RESTRICTED U.S.S. COOK BAY 1168

BUREAU OF SHIPS

RADIO AND SOUND BULLETIN

No. 14

(NAVSHIPS 11. 14 RADIO)

APRIL 1, 1944

RADIO AND SOUND BULLETIN

NAVY DEPARTMENT,
BUREAU OF SHIPS,
April 1, 1944.

MODEL TDQ TRANSMITTING EQUIPMENT

A new series of naval radio transmitting equipment is just coming off the production line and will shortly appear in the Service. The purpose of this article is to very briefly describe some of the aspects of the equipment.

The Model TDQ is designed primarily for communication with aircraft. However, like the TBS series it can be considered as a general purpose, low power transmitting equipment suitable for all line-of-sight communication.

Normal power output is 35 watts with A_2 or A_3 emission. The frequency range of the equipment is between 115 and 156 megacycles with a selection of four crystal-controlled frequencies within this range. Selection of the desired frequency is accomplished by switching to one of the four crystals. Any change of frequency requires retuning of the transmitter. In cases where an immediate shift from one frequency to another or simultaneous transmission on different frequencies is required, the physical size of the equipment permits mounting of two units, one above the other, on a suitable rack.

The main unit is divided into three sections: power supply, modulator, and r-f section. Each of these components is mounted on a separate aluminum chassis. These chassis slide on runners fitted into the main frame, thus permitting easy access or replacement of an entire unit. Interconnection between sections of the transmitter is accomplished by means of plugs and jacks.

Each chassis is provided with a plug board at the rear of the unit which sets into a corresponding jack board mounted on the frame. Two substantial centering pins at the back of each chassis position themselves in corresponding holes in the main frame when the chassis is slid into place. Access to the various components without removal from the transmitter is accomplished through the removal of the side and rear shields of the frame.

The power supply consists of a rectifier which may be connected directly to a 115 or 230 volt, single phase, 50 to 60 cycle power line. By means of a line transformer, it is also possible to operate on 440 volt, single phase, 50 to 60 cycle power line. In cases where the units are to be operated from 115 or 230 volt d. c. power source, motor generator sets with associate magnetic controllers must be provided. The nominal power requirement is approximately 600 watts in locked key operation or 225 watts stand-by. The power chassis contains both the high voltage power supply and the 12 volt supply for the microphone and control circuits.

As a complete unit, the TDQ operates with an associate receiver, the RCK. An antenna transfer relay included in the transmitter unit permits operation of both the TDQ and RCK equipments on a common antenna. The antenna provided is a half-wave dipole and the assembly includes a concentric matching section in order to properly couple the antenna to a 50-ohm transmission line.

Tube complement

Function	Number of tubes	Type
Crystal oscillator	1	807.
First tripler	1	829.
Second tripler	1	829.
Power amplifier	1	829.
Audio amplifier	2	6SK7.
Audio amplifier	2	6J5.
Modulator	2	807.
Limiter rectifier	1	6X5–GT.
Audio oscillator and carrier control	1	6SN7–GT.
Low voltage rectifier	1	5R4–GY.
High voltage rectifier	3	5R4–GY.
Total	16	

List of major units

Unit	Type No.	Height	Width	Depth	Weight
		Inches	*Inches*	*Inches*	*Pounds*
Transmitter-rectifier	CRV–52328	32 7/32	25 1/4	18 23/32	285
Line transformer	CRV–30984	13 3/4	10 7/8	8 7/8	50
Antenna assembly	CRV–66095	24 7/32	46 1/2	4 3/4	23
Microphone	–51004C.				

Auxiliary power units

Unit	Type No.	Height	Width	Depth	Weight
115V. d. c. units:		*Inches*	*Inches*	*Inches*	*Pounds*
Motor generator	CG–211092	11 5/8	27 3/8	13 3/8	160
Magnetic controller	CG–211090	20 27/32	27 25/32	12 61/64	60
230V. d. c. units:					
Motor generator	CG–211093	11 5/8	27 3/8	13 3/8	160
Magnetic controller	CG–211091	20 27/32	17 15/32	12 61/64	60

THE MODEL RCK RECEIVING EQUIPMENT

The Model RCK receiving equipment for use with the Model TDQ transmitter will constitute a new equipment of interesting design. Its delivery to the service will begin in the near future.

This receiver will be the first of a new series of equipments in which the I. F., audio, and power sections will be of standard design with only the R. F. section varying from model to model. Since within certain frequency ranges the audio and power requirements are essentially the same for all receivers, the idea of standardizing these portions suggests itself. Such standardization has many advantages. It provides uniform equipment to the Service, simplifies supply and maintenance, and permits the manufacturer to concentrate on the design of the radio frequency section of the receiver only, without the necessity of redesigning the remainder of the circuits.

The RCK is a superheterodyne receiver capable of receiving signals on any one of four crystal-controlled frequencies in the range of 115 to 156 megacycles. It is designed to receive only voice or modulated C. W. It will operate from 110, 115, or 120 volt, single phase, 55–65 cycle power.

The R. F. section occupies the left portion of the main chassis. Runners permit ready access to or change of the entire unit. This preselection unit contains one tuned r. f. stage, the four crystals, local oscillator and multiplier circuits, and first detector. A single tuning control operates seven tuned circuits. This control has four mechanical detents which are preset in accordance with the frequencies of the crystals being used. Once set, the change from channel to channel is rapidly accomplished. Select the desired crystal by means of the CHANNEL switch. The tuning control is then turned until the proper mechanical detent is reached which is signaled by the lighting of one of four pilot lights. These channel lights simultaneously indicate proper tuning and provide easy determination of the channel on which the receiver is operating. The tuning control has two dial scales, one reading frequency and the other providing a linear scale. A DIMMER control permits variation of both channel and dial lights.

The audio and I. F. sections occupy the middle portion of the cabinet. This section is carefully engineered to permit a logical sequence of stages and the use of terminal strips to mount resistors and capacitors. As a result, wiring is direct, possibility of error in wiring is minimized, and all components are readily accessible for service. This section of the receiver contains five I. F. stages, a second detector and noise peak limiter, a silencer-amplifier, a silencer diode, and three audio stages.

The controls in this section are as follows: a switch marked NOISE LIMITER AND OUTPUT METER has four positions, (1) both noise limiter and output meter "off", (2) noise limiter "on", output meter "off", (3) noise limiter "off", output meter "on", and (4) both "on". A control marked PHONES varies the output at the monitor phone jack thus permitting the operator to control the volume of signal in his phones irrespective of the output power of the receiver. A control marked SILENCER varies the level at which this circuit operates. An AF BAND switch permits selection of narrow and wide response. AF GAIN, RF GAIN, and POWER complete the controls. In addition, there are three front panel meters: plate voltage, an output meter calibrated in decibels, and an input meter to measure the carrier level.

There are three receptacles grouped at the rear corner of the chassis: A. C. input, audio output, and a receptacle to permit remote on and off control of the silencer. All receptacles are carefully filtered.

Tube Complement

Number	Type	Function
1	956	R. F. amplifier.
1	717A	Converter.
2	717A	Multipliers.
1	6N7	Crystal oscillator-multiplier.
5	6AB7	I. F. amplifiers.
1	6H6	2d detector and noise peak limiter.
1	6AB7	Silencer-amplifier.
1	6H6	Silencer-diode.
2	6AB7	Audio amplifiers.
1	6V6GT	Audio output amplifier.
1	5U4G	Rectifier.
1	VR150/30	Voltage regulator.

☆ ☆ ☆

ANESA

Coordinating Agency for Bureau of Ships Signal Corps Specifications

ANESA is the designation of the comparatively new official group, Army-Navy Electronics Standards Agency, which will be responsible for the joint standardization and simplification of military and naval radio component parts. The actual work of joint standardization has been carried on for over a year by Bureau of Ships and Signal Corps' representatives, in collaboration with the American Standards Association and W. P. B., and has resulted in about 20 published specifications, with many more to follow shortly.

By a directive of Rear Admiral E. W. Mills, Assistant Chief of the Bureau of Ships, and Maj. Gen. H. C. Ingles, Chief Signal Officer, ANESA was established effective 17 December 1943, and was given

the responsibility and authority of coordinating the communication equipment component specifications of both services. The specifications will then be processed independently by the Bureau of Ships and Signal Corps through approved channels to the Joint Army and Navy Committee on Specifications for approval as JAN (Joint Army-Navy) specifications.

ANESA operates under the direction of two codirectors; namely, Col. G. C. Irwin, U. S. A., designated by the Signal Corps, and Commander Paul G. Haas, U. S. N., designated by the Bureau of Ships, with offices at No. 12 Broad Street, Red Bank, N. J. Colonel Irwin is also the Commanding Officer of the Signal Corps Standards Agency, and Commander Haas is the Senior Naval Representative at that agency.

After the issuance of specifications, Army and Navy laboratory facilities are being pooled for qualification testing of components and materials. All applications by manufacturers for the submission of test samples for "qualification approval" under joint specification are forwarded to the Army-Navy Electronics Standards Agency, Red Bank, N. J. Distribution of samples to the appropriate testing laboratories is made in accordance with plans agreed upon within ANESA.

Test reports, prepared by the Army or Navy laboratories, are reviewed by the Signal Corps Standards Agency and the Bureau of Ships. Action is taken to establish independent listings of approved components and materials with manufacturers thereof.

The use of joint specifications and the practice of joint qualification testing creates a workable basis for joint inspection at the component manufacturer's plant. This is actually in operation at several plants, where inspection forces and facilities are cut in half by designating one group of inspectors to check the entire production for all Army and Navy contracts.

The entire content of each of these Joint Army-Navy (JAN) specifications represents the consensus of those commercial and Government activities which have a substantial interest in the specification scope and provisions. The objective in preparing JAN specifications is to attain the unification of the standards of the cooperating activities in order to facilitate procurement of standard types, sizes, and ratings of electronic components in large quantities. The use of such standard components, rather than nonstandard or special components, wherever possible in electronic equipment of the Armed Services is strongly recommended and will provide the following advantages:

A. The coordination of production between different plants will be expedited. The control and scheduling of components to equipment manufacturers can be accomplished on a more flexible basis.

B. A terminology is provided, irrespective of the manufacturer or Armed Force involved, which accurately describes each particular component and its essential characteristics, and the methods of testing and measurement of such characteristics.

C. Accrued stocks of components, both in the United States and in the field, will be readily usable if provided with jointly accepted Army-Navy standard markings, nomenclature, and color coding, for common sizes, ratings, and performance requirements.

D. A unified set of minimum acceptable quality requirements is presented for the guidance of component manufacturers, equipment prime-contractors, and equipment project engineers of the Armed Services.

E. The number of sizes and types, variety of manufacturing processes, amount of stock (spare parts), and necessary associated paper work will be reduced.

F. Production losses due to defects, over-runs and inadequate tooling (incidental to odd-lot manufacture) will be minimized, because large-scale production of standard designs will make better tooling, more careful design, more adequate quality control, and the concentration of factory processes on a smaller number of types, both feasible and economical.

G. Forecasts of requirements for standard components will be more readily obtainable, and large-quantity procurement will be made less burdensome.

Joint Army-Navy Specifications

	ASA No.	JAN No.
RESISTORS		
Fixed composition resistors	C75. 7–1943	JAN–R–11.
External meter resistors (ferrule type)	C75. 5–1943	
Variable W. W. res. (low oper. temp.)	C75. 10–1944	JAN–R–19.
Power W. W. rheostats	C75. 9–1944	JAN–R–22.
CAPACITORS		
Fixed mica-dielectric capacitors	C75. 3–1942	JAN–C–5.
Ceramic dielectric capacitors	C75. 12–1944	
INSULATORS		
Steatite radio insulators	C75. 2–1943	JAN–I–8.
Glass-bonded mica radio insulators	C75. 6–1943	JAN–I–7.
Glass radio insulators	C75. 8–1943	JAN–I–9.
Porcelain radio insulators	C75. 14–1944	
Ceramic radio ins. material, class L	C75. 1–1943	JAN–I–10.
Ceramic radio dielec. material, class H	C75. 4–1943	JAN–I–12.
MISCELLANEOUS		
Crystal units CR–1( )/AR	C75. 11–1944	JAN–C–16.
Electrical indicating inst. (2½″ and 3½″ meters).	C39. 2–1943	JAN–I–6.
Shock-testing mech. for elect. ind. inst	C39. 3–1943	
Ammeter shunts	C39. 5–1943	
R. F. thermocouple converters (dimensions)	C39. 4–1943	
Dynamotors	C75. 13	JAN–D–24
Toggle switches	C75	JAN–S–23.
Batteries, dry		JAN–B–18.
Radio frequency cables		JAN–C–17.

H. Equipments in the development stage can be supplied with components from stocks of standard components, thereby enabling designers to employ components satisfactory to the Armed Forces from the start of a design project, and relieving component manufacturers from troublesome rush orders for special items.

I. Installation and maintenance work of the Armed Service will be simplified, both by a reduction of the number of types of replacement components, and by the interchangeability of the Army and Navy components.

J. "Spot" and contractual testing, and the reports, correspondence, conferences, and laboratory equipment and personnel required therefor, will be reduced, both for industry and Government agencies, through the establishment of a unified qualification testing program.

Detailed instructions with regard to the applications of these standards and specifications will be furnished upon request to the Bureau of Ships, Code 930. Copies of the specifications are available from Bureau of Ships, Code 930D.

☆ ☆ ☆

BROADENING SELECTIVITY ON MODEL RAS SERIES RECEIVERS

A limited number of sets of I. F. transformers are being made available at the New York and Mare Island Navy Yards for the purpose of replacing a portion of those in the present model RAS series receivers in use at NAS control towers.

These new transformers were designed to have a square-topped wide pass band which provides a total band width of 13.5 KC. at 6 db. and 51.5 KC. at 60 db. attenuation respectively. This is to correct a noted sharpness in the tuning of the present receiver which is especially noticeable at ground stations contacting off-frequency aircraft using A_3 emission.

The model RAS series modification kits are available to radio material officers under contract NXss–24547 by requisitioning them from New York and Mare Island Navy Yards. These kits contain:

(*a*) Two I. F. transformers, navy type CNA–47340.
(*b*) One I. F. transformer, navy type CNA–47341.
(*c*) Capacitor, navy type CAW–481072.
(*d*) Nameplate which bears the navy type number CNA–46080–A.

The need has already been met in some yards by such means as over-coupling and staggering the I. F. tuning. This can be done by adjusting the transformer tuning while using a wobbulated signal and oscilloscope such as with navy model LP and type CTU–60018 equipments.

Another method is through over-coupling all I. F. transformers, changing the grid connections on the first and second I. F. transformers

576762—44——2

from a tap to the end of the coils, and shunting a suitable resistor across the primary of the third I. F. transformer. This method is fully described as follows:

(*a*) Three intermediate-frequency coils are removed from the shield cans and the coupling is increased by decreasing the distance between the primary and secondary coils from 1½ inches to 7/16 inches. It is necessary to apply heat to the porcelain coil form to accomplish the movement of the primary coil.

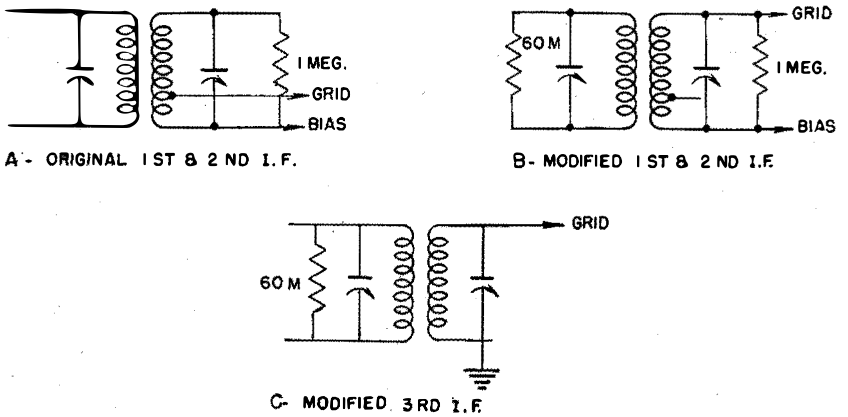


FIGURE 1.—Schematic diagrams of I. F. stages before and after modification.

(*b*) The secondaries of the first and second stage intermediate frequency transformers have a tap to which the grid is connected in the original installation as shown in figure 1a. The grid connection is removed from this tap and attached to the extreme end of the coil which is connected to the stator plates of the trimmer condenser as shown in figure 1b.

(*c*) One-half-watt resistors of 60,000 ohms are connected in parallel with the primary circuits of each intermediate frequency stage. (See figs. 1b and c.)

(*d*) Selectivity before and after modification is shown in figure 2.

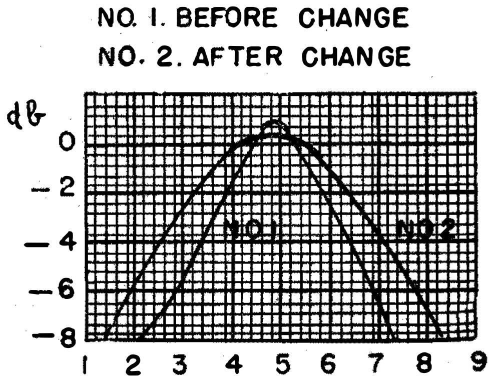


FIGURE 2.—Selectivity of the receiver before (No. 1) and after (No. 2) modification.

CHANGES IN STANDARD FREQUENCY BROADCAST SERVICE OF NATIONAL BUREAU OF STANDARDS

Two changes beginning February 1, 1944, are announced in the standard frequency broadcast service of the National Bureau of Standards. One is the addition of a new radio frequency, 2,500 kilocycles per second, at night. The other is omission of the pulse on the 59th second of every minute. The entire service is described here. It comprises the broadcasting of standard frequencies and standard time intervals from the Bureau's radio station WWV near Washington, D. C. The service is continuous at all times day and night, from 10-kilowatt radio transmitters. 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.

At least three radio carrier frequencies are on the air at all times, to insure reliable coverage of the United States and other parts of the world. The radio frequencies are:

2.5 megacycles (=2,500 kilocycles=2,500,000 cycles) per second, broadcast from 7 p. m. to 9 a. m., E. W. T. (2,300 to 1,300 GMT).

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

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

15 megacycles (=15,000 kilocycles=15,000,000 cycles) per second, broadcast from 7 a. m. to 7 p. m., E. W. T. (1,110 to 2,300 GMT).

Two standard audio frequencies, 440 cycles per second and 4,000 cycles per second, are broadcast on the radio carrier frequencies of 5, 10, and 15 megacycles. The audio frequency 440 cycles only is broadcast on 2.5 megacycles. The 440 cycles per second is the standard musical pitch, A above middle C; the 4,000 cycles per second is a useful standard audio frequency for laboratory measurements.

In addition there is on all carrier frequencies a pulse of 0.005-second duration which occurs periodically at intervals of precisely one second. The pulse consists of five cycles, each of 0.001-second duration, and is heard as a faint tick when listening to the broadcast; it provides a useful standard of time interval, for purposes of physical measurements, and may be used as an accurate time signal. On the 59th second of every minute the pulse is omitted.

The two 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 a detailed announcement is given by voice.

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. Reliable reception is in general possible at all times throughout the United States and the North Atlantic Ocean, and fair reception throughout the world.

☆ ☆ ☆

DESIGN REQUIREMENTS FOR THE ELIMINATION OF NOISE AND INTERFERENCE FROM AIRCRAFT RADIO COMMUNICATION EQUIPMENTS

INTRODUCTION

The Aircraft Radio Section of the Bureau of Ships has been carrying on an exhaustive program of research in an attempt to uncover the fundamental principles underlying the degrees of noisiness of aircraft communication receivers or transmitters.

Numerous radio manufacturers were consulted and their accumulated information based upon years of experience was tapped. The scientists of the Psycho-Acoustical Laboratory, Harvard University, Cambridge, Mass., generously offered the results of their investigations on the audio systems of the equipments. The Naval Research Laboratory was responsible for the testing and verifying the theoretical results in the laboratory, and the Naval Air Station, Patuxent River, with the cooperation of the Bureau of Aeronautics, carried on all the necessary flight tests.

Although the investigation is far from complete, the urgencies of immediate production have required a definite set of requirements to govern the noise free design of equipments which are now being manufactured. As a stop-gap measure, Bureau of Ships Specifications RE 13A 845A was written and issued. It should be noted that this specification covers communications equipments up to but not over 28 mcs. This division about the 28 mcs. point is necessary from the design viewpoint because the noise problems above 28 mcs. are different from those below 28 mcs. The factors which predominate at the higher frequencies are as a rule negligible at the lower frequencies and vice versa.

It is believed that if the men in the field become more acquainted with the way in which the design engineer analyzes the noise problem and the preventive measures he tries to work into the equipment design, they will be in a very desirable position to seek out the cause of the noise and apply preventive measures in a scientific rather than a cut-and-try way. It is with this purpose in mind that the following is written.

NOISE SOURCES

There are several entry paths by which radio frequency noise can be conducted into aircraft communications receivers. These paths are as follows:

(*a*) *Antenna.*—Radio frequency radiated noise field in the vicinity of the antenna lead-in, if of sufficient field strength, will induce noise voltages at the input of the receivers and therefore will result in audio noise output at the headphones.

(*b*) *Power supply.*—Radio frequency noise voltages generated by the power supply and conducted into the receiver by the direct current power cable, will excite tuned circuits in the receiver and will pass through several amplification stages along with the desired signal, thereby producing noise output at the headphones.

(*c*) *Headphones and cords.*—Radio frequency radiated noise field in the vicinity of the headphone cords, if of sufficient field strength, will induce radio frequency voltages which by numerous conductive paths are passed to one of the earlier amplifier stages, detected and then introduced to the receiver output as an audio noise.

(*d*) *Inadequate shielding by receiver case.*—Strong radio frequency fields incident upon the receiver case induce in the receiver case currents which in turn produce a radiation field of their own. If the receiver case is a good conductor without any discontinuities in its conductive property, the radiation fields within the case produced by the currents flowing in the case cancel out; if this cancellation is incomplete, a resultant radiation field will appear in the region enclosed by the case. This resultant field may induce noise voltages which mix with the received signal in any of the amplifier stages and thereby produce noise in the audio output of the receiver.

No quantitative index indicative of the quality of shielding offered by the receiver case has been determined. However, a qualitative estimate of the shielding integrity of the receiver case may be obtained by placing the receiver in a strong field (approximately 1 volt per meter) of wave length equal to about four times the shortest dimension of the receiver case and listening to the noise in the audio output.

COUPLING FACTOR IN RECEIVERS

In order to prevent noise from entering the receiver by any one of the above conduction paths it is necessary to design the receiver in such a way that these noises are attenuated before they can reach any noise-sensitive circuit within the equipment. A quantitative index of the degree of noise rejection which a particular noise entry path offers to conducted radio frequency noise is the "coupling factor".

Coupling factor is defined as the ratio of the r. f. voltage at the antenna to the r. f. voltage at the circuit under test which will produce constant output from the receiver.

In order to measure the coupling factor of the power input circuit of a receiver, the following measurements are made. Using the set up of figure 1A, an r. f. signal source is coupled to the receiver's antenna

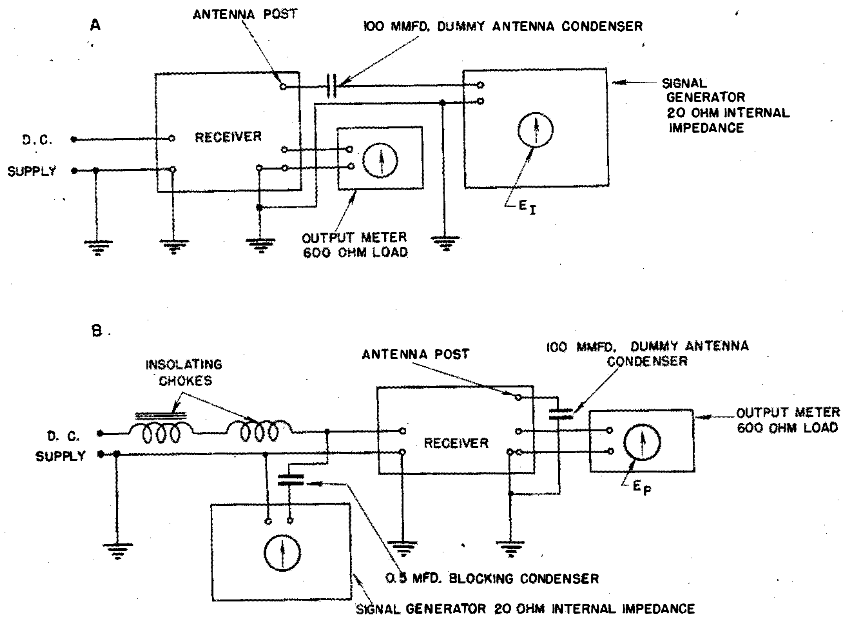


FIGURE 1.—Connections for measuring coupling factor of receiver power circuits.

post through a 100 micro-microfarad condenser. With receiver controls set at "manual control", MCW, and full gain, the r. f. voltage is increased until the output meter reads at least 12 db. above the receiver noise level. For this purpose the signal generator output is modulated 30 percent with 400 cycles per second. Designate the signal generator output as E_i. The signal generator is now coupled to the D. C. power supply line through a 0.5 mfd. condenser as shown in fig-

ure 1B. The isolating chokes in series with the D. C. power supply should have a minimum impedance of 100 ohms at the radio frequency being supplied by the signal generator. The voltage output of the signal generator is increased until the output meter reads the same as in circuit of figure 1B. Designate this output as E_p. The coupling factor N_p is defined as

$$N_p = \frac{E_i}{E_p}$$

It is seen that the lower the value of the coupling factor of a given circuit, the better insulated is the receiver against noise from this conduction path.

In actual practice, it is desirable to keep the power input coupling factor below 0.001. Assuming that this coupling factor has been realized and assuming further that 0.5 microvolts is the maximum tolerable noise voltage at the antenna, then it is seen that the noise voltage must be less than 500 microvolts.

$$E_p = \frac{E_i}{N_p}$$

$$E_p = \frac{.5}{.001} = 500 \text{ microvolts}$$

By similar means the coupling factor of the audio circuits may be measured. Figure 2 shows the circuit corresponding to figure 1B of the previous case. The maximum desirable audio coupling factor is also 0.001.

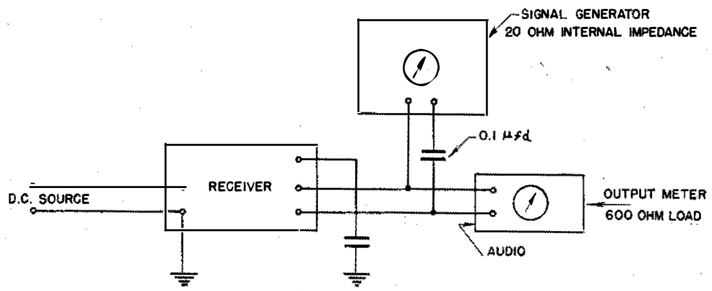


FIGURE 2.—Connections for measuring coupling factor of receiver audio circuit.

COUPLING FACTOR IN TRANSMITTERS

In most aircraft communications installations, the transmitter and receiver are operated from a common antenna which is automatically switched by an antenna switching relay from the transmitter output circuit to the receiver input circuit or vice versa depending upon whether a message is being sent or a signal being received.

In the receive position of the antenna switching relay, the antenna is connected to the input circuit of the receiver. In spite of this, if sufficiently strong R. F. noise voltages are introduced by the transmitter or its power supply into the antenna switching relay, they will induce voltages at the receiver antenna post, thereby causing noise signals to pass into the receiver along with the desired signal. It is therefore fundamental in any noise and interference elimination program to prevent the appearance of R. F. noise voltages at the antenna switching relay due to the transmitter, its power supply, or any of its components.

A desirable method of preventing the transmitter power supply from producing interference noise voltages at the receiver antenna post for the receiver position of the antenna switching relay is to attenuate the noise voltages introduced to the transmitter by the transmitter power supply before these voltages enter the transmitter. This is tantamount to specifying a low coupling factor for the transmitter power input cable.

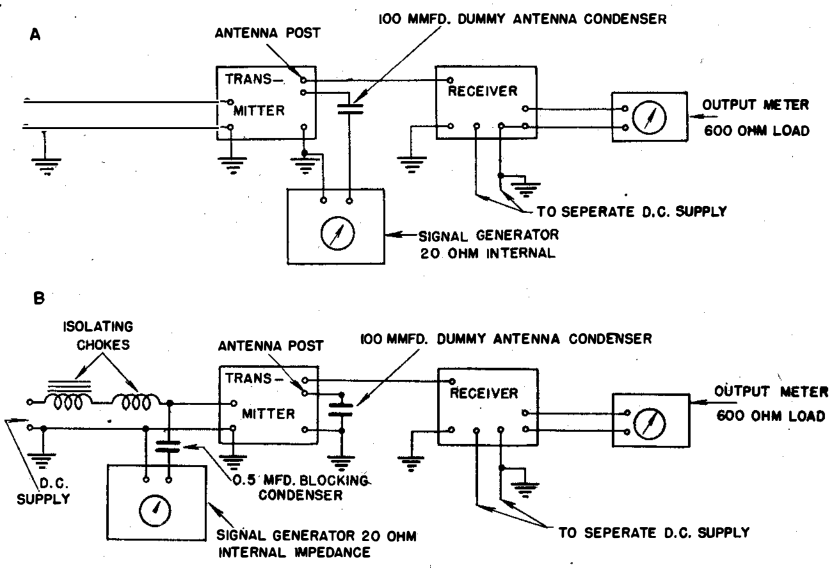


FIGURE 3.—Connections for measuring coupling factor of transmitter power circuits.

In making tests for power input coupling factor the complete transmitter-receiver equipment shall be installed for normal break-in operation and shall be kept in the receiver or standby position. The connections are shown in figure 3A and B.

In this particular case, coupling factor is the ratio of the signal injected into the antenna to that injected into the power input cable to produce a fixed audio output from the receiver.

REMEDIAL MEASURES

The schemes of keeping the coupling factors of the noise entry paths into a receiver below a specified value and maintaining the shielding integrity of the receiver case are preventative measures. In order to obtain a high degree of noise-free operation, certain remedial measures must also be taken.

One of the remedial measures is the proper shaping of the audio frequency response curve so as to pass only those audio frequency components which contribute the most to the intelligibility of the received message.

The noise level inside naval aircraft is high. Because of weight consideration, noise padding cannot be used to keep out propeller and wind noise. An analysis of the ambient noise energy distribution with respect to frequency was determined by actual measurements performed in a variety of military aircraft. It was found that the noise was much more intense at low frequencies, say 200 cps., than at medium audio frequencies, say 1,000 cps. In other words, the frequencies below 200 cps. are the ones that contain most of the ambient cabin noise. It was reasoned that if the audio characteristics of the aircraft transmitters were shaped so as to cut off sharply all frequencies below 200 kcs. and above about 3,500 cps., the more intense ambient noise frequencies would not be transmitted in spite of the fact that they would fall upon the microphone along with speech.

Another remedial measure is the use of a noise limiter which reduces atmospheric noises which enter the receiver through the antenna. A noise limiter is simply a nonlinear circuit arrangement which chops off modulation peaks which exceed a certain predetermined level. This predetermined level is usually taken as the 30 percent modulation level.

In addition to preventing RF noise from entering the receiver, and mitigating its effects once it has leaked into the receiver, it is necessary to take restriction measures to make sure that the receiver (or transmitter) is not itself a source of noise or interference. The frequency conversion oscillator of a superheterodyne receiver is a prolific source of RF interference which invariably reaches the antenna through numerous conduction paths. If another receiver is simultaneously operating from this same antenna, it is easy to see that the interference from the oscillator of the first receiver is fed into the input of the second receiver.

MODIFICATION TO MODEL TBS SERIES EQUIPMENTS

Reports have been received of the failure of the receivers of TBS, TBS-1, TBS-2, and TBS-3 equipments to operate in the 65–69 megacycle range. The immediate conclusion that the crystal of the local

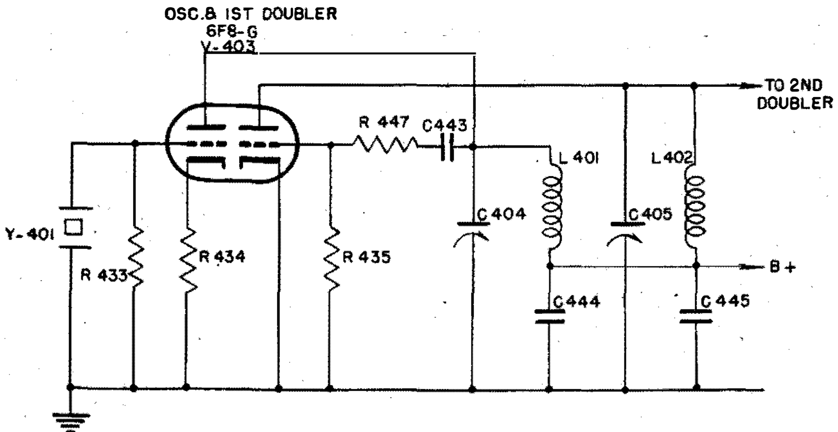


FIGURE 1.—Oscillator and 1st doubler of TBS receiver.

oscillator has failed turns out to be incorrect. Figure 1 is a schematic of the oscillator and first doubler stage. The true cause of the trouble lies in the absorption circuit formed by the two capacitors C-444 and C-445 and the inductance of the connecting leads. The difficulty is remedied by placing a resistance in the circuit as shown in figure 2.

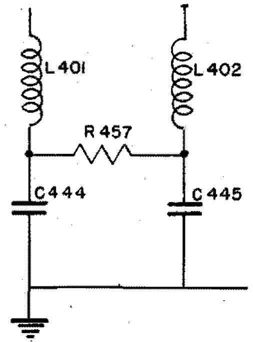


FIGURE 2.—Modification to eliminate absorption by replacing direct connection with resistance.

The modification may be made in the field by using a spare resistor R-437 (270 ohms±10%, ½ watt, Navy type—63360). Many TBS-3's have had this resistor added at the factory, but some TBS-3's and all earlier models will require the change.

INSTRUCTIONS ON VACUUM TUBES

Instructions relating to vacuum tubes published in Radio and Sound Bulletin No. 9 have been changed somewhat. Particularly sections on failure report forms have been modified. In order to supply the latest information and to provide reference for the activities which do not have Bulletin No. 9, the entire instructions are reprinted.

Allowances.—The exact quantity of vacuum tubes to be carried as spares at any radio station ashore or afloat shall be determined by the officer responsible for the maintenance of that station. Where practicable, it is suggested that established allowances be maintained. Vessels expecting to be absent from sources of supply of vacuum tubes for relatively long periods of time, as in extended special duty, should carry sufficient tubes to insure unbroken communication and search facilities.

Guarantees—Service Life.—(1) In the case of tubes covered by the Service Life Guarantee, the actual life of each tube must be determined in service operation. Such tubes are identified by the fact that there is imprinted on the tube itself and on its container the contract number, the serial number, and the number of hours guaranteed. Service-Life Guaranteed tubes are usually expensive, new developments, or of an unconventional design, hence ordinary receiving and low power transmitting tubes are not included in this classification. In general, to be eligible for adjustment under the guarantee a defective tube must have failed due to a manufacturing defect, or have rendered less service life than that for which guaranteed, within 24 months from the date of its acceptance by an inspector of naval material, and must be returned to the contractor within 30 months after its acceptance by the inspector of naval material. This date of acceptance is indicated on the tube containers, and should be recorded after "Date accepted" on a failure report form N. B. S. 304 (Rev. Sept 43) before the container is destroyed.

(2) The life of tubes purchased under Life Rack Guarantee is determined by life rack tests of random-selected samples conducted by the tube manufacturer. Any deficiency in life indicated by these life tests is compensated for by the contractor. Consequently, tubes purchased under this guarantee have no adjustment value upon becoming unfit for further use and except in the case of abnormal recurrent failures, may be destroyed in accordance with current instructions.

(3) In certain instances, where life rack tests are not practicable and Service Life Guarantees are not justifiable, vacuum tubes are purchased without guarantees.

Records.—Ships and stations shall maintain vacuum tube records for determining the service life for each tube covered by a Service Life Guarantee. Where life-hour meters are not provided, records should be maintained to enable a fair approximation of the service life.

Forms.—When tubes covered by a Service Life Guarantee are transferred or returned to stock for reissue, any pertinent life data shall be passed on with the tubes.

Classification.—For accounting purposes, vacuum tubes are classified according to value. Tubes valued at $5 and under are classified as title "C" and those valued at more than $5 are classified as title "B".

Report of Failures.—Except as noted in article below, all vacuum tubes may be destroyed immediately on failure. Complete failure reports should be submitted only when the tube is covered by a Service-Life Guarantee and has failed within the guarantee period. Normal failures of conventional tubes and failures of tubes covered by Service Life Guarantee outside the guarantee period need not be reported at all.

Special Failure Reports.—Other failures to be reported are recurrent abnormal failures of conventional types of tubes, all failures of special Radar tubes, and failures of tubes of the class of types 849, 851, 561, and larger. Types of tubes considered in the category of "Special Radar Tubes" and on which failure reports are desired are listed in the Radar Maintenance Bulletin. However, since many of such tubes are not covered by Service-Life Guarantees, and also are of new design or operated under unusual conditions, failure reports are for the Bureau's engineering information only. Accordingly, ONE COPY ONLY of the failure report form NBS 304 shall be submitted to the Bureau of Ships, Radio Division, Washington, D. C. N. B. S. 383 shall not be used to report vacuum tube failures when vacuum tube failure report forms are available unless specifically requested by the Bureau. Attention is invited to the fact that forms N. B. S. 304 (revised September 1943) (N. ENG. 204) have no security classification. Hence military information, such as fixed frequencies, should not be disclosed. However, failure due to shock from own gunfire should be stated. In cases of recurrent abnormal failures, it is desirable that representative samples (not more than three of each type, unless specifically requested) of such tubes be retained for return to the tube manufacturer or Naval Research Laboratory, Electronics Section, Anacostia, D. C. for engineering information. The failure reports should give all details surrounding failure. The Bureau will then direct disposition of such tubes.

Surveys.—Survey reports for tubes covered by Service-Life Guarantee shall state the type, contract number, serial number, guaranteed hours, and life hours obtained for each tube surveyed, in addition to the other information required to be submitted in the survey. The fact that survey has not been completed or finally been approved shall not prohibit requisitioning of replacement tubes.

Rentention and Disposal of Certain Types or Radiators.—The only tubes that are to be retained after failure are those with exterior metal anodes, those indicative of abnormal recurrent failures, and those specifically requested by the Bureau (this does not mean conventional "metal" tubes or magnetrons). In many cases, such tubes can be reclaimed by the manufacturer, and shortage of material, such as are used in the anodes and radiators, causes such tubes to have high salvage value. Tubes so retained are to be turned into the nearest naval shore supply activity for eventual return to the manufacturer. These activities shall periodically inform the Bureau of Ships (Radio and Sound Division) of the quantity of each type received, whereupon instructions will be issued for their disposal. Since certain of these types are of classified nature, proper security shall be maintained by all activities handling such tubes. The fact that such a tube has been retained for return shall be stated on the failure report, and in survey report, if made. *These Instructions do not apply to magnetrons. Disposition of burnt out and defective magnetrons shall be in accordance with the instructions outlined on pages 4–5 of Radar Maintenance Bulletin, Issue #9 or subsequent revision thereof. It is imperative that the secrecy of magnetrons be carefully safeguarded.*

Demolition of Vacuum Tubes.—When destruction of vacuum tubes is effected, they shall be completely demolished by shattering the envelope and tube elements. Any common "metal" tubes demolished shall have the vacuum destroyed by opening the envelope. This is necessary to assure that the tube will sink immediately after being thrown overside.

Circulation of Stocks.—Tubes should not be allowed to remain indefinitely in storage or inactive. Little used tubes including those in emergency equipment, should be advanced, if practicable, from such location into active equipment as replacements are required. The oldest material should be placed in active service prior to tubes having subsequent dates of acceptance.

Testing.—Each new tube received by a ship or shore radio station shall be tested immediately upon receipt. All activities shall test at least quarterly all vacuum tubes covered by Service Life Guarantee, including spare tubes and tubes held in store. Tubes should be tested preferably in standard equipments under rated operating conditions, which will provide the best indication of gas and general tube condition. Since this method is not practicable for tubes carried in stock status at supply activities; tests in this case should consist of filament continuity check and a test for gas (except for mercury and gas-filled rectifiers), employing the vacuum tube gas detectors (violet-ray generators) where available. Tests should be conducted by qualified technical personnel.

Departures from Instructions.—Since the exigencies of the service do not always allow complete compliance, it is suggested that those responsible for the carrying out of the instructions use discretion in so doing. Departures from these instructions will be acceptable to the Bureau where conditions make compliance impractical.

☆ ☆ ☆

FINAL INSTRUCTION BOOK DISTRIBUTION

It has always been a considerable problem to place final instruction books in the hands of holders of preliminary editions. Accordingly, the plan of using radio material offices as decentralized points of distribution has been instituted as outlined in Radio and Sound Bulletin No. 13.

The following list represents final instruction books which have been forwarded in bulk to Radio Material Officers for redistribution. Holders of preliminary editions should make replacement.

LM–11.	TBK–8/10.
DP–14–15–16–17.	DAG.
TBK–12	WEA.
QCL–7/QCJ–8.	NJ–3/NJ–9.
TCA–1.	

☆ ☆ ☆

DISTRIBUTION OF "NOTES ON SERVICING" AND "SOUND MATERIAL HANDBOOK"

The publications "Notes on Servicing Radio and Sound Equipment" and "Sound Material Handbook" are now being distributed by the Bureau of Ships instead of by the headquarters of the Commander-in-Chief (Tenth Fleet). Requests for copies of these publications should be addressed to the Chief of the Bureau of Ships (Code 903), Navy Department, Washington 25, D. C.

CORRECTION OF MICROPHONE JACK WIRING ON MODEL TCM–2 EQUIPMENTS

(Serial Nos. 1 to 204, inclusive)

Due to an error made by the manufacturer, the wiring of the microphone jack on the subject transmitters is incorrect. The result will be no modulation when using the microphone sent with the equipment. The schematic diagram W7351924 (Rev. O); the connection diagram W7351920 (Rev. 1) and the microphone diagram M48J580 are all correct as shown in the instruction book.

Please make the necessary connections as follows:

1. Remove 4 screws holding the jack assembly to the front panel, and pull assembly forward. This jack assembly is found on the lower right hand side of the front panel.
2. Reverse orange and green wires on center (microphone) jack. This makes wiring agree with connection diagram. No other wiring changes are required.

Tools required are a small screwdriver, a long-nosed pliers, and a soldering iron.

☆ ☆ ☆

TEST DATA FOR THE MODEL OQ SERIES VACUUM TUBE TESTING EQUIPMENT

In the following tables information is given for testing a large number of tubes not described in instruction books of the Model OQ series vacuum tube testing equipment. The combination of this and existing lists should provide tests for nearly all receiving tubes in naval use at present.

The Bureau should be notified of any additional tube types which may be encountered in the service in order that test data may be secured.

No tests are available for thyratrons, cold cathode rectifiers, etc. Data has not been prepared on 6T5, 6W6GT, 6R6G, and 1609 tubes.

The tables of test data are reprinted on following pages on one side of the paper to permit removal from this bulletin and insertion in the instruction book.

Tube type	Heater	Cathode	Control grid	Normal plate	Second plate	Screen	Suppressor	Panel control A	Panel control C	Panel control D	Rej. point	Remarks	Tube type
1A3	1-7	3		2	6			1.4	13	11	20	Diode	1A3.
1A4	1-4		Cap	2		3		2.0	27	9	65		1A4.
1B7-GT	2-7		58 Cap	3 and 6		4		1.4	22	8	45	Pent. Conv.—Norm 90	1B7-GT.
1D5	2-7		Cap	3		4		2.0	33	9	65		1D5.
1E4-G	2-7		5	3				1.4	32	8	65		1E4-G.
1J5	2-7			3		4		2.0	10	10	50		1J5.
1L4	1-7		6	2		3		1.4	45	8	45	Norm 70	1L4.
1LA4	1-8		6	2		3		1.4	50	8	50		1LA4.
1LA6	1-8		4 and 6	2 and 3		5		1.4	45	8	50	Pent. Conv	1LA6.
1LB4	1-8		6	2		3		1.4	35	8	50		1LB4.
1LC6	1-8		4 and 6	2 and 3		5		1.4	40	8	50	Pent. Conv	1LC6.
1LD5	1-8		6	2		3		1.4	36	9	65	Pe	1LD5.
1LD5	1-8			4				1.4	13	11	20	Diode	1LD5.
1LF3	1-8		6	2				1.4	27	8	65		1LE3.
1LH4	1-8		6	2				1.4	50	9	55	Tr; Norm-84	1LH4.
1LH4	1-8				4			1.4	13	11	20	Di	1LH4.
1LN5	1-8		6	2		3		1.4	50	9	65		1LN5.
1N6	2-7		5	3		4		1.4	50	8	50	Pe	1N6.
1N6	2-7			6				1.4	13	11	20	Di	1N6.
1P5	2-7		Cap	3		4		1.4	47	9	65		1P5.
1R4/1294	1-8	7		4				1.4	13	11	25	Di	1R4/1294.
1SA6-GT	2-7		4	8		6	3	1.4	26	9	65		1SA6-GT.
1SB6-GT													1SB6-GT.
6N5	1-6	5	3	2	4			6.3	21	9	58	Norm-90 Pull 2nd 6N5 Plate toggle switch and visually inspect target.	
6N6	2-7	8	5	3		4		6.3	34	8	50	Dir Coup. Amp	6N6.
6P7-G	2-3	8	Cap	4		5		6.3	47	8	65	Pe	6P7-G.
6P7-G	2-3	8	7	6				6.3	20	10	65	Tr	6P7-G.
6Q5-G												Thyrotron—No test	6Q5-G.
6Q6-G	2-7	8	Cap	3				6.3	50	8	65		6Q6-G.
6Q6-G	2-7	8			2			6.3	13	11	20	Di	6Q6-G.
6R6-G													6R6-G.
6SD7-GT	2-7	5	4	8		6	3	6.3	18	7	65		6SD7-GT.
6SF7	7-8	3	2	6		4		6.3	25	8	65		6SF7.
6SF7	7-8	3			5			6.3	13	11	20	Di	6SF7.
6SG7	2-7	3	4	8		6		6.3	20	7	65		6SG7.
6SH7	2-7	3	4	8		6		6.3	19	8	65		6SH7.
6SL7	7-8	3 and 6	1 and 4	2	5			6.3	48	13	65	Tw. Tr	6SL7.
6ST7	7-8	3	2	6				6.3	16	8	65		6ST7.
6ST7	7-8	3		4	5			6.3	13	20	25	Di	6ST7.
6T5													6T5.
6U6-GT	2-7	8	5	3		4		6.3	11	4	50		6U6-GT.
6V6	2-7	8	5	3		4		6.3	8	8	50		6V6.
6W5-G	2-7	8		3	5			6.3	0	6	60	Rect	6W5-G.

Tube type	Heater	Cathode	Control grid	Normal plate	Second plate	Screen	Suppressor	Panel control A	Panel control C	Panel control D	Rej. point	Remarks	Tube type
6W6-GT													6W6-GT.
6Y7-G	2-7	8	4 and 5	3	6			6.3	14	9	65	Tw. Tr	6Y7-G.
6Z4	1-5	4		2	3			6.3	1	6	60	Rect	6Z4.
7C4	1-8	7		4				6.3	13	11	25	Di	7C4.
7K7	1-8	2	4	3				6.3	46	8	65	Tr	7K7.
7K7	1-8	7		5	6			6.3	13	11	25	Di	7K7.
2A4G												Thyrotron—NoTest	2A4-G.
2B4												do	2B4.
0A4-G												Gas Triade—No Test	0A4-G.
3A4	1-7		4	2		3		2.8	10	8	40	Norm-80	3A4.
3A5	1-7		3 and 5	2				2.8	16	8	65	Triode #2	3A5.
3A5	1-7		3 and 5		6			2.8	13	8	65	Triode #1	3A5.
3B7/1291	1-8		3 and 6	7				2.8	17	8	65	Triode #1	3B7/1291.
3B7/1291	1-8		3 and 6		2			2.8	25	8	65	Triode #2	3B7/1291.
3B5-GT	2-7		5	3		4		2.8	50	4	50		3B5-GT.
3D6/1299	1-8		6	2		3		2.8	12	8	50		3D6/1299.
0Z4 and G												Gas Rectifier—No Test	0Z4 and G.
5X3	1-4			2	3			5.0	7	6	60		5X3.
6A3	1-4		3	2				6.3	21	4	50		6A3.
6A5-G	2-7		5	3				6.3	21	4	50		6A5-G.
6AD6-G	2-7	8	3 and 4	5				6.3	44	16	60	Set "Meter Reset" in counter-clockwise position. Pull Gm toggle and note content action.	6AD6-G.
6AE7-GT	2-7	5 and 8	4 and 6	3				6.3	2	8	65		6AE7-GT.
6AF5-G	2-7	8	5	3				6.3					6AF5-G.
6AH7-GT	7-8	2 and 4	1 and 5	3	6			6.3	15	8	65	Two. Tr	6AH7-GT.
6AK5	3-4	2	1	5		6		6.3					6AK5.
6C4	3-4	7	6	1				6.3	11	8	65		6C4.
6E6	1-7	4	3 and 5	2	6			6.3	50	22	50		6E6.
6H4-GT	2-7	8		4				6.3	13	11	25	Di	6H4-GT.
6J6	3-4	7	5 and 6	1	2			6.3	8	7	65		6J6.
6J8-G	2-7	8	5 and Cap	3 and 6		4		6.3	10	8	65	Tr. Hept. Conv	6J8-G.
7V7	1-8	7	6	2		3	4	6.3	7	13	65		7V7.
7W7	1-8	7	6	2		3	5	6.3	7	13	65		7W7.
7Z4	1-8	7		3	6			6.3	6	6	60	Rect	7Z4.
12A5	1-7	5	4	2		3		12.6	31	22	50		12A5.
12AH7-GT	7-8	2 and 4	1 and 5	3	6			12.6	15	8	65	Tw. Tr	12AH7-GT.
12B7	1-8	7	6	2		3	4	12.6	20	8	65		12B7.
12B8-GT	2-7	6	8	5				12.6	35	7	65	Tr	12B8-GT.
12H6	2-7	4 and 8		3	5			12.6	13	11	40	Di	12H6.
12SF7	7-8	3		5				12.6	13	11	25	Di	12SF7.
12SG7	2-7	3	4	8		6		6.3	20	7	65		12SG7.
12SH7	2-7	3	4	8		6		12.5	19	8	65		12SH7.
12SL7-GT	7-8	3 and 6	1 and 4	2	5			6.3	43	13	65	Tw. Tr	12SL7-GT.
12SN7-GT	7-8	3 and 6	1 and 4	2	5			6.3	9	8	65		12SN7-GT

Tube type	Heater	Cath-ode	Control grid	Normal plate	Second plate	Screen	Sup-pres-sor	Panel control			Rej. point	Remarks	Tube type
								A	C	D			
14A7	1–8	7	6	2		3	4	12.6	20	8	65		14A7.
14C5	1–8	7	6	2		3		12.6	6	8	50		14C5.
14N7	1–8	2 and 7	4 and 5	3	6			12.6	10	8	65	Tw. Tr	14N7.
19	1–6		3 and 4	2	5			2.0	18	9	50		19.
25B5	1–6	5	4	2	3			25	43	22	50	Dir. Coup. Amp	25B5.
25B8	2–7	1	Cap	3		4		25	30	7	65	Pe	25B8.
25B8	2–7	6	#8	5				25	35	7	65	Tr	25B8.
25Y5												Test same as 25Z5	25Y5.
117L7–GT	2–7	8	4	3		5		117	0	8	50		117L7–GT.
117L7–GT	2–7	1		6				117	15	11	60	Rect	117L7–GT.
117P7–GT	2–7	6	4	3		5		117	0	8	50		117P7–GT.
841, 842, and 843												Transmitting Type—No test	
884 and 885												Thyratrons—No test	
1232												Listed as 7G7	
1609													1609.
1612												Test as 6L7	
1621												Test as 6F6	
1622												Test as 6L6	
1632	2–7	8	5	3		4		25	38	2	50		1632.
1851	2–7	8	Cap	3		4	5	6.3	10	15	65		1851.
1852												Test as 6AC7	
1853												Test as 6AB7	
2050												Thyraton—No test	
2051												Thyraton—No test	

THIS PAGE MAY BE REMOVED FOR INSERTION IN INSTRUCTION BOOK

MODIFICATION TO MODEL YG AND YG–1 CONTROL UNIT DRIVE MOTOR MOUNTING

The Naval Research Laboratory reported the loosening of the drive motor mounting screws in the Model YG and YG–1 Control Units, when the units were subjected to shock and vibration. The failure was believed due to poor bearing surface afforded the lockwashers by the motor feet. To improve the bearing surface, a flat metal strap (see fig. 1) was bridged across each pair of motor feet and the lockwashers were made to bear upon the straps.

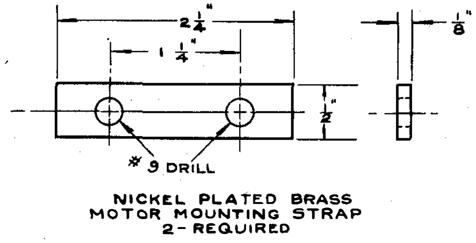


FIGURE 1.—Dimensions of mounting strap.

The application of the straps to equipments now in service can readily be accomplished in the field. The procedure is as follows:

(1) Machine two nickel plated brass straps as outlined below.

(2) Remove the nuts and lockwashers.

(3) Place the nickel plated brass straps and bridge across the motor feet.

(4) Replace lockwashers and nuts.

INSTRUCTIONS FOR EXTENDING FREQUENCY RANGE OF TBX SERIES TRANSMITTER

The following information is supplied in order that an extension of the transmitter frequency range can be undertaken in the field as an emergency measure. This modification, by changing the upper frequency limit from 4525 kc. to 6000 kc., will extend the frequency by 1475 kc. and is being done in order that this set may be used with comparable Army equipments.

Materials required:

2 foot length of No. 14 tinned copper wire.

1 strip of thin copper approximately 3/16 x 2½ x 1/64 inches.

1 sheet of mica or varnished glass tape approximately 3/8 x 2½ x 1/64 inches.

Procedure:

1. Remove RF ammeter M301 to permit access to necessary connections.

2. Remove jumper wire between Capacitors C308 and C312, lugs 1 and 2 (diagram A). In TBX-4 only remove end of resistor R321 from Capacitor C312 lug 1 and reconnect to Capacitor C308 lug 2.

3. Remove wire from variable condenser C307 lug 6 connecting to lug 1 of Capacitor C312 (diagram A).

4. Run a bus bar wire lead as short as possible from variable condenser C307 lug 6 to Capacitor C308 lug 2 (diagram B).

5. Run a bus bar wire lead direct from Capacitor C312 Lug 1 to the left hand terminal of the RF ammeter, viewed from the front panel (see diagram B).

6. Remove the jumper between capacitor C312 lug 4 and variable condenser C307 lug 5 (attached to condenser C307 frame) (diagram A).

7. Run a new lead from Capacitor C312 lead 4 to the lead point 7 on switch S304 and Capacitor C313 lug 8 (diagram B).

8. Be sure that all leads are properly crimped and make secure mechanical connections before soldering.

9. Connect RF ammeter back into circuit.

10. Locate the M. O. inductance L301 and note carefully the 3 coil taps. The tap on the 11th turn should be moved 4 turns toward the center of the coil and placed on the 15th turn. The tap on the 39th turn should be moved 3 turns toward the center of the

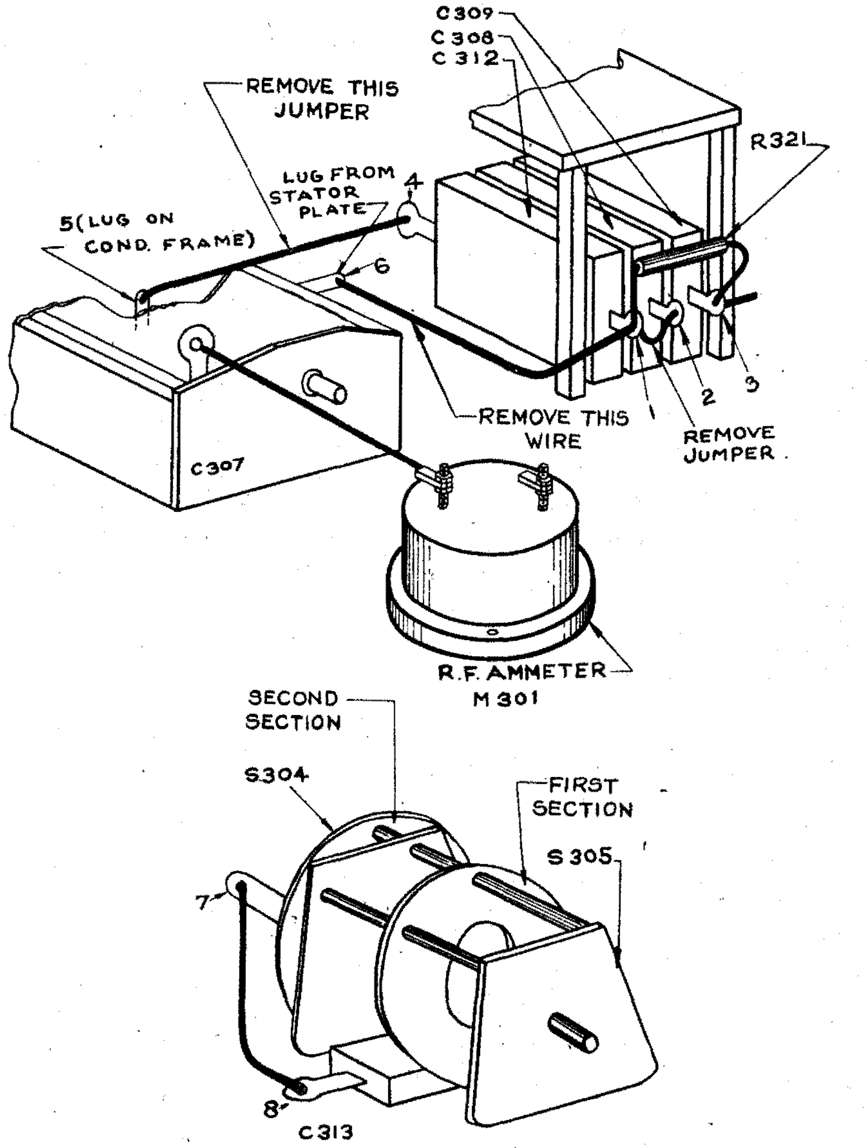


DIAGRAM A.

coil and placed on the 36th turn. These changes should be made by slipping the wires out of the existing taps and making new taps from the copper cut into strips approximately 3/16 x 7/16 inch and slipped under the correct turns after they have had the enamel removed by scraping with a knife. A strip of mica or glass tape approximately 3/8 x ½ inch should be slipped under the copper strip next to the coil form to insulate the new tap from adjacent turns. Old taps on coil should be left in place.

11. Locate the antenna tuning inductance L303. When viewing

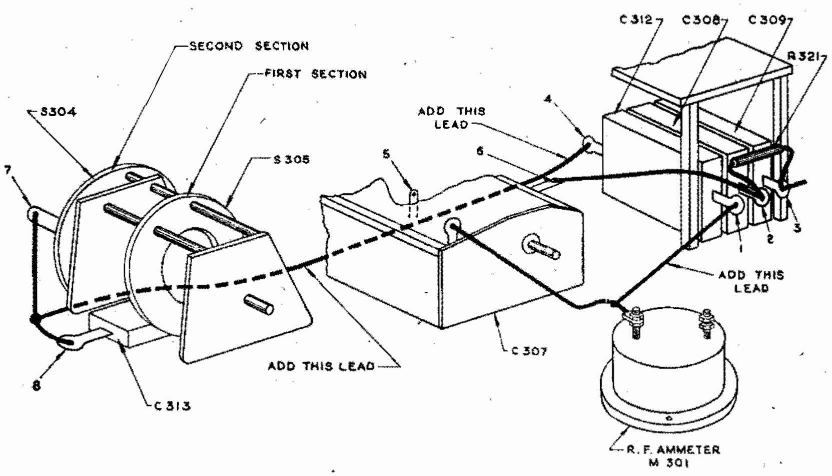


DIAGRAM B.

the chassis facing the front panel, the tap on the 33rd turn should be moved 5 turns to the left, placing it on the 28th turn. This tap is the second from the right end of the coil. This change in tap location should be made as were the changes in L301 as explained above in step 10. Old taps on coil should be left in place.

12. The leads to transmitter plate choke L305 are to be reversed The plate lead of oscillator tube V301 should be connected to the inside or start of choke winding and the outside or finish of choke winding coverage should be connected to the plate supply. This is done as follows:

a. Remove bus-bar lead from rear of capacitor C–308.

b. Remove bus-bar lead from rear of capacitor C–309.

c. Remove plate lead of tube V 301 from micalex support holding RF choke L–305 in place.

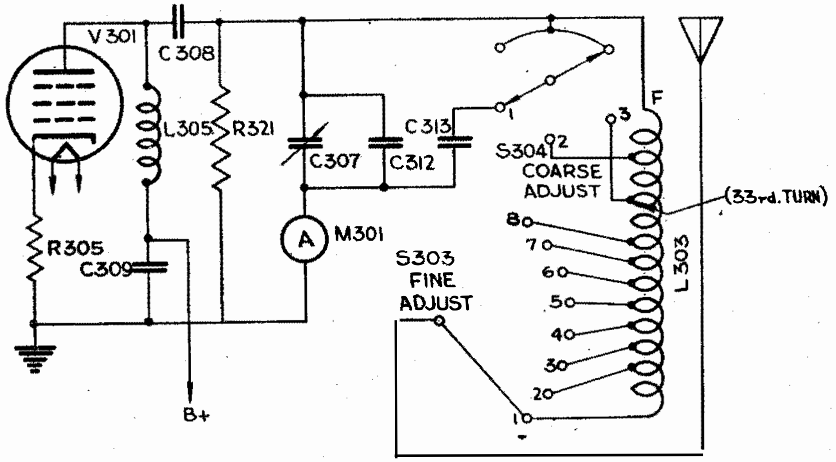
d. Connect bus-bar lead connected at one end to top *and* outside of RF choke L–305 to rear of capacitor C–309.

e. Connect bus-bar lead connected at one end to bottom and inside of RF choke L–305 to rear of capacitor C–308.

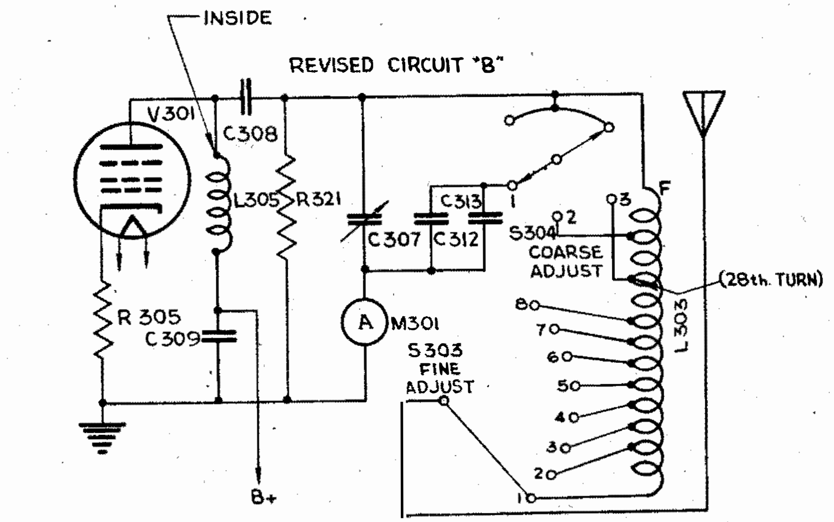
f. Connect plate lead of tube, V 301, to bottom inside lug immediately below and connected to RF choke L–305.

13. Recalibrate the transmitter. This may be done with a frequency standard such as the LD or LM. The transmitter is tuned to zero-beat with the frequency meter at the desired frequency and the dial readings recorded. Where a frequency standard is not available, the receiver calibration may be utilized to calibrate the transmitter. The receiver is tuned to the desired frequency using the receiver calibration chart. With the "netting switch" on and both power supplies in operation, the transmitter is tuned to "zero-beat" in the phones. The transmitter dial readings are then recorded. Improved accuracy can be obtained if a station of known frequency is located near the desired frequency. The receiver calibration can be corrected by means of the "wobbler" control, and this control left in that position when zero-beating the transmitter to the receiver. If such a station is not available, the "wobbler" control should be set at zero. It will be noted that Band one of the transmitter can be plotted to the same chart scale as before but Band two will have to be plotted to a smaller scale (one-half) due to increased frequency coverage. In the absence of new forms for charts the frequencies used for calibration should be listed in the space provided below the curves.

ORIGINAL OUTPUT CIRCUIT "A"



REVISED CIRCUIT "B"



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.

* * *

CARE AND ADJUSTMENT OF BOEHME HIGH SPEED KEYING HEADS AND INK RECORDERS

Lt. L. J. Delworth, USN and C. M. Baum, Chief Telegrapher, USNR.

I. INTRODUCTION

The successful operation of high speed automatic equipment requires special experience and training which few men have the opportunity to obtain. The following notes gleaned from years of practical experience maintaining high speed equipment are passed along for information and use.

The information contained herein is not intended to supplant the manufacturer's instructions but rather to supplement them. These instructions apply equally well to the 2–E, 3–E, and 4–E type heads which are generally similar in construction and method of operation. They will also apply to the 4–G type recorders.

II. FIELD ADJUSTMENT OF BOEHME KEYING HEADS

General:

1. Boehme keying heads are not difficult to keep in adjustment and will normally give up to 2,000 full hours of operation before a complete overhaul is necessary. This 2,000 hours of operation will be appreciably decreased with insufficient or improper maintenance.

2. The contacts should be cleaned daily by brushing with alcohol of carbon-tetrachloride to remove the oil film which accumulates from the oil reservoir. The dust which collects in the teeth of the drum should also be removed daily with a small brush.

3. The tape bridge should be removed weekly and the dirt on the selector pins and gears removed with a small brush. At this time a drop of oil should be placed on the selector pins, the toggle block and the star wheel and drum gears.

4. After every 500 hours of operation the oil should be changed. The old oil is removed by way of the drain plug in the bottom of the head and the head washed out with gasoline or varsol and allowed to dry. It is then refilled with a good grade of oil as recommended in the manufacturer's specifications. At this time the head should be completely cleaned.

Biasing:

1. There are actually two kinds of bias encountered in Boehme keying heads. The first is the keying bias or the relation of the marking pulse to spacing pulse. The second is the internal mechanical bias of the head which is more properly referred to as "timing" the head. The keying bias is entirely dependent upon the adjustment of the contact assemblies and the condition of the contacts themselves. The contacts should be maintained clean, unpitted, and free of oil. A small file or piece of fine emery paper used at the weekly cleaning will assist in keeping the contacts in good condition. The Boehme instruction manual gives the proper setting of the contacts for approximate 50–50 keying. A check of the actual keying characteristics can be made quickly with the use of test equipment to be herein described.

Timing:

1. The Boehme keying head is of the positive drive type through a gear train and as the gears wear the keying head will gradually get "out of time." This timing lag manifests itself by varying bias and the head may tear the tape as it goes through.

In checking a head for mechanical bias the primary interest is the amount of unchecked throw of the contact lever arm toward the upper and lower sides of the contact lever stop plate, the position of the toggle block lever in relation to this travel, and the position in which the selector pins engage the teeth of the selector drum.

2. When it is noticed on electrical tests of the keying characteristics of the head that the bias is not steady, a check should be made of the parts which normally wear the most. These are the 4–E–48 toggle block assembly and the 4–E–42 selector pins. Selector pins will wear most on the upper tip where they engage the drum. Wear on the toggle block is not so apparent but will be indicated by inability of the head to hold adjustment long. Worn selector pins and toggle blocks should be changed when the overall throw of the contact lever

arm is noticeably decreased or the arm is found to be binding on the toggle block.

3. To allow for gradual wear in the running parts of the heads, the Boehme Company has provided an adjustment on the selector drum. An index tooth on the drum (index tooth is beveled at one corner) may be set at any of four positions with respect to the drum gear. The drum gear is provided with a set screw for this purpose and the gear marked with the four positions 0–1–2–3.

New heads or heads which have just been overhauled will be found to have the maximum free travel of the contact arm centered between the upper and lower sides of the contact lever arm stop plate with the drum set at 0. Gradual wear in the gear train, selector pin lever assemblies, pin bearings, star wheel, and drum gears, and all associated parts of the head will tend to bias this travel of the contract arm toward the lower or spacing side of the stop plate. When the travel of the contact arm has lowered enough to make the head difficult to adjust the drum should be adjusted to the next higher number relative to the drum gear. Heads which have been adjusted through all four of the positions to the Number 3 and which are becoming difficult or impossible to adjust, may be considered as needing a complete overhaul.

4. In completely overhauling Boehme heads the following should be examiner closely for wear:

(*a*) Selector pin lever assemblies (4–E–37). Wears oval-shaped where selector pin is inserted and in pin bearing slot.

(*b*) Pin bearings (4–E–36). Should be refitted to bearing pins and selector levers with minimum clearance consistent with free movement.

(*c*) Eccentric block (4–E–34). Should move freely in rocking frame and fit snugly but without bind on eccentric drive shaft.

(*d*) Interlink lever assembly (4–E–39). Must fit 4–E–44 stud bearing snugly but without bind. Must also be fitted to selector pin lever assembly which will be used.

(*e*) Contact lever assembly (4–E–40). Must fit 4–E–35 stud bearing well and be fitted to selector pin lever assembly which will be used.

(*f*) Selector drum (2–E–21). Examine for wear in teeth and change if badly worn.

(*g*) Selector drum gear (2–E–22) and Star wheel gear shaft (4–E–88). Change if gears are worn.

(*h*) All gears in gear bracket assembly. Change if badly worn.

(*i*) Contact points (4–E–60 and 4–E–49). Change if pitted or burned. Should fit freely in sleeve.

(*j*) Gaskets. Change if condition is doubtful.

(*k*) Toggle springs (4–E–56). New toggle springs should be installed being sure not to stretch the new springs.

All parts of a newly overhauled head must be made to fit as snugly as possible without binding. This will be difficult in some cases as the parts, as received from the factory, are likely to be oversized. In this case, it will either be necessary to lap them in carefully with some abrasive compound or make a judicious selection of new and used parts which will accomplish the same purpose. All of the parts should be put in place without forcing, and an effort should be made to fit all retaining pins to be tight without having to be hammered in with excessive force. When the head is finally assembled, it may be found necessary to install a worn set of selector pins temporarily until the new parts have been run for a while. If this is done, it will usually be found that the head can be started in the 0 position of the selector drum.

5. If care is taken in the daily and weekly maintenance work it will be found that heads will often be in use two or even three years at a time before complete overhaul becomes necessary.

III. FIELD ADJUSTMENT OF BOEHME INK RECORDERS

General:

1. The Boehme High-Speed Ink Recorder is a costly and delicate piece of equipment and should be so treated at all times. The amount of maintenance required is small in comparison with the heads with which they are keyed but the fitting together of the parts must be done with considerable greater exactness.

2. The recorders will copy each pulse exactly and with square corners at speeds up to 150 words per minute providing the entire pen and moving coil assembly is free and without bind in any part of its normal operating stroke, and providing the tension of the tape bridge against the pen is not excessive. Speeds up to 500 words per minute can be recorded in good readable characters if the size of the characters are reduced below the usual easily-read height. Square characters at speeds above 150 WPM cannot be expected although care spent in fitting the parts will definitely affect the results obtained.

Adjustments:

1. The tape bridge should be clean at all times and be pressed against the pen with tension just sufficient to make a good ink impression but not appreciably affect the free movement of the pen. The bridge under the pen should be flat and smooth.

2. The pen bearings are jewels mounted in small brass holders. Before they are installed, care should be taken to see that the jewels are tight in the holders. The bearings must fit the pen exactly but without binding. Any bind will slow the operating speed of the pen itself and any excess clearance in the bearing fitting must be compensated for by increased tension of the tape bridge to assure the pen being against the tape at all times.

3. The point of the pen must be exactly at right angles to the paper tape. This can be accomplished by lapping the end of the pen point with a fine emery stone or with a very fine jewelers file. Care must be taken not to bend the point of the pen. The pen arm should connect with the moving coil with no friction in the link but tightly enough to allow smooth transfer of the coil movement to the pen.

4. The moving coil must be centered over the end of the field magnet core and should not touch the outer mounting at any point. The link at the bottom of the coil should be fitted as exactly as the link with the pen.

5. The small hose connection to the pen must be connected so that it exerts the least torque at the center of the normal stroke of the pen. The hose, if not so connected, gives the pen a definite mechanical bias which cannot be entirely overcome by signal current introduced into the voice coil.

Use of the recorder:

1. The results obtained from the Boehme recorder are often impaired by incorrect usage. Where these recorders are used the following instructions should be put into effect and adhered to.

(*a*) The manufacturer's specifications for these recorders list the safe top current allowable in the voice coil as 35 milliamperes. This value must not be exceeded. The operation of the recorder at high speeds is best with a high value of signal coil current but operation practices must take into account that they are delicately made and in some places hard to replace. They are easily burned out.

(*b*) When the recorders are not in use, a piece of tape should be kept under the pen point to assure that the ink in the point does not dry and clog the pen.

(*c*) The lint from the tape should be brushed from the recorders once a day and once a week the dust and dried ink accumulating on the recorder should be cleaned with a slightly damp rag. The dust around the voice coil can be removed with a small camels hair brush taking care that no foreign matter lodges between the sides of the coil and its mounting.

(*d*) Ink for high-speed operation must be quick-drying and volatile. Many special formulas are in use for this purpose but an easily made formula requiring only ink powder, alcohol and water will cover all operations up to 500 words per minute. A 30-proof solution of water and alcohol (approximately 15 percent alcohol) is made up with the use of a spirit hydrometer. Ink powder is then added in the proportion of two to three capsules to the gallon. This ink powder may be obtained from the H. O. Boehme Co. under the name of "Spieske's Telegraph Ink Powder—Medicinal Blue."

(*e*) The ink reservoir should never be allowed to run dry. This allows the introduction of air bubbles into the ink feed line and will

result in spasmodic feeding of the ink. The only solutions for this when it occurs are to let the air bubbles work themselves out by normal feeding of the ink or to remove the entire pen and hose connection system, flush it with water, dry it well, replace, and refill the inkwell with fresh ink. If the inkwells of all recorders are checked at specified times. twice a day, this condition can be eliminated.

Test equipment:

1. The Boehme keying head contact lever is mechanically polarized and lends itself readily to tests with very simple equipment. Tests for keying bias and contact pressure may be made with a battery, meter, and switch arrangement. More elaborate equipment for observing the keying pulses may be made including oscilloscopes for visual observation of the pulse contour. This is very handy in evaluating the effects of contact arcing and variable bias.

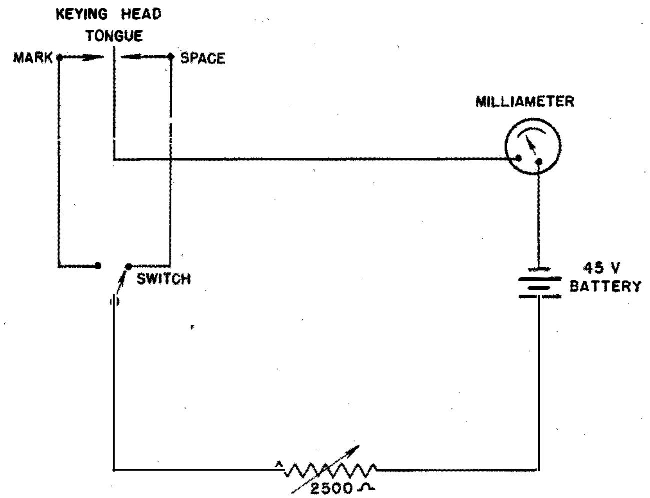


FIGURE 1.—Test set-up for checking keying bias.

2. Figure 1 gives the hookup for a very simple bias test set employing a 0–50 milliampere meter, a 45-volt battery, a 2,500-ohm variable resistor (1 watt or over) and a double throw, single pole switch. With the keying head connected as shown, the current may be adjusted to 20 mils before the head is turned on. When the head is dotting a steady reading of 10 mils with the switch in either position will indicate that the keying is 50–50 on both the mark and space contacts and that the contact pressure is sufficient in both cases. Flickering of the meter in either position will indicate dirty or arcing contacts on that particular side. If the meter is varying evenly on either or both sides it will indicate that the bias is varying—an indication of a worn toggle block or need for retiming the head.

3. A more elaborate layout is given in figure 2 using a 50–0–50 milliameter, a variable 2,500-ohm resistor, a 45-volt battery, 1 three-

position switch, 1 double-pole double-throw switch, a vacuum tube tone-keying unit and an oscilloscope.

The operation of this test set is as follows:

(*a*) With the switch thrown to "Batt. On" position and the keying head stopped, the current may be adjusted to 20 mils by means of the variable resistor. The keyer may then be turned on.

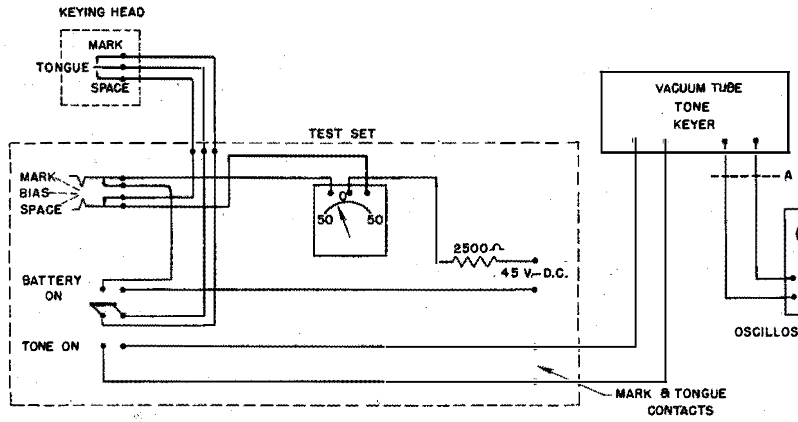


FIGURE 2.—A more elaborate test set for checking keying head.

(*b*) With the mark-bias-space key thrown to the "up" or "mark" position the mark pulse may be checked as with the test set described in paragraph "B" above. When thrown to "lower" or "space" position the spacing contacts are similarly checked. When the key is in the central position the meter will read zero and be steady when the head is keying 50–50 and in good condition. If the indication is not zeroed but reading on the side measuring "mark" current it is an indication that the mark pulse is longer than the space and vice versa.

(*c*) If the switch is thrown to "tone on" position a picture of the actual keying pulse may be observed in the oscilloscope. Breaks in the keyed pulse as seen on the scope will be an indication of dirty

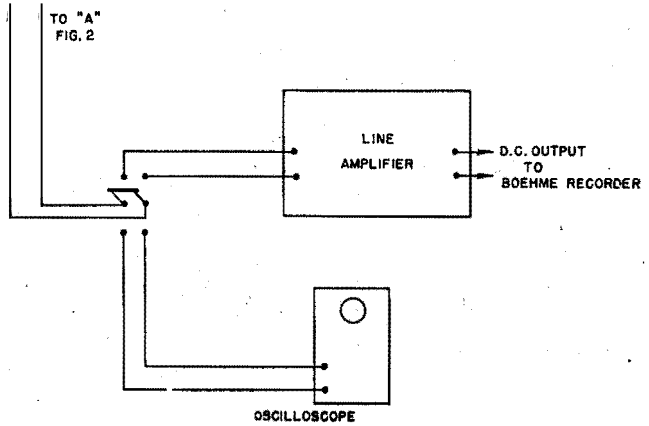


FIGURE 3.—Modification to set-up of figure 2 to permit use of scope or ink recorder.

contacts, bad toggle block or improperly timed keying head. If the head is keying 50–50 and in good condition and marking pulse and the space between pulses will be the same length when focused on the scope.

(*d*) The addition of another switch to the above circuit (wired as in fig. 3) and a line-amplifier will enable the tone output of the tone-keyer to be passed either to the oscilloscope or to the line-amplifier. With this additional feature the head may be tested with the scope; or tape may be run through the head and recorded on an ink recorder on the output of the line-amplifier. This method also provides a quick check on the operation of Boehme Ink Recorders.

Instruction Manuals:

1. The H. O. Boehme Co., Inc., 915 Broadway, New York City, N. Y., issues instruction manuals on the installation, operation, and maintenance of all automatic equipment manufactured by them. These instruction manuals should be obtained and thoroughly digested before putting the equipment into operation.

Bureau comment.—Material of this kind, prepared from long service experience, is of great practical value. Others having similar material are urged to submit it for publication.

* * *

MODIFICATION OF VHF EQUIPMENT, BC 639–A

WILLIAM D. GREENE, RT1/c, U. S. S. *Yorktown*

While using U. S. Army Model BC–639–A VHF Radio Receiving Equipment for reception of messages transmitted from aircraft, serious radar and ignition noise interference has been encountered. Due to their large amplitude during operations, these noises drown out weak signals that might otherwise be successfully intercepted.

In an effort to overcome this difficulty and secure dependable long distance communication, a simple noise-limiting circuit has been devised. In our particular case this limiter has proven to be worth while, reducing the noises from radar and ignition systems to negligible proportions and at the same time leaving the desired signal unaffected. Due to our success with this arrangement, details are supplied herewith, and circuit is suggested as a modification for Model BC–639–A equipment where similar noises are encountered.

Installation of the limiter requires the addition of one type 6H6 double diode vacuum tube (only one section is actually used), two 1 megohm one-fourth- or one-half-watt resistors, one 0.1 microfarad paper capacitator, one single pole double throw toggle switch, one octal tube socket, and (if variable control is desired) one 100,000 ohm potentiometer. The tube socket may be mounted on small metal brackets above the chassis in rear of the audio output jacks, or may be flush mounted in a hole punched in the chassis itself. The toggle switch (provided to switch the limiter in and out of the circuit) may be mounted anywhere on the front panel desired. If the switch is physically distant from the limiter circuit proper, it is advisable to sheath the leads running to it with belden braid and ground the braid to the chassis by means of soldering.

Referring to figure 1, the operation of the circuit is as follows:

Rectified signal current flows through resistors R1 and R2 causing a voltage drop in proportion to the incoming signal amplitude. The

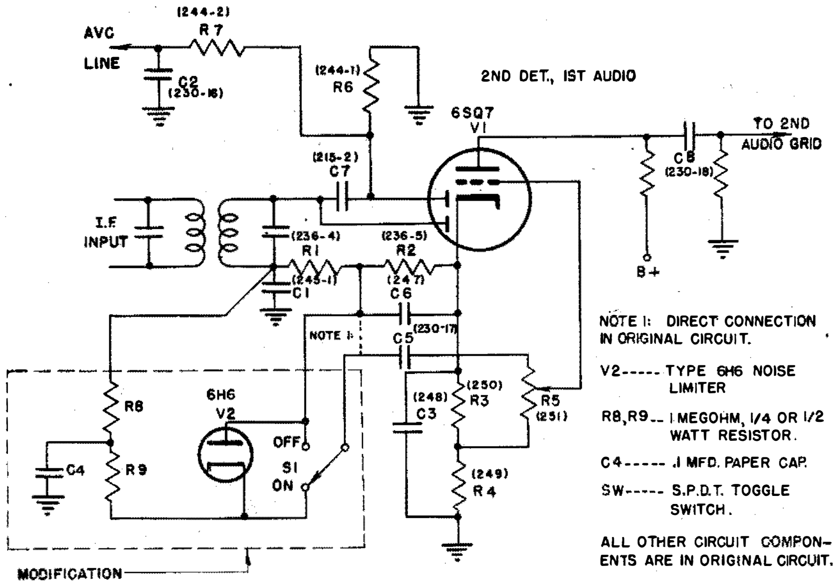


FIGURE 1.—Noise limiter circuit modification.

potential across R1 is utilized as operating voltage for the limiter tube and the audio signal voltage is developed across R2. Both these voltages can vary with instantaneous changes in signal amplitude such as occurs with modulation, but the voltage at the cathode of the 6H6 is not allowed to follow instantaneous voltage variations across R1 due to the filtering action of R8 and C4. However, the voltage on the plate does vary with modulation and if the modulation is heavy enough to cause the instantaneous voltage to go more negative than the cathode, the tube stops conducting, no audio reaches the grid of the 6SQ7 first A. F. stage because this audio is coupled through the electron stream of the 6H6 limiter tube. When a pulse or radar interference comes in, the instantaneous voltage developed across R2 is very high and the plate of the diode is swung highly negative, cutting off the electron stream and no noise reaches the output. The cathode would have made the same downward swing due to the simultaneous drop across R1 had the RC filter not been in the circuit. The resistor

R9 is placed in the circuit to prevent the audio output from being shorted to ground via C4.

The degree of noise limiting action is roughly proportional to the ratio of R2 to R1, but if R2 is made much larger than R1, the voice

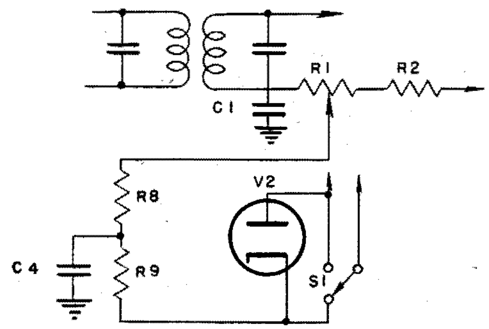


FIGURE 2.—Modification to provide variable noise limiting.

modulation will be limited as well as the noise. Where it is desired to have variable noise limiting action, R1 may be replaced by a 100,-000 ohm potentiometer, the moving contact being connected to the cathode RC filter as shown in figure 2.

Addition of this device to the receiver does not affect the I. F. alignment provided I. F. circuit wiring is not tampered with.

* * *

MODEL LD-4 TEMPERATURE CONTROL CIRCUITS

JOSEPH J. FUSCO, RM1/c, U. S. S. *Williamsburg*

Trouble has been experienced with the above model equipment in the proper functioning of the crystal oven and outer oven temperature control circuit. This was traced to the improper action of relays K-101 and K-102 as designated in the schematic diagram. As the cleaning of the relay points provided only a temporary repair, the trouble was corrected by readjusting the cathode tap to the pair of 41's on bleeder resistor R-105. This is a slider contact so is very easily done.

The cathode tap is adjusted to increase the bias on the pair of 41's thereby increasing the plate current drawn by the 41's through the coils or relays K-101 and K-102 which are connected in series with the plate circuits. This results in more positive action on the part of the relays and therefore the closing of the contacts in the heater supply circuits. Since the above adjustment was made on the equipment aboard this vessel, no trouble has been experienced to date with the temperature control circuits.