of the weight and space, the TED will provide nearly all the facility of a well mannered TDZ (and not many of them are well mannered). Many of us are inclined to feel that the TDZ has not been a howling success for one reason or another. The reason for this can be found in recounting the conditions under which the TDZ was developed. The TDZ design was based on World War II requirements and the development cycle was dictated almost entirely by a production deadline. It was necessary to freeze designs which were based on untried techniques in order to meet that deadline. A great deal of fine engineering was poured into this development program. Many of the most fundamental components such as suitable tubes, crystals and capacitors were not available and had to be developed from scratch. Consideration of the impact on the logistics organization of the Navy made it mandatory that standardization be given top priority. This factor placed a very tight restriction on the equipment designers. They were forced to design equipment using components which were not in existence and with no assurance that components with the required characteristics could be produced within the required time. The competition for development resources was strong from other high priority electronics programs such as radar, countermeasures and IFF. Nothing but credit is due the development activities, commercial as well as Naval, for their part in the original u-h-f development program. The "state of the art" moved forward by leaps and bounds as a result of their efforts, and their experiences have made it easier to develop the TED.

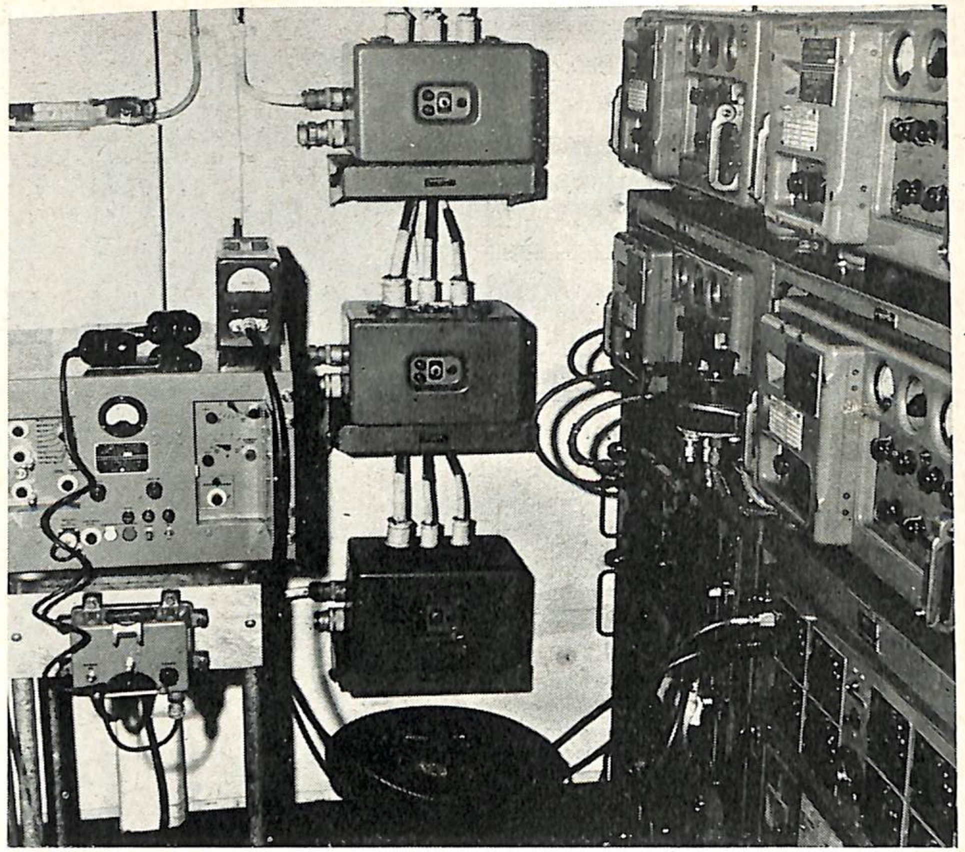

FIGURE 3. Model X-TED u-h-f transmitter installed in the u-h-f room of a light aircraft carrier. View shows the transmitter connected to test equipment set-up which was used during range runs.

Don't get the idea that for ten cents and two empty TDZ box tops you can get a TED from the nearest Naval Supply Center. Although there is a production contract for several hundred equipments, these are commited to shore stations and vessels not now "blessed" with the TDZ. It may be possible to incorporate some of the TED features into field changes for the TDZ. In the meantime all hands should make an earnest effort to keep their TDZ's operating. It has been proven that they will work well if properly treated. Pass along any hints or kinks which will help the rest of the gang solve their problems.

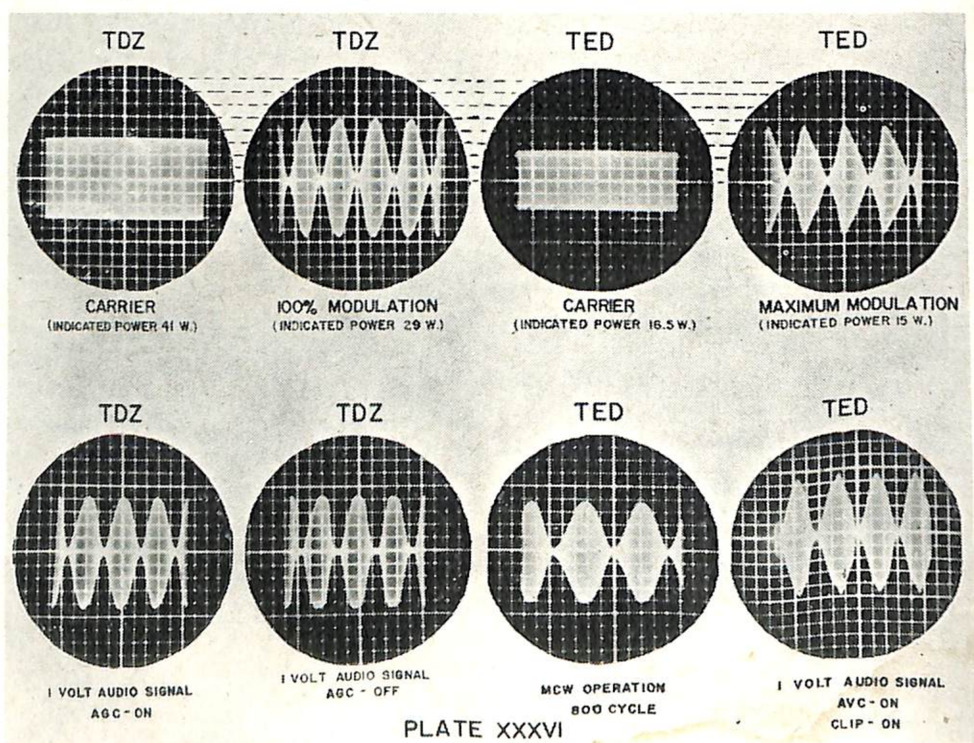

FIGURE 4. Various oscilloscope waveforms showing different patterns obtained under selected operating conditions.

SERAD at Boston Naval Shipyard

The Electronics Reclamation Project originated in April 1948 at the Boston Naval Shipyard, at which time the Bureau of Ships sent to Boston its share of electronic equipment to be repaired. Suitable buildings were secured in Building No. 16 and Building No. 32 at the South Boston Annex. The Supply Building (No. 32) already had over sixty thousand square feet of equipment in need of repair. Building No. 16 at South Boston was selected as the repair building because it could be converted very economically. It had twenty-two thousand square feet of floor space available,

by
William Ferguson
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Shop 67
Boston Naval Shipyard

with suitable lighting and machinery. Other allied crafts were also located in the building, which proved to be a valuable asset. This building was considered ideal because it overlooks the harbor, is near an airport and has a roof suitable for locating radio and radar antennas.

In April 1948, we began operations on a small scale, increasing both our force and working area gradually, while meeting our production schedule consistent with the time and funds allocated. The Reclamation Repair Project, or ZEBRA Project, as it became known later, increased in manpower from six radio mechanics and one supervisor, to approximately one hundred radio mechanics and four supervisors. Our production growth kept in step with our increase of personnel, as witnessed by the tons of equipment shipped to the Supply Officer. Production schedule dates were met, and in many instances, were well ahead of those set up by the Bureau of Ships.

Building No. 32 is used as a supply base for all electronic material brought in from various depots. Here, the equipments are screened into their respective categories by competent radio technicians. An analysis is made and parts are ordered months in advance of repair schedules. This speeds up production, keeping the flow of parts needed on hand when the equipment is being repaired. The ERUPT Project, as it became known, has handled approximately six thousand tons of electronic equipment up to the present date, utilizing sixty thousand square feet of floor space.

On July 1949, we became known as the SERAD Project. At the present time, we are operating eight

Communication equipment is overhauled and tested in this section of the SERAD Program.

Painting and touching-up of equipment processed through the SERAD Program.

production lines, using the most modern methods. Twenty-two thousand feet of floor space are required, including a small Machine Shop, Stock Room, Paint and Spray Booth, an area for Packing and Crating, an Assembly Room, and an equipment standing area.

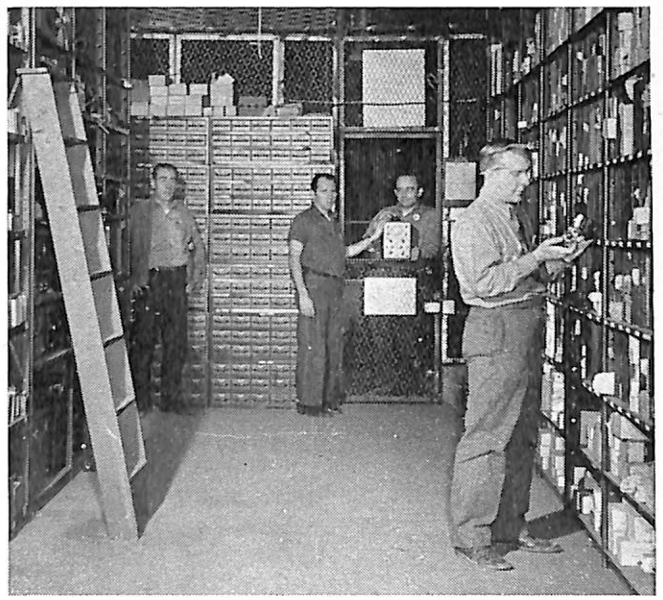
In order that we may illustrate the production methods used at the SERAD Project, let us follow one of the radio mechanics through on the SC Radar Production Repair Line.

In maintaining the standards of the reclamation project, methods are continually being sought to facilitate the repair of radar equipment in the most economical and efficient manner. As is well known among the mechanics, some of this equipment is thrust upon us in the poorest and most weather-beaten condition, and it is our job to return this equipment into service with a "straight from the factory" performance and appearance. It is difficult to visualize the wonderful transformation of our electronic "junk heap" without traveling along with one of our mechanics on his routing of reclamation; so, for an example, let us look in on the processing of a typical piece of gear—the 46ACQ radar receiver:

Reclamation of Type 46ACQ Radar Receiver

Due to war service strain, plus weather and age, the sensitivity rating of this particular receiver has fallen far below the standards of satisfaction called for by the Navy Department, so we have to examine it to determine just what has happened to it since it was first placed in service. The first and most obvious thing noticed about this receiver is the accumulation of dirt, plus a pronounced discoloration of the vital parts of the receiver proper. To renovate it physically is only a matter of removing the dirt with some agent, such as carbon tetrachloride or soap and water, etc.; but to return this receiver to the service with a high operational efficiency is quite another story. First of all, this receiver operated on an extremely high frequency, and radio currents behave most peculiarly at these frequencies if the slightest condition of upset is present. In this case, the discoloration of the parts mentioned above spells trouble, due to the fact that for reasons of high frequency design, all metal parts of this receiver are silver-plated to provide an outstanding efficiency at high frequencies. Time and organic gases in the air have attacked the silvered surfaces and the result is a very badly oxidized and sulphated condition, which must be corrected before normal operation can again be expected. At this point, the real work of reclamation begins.

First, all existing connections and coupling to the re-



SERAD stock room. All items in here have been obtained from spare parts boxes or cannibalized equipment and are used for repairs to equipment in the SERAD Program.

ceiver r-f chassis are disconnected and the r-f assembly lifted out and placed on the bench. It is then completely dismantled so that every single piece of metal can be handled separately. All electrical parts, such as capacitors, resistors, and the wiring are placed in a separate pile, since they cannot be processed in the same manner as the plated metals. Next, a bath of Navy type cleaning fluid (Class 51–C–1586) is prepared by diluting one part of the fluid with three parts of water in a receptacle large enough to hold all the metal parts. This solution is heated to approximately 200° Fahrenheit on an electrical heater, and the metal parts immersed for approximately one hour. Immediately following this treatment the parts are rapidly rinsed in boiling water. At this stage, all of the grease and dirt deposits will have been removed, leaving the surfaces ready for their final treatment. Into another receptacle containing about two quarts of water, a cupful of calcium carbonate, sometime known as "whiting" or "chalk", is stirred; and the metal parts are allowed to soak in this mixture while they are taken out, piece by piece, and rubbed lightly with a damp cloth dipped in powdered calcium carbonate. At this point, you will notice the original silver surface reappears. The parts are again rinsed in hot water and allowed to dry on a clean towel or rag, and afterwards, are wiped free of any powdered deposit and set aside for reassembly. The electrical parts such as the resistors, condensers, etc., are checked for deviation in value before assembly. All ceramic insulators are cleaned with carbon tetrachloride, and the complete unit may now be reassembled and put through a standard performance test.

The foregoing procedure in the reclamation of this particular receiver has proven to be a most valuable asset in improving its performance and physical appearance. Actual testing has shown a difference of as much as an 18-db gain in the signal-to-noise ratio of the receiver, which means that where a receiver of this type was formerly capable of receiving a radar echo from a distance of about ten or fourteen miles, it could now receive up to a distance of seventy miles (which was actually proven here on our radar test gear). Thus, it can be seen that research, plus a little patience and perseverance, has again paid off in successful handling of the reclamation project, and it is in such spirit that all work leaves our shop.

When there is a better way to do it, we'll do it. This statement is just an example of the morale which exists at SERAD Project. During the entire existence of the reclamation project, including SERAD, one hundred and eighty thousand man-hours of work have been performed without a lost-time accident. This is a remarkable achievement considering the high voltages, machine tools, acids, cathode-ray tubes, and heavy equipments which are handled each and every work day by the personnel of this project.

SR–3, SR–6 AND AN/SPS–6 MAINTENANCE NOTES

Waveguide Flange Gaskets

The waveguide gaskets inserted between the flanges of Radar Set AN/SPS–6, and Models SR–3 and SR–6 Radar Equipments are fabricated so that electrical continuity is maintained throughout the entire waveguide run.

Before the waveguide is installed, the gaskets should be cleaned bright with a cloth in order to assure good electrical contact between the flanges. The gaskets should never be coated with Glyptol, shellac, or any other material in order to hold the gaskets in position or to obtain a tight fit.

Standing Wave Ratio Tuner

Bureau of Ships Drawing RE 10F 627B gives details for fabrication of a Standing Wave Ratio Tuner (SWRT) for use with Radar Set AN/SPS–6, and Models SR–3, and SR–6 Radar Equipments. This drawing shows the Standing Wave Ratio Tuner installed adjacent to the Directional Coupler on the top side.

In order to clarify any possible ambiguity as to the correct location in which to install the Standing Wave Ratio Tuner, Bureau of Ships Drawing RE 10F 627B has been altered. The altered drawing, RE 10F 627C, shows the correct location of the Standing Wave Ratio Tuner, immediately adjacent to the Directional Coupler, on the antenna side. The Standing Wave Ratio Tuner should not be installed in the waveguide near the Antenna Pedestal or between the Transmitter and Directional Coupler. Copies of Drawing RE 10F 627C are available, upon request, from Code 991, BuShips.

THANKS—GCA!

On 4 January 1950 at about 0930 a general recall to all locally-based aircraft flying in the vicinity of Quonset Point, R. I. was broadcast by Quonset Tower due to expected instrument conditions at Quonset by 1000R. Two F8F aircraft, Bureau No. 122640 pilot Midshipman W. W. Martin and Bureau No. 122661, pilot Midshipman J. C. Llewellyn, were on a local familiarization flight. Enroute to N.A.S. Quonset both aircraft became "lost" while flying "on top" of the overcast. Radio contact was established with both aircraft at about 1030R, at which time both pilots stated that they were "very low on fuel," that their position was unknown and requested that they be given an immediate "vector" to the field. Quonset GCA gave both aircraft a DBF heading to steer to Quonset. After picking up the aircraft on the radar scopes both aircraft were directed through the overcast under GCA control and landed at Quonset. Upon landing one aircraft had 40 gallons of fuel remaining and the other aircraft had 50 gallons of fuel remaining.

On 15 January 1950 at 0100 the GCA crew at N.A.S. Quonset Point was alerted to land an aircraft under DBF control of Naval Radar Training Center, Beavertail Point, Rhode Island. The plane was an Air Force C–46 enroute from Langley Field to Bedford, Massachusetts. The pilot, 2nd Lieutenant W. E. Cessford, reported that his range receiver was out and that he was lost. GCA took control of the aircraft fourteen miles south at 5000 feet and made a PPI approach, landing the aircraft on the first approach. Quonset weather was 500 feet overcast with two miles visibility.

USN USL notes

ARMED FORCES DAY EXHIBITION

Echo-ranging exhibit.

On 20 May, the Laboratory staged a very successful Armed Forces Day exhibition, designed to acquaint the public with the role of electronics in national defense. Since adequate space for a general "open-house" was not available at Fort Trumbull, the Laboratory's good friend and neighbor, the U. S. Naval Submarine Base came to the rescue and made excellent facilities available for this purpose. Approximately 5000 visitors were logged in at the Base.

Included in the Laboratory's exhibition were the following:

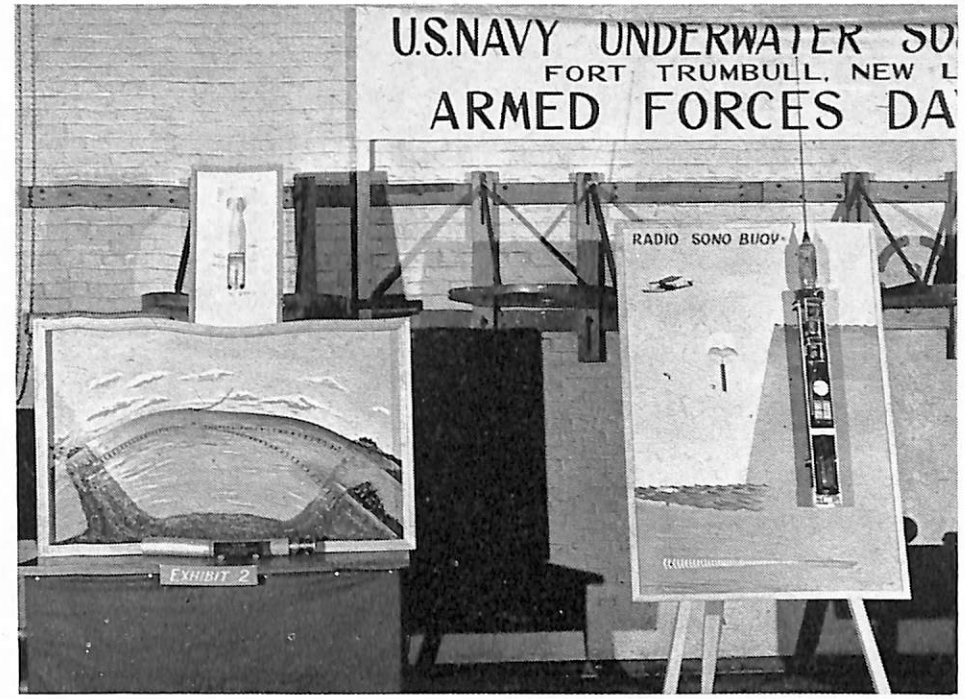
"Fish-Talk"—As on previous occasions of this kind, the "Fish-Talk" proved immensely popular. Using a magnetic tape recorder, sounds from marine life, ships, and miscellaneous man-made devices were played through a large transparent tank of water to a bank of twenty headsets. For effect, a number of tropical fish were placed in the tank. During most of the day, it was necessary to supplement the headsets with a loudspeaker in order that all visitors could be accommodated.

Sofar—an animated panorama was used to illustrate the application of the Sofar technique to air-sea rescue. Those viewing this exhibit saw a plane forced down at sea, the detonation of a Sofar bomb, and the progress of the sound to three monitoring stations.

Hydrophones—This exhibit consisted of cutaway models of typical magnetostrictive and piezoelectric devices and demonstrations illustrating the magnetostrictive effect.

Echo Ranging—In this demonstration, a pictorial representation of a surface vessel echo-ranging on a submarine was painted on the face of a cathode-ray tube. In viewing the demonstration, visitors saw a transmitted pulse leave the surface vessel, strike the target submarine, and return in the form of an echo.

Ultrasonic Transmission—To illustrate the use of ultrasonics in detection, a narrow beam transmitting hydrophone and a receiving hydrophone were so positioned that visitors walking along a chalk line acted as targets, causing the transmitted energy to be reflected at the proper

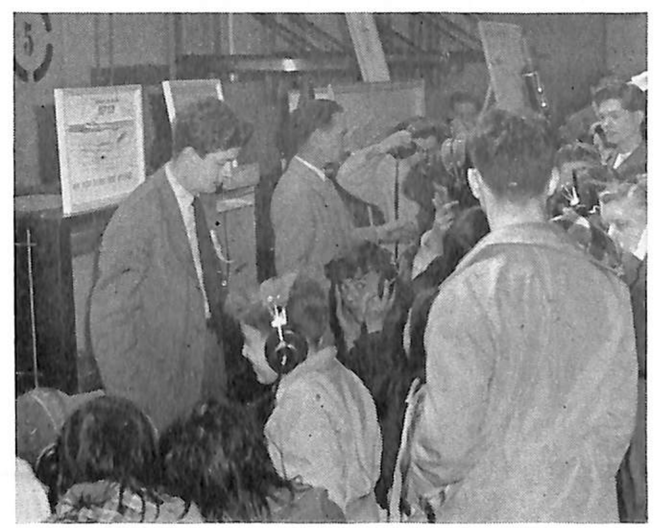


Sofar and expendable radio sono buoy exhibit.

angle to the receiver. As in several other demonstrations, participation by the visitors proved very effective.

Expendable Radio Sono Buoys—This exhibit consisted of a cutaway buoy (of the type developed by USN USL during the war), mounted on a pictorial background which illustrated the principles of operation.

Antenna Pattern Display—Here a visual display of the radiation pattern of a miniature television receiving antenna was presented. Mounted in the center of a field of small neon lamps, the antenna was energized through a rotating joint by a Klystron signal source operating at a frequency of 3000Mc. As the antenna rotated, the actual pattern of radiation was indicated by the


"Fish Talk" exhibit.


Infra-red exhibit.

area of lighted lamps. Owners of television receivers showed particular interest in this demonstration.

Infrared—Two exhibits were used to demonstrate the use of invisible infrared radiation for purposes of communication, and visitors were given an opportunity to carry on two-way conversations. A third exhibit demonstrated how passive detectors respond to infrared radiation and, in effect, measure the temperature of viewed objects.

Copies of a special Armed Forces Day Edition of the *Bulletin,* the Laboratory's biweekly newspaper, were passed out to all visitors.

radioactive tube handling

Radioactive tubes present personnel hazards even in normal use and particularly so in the problems of stowage, breakage, and disposal of broken tubes. Certain precautions must be observed in order that existing supplies of radioactive tubes may be safely handled and used in the equipments for which they are designed within the Naval establishment. Several Naval activities have conducted studies on normal use, breakage and disposition of these tubes, so that personnel may be advised of the hazards they may present under varied conditions. It is altogether possible that radioactive tubes may be used under conditions where neither experienced personnel or survey instruments are available. Therefore, the practices recommended here are the simplest safe procedures for radioactive tube handling.

There are four aspects of the problem of radioactive tube handling.

1—The external radiation hazard with respect to stowage of individual radioactive tubes and the stowage of such tubes in quantity, i.e., where the radiation hazard may be increased by the presence of a number of tubes together.

2—The disposition of useless unbroken radioactive tubes both afloat and shore.

3—The procedures for cleaning up an area where tubes have been broken and the disposition of broken tubes and other radioactive junk.

4—The recommended procedures for treating personnel receiving wounds resulting from breakage of radioactive tubes during handling, where radioactive material may have entered the body through cuts or abrasions.

Poisoning from radioactive materials in the subject vacuum tubes may be of three types:.

1—*Assimilation*—Eating, drinking or breathing radium compounds or absorbing them through cuts. Radium-bearing dust, which may be present in certain tubes, is dangerous in this respect.

2—*Breathing radon*—Radon is a tastless, colorless, odorless gas which is given off by radium and radium compounds at all times.

3—*Radiation*—Radium and radium compounds give off harmful, invisible radiation which can cause dangerous burns.

The following include tubes known to contain radioactive material and which may be hazardous to personnel.

1—Spark Gap Tubes:

1B22	1B31	1B42	1B49
1B29	1B41	1B45	

2—Glow Lamps or Cold Cathode Tubes:

313C	313CD	359A	405A
313CA	333A	372A	413A
313CB	346B	376B	423A
313CC	353A	395A	727A

3—TR Tubes:

1B23	1B40	1B62	709A
1B24	1B50	1B63	721A
1B26	1B55	1B63A	721B
1B27	1B58	702A	724A
1B28	1B60	702B	724B

The external radiation hazard from electron tubes containing radioactive materials was investigated at San Francisco Naval Shipyard, using the tubes available at the Electronic Supply Section. A list of the tubes investigated and the experimental results obtained are shown in Table I.

Tube	Level of One Unwrapped Tube mr/hr	Maximum Reading at Bank of Wrapped Tubes in mr/hr	Reading at 8″ from Bank of Tubes in mr/hr	Configuration of Bank of Tubes Measured
1B22	6	4	0.7 (12 in.)	5 x 8 tubes
1B42	0.6	.3	0.2	4 x 3 tubes
313C	Background (.03)	Background	Background	—
359A	Background (.03)	Background	Background	—
		0.15	0.2	5 x 5 tubes
1B24	3	0.15	0.15	3 x 4 tubes
1B26	0.15	0.15	—	Single tube available
1B27	0.15			
1B63A	0.15	0.2	0.1	3 x 2 tubes

Assuming that the tubes represented are typical and represent the entire range of intensities that are likely to be encountered, it is evident that there is no external hazard involved in the storage of large numbers of these tubes in their shipping containers. The maximum level that could be encountered, according to the experimental data obtained is 8 milli-roentgens per hour (mr/hr). The Atomic Energy Commission tolerance, based on a 40-hour per week exposure, is 7.5 mr/hr.

According to test and data furnished the Bureau of Ships by the Western Electric Company, the subject tubes may contain from 0.01 to 2.0 micrograms of equivalent radium per tube. The level of radiation from one gram of radium at a distance of one meter is 970 mr/hr. (*Advances in Biological and Medical Physics,* J. H. Lawrence and J. G. Hamilton—Academic Press Incorporated, 1948—Robley D. Evans, P. 189). For the maximum quantity of 2 micrograms of equivalent radium which may be present in any one tube the level is computed to be 1.9 x 10–3 mr/hr at one meter. Assuming a point source configuration, the level at one centimeter will be 19 mr/hr. The amount of radiation represented by a large number of these tubes could present an external radiation hazard, if concentrated in a single point source. However, when packed in their shipping container, the spatial distribution is such that the radiation level at any one spot is not significantly greater than the Atomic Energy Commission tolerance level.

A radiological survey was conducted by the Ships Supply Center at the Naval Supply Center, Oakland, California. Investigation of the types 1B41 and 1B42 tubes revealed that the amount of radiation they emit is negligible for any quantity of tubes. Glow lamps or cold cathode tubes were found to contain such small amounts of radioactive material that they are not dangerous unless this material is deliberately injected or inhaled into the human system.

Checks of 1B22 and 1B29 tubes packed in individual cartons, with 100 packed in turn in corrugated cartons indicated an intensity at a distance of 1 foot from the carton of 1.0 mr/hr. An intensity of 4.0 mr/hr was noted when the probe was placed against the carton. A stow of 28 cartons of 100 tubes per carton showed the following intensities: 7.0 mr/hr with the probe placed against the stack, 5.0 mr/hr at a distance of one foot, 1.7 mr/hr at three feet and 0.8 mr/hr at a distance of six feet.

On the basis of the AEC tolerance levels, none of these intensities presents an occupational hazard over an eight hour day. The large stow of 2,800 tubes, with an intensity of 7.0 mr/hr next to the stack, is not dangerous, even if personnel were in bodily contact with it for eight hours. However, if 100 1B22 or 1B29 tubes were piled together without cartons, danger of injury to personnel by radiation would exist.

From these various investigations it is evident that no radiation hazard to personnel exists from radioactive tubes properly stowed in cartons or from normal handling of such tubes for removal or placement of them in equipment. Concentrated stowage of large quantities of radioactive tubes should, of course, be avoided. All of the investigating activities concur, however, in the very serious danger of injury from any radioactive particles or gases entering the body by breathing, eating or through cuts in the skin. It becomes apparent, therefore, that the utmost caution should be observed when handling broken tubes containing radioactive materials to prevent injury to personnel.

Radium bromide is used in spark gap, glow lamp and cold cathode tubes. Radioactive cobalt is used in TR tubes. This radioactive material is generally applied to the glass wall, in the dome or in some other convenient location within the envelope.

Glow lamps or cold cathode tubes and TR tubes contain from 0.01 to 1.0 micrograms of equivalent radium per tube. Spark gap tubes contain from 1.0 to 2.0 micrograms of equivalent radium per tube.

Radium bromide causes the formation of radon gas within the tube envelope and it is dangerous to inhale this gas. Radioactive cobalt has a relatively short life and does not give off radon gas. Radium salts are cumulative poisons and like other radioactive concentrations are extremely hazardous if injected anywhere into the human system.

Recommended Procedures For Disposition of Radioactive Tubes, Broken and Unbroken, And The Cleaning Up of Broken Tube Fragments

Useless unbroken tubes should be treated as any other radioactive waste materials. They should be sunk intact at sea. In shore installations, it is best to collect the tubes in special containers which should then be weighted, sealed and shipped out to be sunk at a convenient time. A plot of land may be set aside near the shore station to be used as a burial ground, however, the former method of sinking is recommended. If a burial plot is used, it should be adequately posted and supervised.

Tubes containing radon gas can be broken up under a ventilated hood, since radon gas is heavier than air, however, burial of such tubes intact or sinking them at sea is the optimum disposal method. If possible, radioactive material that is to be junked should be encased in concrete to insure that no parts will float to the surface when the material is sunk at sea.

Any equipment or tools used in crushing tubes or handling radioactive junk should be thoroughly cleaned before using for other purposes or if practicable such equipment and tools should also be buried or sunk at sea. It should be borne in mind that any buried material may at some later date be exposed by land excavation and cause radium poisoning exposures.

Recommended Procedures for Cleaning an Area Where Tubes Have Been Accidentally Broken

1—*Wet Method*—First pick up large fragments with forceps; Then, using a wet cloth, wipe across the area. Make one swipe at a time and fold cloth in half, keeping the clean side out at all times. When cloth becomes too small, discard and start again with a clean piece of cloth. Care must be taken not to rub the radioactivity into the surface being cleaned by using a back and forth motion. All debris and clothes used for cleaning should be sealed in a container such as a plastic bag, heavy waxed paper ice cream carton, or glass jar and disposed of in the same manner as the unbroken tubes.

2—*Dry Method*—Pick up large pieces with a forceps; then clean the area carefully with a vacuum cleaner. If the breakage of tubes is a frequent occurrence, the exhaust from the vacuum cleaner should be analyzed and the appropriate type of collector used. The collecting bag should be disposed of in the same manner as the debris in method (1).

The following rules should be observed in the disposal and handling of any material contaminated by radioactivity:

1—No material contaminated by radioactivity should be allowed to come in contact with any part of the body at any time. Protective gloves should be worn at all times when the handling of radioactive wastes and broken radioactive parts is involved.

2—No food or drink should be brought into the area contaminated or near any material that is radioactive.

3—Personnel handling radioactive material in any way should thoroughly wash hands and arms and remove any clothing which may have been contaminated before eating, drinking or smoking and immediately after leaving the contaminated area.

In view of the serious damage to an individual's health which could result from wounds contaminated by broken fragments of electron tubes containing radioactive material, it is apparent that every precaution should be observed to prevent the occurrence of such an accident. While it is generally agreed that the introduction of radioactive contaminant into a wound is a potential health hazard, the prediction of definite health damage is variable. Detection of radioactivity contamination in a wound would be practically impossible in the absence of special equipment and techniques. However, assuming that a wound caused by a fragment of a broken radioactive tube will occur, the following first aid procedures are recommended.

1—Immediate application of a venous return tourniquet, if the wound is so placed that a tourniquet is applicable.

2—Stimulation of mild bleeding by manual pressure about the wound and by the use of suction bulbs.

3—The wound should be washed with soap and copious amounts of clean water.

4—If the wound is of the puncture type or the opening is quite small, an incision should be made to promote free bleeding and to facilitate complete flushing of the wound with soap and water.

The above procedures cannot exclude the hazard of a lifetime tolerance of radioactive material entering a wound resulting from breakage of a radioactive tube. However, the best authorities agree that the possibility of such serious results in the circumstances under discussion is so remote as to exclude the necessity for surgery or laboratory analysis. Therefore, the measures for wound treatment outlined above represent the only reasonable first aid treatment which would normally be available to doctors in the field or aboard ship.

MAIN FRAME CROSS CONNECT CABLE

The Bureau of Ships has been advised that the 500,000 feet of standard switchboard cross connect cable, standard Navy stock number 15–C–4683–10, procured under Contract N383s–16731 is now available at Naval Supply Depot, Bayonne and General Supply Depot, Naval Supply Center, Oakland. This is 22-gauge unshielded twisted pair with 600-volt insulation for use in cross connect wiring of telegraph main frames.

AIR SEARCH RADAR SET AN/SPS-6

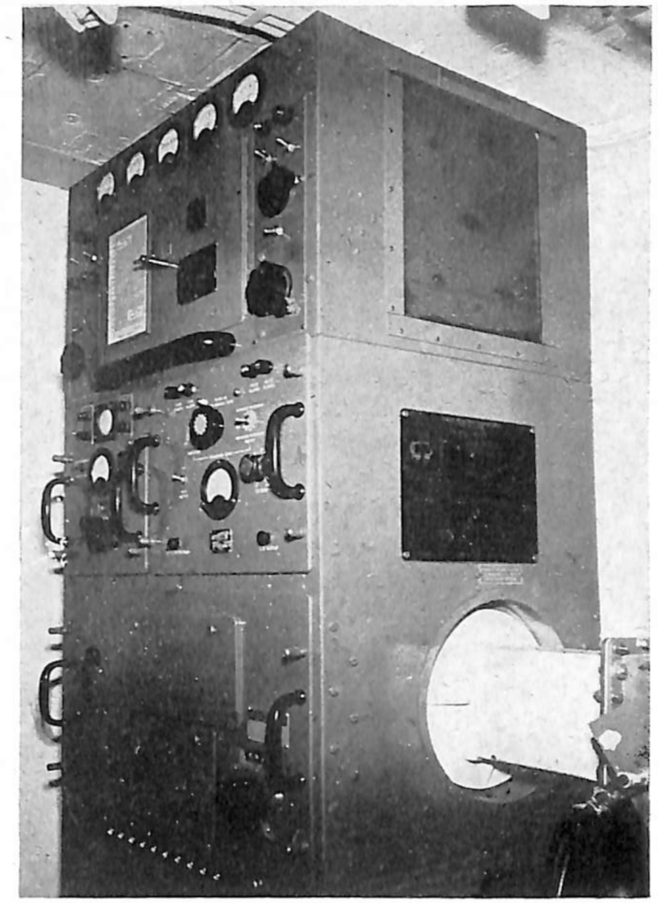


FIGURE 1—AN/SPS–6, –6A, –6B Radar Receiver-Transmitter Type RT–141/SPS–6 showing front panel controls and waveguide coupler on the side.

During the past few years we have witnessed a tremendous effort by the aircraft industry, in cooperation with the armed forces, to improve the striking power of our military aircraft. These efforts have resulted in the production of jet-propelled, high-speed, high-altitude bombers and fighters. These planes have capabilities of speed and altitude far superior to those in use at the close of World War II. However, even at that time it was recognized that the need existed for an air search radar which would facilitate radar and fighter intercepts of approaching aircraft at much greater ranges than was then possible. With the advent of the post-war planes, with their improved speed and altitude capabilities, this need became even more urgent. To meet the challenge and overcome the advantages enjoyed by the aircraft, the Electronics Divisions of the Bureau of Ships, together with numerous research organizations both Naval and commercial, embarked on a program to design an air search radar or series of radars which would fulfill the demands of the fleet.

The first post-war air search radar, developed as the result of these revised fleet requirements and extensive research, was the SR–3 and subsequently the SR–6 which operate in the frequency band from 1244 to 1350 Mc. Exhaustive evaluation and operational tests of this radar disclosed it to be unsatisfactory due to limited range and altitude coverage. Further research efforts were conducted by the above-mentioned agencies, using the experience gained in the development and evaluation of the SR series.

In the early part of 1948 a new air search radar was introduced by the Westinghouse Mfg. Co., designed to eliminate the undesirable electrical and mechanical features of the SR series radars and at the same time afford increased range and high altitude coverage capabilities. This new radar is designated the AN/SPS–6. The improvements incorporated in the AN/SPS–6 consisted primarily of the type of antenna used, type of magnetron used and a more sensitive receiver. The merits of the AN/SPS–6 will be discussed in detail in later paragraphs.

The AN/SPS–6 operates in the L band (1250 to 1350 Mc) using a 5J26 tunable magnetron to cover the entire frequency band. Two pulse repetition rates are available, 150 and 600 pps., with pulse widths of four and one microseconds respectively. These pulse rates may be varied (plus or minus 5%) by a front panel control on the Radar Set Control as an aid to operators in overcoming jamming or other interference. Facilities are also provided for introducing external synchronization, if desired. The equipment normally operates from a 115-volt, 60-cycle, single-phase power source. The power source used must have a capacity of 5.5 kva.

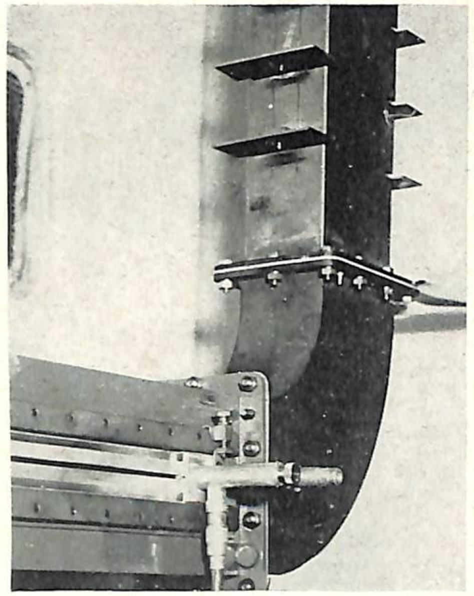


FIGURE 2—Waveguide Connector Type COG–14-ACL with R-F Matching Unit connected.

The complete AN/SPS–6 Air Search Radar includes the following components: 1—Radar Receiver-Transmitter Assembly RT–141/SPS–6; 2—Video Amplifier CRP–50AJW; 3—Radar Set Control C–490/SPS–6; 4—Antenna Control C–491/SPS–6; 5—R-F Line Filter CAY–53AAF; 6—Power Transformer TF–115/U; 7—Antenna Mounting AB–146/SPS–6; 8—Antenna AS/402/SPS–6; 9—IFF Coordinator—Range Indicator CRP–55AHP; 10—Echo Box Type CAY–14ABS; and 11—Waveguide Connector COG–14ACL or CHG–14ACL, a waveguide and an r-f matching section.

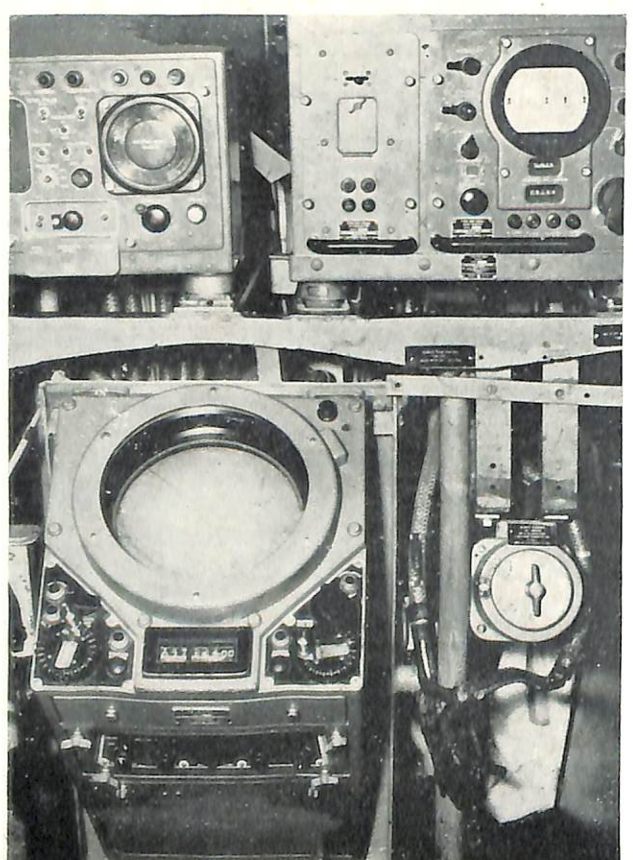


FIGURE 3—CIC installation for AN/SPS–6 series radars. Upper left is the Radar Set Control C–490/-SPS–6. Upper right is the IFF Coordinator–Range Indicator. Below center is the VJ PPI used with the equipment.

The Radar Transmitter consists of internal synchronization circuits, modulator circuits, pulse forming networks, pulse transformer, tunable magnetron with its associated r-f circuits, T/R box, and high voltage power supplies. The pulse repetition rates are determined by a free running blocking oscillator whose output is delivered through a cathode follower to the modulator. One pulse network is employed in the forming of 1-microsecond pulses. When 4-microsecond pulses are desired, a second pulse network is added to the first to give the necessary time duration. These networks are charged through a charging diode and a charging choke from a high voltage power supply. The trigger pulse from the cathode follower fires the modulator thyratron which discharges the pulse network and the resultant positive pulse is coupled through the pulse transformer to be applied as a 25- to 30-kv negative pulse to the cathode of the magnetron. An r-f pulse having a peak power of from 500 to 750 kw is generated in the magnetron and delivered to the waveguide for transmission to the antenna. To permit synchronization of other units operated in conjunction with the AN/SPS–6, a trigger pulse is tapped off the pulse transformer and passed through a variable delay line. This line is constructed so that thirty adjustments of 0.05 microseconds each are available, making possible a delay of from 0 to 1.5 microseconds dependent on the length of the waveguide and other factors.

The I-F Preamplifier includes a mixer input stage and four stages of i-f amplification at 30 Mc. The mixer input stage utilizes a pentode connected as a triode in order to improve the noise figure of the system. The first i-f preamplifier is a grounded grid triode, so connected to further improve the noise figure of the system. The other stages are conventional i-f amplifiers. The output of the I-F Preamplifier is delivered through a coaxial cable to the input of the Radar Receiver Type CAY–46AEG–1.

The Radar Receiver Type CAY–46AEG–1 contains four i-f amplifier stages, video detector, local oscillator, two video amplifiers and circuits for sensitivity time control (STC), high video pass (HVP), and fast time constant (FTC). The receiver also contains a power supply which provides power for both the receiver and the I-F Preamplifier. Two video outputs are furnished by the receiver, one to the monitor scope and the other to the Video Amplifier Type CRP–50AJW. This amplifier is used to amplify the video signals from the radar receiver. The amplifier contains two range scope video amplifiers, three PPI video amplifiers, ship's head marker multivibrator circuits, five video cathode follower stages providing five individual outputs to PPI units, and facilities for mixing IFF video or range marks with the PPI video. The amplifier unit contains its own power supply.

An Echo Box Type CAY–14ABS is provided to measure the output frequency and relative power of the radar transmitter. It also provides a signal for tuning the receiver system. When using the echo box in conjunction with the directional coupler a check may be made of the efficiency of the transmitting and receiving system independent of the waveguide and antenna. If it is desired to check the entire transmitting and receiving system (including the waveguide and antenna), a dipole antenna is provided for mounting on the antenna assembly. This is the Echo Box Antenna Type CAY–66ALO and when used is connected directly to the echo box by a coaxial cable.

The Radar Set Control C–490/SPS–6 provides a central location for various controls of the system. The unit contains remote control of a-c power, radiation, receiver gain, and receiver tuning. Antenna rotation control in either SERVO (hand train), 5 or 15 rpm or EMERGENCY 10 rpm is available on the Radar Set Control. In addition, control of special circuits such as STC, HVP, FTC, and narrow-band long pulse (NLP) or wide-band short pulse (WSP) is provided on the control unit.

Antenna Control C–491/SPS–6 is composed of two separate units built on one frame, the Electronic Control Amplifier and the Antenna Control Unit. The Electronic Control Amplifier contains the electrical circuits to produce d-c power for driving the antenna drive motor when operating in SERVO, HIGH SPEED (15 rpm) or LOW SPEED (5 rpm). The Antenna Control Unit furnishes the d-c power for the antenna drive motor when operating in the EMERGENCY speed (10 rpm) position. A full wave vacuum tube rectifier provides field current and voltage for all conditions of antenna rotation. When in SERVO-, HIGH, or LOW rotation, armature current is provided through a thyratron control system. When operating in EMERGENCY speed, a dry disc rectifier supplies the armature current at a constant rate to produce the desired 10 rpm.

The Antenna Mounting AB–146/SPS–6 contains a ½-horsepower d-c antenna drive motor and associated gearing for rotation of the antenna. The antenna mounting also contains a synchro generator which repeats back the degree of train of the antenna. The waveguide from the radar transmitter is coupled to the coaxial line in the base of the antenna mounting. This coaxial line

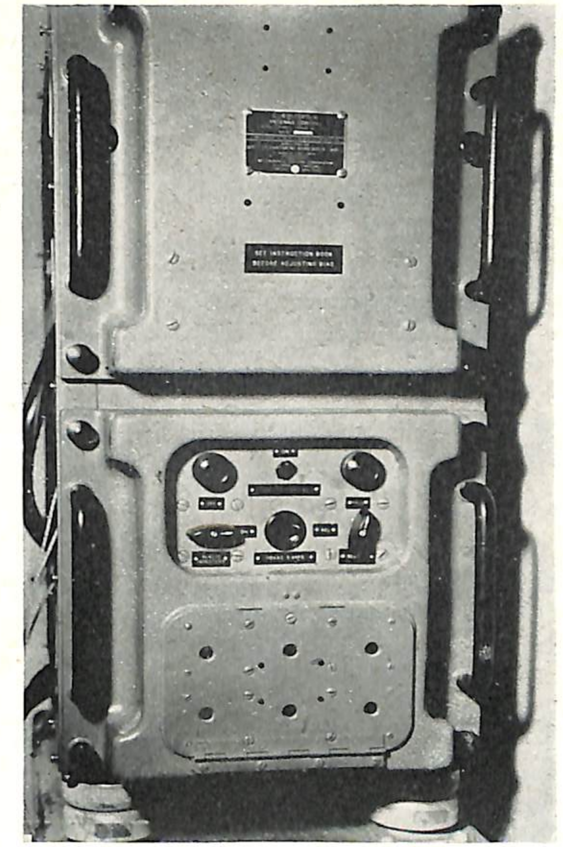


FIGURE 4—Antenna Control C–491/SPS–6 used with the AN/SPS–6 series radars.

passes up through the antenna mounting in a rotating joint where it is coupled to the feed horn waveguide at the top of the antenna mounting. The use of a coaxial line permits a more simple type of construction since it is also necessary to bring the IFF transmission line up through the center of the antenna housing. This is accomplished by making the radar coaxial cable large enough to permit passing the IFF coaxial cable through the center of the inner conductor. The Antenna AS–402/SPS–6 is mounted on the antenna mounting. Heater elements and associated wiring and thermal switches are enclosed in the gear housing.

The Antenna Type AS–402/SPS–6 consists of a horn radiator and a paraboloidal reflecting surface. The vertical beam width is 10 degrees and the horizontal beam width is 3.3 degrees. The entire antenna is constructed of stainless steel with a tubular steel frame braced with steel channel members. The reflecting surface is made of wire mesh with mesh size 1.25″ by 2″.

The Waveguide Connector COG–14ACL or CHG–14ACL facilitates the monitoring of transmitted energy for test purposes. The echo box and the standing wave indicator circuits are connected to the directional coupler and the traveling probe respectively (both units of the waveguide connector) through coaxial cables. The traveling probe also contains a cable connector which

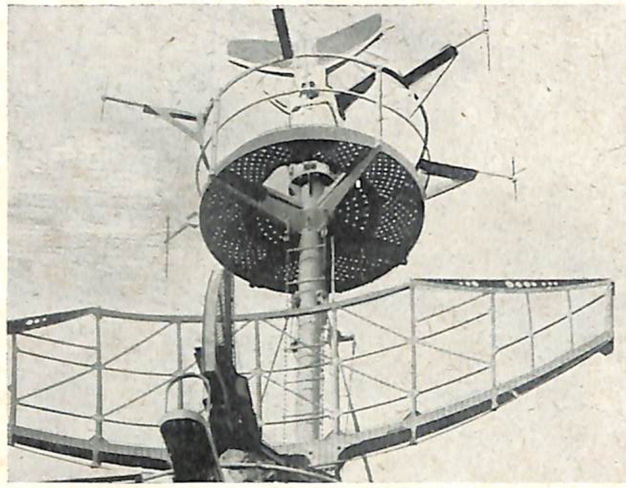


FIGURE 5—Front view of the Type AS–402/SPS–6 Antenna used with the AN/SPS–6 radar.

provides a means of obtaining an output from the waveguide for pulse analysis. Another feature in the waveguide assembly is a matching section which permits reducing mismatch in the r-f section as frequency is changed across the band.

Extensive operational and material evaluation of the AN/SPS–6 has recently been completed by the Operational Development Force, from whose report this article has been prepared. The AN/SPS–6 under evaluation was installed in the *USS Macon* (*ECA–132*). The report, in general, concludes that the radar fulfills design characteristics but does not provide adequate information for the control of high speed, high altitude aircraft. However the coverage on low altitude targets is excellent in the case of conventional aircraft and fair in the case of jet type aircraft. It further concludes that the equipment can be used for surface tracking or navigation provided receiver gain is lowered in order to reduce scope clutter which precludes its use for air search simultaneously. Results obtained over the period of the evaluation indicated the equipment was very susceptible to low altitude trapping, which would adversely affect high altitude coverage.

Two other undesirable features brought out during the evaluation were the presence of so-called "phantom echoes" and the difficulty in obtaining ring time. The "phantom echoes" appeared at random ranges and bearings and were present even when the sea was perfectly smooth and the sky was cloudless. Under these circumstances, the echoes can possibly be attributed to atmospheric turbulences sufficient in intensity to cause a reradiation of energy resulting in the appearance of an echo on the scope. Ring time was found to be impossible to take when the ship was in port due to landlocking. The recommended procedure for taking ring time was to set the local sensitivity control on position "60" (scale calibrated from 0 to 100) and read ring time at that sensitivity setting. When the control was placed on "60", the A-scope presented a solid land-return echo and ring time was impossible to take. Therefore all ring time readings must be taken after the ship clears port.

Radar equipments AN/SPS–6A and AN/SPS–6B are identical to the AN/SPS–6 except for the vertical coverage pattern of the antenna. The AN/SPS–6A and AN/SPS–6B have a cosecant-squared vertical pattern up to 20 degrees and 30 degrees respectively. Both of these equipments are now undergoing operational evaluation by the Operational Development Force and a complete report on each of these evaluations will be forthcoming at a later date.

Preliminary analysis of the AN/SPS–6A and AN/SPS–6B radar evaluations indicates that both equipments are suitable for detection and tracking of jet type aircraft at altitudes up to 40,000 feet (maximum altitude tested) and out to average maximum range of 60 miles plus. Minimum range is largely determined by the amount of clutter as well as the limitations of vertical beam width.

Two-plane sections of modern aircraft were used as the target for the evaluation of the AN/SPS–6A and AN/SPS–6B, making opening and closing runs at 400 knots (target air speed). A satisfactory blip-scan ratio was obtained at altitudes above 30,000 feet. Many instances of severe surface trapping adversely affected air coverage. During this condition, land or large ships were detected at ranges up to approximately 200 miles.

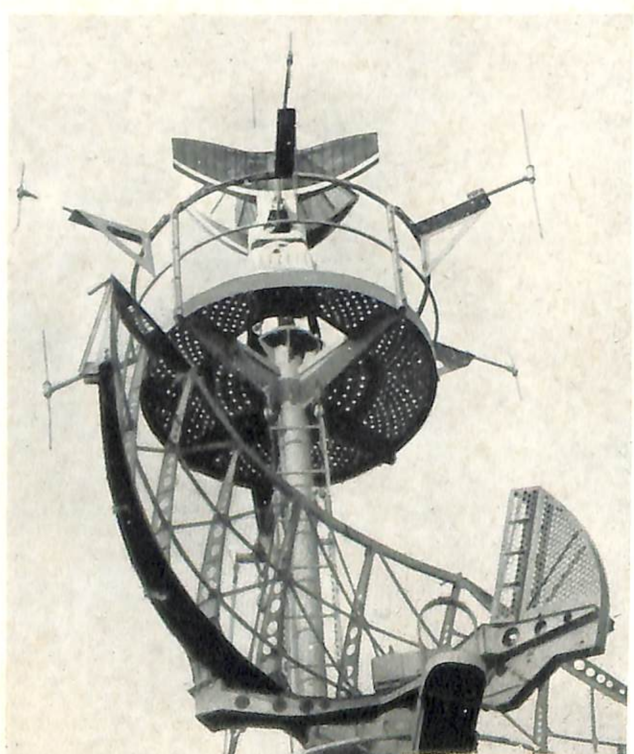


FIGURE 6—Side view of the Type AS–402/SPS–6 Antenna used with the AN/SPS–6 radar.

Echelon MAINTENANCE

for the persistent problem of electronics maintenance, another solution is suggested

by

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BUSHIPS ELECTRON magazine for December, 1949, carried an article by LCdr. Sherwin which reasserted the doctrine of unit self-sufficiency in electronics maintenance and described the responsibilities of a shipboard Electronics Officer therein. The article described what administrative policies ought to be, especially as concerned training and organization of radar operators in assisting ships ET's in the maintenance problem. In the February issue of ELECTRON, LCdr. Scott described the general procedures and some of the facilities required to carry out LCdr Sherwin's preachment. Following this article, BuShips invited opinions on the subject.

First off, what IS electronics maintenance? Basically, it is a logistic service performed by experts in support of operations. Extension of this definition to particulars naturally will be influenced by viewpoint and interest. Subjectively, and from the operational viewpoint, equipment has been maintained when it will perform satisfactorily when needed. Subjectively, and from the technical services viewpoint, equipment has been maintained when a systematic schedule of maintenance procedures has been effectively carried out as a result of which the equipment will function in accordance with performance specifications during operational periods. Quality of interest in, and knowledge of maintenance policies and procedures will determine to what extent maintenance is achieved within the bounds of available services. Here we see that the greater the interest and knowledge of technical personnel, the better the maintenance, and the better the maintenance, the less the interest on the part of operational personnel in maintenance. The end—reliable performance—is the same from either viewpoint, but interest in the means to that end is direct from the technical viewpoint and inversely proportional from the operational.

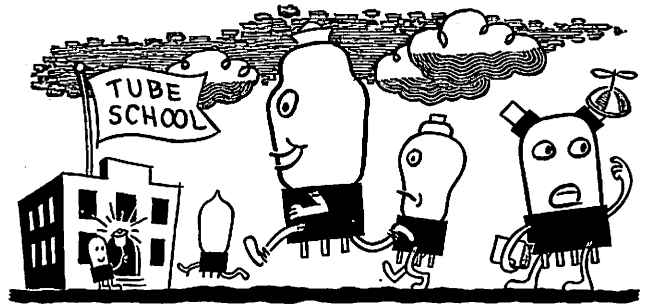
Now as to the objective definition of electronics maintenance: It does not consist entirely of dusting, wiping, contact "cleaning," lug tightening, and bright-work shining. It does consist in: (a) regular use and/or full and complete periodic operational tests to establish readiness; (b) functional evaluations embodied in power tests, sensitivity tests, calibration, non-operational adjustments, and other prescribed qualitative and quantitative performance measurements and evaluations; (c) replacements and repairs required in the replacement of aged, deteriorated, or defective parts and replenishment of lubricants, coolants, filters, and other consumables; (d) repairs incident to parts failures or equipment damage during operations; (f) policing and protection of insulation or conduction, as the case may be, by the removal of dust, lint, conductive or nonconductive deposits or fluids, and the protection of equipment from the accumulation of such substances, or from man-made hazards.

In the foregoing description repair appears as a subordinate part of maintenance. Repairs can occur during times when the equipment is required for operational purposes or before or after these times. In the first case repairs are "emergency", in the latter they are corrective or preventive as they fall before or after requirement for use. In all cases repair consists in the location and identification of malfunctioning parts and their replacement or the correction of their malfunction in place.

Presuming the foregoing to be sufficient description of maintenance and repair and agreeing that the end is reliable equipment performance, we need next to determine the best means and methods to that end. History ought to be consulted before theory is derived. What then is the history of electronics maintenance in the Navy?

When electronics was first introduced into the Navy in the form of "radio" apparatus, it naturally fell to the lot of electrician's mates to install it and to maintain it. (See Page 2 of the ELECTRON for November, 1949). Radio operators (telegraphers) were recruited from civil employment, others were trained by the "striker" method and some electrician's mates became self-taught operators. As late as 1923 it was still usual to see the "sparks" insignia stitched on the sleeve below the electrician's mate rating badge. Up until the first World War, however, there were specialists in material and others who only knew how to operate it.

In the post World War I period the Navy was faced by the same personnel shortage problems as now. The same solution of the maintenance problem as that proposed by LCdr Sherwin was attempted then. Operators had to qualify in maintenance before they could be advanced in rating. Operators *were* the technicians. Technical training for their full qualification was attempted on board ship but was of such limited success that the necessity for a special school became obvious. To meet this need the Radio Material School—Tube School, so



called—was established at the Naval Research Laboratory, Bellevue, D. C. Graduation from this school was a requirement for advancement to Chief Radioman. The tendency remained, however, even after graduation from this school, to classify radiomen unofficially as an operator or as a material man. During this period shipboard electronic equipment was much simpler in design and considerably less in amount. Even so, it took, on an average, not less than six years to turn out a Chief Radioman who could operate and maintain radio equipment.

What happened in the past War? In the early stages ships in commission had much new and complex equipment installed on a "crash" basis. New construction came equipped with far more items than ever before. The need for technical services mounted rapidly. The time required to train the operator versus the technician differed so greatly that the basic rating of Radioman was split by the creation of Electronics Technicians, Radarmen, and Sonarmen. Operators of equipment were quickly and relatively easily provided, but special cases aside, there were never enough electronics technicians of proper qualification to fill the general need fully. We produced enough electronic equipment to meet operational needs, with few exceptions. It was (and remains) essential that equipment be periodically serviced by competent technicians. Within the necessary time limits we couldn't produce enough technicians to allot each operational unit sufficient technicians to perform this maintenance, even after the appearance of Electronics Officers.

Something had to give. It did. It was the doctrine of "a complete unit self-sufficient", as applied to electronics maintenance. There appeared on the scene Manufacturer's Field Representatives (engineers), Electronics Field Service Groups, and finally, Electronics Repair Ships.

For those who have never heard of them, Electronics Repair Ships were of the tender class. Their mission was to provide the electronics logistic support services which ships could no longer adequately provide for themselves. These ships had shop facilities approaching Naval shipyard capabilities, a full inventory of repair parts, plus minor and major equipment components, and repair teams for special services to individual ships. The need for these ships became so urgent that it was necessary for ComServPac to make the first one on the spot, by having his own forces convert an LST into an Electronics Repair Ship. The word finally got passed. When the war was over at least six Electronics Repair Ships had been legislated and three or four were actually produced and commissioned. Two saw service in the Cross Roads Operation. All are now in moth balls or otherwise disposed of. Their brief existence as well as the supplementary services of Electronics Field Service Groups and Manufacturer's Field Representatives acting as repairmen demonstrated the war time need for outside electronics logistic support services.

Just what are logistics or logistic services?

A sufficient general definition is that logistics or logistic services provide and maintain the essential means of military enterprise; that is, basically trained personnel, materials and equipment, and professional and technical services in support. Command employs these means in areas of operations. Operations are exclusive when they occur in areas and during missions where the operating agency is detached from logistics support facilities proper. Such actions as air strikes, surface and submarine strikes, and combat patrols and scouting missions into uncontrolled areas fall into this class. For the sake of brevity we can say that if logistics are exclusive, it will be in the field extending beyond base facilities and towards source. Where operations are exclusive, operating agencies necessarily must be self-supporting logistically. In the case of electronics each operational unit must provide such logistic self-support as is required for certain operational periods. This self-support must be closely coordinated and integrated with command.

The nature of employment of Naval operating units in their elements requires that they be independent of their base support as long as possible, but only so long as exclusive provision for such independence does not impair their battle efficiency. Operations tend to be most successful when command is least burdened with concern in matters of support.

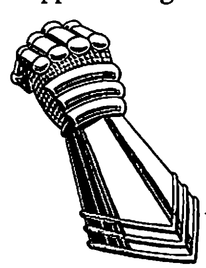
The next question is how much logistic self-support, under war conditions, should each operational unit be required to provide in order to remain operational for essential periods without impairing battle efficiency? If we answer the question by saying that such units must provide the required amount we have only beggared the question. The correct answer is not that easy. First, the amount of self-support a unit needs while operating should, for the sake of operational freedom, be reduced to a minimum by thorough planning. Secondly, to reduce the inhibition of operations, the necessary means of self-support must be as closely integrated into the operational organization of the unit as function will allow. On the other hand such technical and organizational exclusiveness as maintenance requires for efficient and effective accomplishment must be insured. Electronics Officers, Electronics Technicians, and electronics workshops are the realizations of the needs for technical expertness and organizational exclusiveness.

Next comes the problem of integration into the operational organization of the unit. Navy Regulations require Electronics Maintenance to be administered in the Engineering Department. By special arrangement several cruisers and destroyers have placed Electronics in the Operations Department, presumably on the theory that the Operations Officer, having the preponderant interest in the use of non-gunnery electronic equipment, is best suited by that interest to exercise control of electronics maintenance. Shipboard Electronics Maintenance was placed in the Engineering Department on the grounds that Engineering Officers would be better qualified by background and by associate duties to administer it. As it turns out, in either case, the nature of electronics maintenance is so technical that an officer, presumably expert, must be delegated to act for the Engineer Officer or the Operations Officer as the case may be. The question further resolves itself into whether the Operations Officer, with less technical knowledge but with the preponderant direct interest in the use of the equipment, is better qualified to administer shipboard electronics maintenance through a technical assistant than is the Engineer Officer with a better technical background but with vicarious interest in the use of the equipment. If interest is sufficient, the Engineer Officer would be the obvious choice. To assume his interest is insufficient to his responsibilities puts an onus on him gratuitously. In cases where interest is insufficient, it can be generated within the command. The responsibility for electronics maintenance ought to be in the Engineering Department.

As regards the use of Radarmen, Sonarmen, and Radiomen in the maintenance program, BuPers requirements for advancement in rating calls for abilities to make simple routine tests and adjustments (as distinguished from electronics maintenance and repair); follow check-off lists, lubricate and make minor repairs on equipment to which assigned. In addition, Radiomen are required to perform simple emergency repairs, adjust, calibrate, and perform upkeep. Just what upkeep implies is not specified. The extent to which equipment operators will be able to carry out these supplementary maintenance services will depend on their knowledge of the physics of electricity and the functional aspects of their equipment, and the sufficiency of their instruction, training, and direction. Some of this knowledge and training they will get in the basic phases of their training. Most of it, however, under present circumstances, must be provided on board ship. The question arises as to whether or not completion of the Treasure Island Course for Electronics Officers, or even that at the Massachusetts Institute of Technology, provides the average young line officer with the necessary background to be, at one and the same time, a student, a teacher, and an administrator. That is what he has got to be under the present circumstances on board a destroyer.

Doubtless, if LCdr Sherwin's hypothetical Ensign Phreshcaught were allowed to occupy himself principally at the specialty of electronics maintenance, and was provided with a modest number of ET's and equipment operators who were all to remain in the ship for as long as two years, he could, by diligence and attentiveness, educate, train, and organize the Radarmen, Radiomen, and Sonarmen into a supplementary service group, which acting in assistance to the regular ET service group would enable him to achieve a satisfactory condition of equipment operation and dependability.

It should be pointed out here that the articles by LCdr. Sherwin and LCdr. Scott were oriented to the small ship problem and from the Operations Officer's viewpoint. They were offered as a practical solution to the immediate problem in these types. Under present circumstances they offer the most practical and effective method of attack. This does not mean that it is the best solution nor the one which we should support as a general and long range solution. History shows us that complete unit self-sufficiency in electronics maintenance, however desirable and however nearly we achieve it in peace time, will not serve our purpose in war time. That is our objective: war readiness. Nothing less.



One of the most fundamental of our doctrines calls for maintaining our organization in peace time so that a minimum of change will be required in going from a peace to a war condition. What must we do then? Drag those six Electronics Repair Ships out of moth balls, transfer all available ET's to them, and send them tagging along as an electronics service convoy for all our operating forces? No. Let them stay where they are. Sell them. Then, while we do the very best we can with what we have got under current maintenance doctrines, let's start all over again from scratch and make a plan for the future, implementing it as we get the wherewithal.

Number one: Guided by such principles for the establishment of Military Characteristics of Electronic Equipments as are embodied in the Joint Communication-Electronics Committees' JCEC 413/5, of 16 December, 1949, plan a completely new equipment production program, the object of which is to supply the electronic equipment needs of the three armed services:

1—With as few models as possible, but with as many unique equipments as need for which can be visualized;

2—All equipments to require in fabrication a maximum of parts of common and of standard specification and a minimum of those of peculiar specification;

3—Designed in standard functional and shape modulae, where feasible;

4—Further designed so as to facilitate component, unit or system replacement such as is now the case in aircraft equipment installations;

5—Utilizing to a maximum the advantages of miniaturized parts;

6—Engineered for the greatest facility in unit or component replacement servicing.

Number two: Establish an echelon system of maintenance responsibility, which will most relieve command of the necessity of being interested in maintenance. This system should require:

1—Operators to perform only such equipment maintenance as can be taught coincidentally with their instruction and training *as operators.*

2—Only minor specified repairs to be made in ships, mobile units or in advanced field units, and those by junior technicians.

3—Equipment failures of greater than minor repair implication to be rectified by component, unit, and where necessary, by system replacement from spares. (Electronic Repair Ships, some large mobile units and supporting advanced bases would carry extensive stock of spares. Space limitations and other considerations would diminish the amount of spares carried in smaller ship types and units.)

4—Preventive maintenance be carried out by scheduled equipment exchange.

Number three: Design Electronic Repair Ships to perform the same mission as that planned for those now in moth balls, but engineered from the keel up so as to suit them best for their primary purpose. Base Electronic Support Units should be designed on the same principles. Such ships or units should have adequate quarters and "house-keeping" facilities for shop force, field service groups, repair teams, and of course for the crews of repair ships. They should be provided with adequate servicing equipment, tools, raw stock and comprehensive stock of parts common and parts peculiar. There should be well designed shops and test laboratories. Finally, there should be a pool of proven components, units and systems, in which all equipment types for which the Repair Ships or Support Units are responsible, will be represented.

Number four: Tailor an Electronics Officer and an ET training program to suit the new maintenance system as it comes into effect.

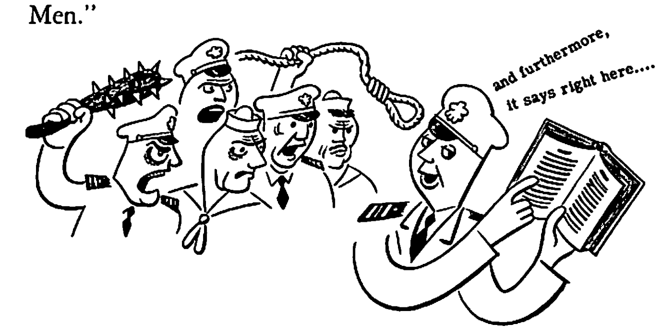
That generally is what I think we ought to do. And it goes down on paper very easily. Those who have served in the Navy Department-Pentagon region within the past three or four years will recognize that several aspects of this proposal already exist in embryonic form, and should be aware that the principle of the many objections which will be forthcoming is: *dollars.* Pulling a figure out of the hat, say a billion a piece for each service for a complete conversion, that is: redesign, prototype production and evaluation, program production and replacement. The second objection will be the lowering of over-all materiel adequacy and performance during the change-over period, probably of not less than six years. Would it be lowered? How low is it now? and so on. But the most dogging objection will be dollars. It takes no intellectual giant to know that the tail of domestic politics wags the dog of military planning in peace time.

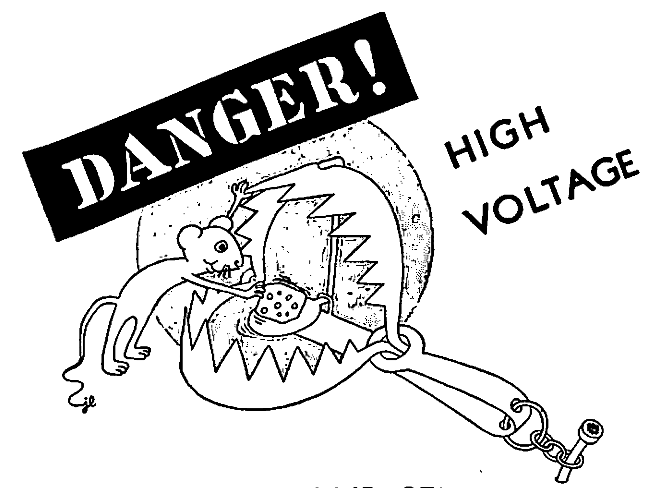
Suppose we agree that electronic unit self sufficiency is feasible only in peace time and that echelon maintenance is our best war time answer, but that we cannot afford it excepting in war time? Whatever our answer to this twister it is obvious that we must do the best we can with what we have. The scheme for utilizing operators for maintenance will have to be used for what it is worth to the fullest. In addition it should be recognized that operators who show aptitude and interest in the technical aspects of their equipment are a valuable source from which to draw Electronics Technicians. Effort should be made to enable such operators to become Technicians. In addition to the practices we must carry out now, the prudent and forehanded thing to do is to commence immediate planning, on separate, joint and combined levels, as necessary, to convert our electronics situation into one most nearly equal in outline and substance to that which we can expect it to develop into if the general situation should rapidly change from peace to war. What that situation will be is fairly clearly indicated by what it was tending towards at the close of the past war.

Operations—or command—must be relieved as much as possible from the necessity of being interested directly in electronics maintenance.

The implications of electronics and its new and giant-like cohort, nucleonics, being what they are, we cannot afford to rely on a system of maintenance which has already proved inadequate in war time to the extent that it had to be shored up by Field Service Groups, Manufacturers' Field Representatives acting as repairmen and finally, however belatedly, Electronics Repair Ships.

Before those readers who most strongly oppose "Echelon Maintenance" commence to tear me limb from figurative limb I recommend that they read, "The Foundations of Future Navy Planning," by Vice Admiral Carney in the October, 1949, issue of the U. S. Naval War College Information Service Pamphlet and also Dr. Vannever Bush's recent book "Modern Arms and Free Men."





MODEL QHB SERIES

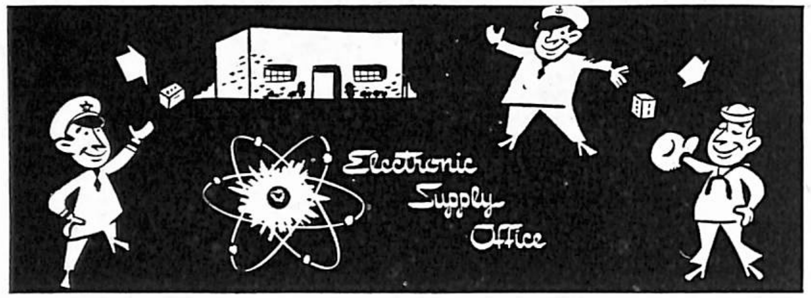
One repair activity has reported that the capacitor shorting switch S–707 in the Sonar Receiver-Transmitter CAN–43073 is failing to close when the lower door is opened, thereby leaving the capacitors C–796, C–797, C–798 and C-799 fully charged at 3700 volts d.c.

This is a very serious failure, which could result in loss of life.

All personnel working on Model QHB series sonar equipment are warned to exercise extreme caution whenever the door to this unit is open.

It is suggested all shorting switches S–707 be examined to determine whether they are positive shorting.

The Bureau of Ships plans to issue a field change in the near future to correct this condition. Until the field change is accomplished, all personnel must be cautioned to examine visually the capacitor shorting switches each time the lower door is opened. Where capacitors have not been discharged by switch action make certain that capacitors are discharged by using a heavily-insulated shorting bar. After shorting, attach a ground lead from the positive side of the capacitors to ground prior to working on the equipment.



E.S.O.

A COMMON LANGUAGE

Electronics technicians have their own terminology for the maintenance repair parts which they requisition. Very frequently, the item names they use are considerably different from those which are listed in supply catalogs.

Sometimes the situation seems to get out of control. Why is inverse nomenclature used, for example, *"resistor, fixed"* instead of fixed resistor? Why do very similar items receive entirely different names, such as *"signal generator"* as compared to *"calibrator, frequency"*?

The subject is quite extensive. This article does not assume to answer all questions which may arise, but is intended to present a few clues to the problems of supply cataloging.

Some of the objectives of supply cataloging methods are to classify items of supply so they can be readily located and compared, to eliminate duplication in storage through proper nomenclature, to provide a means of describing materials for supply management, and to differentiate among different items of supply.

The item name is the first step in establishing item identification. The name is defined to include a specific range of items which have comparable characteristics and can be described by an applicable description pattern.

The concept of an item name usually consists of two or three parts, consisting of a basic name and one or two modifiers. The basic name covers a broad grouping of items which have some principal characteristics in common. *"Resistor"* is an example of a basic name.

In order to have more closely related items brought together for comparison by a single descriptive pattern, further modification is necessary. *"Resistor, fixed"* and *"resistor, variable"* are examples of more descriptive names of items each having closely related characteristics. It is apparent that the order of nomenclature is from the general term toward more specific ones. By using the basic name and the inverse order, all similarly defined items are brought together for cataloging. If the straightforward order of names were used, items having the same basic concept would be distributed at random through the catalog.

Exceptions are made for commonly accepted names which do not conform to the defined character of the basic name by using the straightforward order. *"Signal generator"* is an example of this. This item does not conform to the usually accepted "supply catalog" definition of "generator."

The reason the *"signal generator* and *"calibrator, frequency"* do not receive the same item name is that supply management finds it necessary to differentiate between them. To do so requires an arbitrary delimitation of the type of item which will be stocked under each item name.

The problem of synonyms (e.g., shall it be an *inductor*, a *reactor*, or a *choke?*) also creates some questions which must be resolved arbitrarily after giving due consideration to commonly accepted usage in industry and in technical literature.

Functional names, such as *"isolating resistor,"* are generally avoided because the supply system does not stock circuit functions, but does store materials which are described in a way which permits their applications to be determined.

ESO'S PARTICIPATION IN THE SHIPBOARD CONVERSION PROGRAM

The Electronic Supply Office recently prepared and issued a "Plan for Shipboard Conversion," which attempted to portray the roles played by the various activities involved in the Program and to explain the steps usually taken in effecting a Shipboard Conversion.

The Bureau is furnishing shipboard allowance lists to this office and to the converting activity approximately 60 days prior to the conversion deadline date. Upon receipt of these lists, ESO directs a shipment of material shown as not on hand at the converting activity. This procedure assures that a great percentage of material needed for conversion will be available at the converting activity before changeover actually begins.

The converting activity issues items available from stock, marking allowance lists accordingly. ESO Shipment Orders also are posted to the allowance list to record the item as due. When the vessel arrives, ships spares are off-loaded and screened to supply deficiency

MONTHLY COLUMN

items. When possible, this screening is usually accomplished by ships personnel with the aid of technical and supply personnel from the converting activity, if such personnel are available.

All assembled material is then placed aboard the vessel bins provided for that purpose. Any deficiency items remaining in the allowance list are requisitioned through the normal echelons of supply by the converting activity.

General suggestions, as they pertain to the supply phase of the above listed operations, are contained in the ESO Plan. Copies of this plan are furnished to all converting activities as electronic repair parts changeover schedules occur. Activities desiring copies of the conversion plan may obtain them by forwarding a request to the Electronic Supply Office, Stock Control Division, Attention Code 52.

To date, about 33 submarines either have been completed or are in the process of conversion. This includes two submarine tenders. About 20 destroyers and DDE's have been completed or are in process.

CHANGE!

There have been many times when you, as electronics technicians doing repair work, have submitted requests for material needed to meet scheduled overhauls, installations and repair work. It is believed that, in most instances, you have received that material in an expeditious manner through your local Supply Officer who has made your needs known to the Electronic Supply System. However, at time you may have requested certain materials not immediately available within the System, necessitating procurement action by the Electronic Supply Office. This procurement action is facilitated as rapidly as possible.

Your deadline date represents the urgency you feel is justified. Experience has shown that in some cases, however, deadline dates cannot be met. In such instances, certain other actions have been taken by you to alleviate the condition which prompted your original request. If, as a result, you determine that the item requested will be of no value to you when ultimately received, it is suggested that you advise your Supply Officer to cancel his material request. Such information, of course, will be relayed to the Electronic Supply Officer and records cleared on the way.

This does not necessarily mean that the Electronic Supply Office will cancel procurement action. Electronics technicians assigned to ESO will review the item and may determine that stocks should be carried in the System to insure that an immediate supply of material will be available when requests are submitted, so that future deadline dates can be met. How much better is this, than for you to get material you no longer need, when it could be used more profitably by the System as a whole by stocking it in an activity making regular inventory reports to the Electronic Supply Office. Why not review your records for such instances and help yourself as well as your fellow technicians at other ships and shore stations!

GOLD PILES

If the consumer is to get a part when he needs it, the Supply System must know what material he is using and what identical material it has available in its system.

The evidence of this fact was clearly demonstrated by the "gold pile" situation existing at the end of the war, during which Industrial Managers retained in shop stores expendable material not reported to or under the custody of an accountable Supply Officer.

Consternation was caused when these shop stores stocks were depleted and it was found that no back up stocks were on hand within the Supply Department for continuing requirements of Industrial Managers because, in most cases, the Supply Officer would have had no available knowledge of the material used, issued, and withdrawn for shop stores. Without this data, the Supply System was in no position to provide adequately continuing support by stock replenishment in accordance with the ship or station's actual requirements.

Come to think of it—we wonder if there are still a few little "gold piles" sitting around!

TELETYPE PUNCH BLOCK BANK

Perhaps you'll never break the bank at Monte Carlo, Bub, but you can gain ready access to the Navy's Teletype Punch Block Bank.

All you have to do is to send in a request for punch blocks for teletype equipment, and, whenever the worn punch blocks are in a condition suitable for regrinding, the Supply Officer at the nearest stocking activity will forward the old blocks to the Inspector of Naval Material located at the Teletype Corporation, Chicago. Just let the Supply Officer know the number and type of blocks being turned in and the number and type desired for replacement.

As a result of this Punch Block Bank, the Navy avoids purchasing new blocks whenever it is possible to regrind the worn ones. So don't be surprised if you break the Teletype Punch Block Bank and receive a shipment of reground blocks in return! They're just as good as new, and cost less!

Common SO/-a/-1/-8 RADAR TROUBLES

Modulator Generator

The most common trouble encountered in the modulator generator unit is in the electronic voltage regulator circuit. Complete lack of regulation, poor regulation and incorrect value of output voltage have frequently been noted. Sometimes these faults go unnoticed for long periods of time because the personnel do not know what proper indications of good regulation are. When power is first applied to the radar, the voltage should rise immediately to 105 volts as indicated on the voltmeter on the auxiliary control unit. After a 45-second time delay, the voltage should jump to the normal 115 volts indicated by a red line on the meter. If this sequence does not occur, there is trouble in the regulator circuit.

Normal indications at the regulator unit follow a definite sequence also. When power is first applied, the filaments of V–101, V–102 and V–103 will start to heat. When V–102 reaches the point where it will conduct, the neon bulb V–105 will glow. After the 45-second time delay, relay K–110 will close and a purple haze will appear in V–103.

Most common component failures preventing this normal sequence are vacuum tube failures, intermittent operation or opening of R–167, failure of K–110 to operate, aged or defective neon bulb V–105 and a defective contact in the regulator field brushes.

It has been noted that a good percentage of Navy ships do not have a copy of field change bulletin Number 117 covering the changes made in the regulator by Field Change Number 82–A. This bulletin is the only source of regulator alignment procedure and should be incorporated in the instruction book for the equipment in use.

The poor brush contact mentioned above is also a source of trouble to units other than the regulator. These brushes are difficult to get to and are frequently passed up in preventive maintenance schedules. If the modulator generator unit is located in a more or less exposed place, the brush holder assembly tends to accumulate rust deposits that freeze the brush in the holder, keeping it from riding on the slip rings. Lubrication of the brush holders at frequent intervals with a rust preventive oil or light coating of grease will keep the brushes free and in good contact with the slip rings. Care must be taken to prevent oil or grease from dripping down into the windings of the generator or on the slip rings themselves.

A great many technicians carry on routine greasing of the modulator generator unit without ever thinking where the grease they are pumping in is going. In each bearing housing there is a relief plug which, when removed lets the old dirty grease flow out when the new grease is forced in. If lubrication is carried out without removing this plug, the lubricant is forced through the bearing seals into the windings of the fields or armature. Over a period of time this can cause a great deal of damage to the unit. Always remember to remove the relief plugs when lubricating any piece of rotating machinery.

Indicator Unit

Aside from tube failures, there have been very few consistent failures noticed in the indicator unit. Loose cursor dials, however, have been seen occasionally. This, in conjunction with an off-center sweep on the PPI will give extremely inaccurate and erratic bearings. Sweep centering procedure and cursor dial adjustment are covered in the instruction books and should be made as accurately as possible to give good bearings. Sweep centering adjustments should particularly be made after changing the PPI tube.

In some SO radar indicators unauthorized field changes have been made to provide a 2-mile range. Some of these have even been left in when the authorized Field Change Number 100 was installed. To check for this unauthorized change, throw the ON-OFF switch in the upper left-hand corner of the indicator panel. If the sweep length changes, this modification is present. These changes have been made in different ways so care must be taken in removing them. Usually there are two wires run from the ON-OFF switch to the large register under F–401 or the top of the indicator chassis. Check the circuit before removing any wires.

Transmitter-Receiver Unit

Failure of the waveguide shutter solenoid E–303 is quite common. Check the solenoid for burned sections and overheating. If it is defective, replace it. Do not tie the shutter open if it does not operate. This will result in damage to the receiver.

When measuring current in the receiver, be sure to use a test prod of small enough diameter to prevent spreading the contacts inside J–302. If broken, this jack is difficult to replace. Also, good contact of the center conductor must be maintained when the shorting plug is inserted for operation after crystal current is measured.

Considerable trouble has been encountered in tuning SO radar receivers. Field Change Number 103 is now available to make tuning easier.

Antenna

Water entering the antenna accounts for a lot of troubles by causing decomposition of insulation, rust and decreasing insulation resistance in motors and selsyns. Be sure your gaskets effectively seal out all water and moisture.

General

Many technicians are not aware of the correcting device built into the SO to keep the antenna and the PPI sweep in step. Correct operation of this feature is important and should be checked along with the preventive maintenance schedule. Failure of this feature will cause no apparent difference in the radar operation, but there is a good chance that there will be a bearing error without it. Operation may be checked by removing the indicator unit from its frame and turning the large gear on the PPI assembly about 90°. Replace the unit and start the radar with the antenna rotation switch in the neutral position. When the radar has reached its operating point, rotate the antenna and watch the sweep. If the correcting feature is operating correctly the sweep will rotate to 360 degrees and stop. When the antenna reaches 360°, the PPI sweep will start again and follow the antenna. Try this check with the antenna rotating in the opposite direction just to make sure. After the initial correction the sweep should follow the antenna evenly.—*SerLant Monthly Bulletin.*

ELECTRONICS CONFERENCE—1950

The 1950 Electronics Conference, mentioned in the June 1950 ELECTRON, was held in the Bureau of Ships, May 1–5, 1950. The conference was attended by 141 officers and civilians representing Naval Shipyards, Industrial Managers, Pacific and Atlantic Fleet Commands and advanced bases such as Hawaii and Puerto Rico. Captain A. L. Becker, USN, Assistant Chief of the Bureau of Ships for Electronics was chairman of the conference and delivered the introductory speech, keynoted by the phrase "ELECTRONICS—SWORD FOR DEFENSE, PLOWSHARE FOR PEACE". Guest speakers included many prominent personalities, both military and civilian, who have direct contact with electronics problems and developments. The scope of the addresses ranged from "down-to-earth" discussions on basic fundamentals of fleet and shore electronic maintenance to a dissertation on Dr. Einstein's recently published four equations.

Many problems of common interest to all electronics personnel were presented and extensive recommendations were made to cope with these problems. Three special committees were appointed: Naval Reserve Electronics Affairs; Supply and Logistics; and Fleet Electronics Affairs. Each of these committees took under advisement all problems relevant to their particular assignment and offered recommendations for solving same. A joint presentation of the Norfolk Naval Shipyard and the Mare Island Naval Shipyard pointed out the successes achieved through application of the Special Electronics Restoration and Distribution Program (SERAD). Factual data prepared disclosed that the cost of administering the SERAD program was less than ten percent (10%) of the intial cost of the items reclaimed through this process.

Commander Hunley E. Thomas, USNR, Electronics Officer, Commander Service Force, Atlantic Fleet, delivered an address on the problems and inadequacies of shipboard electronic maintenance, pointing out the fact that a great percentage of our maintenance difficulties is due directly to a dire shortage of adequately trained electronics maintenance personnel. This address was well received and caused considerable discussion on the problems by all hands. A very interesting, though rather "high level" address was delivered by Dr. R. I. Sarbacher, President and Director of Research of the National Scientific Laboratories, Washington, D. C., on the latest four equations recently made public by Dr. Alfred Einstein. Dr. Sarbacher discussed the equations from a general standpoint and from the viewpoint of their possible future influence and effect on electronic research and development.

At the close of the conference on Friday, 5 May, it was the unanimous concensus of opinion that much valuable information had been disseminated, many problems solved and many other problems in the process of being solved. All hands departed with a greater understanding and appreciation of the difficulties encountered by Electronics Officers at other stations than their own. Without exception the conferees enthusiastically agreed that the conference was a tremendous success and that they are looking forward to the next one with extreme delight and anticipation.

DEPTH SOUNDERS . . .

TYPES, TROUBLES AND CURES

Statements have been made at various times by some ship's force technicians that they were not familiar with the depth sounding equipment on board, and thus were dependent upon the Service Force to put their units back into operation after a minor breakdown. This thinking and attitude is undesirable and the following is published to help alleviate this situation.

A depth sounder is merely a very-low-frequency transmitter-receiver combination, used in determining water depth below the keel of the ship. The readings given on the indicator will vary with the draft of the vessel and to a lesser degree, with the salinity of the water. Most quartermasters are familiar with the latter factor, so no further mention will be made of same.

One depth sounder transmitter is of the master oscillator-power amplifier type. The output is fed into an output transformer which matches the impedance of the transducer used. In some cases you will find a filter junction box between the output transformer and the transducer which isolates the transducer from any direct current in the signal line and affords a better impedance match. Transducers of the magnetostriction type consist of a series-parallel combination of coils wound on nickel tubes and insulated to prevent shorting. The nickel tubes are connected to the diaphragm of the unit which is in free contact with the sea. This provides minimum attenuation of the transmitted signal pulse. The nickel tubes are of a length which is resonant at the transmitter frequency.

The second type is found in small depth sounders such as the Model NJ series. A high voltage gas discharge tube is used as follows: First, the high voltage rectifier charges a capacitor. When the keying switches and keying tubes in the indicator recorder are triggered, a brief pulse of high voltage is discharged into the projector. The pulse is roughly tuned to the desired frequency by the combination of the capacity of the signal line, reactance of the filter and the reactance of the transducer. Although somewhat less efficient than the first type, its construction is less complicated and is easier to service except for the inaccessibility of the driver unit which can normally be found in the bilges.

Receivers used are either of the superheterodyne or TRF type. The superheterodyne type consists of two stages of r-f amplification followed by a BFO converter, to give the audio difference in frequency. From the detector the signal goes through either a video-audio channel or straight through a video amplifier to a red neon tube, located on a rotating disc or other indicating means. The signal may also be fed to a chart recorder. Most of the smaller depth sounders have no provision for audibly monitoring the returned signal, and merely operate the red light tube which flashes the outgoing pulse and the return echo.

The TRF type consists of two or three stages of broadly-tuned amplification working into a detector which serves merely to amplify the returned echo and operate a red light tube. This equipment operates on audible frequencies, usually about 14.5 kc, and therefore needs no heterodyning with a local oscillator to produce an audible note since no speaker is provided.

The mechanical variations of the different equipments vary only in their methods of accomplishing the same thing. They either feed the signal to a set of rotating styluses or control the travel and adjustment of a horizontally sweeping arm which works in synchronism with the transmitted signal. On smaller depth sounders, the keying of the transmitter-driver is accomplished by means of small microswitches located on a movable arm directly behind the rotating depth disc in the receiver-indicator. In the more elaborate types, keying is accomplished by motor driven cams which make and break keying the contacts, so mounted that they can be moved in a direction to either advance or retard the point on the indicator scale where the outgoing "zero" flash occurs. With the leading edge of the outgoing pulse set to zero, the echoes show as flashed behind the scale of the indicator disc. This will indicate the true depth of the water under the vessel. In the NMB and NMC series where it is found impossible to see the outgoing pulse flash to zero, it is usually necessary to check the keying contacts to see that they are not bent. In the smaller NJ types, it is merely necessary to rotate the keying microswitch arms behind the indicator disc in such a direction that the "zero" flash is set correctly. In the belt indicators (NMC), eccentric hold-down screws on the idler wheels and/or the adjustment of the spring tension on the one spring-loaded wheel accomplish this. It is also a cure for belts that ride up or down on the wheels and eventually rip the indicator holes or split.

While the above information may be of help to those who have had little or no instruction in this equipment, it is not as important as the following. In practically all instances where Service Force Electronics Engineers have been called, the chief complaint has been low sensitivity. This was accompanied by a constant decrease in average recorded depth and it was found that both receiving and transmitting projectors had very low "megger" readings. This is due to several faults, the most common being slow flooding of the transducer. The cause could be improper installation, developed faults in the water-tightness of the cases or condensation in the transducers over a period of time. While this fault might be expected eventually over a long period of time, a continuous check on the transducer-to-ground resistance by maintenance personnel could have uncovered the slow change in resistance readings. It cannot be too heavily stressed that if you value the dependability of your depth sounder at all, a monthly check of transducer insulation resistance is of the utmost importance.

The instruction book gives detailed information on making a resistance measurement of the transducer and an insulation test to ground. The latter should be at least a 10-megohm reading. The coil resistance is usually between 15 and 30 ohms and the instruction book should be referred to. This is of value in locating a short or open in the windings. Although seldom encountered, it could possibly be the trouble rather than a short to ground. Many equipments have filter junction boxes in which high voltage capacitors are in series with the projector leads. In this case it will be necessary for maintenance personnel to open the box, located in the same bilge space as the transducers, and megger the transducers directly on the lines coming up from them. It is worthwhile to check the capacitors with the megger as well, since in several instances high resistance shorts were discovered. In other equipments the leads may be located conveniently in the receiver-indicator for the receiver transducer, and in the driver-rectifier (located in the bilge) for leads to the transmitter transducer. Make sure the leads you are checking lead directly to the transducer under test, and not through or across capacitors, transformers or other circuits which might introduce sneak circuits and make the resistance readings useless and completely misleading. A thorough check with the instruction book will prevent this. If a proper maintenance program is established as specified by existing BuShips and Fleet doctrines, and you faithfully follow instructions contained in the equipment instruction books, your depth sounder will perform a valuable service for your ship. It is up to you as a technician to let it do what it is capable of doing.—*SerLant Monthly Bulletin.*

CABLE FAILURES IN ROTATING STRUCTURES

The following maintenance note on cable failures is printed for general information:

Multiple conductor cables such as MHFF and MCOP supplied to the Navy prior to 1945 were of the so-called "conventional" type. The wires in this type were layed so that each layer spiraled in opposite direction to the next layer. It has been found that wherever this cable has been used in a gun mount or director mount where twisting is necessary, one layer of wire becomes slack while the next layer tightens as the cable is twisted by the rotating structure. The result is kinking and subsequent breaking of the wires. This type of cable is now in disfavor. The approved type of cable is known as "UNILAY" cable. All layers in this cable spiral in the same direction and have no wires in the center. A center core of hemp (rope) is used instead. The "conventional" cable starts its wires in the center. The external, or physical, appearance of the two types of cable is similar. A cross sectional view provides an easy identification, the hemp core of the UNILAY being the basic difference.—Western Electric Co. *Newsletter.*

AN/ARC-1 ROLLER COIL TIE RODS

It is no longer necessary to remove and disassemble the entire roller-coil assembly in the AN/ARC-1 in order to replace a broken roller-coil tie rod. The following method of repair may be accomplished with the roller-coil in place.

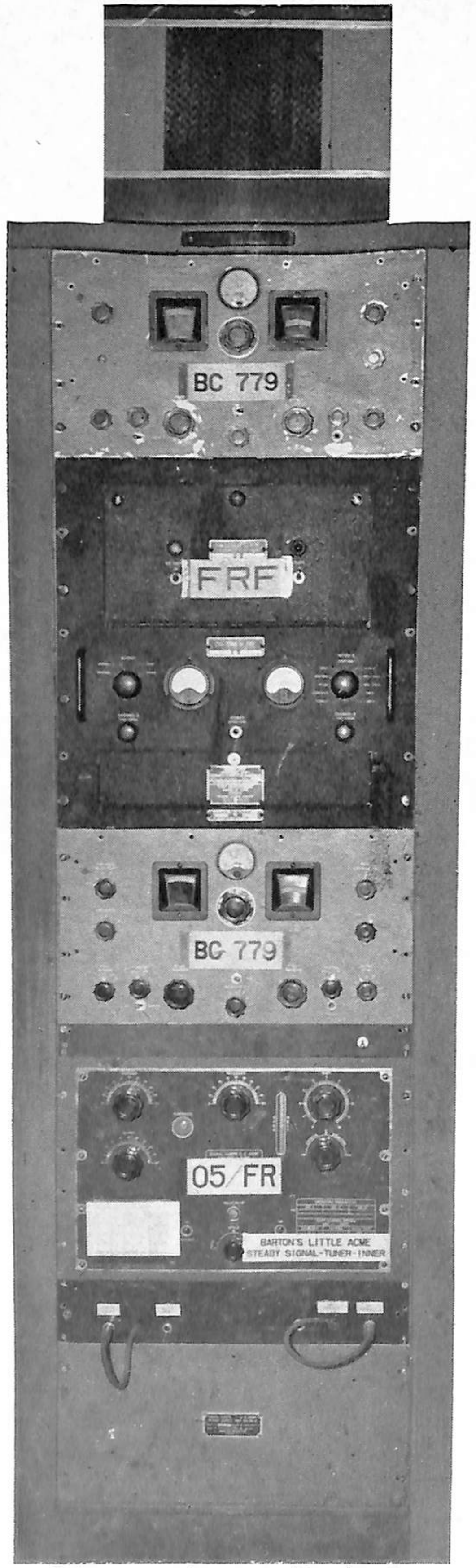
1—Note the position of the roller-coil trolley wheels so they may be reset if accidentally displaced.

2—Remove the nuts securing the broken tie rod in place, saving the flat washers and lock washers for reuse. If necessary, snip out a section of the broken rod with diagonal cutters, and remove all parts of the broken rod.

3—Cut a piece of 1/4 inch diameter laminated phenolic rod, 2 inches in length. Finish the ends flat and square. Drill each end axially to a depth of 1/2 inch and tap 4-40 National Fine—3 threads in each end hole.

4—Place the new rod in position between the phenolic end plates of the roller-coil assembly and secure with machine screws using the original washers. NOTE—before tightening the screws make sure that the new rod places no strain on the end plates.

5—Check the position of the roller-coil trolley wheels. If necessary, realign the transmitter in accordance with the procedures of the equipment instruction book.



Teletype equipment at Naval radio station, Nanking, China.

IMPROVED TELETYPE RECEPTION

by

ROBERT J. BARTON, ET1
Office of the U.S. Naval Attache
Nanking, China

Until recently considerable difficulty had been experienced in the reception of radio-teletype signals at the emergency Naval Radio Station, American Embassy, Nanking. The basic trouble was diagnosed as unstable power supply sources. There were three sources of primary power available, as follows:

1—75-kw Diesel, 220-volt, 3-phase, 50-cycle. This source supplies the entire Embassy compound.

2—City power, 380-volt, 3-phase, 50-cycle. This source was usually low.

3—Army Type PE–95–G gasoline engine generators, 220-volt, 3-phase, 60-cycle and 220-volt, 1-phase, 60-cycle.

The Army Type BC–779 (Super-Pro) receivers have been found suitable for CW communication circuits, using the above power sources. However, they were too unstable for acceptable teletype reception. Stabilization of the local oscillator of the receivers with voltage regulators improved the situation somewhat but was far from satisfactory.

The eventual solution to the problem of instability was to use an extra O5/FR Frequency Shift Exciter to convert the BC–779's to crystal controlled receivers. Since no crystals of the desired frequency were available, it was necessary to hand-grind the crystals. When the crystals were ready, experimental rigs were tried until an acceptable combination was obtained. Since incorporating the crystal control feature, radio-teletype copy has been received over periods of several hours without readjusting the receivers. This has permitted the operator of the watch, who heretofore was almost constantly manning the teletype, to devote more attention to other important functions such as manning the ship-shore, air-ground, aircraft homing circuits, and answering the phone. This has greatly improved the efficiency of the station.

Briefly, the crystal control feature was accomplished as follows: The local oscillator tube (V–4) in the BC–779's and the reactance tube (V102) in the exciter were removed (Figure 1). RG–58/U coaxial cable was used to connect the normal output of the exciter to the injection grids of the first detectors (V–3) in the receivers. Crystals were ground to frequencies between the 2 and 6 kc band as follows:

$$\text{Crystal freq.} = \frac{\text{operating freq.} + 465 \text{ kc}}{\text{harmonic to be used}} - 200 \text{ kc}$$

As expected, the r-f tuning of the receivers was broad and there were several harmonics injected other than the desired one. Also there was a slight decrease of sensitivity when the fourth harmonic was used. It was found practicable, because of the broad r-f characteristic, to tune the receivers to a point near resonance but between undesired harmonics and then tune in the desired signal by varying the 200-kc oscillator in the exciter, maintaining tank circuit resonance in the exciter in the normal manner as though tuning for transmitter use. The advantage of using the 200-kc oscillator of the exciter is that temperature-controlled crystal stability is obtained with a tolerance of ± 1 kc, allowing for frequency discrepancies in the local crystal and/or incoming signal.

BUREAU COMMENT: ET Barton is to be congratulated on his initiative, ingenuity, and professional know-how in accomplishing this change in his equipment with very meager facilities and under adverse circumstances. It is gratifying to receive such examples of improved electronic equipment performance.

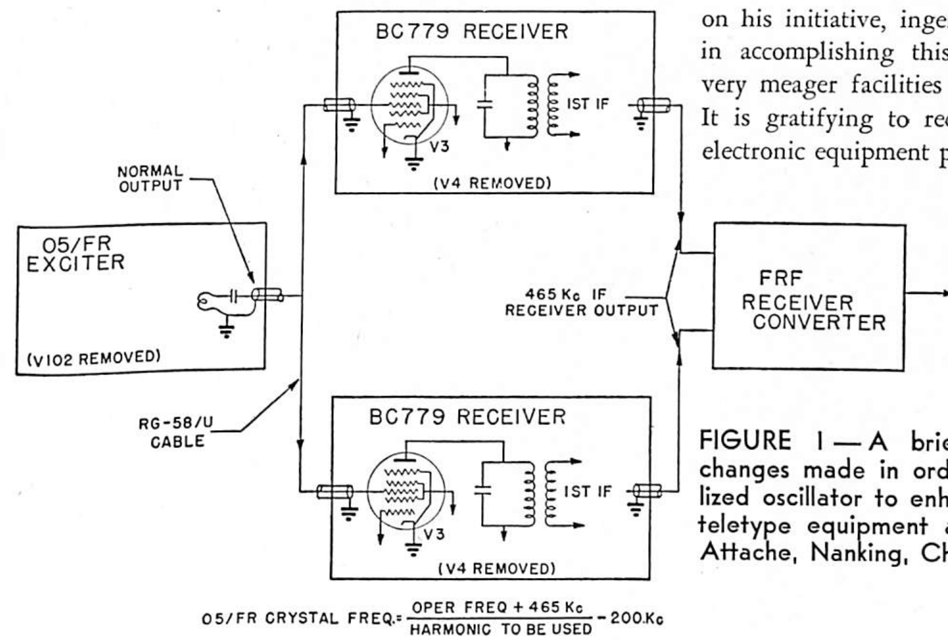


FIGURE 1 — A brief block diagram showing the changes made in order to provide an external stabilized oscillator to enhance the operational stability of teletype equipment at the office of the U.S. Naval Attache, Nanking, China.

QDA HOIST-TILT PACKING

The Commanding Officer of the *Fred T. Berry (DD–858)* recently reported a casualty to the Model QDA hoist-tilt mechanism (CMT–78249) by the entrance of sea water caused by the failure of the flax packing (O–350) in cold weather operations.

The Bureau of Ships investigated several types of packing that would remain flexible and pliable in low temperatures. Two Standard Stock Item types of packing have the required characteristics. Therefore it is recommended that the following replacement packing be installed in Model QDA equipment on vessels operating in cold weather areas:

1—Navy Specification 33P12d, symbol 1300, Standard Stock Nos. 33–P–2810 to 33–P–2380.

2—Ramie fiber packing, symbol 1290, Specification 33P42, Standard Stock Nos. 33–A–96–210 to 33–P–96–1300 inclusive.

Attention is called to the need for proper installation of these packings. If the packing gland is drawn down too tightly when the packing is initially installed it will bind on the shaft and will shrink because the lubricant will be squeezed out. Conversely, if the gland is not drawn down tight enough the packing will not form a smooth bearing surface.

VL I.B. CORRECTION

Holders of NavShips 91177, Instruction Book for Radar Repeater Equipment Model VL, should make the following corrections in the subject book:

1—Figure 2–20—connect upper end of R–412 to +220 volts.

2—Figure 2–42—change value of R–141 from 1000 ohms to 630 ohms.

MODEL SU

U.S.S. Callao

Field Engineer E. M. Ziolkowski of Fort Trumbull, Conn., reports the following:

Excessive heating of the regulating transformer CSY–301496 was reported. Inspection revealed that the transformer was operating at a temperature of approximately 180° F. with the radar in STANDBY. This transformer operates with a temperature rise of 60° C. loaded or without load, therefore tests were made to determine whether the excessive heating was caused by an overload or if the transformer itself was defective.

A 0–25 ampere meter was inserted in series with the primary and with no load in the secondary the meter indicated about 20 amperes, which is approximately normal. The transformer was then checked for grounds and the capacitors which operate in conjunction with the transformer were tested. During the process of checking the capacitors, it was found that at some previous maintenance operation only three capacitors were connected rather than four as recommended by the manufacturer. The fourth capacitor was re-connected and further tests were applied using a Weston Industrial Analyzer Model 639 Type 2. The analyzer was installed in the secondary side of the transformer and the reading indicated 1.4 kw for radar in STANDBY and 1.8 kw for radar in OPERATE. These readings are in accordance with those furnished by the manufacturer. The transformer was then checked for heating effects over a period of an hour or so with no load and full load applied. The temperature of the transformer during those tests was well within the limits specified by the manufacturer. To further determine whether the transformer would operate normally over a long period of time the radar was operated for 24 hours.

All aspects of this case indicate unfamiliarity with this type of transformer by the maintenance personnel involved. In this connection it was recommended that the manufacturer's specification entered on the cover plate of the transformer and capacity housing be strictly adhered to.

SP RADAR

U.S.S. Macon (CA–132)

Ship reported that after having spent several days on the SP installations, they were unable to get the antenna to rotate. In addition to non-rotation, the elevation system would not function.

Investigation disclosed an 1800-ohm resistance to ground from the armature winding output lead on the train amplidyne. Further investigation showed that the trouble was in the No. 2 brush. The insulating sleeve had a voltage breakdown, resulting in a burned hole approximately the size of a penny. The 1800-ohm resistance was caused by the carbon path across the burned spot. The amplidyne was disassembled and a new brush and insulating sleeve were installed which corrected the trouble.

The elevation servo system was causing a loud noise in the amplidyne indicating an extra heavy load on same. A check revealed a low reading on the elevation drive motor armature. Disassembly of the motor revealed the armature was burned beyond further use. All of the insulation on the armature wires had been burned off. A new motor was installed and the SP was again in an operating condition.

VK REPEATER

Field Engineer R. L. Hinchey of the Philadelphia Naval Shipyard reports the following deficiencies and work done to correct same:

U.S.S. Carpenter (DDK–825)

A condition of jittery sweep was observed between 180° and 270°. The gear train was removed which connects the slewing motor, sweep resolver and the 1CT synchro in the servo follow-up assembly. The gears were cleaned with carbon tetrachloride and reassembled. The trouble was then found to be a slight binding on the support for the bearings of the idler gear. This idler gear has two bearings which are held in the bearing support with two screws. Loosening the bottom screw removed the binding effect in this gear train. Similar troubles have been exerienced on other units of this type.

Cursor line was observed to be 180° out of phase with the sweep. Trouble corrected by removing the cursor dial and rotating 180° to align.

The BuShips Electron of September 1949 contained a list of all instruction books distributed from 1 September 1947 to 1 June 1949. The April 1950 issue of Electron contained a list of all instruction books distributed from 1 June 1949 to 1 January 1950. The following pages list all instruction books distributed from 1 January 1950 to 26 May 1950. The key to the abbreviations appearing under *"Edition"* appears below.

Supplementary lists will be published in BuShips Electron at regular intervals, as additional instruction books are distributed.

Abbreviation	*Edition*	*Abbreviation*	*Edition*
C	Commercial Publication	MH	Maintenance Handbook
Ch.	Change	MI	Maintenance Instructions
CI	Complimentary Instructions	OH	Operators' Handbook
DB	Descriptive Booklet	P	Preliminary Instruction Book
FC	Field Change	RS	Revision Sheets
FCB	Field Change Bulletin	S	Supplement
IB	Instruction Book	SP	Spare Parts Catalogue
IH	Installation Handbook	T	Temporary
		TM	Technical Manual
IS	Instruction Sheets	*	Limited Quantities

Model	*Short Title*	*Edition*
AM–215/U	NAVSHIPS 900,995	T–1
AM–215/U	NAVSHIPS 98163	FC ♯1
AM–229/UP	NAVSHIPS 91256	IB
AN/BOC–1	NAVSHIPS 91178	T–1
AN/FGC–5	NAVSHIPS 91265(A)	IB
AN/FRT–14	NAVSHIPS 91318 (Vol. 1)	C IB
AN/FRT–14	NAVSHIPS 91318 (Vol. 2)	C IB
AN/GMQ–2	NAVSHIPS 98164	FC ♯1
AN/GRC–13	NAVSHIPS 91235	IB
AN/SMD–1 (XN–1 and XN–2)	NAVSHIPS 91211	IB
AN/SPS–6	NAVSHIPS 98158	FC ♯8
AN/SPS–6	NAVSHIPS 98161	FC ♯15
AN/SRA–3	NAVSHIPS 91292	IB
AN/SSQ–T–1 (XG–2)	NAVSHIPS 91301	IB
AN/TPS–1B	NAVSHIPS 98138	FC ♯8
AN/TPS–1B	NAVSHIPS 98156	FC ♯10
AN/UDR–7	NAVSHIPS 91246	IB
AN/UMQ–3	NAVSHIPS 91279	IB
AN/UPA–T1	NAVSHIPS 91194	IB
AN/UQR–T1	NAVSHIPS 91285	IB
AN/URA–5 T–1	NAVSHIPS 91225	Temp. Corr.
AN–URR–13	NAVSHIPS 91270	IB
BC–624		SIG M–8
BC–625		SIG M–8
CHZ–60ACY–1	NAVSHIPS 91262	IB
CP–38/UD	NAVSHIPS 91029(A)	IB
CV–49992	NAVSHIPS 98173	FC ♯1
CV–49992	NAVSHIPS 900,781(A)	Temp. Corr.
		T–1
DBN		SIG M–8
IM–4/PD	NAVSHIPS 91033(A)	Ch. 1
IM–7A/PD	NAVSHIPS 91227	T–1
LM–18	NAVSHIPS 91277	IB
LX–1		SIG M–8
LX–2	NAVSHIPS 91130	Ch. 1
Mark III	NAVSHIPS 91233	IB
ME–2/U		SIG M–8
ME–6A/U	NAVSHIPS 91269	IB
MX–561A/TBS–1B	NAVSHIPS 91209	IB
MX–735/MR, MX–735A/MR, MX–736/MR	NAVSHIPS 91316	C Sup.
OC–1/S, OC–2/S, OC–3/S	NAVSHIPS 91151	T–1
OZ		SIG M–8
PP–380/U	NAVSHIPS 91271	IB
PU–151/U	NAVSHIPS 91226	IB
QHC	NAVSHIPS 91186	IB
RBO–2a	NAVSHIPS 91290	IB
RDO–a	NAVSHIPS 91289	IB
SO–2	NAVSHIPS 91193	IB
SO–8	NAVSHIPS 91219	IB
SR–3	NAVSHIPS 900,539	T–1, T–2, T–3
SR–6	NAVSHIPS 900,989	T–1, T–2, T–3

Model	Short Title	Edition
SS	SHIPS 335	Ch. 1
SS	SHIPS 335	Ch. 2
SS	NAVSHIPS 98119	FC #10
SS	NAVSHIPS 98142	FC #12
SU	NAVSHIPS 98171	FC #42
SU	SHIPS 313	T–1
SU–1	NAVSHIPS 900,882	T–1
SU–1	NAVSHIPS 98172	FC #42
TDZ–a	NAVSHIPS 91284	Comp. IB
TDZ	NAVSHIPS 900,809	Ch. 2
TEG–1 –T–4	NAVSHIPS 91167	Temp. Corr.
TS–186A/UP	NAVSHIPS 91205	T–1
TS–239A/UP	NAVSHIPS 91148	IB
TS–611/FG	NAVSHIPS 91237	IB

Model	Short Title	Edition
TV–3/U	NAVSHIPS 91254	IB
VL	NAVSHIPS 91177	IB
X–VK	NAVSHIPS 98151	FC #3
Cable Fabrication	NAVSHIPS 91297	C
Consolidated-Nier Mass Spectograph	NAVSHIPS 91288	C
Shop Practice	NAVSHIPS 91298	C
Spectrophotometer	NAVSHIPS 91311	IB
Training Manual on Antennas	NAVSHIPS 91296	C
Trajectory Display System for the Amphibious Assault Teacher	NAVSHIPS 91302	IB
60089		SIG M–8

MODEL SO-6/-10 ANTENNA FAILURES

From fleet reports and inspection by Bureau of Ships representatives, it has been determined that certain deficiencies exist in the design and construction of the Model SO–6/–10 radar antenna, Type CRP-66AMP.

It has been found that after a short period of service, the Garlock duplex oil seal permits oil leakage from the lower drive gear case into the waveguide. In some cases, inspection prior to installation of the antenna has revealed misalignment and improper meshing tolerances of gears in the drive gear assembly. Also revealed, was improper fastening of securing nuts and screws in the antenna pedestal. In one particular instance, the lock nut and lock nut washer on the lower end of the drive spindle were found to be loose because the fingers of the lock nut washer had not been pressed into notches of the lock nut itself. This was a very critical situation in that had the antenna been installed without inspection and correction, both the lock nut and the lock nut washer would have spun off and dropped into the rotary joint beneath it.

In order to correct oil leakage, the Bureau of Ships has ordered procurement of an improved type, Reich, oil seal which will soon be distributed to activities concerned as a field change, and will replace the presently installed oil seal. To correct other deficiencies as noted, installation activities will be required to conduct a thorough examination of the antenna pedestal and its drive mechanism prior to new installations. It may be necessary in some instances to manufacture a new gear, in order to produce proper meshing and alignment in the gear assembly.

The SO–6/–10 instruction book (NavShips 900, 860) specifies a quantity of three quarts of Navy Type Number 9110 oil for lubrication of the main gear box in the antenna pedestal. By recent tests, it was found that this quantity is not entirely sufficient to properly lubricate all gears and bearings, and it is necessary, therefore, that the amount be increased to four quarts. It further has been determined that the Number 10 oil, due to its light weight, has a very low consistency in warm weather, and it is required that Number 20 oil be used in lieu of Number 10 for other than extreme cold weather. It is intended that the changes in quantity and weight of oil be applicable to all equipments, including those already installed.

Personnel responsible for the maintenance of the SO–6/–10 equipment are advised to make frequent inspections of the gear assembly box to ensure that a sufficient oil level is maintained at all times and that gears are functioning smoothly. Either noisy antenna rotation, reduction in maximum ranging distances, or a combination of both, are the usual symptoms indicating troubles within the antenna pedestal.

Pending receipt of the improved type, Reich, oil seal, maintenance personnel are advised to replace the present oil seal with one of the same type from equipment spares as a temporary measure to prevent oil leakage into the waveguide, should it exist. Oil leakage can easily be determined by the removal and inspection of the uppermost section of the waveguide. Evidence of improper gear functioning will require replacement of gears where necessary.

It is requested that the Bureau of Ships be advised immediately of any difficulties experienced in the operation of the subject equipment. Report should be directed to the attention of Code 983.

This is a picture of a successful man. He has succeded in reducing his maintenance troubles and has helped the Bureau of Ships improve a part of his electronic equipment. Confronted with a part failure, he forwarded a complete Failure Report to the Bureau. The trouble was analyzed and an improved part designed. The result: a better part and one less maintenance problem. This kind of success story helps strengthen electronics defense.

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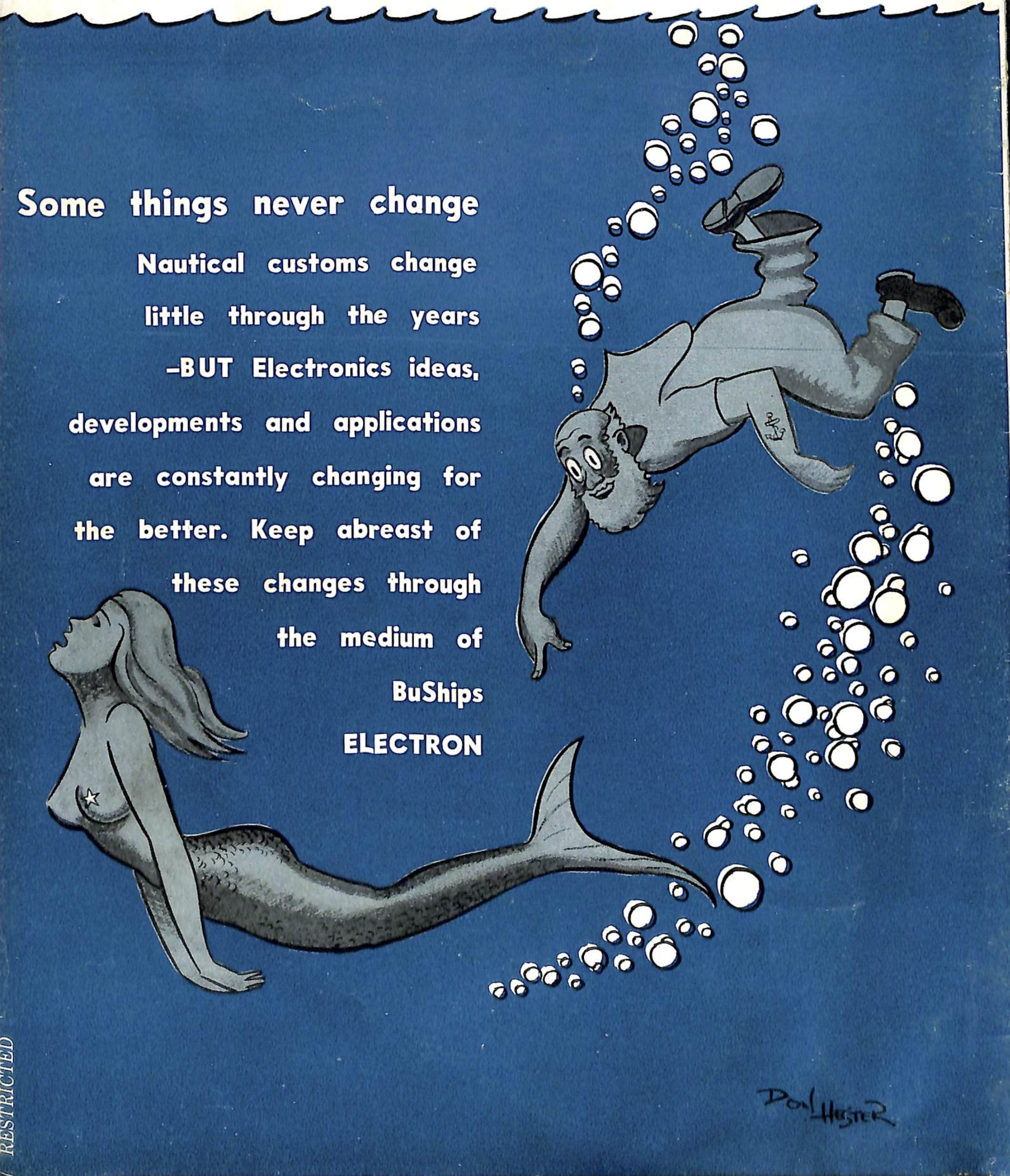

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