BUSHIPS

MAY 1952

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NavShips 900,100

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ELECTRONIC INTERFERENCE

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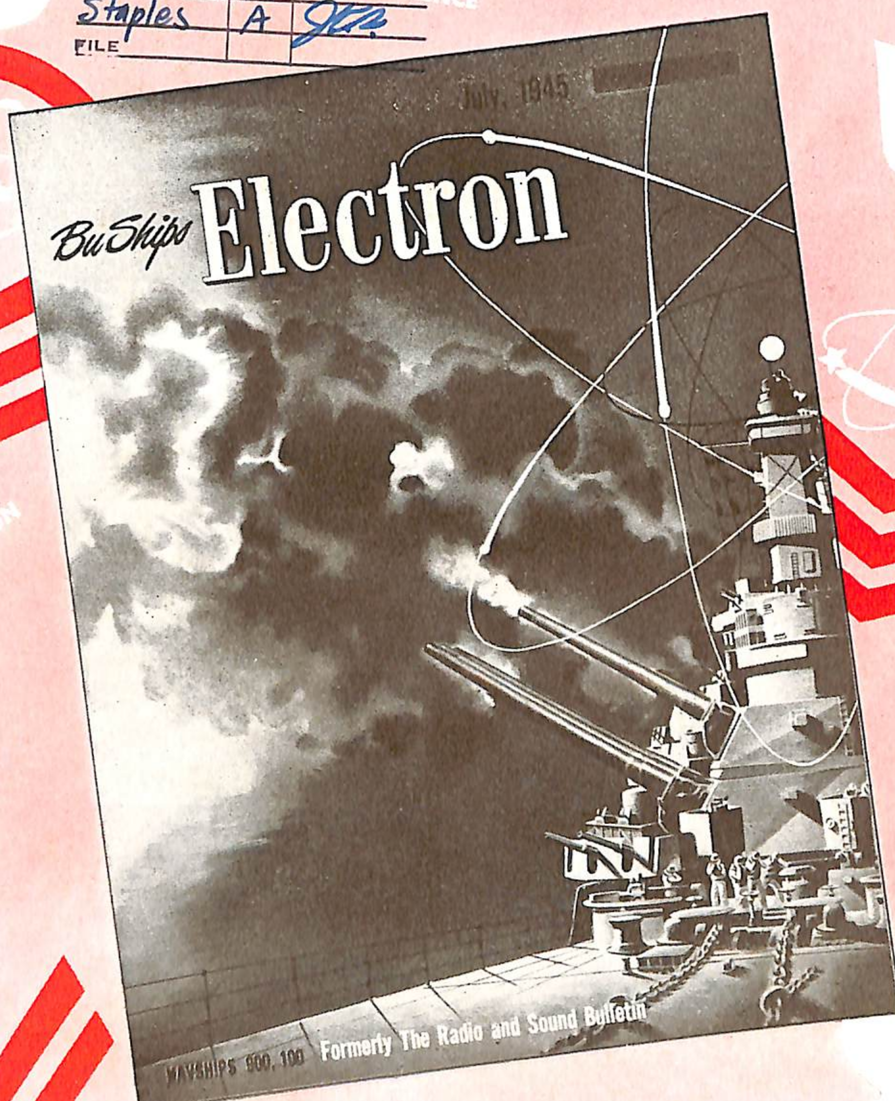

ELECTRONICS ADMINISTRATION

MAGNETIC AMPLIFIER

RESTRICTED
SECURITY INFORMATION

BUSHIPS
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VOLUME 7

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THIS ISSUE

SEE IMPORTANT ANNOUNCEMENT ON PAGE 17.

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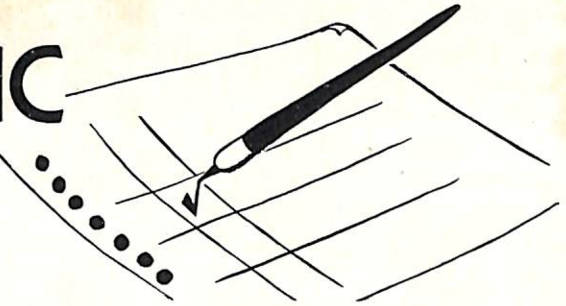
AN ELECTRONIC PREVENTIVE MAINTENANCE PROGRAM



by

Lt. (jg) E. T. Westfall, USN

Much discussion has gone on concerning how an Electronic Preventive Maintenance Program SHOULD be laid out and administered. In the author's opinion too much emphasis has been placed on how things SHOULD be instead of how they CAN be. The particular system of Electronic Preventive Maintenance herein described may not be THE answer to the problem but I believe it to be AN answer. It has been in operation on a Radar Picket Destroyer for one year and an almost identical system has been in operation on another Radar Picket Destroyer for the same time. Both ships have achieved a degree of success scarcely dreamed of during the initial stages. On my ship, the USS E. F. LARSON (DDR–830), we have become such firm believers in the fundamental organizational set up that we are extending it to other maintenance problems such as machinery and electrical equipment. Here again the results have more than repaid the extra effort required to get the system going.

The program has several essential elements. They are: (1) The Check-off Lists (2) The Preventive Maintenance Schedule (3) Administrative Techniques (4) ET Watches (5) Supply.

Maintenance Check-off Lists

Let us examine each of the five elements individually and see how each is an integral part of the whole. First the Check-off Lists. These provide the detailed information to the man performing the preventive maintenance as to what he is to do. They are the first step in the creation of any maintenance program but THEY ARE ONLY THE FIRST STEP. Before our Check-off Lists were prepared we first set down some guide posts. We call them the FIVE CARDINAL POINTS of any preventive maintenance program. They are:

1. A preventive maintenance program must be realistic. It must not be burdened with an over-abundance of desirable but not necessary checks.

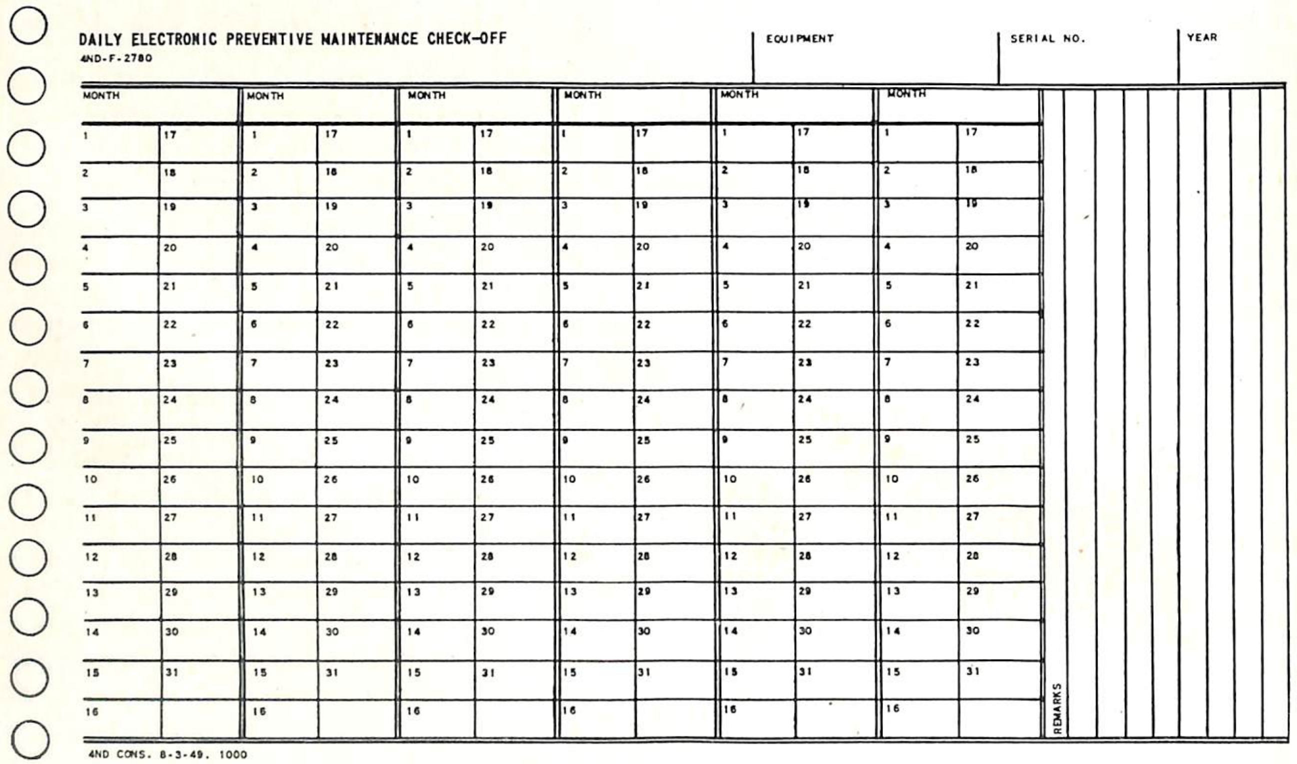
2. Its successful accomplishment must not depend on a few key personnel. Maximum use must be made of non-critical rates. It must be flexible enough to fit the fluctuating personnel situation.

3. The program must provide information for both a short and long range program. Day to day information on equipment operation will provide the necessary information for short range preventive maintenance. But there must be information available that will show long range trends. Day to day records kept in an easily useable form will provide much of the long range information but certain periodic checks of a technical nature must be made also.

4. The performance of the program must be easily checked by one person. This requires that the records be in an easily handled format and that they contain in condensed form all the necessary information.

5. The ultimate responsibility for the carrying out of this program must lie with the officer in the administrative chain of command of the man who actually performs the work. This leads us to divide the program along two lines . . . Technicians' checks (administered by the Electronics Officer) and Operators' Checks (administered by the Operations Officer).

The actual format of the preventive maintenance program was arrived at by keeping these five cardinal points firmly in mind. The checks to be performed are outlined on punched cards (NavShips 532) that fit the McMillan type binder. As far as possible the complete information necessary is given on the card. In many cases the detailed explanation necessary was too lengthy to permit this. Therefore, appropriate references are given on the cards to the applicable portions of instruction books. In this way it has been found operators and technicians are in a sense forced to read instruction books which is something they all profit by. Great pains were taken to see that instruction book references were clearly identified in order to eliminate lost time in using the instruction book on the part of the man making the checks. Checks are divided into periodic checks for operators and periodic checks for technicians. Each card covers only one period of time (day, week, month, etc.) and one equipment for either an operator or a technician. All Check Cards were made out in duplicate. The copies comprise a master file for the Electronics Officer. All those checks to be performed by operators were turned over to the Operations Officer with a detailed explanation of how they were to be used. In addition to Check Cards, there are other cards called Calendar Cards which provide squares for checking off the checks listed on the Check Cards (see Figures 1 and 2). There are two types of these Calendar Cards; one for



DAILY ELECTRONIC PREVENTIVE MAINTENANCE CHECK-OFF
4ND-F-2780

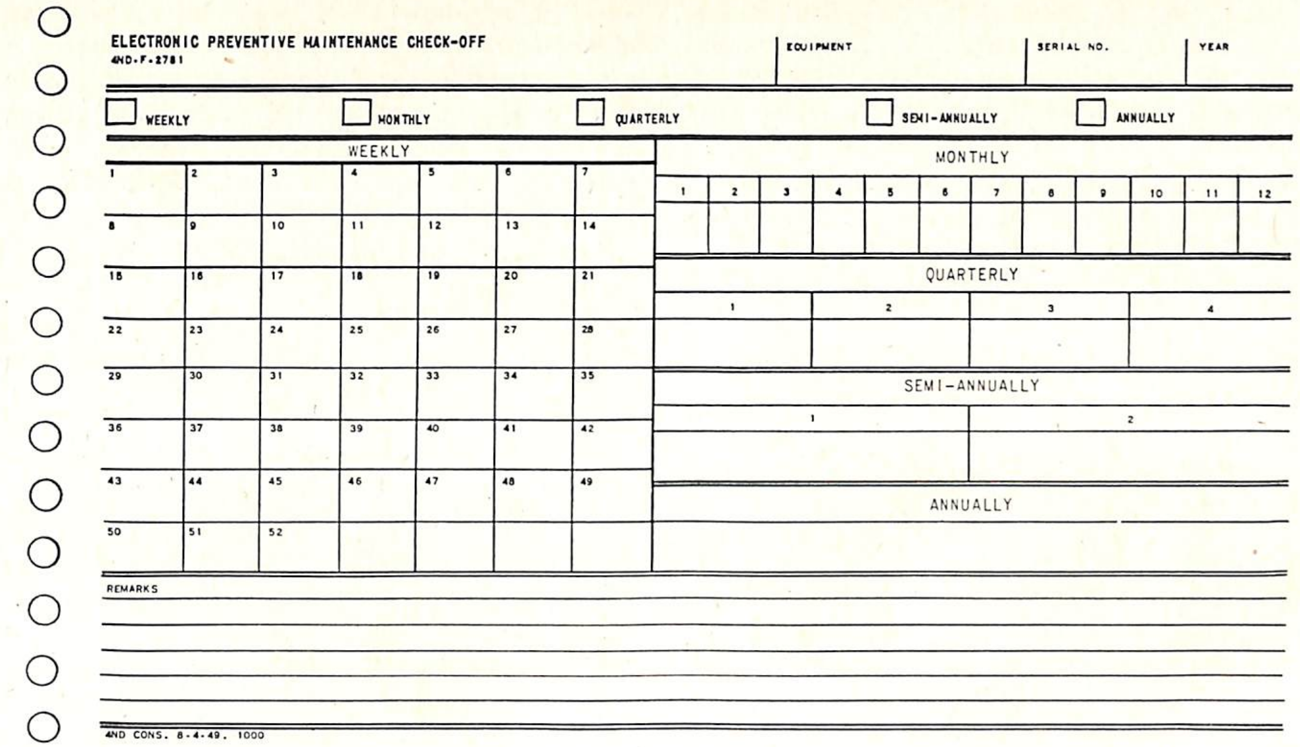
EQUIPMENT	SERIAL NO.	YEAR	

MONTH		MONTH		MONTH		MONTH		MONTH		MONTH		REMARKS
1	17	1	17	1	17	1	17	1	17	1	17	
2	18	2	18	2	18	2	18	2	18	2	18	
3	19	3	19	3	19	3	19	3	19	3	19	
4	20	4	20	4	20	4	20	4	20	4	20	
5	21	5	21	5	21	5	21	5	21	5	21	
6	22	6	22	6	22	6	22	6	22	6	22	
7	23	7	23	7	23	7	23	7	23	7	23	
8	24	8	24	8	24	8	24	8	24	8	24	
9	25	9	25	9	25	9	25	9	25	9	25	
10	26	10	26	10	26	10	26	10	26	10	26	
11	27	11	27	11	27	11	27	11	27	11	27	
12	28	12	28	12	28	12	28	12	28	12	28	
13	29	13	29	13	29	13	29	13	29	13	29	
14	30	14	30	14	30	14	30	14	30	14	30	
15	31	15	31	15	31	15	31	15	31	15	31	
16		16		16		16		16		16		

4ND CONS. 8-3-49. 1000

FIGURE 1—Calendar card for daily electronic preventive maintenance check-off.

daily checks (Figure 1); the other for weekly, monthly, quarterly, semi-annual and annual checks (Figure 2). The one for daily checks has space for one year's time and the other space for two year's time (cards are printed same both sides heel to toe). Each Check Card and Calendar Card is given a number consisting of a letter followed by a number. The letter is either "O" or "T" (signifying Operator or Technician), and the numbers run consecutively from 1 up. The numbers have no significance in themselves, but they do enable one to place the cards in a binder in number order with corresponding Calendar Cards and Check Cards adjacent to each other. When a man has completed the checks listed for him on the Check Card he can flip to the corresponding Calendar Card (which will bear the same number) and initial in the appropriate square. By keeping all the cards in one binder it is easy for the officer in charge to check on the progress of the work. Admittedly, a person could check off certain squares without having actually done the work. That is why the administration of the program must be in the hands of the officer in the administrative chain of command. He is the man that recommends special requests, assigns duties, assigns their quarterly



ELECTRONIC PREVENTIVE MAINTENANCE CHECK-OFF
4ND-F-2781

EQUIPMENT | SERIAL NO. | YEAR

☐ WEEKLY ☐ MONTHLY ☐ QUARTERLY ☐ SEMI-ANNUALLY ☐ ANNUALLY

WEEKLY

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52				

MONTHLY

1	2	3	4	5	6	7	8	9	10	11	12

QUARTERLY

1	2	3	4

SEMI-ANNUALLY

1	2

ANNUALLY

REMARKS

4ND CONS. 8-4-49. 1000

FIGURE 2—Weekly, monthly, quarterly, semi-annual and annual check-off card.

marks, etc. He is the man in the best position to "crack the whip" is such be necessary.

There is one more part to the format of the program. That part is called the Daily Operator's Log. These logs consist of single sheets containing mimeographed tables to be filled in daily by the operators. Each sheet has room enough for one week's entries. These sheets were prepared under the direction of the Electronics Officer. Considerable time and thought were spent in arriving at a simple form containing a maximum amount of USEFUL information capable of being taken in a reasonably short time. A casual inspection of these sheets may give the impression that too much information is asked for. Yet the experience we have had refutes this suspicion. One completely unanticipated advantage has been to arouse the interest of the operators in their equipment. Heretofore operators' maintenance had consisted mainly of the dull uninteresting job of keeping the gear clean. This is still required of course, but by requiring the operator to make meter readings, record waveforms, record ringtime, check dial settings, etc., we have aroused interest in just what makes the gear tick. The expected results have paid dividends too. We are able to inspect a week's reading at a time and in many cases can see where certain adjustments are in order . . . where certain components must be checked for possible replacement before equipment performance has reached an unacceptable level. These Daily Operator's Log Sheets are submitted to the Electronics Officer each Friday. He inspects them, sees that the technician concerned sees them and files them in manila folders to be kept as a permanent record of the performance of the equipment concerned. Each month the log sheets for the preceding month are reviewed for possible slow changes that might not be detected each week. Quarterly the same routine for the preceding quarter's log sheets. This provides us with the desired short and long range information for preventive maintenance and it is in an easily handled form.

To briefly summarize: the format comprises three forms; (1) Check Cards (2) Calendar Cards and (3) Daily Operator's Logs.

It will be noticed that the layout of these forms lends itself readily to modification to suit the particular situation extant on the ship as regards personnel, etc. It is believed that the flexibility of this system is one of its chief advantages.

It has been a source of great concern to this ship for some time that the preventive maintenance checks listed in instruction books are not realistic.

If they are followed to the letter there will be practically zero equipment failures . . . but it would take a crew of technicians the size of the ship's complement to do it! It has taken a lot of work to iron out what is and is not possible to do . . . what is and is not necessary to do . . . how often certain checks should be performed. But it our belief that the time has been well spent. We don't pretend to have the last word. But we do feel that we are on the right track and that with modification as experience may dictate we have a good answer.

Preventive Maintenance

The second essential element—The Preventive Maintenance Schedule. After all the painstaking work that went into creating the format just described we thought that we could sit back and watch the results roll in. Such was not the case. And for a couple of months after the inception of the present program we had fears it would fall flat on its face; that once again we were up a blind alley. The solution was found in a Preventive Maintenance Schedule. We had accumulated a great amount of information about what should be done and how often it should be done but getting it done was another question. There just never seemed to be enough time. We were still involved in the perpetual ratrace (that is as good a description as any of the situation before the present program got underway). What we did is this—We made a list of all the annual checks that had to be made, all the semi-annual, quarterly, monthly and weekly. Then we made up a form sheet (see Figure 3). We took all the annual checks and divided them by 46, all the semi-annual and divided by 23, all the quarterly and divided by 12, all the monthly and divided by 4. Then we proceeded to fill in the form for each week of the year with these divisions of the total work to be accomplished. You will notice that the form gives one week of grace in each quarter and we further shuffled things around to give two weeks of grace the last two weeks in December . . . that is weeks in which nothing is scheduled. We found it impossible to schedule

Dimensions 8" X 13"

	Month of ____				Month of ____				Month of ____			
	Week of	Week of	Week of	Week of	Week of	Week of	Week of	Week of	Week of	Week of	Week of	Week of
ANNUAL												
SEMI-ANNUAL												
QUARTERLY												
WEEKLY												

FIGURE 3—Preventive maintenance schedule check card.

things closer than a week. But when scheduled down to a week it works fine. Thus we have spread out the work load over an entire year. There are no rush periods . . . which is the bane of most programs without such a schedule. And there are periods of grace that occur regularly. We have become so sold on this schedule that we've tied many other things in with it. On a ship this size we have approximately 200 maintenance repair parts boxes that have to be inventoried. That's no small job in itself. We've divided up the boxes into weekly groups and for the first time have really achieved some continuing success in this problem. When a box is inventoried and found complete we have it inventoried immediately by another man. If both agree it is complete we put a seal (Navy Stock Number 42–S–2135–200) on it. If the seal is intact the next time it is scheduled to be inventoried it is considered to be complete. We planned to reinventory all sealed boxes once every three years, if for some reason we are lucky enough to have a box that isn't opened for that long. Of course the new maintenance parts program will eliminate most of this trouble (we hope). We also place on this schedule such items as the preparation of the Communication and Countermeasures Report and any other reports that occur periodically.

Administrative Techniques

I have called the third essential element Administrative Techniques. Boiled down it means "How to get the job done". Every ship is different in so many ways that what works one place may not do the job at all in another. However, there are certain basic administrative techniques that are universal throughout the Navy. Assuming we have perfected the first two essential elements of an electronic preventive maintenance program, how do we go about making it work? How do we make the "wheels go round"? Anyway we approach the problem we ultimately end up with the solution that someone has to be "the boss". The boss in this story is the Electronics Officer. Insofar as electronics is concerned his position may be likened unto that of the Captain of the ship. The Electronics Officer on a DDR, or any destroyer type ship, will have many duties other than electronics. On the LARSON I was the "R" Division Officer. I had to worry about the electricians, the "A" gang and the shipfitters plus the ET's. I also stood ODD watches underway and Duty Department Head duties in port. There were so many demands on my time and energies that I had to deny myself the pleasure of "detailed administration." I had to become a small scale policymaker. I had to have someone to execute my policies. The Captain has an Executive Officer—I had four Leading Petty Officers. My Leading Petty Officers were the ones who really ran the show. They were "Johnny on the spot" all the time. Their primary duty was the detailed supervision of their working group. My leading ET was the one who executed the preventive maintenance program. He was the man I put the pressure on to get the job done. He was the "whip" of the outfit. He was given as free a hand as he showed the ability to take. His excellent performance of duty was rewarded by extra consideration for his special requests and in myriad other ways. His poor performance of duty was the subject of a heart to heart talk on the subject (and in extreme cases appropriate disciplinary action was taken). Usually with patience and direction an average petty officer can be turned into a good leading petty officer. But sometimes it takes a lot of patience and a lot of direction. This unfortunately is more often the case with ET's than most other rates. There are many reasons for this but basically it derives from the fact that to be eligible to be an ET in the first place a man must have far above average mental equipment. And to ever make the grade he must have demonstrated his ability to use this mental equipment. Unfortunately the present schooling set up doesn't turn out petty officers. It does turn out embryo technicians who may or may not make good petty officers. Right there is where the Electronics Officer comes in. He is in the perfect position to make petty officers of his ET's in addition to improving on their technical ability. Sometimes in destroyers the Electronics Officer is not trained in electronics. But that doesn't mean he can't administer the ET's. Their job is basically the same as that of any other member of the engineering force on board ship. There is certain equipment to be maintained, certain periodic checks to be made to effect this maintenance and someone has to "ramrod the deal". You may be faced with a situation where there are several men of equal rank and experience and no one can be said to undeniably by the senior petty officer. What do you do then? I faced that situation once and I picked the most likely candidate and put him in charge. It worked. It didn't run as smoothly as I wanted—but it worked.

There has been too much of a tendency to treat ET's as something extra special. They are something extra special only in the sense that they possess a special skill. There are many special skills and the Navy is full of men with them. But because electronics is comparatively new and still a mystery to most people, an aura of mysticism surrounds those who are "priests at the altar." This has led to many foolish misconceptions concerning the ET's place in the Navy. One hears "Oh, he can't do that. He's an ET". Poppycock! He is in the Navy, and it is high time he *joined* the Navy! Under the current standard shipboard organization ET's are members of the Engineering Department. Hence it is high time they joined the Engineers. We accomplished this fusion on the LARSON and it's well worth the effort. It is one big step in making a good technician into a good petty officer.

What this boils down to is (1) get yourself a leading petty officer (i.e. a "whip") (2) put all your pressure on him (3) see that he "cracks the whip" on the rest of the gang. It's the old Navy way of getting things done. There's nothing new about it. It is used every day throughout the entire Naval Establishment. It is a time tested, time proven method. *And it will work with ET's, too!* Try it and see!

There is one more aspect to administrative techniques. It is the problem of getting operator co-operation. No matter how well the technician's part of the program runs you cannot say the program as a whole is a success until all the operating personnel are doing their share too. How do we get this cooperation? This again is an individual ship problem. I feel it should be settled at as low a level as possible. Thus, if your leading petty officer and the leading petty officer of the operators can settle the problem you're in. More than likely it will have to be settled at the division officer level or higher. You may have to go all the way to the Captain. Here are a few points to remember: (1) Operator's maintenance of equipment is required by the requirements for the various operator's rates as set forth in "Manual of Qualifications for Advancement in Rating (NavPers 18068)"; (2) If you have a good program laid out it doesn't take much persuasion on your part to convince a skeptic of the value to himself of cooperating; (3) sometimes a demonstration of how long it takes to do operator's checks plus a schedule made up by you for the operators will be a convincer. Whatever you do don't give up on getting operator cooperation. There are enough directives from higher authority floating around on the subject to convince most any skipper if you have to drag him into it. Without the help of the operators you'll have a mighty tough time. And your program may fall flat on its face.

ET Watches

The fourth element to be considered is ET watches. How can the talents of the ET gang best be used on a watch? What kind will achieve the desired results? We have tried just about every kind of set up you can think of and we think we have at last arrived at a satisfactory solution. The big trouble is determining just what the man on watch is watching. If you put a man in CIC and tell him he's on watch and to keep an eye on things and to take care of any troubles that may come up, you haven't achieved anything. What is needed is specific instruction on his duties and specific assignment of those duties. We have developed a series of mimeographed sheets listing all the equipment on board versus desired adjustments, observations and measurements to be filled in by the ET on watch. During the watch the ET with the watch fills in all the spaces under all equipment in use or in standby as designated by the leading ET under the supervision of the Electronics Officer. Included in these readings, etc. are such things as ring-time, range calibration, frequency checks, and power output checks. These checks can be just as detailed and comprehensive as the situation calls for. We maintained an ET watch from 1600 to 0800. All ET's and strikers except the leading petty officer of the gand stood these watches. The leading petty officer is always on call and he sees that the situation is handled as necessary between 0800 and 1600. We have found that normally a formal watch from 0800 to 1600 is not necessary or desirable. Every day before 1600 the leading petty officer of the gang writes what might be called "night orders" for the ET watch during the night. These orders could be written by the Electronics Officer if he desired. I have found it most satisfactory to outline to my leading petty officer the general things I want done during those watches and leave its execution up to him. We find these night ET watches are ideal times to catch up on instruction book corrections, head and handset repairs, receiver sensitivity and alignment checks, and any other paper work that may be delegated. Detailed instructions on just what is to be done is included in the leading petty officer's "night orders". Of course the checks, measurements and adjustments to equipment come first and often items of corrective maintenance will keep the man on watch busy for his whole watch. But—that's why he's on watch. On our ship the ET on watch stays in the ET workshop except when his duties require him to be elsewhere as when he is checking equipment. We have found it impractical to say that he *MUST* stay in any one place because electronic equipment is all over the ship. However, when he leaves the CIC area he must notify the CIC watch officer of his whereabouts.

(FRONT)

Dimensions 8" X 13"

REQUEST FOR A REQUISITION

________________ (date)

From: The Engineering Dept.__________ Mach.
__________ Elec.
__________ Damage Control
__________ ET's

To: The Supply Officer

1. The following items are required for use by this department. Priority *__________ recommended.

(Leading Petty Officer) (Division Officer) (Head of Dept.)

* A - Can't get underway without
B - Can't perform mission without
C - Urgently required
D - Desirable

Remarks:

____________ (Ship's Req. No.)

____________ (Dept. Ser. No.)

Status:

FIGURE 4—Front side of requisition request.

Supply

The fifth element, supply, is often the crucial element in the entire system. I have yet to meet a supply officer that can give you any real help in the technical aspects of electronics supply. I gather that electronics supply officers are pretty scarce articles and aren't wasted on ships as small as destroyers. Be that as it may, the supply officer and his assistants can be of great assistance in the general supply problem. And any time spent digging into the workings of the supply office is time well spent. As has often been said, the biggest stumbling block is getting down the correct description of the item you wanted. But that is only the first obstacle. Months after you put in the order the item arrives and no one can identify it. I know of instances where expensive items ended up in the junk box because no one knew what it was. I suspect these are not isolated cases. But there is an answer and a very simple one. It takes a little work but it is worth it. In a sense the electronics officer has to set up his own supply system. On the LARSON we set one up for the entire engineering department. We will consider a case of a requisition originated by the ET gang. The leading ET or someone he might delegate prepared in the rough a form we called "Request for a Requisition" (see Figure 4). The ET's maintained a requisition log

(BACK)

Dimensions 8" X 13"

Item No.	Stock No.	Description	Unit of Issue	No. Required	Unit Price	Ext.	Disposition

FIGURE 4—Back side of requisition request.

book in which the following information was kept:

ET Req. No.	Equip.	Description	Date Ordered	Date Received	Remarks

The ET requisition number and this log were kept for their own convenience. It was not required by the system. The ET requisition number was written in one corner of the rough form. This rough "Request for a Requisition" is submitted by the leading petty officer to his division officer, in our case the electronics officer, for approval. It then went to the log room yeoman who immediately gave it a department serial number and logged it in the Department Requisition Log. He then typed up an original and one copy and submitted all three to the Chief Engineer for final approval. The Chief Engineer either signs the smooth original or directs it be placed in the "Hold File" for later submission. If approved the original and carbon go to the supply officer for preparation of the final requisition. The supply officer indicates on the carbon the ship's requisition number and returns it to the log room, thus signifying action has been taken by him. Meanwhile the rough copy that started the wheels going has been filed in a "Follow up" file. The mere presence of a piece of paper in the "Follow up" file indicates that action on some requisition by the supply department has not been taken. When the carbon is received from the supply officer the log yeoman files the rough copy (after noting the ship's requisition number thereon) in department serial number order and files the carbon in another file in ship's requisition number order. When the material is received on board, the supply office gives the requisition numbers to the log room yeoman, who in a very few minutes can find the man who originated the rough. This man is summoned to check the received material. He is given the rough copy to be prepared against the invoices and received material. Then he signs for the material and sees that proper disposition is made of it. The disposition is indicated on the rough he prepared so even though months may have passed and his memory be hazy, the material will get where it should go. Then he returns the rough to the log room yeoman indicating thereon what was received. This information is transferred to the carbon and the two copies are either replaced in the files (if all material was not received) or the carbon is filed in a "Material Received" file and the rough returned to the gang that originated it.

If material is received which can't be identified from the invoice and the rough "Request for a Requisition"; go to the supply office and get their copy of the ship's requisition which will contain the complete description as given on your rough. The item numbers on the ship's requisition will correspond to the item numbers on the invoice. Often the invoice will have for a description just one word as "capacitor" or "resistor". But, through the item numbers identity can be established.

The log room yeoman is charged with the responsibility of periodically checking on all outstanding requisitions with the supply department. He indicates the status on the bottom of the carbon in his "On Order" file. He is required to notify all concerned of any requisitions that have been cancelled or are outstanding three months or more. Once each quarter all requisitions relegated to the "hold file" are reviewed and submitted as funds are available.

This system may seem cumbersome. And it requires watching. But it does work and we found that as all hands became more familiar with it, it increased both in popularity and effectiveness. We made it a point to have everything we are allowed, needed or desired on order at all times. True, a good percentage of the requisitions found their way to the "Hold" file. But when an unexpected allotment came in, we were prepared to take full advantage of it.

Conclusion

I have made an effort to describe the Elements of a *Working* Preventive Maintenance Program. It isn't the scheme of a spectator. It grew from many mistakes, quite a bit of sweat and as much thought as the press of making the program work would allow. It isn't the brain child of any one man. Many of my shipmates, friends and acquaintances contributed to a bigger part than they will ever know. LTJG J. D. Johnson, USN, former Electronics Officer of the USS HANSON (DDR-832) and L. J. Mills, ETC, USN, formerly on the staff of CDD-142 were in at its inception and did a great share of the dull exhausting work involved in setting it up. The ET gang of the LARSON made it work, were its inspiration and are now (I hope) profiting from it.

BUREAU COMMENT: The opinions expressed in this article are those of the author, and are not necessarily those of the Bureau of Ships.

F.C. NO. 1—AN/APR-9A INVERSION OF VIDEO OUTPUT PULSE

This field change applies to all Radar Sets AN/APR-9A, Bureau of Ships Equipments, that are installed aboard ship to operate in conjunction with the Pulse Analyzer, Model RDJ, and the Radar Direction Finder, Model DBM-1. This field change is necessary in order to invert the existing positive video output pulse of the Mixer-Amplifier CV-43/APR-9A so as to provide the negative video output pulse required by the associated Pulse Analyzer and Radar Direction Finder.

Field Change Kits (SNSN F15-M-384501-960) consisting of the Field Change Bulletin, NAVSHIPS-98427, Complementary Instructions for the Instruction Book, NAVSHIPS-91510, and the Field Change Report Card, NAVSHIPS-2369, are being shipped directly to each ship having an installation of the AN/APR-9A. Additional kits are available from the Bureau of Ships.

In Radar Sets AN/APR-9A that have already been installed, changes have been made to the equipment by the installing activity to provide for the inversion of the video output pulse. These changes, in most cases, do not conform to the requirements of the F.C. No. 1-AN/APR-9A. The equipment should be checked in this regard and if the modifications made are not in accordance with this field change, then those changes made should be removed and this field change installed.

When the field change has been completed, or if inspection shows that the modifications made comply with the requirements of this field change, the responsible technician should follow the routine below:

1. NAVSHIPS 2369 should be filled out to give installation data and mailed to the Bureau of Ships.

2. The field change should be recorded on the "Electronic Equipment History Card", NAVSHIPS-536, and on the "Field Record Change Card", NAVSHIPS-537.

SU RADAR ANTENNA ADJUSTMENT

An SU Antenna Stable Element can be the cause of "Blind Spots", skipping over targets, and/or apparent loss of sensitivity when ringtime is normal.

Indications of abnormal antenna operation, other than the aforementioned, is any deviation from the following:

With the Stow-Stabilized Switch on "Stow" the "Stabilizer Correction Meter" should read zero for all bearings. The antenna dipole should be level plus or minus the list of the ship for a given bearing.

With the Stow-Stabilized Switch on "Stabilize" the meter should read zero plus or minus the list of the ship for a given bearing. The antenna dipole should be level at all bearings.

In port there is only one way to determine if an SU antenna is functioning properly or not. One must climb the mast, take off the radome and make certain checks.

Checks to Make With All Power Off

Inspect visually for excessive play between drive linkage and reflector at taper pin. (See Fig. 6-5 of the instruction book for SU—Ships 313 or Fig. 7-7 of NAVSHIPS 900,882.) Hold the drive linkage with one hand and gently depress the dish with the other. If there is slippage, remove the cotter key and tighten the castellated nut. If this does not correct the trouble remove the castellated nut and insert a 5/16ths lockwasher with internal teeth. Replace the nut but do not tighten. By means of a spirit level adjust the position of the arm on the shaft so that the dipole and the top of the gyro control box are level. (The level from a combination square, usually available in the ship's carpenter shop will be fine for this.) Tighten the nut carefully so as not to upset the alignment. Replace the cotter key. Move the antenna reflector up and down and at the same time observe the action of the cams on the "Limit" and "Stow" microswitches. See that there are no broken or worn parts and that there is no lost motion between the reflector and cams.

Limit and stow switch cams should be positioned as diagrammed in Fig. 6-7 in the SU instruction book—Ships 313 or Fig. 7-9 of NAVSHIPS 900,882. Bear in mind that the limit switches are next to the segment gear. Numerous equipments have been found with the cams set wrong. The drawing in the instruction book is often misinterpreted. The "0" numbers are for the supporting arms for the rollers that actuate the switches. The "S" numbers, of course, are for the switches. The antenna must be level when making these adjustments. Set the stow switches a little further apart than normal. The fine adjustment will come later.

Stand Clear of the Antenna. Have your assistant at the control indicator turn on the power. The antenna may rotate when the power is applied to the control unit after the time delay kicks in.

Have assistant place the "Stow-Stabilized" switch in the "Stow" position. By means of the spirit level determine the level position of the dipole. Have assistant read the "Stabilizer Correction Meter" (M-501). If this is not zero plus or minus the list of the ship for that particular bearing, correct the condition by repositioning R-401 at the antenna. See Para. 3.52, instruction book for SU—Ships 313 or Para. 2 page 7-27. Remember that the trim of the ship will effect the reading of the meter. This procedure will insure that you will be getting proper readings from your assistant in the following checks:

Have assistant put "Stow-Stabilized" switch in "Stabilize". Depress the antenna about five degrees and rotate. The antenna should nod and gradually stabilize itself within three or four minutes. Have assistant read meter. It should be zero plus or minus the list of the ship. If there is a small discrepancy it may be corrected by positioning the Gyro Control Box by means of the mounting bolts. If there is a large discrepancy or the antenna will not stabilize, check for play at the taper pin, the drive linkage, or defective servo generator (B-405). Check voltages. See Para. 1, page 7-29 of NAVSHIPS 900,882. See that relay K-402 inside junction box at antenna assembly is energized in the stabilized position. In nearly all cases a new Gyro Control Box, new brushes in B-405 or a new Servo-Generator will correct the trouble.

Having corrected any discrepancies, and with the antenna stabilized, depress the Dish gently about five degrees. Release and rotate the antenna. See that the antenna stabilizes properly within four minutes. Repeat this process several times. Each time noting the reading of the correction meter for one particular bearing. There should be no difference in this reading. If there is, it is generally an indication that there is excessive mechanical play or that the Silverstats in the Gyro Control Box are fouled.

After the antenna is operating properly in "Stabilized" place the switch in "Stow" position. Depress the dish several degrees and release. The antenna should resist you and return to level position. Have assistant read the meter. If it is not zero, adjust the cam that operates the switch when the antenna is depressed so that it does. Do this in small steps. Repeat the process by elevating the antenna and adjusting the corresponding cam. If antenna starts to oscillate, back off on one cam slightly. After working from one cam to the other several times, a condition should be reached whereby the meter reads zero from either excursion.

B. K. Smith
RCA Field Engineer
COMSERVLANT *Electronics Service Group*

STATUS OF ELECTRONICS MAINTENANCE BULLETINS

The latest supplement to the revised Radar Maintenance Bulletin (sixth edition), NAVSHIPS 900,-096, is Supplement 28 dated January 1951. This supplement contains new and replacement pages for the "C" and "S" editions of the RMB.

The seventh edition of the RMB, NAVSHIPS 900,096D, will be distributed to all holders of the present RMB during June 1952. NAVSHIPS 900,-096D is a complete revision through the last supplement and supersedes the material in all previous editions. Old material is to be removed and destroyed by burning. A report of such destruction is not required. The first supplement to NAVSHIPS 900,096D will be distributed about 1 July 1952.

Supplement 21 dated January 1951 is the latest supplement to the Sonar Maintenance Bulletin, NAVSHIPS 900,025A. A completely revised SMB will be distributed to all holders of the present SMB about August 1952.

The latest supplement to the Communication Equipment Maintenance Bulletin, NAVSHIPS 900,020A is Supplement 37 dated April 1952. This supplement will be distributed by 1 May 1952.

REPAIR OF THE DATA CONVERTER SYNCHRO IN MODELS QHBa AN/SQS-10, AN/SQS-11

The mechanical condition of the various gear trains and associated motors and synchros in the Models QHBa/SQS-10/SQS-11 data converter mechanism may be determined by measuring the ac error signal across the rotors of the 1X control transformers B-402, B-1202, and B-1210, with the slewing controls S-201 or S-202 in operation. Normal operation is indicated by readings of approximately 2-6 volts ac. This voltage may increase to values as high as 50 volts due to bad bearings, gear binds, etc.

Shipboard repair of the QHBa data converter synchro mechanism should be limited to replacement of synchros, motors, dials, ets. Replacement or repair of elements of the gear train with the exception of those gears directly attached to motor and synchro shafts is considered to be a tender or shipyard repair. Particularly, the back mounting plate must not be removed as it results in unmeshing the entire gear train. Reassembly and alignment of the gear mechanism is extremely difficult and may result in impaired performance.

TYPE 3D21A TUBES IN AN/UPX-1

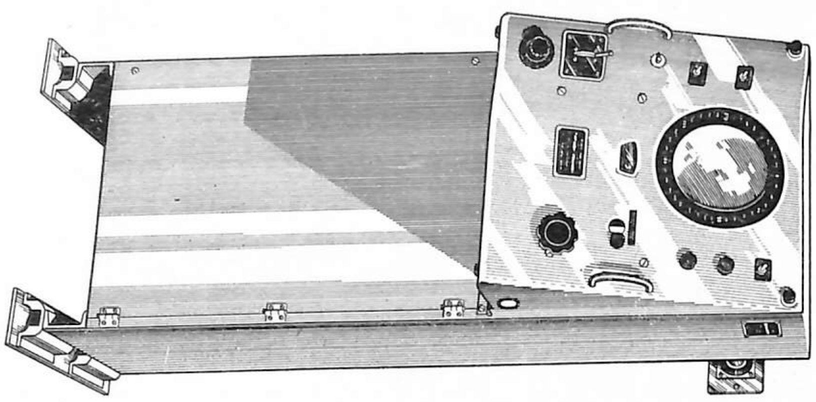
ALL the 3D21A tubes now in stock are about six years old. The Bureau of Ships has received reports that these tubes flash-over in many cases thereby causing a momentary overload in the high voltage circuit.

Temporarily, tubes which are over should be replaced with spare tubes. However ALL tubes which are over should be RETAINED since they can probably be "cleaned up."

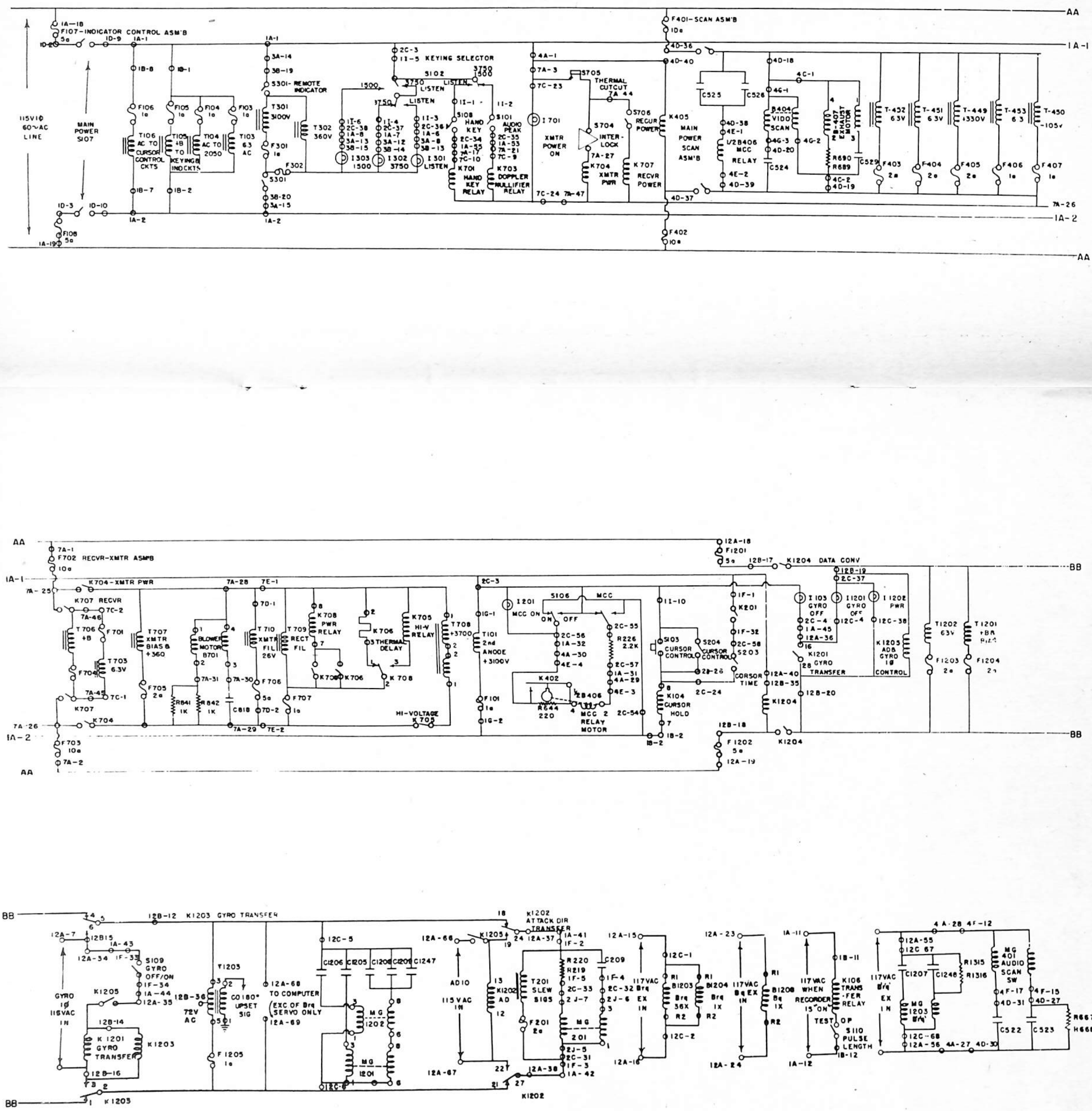
The Bureau of Ships is obtaining the recommended "cleanup" procedure from the tube manufacturer and will disseminate this information when available.

QHB- Primary Power Distribution Diagram

Figure 1 is an "across-the-line type primary power distribution diagram for the QHB-a Scanning Sonar Equipment. This diagram should be of assistance in servicing the primary power circuits of the QHB-a. The diagram was prepared by maintenance personnel of the Surface Anti-Submarine Development Detachment.



QHB–a sonar indicator control.

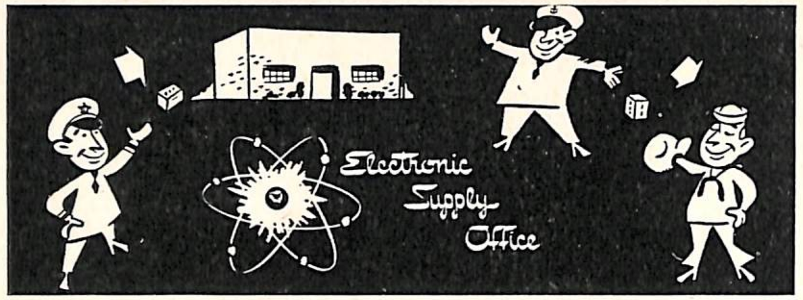


ASSEMBLY	TERMINAL DESIG	SYMBOL DESIG
RECUR XMTR	7A THRU 7E	700 THRU 800
SCANNING	4A " " 4G	400 " " 600
INDICATOR CON'T	1A " " 2J	100 " " 200
DATA CONV	12A " " 12C	1200 " " 1300
REMOTE IND	3A " " 3B	300 " " 308

FJ1-3/822 J15-11 (2)

QHBa SONAR PRIMARY POWER DIAGRAM

FIGURE 1—QHB–a sonar primary power diagram.



E.S.O. MONTHLY COLUMN

RETURN OF SPENT MAGNETRONS

The Electronic Supply Office has directed that end users of thirty-seven types of magnetrons return them, when they become unfit for use, to the nearest Distribution Point. The types designated contain certain critical materials which can be salvaged.

Distribution Points are located at Naval Supply Depot, Bayonne, New Jersey; Ships Supply Depot, Naval Supply Center, Norfolk, Virginia; and Ships Supply Depot, Naval Supply Center, Oakland, California.

A complete listing of the magnetron types which should be returned when spent is given below:

Tube Type	Stock Number	Tube Type	Stock Number	Tube Type	Stock Number
2J38	N16–T–52538	4J54	N16–T–54554	4J78	N16–T–54578
2J39	52539	4J55	54555	QK59	60589
2J41	52541	4J56	54556	QK60	60601
2J42	52542	4J57	54557	QK61	60615
2J42A	52542–5	4J58	54558	QK62	60619
2J51	52551	4J59	54559	A136M	61360
2J55	52555	4J60	54560	QK151	61510
2J56	52556	4J61	54561	QK181	61810
2J70	52570	4J62	54562	QK221	62209–50
2J71	52571	4J63	54563	QK241	62407–50
3J21	53721	4J64	54564	QK247	62470
4J50	52550	4J65	54565	QK283	62829
4J52	52552				

ACCEPTABLE DEVIATIONS FOR FIXED WIREWOUND RESISTORS

It is the objective of the Electronic Supply Office to supply the Fleet with minimum disturbance or interruption in stock number changes. Therefore, in the supply of wirewound resistors under JAN–R–26A, Amendment 2, pending final resolution of applicable Standard Navy Stock Numbers, the following action will be taken by all ESS Activities:

(1) "G" characteristic resistors will be purchased as acceptable deviations for "D" and "F" characteristics in the superseded basic specification JAN–R–26A.

(2) "J" characteristic resistors will be purchased as acceptable deviations for "H" and "E" characteristics in the superseded basic specification JAN–R–26A.

This office interprets Amendment 2 to JAN–R–26A to mean that it is no longer necessary to recognize the "resistant to salt water immersion" characteristic, and that resistors which meet the humidity cycling tests are acceptable for all maintenance requirements, according to their operating temperature characteristics.

BUSHIPS SECTION, PART II, CATALOG OF NAVY MATERIAL DISTRIBUTED TO FIELD ACTIVITIES TO DATE

Those field activities receiving BuShips Sections, Part II (Electronics), Catalog of Navy Material are advised that twenty-two Sections have now been completed. The first twenty sections distributed were listed in the December 1951 ELECTRON. Two additional sections now being distributed are as follows:

Section 17–300 Gaskets
Section 17–810 Discriminator Transformers

Sections in the final compilation stages which will be distributed in the very near future are:

Section 17–050 Batteries
Section 17–075 Brushes
Section 17–801 Teletype

Also scheduled for early promulgation to the field is Catalog Section 16–000. This Section will be titled "Introduction of the Buships Section, Part II (Electronics), Catalog of Navy Material" and will contain a complete listing and index of all Sections distributed as well as those sections or commodities of material being processed.

ADJUSTING THE AFC IN THE SU RECEIVER

One of the more common troubles in the SU receiver is the improper functioning of the AFC circuit. Usually, the first indication of trouble comes when the magnetron, TR, ATR, or the local oscillator has been replaced and the receiver has been retuned. Echoes may be normal when the MANUAL-AFC switch is in the MANUAL position, but will disappear when the switch is placed in the AFC position. This is usually caused by tuning the local oscillator to a frequency 30 mcs. *below* the magnetron frequency. In order for the AFC to function properly, the LO must be tuned to a frequency 30 mcs. *above* the magnetron frequency.

To check if the AFC circuit is operating, place the MANUAL-AFC switch to AFC and connect a 0–1 ma. ammeter from J3103 to ground, and another from J3102 to ground. Turn the coarse LO tuning control fully counter-clockwise and adjust the crystal currents to about 0.5 ma. If the AFC is functioning, the crystal currents will pulsate about once every two seconds.

If the AFC is not functioning, the following tuning procedure should be used:

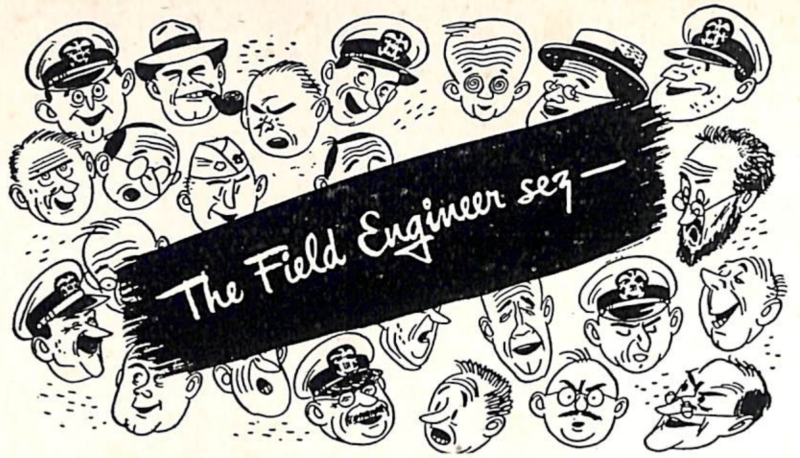
Place the MANUAL-AFC switch in the MANUAL position, and the manual LO frequency control in its mid-position. The receiver gain should be just enough to produce about 1/16 inch of grass on the range scope. Tune the echo box for maximum signal on the IFF trace. If natural targets are available, the echo box need not be used. Turn the coarse LO frequency control on the transmitter-receiver unit to its full counter-clockwise position. Connect a 0-1 ma. ammeter between J3102 and ground, and if another meter is available, connect it between J3103 and ground. This will enable reading both receiver crystal and AFC crystal currents simultaneously. If only one meter is available it can be placed alternately in the two positions. Adjust the two crystal matching screws until both crystal currents are about 0.5 ma. Use the screw position that corresponds to maximum penetration into the crystal cavity. Slowly turn the coarse LO frequency control clock-wise until targets are obtained on the range scope, meanwhile adjusting the crystal currents to keep them about 0.5 ma. Tune the TR and ATR tubes, and readjust the coarse and fine LO tuning for maximum ring time or echo amplitude. Turn the MANUAL-AFC switch to AFC. If the echoes remain steady, the AFC is probably functioning properly. Check the operation by turning the manual LO control slightly to either side of its setting. If the AFC is functioning properly, the echoes will disappear momentarily and then steady echoes will reappear. Return the MANUAL-AFC switch to MANUAL and reset the manual LO tuning control to the correct setting for maximum echoes.

If, however, echoes disappear when the MANUAL-AFC switch is turned to AFC, or fluctuate, the LO is probably tuned to the wrong side of the magnetron frequency. Return the switch to MANUAL and continue tuning the coarse LO tuning until echoes are again obtained. Continue this process until a point is found where echoes remain steady when the MANUAL-AFC switch is turned to AFC. If no such point can be found, it is probable that the trouble is in the AFC circuit. Replace V3116 (884), V3115 (2050), V3114 (6AC7), V3113 (6H6), and V3112 (6AC7), in the order named, repeating the tuning procedure after each tube is replaced. If trouble perists, check relay K3101, and the wiring and the resistance of the AFC circuit. If none of the above steps corrects the trouble, the entire transmitter-receiver unit should be replaced.

When the correct point in the LO tuning has been found, the AFC may fail to "lock in" when the MANUAL-AFC switch is placed in the AFC position. Echoes will fluctuate or decrease in amplitude. It is probable that the discriminator in the AFC circuit is slightly off frequency. Adjust capacitor C3154B in the secondary of TC3101. Extreme caution must be used in making this adjustment as the setting is very critical. A careless adjustment may result in misalignment of the discriminator. Realignment requires the use of a synchronized scope and a signal generator modulated 5 or 10 mcs. around the 30 mc. point. This equipment is not normally available. Therefore, adjustment of the discriminator should not be attempted unless absolutely necessary and then only with extreme care.

After the circuit is operating normally, a final check of the crystal currents should be made to insure that the values do not exceed 0.6 ma. High crystal currents give poor signal-to-noise ratio and may damage the crystals. With proper care, the AFC circuit should prove very helpful in the operation of the SU Radar.

JOHN R. SCHLEDER
RCA Field Engineer
ESG, COMSERVLANT



RDP

USS Leary (DDR 879)

The C–119 had become leaky, placing a positive .5 volt on the grid of the reactance tube, V–112. This shifted the oscillator center frequency to about 20 mcs. The symptoms of this trouble were:

1. VR tube very dim
2. B plus voltage down to about 150 volts, unregulated
3. No signals on the indicator scope, or not enough range on indicator sweep range

The oscillator center frequency was adjusted to its proper setting of 30 mcs. after replacing C–119, V109 and V110. The sweep limits were set to plus and minus 5 mcs. Also, the r-f preamplifier was adjusted for best response. Operating condition of the equipment upon completion of work was good.

KIMBLE

SV

USS Toro (SS 422)

A considerable amount of arcing was occuring at the transmitter output coupling. This condition was corrected by selecting a 4J36 to replace a 4J39 magnetron. The D–152677 Signal Crystal Mixer assembly was bent at the point where it enters the TR cavity. This item was replaced with a new unit.

Trouble was experienced with the machine screw shorting out the meter shunt resistor R(2)18. This difficulty was caused by elongation of the holes in the phenolic spacer rings. The condition was remedied by turning some insulated bushings out of a meter test prod handle. These were installed in the large holes in the magnetron mounting bracket, thus preventing the machine screws from touching ground.

K. K. WHITE

QDA

USS Wilke (EDE 800)

The ship's battle light circuit was found shorted to the ground. The ground was traced through the entire ship's battle light circuit and finally was isolated in the Training Control Amplifier. Considerable difficulty was encountered when the junction box "A" could not be found. Further breakdown of the TCA circuit showed that the ground was in the windings of the K101 and the K102. An extra lead was common to both the K101 and the K102 with the other end of this lead connected to the fuse F101. F101 is in the 115 volt a.c. circuit which has one side grounded throughout the equipment. This lead was removed, and the burned out F101 was replaced. Normal operation of the equipment resulted.

C. KOZANOSKY

TBL–13

USS Thomas (DDE–764)

An inspection of the equipment indicated the following condition: the generator was very noisy as a result of the mis-alignment of the motor and high voltage generator shafts; the taper pins from the base of the motor-generator were missing; the HF side was intermittent.

To correct these conditions, the generator was properly set up and the missing taper pins were installed. The HF master oscillator range switch was cleaned to eliminate the intermittent condition. This intermittent condition is a chronic trouble with the TBL–7/13 units. The frequent use of a commercial type of contact cleaner with a deoxidizing agent will help considerably to prevent the contacts from becoming intermittent.

R. G. SLAUGHTER

THIS IS THE LAST ELECTRON !

The purpose of ELECTRON as stated in the first issue—July 1945—is to bring to the technical personnel of the Navy the latest information in the field of electronics. Your contributions and continuous support of this magazine during the past seven years has been greatly appreciated.

Starting in May 1952 the Bureau of Ships will publish a new magazine called the Bureau of Ships Journal. This magazine will carry features on electronics and a monthly electronics section. Contributions of unclassified articles for the Bureau of Ships Journal will be welcomed.

Electron Tube Users Can Increase Tube Life

by
CHARLES H. SINGER
Assistant Chief Engineer, WOR, WOR-TV, WOR-fm, New York

Experience at WOR has shown that there are four vitally important component groups requiring regular transmitter maintenance. These are electron tubes, condensers, relays, and resistors, respectively, with priority in that order. Since electron tubes occupy the most prominent niche in every transmitter, they deserve every broadcast engineer's consideration and effort to prolong tube life, and keep them operating reliably at peak efficiency. An effective tube operating and maintenance program will contribute to minimum station operating costs, and will be a boon to the station's audience and the broadcast industry as a whole.

Most transmitter engineers are aware of the many factors that enter into tube life. The more important ones are:

1. Filament voltage
2. Plate voltage, residual gases
3. Fatigue of metal parts
4. Heating and cooling cycles
5. Efficiency of cooling system
6. Efficiency of transmitter, maintenance, and associated protective relays
7. Care of spares and tubes in storage

Proper precaution must be taken with each of these factors. Plotting a standard system of procedure for each will eliminate many of the abuses which may cause tubes to burn out or become inoperative long before their useful life is run.

The Problem of Filament Voltage

The life of an electron tube depends more upon the filament voltage setting, which determines filament temperature, than any other factor. In order to monitor tube filament voltage, a voltmeter must be connected permanently across the tube filament terminals.

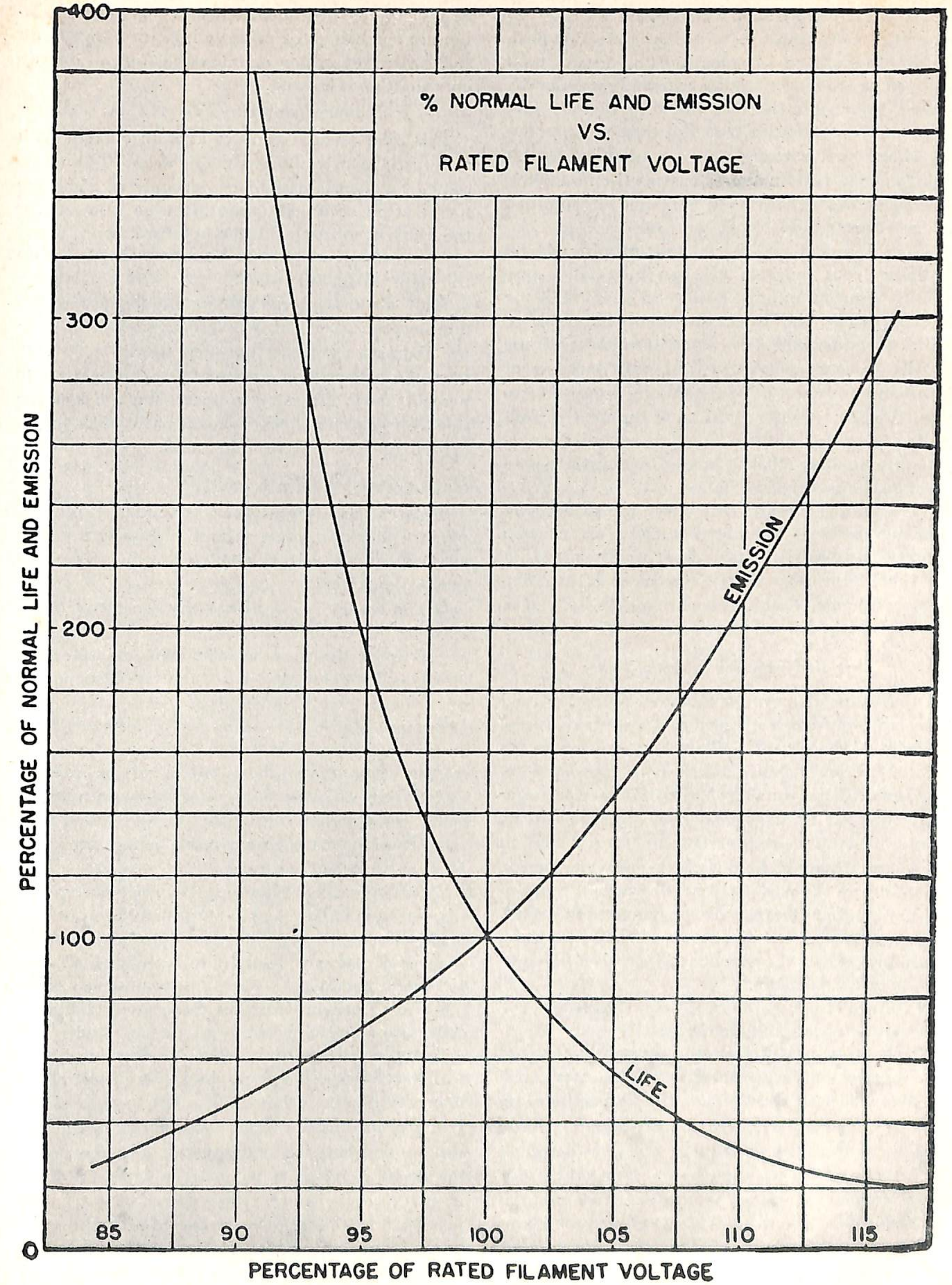
Tungsten Filament Tubes

When direct current is used for heating the filament, returns of the plate and grid circuits are usually connected to the positive filament terminal. Electron current return flow is through one side of the filament. If the polarity is allowed to remain the same for any length of time, there will be a greater thinning of one side of the filament which can result in premature failure. Because of this, the polarity of d.c. filament power supply to these tubes should be reversed each week.

Since a pure-tungsten filament may be operated at saturation, or just within limits of distortion, filament voltage and temperature may be reduced when the tube is operating at relatively low plate current. Activity and emission hours of a pure-tungsten filament are not impaired by its operation at reduced voltage, and appreciable tube economy will result from operation of the filament at a voltage no greater than that necessary to produce the required emission. End of filament life can be expected when the diameter of a filament wire has been reduced, due to evaporation of the tungsten, to approximately 90% of its original value. Life expectancy is nearly doubled when the filament is operated 5% less than rated voltage and is quadrupled when the filament voltage is decreased 10%. On the other hand, as shown by the accompanying curve captioned "% Normal Life and Emission versus % Rated Filament Voltage", if the filament is operated with an overvoltage of 5% it can be expected that the life of the filament will be one-half its design value, since the evaporation rate of the tungsten is nearly doubled.

At WOR, by reducing filament voltage of Type-342A tubes from 20 to 19.5 volts, a reduction of 2½ per cent, the *increase* in life expectancy of the tube is 4,100 hours.

Modern transmitters provide a 22½ per cent increase in antenna current with full modulation, single frequency, when operated normally. Decreasing filament voltage will decrease this antenna current rise if filament emission is reduced. However, longer tube life can be gained without impairing listeners' reception. Increased transmitter distortion may result from decreased filament voltage. This should be given individual attention, with consideration given to the spare tubes on hand.



% Normal life and emission versus % rated filament voltage.

A reduction in filament voltage of 5 per cent can be applied to transmitters with slight effect on peak power. In fact, peak currents equal to the total emission available may be drawn continuously without damage to the filament, if it is of the pure tungsten type. Reference to the tube manufacturer's charts will reveal data on available filament emission. On certain types, such as the ML–298A, marked voltages for a fixed emission are supplied by the manufacturer.

When there is an excess amount of emission available from tungsten filament tubes, it is possible to insert dropping resistors in series with the filament leads, and thus gain many hundreds of hours of additional life. In transmitters of the Western Electric 306A type, filament voltages of the second power amplifier should be dropped from 20 to 19 volts. All the emission of the tubes is definitely not needed, and the tube life can be extended to approximately 30,000 hours with little or no effect on the peaks of modulation.

WOR finds it important to check the accuracy of filament and bias voltmeters each week, using a standard calibrated meter which reads voltage at the tube terminals. Zero adjustment of the filament voltmeter should be checked daily and a standard method should be used.

Thoriated Tungsten Filament Tubes

Tubes using this type of filament are being used in increasingly larger quantities. Careful consideration should be given to filament temperature, to effect a proper balance between the loss and replacement of the thin layer of thorium on the filament surface. As a general rule filament voltage should be kept to manufacturer's ratings, but in some cases it may be held slightly below this figure, depending on the peak currents drawn in the equipment. Manufacturers usually recommend that peak plate currents should be considerably less than the maximum which the filament is capable of emitting, to insure long life.

A voltage check at the tube socket using a precision voltmeter is recommended each week.

If a tube with a thoriated tungsten filament has been overloaded, with resultant overheating, any gas liberated may contaminate the filament and reduce its emissibility. Prior to attempting electrical cleanup of the tube, it may be possible to restore the activity of the filament by operating it at 70% above normal operating voltage for five minutes and then 20% overvoltage for 15 minutes without plate voltage. It may be necessary to vary somewhat and repeat this procedure to obtain the required activation. Electrical cleanup of the tube may then be attempted, with operation under Class C conditions at one-half rated plate voltage for a half hour, and further operation at increased normal operating condition is assured.

Thermionic Mercury Vapor Tubes

This tube usually operates at high current with a low anode to cathode voltage drop. The oxide coated filament is designed to operate at a specific temperature. Sufficient time must be allowed for the filament to reach this temperature, and also for mercury vapor pressure to become normal, before the plate voltage is applied.

With good filament voltage regulation, a five minute preheat period will suffice. Filament voltage should be kept at the rated figure—never below. We believe it is good practice to operate one percent above the rated voltage. We use a precision voltmeter to check voltages each week to get the longest service from these tubes.

Plate Voltage and Gassiness

When adjusting emergency circuits, it is good practice to reduce plate voltage, either with a voltage control switch regulator or a series resistance in the plate circuit.

Gas in a tube is not necessarily the result of air leakage, but is sometimes caused by the liberation of gas from the pores of the elements after the envelope is sealed and the tube conditioned for operation at high plate voltages.

Because of the care taken by manufacturers to remove gas before the tube is shipped, flash arcs seldom occur if the tube is put in service immediately. But with the long life of modern tubes, spares must remain on the shelf for extended periods. Those kept too long without being tested may be gassy when put in service.

Tubes operating at low voltages, such as required for receivers or low power amplifiers, are not generally affected by gas. It is the larger, high voltage, high power tubes which tend to flash arc if allowed to remain inactive.

At WOR we consider that three months of inactivity is too long a period.

Gassy conditions may also develop in a tube which has been operating in the transmitter for many thousands of hours. The exact cause of this is not clear, but the result can be seen in the continuous flash arcs which occur with the tube operating at its rated plate potential and power. However, if the tube is placed in a circuit of lower plate potential, it is definitely possible to get many more hours of service from it. This point should be considered carefully before any tube is discarded because of flash arcs.

A simple and successful method of treating gaseous tubes, and instructions for building the necessary equipment will be covered later in this article.

Metal Fatigue and Other Effects of Heating and Cooling Cycles

After long use, metal parts of tubes tend to evaporate, crystallize and become brittle.

Alternate heating and cooling of tube elements when transmitters are started and stopped causes mechanical strains on filaments and electrode supports. Provision should be made to limit the initial filament current at starting. This can be done by inserting an additional resistance in the filament circuit when voltage is first applied, or by using a transformer having sufficiently high reactance.

It is a good practice to reduce filament voltage as low as possible when filaments are lighted. Operate at minimum voltage for five minutes—then increase to normal operating voltage.

When closing down the transmitter, lower the filament voltage after the plate voltage has been removed. Five minutes operation at lowered voltage will reduce thermal shock caused by sudden cooling. During operation, welding temperatures sometimes occur to wrench the filament out of shape.

Follow the above procedure for air cooled tubes also, but leave the blower on for a minute after the filament has been turned off.

If mercury vapor tubes are operated at ambient temperatures of 20° C. or lower, extra time is required on starting for the mercury vapor to reach a satisfactory pressure. For example, the manufacturer recommends the following for 266B tubes.

For ambient temperature of 10° C. preheat 5 minutes

For ambient temperature of 5° C. preheat 10 minutes.

For ambient temperature of 0° C. preheat 15 minutes

At WOR we have discontinued the practice of preheating mercury vapor tubes at half voltage as we believe that this poisons the tube.

Mercury vapor tubes on the shelf should be heated for one or two hours every three months to insure satisfactory operation when put into service. If allowed to remain inactive for a long period of time without treatment, they have been rendered useless by the mercury vapor diffusing slowly into the pores of the anode or cathode.

Tubes of this type should be kept in an upright position to prevent mercury splashing onto the anode and cathode. If this should occur, the tube must be preheated long enough to vaporize the mercury from the elements and condense it at the bottom of the tube. The lower end of the tube should be cooled by natural air circulation, or by a thermostatically controlled blower to obtain proper condensation of the free mercury.

Severe shocks can cause damage which would never occur in a new tube. All tubes should be mounted and stored vertically and protected against mechanical shock or vibration. Failure to observe these precautions may cause filaments to break or cause misalignment of the elements.

Cooling System Efficiency Can Be Increased

Accumulation of scale on water cooled tubes and in the water system should be avoided. Scale is a poor conductor of heat. When it forms on the anode, less heat is dissipated and the comparatively rough surface breaks up the smooth sheet of water over the plate, causing localized boiling. Overheating of the anode may result.

A piece of scale is often the cause of water whistles. Reflushing the water system through the storage tank during off-the-air periods will usually dislodge the scale from the tube and eliminate the whistle. Water whistles, as a sign of an overheated anode, have caused tube plate distortion, which makes it difficult to remove the tube from its socket. Therefore, the whistle should be used as a guide to proper maintenance.

In many stations it is the practice to remove tubes from their sockets after 1,000 to 5,000 hours of operation in order to remove scale and test the spares. There has been much discussion on the advisability of this procedure. We have found that some tubes can be removed easily after as long as 18,000 hours, while others with but 5,000 to 10,000 hours are difficult to remove because of scale. Experience has shown that after several thousand hours of operation, tubes are usually jarred when removed from their sockets, with occasional breaking of grid laterals. When these tubes are reinserted in their sockets, flash arcs may result; these flash arcs pit the filaments, removing some tungsten, which results in shorter life.

At WOR a tube is never taken out of its socket simply to test another tube. We have weighed the matter of scale accumulation versus jarring and flash arcs, and have chosen to put up with the scale as the lesser of two evils. By leaving tubes in their sockets, we find that the filaments open clean and do not short out the grid circuit. This keeps the transmitter on the air and allows replacement after shut down.

Since it is recommended that final amplifier tubes remain in their sockets until they burn out, methods must be devised for removing scale from tube plates and sludge from rubber hoses and other parts of the water system.

Sludge and residue in the system can be removed with tri-sodium phosphate, available in any paint store, or a commercial product known as "Oakite". After the water in the system has reached a temperature of 160° F., we remove two tubes, preferably from the second power amplifier stage, pour two pounds of the chemical into the sockets, and dissolve with boiling water. Then we insert the tubes in their sockets and flush the chemical solution through the system for one hour with filaments on and the water at approximately 140° F. This will remove an amazing amount of sludge and residue.

We make sure to flush the system again thoroughly with distilled water before final refilling. The amount of leakage current flowing before final filling will indicate how successful the flushing has been. The complete routine procedure used at WOR in cleaning the transmitter water system will be sent to any engineer upon request.

We find the following procedure is helpful in removing accumulated scale from a tube:

Mix a 20 per cent solution of muriatic acid by first pouring eight glasses of water into a stone crock, then slowly adding two glasses of acid. Never pour water into the acid as this will cause boiling and spattering and possible acid burns. Stir with a wooden stick and avoid inhaling the fumes. Fold a small rag into a three inch square and wet this in the solution. (In its diluted state the acid will not injure the hands.) Rub the rag gently over the scale on the tube. Repeat the operation until the tube is clean.

Caution: Do not clean above clamping ring on the tube plate and not drip acid on the glass seal. The bottom of the tube may be rested on the bottom of the crock, but hold the tube so the glass seal does not lie against the rim. When finished, be sure to wash the hand with warm water and soap.

Efficiency of Transmitter, Maintenance, and Associated Protective Relays

Tube life can be increased by operating the various radio frequency stages at highest efficiency. Water flow relays and overload dc relays should be checked and adjusted at least twice a year. Contact points and relay bearings should be carefully maintained.

Store all tubes where they will be free from mechanical shock and excessive vibration. Keep in a vertical position, with cushion rings for the larger tubes. Protect glass parts from scratches.

Clean and test all spare tubes periodically—this is the most important precaution. This precaution includes looking at glass presses and seals for cracks.

The foregoing has described the methods to be used in operating, handling and storing tubes in order to get the longest possible service from them. But what can be done with tubes that develop faults even when all these precautions have been taken?

At WOR we have several special methods of treating tubes. They can be outlined as follows:

1. *Tube Reconditioning:*
   a. Clean up gas in tubes with rated plate potentials above 8,000 volts.
2. *Filament Ageing:*
   a. Clean filament and grid surfaces and remove residual gas from tungsten filament air or water cooled tubes.
   b. Condition thoriated tungsten amplifier and high vacuum rectifier tubes.
3. *Filament Preheat Test*
4. *Test at Maximum Plate Voltage*

Tube Reconditioner

A common problem confronting engineers is the tube which becomes gassy, either from shelf wear or during use in the transmitter. There are only three alternatives—discard the tube, return it to the manufacturer for adjustment, or treat it yourself. The first of these is expensive and unnecessary. In returning tubes to the manufacturer, packing and shipping may be a problem, and there is a chance of damage to elements and glass parts. It is much better to invest one or two hundred dollars in a reconditioner which cleans up gaseous tubes in a few minutes, adds considerably to their life and thus saves many times its moderate cost in a few years.

The reconditioner treats effectively all types of tubes operating at plate potentials above 8,000 volts. It can be used also in tracing faults in lower voltage types. Spares can be tested to eliminate any chance of a faulty tube being placed in service, and tubes which become gassy while in the transmitter can be cleaned up or "degassed", and returned to normal operation. Here is an example from our experience:

One of the Western Electric 342A water cooled tubes in the power amplifier of WOR's 50 KW transmitter developed a series of flash arcs after 5,000 hours of filament life. The auxiliary transmitter was switched into service, the tube in question was removed from the circuit and treated in the reconditioner. At the close of the broadcasting day the tube was returned to its original position in the transmitter.

It operated normally for 1000 additional hours before it again developed the tendency to flash arc. It was removed, reconditioned and put back into service a second time. It continued to operate properly until it finally burned out at the ripe old age of 18,386 hours. This is but one of many cases of greatly increased tube life resulting from the use of our reconditioner.

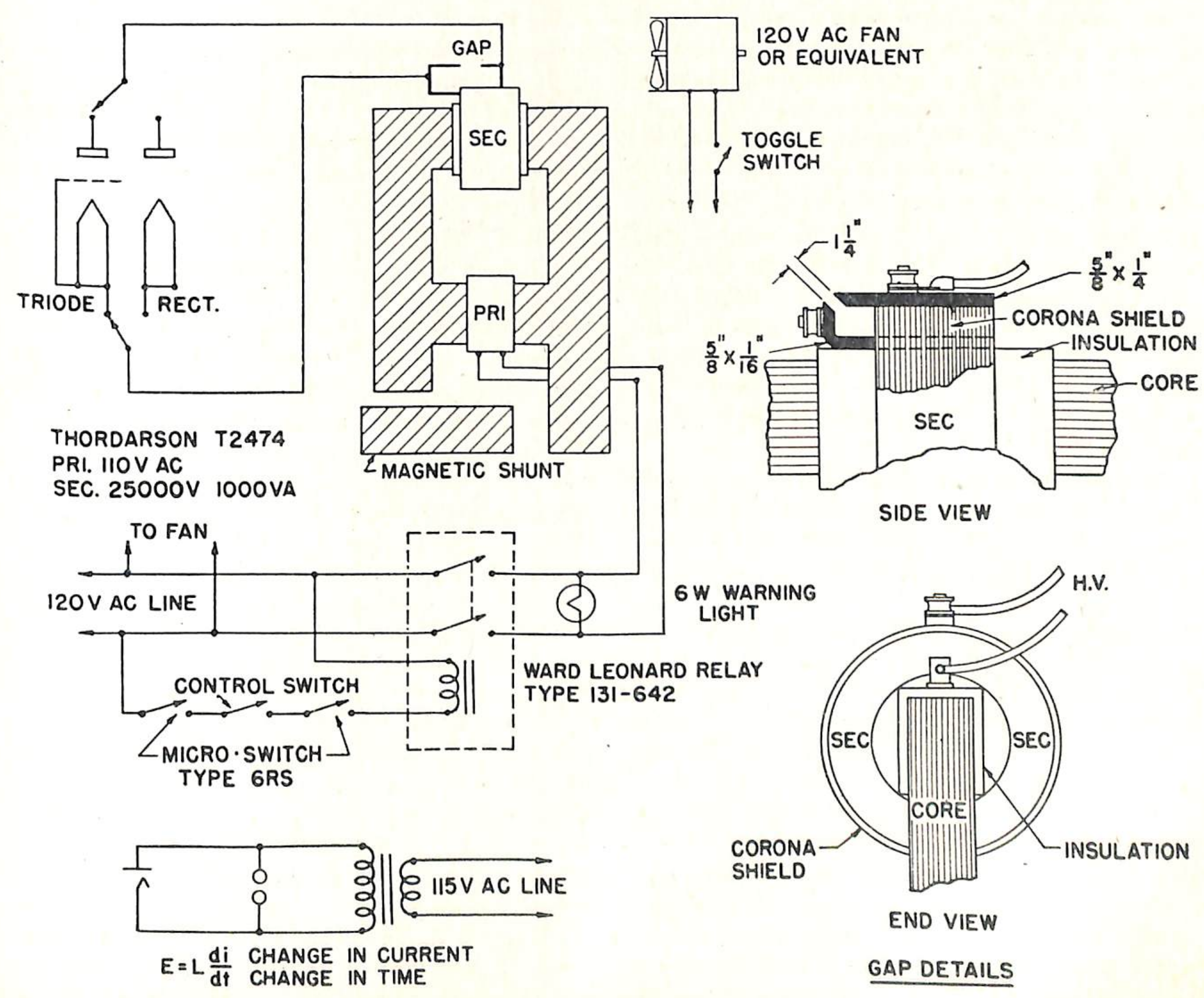
When mercury vapor rectifiers haze up and cause occasional arc backs they can be treated in the same method. After treatment, if the haze disappears, the tube is ready to go back into service.

Construction of our unit is simple—a complete list of parts being shown on the accompanying schematic diagram. The transformer was purchased for about $70.00 and the entire reconditioner was built for about $100.00.

Operation of the reconditioner is as follows:

Alternating current, 115 to 120 volts, is applied to the primary winding of the transformer, which induces a high voltage in the secondary. This induced voltage is applied to the tube between the filament and grid tied together and the anode. When gas ionization is present in the tube, the current in the secondary increases suddenly. The applied voltage drops momentarily, due to transformer reactance, which breaks the internal arc. The sudden change of current develops an e.m.f. of sufficient magnitude to break across the protective gap, thus indicating that the tube has flashed. The internal flashing of the ionized gas in the tube either cleans it up or reorients it on the electrode surface.

As previously pointed out, tubes may become gaseous through shelf wear or the residual gases, such as mercury vapor in the case of rectifier tubes,



Schematic diagram of a tube reconditioner.

may redistribute themselves on the electrode surfaces. Should the potential difference between electrodes become large enough to cause a flash arc, the residual gas molecules are broken up into positively and negatively charged ions. The former are attracted to the cathode—the latter to the plate. The positive ions are momentarily absorbed in the negatively charged electrodes and the negative ions are absorbed in the positive electrodes. A chemical action may even take place.

In the reconditioner, the filament or grid may form either the negative or positive element, depending upon which half of the cycle the flash occurs, while the plate assumes the opposite charge. Since the filament is not lighted, no electrons except from so called field current or cold emission, can help form a breakdown path which results in a flash arc. Thus when a flash arc occurs with the filament off, it must be the result of conduction gases or metallic vapors which are the positively and negatively charged ions in the tube.

The ions are bombarded against the plate, grid and filament. They hit so hard that they may be absorbed in the elements themselves and can only be released again by excessive heating. Sometimes this gas is never released, and thus can do no harm.

In practice, this is the routine followed by WOR in operating the equipment.

1. After checking to insure that the control switch is in the "OFF" position, carefully insert the tube in the socket. Be certain that the shorting bar across filament and grid terminals makes a good connection. In the case of high voltage rectifier tubes, be sure that filament leads are shorted.

2. Switch "ON" the fan in the transformer compartment.

3. Set the transformer in the low voltage position by putting the magnetic shunt all the way in, thus shortening the magnetic path of the lower leg of the transformer and by-passing a considerable portion of the flux.

4. Close the transformer compartment door, leave the tube room and turn the control switch to the "ON" position. If an arc sustains across the transformer gap, break it by snapping the control switch to the "OFF" position. Switch "ON" again and leave on low voltage for one minute.

5. Throw the switch to the "OFF" position. Go into the tube room and put the transformer in the high voltage position by placing the magnetic shunt all the way out which concentrates the magnetic path through the secondary of the transformer.

6. Leave the tube room and turn the control switch to the "ON" position. If an arc is formed across the gap, break it by throwing to the "OFF" position. Condition the tube on high voltage for 10 minutes after the last flash.

Best results will come from the reconditioning process if tubes are treated immediately before being inserted in the transmitter tube socket. If this is done no flash arcs or arc backs will occur during operation. At times the treatment of a stubborn case may take one or two hours. If the 10 minute treatment after the last flash does not clean up the condition, the tube has probably developed a leak which will cause trouble when put in service.

If the tube under test has a small amount of air in it, a pinkish color can be seen when the voltage is applied. This color is evident in mercury vapor tubes as well as in amplifier tubes, but is mixed with the blue color due to mercury vapor. If a tungsten filament type tube has a crack which lets it down to air, a yellowing smoke will appear in the tube when the filament is lighted. This is a tungsten oxide formed from the filament burning in air.

We keep an accurate record of tube reconditioning on a special form. Space is provided for entering the serial number and type of tube, number of flash arcs observed on both low and high voltage, and time required for reconditioning. A condensed entry of this information is made in the log.

Filament Ageing

A second part of the reconditioning treatment which has been tried with some success consists of filament ageing of thoriated tungsten filament tubes for 10 minutes with the filament voltage 30 per cent above normal, followed by one or two hours with normal filament voltage only—no plate voltage.

In order to age tungsten filaments of water cooled tubes, the tube must be placed in the transmitter socket with the standard water cooling conditions. The filament is lighted at the correct operating voltage as measured at the tube terminals. Lighting the filament at normal operating temperature tends to clear up residual gas and clean off the filament and grid surfaces. After one or two hours ageing, the tube is ready to be tested in the transmitter under normal starting and operating conditions.

Even if your station has no reconditioning unit, we believe filament ageing is still of some value. In a few instances the above treatment has been effective in reducing flashing during operation, even though the tube is again returned to the shelf for several weeks prior to being installed in regular service. It is recommended that spare tubes be conditioned by filament ageing every three months to insure continuity of service. High vacuum rectifiers can be given the same treatment as amplifier tubes.

Unless a spare socket is available, this conditioning can be done during off hours when two tubes can be treated at the same time in the second power amplifier.

Filament Preheat Test

Due to long life, spare thermionic mercury vapor tubes usually remain on the shelf from 12 to 15 months. All mercury vapor tubes must be given a filament preheat test every three months for at least two or three hours at the rated filament voltage. We have discontinued the old practice of preheating at one-half filament voltage. We feel it is better to be one or two per cent above the rated voltage than to fall below it.

In our transmitter we remove all rectifier tubes, install the spares and preheat for three hours. Then we test the circuit for operation under full load. Accurate records are kept of these preheat periods.

If a mercury vapor tube fails to rectify without arc backs after the recommended preheating time, the following treatment may be beneficial.

A resistance bank of approximately 1 megohm (such as twenty 50,000 ohm, twenty watt resistance units) is inserted in series with the anode. The voltage is left on for at least one hour or until all visible mercury is removed from the anode. Air at room temperature should be blown on the lower end of the envelope during this treatment. The tube is then operated under standard conditions without the resistance for one or two hours.

Reliability

At WOR the word reliability is not just an idea but rather a duty. The considerations presented in the foregoing result in minimum average tube costs. A program of regular attention to tube operation and maintenance is worthwhile and contributes to tube, equipment, and program reliability.

Reprinted from the Cathode Press, published by MACHLETT LABORATORIES, INC.

1952 ELECTRONICS CONFERENCE AT BUREAU OF SHIPS

The 1952 Electronics Conference will be held at the Bureau of Ships from 12 May to 16 May, inclusive. Representatives of the fleet, field activities, and the Bureau of Ships will meet to discuss common ploblems, such as new technical advances in the electronics art, improved service to the fleet and shore establishments, maintenance and installation problems under stress of strict economy and conservation of critical materials, and the most effective methods by which electronics may better contribute to national defense.

This conference affords an opportunity for the Bureau to obtain the individual and collective opinions of field representatives concerning the many problems which arise in the field of Naval electronics. In addition it provides a close contact between field and Bureau personnel, facilitating the optimum utilization of electronics material and manpower. From this conference, there will emerge, as in years past, plans for progress in research and development, and advances in Naval electronics that will further strengthen our national defense. The major subjects to be considered at this year's conference are outlined below in the tentative agenda:

1. Field Activities
2. Ship Electronics
3. Shore Electronics
4. Electronics Logistics
5. Electronics Design
6. Shipyard Electronics
7. Electronics in the Atlantic Fleet
8. Electronics in the Pacific Fleet

Each of these general topics has been subdivided and each of these subdivisions has been assigned to one of the activities concerned, for preparation and presentation at the conference. The Bureau greatly appreciates the interest taken by the field in the submission of numerous excellent suggestions for the agenda and in the preparation of articles for the conference. Obviously the five-day period will be far too short to discuss all items of interest. Many will be covered during the conference discussions, and the Bureau hopes to provide supplementary information or comment regarding as many other points as possible prior to the end of the conference.

New Books

The following is a list of all Instruction Books distributed from 11 July 1951 to 8 October 1951. The previous list of Instruction Books distributed appears in the February 1952 issue of the BuShips Electron. The key to the abbreviations listed under the heading "Edition" appears below.

All requests for Instruction Books and other NAVSHIPS publications shall be made to the nearest District Publications and Printing Office. Requests for Instruction Books shall state the reason they are required.

Abbreviation	Edition	Abbreviation	Edition
C	Commercial Publication	MI	Maintenance Instructions
Ch.	Change	OH	Operators' Handbook
CI	Complimentary Instructions	P	Preliminary Instruction Book
DB	Descriptive Booklet	RS	Revision Sheets
FC	Field Change	S	Supplement
IB	Instruction Book	SIG M-8	MarCor Parts List
IH	Installation Handbook	MP	Maintenance Parts Catalogue
IS	Instruction Sheets	T	Temporary
MH	Maintenance Handbook	TM	Technical Manual

Model	Short Title	Edition
AN/AMT-9	NAVSHIPS 91363	IS
AN/BPS-1(XN-1)	NAVSHIPS 91400	IB
AN/FGC-5	NAVSHIPS 91265(A)	Ch 1
AN/FGC-5	NAVSHIPS 98242	FC #1
AN/FRA-4	NAVSHIPS 91469	IB
AN/FRT-5A	NAVSHIPS 91457(A)	IB
AN/FRT-6A	NAVSHIPS 91404(A)	IB
AN/GPA-7A	————	SIG M-8
AN/MPN-1B	NAVSHIPS 98231	FC #19
AN/MPN-1B	NAVSHIPS 98237	FC #21
AN/MPN-1B	SHIPS 316A	T-7, T-8
AN/MPS and VK-2	————	SIG M-8
AN/MPS-4	NAVSHIPS 91385(A)	Revised Maint. Prints
AN/PDR-27B	NAVSHIPS 91439	IB
AN/SLA	NAVSHIPS 98241	FC #1
AN/SLT-1	NAVSHIPS 98229	FC #2
AN/SLT-1	NAVSHIPS 98232	FC #4
AN/SLT-1	NAVSHIPS 91258	T-1
AN/SLT-1	NAVSHIPS 91258	T-2
AN/SPQ-2(XN-1)	NAVSHIPS 91207	IB
AN/SPS-5(XN-1)	NAVSHIPS 91428	IB
AN/SPS-6, 6A and 6B	NAVSHIPS 91440	Service and Repair Manual
AN/SRM-1(XG-1)	NAVSHIPS 91370	IB
AN/UDR-4(XN-1)	NAVSHIPS 91482	IB
AN/UPA-T1A	NAVSHIPS 91488	CI
AN/UPX-1	NAVSHIPS 91343	IB
AN/URA-8B and CV-89A/URA-8A	NAVSHIPS 91490	IB
AN/URD-2	NAVSHIPS 91198	T-3
AN/URM-25A	NAVSHIPS 91379	T-1
AN/URN-1(XN-1)	NAVSHIPS 91476	IB
AN/USM-3	NAVSHIPS 91146	Ch 1
AT-177(XN-1)/SQ	NAVSHIPS 91408	TM
AT-343(XN-1)/URC	NAVSHIPS 91494	IB
CBEQ-20218A	NAVSHIPS 91453	IB
CCL-21923A	NAVSHIPS 900,849	Ch 1
CCL-21920A	NAVSHIPS 900,865	Ch 1
CP-87/U and CY-997/G	NAVSHIPS 91387	T-1, T-8
CQS-10563	NAVSHIPS 91449	IB
CTD-53518	NAVSHIPS 900,998	T-1
DBM-1a	NAVSHIPS 91445	CI
IM-58/U	NAVSHIPS 91386	T-3
KY-30/GRT	NAVSHIPS 91232	Ch 1
LM-18	NAVSHIPS 91277	Ch 1
MAR	NAVSHIPS 98051	FC #5
MAR	NAVSHIPS 98224	FC #6
MAR	NAVSHIPS 900,719(A)	T-1
ME-25A/U	————	SIG M-8
ME-49/U	NAVSHIPS 91470	IB
OKA-1	NAVSHIPS 98240	FC #1
OKA-1	NAVSHIPS 91333(A)	T-1
PP-354C/PD	NAVSHIPS 91432	IB
PU-116A/U	NAVSHIPS 91380	IB, Ch 1
QDA	NAVSHIPS 98214	FC #3
QDA	NAVSHIPS 900,700	T-4
RDR	NAVSHIPS 98224	FC #3
SR-3	NAVSHIPS 900,539	T-5
SR-3, 3a, 3b, 3c and X-SR-3	NAVSHIPS 98201	FC #12
SR-6	NAVSHIPS 900,989	T-5
SR-6, 6a and 6b	NAVSHIPS 98200	FC #14
SX	SHIPS 379	Ch 1
SX	NAVSHIPS 98189	FC #9
SX-1	NAVSHIPS 98189	FC #2
TS-419/U	NAVSHIPS 91434	IB, Ch 1
TS-545/UP	NAVSHIPS 91213	Ch 2
TS-690/U	NAVSHIPS 91448	MH
TT-23B/SG	NAVSHIPS 91480	IB
TV-3A/U	NAVSHIPS 91435	IB
TV-3A/U	————	SIG M-8
UOL	NAVSHIPS 91514	Summary Report
VF-a	NAVSHIPS 91486	IB
VH-a	NAVSHIPS 91506	IB
VJ-a	NAVSHIPS 91504	IB
ZM-4/U	NAVSHIPS 91073(A)	IB
Dictionary	NAVSHIPS 250-916	T-1
Filter Eqpt. Rec. Multi-couplers	NAVSHIPS 91450	IB
Filter Eqpt. Trans. Multi-couplers	NAVSHIPS 91451	IB
Ultrasonics	NAVSHIPS 900,167	DB

FAILURE OF TRANSFORMER T-802 AND CHOKE L-804 IN MODEL AN/SPS-6 RADAR

Power transformer T-802 and choke L-804 which are parts of the AFC unit of Field Change No. 7 for Model AN/SPS-6 are failing due to shorts developing in the minus 400 volt circuit. In most cases either capacitor C-833 or capacitor C-820 short to ground and burn out either the transformer or the choke.

To prevent subject failures it is requested that the following be accomplished as quickly as possible on all Model AN/SPS-6 radars having Field Change No. 7 installed or whenever Field Change No. 7 is installed:

a. Check fuses, F-2001 and F-2002, on the front of the receiver to make sure that they are of the proper rating. Their rating should be 3 amps.

b. Check terminal jack, J-2011 in the receiver to insure that there is no lead to ground. This lead should have been removed by Step 29j of Field Change No. 7.

c. Remove capacitor C-833. It has been determined that this capacitor is not required for proper operation of the AFC unit.

d. To prevent failure to capacitor C-820 insert a 22,000 ohm, one-half ($\frac{1}{2}$) watt resistor in the minus 400 volt line of the AFC unit in series with potentiometer, R-833. This can readily be accomplished by removing the wire between potentiometer, R-833 and capacitor, C-818 and inserting the 22,000 ohm resistor in its place. (Refer to Figure 7-57B of Instruction Book NAVSHIPS 91081.)

The foregoing modifications are being prepared as an official Field Change. Field Change numbers assigned will be Number 20, AN/SPS-6; Field Change Number 20, AN/SPS-6A and Field Change Number 20, AN/SPS-6B.

After these modifications have been accomplished it is requested that:

a. The Electronic Equipment History Card—NAVSHIPS 536 and Field Change Record—NAVSHIPS 537 be corrected to show completion of the above Field Change.

b. The Bureau of Ships be notified by including this information in the Electronics Performance and Operational Report, NAVSHIPS 3878, when next submitted.

It is further requested that if any failures occur to the subject components after accomplishment of these modifications they should be brought to the attention of Bureau of Ships, Code 983 as quickly as practicable.

SPARE PINION GEAR FOR DBM-1 ANTENNAS, CBM-66141 AND CBM-66142

The pinion gear employed in the drive system of the Radio Direction Finder Model DBM-1 antennas is available as a replaceable spare part from the Electronic Supply Office, Great Lakes, Ill. This consists of the fibre gear and stainless steel gear hub as a single unit. The Standard Navy Stock Number for this unit is N16-G-413430-0427. There is no description of this gear in the Instruction Book for the DBM-1 nor is there any part number assigned.

REPAINTING, TOUCHING UP AND POLISHING ELECTRONIC EQUIPMENT

Electronic equipment receives abrasive damage from time to time and therefore requires touching up or repainting for preservation. In most cases, it is good practice to only touch up the damaged areas, provided the extent of damage does not warrant a complete repaint job, taking into consideration time and cost. It is desirable, when touching up the damaged areas, that no more than the specified number of coats will be built up, especially when the equipment requires a complete repainting. When the paint has started to crack or peel, and there is an indication of rust, immediate action should be taken to clean the entire surrounding surface of old paint and then touch up or completely repaint. The following general procedures apply when touching up or repainting electronic equipment. (See BuShips Manual, Chapter 67, Article 47 for Sonar hoisting equipment and transducers. This information will be published in the applicable chapters of Bureau of Ships Manual in the near future.)

Equipment In the Weather

All transmitting and receiving antenna hardware and accessories, antenna framework, and dipoles should be inspected quarterly and those installed directly aft of the stack should be inspected monthly. The gases and high temperature in the vicinity of the stacks tend to dry out and crack the paint which accelerates corrosion.

Repainting

When the extent of damage only warrants a touch up job and there is an indication of corrosion, the surrounding area should be entirely cleaned of old paint, soot, rust, etc. One coat of wash primer pre-treatment (Spec. MIL-P-15328, stock No. 52-P-20649-150) should then be applied to improve adherence of the primer and paint. One coat of zinc-chromate primer (Spec. JAN-P-735, stock No. 52-P-20630-2 for 1 gal. or 52-P-20635-2 for 5 gals.) and not less than two coats of outside haze-gray number 27 (Spec. MIL-P-15130, stock No. 52-P-961) should follow the wash primer pretreatment. Brass dipoles need not be coated with the zinc-chromate primer.

The above procedure applies also when the extent of damage warrants complete repainting. When just the finish coat is damaged and there is no indication of corrosion, one or two coats of the outside haze-gray paint number 27 should be applied after the proper cleaning.

Equipment Out of the Weather

Electronic equipment installed out of the weather should have the same care and quarterly inspection as required of equipment in the weather. The procedures and conditions for touching up and complete repainting are identical to those described above, except that light gray enamel paint (Spec. MIL-E-15090, Class II, stock No. 52-E-4034-55 for 1 gal. or 52-E-4034-66 for 5 gal.) should be substituted for the outside haze-gray paint number 27. For portable shipboard equipment, the enamel paint should conform to Class I of spec. MIL-E-15090 followed by a heavy coat of wax.

Where it meets the approval of the local command, all or part of the metal rings, antenna transfer switches, other hardware and accessories associated with transmitting antennas should be painted with red enamel, (Spec. 52P31, stock No. 52-P-7890), as a finish coat. Hardware and accessories associated with receiving antennas should be painted with blue enamel (Spec. MIL-P-2852, stock No. 52-P-7826), as a finish coat.

Metal Polish

Metal polish shall not be used on name plates or on the base of transmitting tubes.

CORRECTION TO NAVSHIPS 98081 FC NO. 18—QGB

The following corrections should be made to Navy Sonar Field Change Bulletin Number 18-QGB, NAVSHIPS 98081:

(a) Page 21, paragraph d—should read, "Connect a jumper between S-801A-D and S-801A-F".

(b) Page 28, paragraph 1 (a)—should read, "From the junction of resistors R5102 (500k) and R5103 (750k) disconnect the lead connecting to terminal 11B and solder to pin 8 on socket X5103, thus connecting terminal 11B to pin 8 of socket X5103".

Paragraph 1(b)—should read, "Solder an insulated jumper from pin 5 of socket X15103 to the junction of resistor R5102 and R5103, thus shorting resistor R5102".

(c) Pages 37-38, Figure 13—add the number "273" on jumper between S801F-B and S-801G-D.

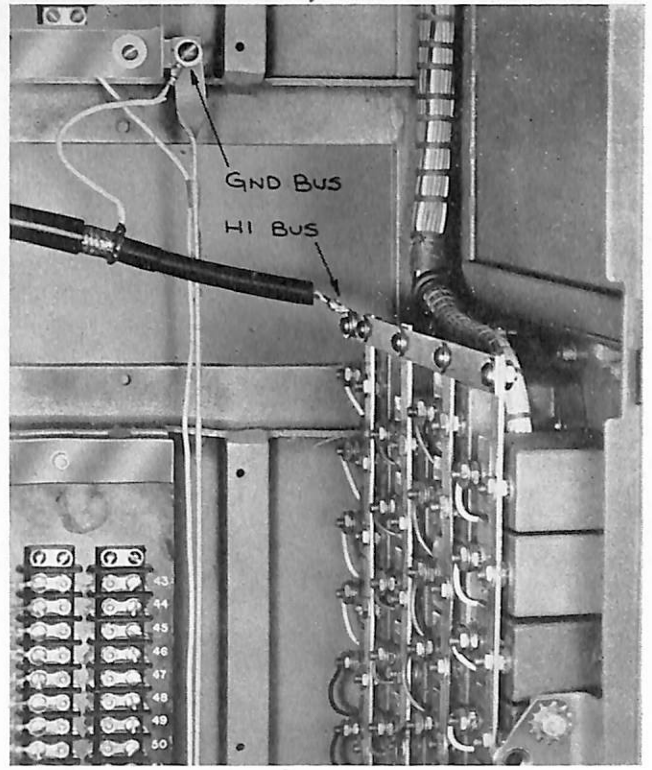
(d) Page 46, paragraph 2—Delete the phrase (following C520-B) "and another lead (white/green tr) between S504-1 and S503-4".

TERMINATION OF RG-27/U CABLE IN AN/SQS-10/11 SONAR

A number of AN/SQS-10 and AN/SQS-11A AF-RF Amplifiers, AM-580/SQS-10 and AM-587/SQS-11, have been shipped from the manufacturer without marking the terminals for the RG-27/U Transmitter Coaxial Cable. These terminals are designated "High Bus" and "Ground Bus" in the system interconnection diagram, Figure 3-26, of NAVSHIPS 91544, the AN/SQS-10, AN/SQS-10A, AN/SQS-11 and AN/SQS-11A Instruction Book. The photograph clarifies the proper connections for the RG-27/U cable as described in detail on page 3-6 and Figure 3-5 of NAVSHIPS 91544. The contractor has been requested to include this marking on future equipments.

Attention is called to the special procedures required in making up the connection as RG-27/U cable contains two layers of conducting rubber. Detailed instructions are given in Note 9, sheet 6, of Bureau of Ships drawing RE-78T-2066, titled Sonar System Type 1D Interconnection Wiring Diagram.

This drawing is available in all naval shipyards.



RG-27/U coaxial cable connection for AN/SQS-10 and AN/SQS-11.

CLASSIFICATION OF RADAR SETS

The Chief of Naval Operations has issued OPNAV INSTRUCTION 10010.1 which contains revised definitions for classifying radar sets installed afloat and ashore by slant range. These definitions have been agreed upon by the Joint Communications-Electronics Committee of the Joint Chiefs of Staff, and are issued for information and guidance.

This instruction cancels and supersedes the Chief of Naval Operations Restricted letter Op-34G by S67-R, ser. 388P34 of 28 April 1948 (Navy Department Bulletin—Cumulative Edition of 1948, 48-300, p. 204).

The following slant-range definitions do not preclude the use of those terms which describe the functions of radar such as fire control, etc. These range definitions are not intended to convey any information concerning the solidity of the search pattern. Therefore, in order to describe fully any given radar set, additional remarks would be required concerning the search pattern; as, for example, hemispherical search.

a. VLR (Very Long Range)—Equipment whose maximum range on a reflecting target of 1 square meter normal to the signal path exceeds 250 miles, provided line of sight exists between the target and the radar.

b. LR (Long Range)—Equipment whose maximum range on a reflecting target of 1 square meter normal to the signal path exceeds 150 miles but is less than 250 miles, provided line of sight exists between the target and the radar.

c. MR (Medium Range)—Equipment whose maximum range on a reflecting target of 1 square meter normal to the signal path exceeds 75 miles, but is less than 150 miles, provided line of sight exists between the target and the radar.

d. SR (Short Range)—Equipment whose maximum range on a reflecting target of 1 square meter normal to the signal path exceeds 25 miles but is less than 75 miles, provided line of sight exists between the target and the radar.

e. (Very Short Range)—Equipment whose maximum range on a reflecting target of 1 square meter normal to the signal path is less than 25 miles, provided line of sight exists between the target and the radar.

INDEX TO ELECTRON VOLUME 7

PART 1 · ALPHABETICAL

The remaining index covers the January 1952 through April 1952 issues of Volume 7. The index to Volume 6, July 1950 through December 1951, appears in the January 1952 ELECTRON.

PART 2 · CLASSIFIED

COMMUNICATIONS EQUIPMENTS

RADAR

SONAR

General:

MISCELLANEOUS

Tubes:

Letters to the Editor:

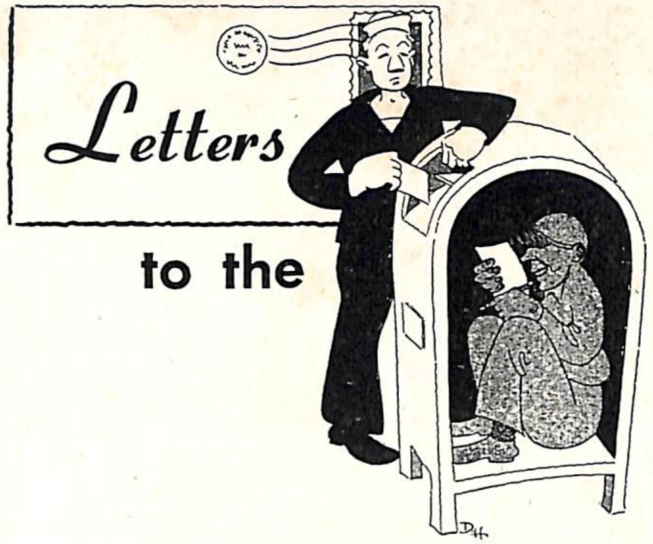
Field Engineer Sez:

General:

Back Copies of ELECTRON (July 1945 through May 1952) are in stock and will be supplied to all Naval activities upon request. A limited number of binders for Volumes 1 through 6 are also available.

LIST OF NAVAL ELECTRONIC EQUIPMENT

The List of Naval Electronic Equipment, NAVSHIPS 900,123(A) contains descriptive data on all equipments to which Navy Model Letters and AN model letters (Navy developed only) have been assigned prior to 1 July 1951. This revised edition replaces NAVSHIPS 900,123 and supplement NAVSHIPS 900,123-1 and will be distributed to the holders of NAVSHIPS 900,123 during May 1952.



Letters to the EDITOR

Editor
BuShips Electron
Sir:

Recently an increasing number of the ships of the fleet have installed television sets as part of the crews recreation program. In smaller ships it has supplemented the motion pictures to some extent either by the crews choice or because of limited facilities for the motion pictures.

With the installation of this equipment it has brought with it a new problem. Because of limited funds in most recreation allowances and the high cost of repair and maintenance by civilian concerns these sets have become to be a problem for the ET.

Even though television incorporates many of the fundamentals of radio and radar there are many circuits and circuit adjustments that are new to the ET. Moreover few of the sets purchased by the ships have any type of literature, instruction books or circuit prints with them. Because of this there is an expanding need for some sort of instruction on practical repair and adjustment of these sets.

There are schools for motion picture operation and repair. It would seem logical that if possible some sort of instruction classes should be maintained at Naval Repair Yards or Naval Bases that could accept limited numbers of electronics personnel for training in practical maintenance for television.

There is an expanding program of use of television in certain Naval operations and would probably be an advantage to electronics personnel to have had perhaps a week's course in television maintenance.

I would appreciate to know if any such plan has been suggested before or if any type has been planned for the future.

H. W. S., ET2

Instruction in television maintenance and the basic theory of television is being given as part of an eight week course "Advanced Maintenance in Electronics for ET's" at Treasure Island School. Television instruction will increase with the expanding use of television by the Navy.

Editor

Editor
BuShips Electron
Sir:

The September 1951 and March 1952 issues of Electron carried Letters to the Editor regarding painting of antenna fittings. Attention is respectfully called to General Specifications for Building Vessels of the U. S. Navy, Appendix 6, "Instructions for Painting" of Section 10. Nowhere in the instructions are the colors red or blue specified for any antenna or electronic device. The color red is only authorized for certain jackboxes, switchboxes and fireplugs. Furthermore, why not make all ships in the Navy alike—and specify just gray paint, as most ships are now.

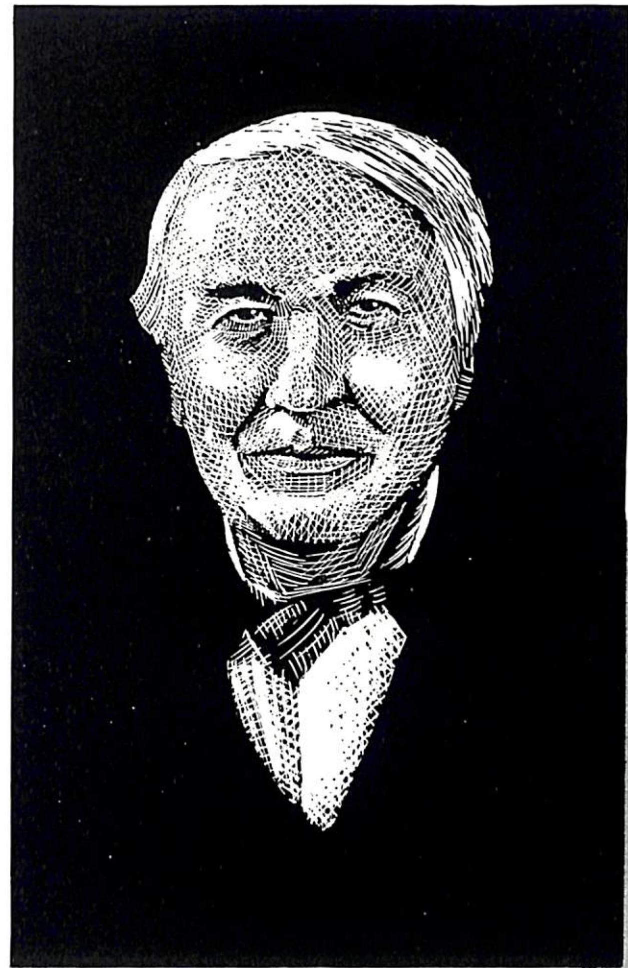
Lt. M. C., USN

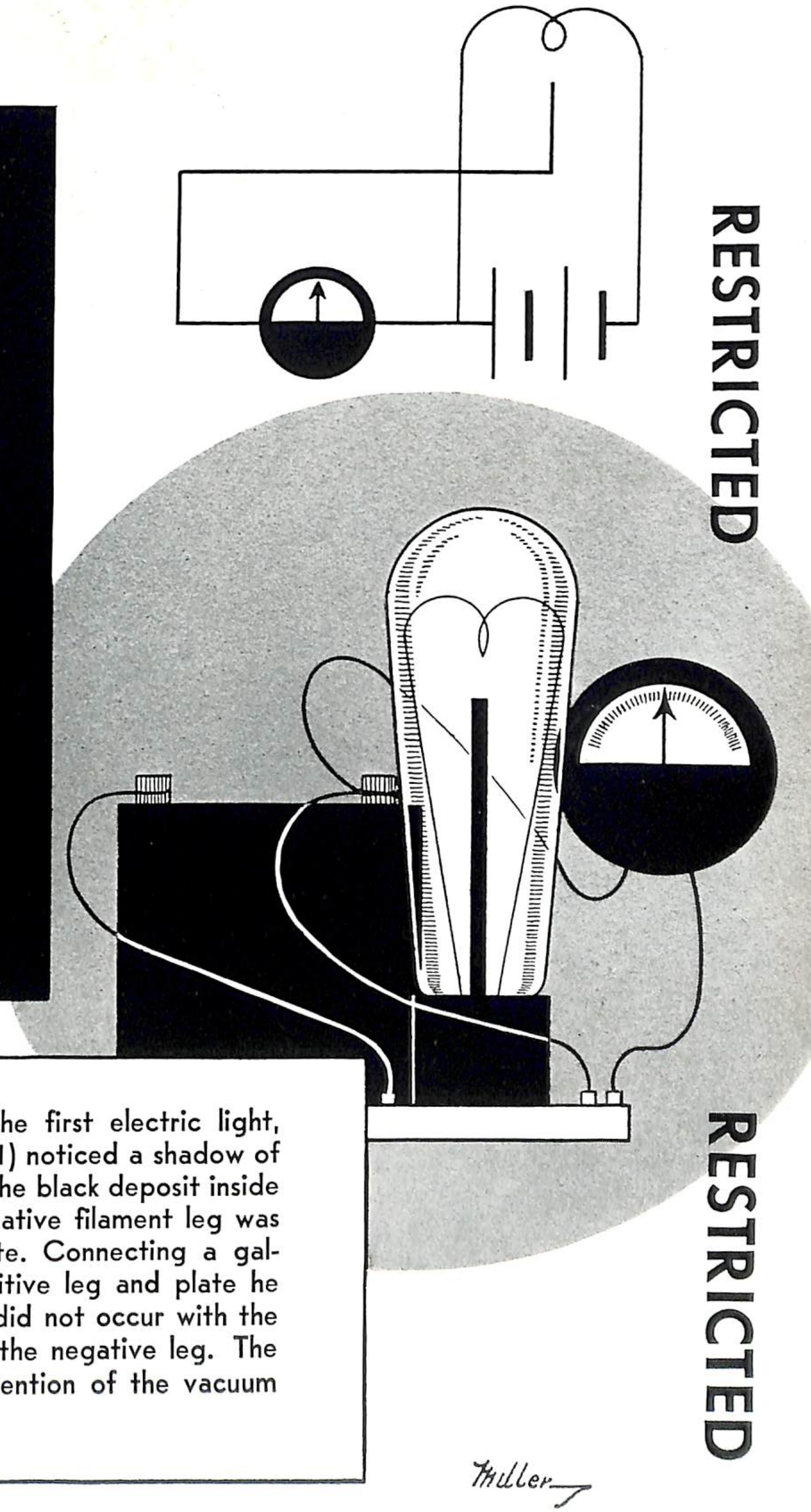
The information contained in the article entitled "Repainting, Touching Up and Polishing Electronic Equipment" on page 28 will be incorporated in Chapter 19 of the Bureau of Ships Manual—Painting Ships in Service. Appendix 6 will also be revised.

It is not the intent of the Bureau to specify a change in color for any electronic device. Gray paint will remain the standard color.

Editor

Famous Firsts in Electronics





While experimenting with the first electric light, Thomas A. Edison (1847-1931) noticed a shadow of the positive filament leg on the black deposit inside the bulb. Reasoning the negative filament leg was emitting, he inserted a plate. Connecting a galvanometer between the positive leg and plate he found a current flow which did not occur with the galvanometer connected to the negative leg. The Edison Effect led to the invention of the vacuum tube.

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