



Unimatic® III Manifold for Medical Gases Service Manual

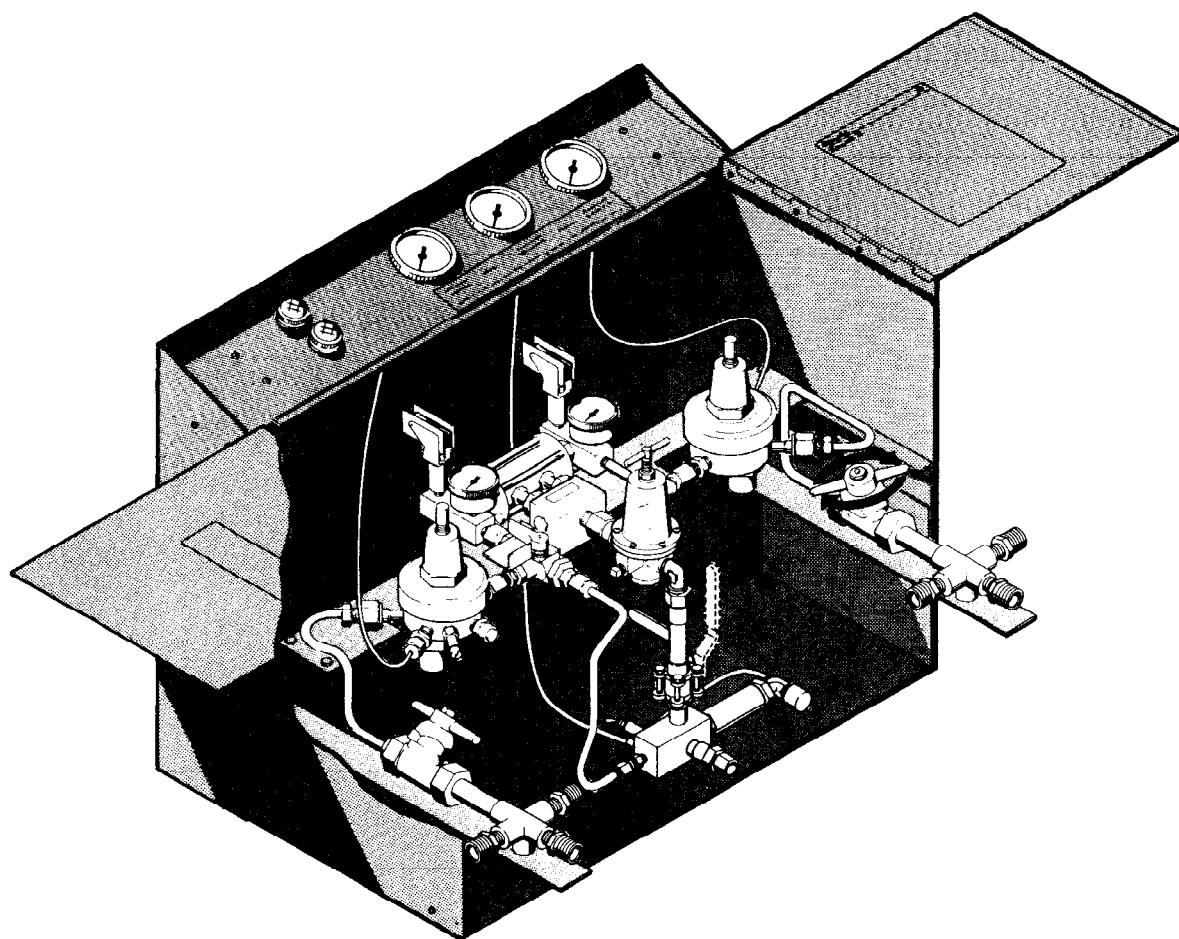


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Technical Competence

The procedures described in this service manual should be performed by trained and authorized personnel only. Maintenance should only be undertaken by competent individuals who have a general knowledge of and experience with devices of this nature. No repairs should ever be undertaken or attempted by anyone not having such qualifications.

Genuine replacement parts manufactured or sold by Ohmeda must be used for all repairs.

Read completely through each step in every procedure before starting the procedure; any exceptions may result in a failure to properly and safely complete the attempted procedure.

Precaution

Warnings

Fire Hazard. Do Not permit smoking or any other source of ignition in area where the manifold is located or near relief valve vent outlet. Be certain all connections are free of dirt, grease and oil. These substances burn with great intensity in air enriched with oxygen or nitrous oxide.

When the **Bypass Mode** is in use **No Secondary Supply Is Available**. Gas is being supplied directly and only from the left bank regulator at line pressure. Monitor pressure in left bank - reestablish normal operation **Before** the left bank nears depletion.

To ensure proper functioning and proper delivery of gas, **Each** regulator must be adjusted while gas is flowing through the regulator as indicated in the following procedure.

All bank regulator pressure settings must be made with a supply pressure of 600 psig or greater for nitrous oxide (N_2O), and 1800 psig or greater for all others. The delivery line must be set with an inlet pressure (intermediate line pressure) of 200 psig $\pm$ 10 psig except nitrogen manifolds which must be 400 psig $\pm$ 10 psig.

The left and right banks must have sufficient gas volume to perform any test and supply hospital demand.

Never oil or grease oxygen or nitrous oxide equipment unless a lubricant that is made and approved for this type of service (such as Vac-Kote, Stock No. 0220-0091-300) is used or a certain type of lubricant is specified for a particular part of a unit. Oils and greases oxidize readily and, in the presence of oxygen, will burn violently.

Use extreme care, when working with high pressure oxygen components and systems, to keep hands, tools and work environment free of oils which are highly combustible in the presence of high pressure oxygen.

The person performing service on the manifold is responsible for obtaining permission from the hospital administration prior to performing any check-out or repairs of the manifold.

Only one header valve may be turned off while the manifold is supplying gas to the hospital. After performing checks or making repairs, return header valves to the open position.

Nitrous oxide and carbon dioxide are in liquid form in the cylinders (at room temperature). Therefore, both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. The possibility of a bank depletion occurring while service is being performed should be avoided. The installation of one or two full nitrous oxide and carbon dioxide cylinders for the duration of the repair or test procedure will prevent this.

To ensure a continuous supply of gas during regulator adjustment, be certain ample supply of gas is available in both cylinder banks and **Never** close a header valve unless the opposite bank header valve is open.

To maintain a gas flow to the delivery line during the pressure switch checking and adjustment procedure, **Be Certain** sufficient supply is available in both cylinder banks.

During the checking and adjustment procedure, bank regulator pressure settings must be changed and readjusted as necessary. To ensure proper flow to the delivery line, the bank regulator adjustment must be made with an inlet (cylinder) pressure of 1800 psig or greater (600 psig or greater for N_2O , CO_2 and gas mixtures).

Do Not interchange indicator light lenses-upper light lens is **Red**, lower light lens is **Green**.

Disconnect electricity to the unit before attempting any electrical component repairs.

Only one header valve may be turned off while the manifold is supplying gas to the hospital. After performing checks or making repairs, return the header valves to the open position.

Do not use oil or oilbearing materials on or near regulators. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. Nonmetallic parts of regulators must be discarded permanently if contaminated with oil or grease. **Do not lubricate regulator parts.**

Cautions

Do not repeatedly bend, sharply bend or twist copper tubing, as damage to the tubing may result.

Each pigtail must be connected to a cylinder to prevent gas leaks. The header connection to the pigtail is equipped with a check valve; however, this valve is not leak free. If an inlet is not to be used, be certain the pigtail is removed and the header inlet is securely sealed with a blind gland and nut.

Repair of the Unimatic III manifolds should be undertaken until all required tools, test equipment, and special materials that may be required are available.

The pressure at which the pressure switch is set to indicate switchover must be checked as pressure in the intermediate line drops.

1/Description

1.1 General

Unimatic III Manifolds are available in different models to match specific gases. They deliver gases at low pressure from high pressure cylinders (3,000 psig maximum). Delivery pressure is 200 psi for nitrogen, 50 psi for oxygen, nitrous oxide, air, carbon dioxide, helium, argon, xenon, and gas mixtures (oxygen and second gas: carbon dioxide < 7.5%, helium < 80.5%, nitrogen < 76.5%, nitrous oxide 47.5% to 52.5%, carbon dioxide > 7.5%, helium > 80.5%) See Table 1 for different gases.

The basic unit consists of a control cabinet housing a manifold with six connections. The basic unit comes with four pigtails to connect four cylinders.

With accessories, the basic unit may be outfitted to mount on the wall or stand on the floor and accommodate additional cylinders, up to 28.

The Unimatic III Manifolds provide for left and right cylinder banks of equal capacity as illustrated in Figure 2. When one bank is exhausted, the manifold automatically switches to supply gas from the other bank. Indicator lights on the pressure control cabinet (and at remote alarm panels, if used) indicate the switch-over. Gauges on the front of the control cabinet continuously indicate pressures within the left cylinder bank, the right cylinder bank, and the delivery line.

The manifolds are also equipped with a bypass system whereby gas can be supplied directly (at delivery pressure) from the left cylinder bank regulator. This feature provides supply in emergency situations and also permits servicing of the delivery line regulator and switch-over system without interrupting the supply of gas.

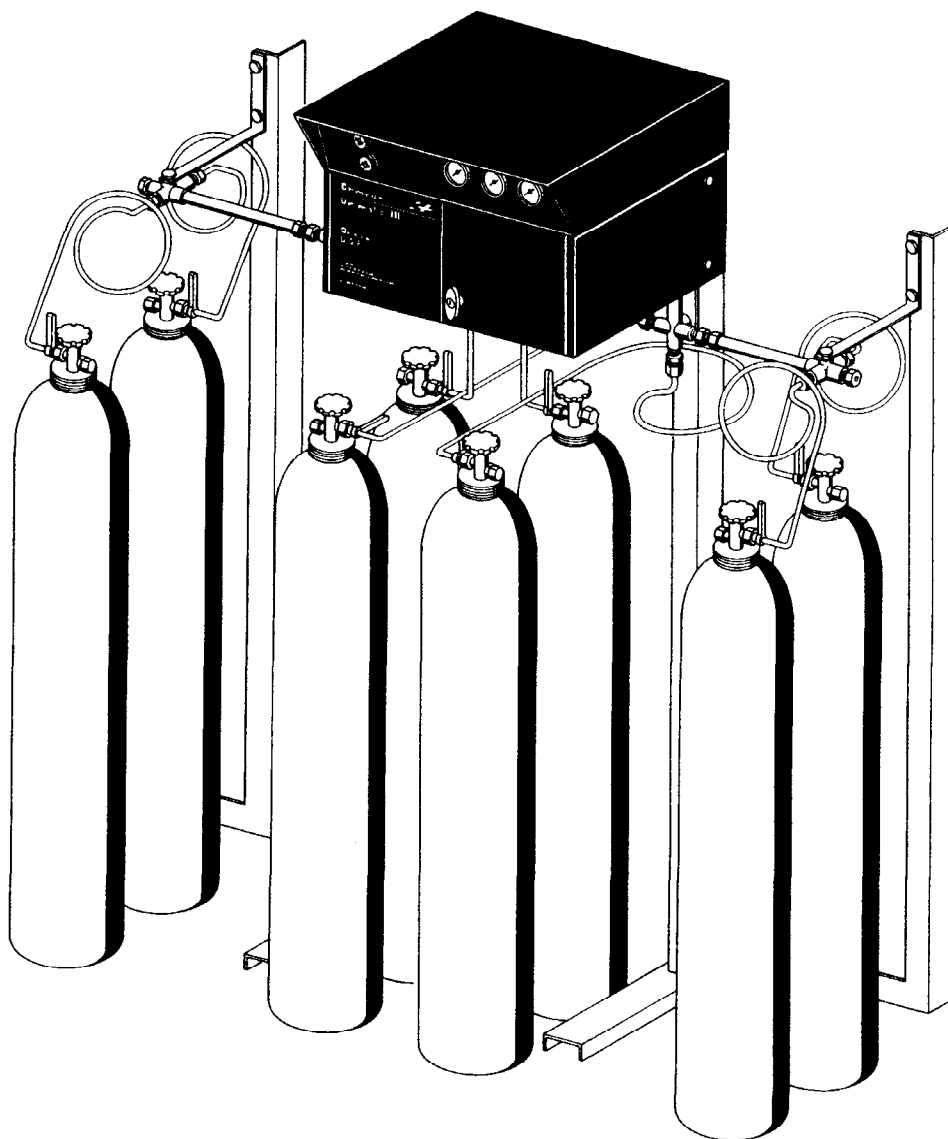


Figure 1-1
Unimatic III Floor Mounted Installation

1/Description

Table 1

Unimatic III Manifolds - Models, Approximate Capacity, and CGA Connector Designations

Gas	Cu. Ft./Cylinder		Manifold Stock No.
	H-Size	G-Size	
Oxygen	244	187	321-7404-910 (CGA 540)
Nitrous Oxide	557	489	321-7404-911 (CGA 326)
321-7404-912	Air	232	178 (CGA 346)
Carbon Dioxide	558	436	321-7404-913 (CGA 320)
Helium	213	141	321-7404-916
Argon	244	187-	(CGA 580)
Xenon	088.8	---	Indicate Gas on Order
Nitrogen	224	---	321-7407-900 (CGA 580)

Gas Mixture: Oxygen and Second Gas

Volumes in cu. ft. depend on percentages. See your gas supplier.

Carbon Dioxide < 7.5%

Helium < 80.5%

Nitrogen < 76.5%

Nitrous Oxide 47.5% to 52.5%

321-7404-914

(CGA 280)

Indicate Gas on Order

Carbon Dioxide < 7.5%

Helium > 80.5%

321-7404-915

(CGA-500)

Indicate Gas on Order

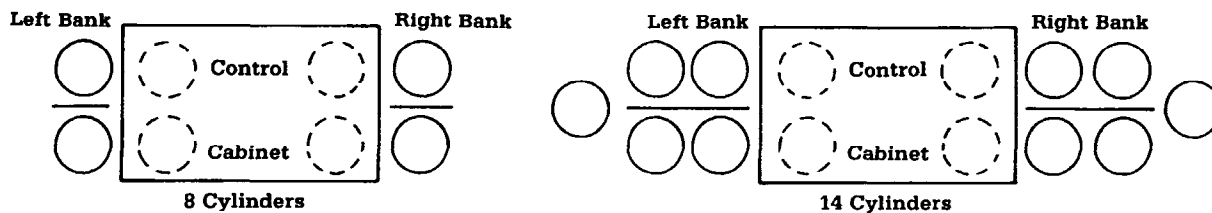


Figure 1-2

Examples of Cylinder Bank Configuration

1/Description

1.2 Theory of Operation

	Oxygen, Nitrous Oxide, Air, Carbon Dioxide, Helium, Argon, Xenon; Mixtures of Oxygen and Second Gas: Carbon Dioxide < 7.5%, Helium < 80.5%, Nitrogen < 76.5%; Nitrous Oxide 47.5% 52.5% Carbon Dioxide > 7.5%, Helium > 80.5%		Nitrogen	
	psig	kg/cm ²	psig	kg/cm ²
Delivery Pressure ¹	50	3.5	180	12.6
Intermediate Pressure ²	200 ± 10	14 ± .7	400 ± 10	28 ± .7
Supply Pressure (Maximum)	3000	210	3000	210
Pressure Switch Setting (On Pressure Drop)	155 ± 5	10.8 ± .4	285 ± 10	20 ± .7
Intermediate Line	250 ± 12.5	17.6 ± .9	475 ± 24	33.4 ± 1.7
Delivery Line Relief Valve Pressure	75 ± 5	5.3 ± .4	225 ± 12	15.8 ± .8

Power Requirements - 24 VAC

psig = pounds per square inch gauge

kg/cm² = kilograms per square centimeter

1. Delivery line regulator pressure settings are to be made while gas is flowing through regulator with inlet (intermediate) pressure of 200 ± 10 psig (14 ± .7 kg/cm²) except nitrogen which must be 400 ± 10 psig (28 ± .7 kg/cm²).
2. Intermediate (bank regulator) pressure settings are to be made with gas flowing through regulator with inlet (cylinder) pressure of 1800 psig (126 kg/cm²) or greater except nitrous oxide, carbon dioxide and gas mixtures which must be 600 psig (42 kg/cm²) or greater.

2/Operation

2.1 Theory of Operation

The Unimatic III Manifold provides for two gas supply banks of equal capacity; one bank is positioned to the left side and the other to the right side of the pressure control cabinet. Gas is supplied from one bank (the **Primary Supply**) while the other remains as a **Secondary Supply**. A schematic of the Unimatic III gas circuits is shown in Figure 2-1.

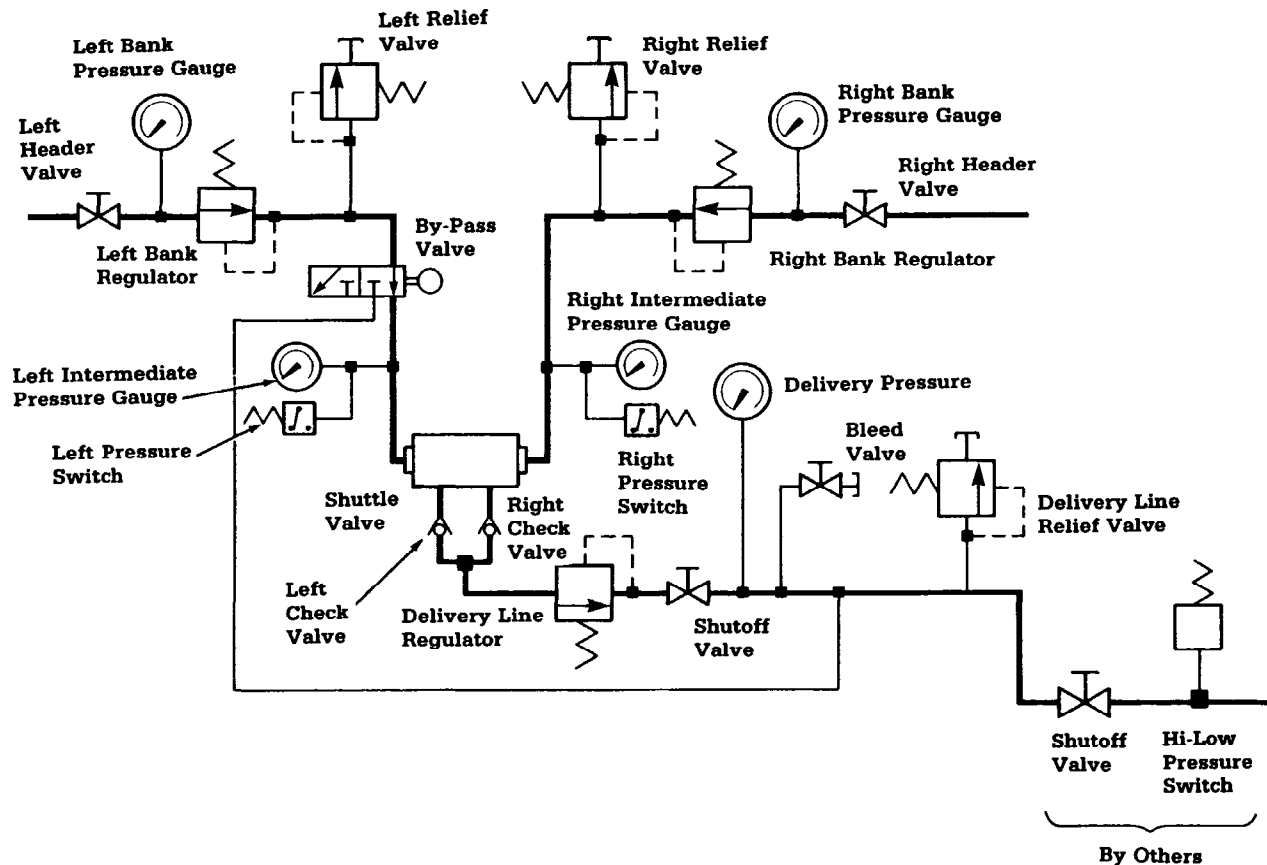
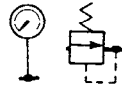


Figure 2-1
Piping Schematic for Unimatic III

2/Operation

Regulators and Pressure Gauges (Figure 2-2)



Each **Bank Regulator** reduces the gas pressure of its corresponding bank to an intermediate line pressure of 200 psig (400 psig on N₂ manifolds). **Left and Right Bank Pressure Gauges** on the front panel of the control cabinet indicate the pressure of each bank, while the intermediate pressure from each bank regulator is indicated on the corresponding **Intermediate Pressure Gauge** within the cabinet.

At any given time, gas from one bank only flows through the **Shuttle Valve** to the **Delivery Line Regulator**. This regulator delivers gas to the hospital

delivery line at 50 psig (180 psig on N₂ manifolds). The delivery pressure is indicated by the center gauge on the control cabinet front panel.

In order to maintain proper gas flow and pressure, the bank and delivery line regulators must be set under dynamic (flow) conditions. This is accomplished by allowing a small amount of gas to flow through the **Bleed Valve** to atmosphere while the regulators are being adjusted. Note that the pressure gauges at static conditions (when gas is not flowing through the bleed valve or from hospital outlets) will indicate slightly greater pressures than indicated under dynamic conditions.

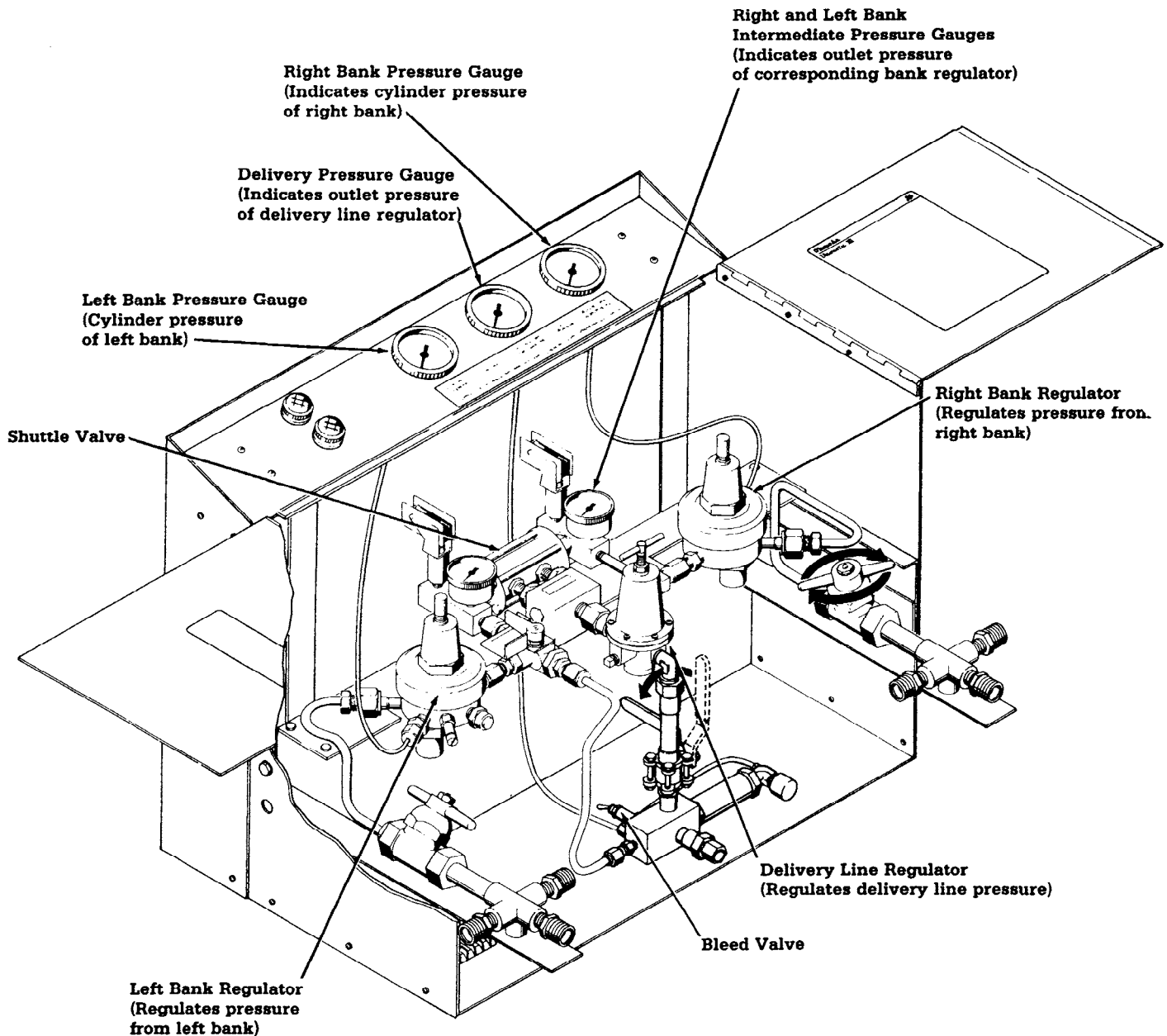
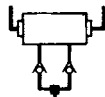


Figure 2-2
Regulators and Pressure Gauges for Unimatic III Manifolds

2/Operation

Primary to Secondary Supply Switch-over Shuttle Valve (Figures 2-2 & 2-3)



The **Shuttle Valve** allows gas to be delivered from only one cylinder bank at a time. When the gas supply in a bank is exhausted (and the pressure drops) the valve automatically switches to allow gas to flow from the other bank.

Figure 2-3 illustrates the operation of the shuttle valve. As shown in Figure 2-3a, gas is supplied from the primary bank regulator at a pressure of 200 psig (400 psig on N₂ manifolds). This gas enters the left side of the shuttle valve and passes out through the check valve to the delivery line regulator. The pressure within the left chamber of the shuttle valve exerts a force on the surface of the large (left) end, pushing the spool to the right. The magnitude of this pushing force (lbs) is equal to the pressure in the left chamber (psi) times the surface area (sq in) of the end of the spool.

The secondary bank regulator (right bank in this example) supplies gas at a pressure of 200 psig (400 psig on N₂ manifolds) to the right end of the spool. This gas pressure pushes against the small right end trying to drive the spool to the left. Since the area of the small end is less than that of the large end, the force exerted is less and consequently, the shuttle valve remains in the position shown.

As the primary bank is depleted of gas, the pressure begins to drop below 200 psig (400 psig on N₂ manifolds). As a result, the force on the large end also decreases. However, the force on the small end remains

the same because the secondary line to the shuttle valve is still at 200 psig (400 psig on N₂ manifolds). The areas of the small and large ends in the shuttle valve are such that when the difference in pressure between the left and right side becomes approximately 100 psig the force on the small area will be greater than that against the large area. The spool will then be driven to the left (in this example), opening the secondary, or right bank, supply and closing the primary, or left bank, supply and closing the primary, or left bank, as shown in Figure 2-3b.

Once the spool has shifted to the secondary bank, full cylinders can be installed on the opposite bank without causing the spool to shift back. The spool shifts only when the difference in pressure between one side and the other is about 100 psig (135 psig on N₂ manifolds). This also means that after cylinder replacement, the left bank in Figure 5b becomes the **Secondary Bank** and is at full capacity. Gas will be delivered from the right (now the **Primary**) bank until depleted, at which time switch-over will occur again.

The shuttle valve must be vented to atmosphere in order for it to function as described above. If the vent were obstructed the pressures on both ends would become equal after a few switch-overs and the differential pressure would be lost. Switch-over could then be caused by much lower pressure differences, such as those occurring from small differences in pressure settings of the bank regulators. This could allow premature switch-over after cylinders have been replaced, resulting in a secondary bank which may not be at full capacity, or it could prevent switch-over completely, resulting in loss of **Secondary Supply** and hence, failure of the supply to the hospital. The check valves at the outlets of the shuttle valve prevent back pressure and gas loss to atmosphere through the vented chamber of the shuttle valve.

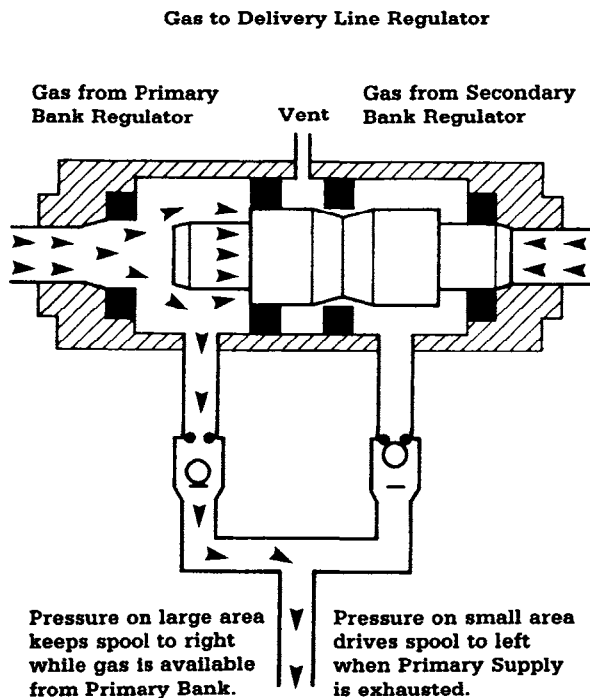


Figure 2-3a.
Shuttle Valve Operation -
Primary Bank Supplying Gas

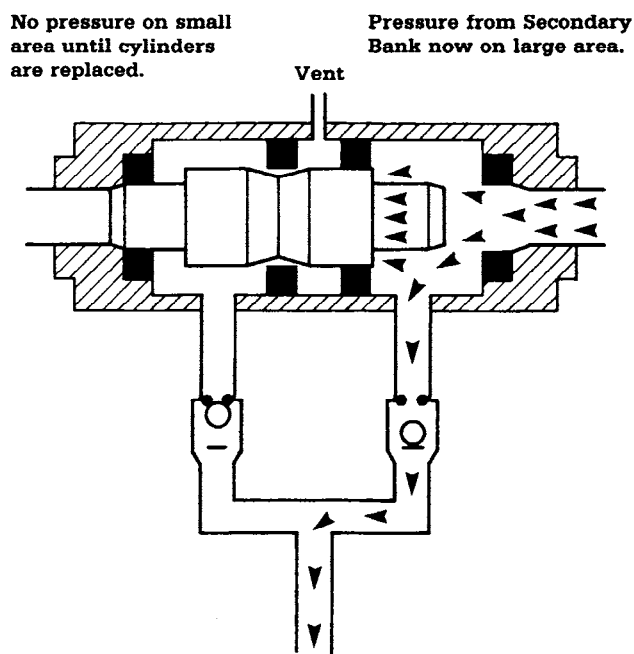
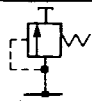


Figure 2-3b.
Shuttle Valve Operation - Switch Over to Secondary Bank
Supplying Gas - Primary Bank Exhausted

2/Operation

Relief Valves (Figure 2-4)

A pressure relief valve is provided on each intermediate line and on the delivery line downstream of the delivery line regulator. These relief valves prevent excessive pressure which could damage a downstream regulator or pressure gauge, or elevate the pressure in the hospital delivery line. Such excessive pressure could develop if an upstream regulator were damaged or developed a leak. The **Intermediate Relief Valves** are set to open to atmosphere at a pressure of 250 psig (475 psig on N₂ manifolds).



The **Delivery Line Relief Valve** is set to open to atmosphere at a pressure of 75 psig (225 psig on N₂ manifolds).

Note that NFPA requires a piped relief valve on all supplies with a total (right and left bank) capacity of 2000 cu. ft. (57m³) or more (including uncorrected reserves). The delivery line relief valve must be vented outside of the building. The outlet of the delivery line relief valve has a 3/8" pipe thread to facilitate attachment of the vent line by the installer. A 3/8" I.D., or larger, vent line should be used. Outside the building, the line must be turned down and screened to prevent contamination.

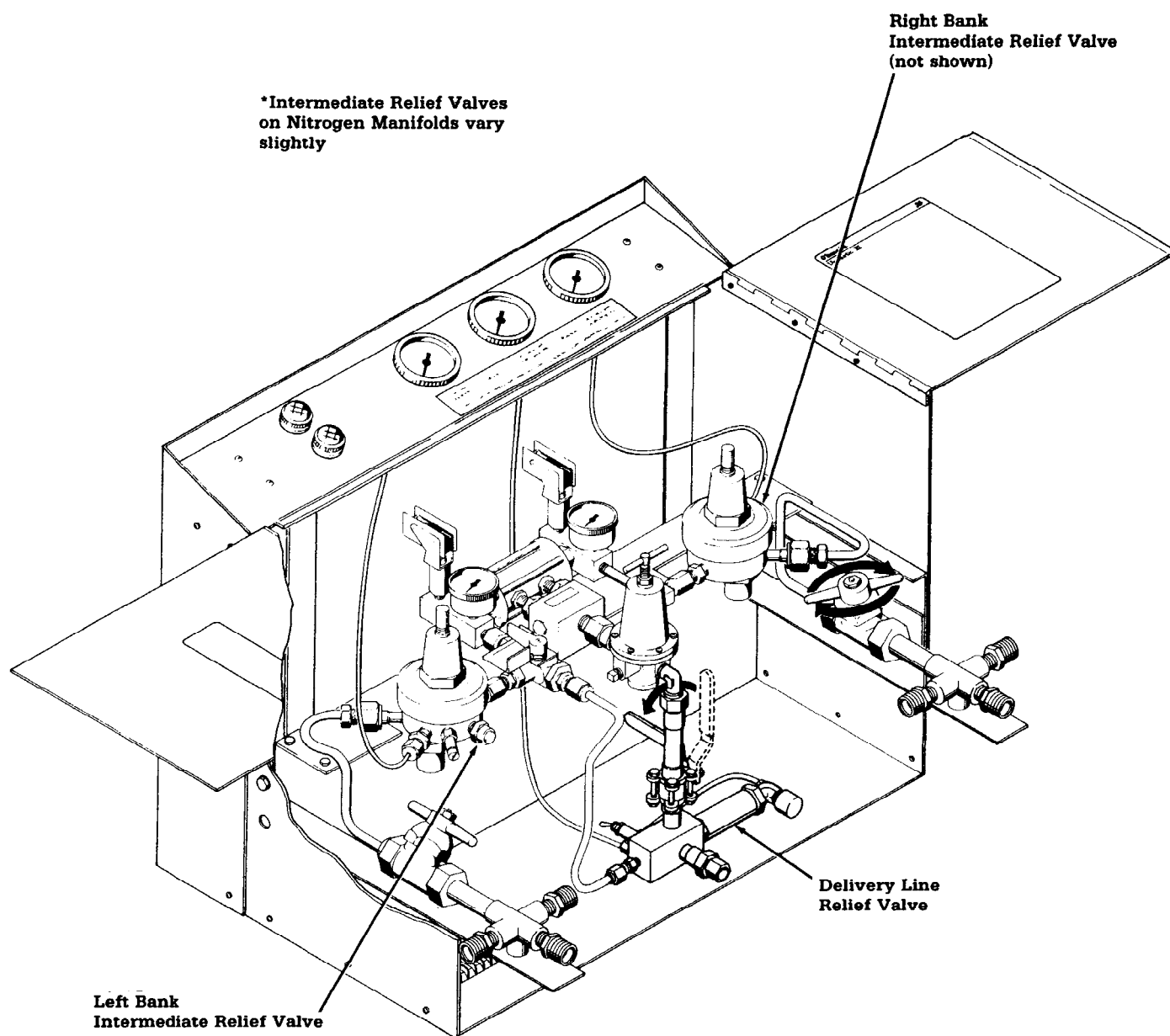


Figure 2-4
Relief Valves on Unimatic III Manifold

2/Operation

Header Valves and Shutoff Valve (Figure 2-5)



The **Header Valve**, upstream from the bank regulator, allows for gas shut off from the cylinder bank. The **Shutoff Valve** between the delivery line regulator and the delivery pressure gauge is closed when the bypass mode is used (see page 2-8 for Bypass Mode Operation). These features permit servicing of various components between the header valve and shutoff valve without interrupting flow of gas.

Bypass Valve (Figure 2-5)

The **Bypass Valve** permits gas to be supplied directly from the left bank to the hospital delivery line during servicing of the shuttle valve, intermediate pressure check valves and delivery line regulator, or in possible emergency situations. When the bypass mode is in use the left bank regulator is adjusted to deliver gas at delivery pressure, the right bank header valve and the shutoff valve are closed, and the bypass valve is turned to the BYPASS position.

Pressure Switches, Indicator Lights and Remote Alarms (Figures 2-5 and 2-6)

The **Pressure Switches** control the **Indicator Lights** on the control cabinet front panel as well as remote alarms (when used). These indicators and alarms relate supply usage as either **Primary** bank (normal operation) or switch-over to the **Secondary** bank. Figure 2-6 shows an electrical wiring schematic of this switch-over indicator circuit.

Under normal operating conditions, the pressure in both primary and secondary intermediate lines will be 200 psig (400 psig on N₂ manifolds) and the green light on the front panel will be **On**. This condition is presented in the electrical schematic, Figure 2-6. The pressure switches are single pole double throw, set to switch at 155 psig (285 psig on N₂ manifolds) as pressure drops. As the primary bank is depleted, its intermediate line pressure decreases; the pressure switch then closes, activates the relay, the green light goes **Off**, and the red light goes **On** to indicate that switch-over to the secondary supply is about to occur. A signal is also transmitted to the remote alarm system.

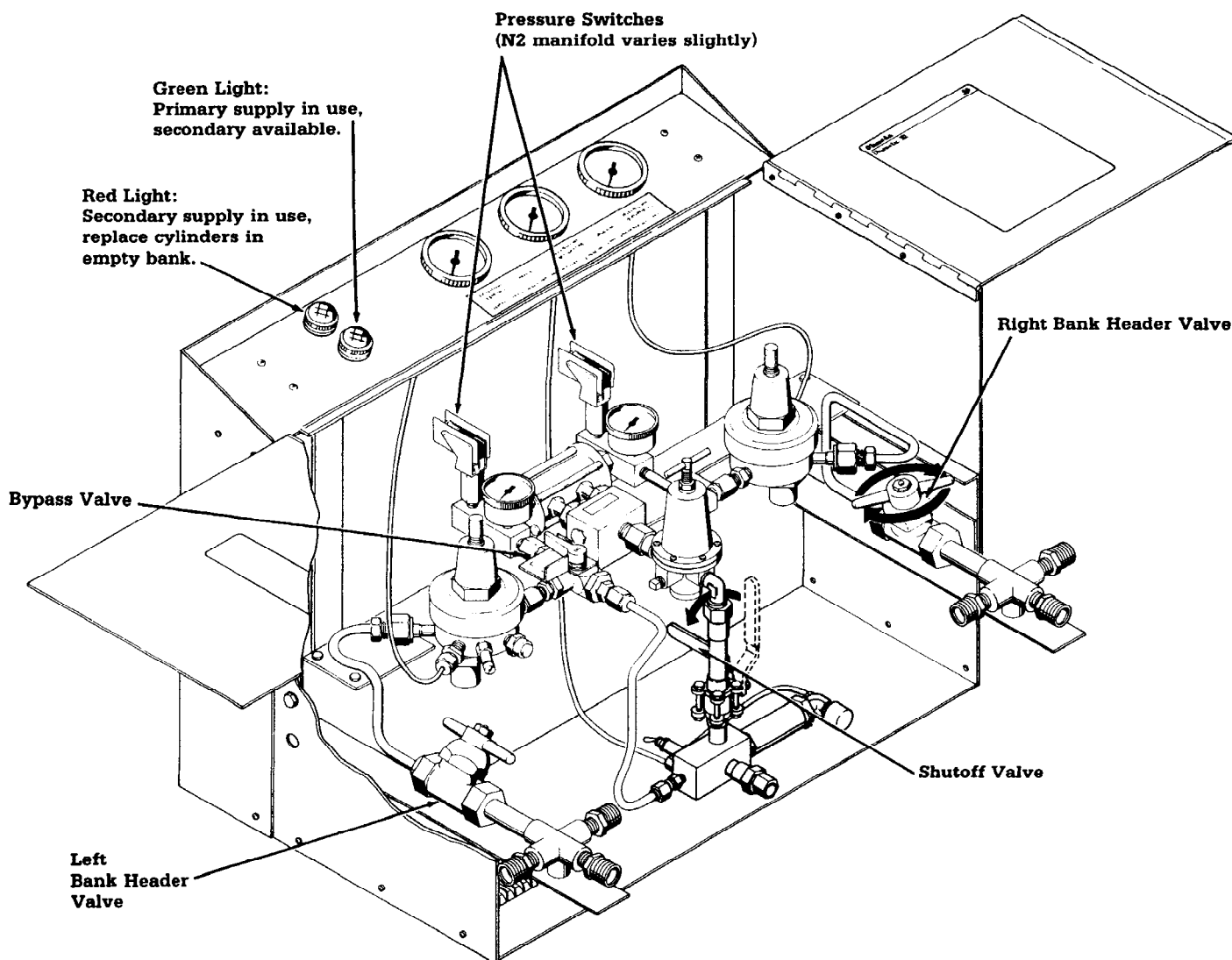


Figure 2-5
Header, Shutoff and Bypass Valves, Pressure Switches and Indicators

2/Operation

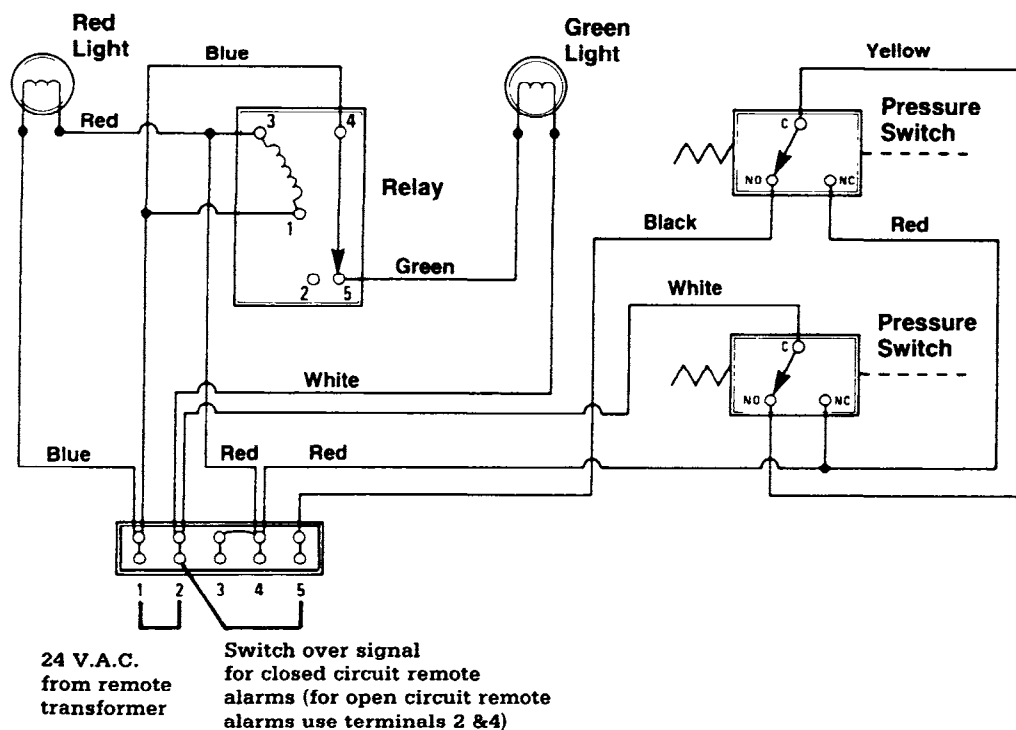


Figure 2-6

Wiring Schematic for Ohmeda Unimatic III Switch Over Alarm System

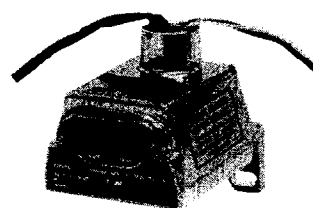
Important: When the red indicator light and alarms first activate, they indicate that the gas supply from the primary bank is approaching depletion and that switch-over is about to occur. They provide an indirect indication of switch-over and signal that cylinders should be replaced on the depleted bank. Refer to Section 2.2, Cylinder Installation and Replacement.

When full cylinders are installed and the header valve is opened, the pressure in the intermediate line is reestablished at 200 psig (400 psig on N₂ manifolds). This opens the pressure switch, deactivates the relay, and returns the indicator lights and alarms to normal operation with green light On, red light Off.

The opposite bank now acts as the primary bank. When depleted of gas its pressure switch will also activate the red indicator light and remote alarms as previously described.

Hospital Main Shutoff Valve and Hi-Low Delivery Line Pressure Switch

A Hospital Main Shutoff Valve should be installed immediately downstream of the Unimatic III Manifold and outside of the manifold enclosure. Also, if a hi-low delivery line pressure alarm is used, the Hi-Low Delivery Line Pressure Switch, should be installed downstream of the hospital main shutoff valve. Figure 2-7 shows delivery line pressure switches available from Ohmeda as accessories.



Hi-Low Pressure Switch
0208-5139-800

Pressure Switch for N₂
(2 required 1-Hi, 1-Low)
0208-5096-300



Figure 2-7
Delivery Line Pressure Switch (Accessories)

2/Operation

2.2 Cylinder Installation and Replacement

WARNING: Fire Hazard. Do Not permit smoking or any other source of ignition in area where the manifold is located or near relief valve vent outlet. Be certain all connections are free of dirt, grease and oil. These substances burn with great intensity in air enriched with oxygen or nitrous oxide and some mixtures.

Attach gas supply cylinders to header pigtail connectors as follows:

1. Check to be certain that the bypass valve is in the "Normal" position, header valves are open, and pig-tails are securely tightened to header check valves.
2. Open and close each cylinder valve momentarily to blow foreign material from each cylinder valve opening.
3. Using the handle on the pigtail, smoothly pull the cylinder connection end of each pigtail to the cylinder valve and hand tighten each cylinder connection nut to the cylinder valve as shown in Figure 2-8. Then use a wrench to firmly tighten each connection.

CAUTION: Do Not repeatedly bend, sharply bend or twist copper tubing as damage to the tubing may result.

CAUTION: Each pigtail must be connected to a cylinder to prevent gas leaks. The header connection to the pigtail is equipped with a check valve; however, this valve is not leak free. If an inlet is not to be used, be certain the pigtail is removed and the header inlet is securely sealed with a blind gland and nut. Refer to illustrated Parts List.

4. S-L-O-W-L-Y open valve on the cylinder nearest the manifold cabinet, and allow at least 60 seconds for heat of compression to dissipate.
5. Then S-L-O-W-L-Y open the valves of the other cylinders.
6. Repeat steps 1-5, for the opposite bank.

To Replace Empty Bank Cylinders:

1. Close all cylinder valves on bank with an intermediate pressure of approximately 100 psig (approximately 265 psig on N₂ manifolds).

Note: Switch-over indicator lights activate before actual switch-over takes place. The indicator lights activate at an intermediate line pressure of 155 psig (285 psig on N₂ manifolds). The shuttle valve switch-over occurs at a pressure of about 100 psig (about 265 psig on N₂ manifolds).

2. Slightly loosen the cylinder valve connection nuts to bleed off any residual pressure, then disconnect the empty cylinders.
3. Connect the full cylinders as indicated in steps 1 through 5 of Section 2.2.

2.3 Gas Flow and Manifold Operation

After the header valves are opened and the cylinders have been installed (per Section 2.2), check to be sure that the delivery line shutoff valve and the hospital main shutoff valve are open fully. Gas will now be supplied to the hospital main.

The bank pressure gauges will indicate pressure in the left and right cylinder banks and the delivery pressure gauge will indicate delivery pressure to the hospital main.

The green light (lower light) on the control cabinet will turn On and remain On as long as the primary bank is supplying gas. The red light (upper light) will turn On and remain On (with green light Off) when the primary supply is interrupted or exhausted, at which time automatic switch-over to the secondary supply will occur. Replace the cylinders on the empty bank per instructions in Section 2.2. The red light will then turn Off and the green light will turn On to indicate the secondary supply is available.

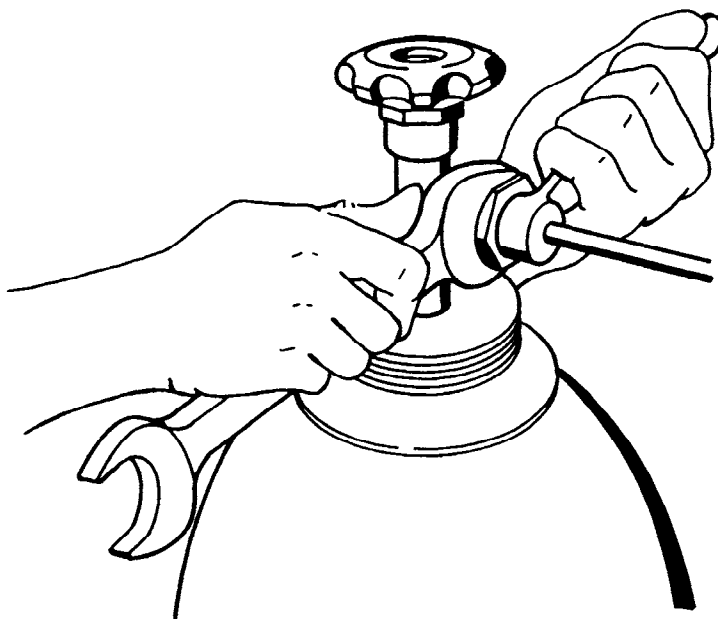


Figure 2-8
Cylinder Connection

2/Operation

2.4 Bypass Mode of Operation

The Bypass Mode of Operation isolates the delivery line regulator and the shuttle valve without interrupting gas supply to the hospital main. The Bypass Mode of Operation should be used only during servicing of the shuttle valve, intermediate pressure check valves and delivery line regulator or in possible emergency situations.

Note: Use of the Bypass Mode of Operation will activate switch-over indicators and alarms.

WARNING: When the Bypass Mode is in use No Secondary Supply is Available. Gas is being supplied directly and only from the left bank regulator at line pressure. Monitor pressure in left bank - reestablish normal operation Before the left bank nears depletion.

Use of Bypass Mode (See Figure 2-9)

1. Make sure there is ample gas supply in the left cylinder bank and the left header valve is open.

WARNING: To ensure proper functioning and proper delivery of gas, Each regulator must be adjusted while gas is flowing through the regulator as indicated in the following procedure.

All bank regulator pressure settings must be made with a supply pressure of 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide and gas mixtures).

The delivery line regulator must be set with an inlet pressure (intermediate line pressure) of 200 ± 10 psig (400 psig ± 10 psig on N_2 manifolds).

2. Close the right bank header valve.
3. Slightly loosen the nut on the output of the right bank regulator. The right bank intermediate pressure should drop to zero.
4. Open the bleed valve and turn the left bank regulator until the left bank intermediate pressure is 50 psig (180 psig on N_2 manifolds). Close the bleed valve.
5. Turn the bypass valve handle to the Bypass position.
6. Turn the delivery line shutoff valve to the off position.
7. Open the bleed valve and check the delivery pressure gauge on the front of cabinet. If necessary, readjust the left bank regulator so that the delivery pressure is 50 psig (180 psig on N_2 manifolds). Close the bleed valve.

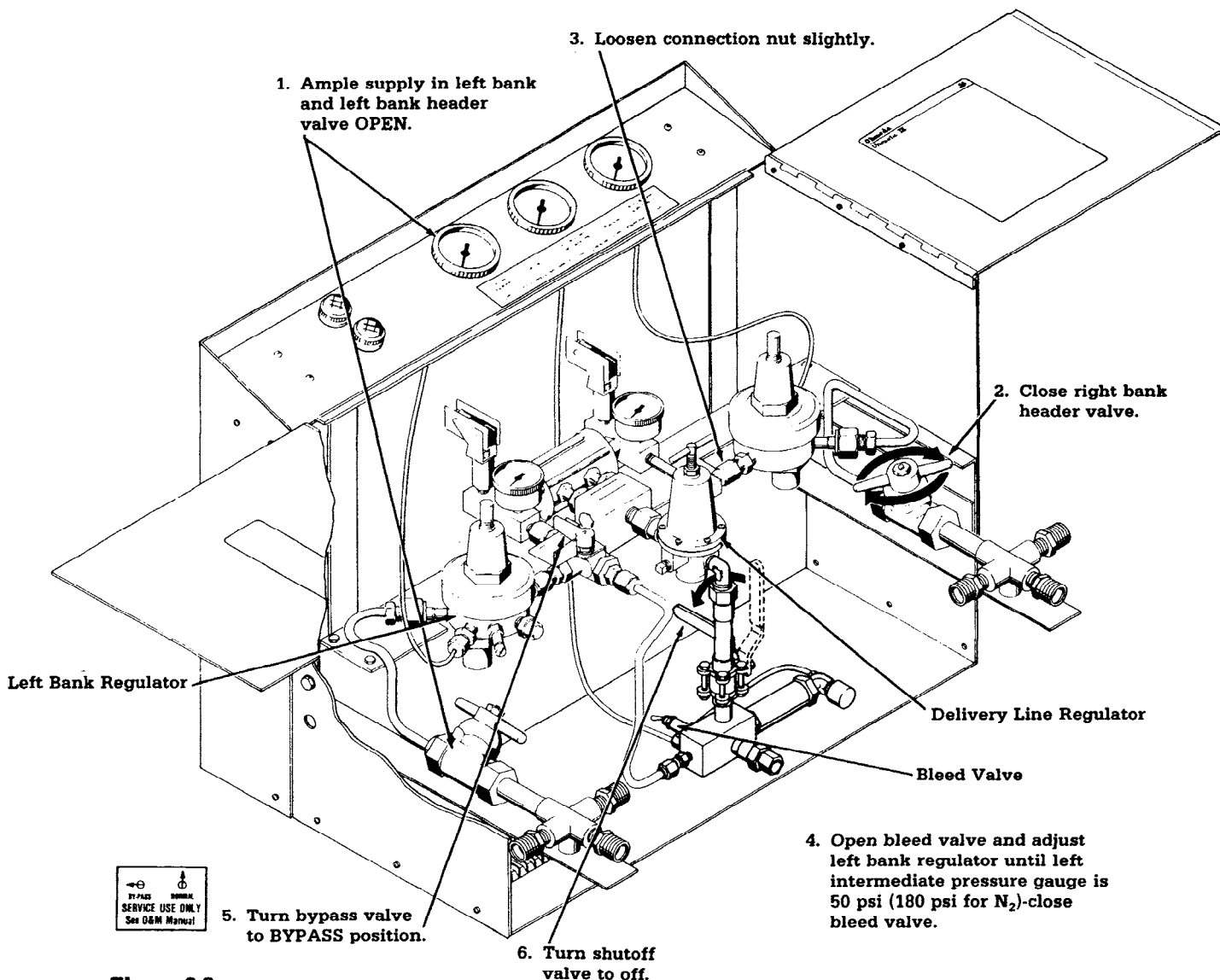


Figure 2-9
Bypass Mode Operation

2/Operation

Return to Normal Operation after Using the Bypass Mode:

1. Be certain an ample supply of gas is available in the right bank.

WARNING: To ensure proper functioning and proper delivery of gas, Each regulator must be adjusted while gas is flowing through the regulator as indicated in the following procedure.

All bank regulator pressure settings must be made with a supply pressure of 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide, and gas mixtures). The delivery line regulator must be set with an inlet pressure (intermediate line pressure) of 200 psig $\pm$ 10 psig (400 psig $\pm$ 10 psig on N₂ manifolds).

2. Turn the delivery line regulator's adjustment counterclockwise until it becomes loose.
3. Tighten the nut at the outlet of the right bank regulator.
4. S-L-O-W-L-Y open the right bank header valve fully. The shuttle valve will switch to the right bank.
5. Open the delivery line shutoff valve. The handle should be in line with the tubing.
6. Turn the delivery line regulator adjustment screw clockwise until the delivery pressure gauge reads 60 psig (200 psig on N₂ manifolds).
7. Turn the bypass valve to the normal position.

8. With the bleed valve open, readjust the delivery line regulator so that the delivery pressure gauge reads 50 psig (180 psig on N₂ manifolds). Close the bleed valve.
9. Turn in the left bank regulator adjustment screw until the intermediate pressure is 250 psig on the left bank (450 psig for N₂ manifolds).
10. Close the right bank header valve to obtain switch-over and flow from the left bank. Then, open the bleed valve and readjust the left bank regulator so that the intermediate pressure is 200 psig $\pm$ 10 psig (400 psig $\pm$ 10 psig on N₂ manifolds). Close the bleed valve and slowly open the right bank header valve.
11. The bank with the least gas* should be chosen as the Primary Supply and the bank with the most gas the Secondary Supply. Open the bleed valve and close the header valve on the bank with the most gas. The corresponding intermediate line pressure will drop and cause a switch-over. If switch-over does not occur, that bank is already supplying the gas.

*Note: Except for nitrous oxide and carbon dioxide manifolds, the bank pressure gauge with lowest reading will indicate the bank having least gas. Nitrous oxide and carbon dioxide, however, are in liquid form in the cylinders (at room temperatures). Therefore both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. Under such conditions it is not practical to determine which bank is fullest; one bank must be chosen as the Primary Supply and the other as Secondary Supply.

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The Mode of Operation for Service

Table 3-1, Mode of Operation for Service, provides a guide to servicing the manifold. Determine from the table which bank needs to be in operation for service to a particular item.

WARNING: Fire Hazard. Do Not permit smoking or any other source of ignition in area where the manifold is located or near relief valve vent outlet. Be certain all connections are free of dirt, grease and oil. These substances burn with great intensity in air enriched with oxygen or nitrous oxide.

3.2 Regulator Adjustment

WARNING: To ensure proper functioning and proper delivery of gas, Each regulator must be adjusted while gas is flowing through regulator as indicated in the following procedure.

All bank regulator pressure settings must be made with a supply pressure of 600 psig or greater for nitrous oxide, carbon dioxide and gas mixtures. The delivery line regulator must be set with an inlet pressure (intermediate line pressure) of 200 psig $\pm$ 10 psig (400 psig $\pm$ 10 psig on N₂ manifolds).

Table 3-1

Mode of Operation for Service

Left Bank Operation:

Permit service, including replacement, of the following Right Bank items with the Right Header Valve closed:

Right Bank Pressure Gauge

Right Intermediate Pressure Gauge

Right Bank Regulator

Right Pressure Switch

Right Relief Valve

Right Bank Operation

Permits service, including replacement, of the following Left Bank items with the Left Header Valve closed:

Left Bank Pressure Gauge

Right Intermediate Pressure Gauge

Left Bank Regulator

Left Pressure Switch

Left Relief Valve

Bypass Mode of Operation:

Permits service, including replacement, of the following:

Shuttle Valve

Check Valves (Intermediate Pressure)

Delivery Line Regulator

The manifold will have to be shut down to service or replace the following:

Shutoff Valve

Delivery Line Relief Valve

Delivery Pressure Gauge

Bypass Valve

Bleed Valve

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3.1 General

WARNING: The person performing service on the manifold is responsible for obtaining permission from the hospital administration prior to performing any check-out or repairs of the manifold.

WARNING: Never oil or grease equipment unless a lubricant that is made and approved for this type of service (such as Vac Kote* Stock No. 0220-0091-300) is used or certain type of lubricant is specified for a particular part of a unit. Oils and grease oxidize readily and, in the presence of oxygen, will burn violently.

WARNING: Use extreme care, when working with high pressure oxygen components and systems, to keep hands, tools and work environment free of oils which are highly combustible in the presence of high pressure oxygen.

WARNING: The left and right banks must have sufficient gas volume to perform any test and supply hospital demand.

CAUTION: Repair of the Unimatic III manifolds should not be undertaken until all required tools, test equipment, and special materials that may be required are available.

Use Teflon* Tape

Teflon tape may be used on all pipe threads; however, it should not be used on compression fittings. See Figure 3-1, How to Apply Teflon Tape.

Testing Piping Connections for Leaks

Leak test piping connections after any repair or replacement procedure. Perform the leak test with Snoop*, a commercial leak test solution approved by the Ohmeda Service Department. A soap solution of one teaspoon Ivory Liquid* detergent per gallon of water may also be used.

The leak test solution should be applied to the piping connection under test. Avoid getting the leak test solution on any electrical components. The formation of bubbles indicates a leak. The leaks should be eliminated by retightening or replacing connections and tubing, then retest the connections.

Note: Clean surface of connection and components after testing - dry soap may be combustible in the presence of oxygen or nitrous oxide.

Nitrous Oxide Manifold Repair and Test Procedure Information

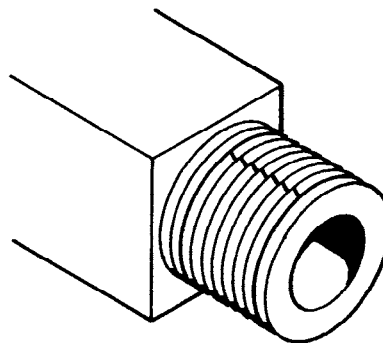
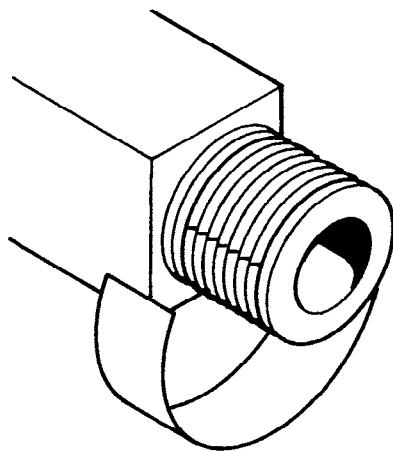
WARNING: Nitrous oxide is in liquid form in the cylinders (at or above 800 psig). Therefore, both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. The possibility of a bank depletion occurring while service is being performed should be avoided. The installation of one or two full Nitrous Oxide cylinders for the duration of the repair or test procedure will prevent this.

*Teflon is a registered trademark of E.I. DuPont DeNemours and Company.

*Snoop is a trade name of the Nupro Co. (2 oz.: P/N 0220-5225-300; 1 gal.: P/N 0220-5226-300).

*Ivory is a registered trademark of Procter & Gamble.

*Vac Kote is a registered trademark of the Ball Corp.



1. Wrap tape clockwise, starting one thread up, as viewed from end of male fitting.
2. Apply enough pressure so tape just starts to follow contours of threads.
3. Wrap two layers of tape.

Figure 3-1
How to Apply Teflon Tape

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3. Close the header valve on the opposite bank (away from the regulator being adjusted).
4. Open the bleed valve. Allow the shuttle valve to switch over so that gas is being supplied from the bank regulator being adjusted.
5. With the bleed valve open, turn the regulator adjustment screw until the corresponding pressure gauge (inside cabinet) indicates $200 \text{ psig} \pm 10 \text{ psig}$ ($400 \text{ psig} \pm 10 \text{ psig}$ on N_2 manifolds).
6. Close the bleed valve and slowly open the header valve on the opposite bank.

Note: The intermediate pressure gauge may indicate a slightly greater pressure (up to 425 on N_2 manifolds, 250 psig on others) when gas is not flowing through the regulator. Such an increase is normal.

7. The bank with the least gas* should be chosen as the Primary Supply and the bank with the most gas the Secondary Supply. Open the bleed valve and close the header valve on the bank with the most gas. The corresponding intermediate line pressure will drop and cause a switch over. If switch over does not occur, that bank is already supplying the gas.
8. Close the bleed valve and slowly open the header valve.

*Note: Except for nitrous oxide and carbon dioxide, the pressure gauge with lowest reading will indicate the bank having least gas. Nitrous oxide and carbon dioxide, however, are in liquid form in the cylinders (at room temperature). Therefore both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. Under such conditions it is not practical to determine which bank is fullest; one bank must be chosen as the Primary Supply and the other as the Secondary Supply.

B. Delivery Line Regulator

(See Figure 3-2)

1. Check to be sure the delivery line regulator inlet pressure (as shown on the intermediate pressure gauge of the bank supplying gas) is $200 \text{ psig} \pm 10 \text{ psig}$ ($400 \text{ psig} \pm 10 \text{ psig}$ on N_2 manifolds). If not, adjust the bank regulator as outlined in Section 3.2A.
2. Open the bleed valve to obtain flow through the regulator.
3. Turn the delivery line regulator adjustment screw until the delivery pressure gauge on the front panel of the cabinet indicates 50 psig (180 psig on N_2 manifolds).
4. Close the bleed valve.

Note: The delivery pressure gauge may indicate a slightly greater pressure, (up to 192 psig on N_2 manifolds, 58 psig on others) when gas is not flowing through the regulator. Such an increase is normal.

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A. Bank Regulators

(See Figure 3-2)

WARNING: To ensure a continuous supply of gas during regulator adjustment, be certain ample supply of gas is available in both cylinder banks and **Never** close a header valve unless the opposite bank header valve is open.

Note: During this procedure, switch-over indicator lamps and alarms will activate.

1. Verify that both bank pressure gauges indicate 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide, and gas mixtures).
2. If necessary, the adjustment screw of the bank regulator to be adjusted should be turned clockwise until at least 200 psig (400 psig on N₂ manifolds) is indicated on the intermediate pressure gauge (inside of cabinet).

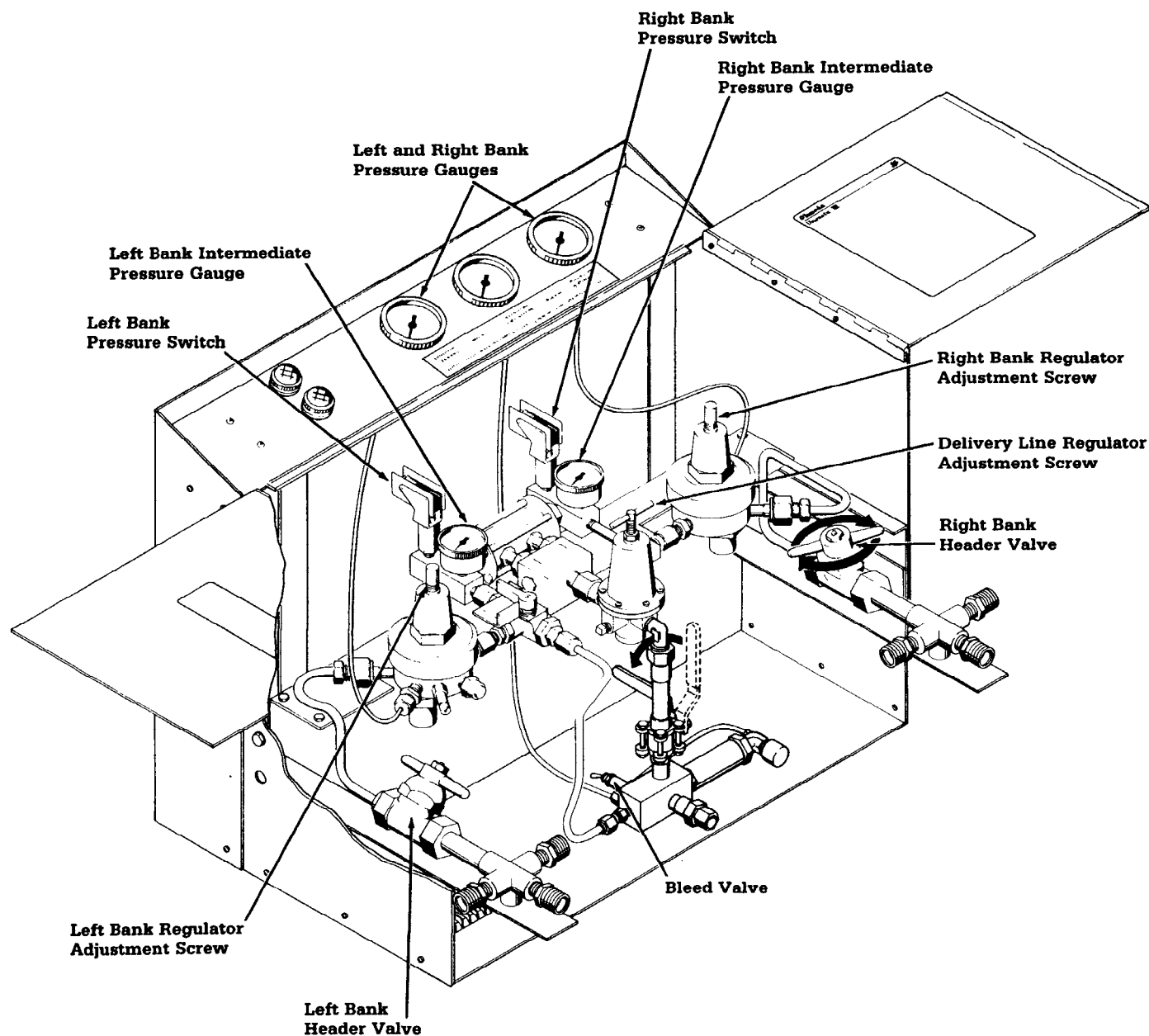


Figure 3-2
Regulator Adjustment. N₂ Unimatic III Manifolds Vary Slightly.

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3.4 Pressure Switch Adjustment

(Figure 3-3)

Note: During the pressure switch checking and adjustment procedure, switch over indicators and alarms will activate.

WARNING: To maintain a gas flow to the delivery line during the pressure switch checkout procedure, Be Certain sufficient supply is available in both cylinder banks.

During the checking and adjustment procedure, bank regulator pressure settings must be changed and readjusted as necessary. To ensure proper flow to the delivery line, the bank regulator adjustment must be made with a bank pressure of 1800 psig or greater (600 psig or greater for N₂O).

1. With the bleed valve open, turn the bank regulator adjustment screw to set the outlet pressure (on the intermediate pressure gauge) between 155 psig and 160 psig (between 285 psig and 295 psig on N₂ manifolds) - the red indicator light should be on. Close the bleed valve.
2. Turn the adjusting nut of the pressure switch (see Figure 3-3) until the red light turns off - green light on. To raise pressure switch setting, turn adjusting nut counterclockwise. To lower pressure switch setting, turn adjusting nut clockwise.
3. Turn the bank regulator adjustment screw clockwise until the intermediate pressure reaches 180 psig to 200 psig (380 psig to 400 psig on N₂ manifolds) - green light should be ON. Then, open the bleed valve and slowly turn the regulator adjustment screw counterclockwise until the red light turns ON - green light turns OFF.

CAUTION: The pressure at which the pressure switch is set to indicate switch-over must be checked as pressure in the intermediate line drops.

Check the intermediate pressure - it must be between 150 psig and 160 psig (between 275 and 295 psig for N₂ manifolds). If it is not within this range, readjust the switch slightly and check setting by raising and lowering the intermediate pressure as described earlier. Repeat as necessary until proper adjustment is made.

4. Perform a final check of the pressure setting by again turning the bank regulator adjustment screw to raise and then (with bleed valve open) lower the intermediate pressure.
5. With the bleed valve open, readjust the bank regulator intermediate pressure to 200 psig $\pm$ 10 psig (400 psig $\pm$ 10 psig on N₂ manifolds).

3.5 Switch Over Indicator Circuit Check-out

WARNING: The left and right banks must have sufficient gas volume to perform any test and supply hospital demand.

WARNING: Only one header valve may be turned off while the manifold is supplying gas to the hospital. After performing checks or making repairs return header valves to the open position.

The switch over indicator circuit may be tested by simulating left and right bank pressure depletion. See Section 2:1 for the theory of operation.

Checkout Procedure

Normal Manifold Pressure Settings

Nitrogen Manifold

Intermediate Pressure Switches	275-295 psig
Bank Regulators	400 psig
Delivery Line Regulator	180 psig

All Manifolds Except Nitrogen

Intermediate Pressure Switches	150-160 psig
Bank Regulators	200 psig
Delivery Line Regulator	50 psig

Note: See Sections 3.2, 3.3 and 3.4 for proper adjustment procedures.

1. The manifold is in a normal operating condition when the pressure in both primary and secondary intermediate lines is 200 psig (400 psig on N₂ manifolds) and the green light on the front panel is on. The condition is presented in the electrical schematic Figure 3-4.
2. Determine which bank is supplying gas to the delivery line. The bank pressure gauge with the lowest reading will generally indicate the bank supplying the gas to the delivery line.

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3.3 Pressure Switch Checkout

(Figure 3-3)

Note: During the pressure switch checking and adjustment procedure, switch over indicators and alarms will activate.

WARNING: To maintain a gas flow to the delivery line during the pressure switch checking and adjustment procedure, **Be Certain sufficient supply is available in both cylinder banks.**

During the checking and adjustment procedure, bank regulator pressure settings must be changed and readjusted as necessary. To ensure proper flow to the delivery line, the bank regulator adjustment must be made with an inlet (cylinder) pressure of 1800 psig or greater (600 psig or greater for nitrous oxide, carbon dioxide and gas mixtures).

1. Be certain the header valve and cylinder valves on each bank are open and the outlet pressure of each bank regulator is at 200 psig $\pm$ 10 psig (400 psig $\pm$ 10 psig on N₂ manifolds.) If necessary, adjust bank regulator as instructed in Section 3.2A.
2. The bank being serviced must be the bank which is supplying gas. If the opposite bank is supplying gas, close that bank header valve and open the bleed valve. This will cause the shuttle valve to switch over and the bank to be serviced will be supplying gas. Slowly reopen the header valve.

3. To check Pressure Switch Setting on Bank Supplying Gas:

CAUTION: The pressure at which the pressure switch is set to indicate switch over must be checked as pressure in the intermediate line drops.

Open the bleed valve and slowly turn the bank regulator adjustment screw counterclockwise - this will cause the intermediate line pressure of this bank to drop.

Observe the intermediate line pressure gauge and the switch over indicator lights as the pressure drops. The pressure switch must activate - red light to ON, green light OFF - when the pressure gauge indicator drops between 160 psig and 150 psig (between 295 psig and 275 psig on N₂ manifolds).

In Adjustment

The switch is properly set if it activates within the previously described range. With the bleed valve open, turn the bank regulator adjustment screw clockwise until the intermediate pressure gauge is at 200 psig $\pm$ 10 psig (400 psig $\pm$ 10 psig on N₂ manifolds).

Out of Adjustment

- A. The switch is set to high if it activates red light ON - green light OFF at a pressure above 160 psig (above 360 psig on N₂ manifolds).
- B. The switch is set to low if it activates at a pressure below 150 psig (below 340 psig on N₂ manifolds). Adjust the pressure switch as instructed in Section 3.4.

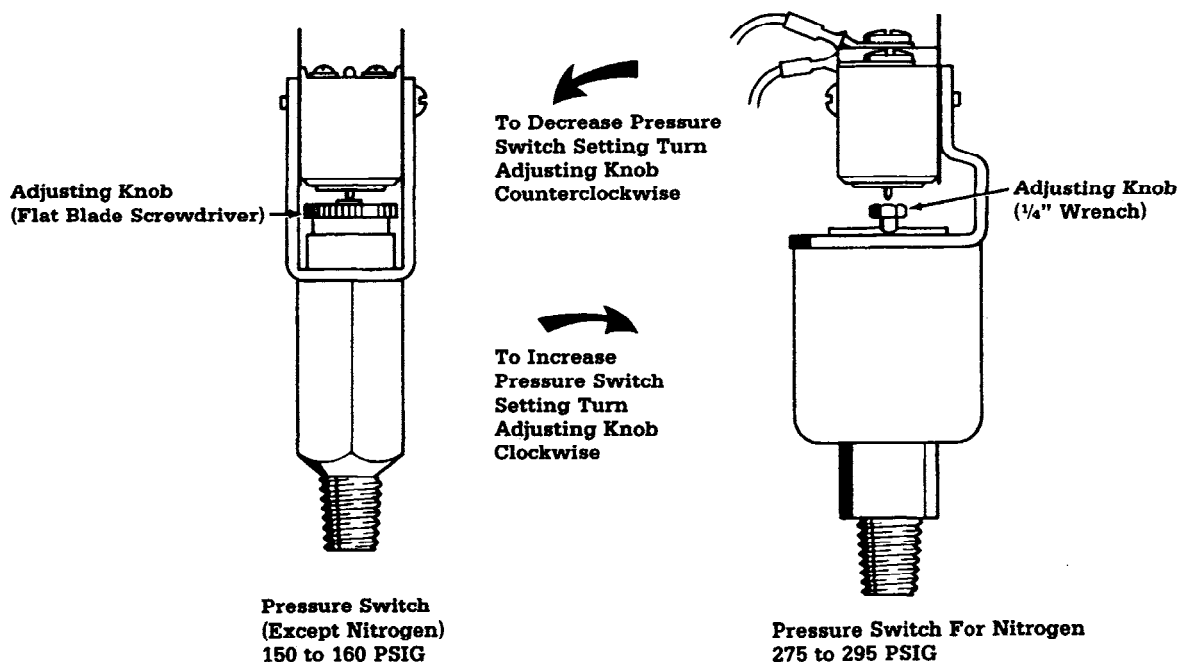


Figure 3-3
Pressure Switch Adjustments

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3.6 Switch Over Indicator Circuit - Troubleshooting Information

See section 2.1 for a theory of operation of the switch over alarm system.

See Section 3.5 for Switch Over Indicator Circuit Check-Out and Section 3.8 for Switch Over Indicator Circuit Repairs.

The troubleshooting table for the switch over alarm system is shown in Table 3-2. The table is a guide to possible solutions for repairs to the switch over indicator circuit. Multiple component failures are not covered in the table.

The remote alarms vary for each installation. Switch over signals are taken from terminals 2 and 4 or 2 and 5 (See Figure 3-4). Terminals 2 and 4 provide a switch over signal for open circuit remote alarms. A failure in the switch over alarm circuit may not cause a change in the open circuit remote alarm. Terminals 2 and 5 provide a switch over signal for closed circuit alarms. A failure in the switch over alarm circuit will cause a change in the closed circuit remote alarm. Maintenance is required when the indicator circuit display differs from the remote alarm display.

Note: The closed circuit remote alarm system provides the best assurance of correct operation of the manifold switch over alarm circuits.

How to Use the Troubleshooting Table

Compare the actual condition of the manifold with the possible condition listed in Table 3-2. The right side of the table lists the possible component failure by number; refer to the list of possible component failures for explanation.

Conditions 8, 9, 10, and 11 are normal conditions; however, the possible component failures listed will make the manifold appear to be in a normal state of operation when in fact there may be a problem with the component. The problem in some cases may not show up until the secondary bank pressure is depleted if an open circuit remote alarm is in use.

Table 3-2
Troubleshooting Information Switch Over Alarm System

Condition	Red Lamp	Green Lamp	Left Intermediate Pressure	Right Intermediate Pressure	Possible Component Failures
1.	OFF	OFF	LOW	LOW	1,2
2.	OFF	OFF	LOW	HIGH	1,2
3.	OFF	OFF	HIGH	LOW	1,2
4.	OFF	OFF	HIGH	HIGH	1,3,4
5.	OFF	ON	LOW	LOW	6
6.	OFF	ON	LOW	HIGH	6
7.	OFF	ON	HIGH	LOW	5,6,7
8.	OFF	ON	HIGH	HIGH	Normal 5,6,7
9.	ON	OFF	LOW	LOW	Normal 4,6,7
10.	ON	OFF	LOW	HIGH	Normal 4,6,7
11.	ON	OFF	HIGH	LOW	Normal 4,6,7
12.	ON	OFF	HIGH	HIGH	8
13.	ON	ON	LOW	LOW	5
14.	ON	ON	LOW	HIGH	5
15.	ON	ON	HIGH	LOW	5
16.	ON	ON	HIGH	HIGH	5

Note: The left and right intermediate pressure gauges are assumed to be accurate for this table. An indication of intermediate gas pressure presence may be verified by reading the left and right bank pressure gauges.

List of Possible Component Failures

1. Power Off - check transformer and supply voltage.
2. Red light out - replace lamp. See Page 3-9.
3. Green light out - replace lamp. See Page 3-9.
4. Relay (4-5 OPEN) - replace relay. See Page 3-10.
5. Relay (Open coil) - replace relay. See Page 3-10.
6. Left intermediate pressure switch in need of adjustment or defective - adjust or replace as required. See Pages 3-6 & 3-20.
7. Right intermediate Pressure switch in need of adjustment or defective - adjust or replace as required. See Pages 3-6 & 3-18.
8. Incorrect lens position or improper wiring. See Page 4-1.

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4. S-L-O-W-L-Y close the header valve on the bank supplying gas to the delivery line. This action simulates the depletion of the primary bank.

Note: If the shuttle valve does not shuttle you may have closed the wrong header valve. Slowly reopen the header valve closed previously and slowly close the other header valve.

Note: The bleed valve may have to be opened to simulate hospital demand.

The following activities should then take place:

- a. Bank pressure decreases.
- b. Intermediate line pressure decreases.
- c. The pressure switch closes.
- d. The relay is activated.
- e. The green light goes OFF.
- f. The red light goes ON.
- g. Remote alarms are activated if present.
- h. The shuttle valve shuttles.

The troubleshooting information of Section 3.6 will be of assistance in determining malfunctions in the switch over indicator circuit.

5. Close the bleed valve if opened, and S-L-O-W-L-Y reopen the header valve closed previously. The following activities should then take place.

- a. Bank pressure is reestablished.
- b. Intermediate line pressure is reestablished at 200 psig (400 psig on N₂ manifolds).
- c. The pressure switch opens.
- d. The relay is deactivated.
- e. The red light turns off.
- f. The green light turns on.
- g. Remote alarms are deactivated if present.

The manifold is now operating from the opposite bank.

The bank with the least gas* should be chosen as the Primary Supply side.

*Note: Except for nitrous oxide and carbon dioxide manifolds, the bank pressure gauge with the lowest reading will indicate the bank having least gas. Nitrous oxide and carbon dioxide, however are in liquid form in the cylinders (at room temperature). Therefore, both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. Under such conditions it is not practical to determine which bank is fullest; one bank must be chosen as the Primary Supply and the other as Secondary Supply.

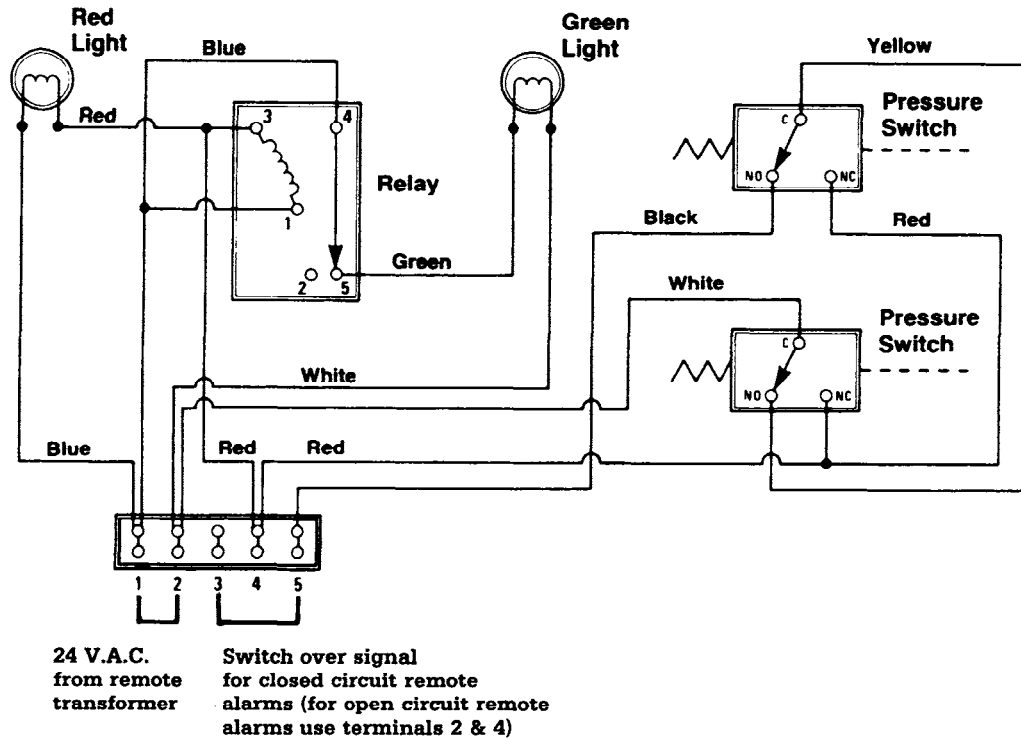


Figure 3-4
Wiring Schematic for Ohmeda Unimatic III Switch Over Alarm System

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Relay Replacement

WARNING: Disconnect electricity to the unit before attempting any electrical component repairs.

The troubleshooting information of Section 3.6 will be of assistance in determining relay malfunctions.

Relay Replacement Procedure:

1. Refer to Figure 4-1 for wiring diagram and Figure 3-6 for a photo.
2. Disconnect the electrical power.
3. Verify that the wires on the relay agree with the wiring diagram. Label the wires if necessary.
4. Remove the wires from the relay.
5. Remove the two mounting screws and the relay.
6. Mount the replacement relay with terminals 3 and 4 at the top.
7. Reconnect the wires to the relay. Verify that the wires on the relay agree with the wiring diagram.
8. Reconnect the electrical power.
9. Perform a check out of the switch over indicator circuit. See Section 3.5 Switch Over Indicator Circuit Check-Out.

Note: The two blue wires on the relay are electrically the same point.

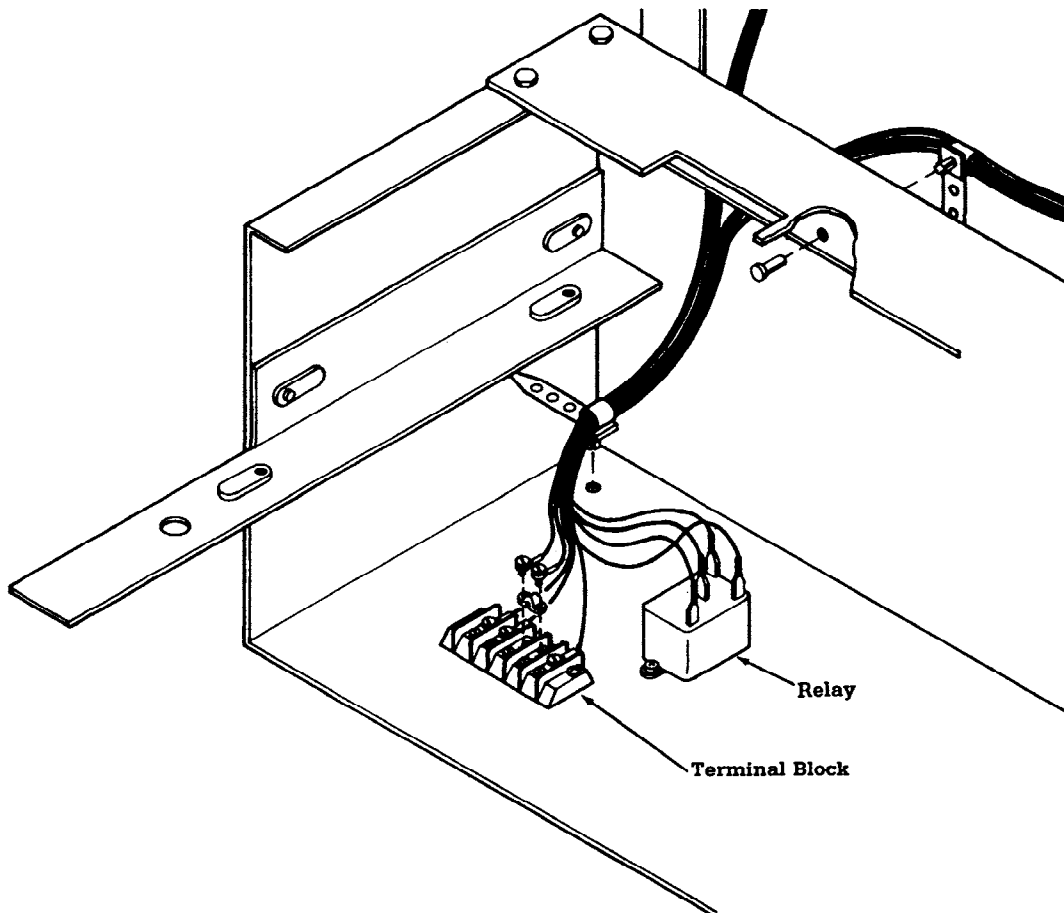


Figure 3-6
Relay Replacement

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3.7 Pressure Switch Electrical Check Out

The troubleshooting information of Section 3.6 will be of assistance in determining possible pressure switch malfunctions.

The pressure switch may be tested with an ohmmeter to verify proper operation. Ohmmeter check out procedure.

1. Refer to Figure 4-1 for the wiring diagram.
2. Unplug the switch in question.

Note: Unplugged switches produce a green light condition on the manifold but also activate closed circuit remote alarms. The switches should be replugged securely after the ohmmeter test.

3. Insert the ohmmeter probes in the back of the connector. See Figure 3-4 for electrical wiring schematic. Check the continuity from common to normally open and common to normally closed. Activate the switch manually by using a small blade screwdriver.

Note: Pressure switches are in the normally open position when pressure is applied.

4. If the switch is working normally replug the switch into the circuit. See Section 3.20 to replace a defective pressure switch. See Section 3.3 for Pressure Switch Checkout.

3.8 Switch Over Indicator Circuit Repairs

An electrical schematic of the switch over indicator circuit is shown in Figure 3-4. The switch over indicator circuit wiring diagram with replacement parts is given in Figure 4-1.

Lamp Replacement

Lamps for the indicator lights are set deep in the lampholders. To remove these lamps, use a short (2") length of 1/2" I.D., thin walled, rubber tubing. Push tubing over end of lamp and unscrew lamp from socket.

WARNING: Do Not interchange indicator light lenses - upper light lens is Red, lower light lens is Green.

Lampholder Replacement

WARNING: Disconnect electricity to the unit before attempting any electrical component repairs.

After power has been disconnected use an ohmmeter to check continuity of the portion of the circuit in question.

The primary and secondary supply lampholders are easily replaced. Refer to Figures 3-5 and 4-1 for proper assembly and electrical connections.

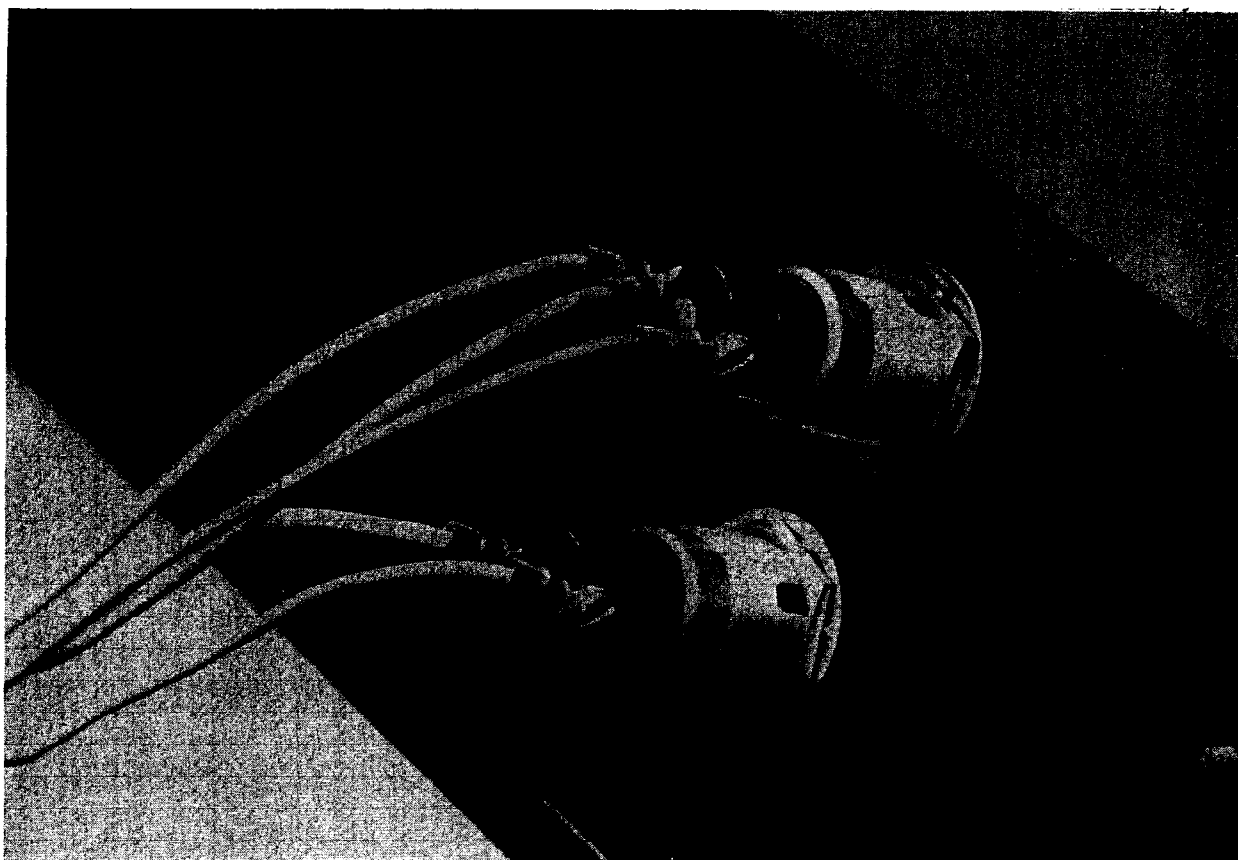


Figure 3-5
Lampholder Replacement

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3.10 Pneumatic Circuit - Troubleshooting Information

Table 3-3

Condition	Possible Cause	Solution
Pressure on intermediate pressure gauge rises slowly.	Bank regulator seat is defective.	Repair or replace bank regulator.
Pressure on delivery line gauge rises slowly.	Delivery line regulator seat is defective.	Repair or replace regulator.
Intermediate line relief valve leaks.	Bank regulator is out of adjustment or defective. Relief valve is defective.	Readjust, repair or replace regulator. Replace relief valve.
Delivery line relief valve leaks.	Delivery line regulator is out of adjustment or defective. Relief valve is defective.	Readjust, repair or replace regulator. Replace relief valve.
Shuttle valve leaks.	Check valve is defective. Teflon seal is defective. Shuttle spool is defective.	Replace check valve. Replace shuttle valve.
Bleed valve leaks.	Bleed valve is defective.	Replace bleed valve.
Pressure switch activation is erratic.	Pressure switch is defective.	Replace pressure switch.
Pressure gauge leaks, does not return to zero, or readings are inconsistent.	Gauge is defective.	Replace gauge.

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3.9 Pneumatic Switch Over Circuit Check-Out

WARNING: The left and right banks must have sufficient gas volume to perform any test and supply hospital demand.

WARNING: Only one header valve may be turned off while the manifold is supplying gas to the hospital. After performing checks or making repairs return the header valves to the open position.

The pneumatic switch over circuit may be tested by simulating left and right bank pressure depletion. See Section 2.1 for Theory of Operation.

Check Out Procedure:

Normal Manifold Pressure Settings

All Gases Except Nitrogen

Intermediate Pressure Switches	150-160 psig
Bank Regulators	200 psig
Delivery Line Regulator	50 psig

Nitrogen Manifold

Immediate Pressure Switches	275-295 psig
Bank Regulators	400 psig
Delivery Line Regulator	180

Note: See Sections 3.2, 3.3 and 3.4 for proper adjustment procedures.

1. The manifold is in a normal operating condition - the pressure in both primary and secondary intermediate lines is 200 psig (400 psig on N₂ manifolds) and the green light on the front panel is on. This condition is presented in the electrical schematic Figure 3-4.
2. Both header valves are in the open position.
3. Determine which bank is supplying gas to the delivery line. The bank pressure gauge with the lowest reading will generally indicate the bank supplying the gas to the delivery line.

4. S-L-O-W-L-Y close the header valve on the bank supplying gas to the delivery line. This action simulates the depletion of the primary bank.

Note: If the shuttle valve does not shuttle you may have closed the wrong header valve. **Slowly** reopen the header valve previously closed and slowly close the header valve.

Note: The bleed valve may have to be opened to simulate hospital demand.

The following should then take place.

- a. Bank pressure decreases.
- b. Intermediate line pressure decreases.
- c. The pressure switch closes.
- d. Remote alarms are activated if present.
- e. The shuttle valve shuttles.

Check for leaks in the manifold.

The troubleshooting information of the pneumatic circuit, Section 3.10, will assist you in determining any malfunctions in the pneumatic switch over circuit.

5. Close bleed valve if opened, then S-L-O-W-L-Y reopen the header valve. The following activities should then take place.
 - a. Bank pressure is reestablished.
 - b. Intermediate line pressure is reestablished at 200 psig (400 psig on N₂ manifolds).
 - c. The pressure switch opens.
 - d. Remote alarms are deactivated if present.

The manifold is now operating from the opposite bank. The manifold should always be operating from the bank with the lowest capacity. The manifold can be returned to the original bank by slowly closing the opposite header valve. This causes the manifold to shuttle to the original bank. Slowly reopen the header valve returning the manifold to its original state. **After** performing checks or making repairs always return header valves to the open position.

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3.12 Delivery Line Regulator Replacement

WARNING: Do not use oils or oilbearing materials on or near regulators. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. Nonmetallic parts of regulators must be discarded if contaminated with oil or grease. Do Not Lubricate Regulator Parts.

Removal Procedure (See Figure 3-9)

1. Refer to Section 2.4, Bypass Mode of Operation and perform steps 1 through 7 of the Use of Bypass Mode. After the manifold is in the bypass mode of operation the replacement procedure may be started.
2. The bottom cover of the manifold may be removed for easier access.
3. While holding the regulator, slowly turn the compressor elbow nut counterclockwise to release any pressure still present in the line. Turn the compression elbow union nut off completely.
4. While holding the regulator, turn the regulator inlet union nut counterclockwise and remove the regulator.

Refer to Section 4, Illustrated Parts List for delivery line regulator repair kits.

Installation Procedure

1. See that the nose and tail piece of the inlet and outlet unions are firmly seated.
2. Place the regulator in position and start both the inlet union and outlet compression nuts by turning them clockwise by hand.
3. While holding the regulator, tighten the regulator inlet union nut. (Do not overtighten.)
4. While holding the regulator, tighten the outlet compression nut. (Do not overtighten.)
5. Refer to Section 2.4, Bypass Mode of Operation and perform steps 1 through 11 of the Return to Normal Operation after Using the Bypass Mode.
6. Test the piping connections for leaks.

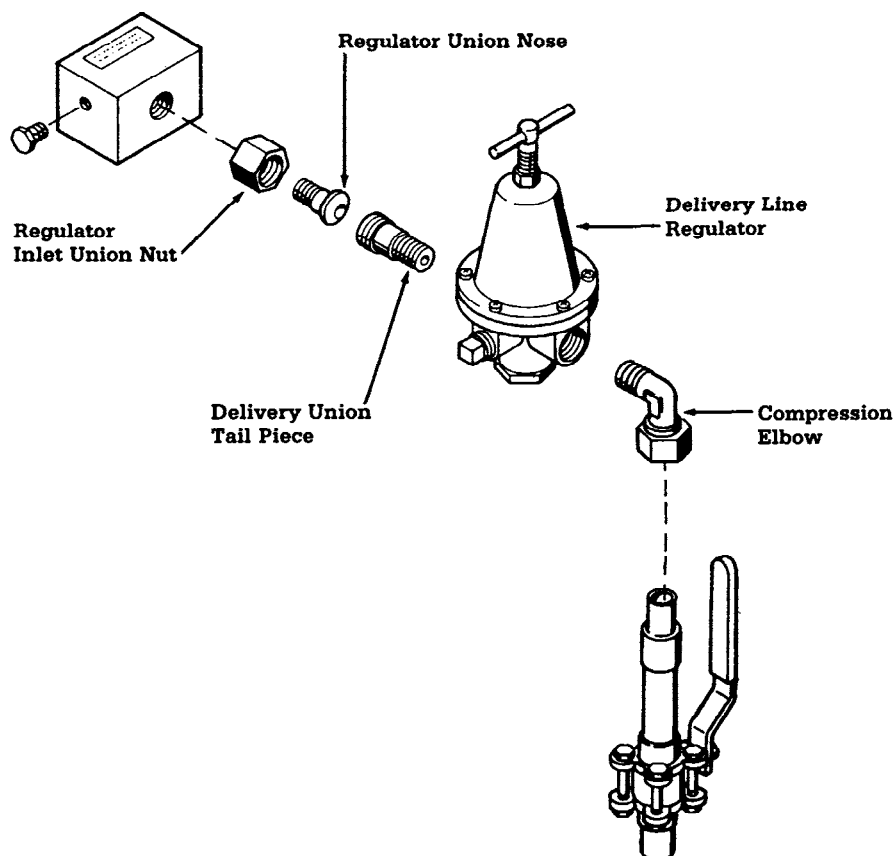


Figure 3-9
Delivery Line Regulator Replacement

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3.11 Bank Regulator Replacement

WARNING: Do not use oil or oilbearing materials on or near regulators. Oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. Nonmetallic parts of regulators must be discarded if contaminated with oil or grease. Do Not Lubricate Regulator Parts.

Removal Procedure (See Figures 3-7 and 3-8)

1. Refer to Table 3-1, Mode of Operation for Service to determine which bank must be in operation.
2. Slowly close the header valve on the side of the manifold requiring service.
3. While holding the connection fitting slowly turn the regulator outlet nut counterclockwise to release any pressure still present in the line. Then turn the outlet nut off completely.
4. While holding the connection fitting, remove the compression nut on the line to the bank pressure gauge.
5. While holding the regulator with a wrench, use a second wrench to turn the regulator inlet nut counterclockwise and remove the regulator. See Figure 3-8.

Refer to Section 4, Illustrated Parts List for bank regulator kits.

Installation Procedure

Note: Transfer the relief valve if a new regulator is used.

1. Place the regulator in position and start both the inlet and outlet nuts by turning them clockwise by hand.
2. While holding the regulator, tighten the regulator inlet nut. (Do not overtighten.)
3. While holding the connection fitting of the regulator, tighten the outlet nut. (Do not overtighten.)
4. Replace the line to the bank pressure gauge. (Do not overtighten.)
5. The bank with the least gas* should be chosen as the Primary Supply side.
5. Test the piping connections for leaks.

*Note Except for nitrous oxide and carbon dioxide manifolds, the bank pressure gauge with lowest reading will indicate the bank having least gas. Nitrous oxide and carbon dioxide, however, are in liquid form in the cylinders (at room temperature.) Therefore, both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. Under such conditions it is not practical to determine which bank is fullest; one bank must be chosen as the Primary Supply and the other as Secondary Supply.

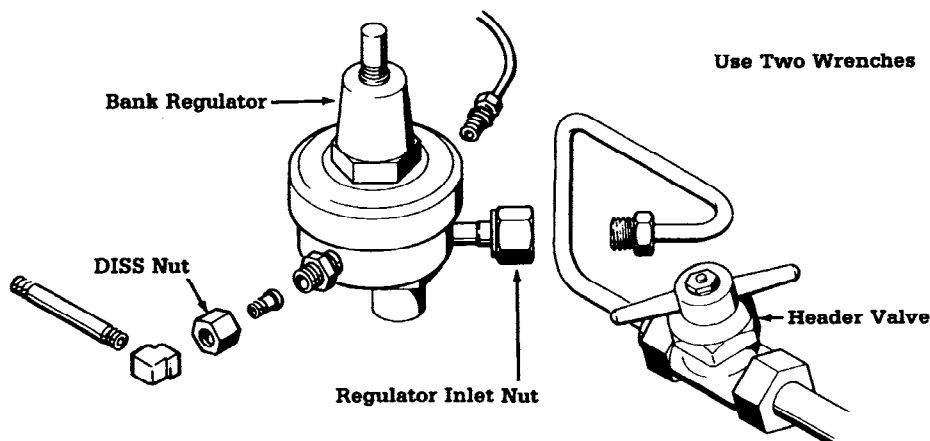


Figure 3-7
Bank Regulator Replacement

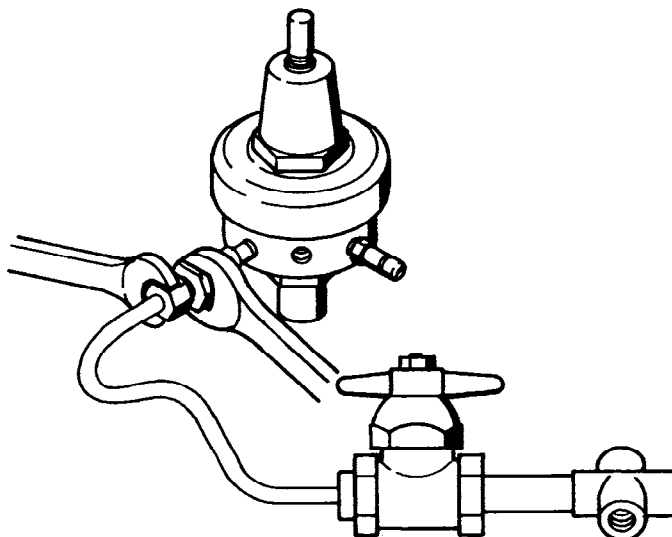


Figure 3-8
Bank Regulator Disconnection

3/Maintenance

3.14 Intermediate Pressure Check Valve Replacement

Determine which check valve is the possible cause of a gas leak through the shuttle valve vent. Refer to Figure 2-3b.

When the left bank is supplying gas to the manifold and a leak is present at the shuttle valve vent, the right check valve could be the probable cause. Replace the right check valve.

When the right bank is supplying gas to the manifold and a leak is present at the shuttle valve vent, the left check valve could be the probable cause. Replace the left check valve.

Removal Procedure (See Figure 3-10)

Note: The Check Valve(s) may be serviced only after the manifold is in the Bypass Mode of Operation.

1. Refer to Section 2.4, Bypass Mode of Operation, and perform steps 1 through 7, of the Use of Bypass Mode.
2. The top cover of the manifold may be removed for easier access.
3. Refer to Section 3.13, Shuttle Valve Replacement, and perform steps 1 through 7 under Removal Procedure.
4. Remove the check valve assembly and O-rings from the delivery manifold.

Installation Procedure

1. Install replacement O-rings.
2. Install replacement check valve assembly with O-rings nearest the top.
3. Refer to Section 3.13, Shuttle Valve Replacement, and perform steps 1 through 8 under Installation Procedure.

3.15 Intermediate Line Relief Valve Test

To prevent damage to the delivery line regulator and the intermediate line pressure gauge, the relief valves are set at 250 psig, (the N₂ relief valves are set at 475 psig). The relief valve will also prevent a premature switch over of the shuttle valve should a bank regulator seat leak occur.

The following is a test for proper operation of the intermediate relief valve:

Note: The relief valve being tested must be in the circuit supplying gas to the hospital.

1. Slowly turn the bank regulator adjustment screw clockwise while observing the intermediate line pressure gauge.
2. The pressure should increase and an audible escape of gas from the relief valve must occur between 238 and 262 psig (between 451 and 499 psig on nitrogen manifolds).
3. The relief valve must be replaced if it fails to meet the specification. Refer to Section 3.16, Relief Valve Replacement - Intermediate Line.
4. Readjust the bank regulator. Refer to Section 3.2, Regulator Adjustment.

3.16 Relief Valve Replacement - Intermediate Line

Removal Procedure (See Figure 3-11)

1. Refer to Table 1-3, Mode of Operation for Service to determine which Bank must be in operation to perform service.
2. Slowly close the header valve on the side of the manifold requiring service.
3. Hold the bank regulator and slowly turn the relief valve counterclockwise to remove any pressure still in the line.
4. Remove the relief valve.

Installation Procedure

1. Wrap the threads of the relief valve with 2 layers of Teflon tape.
2. While holding the regulator, turn the relief valve clockwise and tighten securely. (Do not overtighten.)
3. Test the piping connection for leaks.

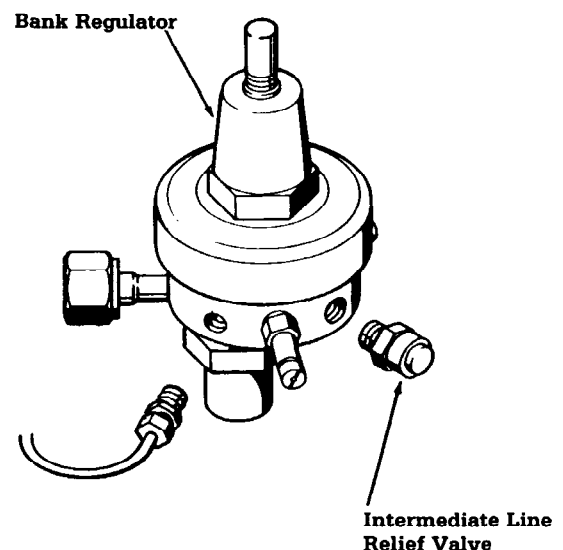


Figure 3-11
Intermediate Line Relief Valve Replacement

3/Maintenance

3.13 Shuttle Valve Replacement

Removal Procedure (See Figure 3-10)

Note: The shuttle valve may be serviced only after the manifold is in the bypass mode of operation.

1. Refer to Section 2.4, Bypass Mode Operation and perform steps 1 through 7 of the Use of Bypass Mode.
2. The bottom cover of the manifold may be removed for easier access.
3. While holding the shuttle valve, slowly turn the union nut counterclockwise to release any pressure still present in the line, then turn the nut off completely.
4. The other shuttle valve inlet connection nut may be removed in the same manner as step 3.
5. While holding the shuttle valve, slowly turn the flange nut counterclockwise to release any pressure still present in the line, then turn the nut off completely.
6. The other shuttle valve flange nut may be removed in the same manner as step 5.
7. The shuttle valve may now be removed.

Installation Procedure

1. Make sure manifold block is clear of old O-rings before installing shuttle valve.

Note: O-rings can be retained in the groove on the flange face by applying a small amount of Vac Kote*

2. Place the shuttle valve in position and start the flange nuts by turning them clockwise by hand.
3. Start the union nuts in the same manner as step 1.
4. Tighten the flange nut. (Do not overtighten.)
5. The other shuttle valve flange nut may be tightened in the same manner as step 3.
6. Tighten the union nut. (Do not overtighten.)
7. The other shuttle valve union nut may be tightened in the same manner as step 5.
8. Refer to Section 2.4, Bypass Mode of Operation and perform steps 1 through 11 of the Return to Normal Operation After Using the Bypass Mode.
9. Test the piping connections for leaks.

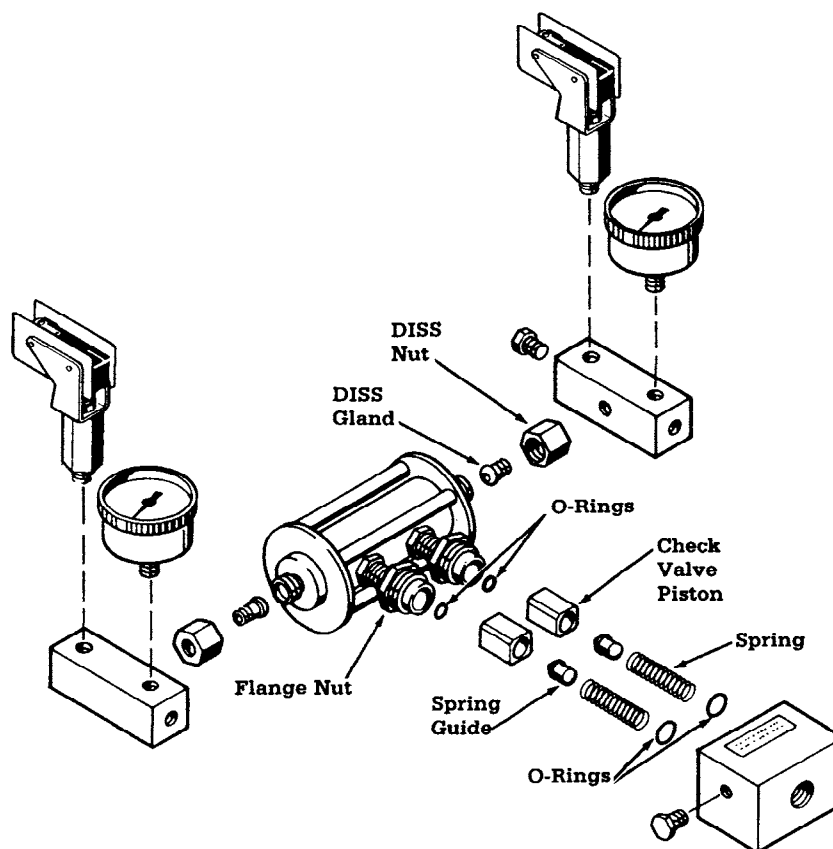


Figure 3-10
Shuttle Valve Replacement

3/Maintenance

3.18 Delivery Line Pressure Gauge Replacement

Note: The delivery line pressure gauge cannot be replaced without shutting the manifold down. Refer to the Manifold Shut-Down Procedure, Section 3.24 for instructions.

Removal Procedures (See Figure 3-12)

1. After the manifold has been shut down the removal procedure may be started.
2. The top cover of the manifold may be removed for easier access.
3. While holding the connection fitting, turn the compression nut slowly counterclockwise to release any pressure still present in the line. Turn the compression nut off completely and remove the gauge connecting line.
4. Remove the gauge mounting braces.
5. The gauge may be removed from the front panel.

Installation Procedure

1. Transfer the gauge connection fitting to the replacement gauge.
2. Wrap the threads of the gauge with two layers of Teflon tape.
3. Install the replacement gauge from the front.
4. Secure the gauge with the gauge mounting braces.
5. Connect the gauge connecting line.
6. While holding the connection fitting, turn the compression nut clockwise to tighten the connecting line to the gauge. Do not overtighten.
7. Test the piping connection for leaks.
8. Replace the top cover of the manifold.

3.19 Intermediate Pressure Gauge Replacement

Removal Procedure (See Figure 3-13)

1. Refer to Table 3-1, Mode of Operation for Service to determine which Bank must be in operation to perform service.
2. Slowly close the header valve on the side of the manifold requiring service.
3. The top or bottom cover of the manifold may be removed for easier access.
4. Turn the gauge counterclockwise removing it.

Installation Procedure

1. Wrap the threads of the gauge with two layers of Teflon tape.
2. Install the replacement gauge from the front.

3.20 Pressure Switch Replacement

Removal Procedure (See Figures 3-13 and 4-1)

1. Refer to Table 3-1, Mode of Operation for Service to determine which bank must be in operation to perform service.
2. Slowly close the header valve on the side of the manifold requiring service.
3. The top or bottom cover of the manifold may be removed for easier access.
4. Unplug the pressure switch.

Note: Unplugged switches produce a green light condition on the manifold and also activate closed circuit remote alarms.

5. While holding the connection fitting, slowly turn the pressure switch assembly counterclockwise to release any pressure still present in the line. Turn the Pressure Switch Assembly out completely and remove it.

Installation Procedure

1. Wrap the threads on the pressure switch with two layers of Teflon* tape.
2. While holding the connection fitting, turn the Pressure Switch Assembly in as far as the previous switch assembly was installed.
3. Reconnect the pressure switch.
4. Test the piping connection for leaks.
5. Perform the Pressure Switch Adjustment as outlined in Section 3.4.

*Teflon is a registered trademark of the DuPont De Nemours Company.

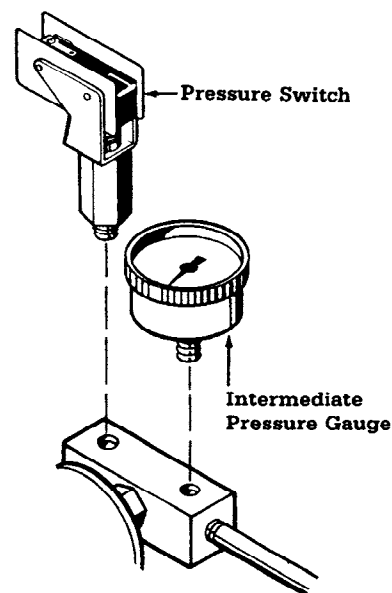


Figure 3-13
Intermediate Pressure Gauge
and Pressure Switch Replacement

3/Maintenance

3.17 Bank Pressure Gauge Replacement

Removal Procedure (See Figure 3-12)

1. Refer to Table 3-1, Mode of Operation for Service to determine which Bank must be in operation to perform service.
2. Slowly close the header valve on the side of the manifold requiring service.
3. The top cover of the manifold may be removed for easier access.
4. While holding the connection fitting, turn the compression nut slowly counterclockwise to release any pressure still present in the line. Turn the compression nut off completely and remove the gauge connecting line.
5. Remove the gauge mounting braces.
6. The gauge may be removed from the front panel.

Installation Procedure:

1. Transfer the gauge connection fittings to the replacement gauge.
2. Wrap the threads of the gauge with two layers of Teflon tape.
3. Install the replacement gauge from the front.
4. Secure the gauge with the gauge mounting braces.
5. Connect the gauge connecting line.
6. While holding the connecting fitting, turn the compression nut clockwise to tighten the connecting line to the gauge. Do not overtighten.
7. Test the piping connection for leaks.
8. Replace the top cover of the manifold.

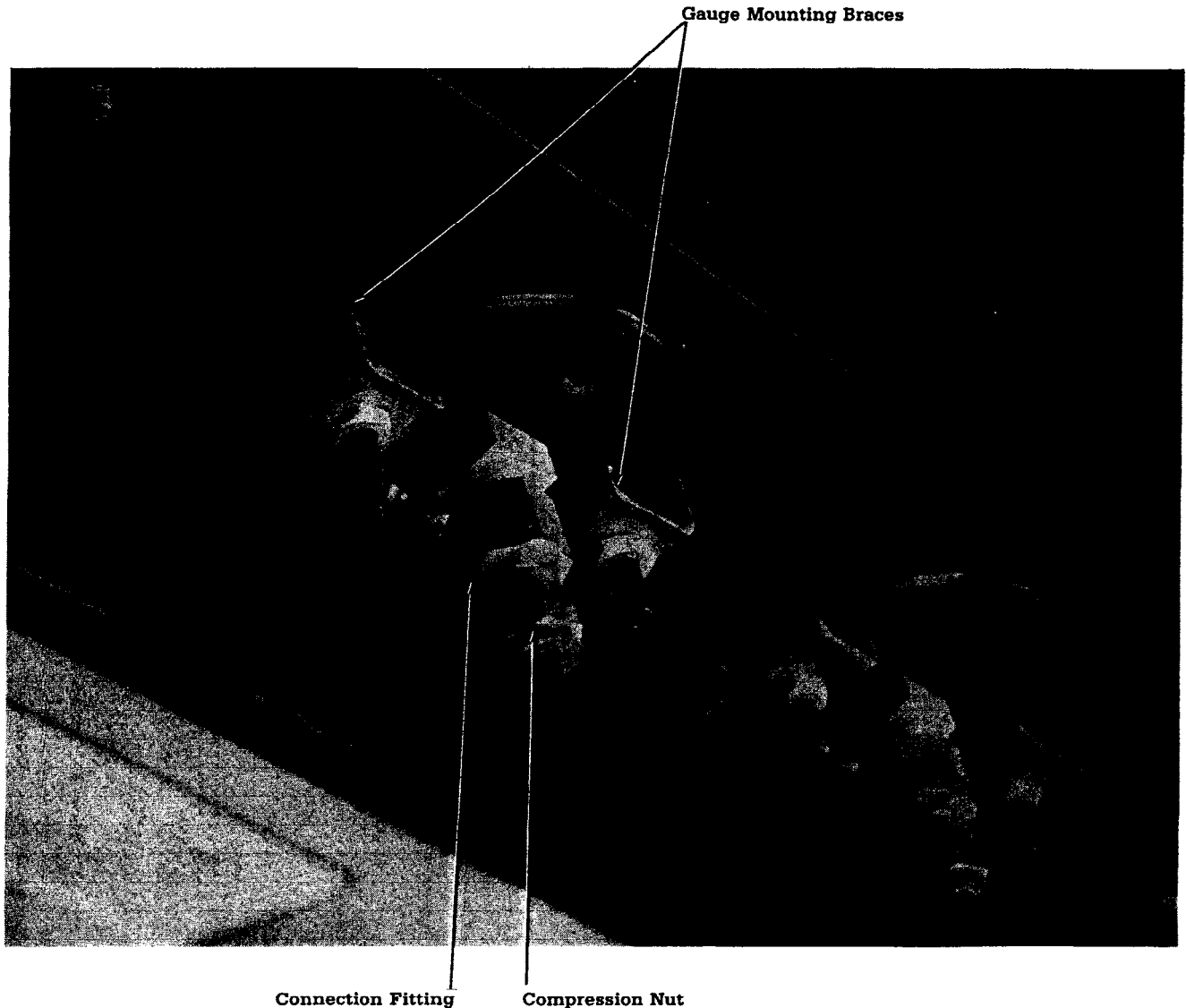


Figure 3-12
Bank and Delivery Line Pressure Gauge Replacement

3/Maintenance

3.23 Bypass Valve Replacement

Note: The manifold will have to be shut down to service the Bypass Valve. Refer to the Manifold Shut-Down Procedure, Section 3-24, for instructions.

Removal Procedure (See Figure 3-15)

1. After the manifold has been shut down the removal procedure may be started.
2. While holding the connection fitting, turn each of the DISS nuts clockwise to tighten. Do not overtighten.

Installation Procedure

1. While holding the connection fitting, turn each of the DISS nuts clockwise to tighten. Do not overtighten.
2. Be sure the bypass valve is in the "normal" operating position.
3. Test the piping connections for leaks.

3.24 Manifold Shut-Down Procedure

The Shut-Down Procedure will be necessary for items which cannot be serviced while the manifold is in the Bypass Mode of Operation or normal left or right bank operation.

The person performing service on the manifold is responsible for the following:

1. Obtaining permission from the appropriate hospital personnel to perform any service procedure.

2. Informing the hospital personnel of the extent of the work involved and estimating the amount of time necessary for any service procedure.
3. Informing the hospital personnel when work has been completed on the manifold and it is in a normal operating condition.

The manifold, in most cases, may not shut down without providing alternate gas supply sources.

Note: The requirement of an alternate gas supply should be determined by the proper hospital authorities.

The hospital may be able to do one or both of the following while the manifold is shut down:

1. Use portable gas cylinders as needed.
2. Temporarily pressurize the hospital gas line by the use of a regulated portable gas supply connected to the appropriate gas lines.

The shut-down of a manifold should be avoided if at all possible, but in the event that the manifold must be shut down, the following guidelines should be adhered to:

1. Get permission from the proper hospital authorities to shut down the manifold.
2. Have everything ready, including parts, tools and service information. The customer shall provide alternate gas supply sources, if required.
3. Perform a complete checkout of the manifold for proper operation after service is completed.

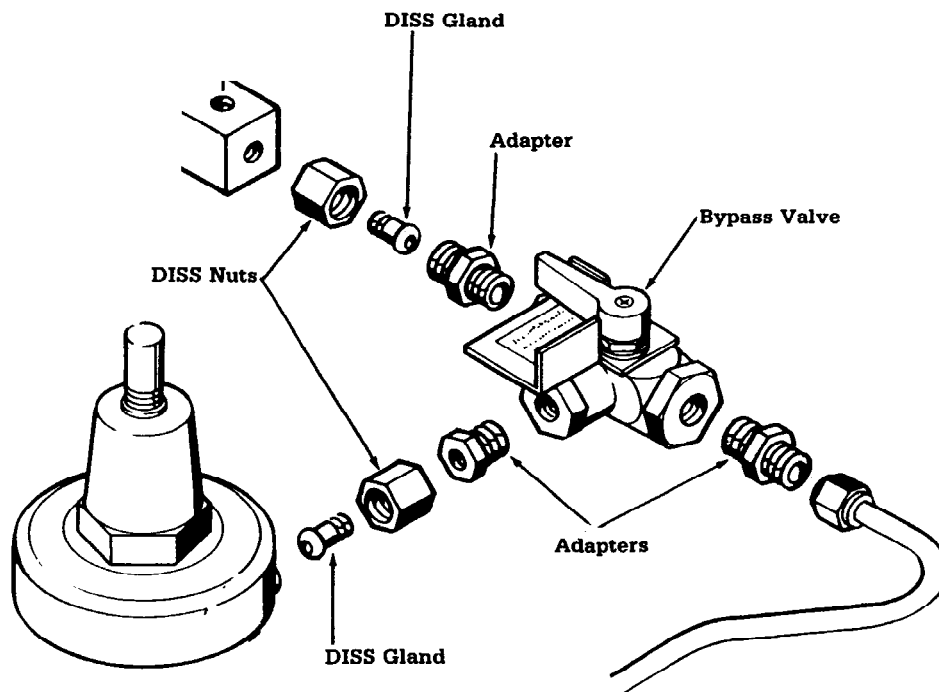


Figure 3-15
Bypass Valve Replacement

3/Maintenance

3.21 Relief Valve Replacement - Delivery Line

Note: The manifold will have to be shut down to service the delivery line relief valve. Refer to the Manifold Shut-Down Procedure, Section 3.24 for instruction.

Removal Procedure (See Figure 3-14)

1. After the manifold has been shut down, the removal procedure may be started.
2. The bottom cover of the manifold may be removed for easier access.
3. Remove the end of the bleed valve tubing connected to the relief valve elbow-fitting.
4. Remove the relief line.
5. Remove the relief line fitting.
6. Turn the relief valve counterclockwise & remove it.
7. Remove the elbow fitting from the relief valve.

Installation Procedure

1. Wrap two layers of Teflon tape on the elbow fitting.
2. Install the elbow fitting on the replacement relief valve.
3. Wrap two layers of Teflon tape on the relief valve pipe threads.
4. Turn the relief valve on as far as the previous valve was installed.
5. Connect the relief line fitting.
6. Connect the relief line.
7. Connect the bleed valve tubing to the relief valve elbow fitting.
8. Replace the delivery pressure gauge line, if removed, and pressure test the connections.

3.22 Bleed Valve Replacement

Note: The manifold will have to be shut down to service the Bleed Valve. Refer to the Manifold Shut-Down Procedure Section 3.24 for instruction.

Removal Procedure (See Figure 3-14)

1. After the manifold has been shut down the removal procedure may be started.
2. The bottom cover may be removed for easier access.
3. The bypass tube may be removed for easier access.
4. Remove the small gas discharge tubing connected to the bleed valve.
5. Remove the bleed valve by turning it counterclockwise.

Installation Procedure

1. Wrap two layers of Teflon tape on the replacement bleed valve threads.
2. Install the bleed valve by turning it clockwise as far as the previous valve was installed.
3. Replace the small gas discharge tubing connected to the bleed valve.
4. Replace the bypass delivery line if it was removed.
5. Test the piping connections for leaks.
6. Replace the bottom cover.

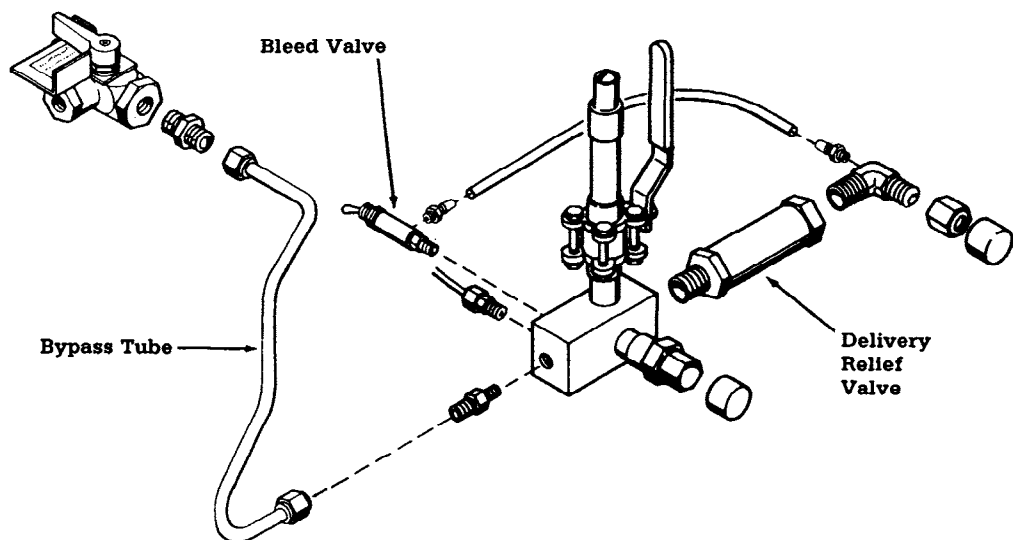
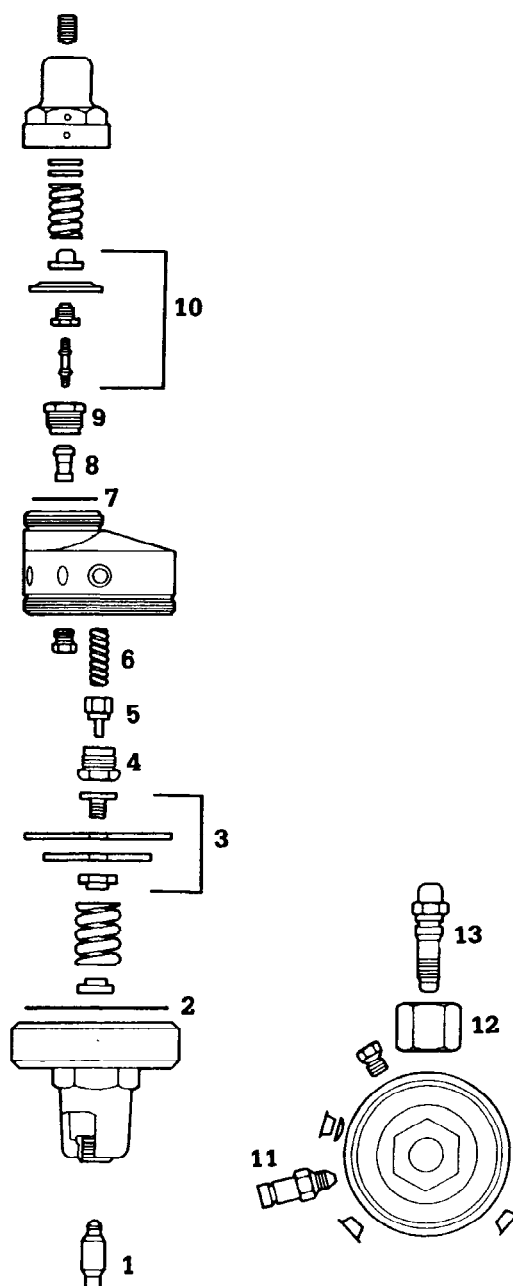


Figure 3-14
Delivery Line Relief Valve and Bleed Valve Replacement

4/Illustrated Parts List



Description	Stock Number
1. Adjusting Screw	NLA
2. Ring Spacer Gasket	0210-5355-300
3. Diaphragm Assembly	
Low Pressure	NLA
4. Low Pressure Seat Assembly	
(Holder and Seat)	NLA
5. Low Pressure Valve Assembly	0206-2414-300
6. Low Pressure Spring Valve Assembly	NLA
7. Gasket Inlet Cap	NLA
8. Valve High Pressure	0206-2418-300
9. High Pressure Seat Assembly	
(Holder and Seat)	NLA
10. Diaphragm Assembly High Pressure	NLA
11. Safety Valve	NLA
12. Nut CGA 540	NLA
13. Inlet Stem	NLA

Figure 4-2
Bank Regulator - all gases except nitrogen. 6804-8040-029

4/Illustrated Parts List

Pressure Switches
(Including leads and female mating connector w/sockets)
0208-5132-700 for all manifolds except nitrogen
0221-5397-800 for N₂

N₂ - 208-5143-300
all - 208-5131-300

Switch only (No wire)

Transformer

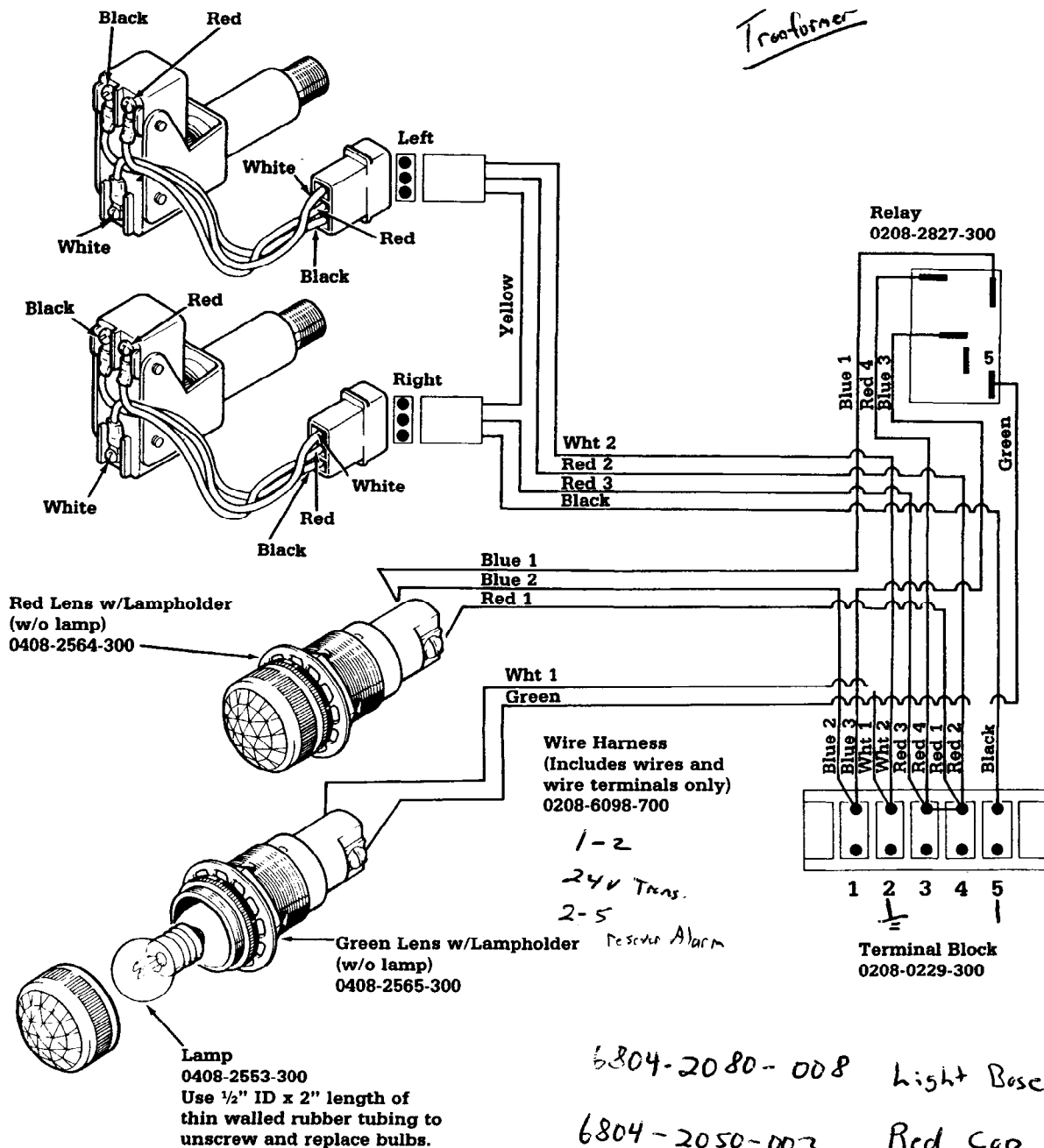
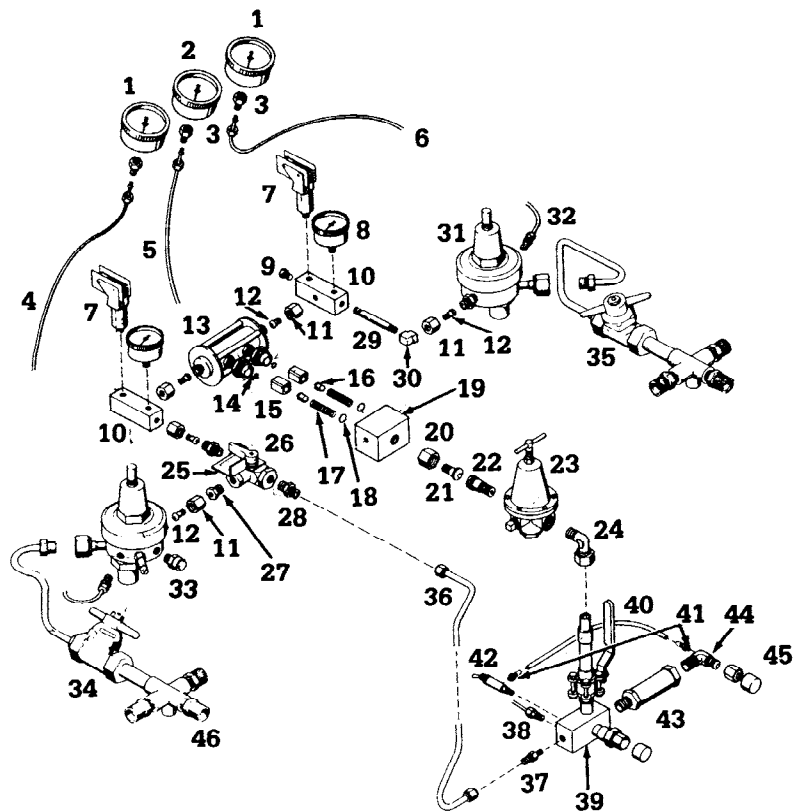


Figure 4-1
Switch Over Indicator Circuit Wiring Diagram and Replacement Parts

4/Illustrated Parts List



Description	Stock Number	Description	Stock Number
1. Gauge, 3000 PSI (2)	0205-8225-300	32. Fitting, Compression 1/4" NPTM,	0213-4047-300
2. Gauge, 100 PSI (except Nitrogen)	0205-8223-300	1/8" tube (2)	0213-4045-300
3. Fitting, Compression 1/8" NFPT	0213-4045-300	33. Valve, Regulator Relief 1/2" Relief —	0207-8218-300
4. Tubing, Copper, 1/8" O.D., 23" length	0213-7882-300	(except Nitrogen) (2)	0221-5441-801
5. Tubing, Copper, 1/8" O.D., 32" length	0213-7892-300	34. Inlet Assembly, Left* (except Nitrogen)	0221-5441-801
6. Tubing, Copper, 1/8" O.D., 18 1/2" length	0213-7880-300	Inlet Assembly, Left* (Nitrogen Only)	0207-6011-325
7. Switch, Pressure (2) (except Nitrogen)	0208-5132-700	* Valve Repair Seat	0221-5441-805
8. Gauge, 400 PSI (2) (except Nitrogen)	0205-8257-300	Inlet Assembly, Right* (except Nitrogen)	0221-5441-804
Gauge, 600 PSI (2) (Nitrogen only)	0205-8273-300	Inlet Assembly, Right* (Nitrogen Only)	0207-6011-325
9. Plug, 1/8" NPTM (3)	0213-6035-300	* Valve Repair Seat	0221-5428-600
10. Inlet Manifold (2)	0221-5402-525	36. Tube, Bypass	0204-7928-300
11. Nut, DISS (5)	0204-6533-300	37. Adapter, DISS, 1/8" NPTM	0213-4046-300
12. Gland, DISS (5)	0204-8168-525	38. Fitting, Compression	0221-5428-600
13. Shuttle Valve Assembly	0221-5440-800	39. Outlet Assembly	0995-6351-010
14. O-Ring, Viton (2)	6804-2110-000	40. Tube, Silastic	0995-6351-010
15. Piston, Check Valve (2)	6804-2560-000	41. Adapter, Nylon Barb	0207-6054-300
16. Spring Guide, TIP (2)	6804-2560-001	42. Valve, Bleed	0207-8234-300
17. Spring, .300 x 1.16L (2)	6804-2040-000	43. Valve, Relief 75 PSI (except Nitrogen)	0207-8235-300
18. O-Ring (2)	0210-0636-300	Valve, Relief 225 PSI (Nitrogen only)	0213-6161-300
19. Delivery Manifold	0221-5403-525	44. Elbow, Male, 1/2" NPT x 45 Flare w/Port	0213-4210-300
20. Nut, Delivery Regulator Union	0221-5413-300	45. Nut, 1/2"	
21. Nose, Delivery Regulator Union	0221-5414-300	46. Valve, Check (6)	
22. Tail Piece, Delivery Regulator Union	0221-5415-300	Nitrogen	0207-8033-800
23. Regulator, Delivery Line (See Fig. 4-4)	0306-1122-300	Oxygen	0207-8025-800
24. Elbow, male, 1/2" NPT x 3/4" O.D. Tube	6804-2060-000	Nitrous Oxide	0207-8034-800
25. Stop Bracket, Bypass Valve	0214-3909-500	Air	0207-8228-800
26. Valve, Bypass	0207-6022-300	Carbon Dioxide	0207-8035-800
27. Adapter, 1/8" NPTF, 1/4" NPTF	0413-3350-300	Mixtures, Manifold No. 0321-7407-914, CGA 280	
28. Adapter, 1/4" NPTM DISS (2)	0204-7928-300	state gases and percentages	0207-8229-800
29. Nipple, 1/8" NPT x 3"	0213-5027-525	Helium, Argon, Xenon	0207-8033-800
30. Elbow, 1/8" NPTF, 1/8" NPTF	0213-6141-300		
31. Regulator, Bank (except Nitrogen) (2)			
(See Figure 4-2)	0306-1141-800		
Regulator, Bank (Nitrogen Only) (2)			
(See Figure 4-3)	0306-1102-300		

Figure 4-5
Unimatic III Manifold

4/Illustrated Parts List

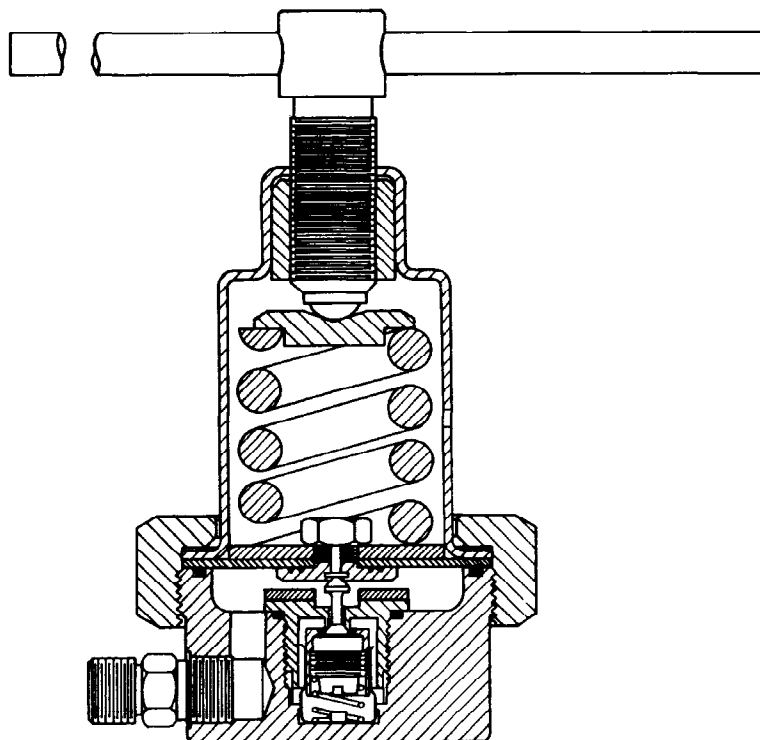


Figure 4-3
Nitrogen Bank Regulator
0306-1102-300

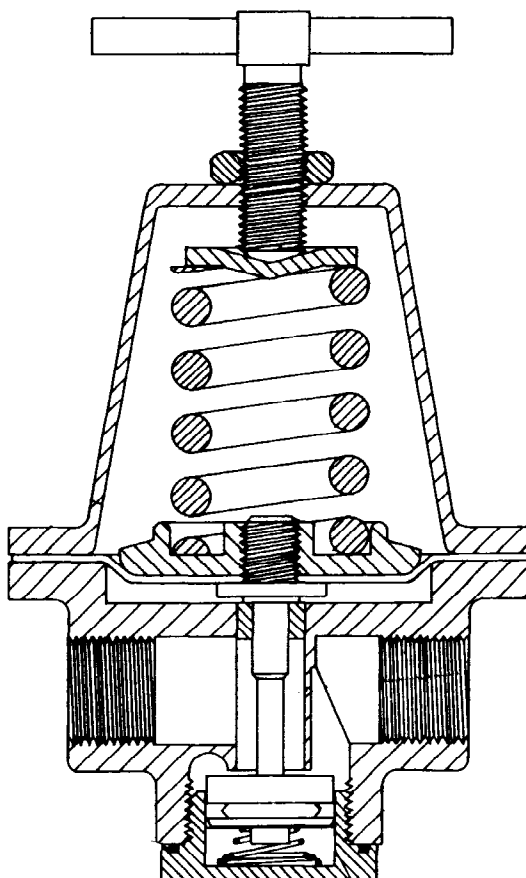


Figure 4-4
All Gases Delivery Line Regulator
0306-1122-300

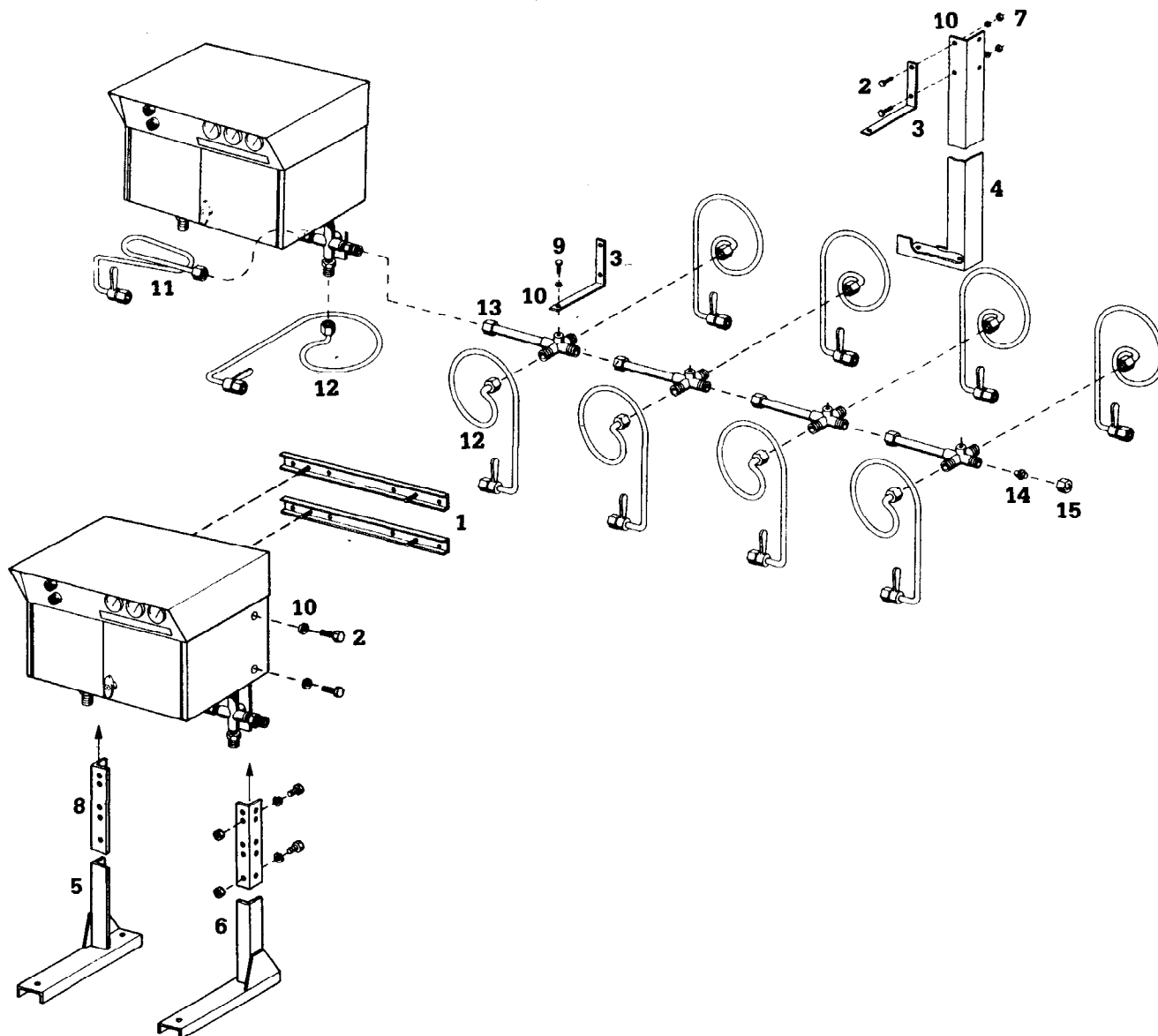
4/Illustrated Parts List

Part Numbers Manifolds	Manifold Stock No.	Header Ext. Kits (item 18)	Header Extensions (item 13)	Pigtails Down & Side (item 12)	Pigtails Under Cabinet (item 11)
Gases					
CGA 540 Oxygen	321-7404-910	221-5580-870	221-5525-801	221-5282-701	221-5392-725
CGA 326 Nitrous Oxide	321-7404-911	221-5580-871	221-5578-800	221-5538-725	221-5393-725
CGA 346 Air	321-7404-912	221-5580-873	221-5578-802	221-5558-700	221-5554-700
CGA 320 Carbon Dioxide	321-7404-913	221-5580-874	221-5578-803	221-5559-700	221-5555-700
CGA 580 Helium	321-7404-916	221-5580-872	221-5578-801	221-5394-701	221-5396-701
Argon	(Specify Gas)				
Xenon					
CGA 580 Nitrogen	321-7407-900	221-5580-872	221-5578-801	221-5394-701	221-5396-701
Oxygen and Second Gas Mixture (CGA 280)					
Carbon Dioxide 7.5%	321-7404-914	221-5580-875	221-5578-804	221-5563-700	221-5556-700
Helium 80.5%					
Nitrogen 76.5%					
Nitrous Oxide 47.5% to 52.5%					
(Specify gases and percentages)					
Oxygen and Second Gas Mixture (CGA 500)					
Carbon Dioxide 7.5%	321-7404-915	221-5580-876	221-5578-805	221-5564-700	221-5557-700
Helium 80.5%					
(Specify gases and percentages)					

To Determine Quantities

No. Cylinders	4	6	8	10	12	14	16	18	20	22	24	26	28
Wall Mounted Manifold													
Wall Mounting Kit	1	1	1	1	1	1	1	1	1	1	1	1	1
Header Extension Kit	0	0	1	1	2	2	3	3	4	4	5	5	6
Down and Side Pigtails	0	2	4	6	8	10	12	14	16	18	20	22	24
Floor Mounted Manifold													
Floor Mounting Kit	1	1	1	1	1	1	1	1	1	1	1	1	1
Header Support Leg Kit	0	0	1	1	2	2	3	3	4	4	5	5	6
Header Extension Kit	0	0	1	1	2	2	3	3	4	4	5	5	6
Down and Side Pigtails	0	2	4	6	8	10	12	14	16	18	20	22	24

4/Illustrated Parts List



Description	Stock Number
1. Wall Anchor	214-3944-710
2. Bolt, 3/8" x 7/8"	144-2245-214
3. Bracket, Mounting	221-5522-500
4. Header Support Leg* (Floor Mount Only)	221-5521-500
5. Leg, Left	214-3943-710
6. Leg, Right	214-3942-710
7. Nut, hex, 3/8"	144-3145-133
8. Leg Substitute	214-3936-510
9. Capscrew, 3/8" x 1/2"	144-2245-208
10. Lock Washer, 3/8"	202-3032-342
11. Pigtail, Under-Cabinet	Items 11,12,
12. Pigtail, Down-and-Side	13: Match to
13. Extension, Header	gas. See pg. 13
14. Gland, Blind, CGA 540	829-3459-300
15. Nut, Union, CGA 540 only	204-6670-525

Blind Gland and Union Nut, Complete Sets:

CGA 326	204-6668-300
CGA 346	204-6661-300
CGA 320	204-6662-300
CGA 580	204-6669-300
CGA 500	204-6664-300
CGA 280	204-6663-300

Installation Kits

Kit, Floor-Mounting Part No. 221-5582-870

Contains: 1 left leg (item 5)
 1 right leg (item 6)
 8 hex nuts 3/8" (item 7)
 8 lock washers 3/8" (item 10)
 8 bolts 3/8" x 7/8" (item 2)

Kit, Wall-Mounting Part No. 221-5583-870

Contains: 2 wall anchors (item 1)
 2 leg substitutes (item 8)
 12 hex nuts 3/8" (item 7)
 12 lock washers 3/8" (item 10)
 8 bolts 3/8" x 7/8" (item 2)

Kit, Head Extension Part No. Match with gas. Pg. 13.

Contains: 2 mounting brackets (item 3)
 2 header extensions with union nuts (item 13)
 3 blind glands and nuts)
 2 capscrew 3/8" x 1/2" (item 9)
 2 lockwashers 3/8" (item 10)

Kit, Header Support Left Part No. 221-5584-870

Contains: 2 header support legs (item 4)
 4 bolts 3/8" x 7/8" (item 4)
 4 hex nuts 3/8" (item 7)
 4 lock washers 3/8" (item 10)

Figure 4-6
 Mounting Assembly and Pigtail and Header Extension Installation

4/Illustrated Parts List

OXYGEN
USE NO OIL

0405-9962-300

BY-PASS NORMAL
SERVICE USE ONLY
See O&M Manual

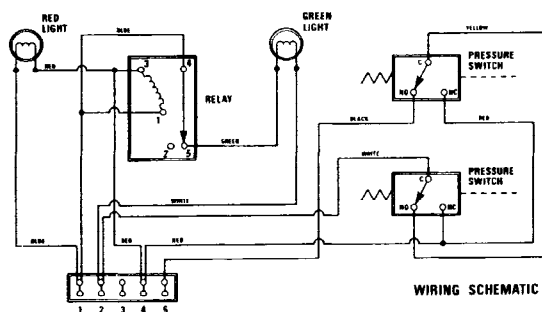
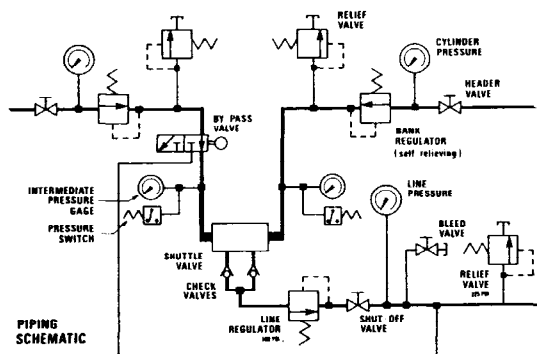
0405-9986-300

NITROUS OXIDE
USE NO OIL

0405-9963-300

LEFT BANK PRESSURE	USE NO OIL	DELIVERY PRESSURE	USE NO OIL	RIGHT BANK PRESSURE
GREEN LIGHT INDICATES NORMAL OPERATION		RED LIGHT INDICATES RESERVE SUPPLY IS BEING USED.		

6804-0010-000



0205-6567-300 (except N₂)

0205-6566-300 For N₂

Figure 4-8
Instruction and Information Labels

4/Illustrated Parts List

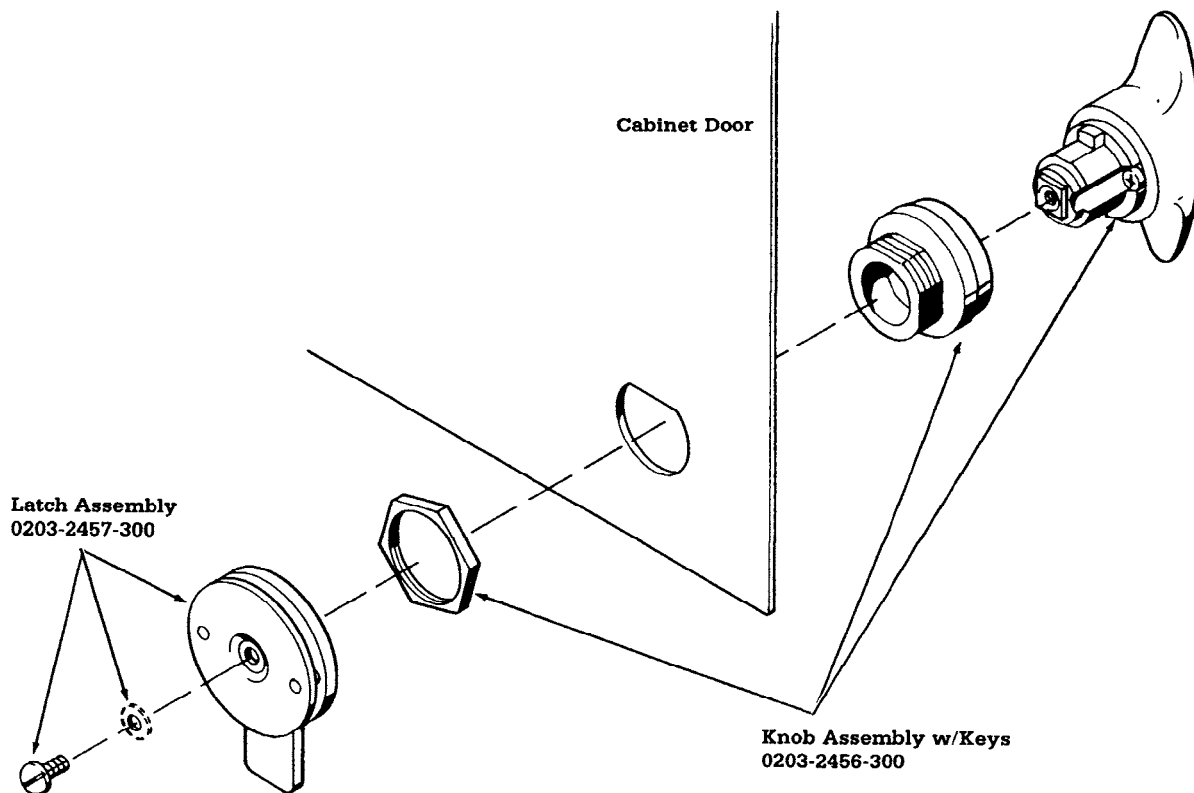


Figure 4-7
Cabinet Door Knob Assembly and Latch Assembly



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