Unimatic® II Manifolds for Oxygen, Nitrous Oxide & Nitrogen
Service Manual
Important

The information contained in this service manual pertains only to those models of this Product which are marketed by Ohio as of the effective date of this manual or the latest revision thereof. This service manual was prepared for exclusive use by Ohio service personnel in light of their training and experience as well as the availability to them of proper tools and test equipment. Consequently, Ohio provides this service manual to its customers purely as a business convenience and for the customer's general information only without warranty of the results with respect to any application of such information. Furthermore, because of the wide variety of circumstances under which maintenance and repair activities may be performed and the unique nature of each individual's own experience, capacity, and qualifications, the fact that customer has received said information from Ohio does not imply in any way that Ohio deems said individual to be qualified to perform any such maintenance or repair service. Moreover, it should not be assumed that every acceptable test and safety procedure or method, precaution, tool, equipment or devices which could be used in servicing this Product is referred to within, or that abnormal or unusual circumstances may not warrant or suggest different or additional procedures or requirements.

This manual is subject to periodic review and customers are cautioned to obtain and consult the latest revision thereof before undertaking any service of the Product. Comments and suggestions are invited from our customers for consideration by Ohio in connection with these periodic reviews.

WARNING: Read all of the warnings and cautions as listed in the Precautions section of this manual before attempting to perform any of the procedures described in this manual.

CAUTION: Servicing of this Product in accordance with this service manual should never be undertaken in the absence of proper tools, test equipment and the most recent revision to this service manual which is clearly and thoroughly understood.
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**Cover Photo**
Oxygen Unimatic® II Manifold-
Four Cylinder, Wall Mounted Model
Stock No. 0321-7408-910
Precautions

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 Ohio Medical Products 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.

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. See Pages 12 and 16.

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. See Page 14.

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 (N₂O) and 1800 psig or greater for oxygen (O₂) and nitrogen (N₂). The delivery line must be set with an inlet pressure (intermediate line pressure) of 200 psig ± 10 psig on O₂ and N₂O manifolds, and 400 psig ± 10 psig on N₂ manifolds. See Pages 14 and 18.

The left and right banks must have sufficient gas volume to perform any test and supply hospital demand. See pages 16, 22 and 27.

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. See Page 16.

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. See Page 16.

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. See Page 16.
**Precautions**

**Warnings Continued**

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. See Pages 16, 22 and 27.

Nitrous oxide is in liquid form in the cylinders (at 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. See Page 16.

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. See Page 18.

To ensure flow of gas 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 for O₂ and N₂, and 600 psig or greater for N₂O. See Page 20.

Do NOT interchange indicator light lenses—upper light lens is RED, lower light lens is GREEN. See Page 25.

Disconnect electricity to the unit before attempting any electrical component repairs. See pages 25 and 26.

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. See Page 27.

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. See Pages 29 and 30.

**Cautions**

Do NOT repeatedly bend, sharply bend or twist copper tubing as damage to the tubing may result. See Page 12.

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. See Page 12.

Repair of the Unimatic II O₂, N₂O and N₂ manifolds should not be undertaken until all required tools, test equipment, and special materials that may be required are available. See Page 16.

The pressure at which the pressure switch is set to indicate switchover must be checked as pressure in the intermediate line drops. See Pages 20 and 22.
1/ Description

Figure 1.
Nitrogen Unimatic® II Manifold-
Twelve Cylinder, Free Standing Model
Stock No. 0321-7435-914

1.1 General

Unimatic® II Manifolds are available in wall mounted models (Cover Photo) or free standing models (Figure 1) providing oxygen ($O_2$), nitrous oxide ($N_2O$), or nitrogen ($N_2$) gas service. The manifolds are designed to deliver low pressure (50 psig on $O_2$ and $N_2O$ manifolds or 180 psig on $N_2$ manifolds) medical gas from high pressure (3000 psig max) cylinders. The number of cylinders which can be accommodated by the various manifolds is given in Table 1 on Page 4.

The Unimatic II 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.
Table 1.
Unimatic II Manifolds - Models, Cylinders and Approximate Capacity

<table>
<thead>
<tr>
<th>Gas Service</th>
<th>Free Standing Model Stock No. (cylinders not included)</th>
<th>Wall Mounted Model Stock No. (cylinders not included)</th>
<th>Number of Cylinders</th>
<th>Total Cu Ft Capacity* (with H size cylinders)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen (O₂)</td>
<td>321-7412-910 911 912 913 914 915 916 917 918 919 920</td>
<td>321-7408-910 911 912 913 914 915 916 917 918 919 920</td>
<td>4 6 8 10 12 14 16 18 20 22 24</td>
<td>976 1,464 1,952 2,440 2,928 3,416 3,904 4,392 4,880 5,368 5,856</td>
</tr>
<tr>
<td>Nitrous Oxide (N₂O)</td>
<td>321-7434-910 911 912 913 914 915 916 917 918 919 920</td>
<td>321-7428-910 911 912 913 914 915 916 917 918 919 920</td>
<td>4 6 8 10 12 14 16 18 20 22 24</td>
<td>2,228 3,342 4,456 5,570 6,684 7,798 8,912 10,026 11,140 12,254 13,368</td>
</tr>
<tr>
<td>Nitrogen (N₂)</td>
<td>321-7435-910 911 912 913 914</td>
<td>321-7429-910 911 912 913 914</td>
<td>4 6 8 10 12 14 16 18 20 22 24</td>
<td>896 1,344 1,792 2,240 2,688</td>
</tr>
</tbody>
</table>

* Approximate capacity based on "full" H size cylinder contents at Normal Temperature and Pressure; 244 cu ft/O₂ cylinder, 557 cu ft/N₂O cylinder, and 224 cu ft/N₂ cylinder.

Figure 2. Examples of Cylinder Bank Configurations
### 1.2 Specifications

<table>
<thead>
<tr>
<th></th>
<th>Nitrous Oxide (N₂O)</th>
<th>Oxygen (O₂)</th>
<th>Nitrogen (N₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delivery Pressure</strong></td>
<td>psig 50, kg/cm² 3.5</td>
<td>psig 50, kg/cm² 3.5</td>
<td>psig 180, kg/cm² 12.6</td>
</tr>
<tr>
<td><strong>Intermediate Pressure</strong></td>
<td>200 ± 10, 14 ± .7</td>
<td>200 ± 10, 14 ± .7</td>
<td>400 ± 10, 28 ± .7</td>
</tr>
<tr>
<td><strong>Supply Pressure (Maximum)</strong></td>
<td>1,000, 70</td>
<td>3,000, 210</td>
<td>3,000, 210</td>
</tr>
<tr>
<td><strong>Pressure Switch Setting (On Pressure Drop)</strong></td>
<td>155 ± .5, 10.8 ± .4</td>
<td>155 ± 5, 10.8 ± .4</td>
<td>285 ± 10, 20 ± .7</td>
</tr>
<tr>
<td><strong>Intermediate Line Relief Valve Pressure</strong></td>
<td>250 ± 12.5, 17.6 ± .9</td>
<td>250 ± 12.5, 17.6 ± .9</td>
<td>475 ± 24, 33.4 ± 1.7</td>
</tr>
<tr>
<td><strong>Delivery Line Relief Valve Pressure</strong></td>
<td>75 ± 5, 5.3 ± .4</td>
<td>75 ± 5, 5.3 ± .4</td>
<td>225 ± 12, 15.8 ± .8</td>
</tr>
</tbody>
</table>

| 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) for N₂O and 200 ± 10 psig (14 ± .7 kg/cm²) for N₂.
2. Intermediate (bank regulator) pressure settings are to be made with gas flowing through regulator with inlet (cylinder) pressure of 600 psig (42 kg/cm²) or greater for N₂O, and 1800 psig (126 kg/cm²) or greater for O₂ and N₂.

**Power Requirements** - 24 VAC.
2/ Operation

2.1 Theory of Operation

The Unimatic II 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 II gas circuits is shown in Figure 3.

Regulators and Pressure Gauges (Figure 4)

Each BANK REGULATOR reduces the gas pressure of its corresponding bank to an intermediate line pressure of 200 psig on O₂ and N₂O manifolds and 400 psig on N₂ manifolds. LEFT and RIGHT BANK PRESSURE GAUGES on the front panel of the control cabinet indicate the pressure within 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 on O₂ and N₂O manifolds or 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.
2/ Operation

Primary to Secondary Supply Switch Over - Shuttle Valve (Figure 5)

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 6 illustrates the operation of the shuttle valve. As shown in Figure 6a, gas is supplied from the primary bank regulator at a pressure of 200 psig on O₂ and N₂O manifolds or a pressure of 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) disc, pushing the spindle assembly 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 side of the disc (perpendicular to the spindle assembly rod).

The secondary bank regulator (right bank in this example) supplies gas at a pressure of 200 psig on O₂ and N₂O manifolds or a pressure of 400 psig on N₂ manifolds to the right side of the shuttle valve. This gas pressure pushes against the small right disc trying to drive the spindle assembly to the left. Since the area of the small disc is less than that of the large disc, the force exerted on the small disc is less than that on the large disc, 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 on O₂ and N₂O manifolds (400 psig on N₂ manifolds). As a result, the force on the large disc also decreases. However, the force on the small disc remains the same because the secondary line to the shuttle valve is still at 200 psig on O₂ and N₂O manifolds (400 psig on N₂ manifolds). The areas of the small and large discs 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 spindle assembly will then be driven to the left (in this example), opening the secondary, or right bank supply and closing the primary, or left bank, as shown in Figure 6b.

Once the spindle has shifted to the secondary bank, full cylinders can be installed on the opposite bank without causing the spindle to shift back. The spindle 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 6 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 closed or obstructed the pressures on both sides of the large discs 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 pres-
Operation

GAS from PRIMARY BANK Regulator

Pressure on large area keeps spindle to right while gas is available from Primary Bank

GAS from SECONDARY BANK Regulator

Pressure on small area drives spindle to left when Primary Supply is exhausted

GAS to DELIVERY LINE REGULATOR

Figure 6a.
Shuttle Valve Operation - PRIMARY BANK SUPPLYING GAS

NO pressure on small area until cylinders are replaced

Pressure from Secondary Bank now on large area

Figure 6b.
Shuttle Valve Operation - SWITCH OVER to SECONDARY BANK
Supplying Gas - Primary Bank Exhausted

sure 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.
Relief Valves  
(Figure 7)

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 on O\textsubscript{2} and N\textsubscript{2}O manifolds or 475 psig on N\textsubscript{2} manifolds. The DELIVERY LINE RELIEF VALVE is set to open to atmosphere at a pressure of 75 psig on O\textsubscript{2} and N\textsubscript{2}O manifolds or 225 psig on N\textsubscript{2} manifolds.

Note that NFPA requires a vent on all supplies with a total (right and left bank) capacity of 1500 cu ft or more. The delivery line relief valve should be vented outside of the building to meet local and state codes and regulations. The outlet of the delivery line relief valve has a ½” pipe thread to facilitate attachment of the vent line by the installer. A ¾” I.D., or larger vent line should be used. Outside the building, the line must be turned down and screened to prevent contamination.
2/ Operation

Figure 8.
O₂ and N₂O Unimatic II: Header, Shutoff and Bypass Valves, Pressure Switches and Switch Over Indicators

Header Valves and Shutoff Valve (Figure 8)

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 14 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 8)

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 8 and 9)

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 9 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 on O₂ and N₂O manifolds (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 9. The pressure switches are single pole double throw, set to switch at 155 psig on O₂ and N₂O manifolds (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.

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 re-established at 200 psig on O₂ and N₂O manifolds (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.
2/ Operation

Figure 10.
Hi-Low Delivery Line Pressure Switch
(Accessory)
208-5139-800

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

A HOSPITAL MAIN SHUTOFF VALVE should be installed immediately downstream of the Unimatic II Manifold. 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 10 shows a hi-low delivery line pressure switch available from Ohio as an accessory.

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.

Attach gas supply cylinders to header pigtails connectors (Figure 11) as follows:

1. Check to be certain that the bypass valve is in the “Normal” position, header valves are open, and pigtails 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 pigtails, smoothly pull the cylinder connection end of each pigtails to the cylinder valve and securely tighten each cylinder connection nut to the cylinder valve.

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

CAUTION: Each pigtails must be connected to a cylinder to prevent gas leaks. The header connection to the pigtails is equipped with a check valve; however, this valve is not leak free. If an inlet is not to be used, be certain the pigtails is removed and the header inlet is securely sealed with a blind gland and nut. Refer to Illustrated Parts List, Page 23.

4. S-L-O-W-L-Y open valve on the cylinder nearest the manifold cabinet, and allow at least 30 seconds for heat 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 to be replaced.

NOTE: Switch over indicator lights activate before actual switch over takes place. The indicator lights activate at an intermediate line pressure of 155 psig on O₂ and N₂O manifolds or 285 psig on N₂ manifolds. The shuttle switch valve over occurs at about a pressure of 100 psig on O₂ and N₂O manifolds or about 265 psig on N₂ manifolds.

Check the shuttle valve spindle - the side (left or right) from which the spindle rod protrudes the least indicates the bank which is supplying gas. Refer to Figures 5 and 11.

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 Sec. 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.
2/ Operation

Red Light "ON" indicates secondary supply is being used and cylinders are to be replaced.

Green Light "ON" indicates normal operation.

Open Left and Right Header Valves

Cylinder Connection Nut
- smoothly pull pigtails to cylinder valve and securely tighten connection nut.

Bypass Valve
in "Normal" position

Delivery Line Shut-off Valve

Shuttle Valve Spindle Rod

Under cabinet Pigtail
Stock No. 02 221-5392-725
N2O 221-5393-725
N2 221-5396-701

Header Check Valve

Be certain pigtails are tightened securely to header check valves

Figure 11.
Cylinder Installation and Manifold Operation
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 (Figure 11) 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.

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 12):

1. Make sure there is ample gas supply in the left cylinder bank and the 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 600 psig or greater for nitrous oxide (N2O) and 1800 psig or greater for oxygen (O2) and nitrogen (N2). The delivery line regulator must be set with an inlet pressure (Intermediate line pressure) of 200 psig ± 10 psig on O2 and N2O manifolds, and 400 psig ± 10 psig on N2 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 down the left bank regulator until the left bank intermediate pressure is 50 psig on O2 and N2 manifolds (180 psig on N2 manifolds). Close the bleed valve.

5. Turn the bypass valve handle until it points to the back of the cabinet (the Bypass position).

6. Turn the delivery line shutoff valve (above the bleed valve, Figure 12) to the off position. The handle should then be at 90° to the tubing and the manifold will then be in the bypass mode.

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 on O2 and N2O manifolds, (180 psig on N2 manifolds). Close the bleed valve.

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 600 psig or greater for nitrous oxide (N2O) and 1800 psig or greater for oxygen (O2) and nitrogen (N2). The delivery line regulator must be set with an inlet pressure (Intermediate line pressure) of 200 psig ± 10 psig on O2 and N2O manifolds and 400 psig ± 10 psig on N2 manifolds.

2. Turn the delivery line regulator's adjustment screw counterclockwise until it becomes loose.

3. Securely 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 on O2 and N2O manifolds (200 psig on N2 manifolds).

7. Turn the bypass valve to the normal position.

8. With the bleed valve open, readjust the deliv-
2/ Operation

1. Ample supply in left bank and Left Bank Header Valve OPEN.


3. Loosen Connection Nut slightly.

4. Open bleed valve and turn down Left Bank Regulator until Left Intermediate Pressure Gauge is 50 psi O₂ and N₂O (180 psi for N₂) - close bleed valve.

5. Turn Bypass Valve handle to back of cabinet.

6. Turn Shutoff Valve to OFF.

Figure 12. Bypass Mode Operation

ery line regulator so that the delivery pressure gauge reads 50 psig on O₂ and N₂O manifolds (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 for O₂ and N₂O manifolds 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 ± 10 psig on O₂ and N₂ manifolds (400 psig ± 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 side. Check the position of the shuttle valve spindle rod. The bank which is supplying gas will be indicated by the side of the shuttle valve on which the spindle rod protrudes the LEAST (See Figure 5). If this is the fullest bank* turn the corresponding header valve OFF until the shuttle valve switches. If gas is not being used, the bleed valve may have to be open- ed until intermediate line pressure drops enough to cause switch over. After switch over, close the bleed valve and slowly open the header valve.

* NOTE: For O₂ and N₂ manifolds the bank pressure gauge with lowest reading will indicate the bank having least gas. Nitrous oxide, however, is in liquid form in the cylinders (at above 800 psig). 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.
3/ Maintenance

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 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.

**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.

**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.

**CAUTION:** Repair of the Unimatic II O₂, N₂, and N₂O manifolds should not be undertaken until all required tools, test equipment, and special materials that may be required are available.

**Use of Teflon Tape**

Teflon tape may be used on all pipe threads; however, it should not be used on compression fittings. See Figure 13, 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 Ohio Medical Products 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 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.

**The Mode of Operation for Service.**

Table 2 on Page 17, 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.**

*Vac Kote is a registered trademark of the Ball Corporation. A one ounce supply of Vac Kote is available from Ohio Medical Products, Stock No. 0220-0091-300.

*Snoop is a tradename of the Nupro Company (2 oz. supply 0220-5225-300, 1 gal. supply 0220-5225-300).

*Ivory Liquid is a registered trademark of Procter & Gamble.
3/ Maintenance

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 thick.

Table 2.
Mode of Operation for Service

Left Bank Operation: permits service including replacement, of the following Right Bank items with the Right Header Valve closed:
- Right Bank Pressure Gauge
- Right Bank Regulator
- Right Relief Valve
- Right Intermediate Pressure Gauge
- Right Pressure Switch

Right Bank Operation: permits service including replacement, of the following Left Bank items with the Left Header Valve closed:
- Left Bank Pressure Gauge
- Left Bank Regulator
- Left Relief Valve
- Left Intermediate Pressure Gauge
- Left Pressure Switch

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 Pressure Gauge
- Bleed Valve
- Delivery Line Relief Valve
- Bypass Valve

NOTE: The spindle position on the shuttle valve will determine which bank is supplying gas to the manifold. Check the shuttle valve spindle - the side (left or right) from which the spindle rod protrudes the least indicates the bank which is supplying gas.
3.2 Regulator Adjustment

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 600 psig or greater for nitrous oxide (N₂O) and 1800 psig or greater for oxygen (O₂) and nitrogen (N₂). The delivery line regulator must be set with an inlet pressure (Intermediate line pressure) of 200 psig ± 10 psig on O₂ and N₂O manifolds or 400 psig ± 10 psig on N₂ manifolds.

A. Bank Regulators (See Figure 14)

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. Check to be sure the cylinder pressure to the bank regulator being adjusted is 600 psig or greater for N₂O, 1800 psig or greater for O₂ and N₂.

2. Slowly open the header valve on the bank being adjusted.

3. If necessary, the adjustment screw of the 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).

4. Close the header valve on the opposite bank (away from the regulator being adjusted). This will ensure shuttle valve switch over and flow through the regulator being adjusted.

5. Open the bleed valve. Allow the shuttle valve to switch over so that gas is being supplied from the bank regulator being adjusted.

NOTE: The shuttle valve is supplying gas from the bank corresponding to the side of the shuttle valve from which the spindle rod protrudes the least; see Figures 5, 6 and 13.

6. With the bleed valve open, turn the regulator adjustment screw until the corresponding pressure gauge (inside cabinet) indicates 200 psig ± 10 psig on O₂ and N₂O manifolds, 400 psig ± 10 psig on N₂ manifolds.

7. 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 215 psig on O₂ and N₂O manifolds, up to 425 psig on N₂ manifolds) when gas is not flowing through the regulator. Such an increase is normal.

8. The bank with the least gas* should be chosen as the PRIMARY SUPPLY side. Check the position of the shuttle valve spindle rod. If the fullest bank is feeding the system, turn the corresponding header valve off until the shuttle valve switches. If gas is not being used the bleed valve may have to be opened until intermediate line pressure drops enough to cause switch over. After switch over, close the bleed valve and slowly open the header valve.

NOTE: For O₂ and N₂ manifolds the bank pressure gauge with lowest reading will indicate the bank having least gas. Nitrous oxide, however, is in liquid form in the cylinders (at above 800 psig). 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 Fig. 14)

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 psig ± 10 psig on O₂ and N₂ manifolds or 400 psig ± 10 psig on N₂ manifolds. If not, adjust the bank regulator as outlined in 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 on O₂ and N₂O manifolds, 180 psig on N₂ manifolds.

4. Close the bleed valve.

NOTE: The delivery pressure gauge may indicate a slightly greater pressure (up to 58 psig on O₂ and N₂O manifolds or up to 192 psig on N₂ manifolds) when gas is not flowing through the regulator. Such an increase is normal.
3/ Maintenance

3.3 Pressure Switch Checking and Adjustment (Figure 15)

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

WARNING: To ensure flow of gas 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 for O₂ and N₂, and 600 psig or greater for N₂O.

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 ± 10 psig on O₂ and N₂O manifolds, 400 psig ± 10 psig on N₂ manifolds, if necessary, adjust bank regulator as instructed in Section 3.3A, Page 20.

2. The bank being serviced must be the bank which is supplying gas. If the opposite bank is supplying gas (as indicated by the position of the shuttle valve spindle rod - see Figures 5 and 6, Pages 7 and 8), close the header valve on this bank 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 on, green light off - when the pressure gauge indicator drops to between 160 psig and 150 psig on O₂ and N₂O manifolds, or 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 ± 10 psig on O₂ and N₂O manifolds, or 400 psig ± 10 psig on N₂ manifolds. Close the bleed valve.

Out of Adjustment
A. The switch is set too high if it activates red light ON - green light OFF at a pressure above 150 psig on O₂ and N₂O manifolds, or above 360 psig on N₂ manifolds.

B. The switch is set too low if it activates at a pressure below 150 psig on O₂ and N₂O manifolds, or below 340 psig on N₂ manifolds.

Adjust the pressure switch as instructed in Step 4.

4. To Adjust Pressure Switch on Bank Supplying Gas:

A. Switch Set Too High (as indicated in Step 3)

a. 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 on O₂ and N₂O manifolds, or between 285 psig and 295 psig on N₂ manifolds - the red indicator light should be on. Close the bleed valve.

b. Turn the knurled nut of the pressure switch to the left until the red light turns off - green light on. The pressure within the intermediate line may make it difficult to turn the knurled nut - if so, use a flat head screwdriver as a lever against the side of the switch with blade on knurled nut and carefully work the nut to the left as illustrated in Figure 15.

NOTE: Nitrogen pressure switches have a ¼" hex adjustment nut (not a knurled nut).

c. Turn the bank regulator adjustment screw clockwise until the intermediate pressure reaches 180 psig to 200 psig on O₂ and N₂O manifolds (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 switchover must be checked as pressure in the intermediate line drops.

Check the intermediate pressure - it must be between 150 psig and 160 psig for O₂ and N₂O.
3/ Maintenance

Left Intermediate Pressure

Right Intermediate Pressure

Left Bank Regulator Adjustment Screw

Bleed Valve behind tubing

Shuttle Valve Spindle

Right Bank Regulator Adjustment Screw

Turn clockwise to increase intermediate pressure - counterclockwise to decrease intermediate pressure.

Knurled Adjustment Nut

Use flat blade screwdriver to turn knurled nut to left to lower pressure setting - to right to raise pressure setting.

Nitrogen Pressure Switches

Use 1/4" wrench to adjust

Oxygen and Nitrous Oxide Pressure Switches

Figure 15.
Pressure Switch Checking and Adjustment
3/ Maintenance

manifolds or between 275 psig and 295 psig for \( N_2 \) 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.

d. 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.

e. With the bleed valve open, readjust the bank regulator (intermediate pressure) to 200 psig ± 10 psig on \( O_2 \) and \( N_2O \) manifolds, or 400 psig ± 10 psig on \( N_2 \) manifolds.

B. Switch Set Too Low (as indicated in Step 3)

a. With the bleed valve open, turn the bank regulator adjustment screw to set the outlet pressure (on intermediate pressure gauge) between 150 psig and 155 psig on \( O_2 \) and \( N_2O \) manifolds or between 275 psig and 285 psig on \( N_2 \) manifolds - the green indicator light should be ON. Close the bleed valve.

b. Turn the knurled nut of the pressure switch to the right until the green light turns OFF and the red light turns ON. The pressure within the intermediate line may make it difficult to turn the knurled nut, if so, use a flat head screwdriver as a lever against the side of the switch with the blade on the knurled nut and carefully work the nut to the right.

NOTE: Nitrogen pressure switches have a \( \frac{1}{4} \)" hex adjustment nut (not a knurled nut).

c. Turn the bank regulator adjustment screw clockwise until the intermediate pressure reaches 180 psig to 200 psig on \( O_2 \) and \( N_2O \) manifolds (380 psig to 400 psig for \( N_2 \) manifolds) - green light should be on. Then, open the bleed valve and slowly turn the regulator adjustment screw counterclockwise until the red light turns screw counterclockwise until the red light turns ON and the 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 on \( O_2 \) and \( N_2O \) manifolds or between 275 psig and 295 psig on \( N_2 \) manifolds. If it is not within this range, readjust the switch slightly and check setting by raising and lowering the intermediate pressure as described above. Repeat as necessary until proper adjustment is made.

d. 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.

e. With bleed valve open, readjust the bank regulator (intermediate pressure) to 200 psig ± 10 psig on \( O_2 \) and \( N_2O \) manifolds, or 400 psig ± 10 psig on \( N_2 \) manifolds.

3.4 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.

Check Out Procedure:
Normal Manifold Pressure Settings

Nitrogen Manifold

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

Oxygen and Nitrous Oxide Manifolds

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

NOTE: See sections 3.2 and 3.3 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 on \( O_2 \) and \( N_2O \) manifolds (400 psig on \( N_2 \) manifolds) and the green light on the front panel is on. This condition is presented in the electrical schematic Figure 16.

2. Both header valves are in the open position.

3. Determine which bank is supplying gas to the delivery line. The spindle position on the shuttle valve will determine this. See Figure 6b. Check the shuttle valve spindle - the side (left or right) from which the spindle rod protrudes the least indicates the bank which is supplying gas. Refer to Figure 5.
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 3.5 will be of assistance in determining malfunctions in the switch over indicator circuit.

5. S-L-O-W-L-Y reopen the header valve closed previously. The following activities should then take place.

a. Bank pressure is re-established.
b. Intermediate line pressure is re-established at 200 psig on O₂ and N₂O manifolds (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. Check the position of the shuttle valve spindle rod. The bank which is supplying gas will be indicated by the side of the shuttle valve on which the spindle rod protrudes the least (See Figure 5). If this is the fullest bank* turn the corresponding header valve OFF until the shuttle valve switches. If gas is not being used, the bleed valve may have to be opened until intermediate line pressure drops enough to cause switch over. After switch over, close the bleed valve and slowly open the header valve.

*NOTE: For O₂ and N₂ manifolds the bank pressure gauge with lowest reading will indicate the bank having least gas. Nitrous oxide, however, is in liquid form in the cylinders (at above 800 psig). 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.
3/ Maintenance

3.5 Switch Over Indicator Circuit-Troubleshooting Information

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

See Section 3.4 for Switch Over Indicator Circuit Check-Out and section 3.7 for Switch Over Indicator Circuit repairs.

The troubleshooting table for the switch over alarm system is shown in Table 3. 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 16). 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.

### Table 3.

Troubleshooting Information
Switch Over Alarm System

<table>
<thead>
<tr>
<th>Condition</th>
<th>Red Lamp</th>
<th>Green Lamp</th>
<th>Left Intermediate Pressure</th>
<th>Right Intermediate Pressure</th>
<th>Possible component failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>2. OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>LOW</td>
<td>HIGH</td>
<td>1, 2</td>
</tr>
<tr>
<td>3. OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>HIGH</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>4. OFF</td>
<td>OFF</td>
<td>ON</td>
<td>HIGH</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>5. OFF</td>
<td>OFF</td>
<td>ON</td>
<td>LOW</td>
<td>HIGH</td>
<td>1, 2</td>
</tr>
<tr>
<td>6. OFF</td>
<td>ON</td>
<td>ON</td>
<td>LOW</td>
<td>HIGH</td>
<td>1, 2</td>
</tr>
<tr>
<td>7. OFF</td>
<td>ON</td>
<td>ON</td>
<td>HIGH</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>8. OFF</td>
<td>ON</td>
<td>ON</td>
<td>HIGH</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>9. ON</td>
<td>OFF</td>
<td>OFF</td>
<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>10. ON</td>
<td>OFF</td>
<td>OFF</td>
<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>11. ON</td>
<td>OFF</td>
<td>HIGH</td>
<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>12. ON</td>
<td>OFF</td>
<td>HIGH</td>
<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>13. ON</td>
<td>OFF</td>
<td>HIGH</td>
<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>14. ON</td>
<td>OFF</td>
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<td>1, 2</td>
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<td>15. ON</td>
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<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
<tr>
<td>16. ON</td>
<td>OFF</td>
<td>HIGH</td>
<td>LOW</td>
<td>LOW</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

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.
6. Left Intermediate Pressure switch in need of adjustment or defective - adjust or replace as required. See Pages 20 and 37.
7. Right Intermediate Pressure switch in need of adjustment or defective - adjust or replace as required. See Pages 20 and 37.
8. Incorrect lens position or improper wiring. See Page 41.
3/ Maintenance

How to use the troubleshooting table.

Compare the actual condition of the manifold with the possible condition listed in Table 3. The right side of the table lists the possible component failures by number, refer to the list of possible component failures for explanations.

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 a 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.

3.6 Pressure Switch Electrical Check Out

The troubleshooting information of section 3.5 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 31 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 16 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 3.19 to replace a defective pressure switch. See section 3.3 for Pressure Switch Checking and Adjustment.

3.7 Switch Over Indicator Circuit Repairs

An electrical schematic of the switch over indicator circuit is shown in Figure 16. The switch over indicator circuit wiring diagram with replacement parts is given in Figure 31 of Section 4, Illustrated Parts List.

Lamp Replacement

Lamps for the indicator lights are set deep in the lampholders. To remove these lamps, use a short (2") length of ½" 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 17 and 31 for proper assembly and electrical connections.
3/ Maintenance

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

The troubleshooting information of section 3.5 will be of assistance in determining relay malfunctions.

Relay Replacement Procedure:
1. Refer to Figure 31, page 41 for a wiring diagram and Figure 18 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 by pulling them off by hand or with a pliers.
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 3.4.

NOTE: The two blue wires on the relay are electrically the same point.
3/ Maintenance

3.8 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

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

Oxygen and Nitrous Oxide Manifold
Intermediate Pressure Switches 150-160 psig
Bank Regulators 200 psig
Delivery Line Regulator 50 psig

NOTE: See Sections 3.2 and 3.3 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 on O₂ and N₂O manifolds (400 psig on N₂ manifolds).

2. Both header valves are in the open position.

3. Determine which bank is supplying gas to the delivery line. The spindle position on the shuttle valve will determine this. See Figure 6b. Check the shuttle valve spindle - the side (left or right) from which the spindle rod protrudes the least indicates the bank which is supplying gas. Refer to Figures 5 and 11.

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 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. Remote alarms are activated if present.
e. The shuttle valve shuttles.

Check for leaks in the manifold. The shuttle valve is allowed to leak through the vent valve at a rate of 18cc/minute and through the end caps at a rate of 4cc/minute each with a pressure of 200 psig applied.

The troubleshooting information of the pneumatic circuit, Section 3.9, Page 28 will assist you in determining any malfunctions in the pneumatic switch over circuit.

5. 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 for 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.
# 3/ Maintenance

## 3.9 Pneumatic Circuit-Troubleshooting Information

<table>
<thead>
<tr>
<th>Condition</th>
<th>Possible Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure on Intermediate pressure gauge rises slowly.</td>
<td>Bank regulator seat is defective.</td>
<td>Repair or replace bank regulator.</td>
</tr>
<tr>
<td>Press on delivery line gauge rises slowly.</td>
<td>Delivery line regulator seat is defective.</td>
<td>Repair or replace regulator.</td>
</tr>
<tr>
<td>Intermediate line relief valve leaks.</td>
<td>Bank regulator is out of adjustment or defective. Relief valve is defective.</td>
<td>Readjust, repair or replace regulator. Replace relief valve.</td>
</tr>
<tr>
<td>Delivery line relief valve leaks.</td>
<td>Delivery line regulator is out of adjustment or defective. Relief valve is defective.</td>
<td>Readjust, repair or replace regulator. Replace relief valve.</td>
</tr>
<tr>
<td>Shuttle valve leaks.</td>
<td>Check valve is defective. Teflon seal is defective. Shuttle spool is defective.</td>
<td>Replace check valve. Repair or replace shuttle valve.</td>
</tr>
<tr>
<td>Bleed valve leaks.</td>
<td>Bleed valve is defective.</td>
<td>Replace bleed valve.</td>
</tr>
<tr>
<td>Pressure switch activation is erratic.</td>
<td>Pressure switch is defective.</td>
<td>Replace pressure switch.</td>
</tr>
<tr>
<td>Pressure gauge leaks, does not return to zero, or readings are inconsistent.</td>
<td>Gauge is defective.</td>
<td>Replace gauge.</td>
</tr>
</tbody>
</table>
3.10 Oxygen, Nitrous Oxide and Nitrogen 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 permanently if contaminated with oil or grease. DO NOT LUBRICATE REGULATOR PARTS.

Removal Procedure: (See Figures 19 and 20)

1. Refer to Table I, Page 4, 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 compression nut counterclockwise to release any pressure still present in the line. Then turn the outlet compression nut off completely.
4. While holding the regulator, turn the regulator inlet compression nut counterclockwise and remove the regulator.

Refer to Section 4 for bank regulator repair kits.

Installation Procedure:

NOTE: Transfer relief valve for oxygen and nitrous oxide regulators if a new regulator is used.

1. Place the regulator in position and start both the inlet and outlet compression nuts by turning them clockwise by hand.
2. While holding the regulator, tighten the regulator inlet compression nut. (Do not overtighten.)
3. While holding the connection fitting of the regulator, tighten the outlet compression nut. (Do not overtighten.)
4. The bank with the least gas* should be chosen as the PRIMARY SUPPLY side. Check the position of the shuttle valve spindle rod. The bank which is supplying gas will be indicated by the side of the shuttle valve on which the spindle rod protrudes the LEAST (See Figure 5). If this is the fullest bank* turn the corresponding header valve OFF until the shuttle valve switches. If gas is not being used, the bleed valve may have to be opened until intermediate line pressure drops enough to cause switch over. After switch over, close the bleed valve and **slowly open the header valve.**

*NOTE: For O₂ and N₂ manifolds the bank pressure gauge with lowest reading will indicate the bank having least gas. Nitrous oxide, however, is in liquid form in the cylinders (at above 800 psig). Therefore both bank pressure gauges may indicate the same pressure although the liquid level in one bank may be lower. Under such con-
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3.11 Oxygen, Nitrous Oxide and Nitrogen Delivery Line 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 permanently if contaminated with oil or grease. **DO NOT LUBRICATE REGULATOR PARTS.**

**Removal Procedure (See Figures 21 and 22):**

1. Refer to Section 2.4, Page 14, 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 top cover of the manifold may be removed for easier access.

3. While holding the connection fitting of the regulator, slowly turn the regulator outlet compression nut counterclockwise to release any pressure still present in the line. Turn the outlet connection nut off completely.

4. While holding the regulator, turn the regulator inlet compression nut counterclockwise and remove the regulator.

   Refer to Section 4 for delivery line regulator repair kits.

**Installation Procedure:**

1. Place the regulator in position and start both the inlet and outlet compression nuts by turning them clockwise by hand.

2. While holding the regulator, tighten the regulator inlet compression nut. (Do not overtighten.)

3. While holding the connection fitting of the regulator, tighten the outlet compression nut. (Do not overtighten.)

4. Refer to Section 2.4, Page 14, Bypass Mode of Operation and perform steps 1 through 11 of the Return to Normal Operation after Using the Bypass Mode.

5. Test the piping connections for leaks.
3/ Maintenance

Figure 21.
Oxygen and Nitrous Oxide Delivery Line Regulator Replacement

Figure 22.
Nitrogen Delivery Line Regulator Replacement
3.12 Shuttle Valve Replacement

Removal Procedure (See Figure 23):

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

1. Refer to Section 2.4, Page 14, 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 inlet connection fitting, slowly turn the inlet compression nut counterclockwise to release any pressure still present in the line, then turn the nut off completely.

4. The other shuttle valve outlet connection nut may be removed in the same manner as step 5.

5. While holding the shuttle valve outlet connection fitting, slowly turn the outlet compression nut counterclockwise to release any pressure still present in the line, then turn the nut off completely.

6. The other shuttle valve outlet connection nut may be removed in the same manner as step 5.

7. The shuttle valve may now be removed.

Installation Procedure:

1. Place the shuttle valve in position and start the outlet connection nuts by turning them clockwise by hand.

2. Start the inlet connection nuts in the same manner as step 1.

3. While holding the shuttle valve outlet connection fitting, tighten the outlet connection nut. (Do not overtighten.)

4. The other shuttle valve outlet connection nut may be tightened in the same manner as step 3.

5. While holding the shuttle valve inlet connection fitting, tighten the inlet connection nut. (Do not overtighten.)

6. The other shuttle valve inlet connection nut may be tightened in the same manner as step 5.

7. Refer to Section 2.4, Page 14, Bypass Mode of Operation and perform steps 1 through 11 of the Return to Normal Operation After Using the Bypass Mode.

8. Test the piping connections for leaks.
3.13 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 6b, Page 8.

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 25)

NOTE: The Check Valve(s) may be serviced only after the manifold is in the Bypass Mode of Operation, and perform steps 1 through 7, of the Use of Bypass Mode.

1. The top cover of the manifold may be removed for easier access.
2. While holding the check valve, turn the compression nut counterclockwise and remove the copper tubing.
3. While holding the inlet fitting, turn the check valve counterclockwise and remove it.

Installation Procedure:

1. Wrap 2 layers of teflon tape on the inlet fitting.
2. Install the replacement check valve.
3. While holding the inlet fitting, turn the check valve clockwise to tighten. Do not overtighten.
4. While holding the check valve, turn the compression nut clockwise and tighten the copper tubing.
5. Test the piping connections for leaks.
3.14 Intermediate Line Relief Valve Test
(See Figure 25)

To prevent damage to the delivery line regulator and the intermediate line pressure gauge, the relief valves on O\textsubscript{2} and N\textsubscript{2}O manifolds are set at 250 psig, while the N\textsubscript{2} 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 245 and 260 psig for O\textsubscript{2} and N\textsubscript{2}O manifolds or at 475 ± 24 psig on nitrogen manifolds.
3. The relief valve must be replaced if it fails to meet the specification. Refer to Section 3.15 page 34, Relief Valve Replacement-Intermediate Line.
4. Readjust the bank regulator. Refer to Section 3.2, Page 18, Regulator Adjustment.

3.15 Relief Valve Replacement - Intermediate Line

Removal procedure (See Figure 25):

1. Refer to Table 2, Page 17, 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.

NOTE: Nitrogen Unimatic II Intermediate Relief Valves have a slightly different configuration.
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3.16 Bank Pressure Gauge Replacement

Removal procedure (See Figure 26):

1. Refer to Table 2, page 17, 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 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. Perform the Pneumatic Switchover circuit checkout procedure.
9. Replace the top cover of the manifold.

3.17 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 3.23 for instructions.

Removal Procedure (See Figure 26):

1. After the manifold has been shut down the removal procedure may be started.
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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.

3.18 Intermediate Pressure Gauge Replacement

Removal Procedure (See Figure 27):
1. Refer to Table 2, Page 17, 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.

NOTE: The pressure switch must be removed before the intermediate pressure gauge can be replaced.

4. Refer to Section 3.19, Page 37, Pressure Switch Replacement and follow the removal procedure.

5. After the pressure switch has been removed, hold the connection fitting while turning the compression nut counterclockwise and remove the gauge connecting line.

6. Remove the gauge mounting braces.

7. The gauge may be removed from the front of the 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. Refer to Section 3.19, Page 37, Pressure Switch Replacement and follow the installation procedure.
8. Test the piping connections for leaks.
3.19 Pressure Switch Replacement

Removal Procedure (See Figures 27 and 28):

1. Refer to Table 2, Page 17, 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 Checking and Adjustment Procedure of Section 3.3, Page 20.
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Figure 28.
Oxygen/Nitrous Oxide Manifold:
Pressure Switch Replacement

Figure 29.
Delivery Line Relief Valve Replacement
3/ Maintenance

3.20 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 3.23, for instructions.

Removal Procedure (See Figure 30):
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. The delivery pressure gauge line may be removed for easier access.
4. Remove the relief line.
5. Remove the relief line fitting.
6. Turn the relief valve counterclockwise and 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. Replace the delivery pressure gauge line if it was removed and pressure test the connections.

3.21 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 3.23 for instructions.

Removal Procedure (See Figure 30):
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 delivery line may be removed for easier access.
4. Remove the small gas discharge tubing connected to the bleed valve if present.
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 if present.
4. Replace the bypass delivery line if it was removed.
5. Test the piping connections for leaks.
6. Replace the bottom cover.

3.22 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 3.23, for instructions.

Removal Procedure (See Figure 31):
1. After the manifold has been shut down the removal procedure may be started.
2. While holding the bypass valve, turn each of the three compression nuts counterclockwise and remove the bypass valve.

Installation Procedure:
1. While holding the bypass valve turn each of the three compression 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.
3.23 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 be 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.
### 4/ Illustrated Parts List

**Pressure Switches**
(Including leads and female mating connector w/sockets)
- 0208-5132-700 for O₂ and N₂O
- 0221-5397-800 for N₂

**Lamp**
- 0408-2553-300

**Use**
IA” ID x 2” length of thin walled rubber tubing to unscrew and replace bulbs.

---

**Relay**
- 0208-2927-300

**Wire Harness**
(Includes wires and wire terminals only)
- 0208-6098-700

**Terminal Block**
- 0208-0229-300

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**Figure 31.**
Switch Over Indicator Circuit
Wiring Diagram and Replacement parts
Legend for Figure 32.
Repair Parts
1. Diaphragm 0830-1603-300
2. Rubber Seat 0830-1731-300
3. Metal Seat 0830-1732-300
4. O-ring 0830-1367-300
5. Screen 0830-2382-300

Unimatic II
Oxygen, Nitrous Oxide Delivery Line Regulator
0306-1136-800

Unimatic II
Oxygen, Nitrous Oxide Bank Regulator
0306-1135-400
Teflon Seat 0830-4025-300

Figure 32.
Unimatic II
Nitrogen Bank Regulator
0306-1102-300
Repair Kit 0206-5208-300
(Includes O-rings, slip rings, diaphragm, and seat assembly.)

Unimatic II
Nitrogen Delivery Line Regulator
0306-1117-800
Repair Kit 0206-5213-300
(Includes diaphragm, piston, screen, and O-ring.)
Figure 34.
O₂ and N₂O Unimatic II Manifold
## Illustrated Parts List

### Legend for Figure 34.

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty.</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 3000 PSI Gauge</td>
<td>2</td>
<td>0265-8535-300</td>
</tr>
<tr>
<td>2. 100 PSI Gauge</td>
<td>1</td>
<td>0205-8223-300</td>
</tr>
<tr>
<td>3. Bank Pressure Gauge Tubing</td>
<td>2</td>
<td>0213-7870-300</td>
</tr>
<tr>
<td>4. Delivery Pressure Gauge Tubing</td>
<td>1</td>
<td>0213-7892-300</td>
</tr>
<tr>
<td>5. Elbow ¾ MNPT-¾ OD Tube</td>
<td>1</td>
<td>0213-4044-300</td>
</tr>
<tr>
<td>6. O₂, N₂O Line Regulator</td>
<td>1</td>
<td>0306-1136-800</td>
</tr>
<tr>
<td>7. Regulator Support Block</td>
<td>3</td>
<td>0221-5361-525</td>
</tr>
<tr>
<td>8. Check Valve</td>
<td>2</td>
<td>0207-8023-300</td>
</tr>
<tr>
<td>9. Straight Connector ½ FNPT-½ OD Tube</td>
<td>2</td>
<td>0213-4049-300</td>
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<tr>
<td>10. Left Shuttle Output Tube</td>
<td>1</td>
<td>0213-1431-500</td>
</tr>
<tr>
<td>11. Right Shuttle Output Tube</td>
<td>1</td>
<td>0213-1430-500</td>
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<tr>
<td>12. O₂ N₂O Bleed Valve</td>
<td>1</td>
<td>0207-6033-300</td>
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<tr>
<td>13. Straight Connector ¾ MNPT-¾ OD Tube</td>
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<td>0213-4062-325</td>
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<td>14. Outlet Block</td>
<td>1</td>
<td>0221-5387-701</td>
</tr>
<tr>
<td>15. Straight Connector ½ MNPT-½ OD Tube</td>
<td>1</td>
<td>0213-4046-300</td>
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<tr>
<td>16. 75 PSI Relief Valve</td>
<td>1</td>
<td>0207-8219-300</td>
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<tr>
<td>17. Elbow ¼ MNPT to ¼ FNPT</td>
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<td>0213-6132-300</td>
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<tr>
<td>18. Union Half ¼ 45° Flare ¼ MNPT</td>
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<td>0213-4236-300</td>
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<tr>
<td>19. 45° Flare Nut ½ SAE</td>
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<td>0213-4210-300</td>
</tr>
<tr>
<td>20. Straight Connector ¾ MNPT-¾ OD Tube</td>
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<td>0213-4048-300</td>
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<td>21. Shuttle Valve</td>
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<td>0221-5399-800</td>
</tr>
<tr>
<td>22. Straight Connector ½ MNPT - ¼ OD Tube</td>
<td>2</td>
<td>0213-4047-300</td>
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<tr>
<td>23. 400 PSI Gauge</td>
<td>2</td>
<td>0205-6256-300</td>
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<tr>
<td>24. O₂, N₂O Pressure Switch Assembly</td>
<td>2</td>
<td>0208-5132-700</td>
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<tr>
<td>26. See inlet assemblies and parts breakdown page 52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27. Hex Socket Plug ¾ MNPT</td>
<td>2</td>
<td>0413-3512-325</td>
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<tr>
<td>28. High Pressure O₂ Check Valve</td>
<td>4</td>
<td>0207-8025-800</td>
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<td>High Pressure N₂O Check Valve</td>
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<td>0207-8034-800</td>
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<td>29. Right Regulator Output Tube</td>
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<td>0221-5375-701</td>
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<tr>
<td>30. O₂, N₂O Bank Regulator</td>
<td>2</td>
<td>0306-1135-400</td>
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<tr>
<td>31. Relief Valve 250 PSI</td>
<td>2</td>
<td>0207-8218-300</td>
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<td>32. Left Regulator Output Tube</td>
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<td>33. Bypass Valve 3 Way ¾ OD Tube</td>
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<td>0207-6024-300</td>
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<tr>
<td>34. Bypass Tube</td>
<td>1</td>
<td>0213-1432-500</td>
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Figure 35.
N2 Unimatic II Manifold
<table>
<thead>
<tr>
<th>Description</th>
<th>Qty.</th>
<th>Part No.</th>
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</thead>
<tbody>
<tr>
<td>1. 3000 PSI Gauge</td>
<td>2</td>
<td>0205-8535-300</td>
</tr>
<tr>
<td>2. 400 PSI Gauge</td>
<td>1</td>
<td>0205-8258-300</td>
</tr>
<tr>
<td>3. Bank Pressure Gauge Tubing</td>
<td>2</td>
<td>0213-7870-300</td>
</tr>
<tr>
<td>4. Delivery Pressure Gauge Tubing</td>
<td>1</td>
<td>0213-7892-300</td>
</tr>
<tr>
<td>5. Elbow ¾ MNPT ½ OD</td>
<td>1</td>
<td>0213-4099-300</td>
</tr>
<tr>
<td>6. N₂ Line Regulator</td>
<td>1</td>
<td>0306-1117-800</td>
</tr>
<tr>
<td>7. Regulator Support Block</td>
<td>3</td>
<td>0221-5361-525</td>
</tr>
<tr>
<td>8. Check Valve</td>
<td>2</td>
<td>0207-8013-300</td>
</tr>
<tr>
<td>9. Straight Connector ¾ FNPT - ¾ OD Tube</td>
<td>2</td>
<td>0213-4049-300</td>
</tr>
<tr>
<td>10. Left Shuttle Output Tube</td>
<td>1</td>
<td>0213-1431-500</td>
</tr>
<tr>
<td>11. Right Shuttle Output Tube</td>
<td>1</td>
<td>0213-1430-500</td>
</tr>
<tr>
<td>12. N₂ Bleed Valve</td>
<td>1</td>
<td>0207-6054-300</td>
</tr>
<tr>
<td>13. Straight Connector ¼ MNPT - ¾ OD Tube</td>
<td>3</td>
<td>0213-4082-325</td>
</tr>
<tr>
<td>14. Outlet Block</td>
<td>1</td>
<td>0221-5387-701</td>
</tr>
<tr>
<td>15. Straight Connector ¾ MNPT - ¾ OD Tube</td>
<td>2</td>
<td>0213-4046-300</td>
</tr>
<tr>
<td>16. 225 PSI Relief Valve</td>
<td>1</td>
<td>0207-8214-300</td>
</tr>
<tr>
<td>17. Elbow ¼ MNPT to ¼ FNPT</td>
<td>2</td>
<td>0213-6132-300</td>
</tr>
<tr>
<td>18. Union Half ¼ 45° Flare ¾ MNPT</td>
<td>1</td>
<td>0213-4236-300</td>
</tr>
<tr>
<td>19. 45° Flare Nut ½ SAE</td>
<td>1</td>
<td>0213-4210-300</td>
</tr>
<tr>
<td>20. Straight Connector ¼ MNPT - ¾ OD Tube</td>
<td>4</td>
<td>0213-4048-300</td>
</tr>
<tr>
<td>21. Shuttle Valve</td>
<td>1</td>
<td>0221-5399-800</td>
</tr>
<tr>
<td>22. Straight Connector ¼ MNPT - ¾ OD Tube</td>
<td>2</td>
<td>0213-4047-300</td>
</tr>
<tr>
<td>23. 600 PSI Gauge</td>
<td>2</td>
<td>0205-8272-300</td>
</tr>
<tr>
<td>24. Tee ¾ FNPT</td>
<td>2</td>
<td>0213-6114-300</td>
</tr>
<tr>
<td>25. N₂ Pressure Switch Assembly</td>
<td>2</td>
<td>0221-5397-800</td>
</tr>
<tr>
<td>26. See inlet assemblies and parts breakdown page</td>
<td>2</td>
<td>0413-3512-325</td>
</tr>
<tr>
<td>27. Hex Socket Plug ¾ MNPT</td>
<td>2</td>
<td>0207-8003-325</td>
</tr>
<tr>
<td>28. High Pressure N₂ Check Valve</td>
<td>4</td>
<td>0221-5375-701</td>
</tr>
<tr>
<td>29. Right Regulator Output Tube</td>
<td>1</td>
<td>0221-5375-701</td>
</tr>
<tr>
<td>30. N₂ Bank Regulator</td>
<td>2</td>
<td>0306-1102-300</td>
</tr>
<tr>
<td>31. Left Regulator Output Tube</td>
<td>1</td>
<td>0221-5375-701</td>
</tr>
<tr>
<td>32. Bypass Valve 3 Way ½ OD Tube</td>
<td>1</td>
<td>0207-6024-300</td>
</tr>
<tr>
<td>33. Bypass Tube</td>
<td>1</td>
<td>0213-1432-500</td>
</tr>
<tr>
<td>34. Relief Valve 475 psig</td>
<td>2</td>
<td>0207-8213-300</td>
</tr>
</tbody>
</table>
Figure 36.
Free Standing Unimatic II Manifold
# Illustrated Parts List

## Table 5.
Free Standing
Unimatic II
Manifolds

<table>
<thead>
<tr>
<th>Replacement Part/Stock No.</th>
<th>QTY.</th>
<th>Gas/Cylinder/Stock No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bolt ( \frac{3}{8} \times \frac{3}{8} )</td>
<td>8</td>
<td>4 0321-7412-910</td>
</tr>
<tr>
<td>2. BRKT, HDR SGL</td>
<td>11</td>
<td>6 0811-3979-510</td>
</tr>
<tr>
<td>3. BRKT, HDR DBL</td>
<td>13</td>
<td>14 0214-3914-510</td>
</tr>
<tr>
<td>4. Adapter</td>
<td>17</td>
<td>16 0204-0850-525</td>
</tr>
<tr>
<td>5. Check Valve, O₂</td>
<td>19</td>
<td>18 0207-8025-800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 0207-8034-800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 0207-8033-800</td>
</tr>
<tr>
<td>6. Coupling 1( \frac{3}{4} )</td>
<td>20</td>
<td>19 0221-4293-300</td>
</tr>
<tr>
<td>7. Leg L.H.</td>
<td>21</td>
<td>17 0221-5361-710</td>
</tr>
<tr>
<td>8. Leg R.H.</td>
<td>22</td>
<td>16 0221-5380-710</td>
</tr>
<tr>
<td>9. Screw 1/4-20</td>
<td>23</td>
<td>15 0144-2236-206</td>
</tr>
<tr>
<td>11. Washer 3/8 Lok</td>
<td>25</td>
<td>13 0202-3032-360</td>
</tr>
<tr>
<td>12. Channel HDR</td>
<td>26</td>
<td>12 0214-3919-510</td>
</tr>
<tr>
<td>14. Nut 1/4-20</td>
<td>28</td>
<td>10 0402-8000-300</td>
</tr>
<tr>
<td>15. Pigtail, Under Cabinet</td>
<td>29</td>
<td>9 0221-5392-725</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 0221-5393-725</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 0221-5396-701</td>
</tr>
<tr>
<td>16. Pigtail, Down and Side</td>
<td>30</td>
<td>6 0221-5282-701</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 0221-5538-725</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 0221-5394-701</td>
</tr>
<tr>
<td>17. Header w/two check valves</td>
<td>31</td>
<td>3 0221-5525-800</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 0221-5525-804</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 0221-5398-800</td>
</tr>
<tr>
<td>18. Header w/three check valves</td>
<td>32</td>
<td>2 0221-5525-801</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 0221-5525-805</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 0221-5398-801</td>
</tr>
<tr>
<td>19. Gland, Blind</td>
<td>33</td>
<td>8 0829-3459-300</td>
</tr>
<tr>
<td>20. Nut</td>
<td>34</td>
<td>7 0204-8670-525</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 0221-5382-710</td>
</tr>
</tbody>
</table>

---

**Note:** The table includes parts and quantities for various components of the Unimatic II manifolds, with specific stock numbers provided for each item.
NOTE: HDR BRKTs (#3 and 4) are used on manifolds of 8 to 14 cylinders - Wall BRKTs (#s 11 and 12) are used on manifolds of 16 cylinders and larger.

Figure 37.
## Table 6.
Wall Mounted
Unimatic II
Manifolds

<table>
<thead>
<tr>
<th>Replacement Part/Stock No.</th>
<th>Gas/Cylinder/Stock No.</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Wall Anchor</strong></td>
<td>0221-5386-710</td>
<td>2</td>
</tr>
<tr>
<td><strong>2. Bolt ¾x¾</strong></td>
<td>0144-2245-414</td>
<td>8</td>
</tr>
<tr>
<td><strong>3. BRKT, HDR SGL</strong></td>
<td>0214-3907-510</td>
<td>2</td>
</tr>
<tr>
<td><strong>4. BRKT, HDR DBL</strong></td>
<td>0214-3814-510</td>
<td>2</td>
</tr>
<tr>
<td><strong>5. Adapter</strong></td>
<td>0204-0650-525</td>
<td>2</td>
</tr>
<tr>
<td><strong>6. Check Valve,</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O₂</td>
<td>0207-8025-800</td>
<td>2</td>
</tr>
<tr>
<td>N₂O</td>
<td>0207-8034-800</td>
<td>2</td>
</tr>
<tr>
<td>N₂</td>
<td>0207-8033-800</td>
<td>2</td>
</tr>
<tr>
<td><strong>7. Coupling 1½</strong></td>
<td>0213-4293-300</td>
<td>1</td>
</tr>
<tr>
<td><strong>8. Angle, Leg Sub</strong></td>
<td>0221-5364-510</td>
<td>2</td>
</tr>
<tr>
<td><strong>9. Bolt ¾x¾</strong></td>
<td>0144-2249-208</td>
<td>2</td>
</tr>
<tr>
<td><strong>10. Washer ¾ Lok</strong></td>
<td>0202-3032-360</td>
<td>2</td>
</tr>
<tr>
<td><strong>11. BRKT, Wall</strong></td>
<td>0221-5245-510</td>
<td>2</td>
</tr>
<tr>
<td><strong>12. BRKT, Wall/End</strong></td>
<td>0221-5246-510</td>
<td>2</td>
</tr>
<tr>
<td><strong>13. Pigtail, Under Cabinet,</strong></td>
<td>0221-5392-725</td>
<td>2</td>
</tr>
<tr>
<td>O₂</td>
<td>0221-5393-725</td>
<td>2</td>
</tr>
<tr>
<td>N₂O</td>
<td>0221-5396-701</td>
<td>2</td>
</tr>
<tr>
<td>N₂</td>
<td>0221-5397-701</td>
<td>2</td>
</tr>
<tr>
<td><strong>14. Pigtail, Down and Side,</strong></td>
<td>0221-5282-701</td>
<td>2</td>
</tr>
<tr>
<td>O₂</td>
<td>0221-5358-725</td>
<td>4</td>
</tr>
<tr>
<td>N₂O</td>
<td>0221-5394-701</td>
<td>2</td>
</tr>
<tr>
<td>N₂</td>
<td>0221-5399-800</td>
<td>2</td>
</tr>
<tr>
<td><strong>15. Header w/two check valves,</strong></td>
<td>0221-5525-800</td>
<td>2</td>
</tr>
<tr>
<td>O₂</td>
<td>0221-5525-804</td>
<td>2</td>
</tr>
<tr>
<td>N₂O</td>
<td>0221-5528-800</td>
<td>2</td>
</tr>
<tr>
<td>N₂</td>
<td>0221-5539-801</td>
<td>2</td>
</tr>
<tr>
<td><strong>16. Header w/three check valves,</strong></td>
<td>0221-5525-501</td>
<td>2</td>
</tr>
<tr>
<td>O₂</td>
<td>0221-5525-805</td>
<td>2</td>
</tr>
<tr>
<td>N₂O</td>
<td>0221-5528-801</td>
<td>2</td>
</tr>
<tr>
<td>N₂</td>
<td>0204-6670-525</td>
<td>2</td>
</tr>
<tr>
<td><strong>17. Gland, Blind</strong></td>
<td>0204-6670-525</td>
<td>2</td>
</tr>
<tr>
<td><strong>18. Nut</strong></td>
<td>0204-6670-525</td>
<td>2</td>
</tr>
</tbody>
</table>

4/ Illustrated Parts List
### Table 7.
Parts Breakdown of Inlet Assemblies

<table>
<thead>
<tr>
<th>Parts Description</th>
<th>Qty.</th>
<th>Part Number</th>
<th>(O_2) Right Inlet Assembly</th>
<th>(O_2) Left Inlet Assembly</th>
<th>(N_2O) Right Inlet Assembly</th>
<th>(N_2O) Left Inlet Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulator Support Block</td>
<td>1</td>
<td>0221-5361-525</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Straight connector (\frac{1}{4}) MNPT-%OD tube</td>
<td>1</td>
<td>0213-4062-325</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Left Header Valve</td>
<td>1</td>
<td>0221-5391-725</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Right Header Valve</td>
<td>1</td>
<td>0221-5390-725</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Stem and Handwheel Assembly</td>
<td>1</td>
<td>0829-4762-325</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Disc and Plug Assembly</td>
<td>1</td>
<td>0829-4730-325</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hex Socket Plug (\frac{3}{8}) MNPT</td>
<td>1</td>
<td>0413-3512-325</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>High Pressure (O_2) Check Valve</td>
<td>2</td>
<td>0207-8025-800</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Pressure (N_2O) Check Valve</td>
<td>2</td>
<td>0207-8034-800</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>High Pressure (N_2) Check Valve</td>
<td>2</td>
<td>0207-8033-800</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
4/ Illustrated Parts List

**OXYGEN**

*USE NO OIL*

0405-9962-300

**NORMAL BY-PASS SERVICE USE ONLY**

See O & M Manual

0405-9961-300

**NITROUS OXIDE**

*USE NO OIL*

0405-9963-300

<table>
<thead>
<tr>
<th>LEFT BANK PRESSURE</th>
<th>USE NO OIL</th>
<th>DELIVERY PRESSURE</th>
<th>USE NO OIL</th>
<th>RIGHT BANK PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GREEN LIGHT INDICATES NORMAL OPERATION</td>
<td>RED LIGHT INDICATES SECONDARY SUPPLY IS IFING USED</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

0405-9959-300

**Figure 38.**

Instruction and Information Labels

0205-6534-300

For O₂, N₂O, and N₂
4/ Illustrated Parts List

![Diagram of Latch Plate and Lock Knob with Keys]

- **Latch Plate** 0203-2457-300
- **Lock Knob w/Keys** 0203-2456-300

**Figure 39.**
Cabinet Door Knob and Latch
<table>
<thead>
<tr>
<th>Regional Service Offices</th>
<th>International</th>
<th>National Service Center</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eastern Region</strong></td>
<td><strong>Europe, Africa</strong></td>
<td><strong>Ohmeda</strong></td>
</tr>
<tr>
<td>440 Sylvan Avenue</td>
<td>Elizabeth Way</td>
<td>4507 C Mills Place</td>
</tr>
<tr>
<td>Englewood Cliffs NJ 07632</td>
<td>Harlow</td>
<td>Atlanta GA 30336</td>
</tr>
<tr>
<td>800 222 0443 Outside NJ</td>
<td>Essex CM19 5AB England</td>
<td>800 241 9442</td>
</tr>
<tr>
<td>201 569 1670 In NJ</td>
<td>Telex 817566</td>
<td>404 691 3635</td>
</tr>
</tbody>
</table>

| **Midwestern Region**   | **Latin America, Caribbean** | **Canadian Region/Service Office** |
| 1801 W 16th St          | 10700 N Kendall Dr Suite 301 | 172 Belfield Road       |
| Broadview IL 60163      | Miami FL 33176  Telex 810 8486057 | Rexdale Ontario M9W 1H1 |
| 800 372 5867            |                          | 416 243 9633           |

| **Pacific Region**       | **Southeast Asia**      | **Telex 06989-362**    |
| Suite 466 5635 W Las Positas Blvd | #06 01 Eng Cheong Tower |                  |
| Pleasanton CA 94577      | 5611 N Bridge Road      |                      |
| 800 227 2654 Outside CA | Singapore 0719 Telex RS35276 |                  |
| 800 772 3517 In CA      |                          |                      |

| **Southeastern Region**  | **Middle East, Nigeria** | **Telex 8154664**    |
| 4565 Winters Chapel Rd  | Elizabeth Way           |                      |
| Atlanta GA 30360        | Harlow Essex            |                      |
| 800 241 4300 Outside GA | CM19 5 AB England      |                      |
| 404 440 7990 In GA     | Telex 817566             |                      |

| **Southwestern Region**  |                          |                      |
| 324 Exchange Drive      |                          |                      |
| Arlington TX 76011      |                          |                      |
| 800 433 S070 Outside TX |                          |                      |
| 800 772 5420 In TX      |                          |                      |