TECHNICAL MANUAL

AIR DEMAND REGULATOR

AEROTEC INDUSTRIES, INC.
GREENWICH, CONNECTICUT

CONTRACT SPCC-1-51303 AND
N104-77325

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It is hereby certified that the Manual, NAVSHIPS 394-0067, provided under this contract N104-77325, has been approved by authority of basic approval data shown above.

James J. Murphy Jr.

MANUFACTURER'S SIGNATURE

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SECTION I

GENERAL INFORMATION

INTRODUCTION

The Air Demand Regulator (Figures 1 and 4), manufactured by Aerotec Industries, Inc. of Greenwich, Connecticut is a two-stage demand type diving regulator designed for use with compressed air. Compressed air is supplied by a high-pressure tank worn on the diver's back as a self-contained unit for underwater swimming or diving.

Tanks used in conjunction with the regulator must be equipped with a valve for attachment and be capable of withstanding high pressures. The air is supplied to the diver through a hose and mouthpiece assembly attached to the regulator. (Figures 1 and 4).

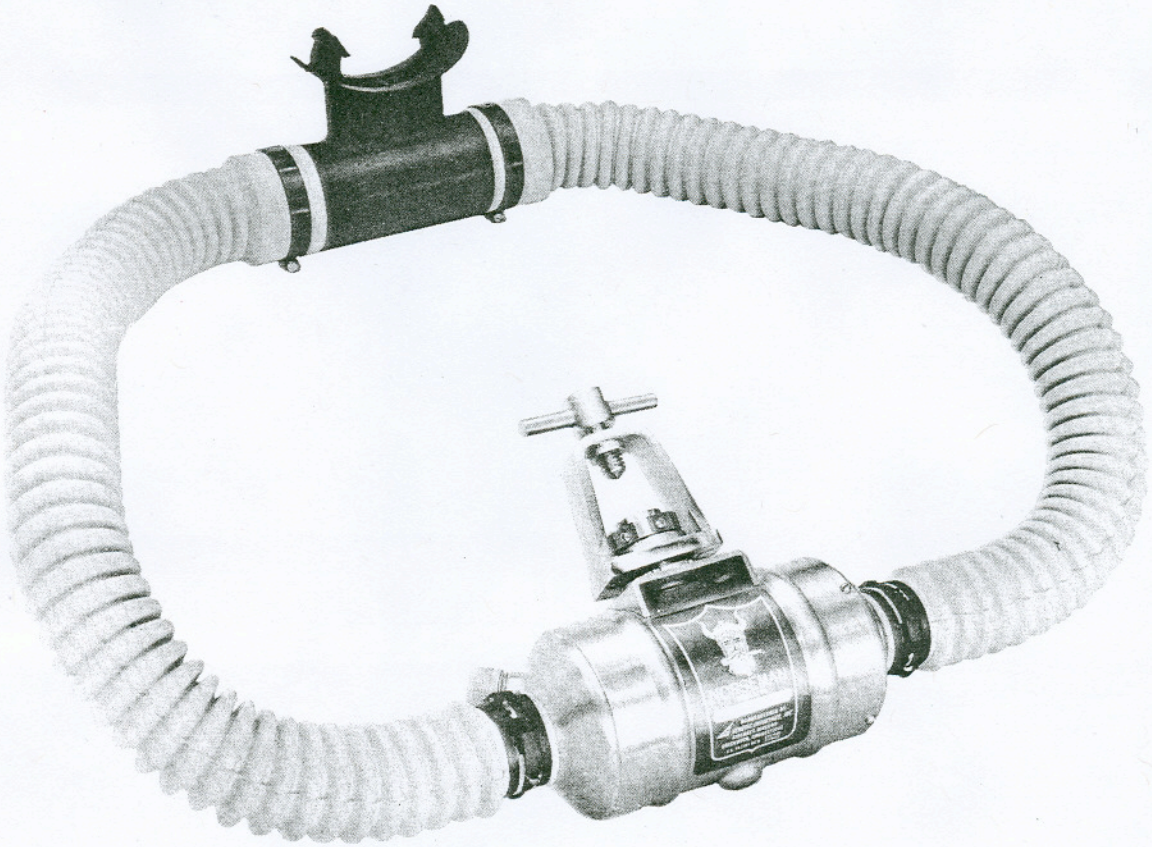

Figure 1. Two Stage Air Demand Regulator and Hose Assembly

REGULATOR

The regulator is attached to the tank by placing the regulator yoke over the tank valve. It is necessary to center the regulator filter housing over the rubber "O" ring in the valve outlet before hand tightening thumbscrew on the regulator yoke.

DEMAND REGULATOR

The regulator is a two-stage air valve, regulated by surrounding pressures. Air is supplied for breathing from the high pressure tank, through the regulator, on demand. The air supplied to the diver is automatically regulated proportionately to the surrounding pressure at a rate required by the diver.

WARNING
NEVER USE OXYGEN

The regulator is to be used with compressed air only. The use of other gases, such as oxygen can be fatal to the diver. Except for air do not use any other gas without specific instructions from the Bureau of Ships.

MOUTHPIECE AND TUBE ASSEMBLY

The mouthpiece and tube assembly (Figure 2) directs the air from the regulator to the diver on inhalation. One way valves prevent air from re-entering the breathing system and directs exhaust air through the exhaust ports of the regulator while stopping water from entering the mouthpiece.

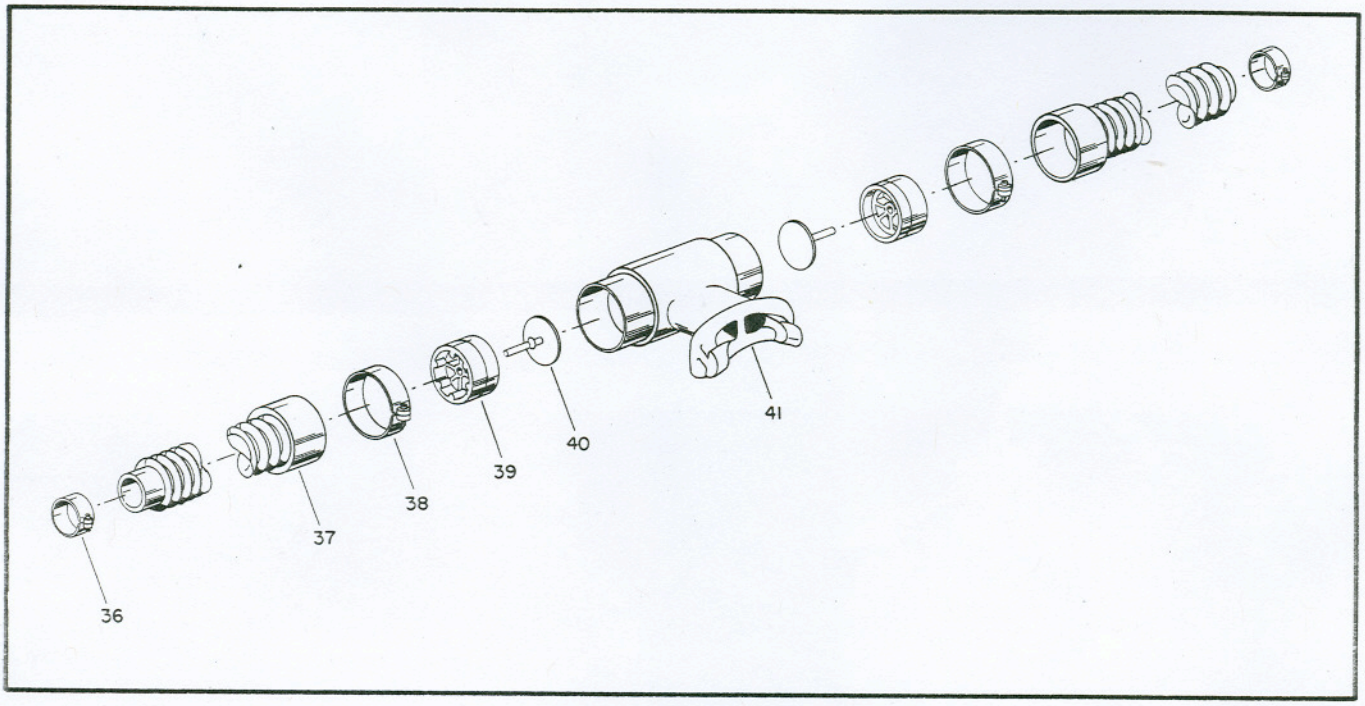

Figure 2. Hose and Mouthpiece Assembly

SECTION II

PRINCIPLE OF OPERATION

GENERAL

The air demand regulator is a two-stage air valve which is activated by the motion of a flexible diaphragm. The flexible diaphragm is a separating wall between the main housing of the regulator and the outside pressure of the water. The difference in pressure between the air chamber and the water determines the displacement of the diaphragm. This in turn affects the opening and closing of the valve. When the water pressure exceeds the air chamber pressure, the valve opens and allows the flow of air.

When high-pressure air is introduced into the first stage of the regulator it passes through two high-pressure cores and enters the L.P. Chamber. This pressure is reduced to between 150 and 250 P.S.I. by a spring action in the low pressure chamber. The air then passes through the low pressure valve and is reduced to ambient pressure in the main housing. At this point the regulator is in a balanced state of pressure. Breathing reduces the pressure in the main housing, activating the diaphragm by the unbalanced pressure initiating another cycle.

LOW TANK PRESSURE

Air pressure exceeding 250 P.S.I. forces the piston away from the H.P. valves allowing them to close, maintaining the L.P. Chamber at 250 P.S.I.

The air in the main body of the regulator is maintained at ambient pressure by the action of the diaphragm. This air is drawn from the regulator by breathing, deflecting the diaphragm inward, activating the linkage which opens the L.P. Valve. The air in the main body is then replenished by the air from the L.P. Chamber.

As air flows from the L.P. Chamber the pressure is reduced to below 250 P.S.I. The piston opens the H.P. Valves and the L.P. Chamber is again maintained at 250 P.S.I. as the piston is forced away from the H.P. Valves allowing them to close, completing the cycle.

When the air supply drops to below 250 P.S.I. the piston remains against the H.P. Valves holding them in an open position allowing a direct flow of air into the L.P. Chamber. As the air is drawn from the L.P. Chamber it is reduced to ambient pressure in the main body. This feature gives the regulator the ability to supply adequate volumes of air with pressures of 3000 P.S.I. to less than 100 P.S.I.

The demand regulator is kept in a state of pressure balance by the water exerting pressure on one side of the diaphragm through holes in the exhaust end of the regulator and the air supply exerting pressure on the other side. This pressure balance enables the valve to function with ease at any pressure and insures that the diver's air supply is at a pressure equal to that of the surrounding water.

MAGNETIC EFFECT LIMIT

This regulator has been tested by the Naval Weapons Testing Laboratories in Dahlgren Virginia and has been found to meet the requirements for Magnetic Effect Limits as outlined in Specification MIL-M-19595A.

SECTION III

OPERATING INSTRUCTIONS

PRE-DIVE TEST

After connecting the regulator to the tank, turn the tank valve to the ON position by turning the thumbscrew counter-clockwise. Breathe through the unit to see that it is functioning properly. After taking a few breaths listen closely for hissing noises which indicates an air leak. If an air leak is detected, shut off air tank, breathe remaining air out of regulator, detach regulator from tank, connect back on tank being sure a proper seat is effected. If after turning air back on, leak is still present and tank valve "O" ring has been inspected and found to be in good condition, the regulator is improperly adjusted.

If the regulator passes the above test it should now be worn on the back and tested in water. This regulator is very easy breathing and if any abnormal restriction to breathing is noticed, the system should be carefully checked for possible malfunction.

CLEARING WATER

If water should enter mouthpiece while diving simply tilt head to the left, and blow into mouthpiece. This will force water out through the exhalation ports of the regulator. If water is persistantly in mouthpiece and hoses, there is probably a tear in either the hose or the regulator diaphragm. Inspection should be made immediately and defective part replaced.

WARNING

Serious injury can occur if this type of equipment is used by a person not thoroughly trained in diving procedure. DO NOT USE THIS EQUIPMENT IF YOU ARE NOT QUALIFIED.

BREATHING OF REGULATOR

Insert the mouthpiece into the mouth and grip firmly with the teeth, with the lips completely closed over the mouthpiece ridges. Inhale and exhale normally, establishing a steady rhythm.

If water seeps into mouth, it can be removed by exhaling into the mouthpiece. There are two check valves in the main body of the mouthpiece, the exhaled air closes the right check valve on the exhaust side of the mouthpiece forcing the entrapped water out of the exhaust hose.

SECTION IV

INSTALLATION

INSPECTION OF EQUIPMENT

Before attaching regulator to air tank, inspect thoroughly for possible damage in shipment. Inspect regulator body for dents and abrasions, thoroughly inspect hoses and mouthpiece for cuts or tears. Be sure plastic flutter valve housing, found inside mouthpiece are not cracked or damaged. Remove all traces of residual packaging material.

Check tank valve "O" ring for slight cuts and general deterioration. Before regulator is attached to air tank check pressure to see that tank is full. Slip regulator yoke over tank valve, seat properly with "O" ring and tighten by turning thumbscrew clockwise.

NOTE

Before diving with the regulator the PRE-DIVE TEST should be performed. Refer to PRE-DIVE TEST instructions in SECTION III, page 4 of this Manual.

BREATHING RHYTHM

While diving with this regulator be sure to inhale and exhale with a normal rhythm. Never, under any conditions or circumstances, hold your breath while ascending. TO DO SO CAN RESULT IN AN AIR EMBOLISM AND BE FATAL TO THE DIVER.

CLEANSING

Upon completion of each dive, the regulator should be cleaned thoroughly. Refer to "SUGGESTIONS FOR CLEANING" in SECTION V, Page 6 of this Manual.

SECTION V

MAINTENANCE

PREVENTATIVE MAINTENANCE

Although the regulator is constructed of high-quality material, it is subject to deterioration due to aging and carelessness in use. Deterioration due to aging can be greatly retarded through proper cleansing practice.

SUGGESTIONS FOR CLEANING

1. Detach hoses from regulator and clean with warm, fresh water. Run water through one end opening for a few minutes and then the other end opening. Repeat by running water through the mouthpiece.

2. Rinse regulator with fresh water both inside and out. While rinsing the outside of the regulator rub vigorously to be sure no salt particles or other foreign matter remains. Clean the inside of the regulator by running water through end openings for a few minutes.

3. Attach hoses onto regulator and hang by yoke to dry.

DISASSEMBLE PROCEDURE

1. Remove hoses from regulator

2. Unscrew four screws (#29) and pull off exhaust and bell. (#30)

3. Loosen locknut (#4) with tool (#T-104) by turning counter-clockwise.

4. Remove high-pressure housing (#7) with tool (#T-104) by turning counter-clockwise.

5. Pull diaphragm free of housing with fingers and low pressure assembly will drop out.

REPLACING DIAPHRAGM

Complete disassembly procedure. Remove nut from pin (#26) and diaphragm plate (#25). Diaphragm will now fall free of assembly. Reverse procedure to install new diaphragm. (See Figure 3)

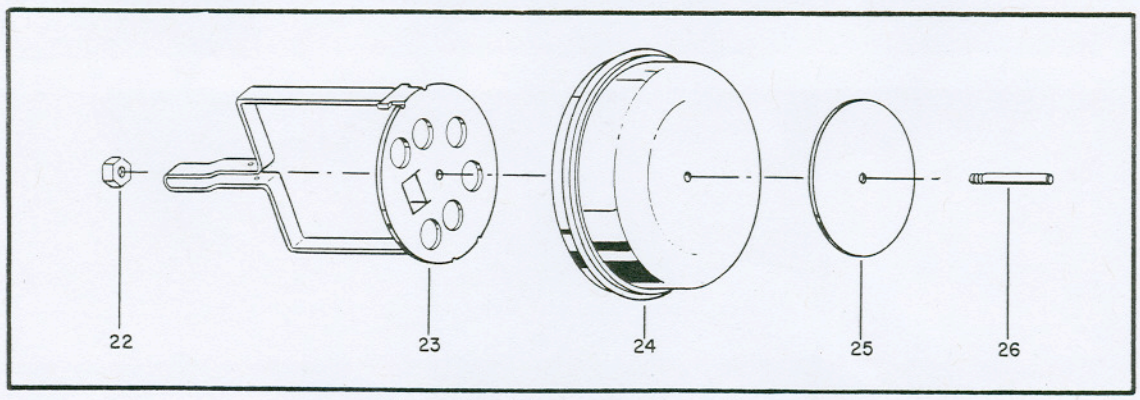

Figure 3. Diaphragm Assembly

REPLACING LOW PRESSURE CHAMBER

Remove two Socket Head Cap Screws (#31) and move linkage to expose hex nut (#33). Remove hex nut (#33) and low pressure chamber will drop free. Reverse procedure to assemble new low pressure chamber. "O" Ring (#2) found inside of threaded end of low pressure chamber should be replaced during each assembly and disassembly. Low pressure chamber consists of parts (#12) through (#21) inclusive.

NOTE

Low pressure chamber is pre-set by the factory and should be replaced in its entirety if damaged.

REPLACING HIGH PRESSURE VALVES

Complete Step 3 of Disassembly Procedure. The two high pressure valves are located in the threaded end of the high pressure housing. To replace valves, insert slotted end of tool (standard tire valve removing tool) into valve holes. Rotate tool until it catches on valve and turn counter-clockwise. Reverse procedure to insert new valve. The "O" ring (#6) fitted on threaded neck of high pressure chamber should be replaced during each assembly and disassembly.

ASSEMBLY PROCEDURE

"O" Rings should be lubricated by coating lightly with Dow Corning Compound (#7). DO NOT use Petroleum Lubricants of any kind. The low pressure chamber, linkage and diaphragm must be slipped into the regulator housing, diaphragm entering last. Line up the square end of the low pressure chamber with the square indentation of the regulator housing. Slip high pressure housing (#7) into yoke and screw on securing nut (#4) half way. Slip plate (3) over end of high pressure chamber, holding assembly by yoke in right hand and pointing upward. Hold regulator body containing low pressure assembly in left hand with indented hole pointing down. Slip end of high pressure chamber. Tighten high pressure chamber by placing tool (#T-104) in holes found on hex and turning clockwise. Tighten locknut (#4) against plate (#3). Secure end bell with four screws (#29) after seating diaphragm edge into ridge in regulator body. Add hose assembly and submit pre-dive test, refer to SECTION III, Page 4 of this Manual.

BREATHING ADJUSTMENT

To adjust regulator mount to air supply of at least 500 P. S. I., remove cover screw (#35) and insert wrench (T-102) through hole and into adjustment screw (#32).

If air flow is detected turn adjustment screw counter-clockwise until air stops and continue to turn counter-clockwise an additional 1/4 turn.

If air flow is not detected turn adjustment screw (#32) clockwise. When air flows, turn adjustment screw counter-clockwise until air stops plus 1/4 turn.

If regulator is adjusted properly it will flow when submerged in 5 inches of water while mouthpiece is above surface. As regulator is slowly lifted to surface, air flow should stop.

SECTION VI

PARTS LIST

This section contains a list of part numbers keyed to the exploded view illustration. This listing gives the part number by which the part is to be ordered. The exploded view illustration also serves to show a part and its relative position in the assembly and will act as an aid in maintenance and assembly.

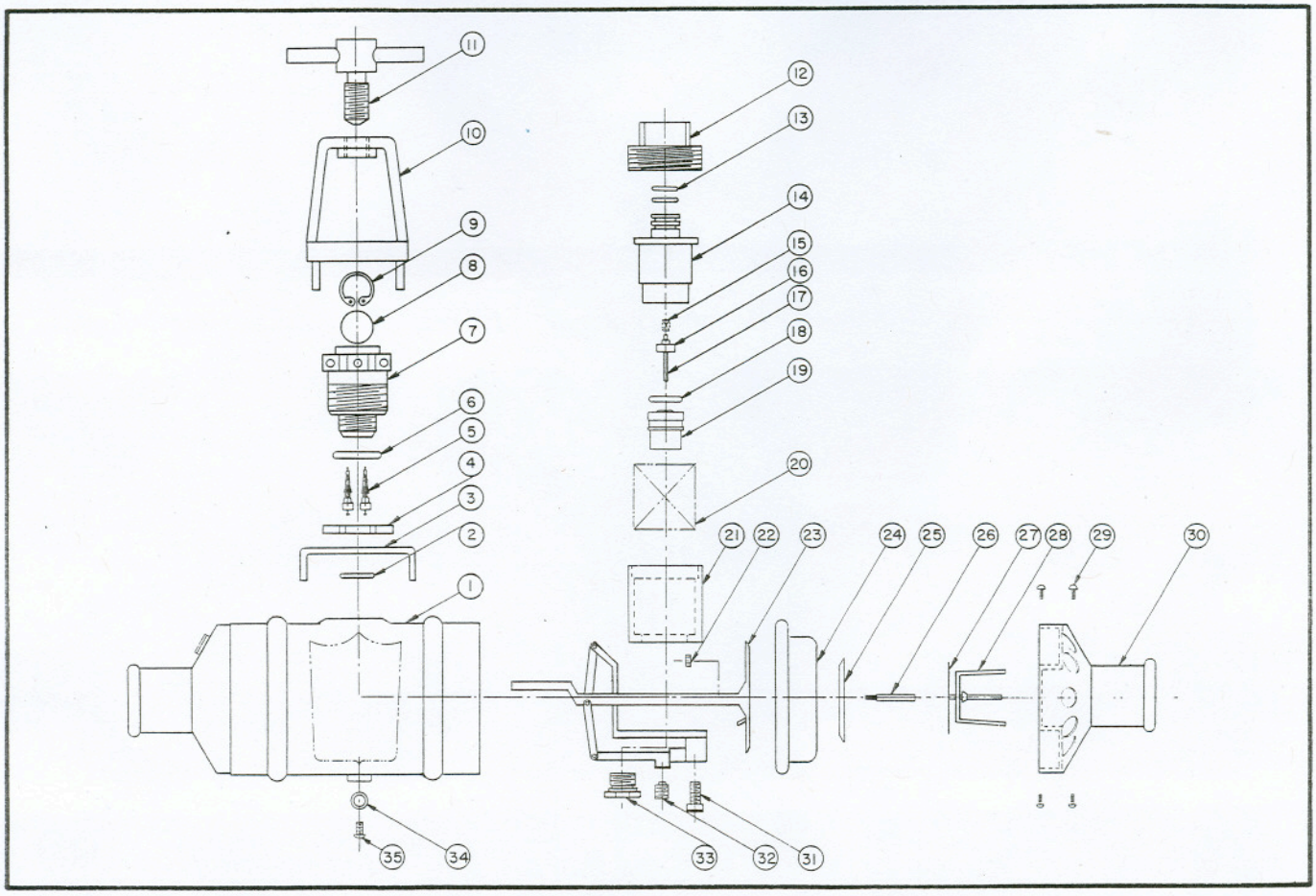

Figure 4. Exploded View - Demand Type Regulator Assembly

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY
1	17959-1	MAIN HOUSING	1
2	8307-014	"O" RING/H.P. VALVE HOUSING PRECISION "O" RING	1
3	18319	HOUSING SUPPORT	1
4	18320	SPANNER NUT/HOUSING SUPPORT	1
5	18305	VALVE CORE SUB ASS'Y	2
6	8307-016	"O" RING PRECISION "O" RING	1
7	18160	H.P. VALVE CORE HOUSING	1
8	17926	FILTER	1
9	5100-50C	RETAINING RING/FILTER WALDIES	1
10	18316	YOKE	1
11	18321	THUMB SCREW/YOKE	1
12	17929	LOWER SUPPORT - EXPANSION CHAMBER	1

FIG. & INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY
13	8307-011	"O" RING/L.S. EXPANSION CHAMBER 301 I.D. x .070 WALL PRECISION	1
14	17930	PISTON - EXPANSION CHAMBER	1
15	17931	LOW PRESSURE CORE SPRING/EXP. CHAMBER	1
16	18317	VALVE STEM CAP	1
17	18314	VALVE STEM	1
18	8307-014	"O" RING PRECISION "O" RING	1
19	17934	LOW PRESSURE/VALVE HOUSING	1
20	18318	MAIN SPRING	1
21	17936	PISTON - EXPANSION CHAMBER CYLINDER	1
22	60 FM-256	FLEX LOCK NUT #2-56 THREAD	1
23	17940	FORK & DISC SUBASSY	1
24	18237	DIAPHRAGM	1
25	17946	FLUSH PLATE	1
26	17947	RESERVE GUIDE PIN	1
27	17948	FLUTTER VALVE	1
28	18274	FLUTTER VALVE BRACKET-EXHAUST	1
29	Comm.	#2 SELF TAPPING SCREW OVAL HD. SELF TAPPING	4
30	18420	SUB ASSY BELL & HOSE MOUNT	1
31	Comm.	ADJUSTMENT SCREW WITH NYLOK #8-32 x 5/16 LG	1
32	Comm.	SET SCREW FLAT POINT WITH NYLOK #8-64 x 3/16	1
33	17954	LOW PRESSURE VALVE CAP	1
34	8307-007	"O" RING - .145 I.D. x .070 WALL-PRECISION	1
35	Comm.	ROUND HEAD SCREW #8-32 x 1/8 LG	1
	18571	HOSE AND MOUTHPIECE ASSEMBLY	1
36	18575	CLAMP, HOSE, NYLON	2
37	18236	HOSE	2
38	18574	CLAMP, HOSE, NYLON	2
39	18572	VALVE, SUPPORT	2
40	17948	FLUTTER VALVE	2
41	18577	MOUTHPIECE	1
	18370	NAMEPLATE INTAKE	1
	18371	NAMEPLATE EXHAUST	1
	18079	WASHER - RUBBER	1
	17977	ASSY LOW PRESSURE VALVE SEAT	1

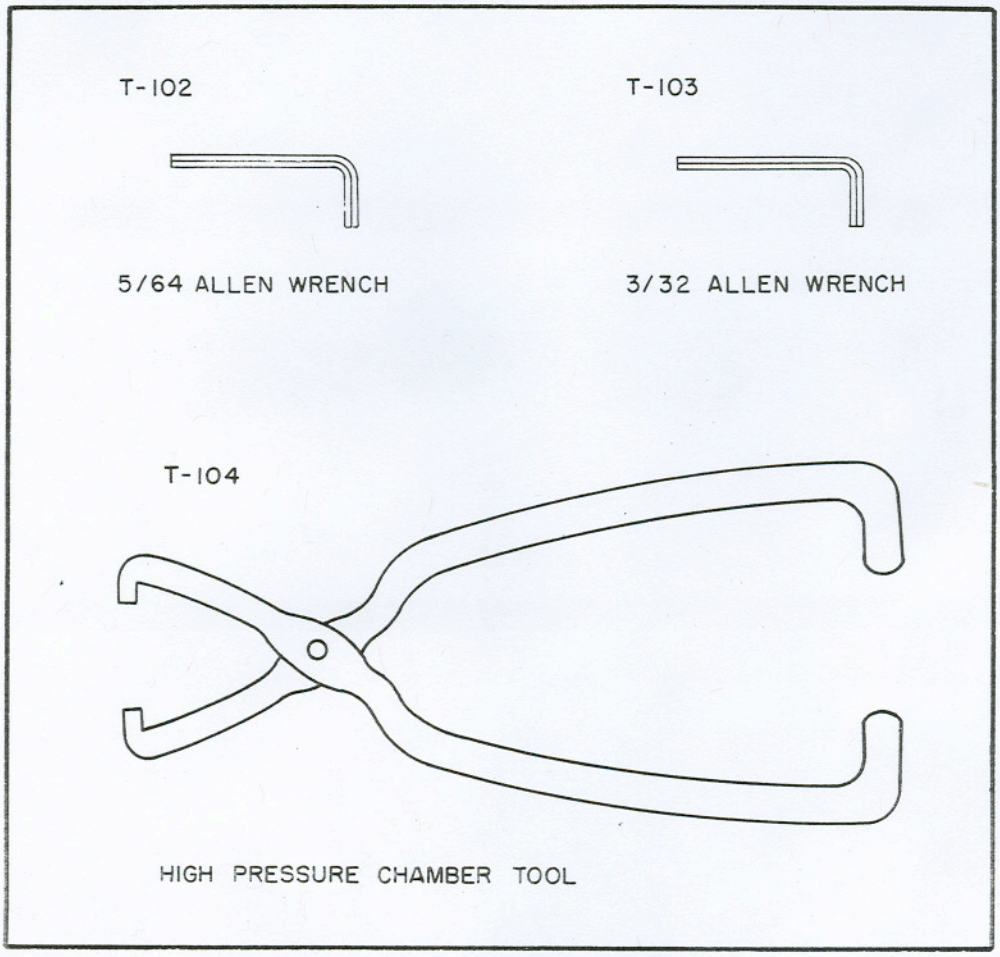

Figure 5. Special Tools

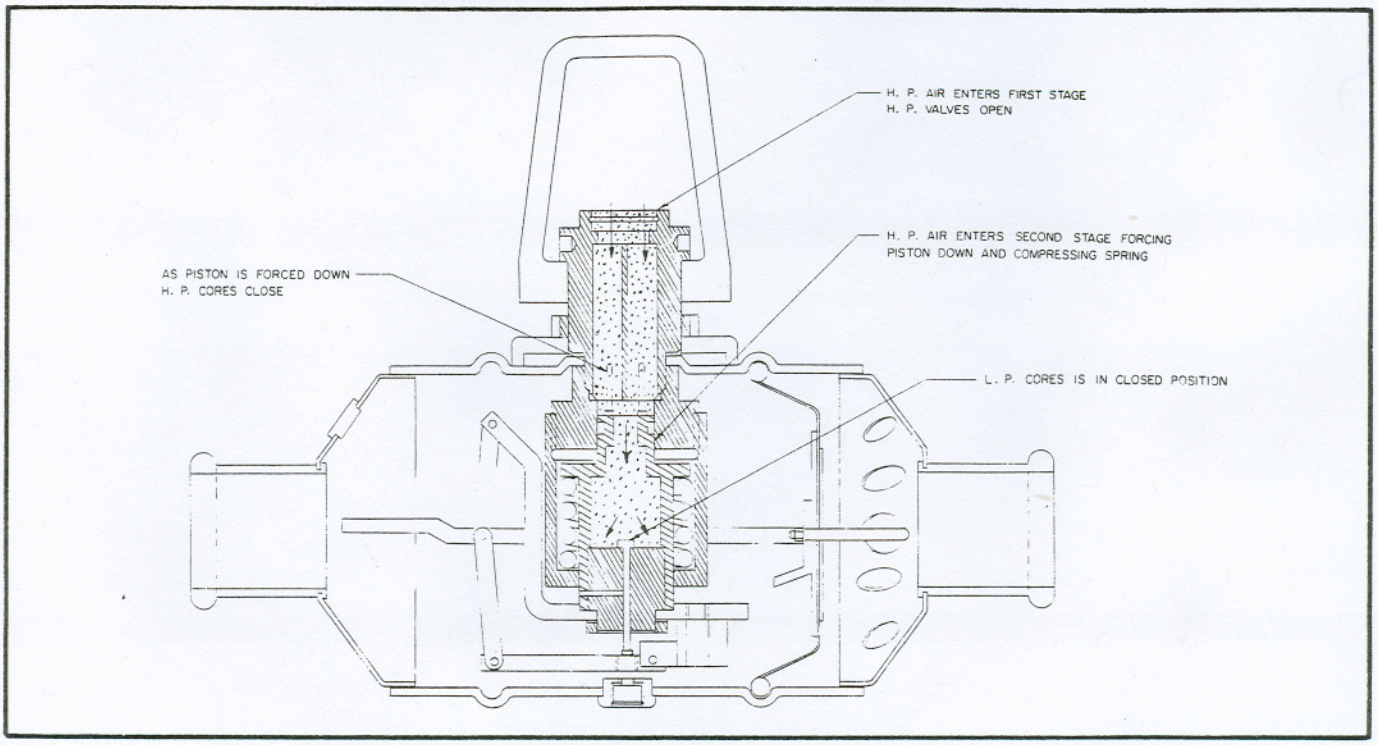

Figure 6. Regulator Schematic - High Pressure Air Entering First Stage

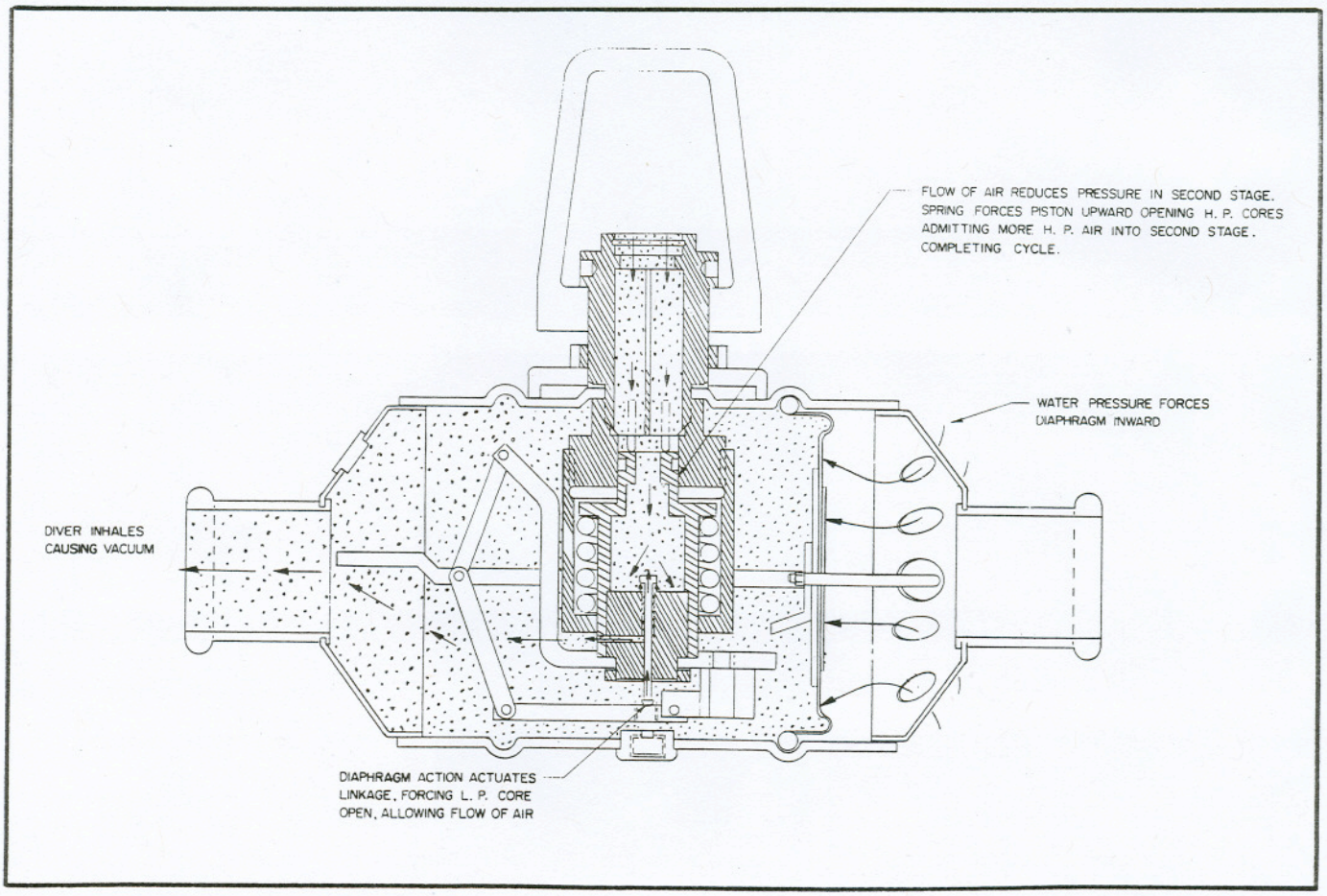

Figure 7. Regulator Schematic - Operation

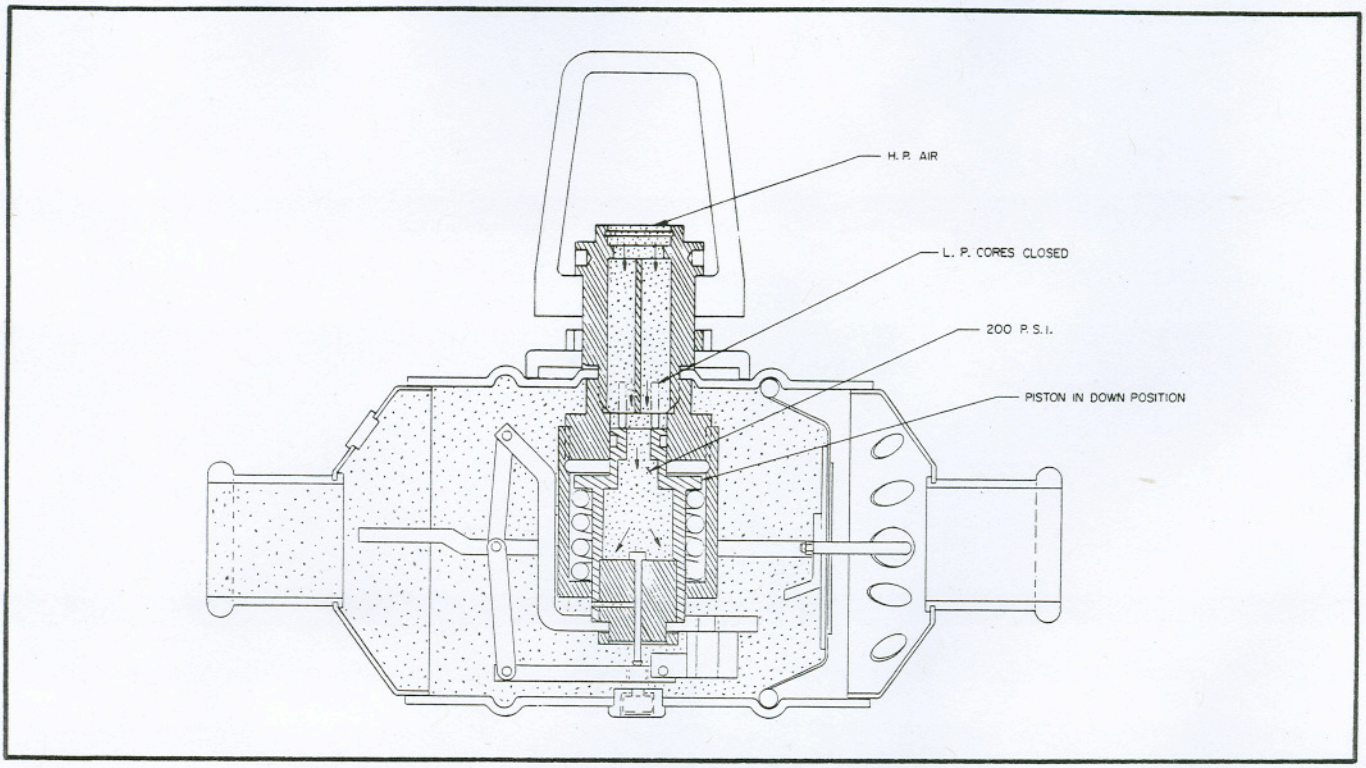

Figure 8. Regulator Schematic - Balanced Condition