P/L 500c 92
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13-9-601
1st EDITION

Instruction & Service Manual

ELECTRA-SCREW®

STATIONARY

COMPRESSORS

- 30 HP - MODEL ESG
- 40 HP - MODEL ESH
- 50 HP - MODEL ESJ

13-9-601

GARDNER-DENVER COMPANY
QUINCY, ILLINOIS

WARRANTY

Subject to the terms and conditions hereinafter set forth, Gardner-Denver Company (the Company) warrants products and parts sold by it, insofar as they are of its own manufacture, against defects of material and workmanship, under use and service in accordance with Company's written instructions, recommendations and ratings for installation, operating, maintenance and service of products, for a period of three months from the date of initial use, provided that such three month period shall in no case extend beyond one year from the date of shipment by Company. THIS WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT, AS COMPANY MAY ELECT, OF ANY DEFECTIVE PARTS, REGARDING WHICH, UPON DISCOVERY OF THE DEFECTS, THE PURCHASER HAS GIVEN IMMEDIATE WRITTEN NOTICE. Installation and transportation costs are not included. Company shall have the option of requiring the return to it of the defective material, transportation prepaid, for inspection. Because of varying conditions of installation and operation, all guarantees of performance are subject to variation of 3%. COMPANY DOES NOT WARRANT THE MERCHANTABILITY OF ITS PRODUCTS AND DOES NOT MAKE ANY WARRANTY, EXPRESS OR IMPLIED, OTHER THAN THE WARRANTY CONTAINED HEREIN. Company has not authorized anybody to make any representation or warranty other than the warranty contained herein.

FOREWORD

Gardner-Denver ELECTRA-SCREW® 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.

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SECTION 1

GENERAL INFORMATION

COMPRESSOR – The Gardner-Denver Model "ES" Electra-Screw® compressor is a single stage, positive displacement rotary machine using meshing helical rotors to effect compression. The input drive shaft and helical drive gear are supported in the gear case by high capacity ball bearings; the drive gear meshes with a driven gear mounted on the main rotor shaft to drive the rotors. Both rotors are supported between large capacity antifriction bearings located outside the compression chamber. Single-width cylindrical roller bearings are used at the inlet end of the rotors. Two heavy-duty single row angular contact ball bearings at the discharge end locate each rotor axially and carry all thrust 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 helical lobes 90° apart. The secondary rotor has six matching helical grooves 60° apart to allow meshing with main rotor lobes.

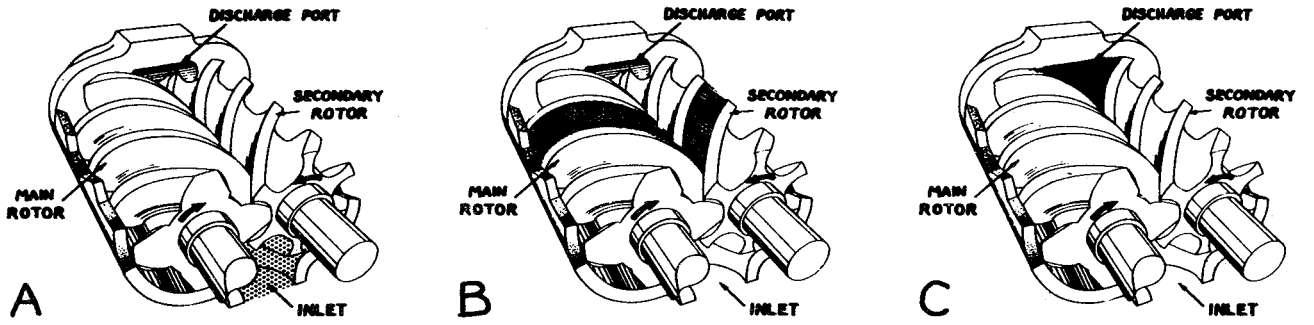


FIGURE 1-1. – COMPRESSION CYCLE

The air inlet port is located on top of the compressor 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 to remove the heat of compression and seal internal clearances. 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).

AIR FLOW (Figure 1-3) – 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 more than 99% of the entrained oil is removed by velocity change and impingement and drops back into the reservoir. A multiple element final separator removes the balance of the oil and returns it to the system through tubing connecting the separator and compressor. The air then passes through the reservoir check valve, the air receiver section and the minimum pressure valve to the plant air lines.

LUBRICATION, COOLING AND SEALING – Oil is forced by air pressure from the oil reservoir through the oil filter, oil cooler and thermostatic mixing valve (mixing valve is not used with the water-cooled oil cooler), 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 seals. The balance of the oil is injected directly into the compression chamber to remove heat of compression, seal internal clearances and lubricate the rotors.

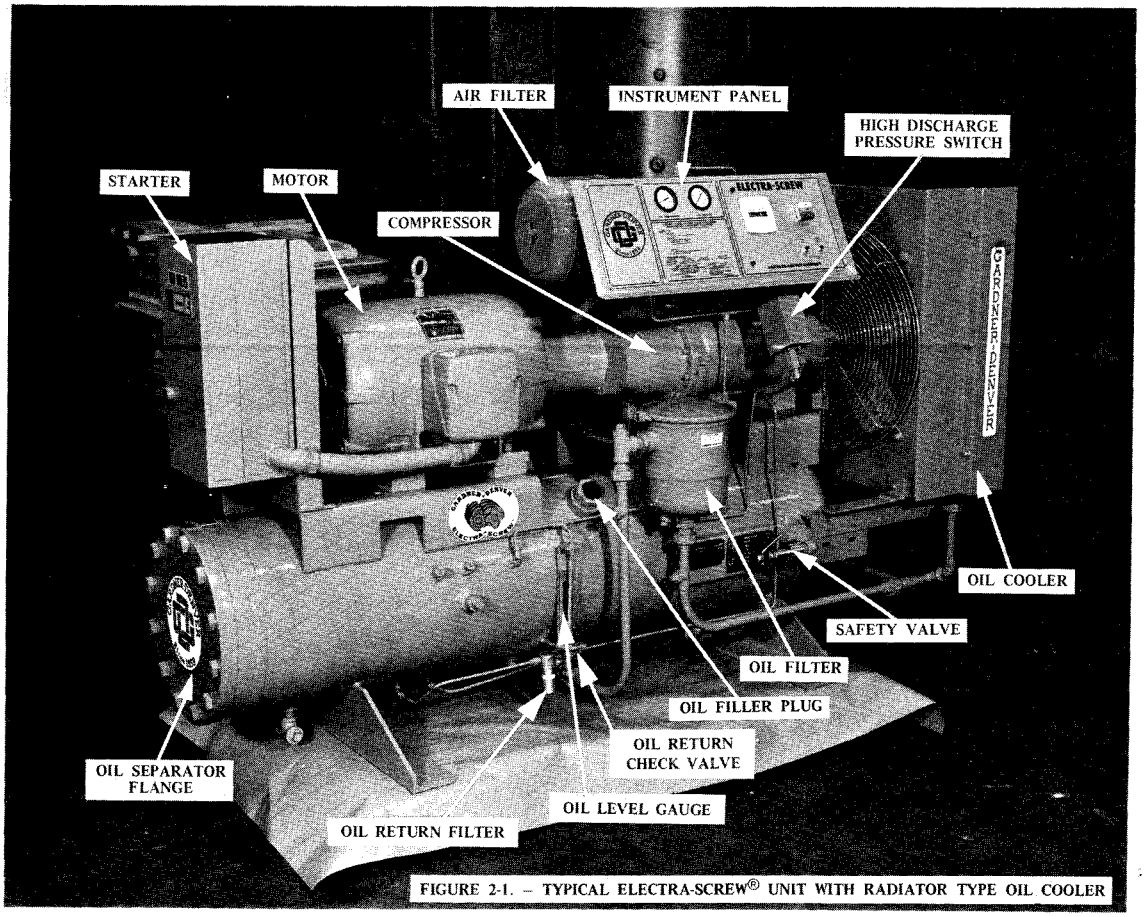


FIGURE 2-1. – TYPICAL ELECTRA-SCREW® UNIT WITH RADIATOR TYPE OIL COOLER

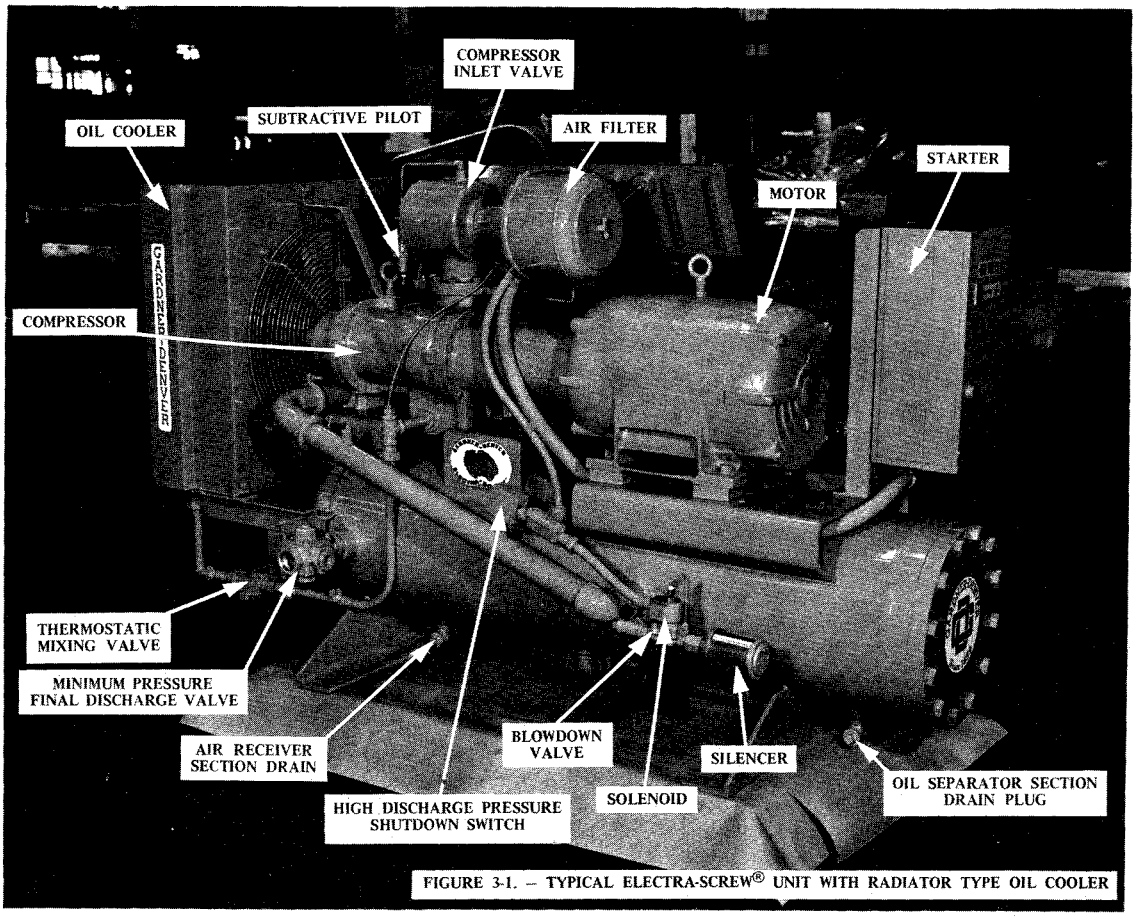


FIGURE 3-1. – TYPICAL ELECTRA-SCREW® UNIT WITH RADIATOR TYPE OIL COOLER

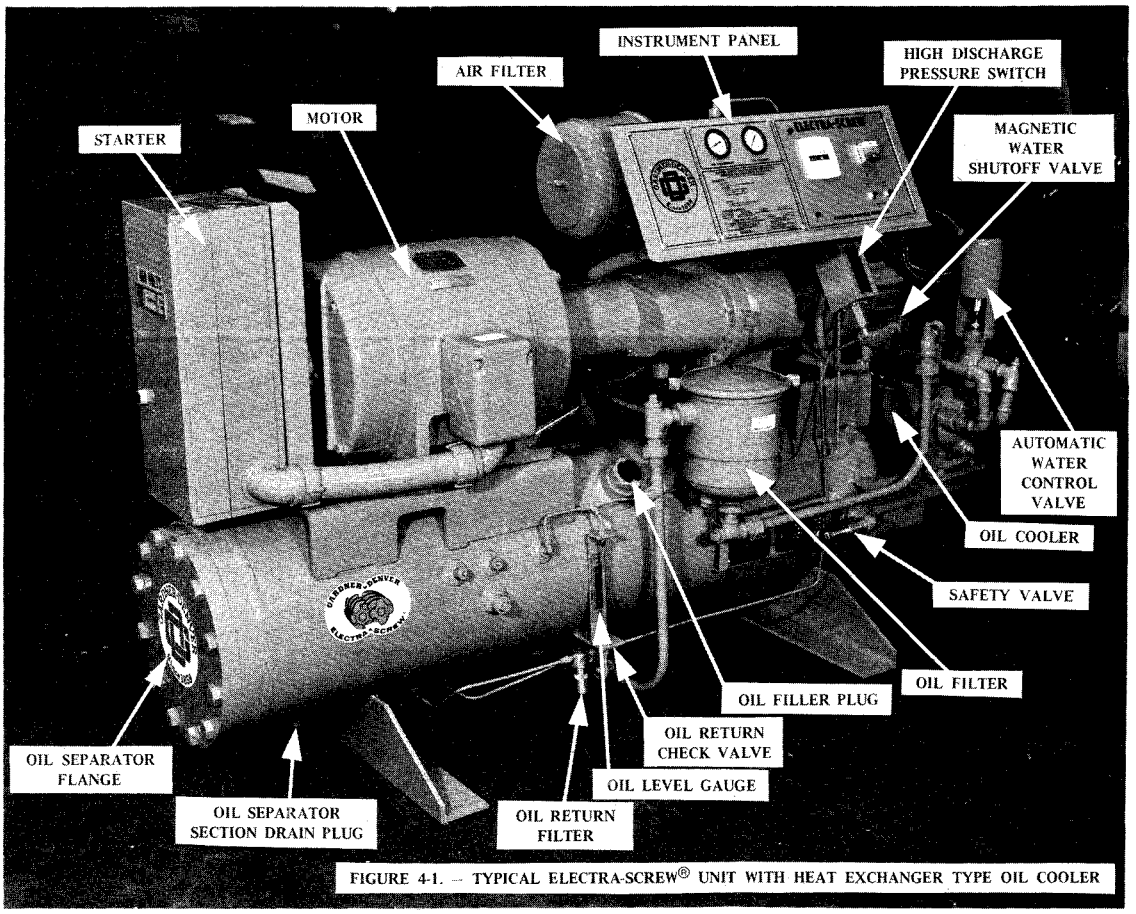
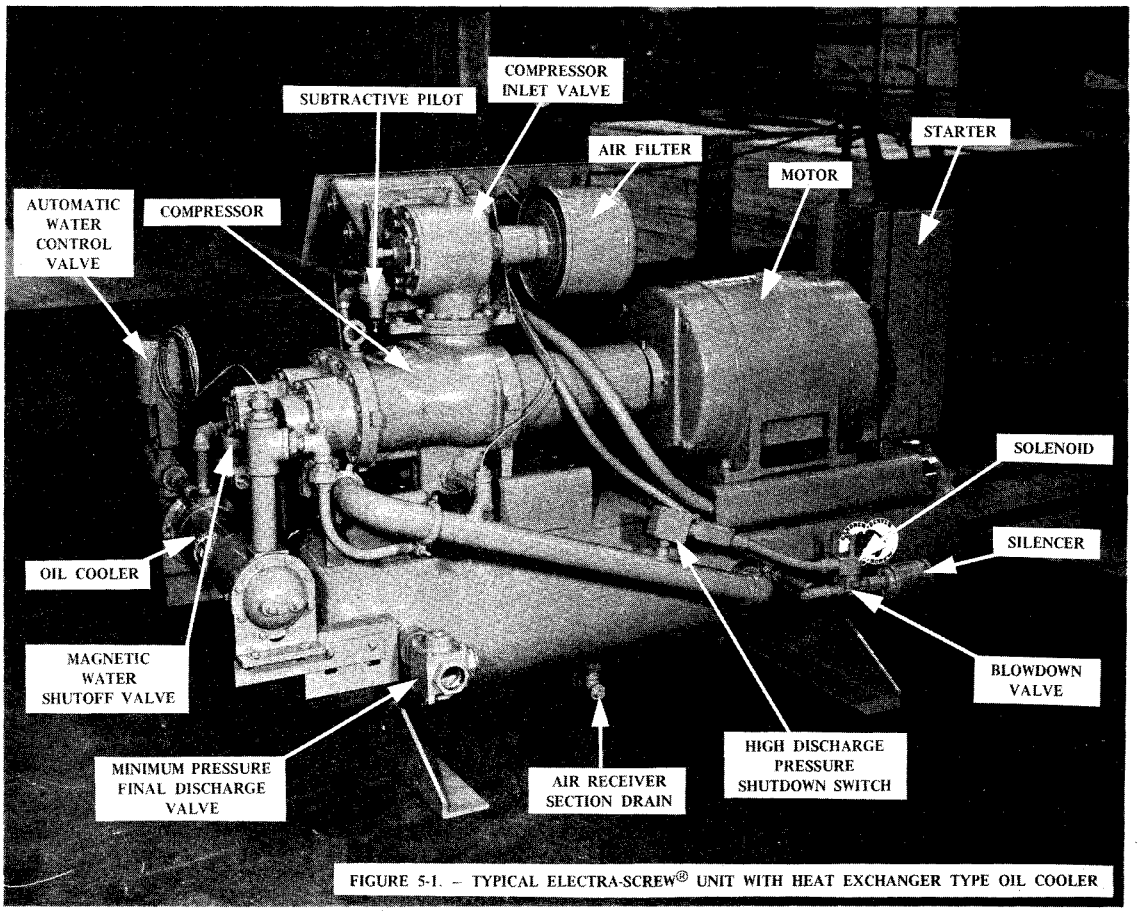


FIGURE 4-1. – TYPICAL ELECTRA-SCREW® UNIT WITH HEAT EXCHANGER TYPE OIL COOLER



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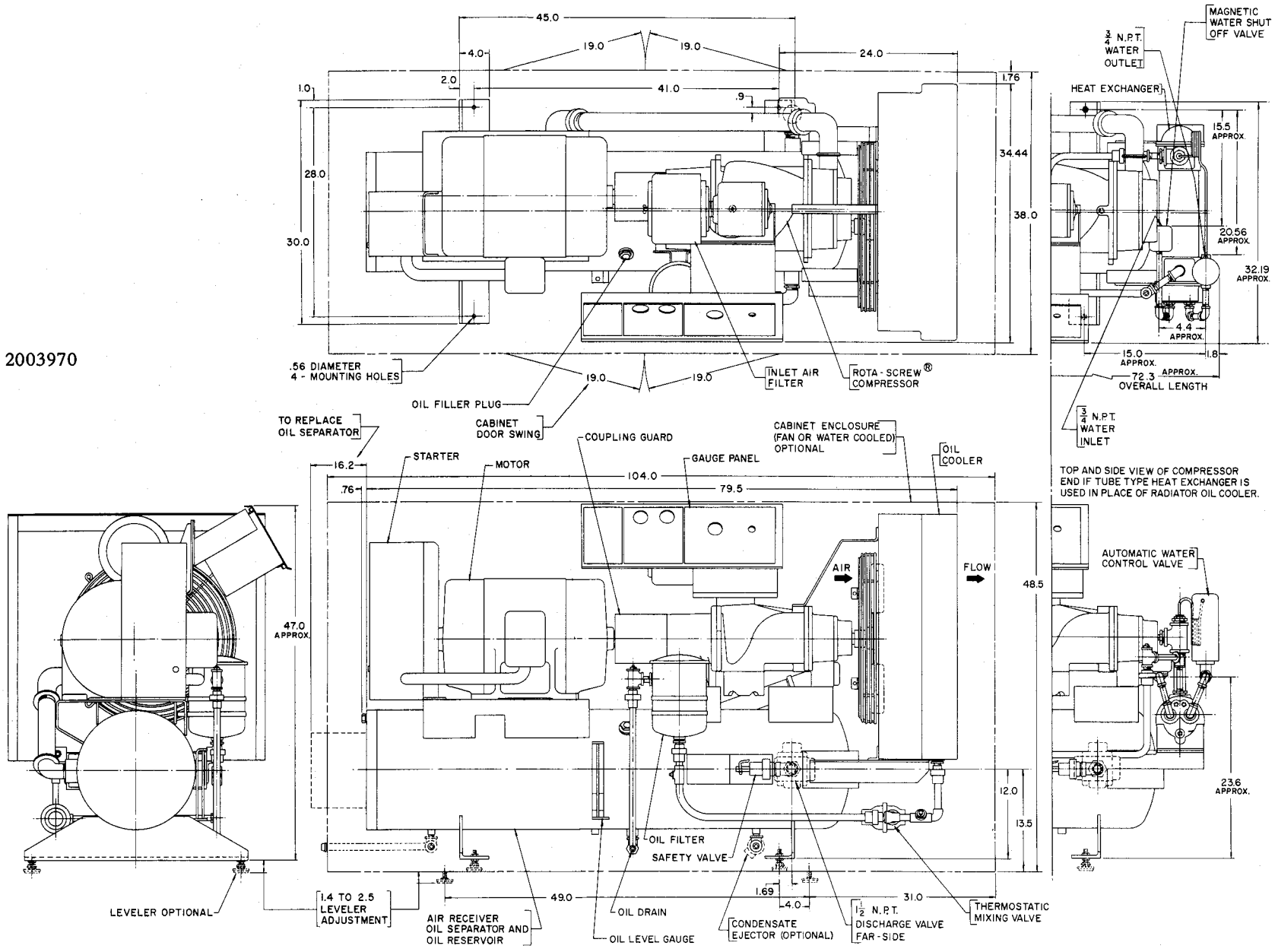


FIGURE 6-1. – OUTLINE OF COMPRESSOR

SECTION 2

CONTROLS & INSTRUMENTS

GENERAL – The Gardner-Denver Model "ES" Electra-Screw® compressor units are available with four different control systems:

Constant Speed

Automatic Start-Stop

Dual (Selective – Constant Speed or Automatic Start-Stop)

Duomatic (Selective – Constant Speed With Low Unloaded Horsepower or Automatic Start-Stop)

Unless customer specifications instruct otherwise, the Electra-Screw® unit is prewired at the factory with 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 and the shop air line and water line if the unit is the heat exchanger type. The standard unit is supplied with the control system specified, an open drip-proof motor, NEMA 1 starter enclosure and a dust resistant control enclosure/instrument panel.

CONTROL VOLTAGE – The control voltage for push buttons, lights, hourmeter, pressure switches, high discharge temperature shutdown switch, blowdown valve, 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.

CIRCUIT BREAKERS – The instrument panel for any of the four control systems incorporates two separate push-to-reset type circuit breakers for high discharge temperature and high reservoir pressure shutdown switches (Figures 4-2, 7-2, 8-2 and 11-2). If either a temperature or pressure failure occurs, the circuit breaker button will pop up indicating which safety device has stopped the unit.

DO NOT CONTINUE TO RESET THE CIRCUIT BREAKER IF THE SAME MALFUNCTION OCCURS WITHIN A SHORT PERIOD. FIND AND CORRECT THE TROUBLE BEFORE RESUMING OPERATION.

ON-OFF SWITCHES – The "On-Off" switch for the constant speed, automatic start-stop and dual control units has an amber lighted "On" section. The timed duomatic control switch has a green lighted "Load" section in addition to the "On" section; the black bar on the bottom of this switch is nonfunctional. To replace the bulb (Sylvania 120 PSB or equal) in the switch:

1. Turn power off at main breaker panel.
2. Open control panel.
3. Turn slotted locking screw on upper side of switch body counterclockwise 1/4 turn and remove switch body from switch operator.
4. Remove old bulb located in stem of switch body and insert new bulb.
5. Reassemble switch body to operator and lock in place by turning locking screw 1/4 turn clockwise.

SAFETY DEVICES – All four control systems 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 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 are in a common overload block in the starter and have a single common percentage adjustment with a 90 to 110% range. The unit is set at the factory on the 100% mark.

High Air Temperature Shutdown – The compressor is protected from lubrication failure by a high discharge temperature switch located in the discharge pipe between the compressor discharge and the oil reservoir. This switch is wired into the motor control circuit and will shut the unit down if discharge temperature exceeds 225° F. The manual reset is located as described in "Circuit Breakers" paragraph, and must be reset any time unit is shut down due to high air discharge temperature.

High Oil Reservoir Pressure Shutdown – The unit is protected from high oil reservoir pressure by a pressure switch located under the control panel and wired into the motor control circuit with piping to the oil reservoir section. This switch will shut the unit down if pressure in the oil reservoir exceeds 165 PSIG, acting as a safety valve without loss of oil. THE MAXIMUM ALLOWABLE SETTING IS 165 PSIG. The manual reset is located as described in "Circuit Breakers" paragraph, and must be reset any time unit is shut down due to high oil reservoir pressure.

Automatic Blowdown Valve (Figure 1-3) – A solenoid valve piped into the oil reservoir section between the oil separator and reservoir check valve and wired into the motor control circuit will release pressure from the oil reservoir each time the motor stops on constant speed, automatic start-stop or dual control systems. On the duomatic system, pressure will be released from the oil reservoir each time the compressor unloads or is shut down. A 3/16" diameter orifice is used to maintain blowdown time to about 45 seconds and prevent oil carry-over due to too rapid a release of pressure. A silencer terminates the blowdown line to muffle air discharge noise.

Safety Valve (Figures 2-1 & 4-1) installed in the air receiver section is set at the factory to 110% of the specified operating pressure for protection against overpressure of the air receiver section. Periodic checks should be made to insure its proper operation. Never operate the unit without a proper safety valve setting.

NEVER DISCONNECT SAFETY DEVICES THAT PROTECT THE UNIT.

INSTRUMENTS AND GAUGES (Figures 4-2, 7-2, 8-2 & 11-2) – The constant speed and the automatic start-stop units have a lighted "ON-OFF" push button.

The dual control unit has a lighted selector switch with "CON-OFF" and "AUTO-OFF" push buttons for the two modes of operation.

The duomatic control unit has a lighted "ON-OFF" push button with lighted sections which indicate "On" (compressor running) and "Load" (compressor loaded).

All four control system instrument panels incorporate the following:

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

Air Pressure Gauge – A direct reading air pressure gauge indicates air pressure in the air receiver section of the reservoir.

Oil Temperature Gauge – A direct reading temperature gauge indicates compressor oil inlet temperature.

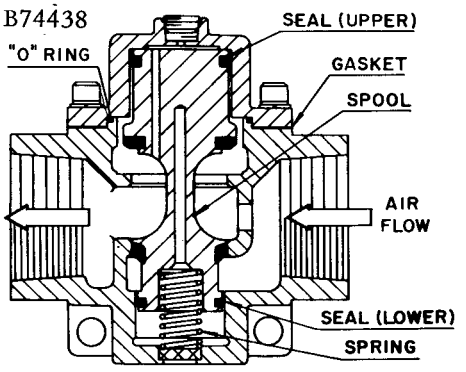


FIGURE 1-2. – MINIMUM DISCHARGE PRESSURE VALVE

MINIMUM DISCHARGE PRESSURE VALVE (Figure 1-2) – An internal pilot operated minimum pressure valve is used in the discharge line from the air receiver section of the reservoir to provide a positive pressure on the oil system of the compressor and prevent excessive oil carry-over into shop air lines even when the air service valve is fully open. The amount of oil carry-over into the air service line depends on the operating pressure. A normal carry-over amount is one pint per 100 hours of operation at 100 PSIG.

The valve incorporates an orifice which, when air is flowing through it, maintains approximately 65 PSIG in the air receiver section. A spring-loaded piston valve senses air pressure in the air receiver section. When the system pressure rises above 65 PSIG, the piston 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 piston O-rings for sealing, piston orifice for restriction, or piston and valve seat for burrs and dirt.

CHECK VALVE (Oil Reservoir) (Figures 2-2 & 1-3) – A renewable resilient disc-type check valve between the oil reservoir (separator) and air receiver sections prevents backflow of air when the unit stops, unloads or is shut down.

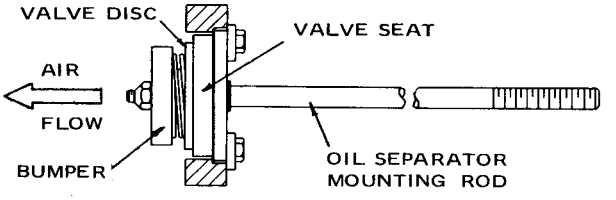


FIGURE 2-2. – RESERVOIR CHECK VALVE

CONSTANT SPEED CONTROL SYSTEM (Figures 3-2, 4-2 & 5-2) – The Constant Speed Control system is used where requirements for air are high for long periods, causing the unit to remain loaded most of the time. The "On-Off" switch and instrument panel is shown in Figure 4-2. The control is a stepless pneumatic system which regulates the compressor inlet to match the air demand made on the compressor. Effective from 0 to 100% of compressor capacity, the system opens the inlet valve as air is drawn from service valve, maintains a constant valve opening as air demand levels off, or closes the valve when the demand ceases. This system includes the subtractive pilot and inlet valve.

Subtractive Pilot – The subtractive pilot is a spring-loaded diaphragm-actuated valve that regulates air pressure from the air receiver section to the unloader piston. The pilot admits air to the inlet valve piston when an air receiver section pressure equal to the pilot low setting is reached. The air begins to pass through pilot to the piston, and the inlet valve begins to close. As the air receiver section pressure increases the pilot pressure also increases on the inlet valve piston, closing the inlet valve. At full receiver 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 air receiver section 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. Normal pilot setting (unload) is 105 PSIG, but the pilot can be adjusted from 50 to 150 PSIG. The differential range of approximately 15 PSI cannot be changed.

Example with normal setting of 90-105 PSIG:

Air Receiver Pressure	Pressure In Control System	Inlet Valve	Compressor
85	0	Open	At full capacity
90	0	Open	At full capacity
95	5	Closing	Reduced capacity
100	10	Closing	Reduced capacity
105	15	Closed	Not compressing

Inlet Valve (Figure 3-2) – The inlet valve is a piston-actuated device which controls the compressor inlet and operates on air pressure from the subtractive pilot. The valve is closed when full pressure is on the system and changes degree of opening in direct response to system pressure changes.

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

Air Receiver Section Pressure Adjustment – Start the unit. Close the air service line valve, allow the air receiver section to build to full pressure and the unit to unload, and proceed as follows:

AIR RECEIVER PRESSURE TOO HIGH:

1. Loosen the subtractive pilot locknut. Back the adjusting screw out about one turn.

2. Open the air service line valve and bleed air from the receiver section so that the compressor loads again. Close the valve and allow the compressor to unload.

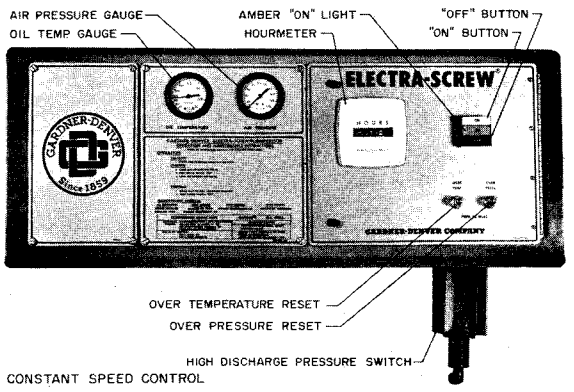


FIGURE 4-2. – INSTRUMENT PANEL CONSTANT SPEED CONTROL

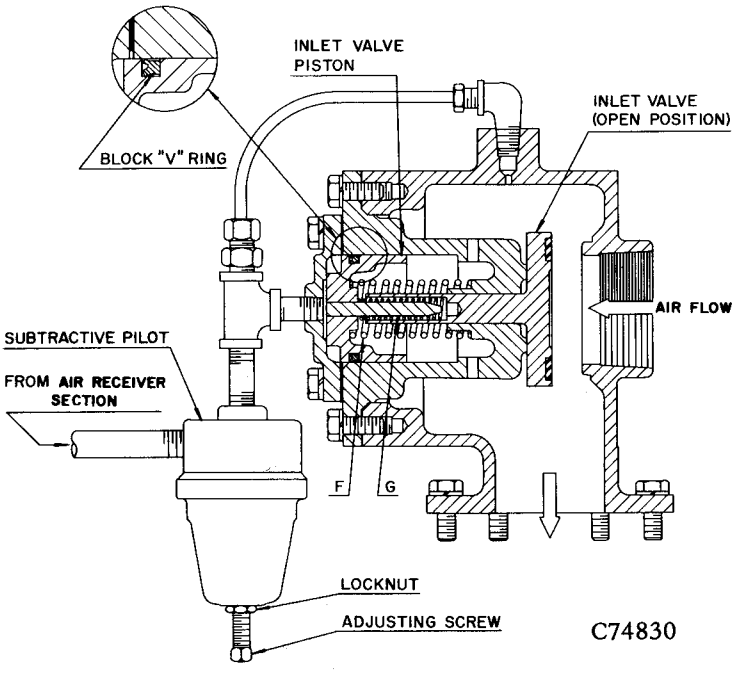


FIGURE 3-2. – INLET VALVE FOR CONSTANT SPEED CONTROL

3. Repeat steps 1 and 2 until proper pressure is obtained. Tighten the locknut.

AIR RECEIVER PRESSURE TOO LOW:

1. Loosen the subtractive pilot locknut.

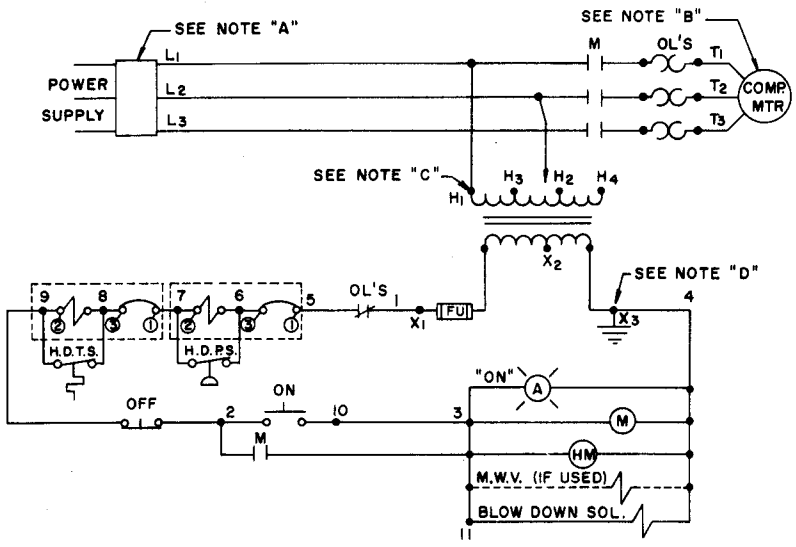
2. Turn the adjusting screw in until proper pressure is obtained.

3. Tighten the locknut.

DO NOT ADJUST THE OPERATING AIR PRESSURE HIGHER THAN THE MAXIMUM STAMPED ON THE UNIT NAMEPLATE.

MINIMUM OPERATING PRESSURE IS 65 PSIG.

Electrical Wiring – Figure 5-2 is the wiring diagram for the unit with Constant Speed Control.



NOTE "A" – FUSED SWITCH OR CIRCUIT BREAKER (NOT FURNISHED AS STANDARD ITEM – IF ORDERED IT MUST BE REMOTE MOUNTED BY CUSTOMER).

NOTE "B" – SINCE MOST A.C. MOTORS ARE WOUND FOR DUAL VOLTAGE BE CERTAIN LEADS ARE CONNECTED FOR THE CORRECT VOLTAGE.

NOTE "C" – STANDARD TRANSFORMER VOLTAGES ARE 230/460/575 VOLTS PRIMARY, 115/95 VOLTS SECONDARY, 50/60 Hz (PART NO. 24CA43). ALTERNATE TRANSFORMER AVAILABLE FOR 208/277/380 VOLTS PRIMARY, 115/95 VOLTS SECONDARY, 50/60 Hz (PART NO. 24CA44).

NOTE "D" – X3 TERMINAL ON TRANSFORMER IS GROUNDED UNDER MOUNTING FOOT OF TRANSFORMER. THIS GROUNDING JUMPER (GREEN WIRE) IS EASILY REMOVED IF GROUNDING OF CONTROL CIRCUIT IS NOT DESIRED.

FUSE – 2 AMP – 250 V – BUSS FUSETRON FRN2.
H.D.P.S. – HIGH DISCHARGE PRESSURE SWITCH 88A305 – SET 140-160 LBS.
H.D.T.S. – HIGH DISCHARGE TEMPERATURE SWITCH 21B90 – SET 230° F.
H.M. – HOURMETER 2009369 – 115 V – 60 Hz (2009370 – 115 V – 50 Hz ALTERNATE).
M. – MOTOR STARTER COIL AND CONTACTS.
M.W.V. – MAGNETIC WATER VALVE – 90AC118 – 115 VAC – TWO-WAY NORMALLY CLOSED – 3/4" (2W.N.C.).
O.L. – OVERLOAD.
RESET – TEMPERATURE AND PRESSURE – 24CA41. RESET BUTTON SEAL – 24CA42. THE 1/2 INCH EXTENSION OF THE RESET BUTTON RED PLUNGER (1/4 INCH NORMAL) GIVES VISUAL INDICATION OF THE SHUTDOWN TROUBLE POINT. THE RESET BUTTON WILL NOT RESET IF TROUBLE STILL PERSISTS WHEN THE RESET BUTTON IS PRESSED.
SOL. – AUTOMATIC BLOWDOWN SOLENOID VALVE – 90AC162 – 115 VAC – TWO-WAY NORMALLY OPEN – 1/2" (2W.N.O.).

○ – TERMINAL ON RESET BUTTONS

– INDICATING LIGHTS – 24CA40 (SYLVANIA 120 P.S.B.)

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 COMPANY.

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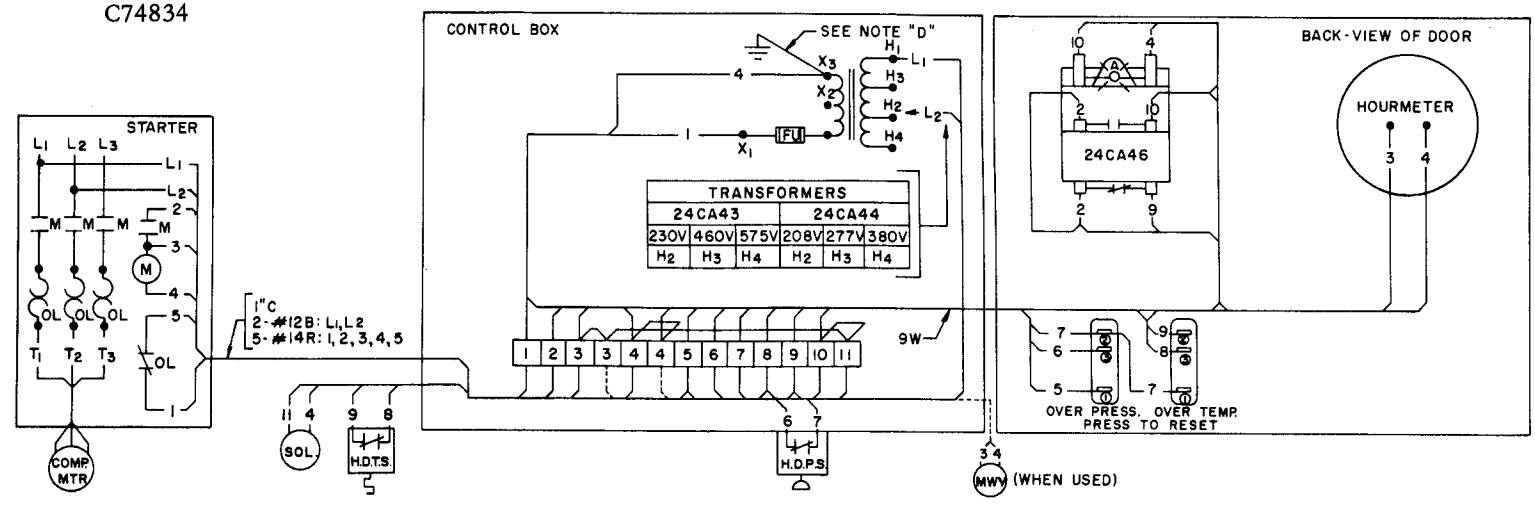
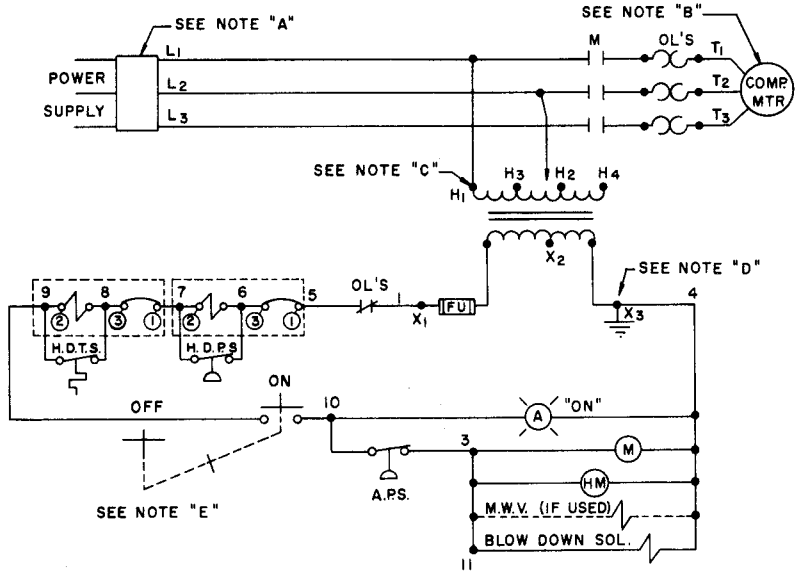


FIGURE 5-2. – WIRING DIAGRAM FOR UNIT WITH CONSTANT SPEED CONTROL



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NOTE "E" – MAXIMUM 20 STARTS PER HOUR.

A.P.S. – AIR PRESSURE SWITCH 2009353 NORMALLY SET 90-100 LBS. IF RESET _____ (150 LBS. MAXIMUM CUTOUT SETTING).
FUSE – 2 AMP – 250 V – BUSS FUSETRON FRN2.
H.D.P.S. – HIGH DISCHARGE PRESSURE SWITCH 88A305 – SET 140-160 LBS.
H.D.T.S. – HIGH DISCHARGE TEMPERATURE SWITCH 21B90 – SET 230° F.
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M. – MOTOR STARTER COIL AND CONTACTS.
M.W.V. – MAGNETIC WATER VALVE – 90AC118 – 115 VAC – TWO-WAY NORMALLY CLOSED – 3/4" (2W.N.C.).
O.L. – OVERLOAD.
RESET – TEMPERATURE AND PRESSURE – 24CA41. RESET BUTTON SEAL – 24CA42. THE 1/2 INCH EXTENSION OF THE RESET BUTTON RED PLUNGER (1/4 INCH NORMAL) GIVES VISUAL INDICATION OF THE SHUTDOWN TROUBLE POINT. THE RESET BUTTON WILL NOT RESET IF TROUBLE STILL PERSISTS WHEN THE RESET BUTTON IS PRESSED.
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○ – TERMINALS ON RESET BUTTONS

– INDICATING LIGHTS – 24CA40 (SYLVANIA 120 P.S.B.)

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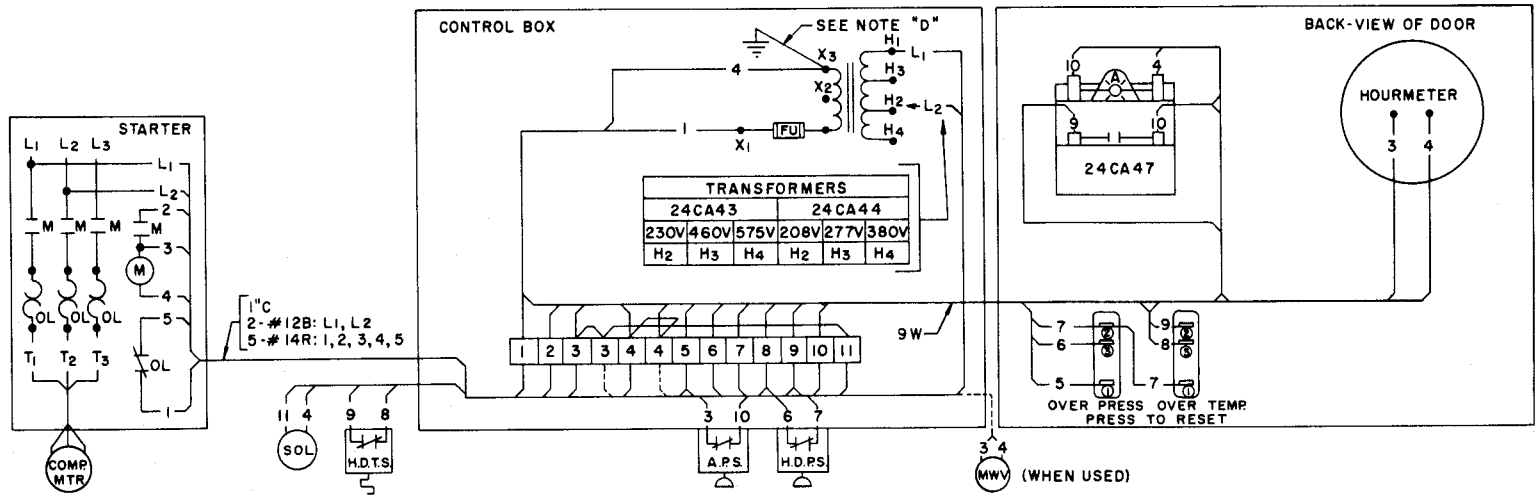


FIGURE 6-2. – WIRING DIAGRAM FOR UNIT WITH AUTOMATIC START-STOP CONTROL SYSTEM

AUTOMATIC START-STOP CONTROL SYSTEM (Figures 6-2 & 7-2) – The Automatic Start-Stop Control system is used where requirements for air are for short and/or intermittent periods. The system automatically starts the motor when the air receiver section pressure falls to a predetermined point and stops the motor when the air receiver section pressure rises to a predetermined point. An auxiliary air receiver with adequate volume must be used with this system to prevent rapid cycling of the unit. Occasionally, shop lines are of such length as to provide adequate volume, but this should be checked carefully before using the unit without an auxiliary air receiver.

The operating pressure of the system is controlled by the air pressure switch located under the control panel, Figure 7-2. The switch is piped to the air receiver section of the reservoir and connected to the electrical circuit in the control box.

Operating Air Pressure Adjustment – Start the unit. Close the air service line valve sufficiently to hold an air receiver section pressure near the system pressure desired. Remove pressure switch cover.

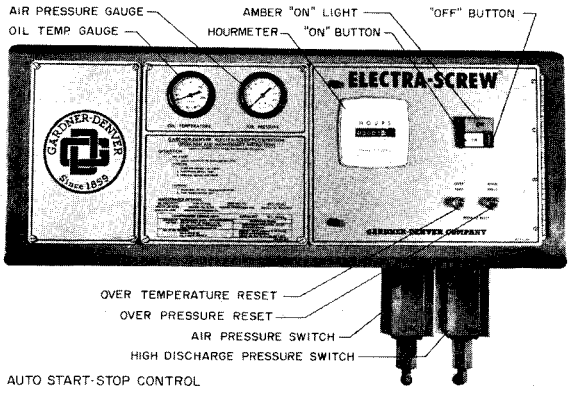


FIGURE 7-2. – INSTRUMENT PANEL – AUTO START-STOP CONTROL

SET FULL RECEIVER PRESSURE (MOTOR STOP) POINT –

1. Turn the upper adjusting screw on the pressure switch until the pointer on left edge indicates the desired pressure; turn clockwise to raise pressure, counterclockwise to lower.
2. Close the air service valve, allow air receiver pressure to build until the unit stops and observe pressure.
3. Open the air service line valve, bleed air from the air receiver section until the unit starts, then repeat steps 1 and 2 until the proper pressure is obtained.

SET LOW RECEIVER PRESSURE (MOTOR START) POINT –

1. With power on, air receiver section at full pressure and air service line valve closed, set lower (differential) adjusting screw near desired pressure; turn counterclockwise to increase differential, clockwise to decrease. Full receiver pressure minus differential is the low receiver pressure (motor start) point. Differential range is approximately 2-18 PSIG on the circular scale above the adjusting screw.
2. Open the air service line valve, bleed air from the air receiver section so that the motor starts and observe pressure at that point.
3. Repeat steps 1 and 2 until the desired low receiver pressure point is obtained.
4. Replace the pressure switch cover.

DO NOT ADJUST THE OPERATING AIR PRESSURE HIGHER THAN THE MAXIMUM STAMPED ON THE UNIT NAME PLATE. MINIMUM OPERATING PRESSURE IS 65 PSIG.

Electrical Wiring – Figure 6-2 is the wiring diagram for the unit with Automatic Start-Stop Control system.

DUAL CONTROL SYSTEM (Figures 8-2 & 9-2) – The Dual Control system incorporates both the Constant Speed Control and the Automatic Start-Stop Control systems for use where air requirements vary from high usage for long periods to short and intermittent periods of use. When the air use is high, operate the unit at constant speed to eliminate excessive starting and stopping of the unit. When the air demand is low, operate the unit on automatic start-stop to eliminate long unloaded periods and wasted power. The unit control panel (Figure 8-2) incorporates both CON and AUTO sections in the On-Off push button. These buttons are interlocked so that the unit cannot be changed from one mode of operation to the other unless the unit is first stopped.

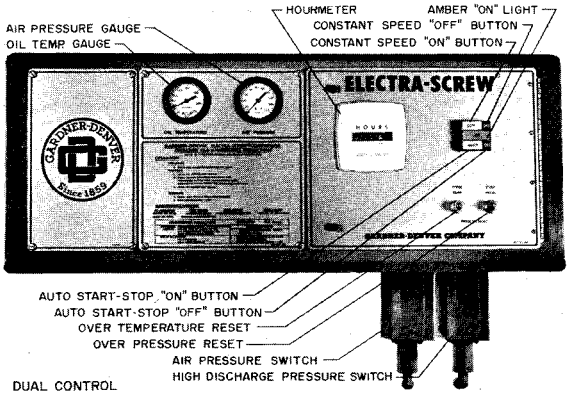
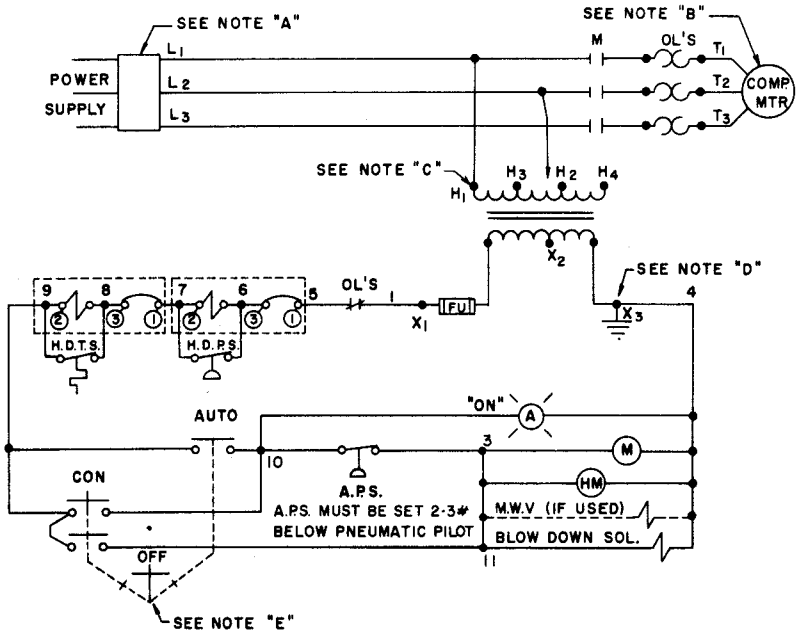


FIGURE 8-2. – INSTRUMENT PANEL – DUAL CONTROL

An auxiliary air receiver of adequate volume must be used with this system to prevent rapid cycling on automatic start-stop. Occasionally, shop lines are of such length as to provide adequate volume, but this should be carefully checked before using the unit without an auxiliary air receiver.

Operating Air Pressure Adjustment – With unit operating on CON section of the On-Off push button, follow procedure for Constant Speed system pressure adjustment on page 3 of this section.



NOTE "A" – FUSED SWITCH OR CIRCUIT BREAKER (NOT FURNISHED AS STANDARD ITEM – IF ORDERED IT MUST BE REMOTE MOUNTED BY CUSTOMER).

NOTE "B" – SINCE MOST A.C. MOTORS ARE WOUND FOR DUAL VOLTAGE BE CERTAIN LEADS ARE CONNECTED FOR THE CORRECT VOLTAGE.

NOTE "C" – STANDARD TRANSFORMER VOLTAGES ARE 230/460/575 VOLTS PRIMARY, 115/95 VOLTS SECONDARY, 50/60 Hz (PART NO. 24CA43). ALTERNATE TRANSFORMER AVAILABLE FOR 208/277/380 VOLTS PRIMARY, 115/95 VOLTS SECONDARY, 50/60 Hz (PART NO. 24CA44).

NOTE "D" – X3 TERMINAL ON TRANSFORMER IS GROUNDED UNDER MOUNTING FOOT OF TRANSFORMER. THIS GROUNDING JUMPER (GREEN WIRE) IS EASILY REMOVED IF GROUNDING OF CONTROL CIRCUIT IS NOT DESIRED.

NOTE "E" – MAXIMUM 20 STARTS PER HOUR.

A.P.S. – AIR PRESSURE SWITCH 2009353 NORMALLY SET 90-100 LBS. IF RESET _____ (150 LBS. MAXIMUM CUTOUT SETTING).
FUSE – 2 AMP – 250 V – BUSS FUSETRON FRN2.
H.D.P.S. – HIGH DISCHARGE PRESSURE SWITCH 88A305 – SET 140-160 LBS.
H.D.T.S. – HIGH DISCHARGE TEMPERATURE SWITCH 21B90 – SET 230° F.
H.M. – HOURMETER 2009369 – 115 V – 60 Hz (2009370 – 115 V – 50 Hz ALTERNATE).
M. – MOTOR STARTER COIL AND CONTACTS.
M.W.V. – MAGNETIC WATER VALVE – 90AC118 – 115 VAC – TWO-WAY NORMALLY CLOSED – 3/4" (2W.N.C.).
O.L. – OVERLOAD.
RESET – TEMPERATURE AND PRESSURE – 24CA41. RESET BUTTON SEAL – 24CA42. THE 1/2 INCH EXTENSION OF THE RESET BUTTON RED PLUNGER (1/4 INCH NORMAL) GIVES VISUAL INDICATION OF THE SHUTDOWN TROUBLE POINT. THE RESET BUTTON WILL NOT RESET IF TROUBLE STILL PERSISTS WHEN THE RESET BUTTON IS PRESSED.
SOL. – AUTOMATIC BLOWDOWN SOLENOID VALVE – 90AC162 – 115 VAC – TWO-WAY NORMALLY OPEN – 1/2" (2W.N.O.).

○ – TERMINALS ON RESET BUTTONS

☼ – INDICATING LIGHTS – 24CA40 (SYLVANIA 120 P.S.B.)

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 COMPANY.

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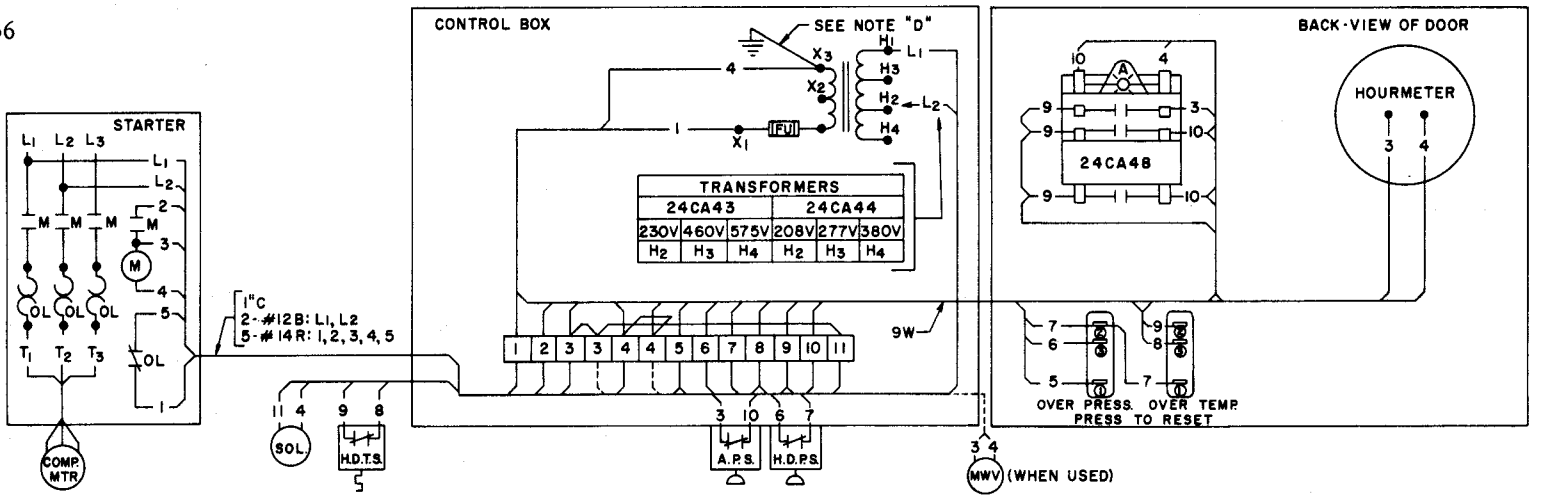


FIGURE 9-2. – WIRING DIAGRAM FOR UNIT WITH DUAL CONTROL SYSTEM

With unit operating on the AUTO section of the On-Off push button, follow the procedure for Automatic Start-Stop system pressure adjustment on page 6 of this section.

The pressure switch unload point must be set approximately 3 PSI lower than the subtractive pilot unload point to prevent overriding and closing of the inlet valve by the pilot on Automatic Start-Stop operation.

DO NOT ADJUST THE OPERATING AIR PRESSURES HIGHER THAN THE MAXIMUM STAMPED ON THE UNIT NAME PLATE. MINIMUM OPERATING PRESSURE IS 65 PSIG.

Electrical Wiring – Figure 9-2 is the wiring diagram for the unit with Dual Control system.

DUOMATIC CONTROL SYSTEM (Figures 10-2, 11-2 & 12-2) – The Duomatic Control system is used where air requirements vary widely, change in frequency of demand and where it is desirable to have some degree of control over the length of time the motor will run after the compressor unloads. During the time the compressor is unloaded with the motor running, the unit draws only about 20% of loaded power at 100 PSIG.

The Duomatic Control system offers three modes of operation controlled by the adjustable timer on the instrument panel (Figure 11-2).

Constant Speed – When the timer is set in the space between 30 and 0, the unit will run continuously. The inlet valve will open and allow the compressor to load when the pressure switch low setting is reached. When the pressure switch high setting (full receiver pressure) is reached, the inlet valve closes, unloading the compressor. Each time full pressure is reached, the oil reservoir section blows down through the automatic blowdown valve to reduce the unloaded horsepower. The LOAD indicator light will signal whether unit is loaded (On) or unloaded (Off). The ON indicator light will remain on as long as the On-Off switch ON push button is depressed.

Automatic Start-Stop – When the timer is set at 0, the unit will start and inlet valve will open each time the pressure in the receiver section falls to the pressure switch low setting. When the pressure rises to the pressure switch high setting, the unit will stop, the inlet valve will close, and the oil reservoir section will blow down. The LOAD indicator light will remain on only when the compressor is running. The ON indicator light will remain on as long as the On-Off switch ON push button is depressed.

Timed Automatic Start-Stop – When the timer is set between 0 and 30, the unit will start and the inlet valve open when the pressure in the receiver section falls to the pressure switch low setting. When the pressure rises to the pressure switch high setting, the unit will unload (LOAD light off), the inlet valve will close, the motor will continue to run and the oil reservoir section blow down. If system pressure does not fall to the pressure switch low setting within the time set on the timer, the unit will stop. The ON indicator light will remain on as long as the On-Off switch ON push button is depressed. When air is again required, the unit will start, the timer will reset and the loaded-unloaded-stop cycle will repeat.

The timer should be set beyond the one (1) minute mark since the repeat accuracy of the timer between the zero (0) and one (1) minute marks is not reliable. Second, the blowdown valve requires about 45 seconds to completely blow down the oil reservoir. If the compressor restarts before the reservoir is blown down, oil mist is carried over into the air lines. Finally, repeated compressor starting under loaded conditions can cause motor failure.

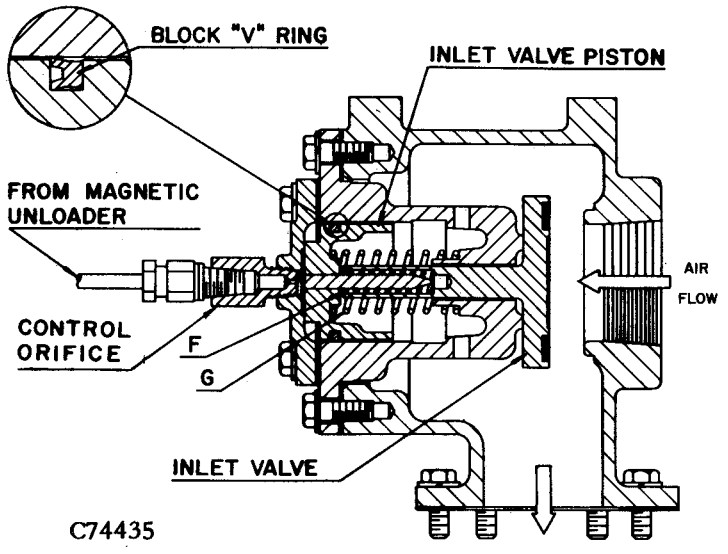


FIGURE 10-2. – INLET VALVE FOR DUOMATIC CONTROL

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

The air pressure switch located under the unit control panel (Figure 11-2) controls operating pressure of the system by opening and closing inlet valve (Figure 7-2) as in Constant Speed and Timed Duomatic operation, or by starting and stopping unit as in Automatic Start-Stop operation. The switch is piped from the air receiver section to the magnetic unloader valve and connected to the electrical circuit in the control box.

Inlet Valve (Figure 10-2) – The piston-actuated inlet valve controls the compressor inlet and operates on air pressure from the control circuit. The valve is closed when preset full pressure is on the system, and open when the pressure in system falls to a preset minimum. The inlet valve contains piston spring "F" which returns piston and allows the inlet valve to open when the pressure is removed, and valve spring "G" which returns the valve to closed position on shutdown of the compressor to prevent blowback from the compressor to the air filter. The control orifice prevents valve "slam".

Operating Air Pressure Adjustment – Set the timer for constant speed operation. Start the unit and close air service line valve sufficiently to hold an air receiver section pressure near the desired system pressure. Remove the pressure switch cover.

SET FULL RECEIVER PRESSURE (COMPRESSOR UNLOAD) POINT –

1. Turn upper adjusting screw on the pressure switch until pointer on the left edge indicates desired pressure.

2. Close the air service line valve and allow the air receiver section pressure to build until the compressor unloads.

3. Note air receiver pressure shown on the instrument panel gauge. If not the pressure desired, open air service line valve and bleed air from the air receiver section until the compressor loads again. Repeat steps 1 and 2 until the proper unloaded pressure is obtained.

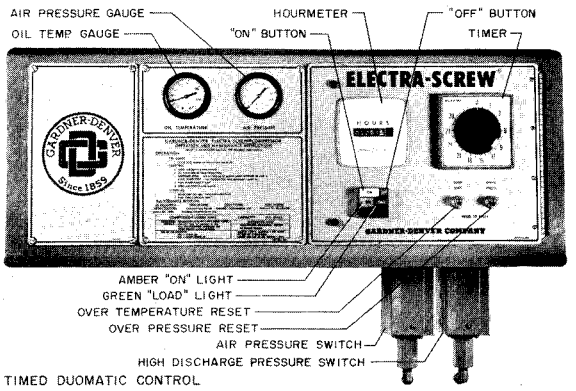


FIGURE 11-2. – INSTRUMENT PANEL – TIMED DUOMATIC CONTROL

SET LOW RECEIVER PRESSURE (COMPRESSOR LOAD) POINT –

1. With power on, air receiver section at full pressure and air service line valve closed, set lower (differential) adjusting screw near desired pressure. Full receiver pressure minus differential is the low receiver (compressor load) point. Differential range is approximately 2-18 PSIG on the circular scale above the adjusting screw.

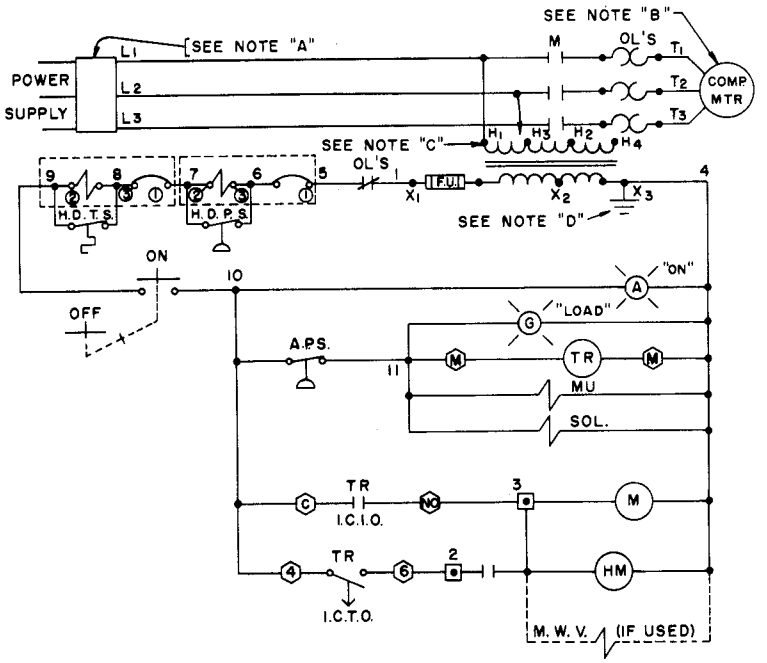
2. Open the air service line valve, bleed air from the air receiver section so that the compressor loads and note pressure obtained.

3. Repeat steps 1 and 2 until desired low receiver pressure point is obtained.

4. Replace pressure switch cover.

DO NOT ADJUST THE OPERATING AIR PRESSURE HIGHER THAN THE MAXIMUM STAMPED ON THE UNIT NAME PLATE. MINIMUM OPERATING PRESSURE IS 65 PSIG.

Electrical Wiring – Figure 12-2 is the wiring diagram for the unit with Duomatic Control system.



NOTE "A" – FUSED SWITCH OR CIRCUIT BREAKER (NOT FURNISHED AS STANDARD ITEM – IF ORDERED IT MUST BE REMOTE MOUNTED BY CUSTOMER).

NOTE "B" – SINCE MOST A.C. MOTORS ARE WOUND FOR DUAL VOLTAGE BE CERTAIN LEADS ARE CONNECTED FOR THE CORRECT VOLTAGE.

NOTE "C" – STANDARD TRANSFORMER VOLTAGES ARE 230/460/575 VOLTS PRIMARY, 115/95 VOLTS SECONDARY, 50/60 Hz (PART NO. 24CA43). ALTERNATE TRANSFORMER AVAILABLE FOR 208/277/380 VOLTS PRIMARY, 115/95 VOLTS SECONDARY, 50/60 Hz (PART NO. 24CA44).

NOTE "D" – X3 TERMINAL ON TRANSFORMER IS GROUNDED UNDER MOUNTING FOOT OF TRANSFORMER. THIS GROUNDING JUMPER (GREEN WIRE) IS EASILY REMOVED IF GROUNDING OF CONTROL CIRCUIT IS NOT DESIRED.

A.P.S. – AIR PRESSURE SWITCH 2009353 NORMALLY SET 90-100 LBS. IF RESET _____ (150 LBS. MAXIMUM CUTOUT SETTING).
FUSE – 2 AMP – 250 V – BUSS FUSETRON FRN2.
H.D.P.S. – HIGH DISCHARGE PRESSURE SWITCH 88A305 – SET 140-160 LBS.
H.D.T.S. – HIGH DISCHARGE TEMPERATURE SWITCH 21B90 – SET 230° F.
H.M. – HOURMETER 2009369 – 115 V – 60 Hz (2009370 – 115 V – 50 Hz ALTERNATE).
I.C.I.O. – INSTANTANEOUS CLOSING ON ENERGIZATION – INSTANTANEOUS OPENING ON DE-ENERGIZATION.
I.C.T.O. – INSTANTANEOUS CLOSING ON ENERGIZATION – TIME OPENING ON DE-ENERGIZATION.
M. – MOTOR STARTER COIL AND CONTACTS.
M.U. – MAGNETIC UNLOADER – 90AC183 – 115 V – THREE-WAY NORMALLY OPEN (3W.N.O.).
M.W.V. – MAGNETIC WATER VALVE – 90AC118 – 115 VAC – TWO-WAY NORMALLY CLOSED – 3/4" (2W.N.C.).
O.L. – OVERLOAD.
RESET – TEMPERATURE AND PRESSURE – 24CA41. RESET BUTTON SEAL – 24CA42. THE 1/2 INCH EXTENSION OF THE RESET BUTTON RED PLUNGER (1/4 INCH NORMAL) GIVES VISUAL INDICATION OF THE SHUTDOWN TROUBLE POINT. THE RESET BUTTON WILL NOT RESET IF TROUBLE STILL PERSISTS WHEN THE RESET BUTTON IS PRESSED.
SOL. – AUTOMATIC BLOWDOWN SOLENOID VALVE – 90AC162 – 115 VAC – TWO-WAY NORMALLY OPEN – 1/2" (2W.N.O.).
T.R. – TIMING RELAY – 24A482 – 115 VAC – IF COMPRESSOR REMAINS UNLOADED FOR TIME SET ON TIMER DIAL HEAD (0 TO 30 MIN. ADJUSTABLE – DO NOT SET BETWEEN 0 AND 1), COMPRESSOR WILL STOP AND THEN START UP WHEN AIR IS NEEDED, (MAXIMUM 20 STARTS PER HOUR). TO MAKE COMPRESSOR RUN CONSTANT SPEED, SET TIMER DIAL HEAD IN THE 60° SPACE MIDWAY BETWEEN THE 30 AND 0 MIN. DIAL MARKINGS. 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) UNLESS COMPRESSOR WAS PREVIOUSLY OPERATING CONSTANT SPEED WHEN SHUT DOWN.

⬡ – TERMINALS ON TIMING RELAY
◉ – TERMINALS 2 & 3 ARE ALSO STARTER INTERLOCK NUMBERS
☼ – INDICATING LIGHTS – 24CA40 (SYLVANIA 120 P.S.B.)
○ – TERMINALS ON RESET BUTTONS

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 COMPANY.

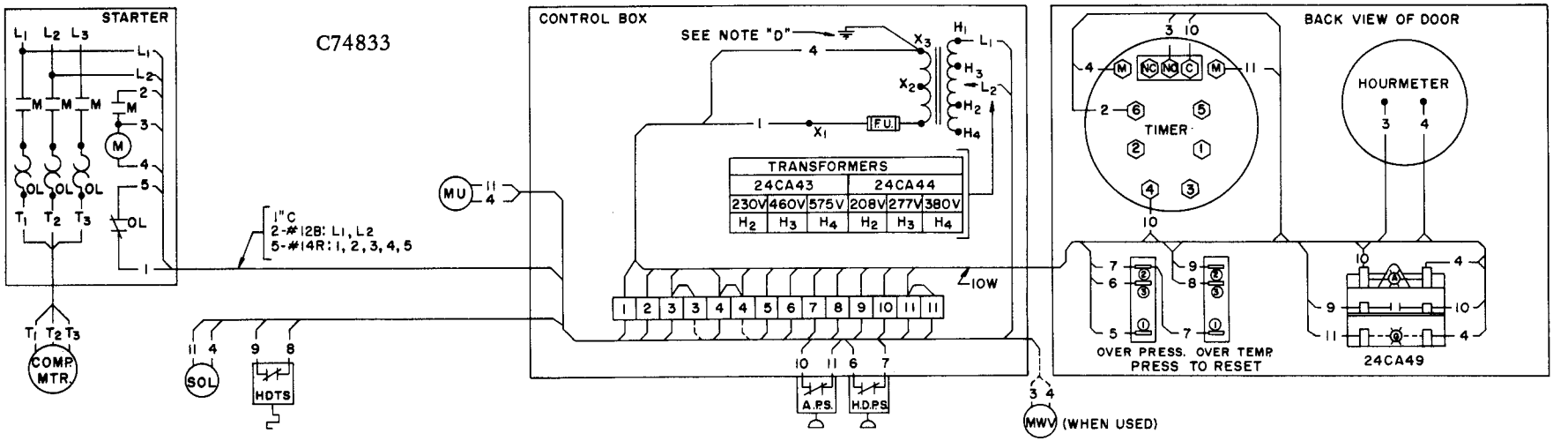
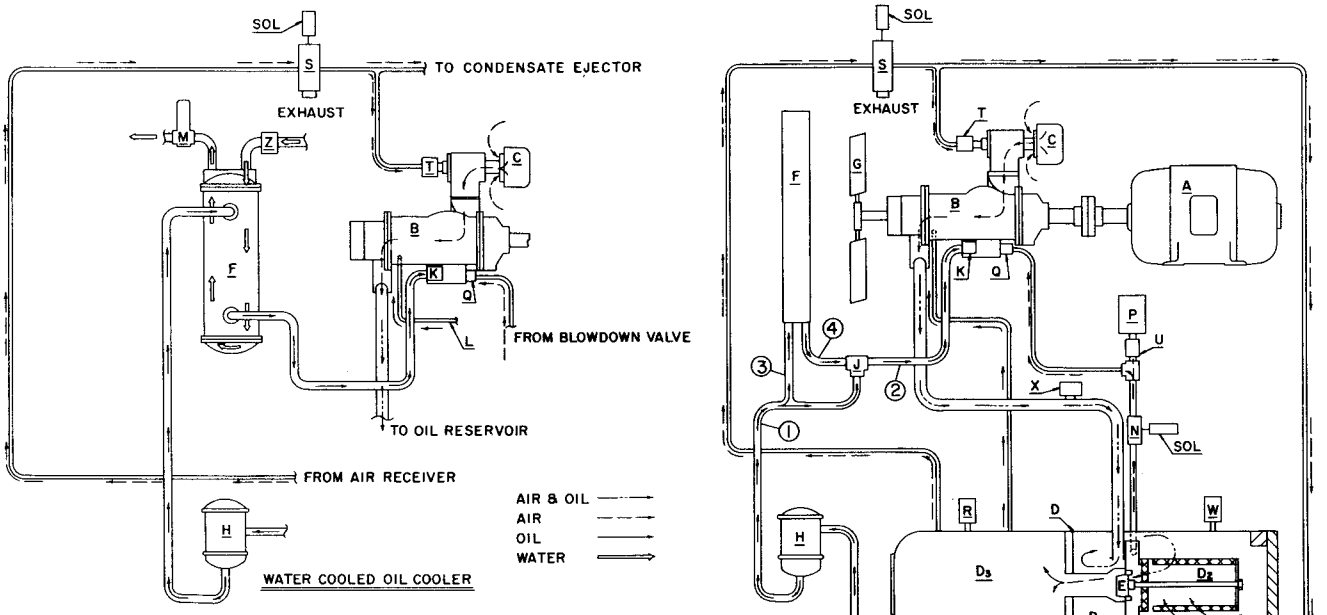


FIGURE 12-2. – WIRING DIAGRAM FOR UNIT WITH DUOMATIC CONTROL SYSTEM

SECTION 3
LUBRICATION
OIL COOLER, OIL FILTER & SEPARATOR

COMPRESSOR OIL SYSTEM (Figure 1-3) cools the compressor, lubricates moving parts and seals internal clearances in the compression chamber.

The oil suction line is connected near the bottom of the oil reservoir. Air pressure in the oil reservoir forces oil through the oil filter, oil cooler, thermostatic mixing valve on radiator-type oil cooler units, oil control valve on duomatic units, and into the compressor main oil gallery. The oil passes through internal passages for lubrication, cooling and sealing during the compression cycle. The air-oil mixture is then discharged to the oil reservoir where impingement and velocity change remove more than 99% of the oil from the air. The remaining oil is removed by the oil separator before the air passes to the air receiver section of the reservoir.



A - MOTOR
B - COMPRESSOR
C - AIR FILTER
D - RESERVOIR - SEPARATOR & RECEIVER
D_1 - RESERVOIR & FIRST STAGE SEPARATION
D_2 - OIL SEPARATOR
D_3 - AIR RECEIVER SECTION
E - RESERVOIR CHECK VALVE
F - OIL COOLER
G - FAN
H - OIL FILTER
J - THERMOSTATIC MIXING VALVE
K - OIL FLOW CONTROL VALVE (DUOMATIC ONLY)
L - SEPARATOR TO COMPRESSOR CYLINDER OIL RETURN LINE
L_1 - WET SUMP RETURN FILTER
L_2 - WET SUMP RETURN ORIFICE
L_3 - SEPARATOR RETURN ORIFICE
L_4 - CHECK VALVE
M - WATER FLOW CONTROL VALVE
N - BLOWDOWN VALVE
P - BLOWDOWN SILENCER
Q - BLOWDOWN LINE CHECK VALVE (DUOMATIC ONLY)
R - OPERATING AIR PRESSURE SWITCH - LOAD, UNLOAD (AUTO START-STOP, DUAL & DUOMATIC ONLY)
S - MAGNETIC UNLOADER (DUOMATIC ONLY)
T - AIR INLET VALVE CONTROL ORIFICE (DUOMATIC ONLY) OR PILOT (CONSTANT SPEED AND DUAL CONTROL)
U - BLOWDOWN LINE ORIFICE
V - MINIMUM PRESSURE FINAL DISCHARGE VALVE
W - HIGH OIL RESERVOIR PRESSURE SWITCH
X - HIGH DISCHARGE TEMPERATURE SHUTDOWN SWITCH
Y - AIR RECEIVER CONDENSATE EJECTOR (AUTO START-STOP, DUAL & DUOMATIC ONLY)
Z - MAGNETIC WATER SHUTOFF VALVE

FIGURE 1-3. – FLOW DIAGRAM – AIR-OIL SYSTEMS

OIL SPECIFICATIONS – The recommended compressor lubricant is automatic transmission fluid meeting AQ-ATF, Type A, Suffix A, Dexron or Ford M2C33 specifications. On fan-cooled radiator models, automatic transmission fluid can be used for year-round operation except when operating ambient temperature exceeds +90° F. for 8 hours per day, then SAE 30 oil meeting MIL-L-2104B (API Engine Service CC) specifications should be used. On water-cooled heat exchanger models, automatic transmission fluid can be used for all operation, provided the compressor oil inlet temperature is held 130°-160° F. by adjustment of water flow control valve; if oil inlet temperature will exceed 160° F. for more than 8 hours of operation, then SAE 30 oil meeting MIL-L-2104B (API Engine Service CC) specifications should be used.

The oil must contain the following additives to be suitable for Electra-Screw® compressor use: (a) corrosion inhibitor, (b) oxidation inhibitor, and (c) foam inhibitor. Any other additives the above oil may contain as a standard of the refiner

are acceptable. Mixing of different types, or the use of lubricants without sufficient oxidation inhibitor will result in formation of heavy varnish and sludge deposits throughout the system.

SYSTEM CAPACITY: Models ESG & ESH – 9 U.S. Gallons; Model ESJ – 10.5 U.S. Gallons	
Recommended Oils	Temperature Range
Automatic Transmission Fluid – -50° F. Pour Point – Meeting AQ-ATF, Type A, Suffix A, or GM Specification (Dexron), or Ford Specification (M2C33)	Year-round Operation – Except As Noted Below.
SAE 30 – Meeting Specification MIL-L-2104B (API Engine Service CC), or MIL-L-45199 (Series 3) (API Engine Service CD)	Above +90° F. During 8 Or More Hours Of Operation – **NEVER USE SAE 30 OIL BELOW +40° F.**

FIGURE 2-3. – COMPRESSOR LUBRICANTS

OIL QUALITY – There are many brands of lubricating oils which are represented by the suppliers as meeting one or more of the specifications listed under "Compressor Lubricants" (Figure 2-3). The ability of an oil to meet the minimum performance level of a specification is determined by the supplier. Therefore, the responsibility for the QUALITY of the oil and its PERFORMANCE IN SERVICE rests with the oil supplier.

COLD AMBIENT OPERATION – If an SAE grade oil is used, the oil should be changed to automatic transmission fluid when the ambient temperature drops to +40° F. in the space enclosing the compressor unit. Experience clearly indicates that an oil with a pour point above the ambient temperature may chill in the oil cooler and block oil flow to the compressor. The loss of circulation causes excessive discharge air temperature and may result in compressor damage and/or a flash fire in the oil reservoir. This rise of discharge air temperature occurs very rapidly, and without oil as a wetting agent surrounding the sensing bulb of the high air temperature shutdown switch, damage generally results before the device can actuate to stop the unit. **Never use SAE 30 oil below +40° F.**

ADDITION OF OIL BETWEEN CHANGES must be made when level of oil in the gauge is below ON LOAD 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 necessary to return the oil level to the center of the ON LOAD range when the unit is operating (spread of ON LOAD range is approximately 2 U.S. gallons). Repeated addition of oil between oil changes may indicate excessive oil carry-over and should be investigated.

OIL LEVEL GAUGE indicates the amount of oil in the oil reservoir section. When the unit is stopped the oil level will be in the UNLOAD-STOP range. When the unit is operating the oil level should be in the ON LOAD range. In normal operation the oil level will rise and fall within these ranges 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.

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 operating conditions automatic transmission fluid may be used up to 2000 hours of operation and SAE 30 oil up to 1000 hours. When operating conditions are severe (very dusty, high humidity or high temperature) it may be necessary to change the oil more frequently. Operating conditions and appearance of drained oil must be surveyed and oil change intervals planned accordingly by the user. Change the oil filter every 1000 hours.

DRAINING AND CLEANING OIL SYSTEM – STOP UNIT. **Be sure no air pressure is in the reservoir.** 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 oil reservoir drain openings to drain oil, a small hand-, electric- or air-operated pump should be used to drain reservoir. Remove compressor sump drain, oil cooler drain (2), and oil filter plug. After oil reservoir is emptied, remove oil reservoir magnetic and drain plugs.

If the unit is elevated so that the oil reservoir drain openings can be used, remove the following plugs: oil reservoir drain, oil reservoir magnetic, compressor sump drain, oil cooler drain (2) and oil filter.

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

FILLING OIL RESERVOIR – Wipe away all dirt before removing the oil filler plug. Refer to "Compressor Lubricants" (Figure 2-3) for oil quantity required to fill the compressor oil system. This amount brings the oil level into EXCESS OIL range on the gauge. After a few minutes of operation, the oil level will drop into ON LOAD range as oil fills other parts of the system. Maintain the oil level in the ON LOAD 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 3-3) is a vital part in maintaining a trouble-free compressor, since it removes dirt and abrasives from the circulated oil. The filter is a replaceable paper element type and is equipped with an 18-21 PSI relief valve that opens in the event the element becomes dirty enough to block the flow of oil. **Element must be replaced every 1000 hours**, or when pressure drop is 15 PSI. More frequent changes improve the system reliability and are recommended.

Use only the replacement element shown on the filter tag, or refer to the parts lists for the part number. Use the following procedure to replace the filter element.

1. Loosen the clamp screws, remove clamp ring and filter cover, clean all parts and replace the gasket on filter cover.

2. Slide the new element over center tube and screw the relief valve assembly into end of tube hand tight.

3. Replace the cover and clamp ring. Tighten both clamp screws securely.

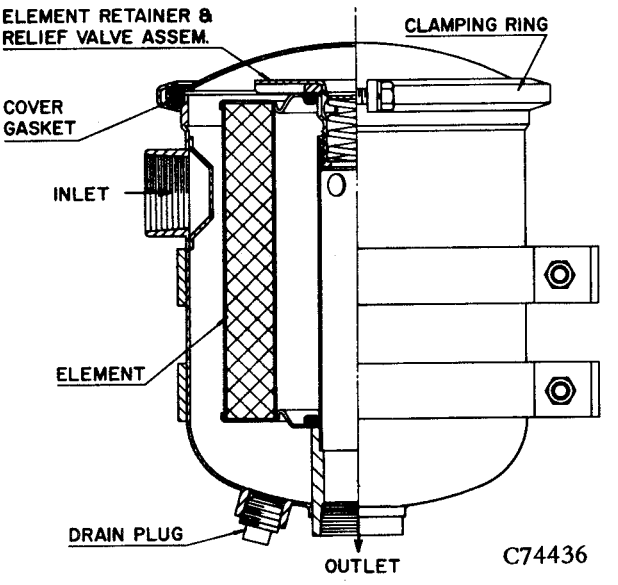


FIGURE 3-3. – COMPRESSOR OIL FILTER

COMPRESSOR OIL COOLER – RADIATOR TYPE (Figure 6-1) – The fan is direct connected to the main rotor shaft and exhausts air through the oil cooler away from the unit. Keep both faces of the oil cooler core clean for efficient cooling of the compressor oil. Oil cooler malfunction may be traced by checking oil pressure drop through the cooler; check by installing pressure gauges in each drain plug opening at bottom of 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.

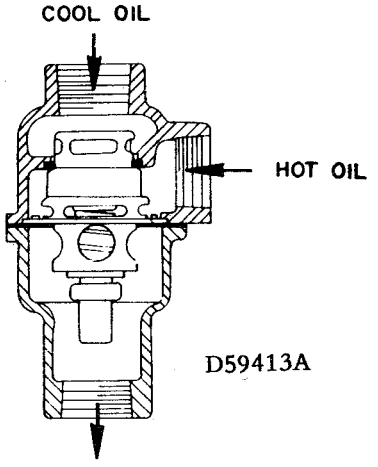


FIGURE 4-3. – THERMOSTATIC MIXING VALVE

THERMOSTATIC MIXING VALVE (Used With Radiator-Type Oil Cooler Only) (Figure 4-3) is installed in the system as shown in the flow diagram, Figure 1-3. On start-up, with the unit cold, the thermostat in the valve is open to the bypass line, allowing the oil to circulate directly from the oil reservoir to the compressor during the warm-up period. As the oil warms up, the thermostat gradually opens to allow oil from the cooler to mix with oil from bypass line. After the unit is warmed up, the mixing valve maintains oil injected into compressor at a minimum of 130° F. This system provides proper compressor warm-up and prevents moisture contamination of the oil.

To check the thermostat, heat in oil – it should be wide open at 130° F. If the unit shuts down due to high air discharge temperature, the cause may be that the thermostat is stuck open in the bypass position blocking the cooler out of the system, in which case lines 1 and 2 (Figure 1-3) will be hot to the touch and lines 3 and 4 much cooler. When flushing the oil system, remove the mixing valve and clean all parts thoroughly.

COMPRESSOR OIL COOLER – WATER-COOLED HEAT EXCHANGER (Figure 6-1) – The heat-exchanger cooler is a multiple pass type, with water in the tubes and oil in the shell. The water flow is regulated by a self-operated flow control valve (Figure 5-3) installed in the water outlet line from the oil cooler as shown in the flow diagram (Figure 1-3) and designed to maintain the oil injected into the compressor at a minimum of 130° F. The valve's temperature sensing bulb is located in the oil outlet line of the oil cooler. An oil temperature change at the bulb operates the valve, increasing or decreasing the water flow, to maintain the oil temperature within the set range. The control panel thermometer indicates the oil temperature to the compressor.

Oil cooler malfunction may be traced by checking pressure at oil inlet and outlet. Fittings at these locations are equipped with a 1/4" pipe tap for a gauge. 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 (dissolved) and/or suspension. These substances can cause scale formations, corrosion and fouling (plugging) of any water-cooled heat exchanger equipment. Disregarding the possibility that one or more of these conditions exists 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 only involve filtration (screening) to remove debris, sand and/or silt in the cooling water supply. However, chemical treatment methods may be necessary in certain instances to inhibit corrosion and/or remove suspended 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 on the tube side (water side) of the heat exchanger to remove deposits which enhance fouling and corrosion.

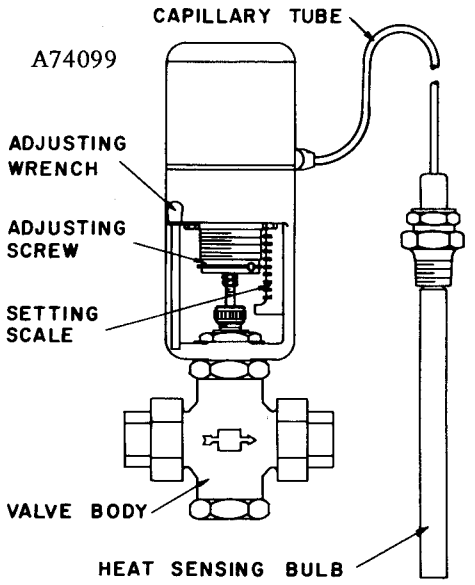


FIGURE 5-3. – WATER CONTROL VALVE

WATER FLOW CONTROL VALVE FOR HEAT EXCHANGER (Figure 5-3) – The water flow control valve is adjustable to compensate for varying inlet water temperatures. Use the oil temperature thermometer on the control panel in setting the flow control valve. **To decrease water flow** (increase oil inlet temperature) insert the adjusting rod into one of the holes in the adjusting screw and move from left to right, increasing spring tension. **To increase water flow** (decrease oil inlet temperature) turn the adjusting screw in the opposite direction. The rib through the adjusting screw wrench holes is an index line for use with the index scale 0 to 8 in obtaining a desired setting.

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 unit.

If a 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 foreign material in the valve, erosion, 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 (Figure 1-3) – A magnetic solenoid operated water shutoff valve rated at 150 PSIG water pressure is supplied in the water inlet line ahead of the oil cooler. The valve is wired into the compressor control circuit and opens to allow water to flow any time the ON-OFF push button is ON and the compressor is running. When compressor stops under automatic control, or is shut off manually, the valve closes, stopping water flow through the system.

AIR RECEIVER – OIL RESERVOIR (Figures 4-1 & 1-3) – The tank which supports the compressor, motor and auxiliary items is divided internally into three sections: oil reservoir, oil separator and air receiver. Approximately one-third of the tank length at the motor end is occupied by the oil separator section. The middle one-third of the tank is the oil reservoir. The remaining one-third at the compressor end of the tank is the air receiver section.

The oil reservoir section between the oil separator and air receiver acts as the primary oil separation device by centrifugal action and impingement. From this section the air-oil mixture flows into the oil separator section for final removal. After passage through the oil separator, the air flows through a check valve into the air receiver section and final discharge. The air receiver section provides limited air storage and pneumatic pickup point for the compressor control system.

COMPRESSOR OIL SEPARATOR (Figure 6-3) located at the motor end of the oil reservoir is a renewable cartridge type oil separator element and provides final removal of oil from the air stream. Oil from inside the separator and the sump section of the reservoir surrounding it, is returned through tubing to the compressor cylinder.

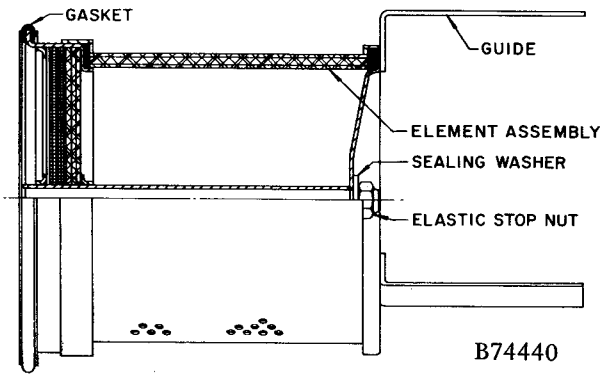


FIGURE 6-3. – OIL SEPARATOR

Oil carry-over through the service lines may be due to a malfunction of the oil separator – blown gasket and/or a ruptured or collapsed element. A malfunction of this type may be due to using the element 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 and varnish build-up in the filtering material. Excessive tilt angle of the unit will hamper separation and also cause oil carry-over.

Oil carry-over may also be caused by operation at pressure below 65 PSIG, overfilling of the oil reservoir, oil that foams, or oil return line malfunction. When oil carry-over occurs, inspect the separator only after it is determined that the oil return lines are not the cause. Refer to "Oil Return" and "Trouble Shooting" paragraphs below.

The oil separator should be changed every 4000 hours. Extended separator life may be experienced depending on air and oil filter maintenance as well as oil quality and condition. When unit is equipped with the optional pressure differential gauge, separator should be changed at 8 PSI differential reading.

To remove the separator for inspection or replacement:

1. Remove the separator flange. Remove the separator elastic stop nut and sealing washer and slide the separator from the supporting rod.

2. Clean oil return opening at bottom of separator section.

3. Inspect the separator gasket; replace if damaged. The gasket is a "U" cross section and is stretched slightly to snap over the separator flange.

4. Replace the oil separator if necessary, by sliding the new separator with gasket over the supporting rod. Check the orientation of the corrugated inner screen at the gasket end of the separator. Corrugations should be vertical as indicated by word TOP stamped on the gasket flange and on the bottom (nut end) of the separator. If word TOP is not correctly aligned with the corrugations, be sure to install the separator with the corrugations in a vertical position. Oil carry-over may result if corrugations are in another position.

5. Inspect and install the sealing washer. If the soft gasket surface is damaged, replace with a new washer.

6. Install the elastic stop nut. Pull up securely, making sure the separator gasket flange is seated squarely on the reservoir flange.

OIL RETURN (Figure 1-3) – Two lines return oil from the separator system to the compressor oil system through an orifice cross and tubing to the compressor cylinder. Orifice fitting stamped "R" contains a 1/16" orifice and is connected to the return line from the dry sump portion of the oil separator section. Orifice fitting stamped "S" contains a 3/32" orifice and is connected to the line from the separator element. The line from the dry sump has a filter which should be cleaned at each oil change. Check valve at orifice cross prevents backflow of oil from compressor during blowdown.

Oil carry-over through the service line may be due to: plugged filter, plugged orifices, return lines pinched shut or clogged, loose or broken connections, return line connected to wrong orifice opening. If a return line is replaced, use only 1/4" OD tubing.

OIL FLOW CONTROL VALVE (Duomatic Control Unit Only) (Figures 1-3 & 7-3) – An oil flow control valve is located in the compressor oil sump at the end of the oil piping from the oil cooler. This valve functions as a metering and check valve during unloaded operation; release of the air pressure in the oil reservoir allows pressure to fall on the upstream side of the valve and the spring seats the disc. The vacuum developed in the compressor when unloaded is sufficient to cause a lubricating amount of oil to flow through the orifice hole in the seated disc. When air pressure is again applied in the oil reservoir on loaded operation, the spring force is overcome, and the full amount of oil flows into the compressor. The spring and disc are available for repair. If the valve seat is damaged, a complete new valve should be purchased to insure proper mating of seat and disc.

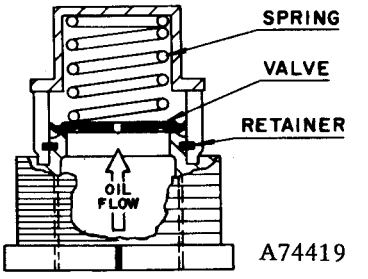


FIGURE 7-3. – OIL FLOW CONTROL VALVE

AUTOMATIC BLOWDOWN SYSTEM (Figure 1-3) – A solenoid operated magnetic valve wired into the control circuit is used to relieve pressure in the oil reservoir section each time the unit unloads (Duomatic Control only) or is shut down. A 3/16" diameter orifice in the line downstream from the valve is used to hold blowdown time to about 45 seconds and prevent oil carry-over due to too rapid a release of pressure. On the Duomatic Control system only, a line from the pipe tee just downstream of the blowdown valve directs a portion of the blowdown air to the compressor sump to aid in scavenging oil for a smooth transition to unloaded operation; the in-line check valve at the compressor sump prevents flow to atmosphere during loaded operation. A silencer terminates the blowdown line to muffle air discharge noise.

PRESSURE DIFFERENTIAL GROUP (Optional) – A set of gauges mounted on the left portion of the instrument panel is available for checking pressure differential across the oil filter and the oil separator. These gauges use a directional valve with an operating lever. To check the differential, read the gauge, turn the lever 180° and read the gauge a second time;

the difference in the reading is the pressure drop across the element being monitored. If the gauge is erratic or inoperative, check the three-way valve for dirt or moisture before attempting other corrective action. The oil filter element should be changed when the pressure drop is 15 PSI. The oil separator should be changed when the pressure drop is 8 PSI.

FAN is pinned and piloted to the compressor main rotor shaft extension and requires no maintenance.

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 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 – 150° to 180° F. – Check with a thermometer in the tapped opening on top of the compressor discharge pipe to the oil reservoir.

Compressor Oil Inlet Temperature – 130° to 150° F. – Read at thermometer on the control panel or check with a thermometer at compressor oil inlet line tee.

Oil Inlet Pressure – 70 to 80 PSI at 100 PSI Air Receiver Pressure – Check at fitting in the line from the mixing valve discharge to compressor.

Oil Cooler Oil Pressure Drop (Air-Cooled Radiator Type) – 2 to 12 PSI (65 to 150 PSIG Receiver Pressure) – Check at the pipe plug near the inlet and outlet lines of the oil cooler, inlet at the left side, outlet at the right side when facing cooler end of the compressor unit.

Oil Cooler Oil Pressure Drop (Water-Cooled Heat Exchanger) – 3 to 12 PSI (65 to 150 PSIG Receiver Pressure) – Check at the heat exchanger inlet and outlet fittings. Water pressure drop through the heat exchanger depends on supply pressure, flow rate and outlet pressure.

SECTION 4
AIR FILTERS

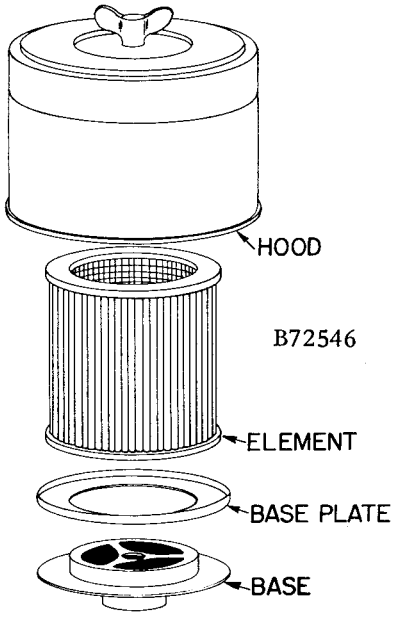


FIGURE 1-4. – DRY-TYPE AIR FILTER

AIR FILTER (Figure 1-4) furnished as standard equipment is a washable element dry type 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. When the outside surface of the element appears to be evenly coated with dirt, it should be cleaned as follows:

1. Remove wing bolt, lift off hood and filter media.
2. Vibrate or blow heavy dirt accumulations from element.
3. If required, wash element with a household detergent and water; rinse with clear water. Allow to dry before reinstalling. DO NOT USE OIL, GASOLINE, OR OILY WASTE TO CLEAN.

Replace the element after five cleanings, or if the filter media or seal at the ends are damaged, or if the element cannot be thoroughly cleaned.

Replace the filter element with genuine replacement parts whenever needed. Good judgement 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: Do not run unit with damaged filter or filter parts. Always handle filter parts with care.

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

HEAVY-DUTY AIR FILTER (Figure 2-4) – Extremely dusty locations require a heavy-duty two-stage dry type air filter. If a unit has been so equipped, service the filter as follows:

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

Filter Element – The element should be serviced when the pressure drop through the filter reaches 20 inches of water or when inspection indicates a heavy accumulation of dirt on the outside of the element. Clean every 50 to 250 operating hours depending on dust conditions. Inspect every few days until experience determines proper time for servicing. Higher than normal current use by the motor or loss of compressor delivery may indicate need for servicing filters.

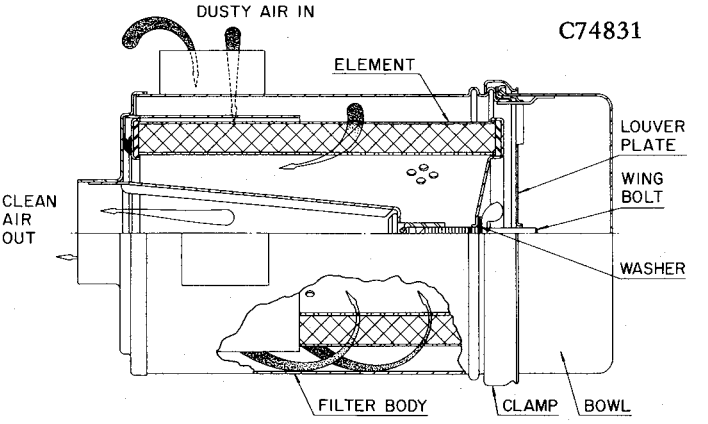


FIGURE 2-4. – HEAVY-DUTY AIR FILTER

To service:

(a) Loosen retaining band clamp and remove the dust cup from body of the filter.

(b) Visually inspect element in place. If cleaning is not necessary, reinstall the dust cup on the filter. If element requires cleaning, unscrew the wing bolt and withdraw the element from the body.

(c) Wash the element by soaking about 15 minutes in warm water with a mild detergent. Rinse thoroughly with clean water. A hose may be used if pressure does not exceed 40 PSI.

(d) Inspect element for ruptures or cracks in the pleated media. Replace the element if any are found. Inspect the double seal gasket on the bottom of the element. Replace entire element if the gasket is damaged.

(e) Allow element to dry COMPLETELY. Install element in body and fasten securely with wing bolt. Reinstall the dust cup and retaining band clamp.

CAUTION: *Do not oil this element. Do not wash in other cleaning fluids. Never operate unit without 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 down time. Store elements in a protected area free from damage, dirt and moisture. Handle filter parts with care.*

Filter Element Life – The element should be replaced after eight cleanings or if:

(a) 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.

(b) Pressure drop through a filter with a freshly cleaned element is below 3 inches of water with compressor running at full speed – this would indicate a rupture or crack.

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

SECTION 5
COUPLING

COUPLING (Figure 1-5) – The motor and compressor are direct connected by a spider cushion-type flexible coupling. The coupling does not require lubrication.

The coupling is carefully aligned at the factory; however, if thermal expansion, settling, deflection of unit through shipment or handling, or maintenance on mating parts requires that coupling be realigned, proceed as follows:

1. Tighten the set screws over keyways in each coupling body. Motor shaft and compressor shaft ends are set flush with the inner face of the coupling body. Distance between shaft ends will be approximately 1".

2. Position compressor and motor so that the coupling body flanges rest snugly against the raised dots on the coupling spider faces.

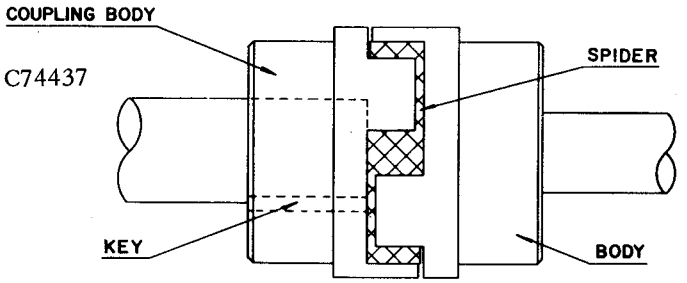


FIGURE 1-5. – COUPLING

NOTE: It is recommended that a dial indicator be used to check angular and parallel alignment. Maximum allowable runout for either angular or parallel alignment is .020 T.I.R. Steps 3 and 4 give an alternate method if dial indicator is not available.

3. Check angular alignment with a feeler gauge by comparing the gap between the coupling jaw and the opposite flange at the three points of proximity. Shim and adjust the motor and compressor so that the gaps are uniform (Views "A" and "C", Figure 2-5). Maximum recommended gap variation is .010".

4. Check parallel alignment by placing a straight edge across both coupling body flanges. Shim and adjust the compressor and motor until the straight edge lies flat on both hubs measured at two (2) points 90° apart (Views "A" and "B", Figure 2-5). Maximum recommended difference in hub level is .010".

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

6. Tighten all motor and compressor screws securely.

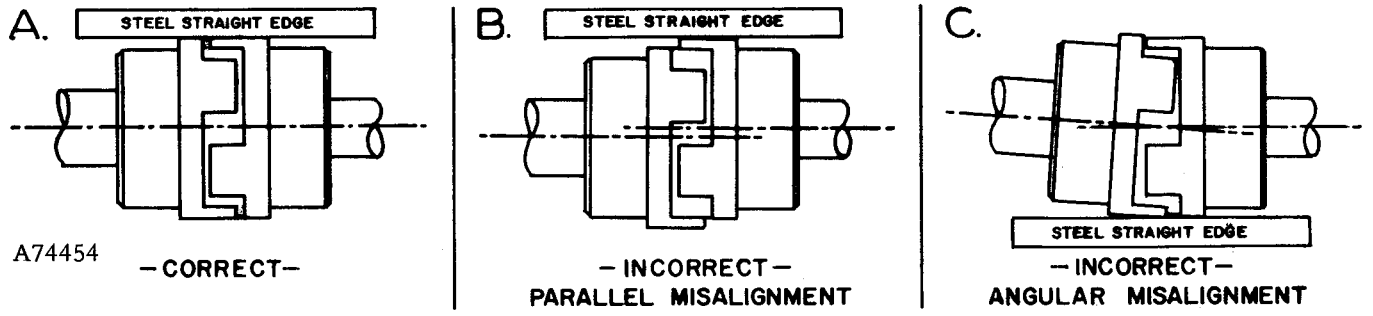


FIGURE 2-5. – COUPLING ALIGNMENT

SECTION 6
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.

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

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 for the inlet air filter. In some cases it may be necessary to install the air filter at some distance from the compressor to obtain proper air supply.

If the unit is to be operated in an enclosed space, provide an adequate inlet and outlet for cooling air. Proper ventilation MUST be provided for adequate cooling; hot air must be exhausted from the enclosure. Do not block air flow through the cooler. Allow two feet from the cooler face to nearest obstruction. Figure 1-6 is a typical inlet-outlet air flow arrangement.

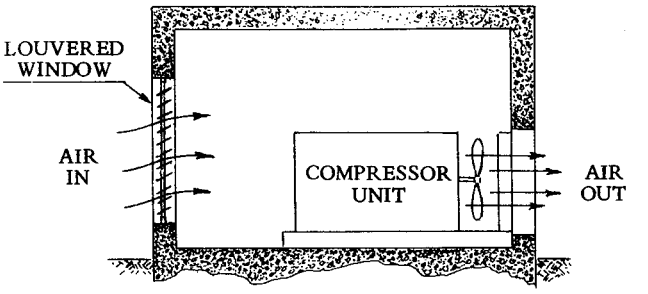


FIGURE 1-6. – COMPRESSOR ENCLOSURE

FOUNDATION – The Electra-Screw® compressor requires no special foundation, but should be mounted on a smooth, solid surface. Whenever possible install unit near level. Temporary installation can be made at a maximum 10^{o} angle lengthwise or 30^{o} 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 – By adjusting the height of the optional leveling feet, the centerline of the oil reservoir drain can be positioned approximately 3 to 4 inches from 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 desired drain height.
2. Construct an oil sump or trough below the floor level and pump or bail drained oil.
3. Pump oil from the reservoir filler or drain to a container.

CONDENSATE EJECTOR DRAIN – The Duomatic Control Electra-Screw® unit is equipped with a condensate ejector piped to the bottom of the air receiver section of the oil reservoir. The ejector operates each time the compressor unloads. The condensate should be piped away from the unit to a suitable drain.

CANOPY ENCLOSURE – The Electra-Screw® unit is available with a canopy enclosure. Normal location and foundation instructions given above apply. Be sure to allow enough space around the unit for canopy doors to open completely during servicing.

AUXILIARY AIR RECEIVER – Constant speed control units do not normally use an auxiliary air receiver. Automatic start-stop, dual and duomatic units require an auxiliary air receiver unless 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 and a means of draining condensate. Figure 2-6 shows a typical air receiver and auxiliary accessories. When two or more units are manifolded into the same line, a check valve is required between each unit and the manifold.

AFTERCOOLER (Figure 2-6) – An aftercooler will provide control of moisture entering the shop air lines while reducing the normal low discharge temperature of about 170^{o} F. at 100 PSIG discharge to near inlet conditions.

When an aftercooler is used, it is to be installed between the auxiliary air receiver and the compressor discharge. A moisture separator is to be mounted between the aftercooler and the auxiliary air receiver with a condensate drain provided at bottom.

For complete installation and maintenance instructions on any accessory equipment, refer to the manufacturer's bulletin included in the unit data package.

CONTROL PIPING – Control piping is not necessary since the Electra-Screw® unit is factory wired and piped for the control system specified.

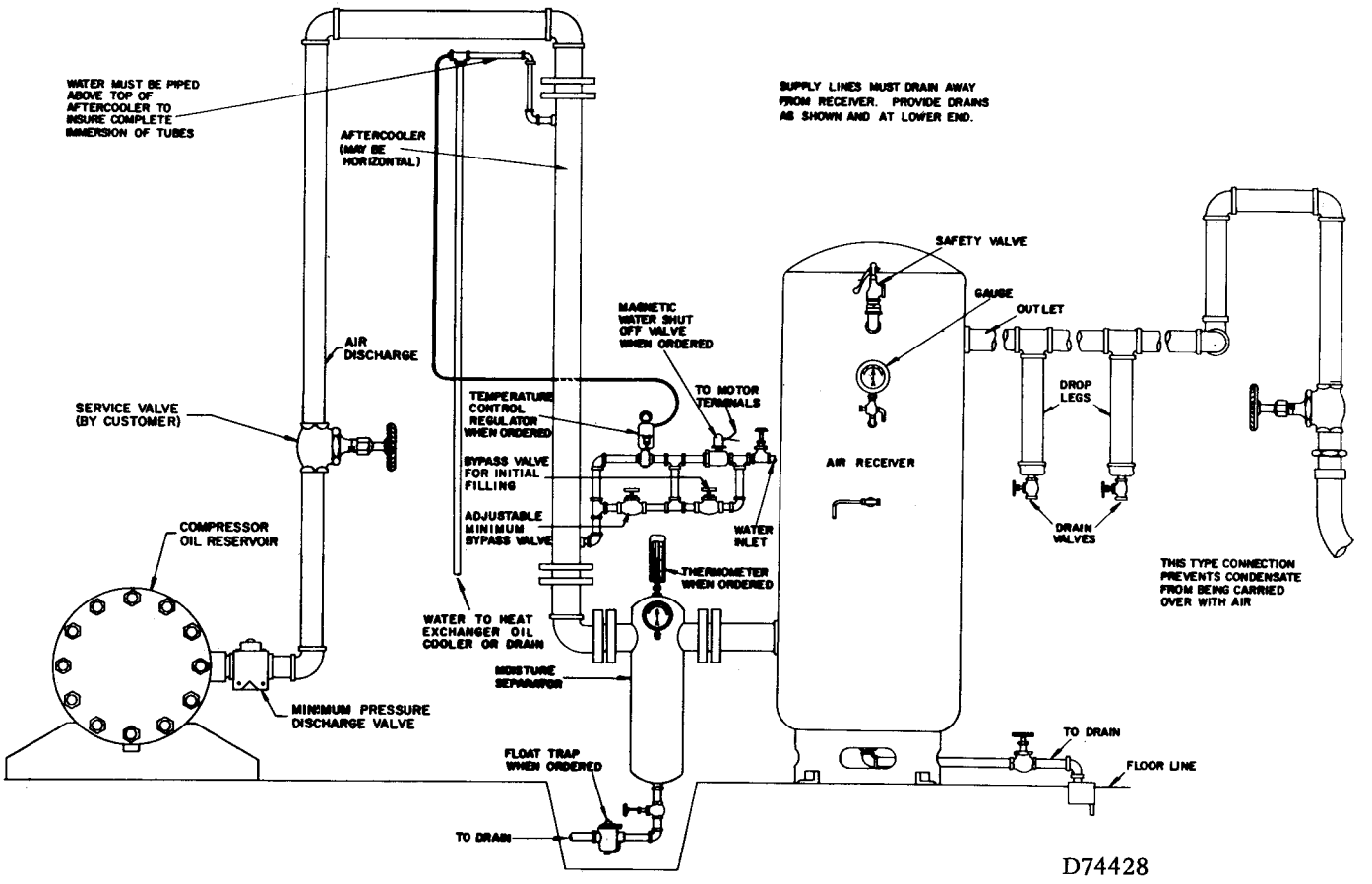


FIGURE 2-6. – AUXILIARY ACCESSORIES

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 construction 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. 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.

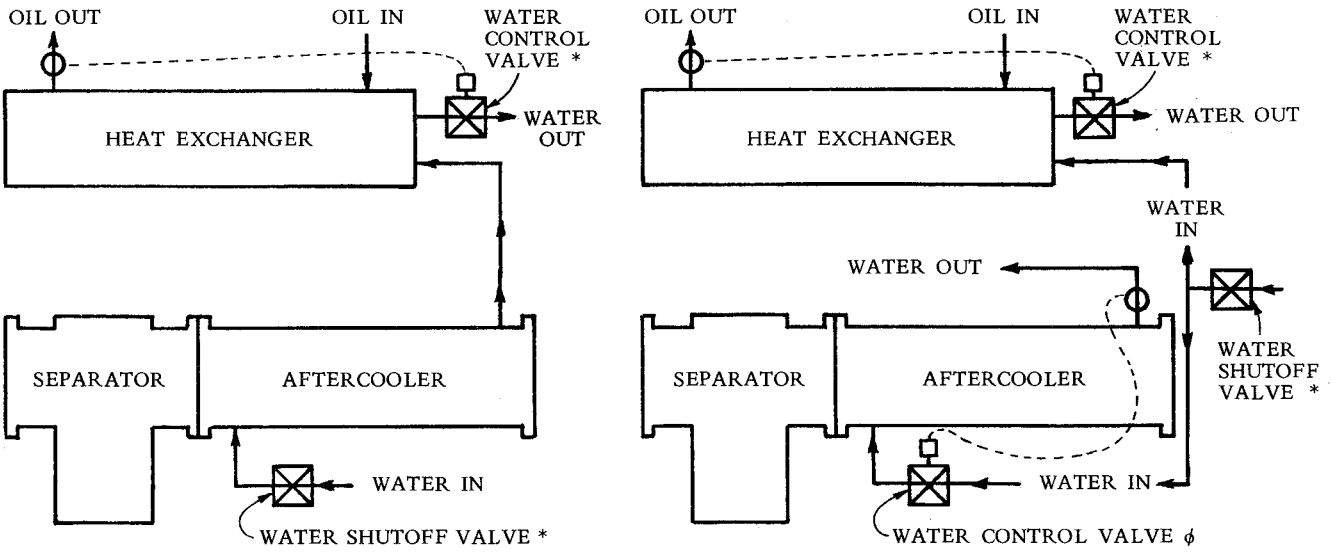
DISCHARGE SERVICE LINE – The discharge service line (minimum pressure valve) is normally located in the air receiver section of the oil reservoir on the side opposite the control panel. The service line may be attached to the control panel side of the reservoir by relocating the minimum pressure valve to this side. **Any service line connection to the air receiver section of the oil reservoir must be made through the minimum pressure valve and should contain a full closing service valve.**

BLOWDOWN VALVE PIPING – The blowdown valve is fitted with a silencer for operation indoors. If the installation requires, the silencer may be removed and the blowdown valve piped to the outside with pipe size the same as the blowdown valve outlet connection.

DO NOT REMOVE THE ORIFICE FITTING JUST UPSTREAM OF THE SILENCER.

WATER PIPING (Water-Cooled Heat Exchanger Models Only) – On machines equipped with a water-cooled heat exchanger, pipe water to the magnetic water shutoff valve mounted in the water inlet piping to the heat exchanger. Pipe outlet water from the water flow control valve to a sump or drain.

Aftercooler – Heat Exchanger Water Piping (Figure 3-6) – If an aftercooler is used and piped in series with the heat exchanger, remove the magnetic water shutoff valve from the compressor unit and relocate in the water inlet line upstream



SERIES PIPING – WATER FLOW MUST BE THROUGH AFTERCOOLER FIRST FOR EFFECTIVE COOLING OF DISCHARGE AIR.

PARALLEL PIPING – TWO WATER CONTROL VALVES REQUIRED FOR TEMPERATURE CONTROL.

* FURNISHED BY GARDNER-DENVER COMPANY.
ϕ MUST BE ORDERED SEPARATELY.

FIGURE 3-6. – PIPING DIAGRAM FOR AFTERCOOLER AND HEAT EXCHANGER

of the aftercooler. Pipe the aftercooler outlet water to heat exchanger on the compressor unit. If the aftercooler is piped in parallel with the heat exchanger, provide a separate magnetic water control valve for the aftercooler and pipe separate inlet water lines to both the aftercooler and heat exchanger.

The water source should be capable of supplying up to 50 gallons per minute at 40 PSIG minimum pressure; maximum water pressure should not exceed 150 PSIG. Maximum allowable water inlet temperature is +95° F.; operation at this maximum temperature will require up to 10 GPM more water flow than that shown for 90° F. water in Figure 4-6. Water outlet temperature should be held to +105° F. Maximum water outlet temperature is 110° F.

The water flow rates shown in Figure 4-6 are approximate and a guide to sizing pipe, cooling towers or other water system equipment. The machine should not be operated at pressures and water inlet temperatures where blanks exist in the table as heat exchanger fouling and/or oil cooling problems are likely to occur at these border-line conditions.

The water control valve is to be adjusted to maintain oil out of the heat exchanger within the 130°-140° F. range regardless of inlet water flow or temperature. See Section 3 for adjustment instructions.

ELECTRICAL WIRING – The Electra-Screw® unit 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 2 for wiring diagrams of the control system of your unit. The standard unit is supplied with an open drip-proof motor, a NEMA I starter enclosure and a dust resistant control enclosure.

FIGURE 4-6. – APPROXIMATE WATER FLOW (U.S. Gallons/Minute)

Model	Service Pressure PSIG	55° F. Water In 130° F. Oil Out	70° F. Water In 130° F. Oil Out	90° F. Water In 130° F. Oil Out
ESG (30 HP) Min. Flow 2.2 gpm Max. Flow 18.0 gpm	80	2.3	3.3	7.7
	100	2.8	4.1	9.4
	110	3.0	4.4	10.3
	125	3.5	5.0	11.6
	150	4.0	6.0	13.7
ESH (40 HP) Min. Flow 2.2 gpm Max. Flow 18.0 gpm	80	3.2	4.6	10.9
	100	3.8	5.4	12.8
	110	4.1	5.8	13.8
	125	4.5	6.5	15.2
	150	5.2	7.5	17.5
ESJ (50 HP) Min. Flow 5.6 gpm Max. Flow 31.0 gpm	80		6.2	14.5
	100		6.8	16.0
	110		7.3	17.0
	125	5.6	8.2	18.7
	150	6.5	9.4	22.0

NOTE: Where blanks occur in the table, water flow is below minimum recommended.

SECTION 7
STARTING & OPERATING PROCEDURES

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** – Fill the oil reservoir with the proper amount and grade of oil recommended in "Compressor Lubricants" (Section 3). Do not mix different type oils.

   Initial fill, or filling after a complete draining of the system, will show the oil level beyond 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 ON LOAD range when the unit is operating (spread of the ON LOAD range is approximately 2 U.S. gallons). ALWAYS STOP THE UNIT AND RELEASE AIR RECEIVER SECTION PRESSURE TO ADD OIL. During unloaded operation and after shutdown, the system will partially drain back into the oil reservoir and the oil level may read in EXCESS OIL range. DO NOT DRAIN OIL TO CORRECT; on the next loaded cycle or start, oil will again fill the system and the gauge will indicate operating level.

2. **Air Filter** – Inspect the air filter to be sure it is clean and tightly assembled. Refer to Section 4 "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 5 "Coupling" for procedure.

4. **Piping** – Refer to Section 6 "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 2 "Controls and Instruments" for general wiring diagrams.

6. **Rotation** – Check the motor rotation by momentarily starting the motor. Compressor drive shaft rotation is counterclockwise standing at the motor end.

7. **Operating Light Test** – Observe operating lights at the ON-OFF switch 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 2 "Controls and Instruments" for procedure. Check the high pressure shutdown switch setting (165 PSI maximum).

9. **Operating Mode** – Refer to Section 2 for detailed information on the control system with which your unit is equipped (Constant Speed, Automatic Start-Stop, Dual, or Duomatic).

STARTING UNIT – Constant Speed and Automatic Start-Stop units require only pressing of ON push button. Dual Control units require pressing of constant speed (CON) push button or automatic start-stop (AUTO) push button as desired. Duomatic control units require setting of the timer (constant speed, set in center of space between 30 and 0; automatic start-stop, set desired time between 0 and 30) and pressing of ON push button. **OBSERVE UNIT COLD OR UNIT HOT STARTING PROCEDURES.**

Unit Cold – If discharging into a pressurized air system, close the air service valve between the main air system and the unit minimum pressure discharge valve. If the unit is a water-cooled heat exchanger model, open any manual water inlet valves wide open. Start the unit and run for one 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. If the unit is water-cooled heat exchanger model, open any manual water inlet valves wide open. Start unit. Open the air service valve.

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

STOPPING UNIT

Unit Operating On Constant Speed – Close the air service line valve, allow the unit to build up to full unloaded pressure and press the OFF push 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 air service valve to remove pressure from air receiver section.

Unit Operating On Automatic Start-Stop – If the unit is operating, close the air service line valve, allow the unit to build up to full receiver pressure and stop automatically, then press OFF push button. Stopping the unit at a pressure below full

receiver may cause oil carry-over. If the unit is stopped because of full receiver pressure or stopped on unloaded time cycle, press OFF push button. On water-cooled heat exchanger units, close any manual water inlet valves. Open air service valve to remove pressure from air receiver section.

SECTION 8
MAINTENANCE SCHEDULE

SERVICE CHECK LIST

Air Filter – Because operating conditions determine frequency of service, refer to Section 4 "Air Filters" and plan maintenance accordingly.

Every 8 Hours Operation

1. Check the reservoir oil level – add oil if required. If oil consumption is high, refer to "Compressor Oil Separator" in Section 3.
2. Observe if the unit loads and unloads properly.
3. Drain the moisture traps on separate air receiver and moisture separator (if used).
4. Drain the filter in the oil return line (see Figure 1-3).

Every 125 Hours Operation

1. Check for dirt accumulation on radiator-type oil cooler core faces. Blow off dirt if accumulation is excessive.

Every 1000 Hours Operation

1. Change the oil filter element.
2. Change the compressor oil if using an SAE grade oil. UNDER ADVERSE CONDITIONS, CHANGE MORE FREQUENTLY (refer to "Oil Change Interval" in Section 3). Flush system if required.

Every 2000 Hours Operation

1. If using automatic transmission fluid, change compressor oil. UNDER ADVERSE CONDITIONS, CHANGE MORE FREQUENTLY (refer to "Oil Change Interval" in Section 3). Flush system if required.
2. Clean the filter in the oil return line. Clean the magnetic plugs in the oil reservoir.

Every 4000 Hours Operation

1. Replace the oil separator element. If the unit is equipped with the optional pressure differential gauge, change the element at 8 PSI differential. *NOTE: More frequent replacement of separator element may be required; refer to "Compressor Oil Separator" in Section 3.*

SECTION 9
TROUBLE SHOOTING

IF UNIT FAILS TO START, check the wiring system for wrong lead connections; check pressure and temperature shutdown circuit breakers on the control panel; check the fuse in the control enclosure; check motor starter overload heaters.

UNIT STARTS BUT STOPS AFTER A SHORT RUN, check for: high discharge pressure switch setting (165 PSIG Max.); high air discharge temperature caused by low compressor oil level, clogged oil cooler or oil filters, thermostatic mixing valve stuck, dirt on oil cooler core faces, unit operating in an area with poor ventilation, oil control valve stuck, water control valve inoperative, magnetic water shutoff valve inoperative; check the pressure and temperature shutdown circuit breakers on the control panel; check the fuse in the control panel enclosure; check motor starter overload heaters.

COMPRESSOR DOES NOT UNLOAD, check: magnetic unloader or pressure switch for malfunction; control lines for restriction; air leaks in control system; inlet valve stuck; pilot or pressure switch adjustment; pilot for dirt or leaking diaphragm.

UNIT FAILS TO SHUT DOWN ON START-STOP SYSTEM, check: control for malfunction, control lines for restriction or leaks; pressure switch for dirt or leaking diaphragm; wiring and tubing to pressure switch.

SOLENOID BLOWDOWN VALVE CONTINUES TO PASS AIR, check for: loose wiring to the blowdown valve; coil failure. Inspect the blowdown line check valve at the compressor oil sump for dirt or moisture (Duomatic control only).

EXCESSIVE OIL CONSUMPTION, check for: oil carry-over through the discharge line caused by overfilling the reservoir; clogged, broken or loose oil return lines; oil return lines connected incorrectly to the orifice block; ruptured oil separator element, either agglomerator or second stage screen; oil separator second stage inner screen element corrugations not in vertical position; defective separator flange gaskets; sealing of separator elastic stop nut and neoprene faced washer; faulty reservoir check valve seat gasket; loose assembly; incorrect oil causing foam; oil leaks at all fittings and gaskets; operation below minimum pressure (65 PSIG); inoperative minimum pressure valve.

COMPRESSOR LOW ON DELIVERY AND PRESSURE, check for: clogged air filter; restricted inlet valve; broken inlet valve spring; binding inlet valve piston; incorrect motor speed; pilot adjustment and/or malfunction.

SECTION 10
COMPRESSOR OVERHAUL

ELECTRA-SCREW® COMPRESSOR DISASSEMBLY AND ASSEMBLY procedures are explained in the text. Some models have a different or supplementary procedure which is listed following the general instructions for that step. Illustrations have been taken from various sizes of Electra-Screw® compressors. Minor variations in construction will be noted, but should not cause concern; all significant differences are covered by the text.

DISASSEMBLY INSTRUCTIONS

Pull the main breaker switch. Remove tubing from the inlet valve to magnetic unloader (Duomatic control model only). Provide a temporary support for the control panel and remove the control panel bracket to inlet valve plate screws. Remove the air filter, inlet valve and inlet valve plate. Remove the discharge manifold, oil lines and tubing as required to remove the compressor from reservoir base. Cover the air filter and all openings of the reservoir and lines to keep out dirt. Remove the fan guard and fan from the radiator-type oil cooled units. Remove the coupling guard. Remove the compressor from the oil reservoir. Remove coupling hub from the compressor drive shaft. Remove the key from keyway and inspect the shaft for and remove any burrs.

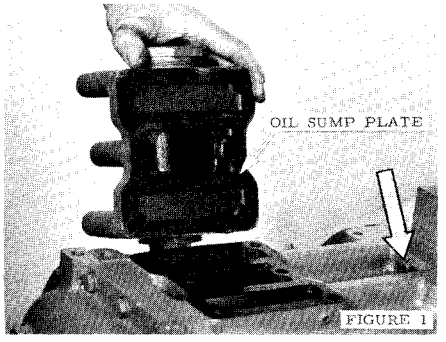


FIGURE 1

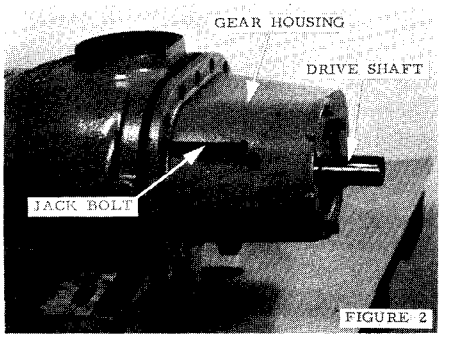


FIGURE 2

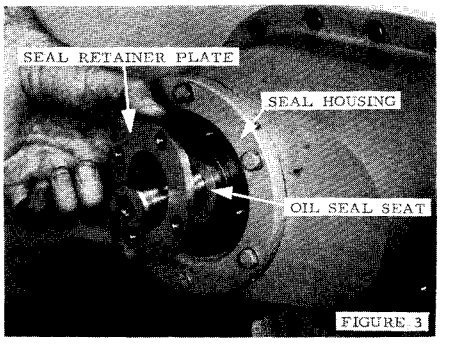


FIGURE 3

1. Place the compressor upside down and remove the oil sump plate, Figure 1. Remove the one (1) cylinder flange to discharge end plate socket head screw (see arrow).

2. Block the compressor upright, Figure 2. Remove all gear end cover to cylinder cap screws. With two (2) jack bolts – one each side, Figure 2, jack the cover from the dowel pins. Tighten jack bolts evenly to prevent binding on the dowel pins and damage to the gears. Remove cover with care. Drive shaft assembly with drive gear, shaft seal and bearings will slide off with the gear cover; driven gear will remain on the main rotor shaft.

   If the drive gear and/or drive shaft bearings are to be replaced, proceed with Steps 3 and 4. If repairs are not required, go to Step 5.

3. Remove the seal retainer plate and oil seal seat, Figure 3. Remove the seal housing and tap the drive shaft assembly through the seal housing bore using a piece of hard wood against the shaft end, Figure 3A. Drive shaft bearings are a light press fit in the housing bores.

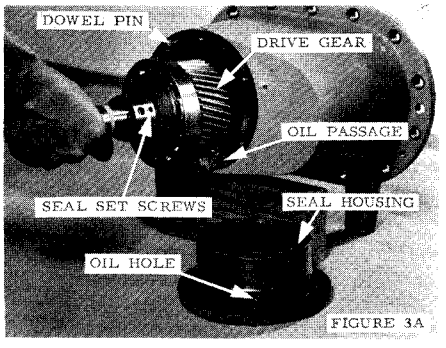


FIGURE 3A

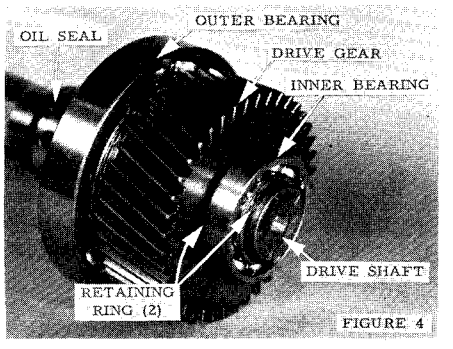


FIGURE 4

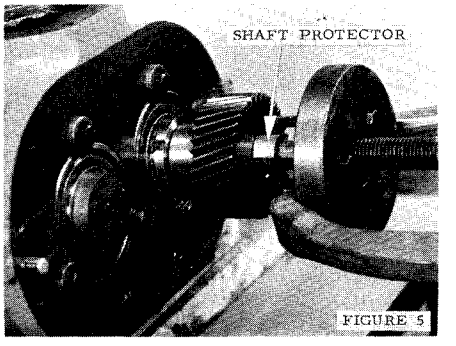


FIGURE 5

4. Be sure there are no burrs on the drive shaft or keyway to damage the seal. Loosen the set screws in the seal body and slide the seal from the shaft. Protect the carbon face of the seal if it is to be reused. Remove the outer (bearing) retainer ring from the shaft and pull the small ball bearing, Figure 4. Remove the inner (gear) retaining ring. Pull or

press the drive gear from the shaft; tapped holes are provided on the gear face for this operation. Do not pull directly on the drive gear if it is to be reused, as damage to the teeth will result. Pull or press the large ball bearing from the shaft toward the drive end. If the bearing is to be reused, pull or press against inner race only.

5. Remove the driven gear retaining plate, Figure 5. With a puller rigged as shown, pull the gear from main rotor shaft. *NOTE: If the gear is to be reused, pulling directly on gear will damage teeth. Use a shaft protector to prevent damage to end of the rotor shaft.*

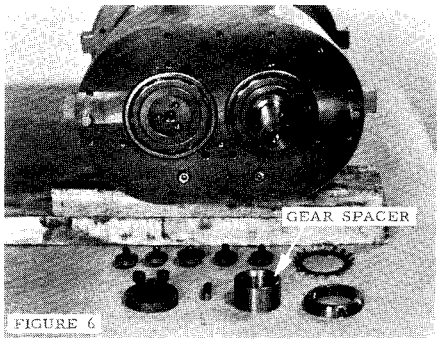


FIGURE 6

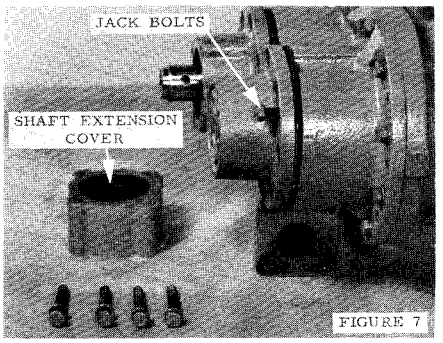


FIGURE 7

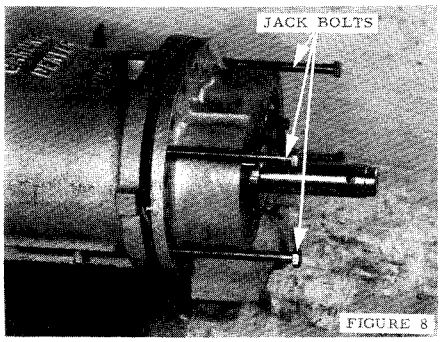


FIGURE 8

6. Remove the gear spacer, bearing locknut and washer, bearing retainer plate and five (5) outer race retainer screws and washers, Figure 6.

7. **If Water-Cooled Model** – remove the shaft extension cover, Figure 7.

   If Fan-Cooled Model – remove the fan hub from shaft extension; hub is held in place by a straight pin. Remove the seal retainer and oil seal seat.

   For Either Model – remove all bearing cover to discharge end plate screws. With two (2) jack bolts, Figure 7, pull the bearing cover from dowel pins. Tighten jack bolts evenly to prevent binding on dowel pins (and damage to shaft seal if fan-cooled model). Remove bearing outer race shims from bearing bore.

   If Fan-Cooled Model – check shaft for and remove any burrs, then remove seal and seal spacer.

8. Remove all discharge end plate to cylinder screws. *(Note: See arrow in Figure 1.)* With four (4) jack bolts, Figure 8, pull the end plate, fixed bearings and rotors from cylinder as an assembly. This will pull rotor shafts through bearings at inlet end. Take care that the bearings do not fall from inner race. Be careful not to burr rotors or cylinder during this operation.

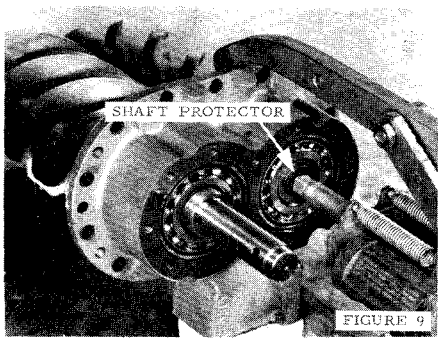


FIGURE 9

9. Remove the bearing retainer plate and bearing locknut from rotor shafts. With a puller rigged as shown, Figure 9, or if a press is available, press the rotors through bearings and discharge end plate. Handle parts carefully to prevent burrs.

   Remove the bearings from discharge end plate and from the inlet end of the cylinder. Remove with care to prevent damage to bore through end plate. A close running fit to rotor shaft is provided and burrs in the bore may cause rotor shaft to end plate seizure.

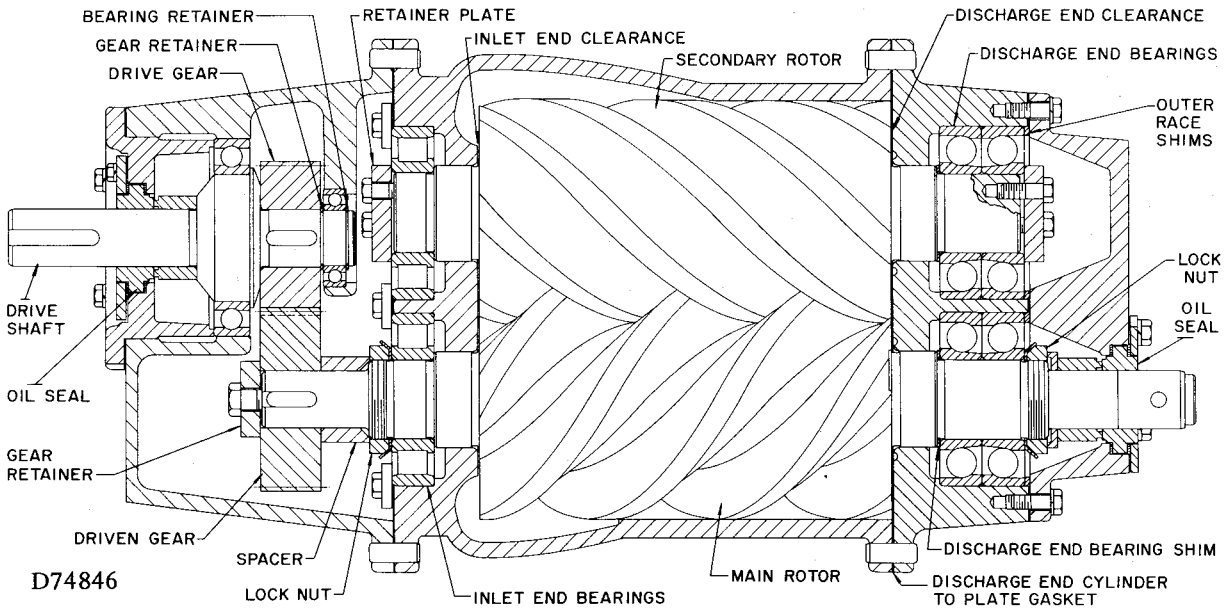
   If the bearings are to be reused, keep them matched as originally assembled. *NOTE: Never reuse worn bearings.*

ASSEMBLY INSTRUCTIONS

The Electra-Screw® compressor is manufactured with close tolerances for efficient operation. All parts must be handled carefully to prevent burrs which will give false tolerance readings and/or cause rapid wear. All parts and oil passages must be thoroughly cleaned of dirt which will cause galling of close running parts. Clean work area, washing tank, tools and wiping rags must be provided. Refer to the sectional view for a complete assembly of the parts.

The measurements and procedures described in the following steps must be done accurately for an efficient and quiet operating compressor. The measurements establish total rotor end clearance (inlet end plus discharge end) and fix the rotor in position to give the correct discharge end clearance.

Angular contact bearings and shims hold these close clearances when they are locked in position. Other clearances, such as rotor O.D. to cylinder, do not require measurement or setting since they are controlled by close manufacturing tolerances. As a general rule, if the assembled compressor turns freely, without drag or tight spots, proper clearances have been established within the machine.



SECTIONAL VIEW OF COMPRESSOR

SCREW TORQUE TIGHTENING RECOMMENDATIONS – All screws on the compressor should be tightened to the torque values shown in the table below to insure a correctly assembled and leak-free machine.

All hex head cap screws used on Gardner-Denver Rota-Screw® and Electra-Screw® compressors are SAE Grade 5. Grade 5 hex head cap screws are identified by the three raised lines on the head: 

All socket (Allen) head cap screws are SAE Grade 8.

The torque values shown in the table are to be used only with the appropriate grade and type of screw. Tightening a Grade 5 screw to a Grade 8 torque could result in screw breakage; tightening a Grade 8 screw to a Grade 5 torque will result in a loose assembly.

	SAE Grade 5 Hex Head Cap Screw			**SAE Grade 8** Socket Head Cap Screw		
Screw Size	Plain	With Nylok Insert	Maximum	Plain	With Nylok Insert	Maximum
1/4 - 20 UNC	8.5	11	11	12	14.5	15.5
5/16 - 18 UNC	17	22	23	24	29	32.5
3/8 - 16 UNC	31	38	41	44	51	58
7/16 - 14 UNC	50	58	66	70	78	93
1/2 - 13 UNC	75	88	100	105	118	140
9/16 - 12 UNC	108	125	145	152	169	205
5/8 - 11 UNC	150	175	200	210	235	280
3/4 - 10 UNC	260	293	350	365	398	490
7/8 - 9 UNC	400	450	530	615	665	800
1 - 8 UNC	590	660	785	915	982	1210

All **Torque Values** shown are in **Foot-Pounds** and are based on clean, dry parts without burrs. The use of plated screws, lubrication, etc. will reduce torque values as much as 20% and must be taken into consideration.

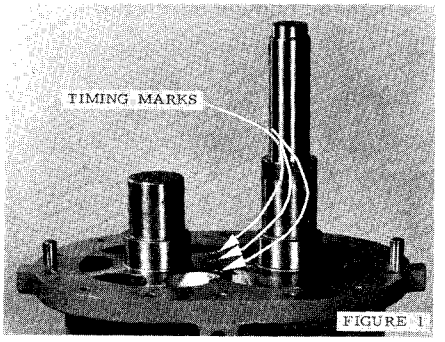


FIGURE 1

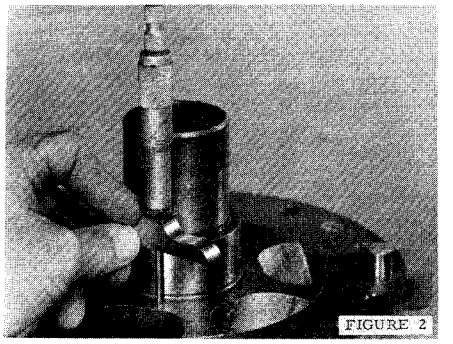


FIGURE 2

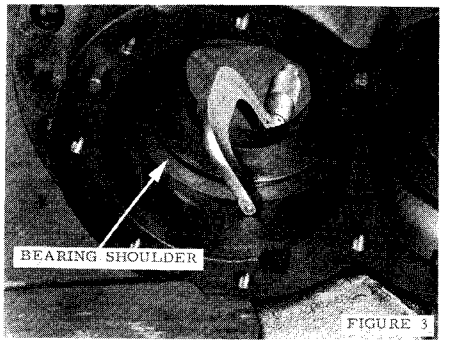


FIGURE 3

1. Stand the cylinder on blocking high enough to clear the main rotor shaft extension. Check in the bottom of the cylinder and cylinder walls for burrs. Coat both bores, bottom of cylinder and walls with oil. Check ends, lobes and cavities of rotors for burrs. Coat rotors with oil. Lower rotors into the cylinder. The main rotor is installed with the shaft extension with keyway down. The secondary rotor is installed with the shortest shaft extension down. Make sure the timing marks on the ends of the rotors line up, Figure 1. Timing marks are also rotor pair identification marks. Rotors must be matched pairs for proper operation. DO NOT INTERMATE ROTORS WITH DIFFERENT TIMING-IDENTIFICATION MARKS. Rotate the rotors to be sure they rest squarely in the bottom of the cylinder.

2. With a depth micrometer measure from the shoulder of the shaft to end of rotor, Figure 2. Make this measurement on both rotors and record each measurement under main rotor and secondary rotor.

3. With 0-2" outside micrometer, measure from flat side of the discharge end plate to the shoulder in each bearing bore, Figure 3, match and record with measurement made on main and secondary rotors in Step 2. These measurements are to be used later.

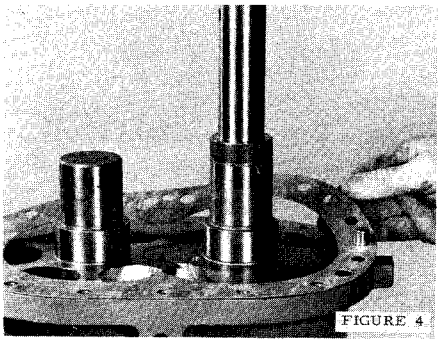


FIGURE 4

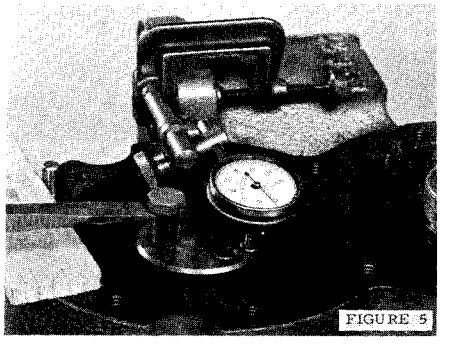


FIGURE 5

CLEARANCE CHART – UNIT COLD

Total End Clearance (Inlet + Discharge)	.010-.028
Inlet End Clearance	.008-.022
Discharge End Clearance	.002-.006

4. Lay the fiber gasket on the face of the cylinder – make sure the contour of the gasket matches the cylinder, Figure 4.

5. Lower the discharge end plate in place and tighten all plate to cylinder screws. Discharge port on the end plate is to be on opposite side of cylinder from inlet opening. Pull screws up evenly to prevent damage to the dowel pins.

   Mount an indicator with the button on end of either rotor shaft; set needle on zero (Figure 5). Pry the rotor up until it hits end plate and note if indicator reading falls within total end clearance range in clearance chart (.010-.028). Make same check on other rotor. Due to machining tolerances at the inlet end of the cylinder, there may be up to .010" variation in the indicator reading of the two rotors. The indicator reading of either rotor should not be less than minimum total end clearance.

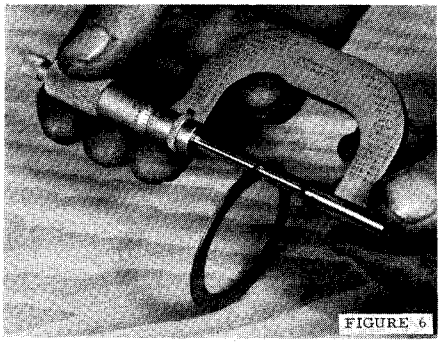


FIGURE 6

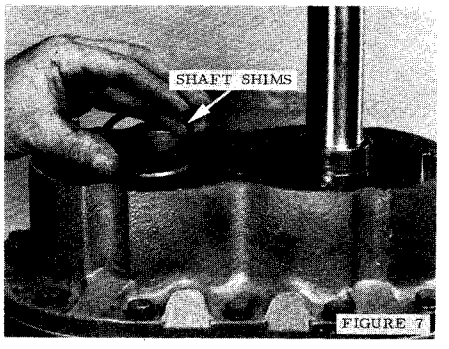
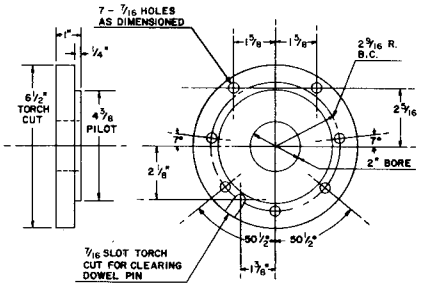


FIGURE 7



PRESS PLATE FOR INSTALLING DISCHARGE END BEARINGS
BEARING COVER PLATE GASKET (DISCHARGE END) CAN BE USED AS TEMPLATE FOR LAYOUT

SKETCH "A"

6. *NOTE: Rotor end clearance at the discharge end is most important and is established by use of shims between the bearing and rotor shaft shoulder to position the end of rotor a proper distance from the end plate. Steps 6, 7, 8 and 9 must be performed carefully.*

   To determine amount of shaft shims needed to position the rotors to give correct discharge end clearance, subtract the shaft shoulder dimension, Step 2, from end plate dimension, Step 3. To this sum add .003" for rotor end running clearance.

   EXAMPLE: End plate dimension 1.124" minus shoulder dimension 1.101", plus end clearance .003" equals a shim set thickness of .026".

   Check shim thickness with an outside micrometer, Figure 6.

   NOTE: The discharge end bearings have a built-in axial play of up to .003". A set of bearings with minimum tolerance may have no axial movement and will hold .003" discharge end clearance, less a minute amount for shim crushing. A maximum tolerance set may have up to .003" axial movement and maximum discharge end clearance will be .006". In either case, the closest the rotors will approach the end plate is .003", less the shim crush. In operation the air pressure moves the rotors toward the inlet end of the compressor and a maximum discharge end running clearance is obtained. This variation accounts for the .002" to .006" tolerance range for the discharge end, which is checked in Step 11.

7. Determine the shaft shim set for each rotor and install over the rotor shaft and against the shoulder, Figure 7. Be sure to apply dimensions and shims for the main rotor to the main rotor shaft, and those for the secondary rotor shaft to the secondary rotor shaft. DO NOT INTERCHANGE.

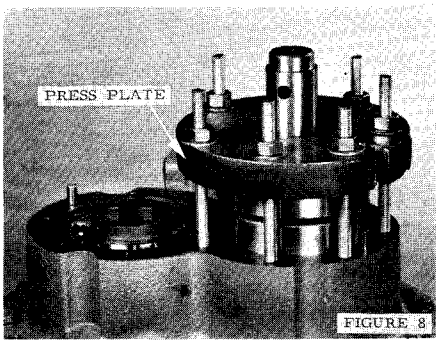
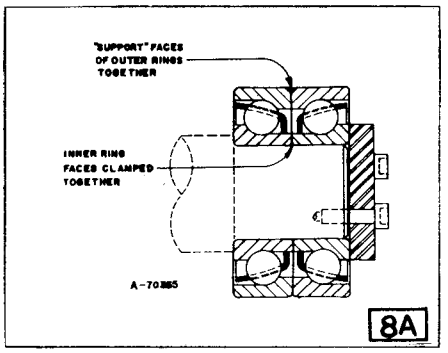


FIGURE 8



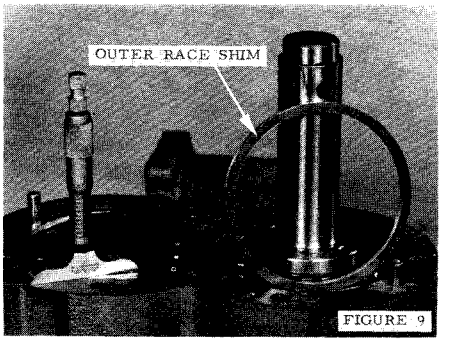


FIGURE 9

8. For ease of bearing assembly, lightly coat the bearing bore and shaft extension with "Moly" type grease. Using the adaptor plate (Sketch A) assembled as shown in Figure 8, press the discharge end angular contact bearings in place. Assemble the adaptor plate with the pilot side down so the bearing can be pressed to the bottom of bore. ASSEMBLE BEARINGS IN END PLATE IN POSITION SHOWN IN FIGURE 8A. Faces marked "SUPPORT" go together. This gives a fixed bearing, holding the rotors in a fixed position.

   NOTE: Do not drive any bearing in with a hammer and drift as damage to the bearings may result, leading to early bearing failure. Be sure the bearing is started in the bore evenly and the nuts on press bolts are tightened progressively to prevent cocking of the bearing.

   If a press is used, provide an adaptor plate that catches both inner race and outer race to press the bearing in place. Observe disassembly tags so the bearings go back in the same relation if original bearings are used. Never use worn bearings. OIL BEARINGS THOROUGHLY.

9. Install the bearing retainer with three (3) Nylok screws on the secondary rotor. Install the lock washer and nut on the main rotor and pull up tight. Tightening retainers pulls the rotor shaft through the bearing until the inner race jams shims against the shaft shoulder; this provides a fixed bearing to hold rotor end clearance. Place the cover plate gasket with notches matching oil passage, on the end plate. Tap the end of rotor to be sure the bearing outer race is against the shoulder in the bore. Place the outer race shim in the bearing bore against the outer race. With a depth micrometer check height of the shim in relation to the gasket surface, Figure 9. Peel the shim until it is .002" below the surface of the gasket. Always use a new gasket that has never been crushed. If the shim is more than the correct .002" below the face of gasket, bearing will move in the bore, and end of the rotor may strike the end plate.

9A. **FOR FAN-COOLED MODEL ONLY** – Check the face of the bearing locknut for burrs to provide a square face for the seal spacer. Check shaft for burrs and install the seal spacer with counterbore side towards the bearing locknut. Install the seal with care so the teflon I.D. or carbon face is not damaged, Figure 9A. Tighten four (4) socket head set screws in the seal.

10. Install the bearing cover plate, shown in Figure 11, and pull up tight. With a feeler gauge check the rotor end clearance of both rotors at the inlet end, Figure 10. Refer to clearance chart for correct value. Due to machining tolerance

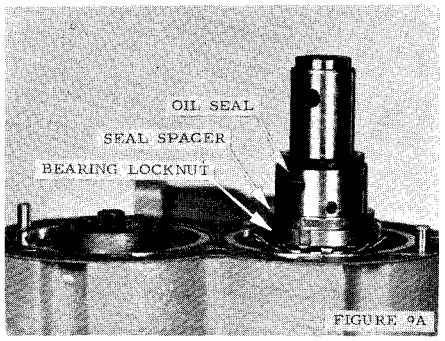


FIGURE 9A

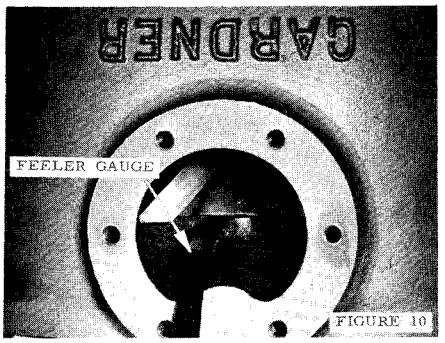


FIGURE 10

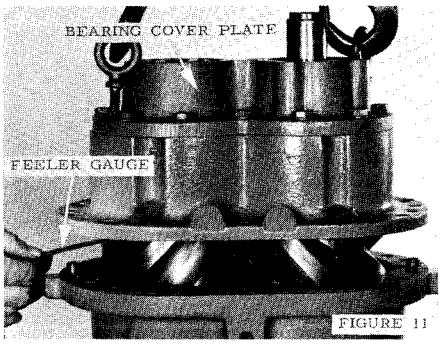


FIGURE 11

at inlet end of the cylinder, rotors may vary in inlet end clearance up to .010". Do not allow clearance below the minimum listed in clearance chart. Cover the inlet opening to keep out dirt.

11. Before continuing with assembly, check the rotor end clearance at discharge end using this procedure:

(a) Remove all end plate to cylinder screws.
(b) With four (4) jack bolts, pull end plate and rotor assembly (complete) from the cylinder dowel pins.
(c) Lift assembly from the cylinder approximately 2".
(d) With feeler gauge check clearance between the end of the rotors and the end plate, Figure 11.

Check both rotors. Refer to clearance chart for correct value. Since the lower end of the rotors are not yet held by bearings, there may be a slight out-of-square condition noticed in this check. Lower the end plate and rotor assembly into the cylinder and bolt tight. Torque all fourteen (14) screws per table on page 3, this section. When tightening and torquing, follow the pattern shown in Figure 11A. See Figure 1 in "Disassembly" for screw on reverse side of the cylinder flange.

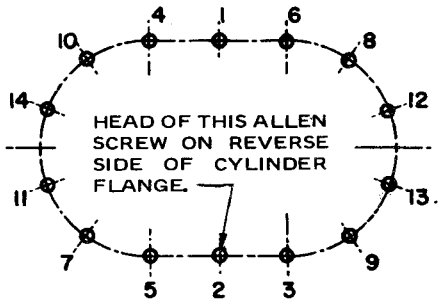


FIGURE 11A.

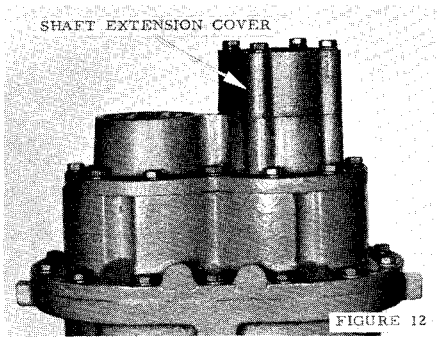


FIGURE 12

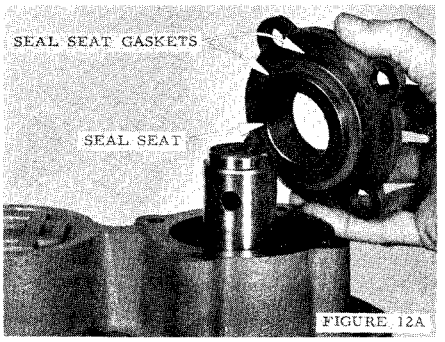


FIGURE 12A

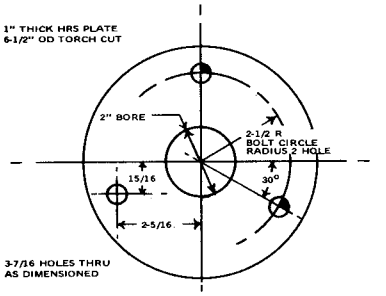
12. **IF WATER-COOLED MODEL** – Install the shaft extension cover and gasket, Figure 12.

12A. **IF AIR-COOLED MODEL** – Wipe carbon face of the seal and polished face of the seat with a soft, clean cloth to remove dust and dirt. **Polished side** of the seat must go next to the carbon face of seal. Place gasket on each side of the seat, Figure 12A, and install, with retainer plate over the shaft. Use care not to damage carbon face of seal. Tighten four (4) screws evenly – torque per table. The retainer plate will not pull up flush against the face of housing as it must clamp the seat and two gaskets to prevent oil leakage.

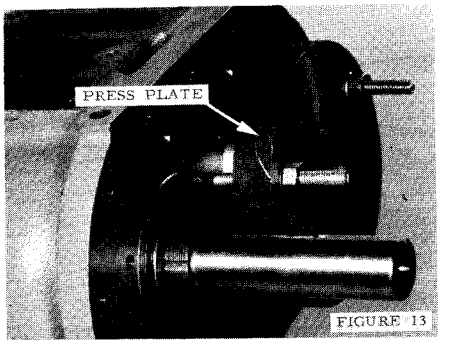
Install the fan drive hub on rotor shaft. It is recommended that a new roll pin be used.

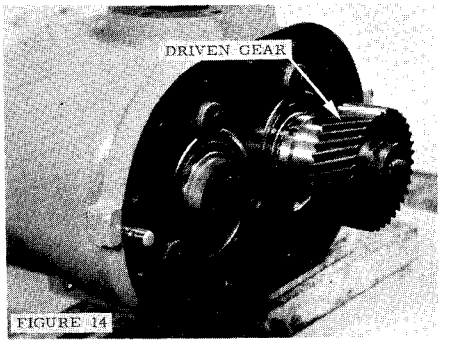
13. Place the assembly in a horizontal position on substantial blocking. Lightly coat the shafts and bearing bores at the inlet end with "Moly" type grease. Slip bearing inner race and roller assembly over the shaft; start outer race in the bearing bore, assemble press plate (Sketch B) as shown in Figure 13, and press the inlet end roller bearings in place. Tighten the nuts on press bolts evenly to prevent cocking of the bearing. If a press is used, provide an adaptor plate that catches both the inner and outer race to press bearings in place. Never use worn bearings. OIL BEARINGS THOROUGHLY. DO NOT DRIVE BEARINGS IN PLACE.

14. Install nut and lock washer on main rotor and pull up tight. Install the retainer plate and three (3) Nylok screws on the secondary rotor and pull tight. Install the five (5) Nylok screws and washers that hold the bearing outer races in place, Figure 14. Check the face of the bearing locknut for burrs to provide square face for gear spacer. Slide the gear spacer over the drive shaft with the counterbored side towards the locknut. Check the shaft and keyway for burrs and install gear key. Heat the driven gear to 250° F. in oil or electric oven – NEVER USE TORCH. Slip the gear on the shaft; be sure gear is installed with tapped holes facing out. Allow the gear to cool and install the gear retainer plate and screw. Be sure correct gear is used – see gear size data chart.



PRESS PLATE FOR INSTALLING INLET END BEARINGS – SKETCH B

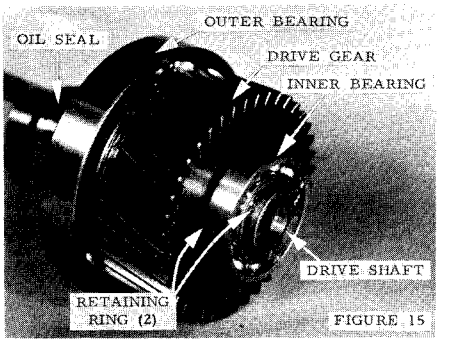




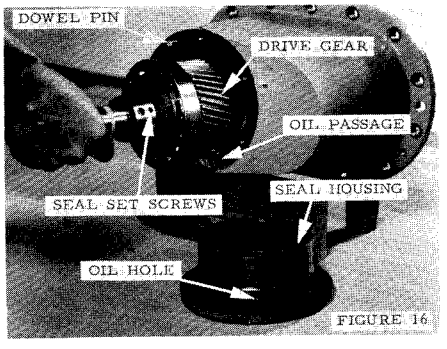
NOTE: If the drive gear or drive shaft bearings have been removed, proceed with Steps 15, 16 and 17. If the gear housing is completely assembled, go to Step 18.

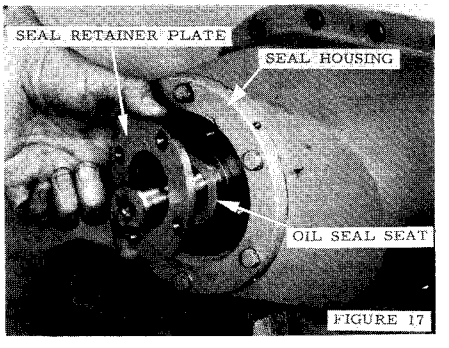
DRIVE AND DRIVEN GEAR SIZE DATA

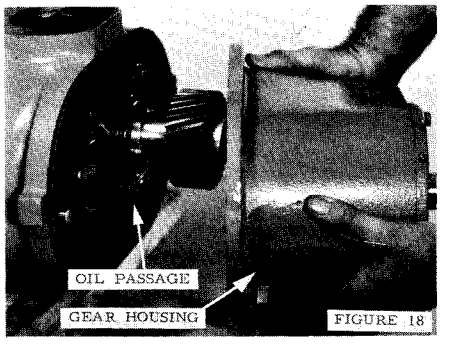
Model	HP	**Drive (Shaft) Gear** Compared To Driven Gear	**Driven (Main Rotor) Gear** Compared To Drive Gear
ESG	30	Smaller	Larger
ESH	40	Larger	Smaller
ESJ	50	Larger	Smaller



15. To reassemble gear housing and drive shaft, be sure shaft and keyways are free of burrs. Lightly coat the drive shaft with "Moly" type grease for ease of assembly and to prevent galling. Heat the bearings and drive gear to 250° F. in oil or an electric oven – DO NOT USE TORCH. Slip the large bearing on shaft up against the shoulder and allow to cool, Figure 15. Install the key in keyway and slip the drive gear on the shaft placing face of drive gear with tapped holes out. Be sure the correct gear is used, see gear size data chart. Install the inner retaining ring next to the drive gear. Slip the small bearing on shaft and install the outer retaining ring. Allow the assembly to cool. Install the oil seal tight against the shoulder of shaft with the carbon face of seal towards end of the shaft. Use care so the carbon face is not damaged. Tighten all seal set screws.







16. Lightly coat both bearing bores in the gear housing with "Moly" type grease for ease of assembly. Generously oil both bearings and drive gear with the same oil as to be used in the compressor system. Install the drive gear shaft assembly in the housing by lightly tapping into place, Figure 16. Use a clean hard wood block to prevent damage to end of the shaft. Be sure the bearings enter the bores squarely to prevent bearing damage. Rotate the assembly to be sure it turns freely. Install the seal housing and gasket. Dowel pin locates the seal housing and gasket for oil passage alignment.

17. Place the oil seal seat in bore with a gasket on each side of the seat, Figure 17. Polished face of the seat must go against the carbon face of seal. Be sure the seat and carbon face are clean. Install the seat retainer plate. Tighten four (4) screws evenly – torque per table. Retainer plate will not pull up flush against the face of the seal housing as it must clamp the seat and two gaskets to prevent oil leakage.

18. Place the gear housing gasket over dowel pins on face of the cylinder; check for oil hole alignment, Figure 18. Oil

the driven gear teeth with the same oil to be used in the compressor system. Install the gear housing over the dowel pins on the cylinder. Slight rotation of the drive shaft may be necessary to engage gear teeth. Tighten the housing screws evenly to prevent binding of gear teeth. Torque all screws following the pattern shown in Figure 11A.

19. Install the gasket and oil sump plate on the cylinder. Tighten all screws evenly – torque per table. Make sure the sump plate is installed with the oil inlet on the proper side as shown in Figure 19.

NOTE: If the compressor is not to be installed immediately, cover all openings to keep out dirt.

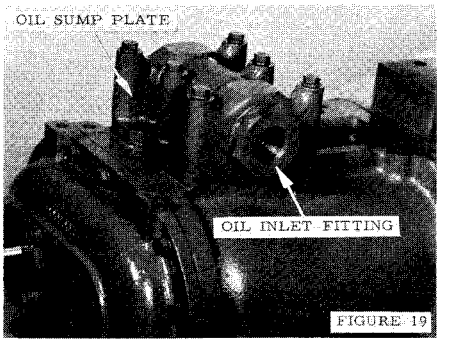


FIGURE 19

BEFORE INSTALLING THE COMPRESSOR ON THE OIL RESERVOIR:

1. Drain and clean the oil system, i.e., reservoir, oil cooler and oil lines. If excessive dirt is noticed, flush the system thoroughly.
2. Install a new oil filter cartridge.
3. Inspect the oil separator in the oil reservoir. Replace if necessary.
4. Inspect, and clean if necessary, the discharge check valve in the reservoir.

ALIGNMENT OF THE COMPRESSOR AND MOTOR:

1. Slip the coupling half on the compressor shaft extension approximately flush with end of the shaft and lock tight.
2. Place the compressor on the mounting pads of the oil reservoir and engage mounting screws.
3. Refer to "Coupling" Section 5 for alignment procedure.

MISCELLANEOUS:

1. Inspect the inlet housing and valve, clean and repair if necessary. Install with a new gasket.
2. Refer to "Air Filter" Section 4 before installing the air filter.
3. Install the instrument panel and connect all tubing and lines. Be sure all lines are connected properly; refer to Flow Diagram in Section 3.
4. Fill the system with oil; refer to Section 3 for oil specifications.
5. **If air-cooled model,** install the fan and fan guard.

DIMENSIONS		
Center of Main Bore to Center of Secondary Bore		4.634/4.636
Cylinder Bore Diameter	Main	6.033/6.038
	Secondary	5.565/5.570
Cylinder Length		10.260/10.265
Inlet End Bearing Bore Diameter		4.3302/4.3312
Inlet End Bearing Bore Depth		1.030/1.045
Inlet End Air Seal Bore Diameter		2.380/2.385
Discharge End Bearing Bore Diameter		4.3307/4.3312
Discharge End Bearing Bore Depth		2.234/2.236
Discharge End Air Seal Bore Diameter		2.380/2.381
Inlet and Discharge End Air Seal Bore Length, Rotor Side of Bore to Bearing Bore Shoulder		1.125/1.120
Rotor Body O.D.	Main	6.024/6.023
	Secondary	5.556/5.555
Rotor Body Length		10.272/10.270
Rotor Shaft Air Seal Diameter	Suction	2.375/2.370
	Discharge	2.376/2.375
* Rotor Shaft Air Seal Diameter Length	Suction	1.135/1.130
	Discharge	1.100/1.095
Rotor Shaft Bearing Diameter		1.9690/1.9686
* Rotor Shaft Bearing Diameter Length	Suction	1.00
	Discharge (Main)	2.06
Main Rotor Shaft Gear Diameter		1.4375/1.4370
* Main Rotor Shaft Gear Diameter Length		2.67
Drive Shaft Coupling and Seal Diameter		1.4375/1.4365
* Drive Shaft Coupling and Seal Diameter Length		4.68
Drive Shaft Outer Bearing Diameter		3.1502/3.1497
Drive Shaft Outer Bearing Diameter Length		0.86
Drive Shaft Outer Bearing Shoulder Diameter		3.47
Drive Shaft Inner Bearing Diameter		1.3785/1.3781
Drive Shaft Inner Bearing Length		0.554/0.552
Drive Shaft Gear Diameter		1.4525/1.4520
* Drive Shaft Gear Diameter Length		1.499/1.493

DIMENSIONS (Continued)		
Drive Shaft Gear and Inner Bearing Snap Ring Groove	Diameter	1.295/1.287
	Width	0.056/0.060
Drive Gear Bore		1.4510/1.4515
Driven Gear Bore		1.4360/1.4365
* Drive and Driven Gear Face Width		1.500/1.495
Gear Center Distance		3.999/4.001
Gear Case Seal Housing Bore		5.000/5.001
Gear Case Outer Bearing Bore		4.9207/4.9223
Gear Case Inner Bearing Bore		2.4405/2.4417
Gear Case Inner Bearing Bore Depth, From Face of Gear Case		5.477/5.482
Gear Case Width, Flange to Face		6.636/6.631
Seal Housing Pilot Diameter		4.999/4.998
Seal Housing Flange to Bearing Shoulder Depth		2.231/2.226
FITS		
Rotor Bearing Inner Race to Shaft		.0001T/.0010T
Rotor Bearing Outer Race to Bore	Suction	.0005T/.0011L
	Discharge	.0000 /.0011L
Drive or Driven Gear to Shaft		.0005T/.0015T
Drive Shaft to Coupling		.000 /.002L
Drive Shaft Outer Bearing	Inner Race to Shaft	.0001T/.0012T
	Outer Race to Housing	.0006T/.0018L
Drive Shaft Inner Bearing	Inner Race to Shaft	.0001T/.0010T
	Outer Race to Housing	.0004T/.0013L
Seal Housing Pilot to Gear Case		.001/.003
RUNNING CLEARANCES		
Rotor to Cylinder — Diametral — Main and Secondary		.009/.015
Rotor Interlobe — Perpendicular Flank to Flank		.005 Max.
End Plate to Rotor — Axial	Inlet	.003/.022
	Discharge	.002/.006
Air Seal — Diametral	Inlet	.005/.015
	Discharge	.004/.006
Gear Backlash		.003/.005

Dimensions in two (2) decimal places may vary $\pm$ .020.

* Includes any radii, chamfer or undercut.

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