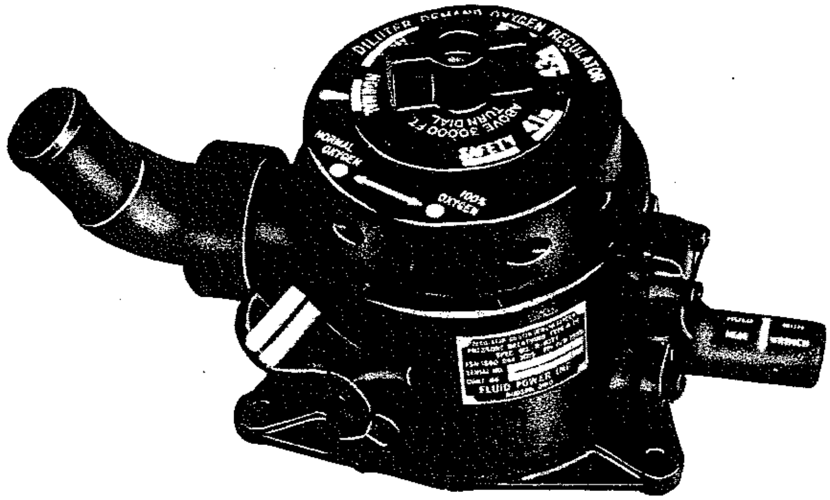
FPI
Fluid Power, Inc.

INSTRUCTION BOOK



TYPE A-14 PRESSURE BREATHING DILUTER DEMAND OXYGEN REGULATOR

PART NUMBER 1550

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T A B L E   O F   C O N T E N T S

SECTION I

I N T R O D U C T I O N

This Handbook contains discriptive data and instructions with parts catalog for the Installation, Operation, Inspection and Maintenence of Fluid Power Inc. Model 1550, Type A-14 Pressure Breathing Diluter Demand Oxygen Regulator.

SECTION II

D E S C R I P T I O N

2.1 GENERAL DESCRIPTION

The type A-14 Diluter Demand Oxygen Regulator, Pressure Breathing (Fig. 1) is essentially a diaphragm-operated flow valve which is opened by the suction of the user's inhalation, and closes automatically when the suction ceases. The Oxygen demand regulator is fully automatic and provides the user with the proper amount of oxygen at all altitudes and under all conditions. A demand system, as the name implies, furnishes oxygen only upon demand. That is, every time the user inhales, a quantity of oxygen in proper mixture with air, is delivered. The percentage of oxygen being delivered to the user increases with increasing altitude, becoming 100 percent at an altitude of approximately 32,000 feet. This action, being completely automatic, makes unnecessary any attention on the part of the user. The regulator is installed as a permanent fixture of the airplane, there being a demand regulator for each station.

2.2 DETAILED DESCRIPTION

2.2.1 REGULATOR - The regulator is of the two-stage reduction type, consisting of two main sections or stages, and a mixing chamber. Oxygen enters the first stage through a diaphragm-controlled valve which automatically regulates the pressure in the first stage. A second diaphragm-controlled valve automatically regulates the pressure in the second stage. The passage of oxygen from the second stage to the mixing chamber is through two separately controlled openings, the oxygen metering port and the auxiliary oxygen by-pass valve. The aneroid actuated lever governs the flow of oxygen through the oxygen metering port in accordance with altitude variations. Moving the diluter control to the "100% Oxygen" position closes the air metering port, and opens both the oxygen metering port and the auxiliary oxygen by-pass valve, thus permitting 100 percent oxygen to be delivered to the mask upon demand only.

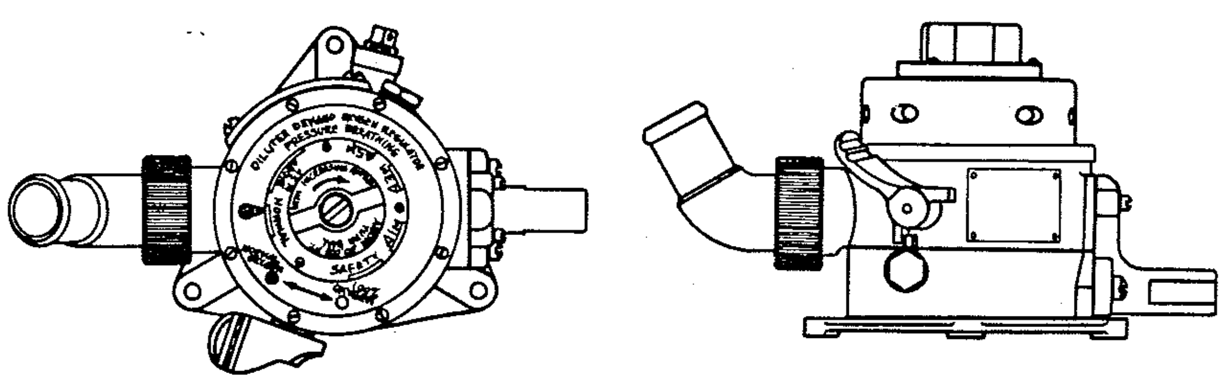


FIGURE 1 — TYPE A-14 PRESSURE BREATHING DILUTER DEMAND OXYGEN REGULATOR - MODEL 1550

2.2.2 SUBASSEMBLIES - The general assembly of the regulator is shown by means of a sectional drawing (Fig. 2).

2.2.2.1 Pressure top assembly (13) containing the diaphragm loading mechanism.

2.2.2.2 High-pressure tee assembly which included among parts the high-pressure tee (1) and oxygen filter assembly (2).

2.2.2.3 First-stage chamber (11) includes first-stage valve mechanism (3), first-stage diaphragm assembly (4) and mounting plate (5).

2.2.2.4 Second-stage regulating chamber (6) and mixing chamber (7) includes auto-mix lever spring-and-vane assembly (8) and outlet gland assembly (9).

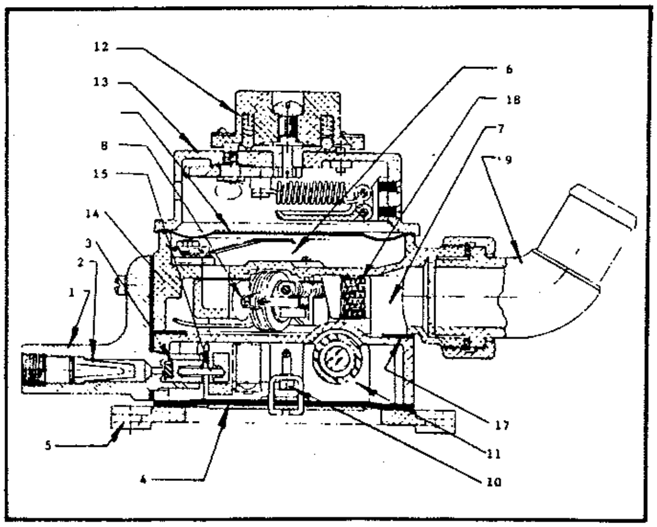


FIG. 2 - SECTIONAL VIEW - MODEL 1550
PRESSURE BREATHING DILUTER DEMAND OXYGEN REGULATOR

1. *High Pressure Tee*
2. *Oxygen Filter Assembly*
3. *First Stage Valve*
4. *First Stage Diaphragm Assembly*
5. *Mounting Plate*
6. *Second Stage Regulating Chamber*
7. *Second Stage Mixing Chamber*
8. *Auto Mix Lever Assembly*
9. *Outlet Gland Assembly*
10. *First Stage Lever*
11. *First Stage Chamber*
12. *Pressure Control Knob*
13. *Cover Assembly*
14. *Second Stage Body*
15. *First Stage Thrust Pin*
16. *Main Assembly Screws*
17. *Interstage Gasket*
18. *Guard Screen*
19. *Second Stage Diaphragm*

2.2.3 PRESSURE BREATHING TOP - (1) The type A-14 Regulator is essentially the Type A-12A regulator, adapted for Pressure Breathing by addition of a diaphragm loading mechanism, which opens and closed the oxygen valve according to the pressure beneath the breathing diaphragm (Fig. 3). Such a mechanical control permits elimination of the Emergency Valve previously used. Loading is accomplished by rotating the pressure breathing knob clock-wise from the "Normal" setting. The rotation of the knob results in the extension of a tension spring mounted at one end to a spur gear and at the other to a lever, causing the lever to depress the diaphragm and open the oxygen valve. When the pressure under the diaphragm increases sufficiently to overcome the pressure of the lever, the oxygen valve returns to its original position shutting off the oxygen. Dial settings are maintained under load, by spring loaded retainer balls, mounted in the knob and bearing on a drilled plate attached to the top, affording definite click-stops. A stop-pin prevents excessive spring loading in either direction. The range of loading permits varying oxygen shut-off pressures from 0 to 12 inches of water. Knob calibrations show as "Safety" pressure, and in altitudes reading "41M", "43M", "45M" and "Above 45M", which correspond to definite positive pressures.

2.2.3.1 The knob is essentially a flat disk having a bar-like projection to facilitate turning. An instruction plate showing altitude settings is mounted on the flat portion of the knob.

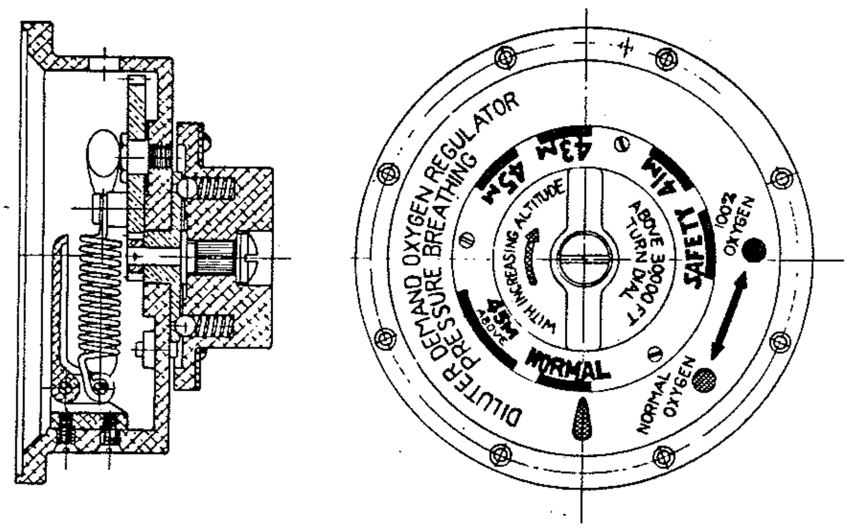


FIG. 3 - PRESSURE BREATHING CAP ASSY.

2.2.4 FIRST STAGE - The interior view of the first stage is shown in Fig. 4. A sectional view through the control spring is shown in Fig. 5.

2.2.4.1 The high-pressure tee (1) shown in Fig. 2 is connected to the source of oxygen having a pressure not to exceed 1800 pounds per square inch. The oxygen enters the first-stage chamber (11) through the high-pressure tee (1), passing through the oxygen filter assembly (2), and through the first-stage valve (3).

2.2.4.2 (See Fig. 2 and 4) The first-stage valve (3) is displaced from the lip of the nozzle until the pressure within the cavity reaches approximately 10 pounds per square inch at which pressure the first-stage diaphragm assembly (4) is forced outward, pulling on the diaphragm end of the first-stage lever (10), and transmitting the motion through the first-stage lever link, the first-stage seat lever, and first-stage thrust pin to the first-stage valve (3) which is thereby closed against the nozzle lip.

2.2.4.3 As oxygen is inhaled from the regulator the resulting decrease in pressure in the second stage causes the valve seat (Fig. 7) to be opened and permits the oxygen to flow from the first stage. This causes a decrease in pressure in the first-stage cavity. The control spring causes the first-stage diaphragm to move inward, thus allowing the high-pressure seat to open. The force of the high-pressure gas against the seat in the region inside the lip proper holds the seat away from the lip, as long as the flow (causing the pressure drop in the first stage) continues.

2.2.4.4 The value of approximately 10 pounds per square inch for the first-stage is obtained by adjusting the control-spring loading by means of the adjusting screw (Fig. 5). Access to this screw is gained by removal of the adjustment sealing plug. The spring guide carries one end of the spring, and a tapered extension of the quide bears in a cavity of the first-stage lever (Fig. 5). The travel of the diaphragm and consequently the seat, is adjusted by means of the seat lever adjusting screw, which bears on the end of the first-stage lever link. This adjustment is locked by means of the seat lever adjusting screw lock nut.

2.2.4.5 A pressure relief valve is incorporated into the first stage. In event the pressure in the first stage becomes greater than 25 pounds per square inch the pressure exerted on the bottom diaphragm is sufficient to cause the diaphragm lever to lift and move the lever arm up against the pressure relief valve spring, thus opening the relief valve and venting the gas into the second stage. When the pressure in the first-stage returns to 10 pounds per square inch the diaphragm returns to normal position and the lever arm moves away from the relief valve spring assembly allowing the relief valve to close.

2.2.4.6 The outlet of the first stage is a small port through the floor, which vents oxygen to the second-stage nozzle. The diaphragm is clamped to the first-stage body by means of the mounting plate (5). (See Fig. 2). The first-stage is clamped to the second-stage by means of six screws passing through the mounting plate, diaphragm, body and inter-stage gasket and threading directly into the second-stage body. Three holes are provided in the mounting plate for fastening the complete regulator to a regulator mounting bracket.

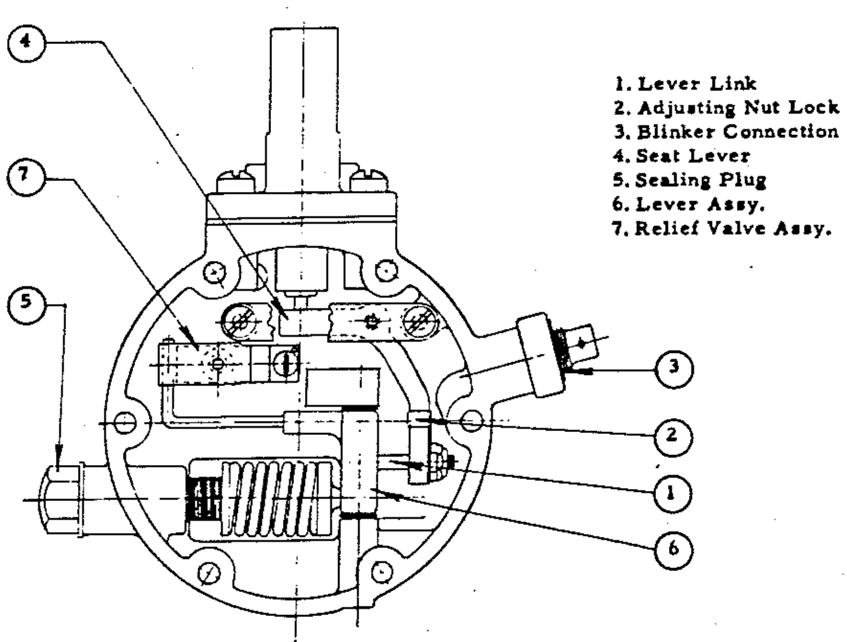


FIG. 4 - INTERIOR - FIRST STAGE

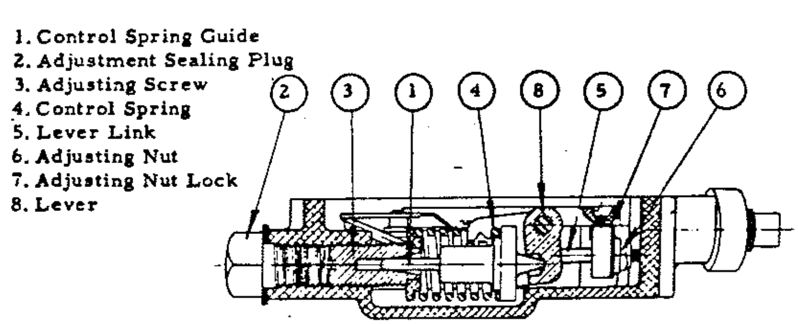


FIG. 5 - SECTIONAL VIEW - FIRST STAGE

2.2.5 SECOND STAGE - The second stage and mixing chamber (Fig. 6) comprises the mechanism which automatically varies the oxygen concentration according to the altitude of flight and supplies oxygen, with a minimum additional effort to normal breathing, only as inhalation occurs. The mixture varies automatically from the normal oxygen concentration of air at ground level to 100 percent oxygen at approximately 32,000 feet. The operation of these parts (Fig. 6 and Fig. 8) is as follows:

2.2.5.1 Regulating Chamber - As the operator inhales, withdrawing oxygen-air mixture from the mixing chamber, the reduction in pressure within the second-stage regulating chamber results in depression of the second-stage diaphragm. This action causes the second-stage regulating lever (fig. 7) which pivots at the second-stage fulcrum to push the second-stage thrust pin against the second-stage valve. This action opens the second-stage valve and oxygen then flows from the first-stage to the second-stage regulating chamber through the oxygen port. (Fig. 6). As the operator exhales, the pressure in the second stage regulating chamber combines with the load exerted by the second-stage valve spring, and the 10 pounds per square inch first-stage pressure to restore the second-stage diaphragm to its original position, thereby closing the valve against the second-stage valve seat. The maximum suction required to operate the second-stage diaphragm under usual conditions is less than 1/10 inch of water.

2.2.5.2 Mixing Chamber - At altitudes from approximately 5,000 to 28,000 feet, when the operator inhales with the diluter control (Fig. 6) in the "Normal Oxygen position (Fig. 9 shows relation of parts), the oxygen enters the mixing chamber through that opening in the oxygen metering port or through the opening formed by the auxiliary by-pass valve lip, and is mixed with the air which enters through the air check valve assembly to the air metering port. The mixture then passes through the outlet-guard screen (Fig. 2) to the user's mask. At inhalation with the diluter in the "100% Oxygen" position (Fig. 10 shows relation of parts) the air port is closed, thus excluding air. The path of flow is then similar to the above description for oxygen.

a. With the diluter control in the "Normal Oxygen" position (Fig. 9) so that mixing is automatic, the aneroid assembly engages the auto-mix lever to which are fastened the oxygen restrictor and the air vane.

b. At sea level the aneroid (evacuated bellows) assembly is compressed by atmospheric pressure, then the auto-mix follower spring engages the diluter actuating cam, thus inserting the flow restrictor into the oxygen metering port while holding the air vane away from the air metering port. Under these conditions air alone is drawn into the chamber.

c. At approximately 5,000 feet, the aneroid has expanded sufficiently to cause the auto-mix lever to move against the action of the follower spring. This slight displacement of the flow restrictor from the oxygen metering port, permits a slight flow of oxygen, at the same time partly closing the air vane toward the air metering port. As higher altitudes are attained, the aneroid expands farther, due to reduced atmospheric pressure, causing the lever to open the oxygen metering port wider and to more nearly close the air metering port. This affords increasingly higher concentrations of oxygen and maintains the air-oxygen mixture at the regulator outlet, equivalent or superior to that of air at 5,000 feet.

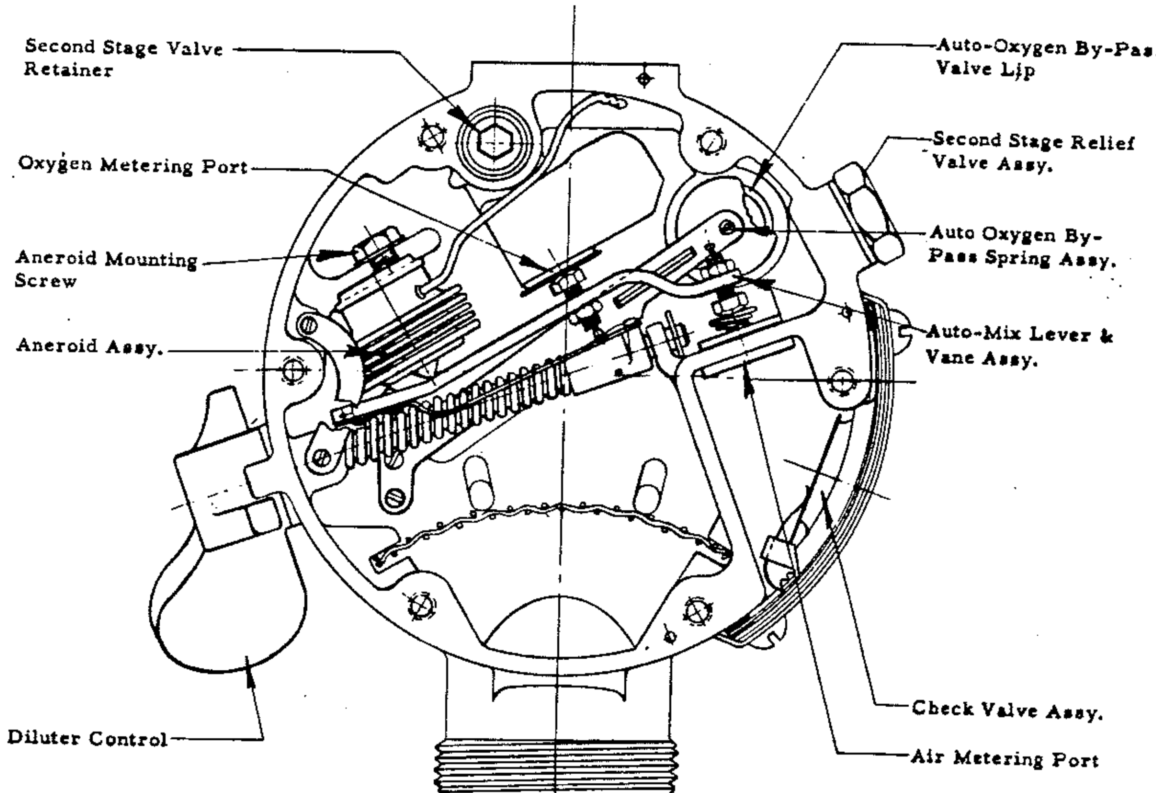


FIG. 6 - INTERIOR - SECOND STAGE MIXING CHAMBER

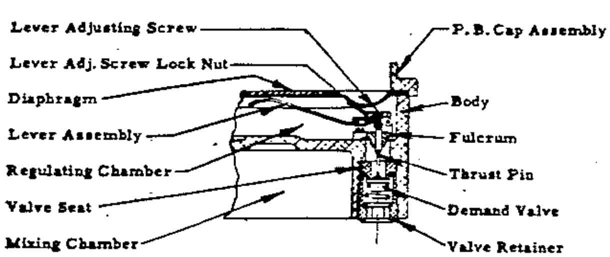


FIG. 7 - SECTIONAL VIEW - SECOND STAGE DEMAND VALVE ASSEMBLY

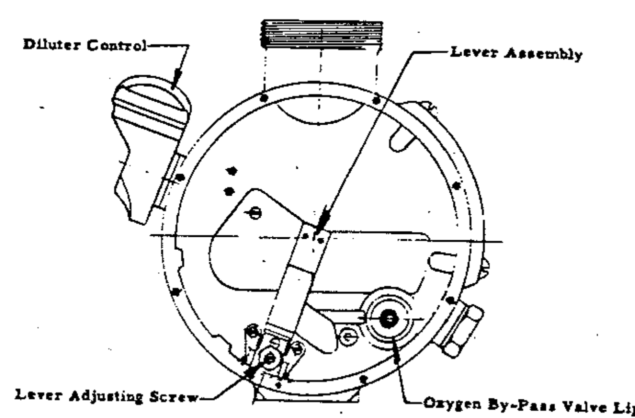
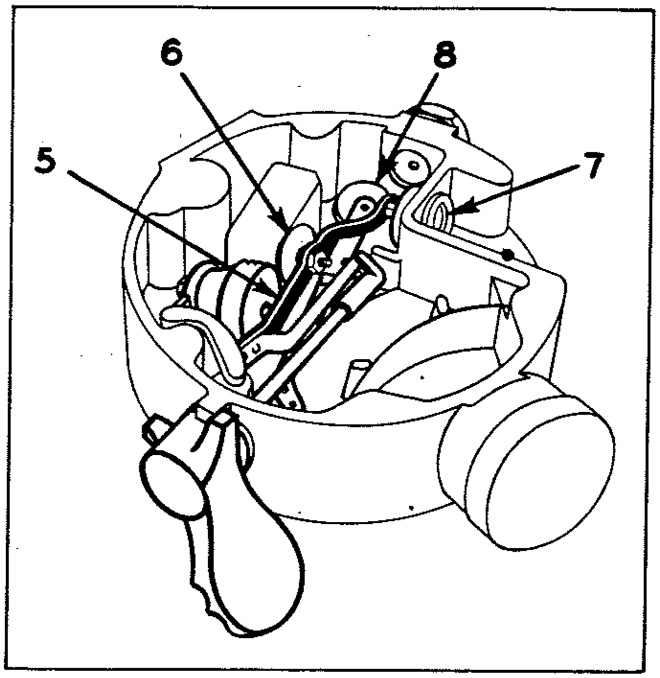


FIG. 8 - INTERIOR - SECOND STAGE DEMAND VALVE CONTROL

d. At an altitude of approximately 32,000 feet the air vane has closed against the air metering port and 100 percent oxygen is supplied thereafter until the aircraft descends to lower altitudes.

e. With the diluter control in the "100% Oxygen" position as shown in Fig. 10, the diluter actuating cam acts upon the auto-mix follower spring, so that air port is closed at all altitudes and lifts the auxiliary oxygen bypass spring assembly, resulting in the admission of oxygen on demand, through the metering port. The auxiliary oxygen by-pass spring and vane work automatically when the diluter control is in the "Normal Oxygen" position and large flows of oxygen, such as would be required in heavy work, pass through the regulator.



AT GROUND LEVEL WITH THE DILUTER CONTROL IN NORMAL OXYGEN POSITION

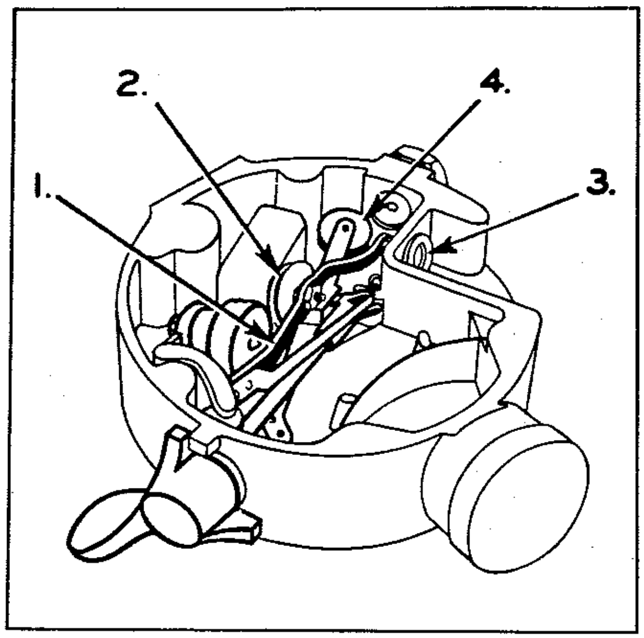
5. *Aneroid and auto-mix lever almost in contact.*
6. *Oxygen metering port closed.*
7. *Air metering port open.*
8. *Auxiliary oxygen by-pass valve closed, but free to open under increased suction.*

AT HIGH ALTITUDES

As higher altitudes are reached the aneroid gradually forces the lever to open the oxygen metering port and to close the air metering port.

Figure 9—

Interior—Second Stage Mixing Chamber-Diluter Control—"Normal Oxygen" position.



AT ANY ALTITUDE— DILUTER CONTROL IN 100% OXYGEN POSITION

1. *Auto mix lever held away from aneroid.*
2. *Oxygen metering port open.*
3. *Air metering port closed.*
4. *Auxiliary oxygen by-pass valve held open.*

Figure 10—

Interior—Diluter Control—"100% Oxygen" position.

2.2.6 EMERGENCY OPERATION - If, below 30,000 feet, for any reason, the supply of oxygen or air should become impaired, clockwise rotation of the pressure breathing knob (Fig. 3) opens and holds open the valve (Fig. 7) until sufficient oxygen flows from the first stage to accumulate a pressure under the diaphragm. This pressure is regulated by knob rotation to overcome any deficiency in oxygen delivery to the mask.

2.2.7 SECOND STAGE RELIEF VALVE - As shown in Fig. 6, a second stage relief valve is incorporated in the second stage which normally does not contain pressure. However, if the outlet is blocked and the pressure breathing knob rotated from "Normal" pressure may rise. At a pressure of less than 3 in. Hg. above ambient, the relief valve opens and vents this pressure to the atmosphere, preventing internal damage to the second stage.

2.2.8 SERRATED OUTLET ELBOW - A serrated outlet elbow is provided to insure against leakage previously caused by movement of the mask-to-regulator tubing. The desired position of the outlet elbow may be selected and the serrations of the elbow engaged with the serrations of the regulator outlet. When the gland nut is firmly tightened the elbow cannot move. (see Fig.2).

SECTION III

I N S T A L L A T I O N

3.1 MOUNTING

3.1.1 The regulator will be installed in conformity with the installation drawings and instructions issued for the aircraft in which it is used. Fittings and connecting tubing shall be maintained tight and secure at all times.

3.1.2 The regulator is designed for operation in any position. However, mounting in the vertical plane is preferred since the formation of a certain amount of sleet is possible when passing first through cold areas and then through areas of high humidity. In the case of the installations that do not benefit from heat in the cabin, the regulator should be mounted with the screen downward, or at least in the lower quadrant, thus permitting possible condensation to drain out.

3.1.3 The regulator should be mounted so that the diluter control is accessible. (Fig. 6)

3.2 CONNECTIONS

3.2.1 In attaching the adapter with union nut to the inlet fitting of the regulator, two wrenches should be used, one holding the inlet fitting and one holding the nut of the adapter.

3.2.2 To avoid straining the regulator or connections, a shallow loop should be provided in the connecting tubing. Three No. 10-32 round-head machine screws, one inch long, part No. AN520-D10-16, three No. 10-32 Hex nuts, part No. AN315-D2-R, and three No. 10 lock washers part No. AN935-B10-L1 are supplied with each regulator.

3.2.3 Before attaching the regulator-to-mask tubing (Part No. MS22055) to the outlet gland assembly, select the angle at which the tubing should leave the regulator. With the outlet gasket in place in the outlet gland, insert the serrations of the outlet gland into the serrations of the second stage outlet of the regulator so that the desired angle is obtained. Tighten the knurled outlet gland nut. Next, remove outlet gland shipping cap and attach the tubing.

3.3 INDICATORS

3.3.1 The AN6029 Flow Indicator ("BLINKER") is connected to the first stage body of the regulator. A special tap is cast into the first stage body 180 degrees away from the diluter handle. The tubing for the indicator is connected to this tap.

SECTION IV

O P E R A T I O N

4.1 PRINCIPLES OF OPERATION

4.1.1 DEMAND FEATURE- Each time the user inhales he applies a small suction to the regulator. This suction is sufficient to deflect a diaphragm which is connected to a valve, thus causing the valve to open and oxygen to flow. It requires only a few tenths of an inch of water suction to operate the regulator. As soon as inhalation ceases and the suction is no longer applied, a spring, plus oxygen pressure in the first stage, returns the diaphragm to its original position and the valve is closed. The operation is entirely automatic. The inhalation of the user alone operates the regulator.

In addition to furnishing oxygen on demand, the A-14 Regulator mixes air with oxygen in varying quantities according to existing altitudes. Obviously, at sea level there is no need for added oxygen. Consequently, this demand regulator supplies primarily air at sea level. With increasing altitude a mixture of oxygen and air is supplied in accordance with physiological requirements. At approximately 32,000 feet, 100 percent oxygen is delivered to simulate low altitude air.

An evacuated metallic bellows (an aneroid similar to that found in altimeters) moves a lever arm which in turn controls air flow through a port. At sea level, the air port is wide open and the oxygen port is closed. As the altitude increases, the bellows expands, gradually closing the air port while opening the oxygen port. Thus, at an altitude of approximately 32,000 feet, the air port is closed and the oxygen port is wide open, thereby substituting 100 percent oxygen in place of the oxygen-air mixture delivered at lower altitudes.

4.1.2 DILUTER CONTROL FEATURE- In normal use, the operation of the A-14 Regulator is completely automatic. Two manual controls are provided for use in special instances. One of these is the diluter control and the other is the pressure breathing knob. The two positions of the diluter control are labeled "Normal Oxygen" and "100% Oxygen".

When the diluter handle is in the "Normal Oxygen" position, the regulator automatically mixes the required amount of oxygen with the inspired air to maintain adequate oxygen concentrations at all altitudes. When the diluter handle is in the "100% Oxygen" position, the air port is closed and no air is taken into the regulator, thereby delivering 100 percent oxygen at all altitudes.

When the diluter handle is in the "Normal Oxygen" position, the luminous bars on the handle appear opposite the luminous spot on the regulator cover indicating normal usage. When the diluter handle is in the "100% Oxygen" position, the luminous bars on the handle are hidden.

4.2 OPERATING INSTRUCTIONS

4.2.1 NORMAL OPERATION- Turn the diluter control to the "Normal Oxygen" position during flight. This is the normal operating condition of the regulator and provides against waste of oxygen at low altitudes even though the operator's mask is in use. No adjustment or manual operation of valves is necessary at altitudes where oxygen is needed or for compensation for varying rates of activity. Supply of suitable oxygen concentrations for all required respiratory rates is automatic.

4.2.2 **ABNORMAL OPERATION-** Personnel operating airplanes with extremely high rates of climb are instructed to breath 100 percent oxygen during denitrogenation, prior to and during high altitude flights. By placing the diluter handle in the "100% Oxygen" position, oxygen only is delivered regardless of altitude. Under conditions of sleeting, exposed regulators should be operated with the diluter handle turned to the "100% Oxygen" position.

4.2.3 **EMERGENCY OPERATION-** If for any reason the supply of oxygen becomes inadequate because of restrictions or faulty dilution mechanism, clockwise rotation of the pressure breathing knob will open the valve (Fig. 7) allowing a free flow of oxygen until sufficient pressure is built up to raise the diaphragm and close the valve.

It must be remembered that any position of the knob other than "Normal" causes the diluter mechanism to become inoperative and allows 100 percent oxygen to flow under pressure. Below 30,000 feet, this operation is uneconomical. The successful completion of a long high-altitude mission will depend on the economical use of the available oxygen supply.

SECTION V

SERVICE INSPECTION, MAINTENANCE AND LUBRICATION

5.1 SERVICE TOOLS

No service tools are required.

NOTE: All regulators found not to be in operating condition, as determined by these tests and examination, must be overhauled by the manufacturer, or an approved overhaul facility.

5.2 SERVICE INSPECTION

Preflight Inspection - When flying is to be done at altitudes requiring oxygen supply, the oxygen equipment must be checked for proper operation prior to each flight. Test for oxygen flow at ground level by placing the auto-mix lever in the "100% Oxygen " position. Open the "trap door" dust cover of the mask-to-regulator tubing, on the end opposite to that connected to the regulator, and exert a suction similar to that in breathing by placing the mouth on the opening. A good flow of oxygen should pass throught the tubing with negligible resistance.

With the dust cover held open, rotate the pressure breathing knob clockwise approximately 90 degrees. A steady flow of oxygen indicates satisfactory performance.

With the diluter control in the "100% Oxygen" position and the pressure breathing knob at "Normal", blow back into the mask-to-regulator tubing. Any indication of a free passage through the regulator would indicate a damaged diaphragm or air metering system.

If the breathing resistance through the instrument or the flow of oxygen with pressure breathing knob turned clockwise, or the blow-back test is not correct, replace the regulator. The tightness of the regulator may be judged by the fact that the oxygen supply pressure does or does not dimish during standby periods while the plane is not in operation. This test, however, is only possible if the connections in the system are entirely free of leaks.

500-HOUR Inspection

At the end of 500 hours of service, the oxygen regulator will be removed from the airplane and returned to the overhaul depot for inspection and overhaul.

5.3 MAINTENANCE

Examine the regulator for any noticeable damage to its exterior parts making sure that: All screws are in place and tight, the diluter is not bent, the stop on the handle mates with the stop on the body, and the pressure breathing knob is secure.
Finally, inspect both inlet and outlet connections for tightness.

5.4 LUBRICATION

No lubrication is required in any part or assembly of this regulator.

CAUTION!

Oils and greases must not be used at any time on any part or on any connector to this regulator. The presence of oil, even in very minute quantities may result in explosion when in contact with oxygen.