Navy Training School Salvage Diving Log (Salvage Diver Training), Pier 88 School

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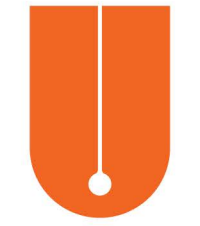
In the collection of the
U.S. Naval Undersea Museum

NUM.2004.081.002

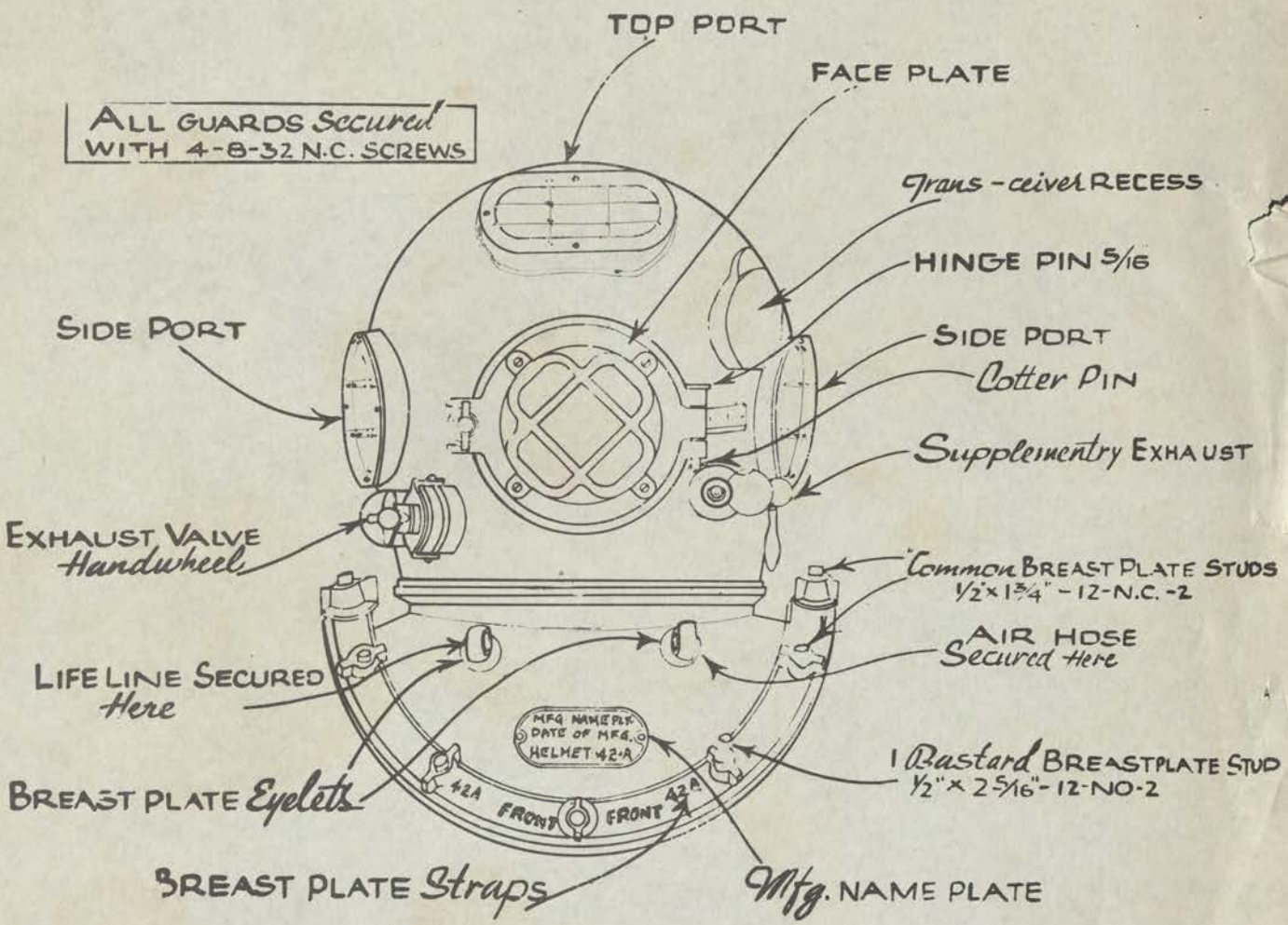


NAVY TRAINING SCHOOL

SALVAGE

DIVING LOG

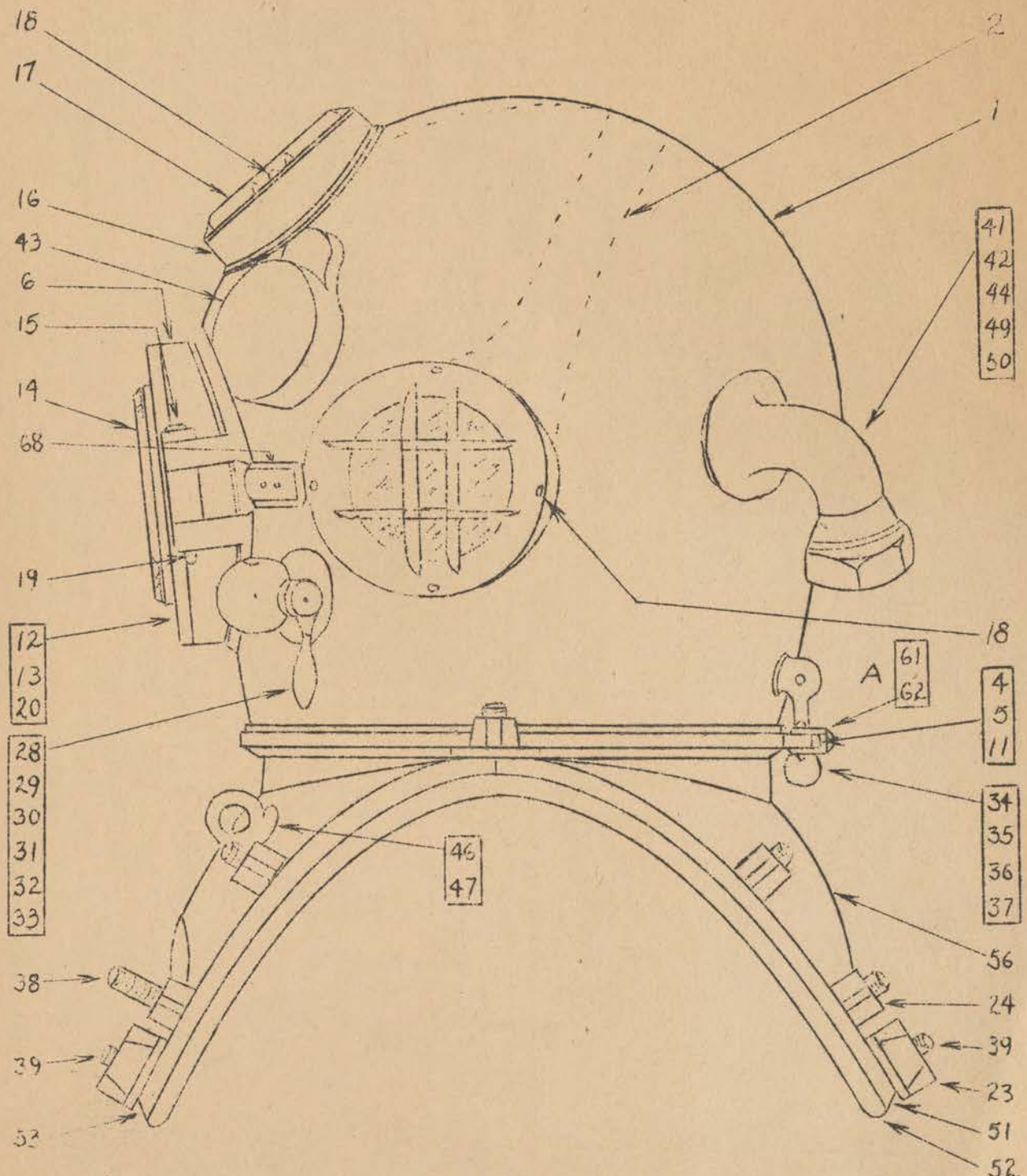
PIER 88 NORTH RIVER, N.Y.



FRONT VIEW

Mark V

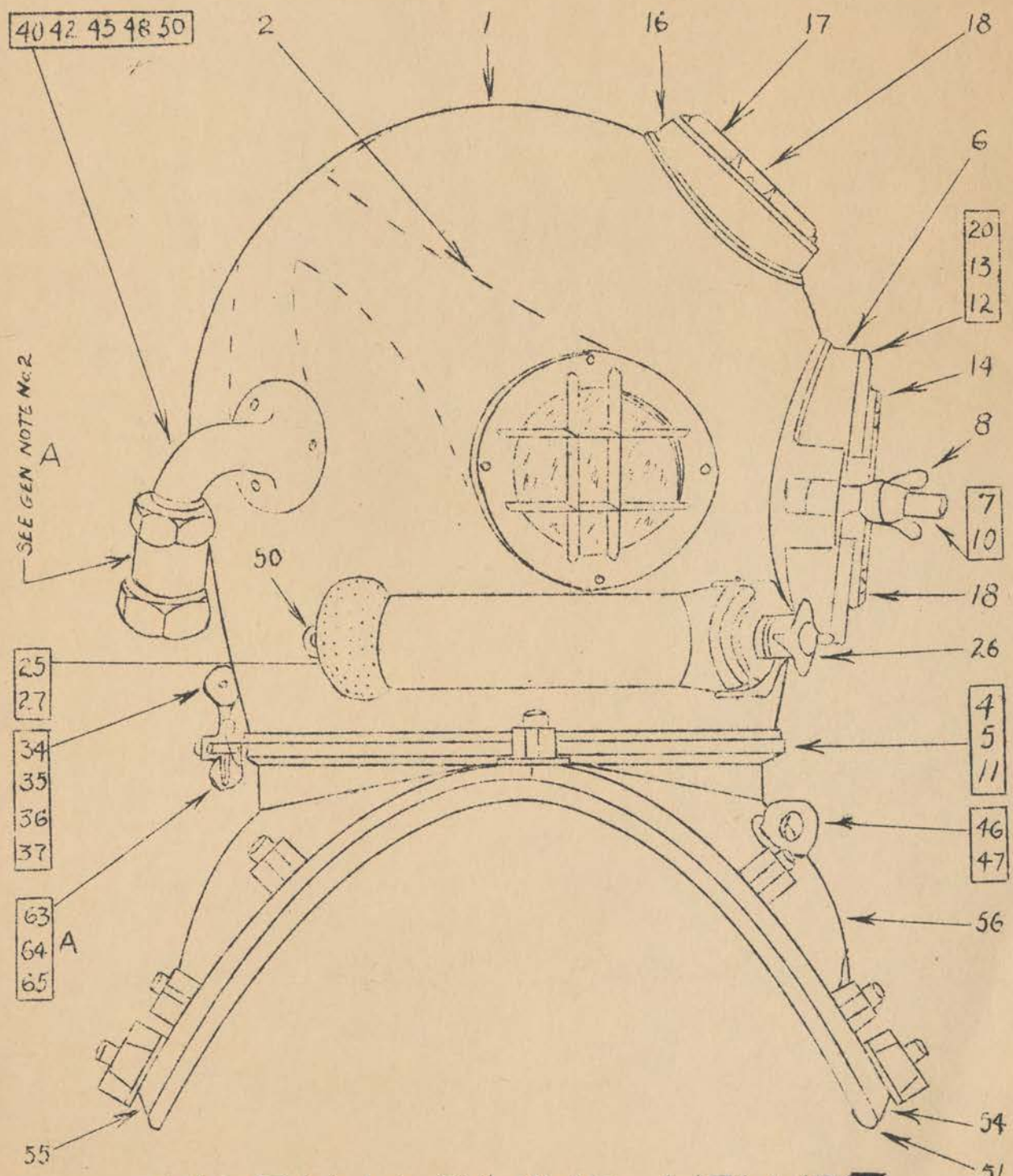
U.S.N.T.S.S. PH.K 83 M V C



MARK V DIVING HELMET

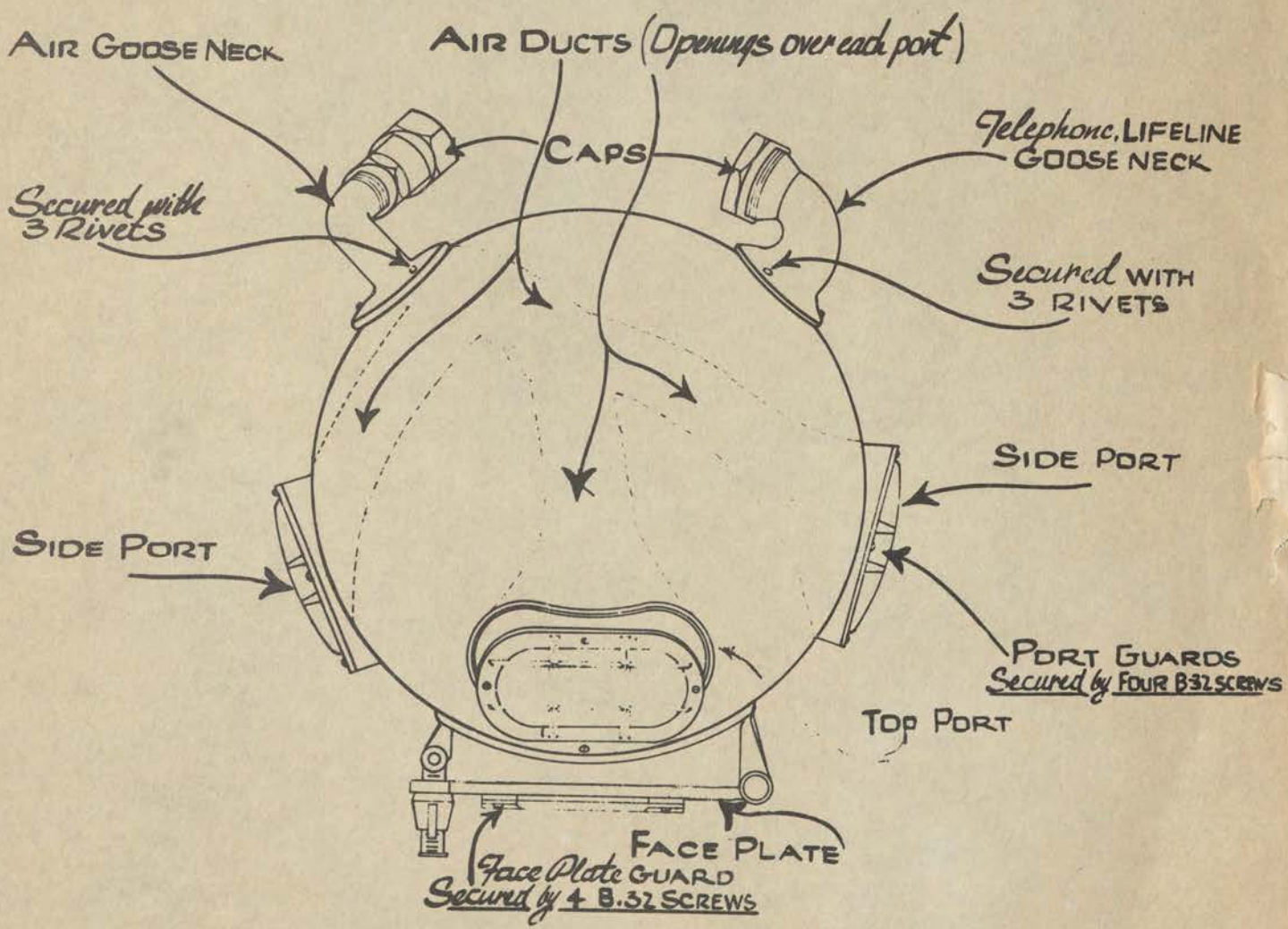
WALSH

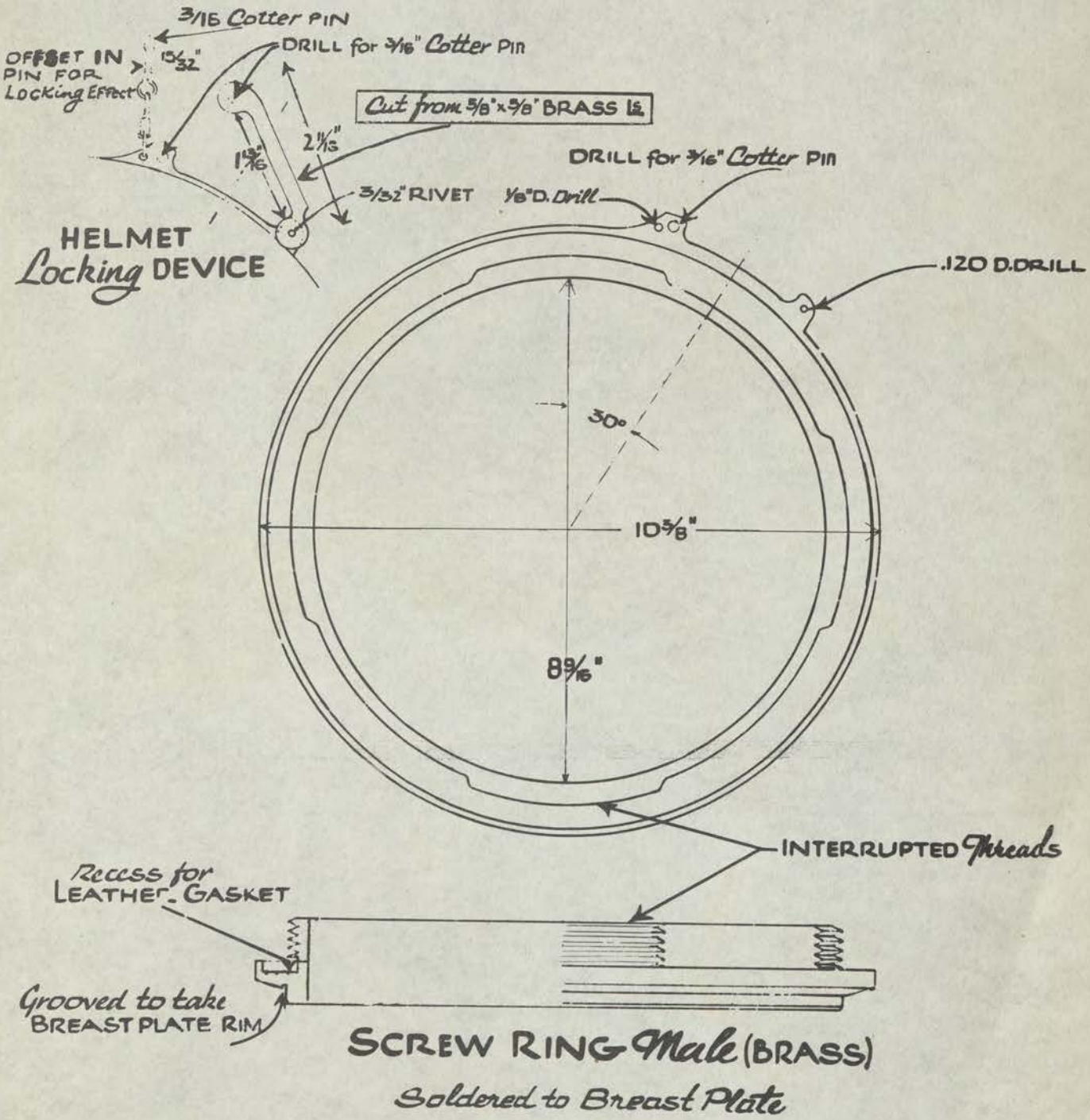
U.S.N.T.S.S. PIER 88 N.Y.C.



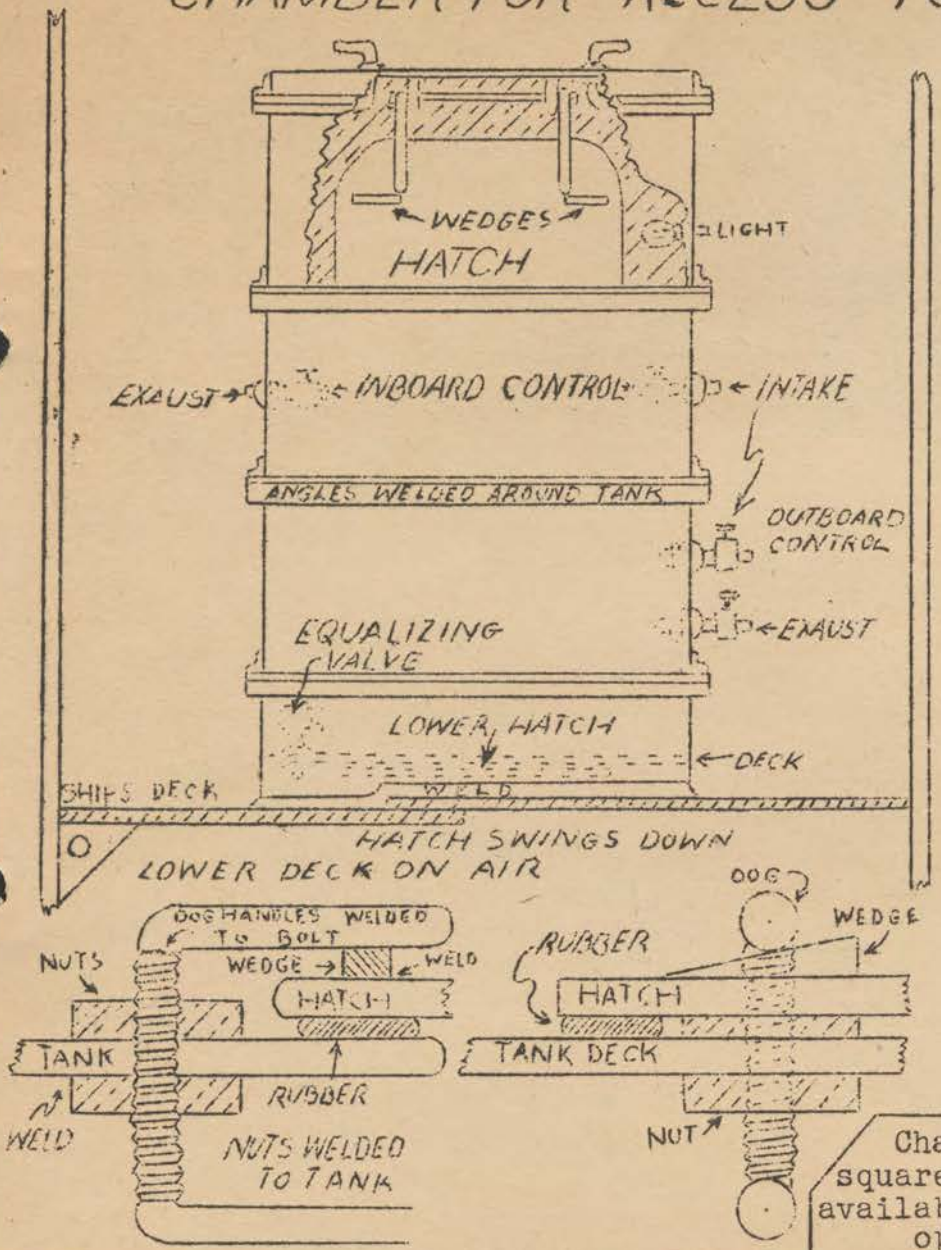
MARK V DIVING HELMET

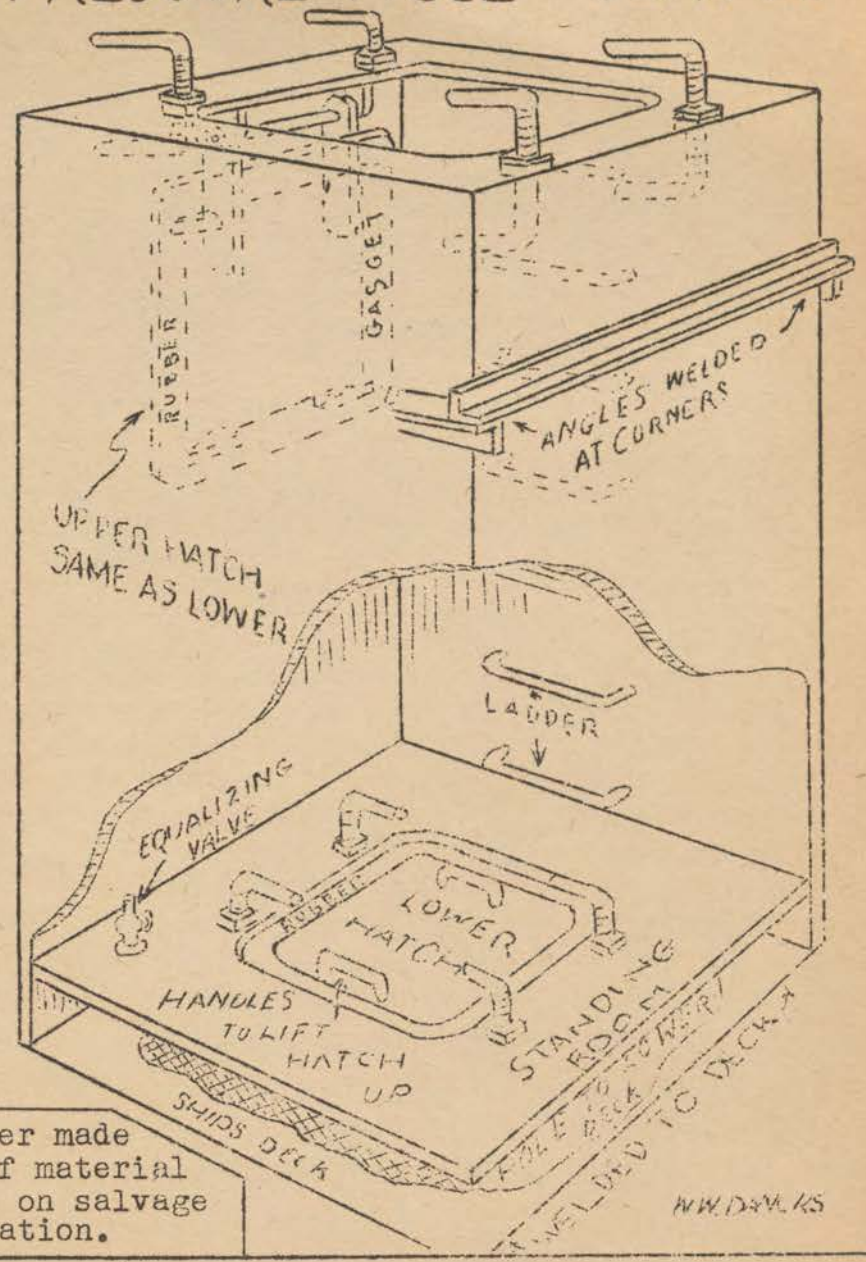
WALSH


AIR GOOSE NECK
AIR DUCTS (Openings over each port)
CAPS
Telephone, LIFELINE GOOSE NECK
Secured with 3 Rivets
Secured WITH 3 RIVETS
SIDE PORT
SIDE PORT
PORT GUARDS Secured by FOUR B32 SCREWS
TOP PORT
FACE PLATE
Face Plate GUARD Secured by 4 B.32 SCREWS


3/16 Cotter PIN
DRILL for 3/16" Cotter Pin
OFFSET IN PIN FOR LOCKING EFFECT
15/32"
Cut from 5/8"x5/8" BRASS Is.
2 1/16"
1 3/16"
3/32" RIVET
1/8" D. Drill
DRILL for 3/16" Cotter Pin
.120 D. DRILL
HELMET Locking DEVICE
30°
10 5/8"
8 9/16"
INTERRUPTED Threads
Recess for LEATHER GASKET
Grooved to take BREAST PLATE RIM
SCREW RING Male (BRASS)
Soldered to Breast Plate

CHAMBER FOR ACCESS TO PRESSURE HULL—USNTSS

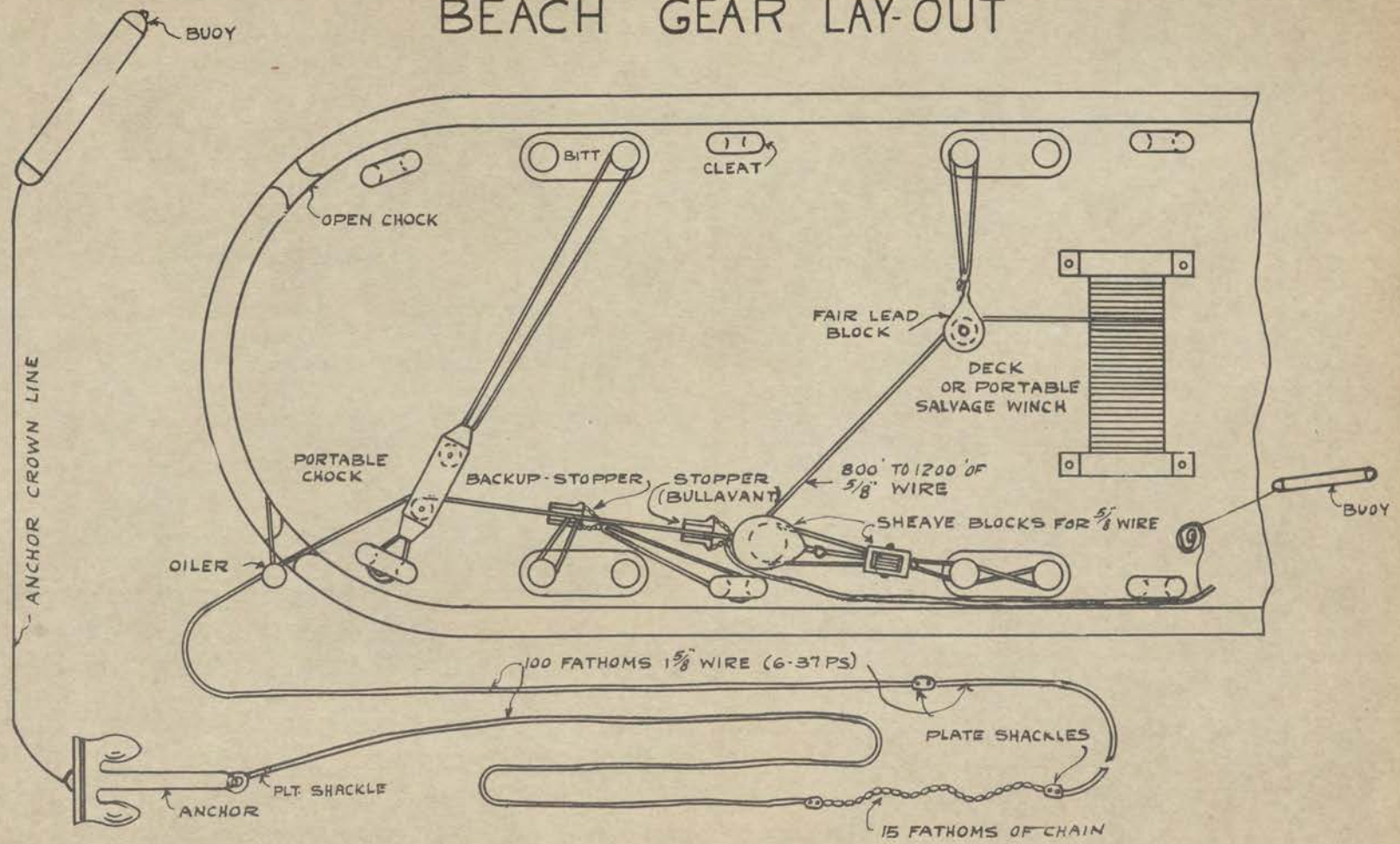




Chamber made square of material available on salvage operation.

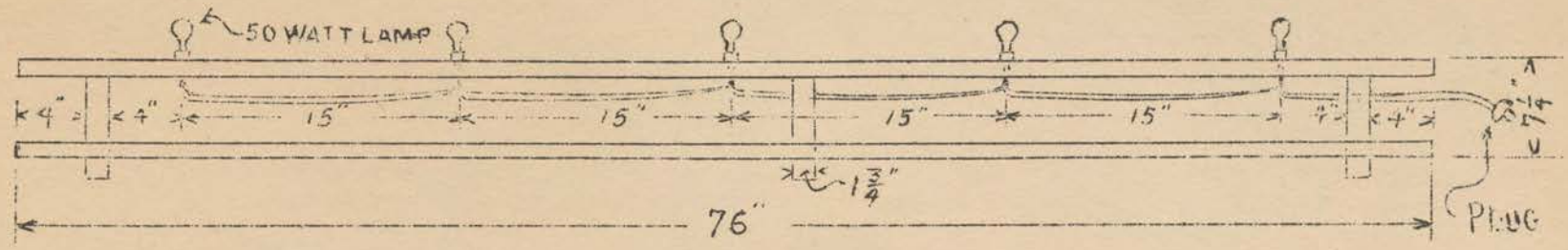
U.S.N.T.S.S

BEACH GEAR LAY-OUT



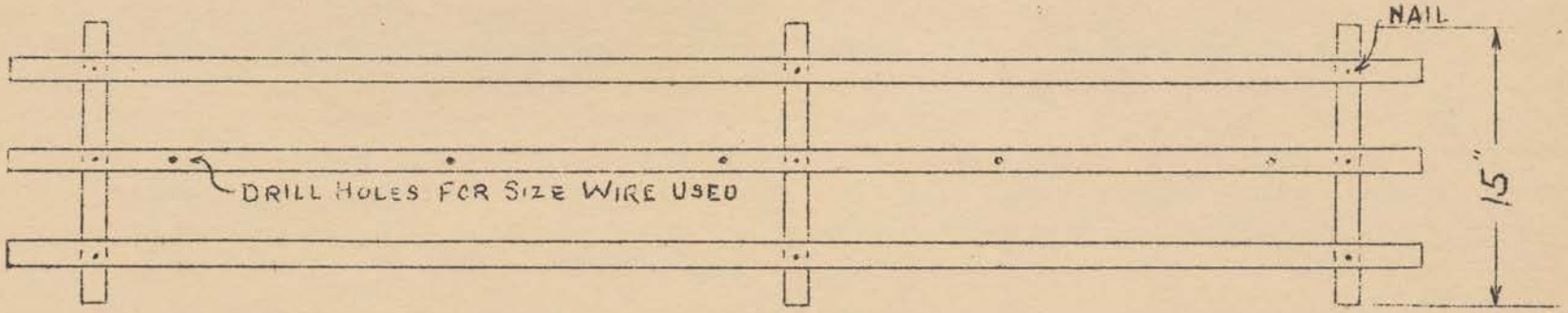
K.M.W.

RACK FOR DIVING HELMETS



FRONT VIEW

END VIEW



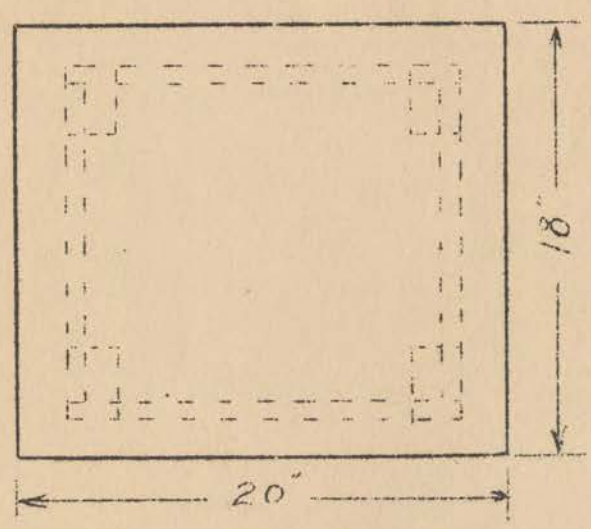
TOP VIEW

U.S.N.T.S.S. PIER 88 N.Y.C.

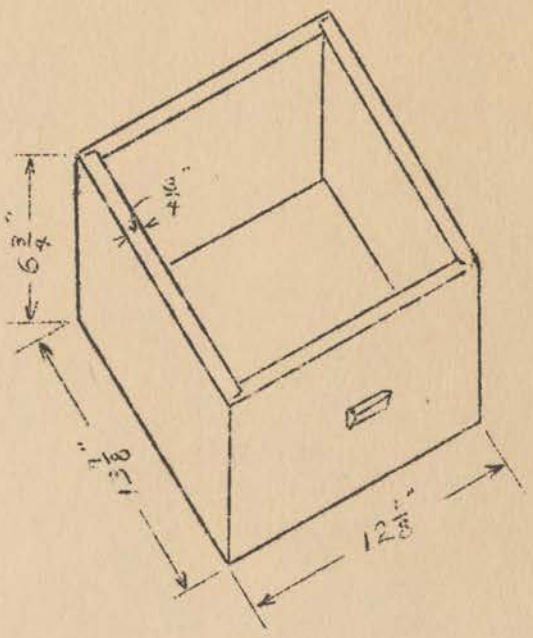
WALSH

U.S.N.T.S.S. PIER 88 N.Y.C.

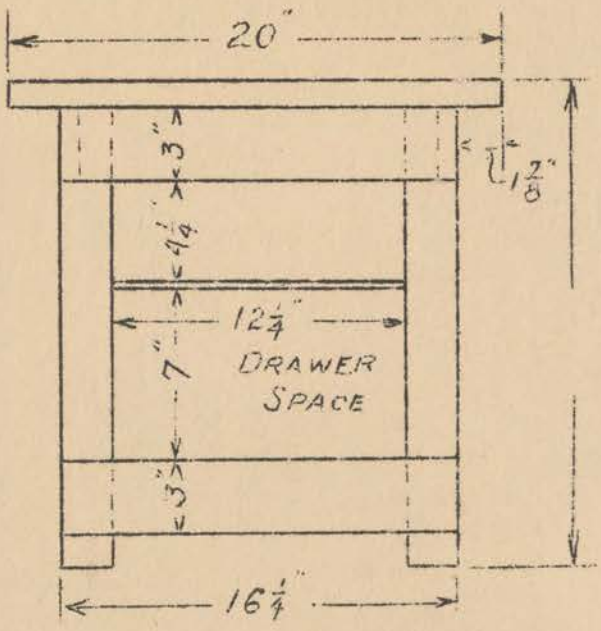
TOP VIEW



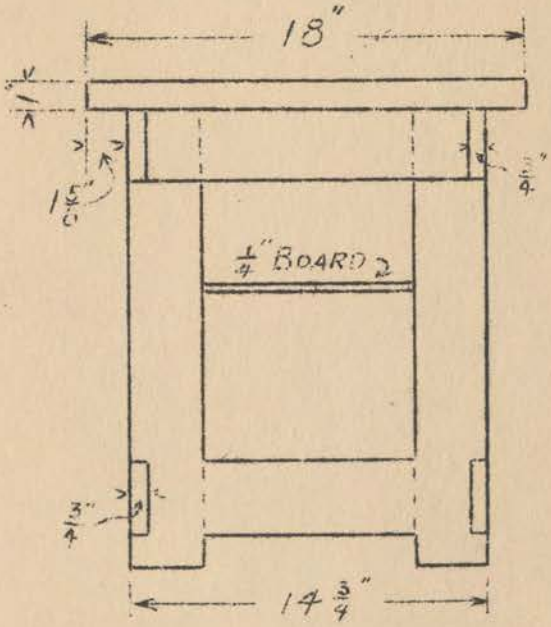
DRAWER



BACK VIEW



SIDE VIEW

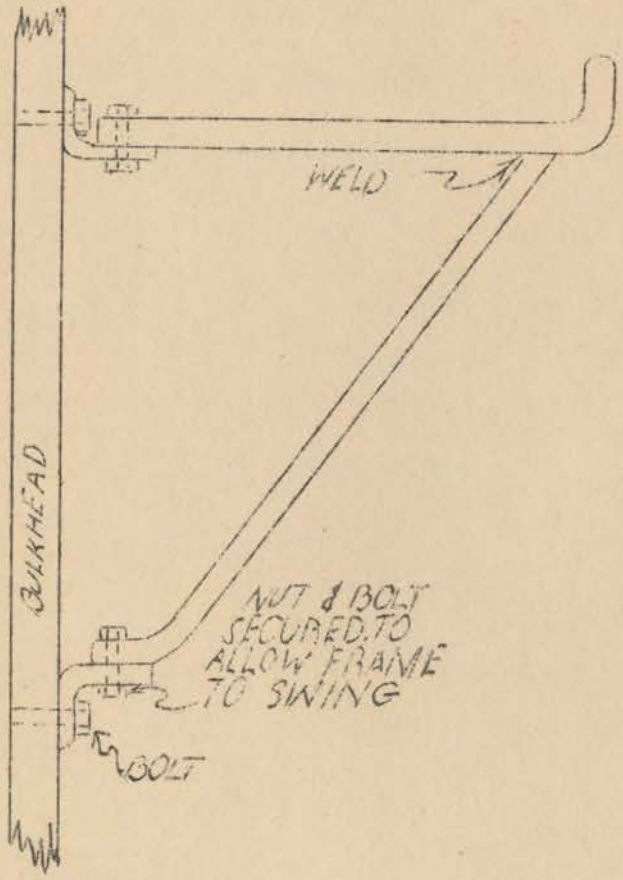


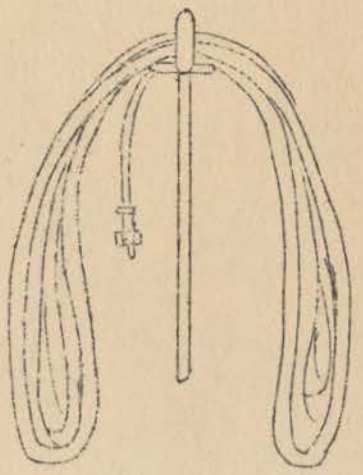
NOTE: Use hard wood for top of stool and board up front and sides. Do not use plywood board on front and sides.

DIVING STOOL

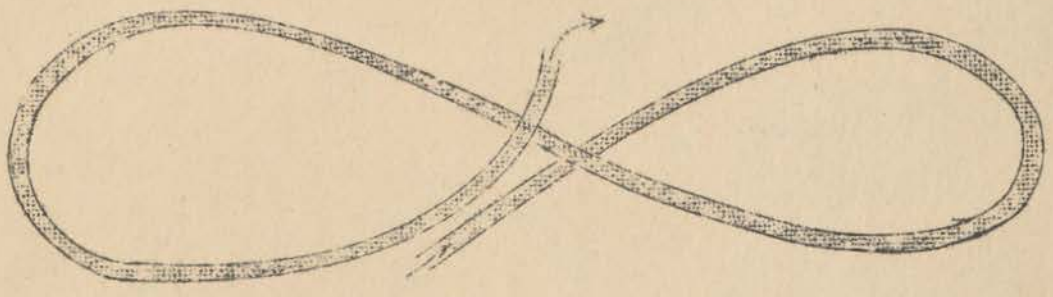
WALSH

AIR HOSE & LIFE LINE STOWING





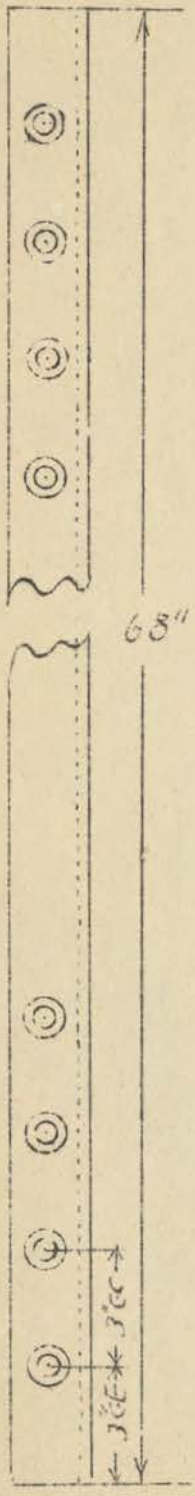
HOSE HUNG AS SHOWN WHEN STOWED ON FRAME



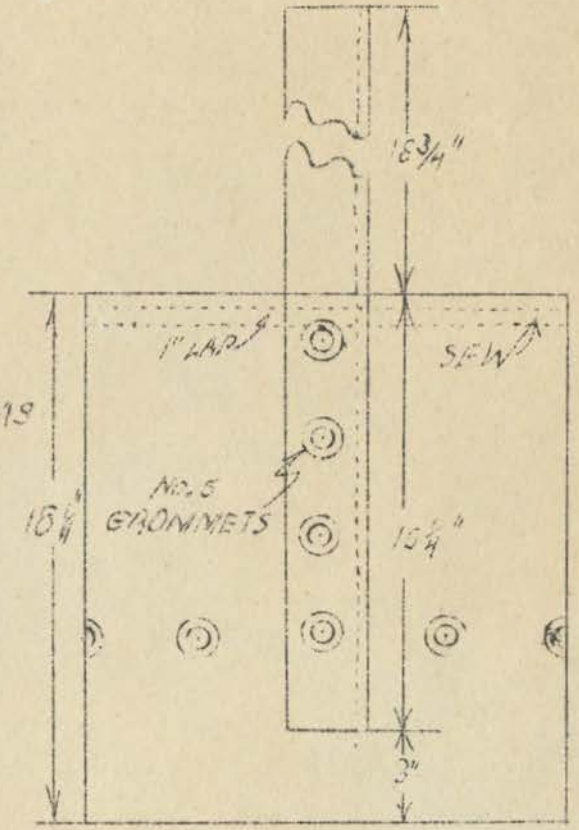
WHEN STOWED ON DECK USE FIG. 8 SHAPE

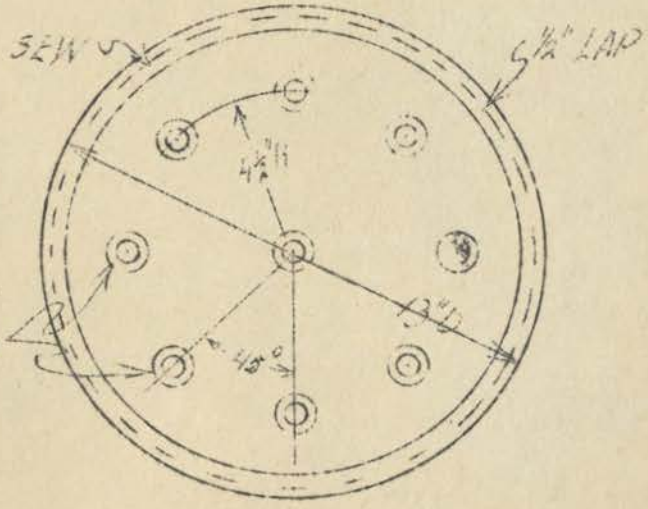
U.S.N.T.S.S.

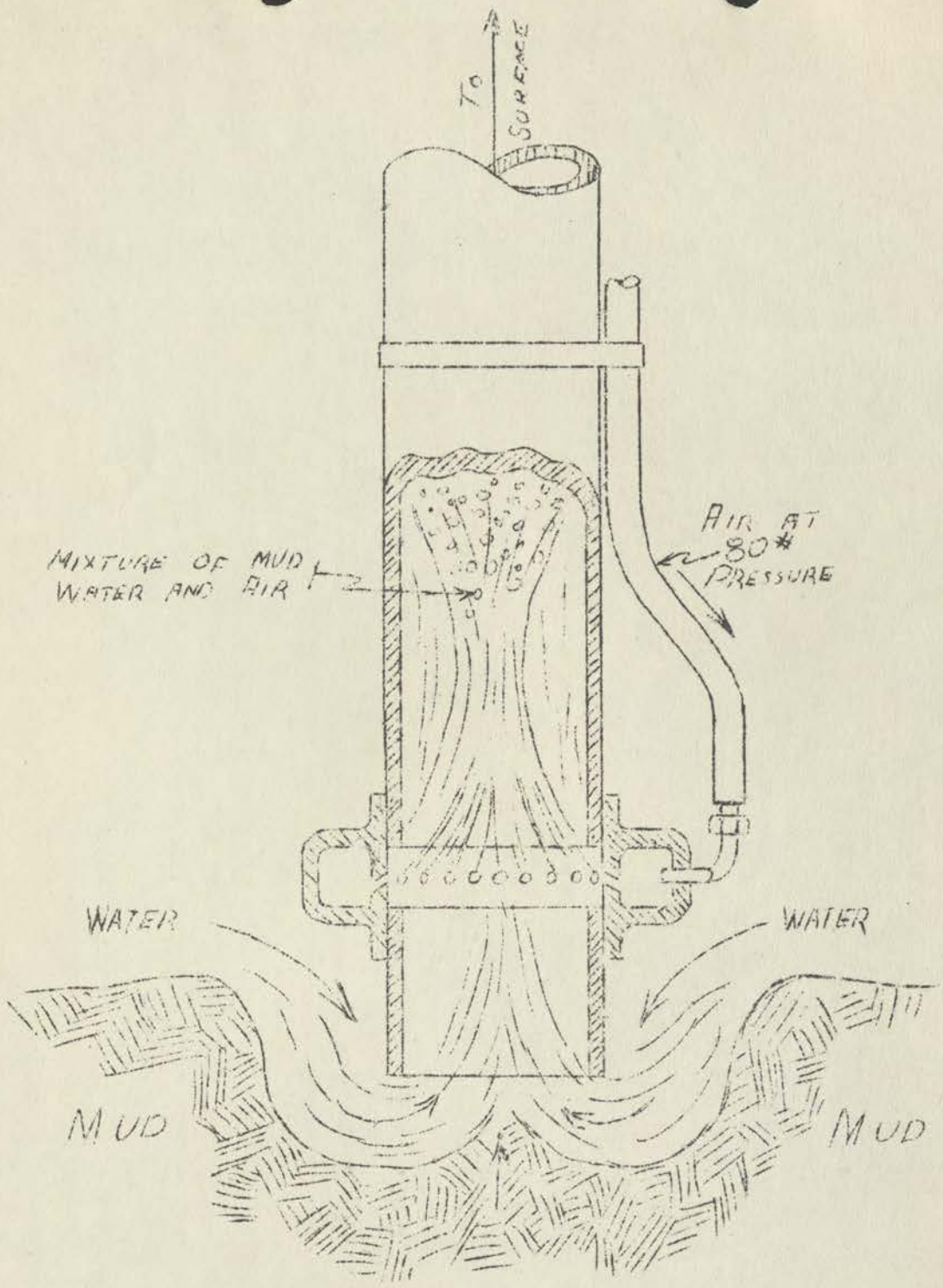
DIVERS CANVAS TOOL BAG
U.S.N.T.S.S.



NOTE:
USE NO. 4. CANVAS





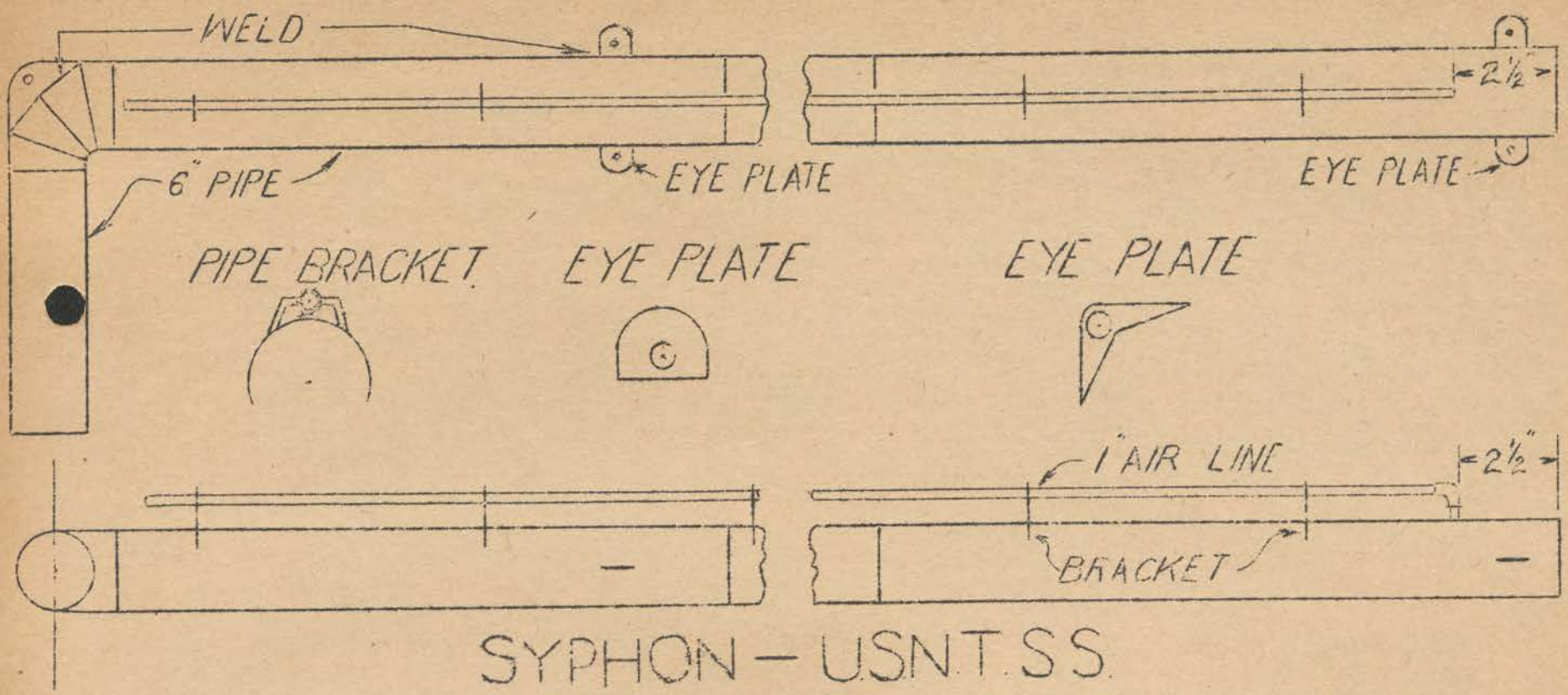


Air Lift

Pumping Mud

U. S. N. T. S. S.

WWD



SYPHON – U.S.N.T.S.S.

PRECAUTIONS: Syphon will kick when first turned on, but will settle down very quickly when flow starts. Diver should be kept clear until syphon has settled.

INSTRUCTION FOR USE: Best size pipe, 12" with 1" air pipe. To be used with 2 or 3 100 lbs. compressors. The air should enter not less than 2 feet from bottom syphon.

USE OF: Syphon can be used on bottom other than hard rock, and for tunneling. In tunneling (example, under a ship's bottom of syphon can be bent to fit hull. Keep syphon inlet 2 feet to 3 feet lower than air inlet.

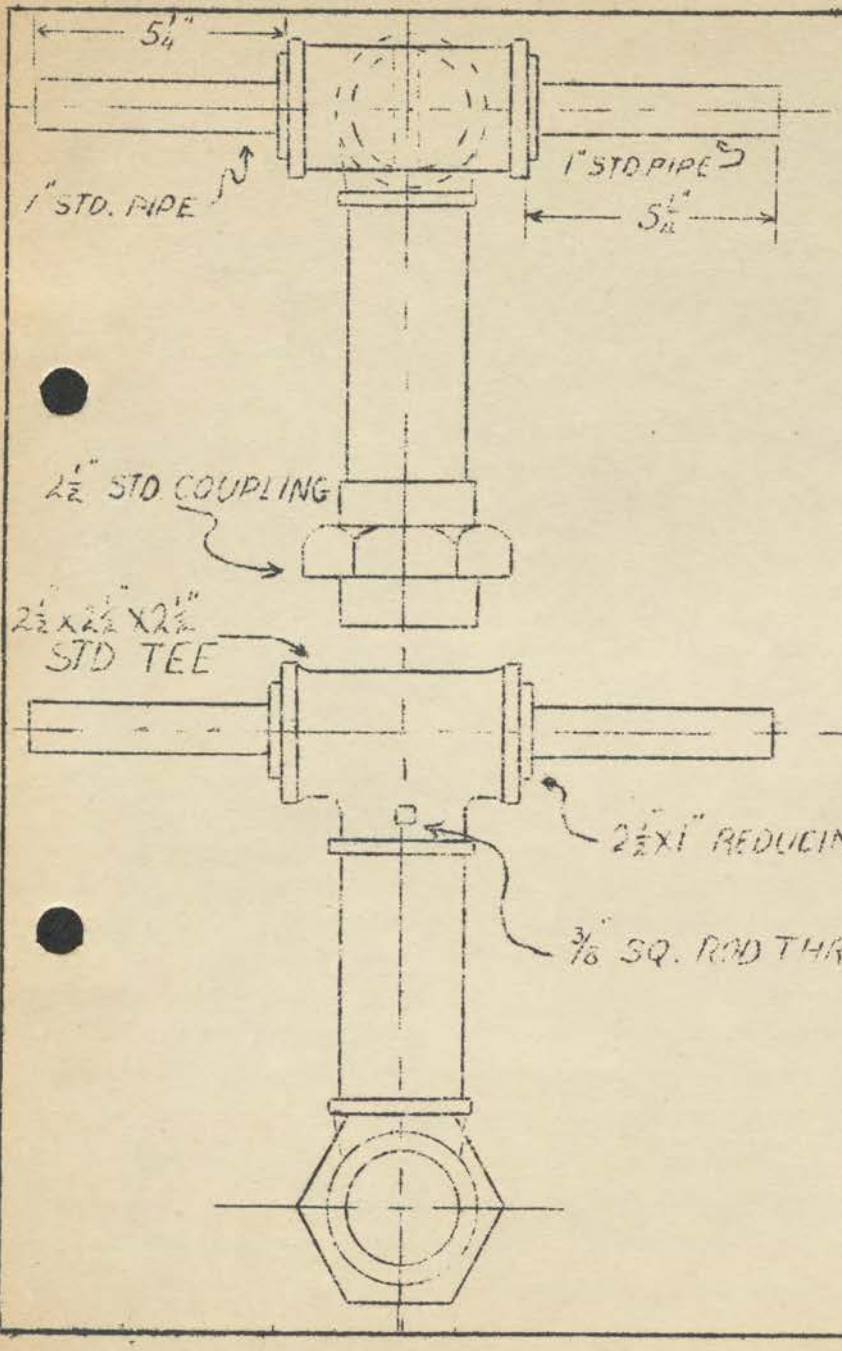
Syphon will lift rocks or other material that will easily pass through pipe.

Syphon can be used to remove cargo such as grain, coal, etc.

When used inside of ships or places where lead out is not fair, bottom of syphon is made of steel pipe, top being hose that can be readily bent.

WALSH

EXCAVATING NOZZLE USNTSS



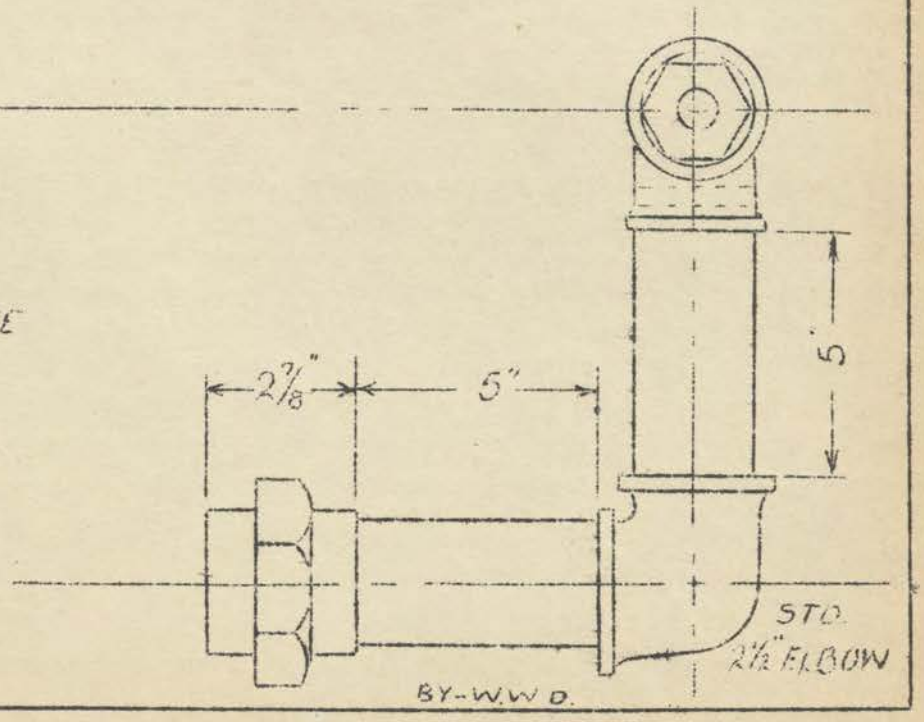
PRECAUTION:

When first used, turn on slow to get air out of hose. To be done before diver goes down.

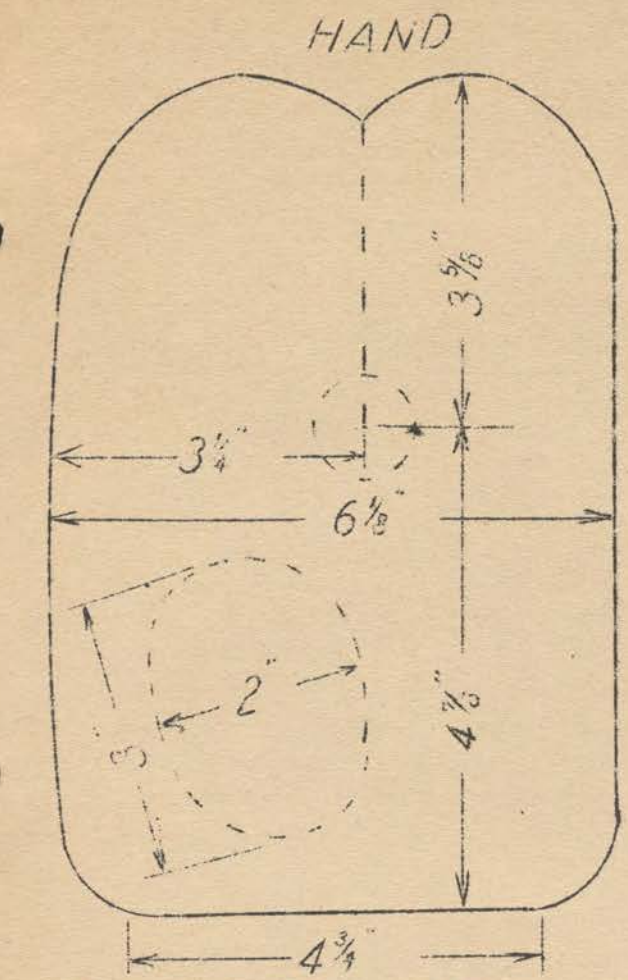
INSTRUCTIONS FOR USE:

Nozzle to be used with a high pressure centrifugal two stage pump. Has been used up to (400 lbs.) pressure by diver.

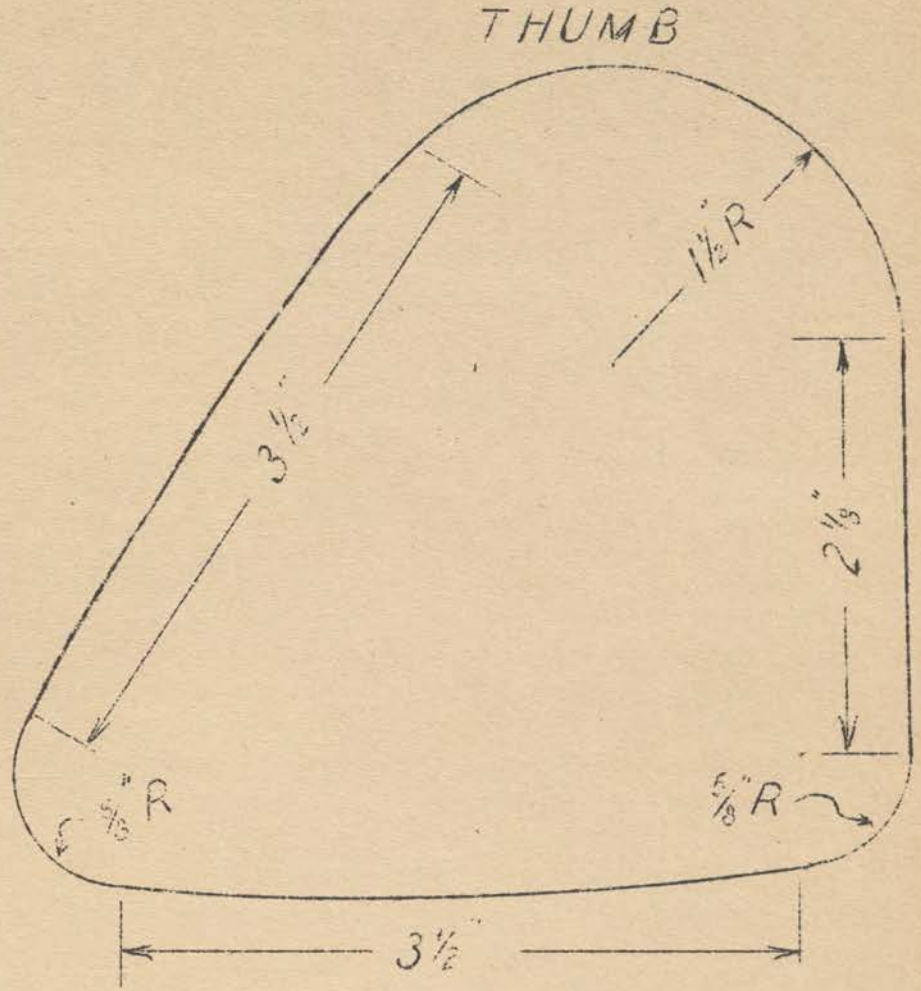
With this nozzle using high pressure (400 lbs.) soft rock such as coral, lava, etc., can be broken up. Less pressure to be used on soft bottoms. Nozzle is used to feed Salvage Unit syphon.



GLOVE PATCHES



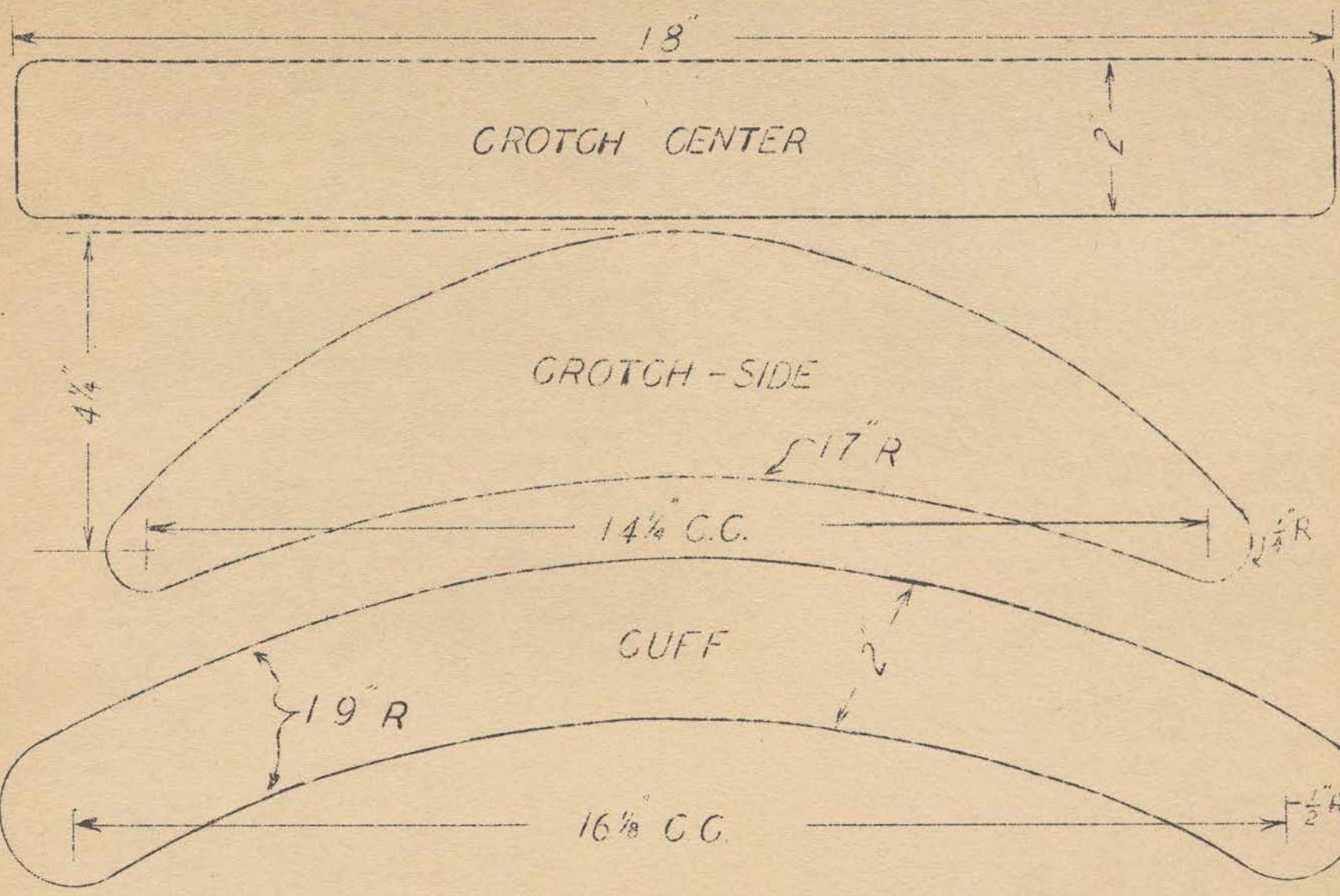
CUT ON DOTTED LINES



U.S.N.T.S.S PIER 88 NEW YORK

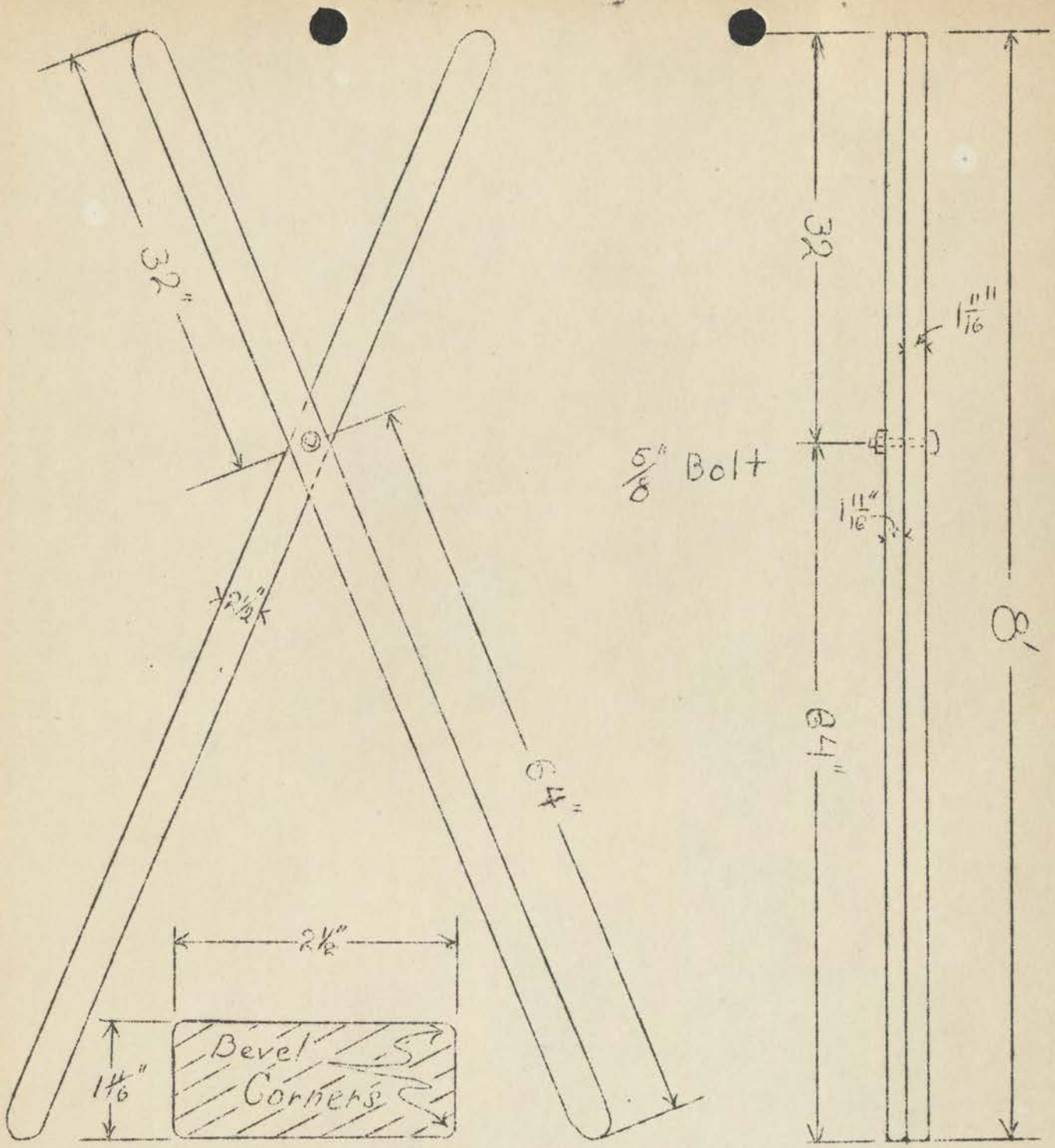
WALSH

CROTCH AND CUFF PATCHES



U.S.N.T.S.S. PIER 88 NEW YORK

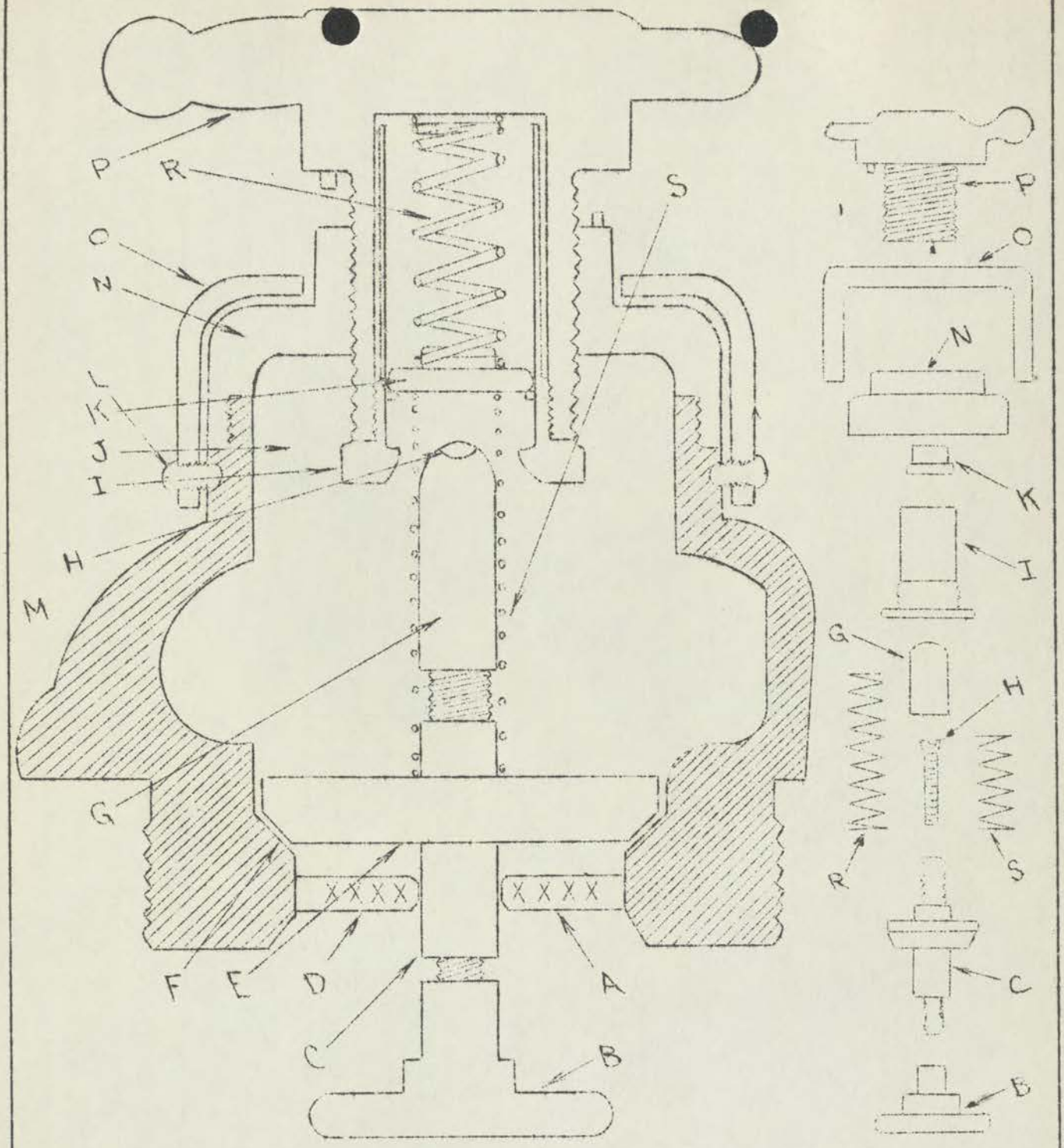
WALSH



RACK FOR DRYING DIVING SUITS

U.S.N.T.S.S.

WWD



REGULATING SAFETY AIR ESCAPE VALVE

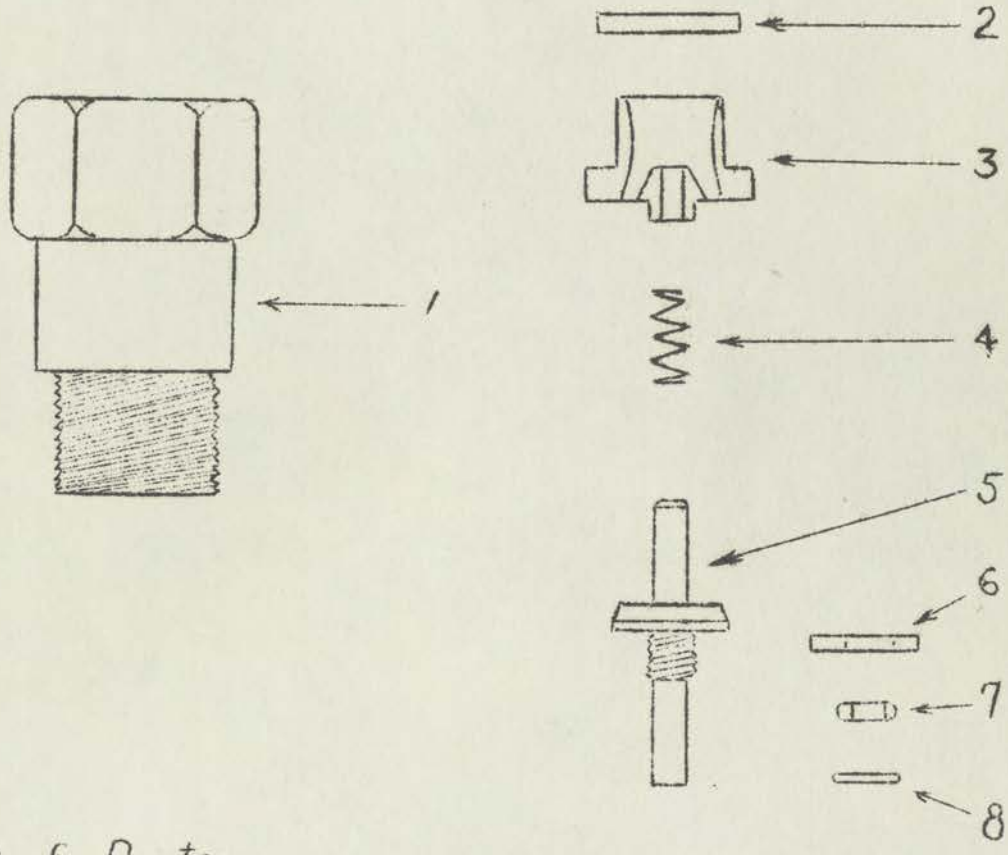
KEY

A Air Outlet	J Air Outlet Area
B Chin Button	K Follower Disc
C Valve Stem	L Screw
D Valve Guide	M Body
E Valve	N Bonnet
F Seat	O Bonnet Guard
G Adjustable Sleeve	P Adj. Hand Wheel
H Adj.Sleeve Set Screw	R 32 oz. Spring
I Sleeve	S 8 oz. Spring

U.S.N.T.S.S.

WALSH

NON RETURN VALVE FOR DIVERS AIR LINE

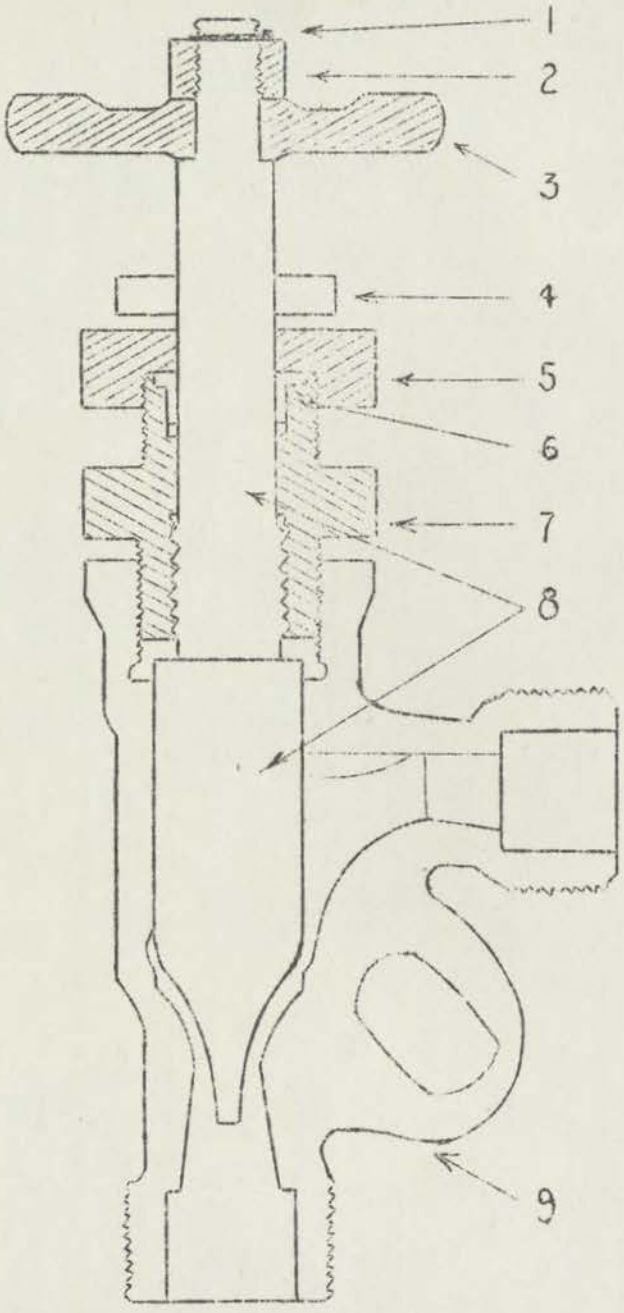


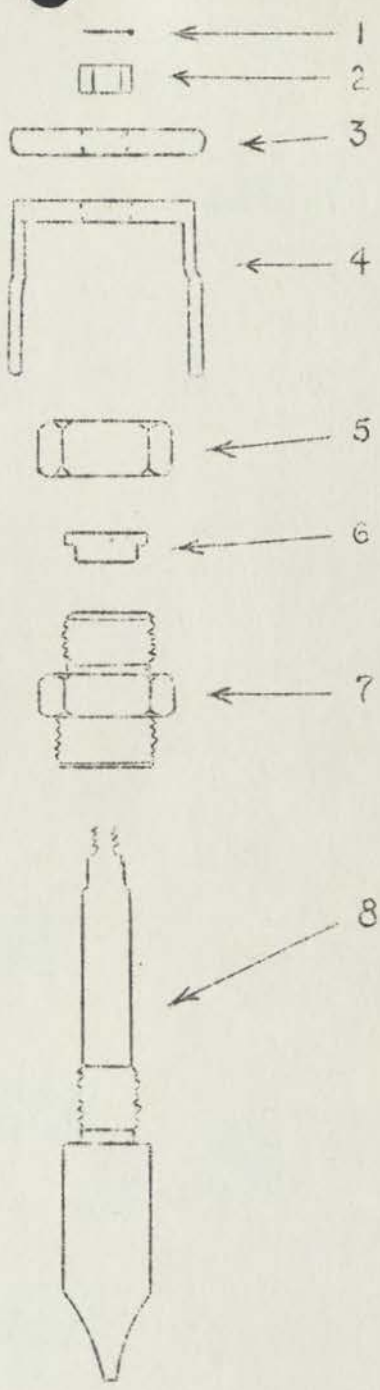
List of Parts

No.	Name	Req.	Material
1	Assembly		—
2	Body Washer	1	Thermo-Leather
3	Upper Guide	1	Brass
4	Spring	1	"
5	Stem	1	"
6	Stem Washer	1	Therme Leather
7	Nut	1	Brass
8	Pin	1	"
9	Body	1	"

U.S.N.T.S.S.

WALSH





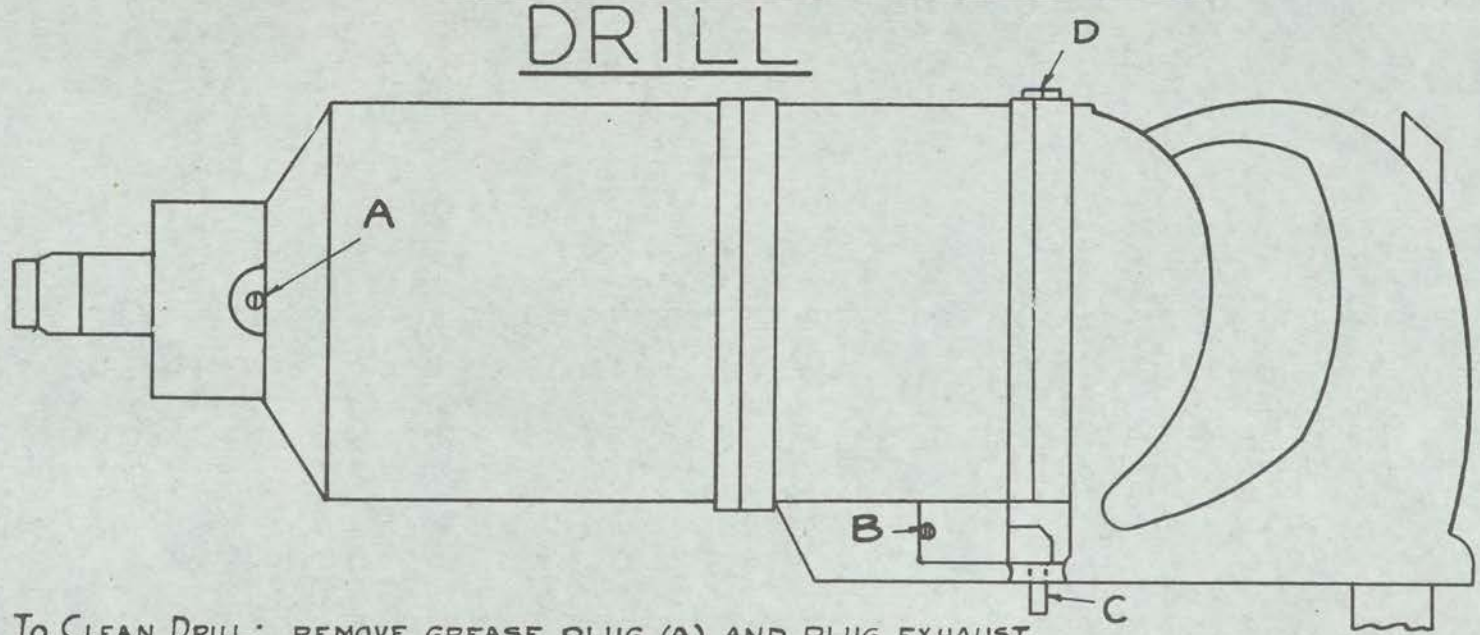
No	NAME	REQ	MATERIAL
1.	COTTER PIN	1	BRONZE
2.	NUT	1	"
3.	ADJUSTING WHEEL	1	"
4.	YOKE	1	"
5.	PACKING NUT	1	"
6.	SLEEVE	1	"
7	S-CONNECTION	1	"
8	NEEDLE VALVE	1	"
9	BODY	1	"

CONTROL VALVE FOR DIVER'S AIR

U.S.N.T.S.S.

WALSH

CHICAGO PNEUMATIC DRILL



To Clean Drill: Remove grease plug (A) and plug exhaust (B) with 3/4" pipe plug. Set direction control lever (C) halfway between dead center and full. Turn on air and let run for 5 minutes. Replace grease plug (A) and remove exhaust plug (B). Attach air line oiler and let run for 5 minutes. Then pack drill with 1/2 pound light grease at (A). Remove oil nut (D) and fill with light oil.

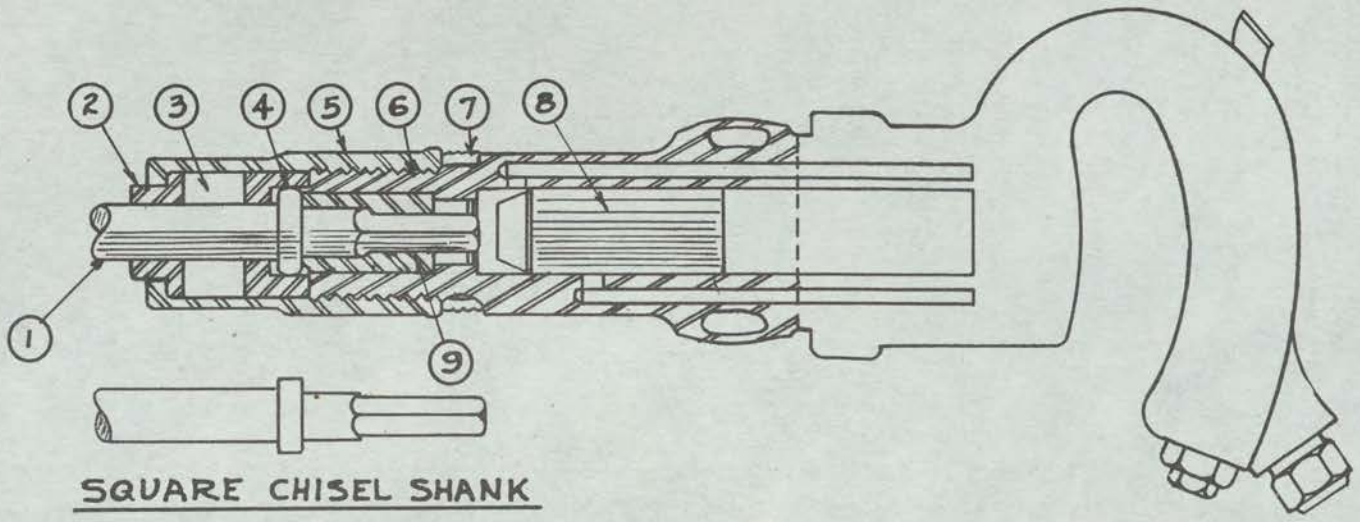
This method must be used before drill is stored after using in sea water.

U.S.N.T.S. SALVAGE

K.M.W.

PNEUMATIC HAMMER WITH CHISEL RETAINER

U.S.N.T.S. 5.

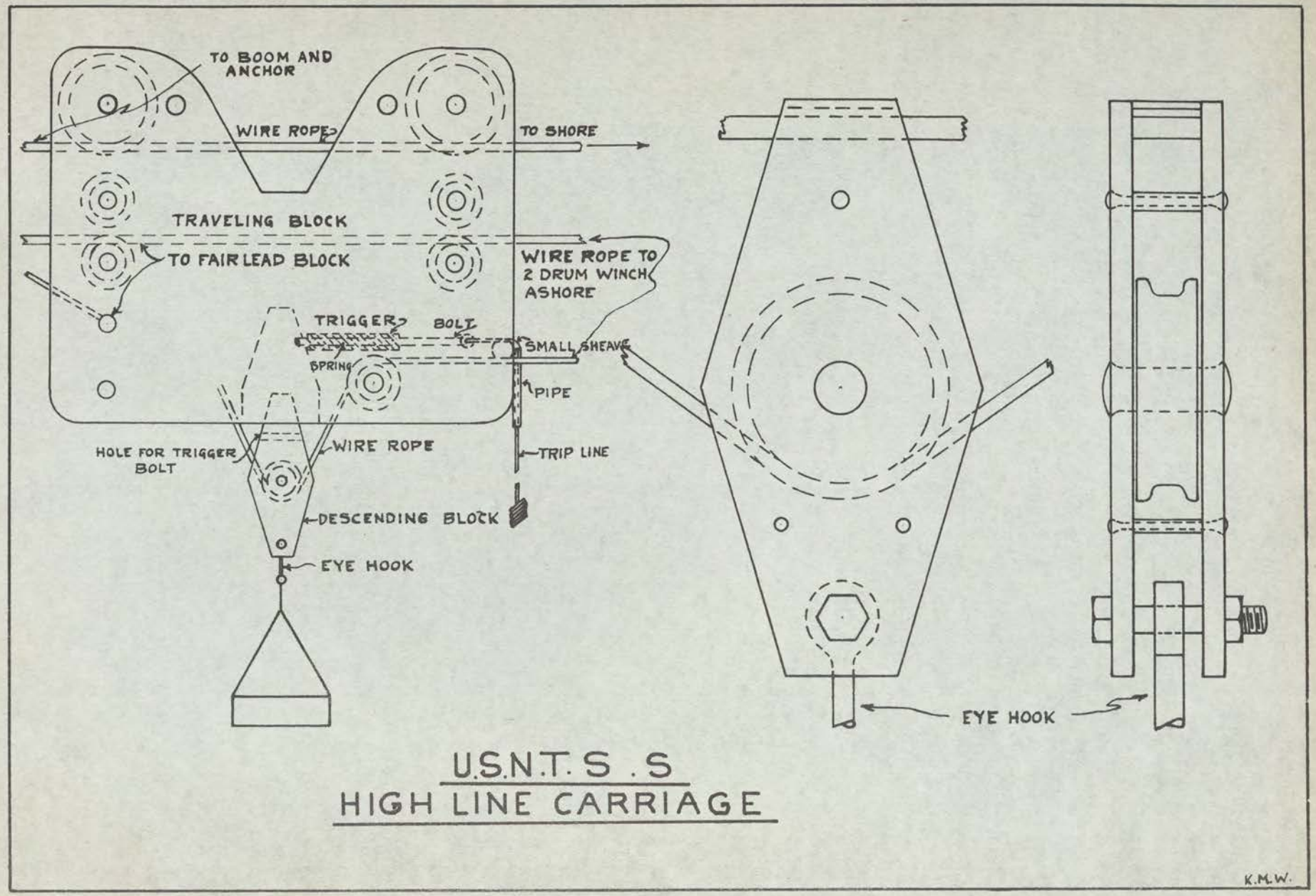


SQUARE CHISEL SHANK

1. CHISEL
2. 2 Pc. LOWER BUFFER WASHER
3. RUBBER BUFFER
4. 2 Pc. UPPER BUFFER WASHER
5. RETAINER NUT
6. THREADED BARREL
7. RETAINER LOCK SPRING
8. PISTON
9. NOZZLE

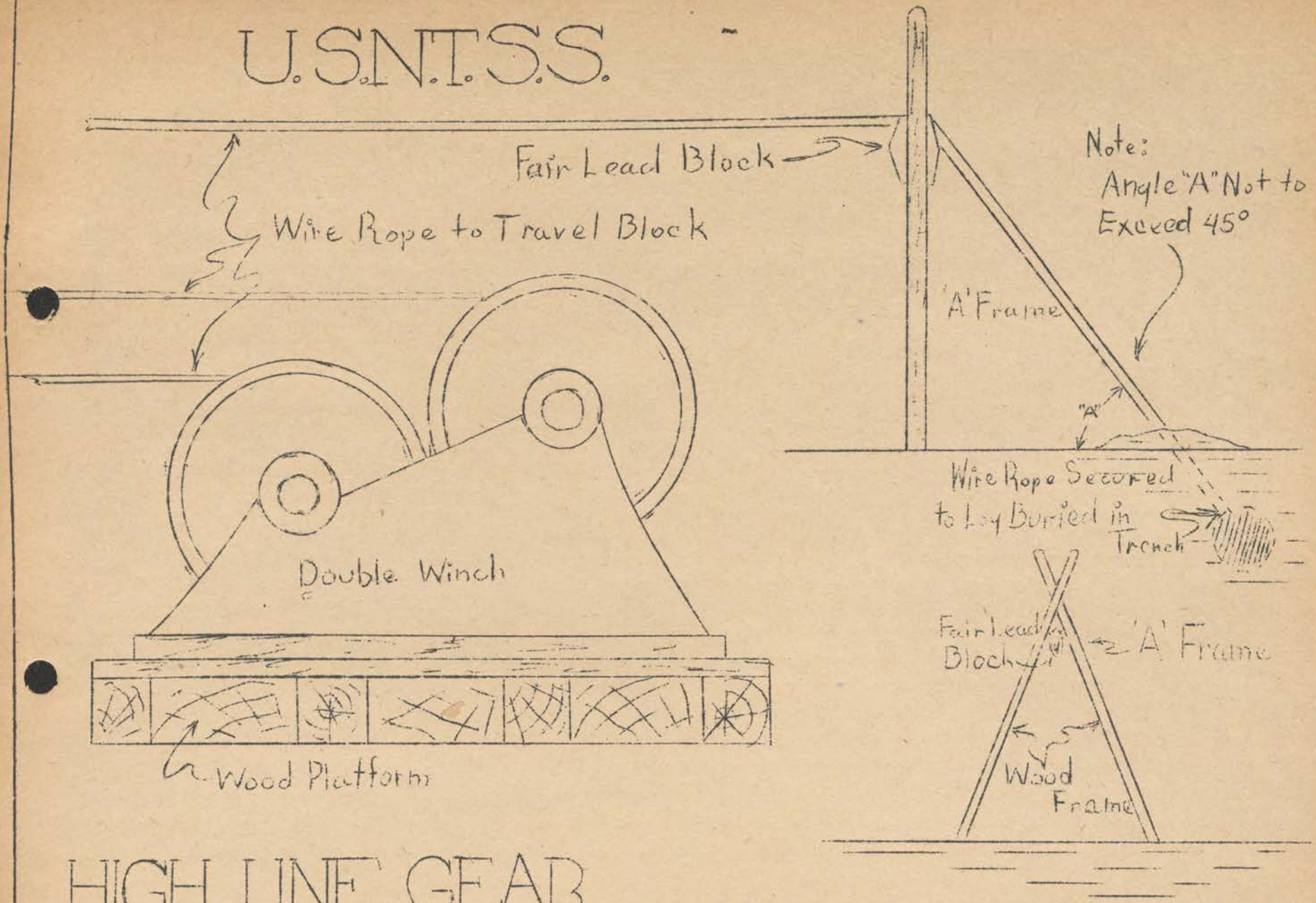
SUBMERGE PNEUMATIC TOOLS IN RUST BAND OIL WHEN NOT IN USE. FOR BEST RESULTS WITH PNEUMATIC TOOLS IN EXTREME COLD WEATHER, USE AIRLINE LUBRICATOR WITH COLONIAL OIL CO. (AROX-NO. 60) OIL.

KMB



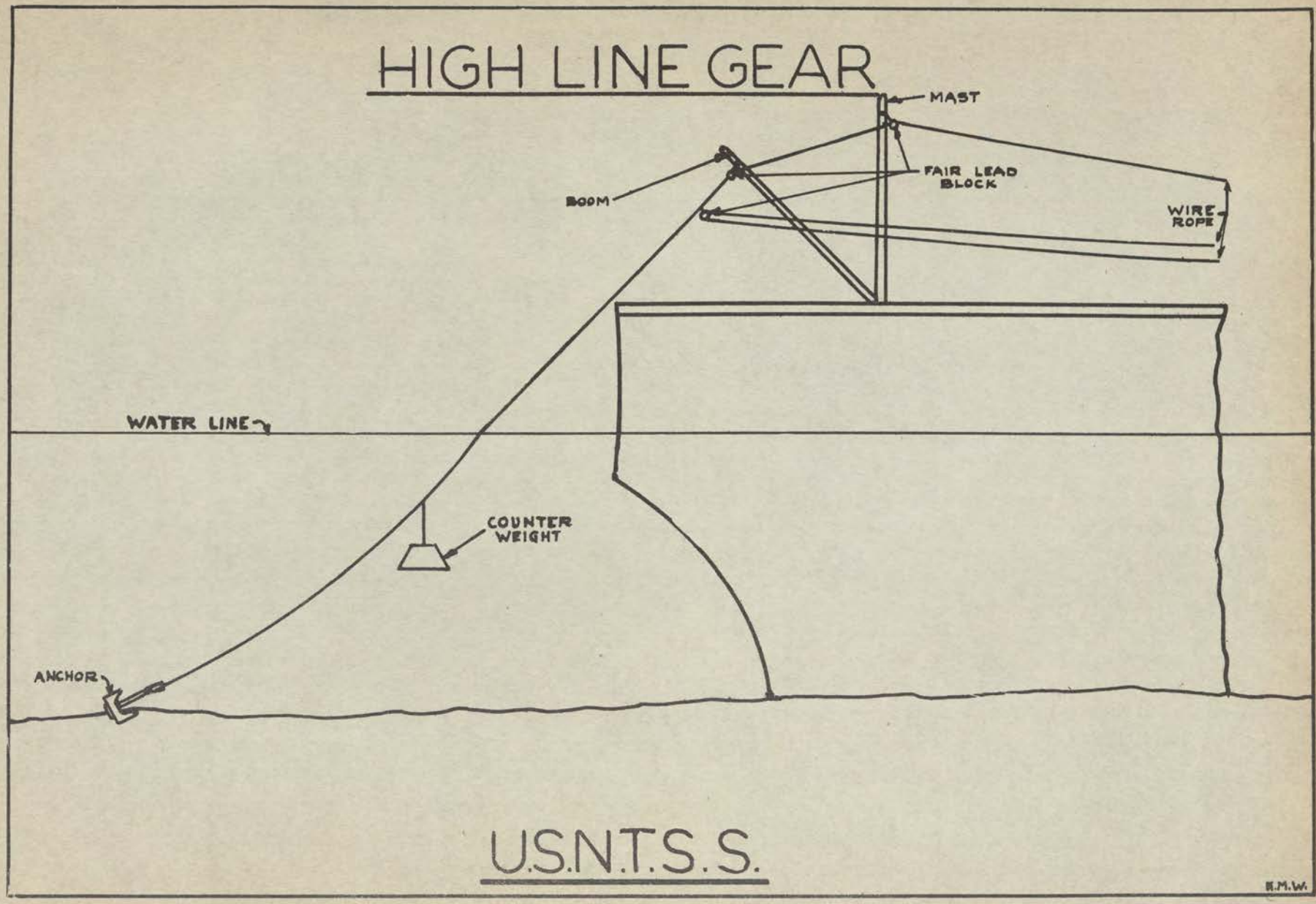
U.S.N.T.S.S
HIGH LINE CARRIAGE

U.S.N.T.S.S.



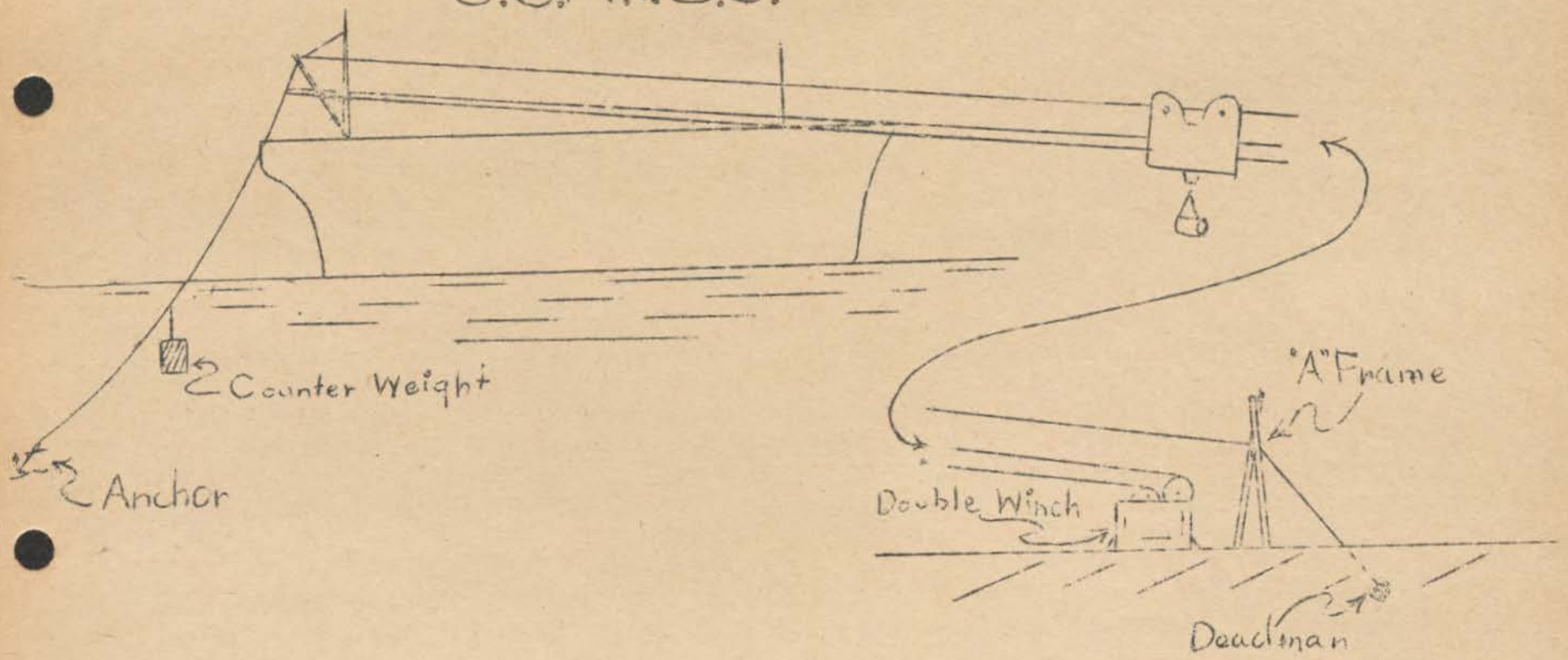
HIGH LINE GEAR

W.W.D.


HIGH LINE GEAR
MAST
FAIR LEAD BLOCK
BOOM
WIRE ROPE
WATER LINE
COUNTER WEIGHT
ANCHOR
U.S.N.T.S.S.
E.M.W.

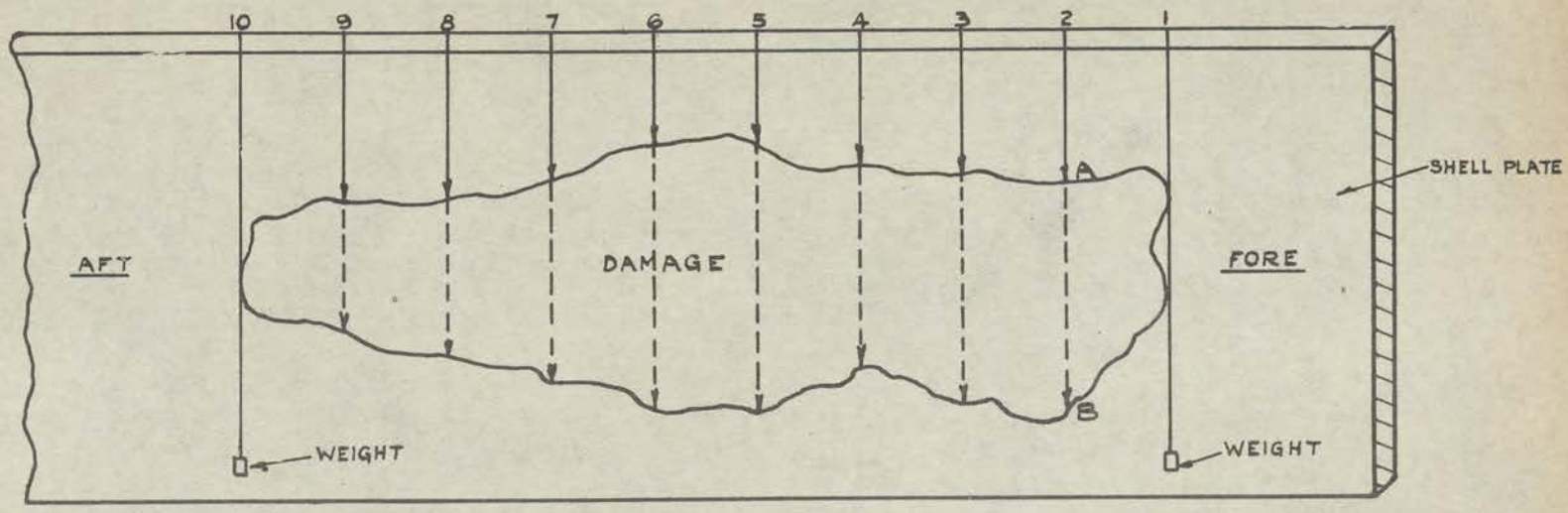
HIGH-LINE FROM STRANDED SHIP TO BEACH

U.S.N.T.S.S.



U.S.N.T.S.S.

MEASURING SIZE OF PATCH BY PLUMB LINE

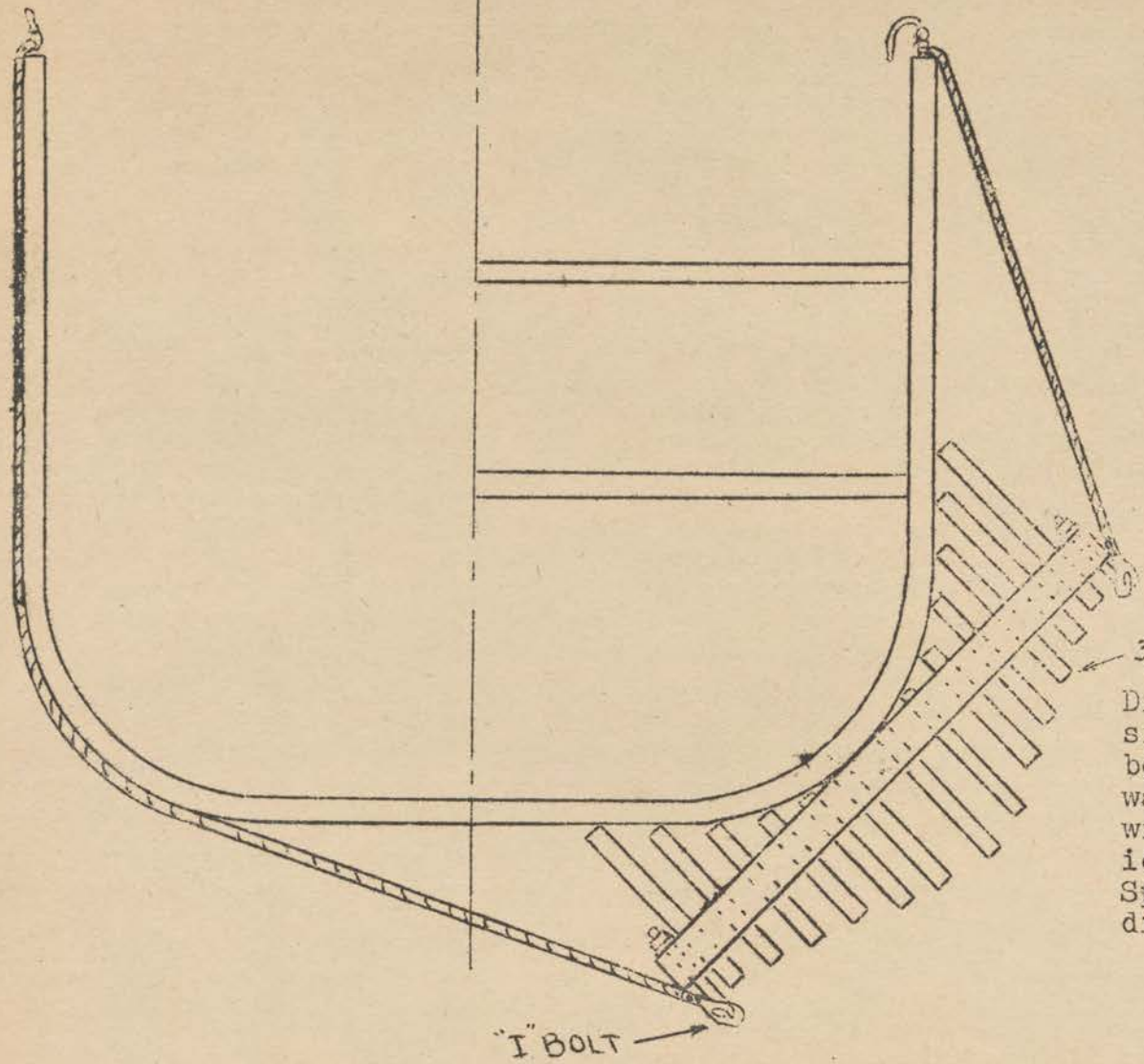


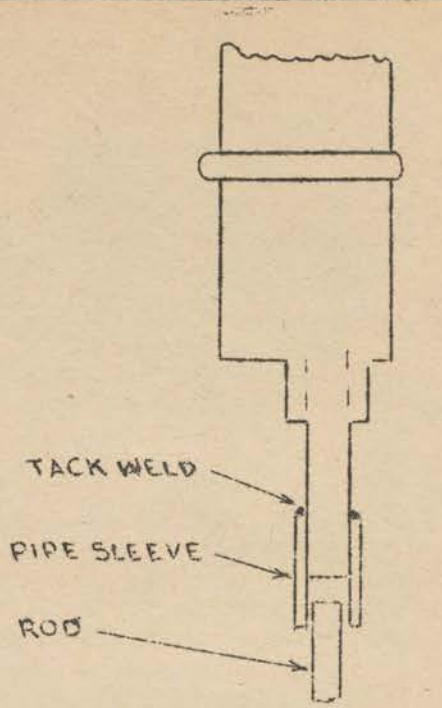
METHOD

DIVER DESCENDS TO DAMAGE IN SHIP'S SIDE. PLUMB LINE IS LOWERED AND DIVER SIGNALS TOPSIDE. THE DISTANCE FORE OR AFT TO MOVE LINE UNTIL THE EXTREME FORWARD END OF DAMAGE IS IN LINE WITH THE PLUMB LINE. THIS POSITION (1) IS MARKED TOPSIDE. THEN DIVER MOVES TO EXTREME AFTER END OF DAMAGE AND THE SAME PROCEDURE IS FOLLOWED. THIS DETERMINES POSITION 10. THE DISTANCE BETWEEN POSITIONS 1 AND 10 IS THE OVER-ALL DIMENSION OF PATCH. THE OVER-ALL DIMENSION IS DIVIDED INTO CONVENIENT INTERVALS – THE LARGER THE PATCH, THE GREATER NUMBER OF INTERVALS OR STOPS. PLUMP LINE IS LOWERED AT POSITION 2 AND DIVER SIGNALS TOPSIDE WHEN PLUMB IS AT POSITION A ON DAMAGE. THIS DISTANCE 2A IS MARKED. PLUMB IS LOWERED TO POSITION B ON DAMAGE AND DISTANCE 2B IS MARKED. THE DIFFERENCE BETWEEN 2A AND 2B GIVES THE SIZE OF THE DAMAGE, AB, AT POSITION 2. THIS PROCEDURE IS REPEATED AT EACH STOP.

KMW

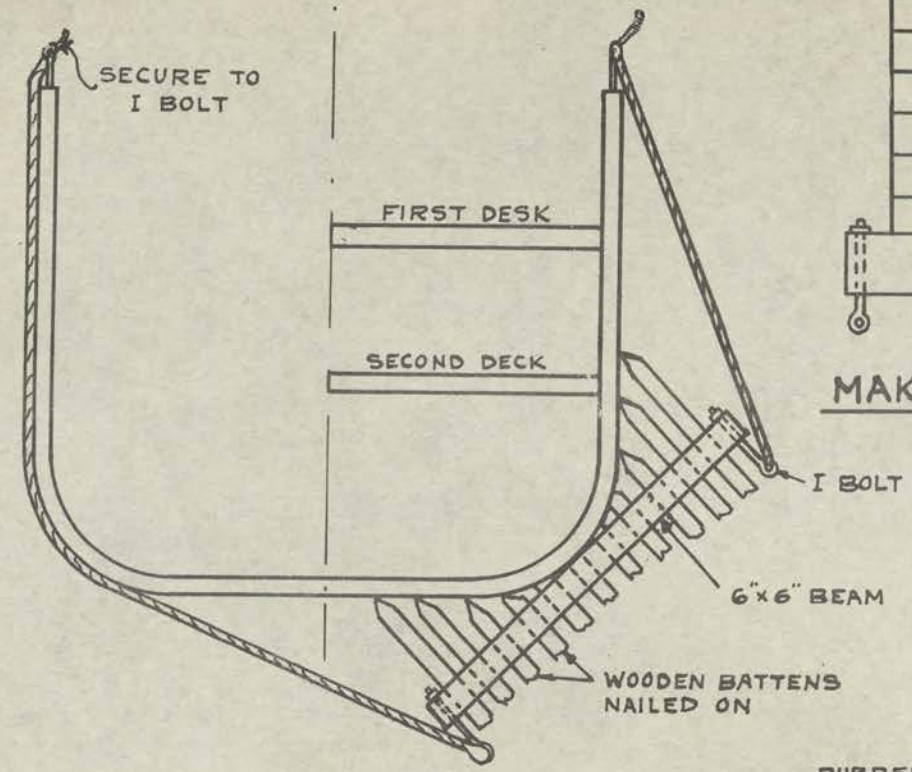
HOGGING TEMPLATE TO SHIP Fig. I

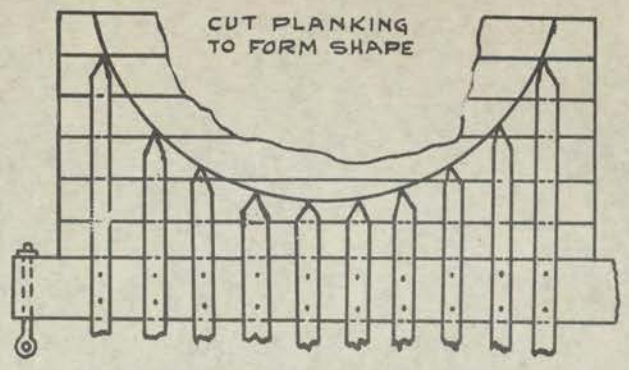




PNEUMATIC HAMMER

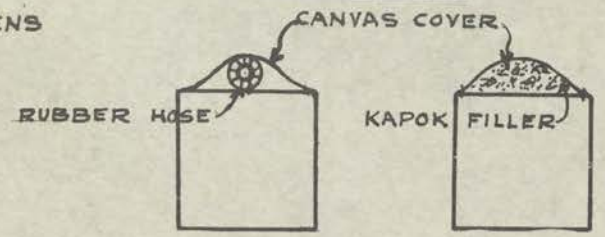
Drill holes in template frame for size of rods used. These should be tight fits, and when placed in water, the wood will swell and it will be necessary to use pneumatic hammer to drive pins.
Special tool used is shown on drawing.





MAKING WOODEN PATCH FROM TEMPLATE

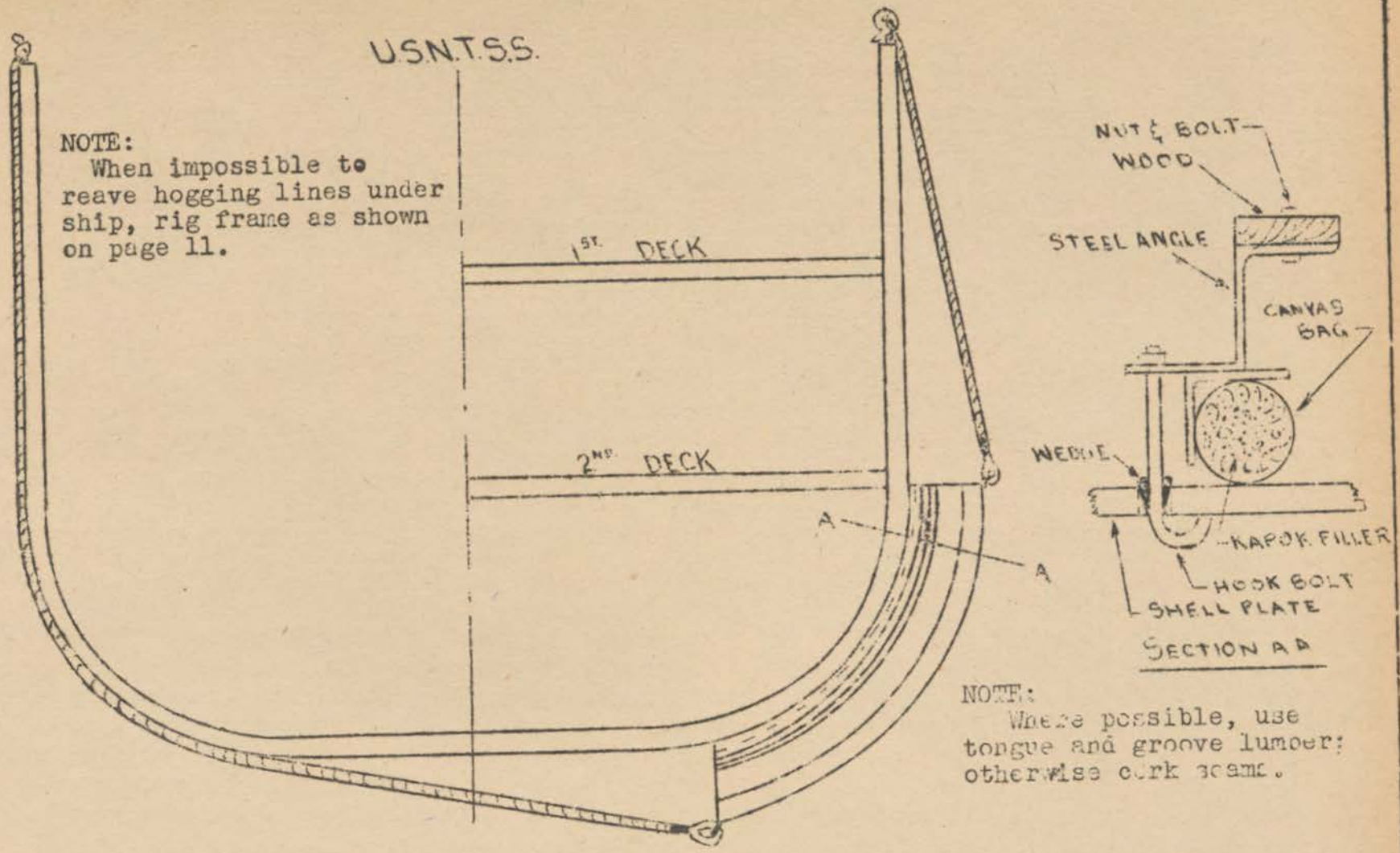
GASKETS



U.S.N.T.S.

HOGGING TEMPLATE TO SHIP FIG. II

K.M.W.



NOTE:
When impossible to reave hogging lines under ship, rig frame as shown on page 11.

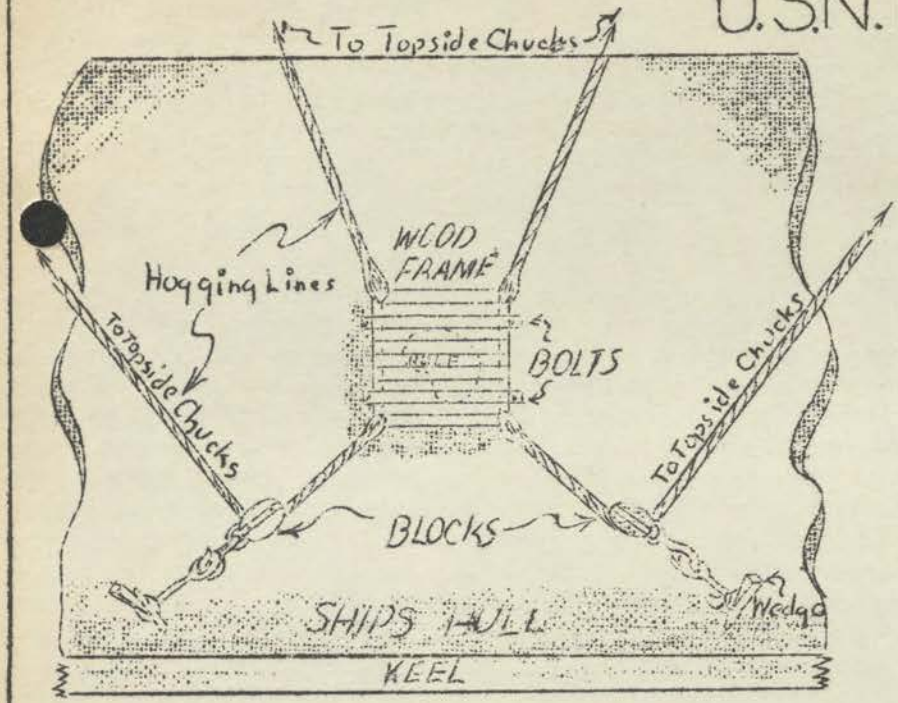
SECTION A A

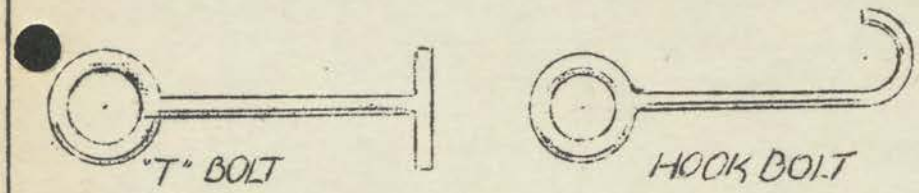
NOTE:
Where possible, use tongue and groove lumber; otherwise cork seams.

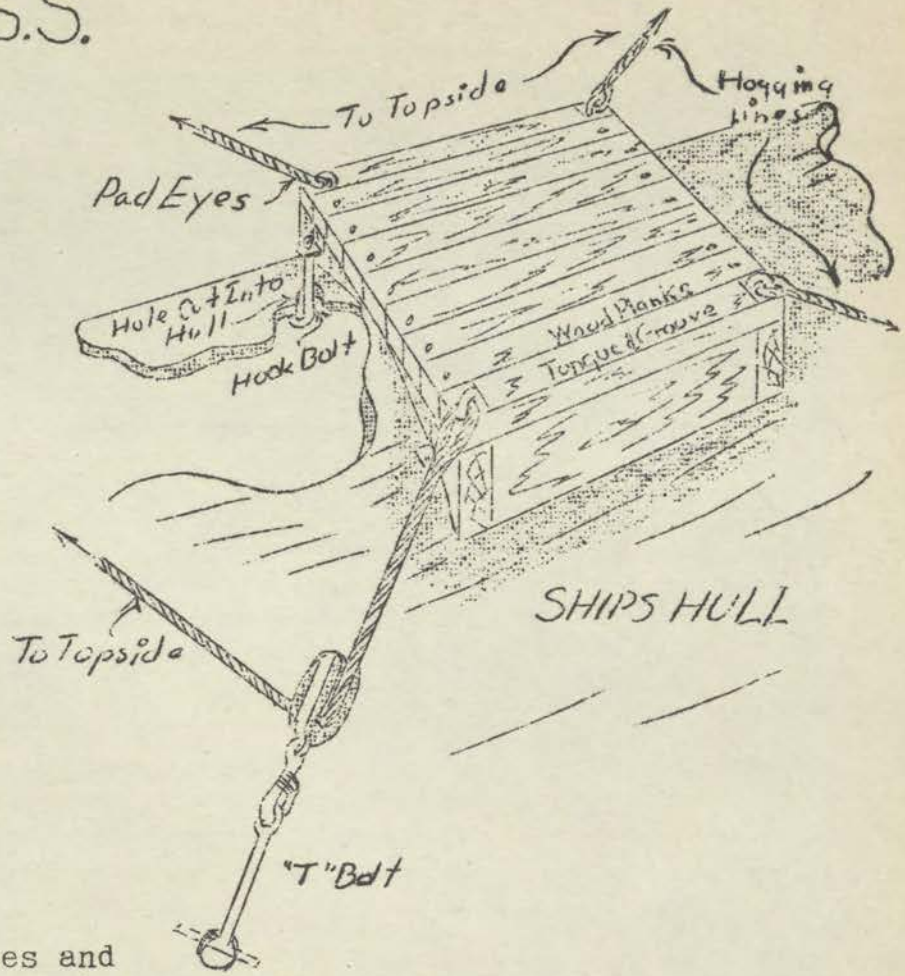
HOGGING PATCH TO SHIP

WALSH

METHOD OF HOGGING A PATCH TO SHIPS HULL
U.S.N.T.S.S.

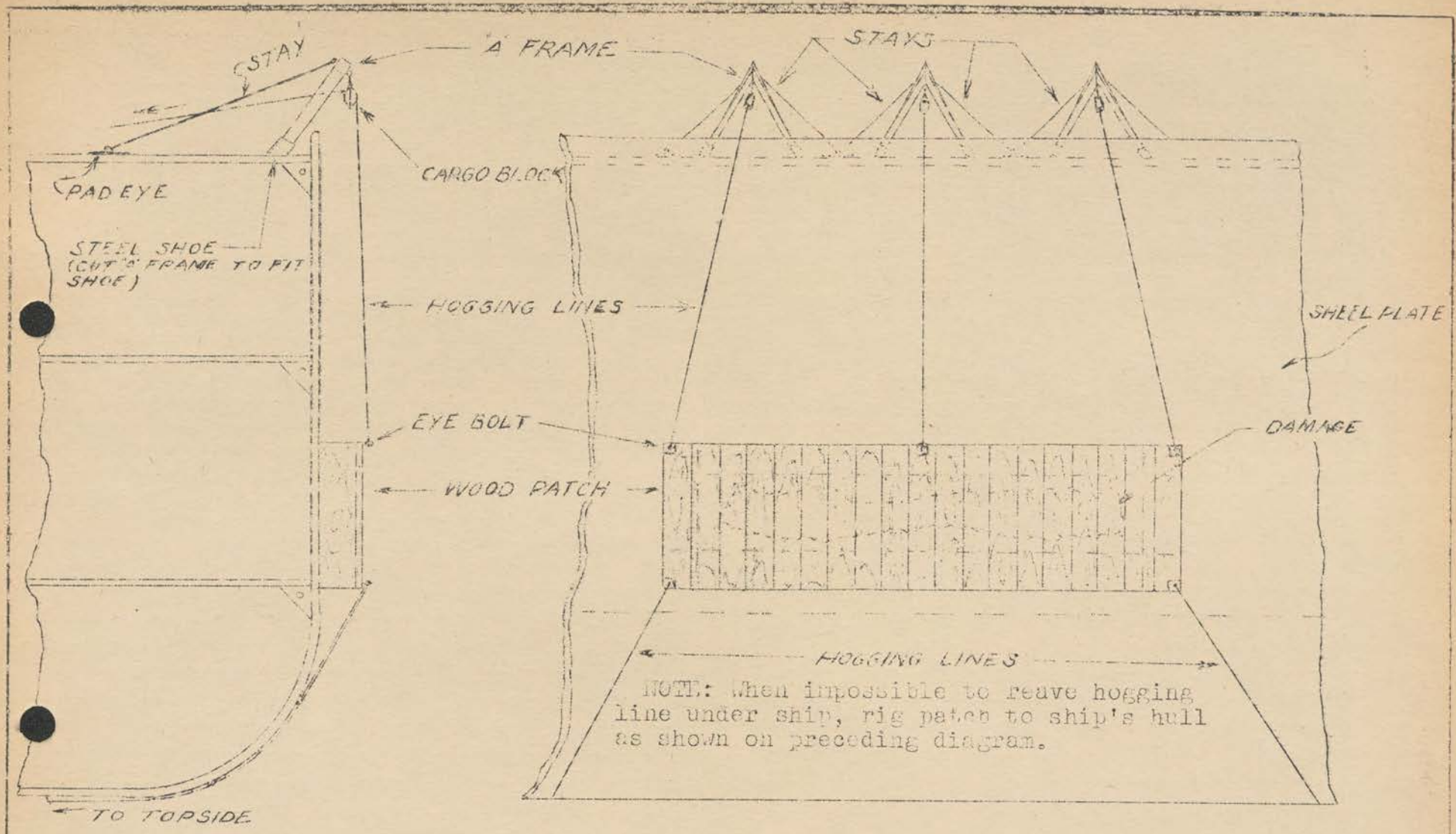






If holes come in way of oil tanks, drill holes and fill tank with CO2 before burning. Place wedges in both holes under hooks. When possible, use tongue and groove lumber; otherwise cord seams.

by DANCIAS

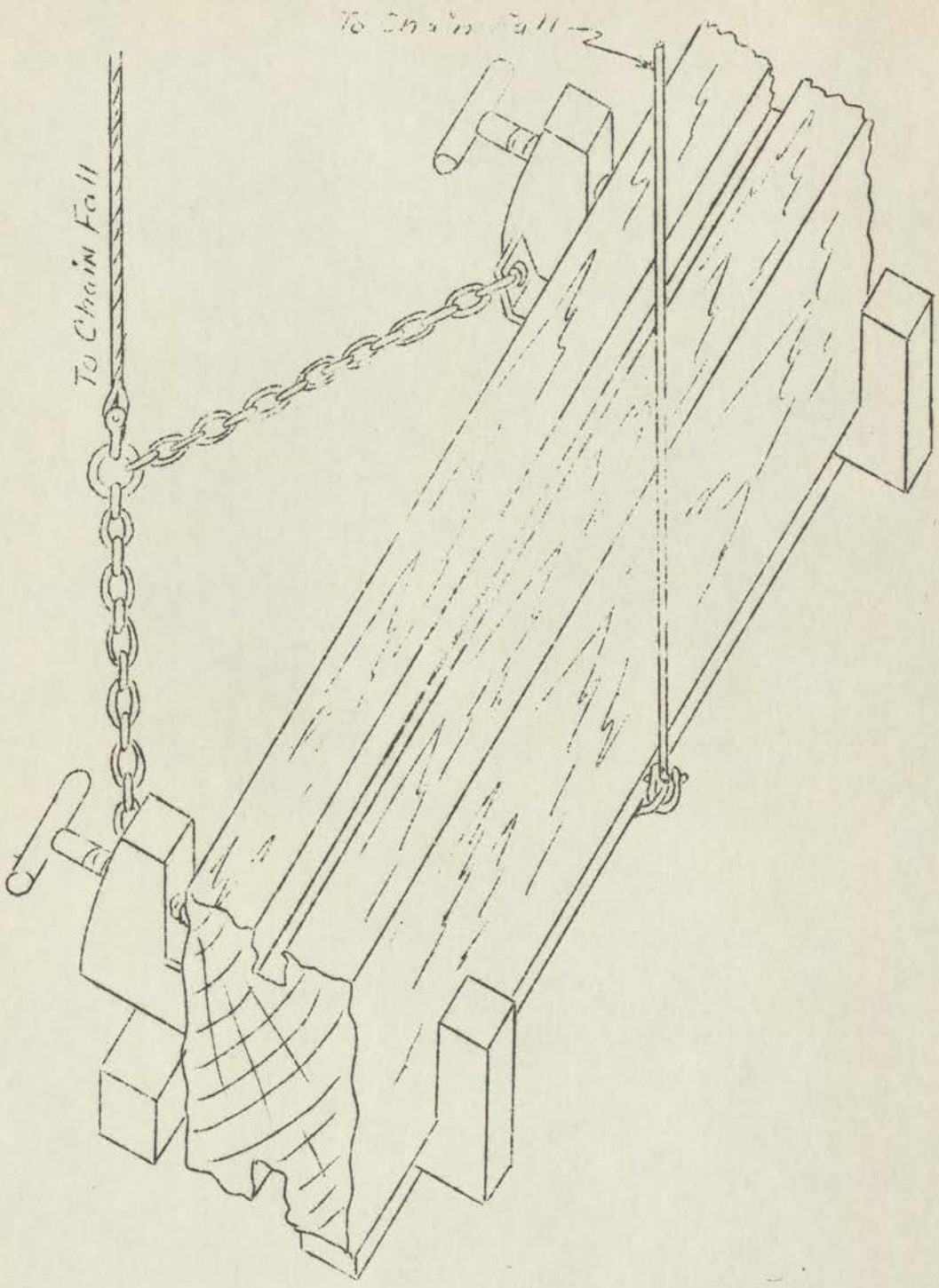


HANDLING PATCH OVER SIDE USING 'A' FRAMES

PIER 88 N.T.S. SALVAGE NEW YORK

MARCH 8 1944

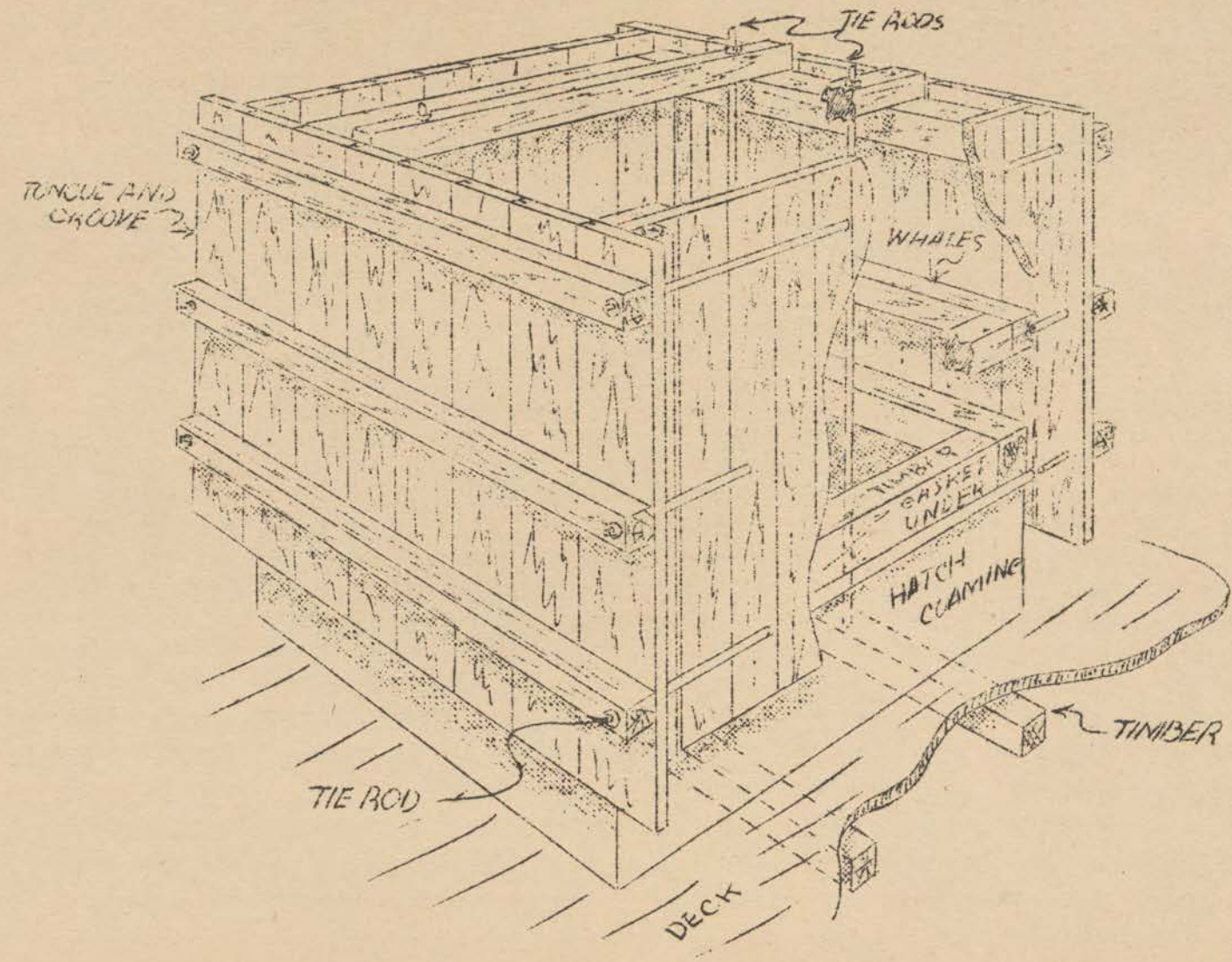
WALSH



U. S. N. T. S. S.

CRADLE WITH TIMBER

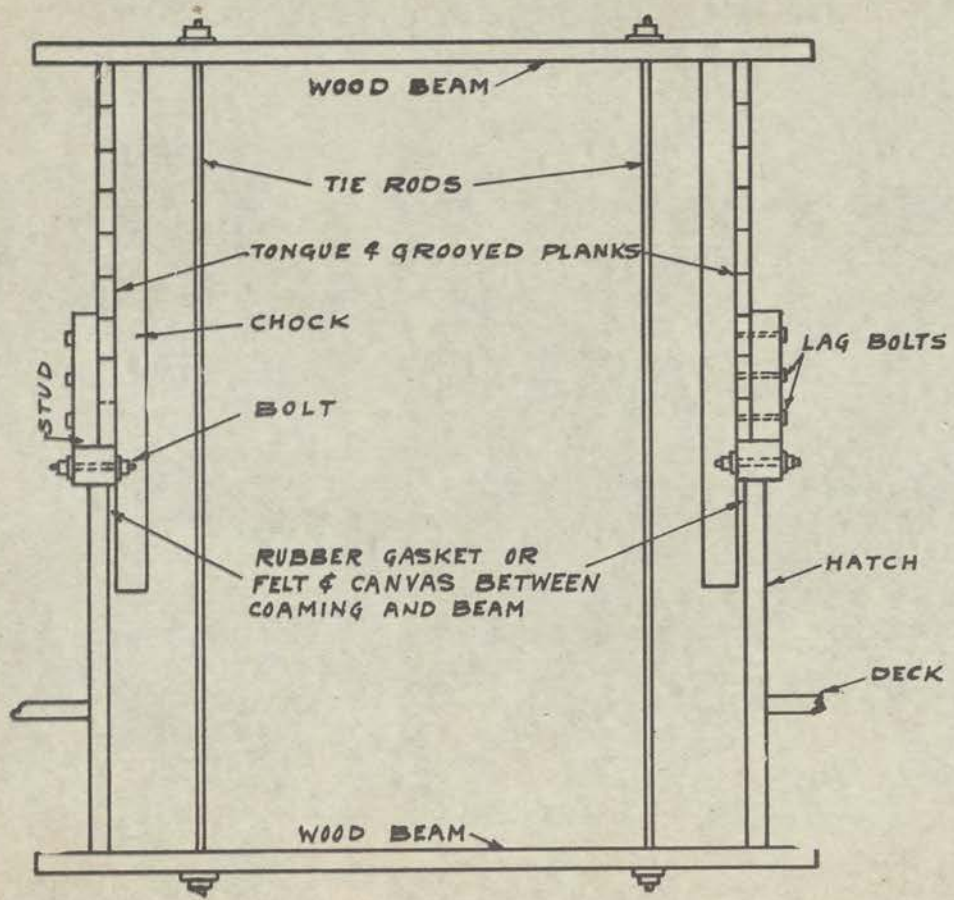
WOODEN COFFERDAM FOR SMALL HATCHES

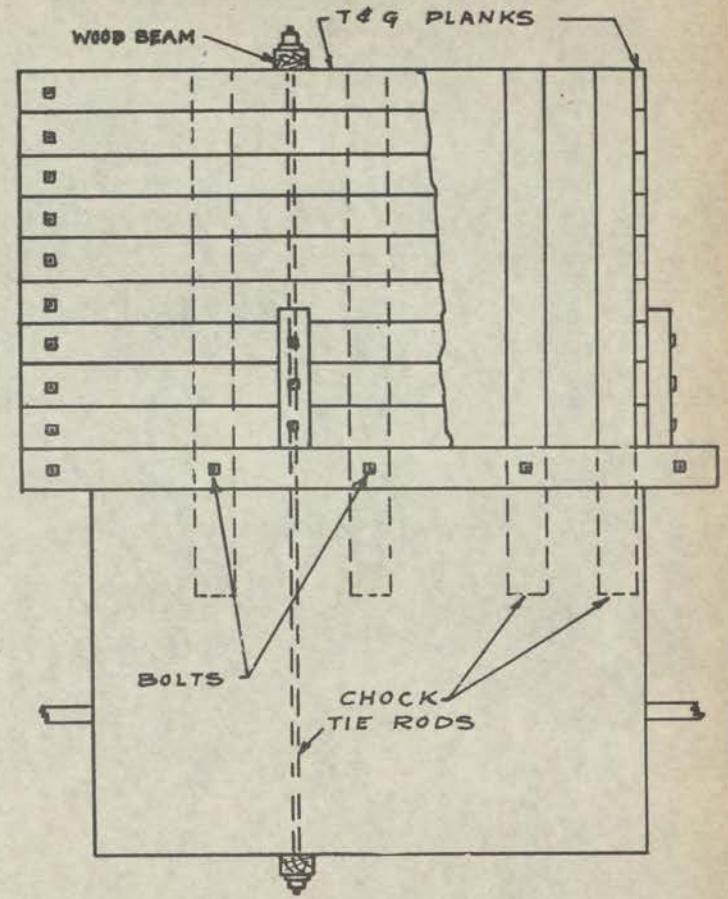


BY DOUGLAS

U.S.N.T.S.S.

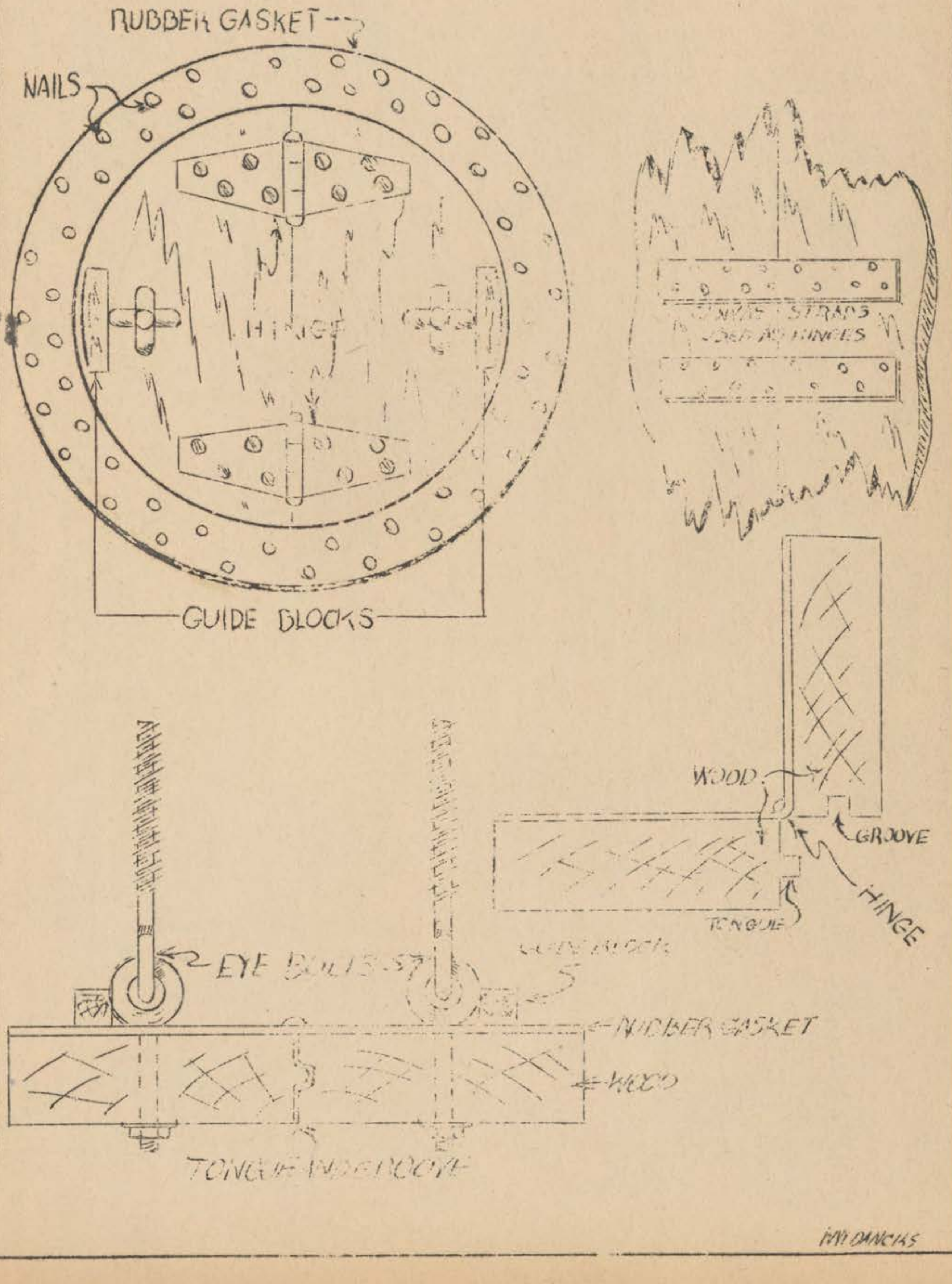
WOODEN COFFERDAM FOR SMALL HATCHES IN SHALLOW WATER



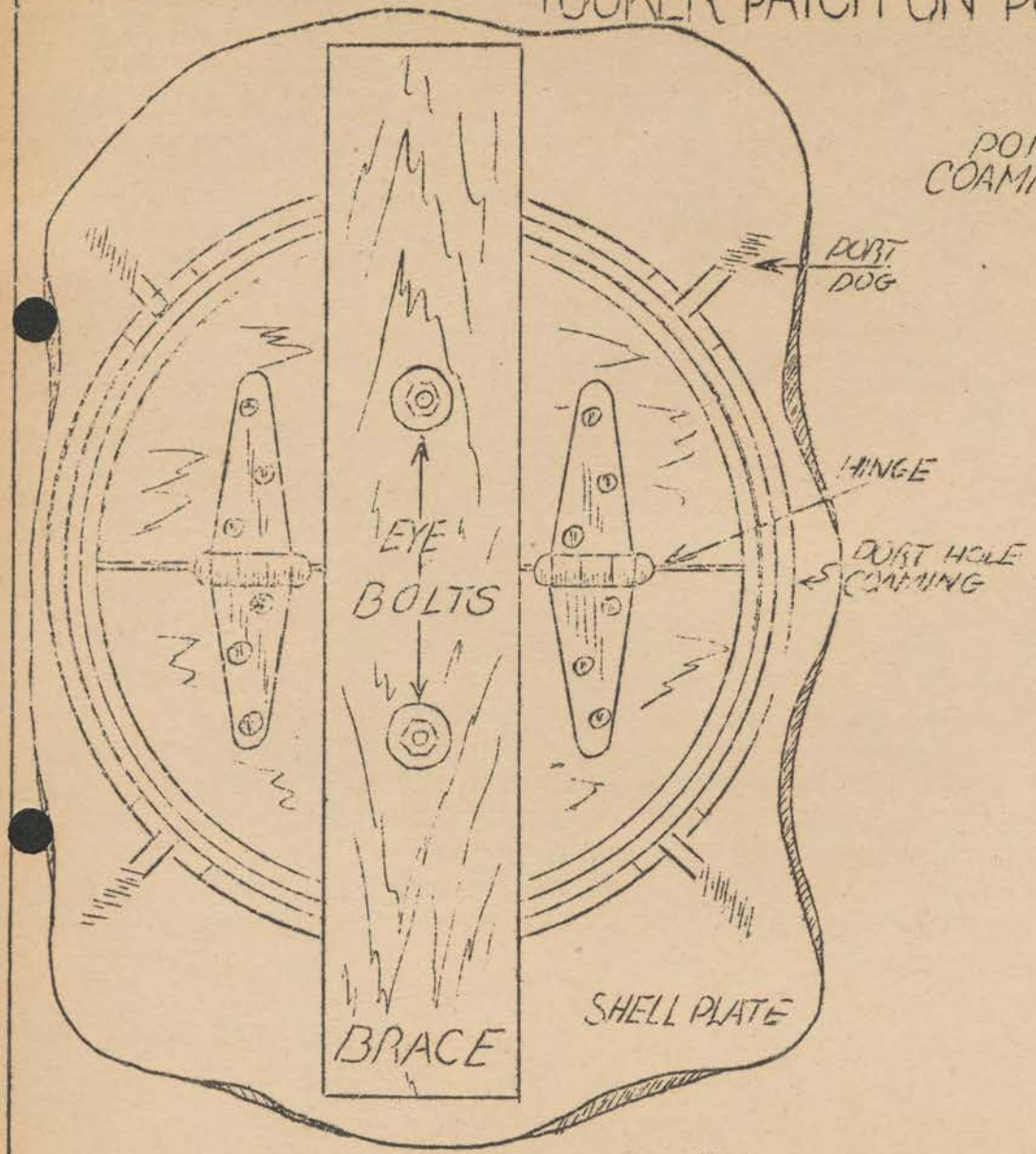


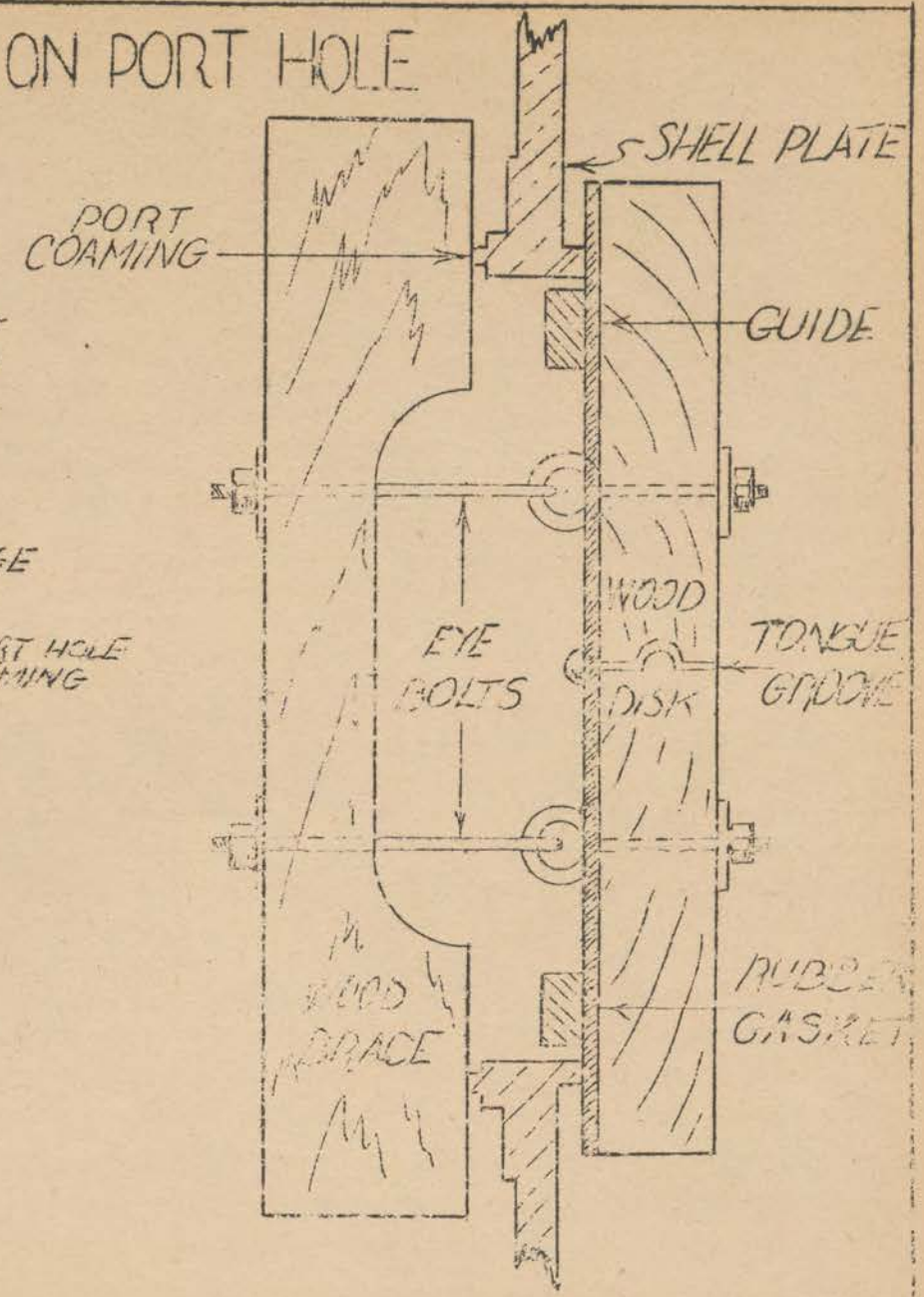
K.M.W.

TOONER — PATCH
USNTSS

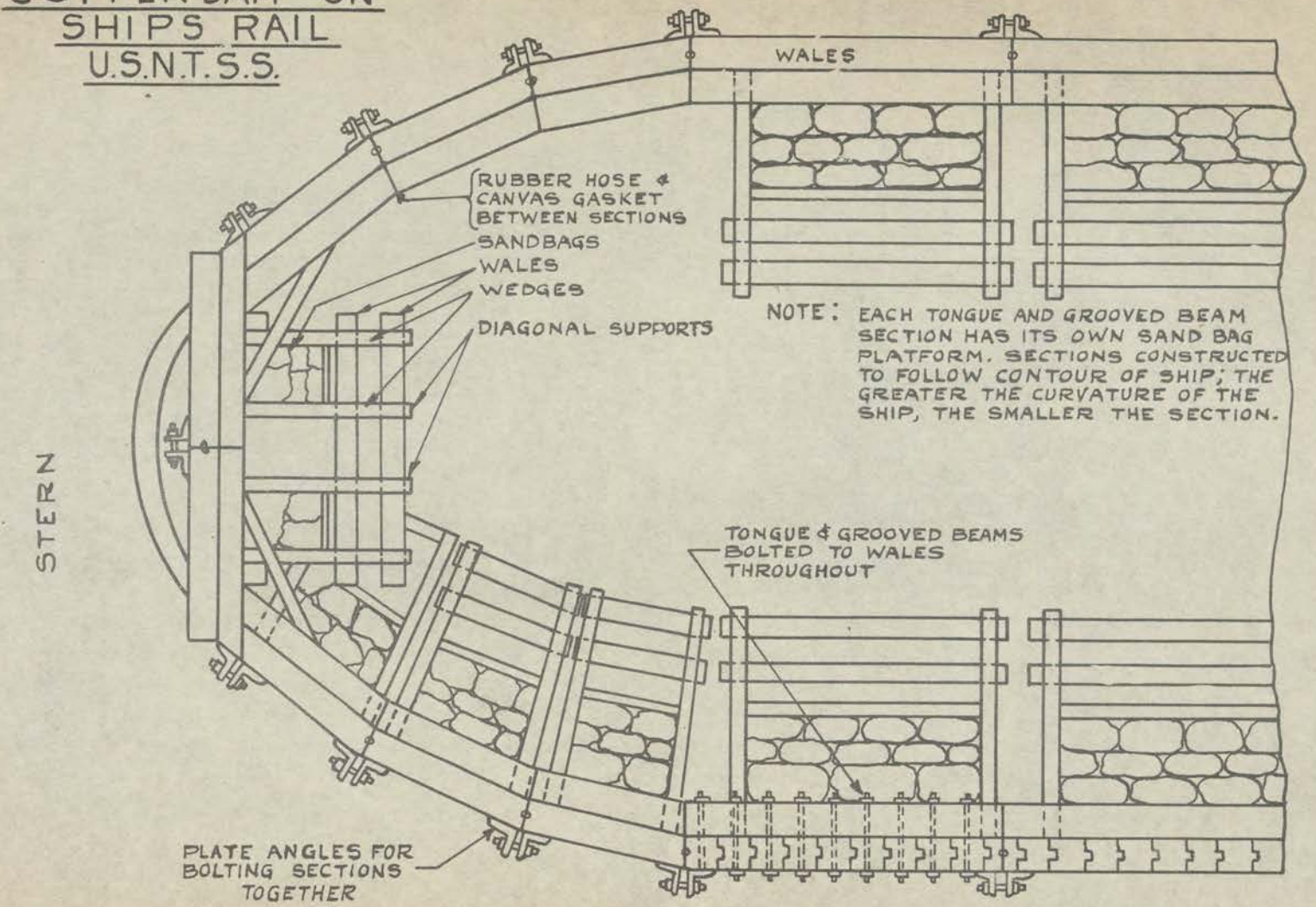


TOOKER PATCH ON PORT HOLE



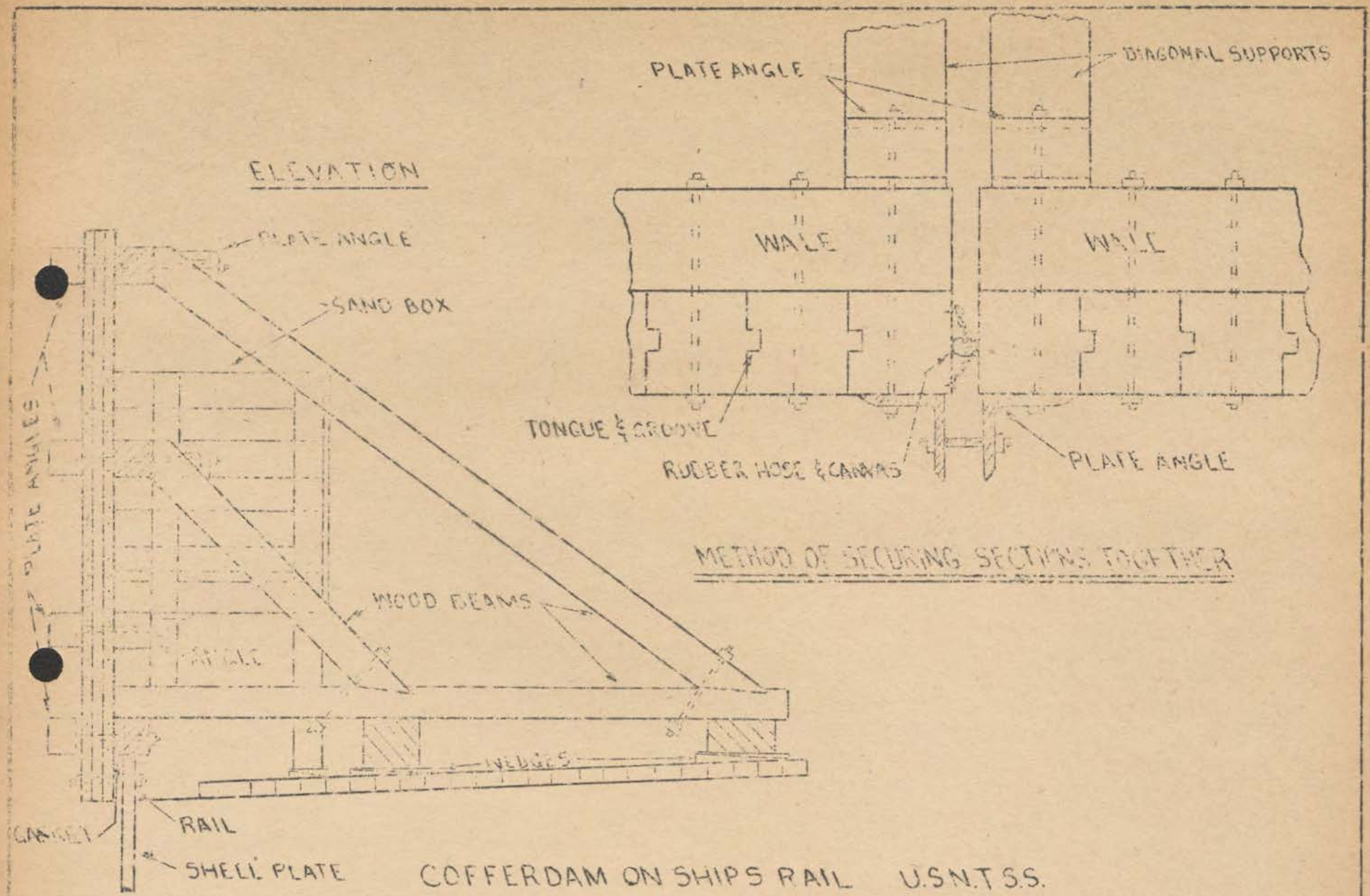


COFFERDAM ON SHIPS RAIL U.S.N.T.S.S.



NOTE: EACH TONGUE AND GROOVED BEAM SECTION HAS ITS OWN SAND BAG PLATFORM. SECTIONS CONSTRUCTED TO FOLLOW CONTOUR OF SHIP; THE GREATER THE CURVATURE OF THE SHIP, THE SMALLER THE SECTION.

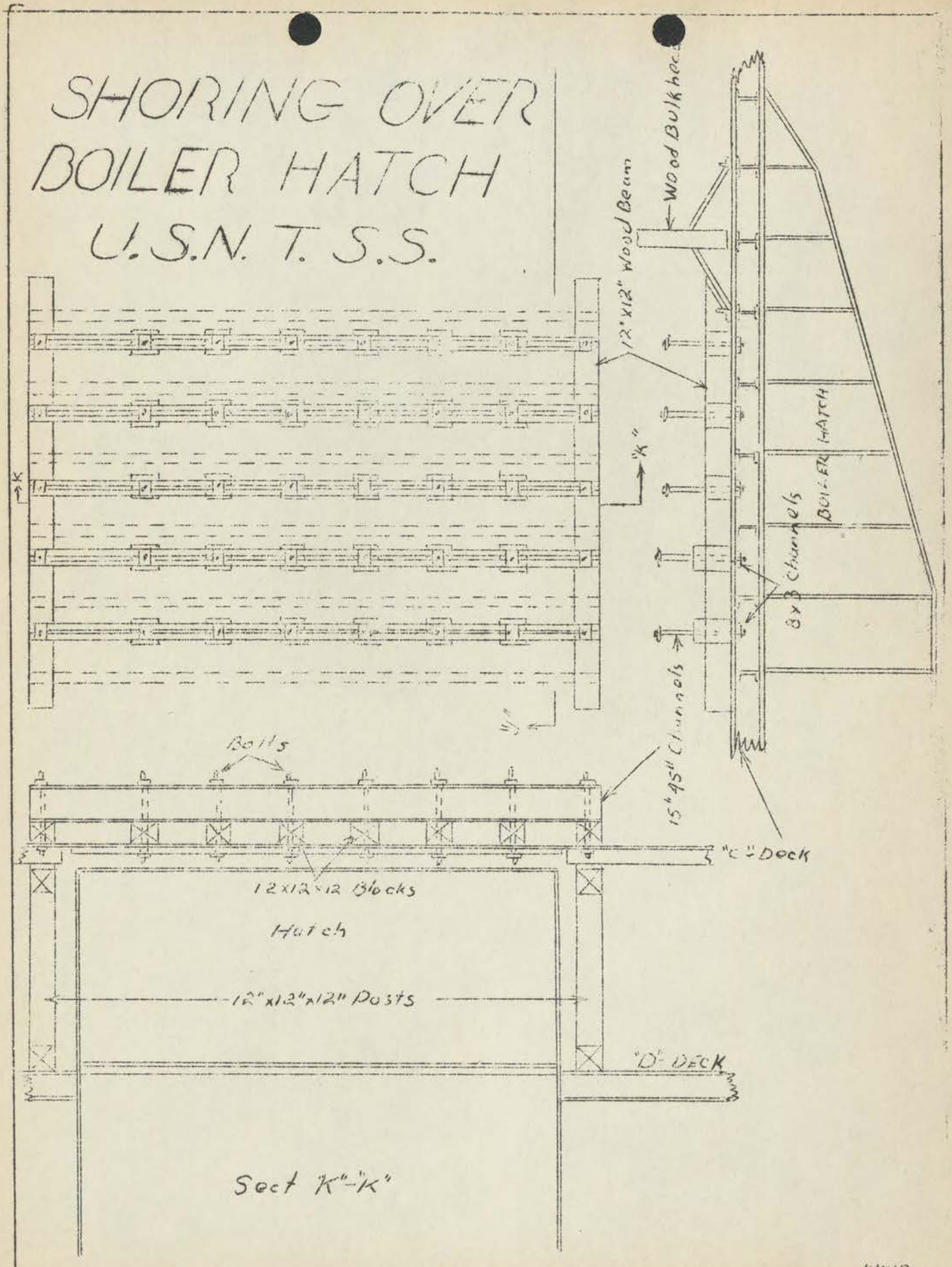
K.M.W.



COFFERDAM ON SHIPS RAIL U.S.N.T.S.S.

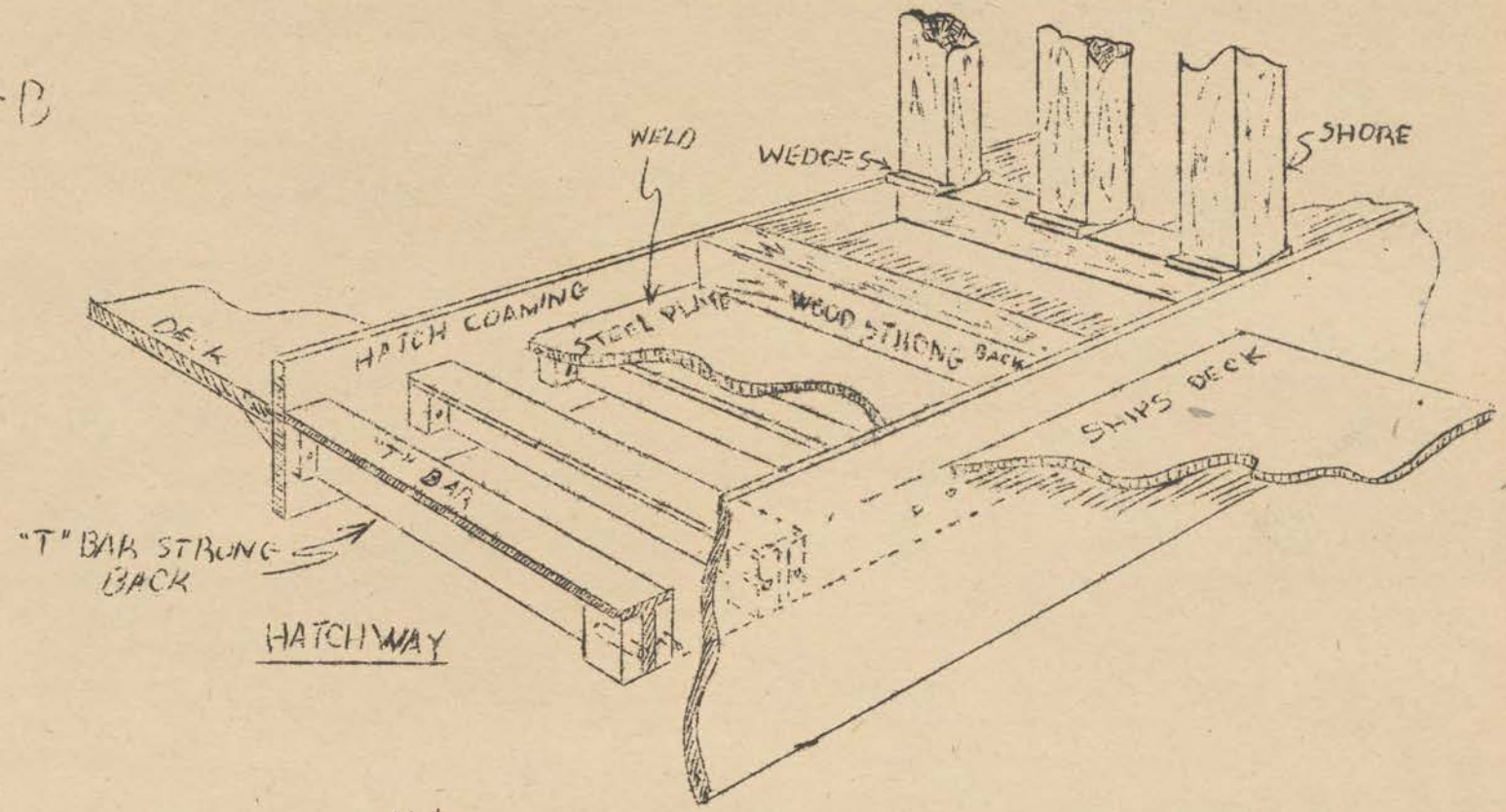
WALSH

SHORING OVER BOILER HATCH U.S.N.T.S.S.



MAKING HATCHES AIR TIGHT

PLATE - B

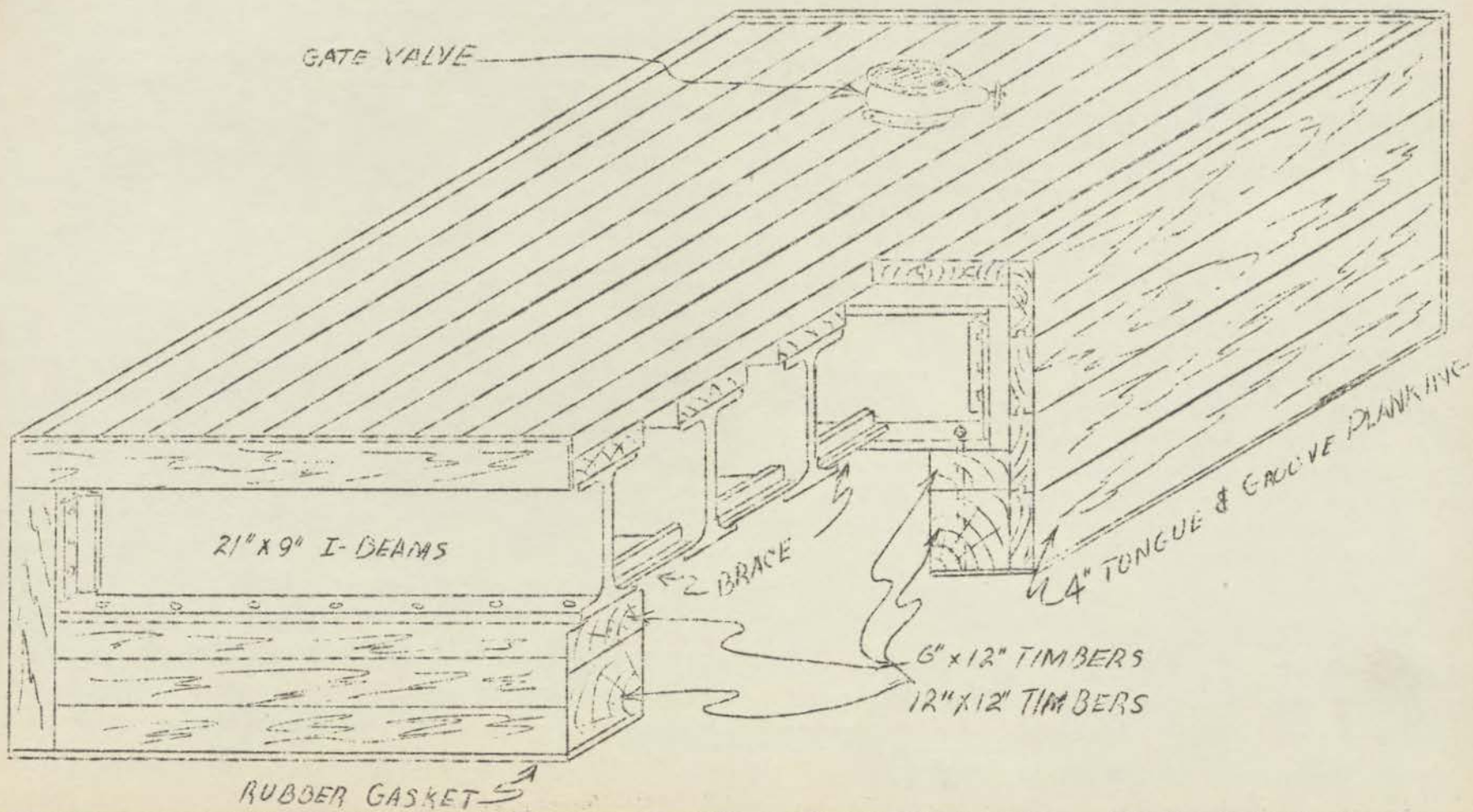


Note
Shoring Placed Directly Over Strong BACKS

U.S.N.T.S.S.

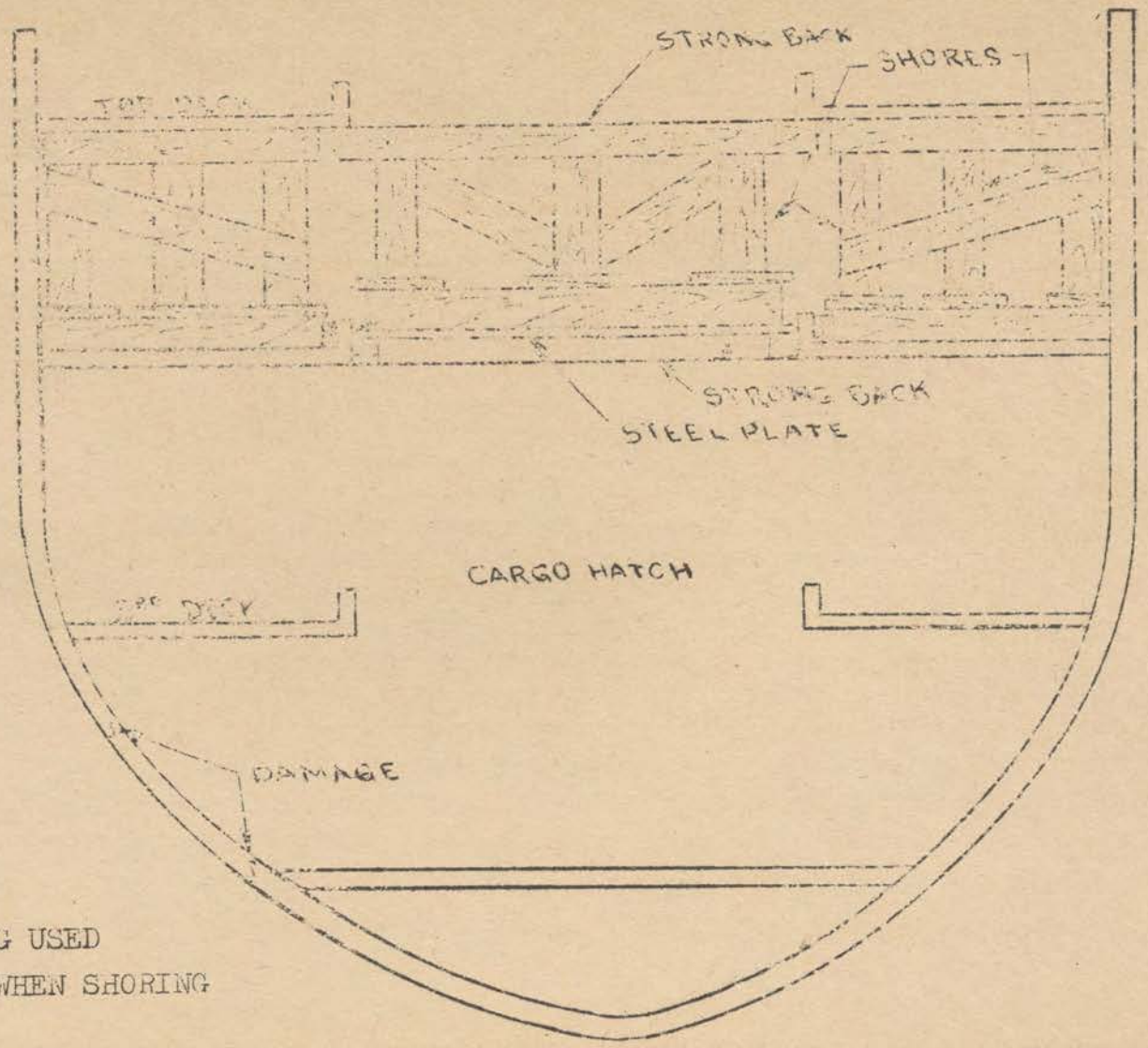
WWD

TIMBER PATCH CON'ST
U. S. N. T. S. S.



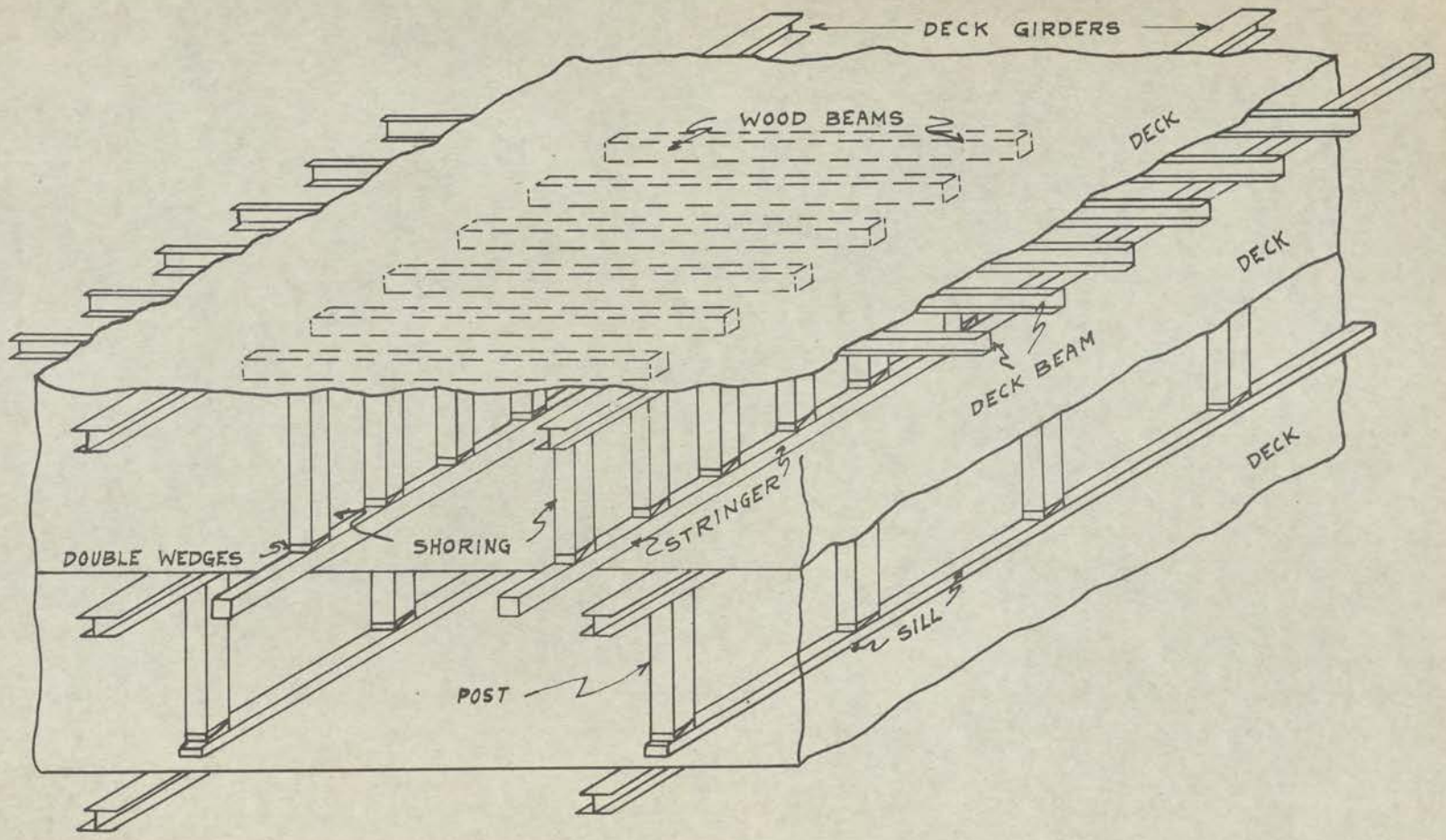
USNTS.S.

SHORING SHIP FOR AIR



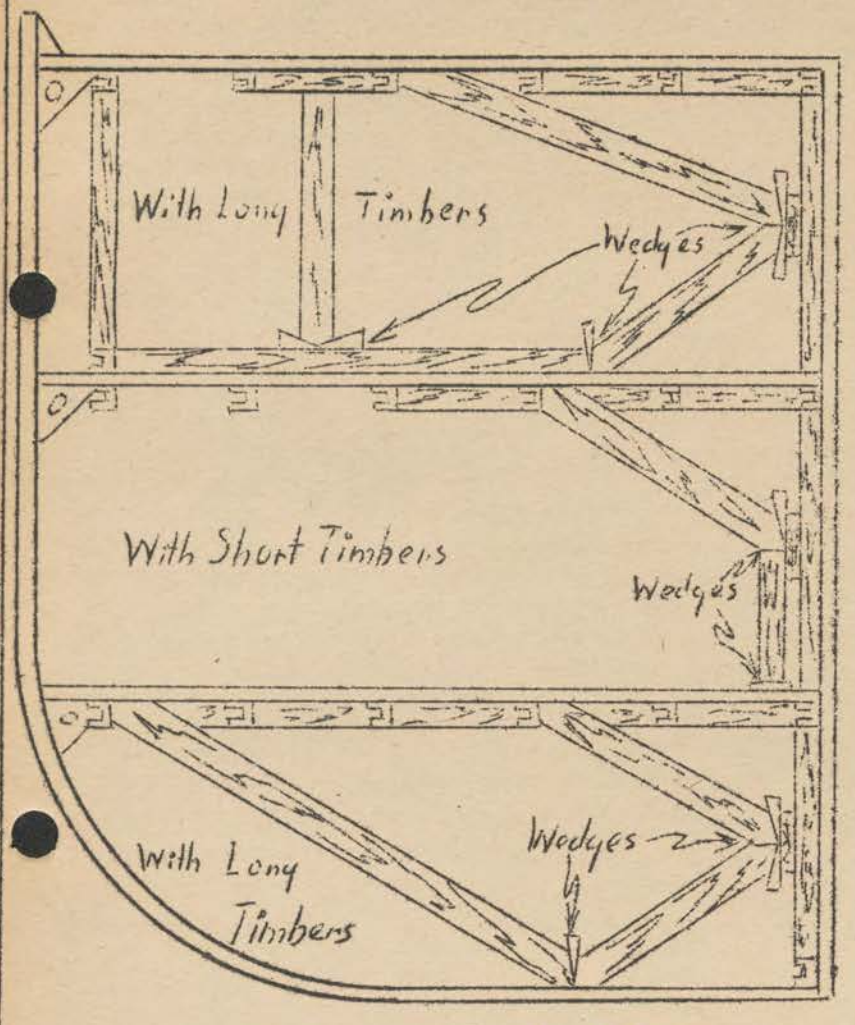
TYPE OF SHORING USED BETWEEN DECKS WHEN SHORING SHIP FOR AIR.

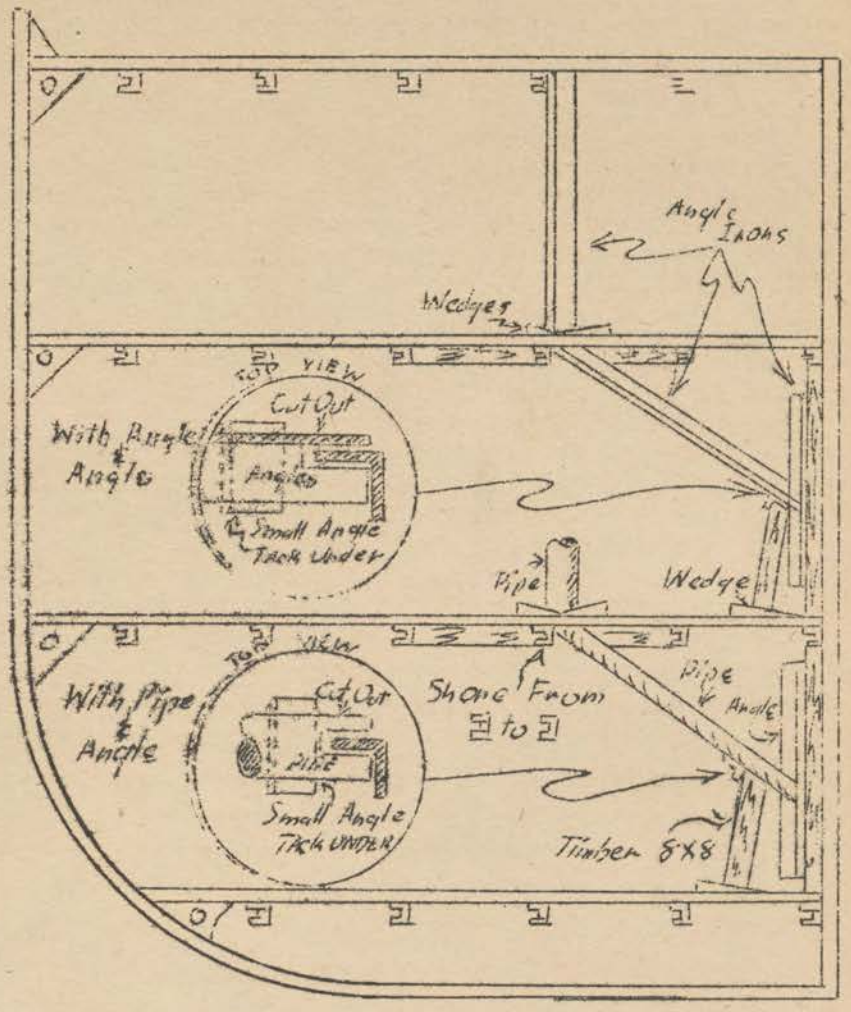
SHORING DECKS
U.S.N.T.S.S.



K.M.W.

U.S.N.T.S.S.

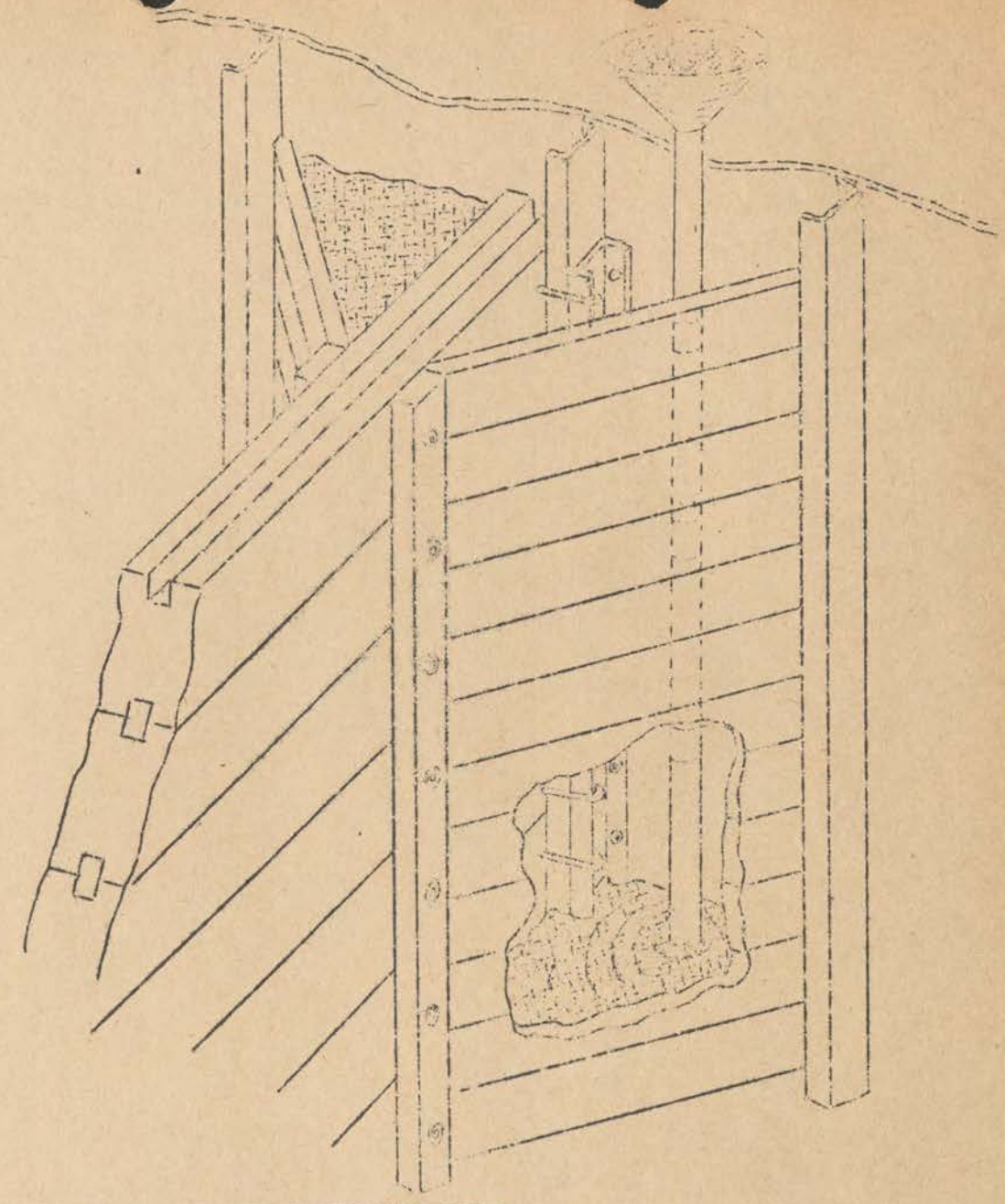


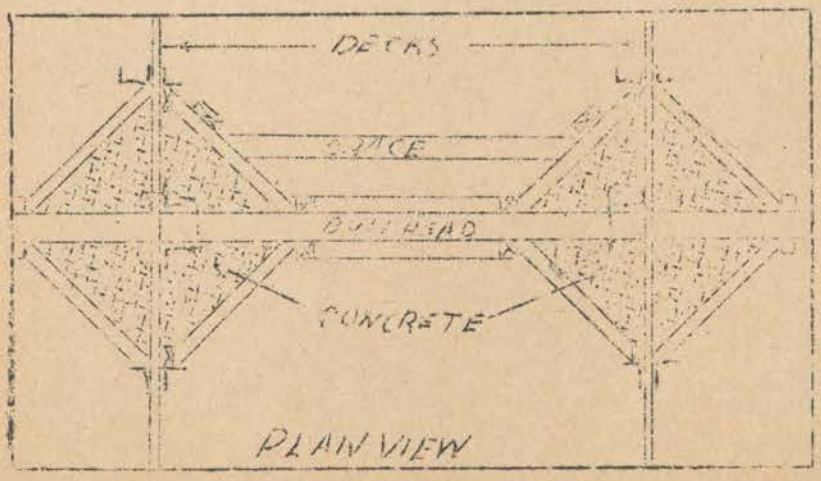


METHODS OF SHORING

Methods of Shoring aboard Ship using material on hand such as timbers, angle irons, or pipe.

HWW DAVIS

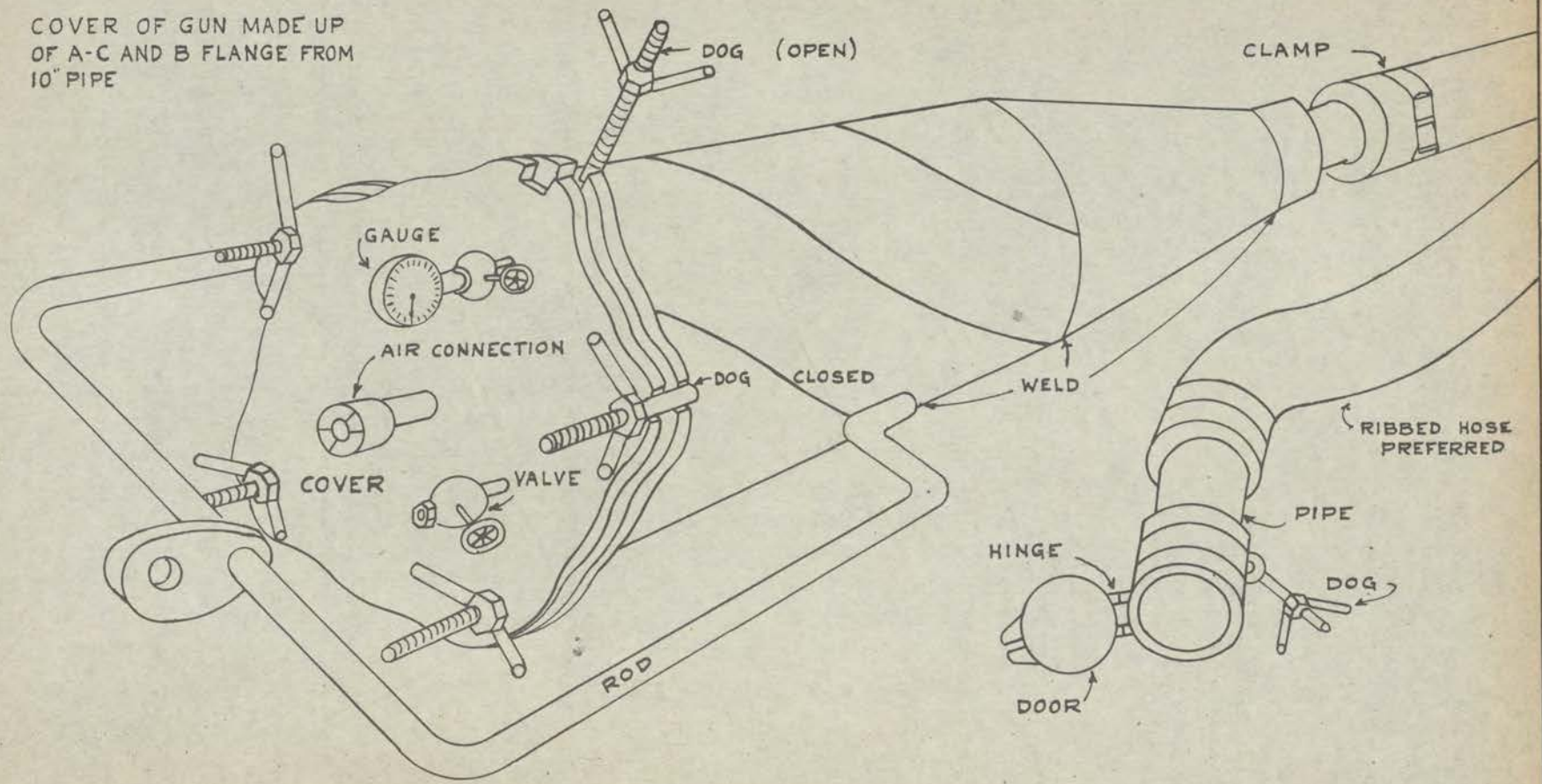




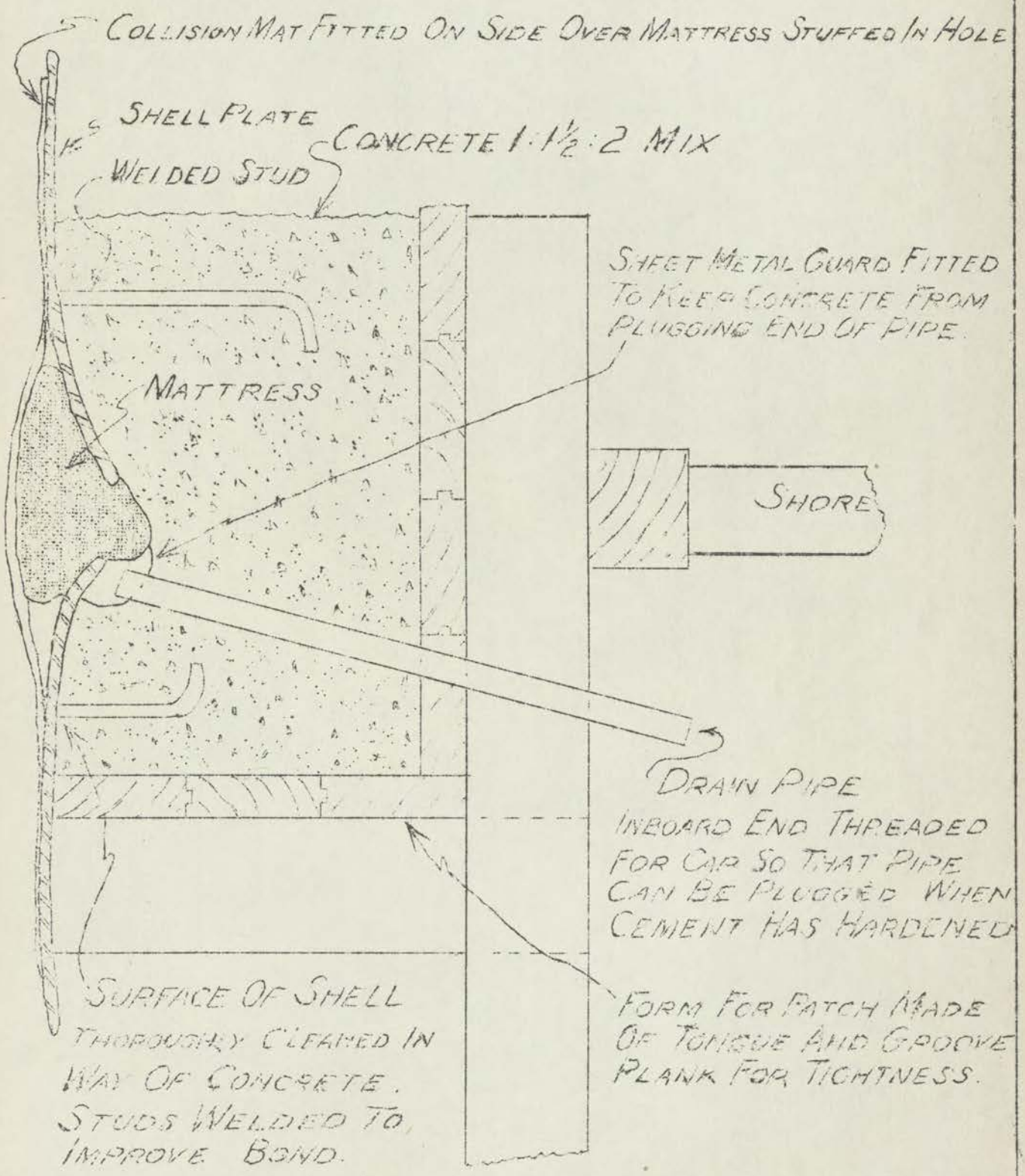
BULKHEAD CONSTRUCTION U.S.N.T.S.S.

WWD

GUN FOR POURING CEMENT (UNDERWATER)



SMALL CONCRETE PATCH



U.S.N.T.S. SALVAGE

PIER 88 NEW YORK, N.Y.

WALSH

Part I

CONCRETE IN SALVAGE WORK

Concrete mixtures in salvage operations must be used under very unfavorable conditions. Strength, watertightness and the ability to adhere to steel are the principle requirements for concrete in salvage work. Concrete mixtures usually set in about forty-five minutes, but for several days the concrete is very weak and the ordinary mixture only attains its maximum strength, watertightness, and adhesion to steel when it is three or four weeks old. Building laws usually prohibit placing any superimposed loads on concrete structures until it has had a chance to set for at least four weeks.

Such a period to permit the concrete to harden properly is never possible in salvage work. Often the concrete must be subjected to pressure in a few hours after it has been placed. If satisfactory results with concrete are to be obtained in salvage work, and if the concrete is to be sufficiently hard in a reasonable length of time, it is necessary to put more cement into the mixture than is ordinarily used in concrete for other purposes; to use a brand of cement that has high early strength, and to observe certain necessary precautions in the design of the patch and in placing the concrete.

MIXTURES TO USE

For general use in making patches a mixture of one part by volume of high early strength Portland cement to one and one-half parts sand, to two parts of crushed rock is recommended.

When cement is laid for ballast or for bulk, a less rich mixture can be used.

The sand should be clear and sharp, free from all traces of vegetable matter, or from contamination with oil.

The water used should, whenever possible, be fresh water. It too should be free from vegetable matter and oil. The amount of water used should be the minimum that is needed to give the mixture a suitable consistency for it to be placed in the form in which it is to be molded. The use of too much water in mixing the concrete diminishes the strength and watertightness of the mixture. Usually between five and six gallons of water should be used for each ninety-four pound bag of cement. When concrete is placed underwater this cannot be controlled.

MIXING

The ingredients should be carefully measured by volume and should be mixed in a watertight platform of ample size. The measured quantity of sand should be spread over the surface of the mixing platform and the cement should be spread evenly over the sand. The two should be mixed thoroughly together, dry. The necessary water and stone, both carefully measured, should then be added and the mass turned back and forth until it is homogeneous in color and appearance. Four or five complete turnings are usually required.

PLACING CONCRETE

Whenever possible concrete should be placed above water. To do this it may be necessary to temporarily dewater the compartment in which it is to be placed but this should be done, if it is possible to do so, by using a temporary patch to stop the leakage until the concrete can be placed and set.

The concrete is usually placed in a box form which molds it in the desired shape. If this is above water the concrete can be shoveled into the form or handed in by buckets. It should never be dropped in place from a height of over 5 feet. Too much air may be entrained in the concrete. Once in the form it should be tamped down sufficiently to eliminate air pockets and to insure the concrete filling all portions of the form. If this is not necessary it is an indication that too much water has been used.

PLACING CONCRETE UNDERWATER

Placing concrete underwater is sometimes unavoidable. It cannot easily be done if satisfactory results are desired. Cement, sand, and stone are, of course, heavy enough to sink in water, but the laitance and some cement which will not be immediately hydrated unless guarded against, will be washed out of the mixture, and a considerable loss of cement may be obtained before the mixture is placed.

Laitance is a whitish scum which is washed out of concrete when there is an excess of water. It consists of the finest flocculent matter in the cement. It will remain suspended in the water for a long time giving it a milky appearance but will eventually settle slowly upon the surface of the concrete. It hardens slowly and never acquires much strength so that, if, at a later date, more concrete is to be added to that previously laid, the laitance must be scraped off if a good bond is required between the two.

It is essential, therefore, that when concrete is placed underwater, it be so done that sea water cannot wash the cement out of the mixture either during the time that the concrete is being transported to the form or while it is in a liquid state in the form.

The form, therefore, should be so designed that no underwater current can flow through it. It must, necessarily, be open at the top to permit the concrete to be placed in it and to permit the sea water displaced by the concrete and the laitance that forms to escape. All other sides should be closed. The hole to be covered by the patch should also be closed by a mattress of some sort which will be sufficient to stop any flow of water.

In most salvage work, concrete underwater is placed by buckets or boxes designed for this purpose. The ordinary tilting bucket cannot be used, for, when the mixture is dumped out of such a bucket, it will be washed by the sea water. The buckets, or boxes, should be of the largest size practicable to handle, since a larger quantity of concrete will compact better and permit a smaller percentage of cement to escape. The buckets are a tightly closed type with a canvas bottom that can be opened by a slip knot for the discharge of the contents. The top is an integral part of the bucket; it cannot be opened. In use, the bucket is placed in contact with cement previously laid; the bottom is then opened.

When large size patches or blocks of concrete must be laid underwater a tremie is sometimes used. This is a large diameter pipe with a conical shaped top to permit it being loaded more easily. It can be made of wood or of metal. In use, it is so supported that it is in as near a vertical position as possible, but it is pivoted so that the bottom can be made to move horizontally over the entire area to be covered by the patch. The lower end is allowed to rest either on the bottom of the form, or the end is closed by a valve arrangement until the tube can be filled with concrete. It is now lifted a few inches and the concrete is allowed to escape as the device is moved over the required area. The concrete should never be allowed to pile up in a pyramid and the pipe should never be raised off the bottom enough to permit the tube to empty. The concrete in the tube should be kept filled to a level above the waterline. Concrete laid by a tremie must be more liquid than that placed by other methods in order that it will flow through the tremie.

Concrete can also be placed underwater in cloth or paper bags. Paper bags are usually of a brown paper which is destroyed shortly after immersion. Cloth bags are not removed or destroyed, but the cloth being very porous, permits enough cement to escape to bind the bags firmly together. Bags are never completely filled as it is necessary to have them pack closely. The divers employed to place the bags can force them more tightly together by walking on them when they are laid.

The concrete placed in these bags should be mixed with water in the usual way and should be of a thick consistency. It should not be a dry mixture when the bags are sent below although this has been sometimes done in the belief that the infiltration of sea water would provide the necessary water. The practice proved to be entirely unsatisfactory as the escape of the cement was very great.

CEMENT GUN

Cement grout can be forced under pressure into void spaces such as pipes, sea chests, etc., by placing the grout in a closed tank and by placing the tank under air pressure. The grout is forced through a hose leading from a fitting in the bottom of the tank to a connection tapped into the shell surrounding the void that is to be filled with concrete. When in use, a vent should be fitted to the top of void in which the grout is to be placed to permit the water displaced by the grout to escape. This vent may, however, be unnecessary as the displaced water may escape by way of the leak which is to be plugged. The mixtures used with this method vary from one-half to one and one-half parts of sand to one part of cement.

Cement grout is applied by this method to plug pipe lines when valves cannot be closed, to close sea chests, to force cement in to plug leaks that have occurred under concrete patches previously made, and in other miscellaneous work of the same character.

A cement mortar is sometimes applied as a spray through a cement gun. In building construction this is used to coat surfaces for appearance purposes or to apply as waterlight facing. It can be used in salvage work when compartments are being made tight for air pressure. In these compartments it can be applied to the underside of decks to plug up leaky rivets or seams provided the compartment in which it is being used is partly dewatered. It can be used by divers in closing minor leaks in the hull from the inside.

It is not practicable for use by divers on the outside of the hull for in this case the cement must be applied from underneath, and, it being heavier than water, will sink when released from the gun. It has been proposed to try a mixture of cement and sawdust in such work. If it is found possible to apply this mixture on an overhead surface it will be of much value in stopping leaks through loose bottom rivets.

When used underwater a richer mixture should be used for a considerable amount of the cement will be lost before it adheres to the bottom plating.

DESIGN OF FORMS FOR PATCHES

When a patch is to be constructed in a compartment that has been dewatered for the purpose, a wood form should be built in which the concrete is to be molded. The hole to be covered by this patch should be tightly closed by some temporary patch. This temporary patch should be of a form that will interfere with the form of the concrete as little as possible. The leakage through the temporary patch should be reduced to a minimum.

The concrete should have a good overlap with sound shell plating all about the hole. The surface of the steel should be thoroughly cleaned to remove any dirt or oil that would prevent adherence to the concrete. It should also be wire-brushed to remove loose paint and every precaution taken to obtain a good bond between the steel and the cement in order that no leakage will be obtained between the two. Such leaks are difficult to correct. To ensure a good bond a couple of inches of a one-to-one cement mortar is sometimes worked into the patch in the portion adjacent to the shell plating. The richer mix ensures a better bond and more watertightness. Studs and scrap steel rod can be welded to the shell plate that is to be covered by the concrete; This will greatly improve the bond.

The concrete should be bonded to the plating as near the edge of the hole as possible in order that the area of the cement patch which will be exposed to the pressure of the water, when the temporary patch is removed or has disintegrated, will be a minimum. For this purpose, no pockets should be allowed to form in the face of the concrete adjacent to the hole.

The back of the form should also be well braced with shores so that the patch, when in use, will be held firmly against the outside water pressure and will be prevented from being dislodged by any rolling or pitching that the ship may do. If the water pressure to which the patch will be subjected is applied on the bottom of the patch, shores will be needed on top of the patch. These can be placed when the concrete has set. Before the temporary patch is removed all shores should be wedged up.

The most important precaution to be taken in fitting a patch on the ship's side is to provide for drainage of any water that should leak in through the temporary patch before the concrete patch has sufficiently set. Failure to take this precaution has frequently caused a great deal of trouble, for the resulting leaks are very difficult, if not impossible, to stop. The leakage through the temporary patch may be small but the void space left between the concrete patch and the temporary one is also small and it may be quickly filled by the leakage. When it is, it will be placed under a hydrostatic pressure which the semi-liquid cement cannot resist. This will usually result in leakage between the cement and the steel, but it may, if the cement has set, cause the patch to crack.

This possible damage can be prevented by fitting a drain pipe to the bottom of the hole just inside the temporary patch. The concrete can be placed about this patch, but not between it and the temporary patch. Through the pipe any pressure developed by leakage will be relieved; when the cement has hardened sufficiently to do its work, the pipe can be plugged.

A similar pipe must be fitted through a concrete patch when one is built behind a temporary patch in a compartment under air pressure. The pipe, in this case, will be an air vent and it can be plugged when the concrete has hardened.

The shoring of a non-reinforced concrete patch should be placed so that the patch is stiffened directly in way of the water pressure. If this is done the concrete in the patch will be subjected to a minimum amount of bending. If it cannot be so shored, the patch should be made sufficiently thick to resist any bending movement induced by the water pressure.

In building the form, advantage should be taken of any structural members in the immediate vicinity that can be enclosed in the concrete and so used to give it better anchorage.

Every possible precaution should be taken to obtain a satisfactory patch, but it should always be remembered that sooner or later the patch must be removed and that the removal of any large block of concrete inside a ship is always a difficult and tedious operation. Consequently, excessive use of concrete should be avoided.

Concrete forms built underwater should be tight enough to prevent any flow of water through the concrete when it is in a liquid state. The hole that the patch is to cover should be temporarily covered with some sort of a mattress that will stop this flow of water and which also will prevent the concrete, when it is placed in the form, from falling through the hole. When the ship in which this work is being done is lying in the presence of a strong ground swell or surf, there will be a strong surge of water in and out of the hole which may cause difficulty in fitting such a mattress. When such conditions are encountered, a large diameter pipe should be fitted to by-pass the hole so that the water can surge in and out of the compartment without subjecting the mattress to large unbalanced pressure. It may, in difficult cases, be advisable to cut a hole that can be plugged later in the ship's side to permit this surge of the water.

REINFORCED CONCRETE PATCHES

When the hole in the ship's side or bottom that is to be closed is a large one, the concrete should be reinforced with steel. The reinforcing should be fitted generally in accordance with the rules used in building practice. At the sides of the patch, the reinforcing rods should be welded or otherwise securely fastened to sound members of the ship's structure in order that the patch will form an integral part of the ship. The entire patch should, for purposes of strength and watertightness, be a monolith with a suitable increase in depth in way of transverse frames. If properly designed and installed, the usual wood shores required to support a plain concrete patch can be eliminated. A few ships have made long voyages with comparatively large areas of the side consisting of a reinforced concrete patch that was built up behind an American Patch or British Standard Patch.

TYPES OF CONCRETE PATCHES

(1) Small concrete patch in ship's side: Figure 16 indicates the construction of a small concrete patch fitted behind a hole in the shell plating of a vessel's side that has been temporarily closed by stuffing.

(2) Concrete patch over a hole in the bottom of a stranded ship: This is the most difficult of all patches to make if satisfactory results are to be obtained. The hole in the bottom, or in the tank top, must be temporarily closed if the cement is not to be washed out of the concrete. Because of the poor visibility which will be found inside, not much can be done to trim up the hole by cutting away the torn plating. This should not be attempted unless it is so deformed that it interferes greatly with making the patch.

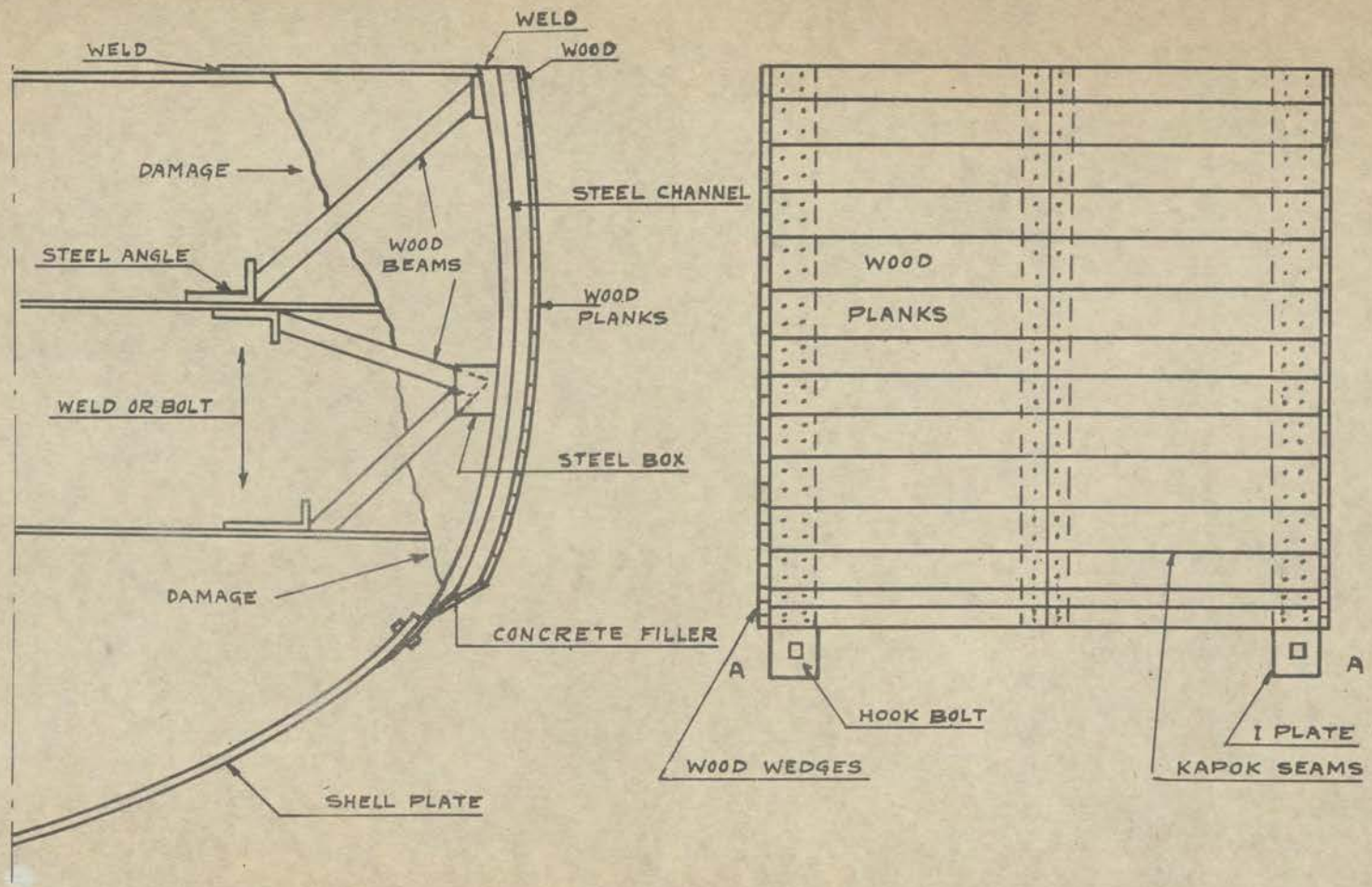
To close the hole in the bottom temporarily, it can be covered with scrap pipe or scrap structural material which, in turn, can be covered by a piece of a tarpaulin. More structural material will be required to weight down the tarpaulin. If difficulty is encountered in keeping the tarpaulin in place it may be necessary to provide a by-pass for the water to surge through. This might be done by fitting a large diameter pipe in a vertical position over the hole in such a way that it will be encased in the concrete patch. It can be closed later when the patch has hardened.

The patch should be designed to overlap on all sides the sound and intact plating around the hole by a substantial margin. The form can be made of planks, but it should be tight and should be well braced. It should make a tight joint with the tank top or bottom plating. If this cannot be done, a rampart of sand bags might be made to serve, especially if some of the bags are filled with a concrete mixture.

Reinforcing rod should be liberally arranged for strengthening the patch and the ends of this rod should be secured wherever possible to the intact structure. If underwater welding is possible it can be used to good advantage. Double hook bolts should be used, wherever possible, to tie the reinforcing rods to the structure.

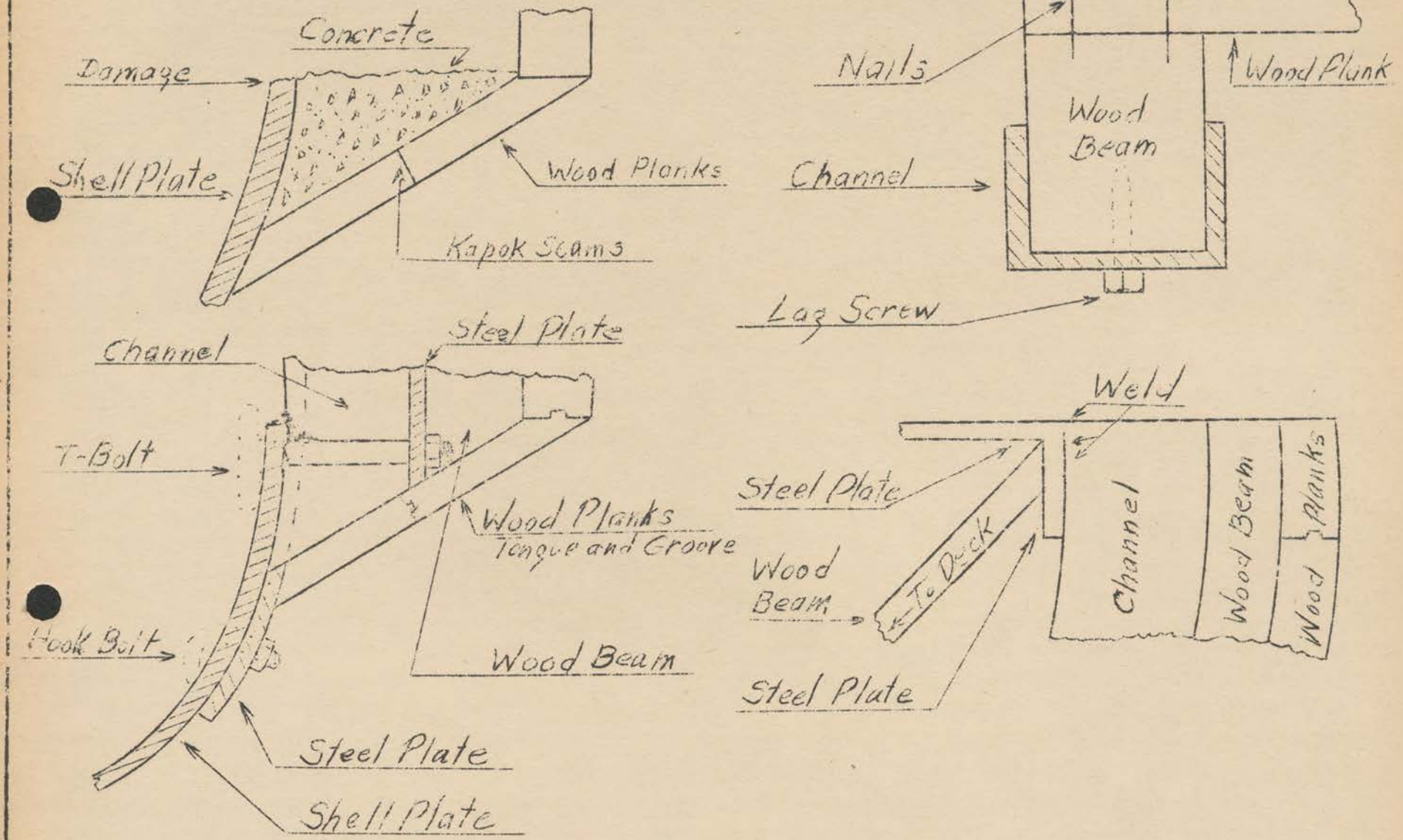
In placing the reinforcing rods, consideration must always be given the problem of placing the cement. This will need to be done in total darkness for the laitance given off by the concrete as it is placed will eliminate any visibility that there may have been inside before the work of placing the concrete was commenced.

Patches of this type heretofore have been made sufficiently heavy to overcome the buoyancy of the water underneath by sheer mass weight. It is not believed that such a weight is necessary if the patch can be properly tied to the adjacent structure. By taking advantage of every place where a fastening can be secured, it is believed that a lighter patch can be satisfactorily constructed. When completed, it should be reinforced with as many shores as can possibly be fitted.



HALF MID SECTION AT DAMAGE

U.S.N.T.S.S.



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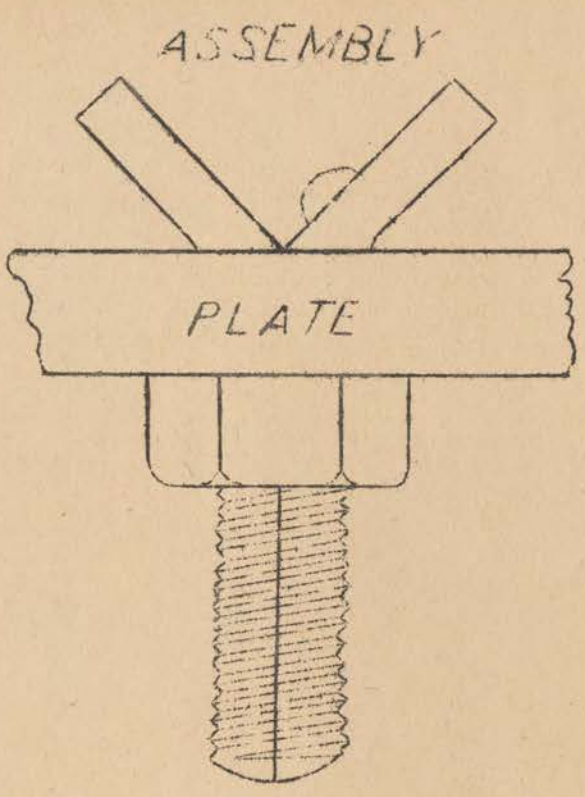
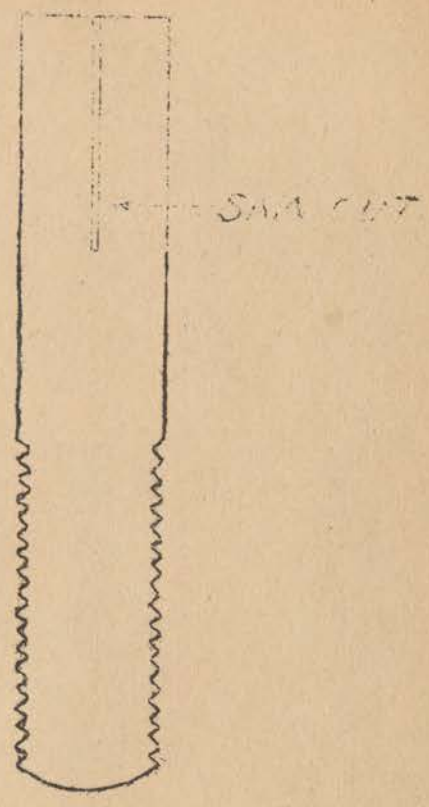
WALSH



SECOND STEP



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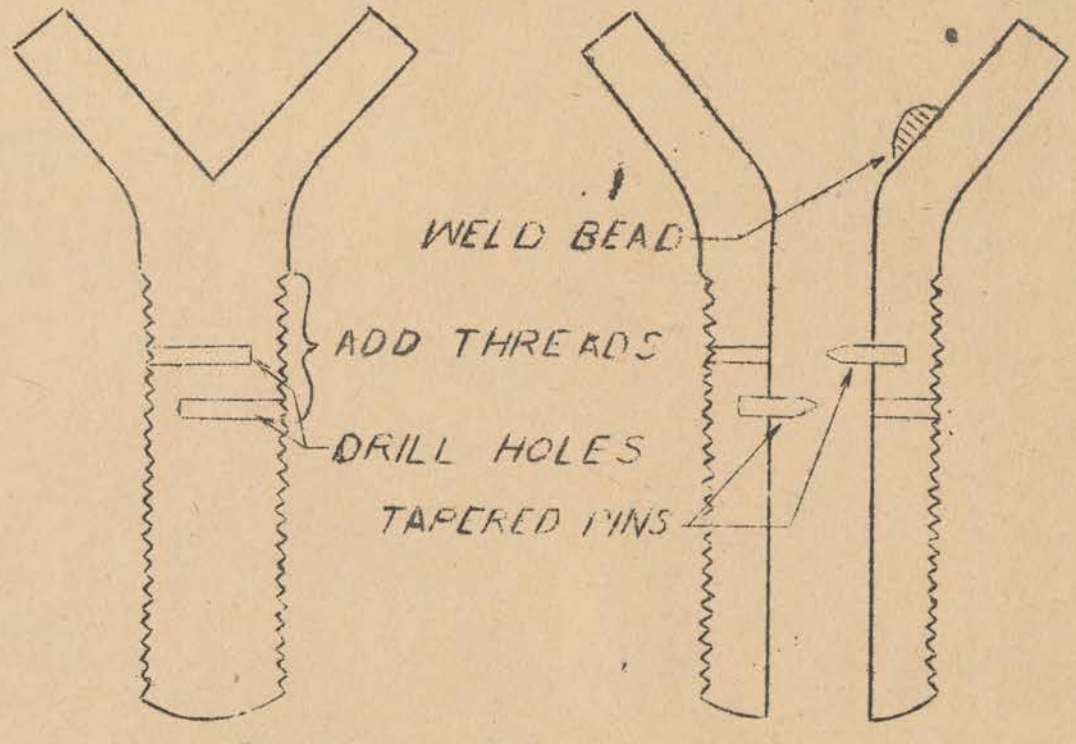
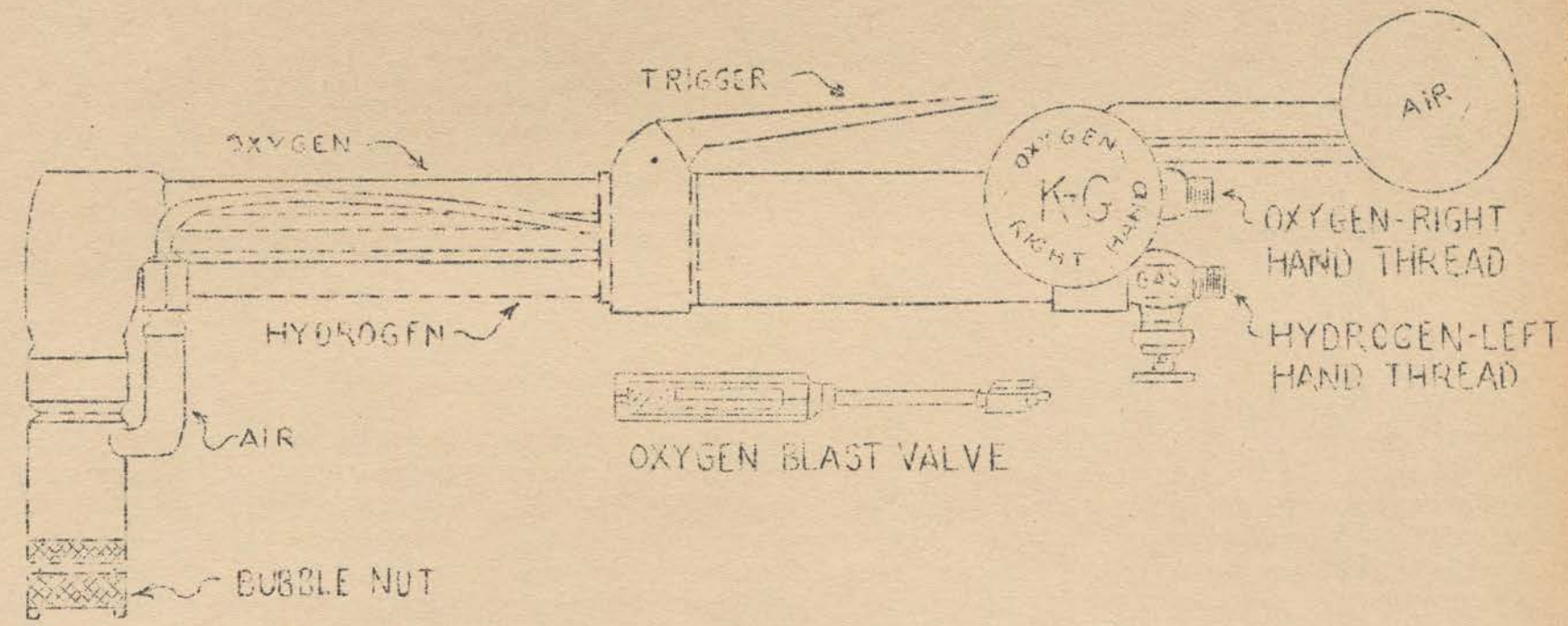


SPLIT BOLT

U.S.N.T.S.S. NEW YORK

WALSH

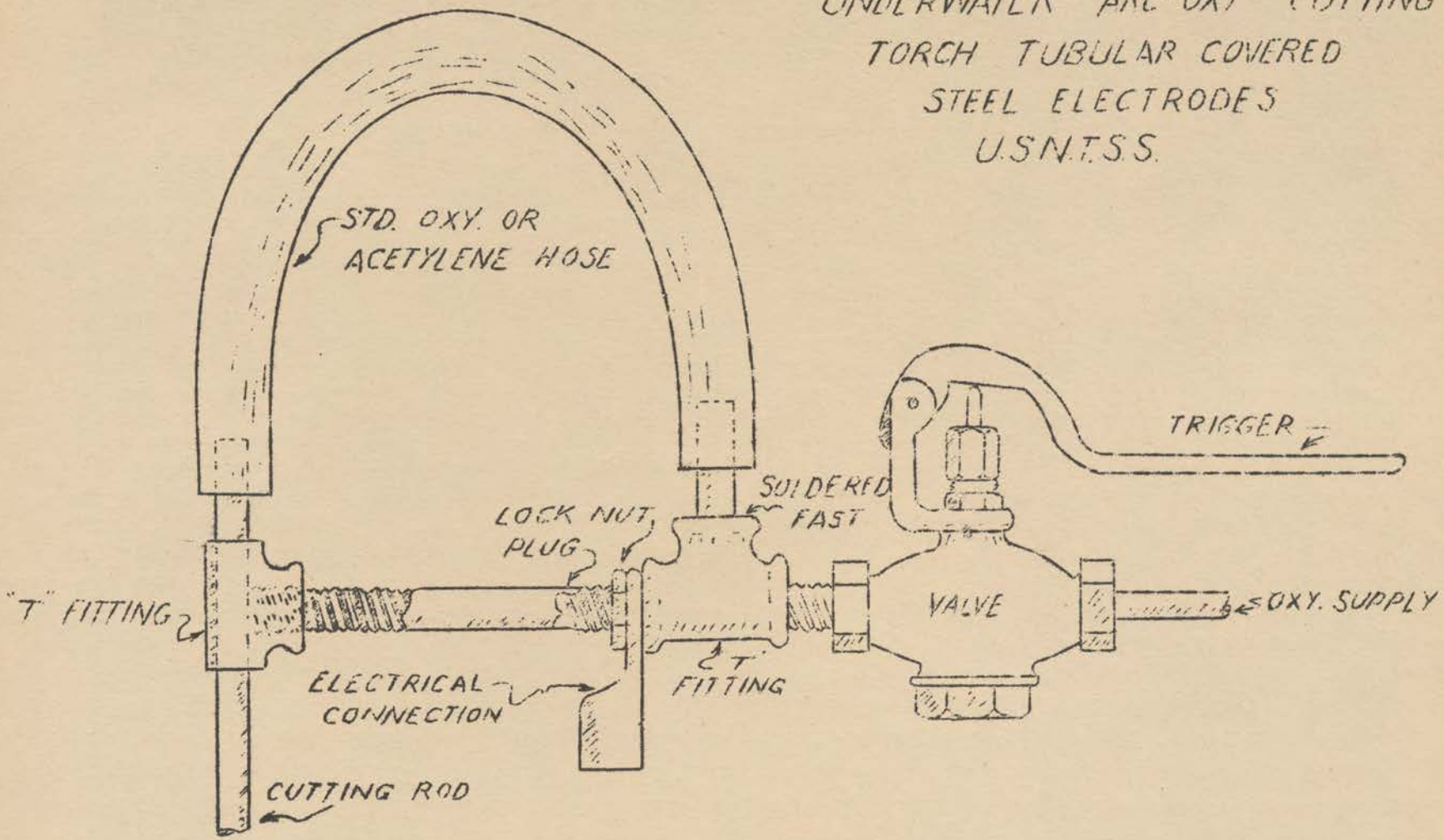
K-G
UNDERWATER CUTTING TORCH



U.S.N.T.S.S. PIER 88 NEW YORK

WALSH

UNDERWATER ARC-OXY CUTTING TORCH TUBULAR COVERED STEEL ELECTRODES U.S.N.T.S.S.



Diver's Diseases

Introduction:

When you divers get away from this activity, out in the combat areas, you will probably be on your own where it comes to medical difficulties. True, there will be a pharmacist's mate in the vicinity and medical officers may be within a 100 mile range, but you will probably not have access to medical attention from men especially trained in diver's diseases. Therefore, you can consider yourselves on your own and if you want to get back to the good old U.S.A. in as good shape as you left, it will pay you well to learn something about how your body functions, and how to take care of yourself.

As you know, there are certain diseases and injuries which divers get that other people do not get. In underwater work, working in varying pressures, there are several serious sicknesses that make your work "extra hazardous". The government recognizes this fact and pays you men extra money because of the chances you take. But if you know about these hazzards, know how to prevent them, what to do for yourselves when you get into trouble, you can pocket that extra cash as just so much "gravey", and not have to stow it away for hospital bills the rest of your life.

Another thing you had better remember. At this school you have been guided and guarded by men who know this diving and salvage game inside out. These men have tried to keep you out of trouble and teach you the tricks and precautions of many years experience. Out in the field, you will not have so much supervision, and may even see men doing things or asking you to do things that are dangerous, and could well be done another way without risking your life. A good point in case is the guy who blows up to the surface after a job of 6 hours at 50 feet. We'll talk more about this later on.

The medical hazzards in diving and salvage operations to which you men are exposed are Caisson's disease (bends), air embolism, squeeze, various poison gases, underwater blast injury, ear ache and sinus trouble.

Caisson Disease

Caisson Disease, commonly called "bends", compressed air sickness, "blind staggers", "the chokes", or just plain "a hit", is probably the most well known of the diver's diseases. It was found that men working in caissons, tunneling operations and other jobs involving work under increased air pressure would develop severe pain, blindness, unconsciousness and other troubles when they came out of the pressure. Hence the different names for the disease.

Before going into a description of "bends" you first have to understand a few simple physical laws.

Let's fill a strong bottle half full of fluid, cork it and through a tube put pressure on the inside of the bottle. To the eye, nothing happens inside the bottle. However, we know that (1) As the pressure increases the volume of the gas over the fluid is compressed. (2) The liquid absorbs the gas in increasing amount. The gas actually passes into the liquid and dissolves, just like sugar dissolves in water and, like the dissolved sugar, is invisible. The more pressure put on this system, the more gas the fluid can hold in solution. The gas dissolves in the fluid slowly and it takes some time before all the gas that can be dissolved gets into the fluid. When no more gas can be dissolved in the liquid we say the liquid is saturated. At every pressure there is a saturation point which is reached slowly by leaving the gas and liquid together. To get more gas into the fluid, you have to increase the pressure. Now let's say the fluid in the bottle is saturated with the gas at a pressure of 50 lbs. P.S.I. and we release this pressure on the bottle. The gas in solution is now too much for the new lower pressure and it comes out of solution back to the surface. If the pressure is released slowly,

the gas passing out is not visible, but if the pressure is released quickly, gas bubbles form in the fluid and rise to the surface. Every time you take a cap off a beer bottle and see the foam appear you are witnessing this change. Bubbles won't form if the pressure is released very slowly.

A diver is just like the fluid in that bottle. In fact a human being is mostly fluid, in spite of the fact we seem to be solid enough. And a diver is exposed to a gas under increased pressure. The air we breath is composed of roughly 1/5 th oxygen and 4/5 ths nitrogen. We suck it into our lungs and it is absorbed into our blood and carried all over our bodies, to the muscles, brain, bones, fat and passes into these tissues in solution. Just like the fluid in the bottle under pressure, our tissues can hold increasing amounts of this oxygen and nitrogen, the greater the pressure (the deeper the man is in the water). And, like the fluid in the bottle, the longer the man stays under a certain pressure the more time he has to become saturated with these gases - up to a certain point - after 8 hours, the human body cannot absorb more gas - it is saturated for that particular pressure and depth.

The oxygen thus absorbed is burned up by the tissues constantly and is therefore not a problem to the diver. The nitrogen gas however doesn't burn up and must be gotten rid of when the pressure is released from the man. And here again the diver is just like the fluid in the bottle. If the pressure is released slowly, the nitrogen passes out of the tissue into the blood and is carried out to the lungs to be given off back into the air space in our lungs and blown out. But if the pressure comes off quickly, just like in a bottle of beer when the cap is removed, nitrogen bubbles are formed in our tissues and blood. These nitrogen bubbles block up the blood vessels stop the blood from flowing in that area and cause plenty trouble.

The fat in our bodies can hold much more nitrogen than muscle, bone, and blood - 5 to 6 times as much to be exact. And because of a poorer circulation of blood through fat tissue, it takes longer for the fat tissue to get saturated with nitrogen and also much longer for the nitrogen to get out of the fat when the pressure is released. Where as blood and muscle and such red tissue takes only 1/2 hour to get rid of its extra nitrogen when pressure is released, the fat tissue takes eight to ten hours to rid itself of its extra nitrogen. So you can see that it is the fat and fat containing parts of the body that are mainly to blame for the production of nitrogen bubbles which cause bends. And if you can figure where these fat tissues are, you can pretty well guess where a diver's troubles are when he gets the bends.

Causes

There are several conditions which make a diver particularly suceptable to bends. We have found from considerable experience that the older a man is, or the fatter he is, or the poorer his general physical fitness, the more likely are his chances of getting bends after a dive. It's easy to understand why the fat man gets bends if it's the fatty tissue which holds most of the extra nitrogen. The older man, say in his late thirties and forties has poorer blood circulation than a younger man and apparently the nitrogen is therefore carried away from the tissues slower, making bubble formation more likely. General poor physical condition has the same effect.

An important cause for getting bends is over indulgence in alcholic beverages. Time after time, divers suffering from this disease have spoken their regrets for having been out drinking the night before a dive. Apparently getting drunk slows up the circulation, therefore making nitrogen bubble formation more likely.

Of course, the conditions of the dive greatly influence the man's chances of getting bends. If the body can hold more nitrogen at the deeper depths, and if the longer a man stays under pressure the greater are his

chances of becoming completely saturated with nitrogen, then it naturally follows that his chances of getting bends are better after the longer and the deeper dives. Many men believe you cannot get bends unless you have been down at least 60 ft., but there are plenty of recent cases of severe bends after dives to 40 and 50 feet. Bends can occur after any dive to 30 ft. or deeper. Two of the most severe cases the Navy has had recently were both at this school after dives to only 40 ft. So don't think you can't get bends unless you have been down deep.

As a matter of fact, your chances of getting bends is far better after a dive to only 50 ft. for 6 hours than after a dive to 300 ft. for only 3 minutes. The reason for this is that even though your body can't hold as much nitrogen at 50 ft. as at 300 ft., you have 6 hours time to absorb nitrogen in the first condition and only 3 minutes during the later, and you therefore contain much more extra nitrogen after the long 50 ft. dive than after the short 300 ft. job.

Experience has taught us that when the water is cold, when the diver is working very hard, and especially if he is in a cramped position, he has a little better chance of getting bends after his dive. If the man has an old healed fractured bone or healed big scar on his arm or leg he may form nitrogen bubbles behind this obstruction to the local circulation.

The most important cause of Caisson disease is inadequate decompression. No matter what other conditions are involved, if the diver comes up too fast, he is asking for nitrogen bubbles to form just like the bubbles that form when the beer bottle is opened. Way back in the early days of diving this fact was recognized and various schedules have been designed for bringing a diver back to the surface slow enough so that nitrogen bubbles will not form. The present decompression tables tell you how slowly to bring a diver up after his particular time and depth. The decompression time varies according to these two factors. If you stick to the tables closely and keep in good condition, you won't get bends.

One serious mistake that some divers make is coming up all the way to the surface to make it easier to find the descending line and then dropping back to the prescribed decompression stop. Sometimes they get by with it. But this is just like pulling off the beer cap and then slapping it back on again. The bubbles form anyhow. If you do come all the way to the surface when you need recompression, drop back to the bottom at once and stay there for at least 30 minutes before again starting up. Many cases of bends could have been avoided by doing this.

Let me interpose a short warning about the "controlled ascent" without descending line. This is a very useful trick, and like a rabbit gun it is fine if you know how and when to use it. Never blow up when you need decompression. Never blow up from deeper than 60 feet. Never blow up if you have been down deeper than 30 ft. longer than 2½ hours.

You are just asking for Caisson disease if you do, and your chances of getting it are good.

Symptoms

The first symptoms of caisson disease usually occur from ½ hour after a dive until 8-10 hours after a dive, but may appear while the man is still in the water, coming up, or as late as 24 hours, after the dive. The symptoms are variable. If bubbles form under the skin the fat tissue that lies there, you would feel a skin itch, maybe see a blotchy, red and white, flat rash. Or maybe the first bubble that gives you trouble is plugging up a vein in the fatty bone marrow in your leg or arm. Then you feel a deep pain. This pain is, in fact, the most common single symptom of bends and may be in your arms or legs, hands, feet, stomach. It is described as a dull ache which gets

gradually worse, becomes throbbing in character, and eventually makes tough, strong men roll on the deck crying.

If a nitrogen bubble forms and sticks in your spinal cord, pressing on important nerves to your lower body, you may not feel pain at all but be unable to use your legs - you are paralysed. Or perhaps the first bubble that causes trouble is in your brain and may cause immediate blindness or roaring in ears, headache, unconsciousness and convulsions. Or, if the bubbles formed all over your body don't stick and block the circulation out in your arms or legs or abdomen, they may be carried along up through the heart and block up the blood vessels in your lungs, just like bread crumbs gradually block up a sieve. Then you have trouble with your breathing, plenty of trouble. You begin to cough, then as more and more bubbles stop up the blood circulation in your lungs you gasp for breath, turn blue, and finally die of asphyxiation. Any one of these symptoms, or several together, may be your first warning that you have bends. Many old divers still believe that it isn't a case of bends unless you have a pain and a rash. Remember, you can drop unconscious, or be suddenly blind, or have some vague symptom of severe bends without ever feeling any pain.

The most important thing to remember about the symptoms of bends is that anything that goes wrong with a diver after a dive must be considered Caisson disease until proved otherwise. And if something goes wrong with you after a dive, don't wait to see if it goes away, without telling somebody about it. Remember it doesn't do any good to have some Doc around to take care of you if you don't go to see him. Another thing to remember: Bends is a killer, and the symptoms of bends never go away spontaneously without doing permanent damage.

Treatment

If a man has Caisson disease, or the symptoms of what might be Caisson disease, what are we going to do for him? What are we trying to do? Get rid of the bubble! And the only way we can do this is to put pressure on the man. Remember Boyles law? The volume of a gas is inversely proportional to the pressure - when the pressure gets greater, the volume of a gas gets less and visa versa. So by putting pressure on a victim of Caisson disease we can make the bubbles smaller and thereby get rid of the blocks in the blood vessels. In addition to this, increasing the pressure increases the absorption of gas back into solution in the man's body. So we try to make the bubble first get smaller and finally go away altogether by being absorbed back into the tissue - then the symptoms caused by that bubble go away too, unless the bubble has been allowed to remain so long that permanent damage has been done.

Immediate recompression is the only treatment for Caisson disease.

The following schedule of treatment is important to remember. You may be able to save some friends life by learning these few directions.

Caisson Disease	Take down to	Leave "on the bottom"	Bring Up On
Ordinary (Pain, rash)	Relief of symptoms plus 33' (14.7 lbs.) or at least 100'	At least 30 minutes No longer than 2 hrs.	Air treatment tables for next deeper depth.
Severe (Paralysis, asphyxia, convulsions, blindness numbness)	Same as above but at least 165'.	Same as above	Air treatment tables for 300'. Stop at 30' for 12-24 hrs. (over-nite soak).

Recompression up to -	140 ft.	130 ft.	120 ft.	110 ft.	100 ft.	90 ft.	80 ft.	70 ft.	60 ft.	50 ft.	40 ft.	30 ft.	20 ft.	10 ft.
100 ft. ----------	--	--	--	--	--	--	--	--	--	--	14	42	52	68
150 ft. ----------	--	--	--	--	--	--	--	--	22	30	35	42	52	68
200 ft. ----------	--	--	--	--	--	7	22	24	26	30	35	42	52	68
250 ft. ----------	--	--	--	13	18	19	22	24	26	30	35	42	52	68
300 ft. ----------	4	14	16	16	18	19	22	24	26	30	35	42	52	68

Time is in minutes. Rate of ascent between stops is not to exceed 10 ft. per minute.

Notice that the depth of recompression has nothing to do with depth of the original dive. We treat Caisson Disease according to relief of symptoms, and not according to the depths of the dive that caused the disease. I stress this because many divers have a misconception on this point. A good case along this line is the diver who developed a paralysis of his lower legs after a dive to 40 ft. for 50 min. Taking him back to 40 ft. would have done no good at all. He had to go to 200 ft. before he could again use his legs. On the other hand many cases of bends after a 250 ft. dive have been relieved at a recompression to only 100 feet.

The above schedule of treatment is for a recompression chamber. If there is one in your vicinity, acquaint yourself with it, and learn to run it if possible. The chances are you may not have a recompression chamber handy, and then it will be necessary to put the man into his dress and send him back down in the water. Treat him along the same lines as in the above schedule as far as possible. Always send a healthy diver along to tend the victim's air for him. You may not have enough depth to give the man the proper treatment, if you can't, lean over backwards in bringing him up plenty slow! Remember that the mistakes in treating Caisson disease are always in either going not deep enough or in coming up too fast. If you want to err, do it by going too deep, or coming up too slow - you can't hurt the man this way.

If you haven't a chamber, and if you can't put the man back in the water, you're in a bad spot. You can't get rid of the nitrogen bubble. You may control the pain with morphine, and hot towels help a little. It's probably quite evident to you by now that it is considerably more important to know how to prevent Caisson disease than to treat it.

Air Embolism

Air embolism is a far too common accident in the Navy. It's a killer and it almost always occurs through ignorance and carelessness on the part of the victim. Recently in Panama a man doned a shallow water mask, went over the side of his destroyer to clear a fouled propellor. Apparently, after finishing the job he "ducked" the mask and swam to the surface holding his breath. I say apparently, because we don't know, because upon surfacing the man was unconscious and in convulsions and he died a few minutes later. This same accident has occurred with minor variations many times. What happened inside this man's body?

The lungs are composed of many very small air sacs which are connected by progressively larger air tubes connected finally with the wind pipe and thereby to the mouth and nose. Around each one of these small air sacs is a rich network of small blood vessels. This is the set up which allows the oxygen from the air we breath to pass into the blood for

transportation to where it is burned in all parts of the body. As you can imagine, the wall between the air space and the flowing blood is necessarily very thin.

Now if a man holds his breath while under the water and starts toward the surface, the air trapped in his lungs expands as the pressure gets less (Boyle's law again) and distends the air sacs, finally bursting through the thin wall of one or more of them. Air is forced into the blood stream in the form of fine bubbles and is rapidly carried to the heart and through it out to the rest of the body. These air bubbles plug up the blood vessels in the brain and the resulting severe symptoms appear very suddenly.

The symptoms are always sudden and severe. Within a matter of seconds the man is unconscious, in convulsions, blind, or paralysed, and if untreated, dies in a few minutes. If a man is conscious he may complain of dull chest pain, may be coughing and he may have a pink froath in his mouth and nose. The damage to the lungs is of secondary importance to the damage done by the air bubbles and usually heals up fairly quickly if the man lives.

In this accident, even more than in Caisson disease, prevention is more important than treatment. Don't duck a face mask. Don't hold your breath while coming up through the water. If in a diving dress breath in and out naturally. If your face is in the water, blow your breath out of your mouth as you come up. Then the expanding air will not be forced into your blood in bubble form. Always warn new divers about this danger and instruct them accordingly. Especially, don't let them duck a shallow water mask or helmet.

The only treatment for air embolism is immediate recompression. Often, immediately is not soon enough. Where as in bends you may have a few moments to an hour or so lea way before the man is beyond help, with air embolism you have to get him under pressure as quickly as possible. Run, don't walk, with the victim to the nearest recompression chamber. Treat as you would a severe case of bends.

Squeeze

Divers squeeze is an uncommon, but plenty serious accident which occurs when the sea pressure is no longer neutralized by the air pressure inside a divers dress and the diver is suddenly hit by tons of water pressure. It occurs when a diver falls through the water rapidly and is unable to get his hand on his control valve to increase his air supply. It happens when his air supply is cut off, and if the non-return valve is not functioning, the air rapidly escapes from his suit. It may happen if he tears his dress, thus allowing air to escape. It may happen after a blow up if the tender is not right on the job to hold him from falling.

Injury received by a squeeze varies all the way from minor bruises of legs, chest, and shoulders to death with diver's body squashed up into his helmet. One bad squeeze happened in Washington recently when the air supply was cut off while a diver was only a few feet deep wearing a face mask. A non-return valve had not been installed on the mask and the air rushed out, causing the water pressure to suddenly force the mask and the face together. The diver experienced sudden severe pain, and surfaced, bleeding from nose and mouth, with his eyes bulging out of their sockets and his face looking like a beat up turnip. Be sure that a non-return valve is installed on all your diving gear.

Ear Trouble

The most common of all divers diseases is ear trouble. Probably all of you have had some trouble with your ears while descending, at one time or other.

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The ear is made up of the following parts: The outer ear is the portion that sticks out from the side of the head. Leading into the head from the outer ear is the ear canal. This tube is about 1½ inches long and is slightly bent. Closing off the bottom of the canal is the drum, a tissue paper thin, round, flat membrane which is put there to vibrate with sounds and transmit these sounds to our inner nerves. The drum also forms an excellent seal protecting delicate organs from the outside air. Behind the drum is a space surrounded by bone and filled with air, about the size of the last joint on your little finger. This space is called the middle ear. Leading from the middle ear and opening into the upper part of the throat at the back of the nose, is a small collapsed tube called the Eustachian tube. The middle ear and Eustachian tube are lined by a delicate moist pink tissue called mucous membrane. the same tissue that lines your mouth and nose.

The only opening of the middle ear to the outside air is through the Eustachian tube and nose.

When a diver descends, pressure increases and air all over his body and in his body is compressed. The pressure pushes in on his ear drums, and to avoid damaging them he must equalize the pressure by getting air into his middle ear. So it is obvious that when a diver can't "pop his ears" the trouble lies in the Eustachian tube which won't allow air to pass to the middle ear. There are a good many causes for a blocked Eustachian tube. Colds, sore throats, blocked nose from irritating smokes - any condition which causes the delicate mucous membrane to swell will block off the opening of the Eustachian tube and make it difficult or impossible to equalize pressure in the middle ear. Often a glob of phlegm, or mucous, will lay over the slit-like opening of the tube in the throat and cork it up nicely.

When the diver descends with one or both of Eustachian tubes blocked, he experiences first a pressure on the ear drum, then a dull pain which gets worse as the drum is stretched farther in by the increasing pressure. If he persists in descending in spite of the pain, he will rupture the drum, experiencing a sudden, knife-like, burning pain in the ear. Upon ascending, he will probably have blood in his mouth and nose, and blood trickling out his ear canal.

You can avoid these difficulties by keeping yourself free from colds and sore throats and by avoiding pressure when you do get these troubles. If you have to dive in spite of a cold, get your nose sprayed out with neosynephrin 1/4% just before you dive. Any similar medicine which causes the nose tissue to shrink and allow the Eustachian tube to open may be used. Remember however, that you are taking a chance diving with a cold, because even if you are able to "pop your ears", you probably will be blowing the germs of your cold or sore throat up into your middle ear, and this is the way ear infections and mastoid infections start. Never descend in such a way that you can't stop yourself on a second's notice if you have difficulty equalizing pressure. As a tender, remember that your diver may fall and it is your job to hold him so that he doesn't get a squeeze or rupture his ear drums.

If you have trouble popping your ears, don't try to go deeper with the idea that a little more pressure is all that is needed to force the Eustachian tube open. Instead, come up your descending line a ways, and try to pop your ears. The opening of the Eustachian tube in the throat has a sort of flapper valve effect and sometimes the greater the pressure on it, the tighter it closes. Don't let enough pressure get on your drums to cause pain, because you will always have damage done to the drum and lining of the middle ear when you feel pain. If you damage your drum or middle ear, you will not hear well with it for several days to a week or longer, and of course you should not dive during this period. You can hasten along the healing process by keeping the Eustachian tube open with nose spray three times a day.

You should always let the doctor know if you have hurt an ear drum. If no medical attention is available, you can pretty well clear yourself up by following the above treatment. If there is blood in your ear canal, do not put anything into your ear except a light cotton plug. Do not let anybody put ear drops into your ear to stop the pain. If the drum is ruptured this medicine runs right through the tear, carrying germs into the middle ear, thus adding infection to your troubles. For the same reason, a diver with a ruptured ear drum does not dive until his drum heals. This may take anywhere from a week to a month or more. Occasionally a ruptured drum never heals, and the man has ear trouble all his life. Like many another trouble, it's far easier to prevent than cure. So don't take chances.

Blocked Sinuses

There are a half dozen other small air spaces in our head that give us trouble while diving. These are our sinuses. They are situated in pairs above and below our eyes, and beneath our brain. The air spaces in our cheek bones are called maxillary sinuses, or antral sinuses, and those above our eyes, the frontal sinuses. The antrals are each about the size of the end of your thumb; the frontals about the size of the last joint of your little finger. The others are smaller. All are completely surrounded by bone except for a small air passage opening out into the nose. And like the opening into the middle ear, these holes are easily blocked by colds and phlegm, so that when a diver descends, air cannot pass into the sinus. When this happens, he feels pain in the blocked sinus, usually either above one or both eyes, or beneath them. The pain is often very sever, and goes away suddenly when the block is relieved. After such an experience, when the diver comes up, he will have blood in his mouth and nose. Sometimes a diver can get down pretty well, but when he starts back up, he gets the same type of pain and has to drop to the bottom again to relieve the pain. This occurs if some thick mucous or phlegm has been forced into the sinus on the descent and is pushed back, blocking the opening on the ascent. Such a plug acts like a ball valve, and has effectively kept many a diver on the bottom much longer than he intended to stay. Infection of the sinuses can and does occur very easily after diving with a cold. The germs are forced into the sinus by the air pressure and grow there quickly. When this happens the man develops a fever, headache, and needs immediate medical attention. Here again, it's far easier to prevent these troubles than to cure them. Avoid diving with a cold.

Some men believe that sinusitis can be cleared up by going under pressure and then releasing the pressure quickly. They are acting on the theory that the pus is blown out of the sinus by the expanding air behind it. Occasionally this does happen, but it is a dangerous, and most often an unsuccessful treatment. Don't try it, or you may be in the same fix as the guy who got down but couldn't get back up. Always get medical aid when you have trouble with your sinuses or your ears.

Gas Poisoning

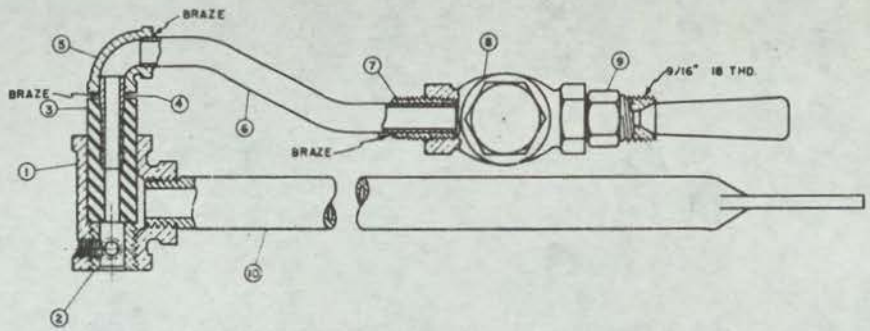
In salvage operations, there are a good many different gas hazards which the salvage man has to contend with at all times. For a very good description of these dangers read the pamphlet "Safety in Ship Salvage Operations - Section One" put out by Bureau of Ships. It is short, easily understandable and very interesting.

There are a few gas dangers with which divers are particularly concerned. The most important of these is carbon monoxide. This is colorless, oderless and tasteless gas, commonly found in the exhaust fumes of all internal combustion engines, and is a killer. It has accounted for a good many lives.

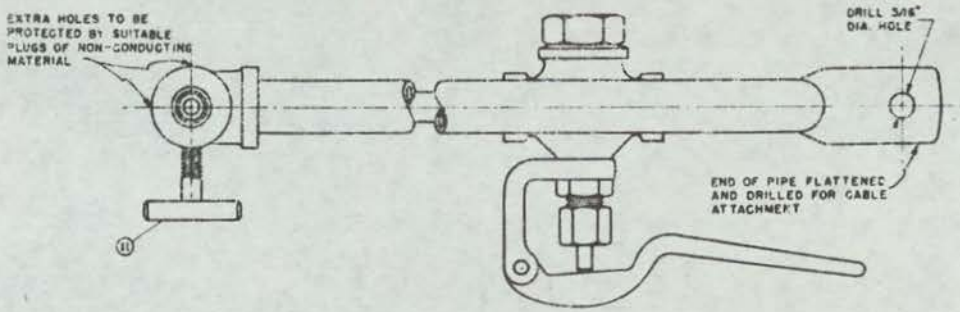
Recently, two advanced student divers working on an underwater wreck from one of our salvage vessels quietly passed out after about one hour at 50 ft. Both men were brought up unconscious, cut out of their dress, and were found to be cherry red in color and not breathing. They were revived by artificial respiration and oxygen from an oxy-acetylene torch. They luckily made a full recovery after several days in oxygen tents in a local hospital. A check up on the air supply system revealed that the exhaust pipe on the gasoline engine running the air compressor had been turned down to prevent the rains of a previous storm from entering the engine, and the air intake on the compressor had been sucking up the exhaust fumes. The divers, did not smell or taste anything, and they just quietly passed out before they even knew what was happening to them. This accident has happened many times, and should always be thought of when rigging up a diver's air compressor. Be sure that no exhaust fumes are getting in his air supply. Never put your unit in an enclosed space where fumes can accumulate. Even in an open boat this danger is present, unless the exhaust is piped over the lea side. The symptoms of carbon monoxide poisoning are as described above. Usually the man so poisoned will die unless quick, correct treatment is instituted. Treat these cases by starting artificial respiration at once and by giving them oxygen from whatever source is immediately available. Burning oxygen is all right. Try to give oxygen by mask, if available, or by rigging a cardboard cone around the end of the oxygen hose or valve. Do not stick a hose in the victim's mouth, or you may distend and rupture his lungs. Keep giving the oxygen after the man regains consciousness, and keep him quiet in bed. Often relapses occur, and the man may die after coming to, if the oxygen breathing is discontinued too soon. Of course this is a good case for the doctor, but do not wait for him to arrive before starting treatment.

Another gas poisoning which stalks the diver is oxygen itself. If a man breaths pure oxygen under pressure he will get oxygen poisoning convulsions. We don't know why this happens, other than it in some way damages brain cells. Working in depths up to 50 ft. you can probably safely breath pure oxygen for half an hour. Over 60 ft. deep, do not breath oxygen. The symptoms are variable, but usually you first feel irritable and jumpy, then after a moment you may develop a headache and feel sick at your stomach. If you can see through the water, you may notice that your vision is cut down on the sides. We call this "tunnel vision". Then you experience what may feel like sparks or small electric shocks in your arms and legs. Then you become unconscious and go into a convulsion, just like epilepsy. This is not so good under the water, and you will probably drown.

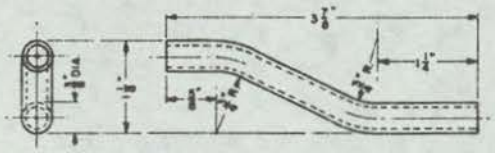
This occurs in just a few moments breathing pure oxygen below 60 ft., but takes longer in the shallower waters. At surface pressure it takes about 8-10 hours of oxygen breathing to develop these symptoms. Treat oxygen poisoning with fresh air and rest. The convulsion will stop of its own accord if the man is in fresh air, and he will be perfectly normal in a day or so if no other injury was sustained while in the convulsion.



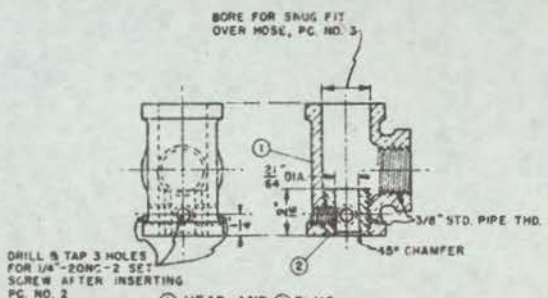
BILL OF MATERIAL				
PC. NO.	QUAN.	DESCRIPTION	MAT'L	SIZE, TYPE ETC.
①	1	HEAD	BRASS	3/8"-3/8"-3/8" STD. TEE, MODIFIED AS SHOWN
②	1	PLUG	BRASS	
③	1	HOSE	RUBBER	3/16" I.D. OXYGEN HOSE 1½" LONG
④	1	ADAPTER	BRASS	3/16" I.D. X 1⅛" LONG
⑤	1	ELBOW	BRASS	1/8" STD. ELL
⑥	1	TUBE	COPPER	3/8" O.D. COPPER TUBING
⑦	1	NIPPLE	BRASS	1/4" STD. NIPPLE, 3/4" LONG
⑧	1	VALVE	BRASS	1/4" - 200 LB. LUKENHEIMER OR EQUAL
⑨	1	HOSE ADAPTER	BRASS	1/4" PIPE THD. ONE SIDE - 3/16" OXYGEN HOSE CONN. OTHER SIDE
⑩	1	EXTENSION	WR. IRON	3/8" WROUGHT IRON PIPE APPROX 10⅝" LONG
⑪	1	SET SCREW	BRASS	MADE FROM 1/4" BAR STOCK



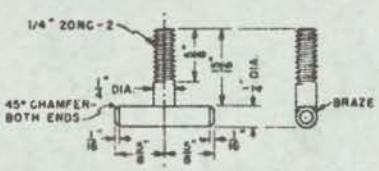
NOTE
1. EXPOSED PARTS OF TORCH TO BE COMPLETELY COVERED WITH RUBBER TAPE AFTER ASSEMBLY. SPECIAL CARE SHOULD BE TAKEN TO TAPE IN SUCH A MANNER AS TO PREVENT ELECTRICAL CONTACT BETWEEN VALVE, PC ⑧ AND EXTENSION, PC. ⑩



⑥ TUBE



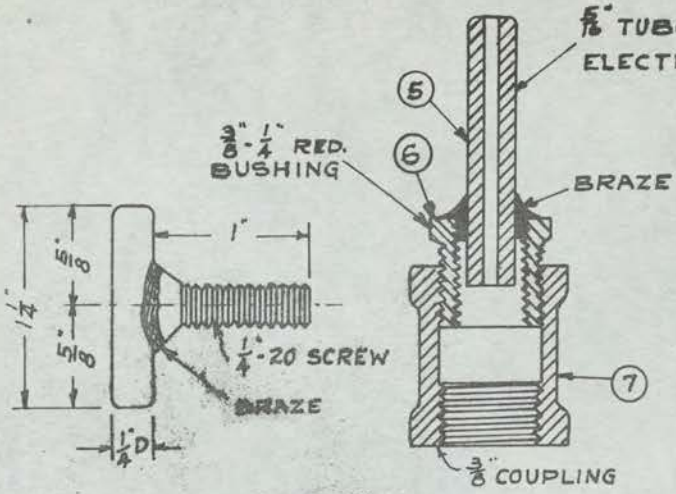
① HEAD AND ② PLUG



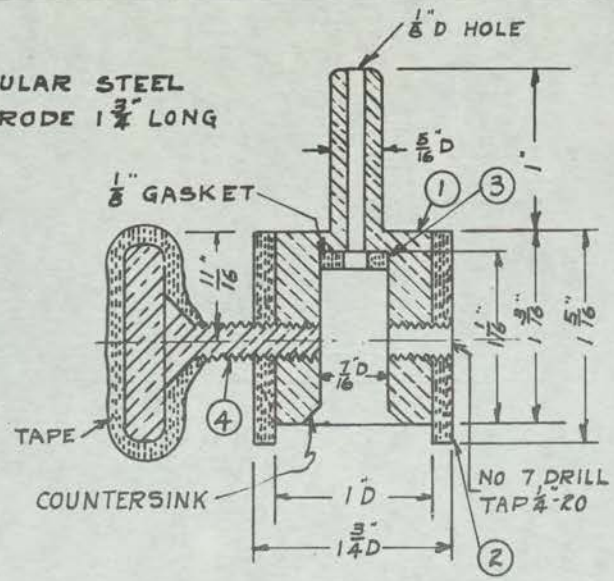
⑪ SET SCREW

THIS PLAN SUPERSEDES CODE 692 SKETCH NOS. 2530 & 2531

	NAVY DEPARTMENT BUREAU OF SHIPS WASHINGTON, D. C	CODE 692 SKETCH NO.
	UNDERWATER ARC-OXYGEN CUTTING TORCH DEVELOPED AT U.S.N.S.(S.) PIER 88, NEW YORK CITY	2550 DATE 2-28-44

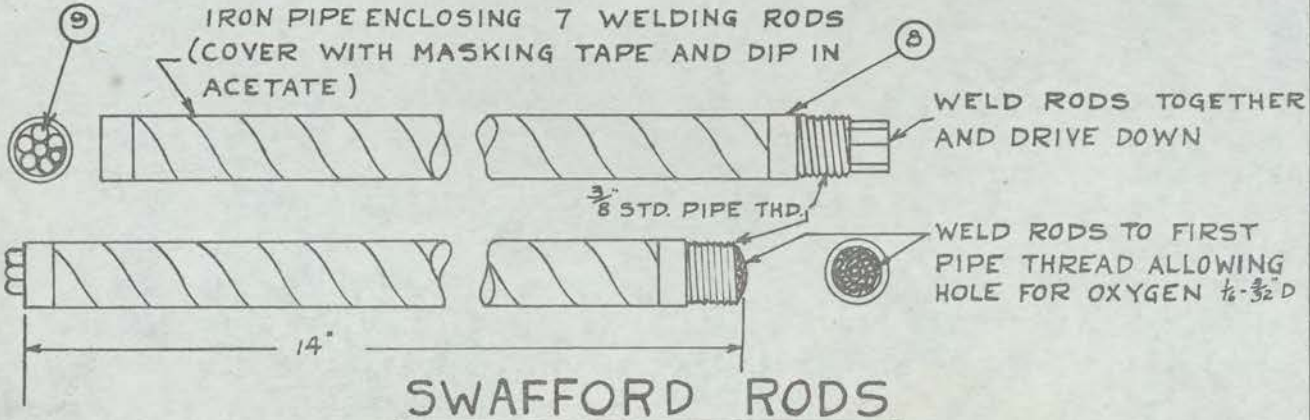


SECURING TEE



SWAFFORD ROD ADAPTOR

SILICON CARBIDE ROD ADAPTOR



SWAFFORD RODS

MATERIAL

NO	NAME	MATERIAL
1	HEAD	BRASS
2	INSULATOR	RUBBER
3	GASKET	"
4	SECURING TEE	BRASS
5	TUBULAR ELECTRODE	STEEL
6	RED. BUSHING 3/8" TO 1/4"	IRON
7	COUPLING 3/8"	"
8	PIPE, STD. 3/8"	STEEL
9	ELECTRODES 1/8"	"

NOTE: TWO (2) SIZES OF SILICON CARBIDE RODS ARE IN USE AT U.S.N.T.S. SALVAGE (7/16"D - 9/16"D). MAKE ADAPTOR TO FIT ROD USED.

ADAPTORS & SWAFFORD RODS

USED WITH OXY-ELECTRIC CUTTING TORCH

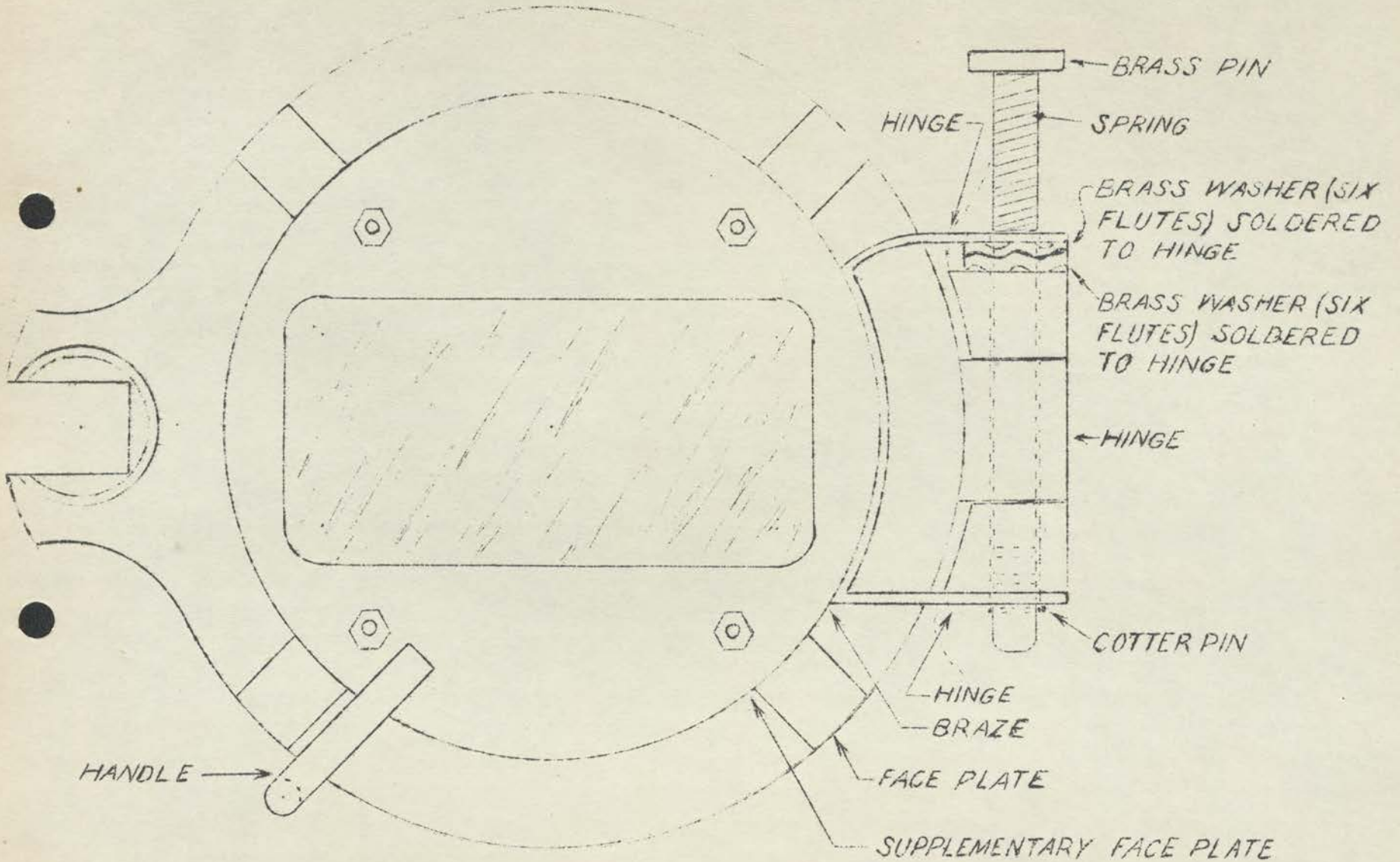
SCALE - FULL SIZE

U.S.N.T.S. SALVAGE

PIER 88 NEW YORK, N.Y.

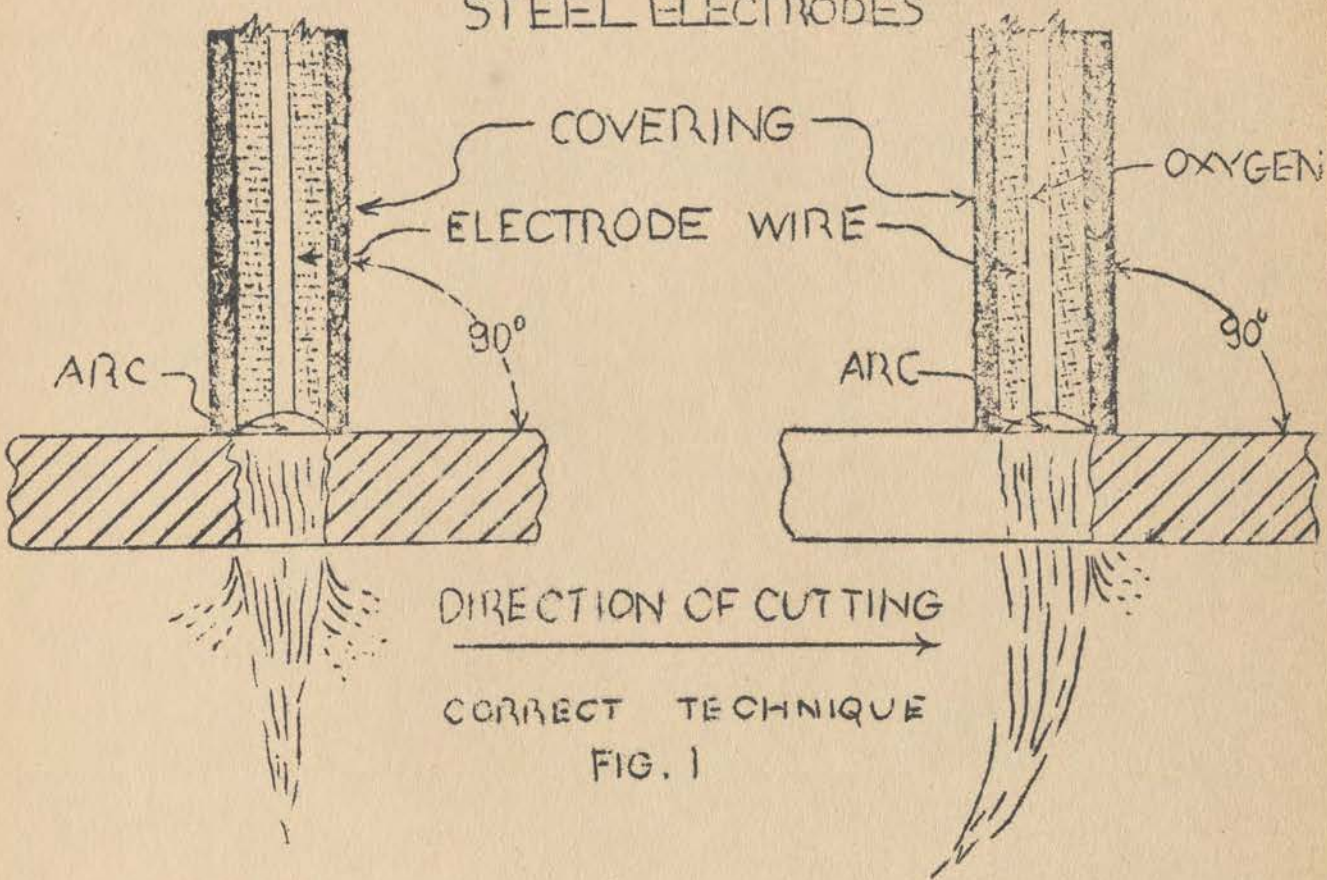
K.M.W.

SPRING TENSION LOCK WASHER FOR NAVY STANDARD SUPPLEMENTARY FACE PLATE



MARCH 13, 1944 N.T.S. SALVAGE PIER 88 NEW YORK WALSH

TECHNIQUE FOR UNDERWATER ARC CUTTING USING TUBULAR (COVERED) STEEL ELECTRODES



CORRECT TECHNIQUE

FIG. 1

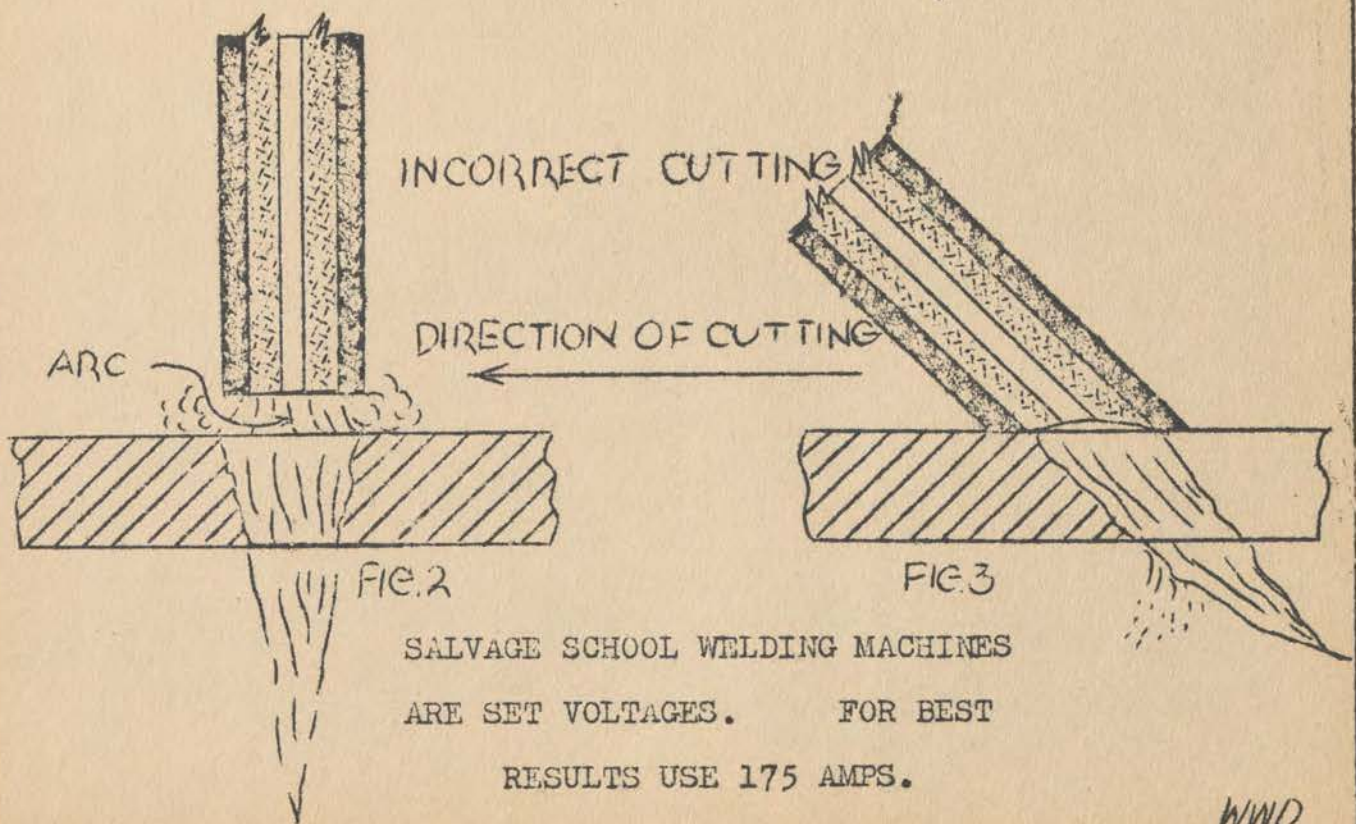
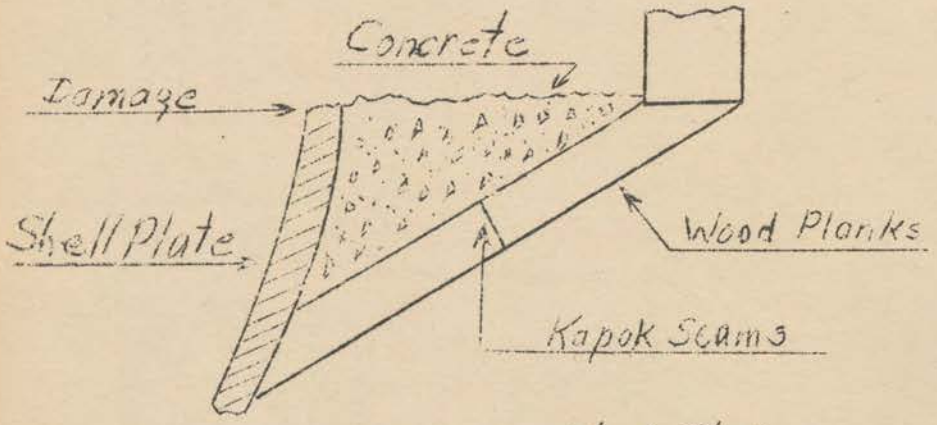


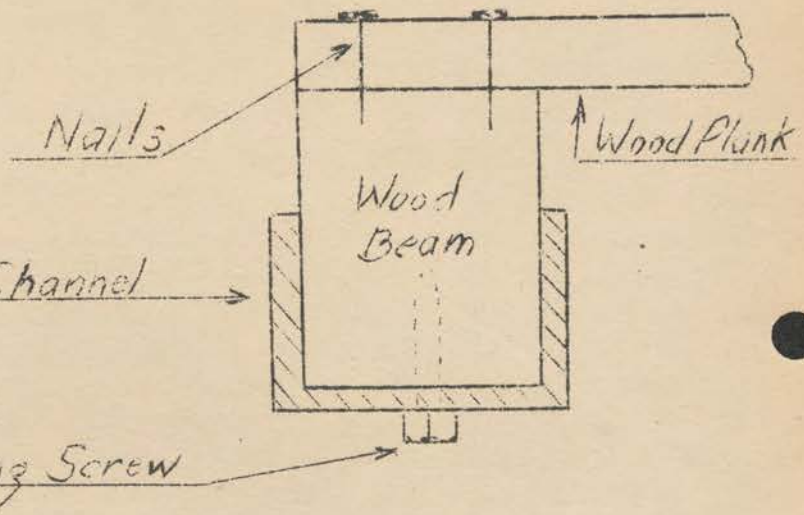
FIG. 2

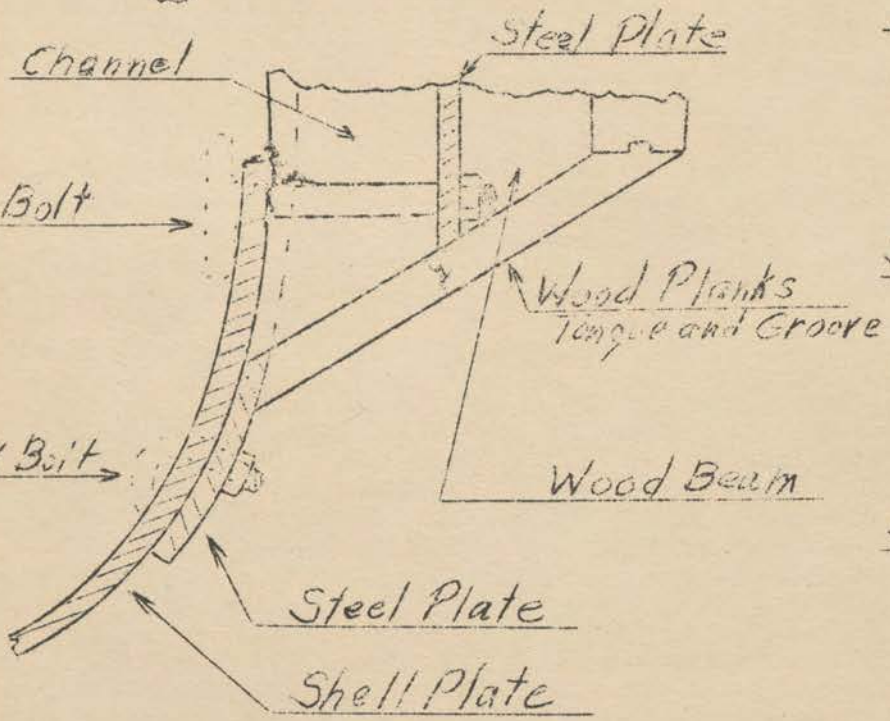
FIG. 3

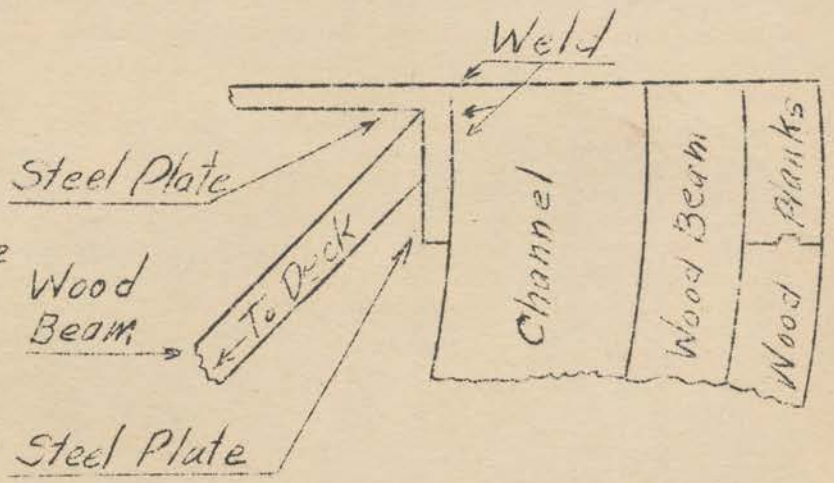
SALVAGE SCHOOL WELDING MACHINES ARE SET VOLTAGES. FOR BEST RESULTS USE 175 AMPS.

W.W.D.









USN.T.S.S.

WALSH

HANDLING AND USE OF OXYACETYLENE EQUIPMENT

1. Never let bottles lay on sides when in use.

2. Always handle bottles with caution.

3. Before attaching gauges, break valves at bottles so as to clean valve seats.

4. When gauges, lines, and torch are hooked up, and all connections are checked for leaks,

   (a) Open valve at tank
   (b) Open valves on torch
   (c) Turn key on gauge until right adjustment is reached.
   (d) Close valves at torch until ready for use.

5. When igniting torch,

   (a) Turn Acetylene on first
   (b) Ignite
   (c) Turn oxygen on until you get a neutral flame.

6. When securing torch,

   (a) Shut off Acetylene at torch
   (b) Shut off oxygen at torch
   (c) Shut valves at tanks
   (d) Drain lines and gauges
   (e) Take keys out of gauges.

CAUTION

Never turn acetylene pressure higher than 20 lbs.
(At 30 lbs. it will explode.)

Care should always be taken when using this equipment, for it is expensive and dangerous.

IF IN DOUBT, ASK SOMEONE WHO IS ACQUAINTED WITH THIS EQUIPMENT

HEATS FOR SWAFFORD

The swafford electric oxygen torch will work satisfactorily over a large range of heats and may be regulated between any of the settings below.

The approximate heat for 1/4" to 1/2" material is:

DEPTH	OXYGEN	ELECTRIC
Sea level	40 lbs.	150 amps.
10'	45 "	
20'	49 "	
30'	53 "	
50'	62 "	155 amps.
75'	73 "	
100'	84 "	160 amps.
200'	128 "	170 amps.

The approximate heat for metal 1/2" up is:

DEPTH	OXYGEN	ELECTRIC
Sea level	80 lbs.	250 amps.
10'	85 "	
20'	89 "	
30'	93 "	
50'	102 "	255 amps.
75'	113 "	
100'	124 "	260 amps.
200'	168 "	270 amps.

NOTE -

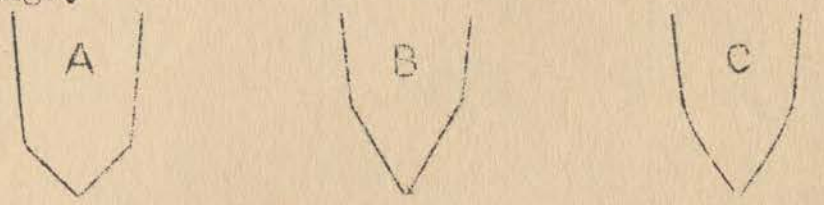
This torch may be used with 150 amps & 168 lbs. of oxygen or 270 amps & 40 lbs. of oxygen - or may be set between any of these settings desired.

The Swafford is good for burning anything that the oxyhydrogen torch can burn (any ferrous metal).

Advantages of Swafford are burning through double metal & no gas cylinders to handle.

PROPER SHAPE OF CHISEL BLADE

It is necessary to use judgment in cutting steel to get best results from the chisel...in cutting hard materials, use a blunt tapered cutting edge as shown in Fig. A. Fig. B represents a good general angle for fast cutting, yet it is blunt enough to hold up on average steel you would work on. Fig. C shows the thin, rounded edge used on Blue-Point Chisels. The angle is the same as Fig. B, but the rounded shape makes for easier and faster cutting and eliminates most of possible breakage.



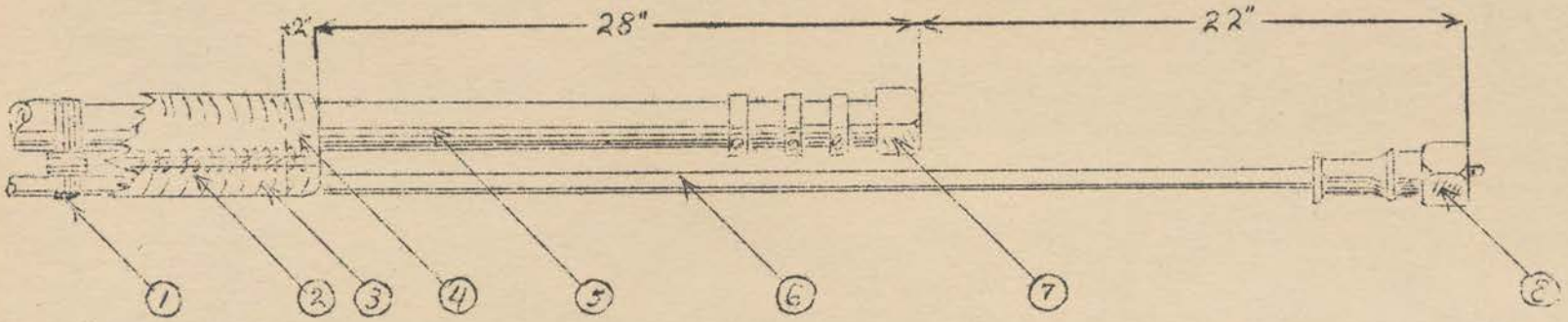
HOW TO USE A CHISEL

1. First score the steel to be cut by striking the chisel a series of light blows.
2. Cut with the full edge of the chisel.
3. Do not use the corner, as it will flatten quickly against hard steel...cut with the center of blade.
4. After scoring with full cutting edge, follow in the same groove with increasingly harder blows of the hammer.
5. Strike directly...glancing blows are dangerous.
6. When a deep cut is made, avoid wedging as a slight glancing blow can weaken or break the chisel blade.
7. If chisel is wedged, remove it carefully without side blows.
8. Grip the chisel with a full firm grip to avoid bouncing on work.
9. Keep the edge solid against the cut, or you will turn the edge easily on hard work.
10. Use Fig. C in pneumatic hammer.
11. Use chisels at a 45° angle for best results.

WHEN REMOVING RIVETS

Use a rivet buster on rivet heads and save your chisels. Fig. D shows wrong method using chisel, Fig. E shows the correct method of using a rivet buster.

MARRYING DIVERS LINES TOGETHER



HOW TO MARRY DIVERS LIFE & AIR LINE TOGETHER

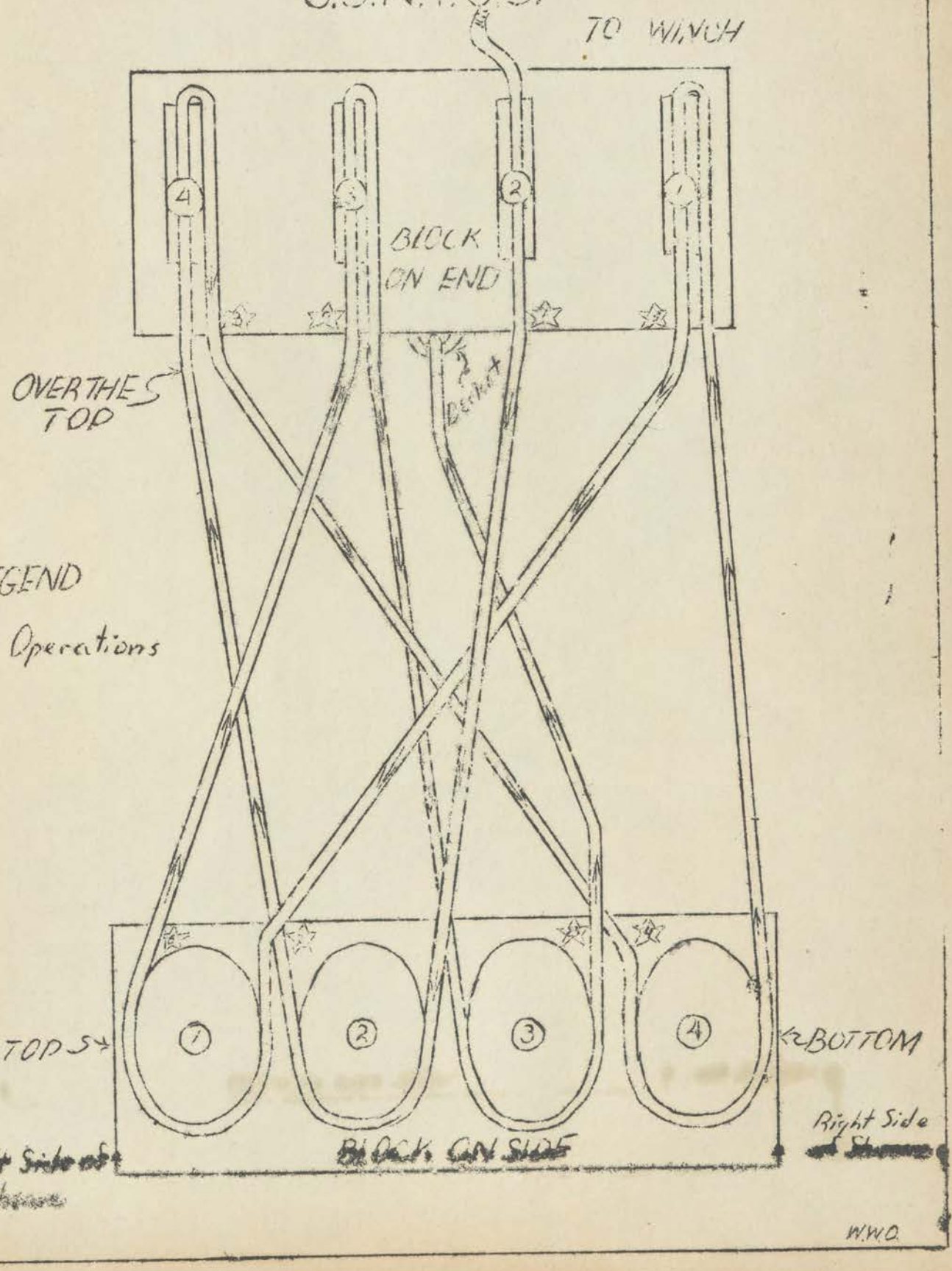
1. Seizing life line and air hose together with marline.
2. Herringbone stitch.
3. Canvas sewed around life and air line. This end also whipped with tape over canvas.
4. Canvas tucked under to give added strength.
5. Air hose.
6. Telephone cable.
7. Female air hose connection to control valve.
8. Telephone Jack-plug.

Length of signal halyard on shoe 48"

Length of signal halyard on breastplate 42"

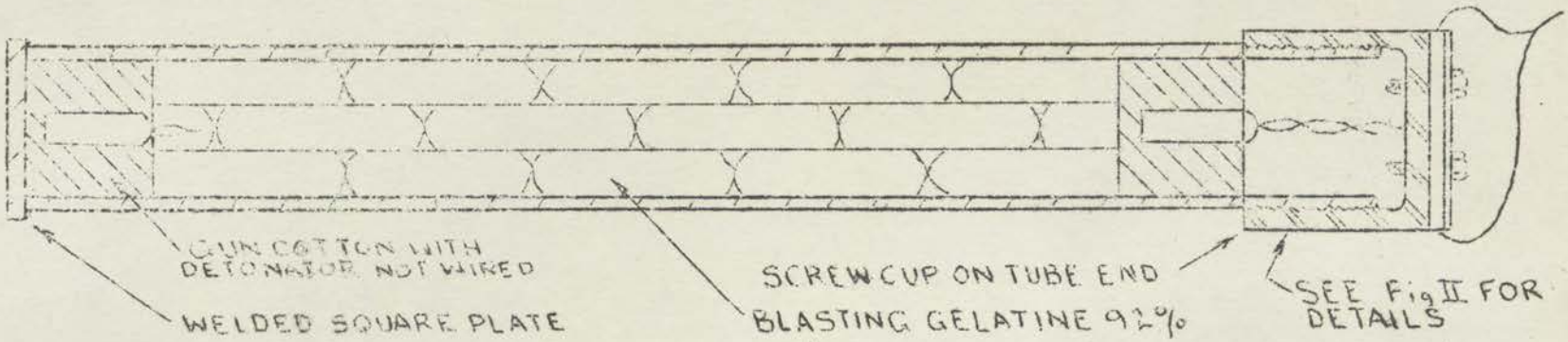
VIWD

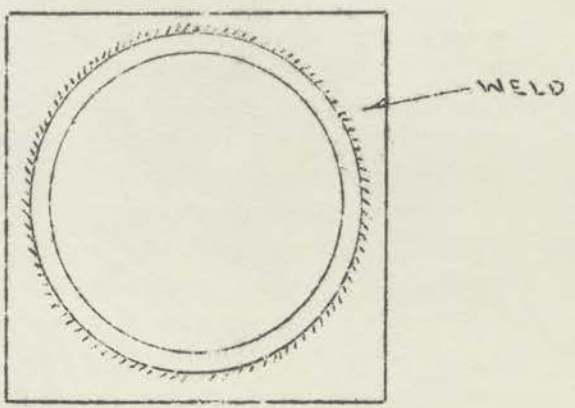
FOUR FOLD PURCHASE
U.S.N.T.S.S.



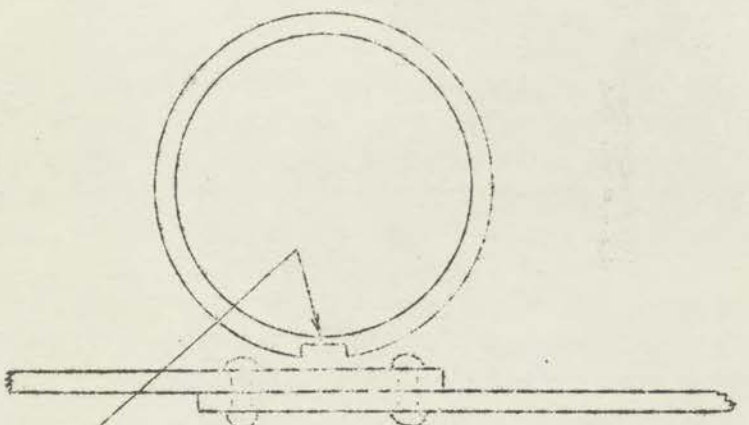
W.W.O.

BOILER TUBE EXPLOSIVE CHARGE COMPLETE Fig. I





WELDED SQUARE PLATE
ON BLANK END OF DEEP
WATER EXPLOSIVE ONLY



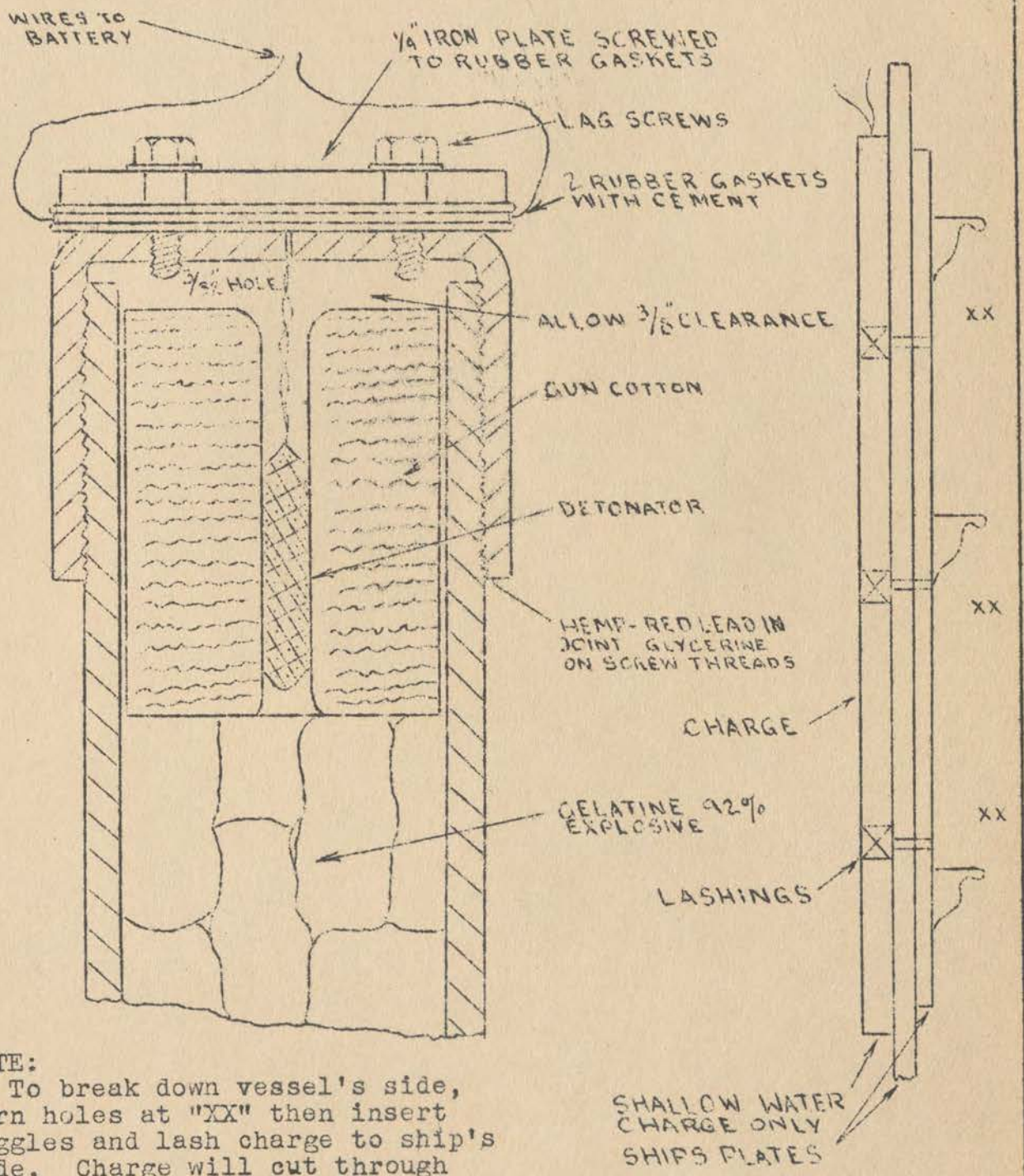
PLACE SLOT IN TUBE ON THE
LAPPING JOINT OF THE PLATE

U.S.N.T.S.S.

WALSH

UNDERWATER EXPLOSIVE

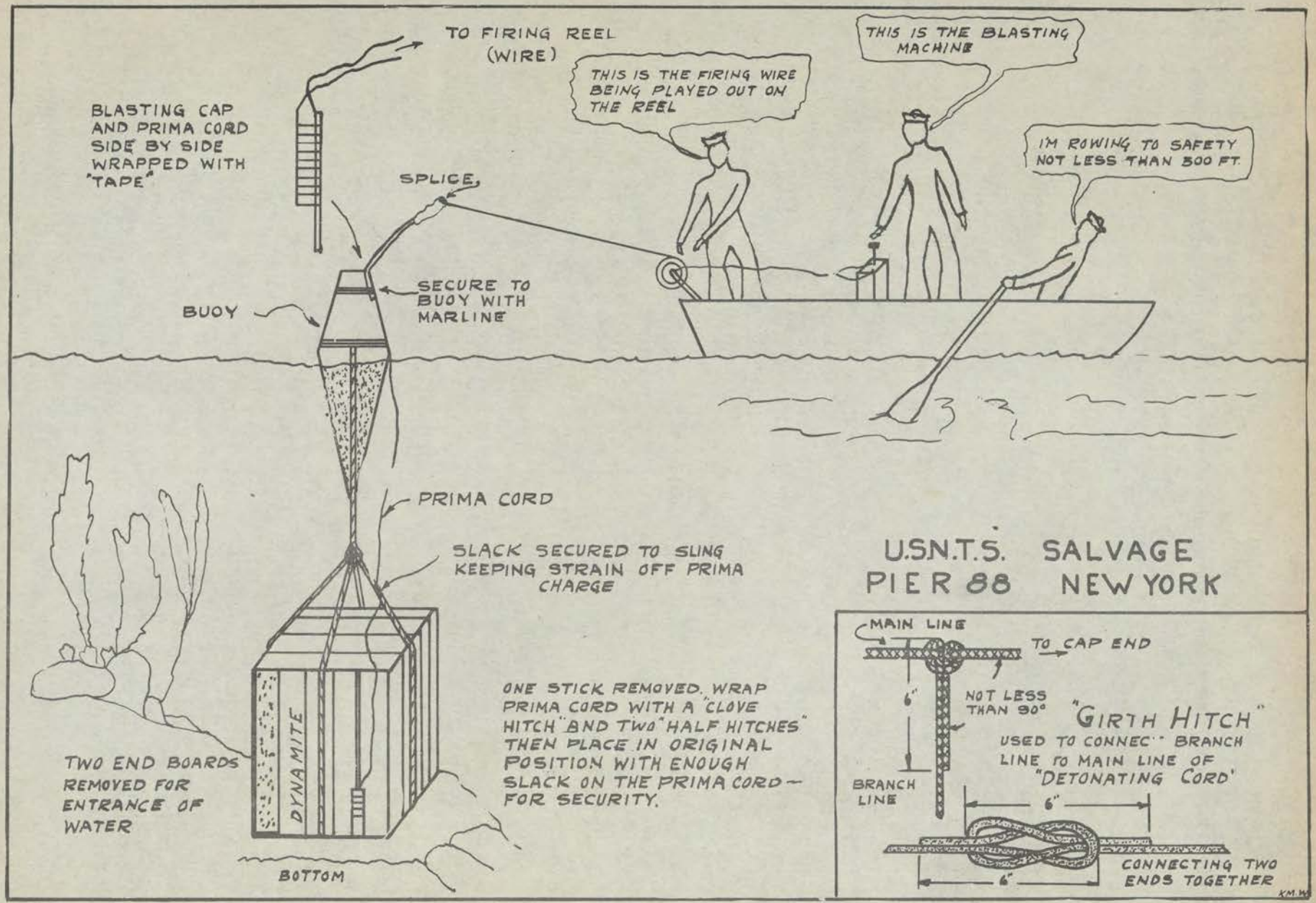
Fig II



NOTE:
To break down vessel's side, burn holes at "XX" then insert toggles and lash charge to ship's side. Charge will cut through plate and frames.

U.S.N.T.S.S.

WALSH


TO FIRING REEL
(WIRE)
THIS IS THE FIRING WIRE BEING PLAYED OUT ON THE REEL
THIS IS THE BLASTING MACHINE
I'M ROWING TO SAFETY NOT LESS THAN 300 FT.
BLASTING CAP AND PRIMA CORD SIDE BY SIDE WRAPPED WITH "TAPE"
SPLICE
SECURE TO BUOY WITH MARLINE
BUOY
PRIMA CORD
SLACK SECURED TO SLING KEEPING STRAIN OFF PRIMA CHARGE
DYNAMITE
TWO END BOARDS REMOVED FOR ENTRANCE OF WATER
BOTTOM
ONE STICK REMOVED. WRAP PRIMA CORD WITH A "CLOVE HITCH" AND TWO "HALF HITCHES" THEN PLACE IN ORIGINAL POSITION WITH ENOUGH SLACK ON THE PRIMA CORD — FOR SECURITY.
U.S.N.T.S. SALVAGE
PIER 88 NEW YORK
MAIN LINE
TO CAP END
6"
NOT LESS THAN 90°
"GIRTH HITCH"
USED TO CONNECT BRANCH LINE TO MAIN LINE OF "DETONATING CORD"
BRANCH LINE
6"
6"
CONNECTING TWO ENDS TOGETHER
KM.W

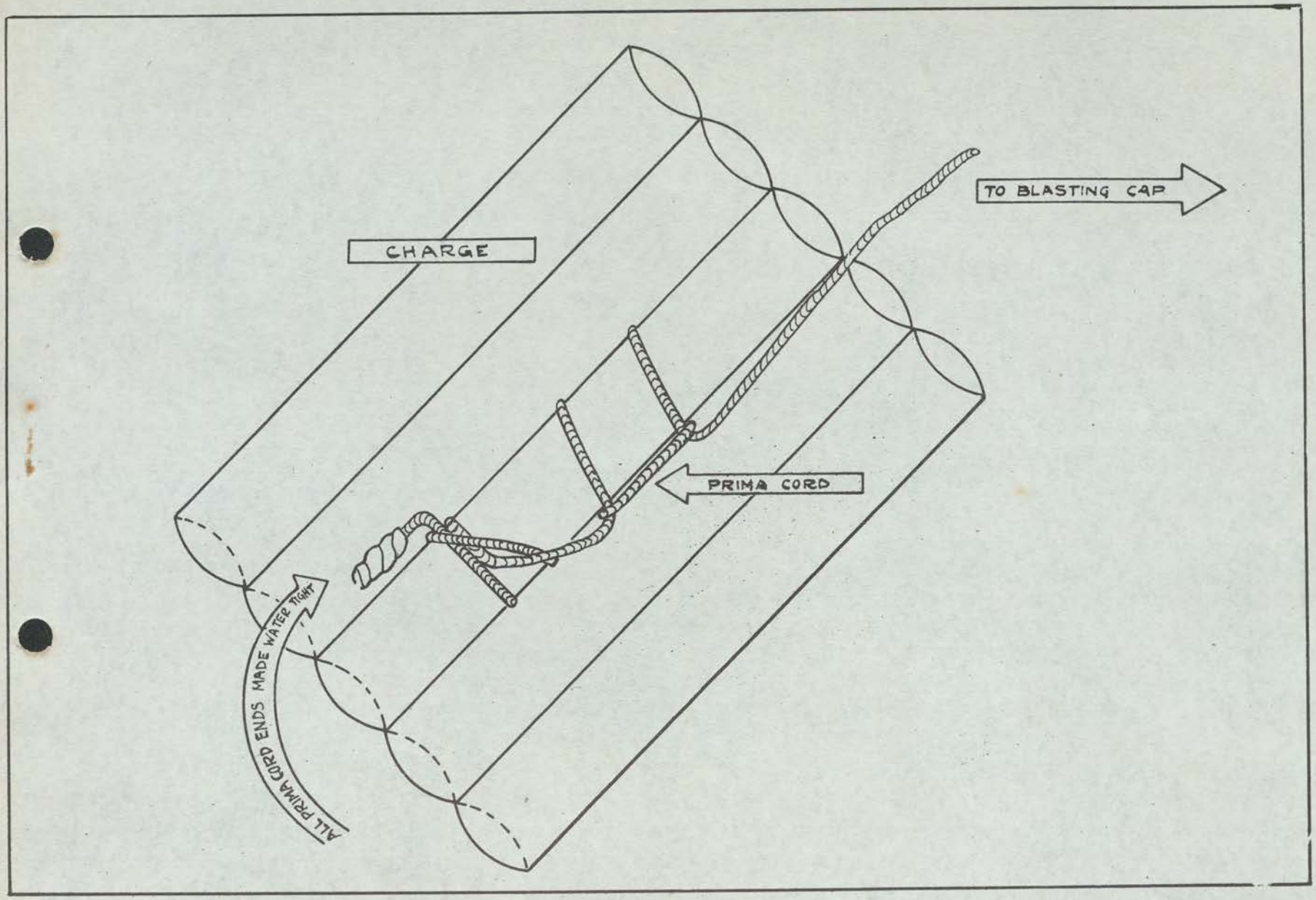
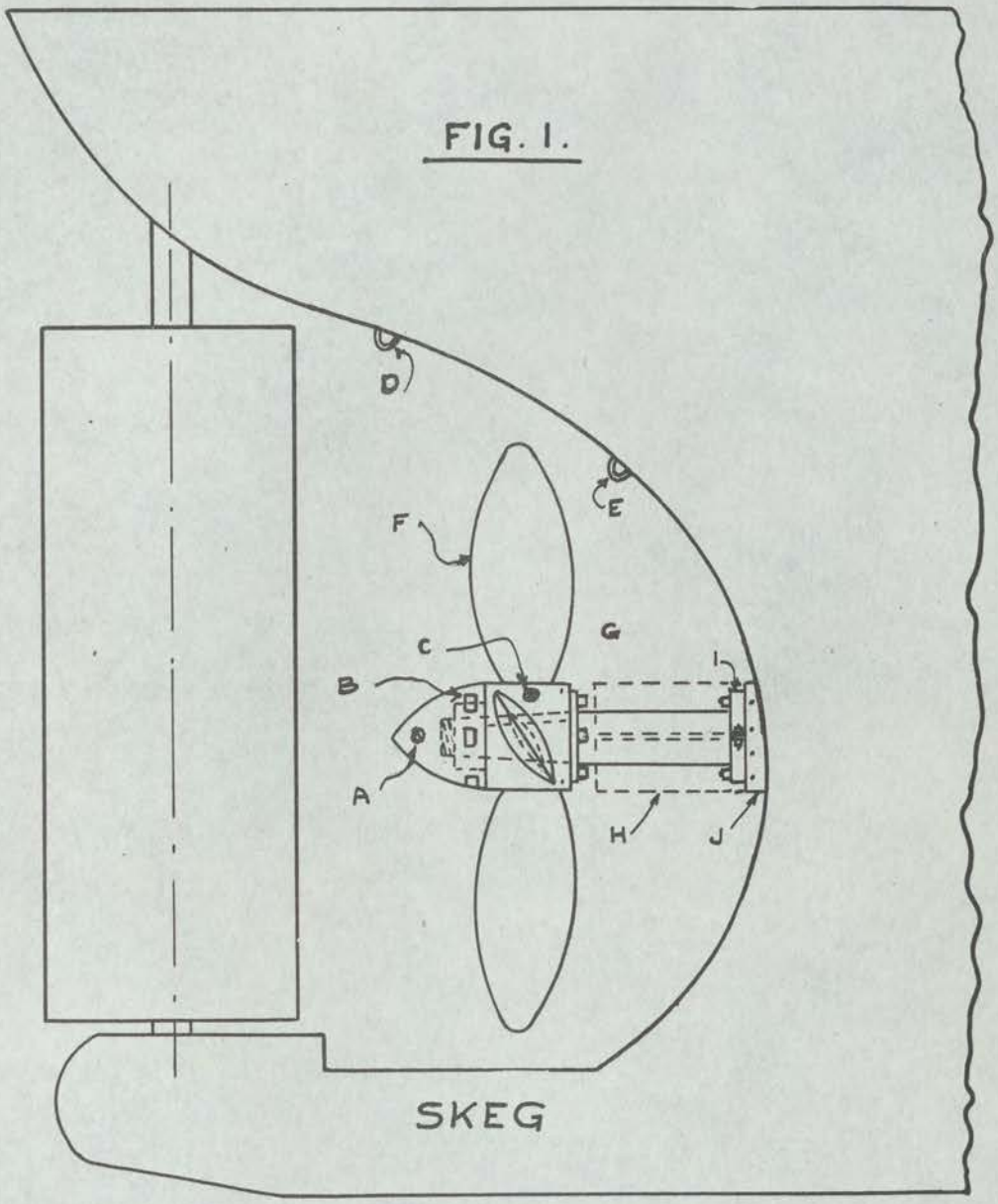

CHARGE
TO BLASTING CAP
PRIMA CORD
ALL PRIMA CORD ENDS MADE WATER TIGHT

FIG. 1.



LEGEND :

A - LIFTING PAD HOLE & PLUG

B - RECESS FOR STUD NUTS

C - LIFTING PAD HOLE & PLUG

D & E - PADS FOR CHAIN FALLS

F - SCREW

G - GASKET RETAINING RING

H - ROPE GUARD (SPLIT)

I - PACKING RETAINER RUNG (SPLIT)

J - STERN TUBE BEARING

SCREW CHANGE OPERATION
EXAMPLE L.S.T.
(OPERATION PRACTICAL ON MOST SHIPS)

U.S.N.T.S (SALVAGE) PIER 88 NEW YORK N.Y.

K.M.W

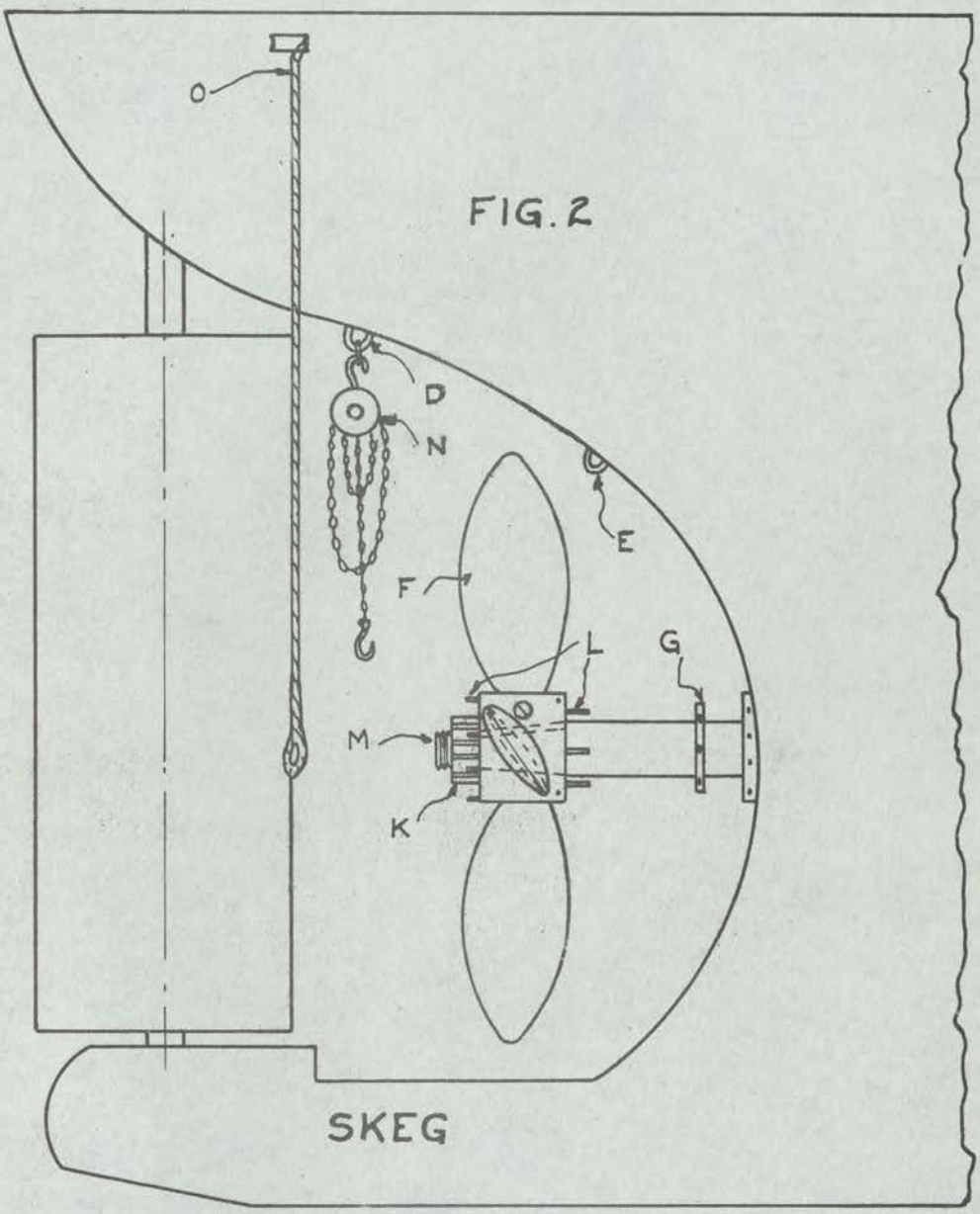


FIG. 2

LEGEND:

D & E - PADS FOR CHAIN FALL

F - SCREW

G - GASKET RETAINING RING

K - SPLEEN NUT WITH LOCKING PIN

L - STUDS

M - THREADS TO BE COVERED WITH CANVAS

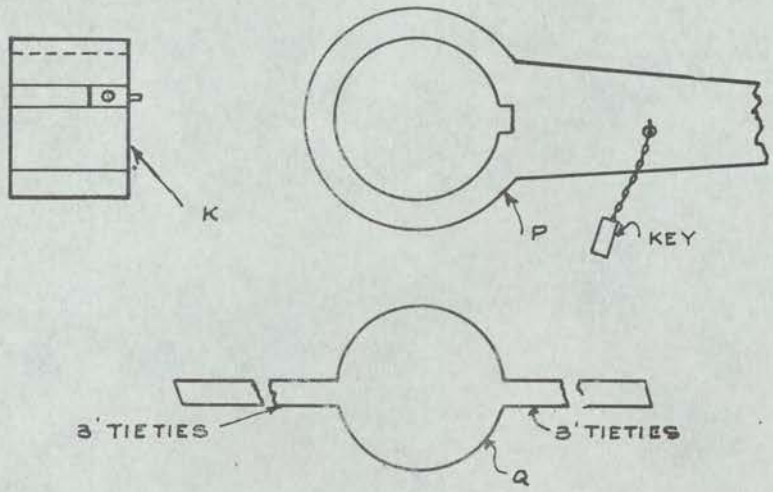
N - CHAIN FALLS

O - WIRE ROPE WITH EYE

SCREW CHANGE OPERATION
EXAMPLE L.S.T.
(OPERATION PRACTICAL ON MOST SHIPS)

U.S.N.T.S (SALVAGE) PIER 88 NEW YORK, N.Y.

K.M.W.



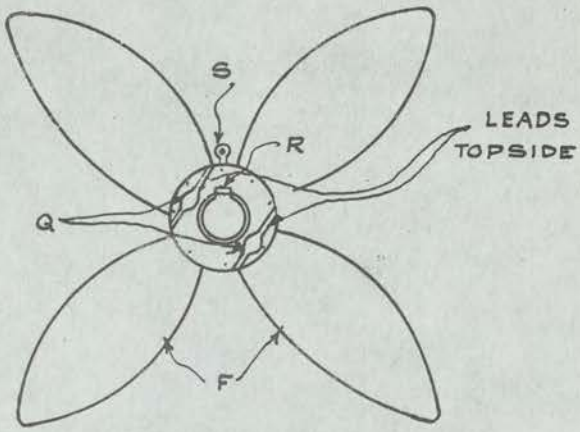


FIG. 3

LEGEND :

F - SCREW

K - SPLEEN NUT WITH LOCKING PIN

P - SPLEEN NUT WRENCH

Q - CHARGE POCKET

R - KEYWAY

S - LIFTING PAD EYE

SCREW CHANGE OPERATION
EXAMPLE L.S.T.
OPERATION PRACTICAL ON MOST SHIPS

U.S.N.T.S. (SALVAGE) PIER 88 N.R. NEW YORK, NY

K.M.W.

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This operation is successful on other ships and the only change is in the rigging. The process is carried out in the same manner.

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From this operation the spleen nut (K) is exposed. The locking pin is found in one groove in the spleen nut. This is removed with a screwdriver. At this point the spleen nut wrench (P) is lowered to the diver. The spleen nut is removed. Remove the studs which hold the dunce cap to the hub. Lifting pad plug (C) is removed and a lifting pad is inserted. At the forward side of the screw on the hub is found the gasket retaining ring (G) held on by studs. The studs are similiar to those found in the dunce cap. The nuts are removed and the ring slid forward and the studs are removed. Next, the stern tube bearing packing retainer ring (I) which is in halves is removed. The screw is turned until the keyway, which can now be seen in the hub, is directly at twelve o'clock. Several turns of canvas (heavy) are wrapped around the threads exposed on the shaft, to protect them, and the canvas is secured with sailtwine or other small stuff.

A charge is now prepared and placed in the charge pocket (Q) fig. III. The charge pocket is packed with a lump of white lead putty about the size of your fist. The powder is pushed into this putty. The charge is wired and placed in position. (Shown in fig. III). Powder goes against hub.

Both divers come to the surface and the charge is set off. A one ton chain fall is placed in lifting pad (D) and by hauling away the screw will be removed from the shaft. A wire pennant (O) is lowered from topside and shackled to lifting pad (C). Haul away on (O) and release the chain fall. Retaining ring (G) is left in place on the shaft and the key in the keyway can be secured in place with some small stuff.

REPLACING THE SCREW ON AN L.S.T.

The replacement screw is placed in a small boat and brought alongside under the counter. Pennant (O) is shackled to lifting pad (C) and the screw is hauled clear of the boat. Prior to lifting the screw from the boat the stud holes may be cleaned with a suitable tap. Keyway should be measured for fit on key. (O) is lowered away until chain fall on lifting pad (D) can reach lifting pad (C). If this operation is done correctly the keyway in the hub and the key in the shaft will both be at twelve o'clock. Haul away on chain fall (E) slacking off on chain fall (D). This is done until enough threads are exposed to start the spleen nut. Chain falls are slacked off and the nut is turned up until the screw is home and the same number of threads are exposed as were on the other screw.

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The most common error made in the replacement of screws is in not being able to remove various parts. Should this occur examine the part carefully and see if there is not a locking pin that has been overlooked.

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RECOMMENDED CHARGE FOR L.S.T.:

Two 3 oz. charges of 60% gelatine.

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Two 5 oz. charges of 60% gelatine.

RECOMMENDED CHARGE FOR APC, LCT, SC, PC AND YMS:

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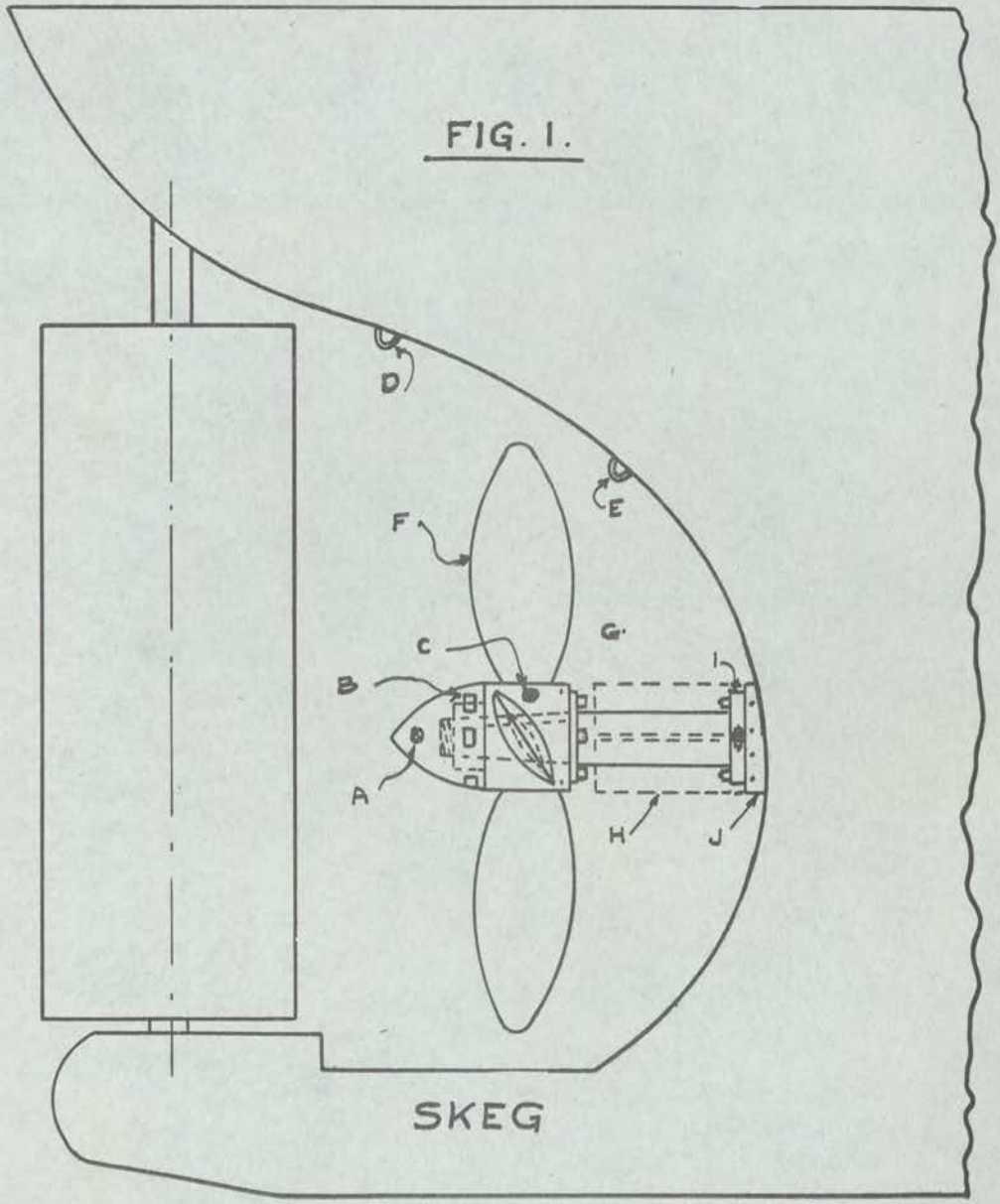
NOTE: Same amount by weight of plastic TNT may be used as a substitute for 60% gelatine.

FIG. 1.



LEGEND :

A - LIFTING PAD HOLE & PLUG

B - RECESS FOR STUD NUTS

C - LIFTING PAD HOLE & PLUG

D & E - PADS FOR CHAIN FALLS

F - SCREW

G - GASKET RETAINING RING

H - ROPE GUARD (SPLIT)

I - PACKING RETAINER RUNG (SPLIT)

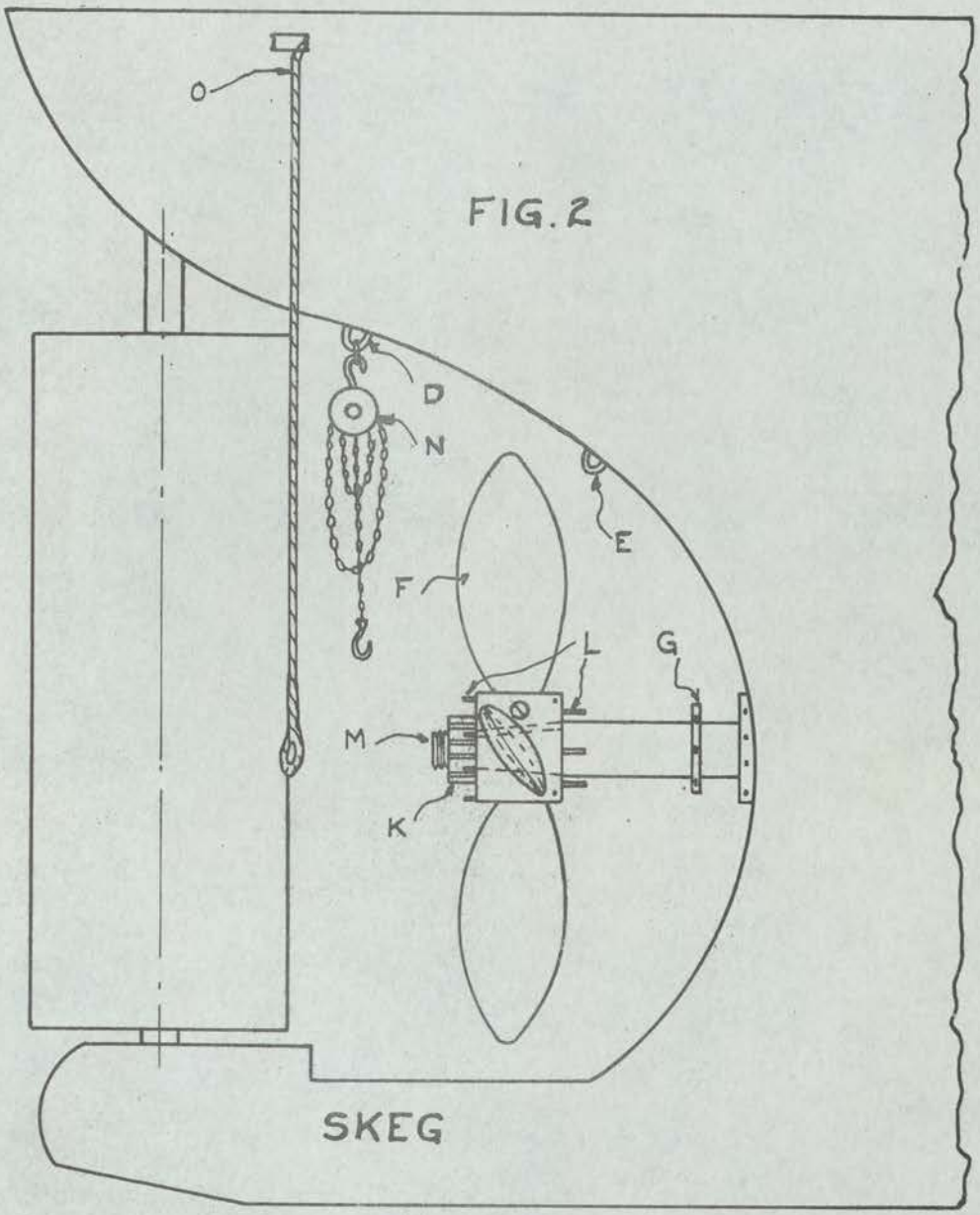
J - STERN TUBE BEARING

SCREW CHANGE OPERATION
EXAMPLE L.S.T.
(OPERATION PRACTICAL ON MOST SHIPS)

U.S.N.T.S (SALVAGE) PIER 88 NEW YORK N.Y.

K.M.W

FIG. 2



LEGEND:

D & E - PADS FOR CHAIN FALL

F - SCREW

G - GASKET RETAINING RING

K - SPLEEN NUT WITH LOCKING PIN

L - STUDS

M - THREADS TO BE COVERED WITH CANVAS

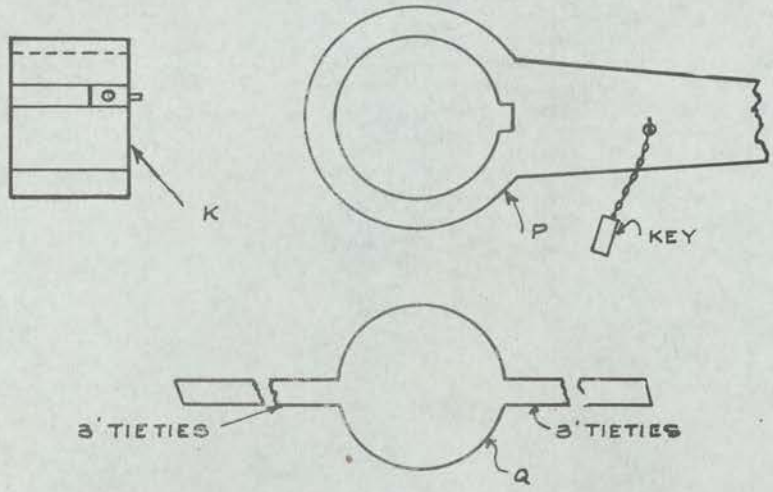
N - CHAIN FALLS

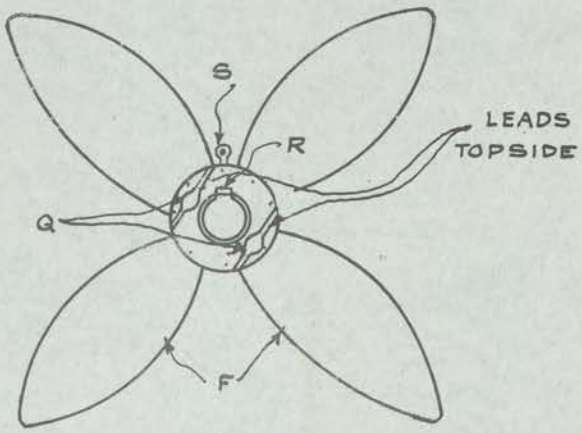
O - WIRE ROPE WITH EYE

SCREW CHANGE OPERATION
EXAMPLE L.S.T.
(OPERATION PRACTICAL ON MOST SHIPS)

U.S.N.T.S (SALVAGE) PIER 88 NEW YORK, N.Y.

K.M.W.





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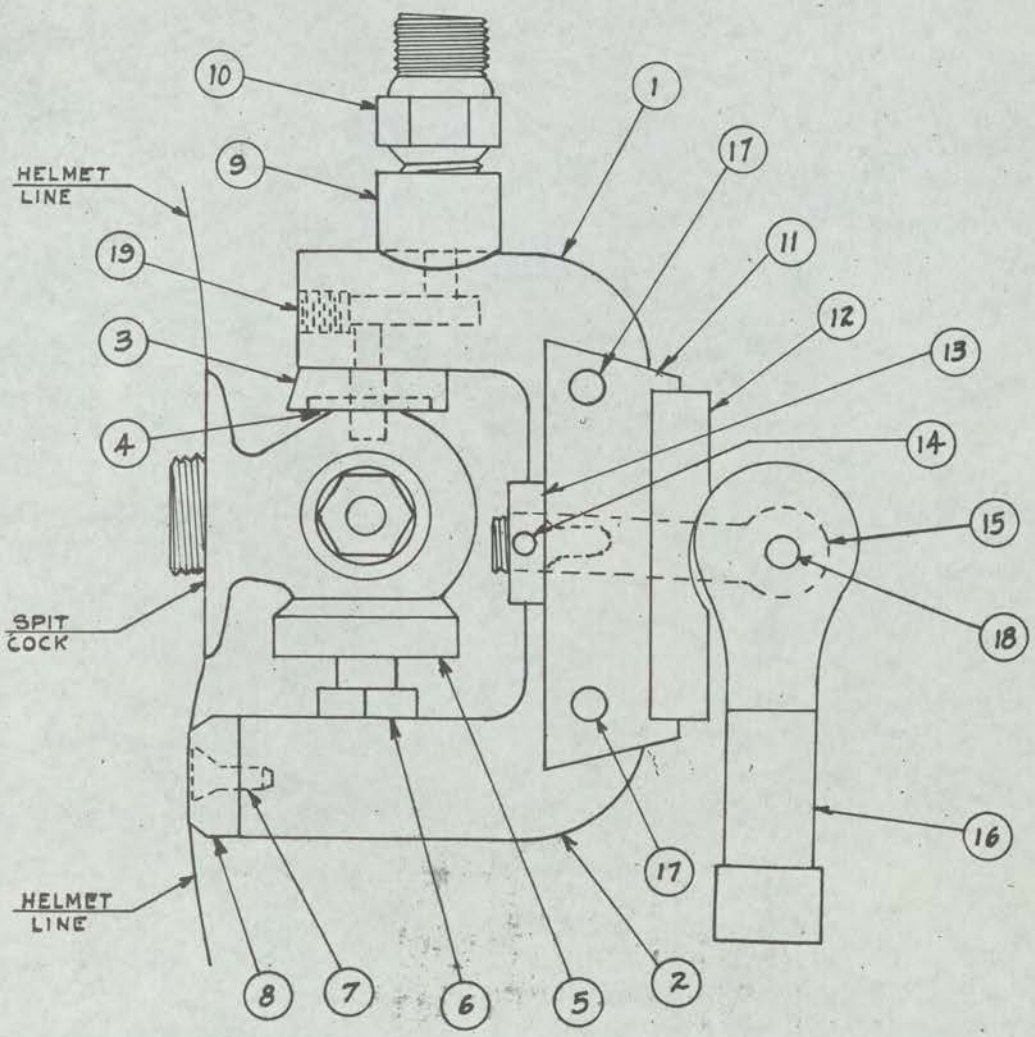


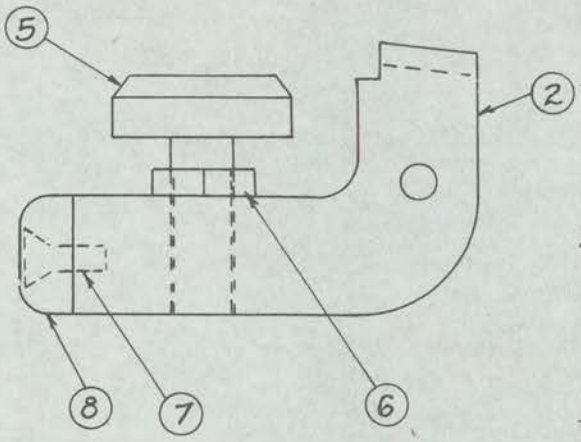
NO	NAME	MATERIAL	REMARKS
1	UPPER ARM	NAVY ROLLED BRASS	
2	LOWER ARM	" " "	
3	UPPER SEAT	" " "	
4	WASHER	LEATHER	
5	LOWER SEAT	NAVY ROLLED BRASS	
6	HEX. NUT	" " "	
7	SCREW	" " "	NO 8 - 32 3/16" LONG
8	HELMET SEAT	FIBER	
9	COUPLING	NAVY ROLLED BRASS	
10	NON-RETURN VALVE	" " "	
11	HINGE	MONEL	
12	HINGE GUARD	NAVY ROLLED BRASS	
13	LOCK NUT	" " "	
14	PIN	" " "	
15	BOLT	" " "	3/8"-24 N.F. 2 1/16" LONG
16	ECCENTRIC CLAMP	" " "	
17	PIN	" " "	
18	PIN	" " "	
19	PLUG	" " "	1/4" 20 N.C 1/4" LONG

DIVER'S AUXILLARY AIR RESCUE APPARATUS

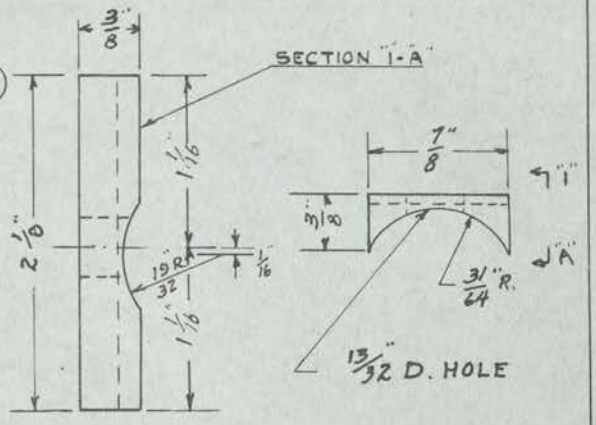
PIER 88 N.T.S. (SALVAGE) NEW YORK, N.Y.

SCALE - FULL SIZE

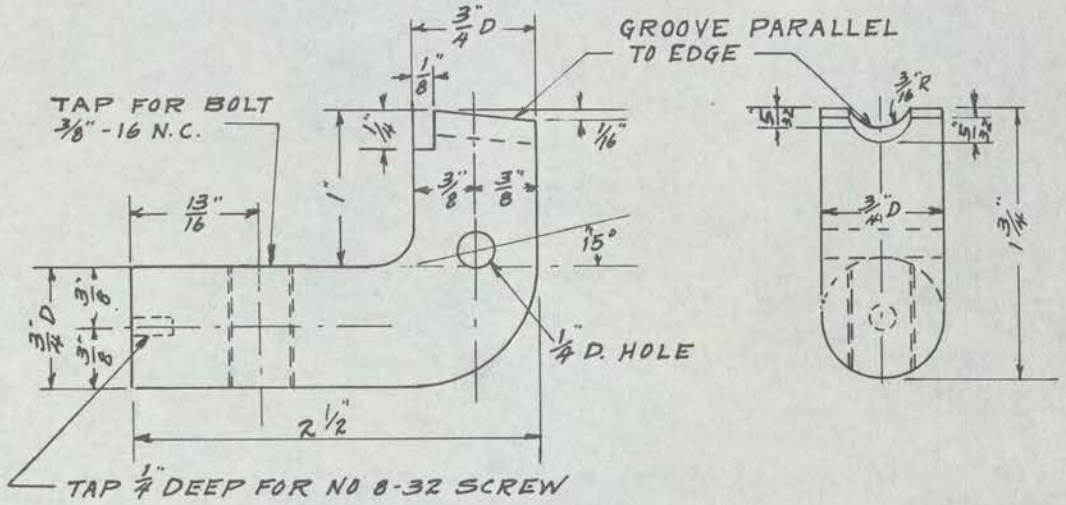
K.M.W.



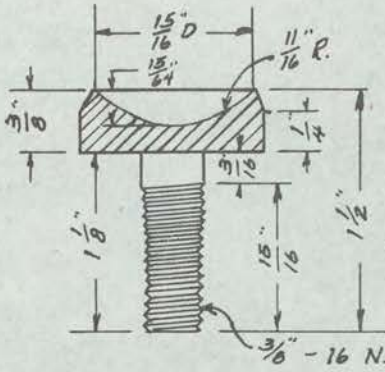
LOWER ARM ASSEMBLY



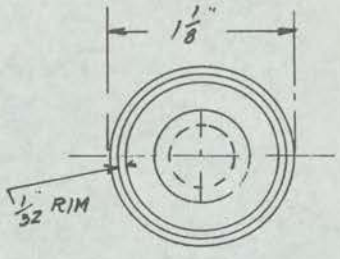
HINGE GUARD 12

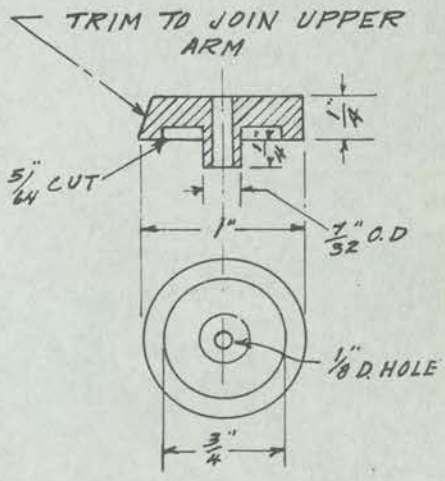


LOWER ARM 2



NOTE: MACHINE HEAD TO 11/16" R THEN CUT TO 15/64" DEPTH WITH 1/2" DRILL



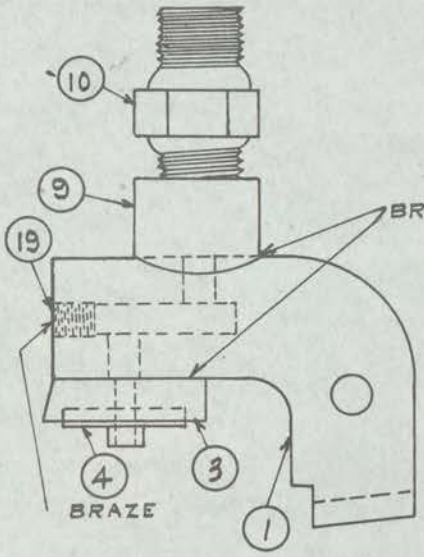


LOWER SEAT 5

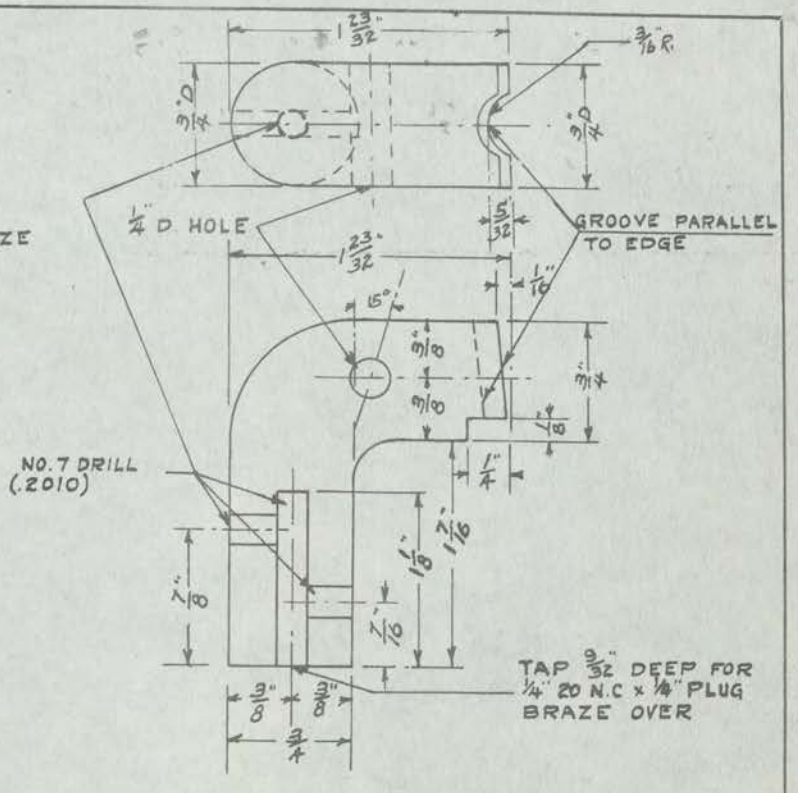
UPPER SEAT 3

AIR RESCUE APPARATUS (SHEET 2)

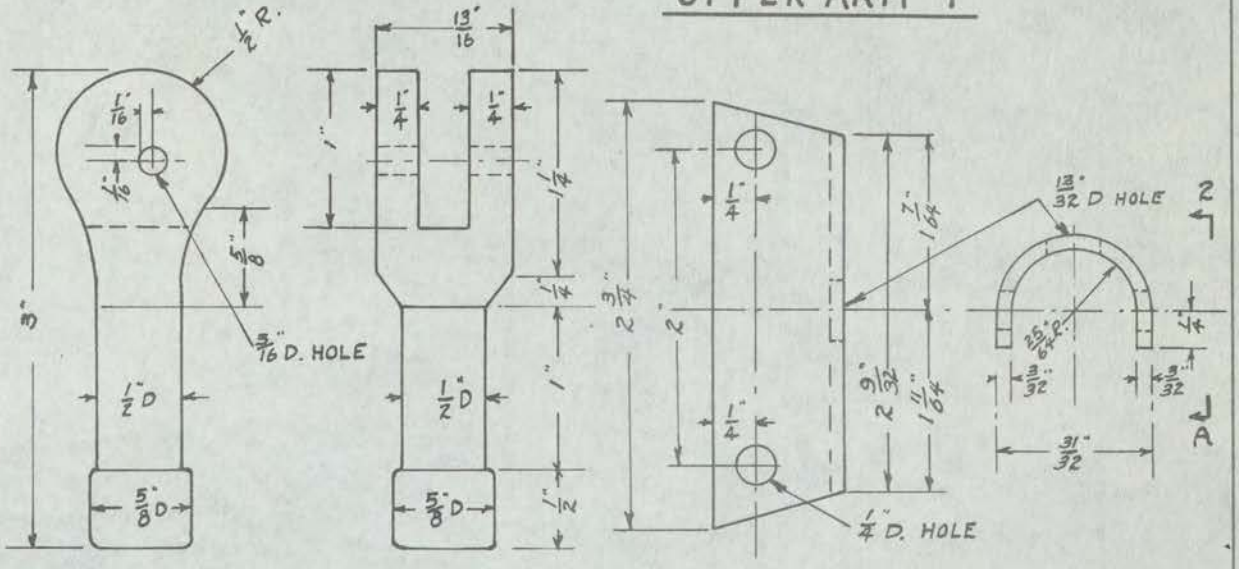
K.M.W.



UPPER ARM ASSEMBLY



UPPER ARM 1



SECTION 2-A

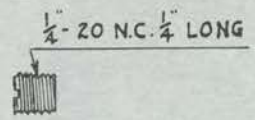
ECCENTRIC LEVER CLAMP 16

HINGE

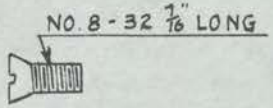
AIR RESCUE APPARATUS (SHEET 3)

K.M.W.

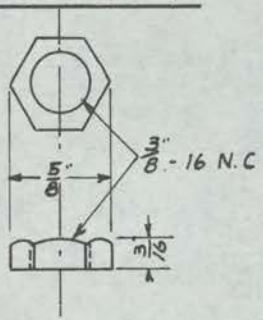
AIR RESCUE APPARATUS (SHEET 4)



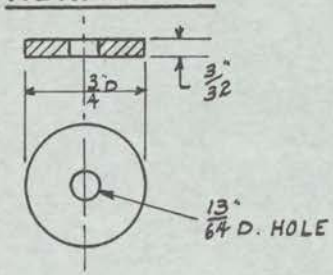
PLUG 19



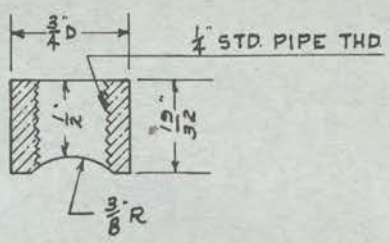
SCREW 7



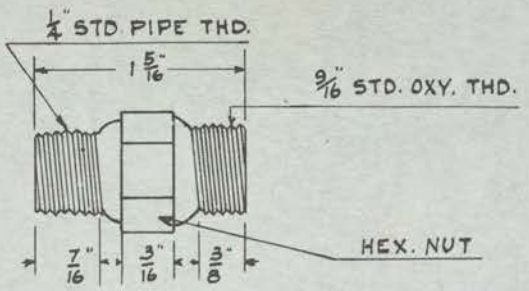
HEX. NUT 6



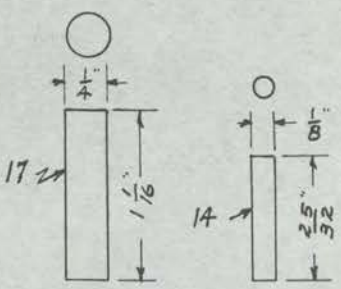
WASHER 4



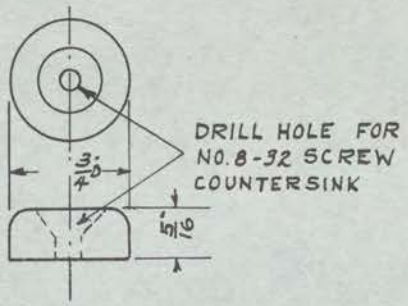
COUPLING 9



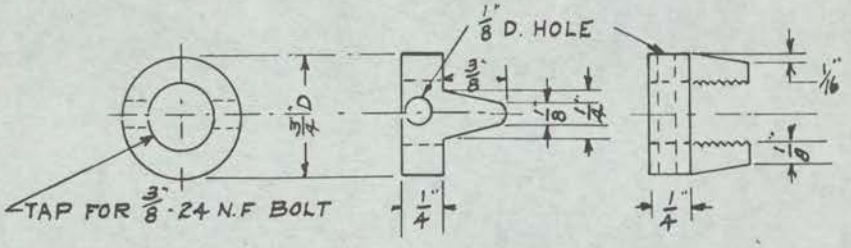
NON-RETURN VALVE 10



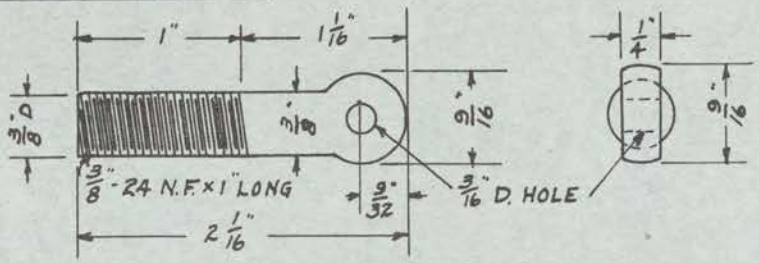
PINS



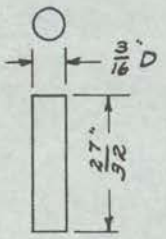
HELMET SEAT 8



LOCKNUT 13

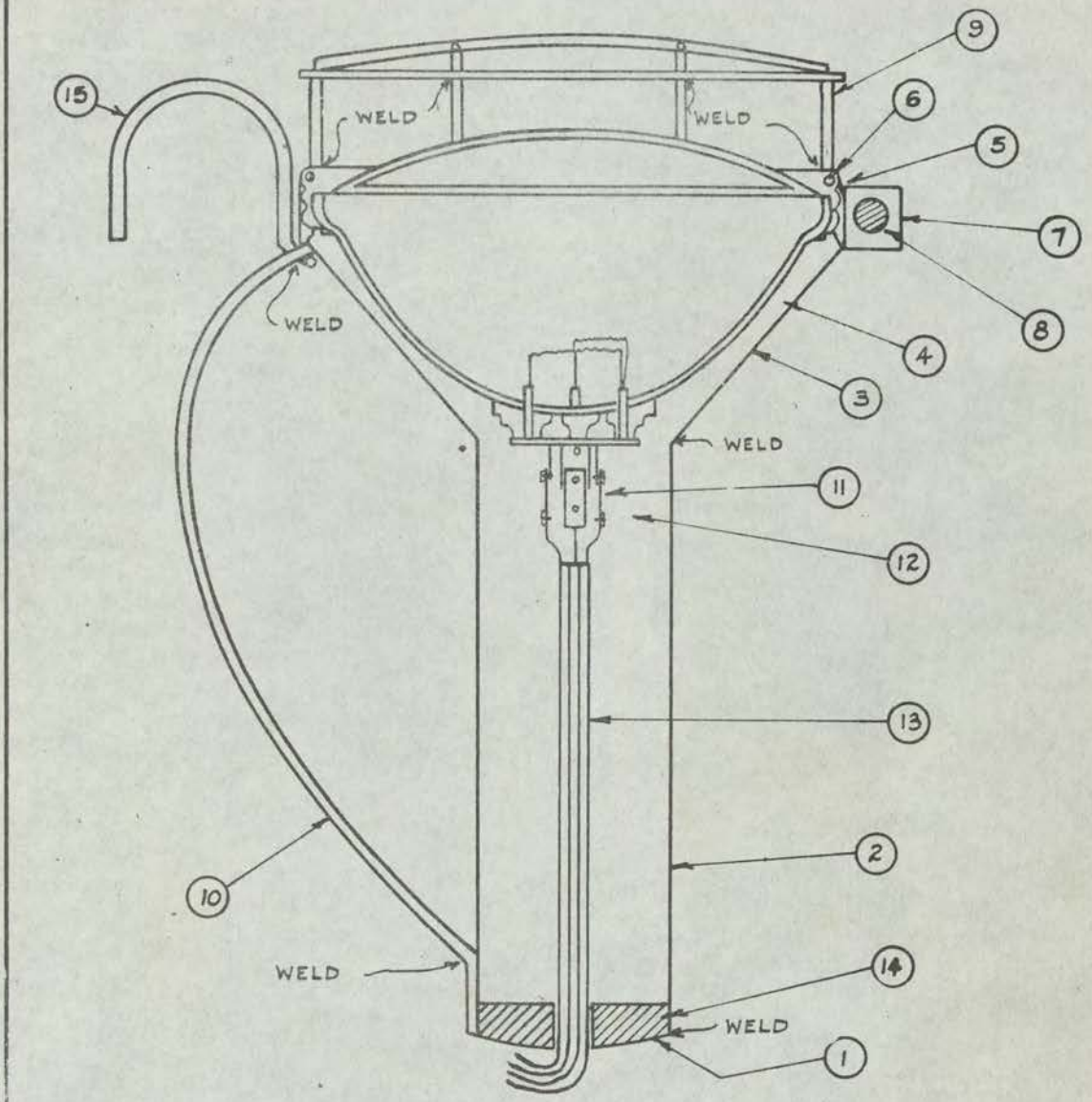


BOLT 15



PIN 18

K.M.W.



NO	NAME	MATERIAL	REMARKS
1	BASE BOTTOM	GALVANIZED IRON	20 GAGE
2	BASE	" "	" "
3	LAMP HOUSING	" "	" "
4	SEALED BEAM LAMP	GLASS	TUNG-SOL AUTO TYPE 4030 6-8"
5	RIM	GALVANIZED IRON	20 GAGE
6	RETAINER RING	IRON WIRE	NO 8 B&S
7	GUARD RIM	GALVANIZED IRON	16 GAGE
8	ADJUSTABLE BOLT	BRASS	1/4"-20 N.C. 1 1/2" LONG HEX. NUT
9	GUARD	IRON WIRE	NO 8 B&S
10	HANDLE	GALVANIZED WIRE	20 GAGE
11	CONTACT TERMINAL	BRASS	18 GAGE
12	" BOLT	"	NO 6-32 N.C 3/8" LONG HEX. NUT
13	ELECTRICAL WIRE	COPPER (RUBBER INSULATED)	NO 18 3 WIRES
14	COUNTERWEIGHT	LEAD	1 POUND
15	SECURING HOOK	IRON WIRE	NO 4 B&S

DIVERS UNDER WATER LIGHT

U.S.N.T.S. SALVAGE PIER 88 NEW YORK, N.Y.

SCALE 6" = 1 FOOT

K.M.W

Decompression Table No. 1 - Ordinary time limits in deep water and stoppages to be made during ascent.

Depth	Time under water I.E., from surface to beginning of ascent.	Stoppage at different depths									Total Time For Ascent
		90	80	70	60	50	40	30	20	10	
Feet											Minutes
0-36	No limit										0-1
36-42	Up to 3 hrs.										1-1 1/2
	Over 3 hrs.									5	6
42-48	Up to 1 hr.										1 1/2
	1 to 3 hrs.									5	6 1/2
	Over 3 hrs.									10	11 1/2
48-54	Up to 1/2 hr.										2
	1/2 - 1 1/2 hrs.									5	7
	1 1/2 to 3 hrs.									10	12
	Over 3 hrs.									20	22
54-60	Up to 20 min.										2
	20 min.,3/4 hr.									5	7
	3/4 hr,-1 1/2 hr.									10	12
	1 1/2 to 3 hrs.								5	15	22
	Over 3 hrs.								10	20	32
60-66	Up to 15 min.										2
	1/4 to 1/2 hr.									5	7
	1/2 to 1 hr.								3	10	15
	1 to 2 hrs.								5	15	22
	2 to 3 hrs.								10	20	32
66-72	Up to 15 min.									2	4
	1/4 to 1/2 hr.								3	5	10
	1/2 to 1 hr.								5	12	19
	1 to 2 hrs.								10	20	32
72-78	Up to 20 min.									5	7
	20 to 45 min.								5	15	22
	3/4 to 1 1/2 hrs.								10	20	32
78-84	Up to 20 mins.									5	7
	20 to 45 min.								5	15	22
	3/4 to 1 1/4 hrs.								10	20	32
84-90	Up to 20 min.									5	10
	20 to 40 min.								5	15	22
	40 to 60 min.							3	10	15	30
90-96	Up to 20 min.								5	5	12
	20 to 35 min.								5	10	22
	35 to 55 min.							5	10	15	32
96-108	Up to 15 min.								5	5	12
	15 to 30 min.							3	7	10	23
	30 to 40 min.							5	10	15	33
108-120	Up to 15 min.							2	5	8	15
	15 to 25 min.							5	5	10	23
	25 to 35 min.							5	10	15	33
120-132	Up to 15 min.							2	5	7	17
	25 to 30 min.							5	10	25	33
132-144	Up to 15 min.							2	5	5	16
	15 to 25 min.						2	5	10	12	32
144-156	Up to 10 min.							2	5	5	16
	20 to 30 min.					2	3	5	8	10	31
156-168	Up to 10 min.						2	3	5	5	18
	20 to 35 min.					2	3	5	7	10	30
168-180	Up to 9 min.						2	3	5	5	18
	9 to 21 min.					2	3	5	7	10	30
180-192	Up to 15 min.					2	3	5	7	10	30
192-204	Up to 12 min.				2	2	3	5	7	10	32
204-216	Up to 10 min.		2	2	3	5	7	10	10	15	58
228-240	Up to 10 min.	2	2	3	5	7	10	10	15	15	73

Decompression Table No. 2.

Stoppages to be made during ascent after exceeding the ordinary limits of time on the bottom.

Depth Ft.	Time from leaving surface to beginning of ascent	Stoppages at different depths (Min.) 100 ft	90 ft	80 ft	70 ft	60 ft	50 ft	40 ft	30 ft	20 ft	10 ft	Total Time
66	Over 3 hours									10	30	42
72	2 to 3 hours									10	30	42
	Over 3 hours									20	30	52
78	1 1/2 - 2 1/2 hrs.									20	30	52
	Over 2 1/2 hours									30	30	62
84	1 1/4 to 2 hours									15	30	47
	2 to 3 hours								5	30	30	67
	Over 3 hours								10	30	35	77
90	1 to 1 1/2 hrs.								5	15	25	47
	1 1/2 - 2 1/2 hrs.								5	30	30	67
	Over 2 1/2 hours								20	35	35	92
96	55 min. - 1 1/2 hrs.								5	15	30	52
	1 1/2 - 2 1/2 hrs.								10	30	35	77
	Over 2 1/2 hours								30	30	35	102
108	40 min. to 1 hour								10	15	20	48
	1 to 2 hours							5	15	25	35	83
	Over 2 hours							15	30	35	40	122
120	35 min. to 1 hour							5	10	15	25	57
	1 to 2 hours							10	20	30	35	97
	Over 2 hours							30	35	35	40	142
132	1/2 to 3/4 hour							5	10	15	20	53
	3/4 to 1 1/2 hrs.						5	10	20	30	30	98
	Over 1 1/2 hrs.						15	30	35	40	40	163
144	25 min. - 3/4 hr.						3	5	10	15	25	61
	3/4 to 1 1/2 hrs.						10	10	20	30	35	108
	Over 1 1/2 hours						30	30	35	40	40	178
156	20 to 35 min.						3	5	10	20	20	61
	35 min. to 1 hr.						7	10	15	30	30	95
	Over 1 hour					20	25	30	35	40	40	193
168	16 to 30 min.						3	5	10	15	20	56
	30 min. to 1 hour					3	10	10	15	30	30	101
	Over 1 hour				5	25	25	30	35	40	40	203
180	14 to 20 min.						3	3	7	10	15	41
	20 to 30 min.					2	2	3	10	15	25	60
	30 min. to 1 hour				3	3	7	10	20	30	35	111
	Over 1 hour				15	25	30	30	35	40	40	218
192	13 to 20 min.						3	3	7	15	15	46
	20 to 30 min.					3	3	5	10	15	25	64
	30 min. to 1 hour				3	5	10	12	20	30	35	118
	Over 1 hour			5	20	25	30	30	35	40	40	228
204	12 to 20 min.					3	3	5	7	10	20	51
	20 to 30 min.				3	3	3	5	10	20	30	67
	30 min. to 1 hour			3	3	5	10	15	20	30	35	124
	Over 1 hour			15	20	25	30	30	35	40	40	238
225	10 to 20 min.			3	5	7	7	10	15	20	20	95
	20 to 30 min.		2	3	5	7	10	15	20	25	30	125
	30 min. to 1 hour		5	5	10	15	15	20	25	30	35	164
	Over 1 hour		10	15	20	25	30	30	35	40	40	249
250	10 to 20 min.		2	3	5	7	10	10	15	20	30	106
	20 to 30 min.	2	3	5	7	10	15	15	25	30	30	146
	30 min. to 1 hour	5	5	10	15	15	20	30	30	35	40	209
	Over 1 hour.	10	15	20	25	30	30	35	40	40	40	289

SIGNALS FROM TENDER TO DIVER

1 Pull. Are you all right; or when diver is going down, it means STOP.
2 Pulls. You have come up too far; go back down until we stop you
3 Pulls. Stand by to come up.
4 Pulls. Come up.
2-1 Pulls. I understand you; or, answer the telephone.

SIGNALS FROM DIVER TO TENDER

1 Pull. I am all right.
2 Pulls. Lower; or give me slack.
3 Pulls. Take up my slack.
4 Pulls. Haul me up.
2-1 Pulls. I understand; or, answer the telephone.

SEARCHING SIGNALS

1 Pull. Stop and search where you are.
2 Pulls. Go straight ahead.
3 Pulls. Go to your right.
4 Pulls. Go to your left.

AIR SIGNALS

3-2 Pulls. More air.
4-3 Pulls. Less air.

EMERGENCY SIGNALS

2-2-2 Pulls. I am fouled and need the assistance of another diver.
3-3-3 Pulls. I am fouled, but can clear myself.
4-4-4 Pulls. Haul me up.

SPECIAL SIGNALS FROM THE DIVER

2-1-2 Pulls. Send me a slate.
When the tender receives this signal, he will answer it with a 2-1-2 and stop off a slate on the lifeline and air hose. When this is done, he will give the diver 1 Pull. The diver will haul down until he gets the slate; he then gives the tender 1 Pull. When the diver has used the slate, he gives the tender 3 Pulls. The tender hauls up the slack until he gets 1 Pull from the diver, which will signify that enough slack has been hauled up.

1-2-3 Pulls. Send me a square mark.
When the tender receives this signal, he will answer it with 1-2-3 Pulls. He then stops off a piece of bunting on the lifeline and air hose about ten feet from the water's edge. When this is done, the same routine is carried out as for sending down a slate.

5 Pulls. Send me a line.

NOTE: All signals will be answered as they are received between tender and diver. When answering or giving signals all slack shall be taken up in lifeline and air hose until diver can be felt before signal is given. The proper method for giving a signal is to use a gentle, distinct Pull. Special signals, in addition to the above signals, may be made up between Diving Officer and Diver to take care of any salvage operations which may occur.

DIVING EQUIPMENT STOCKED IN
NEW YORK NAVY YARD

14 O 3105	Oil, neats-foot
17 B 7533	Batteries, storage (6 volt) - 100 amps.
17 C 755	Cable, D.A., Combination telephone and life line, 200 ft. lengths.
AL-17 T 2657	Telephone and spares
18 W 170	Watch, stop timer
21 H 105	Halliard, signal (shoe lacing)
21 L 260	Line, D.A., descending, 200 ft.
21 L 265	Line, D.A., distance 60 ft.
23 B 245	Bands, D.A., spare part
23 B 305	Buoys, D.A., cork
23 C 105	Cans, D.A., oil feeding
23 C 114	Carriers, D.A., welding rod
23 C 135	Chests, D.A. (2) helmet
23 C 140	Chest, D.A., outfit
23 C 210	Cushion, D.A., helmet
23 D 120	D.A. complete, #1
23 D 125	D.A. complete, #2
23 D 130	D.A. complete, shallow water
23 E 105	Expanders, D.A., cuff
23 F 105	Face plate, D.A., complete
23 F 107	Face plate, D.A., helmet, underwater welding
23 F 200	Filters, D.A., oil separator
23 G 130	Gauges, D.A., pressure indicating
23 G 135	Glass, D.A., helmet, face
23 G 140	Glass, D.A., helmet, side
23 G 145	Glass, D.A., helmet, top
23 H 155	Helmets, D.A., complete
23 L 105	Lauders, D.A., iron galvanized
23 L 167	Lenses, D.A., helmet, shade #4, welding
23 L 168	Lenses, D.A., helmet, shade #5, welding
23 L 169	Lenses, D.A., helmet, shade #6, welding
23 M 105	Manifolds, D.A.
23 N 110	Nuts, D.A., breastplate, large
23 N 115	Nuts, D.A., breastplate, small
23 R 105	Reducers, D.A., Type S
23 R 110	Reducers, D.A., Type T
23 S 145	Separators, D.A., oil
23 S 235	Stages, D.A. Decompression (No.2) (Small 1½ x 3 feet)
23 S 322	Stools, D.A., abrasive, wooden
23 S 335	Stud, D.A., Breastplate, long
23 S 340	Studs, D.A., Breastplate, short
23 T 115	Tank, D.A., testing, complete
23 V 100	Valves, D.A., air supply, control
23 V 105	Valves, D.A., exhaust (without exhaust section)
23 V 110	Valves, D.A., relief, spit cock
23 V 116	Valves, D.A., safety, non-return
23 W 90	Weights, D.A., cast iron, 25 lbs.
23 W 95	Weights, D.A., cast Iron, 50 lbs.
23 W 100	Weights, D.A., cast iron, 100 lbs.
23 W 140	Wrench, D.A., Spanner face
23 W 145	Wrench, D.A., safety valve
23 W 150	Wrench, D.A., T helmet
33 C 4-25	Cellulose strip
33 C 30	Clamp air hose, D.A. - 1-1/8 Inches
33 C 225	Cloth, D.A., rubber - No. 1 & 2.
33 C 300	Couplings, air hose, D.A., 1/2 Inch female
33 C 301	Couplings, air hose, D.A., 1/2" male
33 C 305	Couplings, air hose, D.A., double female, 1/2 inch
33 C 306	Couplings, air hose, D.A., double male, 1/2 inch

33 G 605	Gaskets, face plate, D.A.
33 G 610	Gaskets, helmet, leather, D.A.
33 G 615	Gaskets, oil-separator, leather, D.A.
33 H 16	Hose, air, D.A., high pressure, 3 ft.
33 H 18	Hose, air, D.A., high pressure, 50 ft.
33 H 17	Hose, air double female, D.A., 3 ft.
33 H 20	Hose, air, D.A., 3 ft.
33 H 25	Hose, air, D.A., 50 ft.
33 P 490	Packing, D.A., string graphite
33 T 75	Tubing, D.A., rubber, 3 ft.
33 W 45	Washers, D.A., air hose
33 W 50	Washers, oil-separator, D.A.
33 W 60	Washers, telephone couplings, D.A. No.1
	Washer, non-return valve, small (open purchase)
	Primary & secondary springs for valves (open pur.)
37 B 2850	Belts, D.A., weighted
37 C 3200	Cuffs, D.A.
37 D 280	Drawers, D.A., woolen, size 36
37 D 285	Drawers, D.A., woolen, size 38
37 D 290	Drawers, D.A., woolen, size 40
37 D 295	Drawers, D.A., woolen, size 42
37 D 300	Drawers, D.A., woolen, size 44
37 D 360-100	Dresses, D.A., rubber, No. 1
37 D 360-200	Dresses, D.A., rubber, No. 2
37 D 360-300	Dresses, D.A., rubber, No. 3
37 G 2170	Gloves, divers
37 J 400	Jock-strap, D.A., leather
37 S 800	Shoes, D.A., weighted
37 S 2100-110)	
37 S 2100-120)	Socks, D.A., woolen, Sizes 11, 12, 13.
37 S 2100-130)	
37-T-300	Trousers, D.A., overalls
37-U-75-360)-	Undershirts, D.A., woolen, size 36
37-U-75-380)	" " " " 38
37-U-75-400)	" " " " 40
37-U-75-420)	" " " " 42
37-U-75-444)	" " " " 44
41 K 855	Knives and cases
41 W 1020	Wrench, D.A., open end, 7/8"and 1-1/16"
41 W 1311-50	Wrench, D.A., open end, 1-7/16"
52 C 1315	Cement, rubber
	Spring, exhaust valve, primary (open purchase)
	Spring, exhaust valve, secondary (open purchase)
	Washers, valve, non-return, stem (open purchase)
	De-compression tables (Diving)
	New York Navy Yard
	Washington, D.C. Diving School
	Navy Training School (Salvage)
	Aud weather proof sockets and cable portable.

COMPLETE EQUIPMENT FOR DIVER AND STANDBY
STANDARD STOCK CLASSES

1 qt.	14 O 3105	Oil, neatsfoot
2	17 C 755	Cable, D.A., combination telephone and lifeline 200 ft. lengths.
2	17 B 9533	Batteries, storage, (6 volt) - 100 amps.
1	AL-17 T 2657	Telephone & spares
1	18 W 170	Watch, stop, timer
1	21 L 260	Lines, descending, 200 ft.
1	21 L 265	Lines, distance & circling, 60 ft.
1	21 H 105	Halliard, signal, 3/4", 20 ft.
2	23 W 95	Weights, D.A., 50#
4	23 L 169	Lenses, shade #6
4	23 L 168	Lenses, shade #6
2	23 C 210	Cushions, D.A., helmet
2	23 F 107	Face plate, helmet, welding
2	23 F 280	Filters, Sponge, D.A., oil separator
2	23 H 153	Helmets, D.A., complete
4	23 N 110	Nuts, large
8	23 N 115	Nuts, small
2	23 R 105	Reducers, type "S"
2	23 R 110	Reducers, type "T"
2	23 S 145	Separators, oil
3	23 S 335	Studs, long, breastplate
6	23 S 340	Studs, short, breastplate
2	23 V 100	Valve, D.A., control
1	23 V 110	Valve, regulating
2	23 V 116	Valves, non-return
1	23 W 145	Wrench, safety valve
4	23 W 150	Wrenches, helmet, "T"
1	23 M 105	Manifold, D.A.
1	23 G 135	Glasses, diving, face
1	23 G 140	Glasses, diving, side
1	23 G 145	Glasses, diving, top
8	33 H 18	Hose, air, D.A., 50 ft. lengths
2	33 H 16	Hose, air, 3 ft.
2 yds	33 C 225	Cloth, D.A., rubber
2 yds.	33 T 75	Tubing, D.A., rubber, 3 ft. lengths
2	33 C 305	Couplings, double female
5	33 W 45	Washers, air hose
5	33 W 60	Washers, telephone, coupling
1	33 G 605	Gaskets, face plate, rubber
1	33 G 610	Gasket, helmet, leather
1	37 D 360-100	Dress, Diving, #1
2	37 D 360-200	Dress, Diving, #2
1	37 D 360-300	Dress, Diving, #3
2	37 T 300	Trousers, D.A.
2	37 B 2050	Belts, leather, D.A., weighted
2	37 J 400	Jockstraps
2	37 S 800	Shoes, weighted
2	37 G 2170	Gloves, divers - tenders
1	37 U 75-360	Undershirts, diving, size 36
1	37 U 75-380	Undershirts, diving, size 38
1	37 U 75-400	Undershirts, diving, size 40
1	37 U 75-420	Undershirts, diving, size 42
1	37 D 280	Drawers, diving, size 36
1	37 D 285	Drawers, diving, size 38
1	37 D 290	Drawers, diving, size 40
1	37 D 295	Drawers, diving, size 42
3 pr.	37 S 2100	Socks, D.A., woolen
2	41 K 855	Knives and cases
2	41 W 1311-150	Wrenches, single, open end
1 gal.	52 C 1315	Cement, rubber
2		Springs, exhaust valve, primary (open pur.)
		Springs, exhaust valve, secondary (open pur.)
1 set		De-Compression Tables (Salvage Office)

SALVAGE DIVER

1. Be physically qualified.
2. Understand and operate air compressors.
3. Be able to dive and accomplish work to depths of 125 feet of water.
4. Be able to use hand and pneumatic tool under water.
5. Be able to operate under water the gas and electric cutting torch.
6. Be able to compute the pressure of gasses required to operate the gas underwater torch.
7. Know seamanship and how to sling and lift heavy weights, splicing wire, and manila rope.
8. Know the uses and how to use excavating nozzle.
9. Know the uses and how to operate air syphon.
10. Be able to read a blueprint.
11. Be able to enter a sunken vessel and work, from reading blueprint.
12. Understand the case, preservation, and use of all equipment, such as pump, hose, helmet, suits, etc.
13. Know how to test, repair, and adjust all equipment and determine if they are safe for use.
14. Be expert in dressing and tending a diver.
15. Know diving signals.
16. Have a detailed knowledge of decompression table and how to use them.
17. Understand first aid.
18. Know how and when to use recompression chamber.
19. Be able to equip a boat for diving.
20. Be able to estimate an underwater situation and give an intelligent description.
21. Know how to take measurements of underwater damage.
22. Know how to build template for underwater patch.
23. Know how to manufacture various patches for use under water.
24. Be able to secure patch and various methods used in securing same.
25. Be able to lay out set of beach gear.
26. Know how to set up high line gear and operate.
27. Know how to set up, operate, and care of water pumps.
28. Know how to shore decks and bulkheads for excess pressure.

NAVAL TRAINING SCHOOL
(SAILOR)

SHIP TERMS

BERTH DECK: A name applied to a lower deck at or near the water line on old vessels and used primarily for berthing purposes and not as a gun deck.

DOUBLE BOTTOMS: Water-tight subdivisions of a man-of-war next to the keel and between the outer bottom and inner bottom.

FORECASTLE DECK: A partial deck at the bow over the main deck.

FOURTH DECK: A complete deck next below the third deck.

GUN DECK: A name applied on old vessels to a deck carrying guns and between the main and berth decks.

HALF DECK: A partial deck above the lowest complete deck and below the main deck.

HOLD: The space below decks utilized for the stowage of ballast, cargo and stores.

MAIN DECK: The highest deck extending from stem or stern; in old vessels, the highest covered deck.

ORLOP DECK: A name applied to a lower partial deck below the berth deck and on or above the protective deck on old vessels.

PLATFORM DECK: A partial deck below the lowest complete deck; called first, second, etc., from the top, where more than one is found.

POOP DECK: A partial deck at the stern over the main deck.

PROTECTIVE DECK: The deck fitted with the heaviest protective plating.

QUARTER DECK: A name applied to the part of the upper deck reserved for the use of officers.

SECOND DECK: A complete deck next below the main deck.

SPLINTER DECK: The deck fitted with the lightest protective plating.

SUPERSTRUCTURE DECK: A partial deck above the main, upper forecastle, or poop deck, and not extending out to the side of the ship.

THIRD DECK: A complete deck next below the second deck.

UPPER DECK: A partial deck amidships, over the main decks.

ARMOR BELT: The width of armor carried on a man-of-war above and below the water-line.

BILGE: The curved part of the ship's hull where the sides and the flat bottom meet.

BILGE KEEL: The keel fitted at the turn of the bilge to check a vessel from rolling.

BOTTOM PLATING: The plating on a vessel's bottom.

BULKHEAD: Transverse or longitudinal partitions separating portions of the ship.

BULWARKS: The light plating or wooden extension of the ship's sides above the upper deck.

BUNKER: A compartment for the stowage of coal.

CARGO PORT: A square side-port for [illegible] loading or discharging cargo.

CARGO HATCH: A hatch over a cargo hold.

COAMING: The raised framework about deck openings.

COFFERDAM: A cellular subdivision usually filled with cellulose, found on old ships as a protection at the waterline.

COLLISION BULKHEAD: A water-tight athwartship bulkhead a short distance abaft the stem, for the purpose of confining damage due to a head-on collision.

CUT-WATER: The foremost part of the stem, cutting the water as the vessel forges ahead.

DEAD RISE: The angle of a ship's floor to the horizontal.

DEAD WOOD: The triangular shaped pieces forming the connection between the keel and the stem, and the stem post.

DECK BEAM: An athwartship beam supporting a deck.

LEAD LINE: Line of cotton twine, braided, for boat lead line; of flax twine, braided, for taffrail long line. The line is secured to the log.

LANYARD: A rope made fast to an article for securing it; e.g.: knife lanyard, busket lanyard, etc., or for setting up rigging.

PAINTER: A short piece of rope secured in the bow of a small boat, used for making her fast.

PREVENTER: A rope used for additional support or for additional securing; e.g. preventer backstay, preventer hawser, etc.

SLIP ROPE: A rope bent to the anchor cable outboard of the hawsepipe and secured on the vessel's quarter; used in slipping the cable.

STOPPER: A short length of rope secured at one end; and used in securing or checking a running rope; e.g.: deck stopper, boat-fall stopper.

TOPPING LIFT: A lift used for topping up a boom and sustaining its weight.

TRIPPING LINE: A line used for capsizing a sea anchor.

BELAY: To make fast to a pin or cleat.

BEND: (1) To make fast; e.g.: bend a cable is to make it fast to the anchor. (2) A knot by which a rope is made fast to another.

BIGHT: Any part of a rope except the ends; usually refers to a bend in a rope.

BITTER-END: The last part of a rope or the last link in an anchor chai

CATCH A TURN: To take a turn with a rope quickly, usually for holding it temporarily.

CLAP ON: (1) To seize a rope and haul away. (2) To make more, as clap on sail.

CLEAR FOR RUNNING: Ready to run out without fouling.

CLINCH: A half hitch stopped to its own part.

COW'S TAIL: The frayed or untidy end of a rope.

DEAD ROPE: A rope not lead through a block or sheave.

DOUBLE UP: To double a vessel's s[illegible] lines.

DOCKING KEEL: The heavy wooden keel fitted on flat-floor vessels outboard of the main keel for use in taking the ship's weight when in dock.

FALSE KEEL: A thin keel spiked to the lower side of the main keel of wooden or sheathed ships as a protection to the keel.

FLOOR PLATES: Removable iron plates forming the deck plating in fire and engine rooms.

FOREFOOT: The heel of the stem where it connects to the keel.

FRAME: The ribs of a ship, strengthening and supporting the shell plating.

FREEING PORT: A port about 3 feet long and 18 inches wide in the bulwarks for the purpose of freeing the deck of water.

FARBOARD STRAKE: The strake next to the keel.

HATCH: An opening in a ship's deck for communication or for handling stores or cargo.

INNER BOTTOM: The top of the double bottom and consisting of water-tight plating secured to the reverse frames.

INNER KEEL: The keelson.

KEEL: The timber or bar forming the backbone of the vessel and runnin from the stem to the sternpost at the bottom of the ship.

KEELSON: The longitudinal timber or bar bolted on top of the keel.

KNEE: An angular piece connecting a vessel's frame to the beams.

LANDING STRAKE: The second line of planking below the gunn-wale.

LONGITUDINAL: Fore-and-aft strengthening bars placed at intervals between the keel and the armor shelf or bilge margins.

NOSE: A vessel's cut-water.

OUTER KEEL: The vertical keel.

OVERHANG: The projection of the stern beyond the sternpost, and of the bow beyond the stem.

PLANKING: Broad planks used to cover a wooden vessel's sides, or covering the deck beams.

PORT: An opening in a ship's side--such as air-port, gun-port, or cargo-port.

PROW: The part of the bow above the water.

RIB: A frame of a vessel.

SHEER STRAKE: The uppermost strake of a vessel's side.

SHELL PLATING: The water-tight plating riveted to the frames.

SKEG: The continuation of the keel aft, protecting the propellers and taking the heel of the rudder.

STEM: The foremost vertical timber or casting and fitting into the forward end of the keel.

STERNPOST: The aftermost vertical timber or casting and fitting into the after end of the keel.

STRAKE: A continuous planking or plating fitted end to end from stem to stern of a vessel's side.

STRINGER: A horizontal plank or plate secured to a vessel's frames and supporting beam-ends.

STRUT: The bracket support for a vessel's tail shaft.

VERTICAL KEEL PLATE: A vertical plate running from stem to stern post and secured at its lower edge to the flat keel plate.

ACCOMMODATION LADDER: The portable steps from the gangway down to the water-line.

BREAKER: A small cask for fresh water carried in ship's boats.

BUCKLER: A plating fitted into a port or hawse pipe, to close it.

CHAIN LOCKER: A compartment forward where the chain cable is stowed.

FLAGSTAFF: The staff to which the ensign is hoisted.

JACKSTAFF: The staff fitted over the stem to carry the jack.

MANHOLE: A hole designed so as to admit a man's body and closed by a water-tight plate.

SCUTTLE-BUTT: The container of fresh water for drinking purposes and used by the crew; formerly it consisted of a cask.

SCUPPER-LIP: The metal projection at the bottom of a scupper for the purpose of keeping the water from the scupper clear of the ship's side

SEA COCK: A cock in a pipe connected to the sea; a vessel may be flooded by opening the sea cocks.

STANCHIONS: Wooden or metal uprights used as supports.

VENTILATOR COWL: The swivelled opening at the top of a ventilator.

VENTILATOR: A wooden or metal pipe used to supply or to exhaust air.

Waterway: The gutter at the sides of a ship's deck to carry off water through the scuppers.

WINDSAIL: A canvas trunk spread to admit air below decks.

CROW'S-NEST: The platform on the mast for the lookout.

FANTAIL: The part of the stern of a vessel extending abaft the stern-post.

FORECASTLE: The upper deck forward of the foremast.

FORE PEAK: The part of the vessel below decks at the stem.

HEAD: The ship's water closet.

MAGAZINE: The space provided for the stowage of explosives.

SHAFT ALLEY: The tunnels over the shafts.

SHELLROOM: The space provided for the stowage of shell.

STERN: The after part of the vessel.

UP TAKE: The enclosed trunk connecting a boiler or a group of boilers to the smoke stack.

DISPLACEMENT: The weight of the water displaced by a vessel.

FLUSH DECK: A continuous upper dock.

FREEBOARD: The distance from the waterline to the rail or covering board.

HAND HOLE: A small hole in shell plating for access by hand tools.

KETTLE-BOTTOMED: Having a flat floor.

LIGHTENING HOLE: A hole cut into shell plating in order to lighten the plate.

LIMBER HOLE: A hole cut in the framing near the keelson to allow water to flow fore-and-aft.

PLIMSOLL MARK: The circle with a horizontal line painted on the outside of some merchant vessels.

TUMBLE HOME: The inclination inboard of a vessel's sides.

WATERLINE: The line painted on the side of a vessel at the water's edge to indicate the proper trim.

DRAINAGE: The system of pipes and pumps installed on board ship to expel water.

FIRE MAIN: The large pipe running fore-and-aft underneath the protective deck for distributing water to the fire-plugs.

FLUSHING MAIN: The large pipe running fore-and-aft underneath the second deck for distributing flushing water.

MAGAZINE FLOODING SYSTEM: The salt-water system for flooding magazines

SEA SUCTION: A connection in the ship's side to the sea.

SECONDARY DRAIN: A drain smaller than the main drain and capable of removing small quantities of water by connection to pumps.

HAWSER: A large rope used for heavy work; such as towing.

HEAVING LINE: A small line secured to a hawser and thrown to an approaching vessel or to a dock, for a messenger.

HOGGING LINE: A chain bent to the dip rope and secured to a collision mat for hauling the mat under the side of the vessel.

JACOB'S LADDER: A ladder of rope with wooden steps used over the side and aloft.

FAKE: (1) A circle of a coil of rope; the coils overlap and the rope is clear for running. (2) To fake down is to coil down a rope.

FLEET: To shift from place to place, e.g.; to fleet forward on a boat-fall; specifically to draw the blocks of a tackle apart.

FLEMISH DOWN: To coil flat down on deck, each fake outside of the other, beginning in the middle and all close together.

GEAR: The general name for ropes, blocks and tackles of spars or sails.

IRISH PENNANT: An untidy loose end of a rope or article.

MESSENGER: A light line used for hauling over a heavier rope or cable; in old sailing ships, a line led to the capstain to assist in bearing in the chain.

REEVE: To pass the end of a rope through any lead such as a sheave or fair-lead.

SINGLE UP: To come up double lines so that only single parts remain secured.

VEER: To slack off and allow to run out; said of a change of direction of wind with the sun.

WIRE ROPE CLIPS: Clamps for holding two parts of wire together.

BREECH: The bottom of a block.

BRUSHING: The bearing of the sheave of a block on the pin.

CHEEKS: The sides of a block.

HOOK: The curved metal piece fitted at the top of an upper block and used for hooking the block.

PIN: The metal axle of a block upon which the sheave revolves.

SCORE: The groove cut in the sides of a block to take the rope or wire strap; blocks are now usually strapped with iron.

SHEAVE: The wheel of a block over which the fall of the block reeves.

SHELL: The casing of a block within which the sheave revolves.

STRAP: A rope, wire or iron binding encircling a block and with a thimble seized into it for taking a hook.

SWALLOW: The larger opening in a block above or below the sheave through which the fall leads.

THIMBLE: A wire or metal ring at the top of an upper block into which the hook secures.

DOUBLE BLOCK: A block with two sheaves.

FOUR-FOLD BLOCK: A block with four sheaves.

SINGLE BLOCK: A block with a single sheave.

TREBLE-FOLD BLOCK: A block with three sheaves.

SNATCH BLOCK: A single block siffed so that the shell or hook hinges so that the bight of a rope may be passed through it.

FOUR-FOLD PURCHASE: A tackle with two four-fold blocks--power = 8.

SINGLE WHIP: A tackle with a single stationary block--power = 1.

TWO-FOLD PURCHASE: A tackle with two double blocks--power = 4.

RENDER: To pass through freely.

STANDING PART: That part of the fall of a tackle which is made fast.

TWO BLOCKS: When the two blocks of a tackle have been drawn as close together as possible.

UP BEHIND: An order to cease pulling and slack up roundly so that the gear may be belayed.

VEER AND HAUL: To slack up and haul away alternately.

WALK BACK: In order to keep the [illegible] towards the belaying point.

DRIFTLEAD: A hand lead of from 14 to 20 pounds dropped over the side when at anchor to give notice if the vessel drags.

HAND LEAD: A lead of from 7 to 14 pounds used with the hand lead line for ascertaining the depth of water in entering or leaving port.

HEAVE THE LEAD: The operation of taking a sounding with the hand lead.

LEADSMAN: The seaman detailed to the chains for heaving the lead.

MARK: The fathoms of a lead line which are marked.

FEATHER: Turning the blade of an oar horizontally at the finish of a stroke.

GIVE WAY: In order to begin pulling.

GRAPNEL: A small anchor with four arms, used for dragging purposes.

GRAPPLING IRON: Same as grapnel.

SHACKLE: A horse-shoe shaped piece of iron or steel with eyes in the ends, closed by an egg-shaped bolt held in place by a forelock pin.

SHOT: A short length of chain, usually of 15 fathoms.

BITTS: A vertical wooden or iron timber or timbers projecting above the deck and used for securing gear.

CAPSTAIN: The vertical barrel situated on the forecastle and geared to the windlass.

CHAIN HOOK: Long metal hooks used in handling chain cable.

WILDCAT: A sprocket wheel on the windlass for taking the links of a chain cable.

WINCH: An engine secured on deck and fitted with drums or gypseys driven on a horizontal axle.

WINDLASS: An anchor engine used for heaving in the chain cable and anchor.

COME HOME: Said of an anchor when it drags toward the ship in heaving in.

DRAGGING ANCHOR: To haul the anchor along the bottom when it fails to hold.

FOUL ANCHOR: Said of an anchor when the cable is twisted about it.

FOUL HAWSE: Said of the hawse when moored and the chain does not lead clear of the other chain.

HEAVE IN: To haul in.

HEAVE ROUND: To revolve the drum of a capstan, winch or windlass.

HEAVE SHORT: To heave in until the vessel is riding nearly over her anchor.

SHORT STAY: When the anchor is nearly under the hawse hole.

NAVY DEPARTMENT
NAVAL SALVAGE TRAINING SCHOOL
PIER 88 - NORTH RIVER
NEW YORK CITY, N.Y.

MEMORANDUM

To: All concerned.

Subject: Salvage Divers, Qualifications of and additional compensation of.

Reference: (a) Duked ltr P2-5/S94(103)R:JLA of 18 Feb.1943 as published in Navy Department Bulletin (R-429) of 1 March 1943.
(b) BuPers Manual, Part D, Chapter 5, Para D-5326.
(c) BuPers Manual, Part D, Chapter 5, Para D-5327.

1. References (a), (b), and (c), which contain information relative to salvage divers are quoted herewith for the information of all concerned:

Reference (a):

"From: The Chief of the Bureau of Medicine and Surgery.
To: All Ships and Stations. P2-5/S94(103) R:JLA
Subject: DIVERS, SALVAGE, Physical Qualifications for. Feb. 18, 1943.

References: (a) BuPers Manual Art. D-5327 (1).
(b) Manual of Med.Dept.,Chap. 11,Paragraph 1536.

1. The Secretary of the Navy has approved physical qualifications for the rating "Diver, Salvage" which have been included in reference (a) by an approved modification.

2. For the duration of the present war candidates for "Divers, Salvage," shall meet the requirements of reference (b) except as follows:

(a) (1) Syphilis- history is not disqualifying if there has been adequate treatment and no signs of activity or organic involvement are discovered.

(b) Age- not over 40 years unless the applicant was employed in civilian life as a diver at the time of enlistment. In candidates over 40 years of age the examiner should carefully consider the general physical fitness of the individual in relation to his experience as a diver.

(c) Weight- moderate excess over standards is not disqualifying unless due to obesity.

(d) Vision- not less than 12/20 binocular vision without lenses.

(e) Defective color perception is not disqualifying.

(h) Breath holding- Candidates should be capable of holding the breath after full expiration and inspiration for a period of 30 seconds.

(i) Respiratory system- Deviation of the nasal septum is not disqualifying provided there is adequate ventilation.

(j) Cardiovascular system- (1) Candidates with moderate hardening of the peripheral vessels may be accepted provided there is no evidence of arteriosclerotic changes in the retinal vessels. Blood pressure should be commensurate with age and build of the individual. In general systolic pressure of 150 or more or diastolic pressure of 95 or more is disqualifying.

(2) Circulatory efficiency test- Not required.

(k) Teeth- Shall meet the requirements for enlistment in the U.S. Naval Reserve.

R.C.S. T. McINTIRE

NAVY DEPARTMENT BULLETIN Buried.
March 1, 1943 NR-429

Reference (b)

"D-5326. Permanent and Temporary Additions to Pay.

(3) An enlisted man, who is designated a master diver, a diver, first class, a salvage diver, or a diver, second class, in accordance with article D-5327, shall receive pay, in addition to the pay and allowances of his rating and service, in accordance with the act approved August 4, 1942, as follows:

(a) Master diver, $20 per month as long as designated as such and detailed or assigned to the duty of diving; plus 5 cents per foot of total depth for dives over 120 feet, or equivalent pressure, but not to exceed $10 per month; plus $5 per hour or fraction thereof while employed in diving in actual salvage operations in depths over 90 feet.

(b) Divers, first class, $15 per month as long as designated as such and detailed or assigned to the duty of diving; plus 5 cents per foot of total depth for dives over 120 feet, or equivalent pressure, but not to exceed $15 per month; plus $5 per hour for each hour or fraction thereof while employed in diving in actual salvage operations in depth over 90 feet.

(c) Salvage $12 per month as long as designated as such and detailed or assigned to the duty of diving; plus 5 cents

per foot of total depth for dives over 120 feet, in emergencies when permitted by senior officer present as provided for in Article D-5327(6) but not to exceed $18 per month; plus $5 per hour for each hour or fraction thereof while employed in actual salvage operations in depths over 90 feet in emergencies as provided for in Article D-5327(6).

(d) Divers, second class, $10 per month as long as designated as such and detailed to the duty of diving; plus 5 cents per foot of total depth for dives over 120 feet, in emergencies when permitted by the senior officer present as provided for in Article D-5372(6) but not to exceed $20 per month; plus $5 per hour for each hour or fraction thereof while employed in actual salvage operations in depths over 90 feet in emergencies as provided for in Article D-5327(6). This extra pay will accrue to divers, second class, only when regularly attached to a ship or station to which divers, second class, are authorized by Bureau circular letter. The number of such divers, second class, drawing this extra pay must not exceed the number of divers, second class, authorized for the particular ship or station. Divers, second class, while employed in diving in actual salvage operations in depths over 90 feet in emergencies will receive $5 an hour or fraction thereof while so employed, without application of the above restrictions.

(e) The following men shall receive extra compensation for diving duty at the rate of $30 per month:

(1) Divers, any class, assigned to duty with the Experimental Diving Unit, Navy Yard, Washington, D.C. In addition, these divers will receive $5 an hour for each hour or fraction thereof while employed in diving in actual salvage operations in depths over 90 feet. This compensation provided by subparagraphs (a), (b), (c) and (d) above.

(2) Enlisted men assigned to the duty of diving in connection with the submarine escape training tanks at the submarine bases, New London, Conn., and Pearl Harbor, T.H., not to exceed 10 men at each of the above escape training tanks.

(f) In accordance with the act approved August 4, 1942, amending the acts approved April 9, 1928, and January 16, 1936, enlisted men designated as divers, any class, employed as divers in actual salvage or repair operation in depths of less than 90 feet when the Officer in Charge of the salvage or repair operation shall find that extraordinary hazardous conditions exist, shall, in addition to the foregoing, receive the sum of $5 per hour for each hour or fraction thereof so employed. Extraordinary hazardous conditions shall be deemed to exist when:

(1) Dives are made inside a sunken vessel.
(2) Dives are made alongside a wreck where a jagged plating, debris, or other wreckage may tend to cut the hose lines or to tear the diver's dress.
(3) Dives are made in the open sea under adverse weather conditions or in the presence of a heavy ground swell, or strong undercurrents.
(4) Dives are made in waters exposed to imminent enemy attack.
(5) Live explosives are handled under water.

(g) In other conditions considered by the Officer in Charge as equally hazardous as those mentioned above , the facts shall be presented to the Bureau of Naval Personnel for determination in each case."

Reference (c)

"D-5327. Qualifications For Divers.

(1) Qualified divers are divided into four classes:
(a) Master divers.
(b) Divers, first class.
(c) Salvage divers.
(d) Divers, second class.

(2) Master divers are the most competent leading divers. They will be designated "master divers" by the Bureau. Any diver, first class, may be recommended by his commanding officer to the Bureau for the designation of "master diver" who--

(a) Has served at least one year with the designation of "Diver, first class."
(b) Meets the following requirements--
(1) Has qualifications of diver, first class.
(2) Averages 3.5 in efficiency in diving and as leader of men during the preceding year.
(3) Is able, while on the bottom, to direct two or more divers in their tasks.
(4) Is able to take charge of a diving operation in an efficient manner.
(5) Understands all types of air compressors habitually used in diving operations.
(6) Has knowledge of what a ship fitted for compressed air diving operations should carry, and has a practical knowledge of the air system.
(7) Understands the principles of Boyle's, Charles's and Dalton's laws and the theory of saturation and desaturation of the body fluids and tissues.
(8) Understands the different forms of caisson disease and treatments required and the conditions under which oxygen poising occurs.
(9) Has a thorough knowledge of the effects of such poisonous gasses as may be encountered in diving upon the respiratory system, and be familiar with approved methods of treatment.

(10) Understands the various factors which contribute to the contraction and severity of caisson disease, and form the basic principles of decompression laid down in the Diving Manual is able to devise the proper recompression and decompression tables for the treatment of caisson disease.

(11) Be recommended by the faculty of the deep-sea divers' school, Navy Yard, Washington, D.C., for master diver designation.

(3) Divers, first class, will be trained, qualified, and designated at the deep-sea diving school, Navy Yard, WASHINGTON, D.C. No man will be placed in training for diver, first class, at any other place without prior authority of the Bureau. A diver, first class, must have the following qualifications:

(a) Qualifications of a salvage diver.

(b) Must have completed satisfactorily the course at the deep-sea diving school at Washington,D.C.

(c) Be able to withstand pressures equal to 200 feet of water.

(d) Be able to dive and accomplish work at depths of 150 feet of water.

(e) Be able to use hand and power tools under water.

(f) Be able to operate under water the gas and electric underwater cutting torches.

(g) Understand in detail the operation and care of the machinery and apparatus required for underwater cutting.

(h) Be able to compute the pressures of gases required to satisfactorily operate the gas underwater cutting torch at various depths.

(i) Know the dangers that are associated with the use of such gases.

(j) Know underwater seamanship and how to sling and lift heavy weights.

(k) Know how to wash and reeve lines and to sweep wires and chains under submerged objects.

(l) Be able to enter a vessel with discrimination as to ability to get out; but only supervising officers will plan and decide on this.

(m) Know how to make air connections to different types of submarines.

(n) Know how to ventilate compartments of submerged vessels and make them habitable.

(o) Be able to recognize the symptoms of caisson disease.

(4) Salvage divers may be trained, qualified and designated on board any naval vessel or any naval station having the proper equipment and competent officer personnel for efficient and safe instruction. They shall have the same qualifications as divers, second class, and in addition the following:

(a) Must have demonstrated mechanical ability.

(b) Must know how to use pneumatic and hand tools under water.

(c) Must know how to use the oxygen-hydrogen torch and oxygen-electric torch under water.
(d) Must be proficient in performing underwater work such as taking measurements, making templates, making and fitting patches, using cement, shoring using the excavating nozzle, etc.
(e) Know how to maintain and operate salvage pumps, air compressors, winches, jacks, beach gear assemblies and skyline assemblies.
(f) Understand in general the salvaging of vessels and know how to install the necessary pumps and air compressors, and to lay the necessary beach gear for hauling off stranded vessels.

(5) Divers, second class, may be trained, qualified, and designated on board any naval vessel or at any naval station having the proper equipment and competent officer personnel for efficient and safe instruction. Divers, second class, will not be designated in excess of the number of divers, second class, authorized by the Bureau by circular letter for the particular ship or station. The qualifications for divers, second class, are-

(a) Be physically qualified in accordance with the Manual of the Medical Department.
(b) Understand the care, preservation, and use of all equipment, such as pumps, hose, helmets, suits, etc.
(c) Know how to test out, repair, and adjust all equipment, such as hose, pumps, dresses, helmets, breastplates, valves,etc., and determine whether they are safe for use.
(d) Understand the use of and be able to use storage compressed air and air supplied from power driven air compressors.
(e) Be alert in dressing and tending a diver.
(f) Know the diving signals thoroughly.
(g) Be thoroughly familiar with the theory and practice of decompression and have a detailed knowledge of the decompression table and how to use it.
Understand resuscitation and first aid.
(i) Be familiar with the contents of Diving Manual.
(j) Have knowledge of the physics of diving.
(k) Know the methods employed in recovering objects from the bottom and the precautions to be used in the recovering of a charged air flask and a torpedo.
(l) Know how and when to use the recompression chamber.
(m) Be able to equip a boat for diving.
(n) Be able to anchor a diving boat in wind and tide.
(o) Be able to perform work at fifty feet for a period of 1 hour. (This to constitute the qualifying dive).
(Opportunity should be given for diving at depths up to 150 feet. This qualification to be made by actual dives in water, when operating conditions permit. The Maximum depth for which qualified will be entered in the man's service record.)

(p) Be able to estimate an underwater situation and give intelligent description of the same.
(q) Be able to care for and operate the Navy standard oxygen breathing apparatus.
(r) Be able to assist a diver, first class, in depths up to 90 feet.

(6) Only master divers and divers, first class, will be permitted to dive at depths greater than 150 feet. Salvage divers and divers, second class, will not dive beyond the depth for which qualified, as stated in their service records, except for qualification purposes. In emergencies, the senior officer present shall be the judge of a deviation of the above.

(7) In the selection and training of men for divers, Commanding Officers and examining boards shall be guided strictly by the Navy Regulations, the Diving Manual, the Manual of the Medical Department, and current instructions.

(8) No man shall be allowed to dive until he has been given the physical examination outlined in the Manual of the Medical Department.

(9) All diving operations shall be under the personal direction of a qualified officer, who shall maintain a close contact with the medical officer in order to eliminate accidents.

(10) Unless specific authority is obtained in advance from the Bureau to cintinue his designation, the designation of any master diver or diver, first class, will lapse upon the xpiration of 6 months from date of last qualification, if during these 6 months he has not made four dives in water, each dive to a depth of not less than 150 feet, and remain under water, from the surface to the beginning of the ascent, as follows:

Depth In Feet	Time Under Water, From Surface To Beginning of Ascent - Minutes
150 to 168	15
168 to 250	10

If the designation should lapse, an entry to this effect will be made in the service record. Aman whose designation has so lapsed shall not be permitted to dive again until requalified, except for requalification or in emergencies, of which the senior officer present shall be the judge. This requalification may be made at the nearest ship or station which is equipped with personnel and equipment to safely conduct same in accordance with subparagraph (3), provided that the designation has not lapsed continuously for more than one year. If for more than one year, permission to requalify must be obtained from the Bureau which will designate the place where requalification will be made.

No man shall be designated a master diver except by the Bureau. No man shall be redesignated a diver, first class, except by the Bureau or the deep-sea diving school, Washington, D. C.

(11) The designation of any salvage diver, or diver, second class, will lapse upon the expiration of six months from the date of last qualification, if during these six months, he has not made four

dives in water to the depth of at least 50 feet and remained under water from the time of leaving the surface to the beginning of the ascent, 45 minutes. If designation should lapse, an entry to this effect will be made in the service record. A man whose designation has so lapsed shall not be permitted to dive again until requalified, except for requalification or in emergencies, of which the senior officer present shall judge. Such men may be redesignated salvage divers, or divers, second class, by a ship or station if requalified in accordance with paragraphs (4) and (5) respectively.
(12) Dives made in actual salvage operations will count for retaining designation, provided the dives meet the characteristics described in paragraphs (10) and (11).

Where a diver is habitually employed in prolonged salvage operations in which the depths are less than those required in subparagraphs (9) and (10), special recommendations will be considered by the Bureau to count same for retaining designations.
(13) Entry of designation or redesignation and dates thereof for all divers shall be made in the service record at the time, and a corresponding notation shall be made on the reverse of the discharge certificate.
(14) The designation of salvage diver and diver, second class, may be revoked by commanding officers. Commanding officers may recommend to the Bureau the revocation of the designations of master diver and diver, first class, giving reasons.
(15) Each ship or station allowed divers (any class) will forward a report to the Bureau in duplicate, on the first day of each quarter, using Form B.N.P. 629, containing the following information:

(a) Name in full.
(b) Rating.
(c) Class of diver.
(d) Date designated or last redesignated.
(e) Dates of qualifying dives made during preceding quarter. (If none, indicate date of last qualifying dive).
(f) Maximum depth in feet of dives.

A similar report, quarterly, is required from ships and stations having master or first class divers on board, in cases where no actual allowance of divers is authorized."