

**RESTRICTED**

**BUREAU OF SHIPS**  
**RADIO AND SOUND BULLETIN**

**No. 12**

(NAVSHIPS 903)



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## RADIO AND SOUND BULLETIN

NAVY DEPARTMENT,  
BUREAU OF SHIPS,  
October 1, 1943.

### PANORAMIC RADIO RECEIVING EQUIPMENT

#### I. INTRODUCTION

The increased use of panoramic radio receiving equipment in the naval service suggests the need for a brief description of this type of apparatus together with an indication of its applications. The term "panoramic equipment" implies a panoramic adaptor and a companion receiver.

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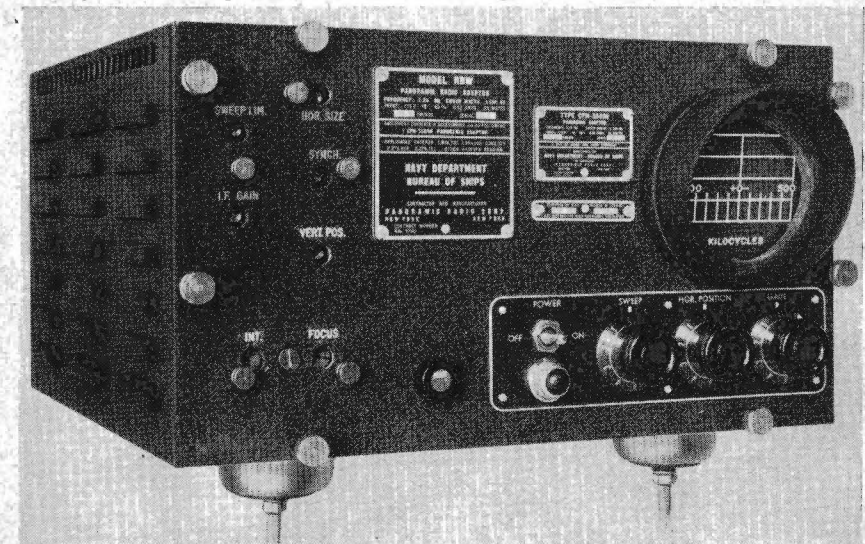


FIGURE 1.—Panoramic adaptor for model RBW receiver.

Panoramic reception is the simultaneous visual reception of several radio signaling stations whose frequencies are distributed over a continuous portion of the frequency spectrum. This definition distinguishes "panoramic reception" from the conventional reception which can be called "uni-signal reception" and which can be either aural or visual or both.

The main distinction between panoramic and uni-signal reception is that panoramic reception is periodic reception over a wide range of the spectrum. Each signal is received at fixed, rapid intervals for a very short period of time. Uni-signal reception is a continuous reception over a very narrow range of the spectrum.

The panoramic adaptor is, in effect, a complete superheterodyne receiver which is periodically tuned over a fixed band of the frequency spectrum, centered at the intermediate frequency of the companion receiver. The output of the adaptor is visual, being in the form of oscillograms on the screen of a cathode ray tube which is an integral part of the unit.

## II. THEORY

The ordinary radio receiver includes, generally, an RF stage followed by a converter stage and an oscillator, which are tunable over various portions of the spectrum. The converter stage is followed by an IF amplifier, a detector and an audio frequency amplifier.

It is generally thought that a superheterodyne receiver takes signals of any frequency and converts them into signals of a given frequency, the frequency of the IF amplifier. The fact is that in the output of the converter tube of the ordinary receiver we have present not only the signals on the frequency of the amplifier, but signals extending over a relatively wide band, this band being centered at the frequency of the IF amplifier. Due, however, to the selectivity of the IF amplifier, only those signals of the given frequency will pass through into the detector and be heard in the phones or speaker of the receiver.

The panoramic adaptor is connected to the output of the mixer tube and receives all the signals over this relatively wide band. Due to the RF or preselecting stage of the companion receiver, the signals of frequencies other than that of the IF amplifier of the receiver, will be greatly attenuated. The panoramic adaptor, however, has an input amplifying stage which has a band-pass characteristic which tends to compensate for the receiver selectivity.

Figure 2 is a block diagram of a panoramic equipment. Block No. 1 is a band-pass amplifier, which is the input stage of the panoramic adaptor and is connected to the plate of the first detector of the receiver, through the isolating or blocking resistor R. This blocking resistor prevents detuning the receiver, and the latter will operate in the usual manner unaffected by the connection of the panoramic adaptor.

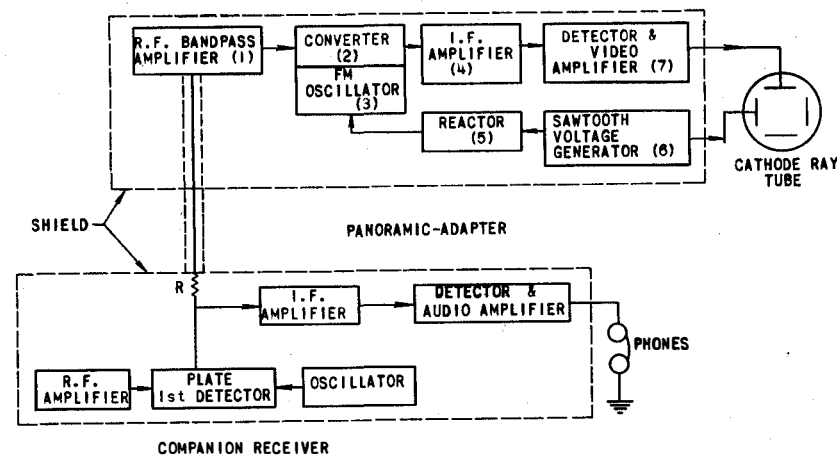


FIGURE 2.—Block diagram of panoramic equipment.

The band-pass of the input amplifier is tuned so as to be centered for the frequency of the IF amplifier of the receiver, and extends on each side of that frequency over a band equal to, or greater than, the maximum visual band which will be shown on the adaptor screen.

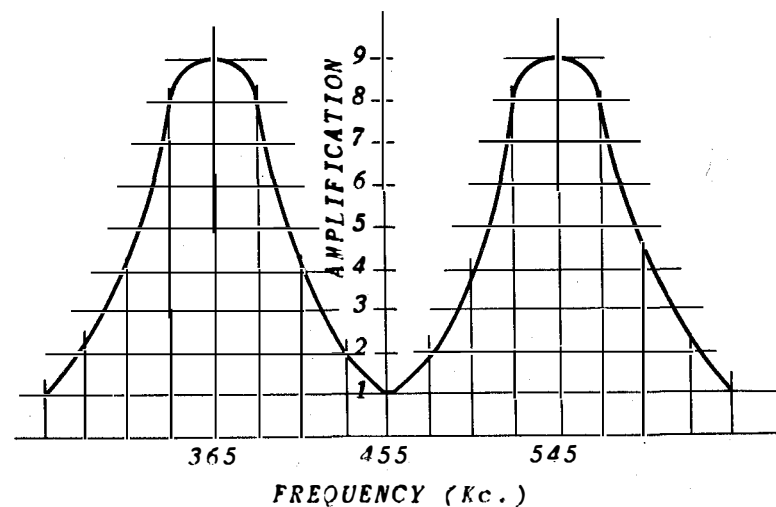


FIGURE 3.—Graph showing amplification as a function of frequency.

From figure 3 it can be seen that this band-pass amplifier amplifies the extremities of the bands more than the center of the band. In this manner we obtain a partial or complete compensation for the selectivity of the RF or preselector stages of the receiver.

The signals from the RF band-pass amplifier are fed into the converter tube No. 2 (see fig. 2) where they are mixed with the signals from an oscillator No. 3. This oscillator is frequency modulated

over a range of frequencies extending equally above and below a mean frequency. In other words, the oscillator is periodically tuned over a band of frequencies at the rate of 30 times per second above and below a given center frequency. This action of periodic tuning will cause the panoramic adaptor to be tuned in synchronism with this frequency modulation, and actually scan the frequency spectrum over a certain range extending equally above and below the frequency of the IF amplifier of the companion receiver. The signals from the output of the converter are fed into a very sharply tuned IF amplifier No. 4, and from there the signals are detected and amplified in a video amplifier, No. 7. The signals from the output of this amplifier are fed into the vertical deflection plates of a cathode ray tube, No. 8.

The oscillator, No. 3, is frequency modulated, as stated above, and this action takes place entirely by electronic means. A reactor tube, No. 5, is provided for the purpose. This reactor is inserted in the oscillating circuit of that oscillator in such a manner as to act as a part of the tuned circuit of the oscillator. The value of this reactor changes according to the instantaneous voltage applied to its grid. This voltage is a sawtooth voltage, which is generated by a sawtooth generator, No. 6. The same sawtooth voltage is also applied to the horizontal deflecting plate of the cathode tube. It can be seen therefore that the movement of the cathode ray beam on the screen will be synchronized with the tuning of the receiver. This is why every signal appearing on the screen, and impressed on the vertical plate, will appear as if stationary, on the same point of the screen at all times. Due to the persistence of vision, and to the fact that the sweep of the adaptor is about 30 cycles per second, the signals will appear as if they are permanently on the screen. It should be remembered, however, that each signal appears periodically, and for only a fraction of the total time. This must be fully understood to facilitate the interpretation of the signals seen.

### III. CHARACTERISTICS OF TYPES OF SIGNALS

With a little experience, the operator is able to visually recognize the character of various types of signals, without the need of listening to them. It should be noted that the panoramic adaptor can show only what the radio receiver is able to receive, and no more. A poorly adjusted receiver cannot be expected to give good results even with a perfectly adjusted adaptor.

A constant carrier appears as a deflection of fixed amplitude. An amplitude modulated carrier appears as a deflection of variable amplitude. Voice or music modulation causes the carrier to vary irregularly in amplitude. A constant tone modulation of low frequency will produce a series of convolutions varying in amplitude, their number being determined by the modulation frequency.

As the modulation increases, the convolutions move toward the two sides of the deflection, as the side bands tend to become visible. When the modulation frequency is increased to above 2,000 cycles, it becomes possible to separate the two side bands by reducing the sweep width of the adaptor. The higher the frequency of modulation, the further away these side bands will move from the center deflection representing the carrier wave. The main deflection appears similar in shape to the top portion of a typical resonance curve.

A CW signal appears and disappears in step with the keying of the transmitter.

A frequency modulated carrier appears as a carrier which is "wobbling" sideways.

A speech or music modulated signal appears as a multiplicity of deflections spreading over a variable bandwidth. During periods of silence a single carrier appears.

### IV. APPLICATIONS

Once the panoramic radio adaptor has been properly installed in connection with a good communication receiver, it will be found useful in many types of applications.

The rapid checking up of the ranges of the frequency spectrum is rendered possible with the aid of the adaptor. For the experienced operator, capable of interpreting the character of each station, the entire band under investigation becomes integrated into a continuity which can be easily visualized as a whole. The "traffic density" at certain points can be noted; characteristic signals are recognizable from among others and upon retuning over the same portion of the spectrum, it is easy to note any changes which may have occurred. Stations previously identified are distinguishable from new stations which have just come in. The use of the panoramic adaptor, therefore, speeds up the work of radio communication. Shorter calls can be made and the replies can be picked up sooner. Constant watch can be made of a series of channels of communication and the receiver quickly tuned to any station which may appear on one of these channels.

By having a battery of panoramic equipments set up so as to keep a constant watch of the channels of communication to be monitored, an immediate indication of a new carrier wave is given and a receiver can be assigned at once to a study of the activity. Important messages can by this means be intercepted.

When mobile units, aircraft or ground, are in combat it sometimes happens that a message intended for the base or carrier does not come in on the frequency expected. A panoramic equipment, then, will reveal the presence of the off-frequency carrier wave and a receiver may be adjusted for its reception.

In case of interference from other stations, one can recognize the character of the interference and its position in the spectrum with respect to station to which one wishes to listen. One can, therefore, intelligently and quickly use the means at ones disposal for reducing or eliminating the interference, by properly retuning the receiver to a higher or lower frequency, using crystal filter, etc. One of the best methods for eliminating certain types of interference is in the use of the directional receiving antenna. The operator may rotate such antenna until the highest ratio is obtained between desired and undesired signals, as shown on the screen of the adaptor.

In direction finding, the panoramic adaptor can be used as an accurate signal strength indicator for several stations simultaneously. If the receiver uses a loop, or any type of directional antenna, either the null method or maximum signal method may be used. The direction of a series of stations on adjacent frequencies can thus be taken in rapid succession without retuning the receiver.

The panoramic adaptor provides an excellent and very accurate method of checking up the alignment of radio receivers. If the adaptor has been properly adjusted for a given IF frequency, and if the RF stages of a radio receiver are properly aligned, any signal deflection moving from one end of the screen to the other will pass through amplitude variations which must be symmetrical with respect to the zero mark. If, however, any deflection appears of greater amplitude on one side than on the other, this indicates that the RF stage, or stages, of that receiver are improperly tuned at that particular point of its receiving range. An experienced operator will be able to judge very rapidly what adjustments must be made for proper tracking and aligning.

Reduced sensitivity or complete insensitivity at certain frequencies may sometimes be due to the reduced power of the receiver's oscillator, or to its failure to oscillate. This can be easily checked with another receiver and panoramic adaptor by tuning that receiver to the frequency of the oscillator, and checking its amplitude over its entire range. This operation provides also a very excellent method of checking up the tracking of the oscillator over the entire range of any given band.

The panoramic adaptor is found to be very useful in many ways around a transmitter. Frequency adjustments of a master oscillator with respect to a standard frequency are easily and quickly made. A check may be made upon the frequency spectrum and the channel selected which is free from interference. A transmitter can be adjusted to any desired frequency difference from a given standard or station and checks quickly made. Proper adjustment of multiplier or buffer stages can be made which gives the greatest signal output that do not "pull" the signal off frequency. Spurious oscillations

caused by improper neutralization can be quickly detected. The percentage of modulation of a transmitter can be checked best by reducing the sweep-width of the adaptor to zero. Undesired frequency modulation can be easily detected.

The panoramic adaptor serving as a visual strength indicator can be used for taking field strength measurements around the transmitter. It can then be used in conjunction with a standard signal generator tuned to a slightly different frequency, to measure the variations of field strength for determining antenna radiation patterns.

## MODIFICATION TO MODEL YG RADIO HOMING EQUIPMENT

The resistors R-110, R-111, R-112, etc., located on a bakelite panel in the upper left hand portion of the model YG transmitting equipment, are mounted in such a manner that the spacing between the resistor connecting links is not great enough to preclude breakdown under conditions of high humidity and high temperature due to high voltages at these points. The addition of small fiber washers between the resistor connecting links and the bakelite panel will increase the effective length of the leakage path, thereby decreasing the voltage gradient. The washers should be at least  $\frac{1}{16}$  inch thick, with the outer diameter not greater than  $\frac{5}{16}$  inch. They should be added to the lower terminals of R-109, R-110, R-111, and R-112, and to the upper terminals of R-102, R-104, and R-118. If fiber washers are not available No. 6 standard metal washers,  $\frac{1}{2}$  inch thick, with an inner diameter of  $\frac{5}{16}$  inch, and an outer diameter of  $\frac{5}{16}$  inch, may be used. Two should be used at each point to provide the proper spacing. A modification similar to the above was incorporated in all equipments after the first 30 sets, prior to shipment. All model YG equipments in service should be examined, and washers added to those which have not been previously modified.

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## USE OF PLASTIC INSULATED CABLES IN AIRCRAFT RADIO INSTALLATIONS

In order to eliminate the use of rubber in aircraft radio installations, a redesigning of the audio and power circuit cabling was undertaken. After considerable trial and experiment, a solution has been achieved in the employment of plastic insulating materials. As a result, not only has the use of rubber been eliminated, but a superior cable has been produced. Further, many secondary problems inherent in rubber insulation have been solved.

Possibly the most important of these is the elimination of the need for tinning the shielding braid and conductors. Shielding of power and audio cabling in aircraft installations is necessary for two reasons: First, it prevents radiation of radio frequency "hash" caused by generators, motors, and regulators. Second, it prevents the pick-up of additional interference from the plane's power circuits. This shielding is covered with an outer protective insulating jacket to prevent intermittent grounding with its attendant receiver noise. When this outer protective cover is of rubber, the shield must be tinned to prevent the corrosive action on the copper shield.

The synthetic materials, however, do not attack copper, and when extruded they form a continuous airtight covering which precludes oxydization. As a result, even after several years the covering can be removed to reveal bright copper which can be readily soldered without treatment of any kind. The elimination of tinning was an important contribution towards saving this critical material.

Plastics approved to date are made by various manufacturers under a variety of trade names. However, all have polyvinyl chloride as their basis. These materials have many important features. Most of the plastics in use will not support combustion, thus eliminating the fire hazard present in rubber cables. When extruded it forms a remarkably tough yet flexible covering which is impervious to oil, sunlight, air, and deterioration from age. The material withstands temperatures up to  $150^{\circ}$  C. and has high dielectric strength in the order of 1,000 volts per mil. The minimum thickness of 20 mils required by the specs has never failed under repeated tests of 10,000 volts.

By replacing rubber with plastics as insulation for the conductors of the cable, many additional advantages have been realized. High among these in importance is the ease with which brilliant and permanent colors are attained. Because rubber cannot be made in a variety of colors and because these change with age, it was necessary to apply the coding through use of colored cotton braid. No braiding is required with plastics. Thus one step in manufacture is eliminated. More important from the standpoint of the service,

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the elimination of the cotton braid materially cuts down the time required to make connections. The tedious process of trimming and lacquering the loose ends of the identifying braid is not present in the new plastic cables, and the possibility of loose cotton fibers, which may absorb moisture and constitute a leakage path, is eliminated.

Fourteen standard colors are available to synthetic insulation in conformity with the standards of the National Electrical Manufacturers Association. These are red, pink, orange, yellow, light green, green, blue, dark blue, purple, white, tan, brown, grey, and black. The number of identifiable conductors can be increased by the use of ridge tracers on the surface of the plastic conductor. Thus a single ridge tracer adds 14 identifiable conductors thereby giving a total of 28 conductors; 2 tracers give 42, and so on.

At the same time the cables were being redesigned, a standardization program was undertaken. The result is that 6 plastic cables have replaced 60 existing cables. The basic approach which permitted the standardization was to utilize cables having more conductors than actually required, leaving the extras as spares. Thus a four-conductor cable would be used for two-, three-, or four-conductor requirements. The dimensions<sup>1</sup> over-all and over the shield were chosen to fit the various plugs in use with different equipments.

The six standard cables now in use are as follows:

1. A highly flexible two-conductor cable for patch cords and other light-duty purposes. It fits microphone plugs, headset plugs, and the single conductor Jones plug used on ZA equipment.
2. A four-conductor cable using 14-gauge conductors.
3. A heavy four-conductor cable using 12-gauge conductors.
4. An eight-conductor cable to replace existing 5-, 6-, 7-, and 8-conductor cables.
5. A twelve-conductor cable to replace existing 9-, 10-, 11-, and 12-conductor cables.
6. An eighteen-conductor cable to replace 13- to 18-conductor cables.

In the near future a thirty-conductor cable will be made standard. This will accommodate the ATC transmitter and a new companion receiver.

This standardization has been made possible as a result of the change to 28-volt power supply. This permits the use of much smaller conductors than were required in the older 14-volt installations. The reduction in the number of different cables assists production and improves the maintenance and supply problem.

While the cost of these new cables is somewhat higher than the old rubber-insulated ones, their many advantages more than offset this factor. It is believed that more permanent and reliable installations will result from their use.

<sup>1</sup> In some plugs the over-all diameter of the cable governs, while in others only the diameter over the shield needs to be considered. Therefore, in establishing a standard cable, both dimensions must be borne in mind.

## MODIFICATION TO MODEL TBK-4 TRANSMITTER FOR BALANCED OUTPUT OPERATION

The model TBK-4 transmitting equipment is designed to operate into a Marconi-type antenna with a single wire feed. In order that this equipment may be operated with balanced output into a 600 ohm line, the United States Naval Radio Station at Annapolis has developed a simple modification in the antenna coupling circuit. This modification has been used at that station for approximately 18 months, and measurements indicate that the full 500-watt output can be obtained over the entire frequency range of the transmitter.

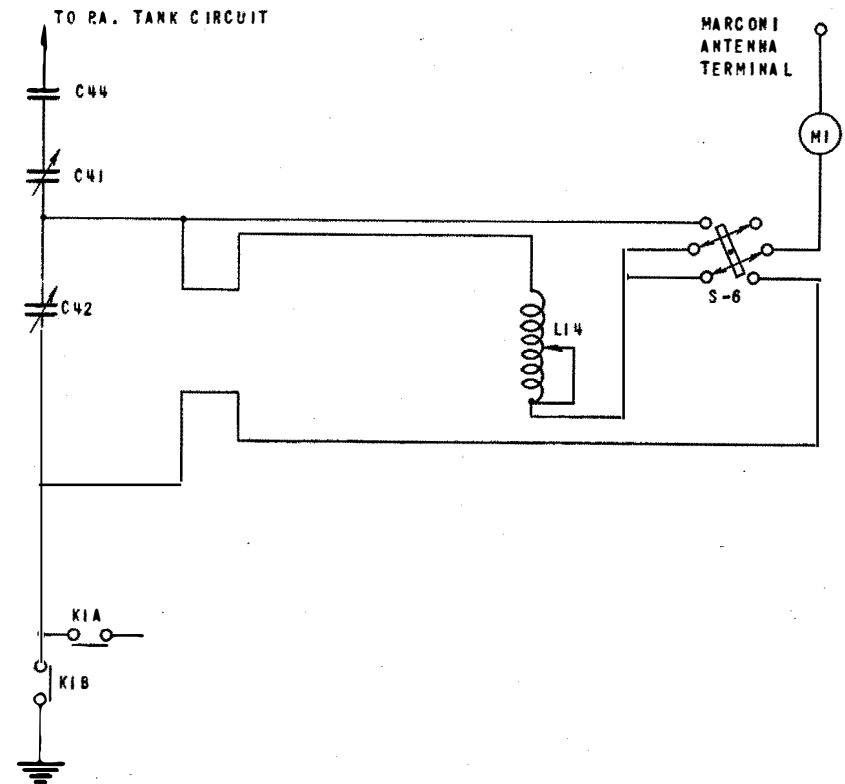
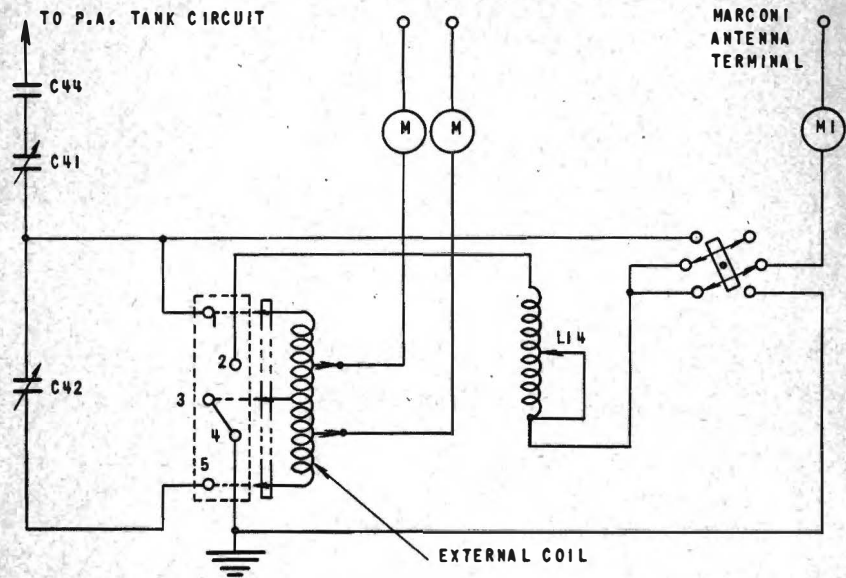


FIGURE 1.—Standard antenna coupling circuit for model TBK-4 transmitter.

Figure 1 shows the standard antenna coupling arrangement before modification. The condenser C-42 and the coil L-14 are used for tuning the antenna. The antenna feed switch S6 throws C-42 and L-14 into series or parallel to provide current or voltage feed respectively to the antenna.

TERMINALS FOR 500 TO 600-  
OHM IMPEDANCE  
TRANSMISSION LINE.



(A)

PLUG-IN  
BLOCK

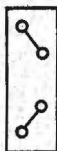


FIGURE 2.—Modified antenna coupling circuit showing external coils and plug-in block.

The modification is indicated in figure 2. The relay K-1 is disconnected, and an arrangement of jacks is made to accommodate an external plug-in coil. Depending on the frequency range desired, one of three coils is selected for use. When operating with balanced output in this manner, switch S6 must be in the current-feed position. Should it be desired to operate the equipment with the Marconi antenna, the circuit may be restored to its original condition by using a plug-in block (shown as A in fig. 2) in place of the plug-in coil.

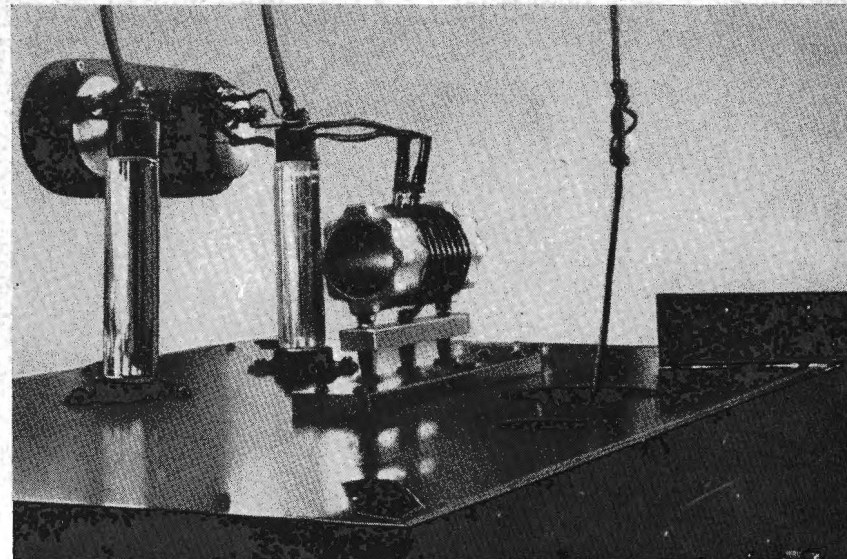


FIGURE 3.—External view of transmitter showing plug-in coil in place

Figure 3 shows the external appearance of the modified transmitter with one of the plug-in coils in place. Figure 4 is a detailed photograph of the coils. Specification for the coils and the materials required for the modification are indicated below.

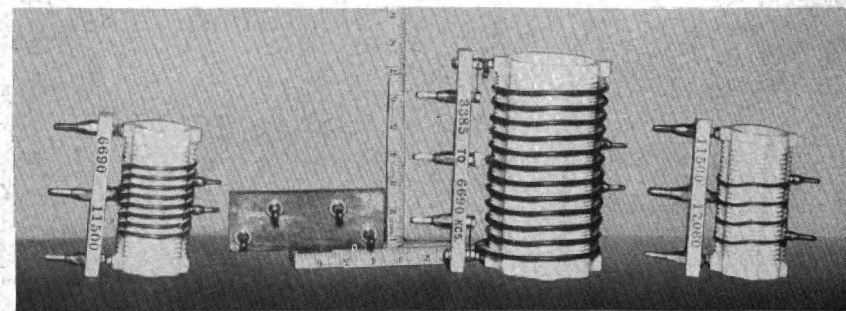


FIGURE 4.—Photograph showing details of coils.

**EXTERNAL COIL SPECIFICATIONS**

	Frequency range		
	3385-6690 kc.	6690-11500 kc.	11500-17060 kc.
Wire size.....	No. 6 A. W. G.....	No. 8 A. W. G.....	No. 10 A. W. G.....
Number of turns.....	12.....	8.....	4.....
Pitch.....	0.5".....	0.3".....	0.66".....
Coil diameter.....	4".....	2½".....	2½".....
T. L. taps.....	4½, 7½ turns.....	2½, 5½ turns.....	½, 3½ turns.....
Ground tap.....	6th turn.....	4th turn.....	2d turn.....



## MATERIAL LIST

Quantity	Description
1	"Bud" porcelain coil form 4" O. D. x 7 $\frac{1}{4}$ ".
2	"Bud" porcelain coil forms 2 $\frac{1}{2}$ " O. D. x 5".
13	Jumbo banana plugs, General Radio Co., Cat. No. 674-J.
5	Jumbo banana plug jacks G. R. Co., Cat. No. 674-J.
6	Small banana plugs, G. R. Co., Cat. No. 274-P.
2	Small banana plug jacks, G. R. Co. Cat. No. 274-J.
2	Transmission line current meters.
15'	No. 6 A. W. G. soft copper wire.
7'	No. 8 A. W. G. soft copper wire.
4'	No. 10 A. W. G. soft copper wire. Mycalex, $\frac{1}{2}$ " thick, for terminal strips and plug-in block. Lugs, hardware, etc.

**COMMENTS ON THE WEA-1 UNDERWATER SOUND  
EQUIPMENT**

The following suggestions are drawn from the RCA Service Company's correspondence to its engineers. These recommendations will improve the operating efficiency of the WEA-1 equipments.

1. *Sea chest.*—Each vessel having a WEA-1 equipment shall have a sea chest so constructed as to completely house the "fish" when hoisted.

2. *Electrical grounds.*—The cables entering the bridge rack should have their shields well bonded together and grounded where they enter the rack. In equipments having steel cases, it is exceedingly important that all grounds (external) be properly made.

3. *Motor generator voltage.*—The MG set should give 115 volts A. C. output under full load (key down) with 115 volts D. C. input. If necessary, adjust the generator shunt field resistor to give required output.

4. *Power output increase.*—Power output of driver amplifiers having serial numbers below 170 can be increased considerably by disconnecting the capacitor C-104 from the "broad-sharp" switch and connecting it directly across the capacitor C-103.

5. *Training shaft assembly hardware.*—The bag containing gaskets, keys, etc., is shipped taped to the inside of the cover of the relay box on the hoist-train.

6. *Signal to noise ratio.*—Signal to noise ratio can sometimes be improved by trying all 6SJ7 tubes available as the converter tube V407. These tubes vary considerably in this respect and noise may be reduced by selecting the best tube.

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**FUSE MODIFICATION FOR MAGNETIC CONTROLLERS OF TBU, TBU-1/2/3, TBM-7/8, TBK-13/15, AND TBL-6 EQUIPMENTS**

Certain of the model TBU, TBU-1/2/3, TBM-7/8, TBK-13/15, and TBL-6 transmitting equipments will show a false indication of the control indicator lights in the event the center fuse in the magnetic controller opens from overload conditions. The Westinghouse Electric and Manufacturing Co. has provided modification parts with instruction data to permit modification in the field of a total of 344 of these equipments already shipped from the factory. In subsequent equipments the modifications will be made at the factory. The modification consists of the removal of one of the three line fuses and fuse clips originally provided and its replacement by a suitable copper strap.

This modification is not of vital importance and may not be considered advisable during wartime activities. The 344 modification kits complete with contractor's instruction have been shipped to the Naval Supply Depot, Mechanicsburg, Pa., Building 307. For equipments now in service modification kits may be obtained by making request direct on the Supply Officer in Command, Naval Supply Depot, Building 307, Mechanicsburg, Pa.—(Attention: Assistant Radio Material Officer).

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**ROLLER PARALLEL RULE**

A roller type parallel rule for use with the radar plotting board described in RADIO AND SOUND BULLETIN No. 11 has been designed by Lt. (j. g.) C. C. Miller, Jr., U. S. N. R. of the Submarine Chaser Training Center, Miami.

The rule is manufactured from plexiglass, left over from the construction of the plotting board, plus a few easily available parts. The rule is divided into the same units of length as are used on the plotting board.

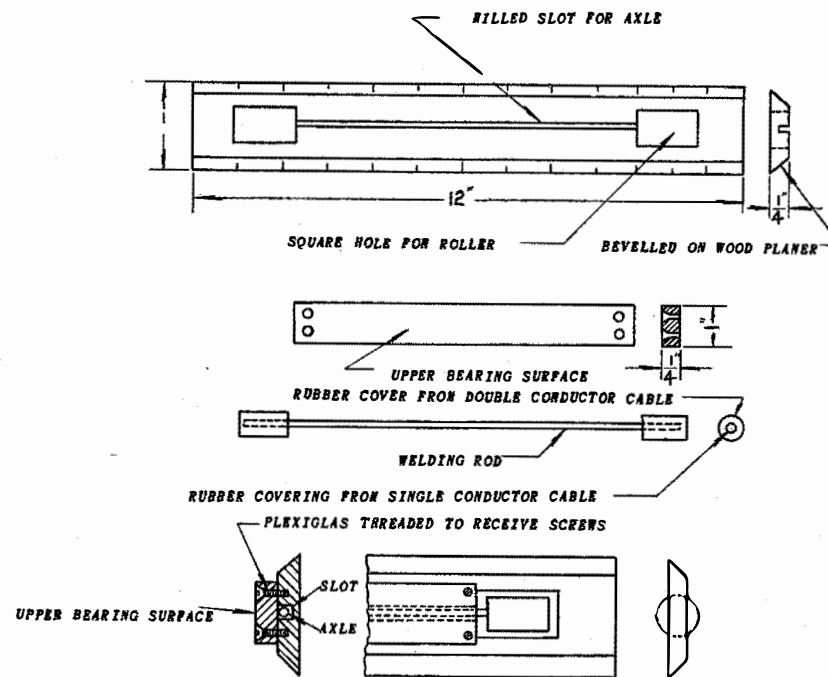


FIGURE 1.—Sketch of roller parallel rule (not drawn to scale).

Figure 1 is a sketch of the rule. A welding rod is used for a roller axis. The rollers are built up from two sections of rubber cable covering and are approximately one inch long. The axle is held in the milled slot by means of a piece of plexiglass screwed to the top of the rule.

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## POWER SUPPLIES FOR MODEL TBP AND TBY SERIES EQUIPMENTS

Three types of power supplies for model TBP and TBY series equipments have been developed to meet the varying needs of the service.

1. *Navy type 19018B dry battery pack.*—The Navy type 19018B dry battery pack is ordinarily supplied with and as a part of the equipment. The later types of this battery have a useful life of about 25 hours and considerably increased shelf life over their predecessors, the 19018 and 19018A types. The battery is shipped hermetically sealed in an impregnated paper case to improve its shelf life under tropical conditions.

2. *Navy type 19029/20144 storage battery and vibrator power unit.*—This power supply consists of a 4-volt 40-ampere-hour type 19029 storage battery and a type 20144 vibrator power unit. These two units plug together and, when assembled, are the same shape and size as the 19018B dry battery pack and may be used with the equipment in exactly the same manner. The discharge time of the battery, under normal operating conditions, is approximately 14 hours. Considerable saving in material and in shipping weight and space may be expected when this power supply is used in the field in place of the dry battery pack, because it may be recharged instead of discarded. Recharging may be accomplished through connection to any 6 volt d. c. source, such as a motor car or truck storage battery, or by making use of the Navy type 20145 battery charger, which is designed to charge the storage battery from a power source of 12, 24, 40, or 110 volt D. C. or from 110 or 220 volts A.C. The storage battery may be charged while in actual use in conjunction with the equipment, although the charging rate is then somewhat reduced.

3. *Navy type 20206 power unit.*—This unit supplies the required voltages to the equipment from a source of either 110 volts A. C. or 110 volts D. C. As is the case of the combination storage battery-vibrator power unit previously mentioned, the type 20206 power supply is the same size and shape, and attaches to the equipment in the same manner as the dry battery pack originally furnished. The type 20206 supply was developed to facilitate the present extensive application of model TBY series equipment aboard ship. It is also useful in any application where portability is not essential, since it permits continuous operation without any necessity for recharging or replacement.

## IMPROVED STANDARD FREQUENCY BROADCAST SERVICE OF NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards broadcasts standard frequencies and related services from its radio station WWV, at Beltsville, Md., near Washington, D. C. The service has been improved and extended, a new transmitting station has been built, 10-kilowatt radio transmitters installed, and additional frequencies and voice announcements added. The services include: (1) standard radio frequencies, (2) standard time intervals accurately synchronized with basic time signals, (3) standard audio frequencies, (4) standard musical pitch, 440 cycles per second, corresponding to A above middle C.

The standard frequency broadcast service makes widely available the national standard of frequency, which is of value in scientific and other measurements requiring an accurate frequency. Any desired frequency may be measured in terms of any one of the standard frequencies, either audio or radio. This may be done by the aid of harmonics and beats, with one or more auxiliary oscillators.

The service is continuous at all times day and night. The standard radio frequencies are:

5 megacycles (=5,000 kilocycles=5,000,000 cycles) per second, broadcast continuously.

10 megacycles (=10,000 kilocycles=10,000,000 cycles) per second, broadcast continuously.

15 megacycles (=15,000 kilocycles=15,000,000 cycles) per second, broadcast continuously in the daytime only (i. e., day at Washington, D. C.)

All the radio frequencies carry two audio frequencies at the same time, 440 cycles per second and 4,000 cycles per second; the former is the standard musical pitch and the latter is a useful standard audio frequency. In addition there is a pulse every second, heard as a faint tick each second when listening to the broadcast. The pulses last 0.005 second; they may be used for accurate time signals, and their one-second spacing provides an accurate time interval for purposes of physical measurements.

The audio frequencies are interrupted precisely on the hour and each 5 minutes thereafter; after an interval of precisely 1 minute they are resumed. This 1-minute interval is provided in order to give the station announcement and to afford an interval for the checking of radio-frequency measurements free from the presence of the audio frequencies. The announcement is the station call letters (WWV) in telegraphic code (dots and dashes) except at the hour and half hour when the announcement is given by voice.

The accuracy of all the frequencies, radio and audio, as transmitted, is better than a part in 10,000,000. Transmission effects in the medium (Doppler effect, etc.) may result in slight fluctuations in the audio frequencies as received at a particular place; the average frequency received is, however, as accurate as that transmitted. The time interval marked by the pulse every second is accurate to 0.00001 second. The 1-minute, 4-minute, and 5-minute intervals, synchronized with the seconds pulses and marked by the beginning and ending of the periods when the audio frequencies are off, are accurate to a part in 10,000,000. The beginnings of the periods when the audio frequencies are off are so synchronized with the basic time service of the United States Naval Observatory that they mark accurately the hour and the successive 5-minute periods.

Of the radio frequencies on the air at a given time, the lowest provides service to short distances, and the highest to great distances. For example, during a winter day good service is given on 5 megacycles at a distances from 0 to 1,000 miles, 10 megacycles from about 600 to 3,000 miles, and 15 megacycles from about 1,000 to 6,000 miles. Except for a certain period at night, within a few hundred miles of the station, reliable reception is, in general, possible at all times throughout the United States and the North Atlantic Ocean, and fair reception over most of the world.

Information on how to receive and utilize the service is given in the Bureau of Standards circular letter, Methods of Using Standard Frequencies Broadcast by Radio, obtainable on request. The Bureau of Standards welcomes reports of difficulties, methods of use, or special applications of the service. Correspondence should be addressed National Bureau of Standards, Washington, D. C.

### MODIFICATION TO MODELS TBA-6 AND TBA-10 TRANSMITTERS

Reports from the field have indicated the desirability of modifying the plate voltage meter (M-111) bypass circuit in order to preclude any further failures of meter M-111 in the model TBA-6 and TBA-10 equipments.

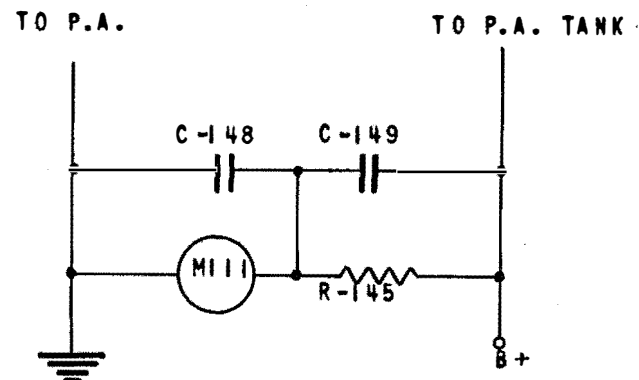


FIGURE 1.—Plate voltage meter bypass circuit for models TBA-6 and TBA-10 transmitters.

It may be seen from figure 1 that the failure of meter bypass capacitor C-149 will short-circuit the meter multiplier resistor R-145, thereby applying the full plate potential directly across the meter M-111.

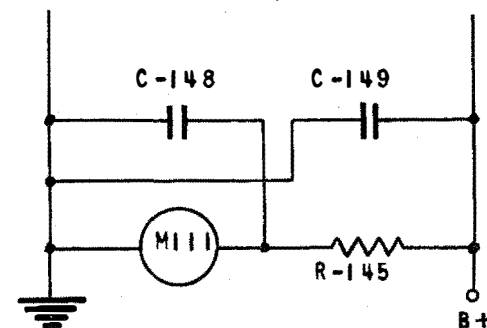


FIGURE 2.—Modified meter bypass circuit.

A simple modification will eliminate this difficulty. The low side of the capacitor C-149 is disconnected and reconnected to ground at the junction of the meter and C-148. Figure 2 shows the modified circuit.

## ANTENNAS FOR SHIPBOARD TBY SERIES EQUIPMENTS

Where TBY equipments are used aboard ship, some semipermanent antenna installation is desirable. The Navy type COA-66089 antenna kit, containing a ground plane vertical antenna together with two lengths of CASSF-50-1 transmission line, has been designed for this purpose. This kit is in the process of manufacture and is expected to be available to the service shortly. However, the quantity immediately available will not be sufficient to meet all demands of the service. Therefore, until such time as sufficient 66089 antennas are available, it is recommended that antennas be constructed in accordance with the following suggestions.

Inasmuch as model TBY series equipments employed aboard ships are to be operated on a single frequency, there are a number of types of antenna installations which are practicable. The use of a  $\frac{1}{4}$  wavelength vertical rod, fed at the end by a transmission line of approximately 50 ohms impedance, or the use of a center fed  $\frac{1}{2}$  wavelength antenna is suggested. Where a  $\frac{1}{4}$  wave length antenna is used, the use of several ground radials, approximately  $\frac{1}{4}$  wavelength in length, or of a ground screen, located immediately beneath the antenna, is suggested. The transmission line employed may be either of the two-wire type or of the coaxial type. It should be cut to an electrical length<sup>1</sup> of a multiple of a half wavelength to minimize reflection loss in the transmission line.

Model TBY-4 equipments incorporate a receptacle for connection to standard CASSF-50-1 flexible concentric cable end fittings. Included with each 66089 antenna kit will be a bracket incorporating a similar receptacle for use with TBY equipments earlier than the TBY-4. Where the type 66089 antenna kit is not available, transmission line connections to TBY series equipments should be made temporarily without alteration to the interior of the set.

<sup>1</sup>For CASSF-50-1 solid dielectric cable, the physical length equals approximately 0.66 times the electrical length.

## CONVERSION OF INACTIVE EQUIPMENT FOR CURRENT USE

In many cases considerable amounts of radio material are lying inactive because of lack of need for the specific equipment as originally designed. Some of this may be subject to minor alterations which will render it suitable for temporary or permanent use in other applications. A good example of this is in the conversion of a model TU-4 shipboard transmitting equipment which was modified by the Radio Laboratory of the Norfolk Navy Yard in order to fill a shore installation need. This equipment has been in successful operation for over a year.

The problem was to convert the original 120-volt D. C. motor for use with the 220-volt 3-phase supply available at the shore establishment. In order to effect this change and secure the necessary A. C. motor drive, a 220-volt, 3-phase, 60-cycle induction motor of 10 hp. rating was mounted on a substantial steel framework over the original D. C. motor. This arrangement is shown in figure 1. The D. C.

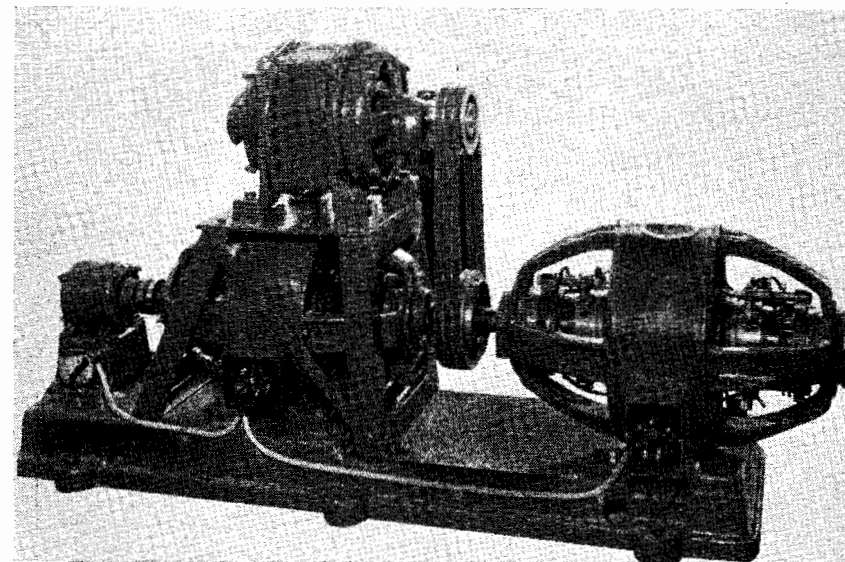


FIGURE 1.—Photograph of converted motor-generator set.

motor was then converted for use as a D. C. generator to supply the necessary field and relay voltages previously drawn from the D. C. shipboard supply. The conversion of the D. C. motor for operation as a generator was accomplished by disconnecting the commutating and series field coils from the circuit and arranging the shunt field coils in series parallel. It was also necessary to modify the commu-



tation area of the brushes. Originally the brushes contacted three commutator bars. Therefore, about one-third of the trailing edge of the two brushes was cut away so that only two bars were contacted during operation. The two brushes were used in the vertical holders, and the brushes in the horizontal holders were permanently removed.

It will be seen from figure 1 that driving coupling between the induction motor and the original D. C. motor is attained through triple V belts running on two, three-grooved pulleys. Since the operating speed of the model TU-4 generator set is 2,400 r. p. m. and since the available induction motor had a speed of 3,400 r. p. m., it was necessary to provide a reduction ratio of approximately 1 to 1.4. This was accomplished by selecting the driving motor pulley with an outside diameter of 6 inches and the pulley for the D. C. motor shaft with a diameter of  $8\frac{1}{2}$  inches. The construction of this latter pulley is such that it forms one-half of a flexible coupling and is attached to the original coupling section on the high-voltage generator. Thus it provides drive to the entire motor generator set. The pulleys and V-belt structure are enclosed in a metal guard which is not shown in figure 1. Remote push-button control and automatic starters are furnished for operation of the A. C. motor.

In order to provide a means for controlling the output of the D. C. generator and for fuse protection in the output circuit, a field resistor and rheostat are mounted on the upper right-hand panel of the transmitter between the plate and filament voltmeters. The variable resistor is a 15-ohm, 25-watt rheostat arranged for knob control on the front of the panel and is connected in series with a 90-ohm, 200-watt semiadjustable resistor which is mounted on the rear of the panel just below the rheostat. This combination is connected in series with the field of the converted generator and provides a limited adjustment of output voltage, to compensate for variations in installation and operating conditions. A 0-150 volt D. C. voltmeter mounted directly above the field rheostat knob indicates the output voltage generated by the converted D. C. motor.

A standard two-circuit fuse block is installed in the transmitter on the back of the lower right hand panel above the terminal board providing protection in both sides of the control voltage line (120 v. D. C.).

## RADAR SECURITY

The following ALNAV is quoted for the information of all radio personnel:

"ALNAV 151. Under no circumstances shall reference to RADAR BE INCLUDED IN ANY RELEASE OF INFORMATION IN SPEECHES OR OTHER PUBLIC COMMUNICATIONS. This applies to all personnel of the naval service irrespective of rank or position. Commanders concerned are directed to request all accredited correspondents to conform with the above by omitting all reference to radar in despatches and articles originated by them. (021330 August 1943)"

Manufacturers of radar equipment have also been directed by the Joint Chiefs of Staff to omit any reference to radar in their advertisements.

(25)

## THE FORUM

AN INFORMAL DISCUSSION OF COMMUNICATION MATERIAL  
MATTERS OF INTEREST TO THE SERVICE

*The purpose of THE FORUM is to provide a means for publishing informal comments by members of the naval service on matters of interest to others in the radio field. These contributions need not have official status, and thus a medium is offered for the expression of personal opinion and observation. Comments, suggestions, experiences, difficulties, and other items concerning radio equipment are welcome at all times. Material of this kind is not only interesting to other radio personnel but is of great value to the Bureau.*

*Contributions may be prepared as informally as desired. They should be forwarded via the commanding officer to the Radio and Sound Bulletin, Bureau of Ships (Code 903), Navy Department, Washington, D. C.*

★ ★ ★

### A NOTE FROM THE FIELD

The following note is from a 173-foot PC in North Africa:

"Yes, the TBS is a great thing. Of course it plays hell with the SW2C, but the two are not usually operating together. The latter is still with us, and has done a damn fine job ever since we left the States; but we hear we're going to get an SJ. I hope we get a radio technician 1c with it, the way we're supposed to. Our lads have done excellently with the knowledge and tools they have; but dammit, they just don't know what goes on in there, except by instinct, and fooling around. And, of course, all casualties occur at sea, when the outfit is needed. But, bless 'em, they fixed everything so far."

★ ★ ★

### USE OF TERM "SILENCER"

The following communication has been received by the RADIO AND SOUND BULLETIN from Lt. Temple V. Ehmsen, U. S. N. R., attached to the Bureau of Ships:

"It is believed the term 'silencer' is incorrectly used in paragraph 2 on page 11 of RADIO AND SOUND BULLETIN No. 7. The term 'noise silencer' as applied to radio receivers is taken to mean a type of noise silencer wherein a hole is actually chopped in the carrier for a very

short time interval during a high noise impulse. A noise silencer does not depend on a carrier for its operation, but acts on carrier variation or superimposed pulses on the carrier, the action depending on the threshold setting. It is an electronic device.

"The word 'squelch' is taken to mean an electronic or mechanical device that is carrier operated; i. e., opens the audio channel with carrier and closes it without carrier.

"In the RADIO AND SOUND BULLETIN article it is a 'squelch' circuit that is described and not a 'noise silencer.'"

★ ★ ★

### TECHNICAL PAPERS

The following technical papers on radio and sound subjects have been listed by the Navy Research Laboratory as received from May 10, 1943, to July 15, 1943. Requests are received from time to time by the Bureau and the Naval Research Laboratory for copies of these papers. However, there are no provisions for circulating the publications containing these articles. This list is published for the purpose of keeping interested personnel informed on the current literature in the field.

(NOTE—Asterisk (\*) preceding entry indicates that an abstract only is available in the library.)

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