Price $ 5.00

GARDNER-DENVER®

13-9-632
2nd Edition

"ECM"

ELECTRA-SAVER II®

STATIONARY

BASE-MOUNTED

COMPRESSOR

Models

60 HP
ECMQKB, ECMSKB

75 HP
ECMQLB, ECMSLB

13-9-632

Service Manual

COOPER INDUSTRIES

INDUSTRIAL MACHINERY

GARDNER-DENVER®

WARRANTY
ROTARY SCREW COMPRESSORS
EC ELECTRA-SAVER II®
EA ELECTRA-SAVER®
EB, ET ELECTRA-SCREW®
SE, ST PACKAGES

A warranty registration card is provided with each machine. The card must be completed by the purchaser and mailed (card is preaddressed and postage paid) within ten days after machine start up in order to validate this warranty.

Gardner-Denver/Industrial Machinery (the "Company") warrants to each original retail purchaser ("Purchaser") of its products from the Company or its authorized distributors that such products will be free from defects in material and workmanship caused by Company and shall be warranted as follows:

BASIC COMPRESSOR AIR ENDS

Basic compressor air ends, consisting of all parts within and including the compressor cylinder and gear housing, are warranted for 24 months from date of initial use or 27 months from date of shipment to the first purchaser, whichever occurs first.

The Company will furnish, at its option, air end repairs, a remanufactured replacement air end, or a new replacement air end, FOB factory for any air end which in its judgment proved not to be as warranted within the applicable period.

Purchaser must return, transportation charges prepaid, any air end claimed to be not as warranted to a Gardner-Denver factory. Any disassembly or partial disassembly of the air end, or failure to return the "unopened" air end per Company instructions, will be cause for denial of warranty.

ELECTRIC MOTORS

Electric motors, when specified and furnished by the Company, are warranted for 12 months from date of initial use or 15 months from date of shipment to the first purchaser, whichever occurs first.

The motor manufacturer or authorized service shop will provide at its option, motor repairs or replacement motor FOB manufacturer's location for any motor which in the manufacturer's judgment proves not to be as warranted within the applicable period.

ENGINES

Engines are warranted to the extent of the original manufacturer's warranty to the Company.

OTHER COMPONENTS

All other components are warranted for 12 months from date of initial use or 15 months from date of shipment to first purchaser, whichever occurs first.

The Company will furnish at its option FOB Company location repairs or replacement parts for any component which in the Company's judgment proved not to be as warranted within the applicable period.

GENERAL PROVISIONS AND LIMITATIONS

No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judement, as to affect the product adversely.

2. Any product which has, in the Company's judgment been subject to negligence, accident, improper storage, or improper installation or application.

3. Any product which has not been operated or maintained in accordance with normal practice and with the recommendations of the Company.

4. Components or accessories manufactured, warranted and serviced by others, except as separately rated.

5. Any reconditioned or prior owned product.

Claims for items descibed in (4) above should be submitted directly to the manufacturer.

The Company's obligation under this warranty is limited to repair or replacement, at its option during normal business hours at an authorized service facility of the Company, of any part which in its judgment proved not to be as warranted within the applicable Warranty Period. The Company may require the return of any part claimed not to be as warranted to one of its facilities as designated by Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

The Company will provide labor for repair or replacement of any product or part thereof which in the Company's judgment is proved not to be as warranted, by Company representative up to the amount specified in the Company's labor rate schedules, or up to the amount the Company determines is reasonable. Labor costs in excess of the Company rate schedule amounts or labor provided by unauthorized service personnel is not provided for by this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components thereof.

DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 days after the date upon which product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

FOREWARD

Gardner-Denver® *Electra-Saver II®* compressors are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine, the owner must exercise care in its operation and maintenance. This book is written to give the operator and the maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.

DANGER — *Failure to observe a DANGER notice could result in injury to, or death of personnel.*

WARNING — *Failure to observe a WARNING notice could result in damage to equipment.*

CAUTION — *CAUTION notices set forth general reminders of good safety practice, or direct attention to unsafe practices.*

NOTE — Information furnished in a NOTE will include general information or the highlights of a procedure.

This manual covers the following *Electra-Saver II®* models with the exclusive Intensive Injection Oil System and previous *Electra-Screw®* models with conventional injection.

THIS BOOK COVERS THE FOLLOWING MODELS

HP	PSIG	Air Cooled	Water Cooled
60	100 125	ECMQKB	ECMSKB
75	100 125 150	ECMQLB	ECMSLB

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SECTION 1

GENERAL INFORMATION

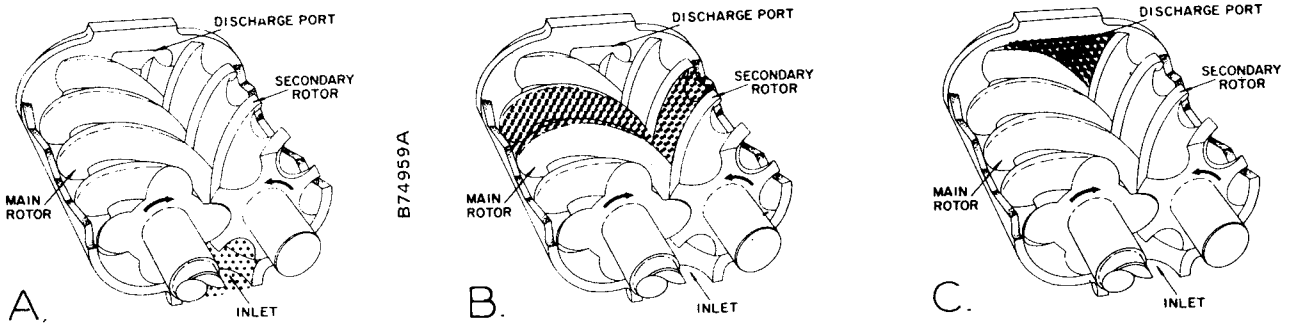

FIGURE 1-1. — COMPRESSION CYCLE

COMPRESSOR — The *Gardner-Denver*® "ECM" *Electra-Saver II*® compressor is a single stage, positive displacement rotary machine using meshing helical rotors to effect compression. Both rotors are supported between high capacity roller bearings located outside the compression chamber. Single width cylindrical roller bearings are used at the inlet end of the rotors to carry part of the radial loads. Tapered roller bearings at the discharge end locate each rotor axially and carry all thrust loads and the remainder of the radial loads.

COMPRESSION PRINCIPLE (Figure 1-1) — Compression is accomplished by the main and secondary rotors synchronously meshing in a one-piece cylinder. The main rotor has four (4) helical lobes 90° apart. The secondary rotor has six (6) matching helical grooves 60° apart to allow meshing with main rotor lobes.

The air inlet port is located on top of the compressor cylinder near the drive shaft end. The discharge port is near the bottom at the opposite end of the compressor cylinder. *Figure 1-1 is an inverted view to show inlet and discharge ports.* **The compression cycle** begins as rotors unmesh at the inlet port and air is drawn into the cavity between the main rotor lobes and secondary rotor grooves (A). When the rotors pass the inlet port cutoff, air is trapped in the interlobe cavity and flows axially with the meshing rotors (B). As meshing continues, more of the main rotor lobe enters the secondary rotor groove, normal volume is reduced and pressure increases. Oil is injected into the cylinder by proprietary means to remove the heat of compression and seal internal clearances. The *Electra-Saver II* utilizes *Gardner-Denver's* exclusive Intensive Injection System to feed coolant into the compression chamber through dozens of small injection ports. This greatly improves the rate of heat exhange between the air/oil mixture with most of the injection and heat transfer occuring where the air has reached its highest pressure and greatest temperature. Hot spots in the compression cycle are eliminated. Volume reduction and pressure increase continues until the air/oil mixture trapped in the interlobe cavity by the rotors passes the discharge port and is released to the oil reservoir (C). Each rotor cavity follows the same "fill-compress-discharge" cycle in rapid succession to produce a discharge air flow that is continuous, smooth and shock-free.

AIR FLOW IN THE COMPRESSOR SYSTEM (Figure 1-5)— Air enters the air filter and passes through the inlet unloader valve to the compressor. After compression, the air/oil mixture passes into the oil reservoir where most of the entrained oil is removed by velocity change and impingement and drops back into the reservoir. The air and remaining oil then passes through the oil separator; the separated oil is returned to the system through tubing connecting the separator and compressor. The air passes through the reservoir discharge manifold, minimum pressure valve and discharge check valve to the plant air lines.

LUBRICATION, COOLING AND SEALING—Oil is forced by air pressure from the oil reservoir through the oil cooler, thermostatic mixing valve, and oil filter and discharges into the compressor main oil gallery. A portion of the oil is directed through internal passages to the bearings, gears and shaft oil seal. The balance of the oil is injected directly into the compression chamber to remove heat of compression, seal internal clearances and lubricate the rotors.

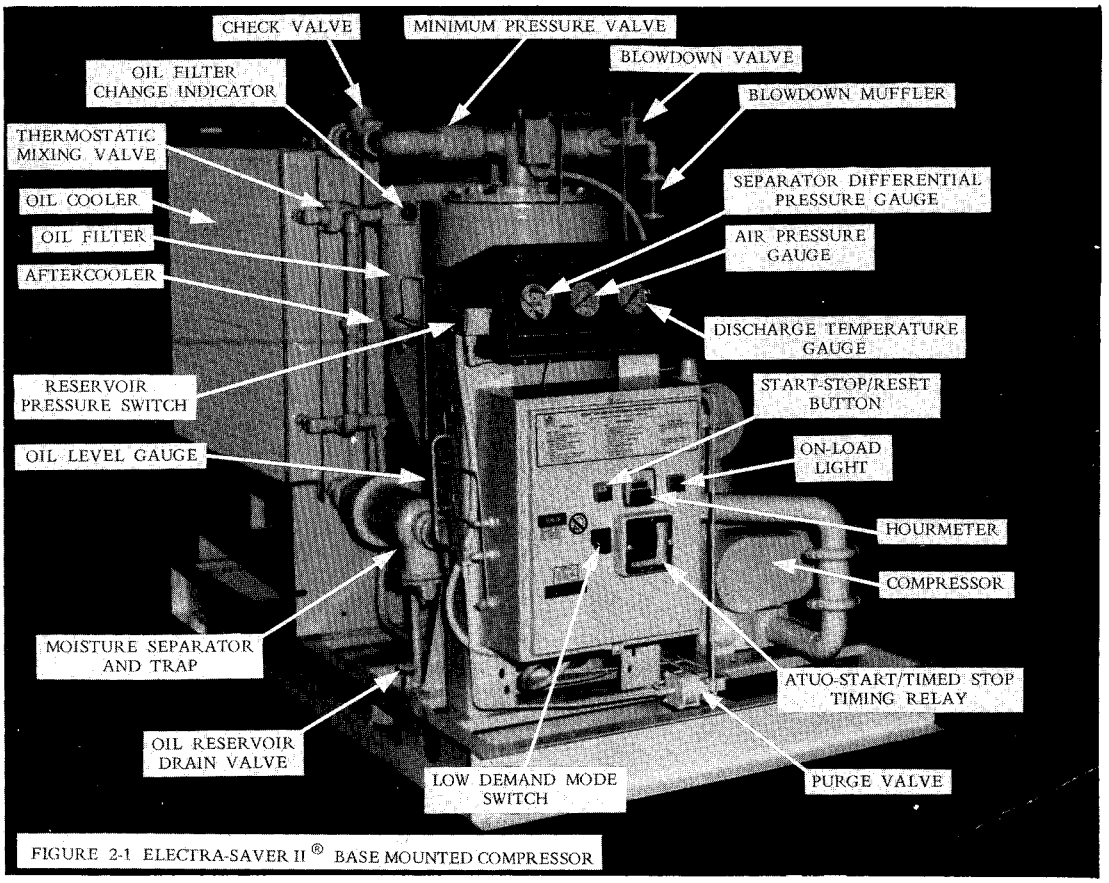

FIGURE 2-1 ELECTRA-SAVER II ® BASE MOUNTED COMPRESSOR

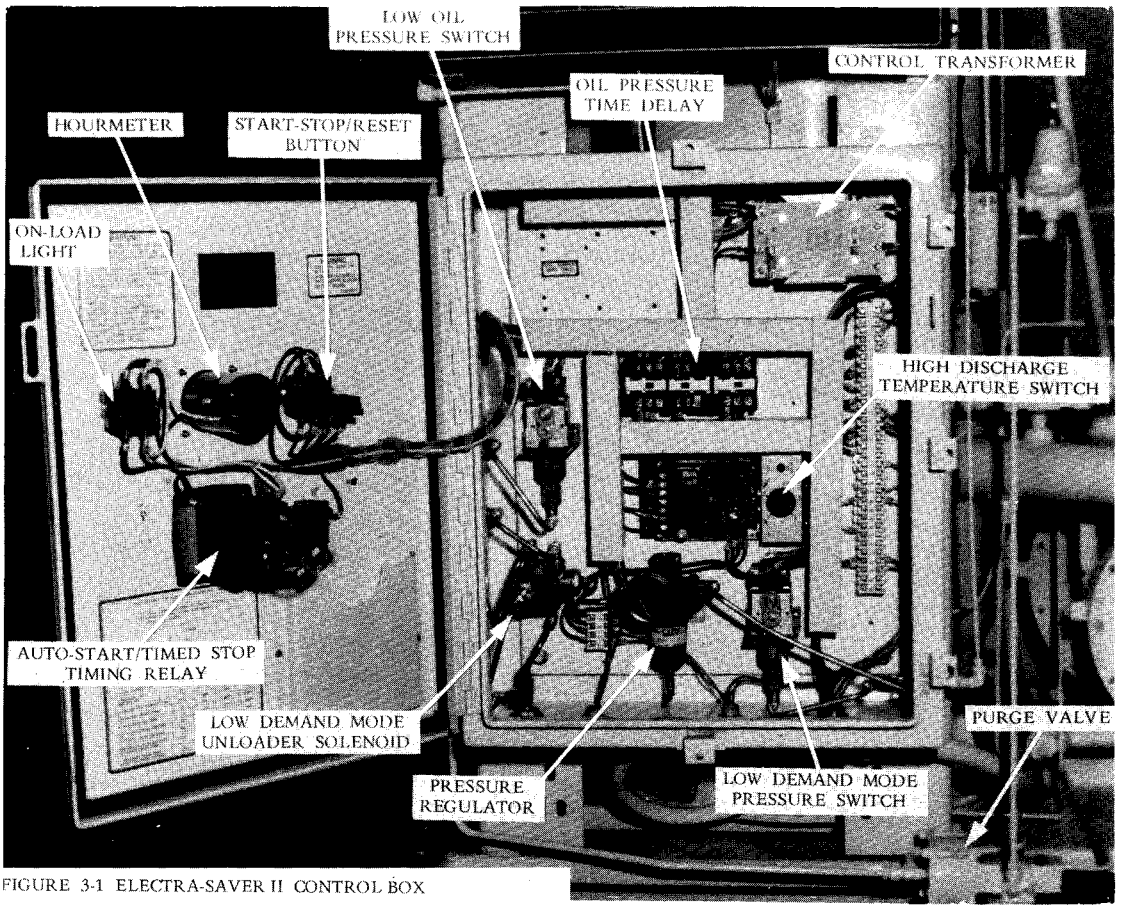

FIGURE 3-1 ELECTRA-SAVER II CONTROL BOX

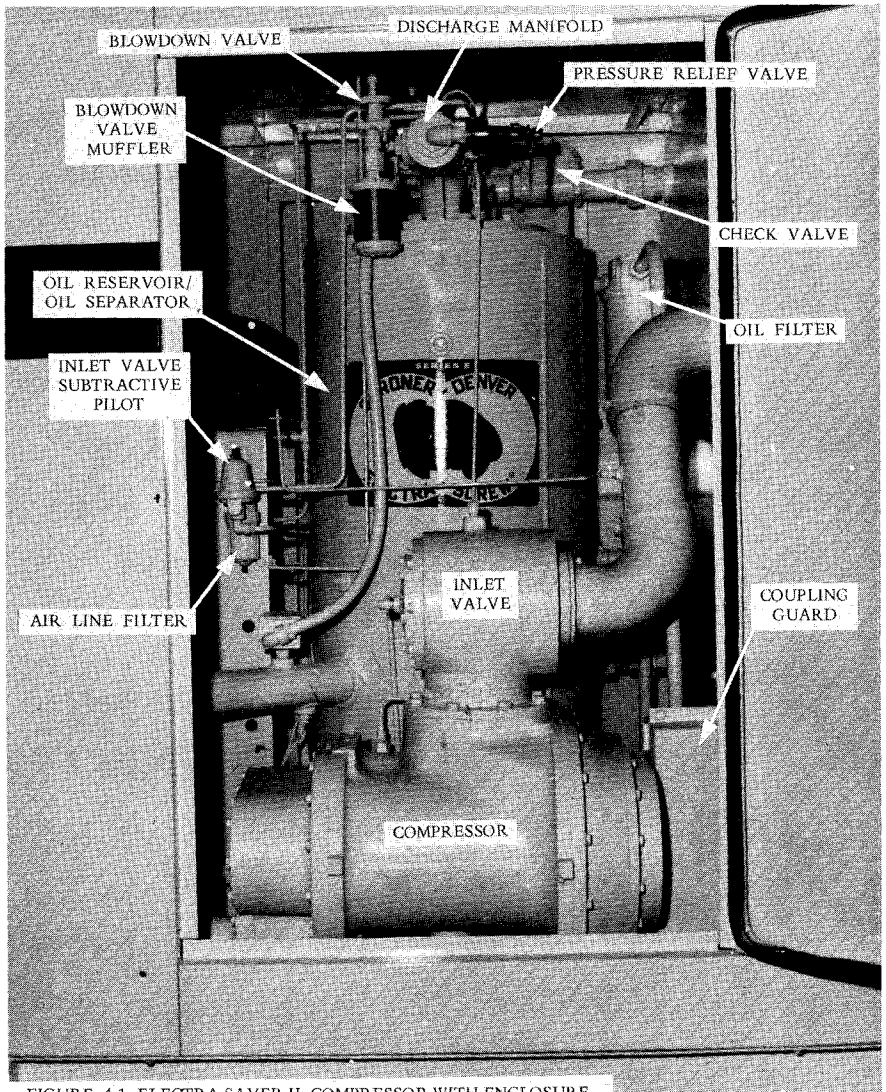

FIGURE 4-1 ELECTRA-SAVER II COMPRESSOR WITH ENCLOSURE

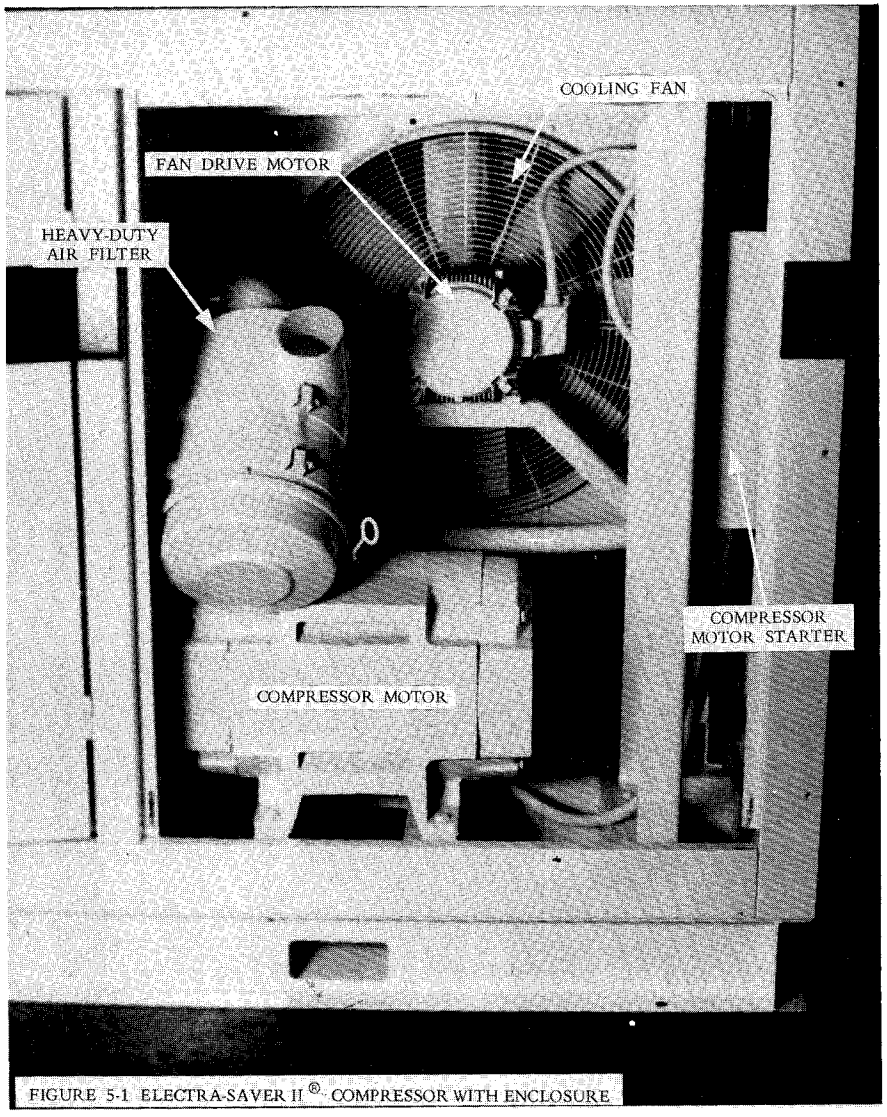

FIGURE 5-1 ELECTRA-SAVER II ® COMPRESSOR WITH ENCLOSURE

SAFETY PRECAUTIONS

Safety is everybody's business and is based on your use of good common sense. All situations or circumstances cannot always be predicted and covered by established rules. Therefore, use your past experience, watch out for safety hazards and be cautious.

Some general safety precautions are given below:

⚠ WARNING

- STOP THE UNIT IF ANY REPAIRS OR ADJUSTMENTS ON OR AROUND THE COMPRESSOR ARE REQUIRED.
- ALL COMPRESSED AIR SUPPLY HOSES EXCEEDING 1/2 INCH INSIDE DIAMETER SHOULD HAVE AN EXCESS FLOW VALVE. (OSHA REGULATION, SECTION 1518.302.)
- DO NOT EXCEED THE RATED MAXIMUM PRESSURE VALUES SHOWN ON THE NAMEPLATE.
- DO NOT OPERATE UNIT IF SAFETY DEVICES ARE NOT OPERATING PROPERLY. CHECK PERIODICALLY. NEVER BYPASS SAFETY DEVICES.

⚠ DANGER

- KEEP FINGERS AND CLOTHING AWAY FROM REVOLVING FAN, DRIVE COUPLING, ETC.
- DO NOT USE THE AIR DISCHARGED FROM THIS UNIT FOR BREATHING — NOT SUITABLE FOR HUMAN CONSUMPTION.
- DO NOT LOOSEN OR REMOVE THE OIL FILLER PLUG, DRAIN PLUGS, COVERS, THE THERMOSTATIC MIXING VALVE OR BREAK ANY CONNECTIONS IN THE COMPRESSOR AIR OR OIL SYSTEM UNTIL THE UNIT IS SHUT DOWN AND THE AIR PRESSURE HAS BEEN RELIEVED.
- ELECTRICAL SHOCK CAN AND MAY BE FATAL.
- COMPRESSOR UNIT MUST BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE. A GROUND JUMPER EQUAL IN SIZE TO THE EQUIPMENT GROUND CONDUCTOR MUST BE USED TO CONNECT THE COMPRESSOR MOTOR BASE TO THE UNIT BASE.
- OPEN MAIN DISCONNECT SWITCH BEFORE WORKING ON THE CONTROL.
- DISCONNECT THE COMPRESSOR UNIT FROM ITS POWER SOURCE BEFORE WORKING ON THE UNIT — THIS MACHINE IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME.

SECTION 2

INSTALLATION

GENERAL — On receipt of the unit, check for any damage that may have been incurred during transit. Report any damage or missing parts as soon as possible.

CAUTION

DO NOT electric weld on the compressor or base; bearings can be damaged by passage of current.

LIFTING UNIT — Proper lifting and/or transporting methods must be used to prevent damage.

CAUTION

Lift compressor unit by base only. Do not use other places such as enclosure, motor, compressor oil discharge manifold and piping as lifting points.

DANGER

The eyebolts or lugs provided on the motor are for lifting the motor only and should not be used to lift any additional weight. All eyebolts must be securely tightened. When lifting the motor the lifting angle must not exceed 15 degrees. Failure to observe this warning may result in damage or personal injury.

Lifting slots are provided in the base for towmotor use. Unit may also be moved into location by rolling on bars.

WARNING

DO NOT operate unit with access doors removed. Doors must be in place and closed to direct cooling air over the motor, oil cooler and aftercooler.

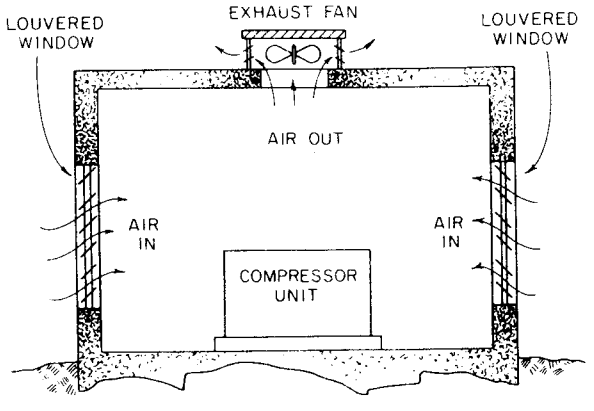

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FIGURE 1-2. — TYPICAL COMPRESSOR ROOM

LOCATION — The compressor should be installed, whenever possible, in a clean, well-lighted, well-ventilated area with ample space all around for maintenance. Select a location that provides a cool, clean, dry source of air. In some cases it may be necessary to install the air filter at some distance from the compressor to obtain proper air supply.

Both the air-cooled and water-cooled units require cooling air as well as air to the compressor inlet. Proper ventilation MUST be provided; hot air must be exhausted from the compressor operating area. A typical inlet-outlet air flow arrangement is shown in Figure 1-2.

Minimum Air Flow* For Compression And Cooling (Cubic Feet/Minute)		
	Air Cooled	Water Cooled
All Models	12500 cfm	1600 cfm
Oil/Aftercooler Only	10900 cfm	- - - - - - - -

* 80° F. inlet air.

FIGURE 2-2.

AIR-COOLED UNIT — The air-cooled unit with the standard enclosure requires sufficient air flow, Figure 2-2, for the compressor oil/after cooling system and for electric motor cooling. Air is drawn into the unit at the motor side of the enclosure and is exhausted at the oil cooler side. Do not block the air flow to and from the unit. Allow three and one-half (3-1/2) feet to the nearest obstruction on the starter end and control box end of the unit. Allow two (2) feet to the nearest obstruction above and on other sides of the unit. If conditions require, the oil cooler module may be removed from the unit and mounted remotely. A vent fan is then mounted in the enclosure for ventilation air.

Air-Cooled Oil Cooler Module — The air-cooled oil cooler is a separate module and may be mounted remote to the compressor unit.

Ventilation — The oil cooler requires adequate cooling air flow. Proper ventilation MUST be provided, with hot air exhausted away from the cooler; take care that hot air is not recirculated from the exhaust to the inlet side of the cooler. Cooling air flow direction is from the motor side through the grille side of the oil cooler. Do not obstruct the air flow to or from the cooler. Allow two (2) feet clearance on all sides of the cooler module. See Figure 2-2 for cooling air flow requirements.

Oil Cooler — Location and General Piping — The oil cooler module can be mounted in any of several remote locations: close coupled but not joined to the compressor unit; horizontal remote, located on the same level as the compressor unit, but some distance away; or overhead remote, located above level of compressor unit, as on a roof.

WARNING

The low demand mode switch CANNOT be used with remote overhead oil cooler. These units require special wiring diagram — check with factory.

All piping and wiring between the compressor unit and the remote oil cooler is to be supplied by the user. THE DESIGN OF THE REMOTE OIL COOLER MODULE SYSTEM MUST BE APPROVED BY THE FACTORY BEFORE INSTALLATION. The design information to be submitted for approval includes:

1. Location of oil cooler module — inside or outdoors.
2. Range of operating ambient temperatures at the oil cooler location.
3. Elevation of oil cooler above the compressor unit.
4. Pipe type and size(s) to be used to connect the oil cooler and the compressor unit. Minimum pipe size is 2" IPS.
5. Horizontal and vertical lengths of the pipe run. If more than one pipe size is used, list length of each size and total length.
6. Number and size of elbows, tees, unions, reducers and valves to be used in the pipe run.
7. A dimensional sketch of the proposed piping system showing location of the compressor unit, oil cooler and pipe and fittings of 3 through 6 above.

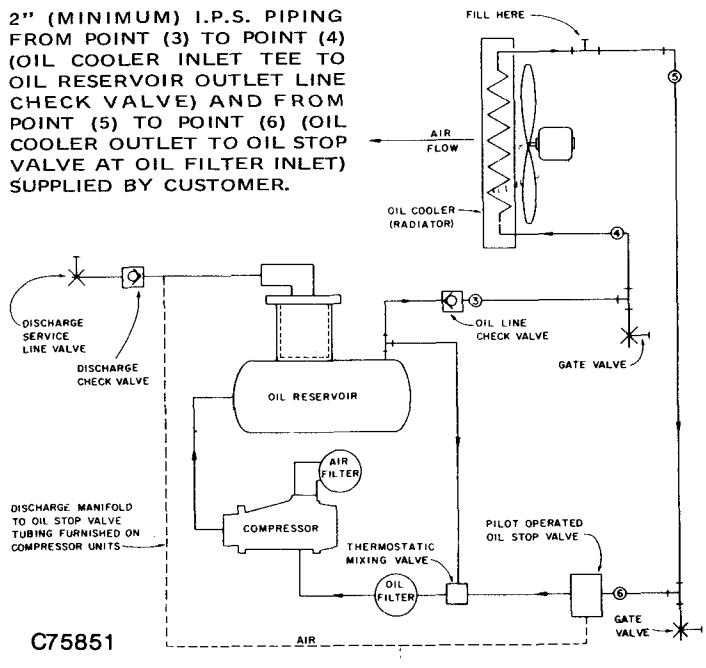


FIGURE 3-2. — OIL FLOW DIAGRAM — REMOTE OVERHEAD MOUNTED OIL COOLER

All remote piping should be of adequate size to insure the minimum pressure loss. Design point 4 above lists the pipe size at the compressor unit oil inlet and outlet connections and is the minimum pipe size to be used. Long runs of pipe and the use of valves and fittings require larger than the minimum pipe sizes in the system to keep the pressure loss low. All pipe and fittings used in a remote oil cooler system should be galvanized or treated internally to prevent rust, and all valves are to be of a nonferrous construction to prevent corrosion and fouling.

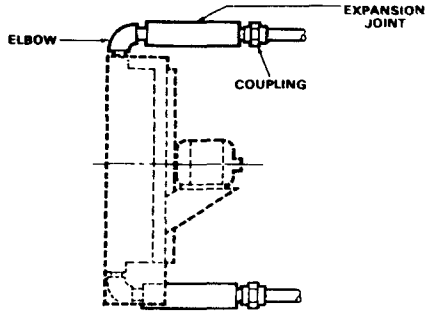
The remote cooler should be placed so that the fan air flow through the cooler (air flow is from motor side through core) and the prevailing winds are in the same direction. A baffle should be provided on the exhaust side of the cooler for protection against occasional wind shifts.

When the oil cooler is mounted above the compressor unit, a check valve is to be mounted on the compressor unit in the line to the oil cooler; see Figure 3-2. A pneumatic pilot-operated normally-closed valve is to be mounted at the oil filter inlet on the compressor unit line from the oil cooler; see Figure 3-2. The check valve permits oil flow to the oil cooler during operation, but prevents return oil flow from the cooler when the unit is shut down. The pilot valve is held open by air pressure from the unit oil reservoir during operation and closes under spring load when the unit is shut down to prevent return oil flow from the oil cooler.

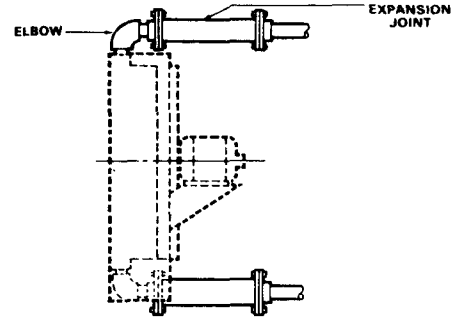
An oil filler stand pipe and plug must be located in the piping on the oil cooler module for ease of filling of a remote oil cooler; see Figure 3-2.

Oil Cooler — Installation — Inspect unit upon arrival. In case of damage, report immediately to transportation company. Before installation, check rating plate on motor to verify that power input and motor specification requirements match available electric power at point of installation.

1. Set the unit level on a firm solid foundation. The larger oil cooler models have lifting holes to facilitate unit hoisting.
2. Allow for linear expansion and contraction of the piping in the direction away from the oil cooler. Use flexible



PIPING SCHEMATIC OF COOLER WITH SCREWED CONNECTIONS



PIPING SCHEMATIC OF COOLER WITH FLANGED CONNECTIONS

FIGURE 4-2.

connectors or suitable expansion joints on all oil cooler inlet and outlet piping. See Figure 4-2 for typical schematics.

3. Select properly tensioned and aligned piping support clamps or hangers and position them to relieve any piping stress at the oil cooler inlet and outlet ports. Do not support from flexible connectors.

4. Service — For continuous efficiency, oil cooler cores must be periodically cleaned with either vacuum or compressed air. If wet cleaning is required, shield motor and spray on a mild soap solution and flush with clear water.

WATER-COOLED UNIT — The water-cooled unit with the standard enclosure requires sufficient air flow, Figure 2-2, for electric motor cooling. Air is drawn into the unit at the motor side of the enclosure and is exhausted at the oil cooler side. Do not block air flow to and from the unit. Allow three and one-half (3-1/2) feet to the nearest obstruction on the starter end and control box side of the unit. Allow two (2) feet to the nearest obstruction above and on other sides of the unit.

FOUNDATION — The *Electra-Saver II*® compressor requires no special foundation, but should be mounted on a smooth, solid surface. Whenever possible install the unit near level. Temporary installation may be made at a maximum 20° angle lengthwise or 20° sidewise.

Mounting bolts are not normally required. However, installation conditions such as piping rigidity, angle of tilt, or danger of shifting from outside vibration or moving vehicles may require the use of mounting bolts to the foundation. Coupling alignment **MUST** be checked after installation.

OIL RESERVOIR DRAIN — The oil drain is piped from the bottom of the reservoir to the side of the frame. This drain is approximately six (6) inches above the floor level. If this height is not sufficient to conveniently drain the oil, some other methods of providing oil drain are:

1. Elevate the compressor unit on raising blocks to obtain the desired drain height.

2. Construct an oil sump or trough below the floor level and pump or bail the drained oil.

3. Pump oil from the reservoir filler opening or drain to a container.

AFTERCOOLER MOISTURE SEPARATOR DRAIN — Located adjacent to the oil reservoir drain.

ENCLOSURE — The compressor, electric motor, oil cooler and aftercooler are mounted inside the enclosure. The enclosure directs the cooling air flow across the motor to the compressor air filter and through the coolers.

Service doors are provided for access to the motor, starters and compressor. Be sure to allow enough space around the unit for the doors to open completely.

Any of the enclosure doors may be removed by opening the door and lifting it up slightly to disengage the lower hinge pin from its bracket. The top pin can then be disengaged by lowering the door. The motor inspection/air filter service panel is held by an upper center latch and lifts away from the enclosure. The air outlet panel is attached by screws to the enclosure and is not readily removable.

⚠ WARNING

Do not operate unit with access doors removed. Doors must be in place and closed to direct cooling air over motor and coolers.

INSTALLATION FOR COLD WEATHER OPERATION — It is recommended that whenever possible the unit be installed inside a shelter that will be heated to temperatures above freezing (32° F., 0° C.). This will eliminate many of the problems associated with operating the units outside in cold climates where freezing rain, drifting snow, freezing condensate and bitter cold temperatures are encountered.

When an outside installation must be made, the precautions required will depend on how severe the environment. The following are general guidelines for outside installations:

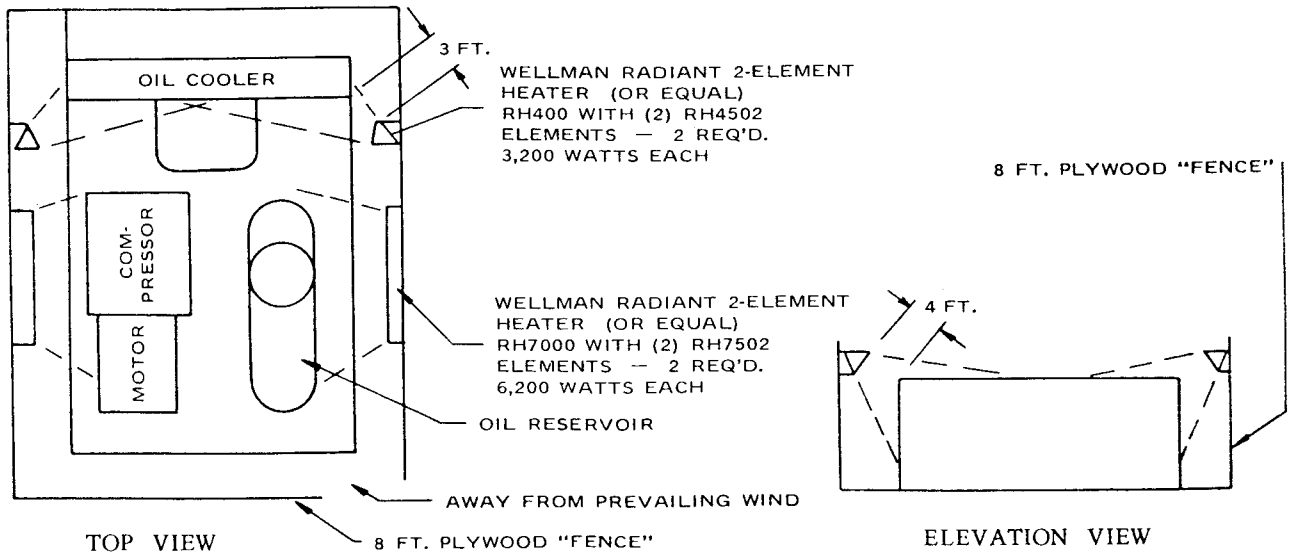


FIGURE 5-2.

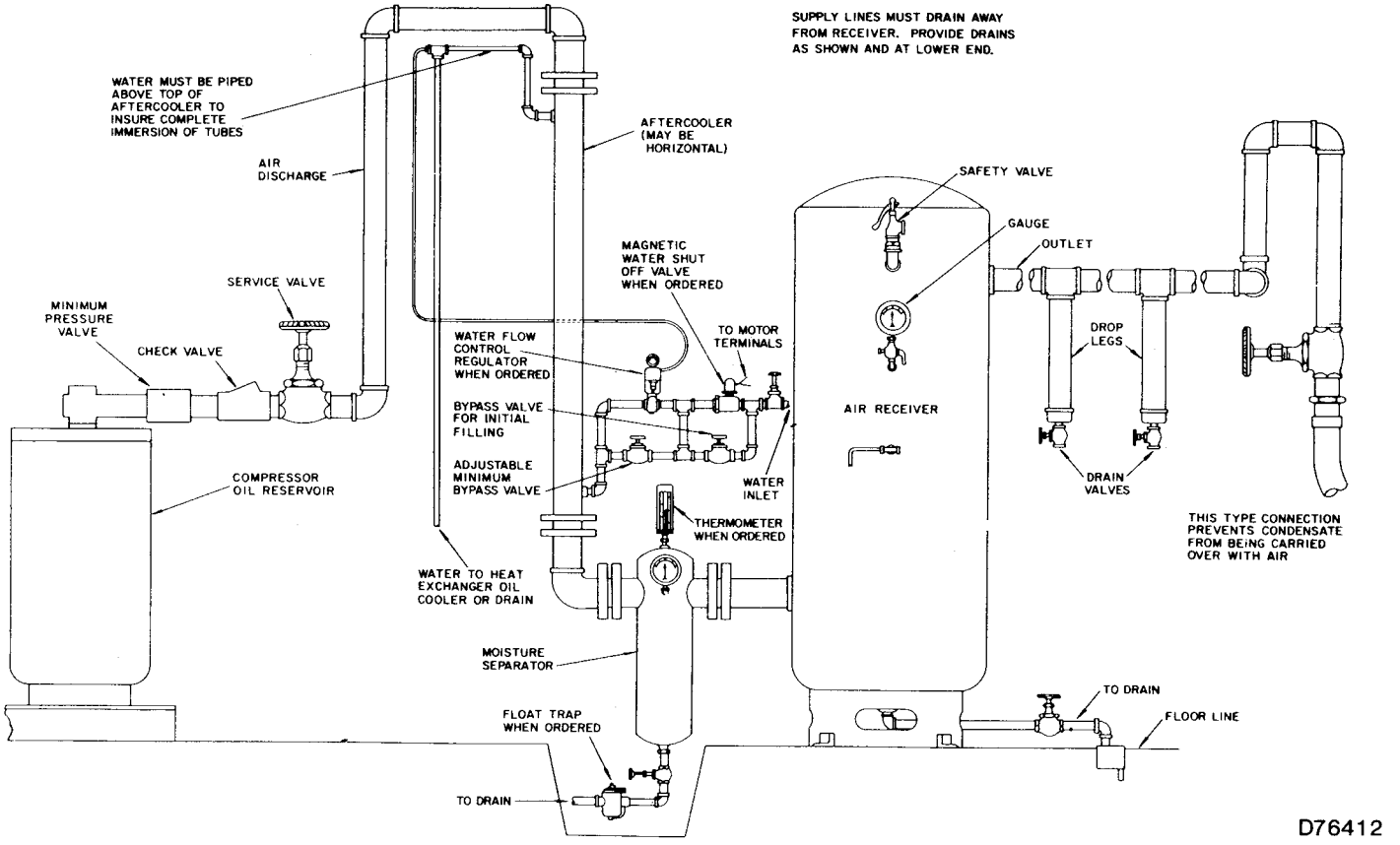


FIGURE 6-2. — AUXILIARY ACCESSORIES

Cold Weather (Down To –10° F.)

1. Be sure all control lines, drains and traps are heated to avoid freezing of condensate. Heat tape with thermostat control is generally satisfactory for this purpose and can be obtained at various local plumbing or hardware outlets at nominal cost.

2. If an air-cooled aftercooler is to be used, provisions to bypass the aftercooler should be made. Since cold air contains very little moisture, successful operation can be achieved without the aftercooler.

3. Provide at least some simple shelter such as a plywood windbreak to protect against drifting snow.

4. Use only *Gardner-Denver*® GD800 lubricant.

5. Monitor unit carefully during start-up and operation to be sure it is functioning normally.

6. Specify NEMA 4 enclosure for electrical devices.

Extreme Cold Weather Operation (Down To –40° F.)

In addition to the above, the following should be provided:

1. It will probably be necessary to provide shutters or to block off part of the cooler in some manner since the cooler is greatly oversized for operation in these low temperatures. Since shutters are not provided as a factory operation, blocking off a portion of the cooler with plywood should be satisfactory.

2. Lo-Demand operation should not be used in extreme environments.

3. Some means of providing heat to the oil reservoir and cooler during shutdown should be provided. There are various methods to accomplish this, but since openings are not provided for sump heaters, the use of radiant heaters is recommended.

   The heaters should be sized to provide at least a –10° F. environment for the coolers, motor and sump. Figure 5-2 shows how these might be located in a typical installation and sizes required.

Remember unsheltered (outside) installations should be avoided where possible. Installation next to a heated building where enough heat can be used to keep the compressor room above freezing, will save many complications in the operation and installation of the unit.

Refer to Engineering Data Sheet 13-9-411 for the advantages of using the heat recovered from rotary compressors. This heat recovery could easily pay for an adequate shelter for the unit.

AUXILIARY AIR RECEIVER — An auxiliary air receiver is not required if the piping system is large and provides sufficient storage capacity to prevent rapid cycling. When used, an air receiver should be of adequate size, provided with a relief valve of proper setting, a pressure gauge and a means of draining condensate. Figure 6-2 shows a typical air receiver and auxiliary accessories.

AFTERCOOLER — An aftercooler will provide control of

moisture entering the shop air lines while reducing the normal low discharge temperature of about 180° F. at 100 PSIG discharge pressure to near inlet air temperature.

Aftercoolers are available in these classifications:

1. Factory-installed built-in air-cooled radiator type.
2. Factory-installed built-in water-cooled shell and tube type.
3. Externally-mounted aftercoolers supplied by user.

BUILT-IN AIR-COOLED AFTERCOOLER — This radiator-type aftercooler is mounted at the factory in the same support as the unit radiator-type oil cooler. The unit cooling fan forces air through the aftercooler and oil cooler. The compressed air is taken from the oil reservoir manifold and passes through the aftercooler. The aftercoolers are coated internally to resist corrosion.

MOISTURE SEPARATOR/TRAP — When unit is equipped with a built-in aftercooler, a combination moisture separator and trap is mounted on the unit. The drain connection is located through the base flange near the oil reservoir drain.

EXTERNALLY-MOUNTED AFTERCOOLER — When the aftercooler is mounted outside the compressor unit, it is to be installed between the final discharge outlet and any auxiliary air receiver. Figure 6-2 shows a water-cooled aftercooler, but the piping arrangement shown also applies to an air-cooled type. A moisture separator trap is to be mounted directly downstream from the aftercooler and before any auxiliary air receiver.

CONTROL PIPING — Control piping is not necessary since the *Electra-Saver II*® unit is factory wired and piped for the control system specified.

INLET LINE — Where an inlet line is used between the air filter and the compressor, it must be thoroughly cleaned on the inside to prevent dirt or scale from entering the compressor. **If welded contruction is used, the line must be shot blasted and cleaned to remove welding scale.** In either case, the inlet line must be coated internally by galvanizing or painting with a moisture and oil-proof sealing lacquer. Up to ten (10) feet in length, the inlet line should be the full size of the inlet opening on the compressor. If an extra-long line is necessary, the pipe size should be increased accordingly:

Length of Inlet Line	Diameter of Pipe Size
0 to 10 Ft	Same As Compressor Inlet Opening
10 to 17 Ft	One Size Larger Than Inlet Opening
17 to 38 Ft	Two Sizes Larger Than Inlet Opening

Accessability for inlet air filter servicing must be considered when relocating the filters from the unit to a remote location.

DISCHARGE SERVICE LINE — The discharge service line connection on both water-cooled and air-cooled units is made at the lower left hand corner of the unit, viewed from the control panel side. When manifolding two or more *Electra-Saver II*® units on the same line, each unit is isolated by the check valve in the unit discharge line. If an *Electra-Saver II* unit is manifolded to another compressor, be sure the other compressor has a check valve in the line between the machine and the manifold. If an *Electra-Saver II* and a reciprocating compressor are manifolded together, an air receiver must be located between the two units.

DANGER

DO NOT USE THE AIR DISCHARGED FROM THIS UNIT FOR BREATHING — IT IS NOT SUITABLE FOR HUMAN CONSUMPTION.

BLOWDOWN VALVE PIPING — The blowdown valve is

OIL COOLER

HP	Model	Water Temperature To Heat Exchanger				Maximum Water Flow	Approximate Water Pressure Drop @ 90° F. Water Flow (PSI)
		60° F.	70° F.	80° F.	90° F.		
60	ECMSKB	5.0	6.2	8.3	12.5	40.8	2.0
75	ECMSLB	6.9	8.6	11.5	17.2	60.6	1.5

AFTERCOOLER

HP	Model	Water Temperature To Heat Exchanger				Maximum Allowable Flow (GPM)	Approximate Water Pressure Drop
		60° F.	70° F.	80° F.	90° F.		
60	ECMSKB	0.8	1.0	1.4	2.1	26.0	Less than 1 PSI for any flow rate shown in table.
75	ECMSLB	1.2	1.5	2.0	3.0	26.0	

Flow rates are based on 110° F. maximum allowable outlet water temperature. Higher water outlet temperatures can lead to heat exchanger malfunction by causing fouling in the last water pass.

FIGURE 7-2. — HEAT EXCHANGER (OIL COOLER-AFTERCOOLER) APPROXIMATE WATER FLOW
U.S. Gallons/Minute

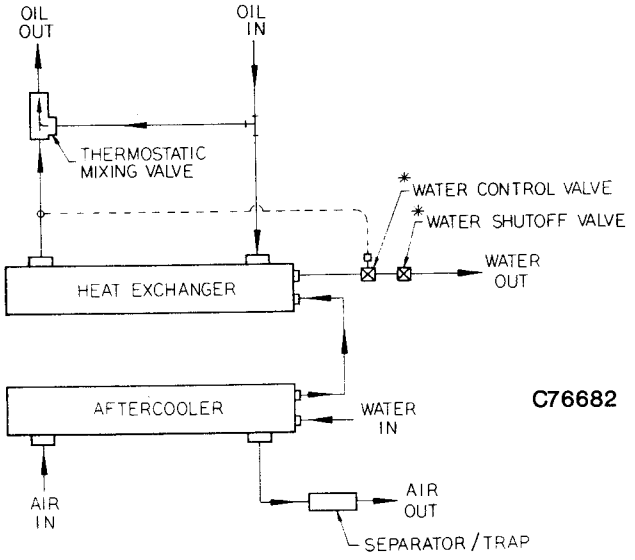
fitted with a muffler for operation indoors. If the installation requires, the muffler may be removed and the blowdown valve piped to the outside with a pipe size the same as the blowdown valve outlet connection.

WATER PIPING (Water-Cooled Heat Exchanger Models Only) — On machines equipped with water-cooled heat exchangers, the water inlet and outlet connections are located in the unit base flange on the left side of the unit.

The water source should be capable of supplying up to the maximum flow shown in Figure 7-2 at a minimum pressure of 40 PSIG; maximum allowable water pressure is 150 PSIG. The water flow rates shown in Figure 7-2 are approximate and a guide to sizing piping, cooling tower and other water system equipment.

The heat exchanger system is designed to operate with water inlet temperatures from 60° F. to 90° F. and a water outlet temperature not to exceed 110° F. If water cooler than 60° F. is used, high water outlet temperatures (over 110° F.) will be experienced along with shortened heat exchanger life caused by tube fouling and corrosion. If water warmer than 90° F. is used, higher compressor oil inlet temperatures and high water usage will result.

Most water systems will require control of impurities: filtration softening or other treatment. See "Compressor Oil Cooler — Water-Cooled Heat Exchanger" for more information on the water system.

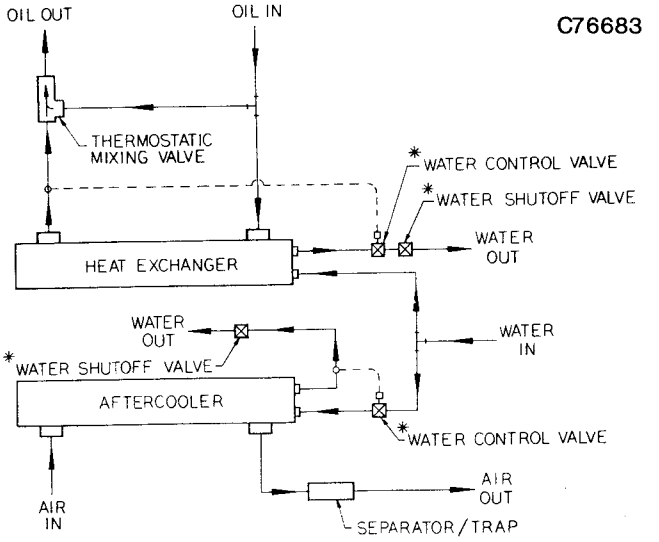


* (OPTIONAL) WATER CONTROL VALVE AND WATER SHUTOFF VALVE MUST BE ORDERED SEPARATELY.

FIGURE 8-2. — SERIES PIPING

SERIES PIPING (Figure 8-2) — Water flow must be through aftercooler first for effective cooling of discharge air and is so piped on the standard water-cooled unit.

PARALLEL PIPING (Figure 9-2) — A separate water control valve is required to control the discharge air temperature. If a remote (externally mounted) water-cooled aftercooler is piped in parallel with the heat exchanger, provide a separate water control valve for the aftercooler and pipe separate inlet water lines to both the aftercooler and heat exchanger.



* (OPTIONAL) WATER CONTROL VALVE AND WATER SHUTOFF VALVE MUST BE ORDERED SEPARATELY.

FIGURE 9-2. — PARALLEL PIPING

The water control valve is to be adjusted to maintain oil out of heat exchanger within the 140°-150° F. range regardless of inlet water flow or temperature. See Section 5 for adjustment instructions and maximum allowable lubricant temperature.

ELECTRICAL WIRING — Standard Units — The "ECM" *Electra-Saver II*® compressor is factory wired for all starter to motor and control connections for the voltage specified on the order. It is necessary only to connect the unit starter to the correct power supply. See Section 4 for wiring diagrams of the control system. The standard unit is supplied with an open drip-proof motor, a NEMA 1 starter enclosure and a dust resistant control enclosure. See "Location" paragraph for distance to nearest obstruction on starter and control box sides of the unit.

GROUNDING — Equipment must be grounded in accordance with Table 250-95 of the National Electrical Code.

MOTOR LUBRICATION — Long time satisfactory operation of an electric motor depends in large measure on proper lubrication of the bearings. The following charts show recommended grease qualities and regreasing intervals for ball bearing motors. For additional information refer to the motor manufacturer's instructions.

The following procedure should be used in regreasing:

1. Stop the unit.
2. Disconnect the unit from the power supply.
3. Remove the relief plug and free hole of hardened grease.
4. Wipe the lubrication fitting clean and add grease with a hand-operated grease gun.
5. Leave the relief plug temporarily off. Reconnect unit and run for about 20 minutes to expell the excess grease.
6. Stop the unit. Replace the relief plug.
7. **Restart the unit.**

GREASE RECOMMENDATIONS

	Standard Service	High Temperature
Worked Penetration	265-296	220-240
Oil Viscosity, SSU At 100° F.	400-550	475-525
Soap Type	Lithium	Lithium
N-H Bomb, Minimum Hours For 20 PSI Drop At 210° F.	750	1000
Bleeding, Maximum Weight % In 500 Hours 212° F.	10	3
Rust Inhibiting	Yes	Yes

REGREASING INTERVAL

Type of Service	Typical Example	Rating	Relubrication Interval
Standard	One- Or Two-Shift Operation	150 HP and Below	18 Months
Severe	Continuous Operation	150 HP and Below	9 Months
Very Severe	Dirty Location, High Ambient Temperature	150 HP and Below	4 Months

SECTION 3

STARTING & OPERATING PROCEDURES

PRESTART-UP INSTRUCTIONS — A new unit as received from the factory has been prepared for shipping only. Do not attempt to operate the unit until checked and serviced as follows:

1. **Compressor Oil** — Check oil level in the reservoir. Add oil only if the oil level gauge reads in the red ADD OIL range. Do not mix different type oils. Unit is shipped filled with *Gardner-Denver*® GD800 Lubricating Coolant which is suitable for the first 2000 hours under normal operating conditions.

   REPLACE OIL FILTER ELEMENT EVERY 1000 HOURS.

   Initial fill, or filling after a complete draining of the system, may show the oil level in the red EXCESS OIL range. After start-up, the oil will fall into the operating range as system components are filled. If necessary, add oil to bring the level into the center of the RUN range when the unit is operating at full load and normal operating pressure; see Figure 3-5.

DANGER

ALWAYS STOP THE UNIT AND RELEASE AIR PRESSURE BEFORE REMOVING OIL FILLER PLUG.

   During unloaded operation and after shutdown, the system will partially drain back into the oil reservoir and the oil level may read higher than when operating on load. DO NOT DRAIN OIL TO CORRECT; on the next loaded cycle or start, oil will again fill the system and the gauge will indicate the operating level.

2. **Air Filter** — Inspect the air filter to be sure it is clean and tightly assembled. Refer to Section 6 "Air Filter" for complete servicing instructions. Be sure the inlet line, if used, is tight and clean.

3. **Alignment** — Check all bolts and cap screws for tightness. Check coupling alignment; refer to Section 7 "Coupling" for procedure.

4. **Piping** — Refer to Section 2 "Installation" and make sure the piping meets all recommendations.

5. **Electrical** — Check the wiring diagrams furnished with the unit to be sure it is properly wired. See Section 4 "Controls and Instruments" for general wiring diagrams and Section 2 for installation instructions.

6. **Rotation** — Check the motor rotation by momentarily jogging the motor. Compressor drive shaft rotation is clockwise standing at the motor end.

WARNING

DO NOT REPEATEDLY JOG THE MOTOR UNLESS ROTATION IS CORRECT. SEVERE COMPRESSOR DAMAGE CAN RESULT.

7. **Operating Light Test** — Observe the operating lights at the ON-LOAD indicator when jogging the motor in Step 6. Be sure all lamps are operative.

8. **System Pressure** — Set the constant speed pilot and/or operating air pressure switch to the desired unload pressure and differential. DO NOT EXCEED MAXIMUM OPERATING PRESSURE ON COMPRESSOR NAMEPLATE. See Section 4 "Controls and Instruments" for procedure.

9. **Operating Mode** — Refer to Section 4 for detailed information on the control system.

10. **Enclosure** — Check for damaged panels or doors. Check all screws and latches for tightness. Be sure doors are closed and latched.

STARTING THE UNIT — OBSERVE UNIT COLD OR HOT STARTING PROCEDURES.

Unit Cold — Close the air service valve (furnished by customer) between the main air system and the unit check valve. If the unit is a water-cooled heat exchanger model, open any manual water inlet wide open. Start the unit by pressing the STOP/RESET button, then the ON (START) button and run for one (1) minute. Open the air service valve. Since the unit is equipped with a minimum (65 PSIG) pressure discharge valve, no special procedure to maintain unit reservoir pressure is required.

Unit Hot — No warm-up period is required. Close the air service valve (furnished by customer). If the unit is a water-cooled heat exchanger model, open any manual water inlet valves wide open. Start the unit by pressing the STOP/RESET button, then the ON (START) button. Open the air service valve.

DAILY CHECK — Refer to Section 8 "Maintenance Schedule".

STOPPING THE UNIT — Close the air service valve (furnished by customer), allow the unit to build up to full unloaded pressure and operate there for 3-5 minutes. Press the OFF/STOP-RESET button. Stopping the unit at a pressure below full receiver may cause oil carry-over. The oil reservoir will automatically blow down as the motor stops. If the unit is a water-cooled heat exchanger type, close any manual water inlet valves. Open the air service valve.

SECTION 4

CONTROLS & INSTRUMENTS

GENERAL — *The Gardner-Denver®* "ECM" *Electra Saver II®* compressors are available with either of two (2) control systems:

1. Constant Speed Modulating Control.
2. Constant Speed Modulating Control With Automatic Start/Timed Stop.

Each of the above systems have a Low Demand Mode Switch to further reduce power consumption by blowing down the reservoir during unloaded operation.

The "ECM" *Electra-Saver II®* compressor unit is prewired with the starter mounted and all starter to motor and control connections for the voltage specified on the order. It is necessary only to connect the unit to the correct power supply, to the shop air line and to the shop water line, if the unit is water cooled. The standard unit consists of the compressor, oil reservoir, air and oil filters, the control system specified, an open drip-proof motor, instrument panel, and a NEMA 1 starter enclosure in a dust resistant enclosure; all mounted on a steel base.

CONTROL VOLTAGE — The control voltage for the start-stop push button, hourmeter, air pressure switch, high discharge temperature shutdown switches, reservoir pressure switch and other electrical control devices is 115 volts regardless of power supply voltage. A transformer in the control enclosure is connected to change the power supply voltage to 115 volt control voltage.

START-STOP/RESET SWITCH — Units with the Constant Speed Modulating Control with Low Demand Mode Switch have a two (2) button Start-Stop/Reset switch mounted in the control box door.

ON-OFF-RESET SWITCH — Units with the Constant Speed Modulating, Automatic Start/Timed Stop control with Low Demand Mode Switch have a three (3) button ON-OFF-RESET switch mounted in the control box door.

RESET — Whenever there is a power interruption or the unit is turned off, the Reset button must be pressed before the unit can be restarted.

CAUTION

DO NOT continue to reset the circuit if the same malfunction occurs within a short period of time. Find and correct the trouble before resuming operation.

PILOT LIGHT — A separate Dual Indicating pilot light is mounted in the control box door with an amber lighted section to indicate "ON" (compressor running) and a blue lighted section to indicate "LOAD" (compressor loaded).

To replace the bulbs in the pilot light: Replacement Bulb Number 24CA40 (Sylvania 120 PSB or equal).

1. Turn power off at main breaker panel.
2. Open control panel.
3. Turn slotted locking screw on upper side of pilot light body counterclockwise one-fourth (1/4) turn and remove the body from the lens holder.
4. Remove old bulb located in the body and insert new bulb.
5. Reassemble body to lens holder and secure by turning locking screw one-fourth (1/4) turn clockwise.

LOW DEMAND SWITCH (Figure 2-1) — The low demand switch, when turned to the ON position, will blow the reservoir down when compressor unloads. When switch is turned to OFF, unit will retain pressure in reservoir when unloaded.

TIMER — The Automatic Start/Timed Stop control uses an adjustable timing relay to stop the unit after a selected period of unloaded operation. The timer is located on the control box door; the calibrated dial allows selection of an unloaded operation interval between 3 and 30 minutes.

CAUTION

Never set the timer for a time interval less than three (3) minutes.

SAFETY DEVICES — All units incorporate these safety devices.

Motor Protection Devices — Overload heaters are furnished for the starter in the voltage range specified. There are three (3) overloads in the starter of proper size for the starter and its enclosure. When replacing or changing overloads, be sure to select them from a 3-overload heater table, since the use of a third overload derates each overload for a given enclosure due to the extra heat. An overload from a 2-overload heater table would be undersize.

The overload heaters have a high-low adjustment of ±6% determined by the position of the heater in the overload relay. The high or low position is shown on the overload heater table inside the starter enclosure. Motor nameplate amperage is used to determine high-low position.

High Discharge Temperature Switch — The compressor unit is protected from high discharge temperature by a two-probe adjustable switch. One probe is located at the discharge port of the compressor to sense compressor discharge air/oil mixture temperature. The second probe is in the final discharge manifold and senses the temperature of the air at the oil separators. The switch is located inside the control box (Figure 3-1); the shutdown temperature is set on the adjustable dial. If the temperature of the air at either of the probes exceeds the temperature set on the dial, the switch will stop the unit. Press reset button of the Start-Stop/Reset switch, then the On (Start) button to restart the unit.

CAUTION

This adjustable switch dial must not be set higher than 225° F.

Do not continue to reset the circuit if the same malfunction occurs within a short period of time. Find and correct the trouble before resuming operation.

CAUTION

Never operate unit without a proper safety valve setting.

In addition to protecting the unit from damage or failure resulting from high air temperature, the switch also incorporates four (4) indicator lights which show the point of high temperature and/or the condition of the temperature probes. This information is shown in Figure 1-4 and on the decal inside the control box door.

The High Air Temperature Switch may be checked periodically to assure proper operation. To check with the unit running, turn the dial on the switch to the temperature indicated by the discharge temperature gauge. Unit should shutdown. If it does not, check the temperature gauge accuracy and indicator lights – refer to the condition decal on the control box door for the malfunction. After operational check, always reset switch dial to the proper setting (225° F.).

Safety Valve — A pressure relief valve is installed in the final discharge manifold and set at the factory to approximately 120% of the specified operating pressure for protection against overpressure. Periodic checks should be made to insure its proper operation.

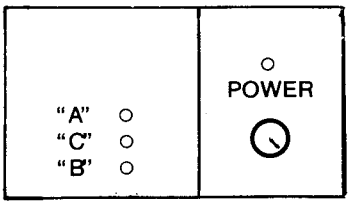
Automatic Blowdown Valve (Figure 2-1) — A pilot operated valve piped into the oil reservoir final discharge manifold ahead of the check valve and connected to the unloader solenoid valve which is wired into the motor control circuit, will release pressure from the oil reservoir each time the unit is unloaded with low demand mode switch ON or when unit is shut down. The blowdown line is equipped with a muffler to reduce air discharge noise.

Low Demand Pressure Switch (Figure 2-1) — The low demand mode switch when turned ON will cause the low demand pressure switch to de-energize the low demand unloader solenoid 4-way valve when the discharge pressure reaches the set point. This switch should be set approximately 2 PSI below the inlet valve subtractive pilot full load pressure setting.

Low Demand 4-Way Solenoid Valve (Figure 3-1) — The low demand solenoid valve when energized passes a low pressure air signal to close the blowdown valve. When de-energized, it passes a low pressure air signal to close the

HIGH DISCHARGE TEMPERATURE SWITCH CONDITION CHART

"A" indicates Temperature Condition at Compressor Discharge.
"B" indicates Temperature Condition at Oil Separator.
"C" indicates Probe Condition.



CONDITION	POWER ON	"A"	"B"	"C"
POWER OFF	OFF	OFF	OFF	OFF
NORMAL TEMPERATURE	RED	RED	RED	OFF
COMPRESSOR HIGH TEMPERATURE	RED	OFF	RED	OFF
SEPARATOR HIGH TEMPERATURE	RED	RED	OFF	OFF
COMPRESSOR PROBE OPEN	RED	OFF	RED	GREEN
SEPARATOR PROBE OPEN	RED	RED	OFF	GREEN
COMPRESSOR PROBE SHORTED	RED	OFF	RED	RED
SEPARATOR PROBE SHORTED	RED	RED	OFF	RED
COMPRESSOR PROBE SHORTED/ SEPARATOR PROBE OPEN	RED	OFF	OFF	ORANGE
COMPRESSOR PROBE OPEN/ SEPARATOR PROBE SHORTED	RED	OFF	OFF	ORANGE

FIGURE 1-4.

compressor inlet valve and exhausts air to open the blow-down valve.

Low Oil Pressure Shutdown Switch (Figure 3-1) — Units are provided with a pressure switch piped to the compressor oil sump and wired into the motor control circuit to protect the unit against operation at too low an oil pressure and against complete lubrication failure due to an oil line restriction or sudden loss of oil pressure. The pressure switch is set 10-15 PSIG and will stop the unit if the oil pressure falls below this pressure any time during operation, and will prevent the unit beings started if the oil pressure does not rise to 10-15 PSIG within 10 seconds of starting.

The pressure switch is set at 10-15 PSIG at the factory. If resetting is necessary:

1. Adjust the upper limit pressure to 15 PSIG by turning the slotted screw near the top of the switch. Clockwise movement of the screw raises the pressure; counter-clockwise lowers the pressure. Note approximate pressure setting is indicated on the range scale on left face of the switch.

2. Adjust the lower limit pressure to 10 PSIG by turning the slotted screw (differential) near the bottom of the switch until the cam-shaped calibrated dial under the pressure setting screw indicates about one-fourth (1/4) of full scale reading from the lowest setting. Clockwise movement of the screw reduces the differential; counter-clockwise increases the differential. Note differential range (3-18 PSI) is indicated by marks on the cam-shaped dial.

If a unit with Constant Speed control shuts down from low oil pressure, press the Stop/Reset button, then the START button to restart the unit.

Since the Automatic Start/Timed Stop control is an automatic starting type, a reset relay is used as a positive means to interrupt the circuit on a low oil pressure shutdown; to restart the unit, press the bar marked RESET and then press the ON button.

CAUTION

Do not continue to restart the unit if the same malfunction occurs within a short period of time. Find and correct the trouble before resuming operation.

This control may be checked periodically to assure proper operation. To check, disconnect the timed-opening instantaneous-closing contact of the time delay relay from the system at point 10; see wiring diagram, Figures 16-4 thru 21-4. Try to start unit — unit should not run — if it does timer is inoperative and should be replaced. Be sure to reconnect the time delay relay at point 10 after checking.

Low Oil Pressure Time Delay Switch (Figures 3-1 & 2-4) located in the control panel enclosure, is wired into the control circuit to provide the 10-second delay required for the compressor oil pressure to rise to 10-15 PSIG and energize the low oil pressure switch circuit.

To check the time delay switch setting:

1. Pull main breaker switch.

2. Move black Manual Operator timer tab located on the left half of relay block to the ON position and hold. Timer will begin to run for set time.

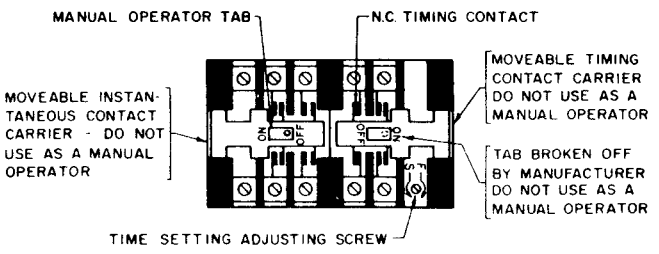


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FIGURE 2-4. — LOW OIL PRESSURE TIME DELAY SWITCH

3. Observe the action of the right hand set of NC timing contacts on the right half of the relay block; the contacts will open when the preset time runs out.

4. Adjustment of time delay setting is made by turning the time setting adjusting screw on the lower right face of relay block to a faster (F) or slower (S) setting. Recheck setting of relay as in No. 2 and 3 above each time screw is turned.

Timer is factory set at 10 seconds. NEVER ATTEMPT TO ADJUST THE TIMING RELAY FOR MORE THAN 15 SECONDS DELAY — serious compressor damage may result from operation without lubrication for even a short period.

CAUTION

NEVER DISCONNECT ANY SAFETY DEVICES THAT PROTECT THE UNIT.

Reservoir Pressure Switch (Figure 2-1) — A pressure switch is connected to the oil reservoir and wired to the motor control circuit to prevent attempted starting of the unit when there is more than 5 PSIG pressure in the oil reservoir. This protects the unit from starting against load when the oil reservoir has not had enough time to blow down. Blowdown time is usually about forty-five (45) seconds.

WARNING

Do not set the switch higher than 5 PSIG or render the switch inoperative; severe damage to the motor can occur if started with pressure in the oil reservoir.

INSTRUMENTS AND GAUGES (Figure 2-1) — All units incorporate the following instruments and gauges; optional instruments are noted. See Figure 3-4 for schematic tubing diagram showing connection of pneumatic controls and gauges.

Hourmeter — A continuous reading (nonreset) type hourmeter displays the accumulated operating time of the unit and provides a convenient means for scheduling changes of oil and servicing of filters, separators and other devices.

Air Pressure Gauge — A direct reading air pressure gauge indicates final discharge air pressure at the discharge manifold.

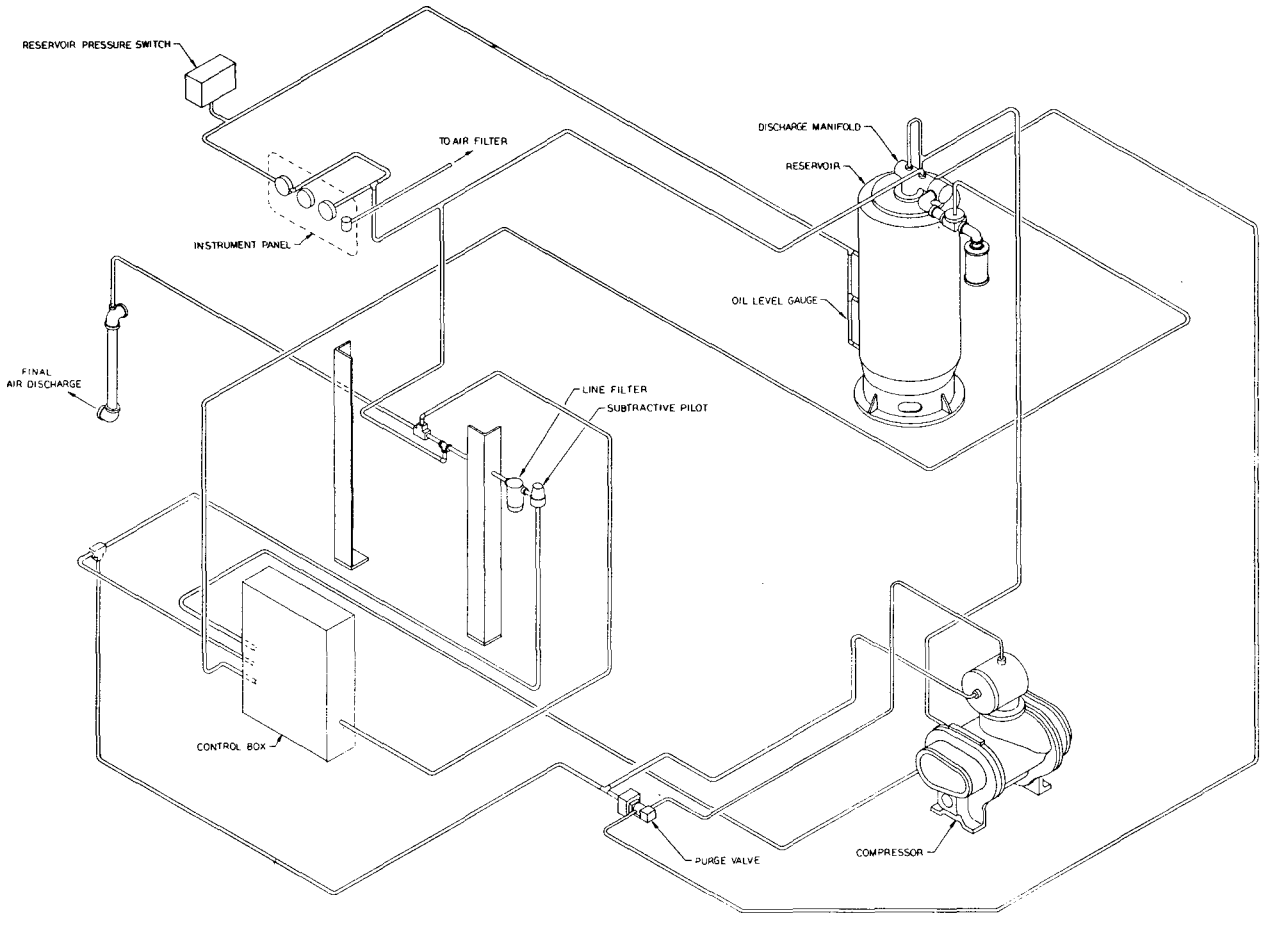

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FIGURE 3-4. — SCHEMATIC TUBING DIAGRAM

Discharge Air Temperature Gauge — A direct reading temperature gauge indicates compressor discharge air temperature.

Pressure Differential Gauge reads the pressure differential across the oil separators providing a continuous monitoring of their condition and indicates when changing of the elements is required.

Oil Filter Indicator — An oil filter indicator is located on the head of the oil filter and indicates when the oil filter requires changing.

CAUTION

Always change oil filter element each 1000 hours of operation regardless of indicator reading. Indicator may show need for earlier change.

Air Filter Indicator — An air filter indicator, furnished with enclosed units only, is located on the instrument panel and indicates when the air filter requires servicing.

AIR CONTROL VALVES — All units incorporate the following air control valves. See Figure 3-4 for schematic tubing diagram showing connection of pneumatic valves.

Subtractive Pilot — The inlet valve subtractive pilot is an an adjustable, spring-loaded diaphragm valve that controls downstream control pressure in relation to the upstream discharge pressure; see Figure 4-4.

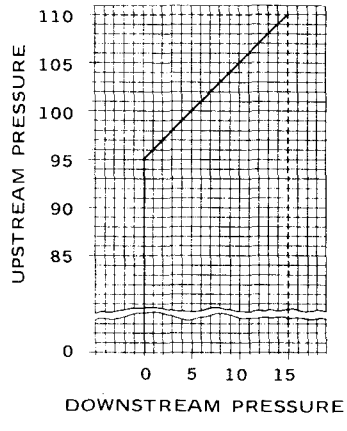

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FIGURE 4-4.

The downstream pressure is maintained equal to the upstream pressure minus a constant. As shown in Figure 4-4, the downstream pressure equals the upstream pressure minus 95. When the upstream (discharge) pressure rises to 100 PSIG, downstream (control) pressure rises to 5 PSIG. This 1 to 1 PSI rise is constant over the pilot differential range of 15 PSI on either rising or falling upstream pressure. Below 15 PSI under the pilot unload pressure the downstream

(control) pressure is vented to atmosphere; in the example of Figure 4-4 the control pressure is vented below 95 PSIG.

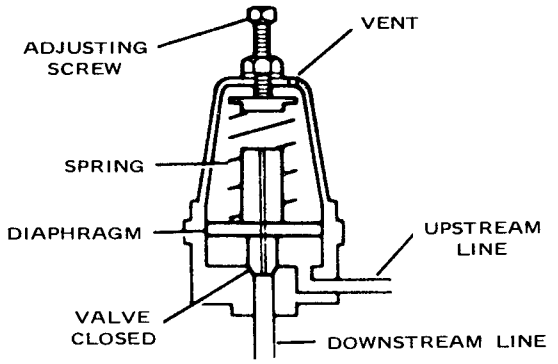

FIGURE 5-4. — SUBTRACTIVE PILOT (Closed)

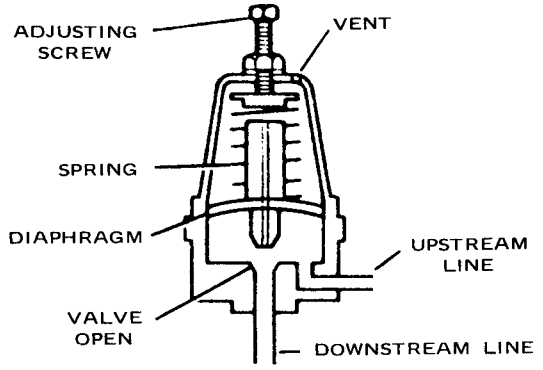

FIGURE 6-4. — SUBTRACTIVE PILOT (Opened)

Figure 5-4 shows a schematic cross-section of the subtractive pilot with the valve seat closed and the downstream line vented. Figure 6-4 shows the pilot with the valve seat open, holding a pressure downstream which is adjustable with the screw. In this position it is normal for the valve to continually bleed air through the small vent hole in the bowl.

The pilot admits air to the inlet valve piston when a discharge manifold pressure equal to the pilot low setting is reached. The air begins to pass through the pilot to the piston, and the inlet valve begins to close. As the discharge manifold pressure increases the pilot pressure also increases on the inlet valve piston further closing the inlet valve. At full manifold pressure (pilot unload setting) the pilot is exerting full differential pressure on the inlet valve piston and the inlet valve is fully closed. As the discharge manifold pressure falls, the pilot exerts proportionally less pressure on the inlet piston allowing the inlet piston spring to return the piston and the inlet valve to open. The pilot can be adjusted from 65 to 150 PSIG. The differential range of approximately 15 PSI cannot be changed. In order to obtain full capacity at the maximum operating pressure, the pilot should be set to unload with the inlet valve fully closed at approximately 10 PSIG above the maximum operating pressure. An example of pilot control air/compressor operation at 95-110 PSIG:

Discharge Manifold Pressure	Pressure In Control System	Inlet Valve	Compressor
90	0	Open	At Full Capacity
95	0	Open	At Full Capacity
100	5	Closing	Reduced Capacity
105	10	Closing	Reduced Capacity
110	15	Closed	Not Compressing

Oil, moisture and dirt in the control lines can cause the set point of the pilot to shift or be erratic. The pilot can be disassembled and the diaphragm and ports cleaned, but this should be done only under the supervision of a trained factory representative.

INLET VALVE (Figure 7-4) — The inlet valve is a piston actuated device controlled by air pressure from the subtractive pilot. As the pressure of the control air increases, the inlet valve closes. With approximately 15 PSIG control pressure on the piston, the valve will close fully and stop the flow of air through the compressor. When the inlet valve closes, a small amount of purge air is directed from a purge air valve into the compressor to minimize a hydraulic knock that can occur in oil-flooded screw type compressors when operating unloaded.

The inlet valve contains piston spring "F" which returns the

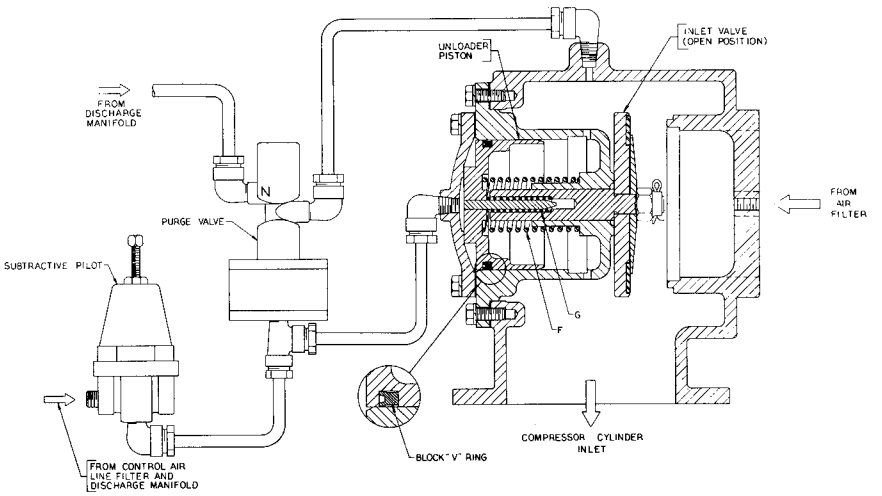

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FIGURE 7-4. — INLET VALVE

unloader piston and allows the inlet valve to open as pressure decreases, and valve spring "G" which returns the inlet valve to closed position on shutdown of the compressor and prevents oil backflow from the compressor to the air filter.

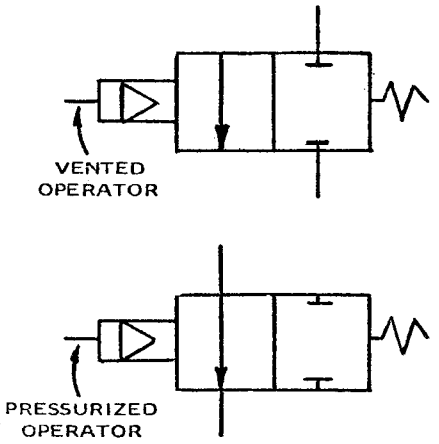


FIGURE 8-4. — PURGE AIR VALVE

Purge Air Valve — The purge air valve is a normally closed two-way air-actuated valve that admits purge air from the final discharge manifold to the compressor to counteract the oil knock that occurs in oil-flooded rotary screw type compressors when they are completely unloaded with pressure in the oil reservoir. See Figure 8-4 for a schematic diagram of the Purge Air Valve in both its modes of operation.

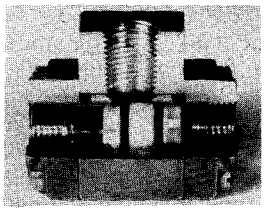


FIGURE 9-4. — SHUTTLE VALVE

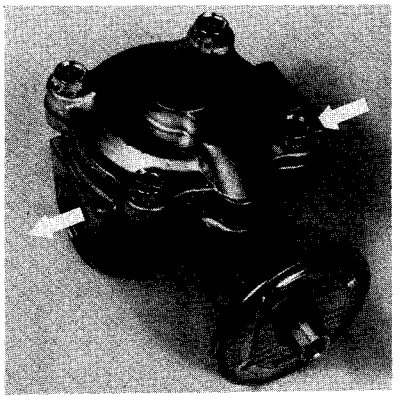


FIGURE 10-4. — BLOWDOWN VALVE

Shuttle Valve (Figure 9-4) — Also known as a double check valve, the shuttle valve is a device which will take two (2) supply signals and allow the one with the highest pressure to pass through.

The shuttle valve is used in the Low Demand control system with reservoir blowdown to allow the control to work from both the oil reservoir and the plant air system side of the check valve.

Blowdown Valve (Figure 10-4) — The blowdown valve is a pilot-operated two-way normally-open valve. When there is no control pressure on the operator (diaphragm) a spring shifts the valve open so that the oil reservoir is blown down. With the operator pressurized (3-30 PSIG), the air pressure depresses the diaphragm, closing the valve and allowing pressure to build in the oil reservoir.

Pressure Regulator — The pressure regulator senses and maintains a constant downstream pressure. The pressure regulator is used to supply a low control pressure to prevent damage to the inlet valve from "slamming". The regulator must be set at 25-30 PSIG; the gauge on the regulator reads this control pressure from the valve.

Minimum Discharge Pressure Valve (Figures 2-1 and 11-4) — An internal spring-loaded minimum pressure valve is used in the final discharge line to provide a positive pressure on the oil system of the compressor even when the air service valve is fully open.

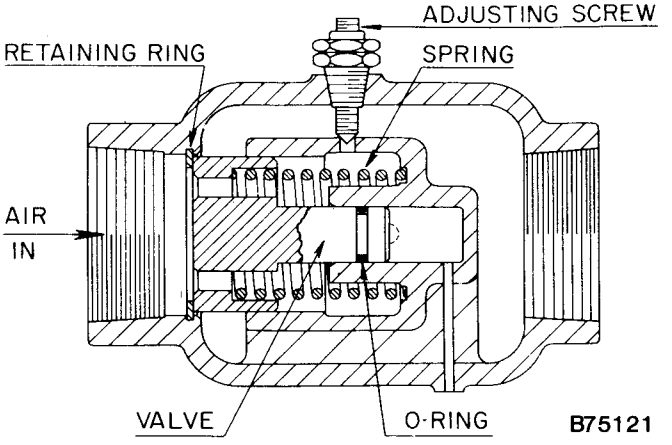


FIGURE 11-4. — MINIMUM DISCHARGE PRESSURE VALVE

The valve incorporates an orifice which, when air is flowing through it, maintains approximately 65 PSIG in the oil reservoir. A spring-loaded piston valve senses air pressure on the upstream (oil reservoir side) of the valve. When the system pressure rises above 65 PSIG, the spring is overridden and the valve opens to full porting.

The valve does not require maintenance or adjustment. If the valve fails to function, check the valve stem O-rings for sealing, valve orifices for restriction, or valve and valve seat for burrs and dirt.

The valve is adjustable within a small range. It is adjusted by a screw on the side of the valve body. The minimum pressure can be adjusted as follows:

1. Start the compressor.
2. Reduce pressure downstream of minimum pressure valve to below desired minimum pressure. DO NOT REDUCE UPSTREAM PRESSURE OR ADJUST VALVE BELOW 65 PSIG.

3. Loosen locknut on adjusting screw.

4. Turn set screw in to increase, or out to decrease minimum pressure to be held.

5. Hold set screw at desired point and tighten locknut.

Check Valve (Oil Reservoir) (Figure 2-1) — A renewable seat swing type check valve in the final discharge manifold prevents backflow of air from the shop air line when the unit stops, unloads or is shut down.

AUXILIARY AIR RECEIVER — An auxiliary air receiver with adequate volume must be used to prevent rapid cycling of the unit. Occasionally shop air lines are such a length as to provide adequate volume, but this should be carefully checked before using the unit without an auxiliary air receiver.

MODULATING CONTROL SYSTEM is the standard control system for the "ECM" *Electra-Saver II®* compressors and is best used in applications where there are no long periods of unloaded operation.

The control system will modulate the compressor capacity to match the air system demand. As demand decreases and air system pressure increases above the subtractive pilot low setting, the pilot passes pressure to the inlet valve piston and the inlet valve closes enough to match the air system demand. As demand increases, and air system pressure decreases toward the subtractive pilot low setting, less pressure is passed to the inlet valve piston and the inlet valve opens enough to match the air system demand; see Figure 12-4. As the demand increases and air system pressure decreases below the subtractive pilot low setting, no pressure is passed to the inlet valve piston and the inlet valve opens fully and the compressor is at full load as in Figure 13-4. Note that the Low Demand switch may be either ON or OFF during modulated operation without effect on the system; if the Low Demand pressure switch setting is not reached, the 4-way solenoid is energized and is passing pressure to hold the blowdown valve closed.

The response of the Modulating Control system to occasional or no demand is determined by the position of the Low Demand switch.

Low Demand Switch ON — The air system pressure will increase above the Low Demand pressure switch high setting and will open the switch contacts and de-energize the Low Demand 4-way solenoid valve. The 4-way valve shifts to pass pressure to the control system and release pressure from the blowdown valve which opens to vent the oil reservoir pressure to atmosphere. The decreasing oil reservoir pressure causes the subtractive pilot pressure to drop and allows shuttle valve 2 to shift to pass pressure from 4-way valve to the inlet valve piston and fully close the inlet valve. The discharge check valve blocks the higher plant air pressure from returning to the lower oil reservoir pressure and shuttle valve 1 shifts to pass plant air pressure to the control system. During the time that the shuttle valves are shifting, there is a momentary cross over between the two systems; however, since the shuttle valve requires only 0.36 PSI differential to shift, the operation is instantaneous for all practical purposes. Figure 14-4 shows the air system after the compressor is fully unloaded. During unloaded, oil reservoir blowdown operation the compressor receives proper lubrication as oil is circulated from the positive atmospheric pressure in the oil reservoir to the negative unloaded pressure (vacuum) in the compressor.

The unit will continue to run unloaded and the oil reservoir remain blown down until the plant air pressure decreases to the Low Demand pressure switch low setting. The pressure switch contacts will close, energizing the 4-way valve which shifts to release pressure from the control system and apply pressure to the blowdown valve. As pressure is released from the inlet valve piston, the inlet valve opens admitting air for compression. With the blowdown valve closed, pressure rises in the oil reservoir. The rising oil reservoir pressure opens the discharge check valve and allows air to flow to the plant air line; shuttle valve 2 shifts to allow the subtractive pilot to modulate the inlet valve. See Figure 12-4 "Compressor at Partial Load".

Low Demand Switch OFF — The air system responds the same as with the Low Demand switch ON, except that the 4-way solenoid valve will not be de-energized to open the blowdown valve. The oil reservoir will not blow down and the inlet valve wll respond to the subtractive pilot control only. See Figure 15-4 "Compressor Unloaded — Low Demand Switch OFF" and Figure 12-4 "Compressor at Partial Load".

MODULATING CONTROL SYSTEM WITH AUTOMATIC START/TIMED STOP is an optional control system for "ECM" *Electra-Saver II®* compressors and is best used in applications where the demand for air varies widely or there are long periods of no demand. The Modulating Control with Automatic Start/Timed Stop system consists of the standard Modulating Control system plus a timer. The addition of a timer to the control system minimizes power consumption by stopping unit during extended periods of unloaded operation. Operation of Modulating Control with Automatic Start/Timed Stop system is identical to operation of the standard Modulating Control system, except as described below.

Low Demand Switch ON — When the air system pressure increases above the Low Demand pressure switch high setting, the switch not only de-energizes the Low Demand 4-way solenoid valve and blows down the reservoir, but also starts the timer. If the air system pressure does not drop to the presssure switch low setting within the period of time set on the timer, the unit will stop. The "ON" indicator light will remain on as long as the "ON" pushbutton of the On-Off switch is depressed. When air system pressure drops to the pressure switch low setting, the unit will start, the timer will reset, and the loaded-unloaded-stop cycle will repeat.

CAUTION

Never set the timer for a time interval less than three (3) minutes. Use of a shorter time interval will cause excess starting and reduced motor life.

When the Low Demand mode switch is in the ON position and the timer is positioned so the range of "MIN" in "MINUTE" is opposite the arrow on the timer ring, the compressor will build to full pressure, unload and blow down. At this setting, the motor will not stop.

Low Demand Switch OFF — When the Low Demand switch is in the OFF position, operation of the Modulating Control System with Automatic Start/Timed stop is identical to operation of the standard Modulating Control System with the Low Demand switch OFF.

OPERATING AIR PRESSURE ADJUSTMENT — Turn Low Demand switch OFF. Start the unit. Close the air service line valve (furnished by customer), allow the unit to build to full pressure and unload, and proceed as follows:

Subtractive Pilot Unload Setting — Set 10 PSI above required operating pressure, but should not exceed 10 PSI above compressor rating.

Pressure Too High:

1. Loosen the inlet valve subtractive pilot locknut. Back the adjusting screw out about one (1) turn.
2. Open the air service line valve and bleed air from the unit so that the compressor loads again. Close the valve and allow the compressor to unload.
3. Repeat Steps 1 and 2 until the proper unload pressure is obtained.
4. Tighten the locknut.

Pressure Too Low:

1. Loosen the inlet valve subtractive pilot locknut.
2. Turn the adjusting screw in until the proper unload pressure is obtained.
3. Tighten the locknut.

Low Demand Pressure Switch Setting —

Set Reservoir Blowdown and Compressor Unload Pressures:

1. Turn the upper adjusting screw on the Low Demand pressure switch until the pointer on the left edge indicates the desired pressure — about 2 PSI below subtractive pilot unloaded pressure setting.
2. Adjust service valve until service pressure is just below desired operating pressure.
3. Turn Low Demand switch "ON".
4. Close service valve. Note the air pressure when unit blows down. If it is not the pressure desired, repeat subtractive pilot and Low Demand setting steps until proper blowdown pressure is obtained.

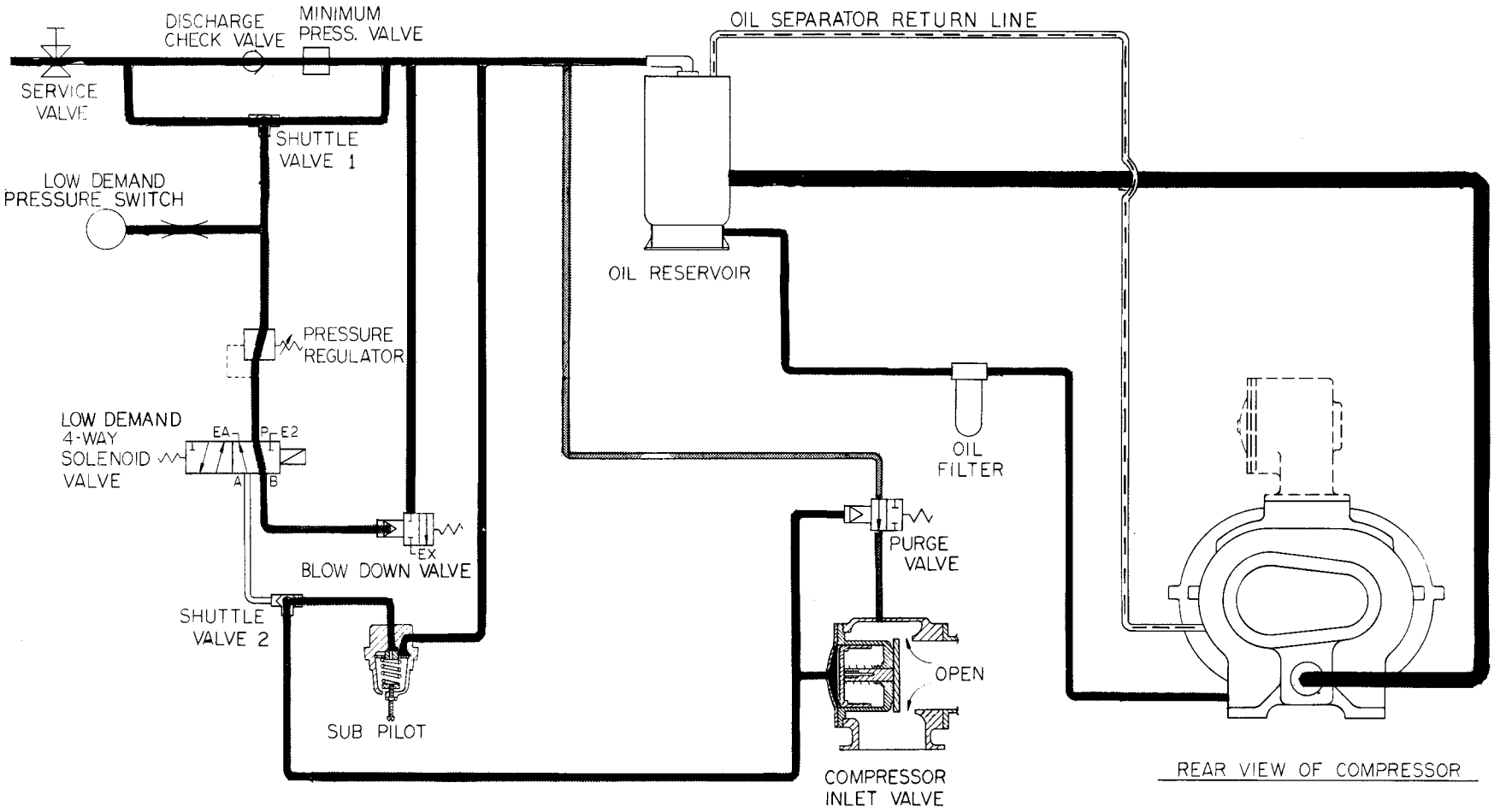
Set Compressor Load Point:

1. With the unit running, oil reservoir at full service pressure, plant air line valve closed, and Low Demand switch in the "ON" position, set the lower (differential) adjusting screw on the Low Demand mode pressure switch near the desired service pressure. Full service pressure minus the differential is the compressor load point. The differential range is approximately 2-18 PSIG on the circular scale above the adjusting screw. It should be set approximately 10 PSIG.
2. Bleed air from the plant air line valve and note the pressure at which the compressor loads.
3. Repeat Steps 1 and 2 until desired low air line pressure point is obtained.

CAUTION

DO NOT ADJUST THE FULL UNLOADED AIR PRESSURE TO MORE THAN 10 PSIG HIGHER THAN THE MAXIMUM STAMPED ON THE UNIT NAMEPLATE.

MINIMUM OPERATING PRESSURE IS 65 PSIG.



FULL AIR PRESSURE

REGULATED (15-20 PSIG) or PILOT AIR PRESSURE

FULL OIL PRESSURE

ATMOSPHERIC PRESSURE

FIGURE 12-4. — CONTROL SCHEMATIC
COMPRESSOR AT PARTIAL LOAD — AIR SYSTEM DEMAND INCREASING OR DECREASING
LOW DEMAND SWITCH ON OR OFF

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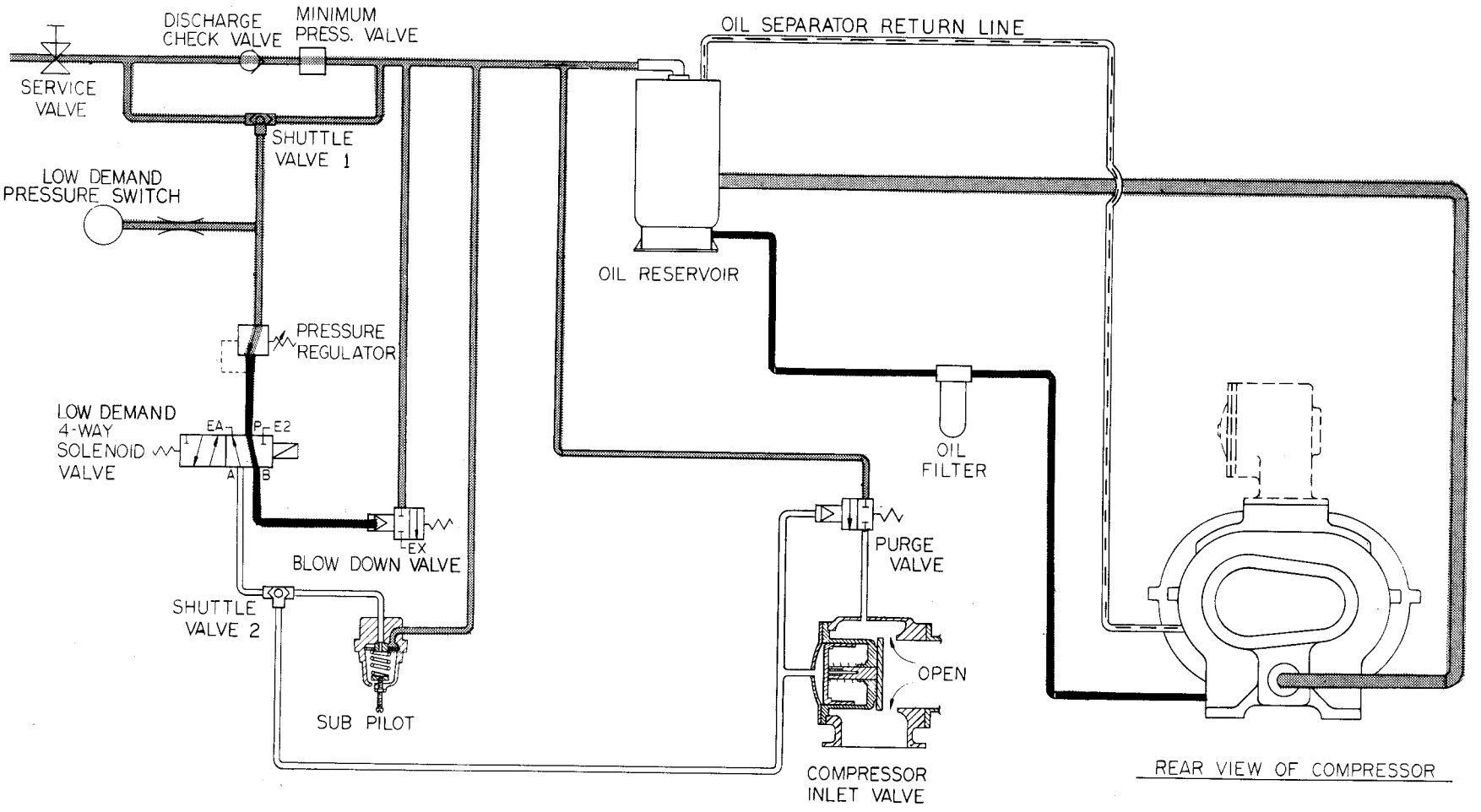

FIGURE 13-4. — CONTROL SCHEMATIC
COMPRESSOR AT FULL LOAD — LOW DEMAND SWITCH ON OR OFF

D76677X

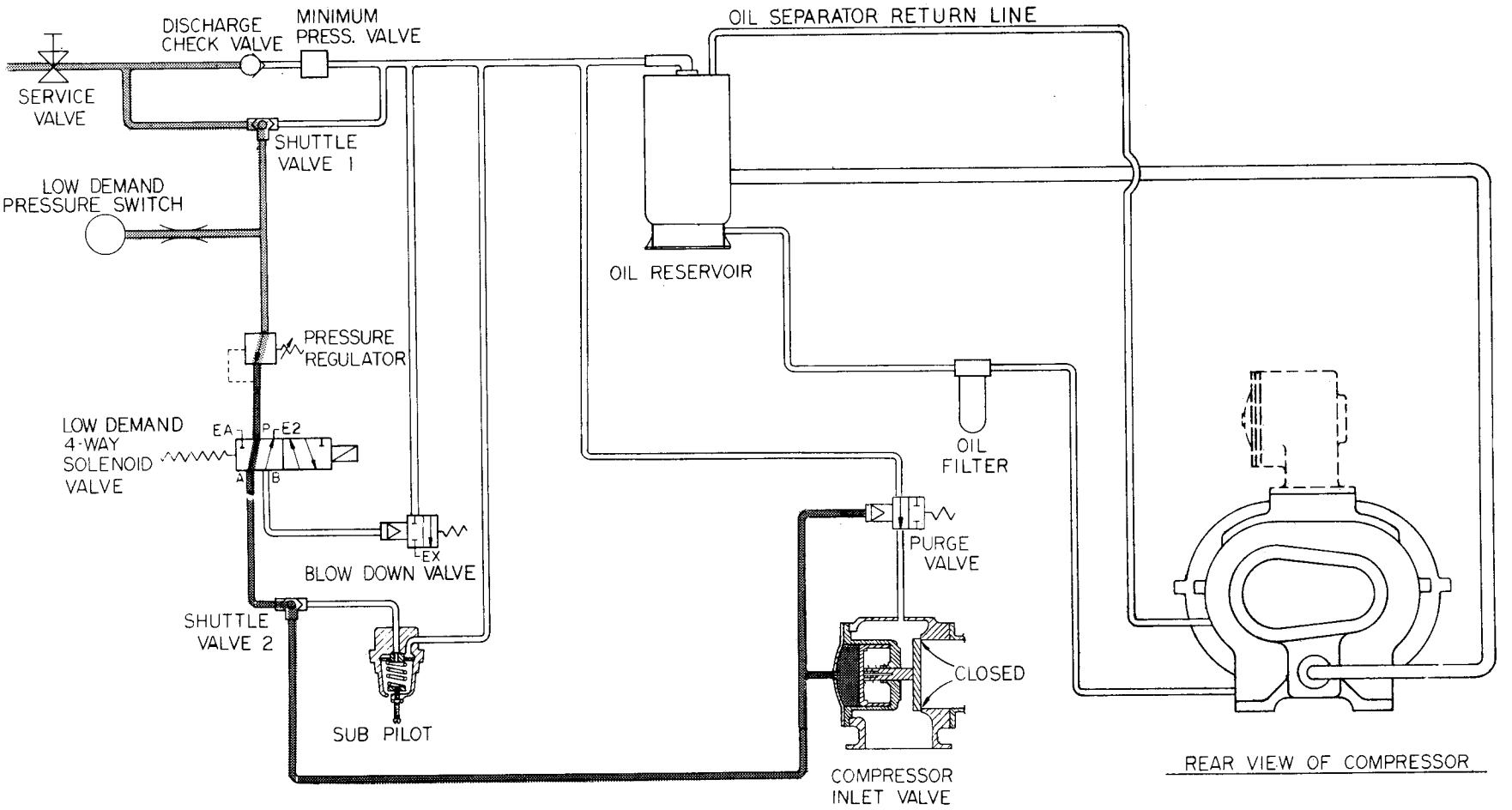

FIGURE 14-4. — CONTROL SCHEMATIC
COMPRESSOR UNLOADED — LOW DEMAND SWITCH ON

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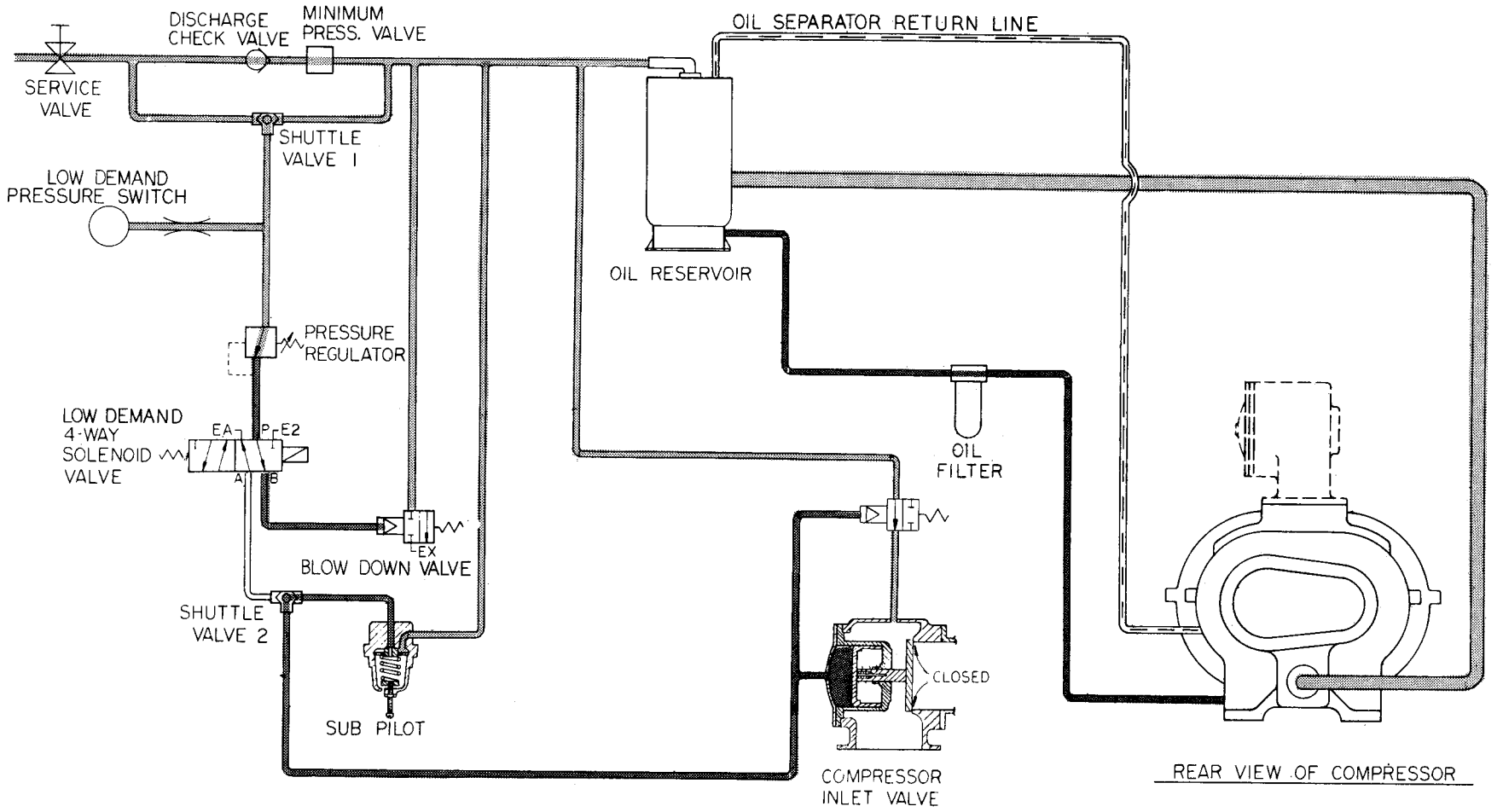

FIGURE 15-4. — CONTROL SCHEMATIC
COMPRESSOR UNLOADED — LOW DEMAND SWITCH OFF

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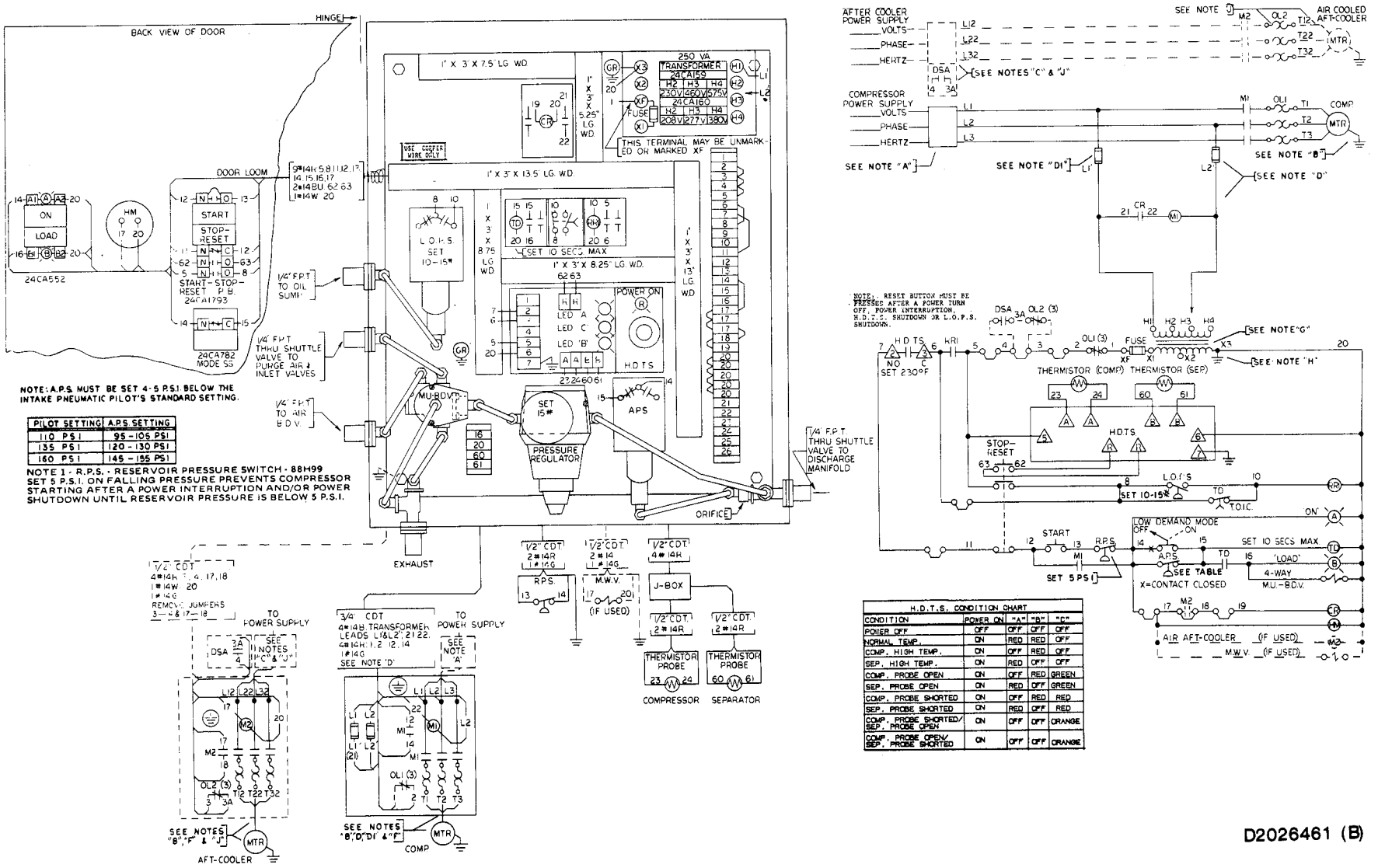


FIGURE 16-4. — WIRING DIAGRAM
CONSTANT SPEED, WATER COOLED, WITHOUT ENCLOSURE

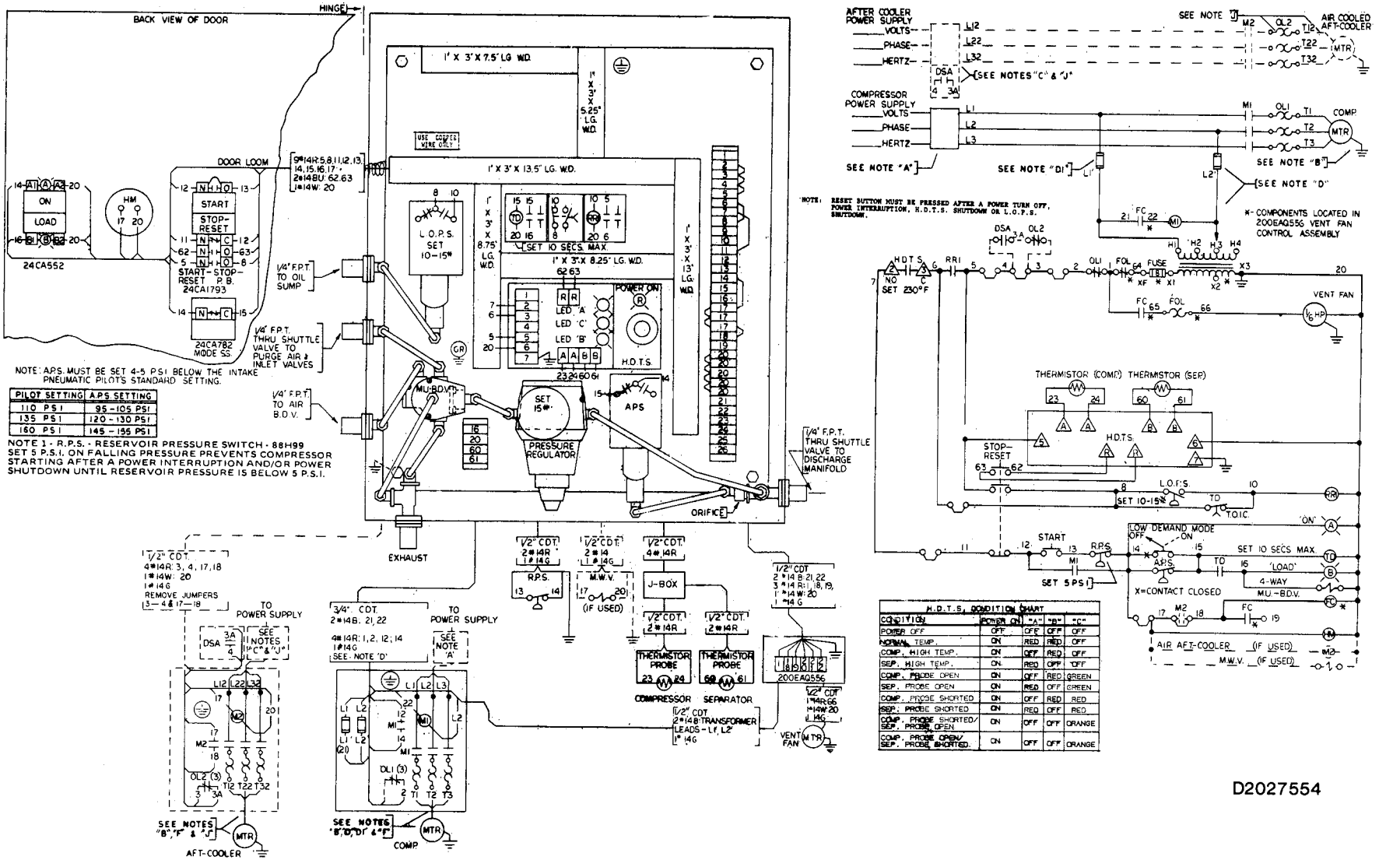


FIGURE 17-4. — WIRING DIAGRAM
CONSTANT SPEED, WATER COOLED, WITH ENCLOSURE

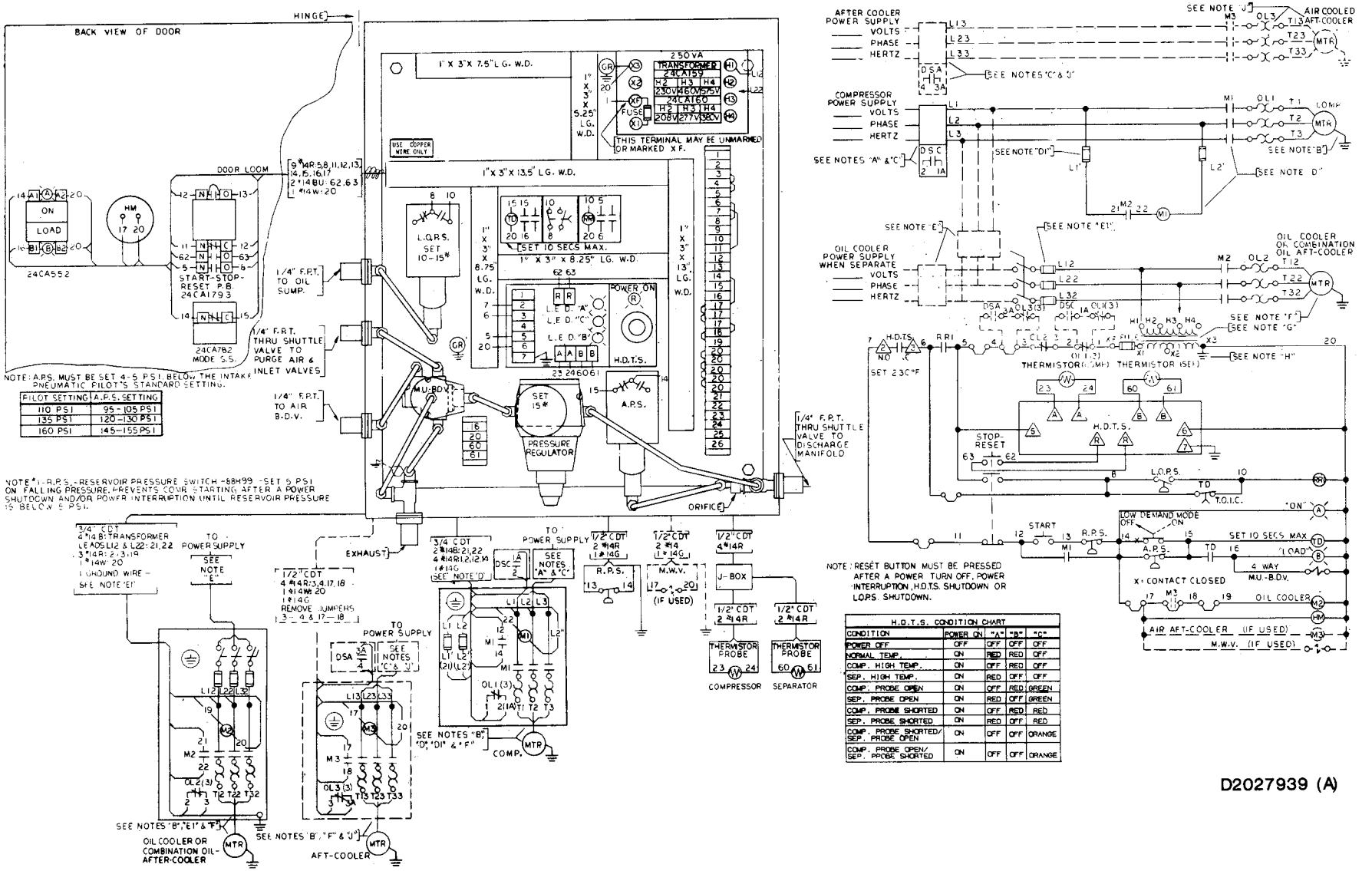


FIGURE 18-4. — WIRING DIAGRAM
CONSTANT SPEED, AIR COOLED, WITH OR WITHOUT ENCLOSURE

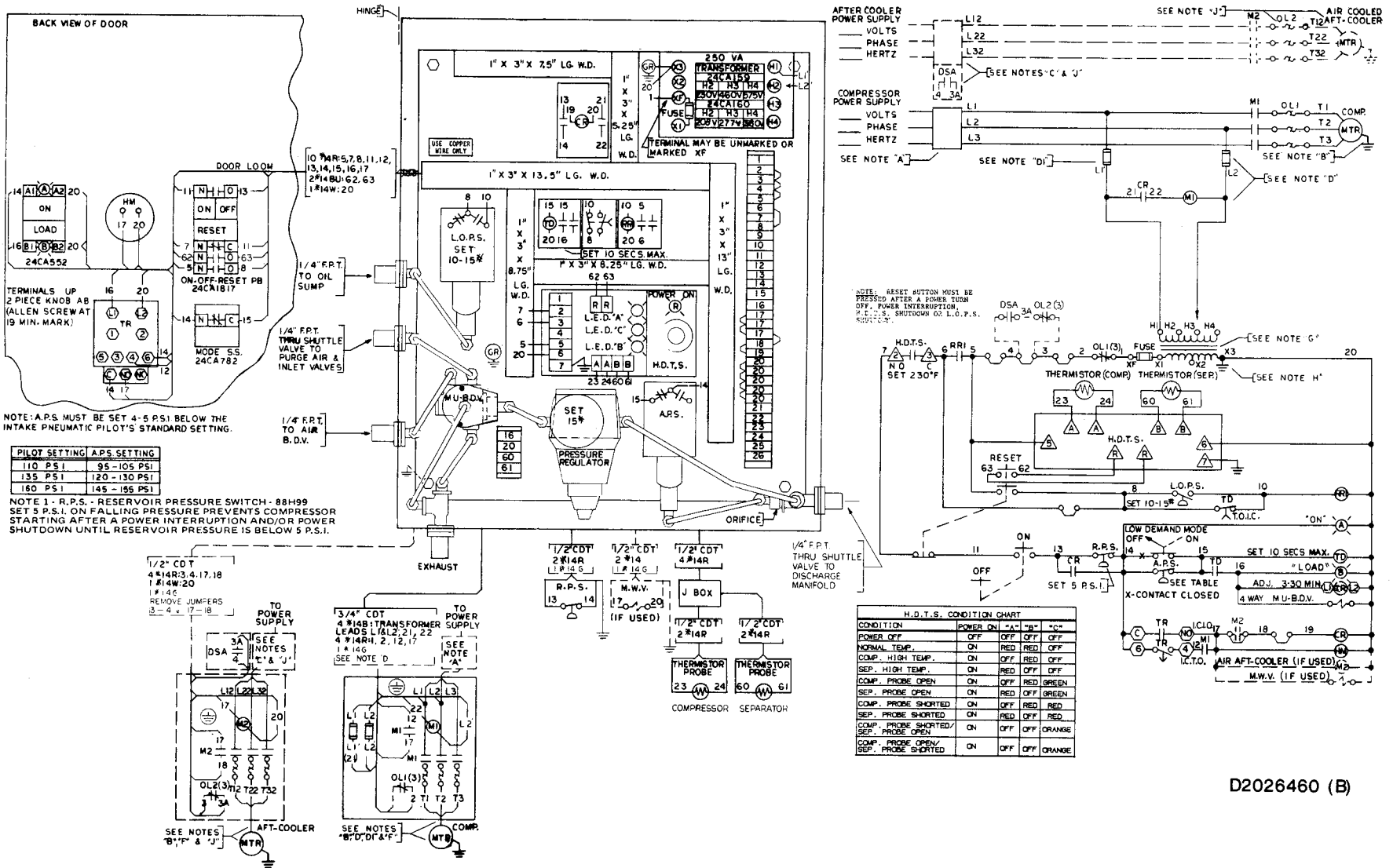


FIGURE 19-4. — WIRING DIAGRAM
AUTOMATIC START TIMED STOP, WATER COOLED, WITHOUT ENCLOSURE

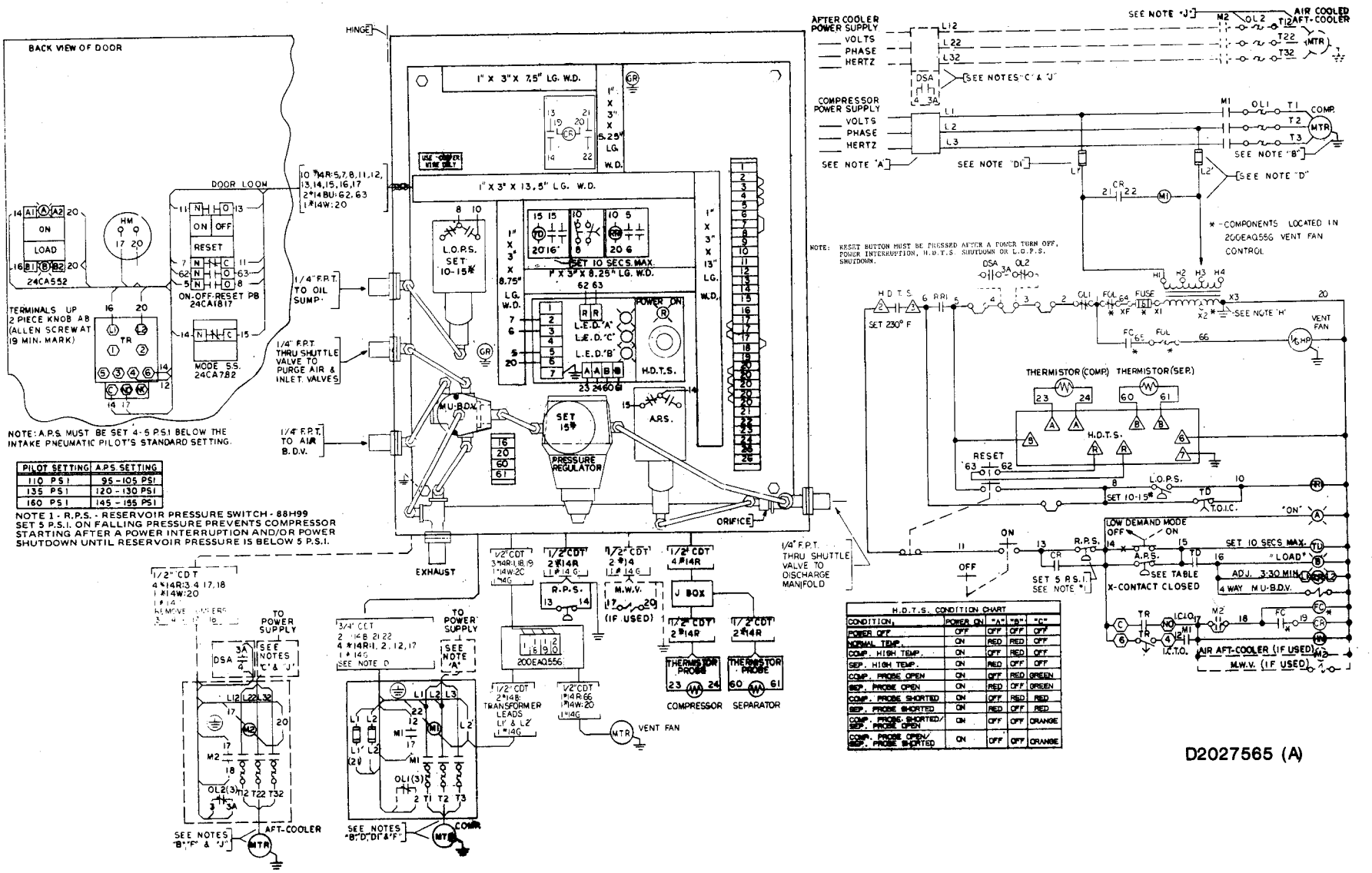


FIGURE 20. — WIRING DIAGRAM
AUTOMATIC START TIMED STOP, WATER COOLED, WITH ENCLOSURE

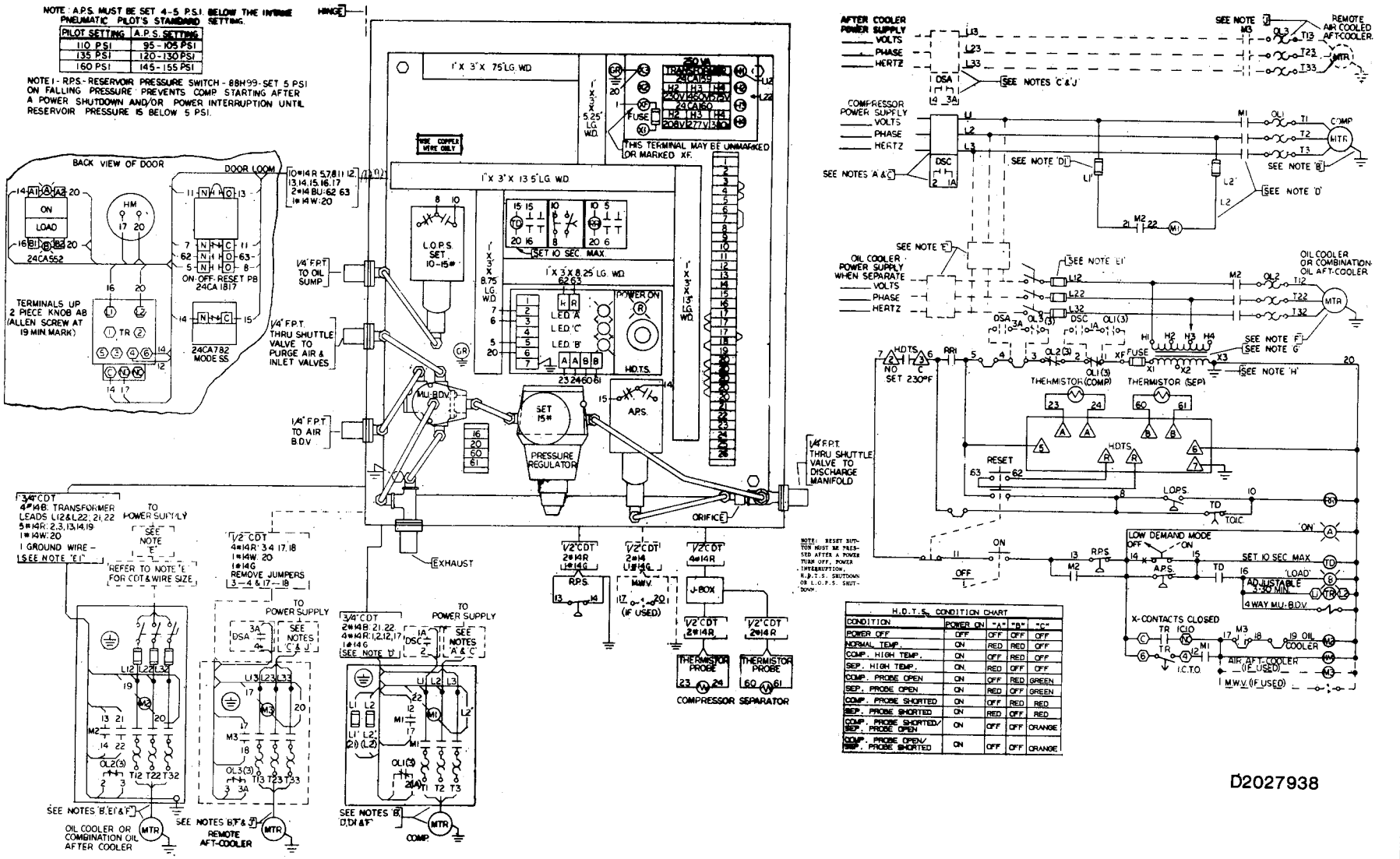
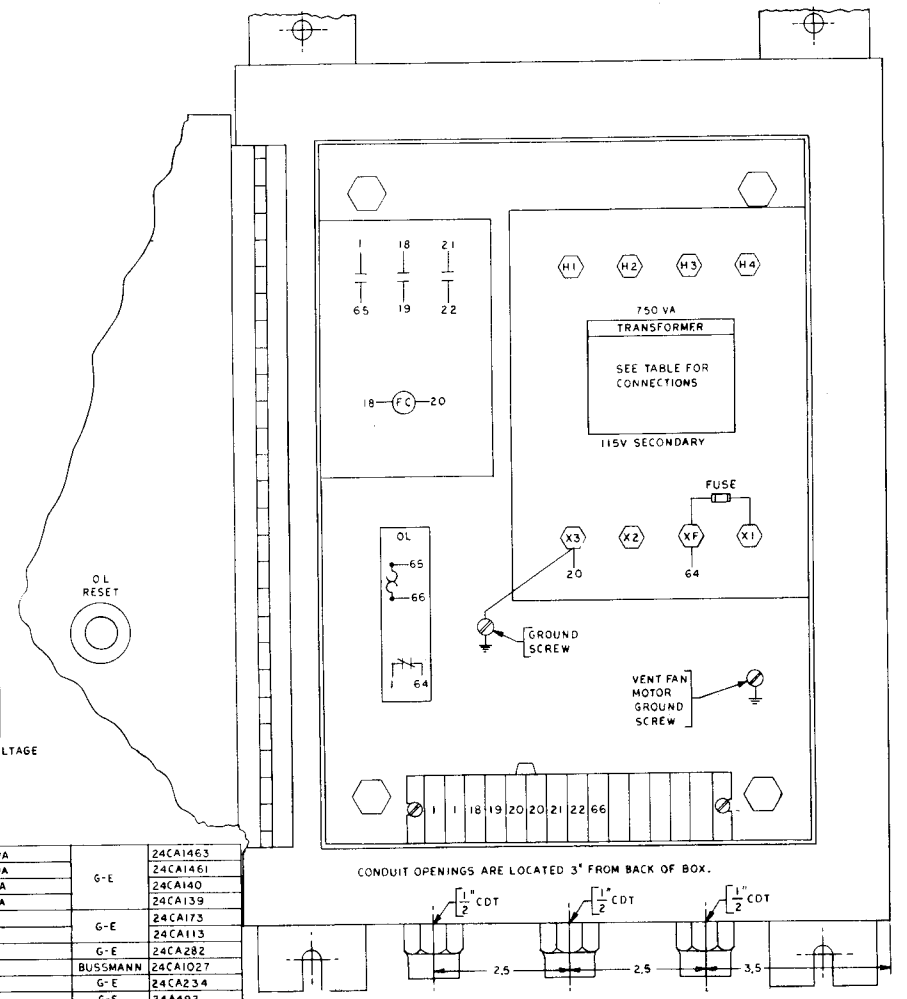
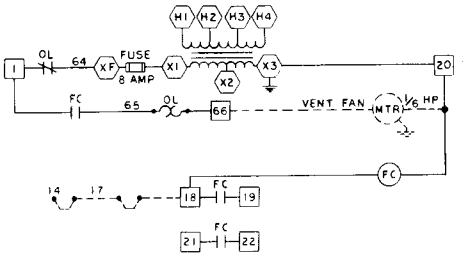


FIGURE 21. — WIRING DIAGRAM
AUTOMATIC START TIMED STOP, AIR COOLED, WITH OR WITHOUT ENCLOSURE





NOTE
REMOVE JUMPER "18-19" IN COMP. CONTROL PANEL AND SEE APPROPRIATE WIRING DIAGRAM FOR COMPLETE COMPRESSOR WIRING.

BOX DIMENSIONS
16.0" HIGH
12.0" WIDE
8.0" DEEP

MOUNTING DIMENSIONS
17.25" HIGH
9.50" WIDE
4 HOLES .44 DIA.

TRANSFORMER		
24CA139		
H2	H3	H4
230V	460V	575V
24CA140		
H2	H3	H4
208V	277V	380V
24CA1461		
H2	H3	H4
380V	400V	415V
24CA1463		
H2	H3	H4
500V	525V	550V

(*) SELECT TRANSFORMER FOR VOLTAGE AND FREQUENCY REQUIRED.

PART	QTY.	DESCRIPTION		G-D PART NO.
TRANS	1 (*)	9T58__G9,500/525/550V-115/95V,50/60HZ,750VA	G-E	24CA1463
		9T58__G9,380/400/415V-115/95V,50/60HZ,750VA		24CA1461
		9T58B9169,208/277/380V-115/95V,50/60HZ,750VA		24CA140
		9T58B7169,230/460/575V-115/95V,50/60HZ,750VA		24CA139
OL HEATER	1	FOR 60 HZ USE | CR123C4.19A	G-E	24CA173
		FOR 50 HZ USE | CR123C3.26A		24CA113
RESET	1	CR124X1000, FOR OVERLOAD HEATER	G-E	24CA282
FUSE	1	MDA8, 8 AMP-250 VOLT	BUSSMANN	24CA1027
RELAY	1	CR124C028, FOR OVERLOAD HEATER	G-E	24CA234
KIT	1	CR124C026, MOUNTING KIT FOR OL RELAY	G-E	24A492
HUB	3	HUB-50 (1/2" CONDUIT)	APPLETON	24A276
JUMPER	1	70 (TWO CIRCUIT)	BUCHANAN	24CA926
TB	14	P0724 (CONTACT SCTION)		24CA925
TB	1	P0730 (END SECTION)		24CA924
FC	1	CR2810A11AB22, 3 N.O. CONTACTS, 110/120V-50/60HZ COIL, CONTACTS 600VAC 10AMP, 1/2 HP RATED AT 115VAC.	G-E	24A494
ENCL.	1	16"H. X 12"W. X 8"D., NEMA 4, WITH 13"X 9" PANEL	WIEGMANN	Z06EAQ179

D2026553

FIGURE 22. — WIRING DIAGRAM
VENT FAN CONTROL

NOTES FOR WIRING DIAGRAMS

(Refer to Figures 16-4 thru 22-4)

All notes are not applicable to all wiring diagrams — read carefully and completely for wiring instructions.

All equipment must be connected and phased exactly as shown. All piping, wiring and other equipment not specified on order is to be supplied by other than Gardner-Denver Compressors.

"A" — Compressor power supply disconnecting means — Fused Switch or Circuit Breaker (not furnished as a standard item — if ordered, it must be remote mounted and wired by customer.).

"B" — Equipment must be grounded in accordance with Table 250-95 of the National Electrical Code.

⚠ WARNING

An equipment ground jumper equal in size to the equipment ground conductor, must be used to connect the compressor motor base to the main base because the bases are isolated from each other by vibration mounts.

"C" — When the control circuit voltage is from a separate power (voltage) source and is not controlled by the motor power supply disconnecting means, a disconnect switch (DS) interlock (not furnished) shall be mounted immediately adjacent to the motor power supply disconnecting means and wired by the customer as shown in the Schematic Wiring Diagram and per the data shown for that starter and its disconnecting means.

This interlocking device (DS) may be an Auxiliary (Aux) or Electrical Interlock (E.I.) contact operated by the handle of the motor power supply disconnecting means.

When this disconnect switch (DS) interlock is a separate device, it shall be used to turn the control circuit "OFF" before operating the motor power supply disconnecting means. See Article 430-74 of the National Electrical Code.

"D" — The compressor motor starter coil voltage is the same as the motor voltage, i.e., 200, 230, 460 volts, etc., unless the starter is ordered with its own fused control transformer. The relay contact from the compressor control panel to the remote mounted starter circuit is rated 600 volts.

Remote mounted magnetic compressor starter control circuits are to be connected for TWO (2) WIRE control.

The remote compressor starter control wiring shall be interlocked with the rest of the control wiring as shown in the Schematic Wiring Diagram and per the wiring data shown for the remote starter. The internal wiring shown is typical only. For exact wiring, see diagram on inside of starter or diagram supplied with starter.

All reduced voltage (current inrush) starters, manual and magnetic, are also remote mounted and wired by the customer. See reduced voltage starter note on page 22, this section.

"D1" — Motor control circuits must be fused in accordance with article 430-72 of the National Electrical Code. Control circuits shall have short circuit protection (fuses, etc.) in all instances because the control circuit wiring leaves the starter enclosure to go to the external devices.

"D2" — A G.E. CR234 air break manual starter is shown. The undervoltage (latch) coil circuit for the G.E. oil break and other manufacturers' manual starters is to be similarly reconnected and interlocked as shown with the compressor control wiring.

"E" — Oil cooler power supply disconnecting means — Fused Switch or Circuit Breaker. NOT FURNISHED — and is remote mounted and wired by the customer.

"E1" — Fused combination starter mounted on separate oil cooler module in NEMA 1 enclosure unless specified NEMA 4 for outdoor usage. The oil cooler module is remote from the compressor and the interconnecting wiring is not furnished. This interconnecting wiring (by customer) is to be interlocked with the rest of the control wiring as shown in the Schematic Wiring Diagram and per the wiring data shown for oil cooler starter. The remote oil cooler equipment ground wire must be connected to the main control panel as shown.

"F" — Since most AC motors are wound for dual voltage, be certain leads are connected per the motor nameplate for the correct voltage.

"G" — Control transformers are sized for the components shown in the Schematic Wiring Diagram on 115 volts and not for any remote mounted compressor starter controls. Transformer part number is shown on the wiring diagrams.

"H" — Control circuit ground. A green ground wire is connected from the terminal shown on the wiring diagram to the control panel.

"J" — Air-cooled aftercooler with its starter and its power supply disconnecting means (Fused Switch or Circuit Breaker) with disconnect switch (DS) interlock — See Note "C" — (Not furnished as standard item — if ordered, it is remote mounted and wired by customer.)

The aftercooler (when sized for an individual compressor) starter coil is 120 volts and is wired and interlocked with the rest of the control wiring as shown in the Schematic Wiring Diagram and per the wiring data shown for the aftercooler starter with its disconnecting means. When the aftercooler is sized for more than one compressor, see instructions for aftercooler starter coil on the special wiring diagram or sketch.

THE FOLLOWING COMPONENTS ARE NOT USED ON ALL UNITS

(See Wiring Diagram For Usage)

A.P.S. — Air Pressure Switch — 2009006 — Set and/or Reset per table on wiring diagram.

The "Low Demand Switch" is furnished to provide low unloaded horsepower when the requirement for air is low. Turning the switch to "ON" switches the A.P.S. into the control circuit.

It is necessary to make sure the unload-load cycle time is greater than 45 seconds or else oil mist will be carried into the air lines. The unload-load cycle time can be increased in the same manner described below for excessive starts.

Excessive starting of motor can and will cause premature motor failure. Too frequent starting causes excessive heat which deteriorates the motor insulation. Excessive starting may be reduced by lowering the A.P.S. cut-in point (increasing differential) or by adding additional receivers to increase the system air storage capacity or both. The elimination of air leaks will also reduce the number of motor starts.

B.D.V. — 1/2" — 2-Way Normally Open — 2W.N.O. Air Operated Valve — 90AR234.

B.D.V.'s are sized to blow down oil reservoir in approximately 45 seconds.

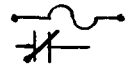
BOOT — 24CA281 — Transparent for PB's when NEMA 4.

C.R. — Control Relay — 24CA771 — 110/120 V — 50/60 Hz Coil — 2S.P.N.O. Convertible 600 Volt Contacts.

D.S.A. — Disconnect Switch Interlock — Aftercooler.

D.S.C. — Disconnect Switch Interlock — Compressor.

F.C. — Fan Contactor — 24A494 — 3 N.O. contacts. 110/120 V, 50/60 Hz Coil; contacts 600 VAC 10 Amp — 1/2 HP rated at 115 VAC.

F.O.L. — Fan Motor Overload — Heater — Contacts 

Fuse — Standard — 2-1/4 Amp 250 Volt, Buss FRN 2-1/4 or equal. With Enclosure and Vent Fan — 8 Amp 250 Volt, Buss MDA 8 or equal.

H.D.T.S. — High Discharge Temperature Switch — Set 230° F. — 21D80. Thermistor Probe (2) — 21D81 (Compressor and Separator).

△ — Terminals on Temperature Switch.

H.M. — Hourmeter — 2009369 — 120 V — 60 Hz (Alternate 2009370 — 110 V — 50 Hz).

I.C.I.O. — Instant Closing — Instant Opening.

I.C.T.O. — Instant Closing — Timed Opening.

I.O.I.C. — Instant Opening — Instant Closing.

I.O.T.C. — Instant Opening — Timed Closing.

L.O.P.S. — Low Oil Pressure Switch — 88A301 Set 10-15 PSI.

NOTE:
When starting unit for first time at final installation, loosen tube fitting on the bottom of pressure switch. After compressor is started and oil appears at the fitting, tighten fitting. If compressor shuts down on low oil pressure on the first start, wait until all air has been bled off thru the blowdown valve before pressing reset button and restarting compressor.

M. — Motor Starter Coil, Contacts, etc.

M.U.-B.D.V. — Magnetic Unloader — Blowdown Solenoid Valve — 110/120 V — 50/60 Hz — Four Way — 91B34.

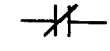
The LOW DEMAND MODE switch should be in the "OFF" position when starting the unit to keep the compressor from cycling rapidly if service valve is closed.

M.W.V. — Magnetic Water Valve — 110/120 V — 50/60 Hz — Two-Way Normally Closed — 2W.N.C.

WATER-COOLED OIL COOLER †		
	NEMA 1	NEMA 4
ECM	90AC118 — 3/4"	90AC103 — 3/4"

† Valves have manual override.

M.W.V.'s are also shown on the Wiring Diagrams for Water-Cooled Aftercoolers (when used) and are to be sized for the aftercooler (if used).

O.L. — Overload — Heater  — Contacts 

R.R.1 — Reset Relay — 24CA541 — 110/120 V — 50/60 Hz Coil — 2S.P.N.O. Convertible 300 Volt Contacts. Used with all automatic start controls which have low oil pressure shutdown. This relay gives LOW VOLTAGE PROTECTION which means a manual reset is required after every power turnoff or interruption. See the appropriate control wiring diagram for additional control switch components and resetting instructions.

T.C.I.O. — Timed Closing — Instant Opening.

T.D. — Time Delay Relay — 24CA285 — 110/120 V — 50/60 Hz Coil — is set for a maximum of 10 seconds to establish oil pressure after each

start-up. If the TD timing coil fails the compressor will not load when started and will unload if running when control is constant speed. If the TD timing relay fails on an auto-start timed-stop control the compressor will not start; if running, the unit will unload and continue running unloaded for the time setting of TR.

T.O.I.C. — Timed Opening — Instant Closing.

R.P.S. — Reservoir Pressure Switch — Set 5 P.S.I. on falling pressure — 88H99 — Prevents compressor from restarting loaded.

 — Jumpers on Terminal Blocks (T.B.).

 — Indicating Light — 24CA40 (Sylvania 120 PSB or Equal).

ADDITIONAL COMPONENTS WHEN COMPRESSOR CONTROL IS OTHER THAN CONSTANT SPEED

T.R. — Timing Relay (Auto-Start/Timed Stop Only) — 24A482 (Thru Door Mounting) — 110/120 V — 50/60 Hz Coil — 24A515 (Inside Panel Mounting) — 110/120 V — 50/60 Hz Coil.

DO NOT SET TIMER DIAL BETWEEN THE 0 AND 3 MINUTE MARK.

See remarks following A.P.S. If compressor remains unloaded for time set on timer dial head (adjustable to 30 minutes), compressor will stop and then start up when needed.

To make compressor run Constant Speed, set timer dial head so the range of "MIN" in "Minute" is opposite the arrow mark on the escutcheon. When timer dial is set for Constant Speed operation and compressor is not running, compressor will not start until air is required (A.P.S. closes).

 — Terminal On T.R. Timing Relay.

Special Notes, Components, Part Numbers and Description, etc. will be shown on Wiring Diagrams requiring the special notes and/or components.

REDUCED VOLTAGE STARTER NOTE

1. Two extra Normally Open Auxiliary contacts are required on most magnetic autotransformer reduced voltage starters. These contacts are required to interlock the compressor starter back to the 115 volt compressor control.

   To determine whether or not these N.O. Aux. contacts are required, look at the typical wiring diagram shown in most starter manufacturers' control handbook, digest, catalog, etc. If the typical wiring diagram shows two or more contacts paralleling the start push button, then these Aux. contacts are required.

   If the typical wiring diagram shows a control (timing) relay, with or without control transformer, then the additional contacts are not required.

   Generally, these Aux. contacts are to be ordered for the start and run contactors. If these Aux. contacts are not ordered with the starter, then the starter manufacturers field installation kits for Aux. contacts will have to be ordered and used.

   These two N.O. Aux. contacts, when required, will be supplied if Quincy orders the starters.

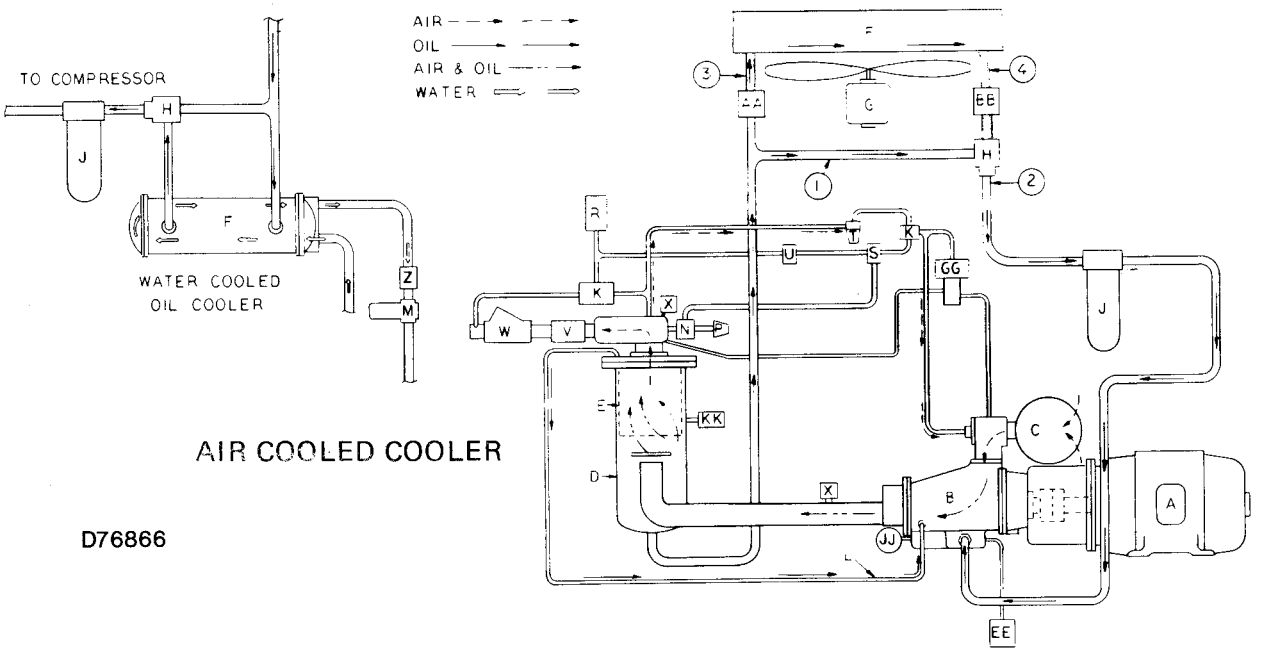
2. STARTING (All Types Reduced Voltage Starters)

   The first point acceleration time should not be longer than 4-5 seconds. This is in order that the pressure buildup in the compressor will not bog down nor stall the motor when the starter goes from the start to the run mode.

   NOTE:
   First point acceleration time may be limited to 2-3 seconds on some part winding motors.

   On magnetic reduced voltage starters, set the starter timer for 4-5 seconds. if the starter is of the manual type, then do not hold the handle in the start position longer than 4-5 seconds.

SECTION 5
LUBRICATION
OIL COOLER, OIL FILTER & SEPARATOR



A — MOTOR
B — COMPRESSOR
C — AIR FILTER
D — OIL RESERVOIR
E — OIL SEPARATOR
F — OIL COOLER
G — FAN AND MOTOR
H — THERMAL CONTROL (THERMOSTATIC MIXING) VALVE
J — OIL FILTER
K — SHUTTLE VALVE
L — SEPARATOR TO CYLINDER OIL RETURN LINE
M — WATER FLOW CONTROL VALVE
N — PNEUMATIC BLOWDOWN VALVE
P — BLOWDOWN MUFFLER
R — OPERATING AIR PRESSURE SWITCH
S — MAGNETIC UNLOADER
T — SUBTRACTIVE PILOT (INLET VALVE)
U — PRESSURE REGULATOR
V — MINIMUM DISCHARGE PRESSURE VALVE
W — DISCHARGE CHECK VALVE
X — HIGH DISCHARGE TEMPERATURE SHUTDOWN SWITCH
Z — MAGNETIC WATER SHUTOFF VALVE
AA — OIL LINE CHECK VALVE (REMOTE OVERHEAD OIL COOLER ONLY)
BB — OIL STOP VALVE (REMOTE OVERHEAD OIL COOLER ONLY)
EE — LOW OIL PRESSURE SWITCH
GG — PURGE AIR VALVE
KK — RESERVOIR PRESSURE SWITCH

FIGURE 1-5. — FLOW DIAGRAM — AIR-OIL SYSTEMS

COMPRESSOR OIL SYSTEM (Figure 1-5) cools the compressor, lubricates moving parts and seals internal clearances in the compression chamber.

The oil inlet line is connected at the bottom of the oil reservoir. Air pressure in the oil reservoir forces oil through the oil cooler, thermostatic mixing valve, oil filter and into the compressor main oil gallery.

The oil passes through internal passages for lubrication, cooling and sealing. The air-oil mixture is then discharged to the oil reservoir where a large part of the entrained oil drops out of the air stream; the air then passes through the final oil separators where most of the remaining oil is removed. The separated oil is returned to the compressor and the air passes to the final discharge line.

OIL SPECIFICATIONS — The recommended compressor lubricant is *Gardner-Denver*® "GD800 Lubricating Coolant" which can be used for year-round operation except as noted in the High Temperature Operation paragraph below. GD800 Lubricating Coolant is a superior petroleum base lubricant formulated and containing additives for use in *Electra-Saver II*® compressors.

CAUTION

Mixing of different types or the use of inferior lubricants will result in the formation of heavy varnish and sludge throughout the system.

SYNTHETIC LUBRICANTS — Certain synthetic lubricants, such as synthetic hydrocarbons, diesters or polyesters offer an extended drain interval when used in screw compressors. A superior diester lubricant is available in *Gardner-Denver* "GD8000 Lubricating Coolant" which can extend lubricant change interval from 2 to 4 times that of GD800. A good

lubricant analysis program for periodic check of lubricant quality and remaining life can maximize the change interval.

See the instructions on use of GD8000 in systems previously filled with other lubricants under "High Temperature Operation" below.

Recommended Oil	Temperature Range
Gardner-Denver® GD800 Lubricating Coolant	Year-round operation at discharge temperatures to 200° F.
Gardner-Denver GD8000 Lubricating Coolant	Over four (4) hours sustained discharge temperature between 200-210° F.

FIGURE 2-5. — COMPRESSOR LUBRICANT

WARNING

Do not mix GD800 and GD8000 Lubricating Coolants or other petroleum or synthetic lubricants.

CAUTION

Regardless of synthetic lubricant change interval used, oil filter and oil separator change intervals remain the same as for GD800 — See Maintenance Schedule, Section 8.

HIGH TEMPERATURE OPERATION — If the discharge temperature is sustained between 200-210° F. for a period of more than four (4) hours due to continuing high ambient air or water temperatures, use *Gardner-Denver*® "GD8000 Lubricating Coolant" which is a superior viscosity grade diester synthetic lubricant. Short periods of up to four (4) hours of sustained discharge temperatures up to 210° F. do not require a change from the recommended year-round lubricant GD800.

When installing GD8000, the original lubricant should be drained completely and the system flushed before filling with GD8000. Complete draining will involve removal of all plugs in the compressor, oil reservoir and oil lines. In some cases, it may be necessary to remove piping to insure complete draining. To insure complete removal of the original lubricant, good practice indicates draining of the original lubricant, refill with GD8000, operation for 100 hours, then draining and final refill.

WARNING

Do not mix GD800 and GD8000 Lubricating Coolants or other petroleum and synthetic lubricants.

WARNING

Do not set the High Discharge Air Temperature switch above ± 225° F. to compensate for high temperature operation.

Use caution when selecting GD8000 lubricant, as some downstream air system components such as air line lubricator bowls, gaskets and valve trim may not be compatible. Check with the component supplier for suitability of the part with diester synthetic lubricant. All materials used in *Electra-Saver II*® compressor units are compatible with GD8000.

COLD AMBIENT OPERATION — *Gardner-Denver* "GD800 Lubricating Coolant" must be used when the ambient temperature drops to +40° F. in the space enclosing the compressor unit. See Installation for Cold Weather Operation" in Section 2.

If a synthetic lubricant is used, a lighter viscosity lubricant than *Gardner-Denver* GD8000 is necessary in the temperture range of +10° F. to –40° F. The lighter viscosity lubricant must have foam depressant, oxidation and corrosion inhibiting characteristics equal to those of GD800 and meet these minimum specifications:

Viscosity at 100° F. ..... 140 SUS
Viscosity at 210° F. ..... 44 SUS
Pour Point ..... –60° F.

Reservoir Capacity to Centerline of RUN Range .... 18 U.S. Gallons

System Capacity Reservoir Plus Oil Cooler and Piping ..... 21 U.S. Gallons

Quantity Top Of ADD To Centerline Of RUN Range ..... 2 U.S. Gallons

FIGURE 3-5. — OIL SYSTEM CAPACITIES

ADDITION OF OIL BETWEEN CHANGES must be made when level of oil in the gauge is below the NORMAL range while the unit is operating. Stop unit and be sure no air pressure is in the oil reservoir. Wipe away all dirt around the oil filler plug. Remove the oil filler plug and add oil as required to return the oil level to the center of the RUN range when the unit is operating. The quantity required to raise the oil level from the top of the ADD range to the centerline of the RUN range is shown in Figure 3-5. Repeated addition of oil between oil changes may indicate excessive oil carryover and should be investigated.

OIL LEVEL GAUGE (Figure 2-1) indicates the amount of oil in the oil reservoir. When the unit is stopped the oil level will be higher in the RUN range than when operating on load. When the unit is operating the oil level should be near the center of the RUN range. In operation the oil level will fluctuate slightly as the compressor loads and unloads. Add oil only when the oil level gauge indicates in the ADD OIL range when the compressor is loaded. Drain oil only when the oil level gauge indicates EXCESS OIL when the compressor is loaded. Note that the top of the RUN range on oil level gauge decal is approximately centerline of filler elbow to prevent overfilling.

MOISTURE IN THE OIL SYSTEM — In normal humidity and with normal operating temperatures and pressures, the thermal mixing valve controls the oil temperature and prevents moisture contamination of the oil. Unusual cooling of the oil reservoir, short loaded cycle in high humidity, malfunctions of the thermal valve or cooling water system may result in moisture in the oil system which is detrimental to compressor lubrication. If moisture is observed in the oil reservoir, drain the moisture and correct the condition causing the accumulation. See "Compressor Oil System Check" and "Thermal Control (Thermostatic Mixing) Valve" in this section.

OIL CHANGE INTERVAL is determined by air filter maintenance, operating conditions and quality of oil. Good practice is to change oil often enough that the drained oil is relatively clean. Under good conditions *Gardner-Denver*® GD800 may be used up to 2000 hours of operation.

FILLING OIL RESERVOIR — When operating conditions are severe (very dusty, high humidity or high temperature) it will be necessary to change the oil more frequently. Operating conditions and appearance of drained oil must be surveyed and the oil change intervals planned accordingly by the user. A good lubricant analysis program is helpful in planning the change interval.

A drain plug is located at the bottom oil level gauge tee to provide a sampling point. Change the oil filter every 1000 hours.

DANGER

Stop unit and be sure no air pressure is in the oil reservoir.

DRAINING AND CLEANING OIL SYSTEM — Always drain the complete system. Draining when the oil is hot will help to prevent varnish deposits and to carry away impurities. To drain the system, use one of the following methods:

If the unit is not elevated high enough to use the oil reservoir drain valve to drain oil, a small hand-, electric- or air-operated pump should be used to drain reservoir through the oil filler opening or from the drain valve. Remove oil cooler drain plugs.

If the unit is elevated so that the oil reservoir drain can be used, empty the oil reservoir and then remove the oil cooler drain plugs.

If the drained oil and/or the oil filter element are contaminated with dirt, flush the entire system: reservoir, oil cooler, mixing valve and lines. Inspect the oil separator elements for dirt accumulation; replace if necessary. If a varnish deposit exists, contact the factory for recommendations for removal of the deposit and prevention of varnish.

DANGER

Stop unit and be sure no air pressure is in the oil reservoir.

Wipe away all dirt before removing the oil filler plug. Refer to Figure 3-5 for the oil quantity required to fill the compressor oil system. This amount may bring the oil level into the EXCESS OIL range on the gauge. After a short time of operation, the oil level will drop into the RUN range as oil fills other parts of the system. Maintain the oil level in the RUN range. On unloaded operation and after shutdown some oil will drain back into the oil reservoir and the oil level gauge may read in EXCESS OIL range. DO NOT DRAIN OIL TO CORRECT. On the next start, oil will again fill the system and the gauge will indicate operating oil level. DO NOT OVERFILL as oil carry-over will result. Use only CLEAN containers and funnels so no dirt enters the reservoir. Provide for clean storage of oils. Changing oil will be of little benefit if done in a slipshod manner.

COMPRESSOR OIL FILTER (Figure 4-5) — This replaceable element filter is a vital part in maintaining a trouble-free compressor, since it removes dirt and abrasives from the circulated oil. The filter is equipped with a relief valve that opens in the event the element becomes dirty enough to block the flow of oil.

CAUTION

Element must be replaced every 1000 hours or sooner, or when top of the indicator on the filter is in the red "Change Filter" half of the window. Unit must be running and warmed up for indicator to read accurately. Check with light to be certain of indicator position — some lubricants will obscure the indicator.

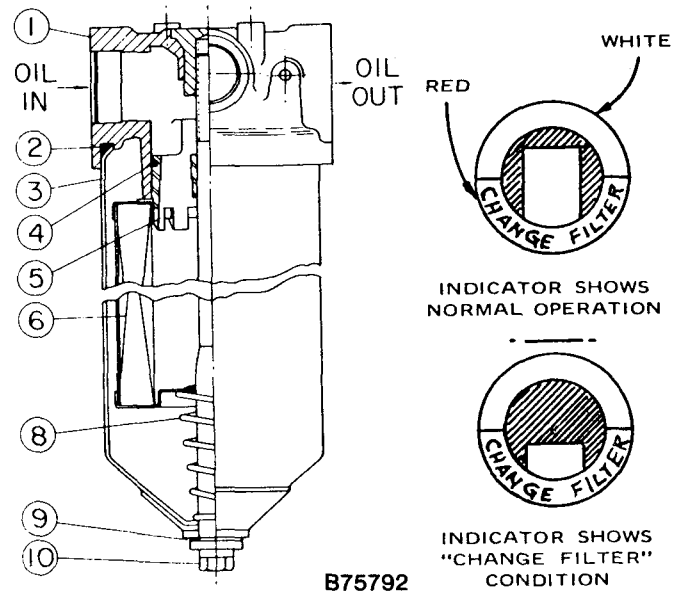


FIGURE 4-5. — COMPRESSOR OIL FILTER

Use only the replacement element shown on filter tag or refer to parts list for the part number. Use the following procedure to replace the filter element. Do not disturb the piping.

1. Stop unit and *be sure no air pressure is in the oil reservoir.* To remove cannister (3) rotate tie bolt (1) counterclockwise until cannister is free of head assembly (1).

2. Remove element (6) from cannister. Remove indicator assembly (5) from element by inserting screwdriver between indicator assembly and element and carefully prying downward. Inspect O-ring (4) for cuts or excessive wear and discard the element. Rinse out cannister with clean fluid to remove any contamination.

3. Remove O-ring (2) from head assembly and inspect for cuts or excessive wear. Wipe O-ring area of head (1) with clean cloth and after covering O-ring with oil, reinstall in head assembly. Check the indicator assembly (5) machined bore in the head for burrs or deep scratches and carefully smooth out if required.

4. Install indicator assembly (5) into new element. Place element into cannister making sure spring (8), washer gasket (9) and tie bolt (10) are in proper position.

   NOTE:
   Large diameter end of spring should contact the new element.

5. Place cannister as previously assembled into head assembly and rotate bolt clockwise until torqued to 20 foot-pounds.

6. If leakage appears at bottom of cannister, replace washer gasket (9). If leakage appears at top of cannister replace O-ring (2). If this does not stop the leakage, the cannister may be nicked or distorted by over-torquing and should be replaced.

COMPRESSOR OIL COOLER — RADIATOR TYPE (Figure 1-5) — The oil cooler motor and fan is mounted on the oil cooler module; air is exhausted through the oil cooler and away from the unit. Do not obstruct air flow to and from the oil cooler. Allow two (2) feet clearance around the cooler. Keep both faces of the cooler core clean for efficient cooling of the compressor oil.

The oil cooler module may be removed from the unit and mounted remotely. See Section 2. A ventilating fan is now used to supply motor cooling air.

Oil cooler malfunction may be traced by checking the oil pressure drop through the cooler; check by installing pressure gauges in each drain plug opening at the end of the cooler. At normal operating air service pressures (65 to 150 PSIG) with the unit warm, a pressure drop of 2 to 12 PSIG can be expected between the inlet and outlet side of the cooler.

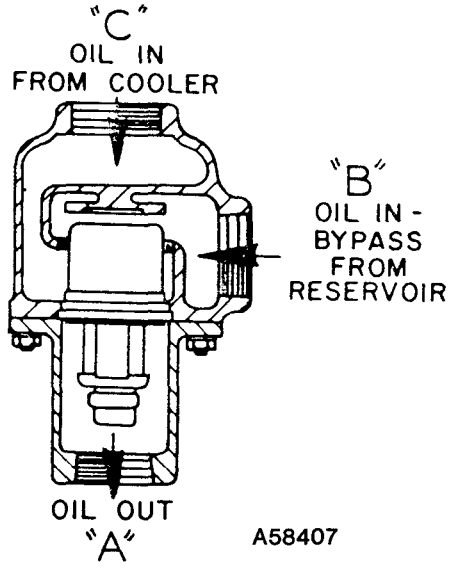


FIGURE 5-5. — THERMOSTATIC MIXING VALVE

THERMAL CONTROL (THERMOSTATIC MIXING) VALVE (Figure 5-5) is installed in system as shown in Figure 1-5. This valve is used to control temperature of the oil in both air-cooled radiator and water-cooled heat exchanger type oil cooler systems. On start-up with unit cold, element is open to bypass, allowing oil to pass directly from the reservoir to compressor during warm-up. As oil warms, element gradually closes to the bypass allowing more of the oil from the cooler to mix with oil from the bypass. After the unit is warmed up, mixing valve maintains oil injection temperature into the compressor at a minimum of 150° F. This system provides proper compressor warm-up and prevents moisture contamination of the oil.

To check element, heat in oil — it should be fully extended at 150° F. If unit shuts down due to high air discharge temperature, the cause may be that the element is stuck open to the bypass, in which case lines 1 and 2 (Figure 1-5) will be hot to touch and lines 3 and 4 much cooler. When flushing the oil system, remove mixing valve and clean all parts thoroughly.

COMPRESSOR OIL COOLER — WATER-COOLED HEAT EXCHANGER (Figure 1-5) — The heat exchanger oil cooler is a multiple pass type, with water in the tubes and oil in the shell. The oil temperature is controlled by the thermal control (thermostatic mixing) valve. The optional water control valve may be used to conserve water.

Oil cooler malfunction may be traced by checking pressure at oil inlet and outlet. Fittings at these locations are equipped with a 1/4" inch pipe tap for a guage. At normal operating air service pressure (65 to 150 PSIG) with the unit warm, a pressure drop of 3 to 12 PSI can be expected between the oil inlet and the oil outlet.

Water pressure drop from water inlet to outlet will vary with the inlet pressure and amount of water flowing. A normal pressure drop may range from 5 to 10 PSI. Any change in the pressure drop from that normally held may indicate tube leakage or fouling and should be investigated.

In many instances, the cooling water supply for the heat exchanger will contain impurities in solution and/or suspension. These substances can cause scale formation, corrosion and plugging of any water-cooled heat exchanger equipment. Disregarding the possibility that one or more of these conditions exist may result in increased maintenance and operation expense, reduced equipment life and emergency shutdown. It is strongly recommended that a reputable, local water treatment concern be engaged to establish the corrosion, scale forming and fouling tendency of the cooling water and take steps necessary to remedy the situation if a problem does exist. The need for water treatment may involve only filtration (screening) to remove debris, sand and/or salt in the cooling water supply. However, chemical treatment methods may be necessary in certain instances to inhibit corrosion and/or remove dissolved solids, to alter the water's tendency to form scale deposits, or prevent the growth of microorganisms. The normal maintenance program for the unit should also include periodic cleaning of the tubes (water side) of the heat exchanger to remove deposits which enhance fouling and corrosion.

Hex head zinc anodes are used in the return bonnet (opposite end to the water pipe connections) of heat exchangers to provide internal water system corrosion protection. These anodes should be inspected periodically and replaced when the zinc has been reduced to about 1/2 inch in length.

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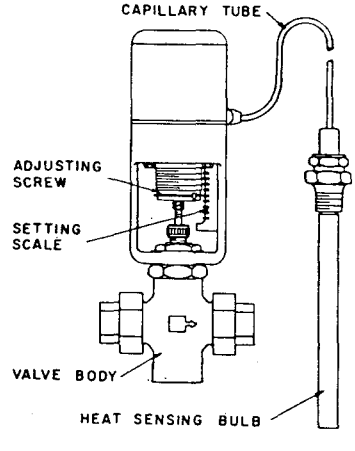

FIGURE 6-5. — WATER CONTROL VALVE

WATER FLOW CONTROL VALVE FOR HEAT EXCHANGER (Optional Equipment) (Figure 6-5) – The water flow control valve is adjustable to compensate for varying water inlet temperatures and pressures and is to be mounted in the water outlet line after the oil cooler (Figure 1-5). Use the compressor discharge air temperature gauge on the instrument panel in setting the flow control valve. The compressor discharge temperature must be maintained a minimum of 10^{o} F. above the dew point temperature at the maximum anticipated ambient; refer to Figure 7-6 for the dew point temperature at the operating pressure and ambient temperature of the application.

To decrease water flow (increase compressor discharge air temperature) turn the adjusting screw from left to right, increasing spring tension. **To increase water flow** (decrease compressor discharge air temperature) turn the adjusting screw in the opposite direction. The groove at the lower edge of the adjusting screw is an index line for use with the index scale 0 to 8 in obtaining a desired setting.

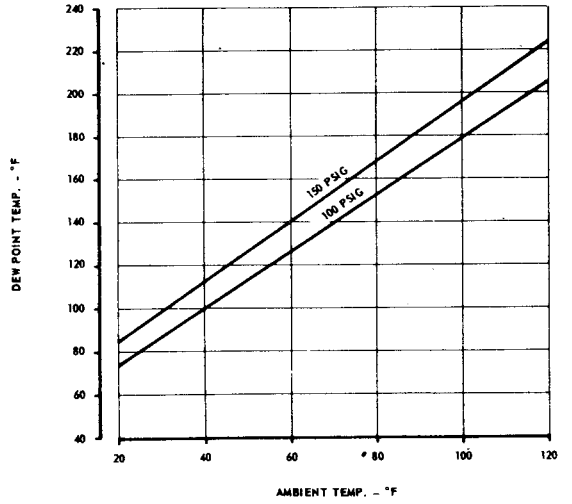

FIGURE 7-5. – DEW POINT TEMPERATURE VS. AMBIENT TEMPERATURE (100% RELATIVE HUMIDITY)

These valves must be handled with care and proper tools and techniques must be used when working on the valves.

Care must be used when handling the capillary tube; a kink or break in the tubing or connections will make the valve inoperative. Never attempt to change capillary length. Excess capillary tube should be carefully coiled and placed so that damage will not occur in normal maintenance or traffic past the unit.

If the leak develops through the packing, tighten the packing gland nut firmly with a wrench to reseat the packing around the valve stem, then back off the nut until loose, and finally retighten the nut finger tight. Tightening the packing nut too tight may cause erratic operation. An occasional drop of oil on the valve stem at the packing nut will prolong packing life.

If the valve malfunctions, check for bent or ginding (paint or corrosion) valve stem, foreign material in the valve, errosion, or thermal system (capillary) failure. If foreign material or scale is likely, the use of a strainer in the inlet water line is recommended.

WATER SHUTOFF VALVE – WATER-COOLED HEAT EXCHANGER (Optional Equipment) (Figure 1-5) – A magnetic solenoid-operated water shutoff valve rated at 150 PSIG water pressure should be mounted in the water outlet line after the oil cooler. The valve should be wired into the compressor control circuit so that the valve opens to allow water to flow any time the ON (START) push button is ON and the compressor is running. When compressor stops under automatic control, or is shut off manually, the valve should close, stopping water flow through the system. See Wiring Diagrams in Section 4.

OIL RESERVOIR – The oil reservoir-separator combines two (2) functions into one vessel. The lower half is the oil reservoir, providing oil storage capacity for the system and a primary oil separation means. The upper half contains the final oil separator with the discharge manifold service line mounted on the upper flange. The reservoir also provides limited air storage for control and gauge actuation.

COMPRESSOR OIL SEPARATOR located in the upper half of the oil reservoir consists of renewable cartridge-type separator elements and provides the final removal of oil from the air stream (Figure 8-5).

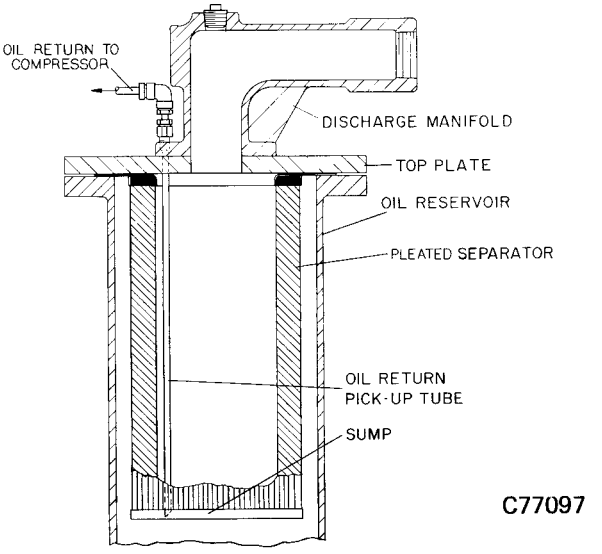

FIGURE 8-5. – SINGLE-ELEMENT OIL SEPARATOR

Oil impinging on the element drains into the sump where it is returned through tubing to the compressor cylinder.

Oil carry-over through the service lines may be caused by a faulty oil separator, faulty minimum pressure valve, overfilling of the oil reservoir, oil that foams, or oil return line malfunction. If oil carry-over occurs, inspect the separator only after it isdetermined that the oil level is not too high, the oil is not foaming excessively, the oil return line from the discharge manifold to the compressor cylinder is not clogged or pinched off, and the return tube inside the separator is not loose or broken.

Oil carry-over malfunctions of the oil separator are usually due to using elements too long, heavy dirt or varnish deposit caused by inadequate air filter service, use of improper oil or using oil too long for existing conditions. Ruptured or collapsed separator elements are usually due to heavy dirt or varnish buildup in the filtering material. Excessive tilt angle of the unit will also hamper separation and cause oil carry-over.

Oil separator element life cannot be predicted; it will vary greatly depending on the conditions of operation, the quality of oil used and the maintenance of the oil and air filters. The condition of the separator can be determined by pressure differential gauging or by inspection.

Pressure Differential Gauging (Figure 2-1) – A pressure differential gauge is mounted on the left portion of the instrument panel for checking pressure differential across the oil separator during all conditions of operation.

The separator should be changed when the oil separator gauge indicates 8 PSI differential with the unit on load at 100 PSIG.

NOTE:
Pressure differential on the new element is approximately 1-2 PSI. As the separator retains dirt, differential will rise. A sudden drop to ZERO differential or a sudden heavy oil carry-over may indicate a ruptured separator.

CAUTION

Using an oil separator at differential pressure exceeding 8 PSI risks increasing oil carry-over and collapse of the separator. Never use an oil separator at a pressure differential over 15 PSI.

Inspection – After removal of the separator, use a drop light inside the element to reveal areas of heavy dirt or varnish deposits or breaks (ruptures) in the element media.

Removal of Oil Separator For Inspection or Replacement:

1. Disconnect oil return to compressor tubing at elbow near discharge manifold flange on top plate.
2. Disconnect tubing from elbow at top plate. Loosen nut on fitting on top plate and withdraw tubing completely through fitting.
3. Disconnect all other tubing from discharge manifold.
4. Disconnect discharge manifold pipe union and screws holding manifold to top plate. Remove manifold assembly.
5. Remove screws holding the top plate to the oil reservoir tower. Lift top plate from the oil reservoir tower.
6. Lift the separator from the oil reservoir tower.
7. Inspect and/or replace separator as necessary. Before installing (or reinstalling) any separator be sure gaskets bonded to separator flanges are not damaged. Remove any gasket material from old separator adhering to top plate or reservoir tower flange.
8. Lower separator into the oil reservoir tower.
9. Lower top plate onto the oil reservoir tower Seat top plate to oil reservoir tower flange; install and tighten all cap screws.
10. Coat bottom of discharge manifold flange with gasket eliminator and install on top plate. Reconnect the discharge manifold pipe elbow and all tubing.
11. Reconnect oil return tubing from compressor to elbow near discharge manifold flange.
12. Install original return by slipping tube through the fitting on top plate until ferrule bottoms in fitting. If a new fitting and return tube is used, slip tube through fitting until it touches the bottom of the separator, then raise the tube about 1/4 inch off the bottom and tighten fitting nut securely. Connect the other end of the tube to the compressor oil return elbow, trim off any excess from new tube to fit into elbow – do not bend tube or raise further than 1/4".

COMPRESSOR OIL SYSTEM CHECK – The following readings are based on ambient temperature of 80° F. for air-cooled oil cooler and 80° F. inlet water on a water-cooled oil cooler, with the system in good condition. Compressor should be at operating temperature at the time of checks. One-half hour of loaded operation is usually sufficient to reach level-out operating temperatures.

Air and Oil Discharge Temperature – 165° to 195° F. – Read at thermometer on the instrument panel or check with a thermometer at the compressor discharge housing.

Compressor Oil Inlet Temperature – 150° to 160° F. – Check with a thermometer in the tee out of oil filter.

Oil Inlet Pressure – Check at the fitting in the line near the compressor oil inlet. With air receiver pressure at 100 PSI, oil inlet pressure should be 55-60 PSIG.

Oil Cooler Oil Pressure Differential (Air-Cooled Radiator) – 2 to 25 PSI (65 to 150 PSIG Receiver Pressure) – Check at the fittings in the oil cooler headers.

Oil Cooler Oil Pressure Differential (Water-Cooled Heat Exchanger) – 2 to 25 PSI (65 to 150 PSIG) Receiver Pressure) – Check at the heat exchanger oil inlet and outlet fittings.

Oil Cooler Temperature Differential (Air-Cooled Radiator) – The oil temperature differential depends on the temperature of the air at the oil cooler fan and cleanliness of the core faces. As ambient temperatures and core restrictions increase, the oil cooler outlet temperature will increase. The oil inlet temperature is approximately the same as air discharge temperature – see gauge on instrument panel. The inlet oil temperature and the outlet oil temperature may be checked at the fittings in the oil cooler header.

Oil Cooler Temperature Differential (Water-Cooled Heat Exchanger) – The oil temperature differential depends on the inlet water temperature and the water flow rate permitted by the water flow control valve setting. The oil inlet temperature is approximately the same as air discharge temperature – see gauge on instrument panel. The oil outlet temperature may be checked at the cooler outlet.

Oil Cooler Water Pressure Differential (Water-Cooled Heat Exchanger) – The water pressure differential through the heat exchanger will depend on supply pressure, flow rate, cooler tube cleanliness and outlet pressure. The inlet and outlet water pressures may be checked at pipe fittings supplied by the customer.

SECTION 6

AIR FILTERS

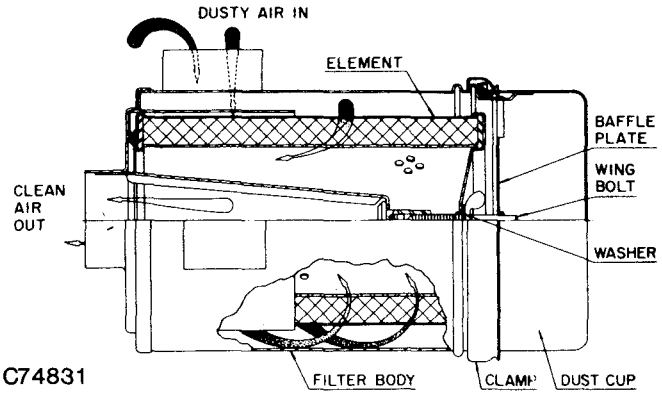

FIGURE 1-6. — HEAVY-DUTY AIR FILTER

HEAVY DUTY AIR FILTER (Figure 1-6) furnished as standard equipment on units with an enclosure is a heavy duty washable element dry type air filter. The air filter must receive proper maintenance if maximum service is to be obtained from the unit. Establishing adequate and timely filter service is MOST IMPORTANT.

Dust Cup — Service every 4 to 120 hours depending on dust conditions. To service, loosen the retaining band clamp and remove the dust cup. Do not wash the dust cup — wipe clean with a clean dry cloth. Do not bend the edge of the cup by striking on a hard surface. When installing dust cup, make sure clamp is securely tightened to prevent leakage.

Filter Element — The element should be serviced when the pressure drop through the filter reaches 20 inches of water or when service indicates time for change. Clean every 50 to 150 operating hours depending on dust conditions. Inspect every few days until experience determines the proper time for servicing. Higher than normal current use by the motor or loss of compressor delivery may indicate a need for servicing the filter element.

To service:

1. Loosen the retaining band clamp and remove the dust cup from the body of the filter.
2. Visually inspect the element in place. If cleaning is not necessary, reinstall the dust cup on the filter. If the element requires cleaning, unscrew the wing bolt and withdraw the element from the body.
3. Wash the element by soaking about 15 minutes in warm water with a mild nonsudsing detergent. Rinse the element thoroughly with clean water; a hose may be used if the water pressure does not exceed 40 PSIG.
4. Inspect the element for ruptures or cracks in the pleated media; replace the element if any are found. Inspect the gasket on the bottom (outlet end) of the element; replace the entire element if the gasket is damaged.
5. Allow the element to air dry COMPLETELY. Do not expose the element to heat over 150° F. Install the element in the filter body and fasten securely with the wing bolt. Reinstall the dust cup and retaining band clamp. Make sure the clamp is tightened securely to prevent leakage.

WARNING

Do not oil this element. Do not wash in inflammable cleaning fluids. Do not use solvents other than water.

CAUTION

Never operate the unit without the element. Never use elements that are damaged, ruptured or wet. Never use gaskets that won't seal. Keep spare elements and gaskets on hand to reduce downtime. Store elements in a protected area free from damage, dirt and moisture. Handle all parts with care.

Filter Element Life — The element should be replaced after six (6) cleanings or if:

1. Visual inspection indicates a rupture, crack or pin hole in the pleated media. Inspection should be done by placing a bright light inside the element.
2. Pressure drop through a filter with a freshly cleaned element is below three (3) inches of water with the compressor running at full load — this would indicate a rupture or crack.

Inlet Screen and Tube — Inspect the inlet screen and tube for dirt accumulation each time the filter is serviced. Clean the tube when required by ramming a clean dry cloth through the tube. Wipe the inside of the filter body to remove any dirt falling from the inlet tube before reinstalling the element.

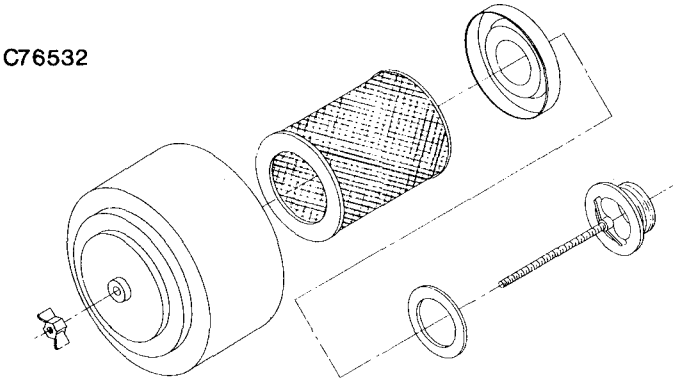

FIGURE 2-6. — DRY TYPE AIR FILTER

AIR FILTER (Figure 2-6) furnished as standard equipment on units without an enclosure is a washable element dry type filters must receive proper maintenance if maximum service is to be obtained from the unit. Establishing adequate and timely filter service is MOST IMPORTANT. When the outside

surface of the element appears to be evenly coated with dirt, it should be cleaned as follows:

1. Remove the wing bolt, lift off the hood and the filter element.

2. Vibrate or blow heavy dirt accumulations from the element. Direct air blast at slight inward angle and parallel to the element pleats; do not point directly at the element.

3. If required, wash element with a nonsudsing household detergent and water; rinse with clear water. Allow to dry before reinstalling.

WARNING

Do not oil this element. Do not wash in inflammable cleaning fluids. Do not use solvents other than water.

Replace the filter element with genuine replacement parts whenever needed. Good judgment should be used in establishing the replacement interval. Do not attempt to overextend the element life; the small savings involved do not justify the risk.

CAUTION

Never operate the unit without the element. Never use elements that are damaged, ruptured or wet. Never use gaskets that won't seal. Keep spare elements and gaskets on hand to reduce downtime. Store elements in a protected area free from damage, dirt and moisture. Handle all parts with care.

Causes of short element life include: severe dust conditions, infrequent servicing, improper cleaning, or contamination by oil or chemical fumes.

SECTION 7
COUPLING

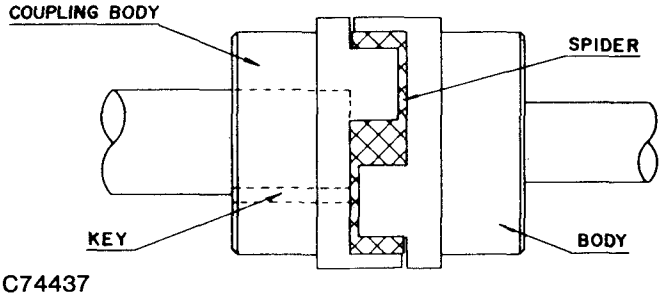

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FIGURE 1-7. — COUPLING

COUPLING (Figure 1-7) — The motor and compressor are direct connected by a resilient cushion-type flexible coupling. The coupling does not require lubrication. On all models the coupling cushion member is a one-piece spider-type construction.

CAUTION

The coupling is aligned at the factory. However, since there may have been settling or deflection of the unit through shipment or handling, rechecking coupling alignment is required; refer to Steps 4 through 8 below.

For cases where the motor or the compressor has been removed from the base, proceed as follows for coupling alignment.

1. Install motor and/or compressor on mounting pads of base, making sure coupling spider is in place and engage coupling. If shims were used under motor or compressor feet be sure they are in place.

CAUTION

A new compressor or motor may have a different shaft height than the previous one and require entirely new shims.

Install screws in compressor feet and tighten. In unusual cases, it may be necessary to shim and adjust the compressor; however, best alignment procedure is for the compressor to remain fixed while the adjustments/shims are made on the motor.

2. Position the coupling body on each shaft (motor and compressor) so that shaft ends are about flush with the face of the body, and flanges rest snugly against the raised dots on the coupling spider faces. When positioning either coupling half on the shaft, make sure the shaft doesn't extend through the coupling to interfere with the spider. Approximate distance between shafts is one (1) inch. Tighten the set screws over the key in each coupling body.

3. Check angular alignment (Figure 2-7, View B) by attaching a dial indicator as shown; base and stem attached to the body of one coupling half, the indicator button resting on the face of the flange of the opposite half. Rotate the coupling and indicator assembly to the top 12 o'clock position and zero the dial. Be sure that the dial button is firmly in contact with the face and that sufficient indicator travel is possible. Tap the indicator face several times to insure return to zero. Rotate the coupling and indicator assembly to the 3, 6 and 9 o'clock positions and record indicator reading at each point. **Maximum allowable indicator reading is .010".** Shim (or lower) motor vertically and/or adjust from side to side until indicator reading is .010" or less.

4. Check parallel alignment (Figure 2-7, View C) by attaching a dial indicator as shown: base and stem attached to the body of one coupling half, the indicator button resting on the outside diameter of the opposite half. Rotate the coupling and indicator assembly to the top 12 o'clock position and zero the dial. Observe the cautions about firm indicator button contact, indicator travel and zeroing outlined in Step 3. Rotate the coupling and indicator assembly to the 3, 6 and 9 o'clock positions and record the indicator reading at each point. **The maximum allowable indicator reading is .010".** Shim (or lower) motor vertically and/or adjust from side to side until indicator reading is .010" or less.

5. Recheck angular alignment to be sure it has not been disturbed.

6. Tighten screws in motor feet evenly. Recheck tightness of screws in compressor feet and in the coupling body.

7. Recheck coupling alignment and adjust if necessary.

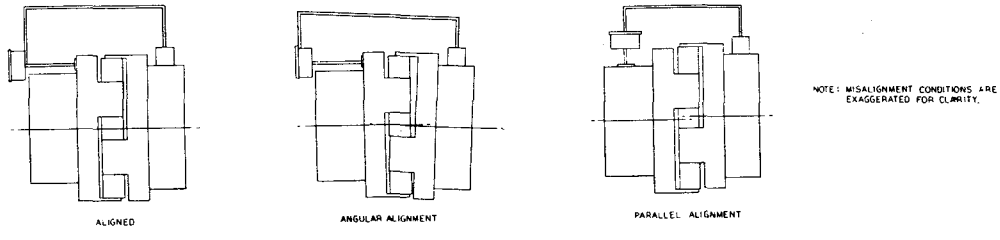

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FIGURE 2-7. — ALIGNMENT OF COUPLING

SECTION 8

MAINTENANCE SCHEDULE

SERVICE CHECK LIST —

Air Filter — Operating conditions determine frequency of service, refer to Section 6 "Air Filters" and plan maintenance accordingly.

Oil Separator — The unit is equipped with pressure differential gauging. Change the oil separator element when the pressure differential gauge indicates an 8 PSI differential.

Refer to "Compressor Oil Separator" in Section 5 for further details.

Motor Lubrication — Refer to Section 2.

Every 8 Hours Operation

1. Check the reservoir oil level — add oil if required. See Section 5.

   If oil consumption is high, refer to "Compressor Oil Consumption" in Section 9.

2. Observe if the unit loads and unloads properly.

3. Drain the moisture trap in the control system. See Section 4.

4. If moisture is noted in the oil level gauge, drain accumulated moisture and see Section 5 "Moisture in the Oil System".

Every 125 Hours Operation

1. Check for dirt accumulation on oil cooler and aftercooler core faces and the cooling fan. If cleaning is required, clean the exterior fin surfaces of the cores by blowing compressed air carrying a nonflammable safety solvent in a direction opposite that of the cooling fan air flow. This cleaning operation will keep the exterior cooling surfaces clean and ensure effective heat dissipation.

Every 1000 Hours Operation

1. Change oil filter element every 1000 hours or when the indicator on filter body is in red range, whichever occurs first.

Every 2000 Hours Operation

1. If using GD800 Lubricant Coolant, change the compressor lubricant. UNDER ADVERSE CONDITIONS, MORE FREQUENTLY (refer to "Oil Change Interval" in Section 5.) flush system if required.

2. The use of GD8000 Lubricating Coolant or other synthetic lubricant may extend the required change interval. See "Synthetic Lubricants" in Section 5.

Every 4000 Hours Operation

1. Check the oil separator element. See Section 5.

SECTION 9

TROUBLE SHOOTING

IF UNIT FAILS TO START, check:

1. Wiring system for wrong lead connections.
2. Unit Start/Stop-Reset (ON-OFF-RESET) switch.
3. Fuses in control enclosure or starter enclosure.
4. Motor starter overload heaters.
5. Air pressure switch setting.

UNIT STARTS BUT STOPS AFTER A SHORT RUN, check:

1. High air discharge temperature caused by:
   (a) Low compressor oil level.
   (b) Clogged oil cooler or oil filter.
   (c) Thermal control (thermostatic mixing) valve stuck.
   (d) Accumulation of grease, oil or dirt on exterior fin surfaces of oil cooler.
   (e) Poor ventilation of unit.
   (f) Water control valve inoperative, water inlet temperate too high or low water pressure or flow.
   (g) Magnetic water shutoff valve inoperative.
2. Reservoir pressure switch setting.
3. Low oil pressure or faulty low oil pressure switch.
4. High discharge temperature switch malfunction.
5. Fuses in control panel enclosure or starter enclosure.
6. Motor starter overloads.
7. Time delay too short on low oil pressure timing relay or faulty timing relay.

COMPRESSOR DOES NOT UNLOAD, check:

1. Low demand 4-way valve or pressure switch for malfunction.
2. Control lines for restriction.
3. Air leaks in control system.
4. Inlet valve stuck.
5. Pilot or low demand pressure switch adjustment.
6. Pilot or low demand pressure switch for dirt or leaking diaphragm.

UNIT FAILS TO SHUT DOWN, check:

1. ON-OFF switch for malfunction.
2. Control lines for restriction or leaks.
3. Low demand pressure switch for dirt or leaking diaphragm.
4. Wiring and tubing to low demand pressure switch.

BLOWDOWN VALVE CONTINUES TO PASS AIR, check for:

1. Air leaks in tubing to blowdown valve.
2. Leaking diaphragm in blowdown valve.
3. Low demand 4-way valve for malfunction, coil failure or loose wiring.

EXCESSIVE OIL CONSUMPTION, check for:

1. Oil carry-over through discharge line caused by:
   (a) Overfilling the reservoir.
   (b) Clogged, broken or loose oil return lines.
   (c) Ruptured oil separator element.
   (d) Loose assembly.
   (e) Incorrect oil causing foam.
   (f) Inoperative minimum pressure valve.
2. Oil leaks at all fittings and gaskets.

COMPRESSOR LOW ON DELIVERY AND PRESSURE, check for:

1. Clogged air filter.
2. Restricted inlet valve.
3. Broken inlet valve spring.
4. Binding inlet valve piston.
5. Incorrect motor speed.
6. Pilot adjustment and/or malfunction.

SECTION 10

REBUILDING DATA

Rebuilding data for the direct drive bare compressor used on Models ECMPKA and ECMPLA is shown below.

(Dimensions in two [2] decimal places may vary ±.020.)

DIMENSIONS

Center of Main Bore to Center of Secondary Bore 6.249/6.251

Cylinder Bore Diameter —
- Main 8.1393/8.1424
- Secondary 7.5072/7.5103

Cylinder Length 13.490/13.486

Rotor Body O.D. —
- Main 8.1304/8.1296
- Secondary 7.4992/7.4983

Main Rotor Body Length 13.470/13.468

Secondary Rotor Body Length (Based on Compressor Capacity)
..... 13.470/13.468
..... 13.020/12.980
..... 11.520/11.480
..... 11.000/10.980

Inlet End Air Seal Diameter (Main and Secondary Rotors) .....
..... 3.200/3.199

Discharge End Air Seal Diameter (Main and Secondary Rotors)
..... 3.000/2.999

Inlet End Plate Air Seal Bore (Main and Secondary) 3.210/3.211

Discharge End Plate Air Seal Bore (Main and Secondary) .....
..... 3.010/3.011

Main Rotor Body Air Seal Length * —
- Inlet 1.270/1.265
- Discharge 1.40

Secondary Rotor Air Seal Length * —
- Inlet 1.270/1.265
- Discharge 1.490/1.485

Main Rotor Shaft Bearing Journal Diameter —
- Inlet 2.3632/2.3627
- Discharge 2.4390/2.4385

Main Rotor Shaft Bearing Journal Length —
- Inlet 1.485/1.475
- Discharge 1.920/1.875

Secondary Rotor Shaft Bearing Journal Diameter —
- Inlet 2.3632/2.3627
- Discharge 2.5015/2.5010

Secondary Rotor Shaft Bearing Journal Length —
- Inlet ..... .995/.910
- Discharge 2.335/2.340

Main Rotor Bearing Bore Diameter —
- Inlet 5.1181/5.1193
- Discharge 5.3730/5.3740

Secondary Rotor Bearing Bore Diameter —
- Inlet 4.3307/4.3321
- Discharge 4.4387/4.4397

Inlet End Bearing Bore Shoulder to Seal Housing End Face of Bearing Housing (Main and Secondary) 2.000/1.995

* Includes any radii, chamfer or undercut.

DIMENSIONS (Continued)

Discharge End Bearing Bore Shoulder to Cylinder End Face of Bearing Housing (Main and Secondary) 1.500/1.495

Main Rotor Inlet Bearing Snap Ring Groove —
- Diameter 5.256/5.268
- Width ..... .079/.084

Secondary Rotor Inlet Bearing Snap Ring Groove —
- Diameter 4.454/4.466
- Width ..... .068/.073

Inlet Bearing Bore Shoulder to Inner Face of Snap Ring Groove —
- Main 1.225/1.230
- Secondary ..... .870/.875

Main Rotor Shaft Seal Diameter 1.876/1.874

Main Rotor Shaft Seal Diameter Length * 2.25

Seal Housing Bore 2.624/2.626

Seal Housing Seal Bore Shoulder to Bearing Housing End Face of Seal Housing 1.480/1.485

Main Rotor Shaft Coupling Diameter 1.750/1.749

Main Rotor Shaft Coupling Diameter Length 3.30

FITS

Main Rotor Bearing Inner Race to Shaft —
- Inlet ..... .0005T/.0016T
- Discharge ..... .0005T/.0015T

Main Rotor Bearing Outer Race to Bore —
- Inlet ..... .0000/.0020L
- Discharge ..... .0010T/.0030T

Secondary Rotor Bearing Inner Race to Shaft —
- Inlet ..... .0005T/.0016T
- Discharge ..... .0005T/.0015T

Secondary Rotor Bearing Outer Race to Bore —
- Inlet ..... .0000/.0020L
- Discharge ..... .0002L/.0022L

Main Rotor Shaft to Coupling ..... .000/.002L

RUNNING CLEARANCES

Rotor to Cylinder — Diametral
- Main ..... .0090/.0139
- Secondary ..... .0090/.0140

End Plate to Rotor — Axial
- Inlet ..... .012/.020
- Discharge ..... .002/.004

Air Seals — Diametral ..... .010/.012

Litho in U.S.A.

1M-10-83

GARDNER-DENVER
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