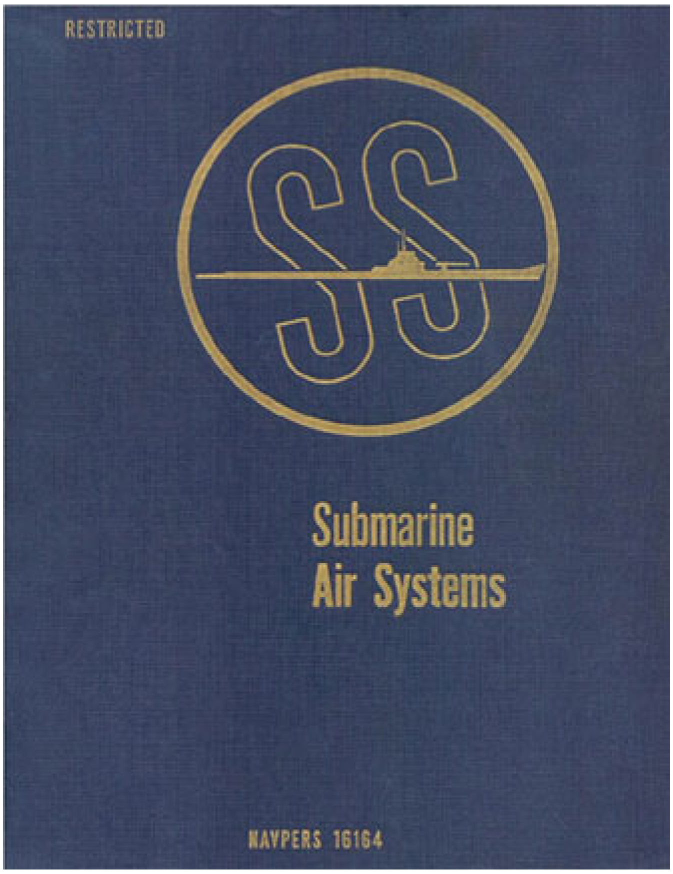
The Fleet Type Submarine Online
Submarine Air Systems



Folks,

Submarine Air Systems, Navpers 16164, is of a series of submarine training manuals that was completed just after WW II. The series describes the peak of WW II US submarine technology.

In this online version of the manual we have attempted to keep the flavor of the original layout while taking advantage of the Web's universal accessibility. Different browsers and fonts will cause the text to move, but the text will remain roughly where it is in the original manual. In addition to errors we have attempted to preserve from the original (for example, it was H.L Hunley, not CS Huntley), this text was captured by optical character recognition. This process creates errors that are compounded while encoding for the Web. Please report any typos, or particularly annoying layout issues with the Mail Feedback Form for correction.

Our thanks to Shelly Shelstad, creator of History on CD ROM for permitting us to use images he has scanned, particularly the oversized images that were meticulously pieced together. History on CD ROM sells a very nice CD or thumb drive version of this manual in PDF format for easy access off the web and for a printing. Thanks also to IKON Office Solutions (now Ricoh USA http://www.ricoh-usa.com) for scanning services.

Richard Pekelney
Webmaster

NavPers 16164

SUBMARINE

AIR SYSTEMS

June 1946

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This is one of a series of Submarine Training Manuals. The series includes:

1. The Fleet Type Submarine	NavPers 16160
2. Submarine Main Propulsion Diesels	NavPers 16161
3. Submarine Electrical Installations	NavPers 16162
4. Submarine Refrigerating and Air-Conditioning Systems	NavPers 16163
5. Submarine Distilling Systems	Navpers 16163A
6. Submarine Air Systems	NavPers 16164
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		16166
9.	Submarine Sonar Operator's Manual	NavPers 16167
10.	Submarine Underwater Log Systems	NavPers 16168
11.	Submarine Hydraulic Systems	NavPers 16169
12.	Torpedo Tubes, 21-Inch submerged, Mks 32 to 39	O.P. 1085

PREFACE

This manual is designed to teach the importance of the air systems on a submarine, the many and indispensable forms of work performed by each system, and the methods of operating each system for specific tasks.

Just as air is the very essence of life to a human being, so the air systems control the operation and life of a submarine. Every man on board a submarine should understand the air systems and be able to operate the air manifolds efficiently. This text, which is intended for use during the ashore training period and by the forces afloat, is presented for the purpose of assisting in the attainment of both objectives.

The descriptions and illustrations used in this manual may be considered as typical for all fleet type submarines. The arrangement of the tanks and the components of the air systems described are typical and do not apply in every detail to all classes of submarines.

The Submarine School, Submarine Base, New London, Connecticut, and other activities of Submarines, Atlantic Fleet, have collaborated in the preparation of this manual.

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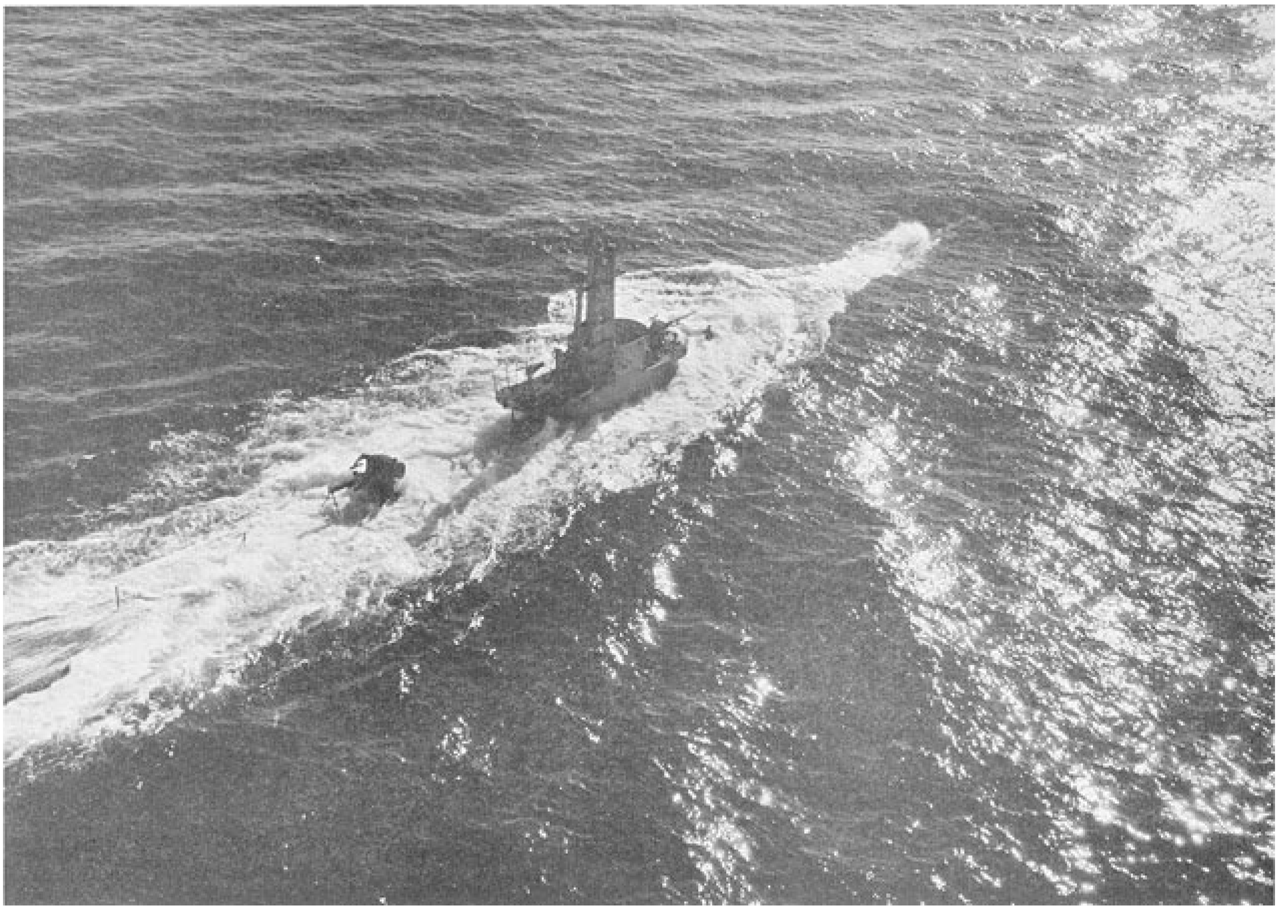

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1
INTRODUCTION

A. GENERAL

1A1. Importance of the air systems to submarines. The importance of the air systems to a submarine cannot be overemphasized since virtually every operation in the diving and surfacing procedure is dependent upon air provided by one or more of the air systems. Some of the more important operations depending on air pressure are the following:

a. The main hydraulic system operates because of the air pressure maintained in the air-accumulator flask.

b. Torpedoes are discharged from the submarine by air.

c. Tanks are blown by air.

d. The main propulsion engines are started by air.

Air, or more specifically compressed air, is necessary in order to surface, submerge, attack, and cruise. These functions, of course, are in addition to the use of compressed air and oxygen to revitalize the air in the ship after long periods of submergence. Pressure in the boat, a test for tightness, utilizes air.

The air systems represent, therefore, one of the most functions many of the operations performed in a submarine.

1A2. Basic principles of compressed air. The basis of the air systems is compressed air, which as the name implies, is air under pressure confined within the limits of a container. The force required for compression of the air is provided by the high-pressure air compressor, a simple machine which compresses air by means of a series of pistons, designed so that one or more pistons discharges air into another for further compression and finally through lines to banks for storage. Air can be compressed easily aboard a submarine, as it requires a relatively small plant and comparatively simple equipment. It can be stored at any convenient place and is always ready for use. Its action can be regulated to produce a low or high pressure, and yet it has enough elasticity or compressibility to cushion its impact against the equipment it operates. It consumes no valuable materials and can be supplied to any part of the submarine by simply extending a line from the air supply. Air, once stored, requires no further expenditure of energy for operation; but rather is a source of power for the operation of other equipment.

versatile of all systems aboard a submarine, in that they are capable of performing either as primary or secondary

B. TYPES AND RELATIONSHIPS OF AIR SYSTEMS

1B1. General information. There are five separate air systems on the submarine: the 3000-pound high-pressure and torpedo impulse system, the 600-pound main ballast tank (MBT) blowing system, the 225-pound service air system (ship's service air), the 10-pound main ballast tank (MBT) blowing system and the salvage air system. (See Figure 1-1.)

The 600-pound MBT blowing system and the 225-pound service air system receive their supply of air from the 3000-pound air system. The 10-pound MBT blowing system is an independent system with its own low-pressure blower. The internal compartment salvage air system is dependent upon the 225-pound service air system, while the external compartment salvage air system is entirely dependent upon an outside source for its supply of air.

1B2. The 3000-pound and torpedo tube impulse air system. The 3000-pound air system consists of the 3000-pound high-pressure compressors, the high-pressure manifold, the interconnecting piping, valves, and compressed air banks. The main function of the 3000-pound air system is to compress, store, and supply air at the maximum pressure of 3000

pounds per square inch for use within the 3000-pound, the 600-pound, and the 225-pound systems.

The 3000-pound air system also supplies air to the hydraulic accumulator air-loading manifold and to the forward and after 600 pound Grove reducing valves which supply the forward and after torpedo tube impulse-charging manifolds.

The 3000-pound air system is equipped with an external charging connection so that the addition to blowing the variable group of tanks, provides the compressed air for all the miscellaneous services aboard the submarine. The 225-pound system consists of the 225-pound service air manifold, interconnecting piping, and various valves.

1B5. The 10-pound MBT blowing system. When the submarine has surfaced, the 10-pound main ballast tank blowing system is used to conserve the compressed air stored in the ship's air banks. The system consists of its own low-pressure blower, control

system may be supplied with air from an outside source.

1B3. The 600-pound MBT blowing system. The function of the 600-pound MBT blowing manifold and system is to remove water ballast from the main ballast tanks, or the fuel ballast tanks when they are used as main ballast tanks, during surfacing of the submarine. It receives its supply of compressed air from the high-pressure system through the distributing manifold.

1B4. The 225-pound service air system. The 225-pound service air system or, as it is sometimes called, ship's service air, in manifold, and piping to the various main ballast tanks. The 10-pound system is operated only after the submarine has surfaced sufficiently to permit the opening of induction valves and hatches.

1B6. The salvage air system. This system actually consists of three separate systems the MBT external salvage, compartment external salvage, and compartment internal salvage. The external salvage connections permit compressed air from an outside source to be supplied to the tanks and/or compartments, while the internal salvage system utilizes the ship's air for compartment salvage only.

Figure 1-1. COMPREHENSIVE SCHEMATIC OF AIR SYSTEMS.

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Figure 1-1. COMPREHENSIVE SCHEMATIC OF AIR SYSTEMS.

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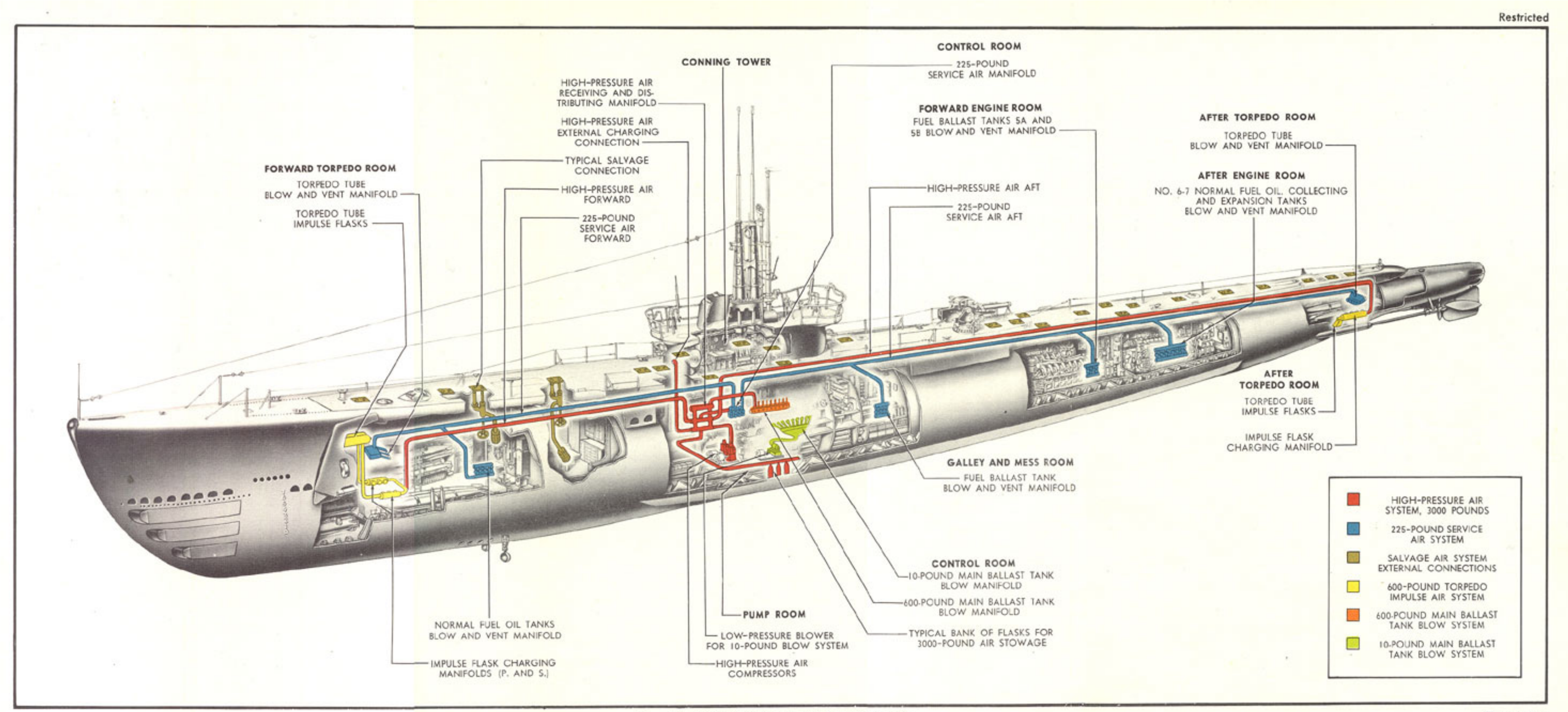

Figure 1-1. COMPREHENSIVE SCHEMATIC OF AIR SYSTEMS.

Figure 2-1. HIGH-PRESSURE AIR SYSTEM.

2
HIGH-PRESSURE AIR AND TORPEDO IMPULSE AIR SYSTEM

A. GENERAL DESCRIPTION

2A1. Introduction. Figure 2-1 shows the location and relationship of the individual units that comprise the high-pressure 3000-pound air system. It must be noted that 3000 pounds is the maximum working pressure of the system and not a constant pressure; actually, the pressure may vary between 1500 and 3000 psi. The system is hydrostatically tested up to 4500 psi or 150 percent of the working pressure. The system extends from the high-pressure air compressors in the pump room to the receiving and distributing manifolds in the control room, and from there forward to the torpedo impulse air system in the forward torpedo room, athwartship to the air banks, and aft to the torpedo impulse air system in the after torpedo room.

In Sections 2A2 through 2A4, immediately following, a more detailed description of the general layout of the high-pressure air system is given. In Sections B through F of this chapter, component parts of the system are described and the function of each is explained.

valves and engine-starting flasks in each engine room. The reducing valves furnish engine-starting air at a pressure of 500 psi, either directly from the 3000-pound air service lines, or from the engine-starting flasks which store the air for use in starting the diesel engines.

The distributing manifolds distribute air to the safety and negative tank blow lines, the main ballast tanks blow manifold, the hydraulic accumulator air flask, the high-pressure air bleeder, the bow buoyancy tank blow line, the 225-pound service air system, and the forward and after 3000-pound service air lines.

2A3. Air banks. Each of the five air banks consists of seven flasks, with the exception of the No. 1 air bank, which has eight. Each flask is provided with a drain valve. The total capacity of the air banks is 560 cubic feet. The No 1 air bank is located inside the pressure hull, with four flasks in each battery compartment. The other four air banks are located in the main ballast tanks. (See Figure 2-1.)

2A4. Torpedo impulse air system. The torpedo impulse air

Complete instructions for specific operations of the 3000-pound air system, and schematic drawings showing the flow of it within the system are given in Chapter 7.

2A2. Manifolds and lines. The high-pressure manifold (made up of a receiving manifold and two distributing manifolds) is mounted on the starboard side of the control room. The receiving manifold receives air from two high-pressure air compressors, and directs it to the air banks, where it is stored. As the air is needed, it flows back through the same piping to the receiving manifold, where it is directed to the distributing manifold. This operation is controlled by the valves on the manifold. (See Figure 2-2.)

The 3000-pound service air lines supply air at a pressure up to 3000 psi to the forward and after torpedo rooms and to the reducing system stores and controls the air used to discharge the torpedoes from the tubes in firing.

The 3000-pound air service line forward, extending from the distributing manifold, ends with a 3000-pound to 600-pound reducing valve, from which a line leads to the forward torpedo impulse air system. This system is composed of two impulse flask charging manifolds (Figure 2-1) and six impulse flasks, connected by lines to the manifolds. The impulse flasks are mounted above the pressure hull in the superstructure forward. One impulse flask charging manifold is located on the port side of the torpedo room and the other on the starboard side. Each manifold is used to charge three flasks with 600-pound air.

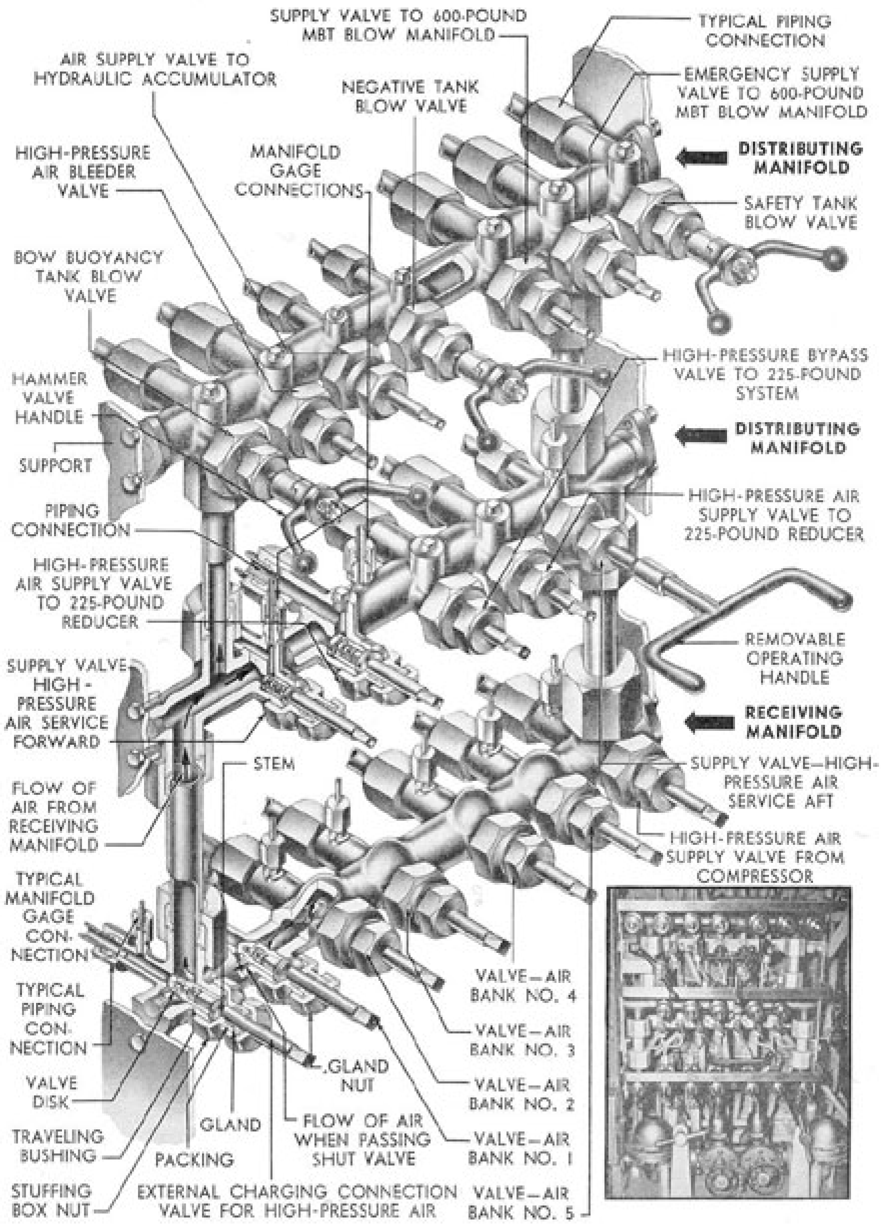

Figure 2-2. High-pressure air manifold.

The 3000-pound air service line aft, extending from the distributing manifold, ends with a 3000-pound to 600-pound reducing valve, through which air is furnished to the after torpedo impulse air system. This system consists of one impulse flask charging manifold with lines leading to the four impulse flasks provided for the four after torpedo tubes. The impulse flasks are mounted below the after torpedo room deck; the manifold is located on the starboard side. (See Figure 2-3.)

In both the forward and the after sections of the torpedo impulse system, a bypass valve and line are provided, leading from the 3000-pound air service line to the charging manifold. The bypass valve and line allow the charging of the impulse flasks in the event of failure of the reducing valves.

B. HIGH-PRESSURE AIR MANIFOLD

2B1. Description. As explained in Section 2A2, the high-pressure manifold is used to direct the storage and distribution of air within the 3000-pound air system.

The high-pressure air manifold is mounted on the starboard side of the control room, with the valves facing inboard.

Pressure gages which indicate the pressure in each air bank and in the receiving manifold are mounted directly above the manifold.

Figure 2-2 shows the mechanical construction of the manifold. It is composed of one receiving manifold and two distributing manifolds, interconnected to allow air to flow through all three. The manifolds are in horizontal layers, one above another, with the receiving manifold at the bottom.

The receiving manifold has seven valves which control connections to the five air banks, the external charging connection, and the supply line from the high-pressure air compressors.

The lower distributing manifold has five valves which control connections to the two reducing valves of the 225-pound air system, the bypass line to the 225-pound air system, and the forward and after 3000-pound service lines. On some of the older fleet type submarines, there is an additional valve at

The upper distributing manifold has seven ports which connect in sequence to the bow buoyancy tank blow valve, the high-pressure air bleeder valve, the air valve to the hydraulic accumulator, the negative tank blow valve, the supply valve to the 600-pound MBT blow manifold, the emergency supply valve to the 600-pound MBT blow manifold, and the safety tank blow valve.

The inset in Figure 2-2 shows the hammer valves (older type boats) which are the high-pressure blow for bow buoyancy, negative, and safety tanks in the lines between the high-pressure manifold and the above mentioned tanks. Note that this arrangement differs from the high-pressure manifold illustrated in Figure 2-2 where the hammer valves for blowing bow buoyancy, negative, and safety tanks are on the manifold itself.

Air at pressures up to 3000 psi is delivered by the compressors through the receiving manifold to the air banks where it is stored. As the air is needed, it flows back from the air banks to the receiving manifold. To place an air bank on service, the valve that controls that bank at the receiving manifold is opened. An air bank should be placed on service only if its pressure gage registers above 1500 psi.

When the submarine is rigged for surface, one air bank is on service. When it is rigged for diving, three banks are placed on service.

each end of the lower distributing manifold which controls the supply of air from the receiving manifold to the distributing manifolds.

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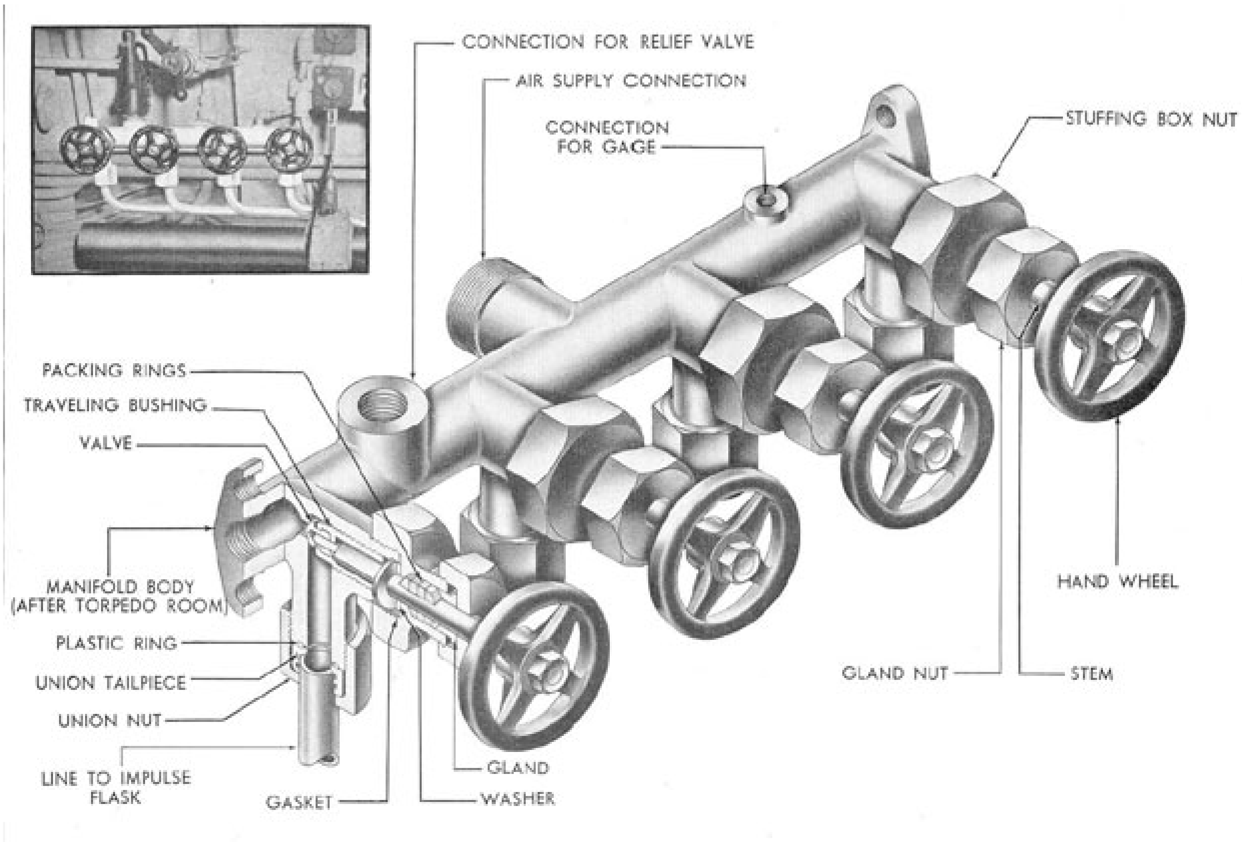

Figure 2-3. After torpedo impulse charging manifold.

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FIGURE 2-4. HIGH-PRESSURE AIR COMPRESSOR.

C. HIGH-PRESSURE AIR COMPRESSORS

2C1. Description. The air used in the 3000-pound air system is compressed by two high-pressure air compressors mounted in the pump room, one on each side of the centerline.

The air compressors are of the four-stage vertical type with a direct electric motor drive. Starting and stopping of the

On the downward stroke of the two second stage pistons the air is compressed to a pressure of 170-185 psi and is forced past the second stage discharge valves. This air passes through the second stage intercooler, giving up its heat of compression for that stage.

The air then enters the third stage through its suction valves, on the

compressors are controlled by manually operated electric switches located in the pump room near the compressors. The mechanical details of the compressor and its accessory equipment are shown in Figure 2-4.

The major components of the high-pressure compressor are the cylinder blocks with compression stages or cylinders, the center frame which houses the crankshaft, and the base which supports the entire assembly and contains the first and second stage intercoolers.

The left-hand cylinder block consists of the third stage cylinder head and shell serving as a head for the left-hand first and second stage (differential) cylinder. The right-hand cylinder block is similar, except that the fourth stage cylinder head and shell form the head of the right-hand first and second-stage (differential) cylinder. Each differential cylinder (left- and right-hand) contains a differential piston operating both the first and second stages. There is one piston for the third stage and one for the fourth. The third and fourth stage pistons are of the built-up type and are attached to the top of the first and second stage (differential) pistons.

2C2. Compression stages. When the compressor is operating, air at atmospheric pressure enters through the top inlet port, passes through the strainer, muffler, and first stage suction valves, and enters the two first stage cylinders on the downward downward stroke of the third stage piston. On the upward stroke of the third stage piston, this air is compressed to 800-860 psi and is forced past the third stage discharge valves. This air passes through the third stage intercooler, giving up its heat of compression for that stage.

The air then enters the fourth stage cylinder through its suction valves on the downward stroke of the fourth stage piston. On the upward stroke of the fourth stage piston, the air is further compressed and discharged through the fourth stage discharge valves and against the pressure that happens to be in the bank being charged, thus building up the pressure in the bank to 3000 psi. This air passes through the aftercooler, the check valve, the separator, the charging stop valve, and up to the high-pressure receiving manifold.

Each compression stage is furnished with a safety valve, two thermometers, a pressure gage, a water separator, and a drain valve. The safety valves are set to blow when the internal pressure in the stage exceeds the allowable safe working pressure. The thermometers indicate the air temperature at the inlet and outlet port of each stage. The pressure gages, grouped together on the gage board, indicate the pressure condition within each compression cylinder. The drain valves are used to drain moisture from each stage cooler separator.

2C3. Lubrication. Lubrication is accomplished by two systems, the pressure system and the forced-feed lubricator. The forced-feed

stroke. The upward stroke of the first stage piston compresses this air to 31-38 psi and forces it past the first stage discharge valves. This air passes through the first stage intercooler, giving up its heat of compression, and then through the second stage suction valves and the two second stage cylinders on the upward stroke.

lubricator, controlled by four adjusting knobs, supplies oil to the piston rings, cylinders, and air valves. The pressure system is supplied with oil by a rotary oil pump actuated by the crankshaft. Oil circulates

from the oil sump, through a Cuno oil filter to all bearing surfaces in the compressor. Oil for the pressure system is cooled by the oil cooler attached to the after end of the bed plate.

2C4. Cooling. As in the automobile engine, the pistons and cylinders of the compressor must be cooled to prevent damage by the heat developed by the compression of air. A water-circulating system is used for this purpose. Cooling water is supplied to the pipe header by means of a water pump attached to the left side of the center frame. From there, water is distributed through branch piping to the intercoolers, the aftercooler, the oil cooler, and the cylinder water jackets. Finally, it is discharged overboard.

The relief valves at the second and third intercoolers and at the aftercooler are set to open when the, water pressure in the system exceeds 150 psi. The cooling system requires approximately 35 gallons of water per minute at 70 degrees Fahrenheit.

2C5. Operating principles. Each compressor has a capacity of 20 cubic feet per hour at 3000 psi.

To start the compressor, the valves in the water cooling line, the discharge drain valve in the fourth stage, and all drain valves from the air piping of the compressor are opened. Then the motor is started by pressing the push-button controls, and the speed is regulated by adjusting the rheostat. After the normal speed has been reached, the first, second, third, and fourth stage drain valves are closed successively, allowing the pressure within the stages to be built up gradually. The oil pressure must also be up to the proper point before the machine is placed in service.

In securing the compressor, the current is turned off and all stage drain valves are opened. The pressure within the compressor is gradually reduced. The check valve at the aftercooler prevents the compressed air in the ship's banks from backing up.

The speed of the compressor should never exceed 550 rpm, because overspeeding may

damage the moving parts and the valves.

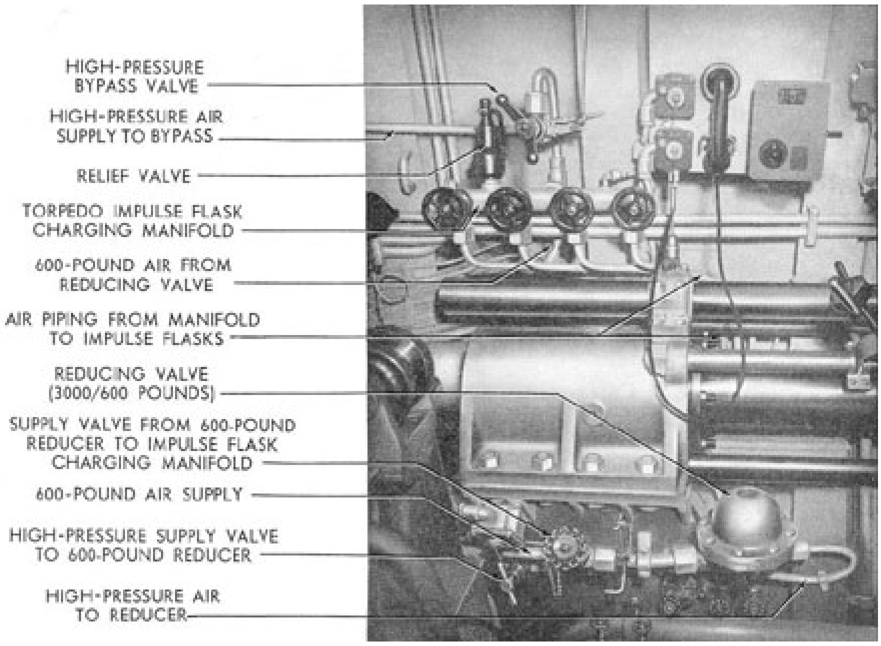

Figure 2-5. Reducing valve and bypass to torpedo impulse charging manifold.

D. TORPEDO IMPULSE FLASKS

2D1. Description. The impulse flasks, forming part of the impulse air system mentioned in Section 2A4, are steel cylinders, dome-shaped at each end. One of the domed ends is flanged and is provided with a port which connects to the impulse lines. There is an impulse flask for each torpedo tube. The six flasks that are mounted in the superstructure above the forward torpedo room are approximately 5 feet 10 inches in length and 16 inches in diameter; the four flasks mounted below the after torpedo room deck are approximately 5 feet 3 inches, in length and 18 inches in diameter.

A torpedo impulse flask has a capacity of approximately 7 cubic feet. It stores air which is the torpedo impulse charging manifold at a pressure of 600 psi. The air that is stored in the impulse flasks is used in firing the torpedoes from the torpedo tubes. A swing check valve prevents the air from being forced back to the manifold. Each impulse flask is connected to the corresponding torpedo firing valve by a line bypassing the swing check valve.

When the torpedo firing valve is opened, air from the impulse flask discharges into the breech of the torpedo tube, forcing the torpedo out of the tube.

The impulse flask, charging manifold, valves, and lines are tested hydrostatically to a pressure of 900 psi or 150 percent of the maximum working pressure.

received through the charging line from

E. BYPASS AND REDUCING VALVES FOR 600-POUND TORPEDO TUBE IMPULSE AIR SYSTEM

2E1. Description. The reducing valves provide the torpedo tube impulse system with 600-pound air by reducing the 3000-pound pressure of the high-pressure air system to 600 pounds. In practice, the reducing valves may be set below 600 pounds for a lower impulse pressure.* Bypass lines with manually operated bypass valves are provided to supply high-pressure air directly from the 3000-pound service lines to the torpedo impulse system in the event of failure of a reducing valve, or in the event that an impulse pressure above the reducer setting is required.

One reducing valve is installed at the end of the forward 3000-pound air service line on the starboard side of the forward torpedo room, and another at the end of the after 3000-pound air service line in the after torpedo room. The bypass valve and line are located above the reducing valve in each case. (See Figure 2-5.) In the forward torpedo room, the reducing valve and the bypass valve and line supply two torpedo impulse flask charging manifolds. In the after torpedo room, they supply one manifold.

The reducing valves are of the balanced

*Pressures as low as 300 pounds at periscope depth are used.

pressure type, set to receive air at a pressure of 3000 psi and to discharge it at a pressure of 600 pounds.

The mechanical construction of the valve is shown in Figure 2-6. A detailed description is given in Section 4C.

2E2. Operation. To supply air to the torpedo impulse air system, the stop valves on both sides of the reducing valve are opened. This allows air to enter the high-pressure side of the reducing valve. When the pressure in the torpedo impulse flask charging lines is less than 600 psi, the diaphragm in the reducing valve unseats the valve disk, permitting the high-pressure air to enter the lines. The entering air is instantly reduced to the required pressure by the valve action. It continues to flow until a pressure of 600 psi has been built up in the torpedo impulse flask charging lines. With the slightest drop in the pressure on the discharge side of the reducing valve, the pressure in the dome forces the valve open, allowing a controlled volume of air to pass, and thereby maintaining the delivery at a constant pressure of 600 pounds.

The bypass valve allows air to enter the torpedo impulse flask charging manifold

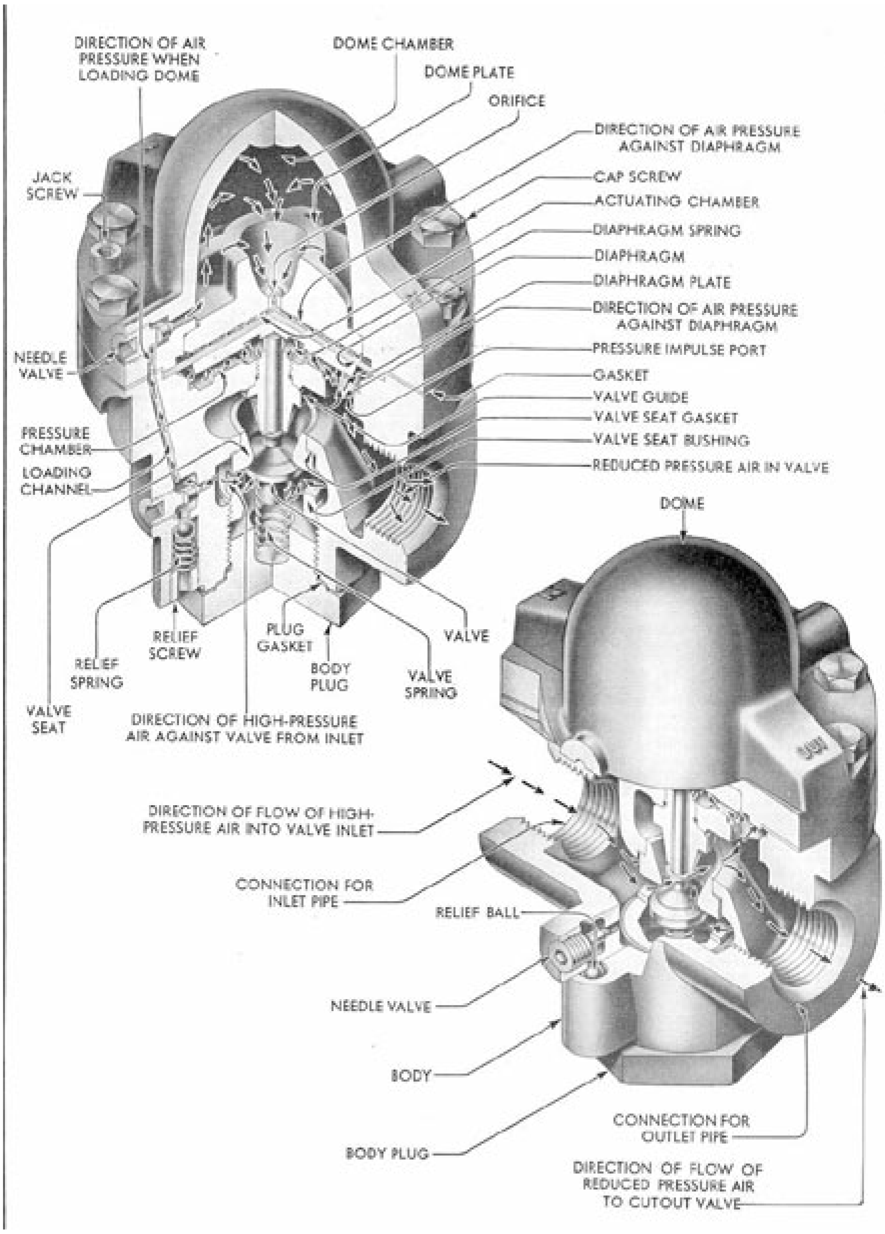

Figure 2-6. Grove reducing valve.

directly from the 3000-pound service line without passing through the reducing valve. The bypass valve should be opened slowly, allowing the high-pressure air to enter the lines gradually. It should be shut as soon as the pressure gage registers 600 psi in the torpedo impulse air system.

F. TORPEDO IMPULSE CHARGING MANIFOLDS

2F1. Description. The torpedo impulse flask charging manifolds charge the torpedo impulse flasks described in Section 2D. operated by a handwheel, on the rim of which is stamped the function of the valve.

There are three such manifolds aboard the vessel, two in the forward torpedo room each serving three flasks, and one in the after torpedo room serving four flasks.

Figure 2-3 is an illustration of the charging manifold in the after torpedo room. Its construction is typical of all three manifolds. It consists of a cast-bronze body, cylindrical in shape, with four valves and pipe connections leading to the four impulse flasks, a supply line connection, a pressure gage connection, and a relief valve connection. The relief valve, of the type described in Section 4I, is set to blow when the pressure in the manifold exceeds 675 psi. Each valve is

The two impulse flask charging manifolds in the forward torpedo room are of similar construction, except that each serves only three impulse flasks and therefore is provided with only three valves and pipe connections.

Air is supplied to the charging manifolds at 600 psi from the 3000-to-600-pound reducing valve described in Section 2E. To charge a flask, the reducing valve must be opened to permit air to enter the chamber of the manifold. When the manifold pressure registers 600 pounds, the valve directing the flow from the charging manifold to the selected impulse flask is opened. The flask is fully charged when its pressure gage reads 600 psi.

Figure 2-1. HIGH-PRESSURE AIR SYSTEM.

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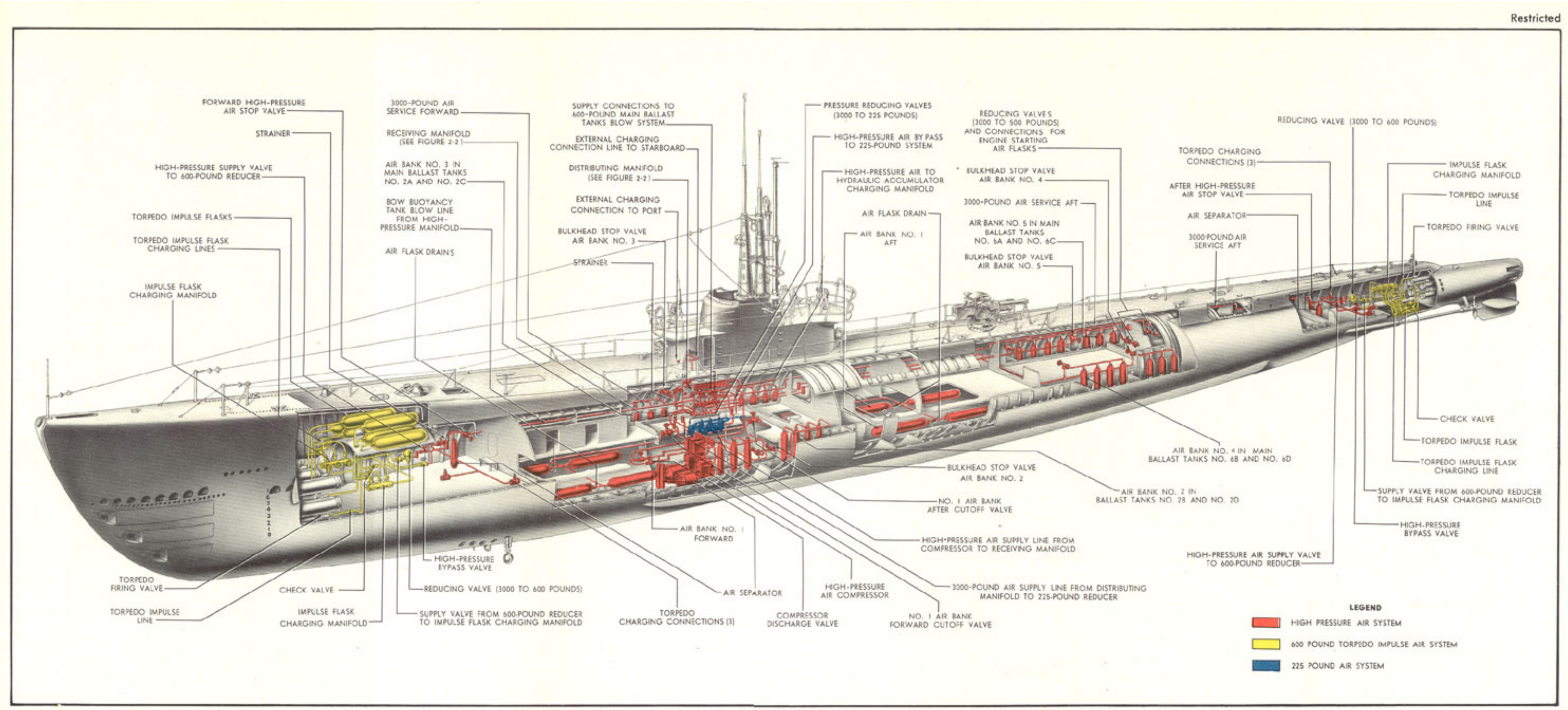

Figure 2-1. HIGH-PRESSURE AIR SYSTEM. Figure 2-1

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FIGURE 2-4. HIGH-PRESSURE AIR COMPRESSOR.

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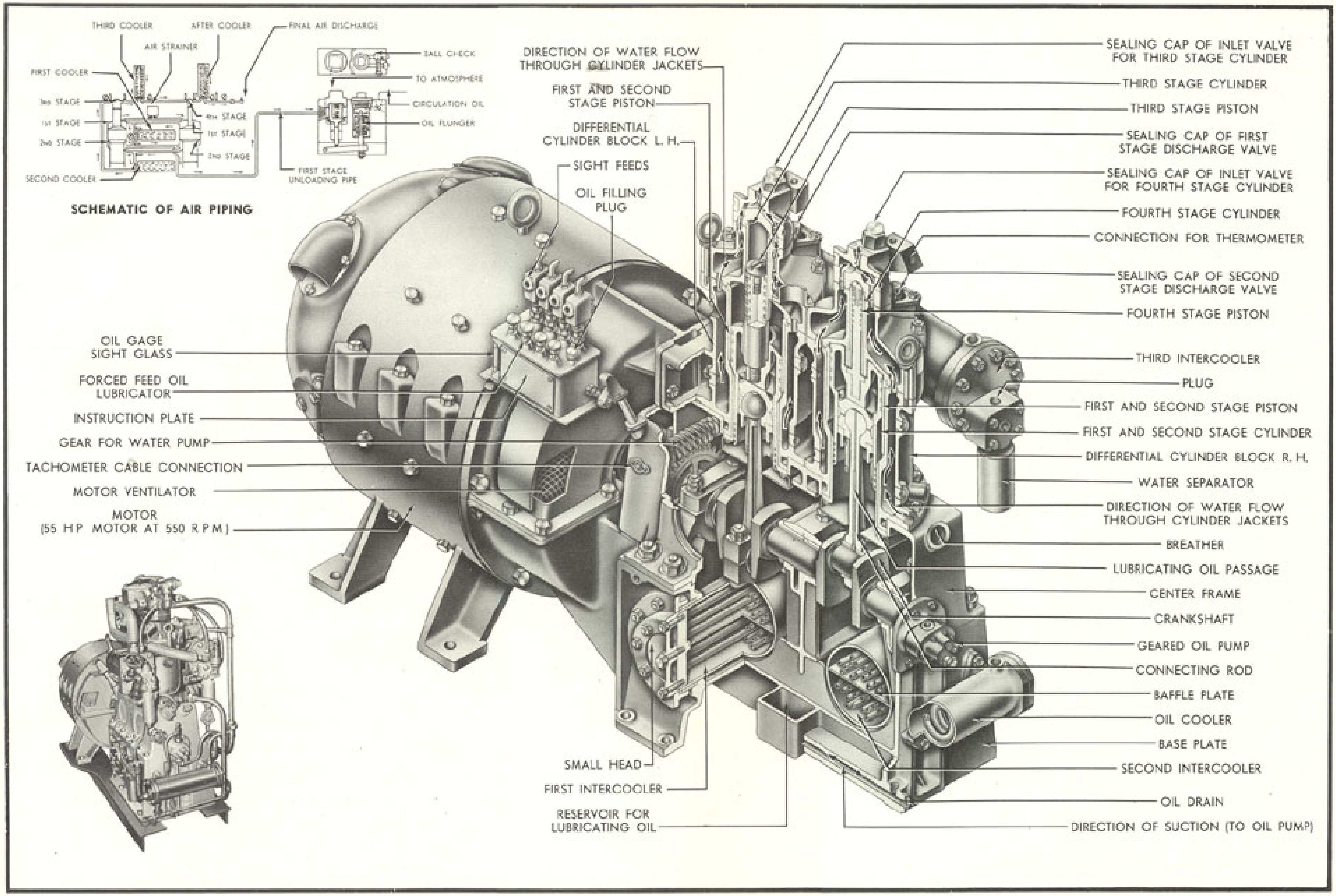

FIGURE 2-4. HIGH-PRESSURE AIR COMPRESSOR.

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3
THE 600-POUND MAIN BALLAST TANK BLOWING SYSTEM

A. GENERAL DESCRIPTION

3A1. Introduction. The main ballast tanks are normally filled with sea water when the submarine is submerged. These tanks cannot be pumped; therefore, when the submarine is surfacing, compressed air must be used to blow the water out through the flood ports to the sea.

Two separate systems are provided to blow the main ballast tanks. This chapter deals with the first of these, the 600-pound MBT (main ballast tank) blowing system. The second system, the 10-pound MBT blowing system, is used only when the ship is surfaced. It is discussed in Chapter 5.

Figure 3-1 shows the location of the lines and component parts of the 600-pound MBT blowing system. The system is inside the pressure hull and extends from the MBT blowing manifold in the control room fore and aft along the starboard side to the main ballast tanks and fuel ballast tanks.

The MBT blowing manifold, described in Section 3B, is the distribution control unit of the one does not supply enough air or in case of failure, the other hammer valves can be used. The group stop check valves permit the blowing of tanks by groups. The manifold is protected by a sentinel valve and two relief valves (Figures 4-8 and 4-9) set to blow when the pressure in the 600-pound system reaches 750 psi. The sentinel valve is set to blow at a pressure of 610 psi. When the sentinel valve opens, it acts as a relief valve for comparatively small rises in pressure and gives notice of excess pressure in the system.

To supply air to the 600-pound MBT blowing system, one of the hammer valves is opened. The valve permits air from the 3000 pound manifold to enter the MBT blow manifold at a reduced pressure. The pressure gage of the MBT blow manifold is closely watched, to guard against the pressure exceeding 600 psi.

3A3. Operation. The depth at which the submarine is operating will have a direct effect on the resistance offered to the air in blowing the main ballast tanks and therefore will build up the pressure within the system more rapidly at greater depths than it will on the surface. Since the hammer valve regulates the volume of air entering the 600-pound MBT blowing system, while the resistance offered

system. It is located on the starboard side of the control room with its pressure gage next to it. The piping mounted directly above the manifold connects the MBT blowing manifold with the high-pressure air manifold, through two hammer valves.

The maximum working pressure of the 600-pound main ballast tank blowing system is 600 psi. It is tested hydrostatically to a pressure of 1000 psi, or 166 percent of the maximum working pressure.

3A2. Hammer valves. Air at bank pressure (1500 to 3000 psi) passes through two manually operated hammer valves and two group stop check valves to the 600-pound MBT blowing manifold. The flow of the air is regulated by the hammer valves so that it is delivered at the required pressure. Normally only one hammer valve is used for blowing; in case to this air varies with submerged depth, it follows that when submerged at great depths, the hammer valve must be opened cautiously, otherwise the pressure within the system will build up rapidly and exceed the safe working pressure. When the gage indicates that the pressure is dropping, the hammer valve is opened wider to maintain the required pressure. When blowing is finished, the hammer valve is shut.

Blow lines extend from the forward section of the 600-pound MBT blow manifold to tanks No. 1 MBT, Nos. 2B and 2D MBT, Nos. 2A and 2C MBT, and Nos. 3A and 3B

Figure 3-1. THE 600-POUND MAIN BALLAST TANK BLOWING SYSTEM.

FBT. From the after section of the manifold, blow lines to tanks Nos. 4A and 4B FBT, Nos. 5A and 5B FBT, Nos. 6B and 6D MBT, Nos. 6A and 6C MBT, and No. 7 MBT. Any tank, or any combination of tanks, can be blown by opening the required individual tank valve, or the 600-pound MBT blow manifold on the distributing manifold are open.

To operate the 600-pound MBT blow system, the hammer valve is opened and air is admitted to the blow manifold, from which it is directed to the main ballast tanks by the lines of the system.

valves, the group valves, and finally the hammer valves.

When the submarine is rigged for diving, all the blow valves on the manifold, except the fuel ballast tank valves, are open, as are the two group stock check valves. (See Section 3B.) The individual regulator valves at the main ballast tanks are open, while the MBT blow hammer valves on the 600-pound manifold are shut. The two supply valves to

At the point where each blow line enters the tank, it is provided with a regulator valve. The regulator valve acts as a combination stop and check valve and is equipped for securing the stop in any position required to equalize the flow of air into the tanks.

Detailed instructions for blowing specific tanks or combination of tanks are given in Chapter 8.

B. THE 600-POUND MAIN BALLAST TANK BLOW MANIFOLD

3B1. Description. The 600-pound MBT blow manifold directs the flow of air within the 600-pound MBT blowing system. It is located on the starboard side of the control room, adjacent to and aft of the low-pressure (225-pound) manifold, with the connecting piping directly above it (see Figure 3-2).

The 600-pound MBT blow manifold is made up of two parts, the forward section and the after section. The upper half of Figure 3-2 shows the construction of the forward section of the manifold. The after section is of similar construction (lower half of Figure 3-2) except that it contains one additional blow valve. The forward section has four blow valves and the after section of the manifold has five blow valves.

The blow valves and the two group stop check valves have

Both sections of the 600-pound MBT blow manifold, as well as the lines carrying the 600-pound air, are capable of withstanding depth pressure.

High-pressure air, controlled* by one or both manually operated hammer valves, passes through the group stop check valves into the two sections of the 600-pound MBT blow manifold. From there it is directed by the blow valves into the blow lines connecting with the main ballast tanks. When all the tanks are to be blown simultaneously, the tank blow valves on the manifold, the two group stop check valves, and a hammer valve are opened in the order given. When the tanks in either the forward or the after group are to be blown, the blow valves, the group stop check valve for that group, and the hammer valve are opened. When the tanks are to be blown separately, the individual tank blow valves, the corresponding group stop check valve or valves, and the hammer valve are opened in the order given.

no permanently attached handles, but are provided with square-ended stems. A double-handled socket wrench is supplied to fit these stems, and the valves are opened and shut by applying the valve wrench to one stem at a time. This lessens the possibility of accidentally opening or shutting the wrong valve.

The stems of the blow valves for the fuel ballast tanks are furnished with chain-attached locking caps and padlocks as a safe guard against accidental blowing of the tanks when they contain fuel oil.

When the ship is rigged for diving, all individual tank blow valves on the 600-pound MBT blow manifold, as well as the two group stop check valves, are open.

Detailed instructions for main ballast tank blowing operations are given in Chapter 8.

*Hammer valves are not automatic reducers. They control air pressure only by regulating the volume of air admitted to the system.

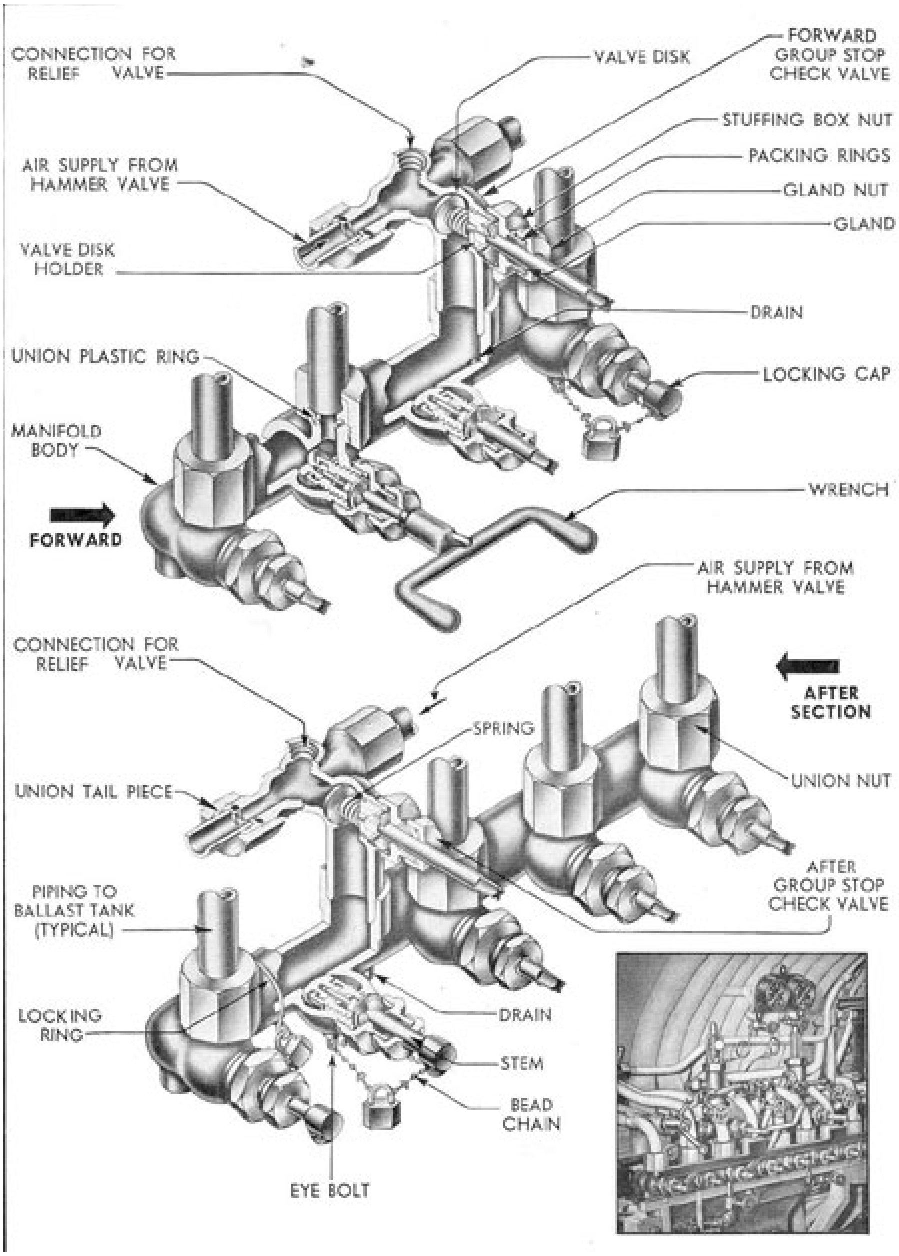

Figure 3-2. The 600-pound MBT blow manifold.

Figure 3-1. THE 600-POUND MAIN BALLAST TANK BLOWING SYSTEM.

Sub Air Home Page

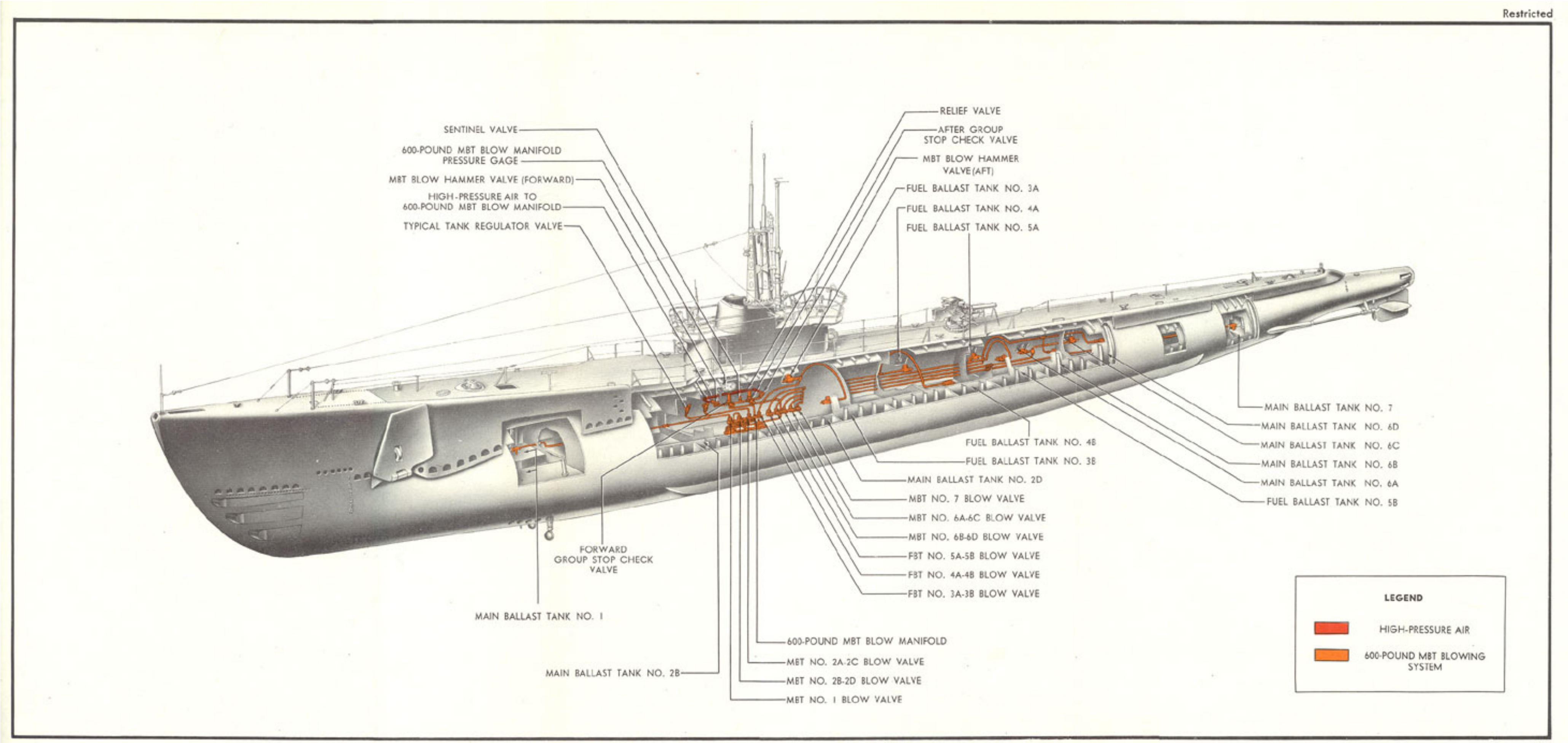

Figure 3-1. THE 600-POUND MAIN BALLAST TANK BLOWING SYSTEM

Figure 3-1

Figure 4-1. THE 225-POUND AIR SYSTEM.

4
THE 225-POUND AIR SYSTEM

A. GENERAL DESCRIPTION

4A1. Introduction. The 225-pound compressed air system, known as the ship's service air system, performs or controls many operations other than those discussed in the chapters dealing with the 3000-pound, the torpedo impulse, and the 600-pound air systems. The 225-pound air system provides the air for approximately 100 operations which are discussed in later sections of this chapter and in Chapter 9. The system extends from the forward torpedo room to the after torpedo room, with service connections in every compartment of the vessel, and supplies air at pressures ranging from 225 to 8 psi. The center of direction of the system, the 225-pound service air manifold (see Section 4B) is located in the control room. The 225-pound system is hydrostatically tested to 350 psi or 155 percent of its maximum working pressure of 225 psi.

Figure 4-1 shows the nomenclature, location, and relationship of the parts of the system. Detailed descriptions of the main components of the system are given in later sections of this chapter.

the 225-pound bypass which is controlled by a manually operated 225-pound bypass valve located at the high-pressure distributing manifold. When the 225-pound bypass is used, the high-pressure air bypasses the reducing valves and is admitted directly into the 225-pound system. The bypass valve is opened only partly, so that the pressure can be built up gradually. The 225-pound manifold pressure gage must be watched constantly and the pressure must never be allowed to go beyond 225 psi.

The 225-pound air system is protected by one sentinel valve and two relief valves located in the line between the Grove reducers and the 225-pound manifold.

If the air within the 225-pound system reaches a pressure of approximately 250 psi, the sentinel valve opens, allowing the excess air to escape into the compartment. The sentinel valve has a comparatively small capacity, and serves primarily to warn that the normal working pressure is exceeded.

If the rise in pressure is rapid and above the capacity of the sentinel valve, the two relief valves, set to operate at 275 psi, open and allow

Discussion of the ship's service air system will start with the control room, describing each component part of the system located there, and explaining its function in the operation of the submarine A similar procedure will be followed for each of the compartments of the vessel, proceeding first forward and then aft of the control room.

4A2. Control room. The 225-pound service air manifold is located in the control room on the starboard side, aft of the high-pressure manifold. This manifold receives its air supply through two Grove pressure-reducing valves, which reduce the high-pressure air from 3000 psi to 225 psi. Stop valves are provided on the low-pressure side of the 225-pound Grove reducers, cutting them off the 225-pound system. This permits removal of Grove reducer without impairing the operation of the 225-pound system. The 225-pound service air manifold can also be supplied from the excess air to escape into the compartment.

The relief valves and the sentinel valve shut automatically when the normal working pressure is restored.

The supply line from the Grove reducing valves has two branches. One branch supplies 225-pound air to the hydraulic oil supply volume tank, the signal ejector, the drain pump air domes, the negative tank blow valve, and the sea pressure and depth gage blows. The other branch supplies air to the 225-pound service air manifold. This air is directed by means of valves to the forward and after service air mains, the auxiliary tank blow and vent line, and the forward and after trim tank blow and vent lines. A hose connection to the manifold provides for air supply from the dock or tender.

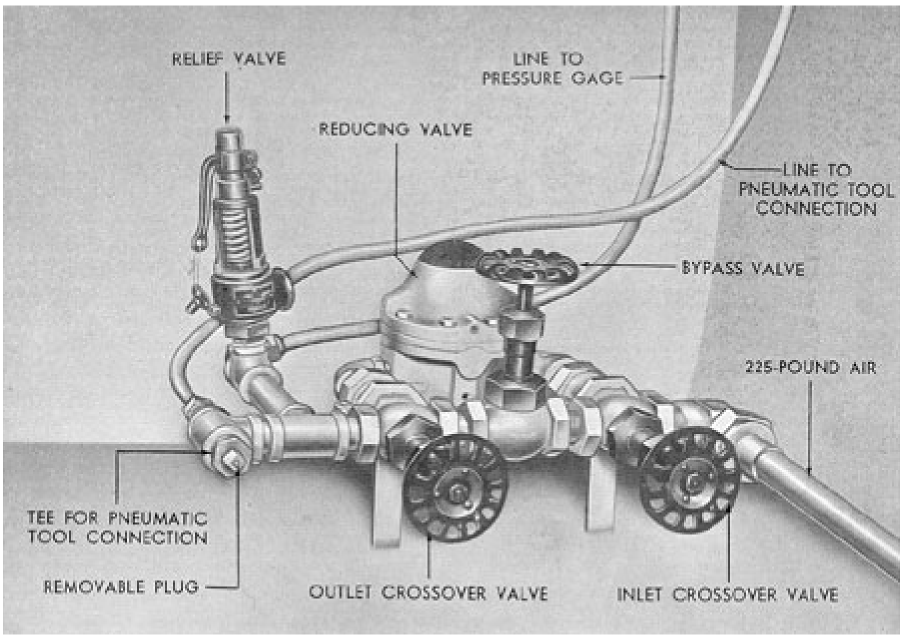

Figure 4-2. Pneumatic tool connection.

A line from the forward service air main is provided with a reducing valve which furnishes air at a pressure of 100 psi to a connection for pneumatic tools. (See Figure 4-2.) A bypass is provided for emergency operation, with a relief valve set to open at a pressure of 110 psi as protection against excessive pressure.

The after service air main carries a connection supplying air to the whistle and siren.

The after service air main has branch connections to the sea pressure gage and to the compartment salvage air. It supplies air through a reducing valve, at a pressure of 12 psi, to fresh water tanks Nos. 3 and 4. A bypass is provided for emergency operation, with a relief valve set to open at a pressure of 15 psi.

4A3. Forward battery compartment. In the officers' quarters, the forward service air main supplies the compartment air salvage valve, mounted on the after bulkhead. This valve can be operated from either side of the bulkhead. A branch of the service air line, passing through an 8-pound reducing valve, supplies air at a pressure of 8 psi to the four battery fresh water tanks, Nos. 1, 2, 3, and 4, in the forward battery compartment. A bypass line is provided for emergency operation, with a relief valve set to open at a pressure of 10 psi.

4A4. Forward torpedo room. In the forward torpedo room, the forward service air main extends to the torpedo tube blow and vent manifold (Figure 4-1.). The service air main is also provided with branch lines to the torpedo stop cylinders, the escape trunk blow, the volume tank, the sanitary tank, the QC and JK sea chests, the Pitometer log, the compartment air salvage valve, and the fuel oil blow and vent manifold. Two other branch lines, equipped with reducing valves and bypass lines, furnish air at 100 psi to the

pneumatic tool connection, and at 12 psi to the No. 1 and No. 2 fresh water tanks. The line to the escape trunk supplies air for the ship's diver's air connection, and a blow and vent line supplies the escape chamber. The forward trim tank blow and vent line from the 225-pound manifold in the control room terminates at the forward trim tank and connects with the forward trim

4A8. After engine room. In the after engine room, the after service air main has direct connections to the compartment air salvage valve, the auxiliary engine shutdown, and the air manifold which controls the blowing and venting of the Nos. 6 and 7 normal fuel oil tanks, the expansion and the collecting tanks. A relief valve, set to open at 15 psi, protects the Nos. 6 and 7

tank blow and vent line from the forward torpedo tube blow and vent manifold.

4A5. After battery compartment. The galley and mess room compartment has one connection from the after service air main, which supplies air to the blow and vent manifold for fuel ballast tanks 3A, 3B, 4A, and 4B. A second connection through an 8-pound reducing valve supplies air at 8 psi to the four battery fresh water tanks, Nos. 5, 6, 7, and 8, located in the after battery compartment. A bypass is provided for emergency use with a relief valve set to open at 10 psi. The lines for blowing and venting the auxiliary ballast tanks connect from the 225-pound manifold to the auxiliary ballast tank angle stop valves, located at the tank top in this compartment.

4A6. Crew's quarters. In the crew's quarters, the after service air main supplies air to the crew's forward water closet and the No. 2 sanitary tank blow line. The sanitary tank is equipped with a relief valve set to open at 105 psi.

4A7. Forward engine room. The forward engine room has direct connecting lines from the after service air main to the compartment air salvage valve, the No. 5A and No. 5B fuel ballast tank manifold, the exhaust valve operating gear, and the lubricating oil tanks' blow and vent manifold. The supply to the fuel oil manifold is protected by a relief valve set to open when the pressure exceeds normal fuel oil tanks and the expansion and collecting tanks against excessive internal pressure. A pneumatic tool connection is also provided; it is equipped with a 100-pound reducing valve, a 110-pound relief valve, and a bypass line to supply air at 100 psi.

4A9. Maneuvering room. The maneuvering room contains lines extending from the after service air main to the after water closet, the compartment air salvage valve, and the main engine shutdown connection.

4A10. After torpedo room. In the after torpedo room, the service air main has branches leading to the 225-pound compartment air supply valve for the escape hatch, the torpedo tube stop cylinder, the volume tank, and the pneumatic tool connection. The pneumatic tool connection is provided with a 100-pound reducing valve and a bypass protected by a 110-pound relief valve. The service air lines terminate at the after torpedo tube blow and vent manifold.

The after trim tank blow and vent line, which extends from the 225-pound manifold in the control room, connects with the after trim tank by a branch line extending to the after torpedo tube blow and vent manifold, similar to that of the forward torpedo room. The compartment air salvage valves are mounted on the transverse bulkheads of each compartment so that they may be operated from either side, releasing air into the compartment from which they are worked or into the adjoining compartment. The compartment air pressure gages are also mounted on either side of the

15 psi. The air for the lubricating oil manifold is reduced to 13 psi by a reducing valve. A bypass is provided for emergency operation, with a relief valve set to open at 15 psi. In addition, the forward engine room is provided with a pneumatic tool connection equipped with a 100-pound reducing valve and a bypass for emergency. A relief valve set to open at 110 pounds safeguards the line against excessive pressure. bulkheads to permit a reading of air pressure in the adjoining compartment.

All manifolds and lines equipped with reducing valves and blow valves are provided

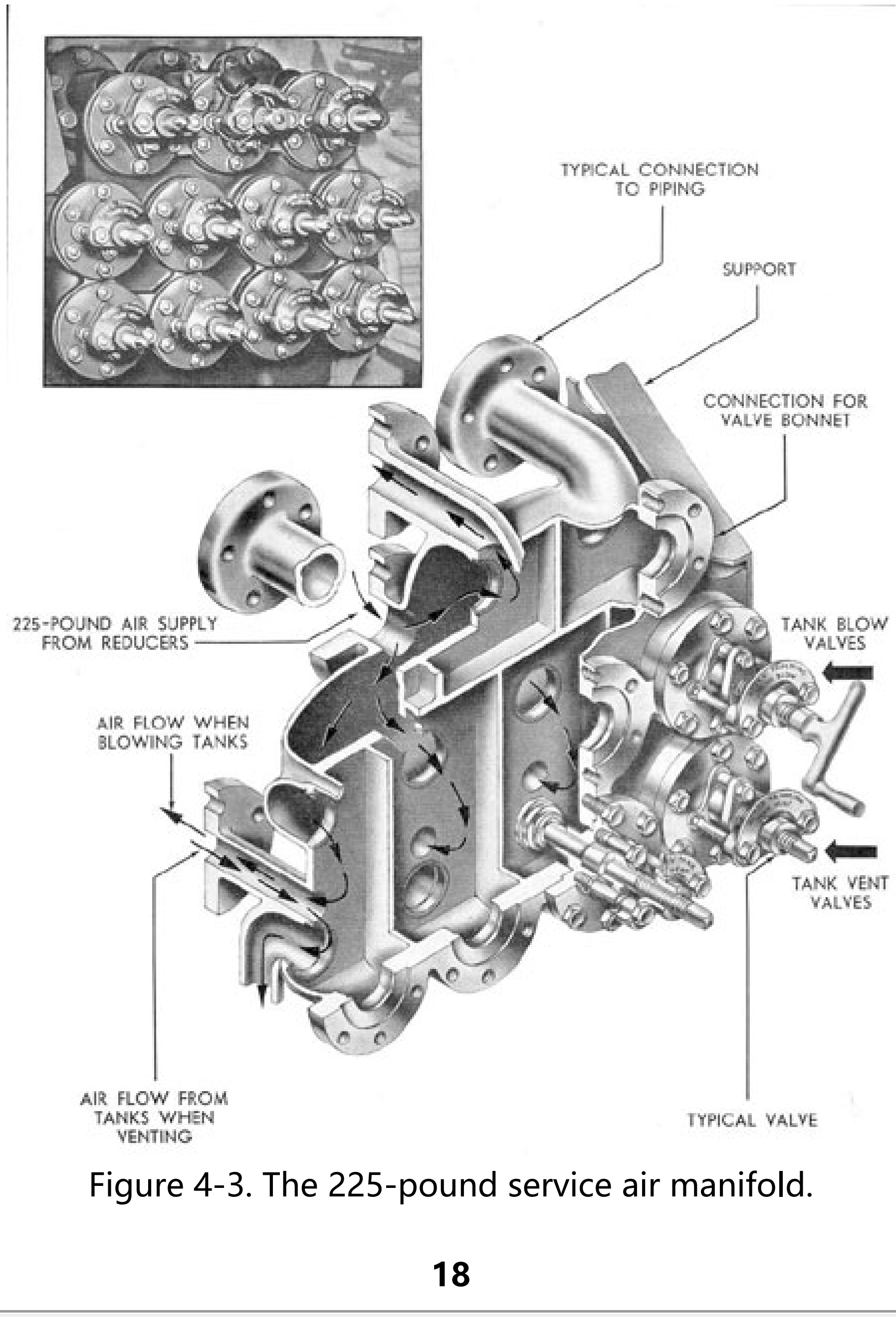

Figure 4-3. The 225-pound service air manifold.

with pressure gages. All fuel oil, lubricating oil, collecting, expansion, sanitary, and variable tanks are provided with pressure gages located in the various rooms and compartments as shown in Figure 4-1.

The main parts and controls of the 225-pound system are described in detail in the following sections of this chapter.

Step-by-step instructions in the use of this system will be found in Chapter 9.

B. THE 225-POUND SERVICE AIR MANIFOLD

4B1. Description. The 225-pound service air manifold which was introduced in the preceding section controls the blowing and venting of the forward and after trim tanks, the No. 1 and No. 2 auxiliary ballast tanks, and the air supply to the forward and after service air mains.

Figure 4-3 shows the mechanical construction of the manifold as well as the proper nomenclature of its parts. The manifold is located on the starboard side of the control room, just aft of the 3000-pound air manifold. Gages indicating the air pressure in the manifold, in the forward and after trim tanks, in the No. 1 and No. 2 auxiliary ballast tanks, and a gage registering sea pressure are mounted on the gage board directly above the manifold.

The body of the manifold is a one-piece bronze casting, divided into eight compartments. There is one large rear compartment provided with a flanged inlet for connection to the 225-pound air supply. Each of the seven smaller front compartments is provided with a flanged port for connection to one of the lines of the 225-pound system. There are four vent ports in the bottom of the are shaped to fit the special wrench provided for their operation.

The valves are arranged in three horizontal rows. Reading from left to right, the first valve on the top row directs the air supply to the forward service air line, the middle valve is a spare, and the end valve directs airflow to the after service air line. These valves lead to the forward and after service air mains and are normally locked open to insure an uninterrupted air supply. The locking caps and padlocks are used to lock the valves in the open position.

The middle row contains the valves controlling the blowing of the forward trim tank, the auxiliary tank No. 2 blow, the auxiliary tank No. 1 blow, and the after trim tank blow. The bottom row of valves controls the venting of the forward trim tank, the auxiliary tank No. 2, the auxiliary tank No. 1, and the after trim tank.

4B3. Operation. In operation, the air supply from the two 225-pound reducers enters the rear compartment of the manifold. When any one of the blow valves (the middle row) is opened, the air in the rear compartment passes to the front part of the manifold

manifold, one from each of the four lower compartments. A drain pan is mounted directly below the manifold to catch any drain water.

4B2. Valves. Eleven valves are provided on the front (or inboard) side of the manifold, each with a bolted bonnet on which a name plate designates the function of that particular valve. The ends of the rising valve stems leading to the line in which the valve is open.

In venting, the opening of any vent valve (the bottom row) allows the air in the corresponding line to flow into the front passage and out the vent port, which discharges into the drain pan.

Step-by-step instructions for the use of the 225-pound service air manifold will be found in Chapter 9.

C. GROVE REDUCER

4C1. Description. The 225-pound service air system is supplied with air by the 3000-pound air system. In turn, the 225-pound system supplies air at 100, 12, 13, 10, and 8 psi to the various service lines, such as the pneumatic tool connections and the fresh water tanks. This reduction or lowering of air pressure is accomplished by a device known as the Grove reducing valve, (See Figure 4-4.)

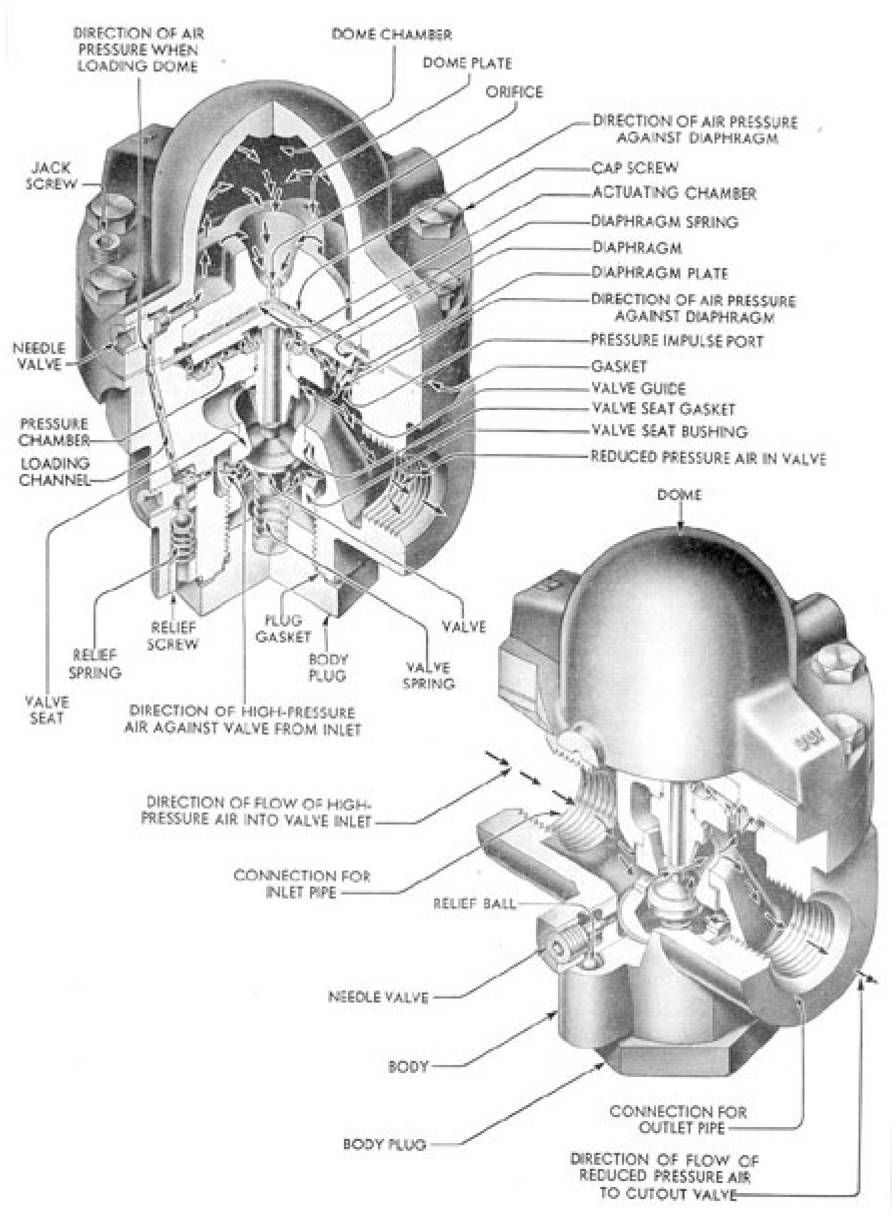

Figure 4-4. Grove reducing valve.

Both the high-pressure and the 225-pound service air systems are provided with pressure reducing valves. There are two 3000-to-600-pound reducing valves for charging the torpedo tube impulse flask, and two 3000-to-500-pound reducing valves for the main engine starting air. Two 3000-to-225-pound reducers are used on the supply line to the 225-pound service air manifold.

The other reducing valves (a total of 12 on the 225-pound air discharge side decreases, the diaphragm is forced down and the valve admits high-pressure air until the correct pressure is restored.

The dome chamber is charged by a loading channel, controlled by two needle valves as shown in Figure 4-4. The dome is loaded as follows:

1. Place the loading wrenches in the dome and body needle valves.
2. Back off the dome valve, to

system) are distributed throughout the submarine as follows: five supplying the pneumatic tool connections with 100-pound air; two supplying the battery fresh water tanks with 8-pound air; one supplying the lubricating oil manifold with 13-pound air; one delivering 10-pound air for the distillate tank; one delivering 40-pound air to the brine tank; and two supplying 12-pound air to the fresh water tanks.

Figure 4-4, which illustrates a typical reducing valve, shows that it consists principally of an air dome, a diaphragm, a regulating valve, and a body provided with both a high-pressure inlet and a low-pressure outlet.

4C2. Operating principle. The reducing valve acts on the balanced pressure principle. As the air is used, and the pressure on the

vent the pressure in the dome.

3. Shut both needle valves.
4. Shut the inlet line stop valve.
5. Shut the outlet line stop valve.
6. Open the body needle valve one half turn.
7. Watching the outlet pressure gage, carefully open the dome needle valve. When the desired delivery pressure is shown on the outlet gage, shut the dome needle valve.
8. Shut the body needle valve.

The reducer is now ready for service.

The reducing valve provides a close, accurate control of air pressure. If the delivered pressure rises or falls, it is necessary to correct it, by reloading the dome, as described above.

D. AUXILIARY BALLAST TANK BLOW AND VENT STOP VALVE

4D1. Description. The connection from each blow and vent line of the 225-pound system to the auxiliary ballast tanks serviced by it is made through a blow and vent stop valve, a typical example of which is shown in Figure 4-5. The flange on the discharge end of the valve body is bolted to the tank opening, and the pipe flange is bolted to the flange on the inlet side of the valve. Thus the flow of air between the pipe and the tank can be stopped by operating the valve.

on it to give access for inspection or repair. The seal between bonnet and body is made by an asbestos gasket. An adjustable packing gland and braided flax packing prevent leakage.

The blow and vent stop valves are opened and shut by a manually operated handwheel.

Counterclockwise rotation of the handwheel raises the valve disk from the seat and allows the passage of air for blowing or venting. Figure 4-5 shows the flow of air through the valve when

The valve is of the disk and seat type with a rising stem. The valve body is a one-piece bronze casting with the bonnet bolted blowing. In venting, the flow of air is reversed.

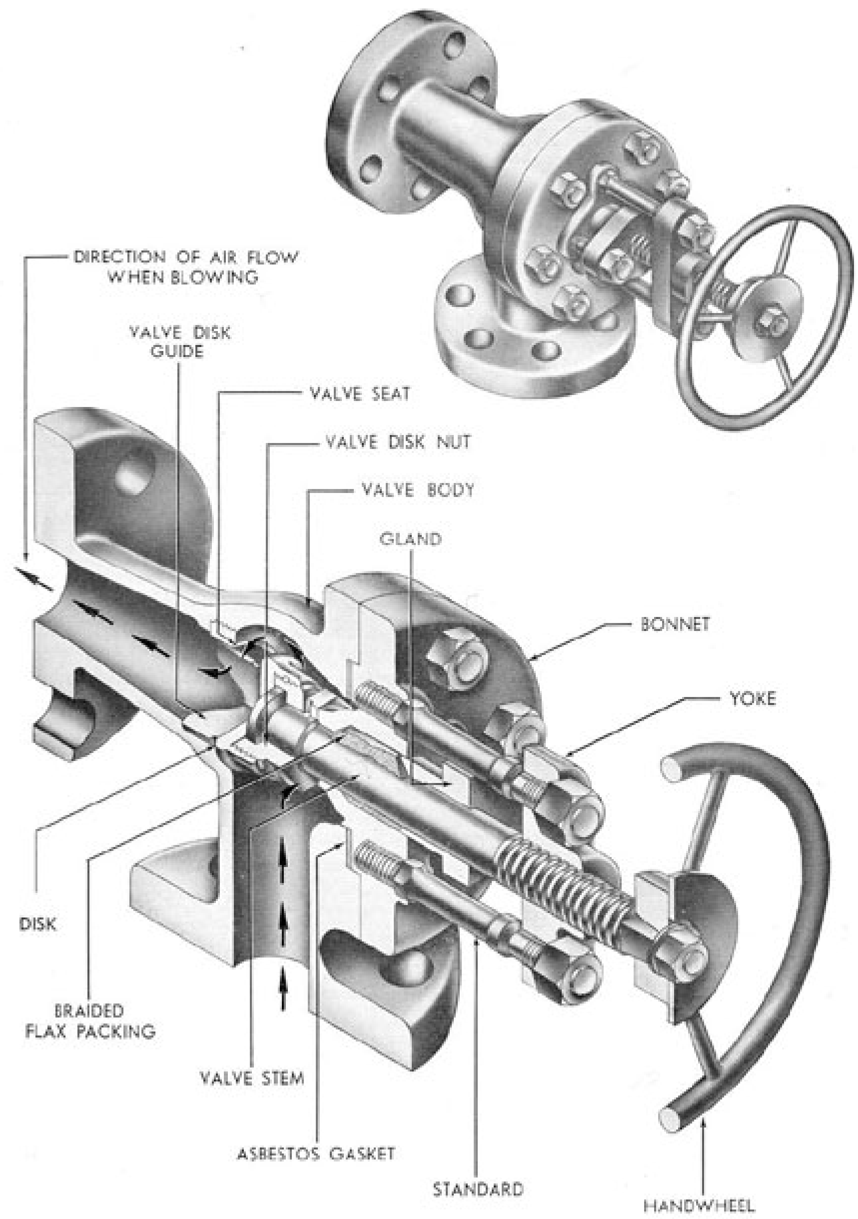

Figure 4-5. Auxiliary ballast tank blow and vent stop valve.

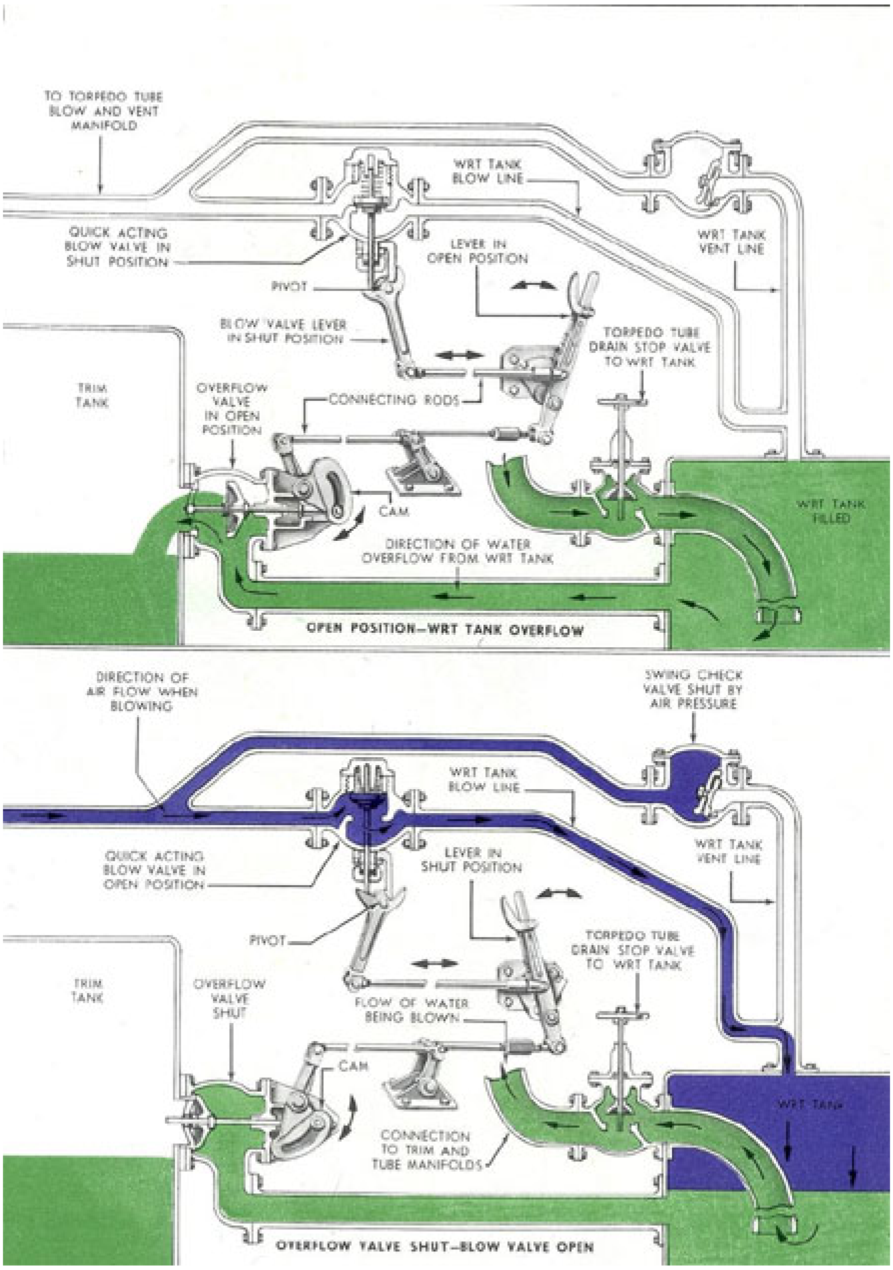

Figure 4-6. WRT BLOW AND WRT OVERFLOW INTERLOCKING SYSTEM.

E. WRT BLOW AND WRT OVERFLOW INTERLOCKING SYSTEM

4E1. Description. The purpose of the WRT overflow interlocking system (see Figure 4-6) is to prevent blowing from the WRT tank to the trim tank by way of the overflow piping and overflow valve. This precaution is necessary in order to assure that needless and useless air pressure will not be put on these two tanks without actually transferring the water ballast from the WRT tank to the trim tank.

entering the WRT tank through the open torpedo tube drain stop valve to the WRT tank. Assuming that the WRT tank is already filled, it therefore cannot hold the entering water which forces the excess water into the overflow pipe, past the open overflow valve, and into the trim tank.

The flow arrows in the lower diagram of Figure 4-6 trace the path of flow and the valve line-up required to get air to the WRT tank and transfer water from the WRT

To prevent this condition, the quick-acting blow valve for the WRT tank, located in the WRT blow and vent line, is mechanically interconnected with the overflow valve in such a way that the opening of the overflow valve automatically shuts the blow valve, and vice versa.

The interconnection consists of a single lever which operates both valves, with connecting links to cams actuating the valves. The linkage is shown in Figure 4-6.

The operating lever for the forward system is located adjacent to the torpedo tubes in the forward torpedo room. The lever for the after system is located forward of the tubes on the port side of the after torpedo room.

The upper diagram of Figure 4-6 shows water being blown from the torpedo tubes and tank to the torpedo tubes or the trim system by way of the torpedo tube drain stop valve to the WRT tank.

The lower diagram also shows the conditions existing when blowing the WRT tank to the torpedo tubes or the trim system. The quick-acting blow valve is open, allowing air to enter the WRT tank and to force the water in it to the torpedo tubes, via the open torpedo tube drain stop valve to the WRT tank.

If the system were not protected with an interlock during this operation, the overflow valve could be opened, allowing the water to be blown from the WRT tank to the level of the overflow pipe, and then the air would rush into the trim tank, through the overflow pipe, and exhaust itself through the trim tank vent.

F. TORPEDO TUBE BLOW AND VENT MANIFOLD

4F1. Description. When a torpedo is fired, sea water rushes in and fills the empty tube. Before the breech door can be opened for reloading, this water must be removed by blowing or draining the tube.

Similarly, after loading and before firing, the excess air in the tube must be vented and the tube flooded with water.

The basic function of the torpedo tube blow and vent manifolds is to direct the 225-pound air used to blow the tubes during draining, and to vent the casting, fitted with blow valves with bolted bonnets, and provided with flanged connections. The cutaway illustration, Figure 4-7, shows the mechanical construction typical of all three manifolds. All blow valves are provided with extended stems and manually operated handwheels. The vent valves are lever-operated. The access plates on the bottom permit inspection and repair of the vent valves.

Figure 4-7 illustrates the port side manifold in the forward torpedo room. Two hundred and twenty-five pound air is supplied through

tubes during flooding. It also provides for blowing and venting the WRT tank and the trim tank when the water from the tubes is transferred to or from either of these tanks.

Each manifold consists of a bronze

the upper flanged connection on the side, filling the upper longitudinal compartment. When any of the blow valves is opened, air is permitted to enter the corresponding

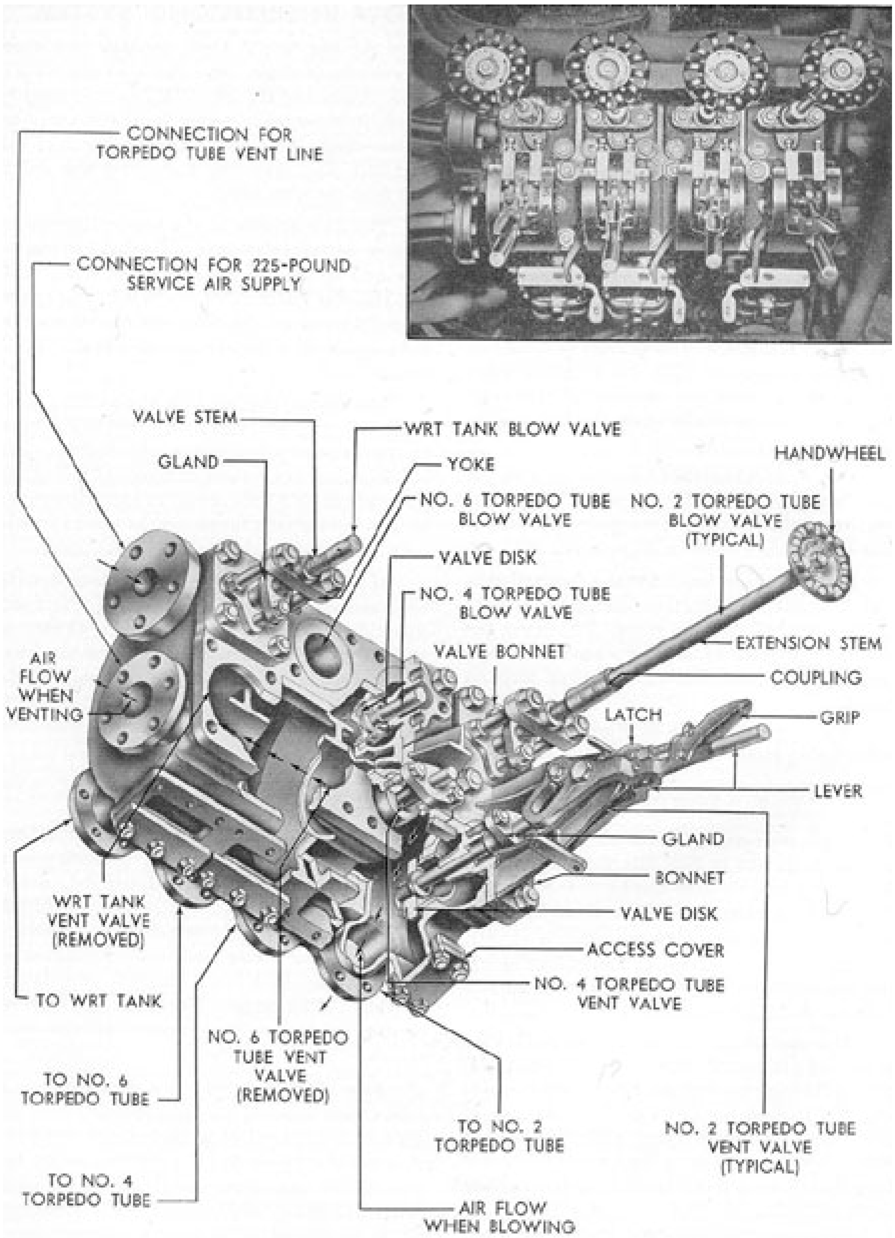

Figure 4-7. Torpedo tube blow and vent manifold (port side).

rear compartment, or passage, to the desired torpedo tube blow

blow and vent manifolds in the submarine. (See Figure 4-1.) Two are mounted aft of the torpedo

and vent line. Shutting the blow valve will stop the flow of air.

The lower flanged outlet on the side connects the lower longitudinal compartment of the manifold to the torpedo tube vent line. Opening any one of the vent valves allows air from the desired tube or tank to flow into the vent line.

4F2. Location. There are three torpedo tube tubes in the forward torpedo room; the manifold on the port side servicing torpedo tubes Nos. 2, 4, and 6, and the forward WRT tank. The starboard manifold services torpedo tubes Nos. 1, 3, and 5, and the forward trim tank. The third manifold is mounted in the after torpedo room just forward of the torpedo tubes and services tubes Nos. 7, 8, 9, and 10, and the after trim and WRT tanks.

G. PNEUMATIC TOOL CONNECTIONS

4G1. Description. Among the functions of the 225-pound service air system is that of supplying air under pressure to the pneumatic tool connections (Figure 4-2) which provide air pressure to operate the grease guns and other air-driven tools necessary to service the vessel.

There are five such connections, located one each in the forward torpedo room, the control room, the forward engine room, the after engine room, and the after torpedo room. Each connection is supplied with 100-pound air through a Grove reducer which receives 225-pound air from the forward or after service air main. In addition, each pneumatic tool connection is provided with a bypass which permits the use of the connection even if the reducing valve is not functioning. The connection is opened or shut by a manually operated handwheel.

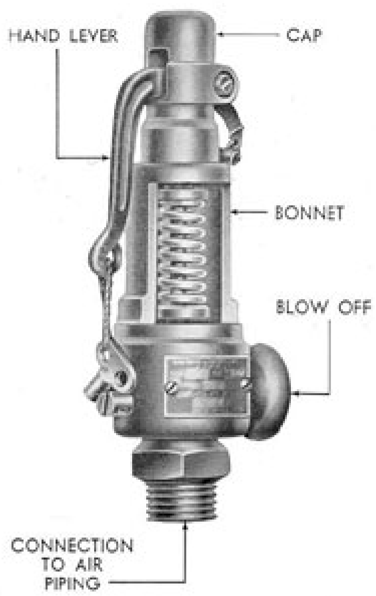

Figure 4-8. Sentinel valve.

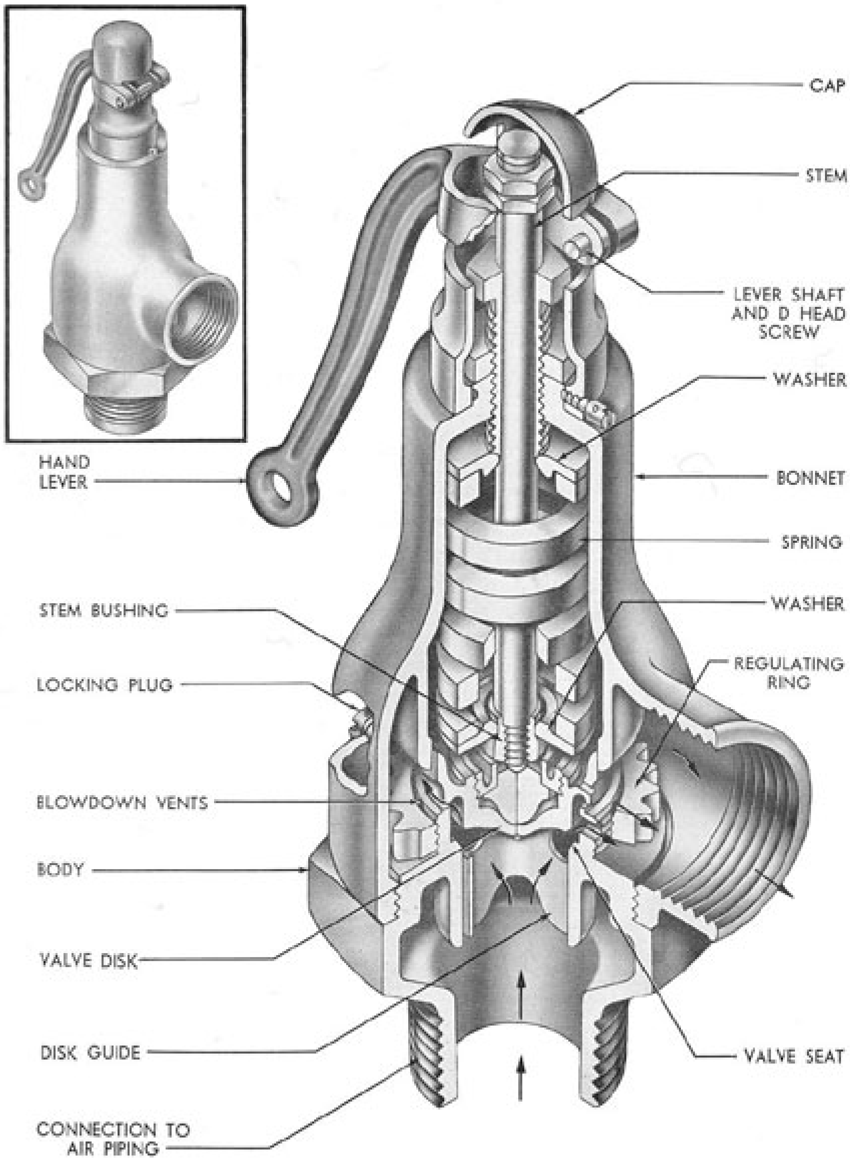

Figure 4-9. Relief valve.

H. SENTINEL VALVES

4H1. Description. If the working pressure of the 225-pound service air system rises to a pressure of approximately 250 psi, the sentinel valve (Figure 4-8) opens automatically, allowing the excess pressure to escape. It will close when sufficient air has been exhausted to lower the pressure below 250 pounds.

The discharge capacity of the sentinel valve is limited and hence it serves principally as a

Figure 4-8 is an illustration of the sentinel valve. Its internal construction is similar to that of the relief valve shown in Figure 4-9. The sentinel valve is set into the line by the threaded male inlet. Air from the 225-pound line fills the lower chamber and exerts pressure against the valve disk which is held shut by the spring. The spring is preset to allow the disk to open when the pressure in the lower chamber approximates 250 psi. The rising of the valve disk allows

warning that excess pressure is being built up in the system. If the pressure in the system becomes so great that the sentinel valve is unable to discharge fast enough to lower it, the two relief valves automatically open and reduce the system pressure. The relief valves are discussed in detail in Section 4I.

excess air to escape through the side outlet. When the line pressure drops below 250 pounds, the spring closes the valve. The hand lever permits manual operation of the valve when necessary.

I. RELIEF VALVES

4I1. Purpose. Relief valves are used to protect the lines of the 225-pound service air system from excessive pressure. Placed directly in the lines, they are set to open at a predetermined pressure, thus allowing air to escape from the lines into the boat, and so relieve internal pressure. When normal pressure in the lines is restored, the valve shuts automatically.

4I2. Description. The construction of a typical relief valve is shown in Figure 4-9. The arrows indicate the flow of air when the valve is blowing, or relieving pressure.

The bottom outlet is fitted to the line or manifold to be protected, thus allowing the air to enter the lower chamber and push against the bottom of the valve disk. The valve disk is held against the valve seat by the tension of the spring, which is adjusted to exert a downward force equal to the maximum allowable pressure in the air line. When the pressure in the air line exceeds this limit, it forces the valve disk up and allows air to escape into the boat through the side outlet. As soon as enough air has escaped to lower the pressure, the spring forces the disk downward and shuts off the flow through the escape outlet. The regulating ring controls the rate of escape by opening or closing the blowdown vents. The hand lever allows the valve to be operated manually. Lifting the lever will raise the valve disk and allow the escape of air.

The cap, body, and bonnet of the valve are made of bronze with a steel spring and valve assembly.

4I3. Location. Relief valves are located throughout the 225-pound service air system as outlined, in the table on page 28, which also shows the service performed and the pressure at which the valve is set to blow.

LOCATION	SERVICE	SETTING (psi)
Forward torpedo room	Sanitary tank Fuel oil manifold Fresh water tanks Pneumatic tool connection	105 15 15 110
Forward battery compartment	Battery fresh water tanks	10
Control room	Pneumatic tool connection 225-pound manifold Fresh water tanks	110 275 15
Galley and mess room	Battery fresh, water tanks Fuel oil manifold	10 15
Crew's quarters	Sanitary tank	105
Forward engine room	Pneumatic tool connection Fuel oil manifold Lube oil manifold Brine tank Distilling tank	110 15 15 44 12
After engine room	Pneumatic tool connection Fuel oil manifold	110 15
After torpedo room	Pneumatic tool connection	110

Figure 4-1. THE 225-POUND AIR SYSTEM. [Sub Air Home Page]

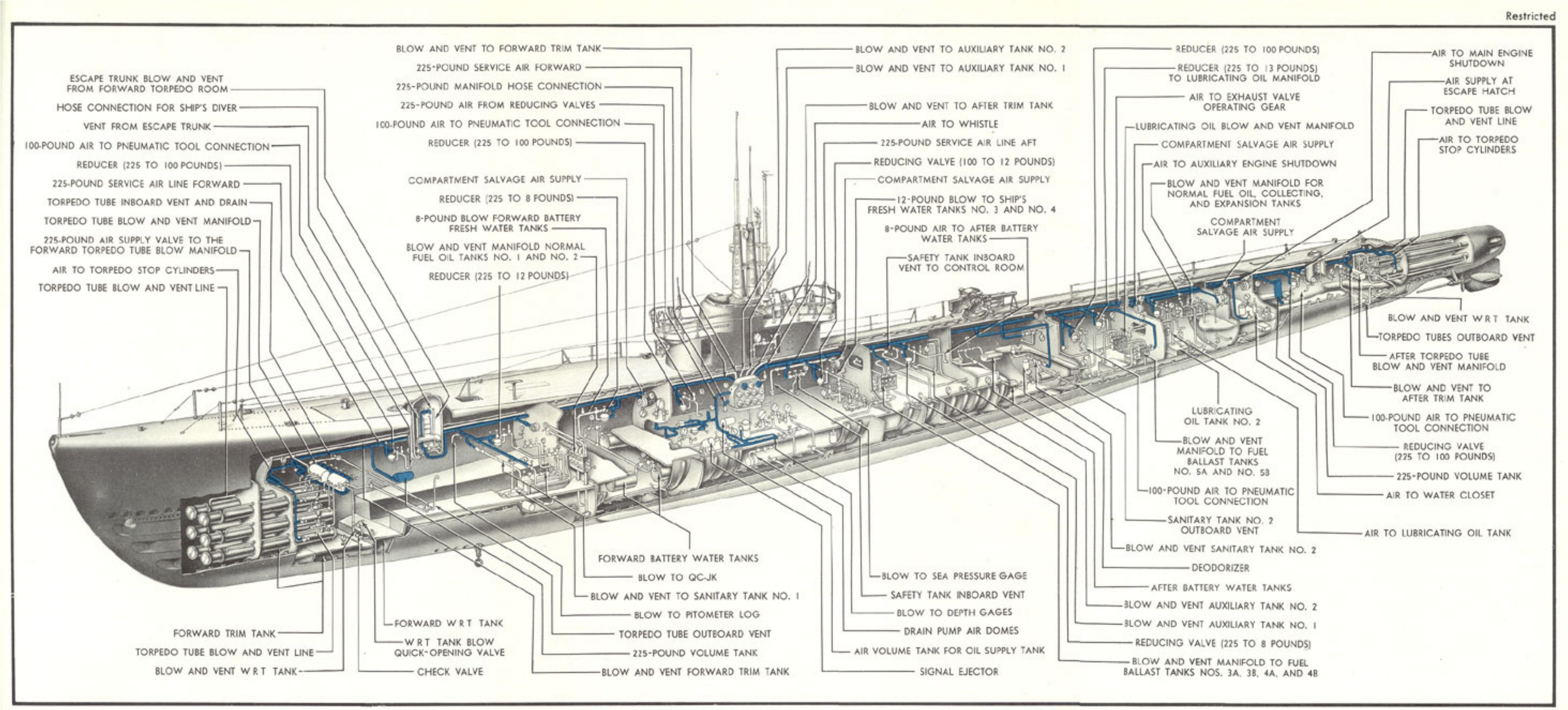

Figure 4-1. THE 225-POUND AIR SYSTEM. Figure 4-1

Figure 5-1. THE 10-POUND MAIN BALLAST TANK BLOWING SYSTEM.

5
THE 10-POUND MAIN BALLAST TANK BLOWING SYSTEM

A. GENERAL DESCRIPTION

5A1. Introduction. The 10-pound MBT blowing system is used to remove water from the main, ballast tanks when the boat is on the surface. It completes the work started by the 600-pound MBT blowing system, thus saving high-pressure air.

The 10-pound MBT system (see Figure 5-1) consists of a low-pressure blower located in the pump room, a manifold, and blow lines to each of the tanks serviced by the system. The low-pressure blower furnishes compressed air to the manifold in the control room at a pressure of approximately 10 psi. The manifold distributes the air supplied by the blower to the ballast tanks, through nine pipe lines which pass through the hull directly above the manifold and extend outside the pressure hull under the superstructure deck.

The air supply to the manifold is controlled by the flapper valve. The manifold and the valves are designed to withstand sea pressure if any of the blow lines fails.

The nine low-pressure lines have lever-operated flapper valves (10-pound blow valves) at the point where they pass through the hull, and swing check valves where they join the main ballast tank (MBT) vent lines.

Gate valves, controlled from the superstructure deck, are installed in the lines leading to main ballast tanks 2A, 2B, 2C, 2D, 6A, 6B, 6C, and 6D.

Detailed operating instructions for blowing the main ballast tanks, using the 10-pound system, are given in Chapter 10.

B. THE 10-POUND MAIN BALLAST TANK BLOW MANIFOLD

5B1. Description. The 10-pound blow manifold, located on the starboard side of the control room (Figure 5-1.), serves as a center from which the shaft. Movement of the shaft attached to the lever arm causes the valve to be unseated, and air from the blower enters the

compressed air supplied by the low-pressure blow is directed to the ballast tanks. The piping outside the pressure hull is hydrostatically tested to a pressure of 300 psi; the system inside the pressure hull is tested by air for strength and tightness to a pressure of 15 psi.

The 10-pound manifold is a boxlike, two-piece casting. (See Figure 5-2.) The top casting, or head, is equipped with nine outlet flanges. It is bolted to the body, or bottom half, of the manifold. The bottom half has an inlet port provided with a flapper valve to admit or shut off the air supply from the blower. The access plate on the bottom forward part of the manifold permits inspection or repair.

The flapper valve is opened by lifting the flapper valve lever which is connected to the manifold to be distributed to the ballast tanks.

The 10-pound manifold is also equipped with two list control dampers, one for each Y-valve, operating on a shaft that runs fore and aft through the head. The dampers are opened and shut by the list control lever located on the after end of the head. (See Section 5E.) The list control dampers are used to correct unequal blowing of the tanks which might cause listing of the boat.

When it is desired to blow the main ballast tanks with the 10-pound MBT blowing system, the 10-pound manifold supply flapper valve is opened by lifting the supply flapper valve lever. With the valve open, the air from the blower passes into the manifold chamber. From there, in accordance with the number of 10-pound blow valves opened in the blow lines above the manifold, the air is

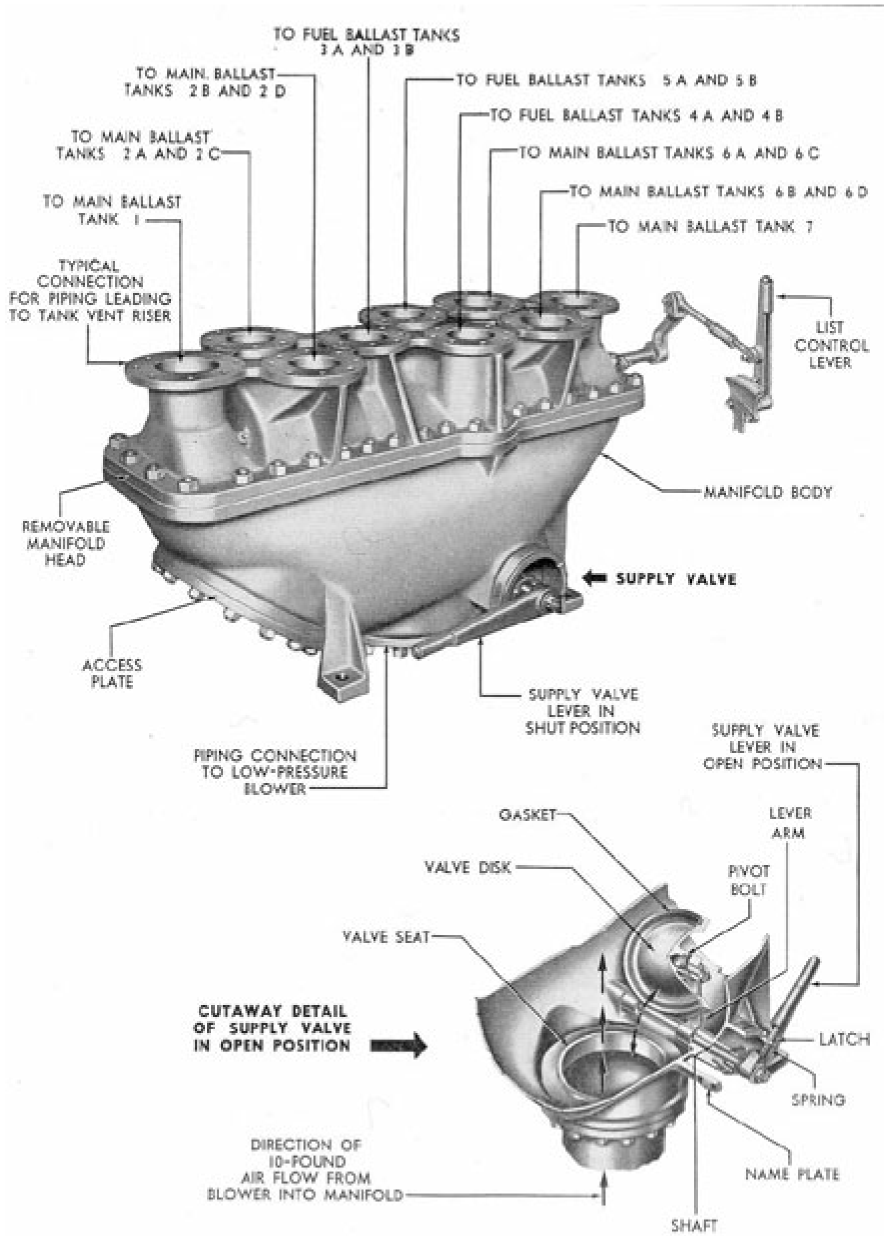

Figure 5-2. The 10-pound main ballast tank blow manifold.

directed to the main ballast tanks. The fuel oil ballast tanks have the same piping and connections as the main ballast tanks and therefore can be blown by the 10-pound blowing system when they are used as main ballast tanks.

C. LOW-PRESSURE BLOWER

5C1. Description. The low-pressure blower supplies compressed air for blowing the main ballast tanks after the boat has surfaced. As the submarine surfaces, the outside air is admitted to its interior. This provides a continuous supply of

of the shafts farthest from the gears, together with a bearing carrier, positively secure the shaft and the impellers axially, thus preventing possible friction between the ends of the impellers and the head plates.

air to the low-pressure blower, and conserves the supply of compressed air in the ship's air banks. The blower is mounted on the starboard side of the pump room with the electrical controls in the control room.

The low-pressure blower is of the rotary, positive displacement, Roots type. It is powered by a 90-hp motor, connected by means of a flexible coupling to the blower driving shaft.

The mechanical construction of the blower is shown in Figure 5-3.

Two lobe-shaped impellers divide the case into two chambers, the upper and lower. The impellers are connected to steel shafts, and rotate with just enough clearance to avoid contact with the casing and with each other. Gears keyed to the shafts maintain the proper relation between the two impellers. A double row of contact bearings at the ends

As the impellers rotate, more space is made available in the lower chamber, causing suction, and less space becomes available in the upper chamber, causing compression. The suction of the blower draws air from the boat's atmosphere, through the screened silencer attached to the air intake, and into the lower impeller chamber. The air thus admitted is forced by impeller action to pass into the upper chamber, where it is compressed, and finally expelled through the discharge connection which is connected by piping, extending through the platform deck to the 10-pound blow manifold in the control room.

Should the volume of compressed air be excessive, or should the discharge valve be closed while the blower is in operation, a spring-loaded relief valve at the entrance to the discharge connection operates automatically to relieve the pressure.

D. THE 10-POUND BLOW (FLAPPER) VALVE

5D1. Description. The 10-pound blow valves direct the flow of air from the 10-pound manifold to the main ballast tanks, and to the fuel ballast tanks when desired. There are nine such manually operated valves, one on each of the blow lines extending from the 10-pound MBT blow manifold, at the point where the lines pass through the inner hull on the starboard side of the control room.

The mechanical construction of a 10-pound blow valve is shown in

disk to adjust itself to the valve seat, thus assuring an airtight fit. When the lever is pulled down, the valve disk is raised and the valve is shut. When the grip is released and the lever is pushed up, the valve is opened and air flows from the manifold to the tank vent risers. A heavy rubber gasket ring on the disk forms an airtight contact surface. A notched quadrant holds the latch, the lever, and the valve disk in a set position. On the quadrant, a name plate

Figure 5-4. Each 10-pound blow valve has a lever grip and spring latch connected to a shaft which is supported by the valve body near the valve seat. A lever arm mounted on the other end of the shaft is connected to the valve disk by a pivot bolt and socket which enable the marked OPEN and SHUT indicates the position of the valve.

The discharge end of the valve body extends through the inner hull, to which it is bolted at the intermediate flange, to form a watertight joint. The flanged end of the valve outside the hull is connected by piping to

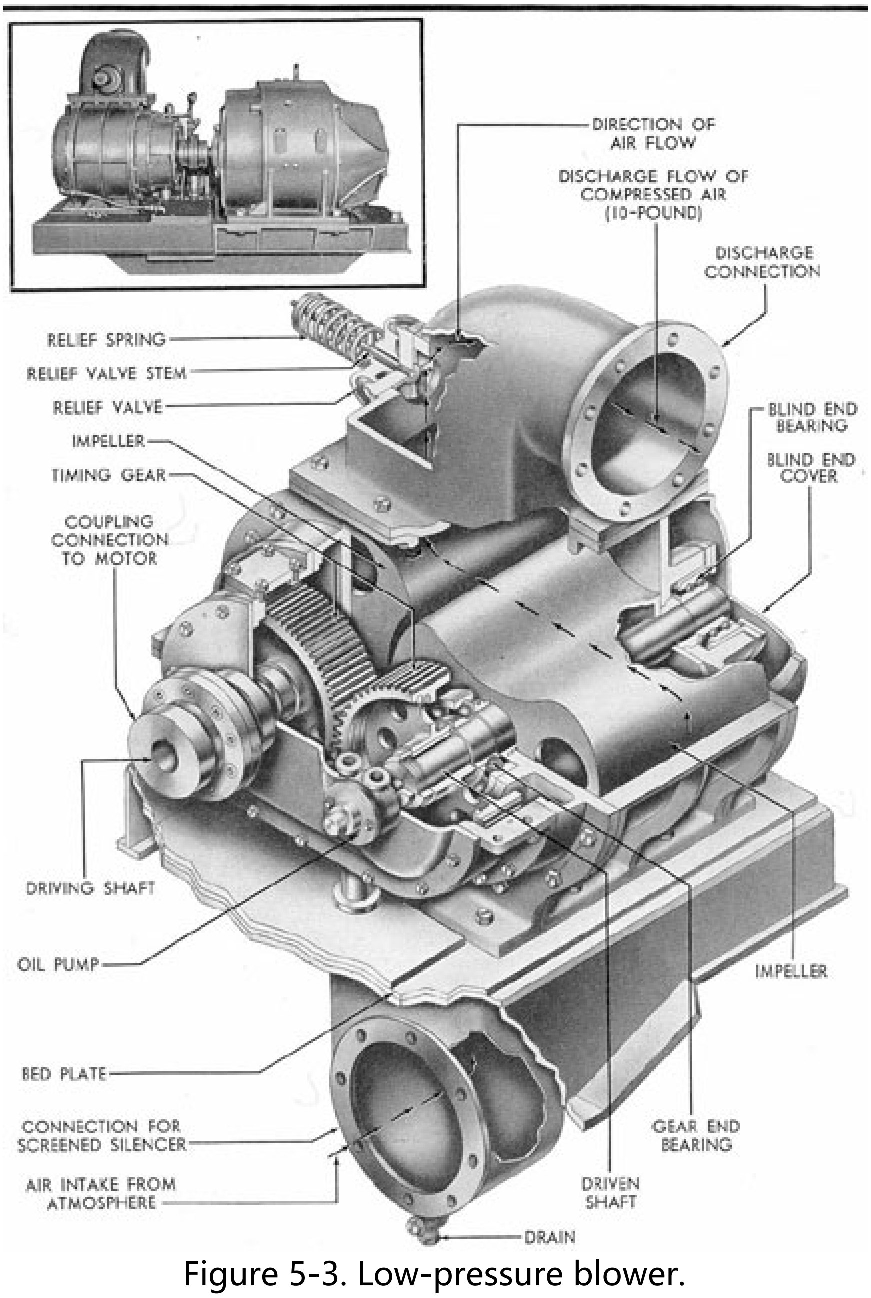

Figure 5-3. Low-pressure blower.

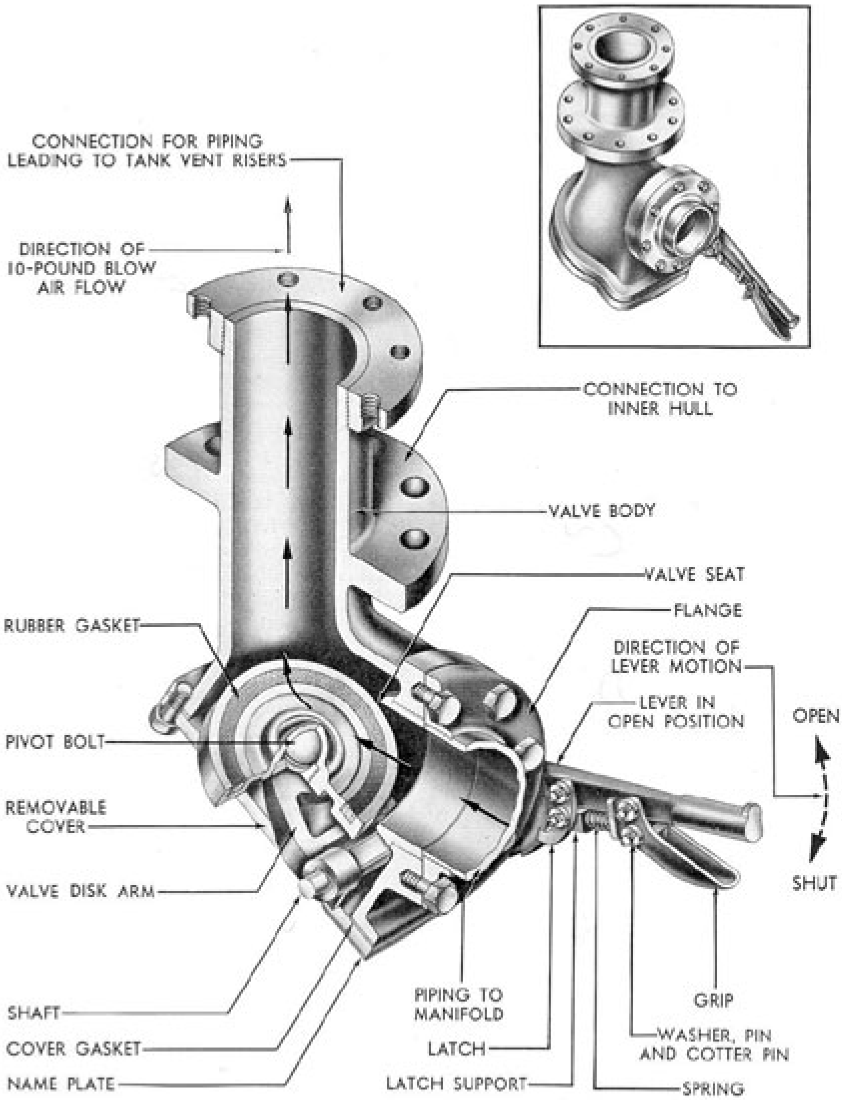

Figure 5-4. The 10-pound blow (flapper) valve.

the tank vent riser. The flanged end inside the hull is connected to the 10-pound blow manifold.

5D2. Location of 10-pound blow valve. The following table lists, from forward aft, the nine 10-pound blow valves in the order in which they are installed on the overhead. Figure 5-2 shows the connection to the manifold.

1. Main ballast tank No. 1
2. Main ballast tanks No. 2B and 2D
3. Main-ballast tanks No. 2A and 2C
4. Fuel ballast tanks No. 3A and 3B
5. Fuel ballast tanks No. 4A and 4B
6. Fuel ballast tanks No. 5A and 5B
7. Main ballast tanks No. 6B and 6D
8. Main ballast tanks No. 6A and 6C
9. Main ballast tank No. 7

E. LIST CONTROL DAMPERS

5E1. Description. The list control dampers are used to correct a turnbuckle secured with a bolt and nut. Pressing down the pushrod

list during the blowing of the main ballast tanks. The list control dampers adjust the amount of air admitted into the port or starboard ballast tanks of the No. 2 and No. 6 MBT group, increasing or decreasing the rate at which the tank is blown. The dampers are located at the Y-valve outlet connections on the 10-pound blow manifold (See Section 5B).

Figure 5-5 shows the construction of the damper. Both list dampers are attached to a shaft that runs through the manifold chamber. The shaft is operated by a hand lever at the after end of the manifold. The handle assembly consists of a push rod at the top of the handle, a handle, a spring, a latch, a name plate, and a bracket. A connecting rod attached to the handle is equipped with a releases the spring, lifting the latch, and leaving the lever free to move inboard or outboard. As the shaft turns, the list dampers are swung to shut one port, or open both ports of the Y.

The movement of the lever and the attached connecting rod turns the shaft by means of an offset arm. Outboard movement of the lever causes the damper to restrict the flow of air to the starboard side. Inboard movement of the lever causes the damper to restrict the flow of air to the port side. Normal position of the damper is neutral, allowing equal flow to both sides.

List control dampers control the flow of air to main ballast tanks 2B and 2D, 6B and 6D on the port side, and to main ballast tanks 2A and 2C, 6A and 6C on the starboard side.

F. THE 10-POUND BLOWING SYSTEM SWING CHECK VALVE

5F1. Description. A swing check valve is located in the piping at the entrance to each main and fuel ballast tank, outside the pressure hull and under the superstructure deck. It prevents air from backing up from the tank into the lines of the 10-pound blowing system.

Figure 5-6 is an illustration of a typical swing check valve. The valve has a swinging disk mounted on a hinge attached within the valve body. The valve opens when the flow of air to the tank forces the disk away from the seat, and shuts when the flow of air in the opposite direction forces the disk against the seat. This prevents a backflow of air into the lines. A hinge pin supports both the hinge and the disk, permitting the swinging motion. A lock nut and pin fasten the hinge and disk together. The disk and seat ring are removable for regrinding. A removable cap on top of the valve allows servicing of the working parts. A gasket between the cap and the valve body prevents leakage.

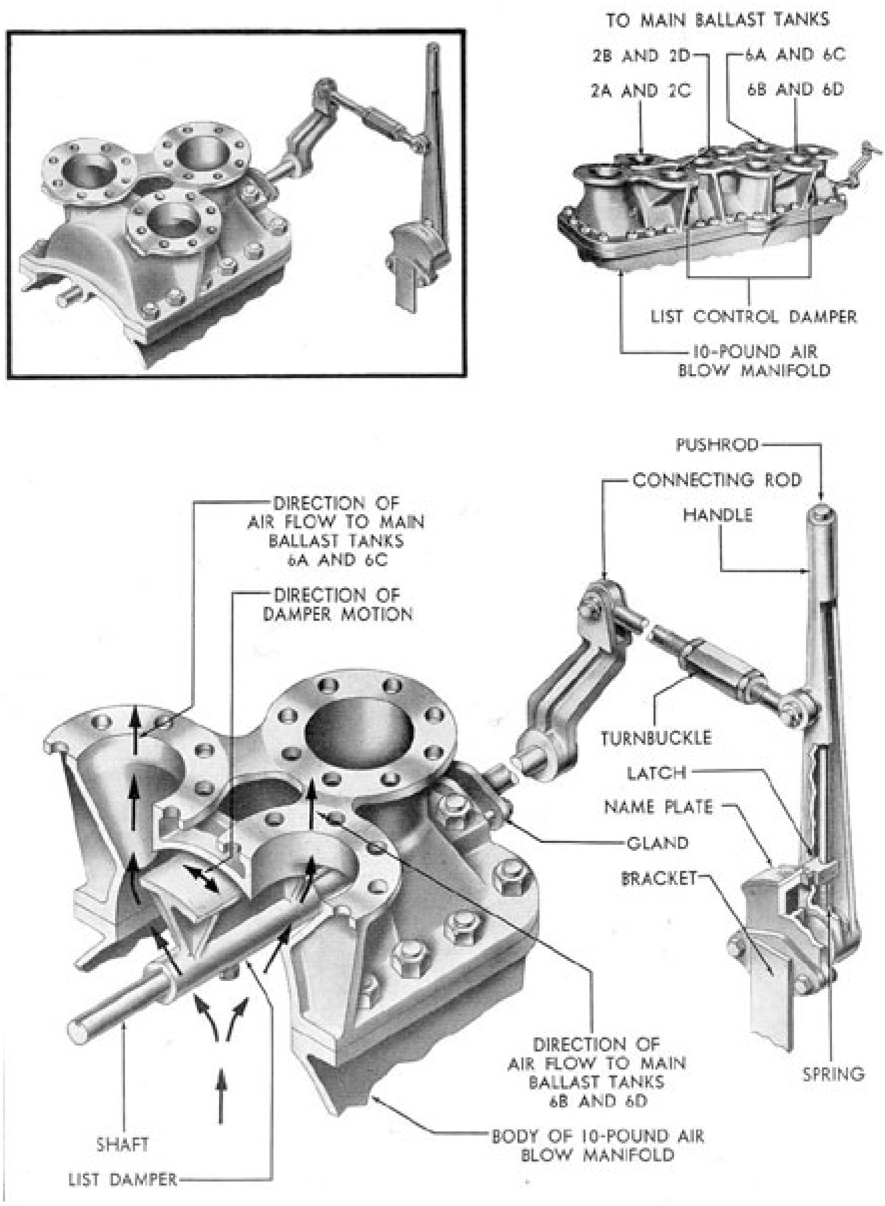

Figure 5-5. List control damper.

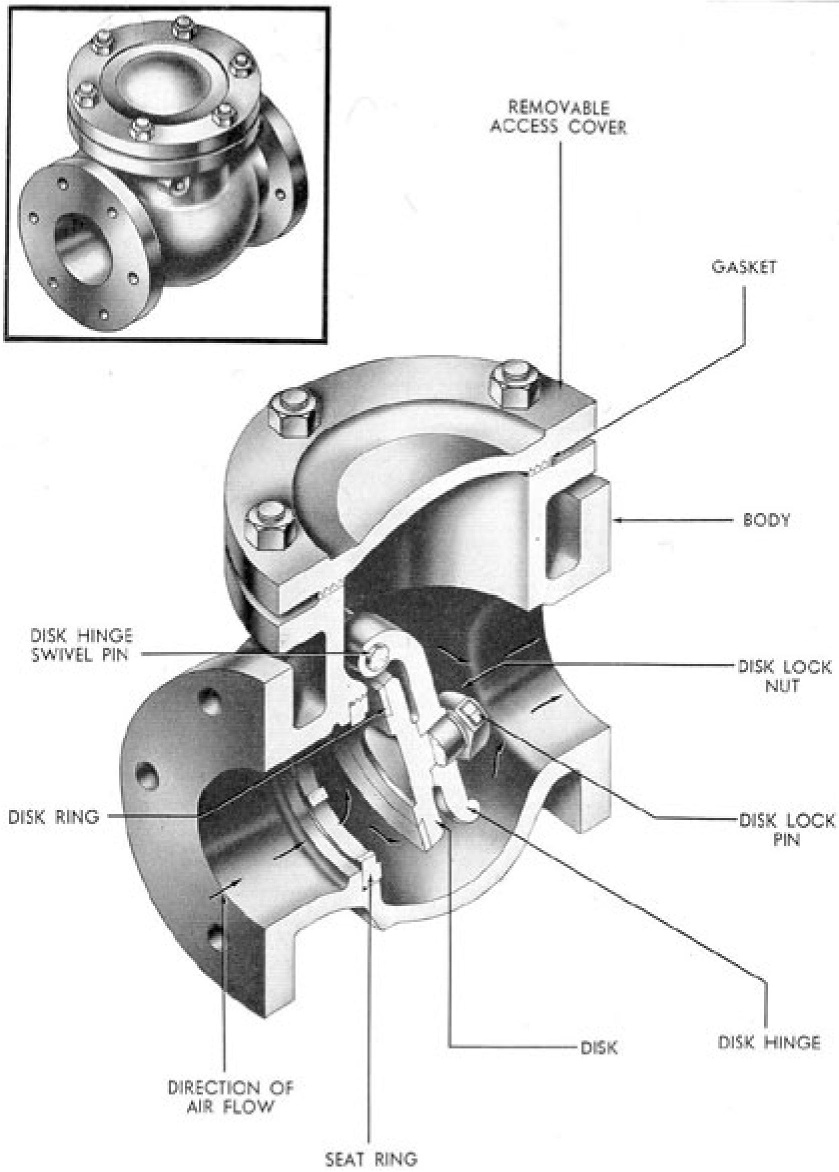

Figure 5-6. The 10-pound blowing system swing check valve.

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Figure 5-1. THE 10-POUND MAIN BALLAST TANK BLOWING SYSTEM.

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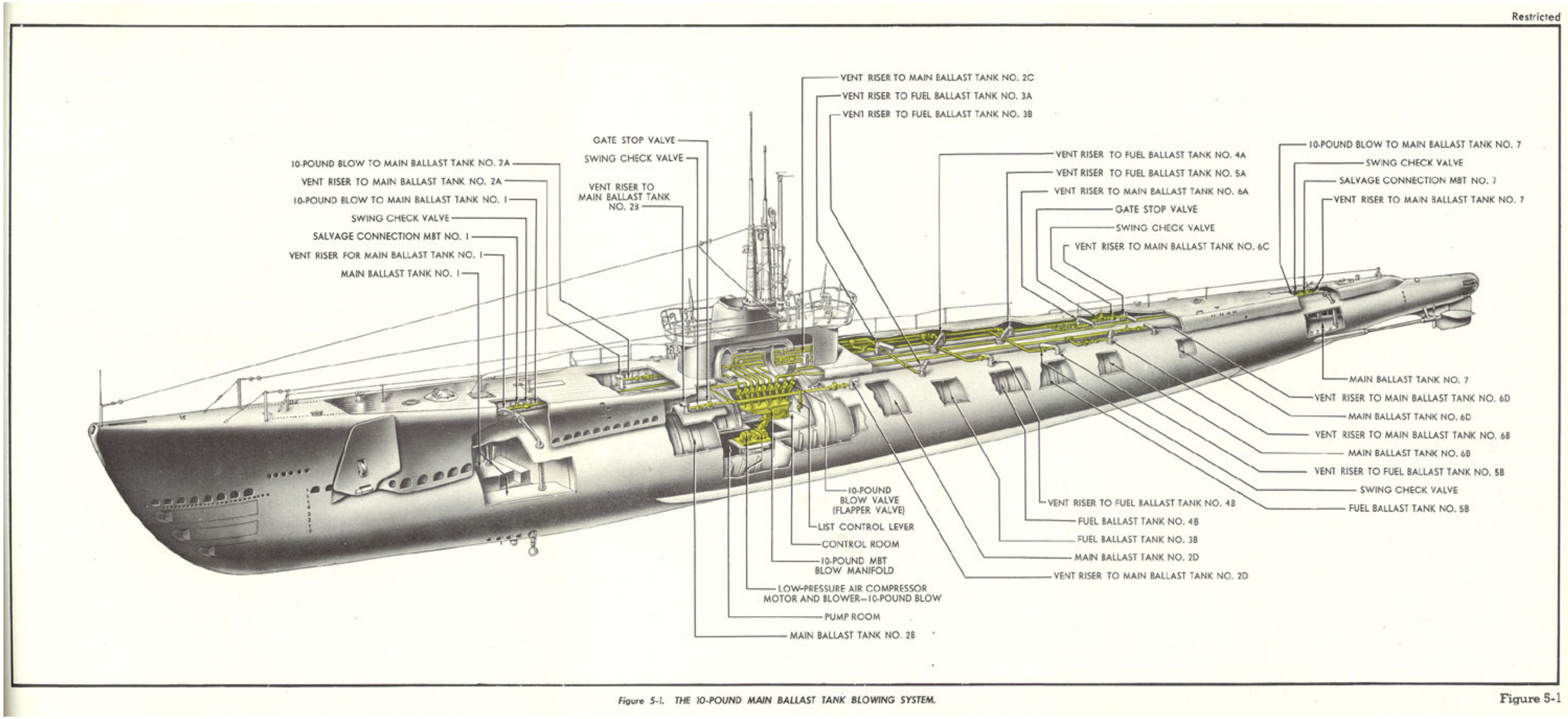

Figure 5-1. THE 10-POUND MAIN BALLAST TANK BLOWING SYSTEM. Figure 5-1

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Figure 6-1. SALVAGE AIR SYSTEM.

6
SALVAGE AIR SYSTEM

A. GENERAL DESCRIPTION

6A1. Introduction. The submarine is provided with a salvage air system for use in salvage operations.

The salvage air arrangements provide external salvage facilities for use by outside salvage agencies (divers, etc.) as well as internal facilities for use by the crew of the submarine or by a diver who succeeds in entering the vessel.

Figure 6-1 shows in schematic form the location and relation of the component parts which comprise the salvage air system.

Two external high-pressure air connections, located on each side of the conning tower, provide a means of supplying high-pressure air from the salvage ship to the high-pressure (3000-pound) receiving manifold. This air can be directed by personnel inside the vessel to the 600-pound blow manifold for use in blowing the main ballast tanks, and to the 225-pound service air manifold for use in blowing water from flooded compartments by means of the compartment salvage air valves.

Each main ballast tank has a blow valve with a blow line connection extending up to a plate set in the deck (Figure 6-2). In salvaging, air hose lines from the salvage ship are attached to the pipe fitting. Opening the valve enables the rescue vessel to blow the ballast tanks free of water.

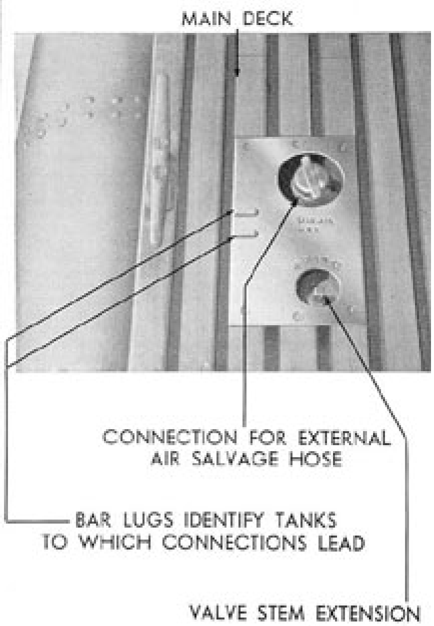

Figure 6-2. Main ballast tank salvage connection.

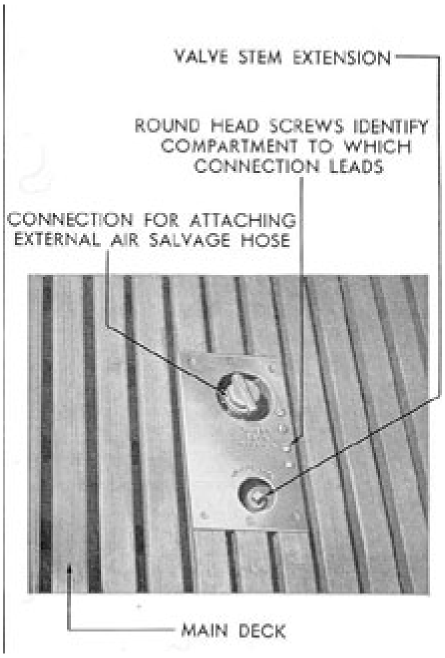

Figure 6-3. Compartment salvage connection.

6A2. Salvage valves. Each compartment of the submarine has two salvage valves, one at each end of the compartment. A salvage line from each valve extends through the hull to a deck plate (Figure 6-3), where it is provided with a capped male fitting similar to those of the main ballast tank salvage lines (Figure 6-2). The valve (Figure 6-3) can be operated by a socket wrench from the outside or by a handwheel from within the compartment. In salvaging operations, air hoses can be attached to the valve fittings to supply the ship with air for breathing, pumping, or circulating purposes.

All the external salvage valve deck plates are identified by lettering and round screw heads and special lugs cast on the plates for touch identification. (See Section 6C.)

Compartment salvage air valves are located on each bulkhead between compartments (Figure 4-1) for use in blowing individual compartments. The 225-pound air is supplied to these compartment salvage air valves by lines extending from the forward and after ship's service air lines. (See Section 4A.) The arrangement of the valves permits the release of air from either side of the bulkhead into the adjacent compartment. Pressure gages are installed on both sides of the bulkhead near this valve arrangement to indicate the pressure in the adjoining compartment.

B. INTERNAL SALVAGE

6B1. Description. This section is mounted on the bulkhead with

describes those air salvage operations conducted from within the submarine, either by the vessel's crew or by a diver who has succeeded in entering the submarine.

The air which is used can come either from the ship's air banks or from the salvage ship by way of the high-pressure air external charging connections.

The main ballast tanks can be blown from within the submarine by directing air from the 3000-pound to the 600-pound MBT blow manifold and from there to the tanks. The procedure followed in blowing the main ballast tanks is the same as outlined in Chapter 3, provided, of course, that none of the blow lines has been broken or the tanks ruptured.

Each compartment of the vessel is provided with a compartment salvage air valve, located high on each transverse bulkhead. (See Figure 4-1.) Two hundred and twenty-five-pound air is supplied to each valve by a branch line from the forward or after service air main, depending upon the location, as outlined in the previous article.

Each salvage valve is provided with two outlets and two controlling handwheels. It one outlet and one handwheel on each side of the bulkhead to permit the blowing of any flooded compartment from the adjoining compartment.

6B2. Operation. To illustrate the general procedure to be followed in blowing a flooded compartment using the compartment salvage air valves, assume that it is desired to remove water from the after battery compartment, working from the control room. In the control room, the salvage air valve on the after bulkhead is opened by turning the handwheel counterclockwise. This admits air into the after battery compartment. (Clockwise rotation of this handwheel would admit air into the control room.) The adjacent pressure gages will indicate the air pressure in the battery compartment. When the pressure necessary to keep the compartment free of water is indicated, the valve handwheel should be returned to the neutral position. By building up an equal pressure in the control room, the door between the compartments can be opened without dropping the pressure in the battery compartment.

Detailed instructions for salvaging flooded compartments are given in Chapter 11.

C. EXTERNAL SALVAGE

6C1. Description. Each main ballast tank is provided with a salvage valve and a salvage line the low connection, is equipped with a pipe extending to the low point of the compartment. The low

for use in external salvage operations. Each valve is fitted with a square-ended extension stem, reaching to the main deck, where a deck plate (Figure 6-2) is located to receive it. The receiving end of the salvage line is fitted with a threaded connection and a protecting cap with projecting lugs for easy unscrewing. This connection is fitted in the same deck plate as the valve stem. The valve stem is operated by a socket wrench. The deck plates are located off the centerline.

In use, the air hose from the salvage ship is connected by a diver to the salvage line and the salvage valve opened, thus admitting air to the tank and blowing it free of water. Each tank must be blown separately.

Each compartment has one salvage valve and one salvage line located at each end of the compartment. These valves and lines have deck fittings similar to those of the main ballast tanks, but located as near the centerline as possible. The valve body is located between the pressure hull and the superstructure deck, with one end of the stem extending up to the deck plate (Figure 6-3) and the other end of the stem projecting through the pressure hull. The inboard end of the stem is fitted with a handwheel containing a luminous button. Thus these valves can be operated from within the vessel or from the outside.

In each compartment, one valve, termed the high connection, supplies air near the high point connection pipe is equipped with a strainer to protect the system from clogging.

To circulate air from the outside throughout a given compartment, the, diver must connect one air hose to the high connection and another to the low connection. With pressure applied to the hose connected to the high connection, its valve is opened, allowing air to enter the compartment. Opening the low connection valve allows the air to escape.

When blowing out the compartment, both the high and low connections are opened. Compressed air entering the compartment through the high connection forces the water into the low-connection pipe and thus overboard.

The external salvage connections for the main ballast tanks are tested hydrostatically to a pressure of 15 psi. The external compartment salvage connections are tested hydrostatically to a pressure of 300 psi.

All the external hose connections (deck plates) are identified by lettering; special markings are provided to enable the diver to identify the plates by touch. These markings are lugs, or screws, cast or attached to the deck plates. The tables on page 40, list the markings used on a typical submarine. The actual arrangement of the markings for any individual submarine is shown on the vessel's air salvage system plans.

of the hull. The other valve, termed

COMPARTMENT SALVAGE DECK PLATE MARKINGS

COMPARTMENT	NUMBER OF SCREW HEADS	
	HIGH CONNECTION	LOW CONNECTION
Officers' quarters	1	2
Forward torpedo and control room	3	4
Crew's quarters	5	6
Forward engine room	7	8
After engine room	9	10
Maneuvering room	11	12
After torpedo room	13	14

TANK SALVAGE DECK PLATE MARKINGS

TANK	NUMBER OF LUGS
MBT Nos. 2A and 2B	1
MBT No. 1	2
MBT Nos. 2C and 2D	2
MBT Nos. 6A and 6B	3
MBT Nos. 6C and 6D	4
MBT No. 7	5

TEN-POUND BLOW DECK PLATE MARKINGS

TANK	NUMBER OF LUGS
MBT Nos. 2A and 2B	2
MBT Nos. 2C and 2D	4
MBT Nos. 6A and 6B	8
MBT Nos. 6C and 6D	10

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Figure 6-1. SALVAGE AIR SYSTEM.

Sub Air Home Page

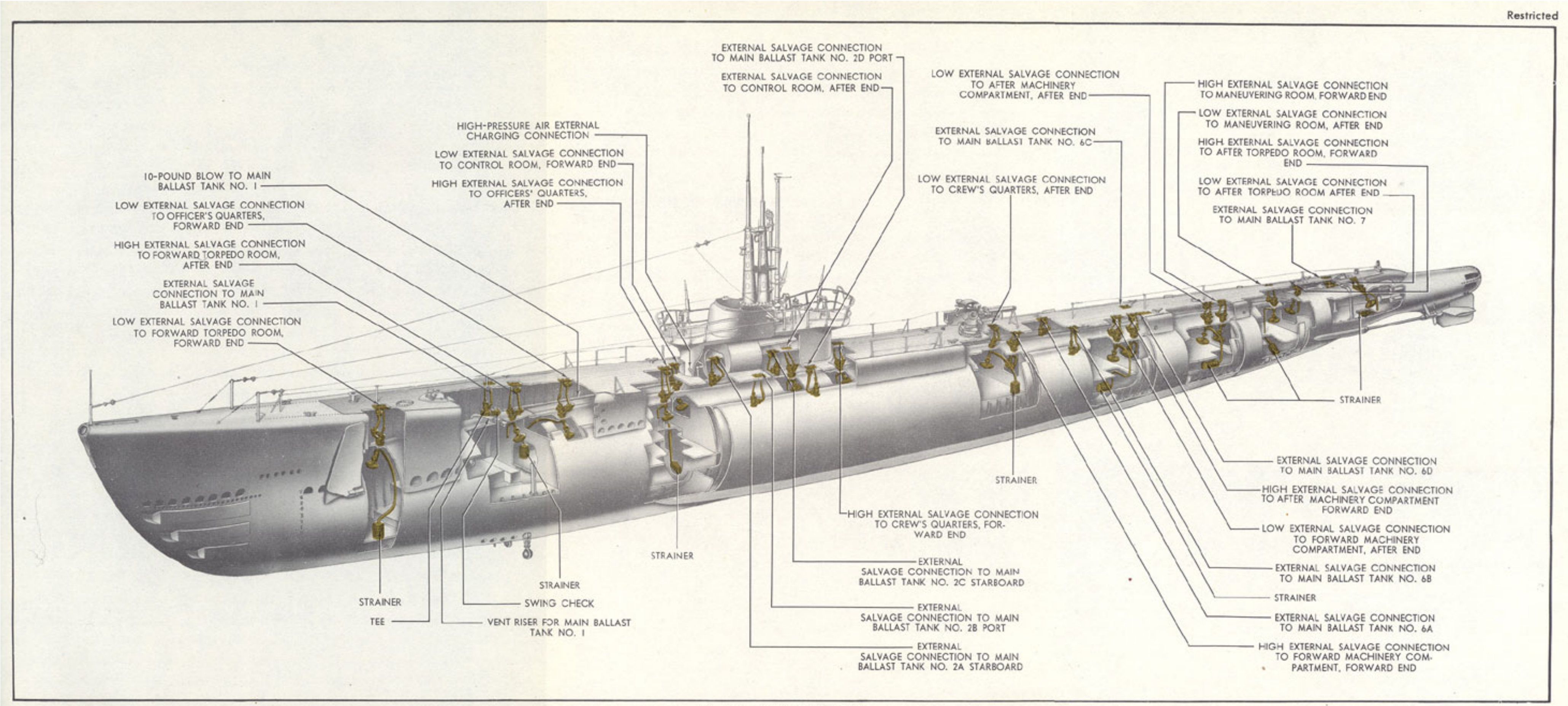

Figure 6-1. SALVAGE AIR SYSTEM.

Figure 6-1

Version 1.11, Feb 2015

7
OPERATING THE HIGH-PRESSURE AIR SYSTEM

A. RIGGING THE HIGH-PRESSURE MANIFOLD FOR DIVING

(Figure 7-1)

7A1. Preparation. 1. Shut all valves on the high-pressure manifold.

2. Open the bulkhead bank stop valves on all the air banks.

3. Open the regulator valves to the safety, negative, and bow buoyancy tanks.

4. Open the high-pressure air stop valves in each torpedo room.

7A2. Steps in operation.

1. Open the No. 2 air bank stop valve on the receiving manifold.

2. Open the No. 3 air bank stop valve on the receiving manifold.

3. Open the No. 4 air bank stop valve on the receiving manifold

(There should be at least three air banks on the manifold when rigged for dive. An air bank with a gage reading of less than 1500 psi should not be placed in service. The No. 1 air bank, because it is located inside the pressure hull, is normally held in reserve.)

4. Open the high-pressure air service forward supply valve on the lower distributing manifold.

5. Open the high-pressure air service aft supply valve on the lower distributing manifold.

6. Open the high-pressure air supply valves to 225-pound reducers.

7. Open the supply valve to 600-pound MBT blow manifold on the upper distributing manifold.

8. Open the emergency supply valve to 600-pound MBT blow manifold on the upper distributing manifold. The high-pressure air manifold is now rigged for diving.

Figure 7-1. RIGGING THE HIGH-PRESSURE MANIFOLD FOR DIVING.

B. BLOWING THE BOW BUOYANCY TANK

(Figure 7-2)

7B1. Preparation.

1. Shut all valves on the high-pressure manifold.

2. Open the bulkhead bank stop valves on all the air banks.

3. Open the regulator valves to the safety, negative, and bow buoyancy tanks.

7B2. Steps in operation.

1. Open the No. 5 air bank stop valve on the receiving manifold.

2. Open the bow buoyancy blow valve on the upper distributing manifold.

3. When blowing is completed, shut the bow buoyancy blow valve.

4. Shut the No. 5 air bank stop valve on the receiving manifold.

Figure 7-2. BLOWING THE BOW BUOYANCY TANK.

C. BLOWING THE SAFETY TANK

(Figure 7-3)

7C1. Preparation.

1. Shut all valves on the high-pressure manifold.

2. Open the bulkhead bank stop valves on all the air banks.

3. Open the regulator valves to safety, negative, and bow buoyancy tanks.

7C2. Steps in operation.

1. Open the No. 1 air bank stop valve on the receiving manifold.

2. Open the safety tank blow valve on the upper distributing manifold. Observe the safety tank pressure gage in order not to exceed the required pressure.

3. When blowing is completed, shut the safety tank blow valve.

4. Shut the No. 1 air bank stop valve on the receiving manifold.

Figure 7-3. BLOWING THE SAFETY TANK.

D. BLOWING THE NEGATIVE TANK

(Figure 7-4)

7D1. Preparation. 1. Shut all valves on the high-pressure manifold.

2. Open the bulkhead bank stop valves on all the air banks.

3. Open the regulator valves to the safety, negative, and bow buoyancy tanks.

7D2. Steps in operation.

1. Open the No. 3 air bank stop valve on the receiving manifold.

2. Open the negative tank blow valve on the upper distributing manifold. Observe the negative tank pressure gage in order not to exceed the required pressure.

3. When blowing is completed, shut the negative tank blow valve.

4. Shut the No. 3 air bank stop valve on the receiving manifold.

Figure 7-4. BLOWING THE NEGATIVE TANK.

E. RIGGING FOR SURFACE FROM RIGGED FOR DIVE

(Figure 7-5)

7E1. Preparation.

1. The high-pressure manifold is rigged for dive with air banks Nos. 2, 3, and 4 on service. (See Section 7A.)

2. Open the bulkhead bank stop valves on all the air banks.

3. Open the regulator valves to the safety, negative, and bow buoyancy tanks.

4. Open the high-pressure air stop valves in each torpedo room.

7E2. Steps in operation.

1. Shut the No. 2 air bank stop valve on the receiving manifold.

2. Shut the No. 3 air bank stop valve on the receiving manifold.

3. Shut the supply valve to the 600-pound MBT blow manifold.

4. Shut the emergency supply valve to the 600-pound MBT blow manifold.

The high-pressure air manifold is now rigged for surface. Note that air bank No. 4 remains on service.

Figure 7-5. RIGGING FOR SURFACE FROM RIGGED FOR DIVE.

F. CHARGING THE NO. 1 TORPEDO IMPULSE FLASK

(Figure 7-6)

7F1. Preparation.

1. Shut all valves on the high-pressure manifold.

2. Open the bulkhead bank stop valves on all the air banks.

3. Shut the high-pressure air stop valves in each torpedo room.

7F2. Steps in operation.

1. Open the No. 4 air bank stop valve on the receiving manifold.

2. Open the high-pressure air service forward supply valve on the lower distributing manifold.

3. Open the high-pressure air stop valve in the forward torpedo room.

4. Open the high-pressure air supply valve to the 600-pound reducer (impulse charging).

5. Open the supply valve from the 600-pound reducer to the impulse flask charging manifold.

6. Open the No. 1 impulse charging valve on the impulse charging manifold, starboard side of the forward torpedo room. Observe the No. 1 impulse flask pressure gage in order not to exceed the required pressure.

7. When the required pressure has been reached, shut the No. 1 impulse charging valve on the impulse charging manifold.

8. Shut the supply valve from the 600-pound reducer to the impulse flask charging manifold.

9. Shut the high-pressure air supply valve to the 600-pound reducer (impulse charging).

10. Shut the high-pressure air stop valve in the forward torpedo room.

11. Shut the high-pressure air service forward supply valve on the lower distributing manifold.

12. Shut the No. 4 air bank stop valve on the receiving manifold.

Figure 7-6. CHARGING THE NO. 1 TORPEDO IMPULSE FLASK.

G. CHARGING THE NO. 1 AIR BANK WITH THE NO. 1 AIR COMPRESSOR

(Figure 7-7)

7G1. Preparation.

1. Shut all valves on the high-pressure manifold.

compressor. Carry out the operating routine for drains, pressures, temperatures,

2. Open the bulkhead bank stop valves on all the air banks.

7G2. Steps in operation.

1. Open the No. 1 air bank stop valve on the receiving manifold.

2. Open the supply valve, high-pressure air from compressors, on the receiving manifold.

3. Open the No. 1 high-pressure air compressor charging valve, in the pump room.

4. Start the No. 1 high-pressure air circulating water, lubrication, and speed. (See Section 2C.)

5. Stop the No. 1 high-pressure air compressor when the pressure gage for the No. 1 air bank shows that the required pressure has been reached.

6. Shut the No. 1 high-pressure air compressor, charging valve.

7. Shut the supply valve, high-pressure air from compressors, on the receiving manifold.

8. Shut the No. 1 air bank stop valve on the receiving manifold.

Figure 7-7. CHARGING THE NO. 1 AIR BANK WITH THE NO. 1 AIR COMPRESSOR.

H. CHARGING THE NO. 2 AIR BANK FROM THE DOCK

(Figure 7-8)

7H1. Preparation.

1. Shut all valves on the high-pressure manifold.

2. Open the bulkhead bank stop valves on all the air banks.

7H2. Steps in operation.

1. Open the drain cock on the external charging stop valve on the overhead above the high-pressure manifold in the control room. (This is a safety precaution which releases high-pressure air trapped between the valve and the cap.)

2. Remove the charging connection caps and connect the flexible copper high-pressure

5. Open the external charging connection valve on the receiving manifold.

6. Open the No. 2 air bank stop valve on the receiving manifold.

7. Open the charging valve on the dock.

8. Shut the charging valve on the dock when the pressure gage for the No. 2 air bank shows that the required pressure has been reached.

9. Shut the external charging stop valve.

10. Shut the external charging connection valve on the receiving manifold.

tubing to the dock connection and to the port external charging connection. As a safety measure, secure the tubing with a line to the dock and on the ship. This will prevent whipping in the event that the tubing breaks.

3. Shut the drain cock.

4. Open the external charging stop valve on the overhead above the high-pressure manifold.

11. Shut the No. 2 air bank stop valve on the receiving manifold.

12. Open the drain cock and release the pressure in the charging tubing.

13. Disconnect the copper charging tubing and replace the caps on the port external charging connection and on the dock connection.

14. Shut the drain cock on the external charging stop valve.

Figure 7-8. CHARGING THE NO. 2 AIR BANK FROM THE DOCK.

I. CHARGING THE HYDRAULIC ACCUMULATOR AIR FLASK WITH HIGH-PRESSURE AIR

(Figure 7-9)

7I1. Preparation.

1. Shut all valves on the high-pressure manifold.

2. Open the bulkhead bank stop valves on all the air banks.

7I2. Steps in operation.

1. Open the No. 2 air bank stop valve on the receiving manifold.

2. Open the accumulator air flask charging valve on the hydraulic accumulator charging manifold.

3. Open the air valve to the hydraulic accumulator on the upper distributing manifold. Observe the accumulator air flask pressure gage in order not to exceed the accumulator air flask pressure.

4. When the required pressure has been reached, shut the air valve to the hydraulic accumulator on the upper distributing manifold.

5. Shut the accumulator air flask charging valve on the hydraulic accumulator charging manifold.

6. Shut the No. 2 air bank stop valve on the receiving manifold.

Figure 7-9. CHARGING THE HYDRAULIC ACCUMULATOR AIR FLASK

J. BYPASSING HIGH-PRESSURE AIR INTO THE 225-POUND SERVICE AIR SYSTEM

(Figure 7-10)

7J1. Preparation.

1. Shut all valves on the high-pressure manifold.

2. Shut all the bulkhead bank stop valves.

3. Shut the forward and after stop valves for the No. 1 air bank. Only the after part of the No. 1 air bank will be used for this operation.

7J2. Steps in operation.

1. Open the No. 1 air bank after cutoff valve.

2. Open the No. 1 air bank stop valve on the receiving manifold.

3. Open slowly the 225-pound bypass valve on the lower distributing manifold. Observe the pressure gage for the 225-pound service air manifold in order not to exceed the 225-pound system pressure.

4. When the required pressure has been reached, shut the 225-pound bypass valve on the lower distributing manifold.

5. Shut the No. 1 air bank stop valve on the receiving manifold.

6. Shut the No. 1 air bank after cutoff valve.

Figure 7-10. BYPASSING HIGH-PRESSURE AIR INTO THE 225-POUND SERVICE AIR SYSTEM.

Figure 7-1. RIGGING THE HIGH-PRESSURE MANIFOLD FOR DIVING.

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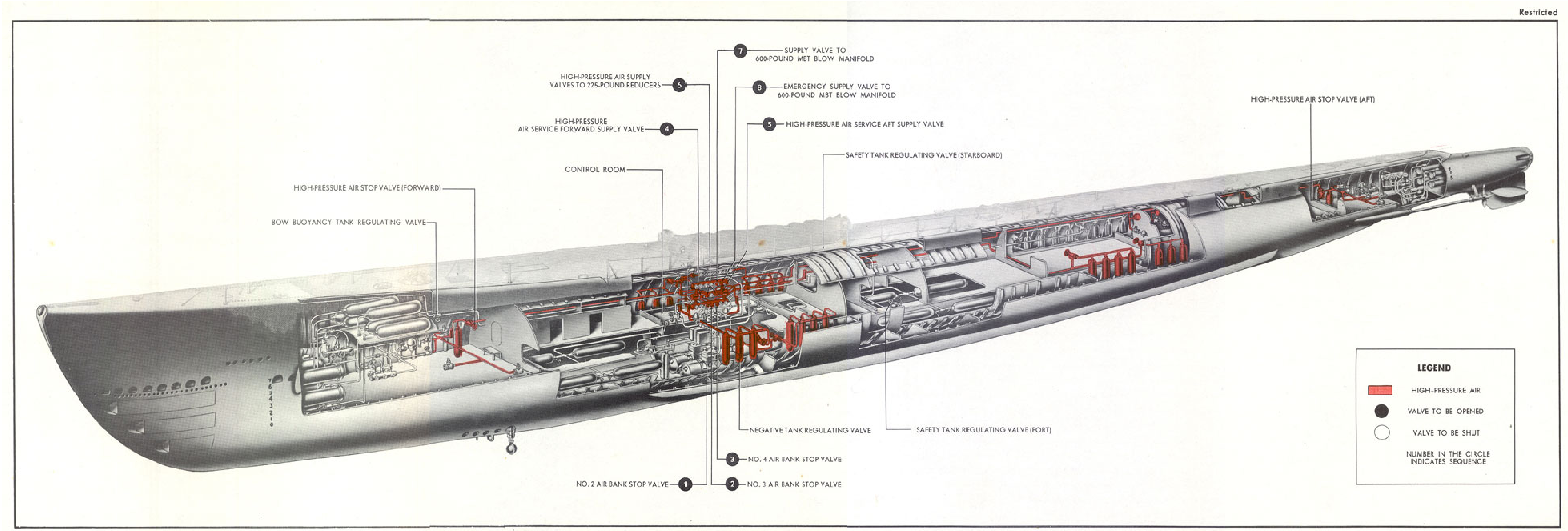

Figure 7-1. RIGGING THE HIGH-PRESSURE MANIFOLD FOR DIVING.

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Figure 7-2. BLOWING THE BOW BUOYANCY TANK.

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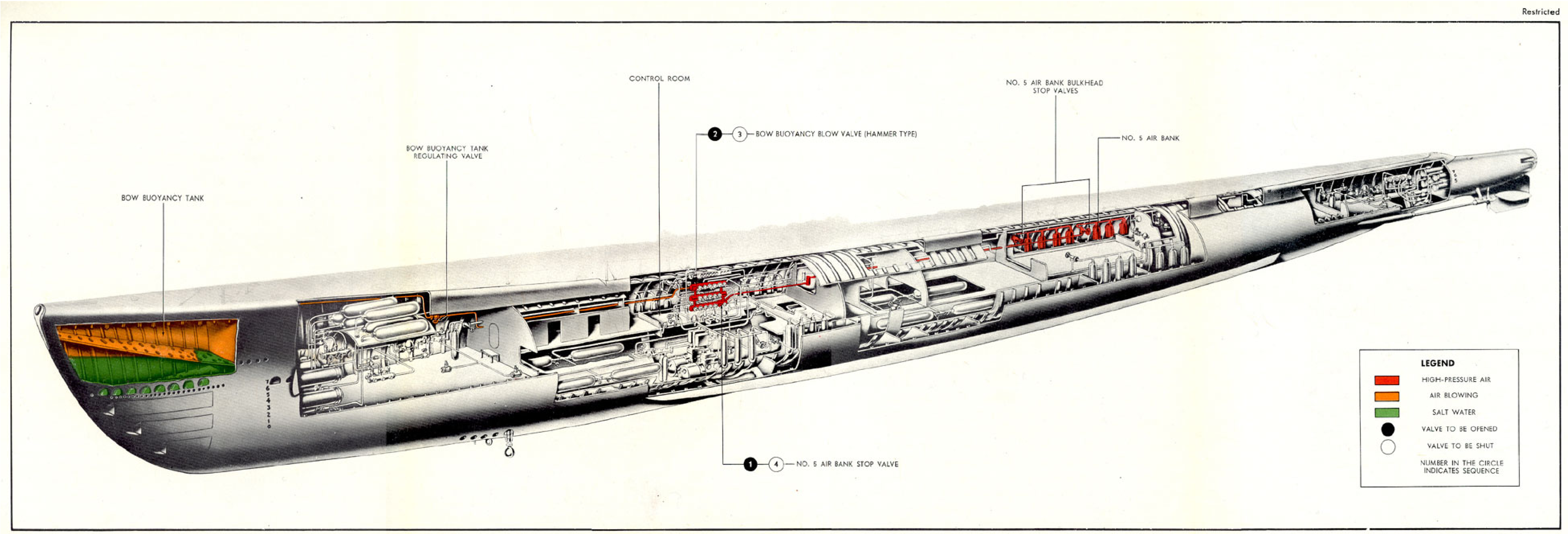

Figure 7-2. BLOWING THE BOW BUOYANCY TANK.

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Figure 7-3. BLOWING THE SAFETY TANK.

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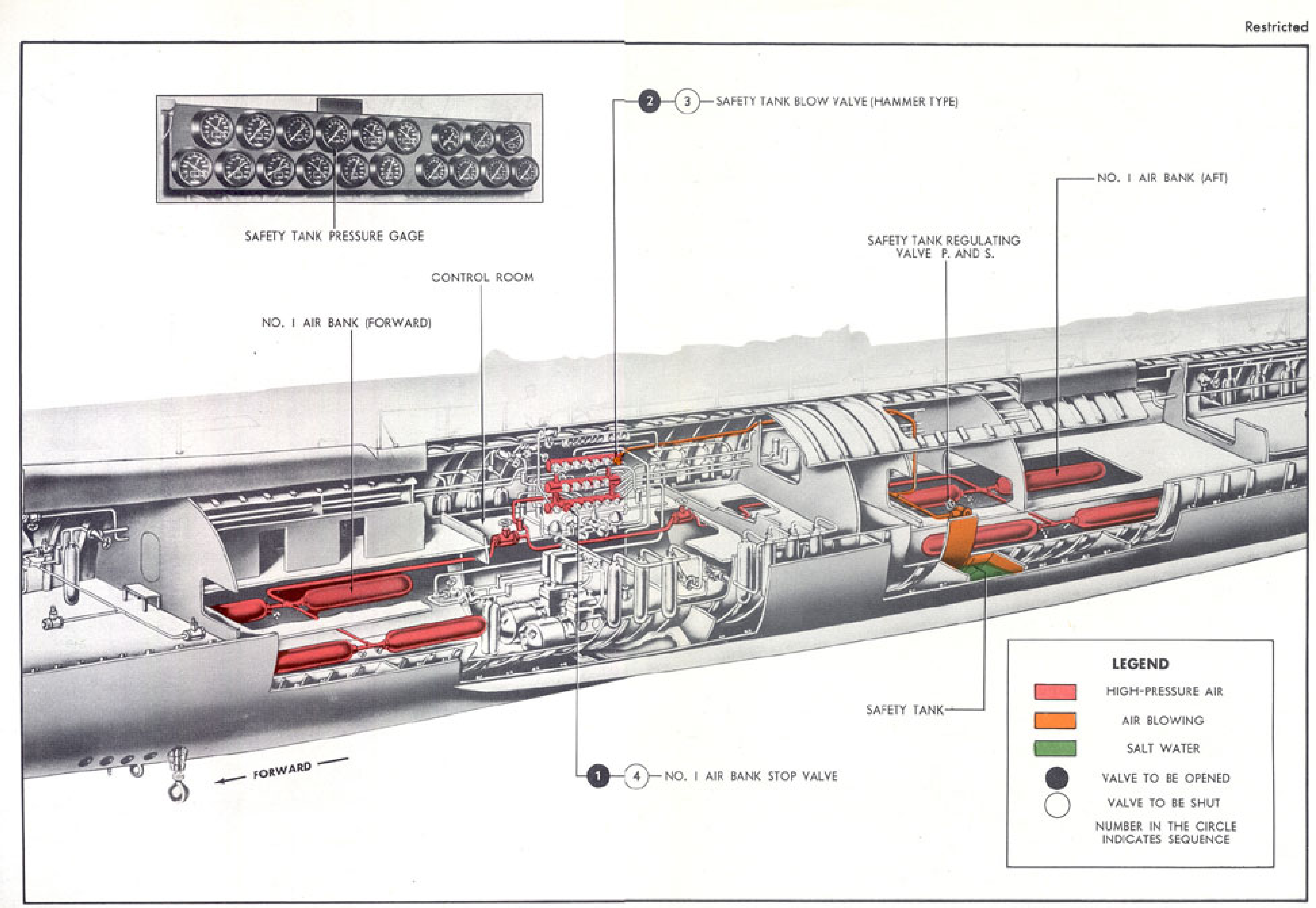

Figure 7-3. BLOWING THE SAFETY TANK.

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Figure 7-4. BLOWING THE NEGATIVE TANK.

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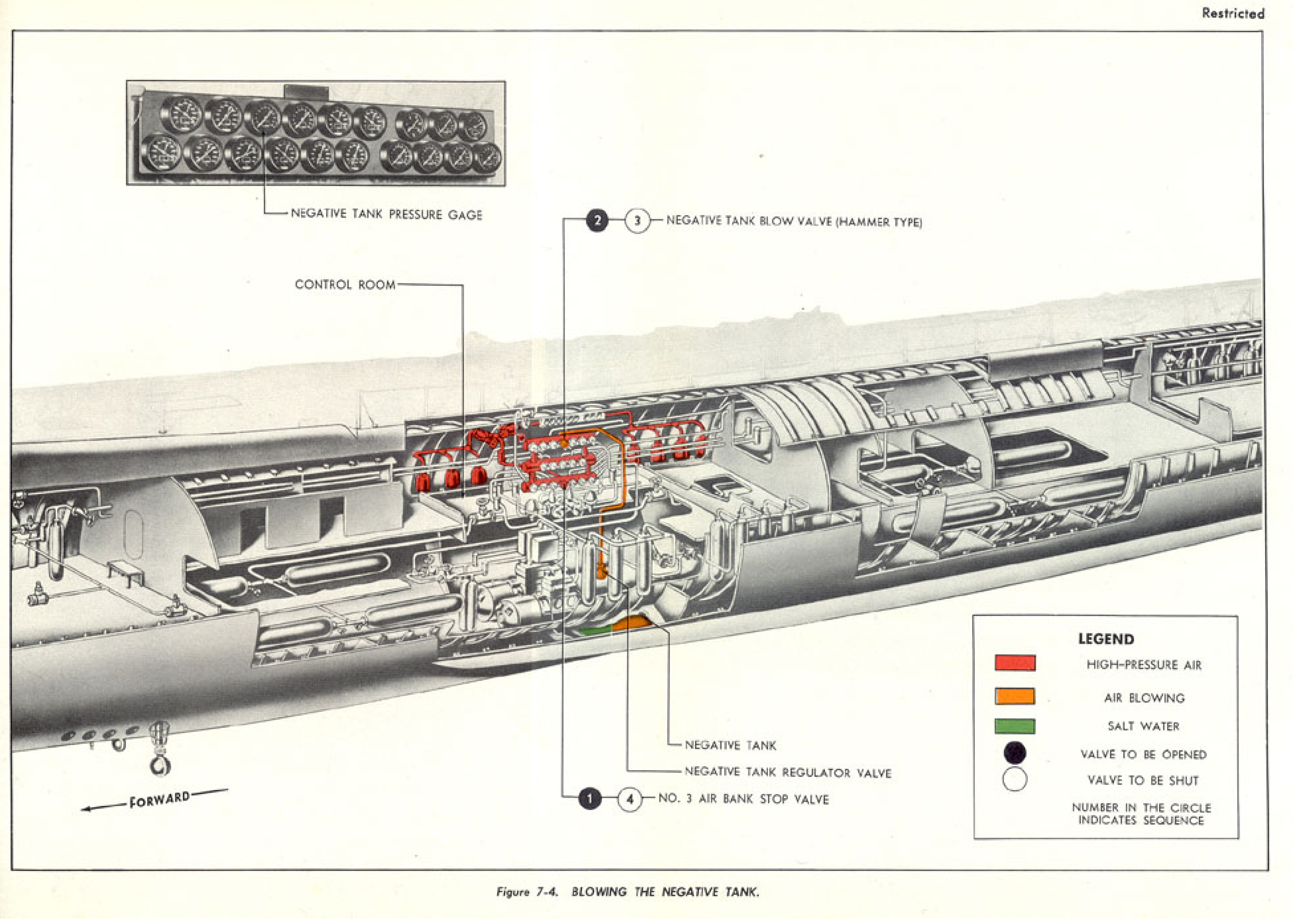

Figure 7-4. BLOWING THE NEGATIVE TANK.

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Figure 7-5. RIGGING FOR SURFACE FROM RIGGED FOR DIVE.

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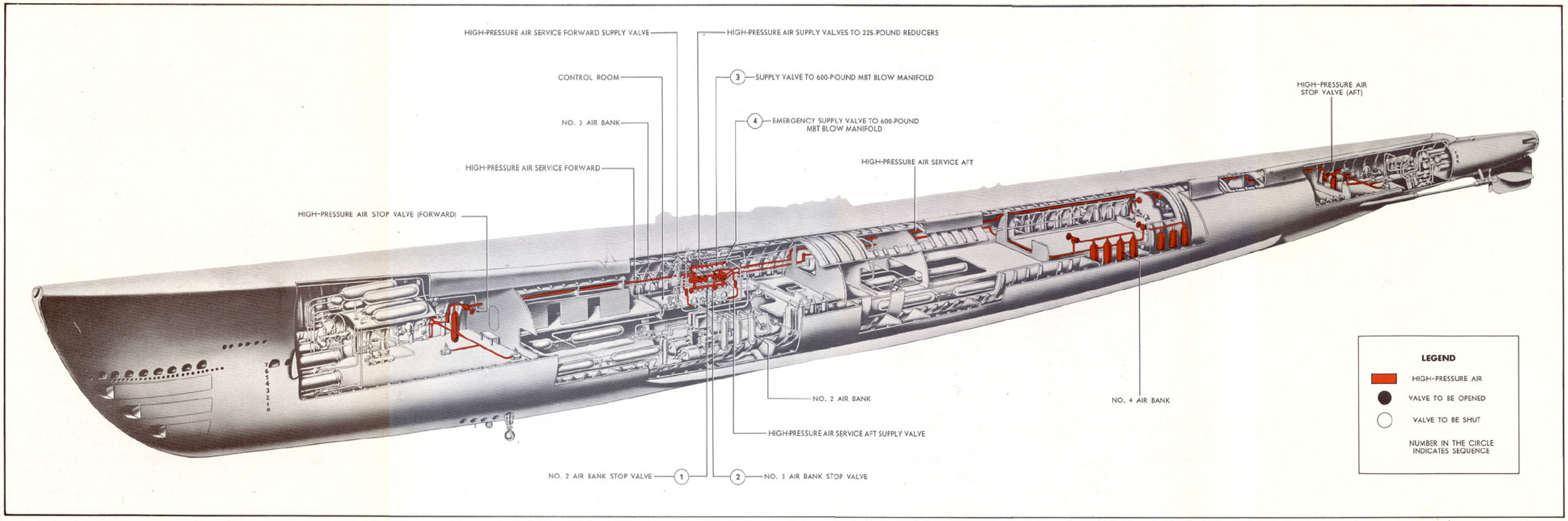

Figure 7-5. RIGGING FOR SURFACE FROM RIGGED FOR DIVE.

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Figure 7-6. CHARGING THE NO. 1 TORPEDO IMPULSE FLASK.

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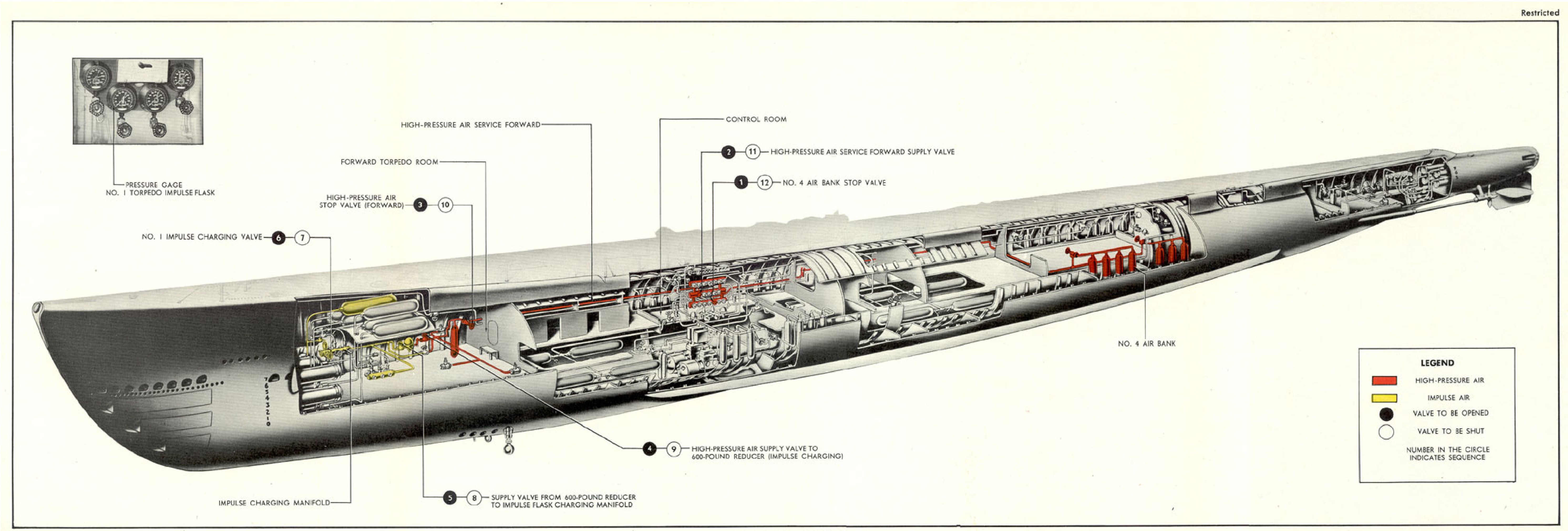

Figure 7-6. CHARGING THE NO. 1 TORPEDO IMPULSE FLASK.

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Figure 7-7. CHARGING THE NO. 1 AIR BANK WITH THE NO. 1 AIR COMPRESSOR.

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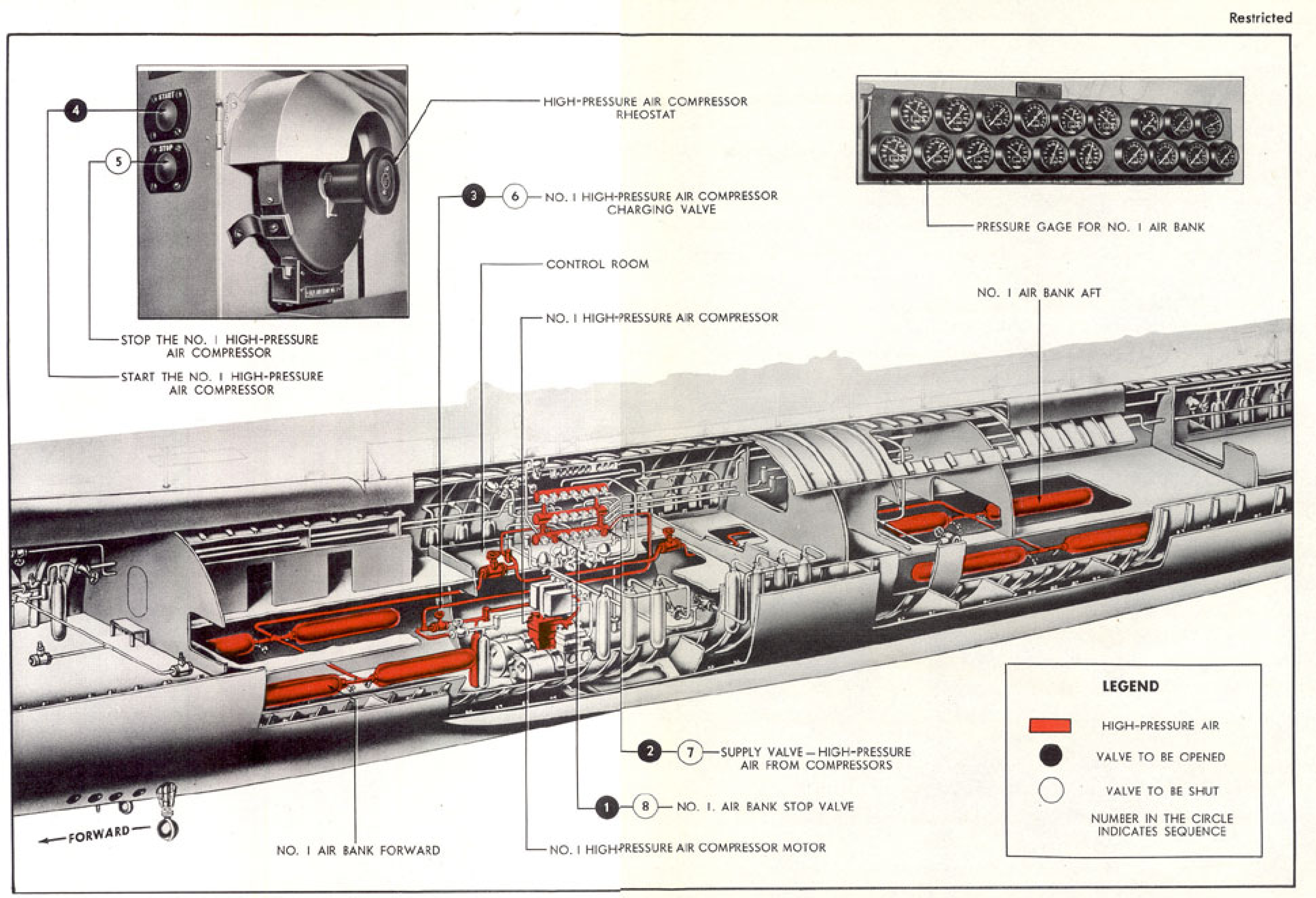

Figure 7-7. CHARGING THE NO. 1 AIR BANK WITH THE NO. 1 AIR COMPRESSOR.

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Figure 7-8. CHARGING THE NO. 2 AIR BANK FROM THE DOCK.

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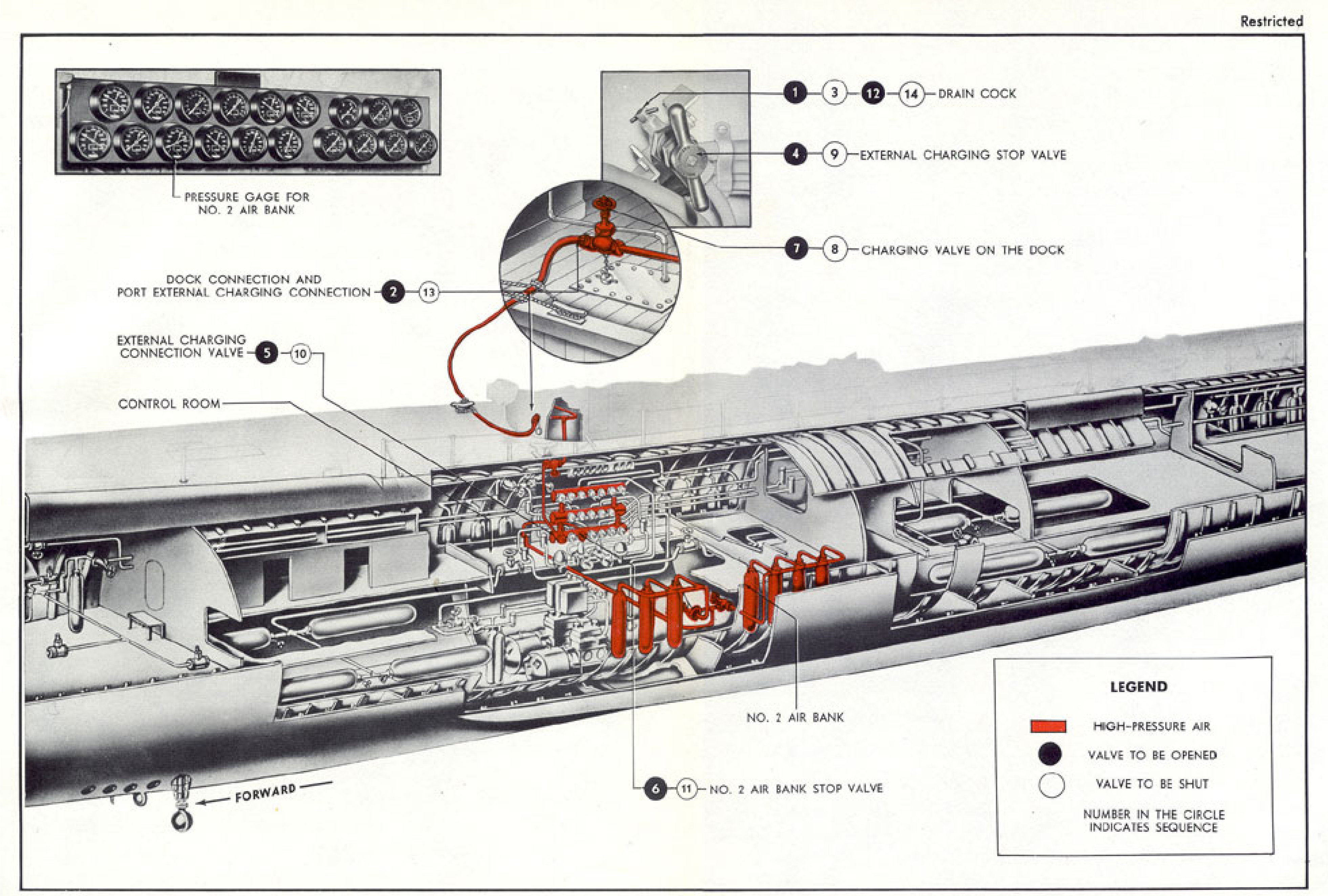

Figure 7-8. CHARGING THE NO. 2 AIR BANK FROM THE DOCK.

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Figure 7-9. CHARGING THE HYDRAULIC ACCUMULATOR AIR FLASK WITH HIGH-PRESSURE AIR.

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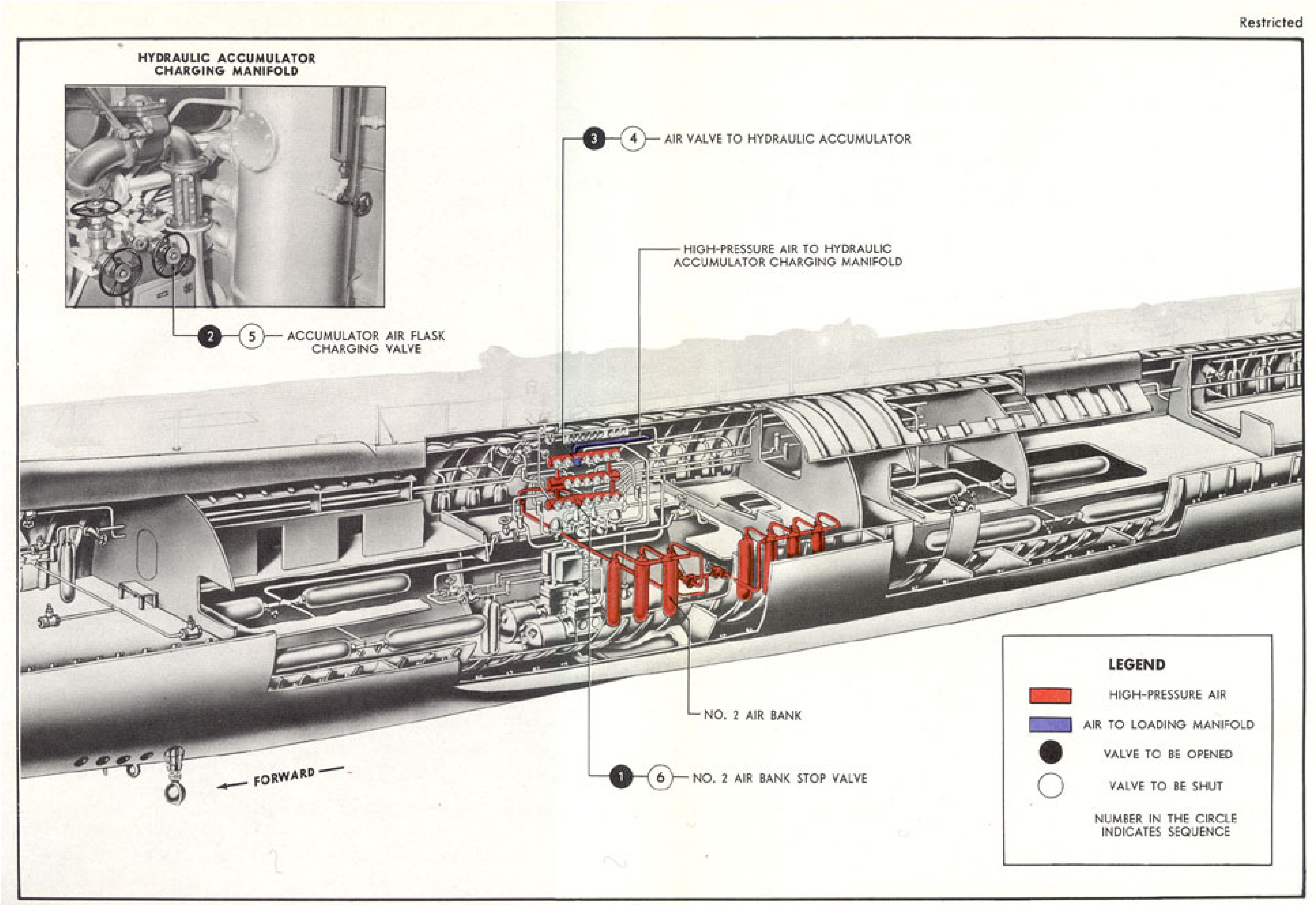

Figure 7-9. CHARGING THE HYDRAULIC ACCUMULATOR AIR FLASK WITH HIGH-PRESSURE AIR.

Figure 7-10. BYPASSING HIGH-PRESSURE AIR INTO THE 225-POUND SERVICE AIR SYSTEM.

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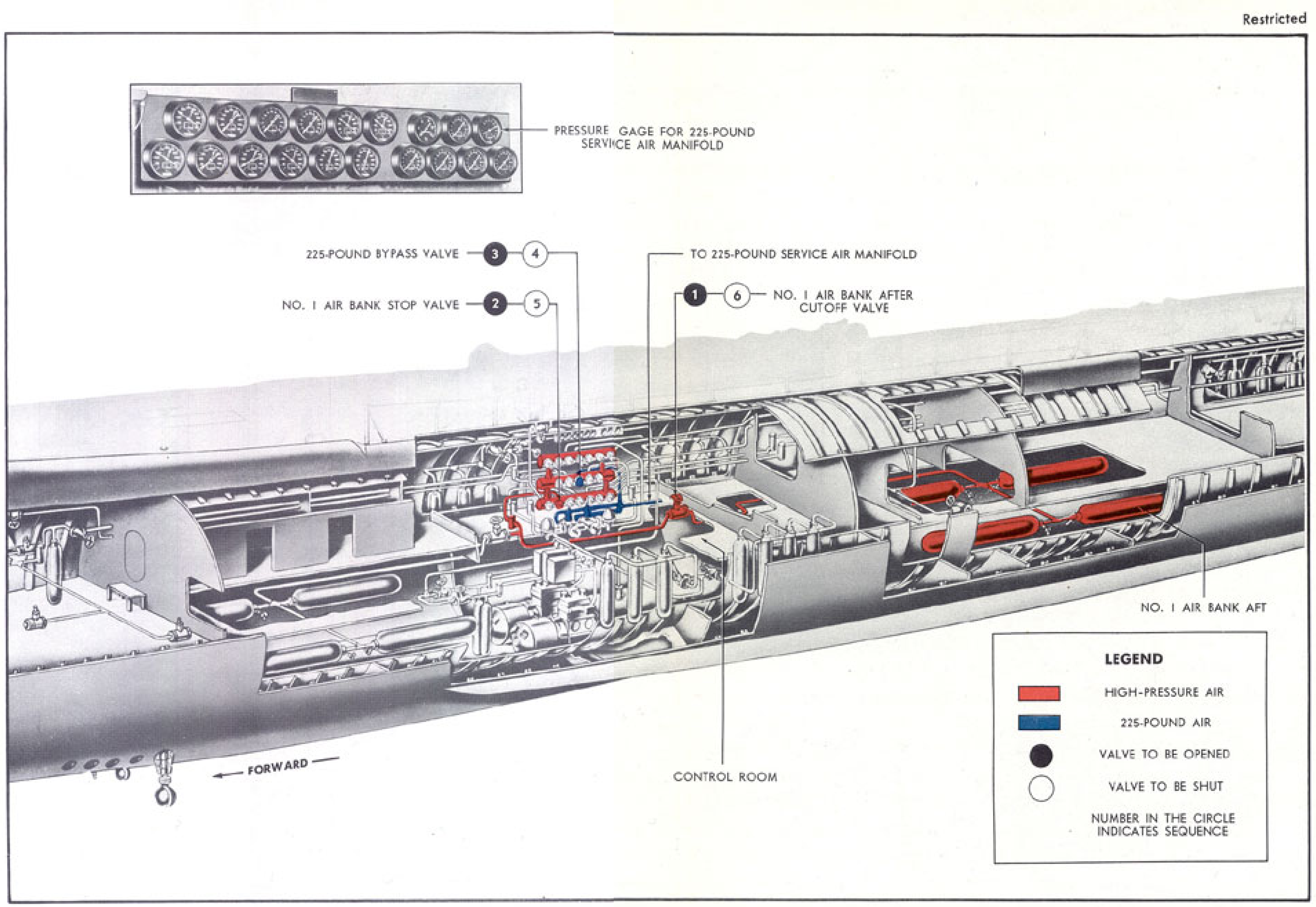

Figure 7-10. BYPASSING HIGH-PRESSURE AIR INTO THE 225-POUND SERVICE AIR SYSTEM.

8
OPERATING THE 600-POUND MAIN BALLAST TANK BLOWING SYSTEM

A. RIGGING THE 600-POUND MBT BLOW MANIFOLD FOR DIVING

(Figure 8-1)

8A1. Preparation.

1. Open the MBT regulator valves at the tanks.

2. Secure the 600-pound blow manifold in the control room.

3. Rig the high-pressure manifold with both supply valves to the 600-pound MBT blow manifold open.

(The individual, FBT blow valves on the manifold are locked shut and therefore not operated since it is assumed that the fuel ballast tanks are carrying fuel.)

8A2. Steps in operation.

1. Open the MBT No. 1 blow valve on the 600-pound MBT blow manifold.

2. Open the MBT No. 2B-2D blow valve.

3. Open the MBT No. 2A-2C blow valve.

The forward group of individual MBT blow valves is now open.

4. Open the MBT No. 6B-6D blow valve.

5. Open the MBT No. 6A-6C blow valve.

6. Open the MBT No. 7 blow valve.

The after group of individual MBT blow valves is now open.

7. Open the forward group stop check valve.

8. Open the after group stop check valve.

The 600-pound MBT blow manifold is now rigged for diving, to blow from either hammer valve.

Figure 8-1. RIGGING THE 600-POUND MBT BLOW MANIFOLD FOR DIVING.

B. BLOWING ALL THE MAIN BALLAST TANKS

(Figure 8-2)

8B1. Preparation.

1. Rig the 600-pound MBT blow manifold for diving.

2. Rig the high-pressure air manifold with both supply valves to the 600-pound MBT blow manifold open. (See Section 8A.)

3. These steps result in the following:

a. The MBT regulator valves at the tanks are open.

b. The individual MBT blow valves on the 600-pound blow manifold are open.

(The individual FBT blow valves on the manifold are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel.)

c. The forward and after group stop check valves are open.

d. The hammer valves are shut.

8B2. Steps in operation.

1. Open the forward hammer valve. Observe the pressure gage so as not to exceed 600 pounds air pressure. (Either hammer valve may be used.)

2. Shut the forward hammer valve upon completion of blowing.

The 600-pound MBT blow manifold is still rigged for diving.

Figure 8-2. BLOWING ALL THE MAIN BALLAST TANKS.

C. BLOWING THE FORWARD GROUP OF MAIN BALLAST TANKS

(Figure 8-3)

8C1. Preparation.

1. Rig the 600-pound MBT blow manifold for diving.

2. Rig the high-pressure air manifold with both supply valves to the 600-pound MBT blow manifold. (See Section 8A.)

3. These steps result in the following:

a. The MBT regulator valves at the tanks are open.

c. The forward and after group stop check valves are open.

d. The hammer valves are shut.

8C2. Steps in operation.

1. Shut the after group stop check valve.

2. Open the after hammer valve. Observe the pressure gage so as not to exceed 600 pounds air pressure. (Either hammer valve may be used.)

b. The individual MBT blow valves on the 600-pound blow manifold are open.

(The individual FBT blow valves on the manifold are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel oil.)

3. Shut the after hammer valve on completion of blowing.

4. Open the after group stop check valve.

The 600-pound MBT blow manifold is still rigged for diving.

Figure 8-3. BLOWING THE FORWARD GROUP OF MAIN BALLAST TANKS.

D. BLOWING THE AFTER GROUP OF MAIN BALLAST TANKS

(Figure 8-4)

8D1. Preparation.

1. Rig the 600-pound MBT blow manifold for diving.

2. Rig the high-pressure air manifold with both supply valves to the 600-pound MBT blow manifold open. (See Section 8A.)

3. These steps result in the following:

a. The MBT regulator valves at the tanks are open.

b. The individual MBT blow valves on the 600-pound blow manifold are open. (The individual FBT blow valves on the manifold are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel oil.)

c. The forward and after group stop check valves are open.

d. The hammer valves are shut.

8D2. Steps in operation.

1. Shut the forward group stop check valve.

2. Open the forward hammer valve. Observe the pressure gage in order not to exceed 600 pounds air pressure. (Either hammer valve may be used.)

3. Shut the forward hammer valve on completion of blowing.

4. Open the forward group stop check valve.

The 600-pound MBT blow manifold is still rigged for diving.

Figure 8-4. BLOWING THE AFTER GROUP OF MAIN BALLAST TANKS.

E. BLOWING MAIN BALLAST TANKS NO. 2A-2C AND NO. 6A-6C

(Figure 8-5)

8E1. Preparation.

1. Rig the 600-pound MBT blow manifold for diving.

2. Rig the high-pressure air manifold with both supply valves to the 600-pound MBT blow manifold open. (See Section 8A.)

3. These steps result in the following:

a. The MBT regulator valves at the tanks are open.

b. The individual MBT blow valves on the 600-pound blow manifold are open. (The individual FBT blow valves on the manifold are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel oil.)

c. The forward and after group stop check valves are open.

d. The hammer valves are shut.

8E2. Steps in operation. 1. Shut the MBT No. 1 blow valve.

2. Shut the MBT No. 2B-2D blow valve.

3. Shut the MBT No. 6B-6D blow valve. 4. Shut the MBT No. 7 blow valve.

S. Open the forward hammer valve. Observe the pressure gage in order not to exceed 600 pounds air pressure. (Either hammer valve may be used.)

6. Shut the forward hammer valve upon completion of blowing.

7. Open the MBT No. 7 blow valve.

8. Open the MBT No. 6B-6D blow valve.

J. Open the MBT No. 2B-2D blow valve.

10. Open the MBT No. 1 blow valve.

The 600-pound MBT blow manifold is still rigged for diving.

Figure 8-5. BLOWING MAIN BALLAST TANKS NO. 2A-2C AND 2A-2C AND NO. 6A-6C.

F. BLOWING MAIN BALLAST TANKS N0. 2B-2D AND NO. 6B-6D

(Figure 8-6)

8F1. Preparation.

1. Rig the 600-pound MBT blow manifold.

8F2. Steps in operation.

1. Shut the MBT No. 1 blow valve.

2. Rig the high-pressure air manifold with both supply valves to the 600-pound MBT blow manifold open. (See Section 8A.)

3. These steps result in the following:

a. The MBT regulator valves at the tanks are open.

b. The individual MBT blow valves on the 600-pound blow manifold are open.
(The individual FBT blow valves on the manifold are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel oil.)

c. The forward and after group stop check valves are open.

d. The hammer valves are shut.

2. Shut the MBT No. 2A-2C blow valve.

3. Shut the MBT No. 6A-6C blow valve.

4. Shut the MBT No. 7 blow valve.

S. Open the forward hammer valve. Observe the pressure gage in order not to exceed 600 pounds air pressure. (Either hammer valve may be used.)

6. Shut the forward hammer valve upon completion of blowing.

7. Open the MBT No. 7 blow valve.

8. Open the MBT No. 6A-6C blow valve.

9. Open the MBT No. 2A-2C blow valve.

10. Open the MBT No. 1 blow valve.

The 600-pound MBT blow manifold is still rigged for diving.

Figure 8-6. BLOWING MAIN BALLAST TANKS NO. 28-2D AND NO. 68-6D.

G. BLOWING MAIN BALLAST TANK NO. 2

(Figure 8-7)

8G1. Preparation.

1. Rig the 600-pound MBT blow manifold for diving.

2. Rig the high-pressure air manifold with both supply valves to the 600-pound MBT blow manifold open. (See Section 8A.)

c. The forward and after group stop check valves are open.

d. The hammer valves are shut.

8G2. Steps in operation.

1. Shut the after group stop check valve.

2. Shut the MBT No. 1 blow valve.

3. These steps result in the following:

a. The MBT regulator valves at the tanks are open.

b. The individual MBT blow valves on the 600-pound blow manifold are open.
(The individual FBT blow valves on the manifold are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel oil.)

3. Open the after hammer valve. Observe the pressure gage in order not to exceed 600 pounds air pressure. (Either hammer valve may be used.)

4. Shut the after hammer valve upon completion of blowing.

5. Open the MBT No. 1 blow valve.

6. Open the after group stop check valve.

The 600-pound MBT blow manifold is still rigged for diving.

Figure 8-7 BLOWING MAIN BALLAST TANK NO. 2.

H. BLOWING MAIN BALLAST TANK N0. 7

(Figure 8-8)

8H1. Preparation.

1. Rig the 600-pound MBT blow manifold.

2. Rig the high-pressure air manifold with both supply valves to the 600-pound MBT blow manifold open. (See Section 8A.)

3. These steps result in the following:

a. The MBT regulator valves at the tanks are open.

b. The individual MBT blow valves on the 600-pound blow manifold are open.
(The individual FBT blow valves on the manifold are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel oil.)

8H2. Steps in operation.

1. Shut the forward group stop check valve.

2. Shut the MBT No. 6B-6D blow valve.

3. Shut the MBT No. 6A-6C blow valve.

4. Open the after hammer valve. Observe the pressure gage in order not to exceed 600 pounds air pressure. (Either hammer valve may be used.)

5. Shut the after hammer valve upon completion of blowing.

6. Open the MBT No. 6A-6C blow valve.

7. Open the MBT No. 6B-6D blow valve.

c. The forward and after group stop check valves are open.

d. The hammer valves are shut.

8. Open the forward group stop check valve.

The 600-pound MBT blow manifold is still rigged for diving.

Figure 8-8. BLOWING MAIN BALLAST TANK NO. 7.

I. RIGGING THE HIGH-PRESSURE AIR MANIFOLD AND 600-POUND MBT BLOW MANIFOLD FOR BLOWING FROM EITHER THE DISTRIBUTING MANIFOLD OR THE 600-POUND BT BLOW MANIFOLD

(Figure 8-9)

8I1. Preparation.

1. Open the MBT regulator valves at the tanks.

2. Secure the 600-pound MBT blow manifold in the control room.

3. Shut the two supply valves to the 600-pound MBT blow manifold on the upper distributing manifold in the control room.

8I2. Steps in operation.

1. Open the MBT No. 1 blow valve on the 600-pound blow manifold.

2. Open the MBT No. 2B 2D blow valve.

3. Open the MBT No. 2A-2C blow valve.

4. Open the MBT No. 6B-6D blow valve.

5. Open the MBT No. 6A-6C blow valve.

7. Open the forward group stop check valve.

8. Open the after group stop check valve.

9. Open the after hammer valve.

10. Open the supply valve to the 600-pound MBT blow manifold on the upper distributing manifold. (This leads to the forward hammer valve.)

The 600-pound MBT blow manifold is now rigged to blow from either the distributing manifold or the 600-pound MBT blow manifold as follows:

a. By operating the emergency supply valve to the 600-pound MBT blow manifold, on the high-pressure air distributing manifold; or

b. By operating the forward hammer valve at the 600-pound MBT blow manifold.

6. Open the MBT No. 7 blow valve.

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Figure 8-9. RIGGING THE HIGH-PRESSURE AIR MANIFOLD AND 600-POUND MBT BLOW MANIFOLD FOR BLOWING FROM EITHER THE DISTRIBUTING MANIFOLD OR THE 600-POUND MBT BLOW MANIFOLD.

Figure 8-1. RIGGING THE 600-POUND MBT BLOW MANIFOLD FOR DIVING.

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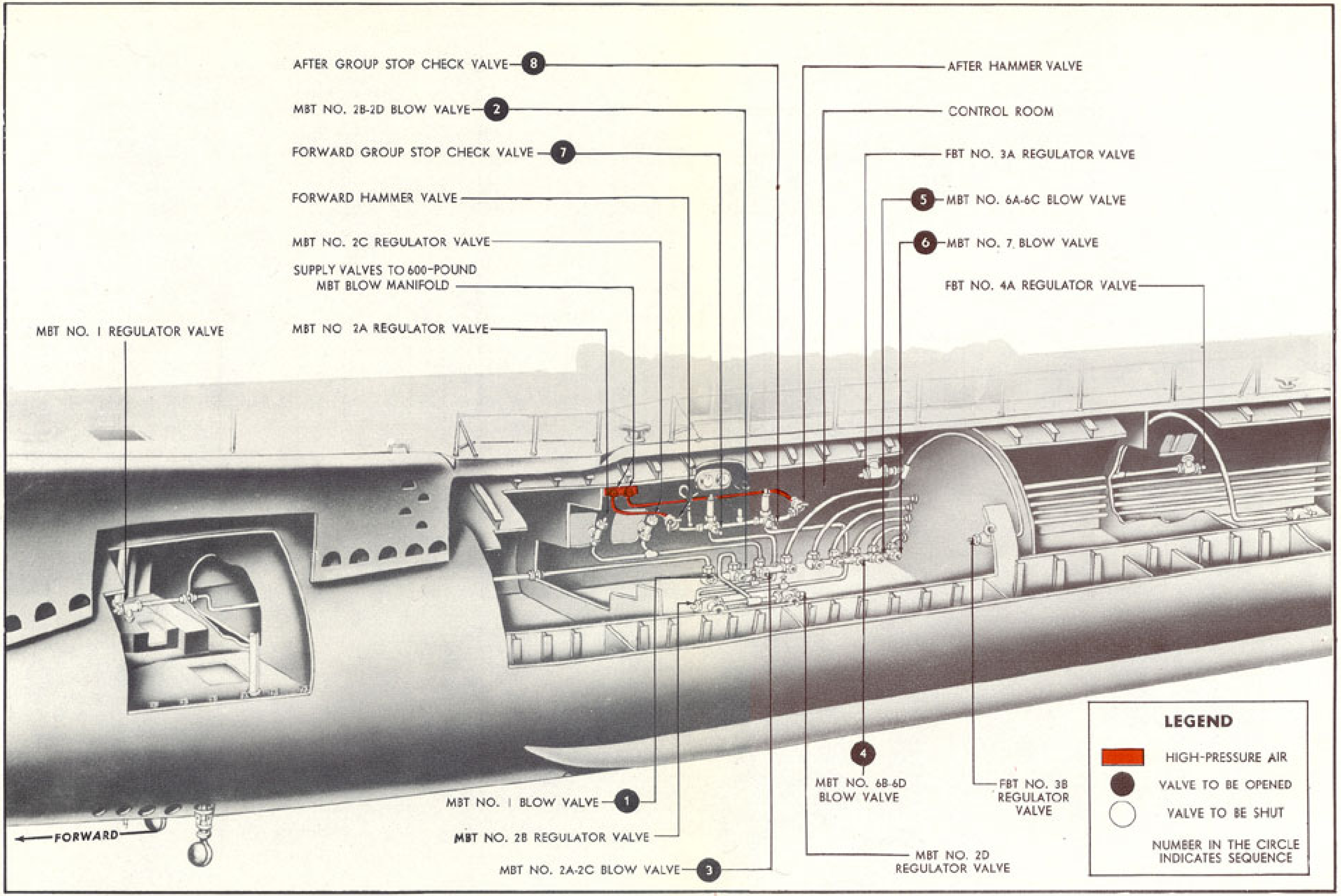

Figure 8-1. RIGGING THE 600-POUND MBT BLOW MANIFOLD FOR DIVING.

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Figure 8-2. BLOWING ALL THE MAIN BALLAST TANKS.

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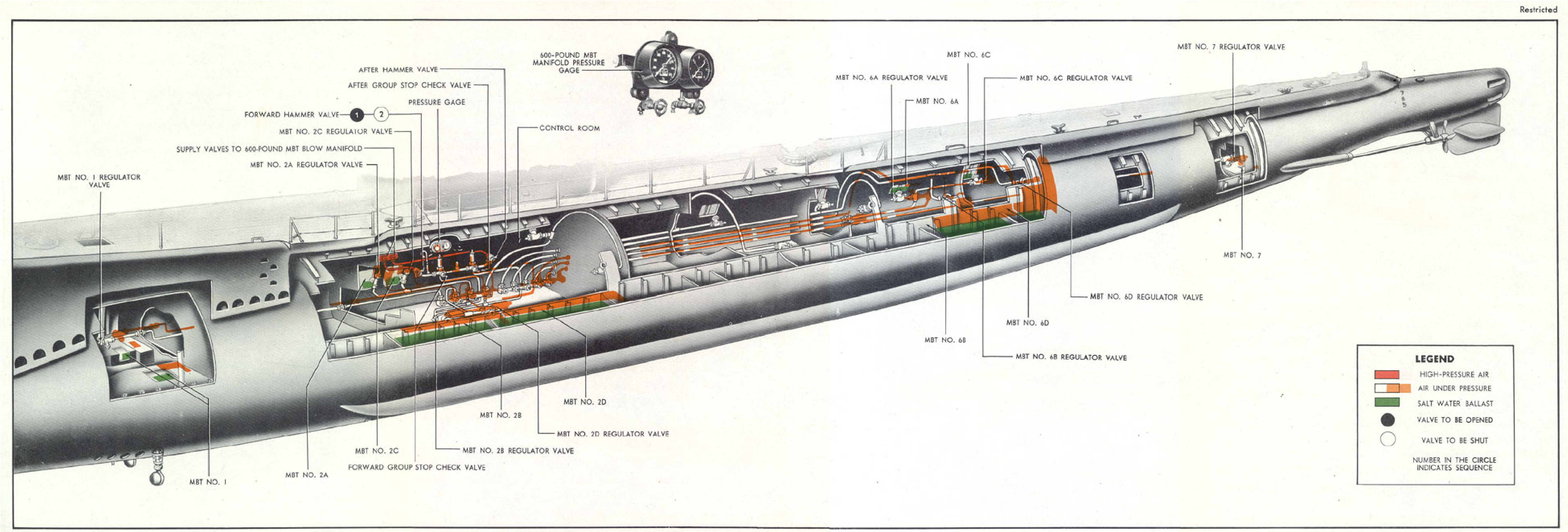

Figure 8-2. BLOWING ALL THE MAIN BALLAST TANKS.

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Figure 8-3. BLOWING THE FORWARD GROUP OF MAIN BALLAST TANKS.

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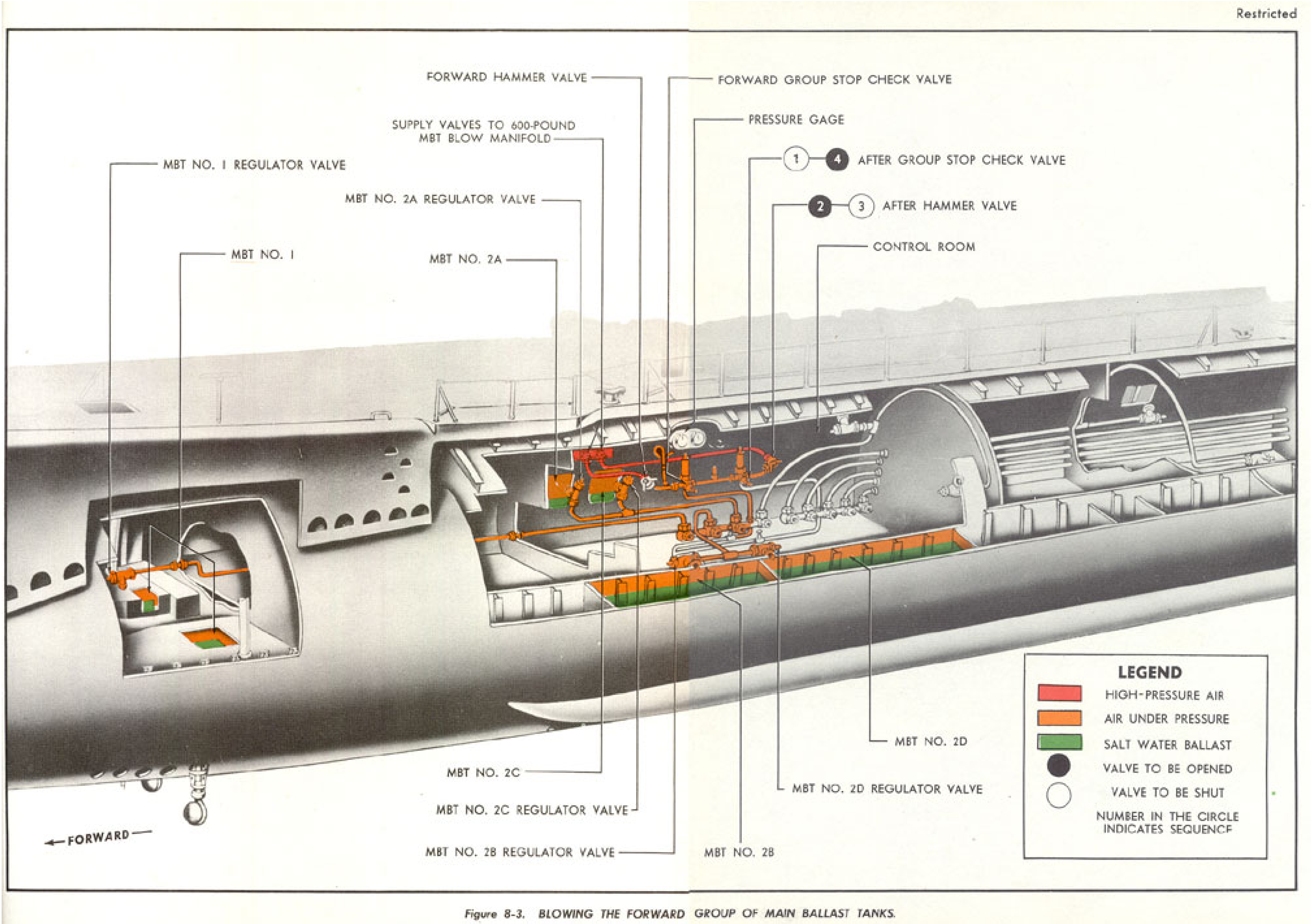

Figure 8-3. BLOWING THE FORWARD GROUP OF MAIN BALLAST TANKS.

Figure 8-4. BLOWING THE AFTER GROUP OF MAIN BALLAST TANKS.

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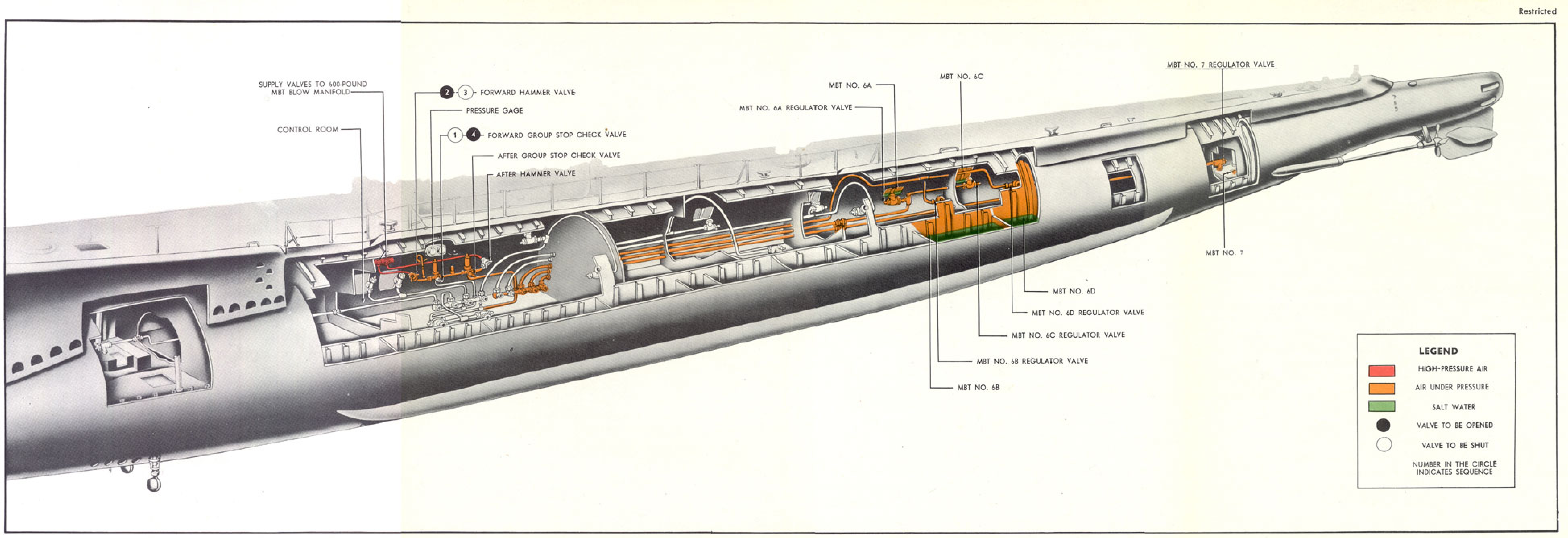

Figure 8-4. BLOWING THE AFTER GROUP OF MAIN BALLAST TANKS.

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Figure 8-5. BLOWING MAIN BALLAST TANKS NO. 2A-2C AND 2A-2C AND NO. 6A-6C.

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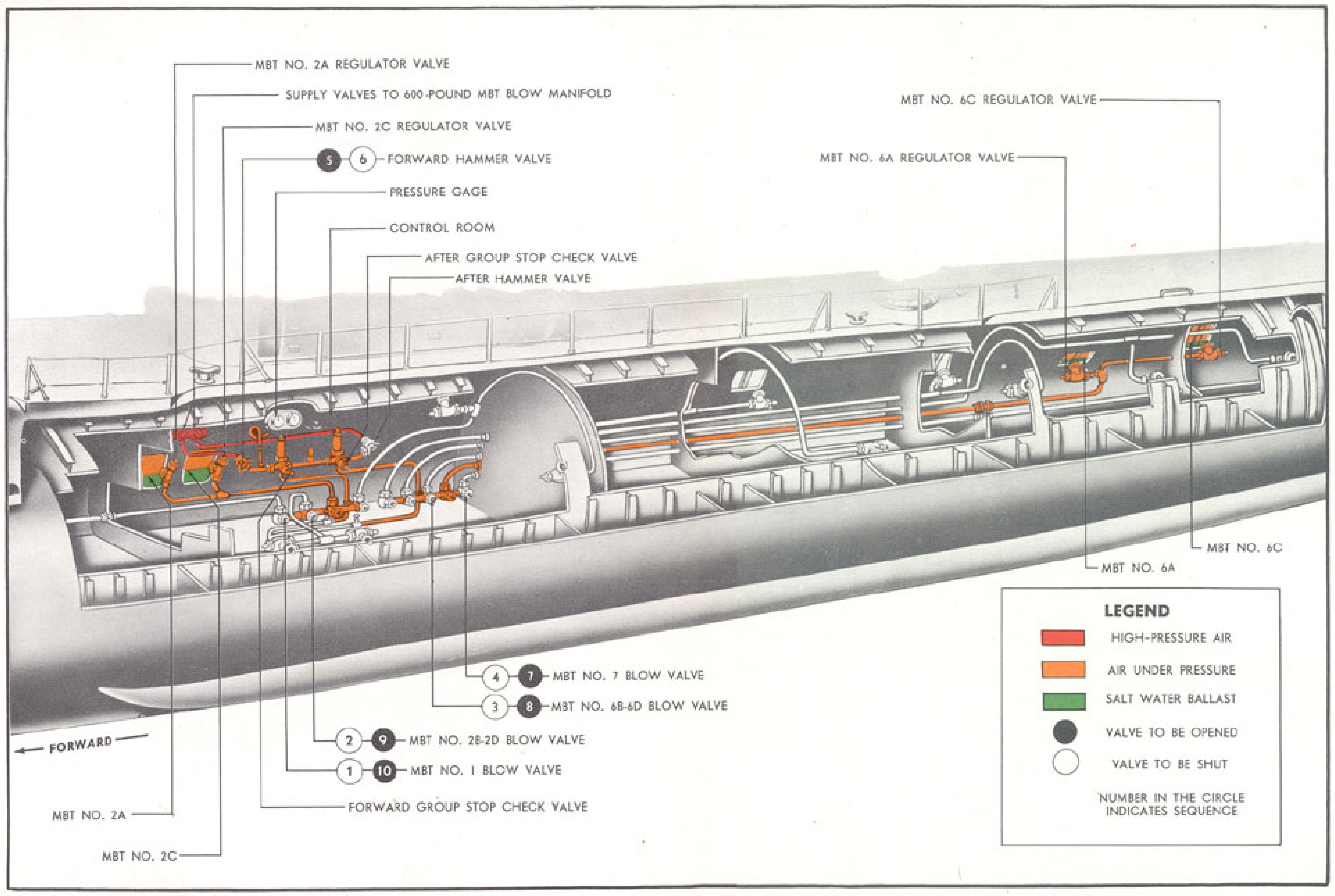

Figure 8-5. BLOWING MAIN BALLAST TANKS NO. 2A–2C AND NO. 6A–6C.

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Figure 8-6. BLOWING MAIN BALLAST TANKS NO. 28-2D AND NO. 68-6D.

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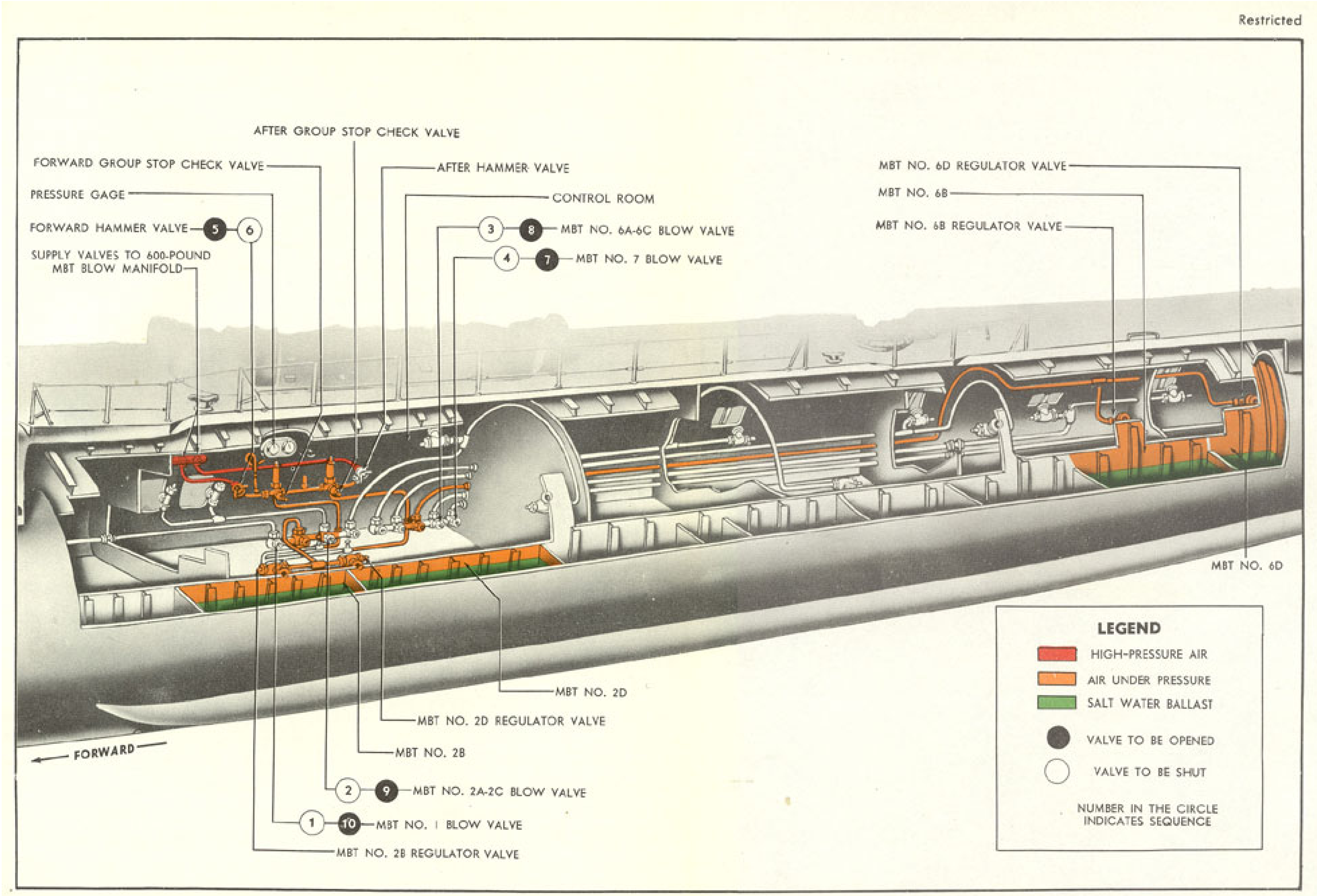

Figure 8-6. *BLOWING MAIN BALLAST TANKS NO. 2B-2D AND NO. 6B-6D.*

Figure 8-7 BLOWING MAIN BALLAST TANK NO. 2.

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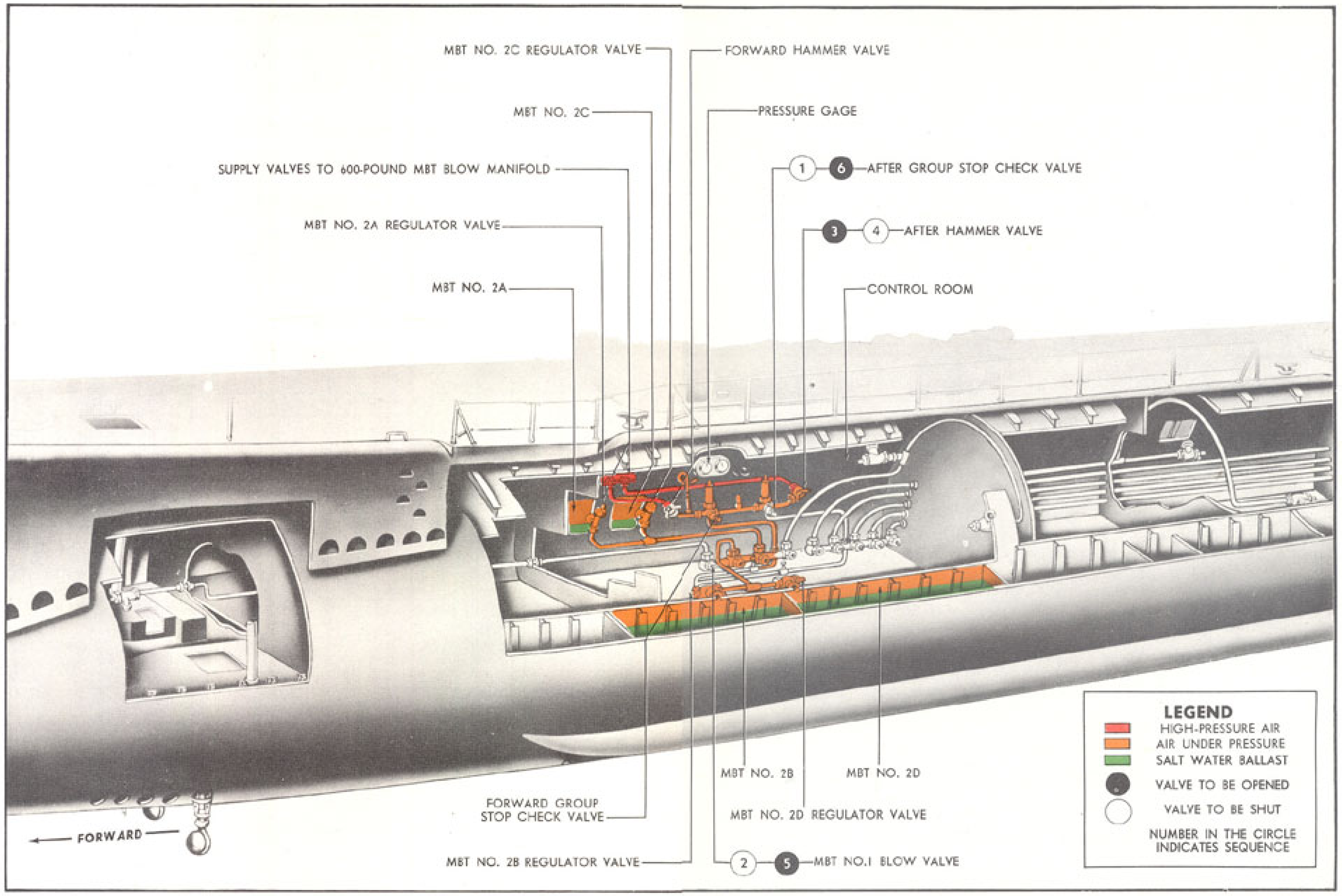

Figure 8-7. BLOWING MAIN BALLAST TANK NO. 2.

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Figure 8-8. BLOWING MAIN BALLAST TANK NO. 7.

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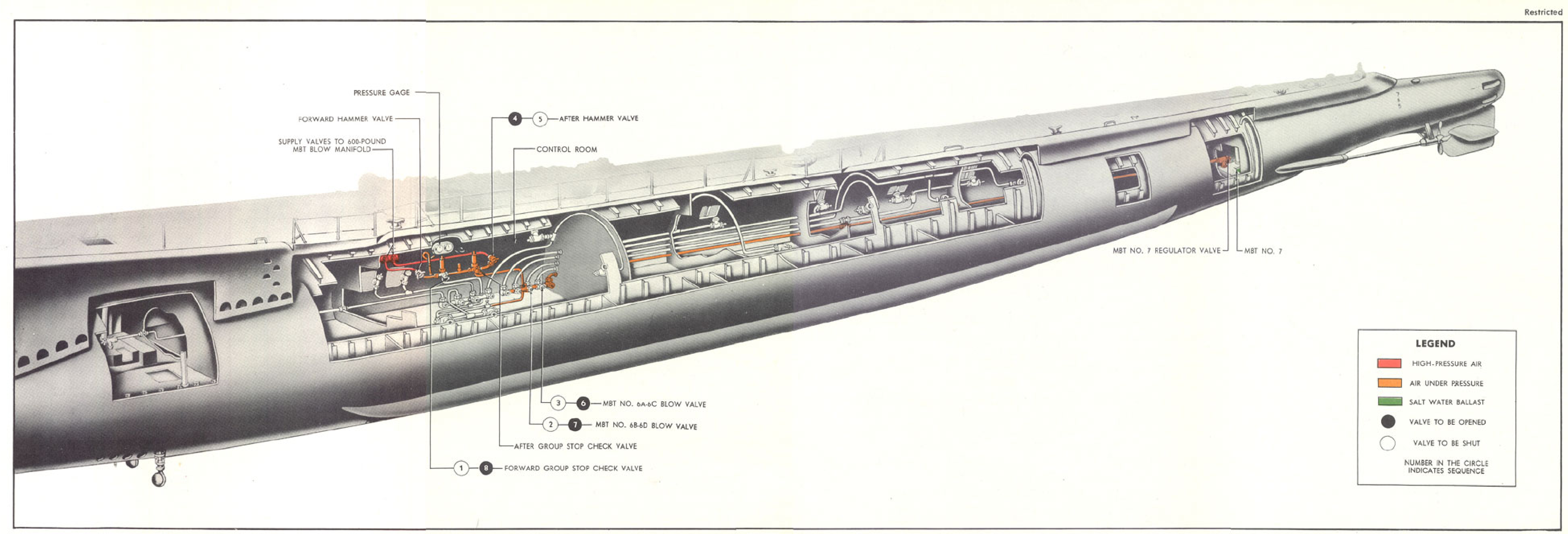

Figure 8-8. BLOWING MAIN BALLAST TANK NO. 7.

Figure 8-9. RIGGING THE HIGH-PRESSURE AIR MANIFOLD AND 600-POUND MBT BLOW MANIFOLD FOR BLOWING FROM EITHER THE DISTRIBUTING MANIFOLD OR THE 600-POUND MBT BLOW MANIFOLD.

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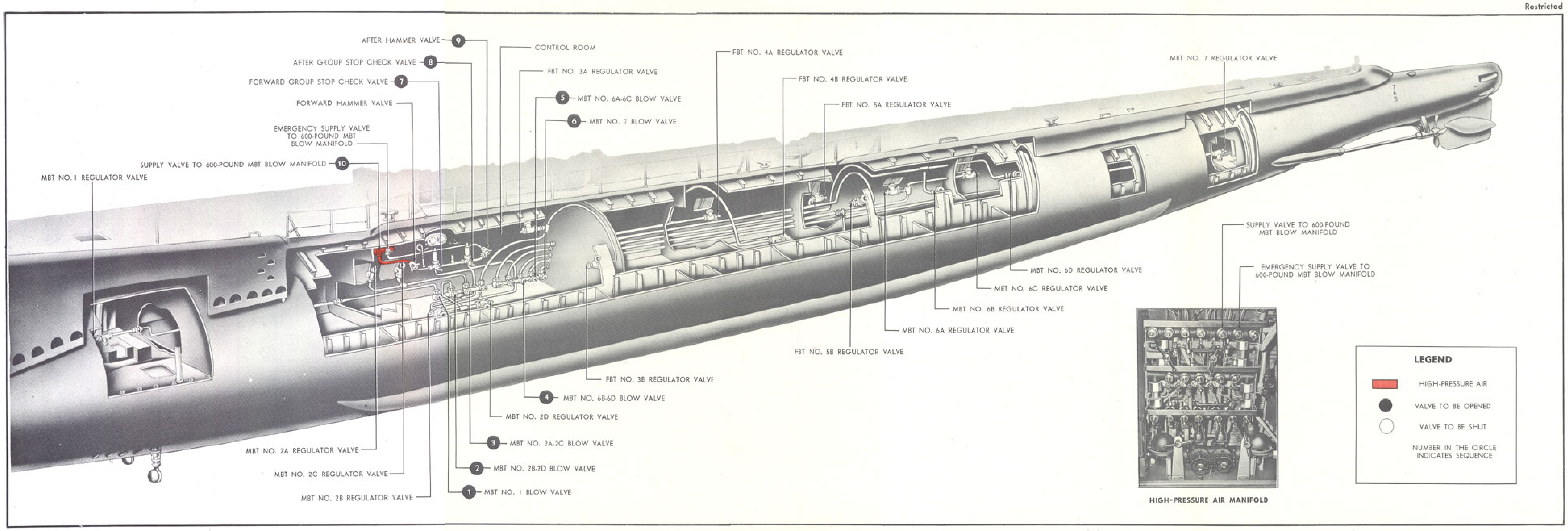

Figure 8-9. RIGGING THE HIGH-PRESSURE AIR MANIFOLD AND 600-POUND MBT BLOW MANIFOLD FOR BLOWING FROM EITHER THE DISTRIBUTING MANIFOLD OR THE 600-POUND MBT BLOW MANIFOLD.

9
OPERATING THE 225-POUND SERVICE AIR SYSTEM

A. CUTTING IN THE 225-POUND SERVICE AIR FORE AND AFT

(Figure 9-1)

9A1. Preparation.

1. Supply high-pressure air to the two 225-pound reducers.

2. Open the supply valve to the 225-pound service air manifold at each 225-pound reducer, so that low-pressure air is being supplied to the manifold.

3. Shut all the valves on the 225-pound service air manifold.

9A2. Steps in operation.

1. Remove the locking cap from the forward service air line valve on the 225-pound service air manifold in the control room.

2. Open the forward service air line valve.

3. Remove the locking cap from the after service air line valve on the 225-pound service air manifold in the control room.

4. Open the after service air line valve.

5. Lock open the forward service air line valve by replacing the locking cap and securing the padlock.

6. Lock open the after service air line valve by replacing the locking cap and securing the padlock.

The 225-pound service air manifold is now rigged to supply service air fore and aft.

Figure 9-1. CUTTING THE 225-POUND SERVICE AIR FORE AND AFT.

B. PUTTING PRESSURE IN THE FORWARD TRIM TANK

(Figure 9-2)

9B1. Preparation.

9B2. Steps in operation.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

1. Open the forward trim tank blow valve on the 225-pound service air manifold in the control room.

2. Observe the forward trim tank pressure gage over the manifold, when the required pressure, is reached.

3. Shut the forward trim tank blow valve on the manifold.

Figure 9-2. PUTTING PRESSURE IN THE FORWARD TRIM TANK.

C. VENTING THE AFTER TRIM TANK OUTBOARD

(Figure 9-3)

9C1. Steps in operation.

1. Open the after trim tank vent valve on the after torpedo tube blow and vent manifold in the after torpedo room.

2. Turn the three-way cock on the starboard side of the after torpedo room to the vent outboard position.

3. Open the after torpedo tube outboard vent valve, on the starboard side of the after torpedo room.

The after trim tank is now vented outboard.

4. Shut the after torpedo tube outboard vent valve upon completion of venting.

5. Shut the after trim tank vent valve on the after torpedo tube blow and vent manifold.

Figure 9-3. VENTING THE AFTER TRIM TANK OUTBOARD

D. BLOWING FROM THE NO. 1 TO THE NO. 2 AUXILIARY BALLAST TANK

(Figure 9-4)

9D1. Preparation.

vent valve on the 225-pound service air manifold in the control

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

c. The trim system is lined up for this operation.

9D2. Steps in operation.

1. Open the auxiliary ballast tank No. 1 blow and vent stop valve on the starboard side of the crew's mess room.

2. Open the auxiliary ballast tank No. 2 blow and vent stop valve on the port side of the crew's mess room.

3. Open the auxiliary ballast tank No. 2 room.

4. Open the auxiliary ballast, tank No. 1 blow valve on the 225-pound service air manifold. Observe the pressure gage for the auxiliary ballast tank No. 1 to be sure that the required pressure is obtained.

5. Shut the auxiliary ballast tank No. 1 blow valve when the required amount of water has been transferred.

6. Shut the auxiliary ballast tank No. 2 vent valve on the 225-pound service air manifold.

7. Shut the auxiliary ballast tank No. 2 blow and vent stop valve in the crew's mess room.

8. Shut the auxiliary ballast tank No. 1 blow and vent stop valve in the crew's mess room.

Figure 9-4. BLOWING FROM THE NO. 7 TO THE NO. 2 AUXILIARY BALLAST TANK.

E. VENTING AUXILIARY BALLAST TANK NO. 1

(Figure 9-5)

9E1. Steps in operation.

1. Open the auxiliary ballast tank No. 1 blow and vent stop valve on the starboard side of the crew's mess room.

2. Open the auxiliary ballast tank No. 1 vent valve on the 225-

3. Shut the auxiliary ballast tank No. 1 vent valve on the 225-pound service air manifold when venting is completed.

4. Shut the auxiliary ballast tank No. 1 blow and vent stop valve in the crew's mess room.

pound service air manifold in the control room.

Figure 9-5. VENTING AUXILIARY BALLAST TANK NO. 1

F. BLOWING FROM THE FORWARD WRT TANK TO THE FORWARD TRIM TANK

(Figure 9-6)

9F1. Preparation.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

Before air pressure can be admitted to the WRT tank, make certain that the WRT tank overflow valve is shut. This automatically opens the quick-acting WRT tank blow valve (whistle valve) to permit blowing the tank, as these two valves are interlocked and operated by the same lever. (See Figure 4-6.)

9F2. Steps in operation.

1. Open the 225-pound air supply valve to forward torpedo tube blow manifold in the forward torpedo room.

2. Open the forward trim tank vent valve on the forward torpedo tube blow and vent manifold.

3. Turn the three-way cock, located on the starboard side forward in the forward torpedo room, to the vent inboard position.

4. Open the WRT tank blow valve on the forward torpedo tube blow and vent manifold. Observe the WRT tank air pressure gage in order not to exceed the required pressure.

5. Shut the WRT tank blow valve on the forward torpedo tube blow and vent manifold when the required amount of water has been transferred.

6. Shut the forward trim tank vent valve on the forward torpedo tube blow and vent manifold.

7. Shut the 225-pound air supply valve to the forward torpedo tube blow and vent manifold.

Figure 9-6. BLOWING FROM THE FORWARD WRT TANK TO THE

FORWARD TRIM TANK.

G. BLOWING FROM THE FORWARD TRIM TANK TO THE AFTER TRIM TANK

(Figure 9-7)

9G1. Preparation.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

c. The trim system is lined up for this operation.

9G2. Steps in operation.

1. Open the after trim tank vent valve on the 225-pound service air manifold in the control room.

2. Open the forward trim tank blow valve on the 225-pound service air manifold. Observe the forward trim tank pressure gage so as not to exceed the required pressure.

3. Shut the forward trim tank blow valve on the 225-pound service air manifold when the required amount of water has been transferred.

4. Shut the after trim tank vent valve on the 225-pound service air manifold.

Figure 9-7. BLOWING FROM THE FORWARD TRIM TANK TO THE AFTER TRIM TANK.

H. BLOWING FROM THE AUXILIARY BALLAST TANK NO. 2 TO THE FORWARD TRIM TANK

(Figure 9-8)

9H1. Preparation.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

blow and vent stop valve, port side of the crew's mess room. 3. Open the auxiliary ballast tank No. 2 blow valve on the 225-pound service air manifold. Observe the pressure gage for auxiliary ballast tank No. 2, in order not to exceed the required pressure.

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

c. The trim system is lined up for this operation.

9H2. Steps in operation.

1. Open the forward trim tank vent valve on the 225-pound service air manifold in the control room.

2. Open the auxiliary ballast tank No. 2

4. Shut the auxiliary ballast tank No. 2 blow valve on the 225-pound service air manifold when the required amount of water has been transferred.

5. Shut the auxiliary ballast tank No. 2 blow and vent stop valve in the crew's mess room.

6. Shut the forward trim tank vent valve on the 225-pound service air manifold.

Figure 9-8. BLOWING FROM THE AUXILIARY BALLAST TANK NO. 2 TO THE FORWARD TRIM TANK.

I. BLOWING FROM THE FORWARD WRT TANK TO THE NO. 2 TORPEDO TUBE

(Figure 9-9)

9I1. Preparation.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

Before air pressure is admitted to the WRT tank, make certain that

4. Open the torpedo tube drain stop valve to WRT tank.

5. Open the 225-pound air supply valve to the forward torpedo tube blow and vent manifold in the forward torpedo room.

6. Open the WRT tank blow valve on the torpedo tube blow and vent manifold. Observe the WRT tank pressure gage in order not to exceed the required pressure.

(Water is now being transferred to the No. 2 torpedo tube.)

the WRT overflow valve is shut. (See Figure 4-5.) This automatically opens the quick-acting WRT tank blow valve (whistle valve) to permit blowing the tank. These two valves are interlocked and operated by the same lever.

9I2. Steps in operation.

1. Open the No. 2 torpedo tube vent valve on the torpedo tube blow and vent manifold in the forward torpedo room.

2. Turn the three-way cock, located on the port side of the forward torpedo room, to the vent inboard position.

3. Open the No. 2 torpedo tube drain valve on the torpedo tube drain manifold.

7. Shut the WRT tank blow valve on the torpedo tube blow and vent manifold when the column gage on the torpedo tube shows that the tube is full.

8. Shut the No. 2 torpedo tube vent valve on the torpedo tube blow and vent manifold.

9. Shut the No. 2 torpedo tube drain valve on the torpedo tube drain manifold.

10. Shut the torpedo tube drain stop valve to the WRT tank.

11. Shut the 225-pound air supply valve to the forward torpedo tube blow and vent manifold in the forward torpedo room.

Figure 9-9. BLOWING FROM THE FORWARD WRT TO THE NO. 2 TORPEDO TUBE.

J. BLOWING FROM THE NO. 8 TORPEDO TUBE TO THE AFTER WRT TANK

(Figure 9-10)

9J1. Preparation.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

to the after torpedo tube blow and vent manifold in the after torpedo room.

6. Open the No. 8 torpedo tube blow valve on the torpedo tube blow and vent manifold. Observe the No. 8 torpedo tube pressure gage in order not to exceed the required pressure. (Water is now being transferred to the WRT tank.)

9J2. Steps in operation.

1. Open the after WRT tank vent valve on the torpedo tube blow and vent manifold in the after torpedo room.

2. Turn the three-way cock, on the starboard side of the torpedo room, to the vent inboard position.

3. Open the after torpedo tube drain stop valve to the WRT tank.

4. Open the No. 8 torpedo tube drain valve on the torpedo tube drain manifold.

5. Open the 225-pound air supply valve

7. Shut the No. 8 torpedo tube blow valve on the torpedo tube blow and vent manifold when the column gage on the torpedo tube shows that the tube is empty.

8. Shut the No. 8 torpedo tube drain valve on the torpedo tube drain manifold.

9. Shut the after torpedo tube drain stop valve to the WRT tank.

10. Shut the after WRT tank vent valve on the torpedo tube blow and vent manifold.

11. Shut the 225-pound air supply valve to the after torpedo tube blow and vent manifold.

Figure 9-10. BLOWING FROM THE NO. 8 TORPEDO TUBE TO THE AFTER WRT TANK.

K. BLOWING FROM THE NO. 6 TORPEDO TUBE TO THE FORWARD TRIM TANK BY WAY OF THE FORWARD WRT TANK

(Figure 9-11)

9K1. Preparations.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

9K2. Steps in operation.

7. Open the No. 6 torpedo tube blow valve on the forward torpedo tube blow and vent manifold. Observe the No. 6 torpedo tube pressure gage in order not to exceed the required pressure.

(Assuming the WRT tank is full, water is now being transferred from the torpedo tube through the WRT tank and into the forward trim tank.)

8. Shut the No. 6 torpedo tube blow valve when the column gage on the torpedo tube shows that the tube is empty.

1. Open the forward trim tank vent valve on the torpedo tube blow and vent manifold in the forward torpedo room.

2. Turn the three-way cock on the starboard side of the forward torpedo room to the vent inboard position.

3. Open the No. 6 torpedo tube drain valve on the torpedo tube drain manifold.

4. Open the forward torpedo tube drain stop valve to the WRT tank.

5. Open the forward WRT tank overflow valve.

6. Open the 225-pound air supply valve to the forward torpedo tube blow and vent manifold.

9. Shut the No. 6 torpedo tube drain valve on the torpedo tube drain manifold.

10. Shut the forward torpedo tube drain stop valve to the WRT tank.

11. Shut the forward WRT tank overflow valve.

12. Shut the 225-pound air supply valve to the forward torpedo tube blow and vent manifold.

13. Shut the forward trim tank vent valve on the forward torpedo tube blow and vent manifold.

Figure 9-11. BLOWING FROM THE NO. 6 TORPEDO TUBE TO THE FORWARD TRIM TANK BY WAY OF THE FORWARD WRT TANK.

L. PUTTING THE NO. 4 FRESH WATER TANK ON SERVICE

(Figure 9-12)

9L1. Preparation.

1. Rig the 22 5-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b, There is 225-pound air in the forward and after service air

The No. 4 fresh water tank is now under 12-pound pressure and is on service provided the proper fresh water system connections are made.

9L3. Taking the No. 4 fresh water tank off service.

1. Shut the No. 4 fresh water tank blow valve.

2. Open the No. 4 fresh water tank vent valve to release pressure from

lines.

9L2. Steps in operation.

1. Open the 225-pound service air valve to the 12-pound reducer in the control room.

2. Open the 12-pound service air valve from the reducer in the control room.

3. Open the No. 4 fresh water tank blow valve in the control room.

the tank.

3. Shut the No. 4 fresh water tank vent valve when the gage shows that the pressure is relieved.

4. Shut the 12-pound service air valve from the reducer.

5. Shut the 225-pound service air valve to the 12-pound reducer.

Figure 9-12. PUTTING THE NO. 4 FRESH WATER TANK ON SERVICE

M. PUTTING THE NO. 2 BATTERY WATER TANK ON SERVICE

(Figure 9-13)

9M1. Preparation.

1. Rig the 225-pound service air manifold. (See Section 9A.)

2. This results in the following:

a. The forward and after service air line valves on the 225-pound service air manifold are locked open.

b. There is 225-pound air in the forward and after service air lines.

9M2. Steps in operation.

1. Open the 225-pound service air valve to the 8-pound reducer in the forward battery room.

2. Open the 8-pound service air valve from the reducer to the forward group of battery water tanks.

The No. 2 battery water tank is now under 8-pound pressure and is on service provided the proper battery water system connections are made.

9M3. Taking the No. 2 battery water tank off service.

1. Shut the No. 2 and No. 4 battery water tanks blow valve.

2. Open the No. 2 and No. 4 battery water tanks vent valve in the forward battery room to release pressure from the No. 2 tank.

3. Shut the No. 2 and No. 4 battery water tanks vent valve when the pressure gage at the tank indicates zero pressure.

4. Shut the No. 2 battery water tank blow valve.

3. Open the No. 2 and No. 4 battery water tanks blow valve.

4. Open the No. 2 battery water tank blow valve.

5. Shut the 8-pound service air valve from the reducer to the forward group of battery water tanks.

6. Shut the 225-pound service air valve to the 8-pound reducer.

Figure 9-13. PUTTING THE NO. 2 BATTERY WATER TANK ON SERVICE.

Figure 9-1. CUTTING THE 225-POUND SERVICE AIR FORE AND AFT.

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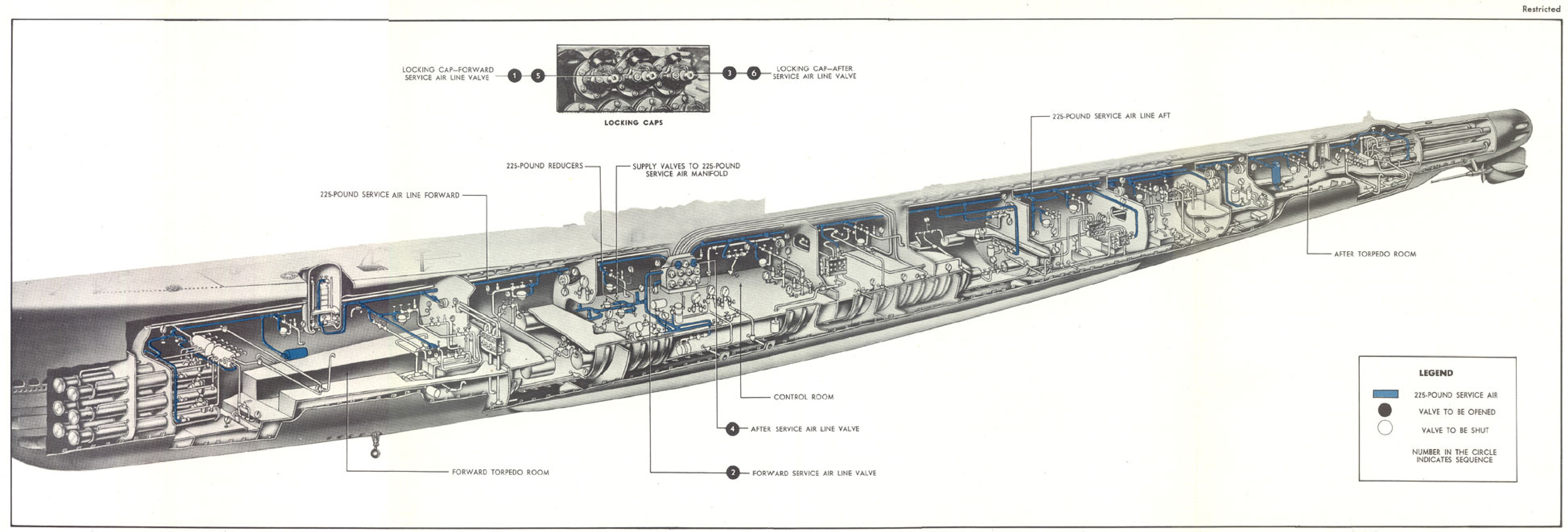

Figure 9-1. CUTTING THE 225-POUND SERVICE AIR FORE AND AFT.

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Figure 9-2. PUTTING PRESSURE IN THE FORWARD TRIM TANK.

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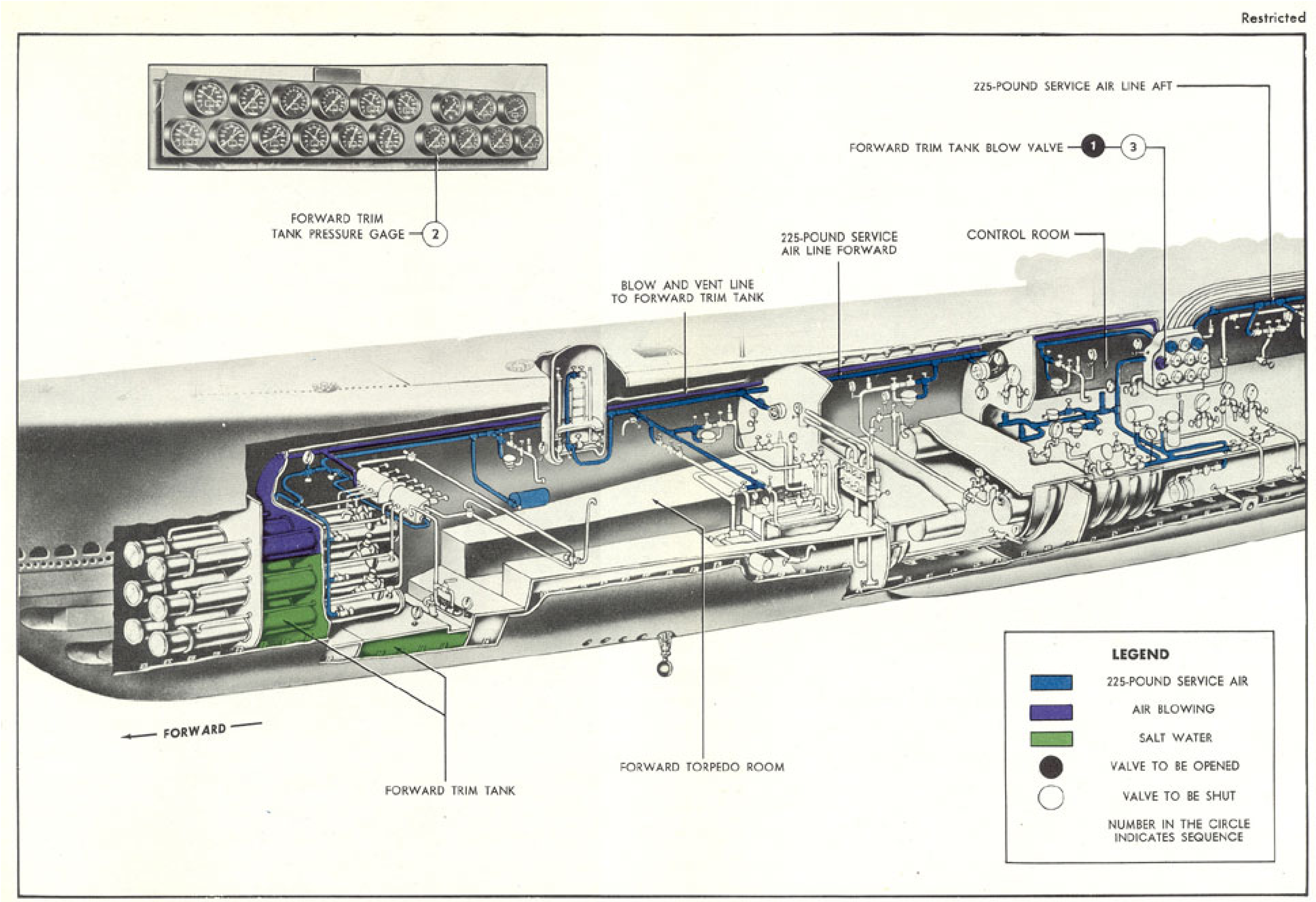

Figure 9-2. PUTTING PRESSURE IN THE FORWARD TRIM TANK.

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Figure 9-3. VENTING THE AFTER TRIM TANK OUTBOARD

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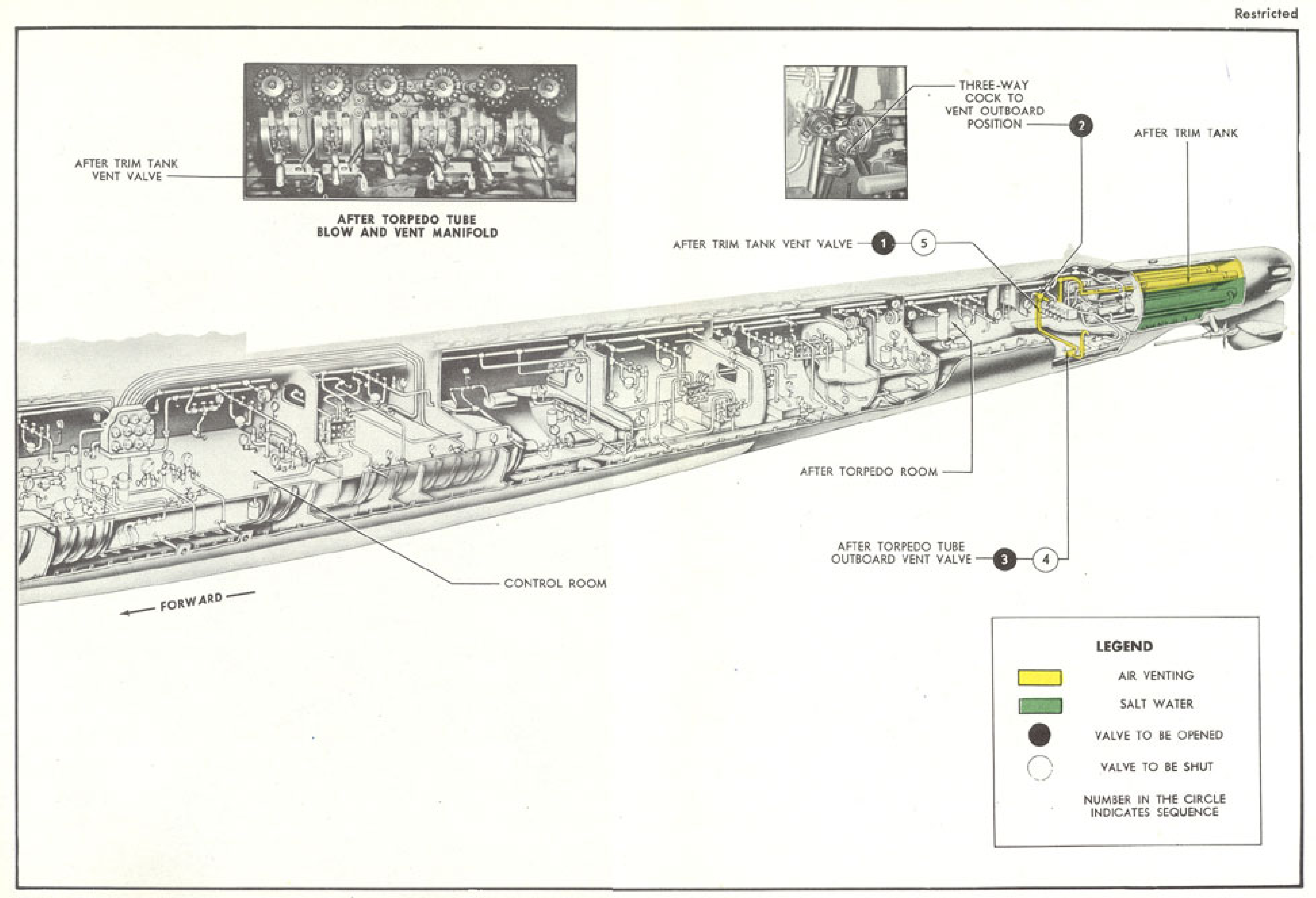

Figure 9-3. VENTING THE AFTER TRIM TANK OUTBOARD.

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Figure 9-4. BLOWING FROM THE NO. 7 TO THE NO. 2 AUXILIARY BALLAST TANK.

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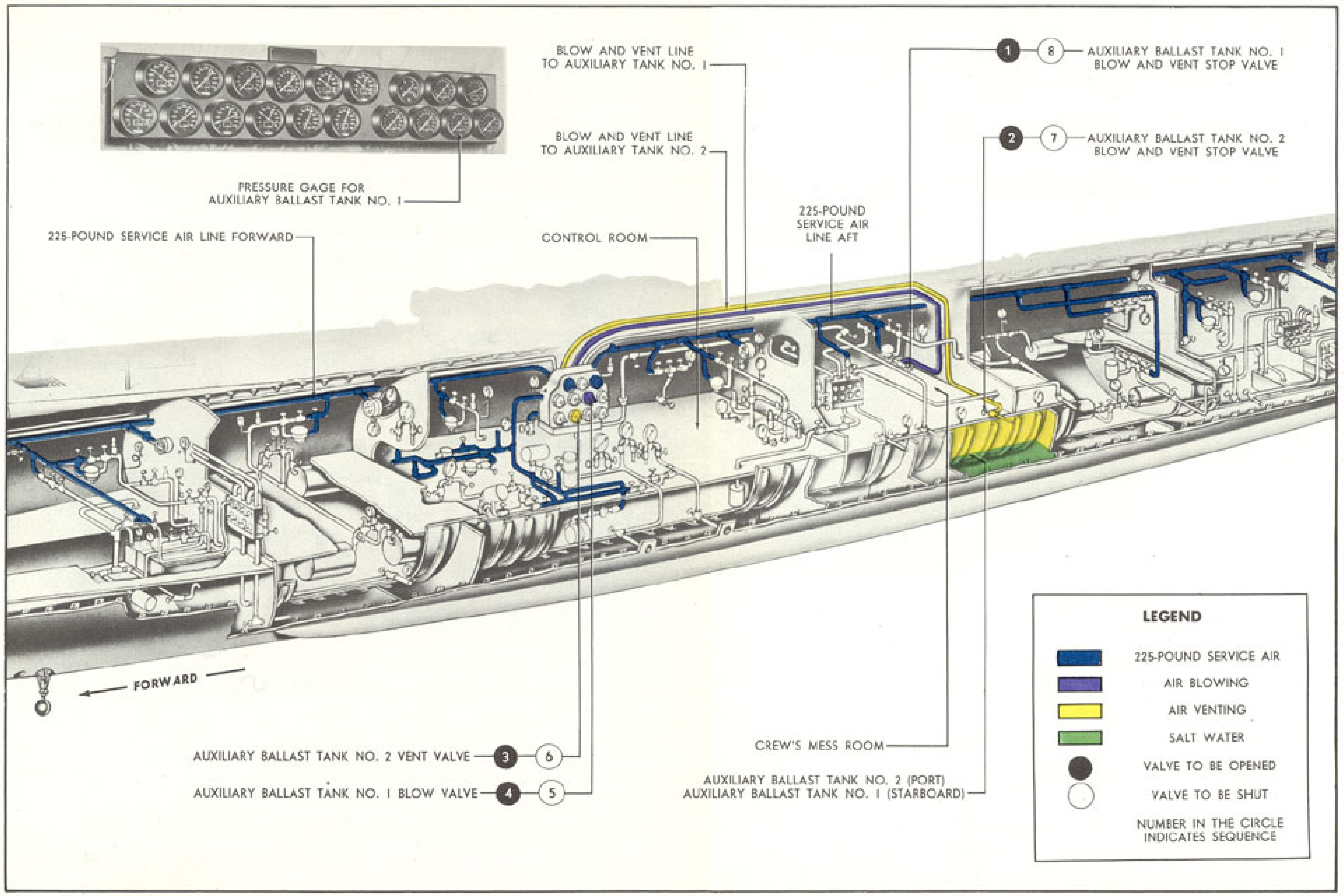

Figure 9-4. BLOWING FROM THE NO. 1 TO THE NO. 2 AUXILIARY BALLAST TANK.

Figure 9-5. VENTING AUXILIARY BALLAST TANK NO. 1

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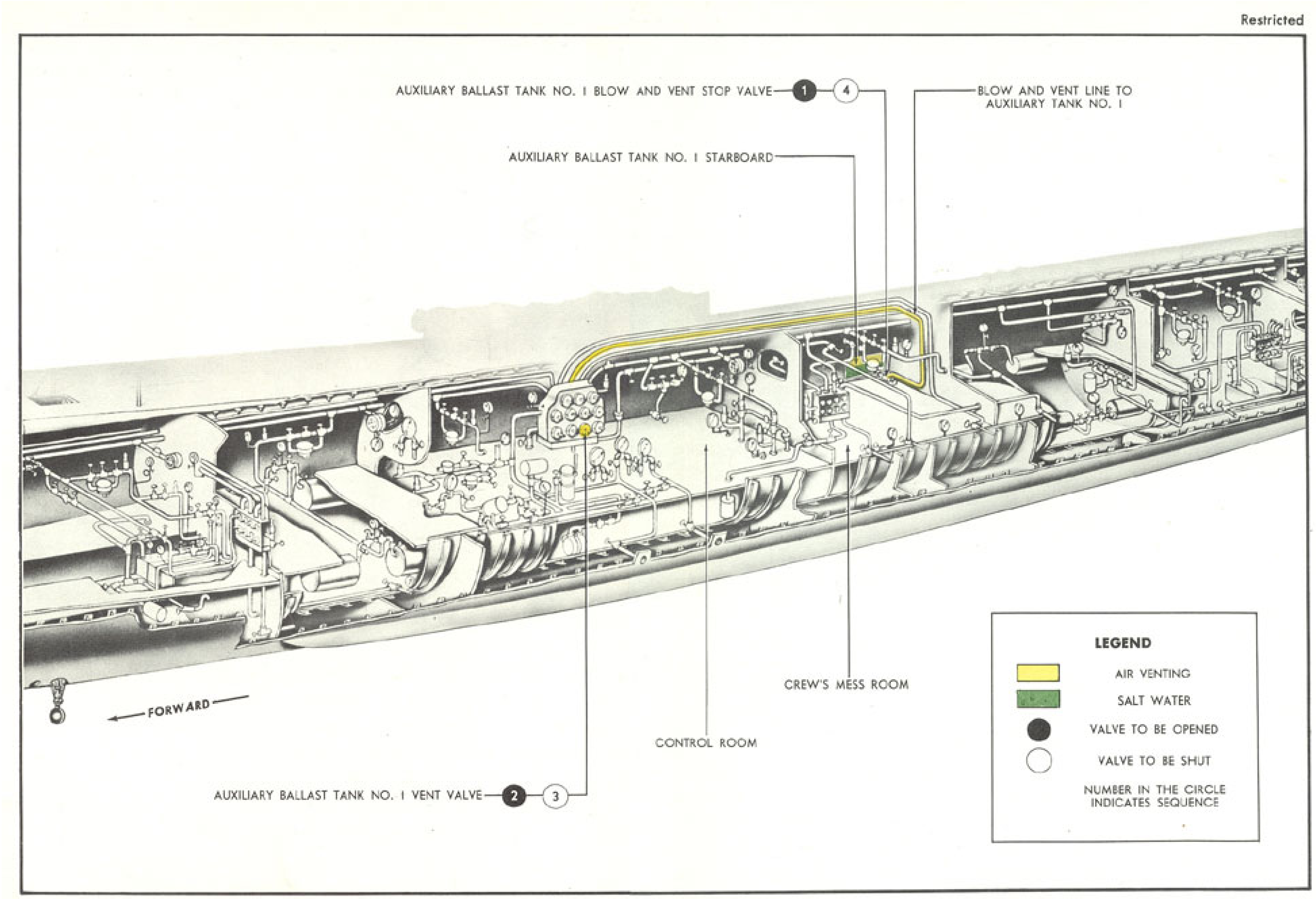

Figure 9-5. VENTING AUXILIARY BALLAST TANK NO. 1.

Figure 9-6. BLOWING FROM THE FORWARD WRT TANK TO THE FORWARD TRIM TANK.

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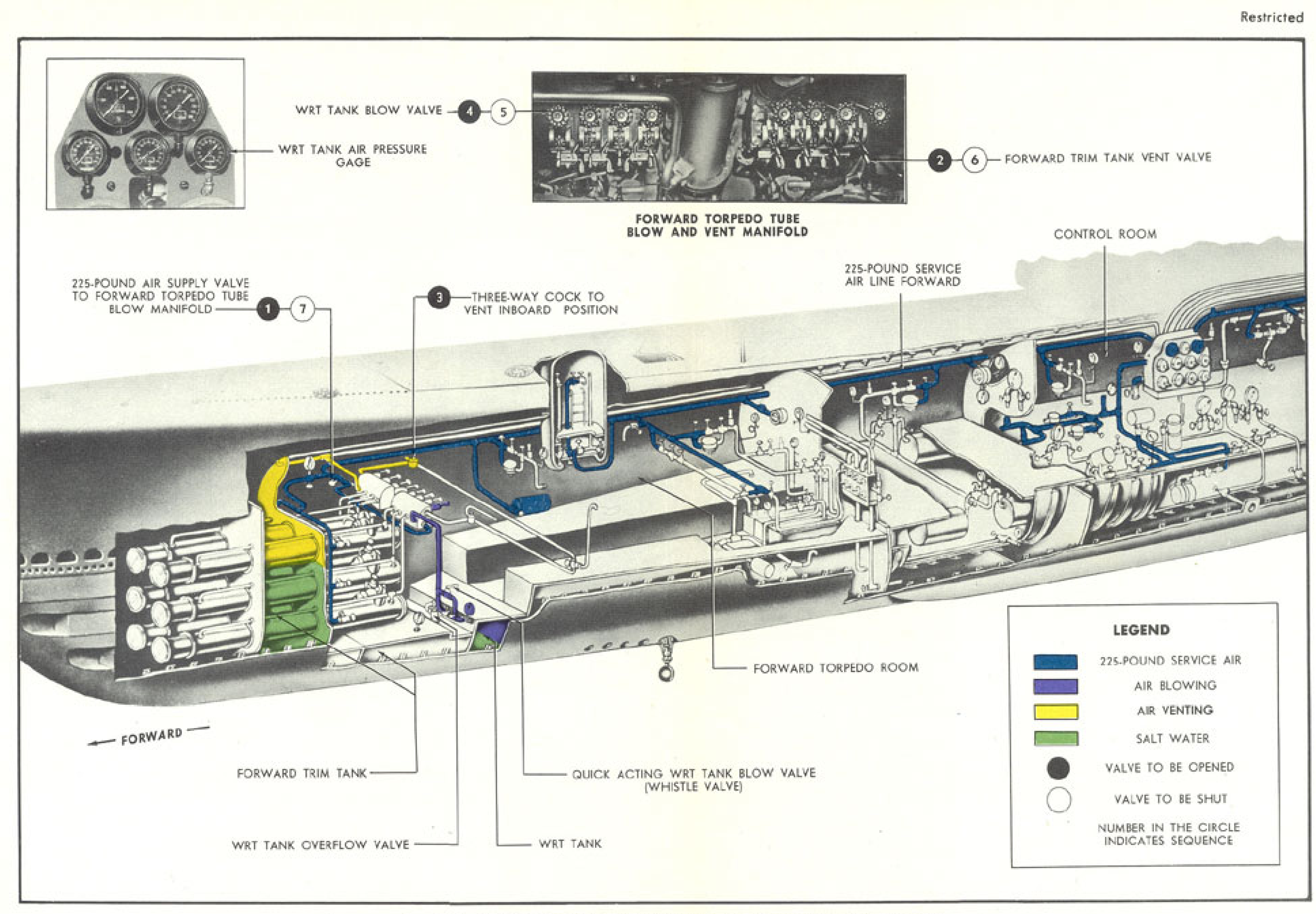

Figure 9-6. BLOWING FROM THE FORWARD WRT TANK TO THE FORWARD TRIM TANK.

Figure 9-7. BLOWING FROM THE FORWARD TRIM TANK TO THE AFTER TRIM TANK.

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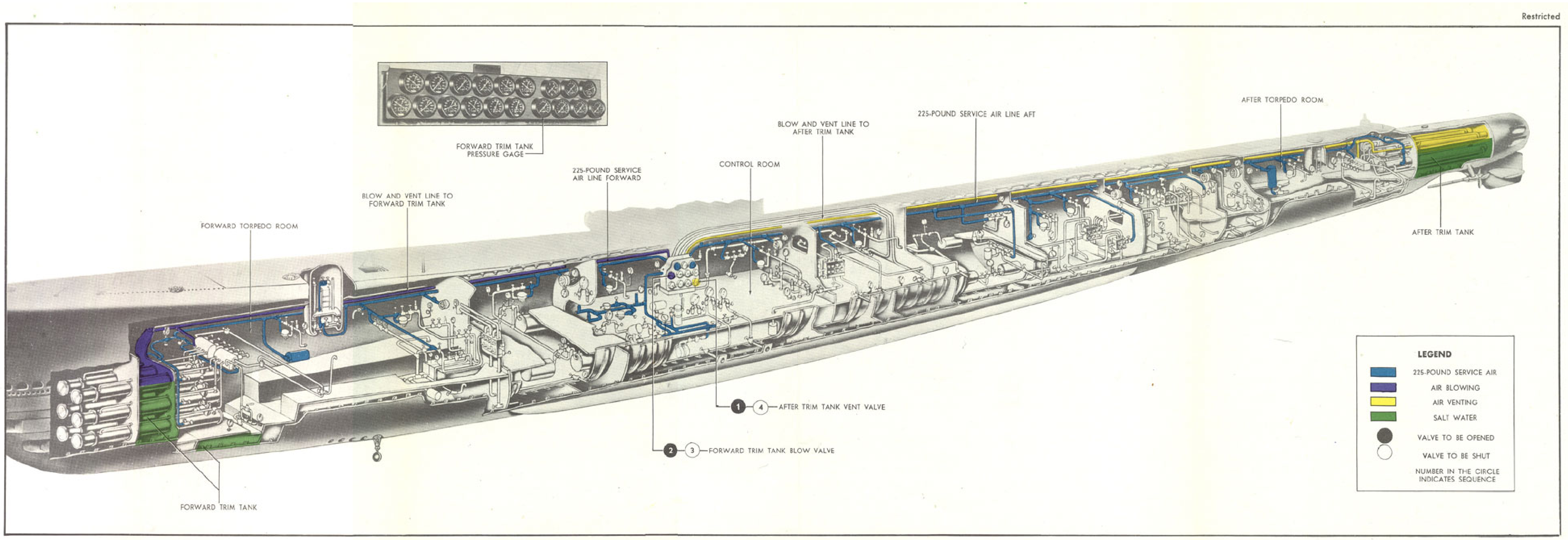

Figure 9-7. BLOWING FROM THE FORWARD TRIM TANK TO THE AFTER TRIM TANK.

Figure 9-8. BLOWING FROM THE AUXILIARY BALLAST TANK NO. 2 TO THE FORWARD TRIM TANK.

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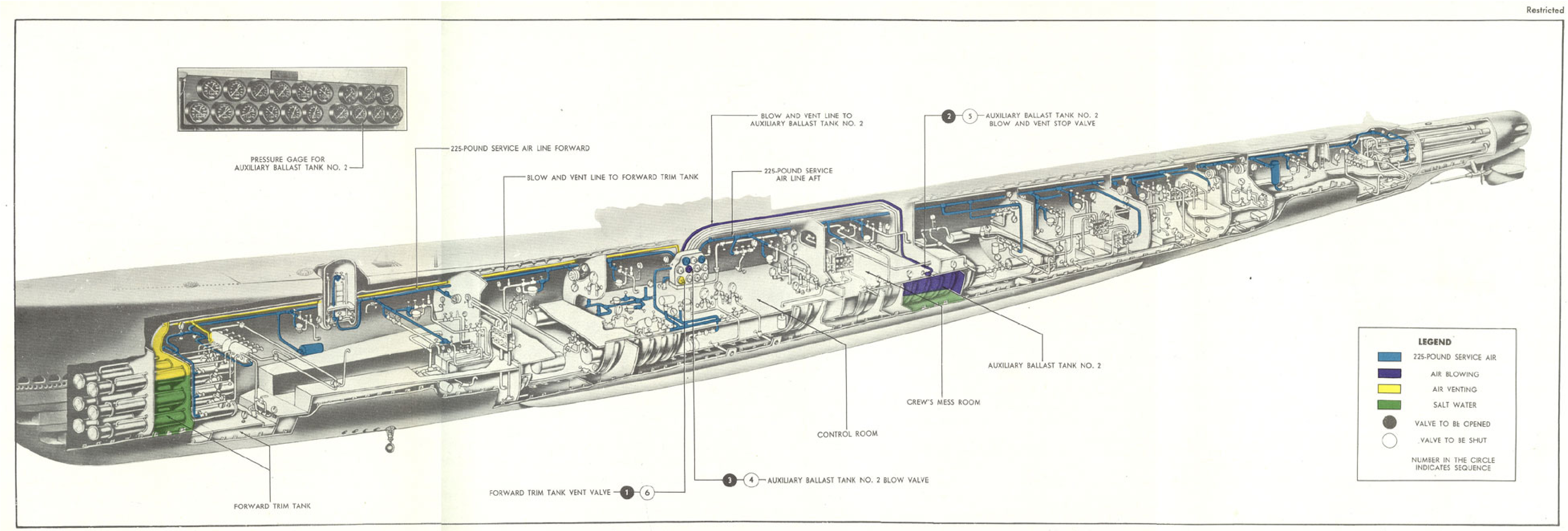

Figure 9-8. BLOWING FROM THE AUXILIARY BALLAST TANK NO. 2 TO THE FORWARD TRIM TANK.

Figure 9-9. BLOWING FROM THE FORWARD WRT TO THE NO. 2 TORPEDO TUBE.

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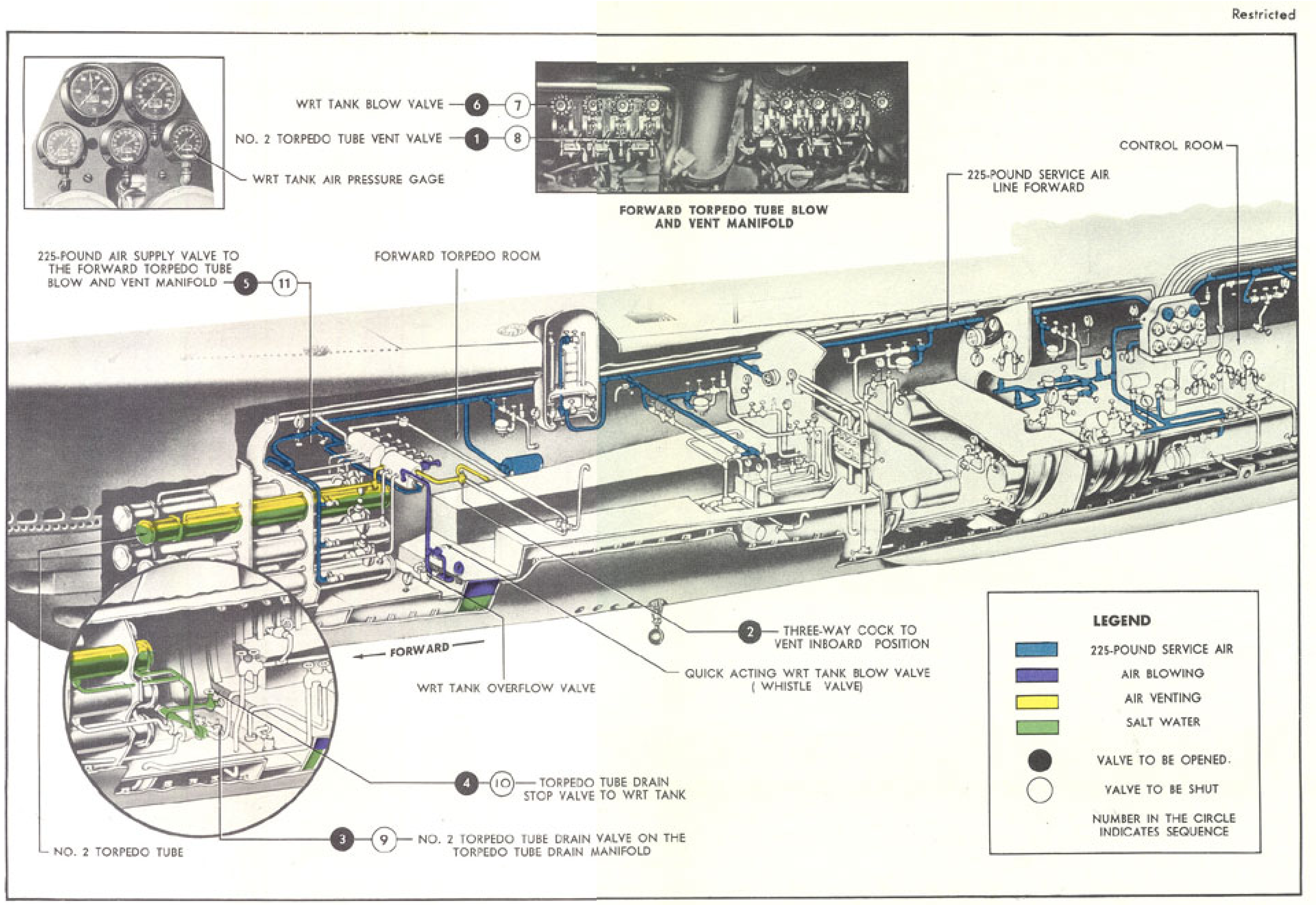

Figure 9-9. BLOWING FROM THE FORWARD WRT TANK TO THE NO. 2 TORPEDO TUBE.

Figure 9-10. BLOWING FROM THE NO. 8 TORPEDO TUBE TO THE AFTER WRT TANK.

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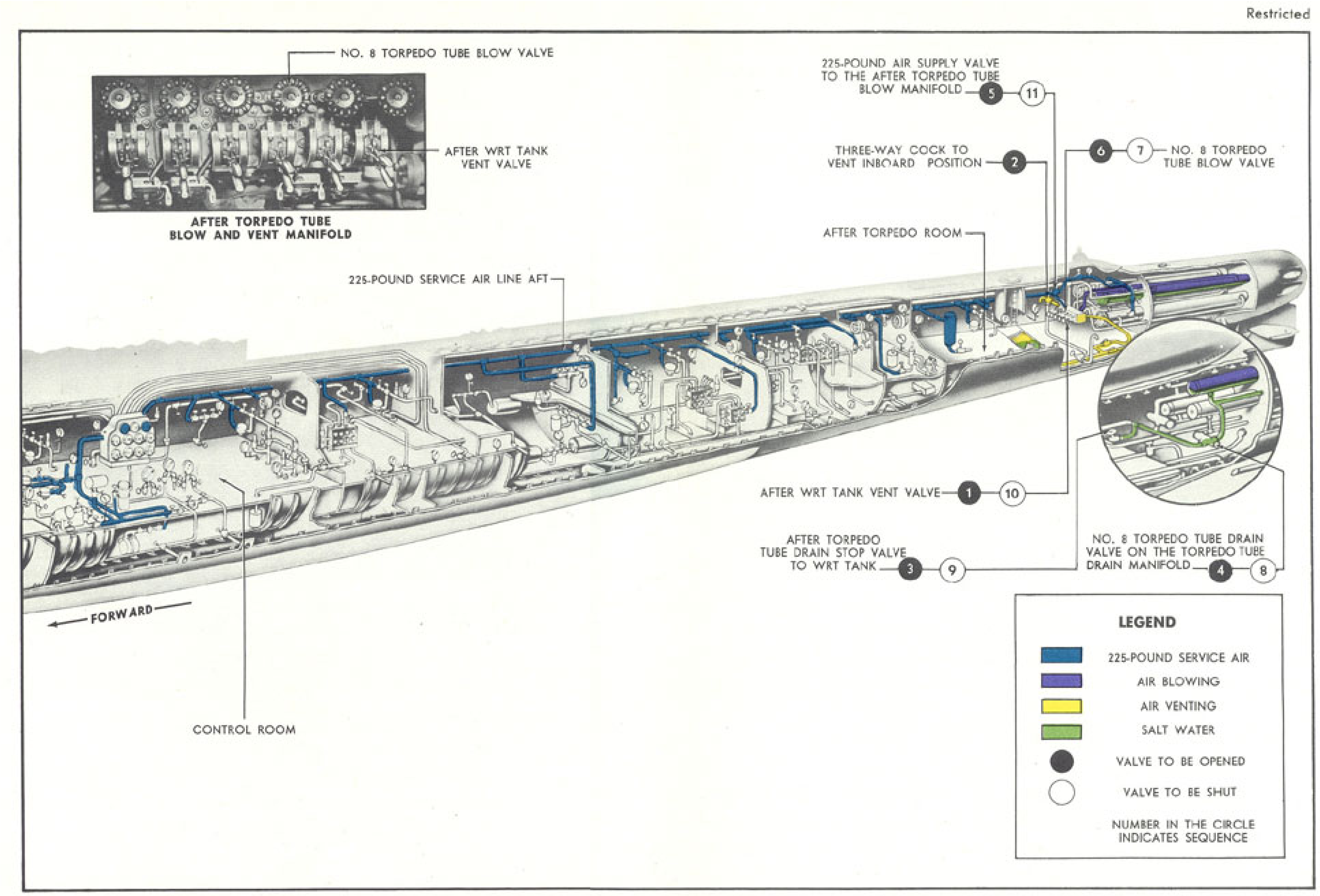

Figure 9-10. BLOWING FROM THE NO. 8 TORPEDO TUBE TO THE AFTER WRT TANK.

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Figure 9-11. BLOWING FROM THE NO. 8 TORPEDO TUBE TO THE AFTER WRT TANK.

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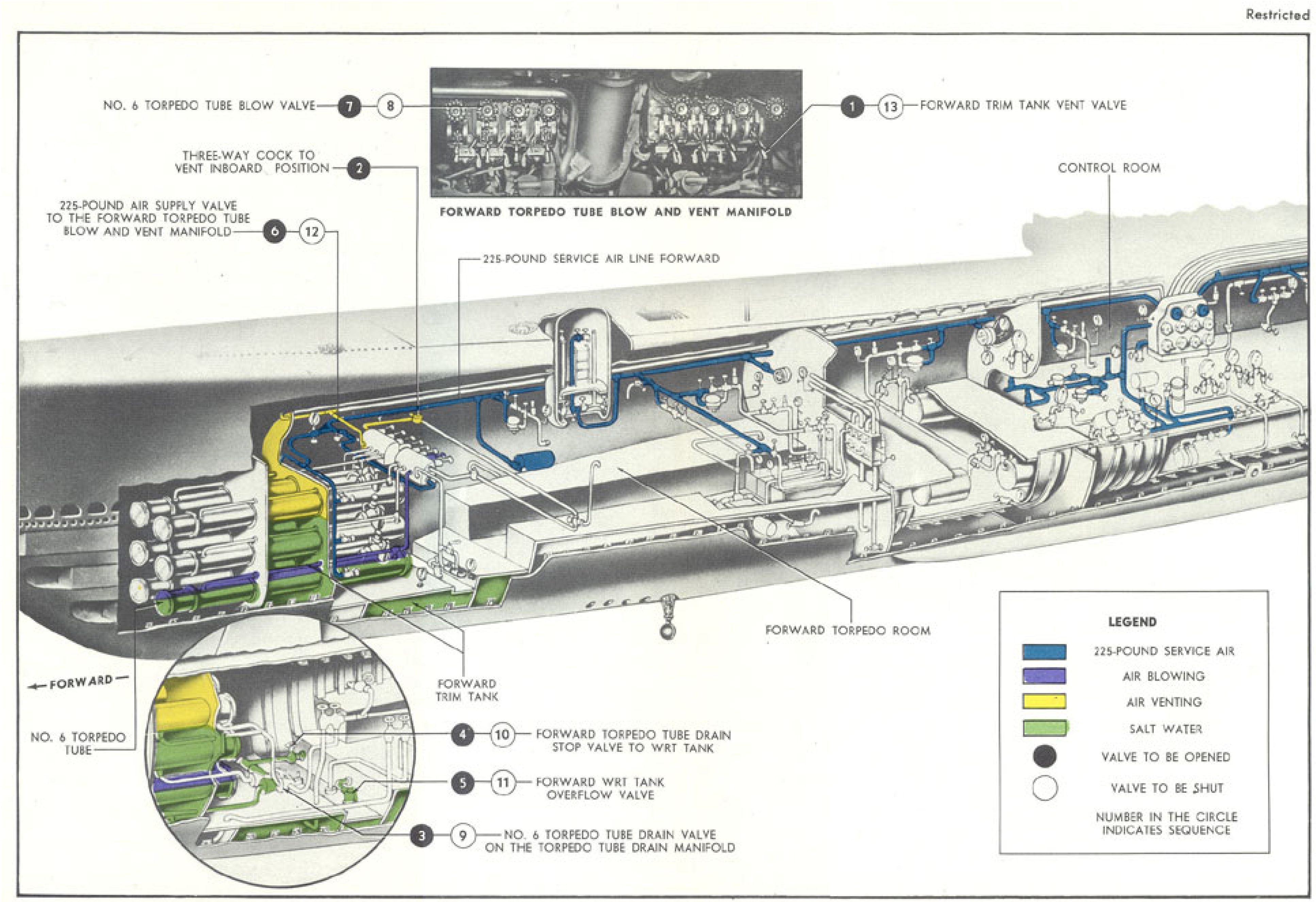

Figure 9-11. BLOWING FROM THE NO. 6 TORPEDO TUBE TO THE FORWARD TRIM TANK BY WAY OF THE FORWARD WRT TANK.

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Figure 9-12. PUTTING THE NO. 4 FRESH WATER TANK ON SERVICE

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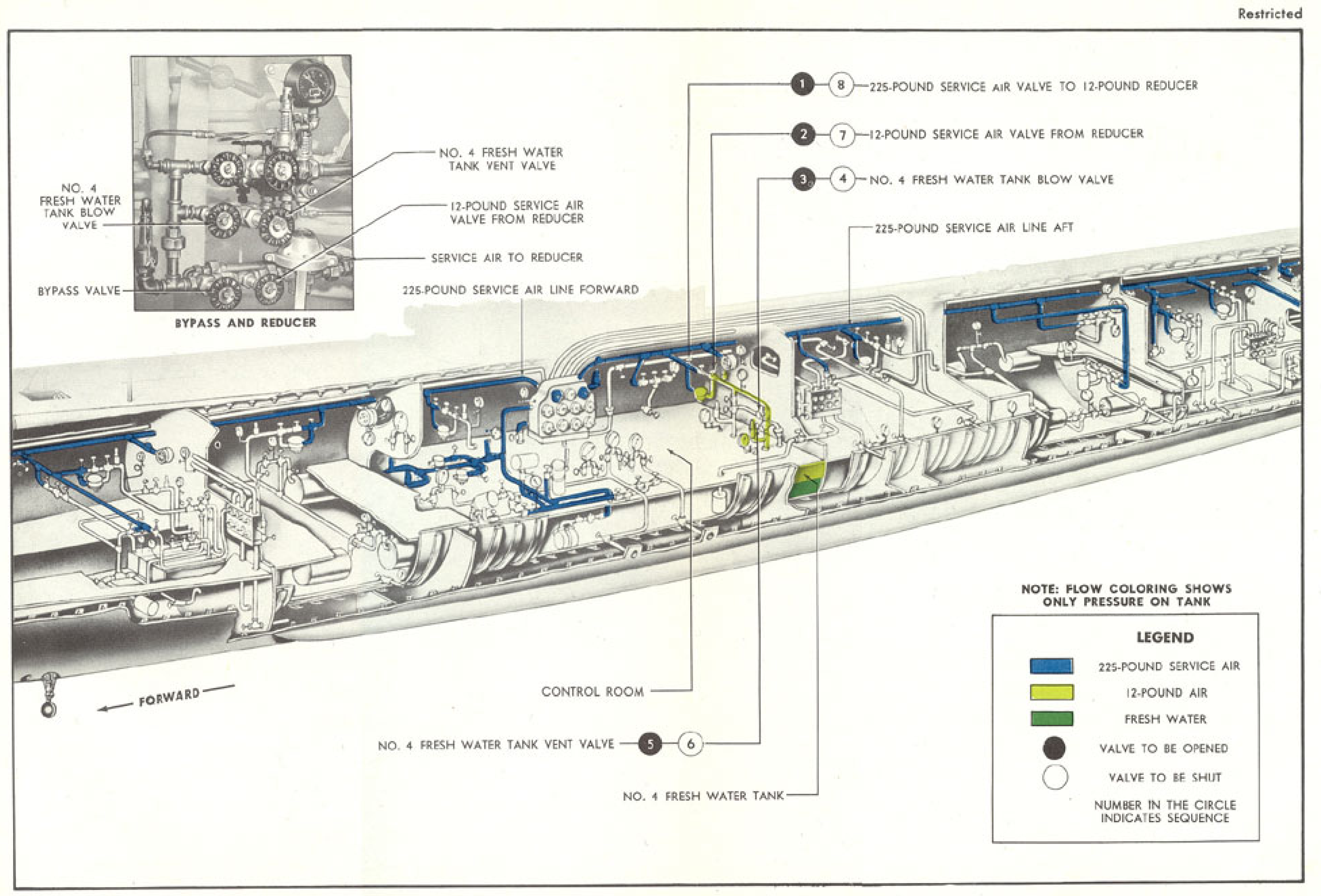

Figure 9-12. PUTTING THE NO. 4 FRESH WATER TANK ON SERVICE.

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Figure 9-13. PUTTING THE NO. 2 BATTERY WATER TANK ON SERVICE.

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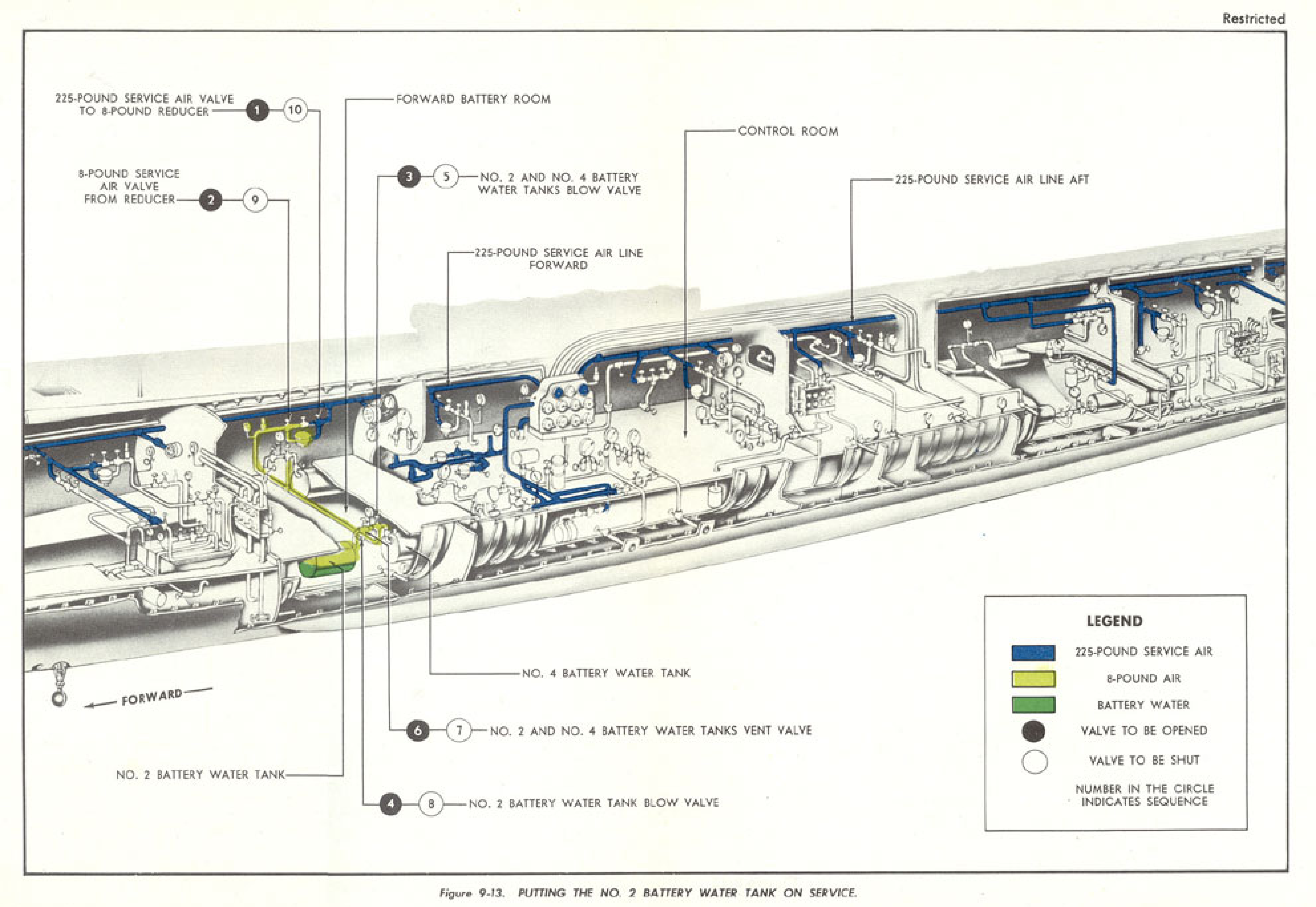

Figure 9-13. PUTTING THE NO. 2 BATTERY WATER TANK ON SERVICE.

10
OPERATING THE 10-POUND MAIN BALLAST TANK BLOWING SYSTEM

A. BLOWING ALL THE MAIN BALLAST TANKS

(Figure 10-1)

10A1. Preparation.

1. Open the 10-pound stop (gate) valves in the superstructure blowing lines leading to main ballast tanks 2A, 2B, 2C, 2D, 6A, 6B, 6C, and 6D. (The emergency vent valves and the 10-pound blow valves to the fuel ballast tanks are locked shut and therefore not operated since the fuel ballast tanks are assumed to be carrying fuel oil.)

10A2. Steps in operation.

1. Open the emergency vent valve MBT No. 2A in the control room on the starboard side forward.

2. Open the emergency vent valve MBT No. 2B in the control room on the port side forward.

3. Open the emergency vent valve MBT No. 2C in the control room on the starboard side aft.

4. Open the emergency vent valve MBT No. 2D in the radio room.

5. Open the emergency vent valve MBT No. 6A in the forward engine room on the starboard side.

10. Start the low-pressure blower.

11. Open the No. 1 MBT 10-pound blow valve.

12. Open the No. 2B-2D MBT 10-pound blow valve.

13. Open the No. 2A-2C MBT 10-pound blow valve.

14. Open the No. 6B-6D MBT 10-pound blow valve.

15. Open the No. 6A-6C MBT 10-pound blow valve.

16. Open the No. 7 MBT 10-pound blow valve.

17. Shut each MBT 10-pound blow valve upon completion of blowing its corresponding tank.

18. Stop the low-pressure blower.

19. Shut the supply flapper valve on the 10-pound MBT blow manifold.

20. Shut the emergency vent valve MBT No. 6D.

21. Shut the emergency vent valve MBT No. 6C.

22. Shut the emergency vent valve MBT No. 6B.

6. Open the emergency vent, valve MBT No. 6B in the forward engine room on the port side.

7. Open the emergency vent valve MBT No. 6C in the after engine room on the starboard side.

8. Open the emergency vent valve MBT No. 6D in the after engine room on the port side. (The valves in Steps 1 to 8 are open in rig for dive.)

9. Open the supply flapper valve on the 10-pound MBT blow manifold.

23. Shut the emergency vent valve MBT No. 6A.

24. Shut the emergency vent valve MBT No. 2D.

25. Shut the emergency vent valve MBT No. 2C.

26. Shut the emergency vent valve MBT No. 2B.

27. Shut the emergency vent valve MBT No. 2A.

Figure 10-1. BLOWING ALL THE MAIN BALLAST TANKS.

B. BLOWING MAIN BALLAST TANK NO. 1

(Figure 10-2)

10B1. Steps in operation.

1. Open the supply flapper valve on the 10-pound MBT blow manifold.

2. Start the low-pressure blower.

3. Open the No. 1 MBT 10-pound blow valve.

4. Shut the No. 1 MBT 10-pound blow valve upon completion of blowing.

5. Stop the low-pressure blower.

6. Shut the supply flapper valve on the 10-pound MBT blow manifold.

Figure 10-2 BLOWING MAIN BALLAST TANK NO. 1.

C. BLOWING MAIN BALLAST TANKS NO. 2A-2C

(Figure 14-3)

10CI. Preparation.

4. Start the low-pressure blower.

1. Open the 10-pound stop (gate) valves in the superstructure blowing lines leading to main ballast tanks 2A, 2B, 2C, 2D, 6A, 6B, 6C, and 6D.

10C2. Steps in operation.

1. Open the emergency vent valve MBT No. 2A in the control room on the starboard side forward.

2. Open the emergency vent valve MBT No. 2C in the control room on the starboard side aft. (Note: Emergency vent valves are open on rig for dive.)

3. Open the supply flapper valve on the 10-pound MBT blow manifold.

S. Open the No. 2A-2C MBT 10-pound blow valve.

6. Shut the No. 2A-2C MBT 10-pound blow valve upon completion of blowing.

7. Stop the low-pressure blower.

8. Shut the supply flapper valve on the 10-pound MBT blow manifold.

9. Shut the emergency vent valve MBT No. 2C.

10. Shut the emergency vent valve MBT No. 2A.

Figure 10-3. BLOWING MAIN ALL MAIN BALLAST TANKS NO. 2A-2C

D. BLOWING MAIN BALLAST TANKS 6B-6D

(Figure 10-4)

10D1. Preparation.

1. Open the 10-pound stop (gate) valves in the superstructure blowing lines leading to main ballast tanks 2A, 2B, 2C, 2D, 6A, 6B, 6C, and 6D.

10D2. Steps in operation.

1. Open the emergency vent valve MBT No. 6B in the forward engine room on the port side.

2. Open the emergency vent valve MBT No. 6D in the after engine room on the port side. (Note: Emergency vent valves are open on rig for dive.)

4. Start the low-pressure blower.

5. Open the No. 6B-6D MBT 10-pound blow valve.

6. Shut the No. 6B-6D MBT 10-pound blow valve upon completion of blowing.

7. Stop the low-pressure blower.

8. Shut the supply flapper valve on the 10-pound MBT blow manifold.

9. Shut the emergency vent valve MBT No. 6D.

10. Shut the emergency vent valve MBT No. 6B.

3. Open the supply flapper valve on the 10-pound MBT blow manifold.

Figure 10-4. BLOWING MAIN BALLAST TANKS NO. 6B-6D.

E. CORRECTING LIST BY BLOWING THE NO. 2 AND 6 MAIN BALLAST TANKS USING LIST CONTROL DAMPERS

(Figure 10-5)

10E1. Preparation.

1. Open the 10-pound stop (gate) valves in the superstructure blowing lines leading to main ballast tanks 2A, 2B, 2C, 2D, 6A, 6B, 6C, and 6D.

10E2. Steps in operation.

1. Open the emergency vent valve MBT No. 2A in the control room on the starboard side forward.

2. Open the emergency vent valve MBT No. 2B in the control room on the port side forward.

3. Open the emergency vent valve MBT No. 2C in the control room on the starboard side aft.

4. Open the emergency vent valve MBT No. 2D in the radio room.

5. Open the emergency vent valve MBT No. 6A in the forward engine room on the starboard side.

6. Open the emergency vent valve MBT No. 6B in the forward engine room on the port side.

12. Open the No. 2A-2C MBT 10-pound blow valve.

13. Open the No. 6B-6D MBT 10-pound blow valve.

14. Open the No. 6A-6C MBT 10-pound blow valve.

(Both port and starboard tanks of the No. 2 and No. 6 groups are being blown.)

15. Shift the list control lever on the 10-pound blow manifold to starboard position to correct a port list. (This prevents air from blowing the starboard tanks while the port tanks are still being blown.)

16. Shift the list control lever to neutral position when the list is corrected.

17. Shut the MBT 10-pound blow valves upon completion of blowing.

18. Stop the low-pressure blower.

19. Shut the supply flapper valve on the 10-pound blow manifold.

20. Shut the emergency vent valve MBT No. 6D.

7. Open the emergency vent valve MBT No. 6C in the after engine room on the starboard side.

8. Open the emergency vent valve MBT No. 6D in the after engine room on the port side. (Note: Emergency vent valves are open on rig for dive.)

9. Open the supply flapper valve on the 10-pound MBT blow manifold.

10. Start the low-pressure blower. 11. Open the No. 2B-2D MBT 10-pound blow valve.

21. Shut the emergency vent valve MBT No. 6C.

22. Shut the emergency vent valve MBT No. 6B.

23. Shut the emergency vent valve MBT No. 6A.

24. Shut the emergency vent valve MBT No. 2D.

25. Shut the emergency vent valve MBT No. 2C.

26. Shut the emergency vent valve MBT No. 2B.

27. Shut the emergency vent valve MBT No. 2A.

Figure 10-5. CORRECTING LIST BY BLOWING THE NO. 2 AND NO. 6 MAIN BALLAST TANKS USING LIST CONTROL DAMPERS.

Figure 10-1. BLOWING ALL THE MAIN BALLAST TANKS.

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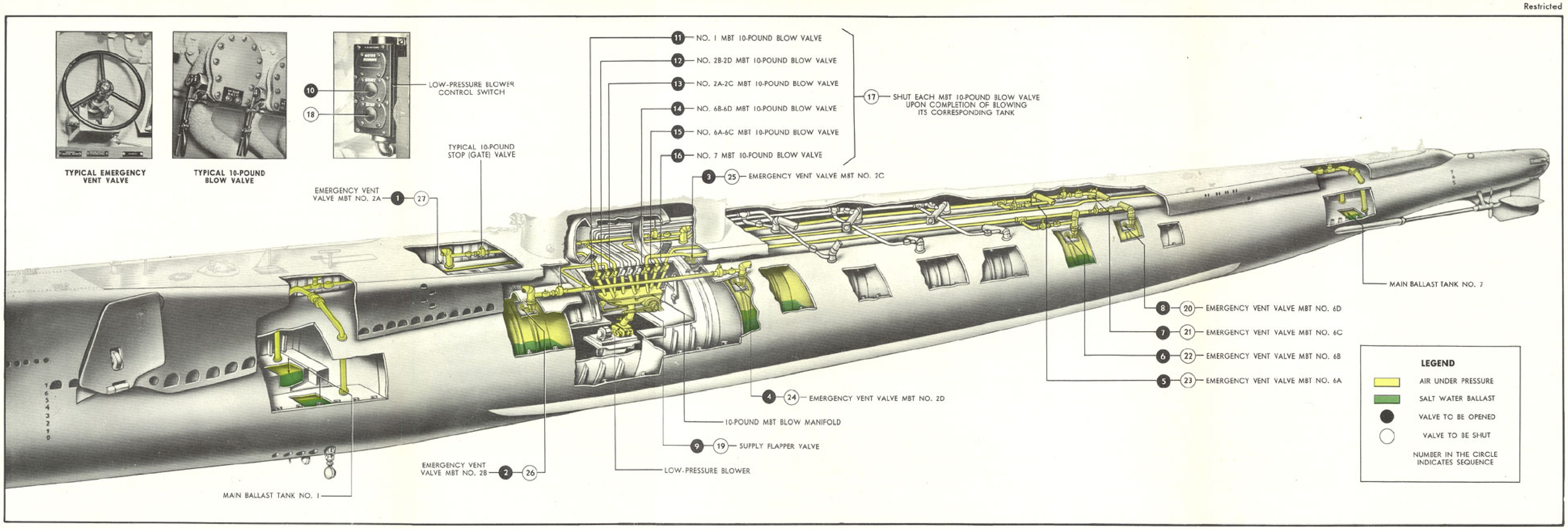

Figure 10-1. *BLOWING ALL THE MAIN BALLAST TANKS.*

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Figure 10-2 BLOWING MAIN BALLAST TANK NO. 1.

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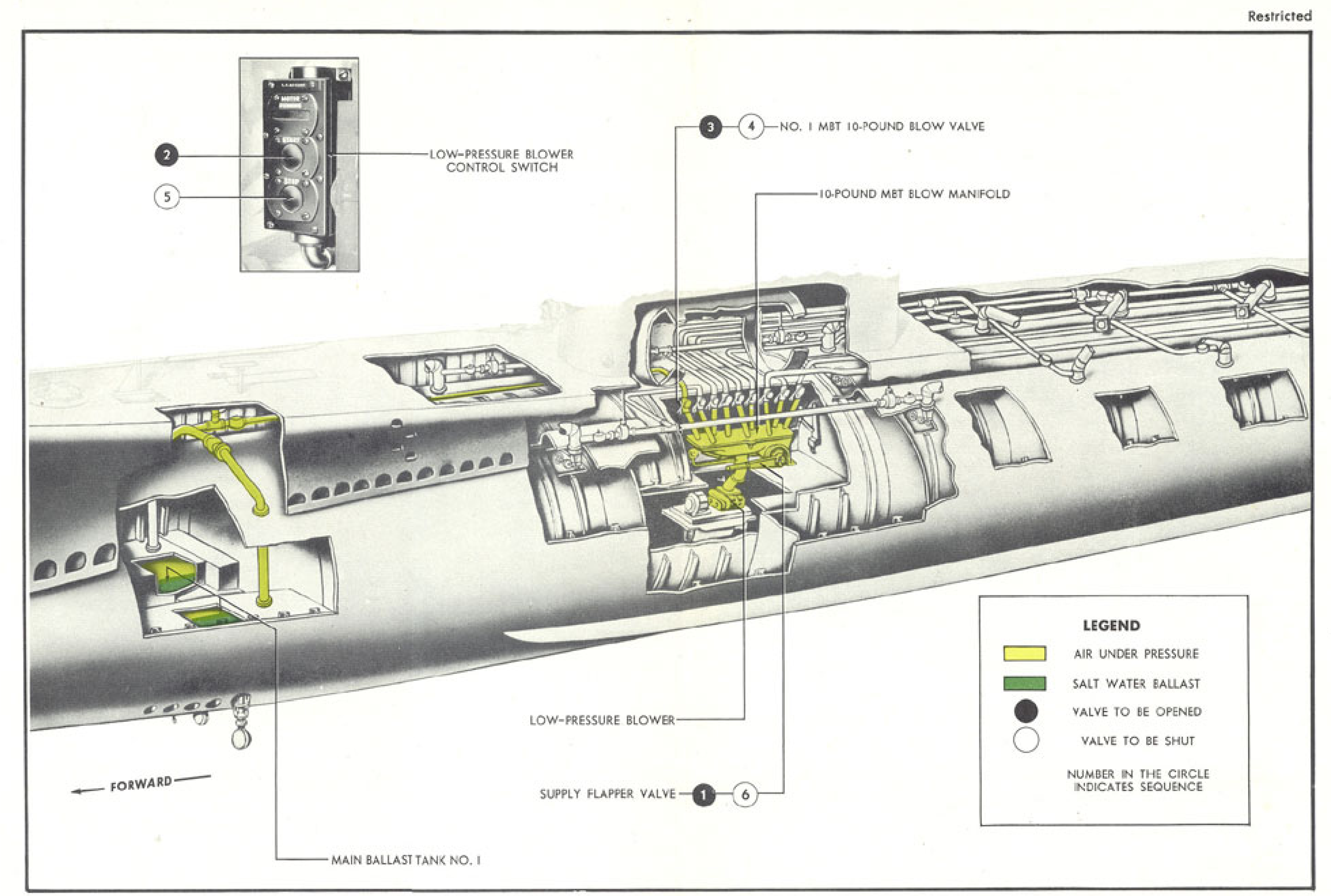

Figure 10-2. BLOWING MAIN BALLAST TANK NO. 1.

Figure 10-3. BLOWING MAIN ALL MAIN BALLAST TANKS NO. 2A-2C

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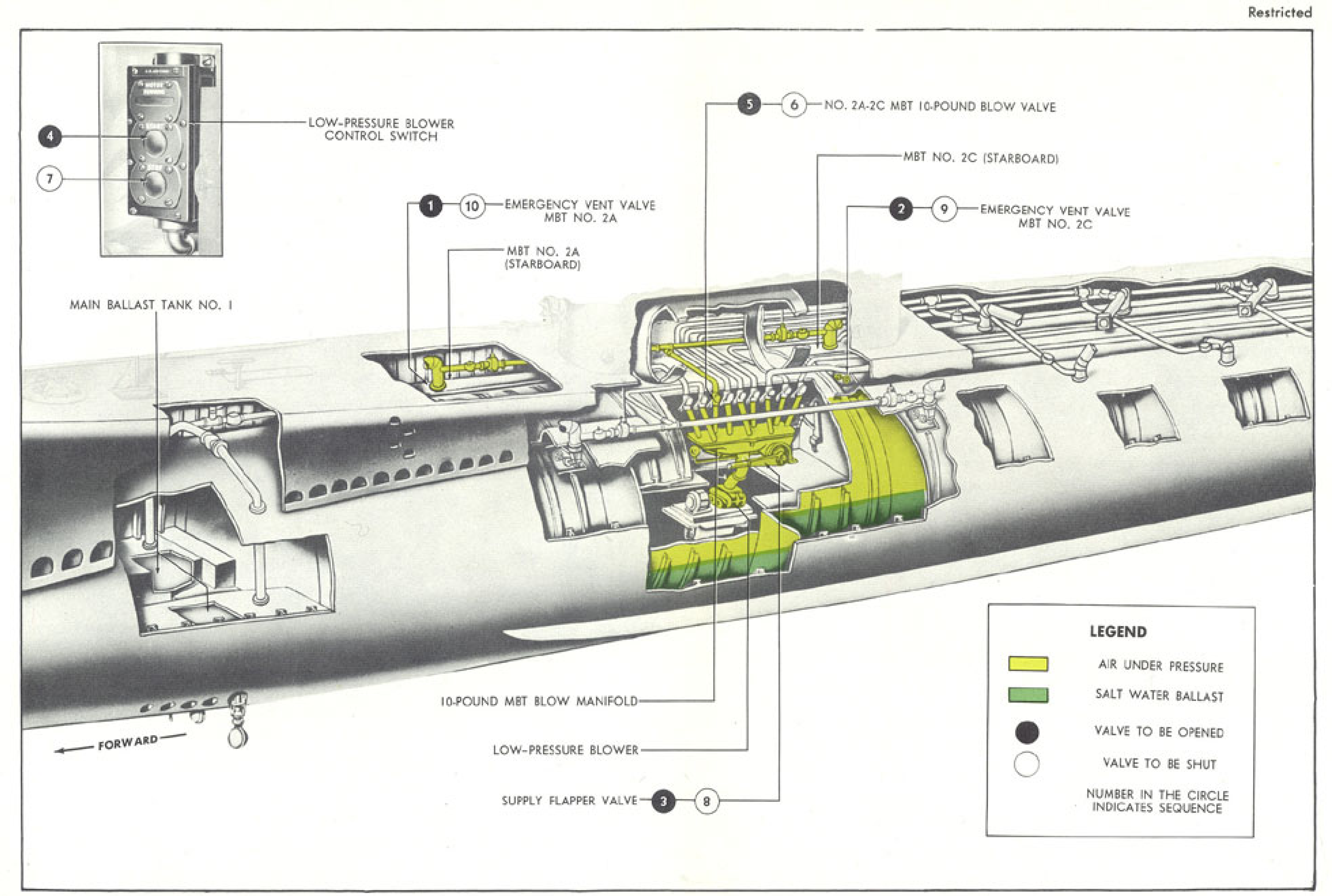

Figure 10-3. BLOWING MAIN BALLAST TANKS NO. 2A–2C.

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Figure 10-4. BLOWING MAIN BALLAST TANKS NO. 6B-6D.

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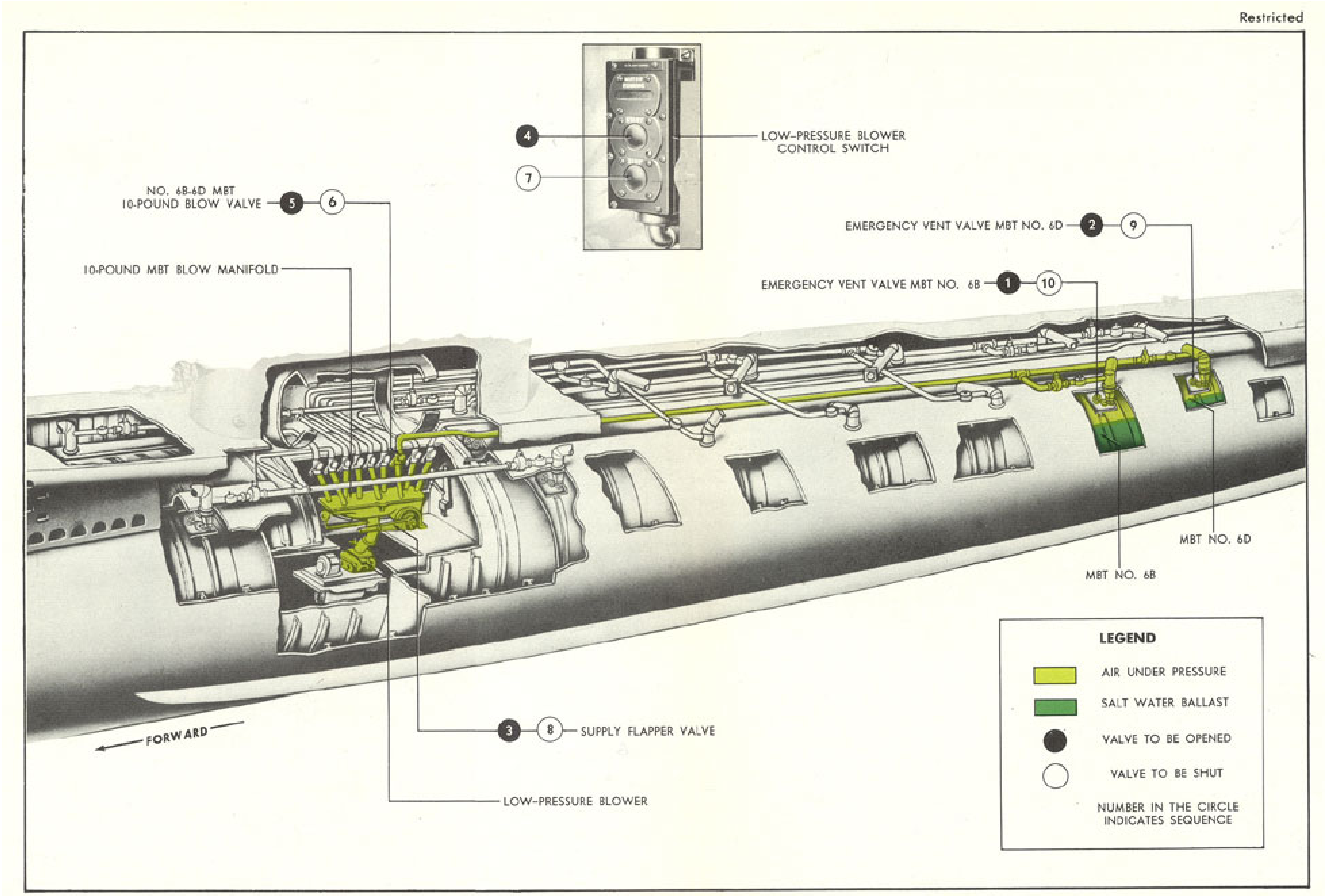

Figure 10-4. BLOWING MAIN BALLAST TANKS NO. 6B-6D.

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Figure 10-5. CORRECTING LIST BY BLOWING THE NO. 2 AND NO. 6 MAIN BALLAST TANKS USING LIST CONTROL DAMPERS.

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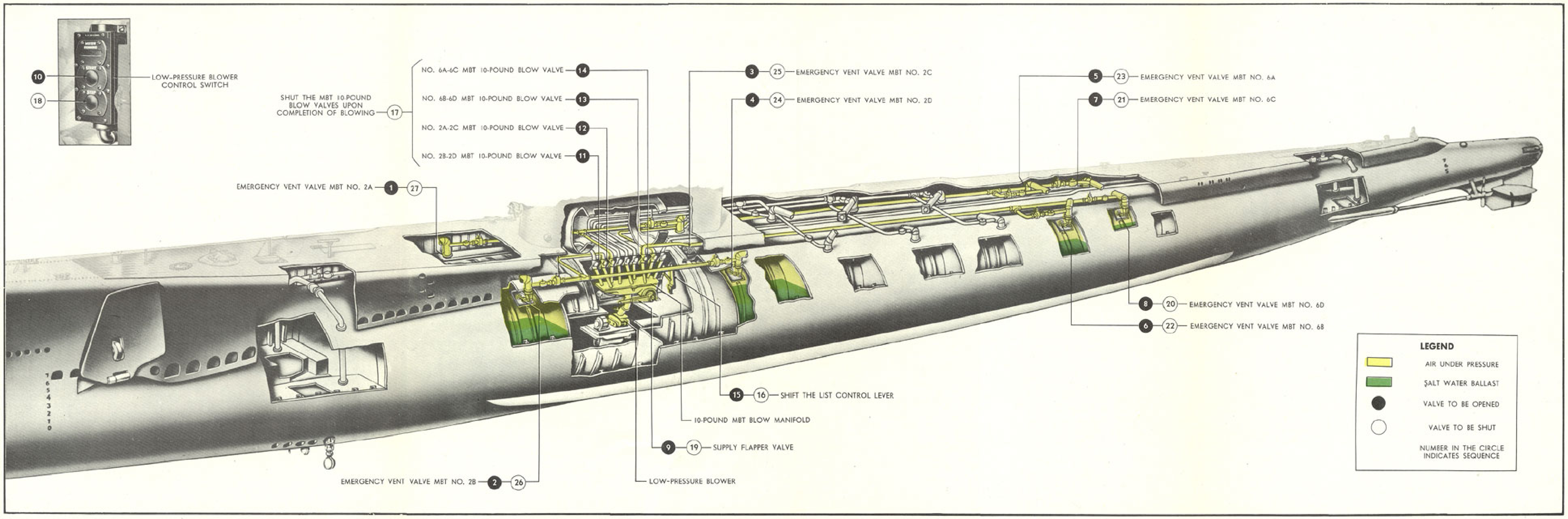

Figure 10-5. *CORRECTING LIST BY BLOWING THE NO. 2 AND NO. 6 MAIN BALLAST TANKS USING LIST CONTROL DAMPER.*

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11
OPERATING THE SALVAGE AIR SYSTEM

A. CIRCULATING AIR IN THE FORWARD TORPEDO ROOM FROM AN OUTSIDE SOURCE

(Figure 11-1)

11A1. Steps in operation.

1. Remove the cap from the high salvage hose connection to forward torpedo room, and connect the diver's hose from the salvage ship.

2. Remove the cap from the low salvage hose connection to forward torpedo room, and connect the diver's hose from the salvage ship.

3. Open the low external salvage valve to the forward torpedo room from the outside, using the diver's wrench.

4. Open the high external salvage valve to the forward torpedo room from the outside, using a diver's wrench.

The valves in Steps 3 and 4 can be operated from the deck or from within the compartment. To open the compartment salvage valve from the outside, turn the wrench counterclockwise. To open the same valve from the inside, turn the handwheel clockwise.

Air can now be supplied from the salvage ship through the high salvage connection and exhausted through the low salvage connection.

5. Upon completion of circulating salvage air through the forward torpedo room, shut the high external salvage valve.

6. Shut the low external salvage valve.

7. Remove the diver's hose from the low salvage hose connection and replace the cap.

8. Remove the diver's hose from the high salvage hose connection and replace the cap.

Figure 11-1. CIRCULATING AIR IN THE FORWARD TORPEDO ROOM FROM AN OUTSIDE SOURCE.

B. SUPPLYING AIR FROM THE CONTROL ROOM SUPPLY AIR TO

THE CONTROL ROOM AND THE TWO ADJOINING COMPARTMENTS

(Figure 11-2)

11B1. Preparation.

1. It is assumed that there is air in the 225-pound service air line forward and aft.

11B2. Steps in operation.

(This operation is performed in the control room.)

1. Admit air to the control room by turning clockwise the handwheel of the compartment salvage air valve located on the after bulkhead of the control room.

2. Turn the handwheel to the neutral position when sufficient air has been admitted.

3. Admit air to the after battery compartment by turning counterclockwise the handwheel of the compartment salvage air valve located on the after bulkhead of the control room. (This is the same compartment salvage air valve used in Steps 1 and 2.)

4. Turn the handwheel to the neutral position when sufficient air has been admitted.

5. Admit air to the forward battery compartment by turning the handwheel of the compartment salvage air valve on the forward bulkhead of the control room counterclockwise.

6. Turn the handwheel to the neutral position when sufficient air has been admitted.

7. Admit air to the control room again by turning the handwheel of the compartment salvage air valve on the forward bulkhead clockwise. (This is the same compartment salvage air valve used in Steps 5 and 6.)

8. Turn the handwheel to the neutral position when sufficient air has been admitted.

Figure 11-2. SUPPLYING AIR FROM THE CONTROL ROOM AIR TO THE CONTROL ROOM
AND THE TWO ADJOINING COMPARTMENTS.

C. SUPPLYING AIR FROM AN OUTSIDE SOURCE TO MBT NO. 1

(Figure 11-3)

11C1. Steps in operation.

MBT No. 1 is now ready to receive air from the salvage ship.

1. Remove the cap and connect a diver's hose from the salvage ship to the MBT No. 1 external salvage hose connection.

2. Open the MBT No. 1 salvage valve from the deck with a diver's wrench. The

3. Shut the MBT No. 1 salvage valve when the salvage operation is completed.

4. Disconnect the diver's hose and replace the cap on the MBT No. 1 external salvage hose connection.

Figure 11-3. SUPPLYING AIR FROM AN OUTSIDE SOURCE TO MBT NO. 1.

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Figure 11-1. CIRCULATING AIR IN THE FORWARD TORPEDO ROOM FROM AN OUTSIDE SOURCE.

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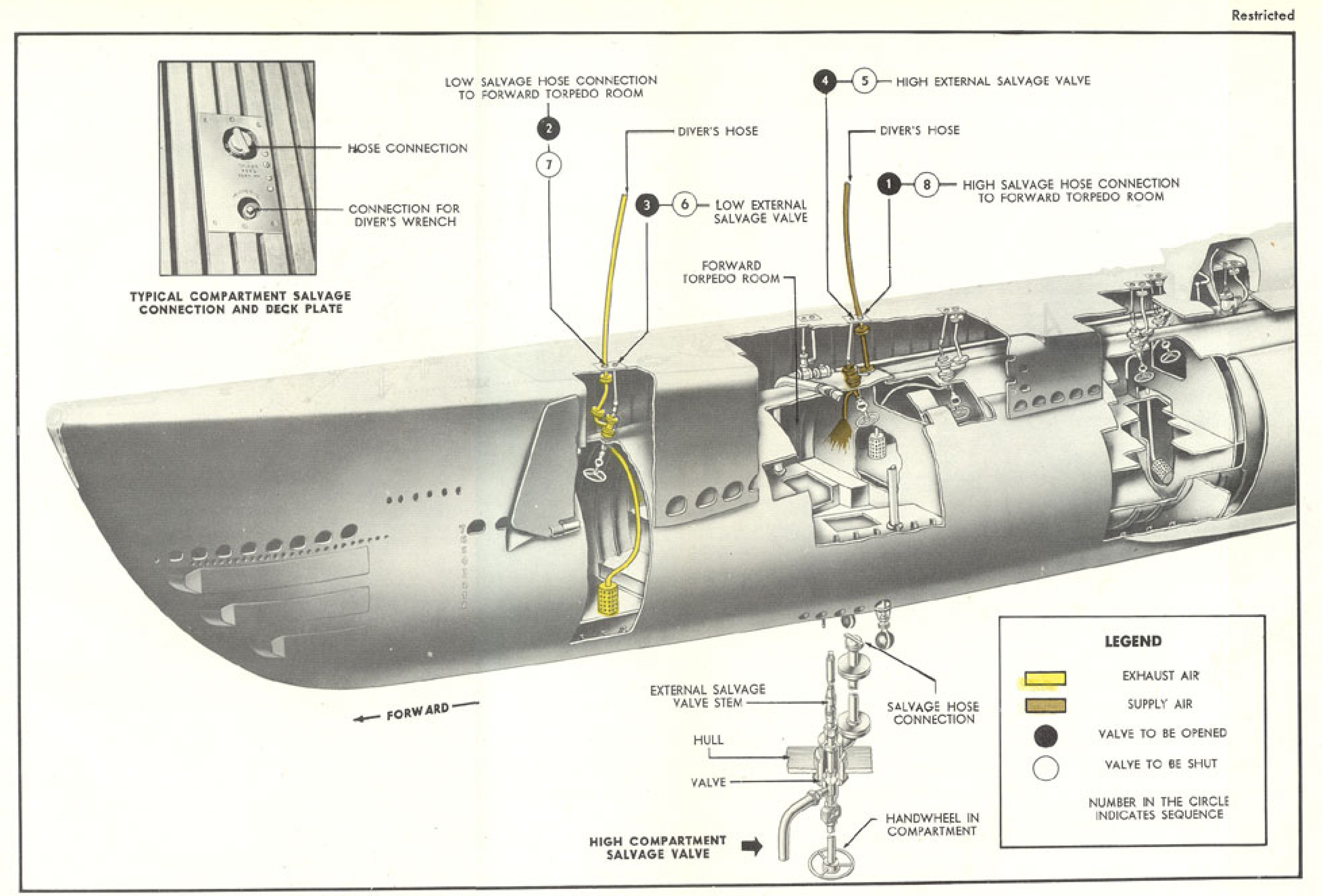

Figure 11-1. CIRCULATING AIR IN THE FORWARD TORPEDO ROOM FROM AN OUTSIDE SOURCE.

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Figure 11-2. SUPPLYING AIR FROM THE CONTROL ROOM AIR TO THE CONTROL ROOM AND THE TWO ADJOINING COMPARTMENTS.

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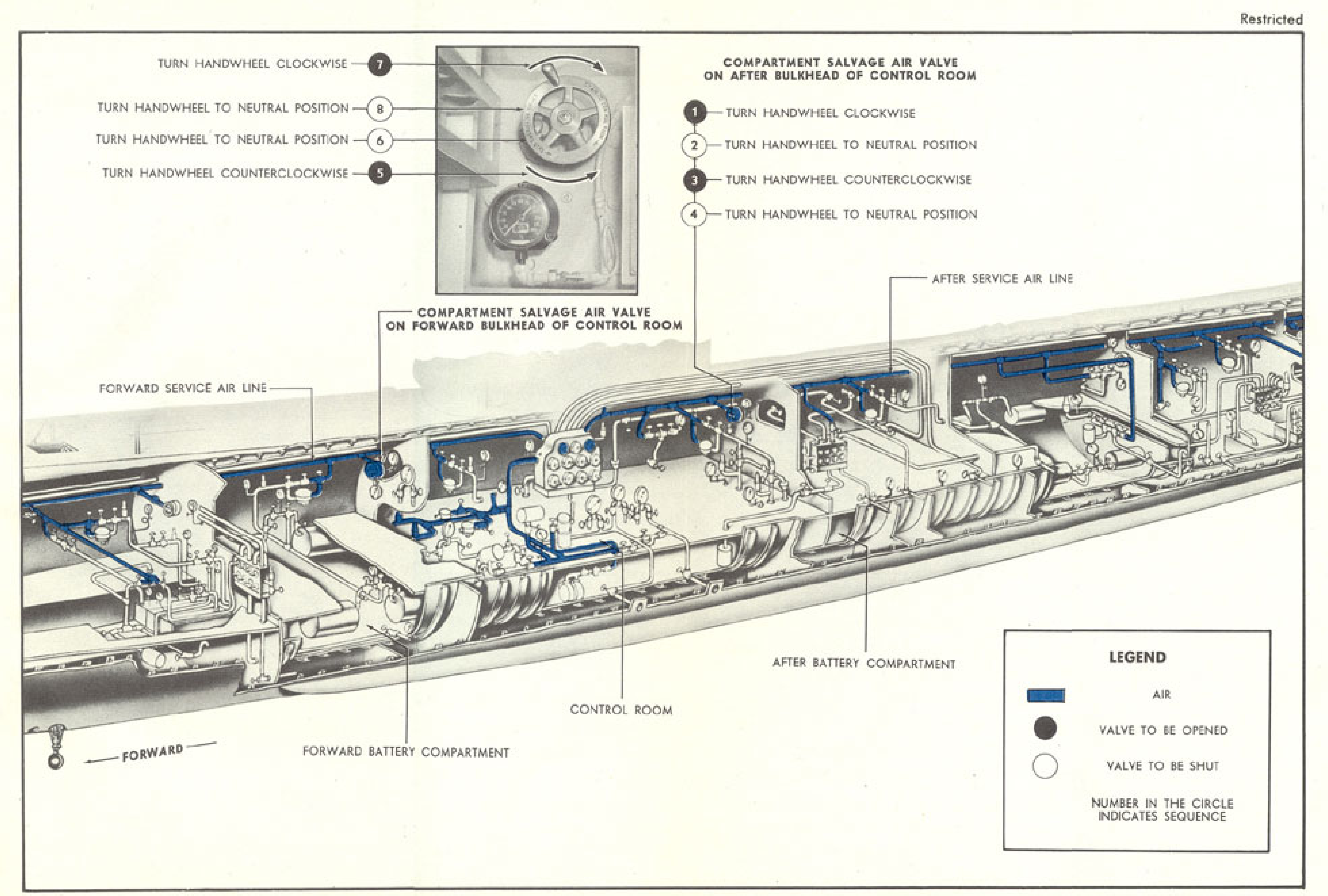

Figure 11-2. SUPPLYING AIR FROM THE CONTROL ROOM SUPPLY AIR TO THE CONTROL ROOM AND THE TWO ADJOINING COMPARTMENTS.

Figure 11-3. SUPPLYING AIR FROM AN OUTSIDE SOURCE TO MBT NO. 1.

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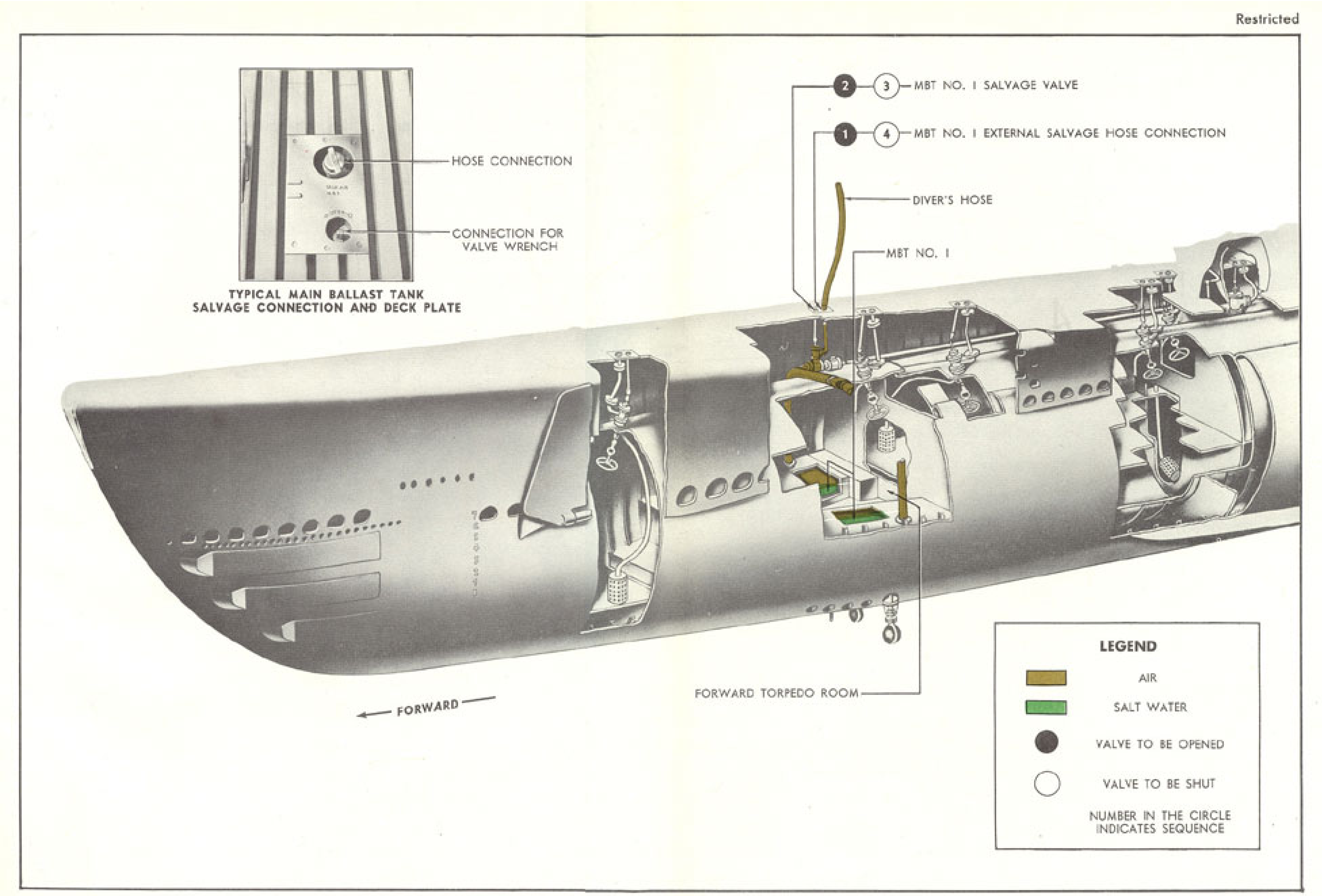

Figure 11-3. SUPPLYING AIR FROM AN OUTSIDE SOURCE TO MBT NO. 1.

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