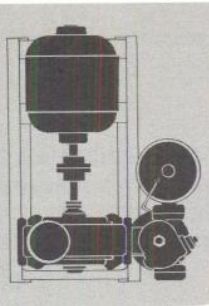
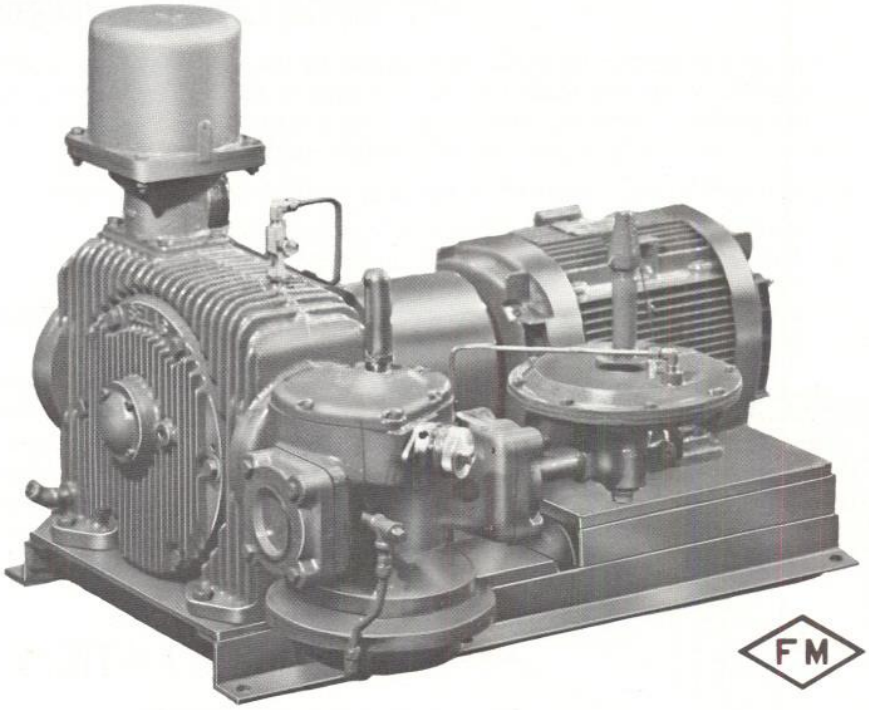
Instructions for INSTALLATION
OPERATION • MAINTENANCE

of the SELAS
COMBUSTION
CONTROLLER
SERIES 60-CA



ROTARY POSITIVE DISPLACEMENT TYPE



Rated Capacity
6000 cfh (170 m³/hr)
of Mixture

Actual capacity may
vary from 95 to 110%
of specified rating.

Pressure: 3 psig (21 kPa)

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selas®
The Heat Technology Company

SELAS HEAT TECHNOLOGY COMPANY LLC
130 KEYSTONE DRIVE, MONTGOMERYVILLE, PA 18936
TELEPHONE (215) 646-6600 • (800) 523-6500 • FAX (215) 646-3536

INTRODUCTION

The Selas Combustion Controller is a combustion delivery system wherein fuel gases are mixed with atmospheric air, in exact proportions, and pumped through flame arresters and control valves to industrial burners. The Mixing Valve automatically adjusts to flow demand thereby providing the same consistent combustible mixture, over a wide range of turndown, to every burner.

Functions of the various components are detailed in "Maintenance" instructions.

IMPORTANT
NOTE FOR USERS & INSTALLERS:

The Selas Combustion Controller is designed for use with combustible gases and should be applied only to its intended function. Proper installation, operation and maintenance are necessary to promote satisfactory operation.

Read carefully and adhere to manufacturer's instructions before installing or using; abide by all codes, government regulations and insurance requirements.

Because uncontrolled combustible mixtures are hazardous, it is extremely important that:

1. Combustion equipment be placed in a well-ventilated area.
2. The care of equipment be assigned to responsible people.
3. Routine maintenance checks be established and followed.
4. Before performing any maintenance operations involving machine disassembly, be certain that the fuel gas supply valve is closed and power supply is off.

The following instructions cover Selas Corporation of America Series 60-CA Combustion Controllers. Supplemental information such as the piping diagram and wiring schematic are provided only as reference data for typical combustion systems and are not to be construed as necessarily adequate without verification by a competent combustion specialist.

It is prudent to study these instructions before proceeding with installation.

Read and save any other instructions which are provided for specific apparatus.

Record all nameplate data and store the information in a file for future reference should the nameplates become illegible:

INSTALLATION

General Installation Arrangement Figure 1 on Page 3
Wiring Diagram Figure 2 on Page 5
Piping Diagram Figure 3 on Page 5

MACHINE LOCATION

The Selas Combustion Controller should be placed in a well-ventilated area. Do not install in pit or depression where even imperceptible gas leaks might accumulate. When possible, select an area in which the combustion air source is likely to be clean and fresh, otherwise remote air intake piping may be required. Protect against condensate freezing if equipment will be exposed to a cold climate. Provide a rigid, level foundation.

HANDLING

Avoid rough handling while unloading and moving the equipment to installation site. Do not remove skids until machine is placed in final position, ready for installation. Do not use slings around shaft. Do not support from, or hang on, added components. Use care not to damage impulse tubing.

Remove all packing material. Do not remove thread protectors and flange covers until ready to install connecting piping. Do not discard instruction tags until installation is completed.

MACHINE PLACEMENT

Machine must be installed on a rigid, level foundation, buffered with vibration pads. If necessary, add sturdy metal shims and lock them in place. Base frame must be seated on vibration mounts at corners. Do not bolt base frame tightly to foundation.

Do not connect motor coupling until motor shaft rotation direction is verified when wiring connections are made.

PIPING

Inside surfaces of all piping must be clean. Connecting pipe must be aligned and supported independently; flexible connections are recommended to avoid strain, reduce vibration and allow for easier assembly.

Use full ported shut-off valves when indicated to eliminate unnecessary restrictions and loss in pipe line pressure. Restrictive valves can prevent regressing flashback flame from reaching the automatic closure mechanism.

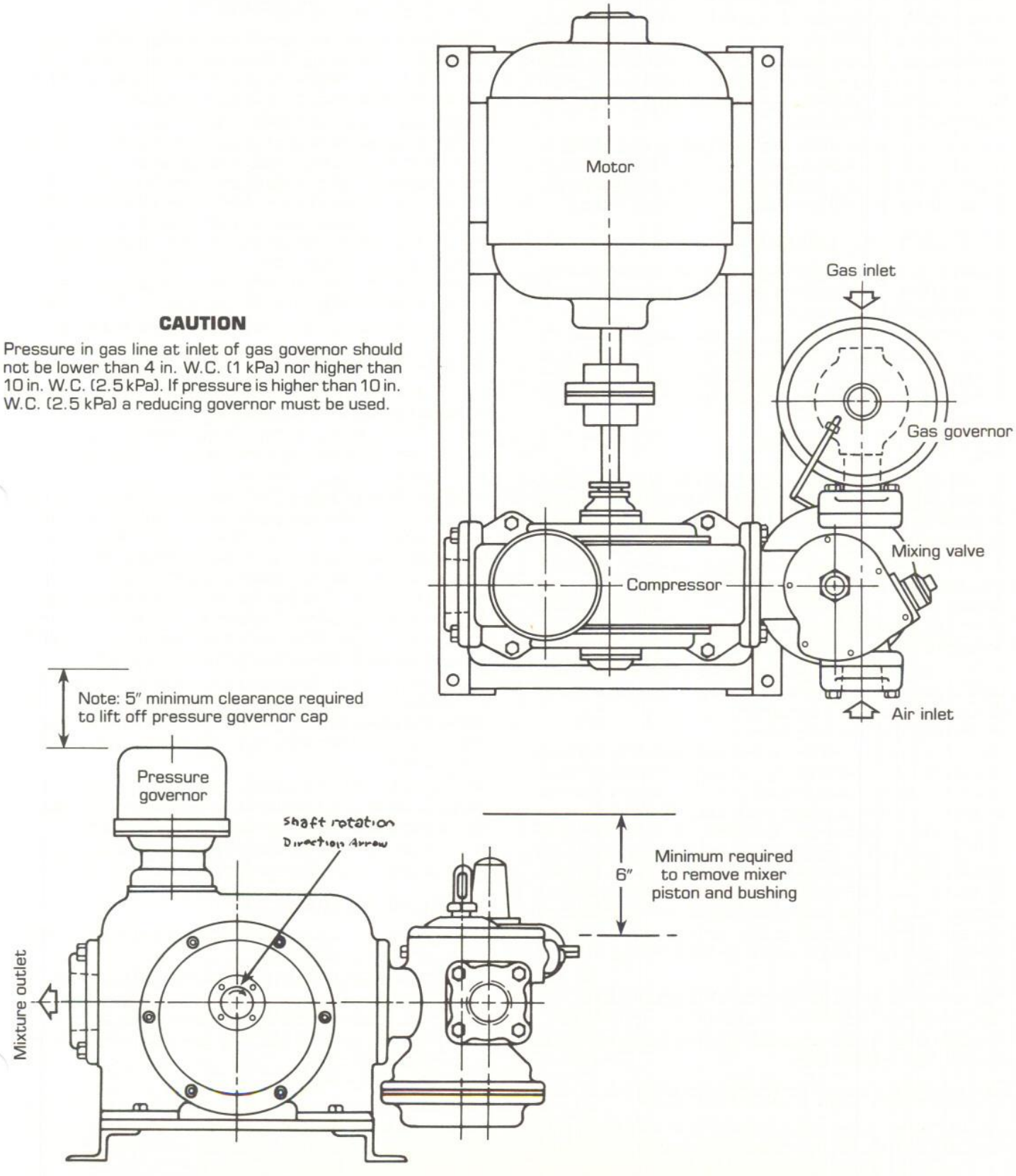
Take care to prevent foreign material from entering any pipe opening. Remove thread protectors and flange covers only

continued on page 4

FIGURE 1
GENERAL VIEW, INSTALLATION ARRANGEMENT FOR 60-CA COMBUSTION CONTROLLER

CAUTION

Pressure in gas line at inlet of gas governor should not be lower than 4 in. W.C. (1 kPa) nor higher than 10 in. W.C. (2.5 kPa). If pressure is higher than 10 in. W.C. (2.5 kPa) a reducing governor must be used.



when ready to make connections. Seal all joints on gas inlet and mixture outlet piping to guard against gas leakage; avoid excessive use of sealing compound which might squeeze inside pipe channel to cause fouling or plugging. Be sure to use gaskets between flanges.

Recommended inlet pressures to the zero gas governor at Mixing Valve are 4 to 10 inches water column (1 to 2.5 kPa). Locate reducing regulator, if required, at least 10 feet (3 m) upstream of gas governor.

Air filters on combustion air intake inlets are recommended because dirt or industrial particulates in unfiltered air will hinder machine performance. Outdoor air filters must be protected from the weather.

Avoid atmospheres which are corrosive to iron, brass or aluminum. If air intake piping must be extended to reach clean, fresh air, use oversize piping with a minimum number of fittings to avoid unnecessary airflow restrictions.

ELECTRICAL WIRING

Figure 2 illustrates a typical electrical wiring arrangement and is offered for reference purposes only; include your special conditions as required.

Verify that the available power supply coincides with the electrical characteristics of the equipment on site. Test to ensure that motor rotation agrees with directions of arrow on compressor; change wiring connections at motor, if necessary.

MOTOR COUPLINGS

Do not connect couplings until electrical wiring has been proven to provide the correct motor shaft rotation indicated on compressor bearing cap (illustrated in Figure 1 General Installation Arrangement).

Shaft alignment specifications depend on which couplings are used. Follow instructions provided by supplier; the more precise the alignment, the longer the life of bearings and couplings. Always allow at least ⅛ inch (3 mm) clearance between ends of abutted shafts.

When motors are supplied with the Combustion Controller, couplings are usually aligned at the factory and then disconnected on motor end for shipment.
In this case, proceed as follows:
Verify that space between shafts is between ⅛ and ¾ inch (3 and 20 mm). Confirm that coupling on compressor shaft is locked tightly. Lubricate only the set screws of loose coupling; wipe the exposed shaft clean. Slide loose coupling on motor shaft toward fixed half. Force resilient disc over pins (expect a tight fit) until disc exactly fills space between couplings (about ⅝ inch or 16 mm); do not compress disc, a small space between disc and coupling is acceptable. Lock the tapered bushing to shaft by tightening the two screws adjacent to slit, turning alternately and evenly until tight. Align shafts by repositioning motor if necessary.

For more information on taper-lock flexible couplings, see the "Couplings" section in "Maintenance" instructions.

For other coupling types, consult the installation specifications of the manufacturer.

COMPRESSOR LUBRICATION

The compressor oil chamber was filled at the factory with high quality SAE 30 automotive oil. Verify that level in sight gauge is between ¼ and ¾ full. Add oil, as needed, by removing plug on fill pipe (#17 of compressor details shown in Figure 11). Replace plug before putting unit in service because compressor pressure could force oil out of the fill pipe. For more information, see "Lubrication" section in "Maintenance" instructions.

PRESSURE GOVERNOR

The pressure governor maintains a constant outlet pressure regulated by one or up to three weights on a variable flow area piston. The weights (one primary and two secondary) are packed separately for shipment purposes.

To prepare for service, remove pressure governor cap (#13 in Figure 11) and remove packing. Take the primary weight with the large hub (#32) and, holding the small end downward, place on top of diaphragm plate; the central cavity should clear the spindle nut. Add secondary weights (#33) as needed, engaging boss of each weight into recess of companion weight. The primary weight alone is adequate for a pressure delivery system requiring 1 psig (7 kPa); two weights provide 2 psig (14 kPa), while three weights establish a nominal 3 psig (21 kPa) discharge pressure system.

See "Maintenance" instructions for more details.

PRESSURE TEST

Leak test requirements for piping and components vary with their relative positions in the piping system. In normal use, the air intake piping to the Mixing Valve operates under suction and small leaks are not hazardous; therefore, pressure tightness is not demanded.

A pressure test of 2 psig (14 kPa) is the maximum recommended for the inlet gas piping which supplies raw fuel to the gas governor at the Selas Mixing Valve. Many zero gas governors have a use limit of 2 psig (14 kPa) but the normal operating pressure at this point is less than 10 inches water column (2.5 kPa). If higher test pressures are indicated by local codes or regulations, isolate the gas governor and other vulnerable devices from the higher test pressure. Set or check pressure switches during the pressure test.

The piping between compressor discharge and burner shut-off valves (which holds premixed gas and air) should be tested at a pressure not exceeding 10 psig (70 kPa). Higher pressures can blow grease seals in firechecks or rupture a blowout disc.

The piping between burner shut-off valve and burner can be tested for leaks at the maximum delivery pressure produced by the compressor, most commonly 3 psig (21 kPa).

In all cases, apply test pressure slowly to eliminate sudden impulse loads on diaphragm membranes.

TRIAL RUN (Air Only)

Once Combustion Controller is in place and piping essentially completed, verify that:

1. Combustion Controller base is not bolted to floor.
2. Motor couplings are connected and aligned.
3. Shaft rotation is correct and turns freely by hand.
4. Pressure governor packing has been removed and weights inserted.
5. Gas valve is closed.

Close mixture outlet valve to make a test run of the compressor on air only. Start the motor. When it attains full speed, open mixture outlet valve; open other restricting

valves gradually. With machine running, add oil to compressor according to "Lubrication" section in "Maintenance" instructions. Check for vibration and unusual noise. Check that pressure and volume flow are near expected capacity. Complete any leak tests which have not been made.

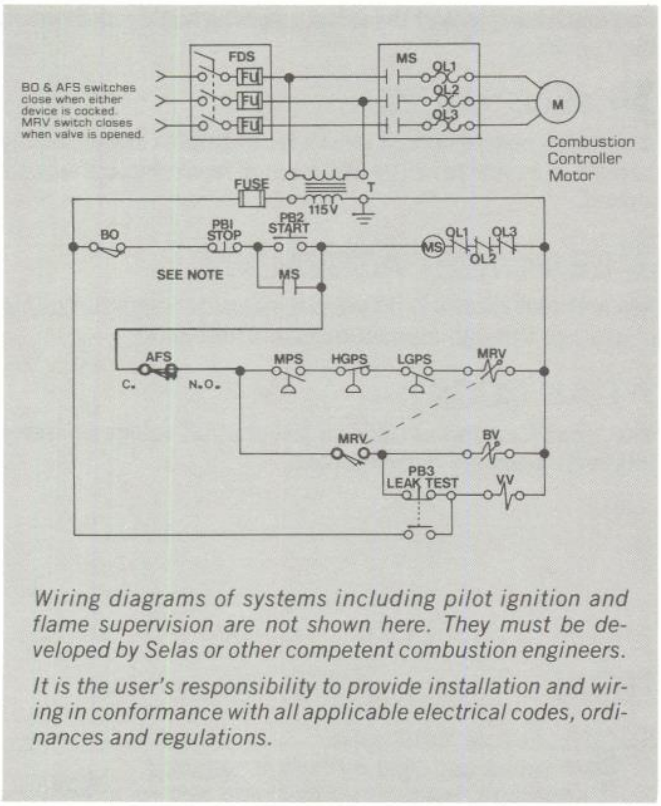
PREPARATION FOR START

Verify that pressure switches in gas supply piping are properly set. Ensure that gas supply is available to gas governor of Combustion Controller at a pressure between 4 to 10 inches of water column (1 to 2.5 kPa). Provide a temporary line to bleed air from the gas supply pipe, perhaps at leak test station nearest Combustion Controller, and purge all air to vent or flare in a safe place. Replace pipe cap at bleed point.

Check that all piping is completed and secure. Close all valves. Make sure that all electrical connections are completed and operable. Turn off all switches.

Set ratio adjustment dial on Mixing Valve to the expected air-gas ratio. Preliminary setting will be an estimate; more precise adjustment can be made after unit is in operation. A nominal setting of the range of port opening scale for typical natural gas operation is 92 on the air scale; for propane use a preliminary setting of 95. Leaner fuels like coke oven gas, town gas or manufactured gas are likely to require a range of port openings beginning at approximately 83 on the air scale.

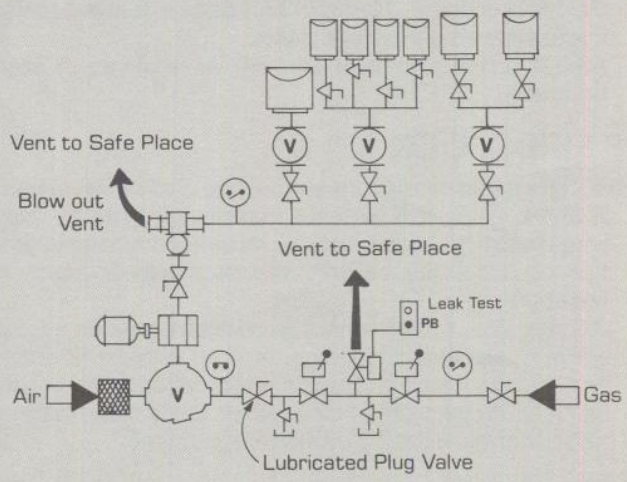
FIGURE 2
WIRING DIAGRAM



Wiring diagrams of systems including pilot ignition and flame supervision are not shown here. They must be developed by Selas or other competent combustion engineers.

It is the user's responsibility to provide installation and wiring in conformance with all applicable electrical codes, ordinances and regulations.

FIGURE 3
PIPING DIAGRAM



The piping diagram shows a typical interrelation among firechecks, blowout and major systems components. Specific applications may require variations of the basic system. Consult with Selas engineers for the optimum configuration to meet your requirements.

OSHA or local regulations, underwriter requirements or plant policies may dictate deviations from typical installations.

LEGEND	DESCRIPTION
AF	AUTOMATIC FIRECHECK
BV	BLOCKING VALVE
FDS	FUSIBLE DISCONNECT SWITCH
HGPS	HIGH GAS PRESSURE SWITCH
LGPS	LOW GAS PRESSURE SWITCH
LT	LEAK TEST ASSEMBLY
M	MOTOR (COMB. CONT.)

LEGEND	DESCRIPTION
MPS	MIXTURE PRESSURE SWITCH
MRV	MANUAL RESET VALVE
MS	MOTOR STARTER
OL	OVERLOAD
PB	PUSH BUTTON
BO	BLOWOUT
VV	VENT VALVE

PIPING INFORMATION

The following information is of a general nature only and it is not intended as a specific instruction for any particular installation. Each combustion system must have safety interlocks incorporated into the operating control system established by a competent combustion specialist within the specification of the authority having jurisdiction.

PIPING

A. The piping from the Combustion Controller to the blowout is generally the same size as the Combustion Controller discharge connection.
B. The piping from the blowout must not exceed the size of the blowout discharge connection. Long or complex piping systems may require special sizing.
C. The piping from the main header to the automatic firechecks should be sized with reference to allowable pipe line losses. Flow velocities of 50 ft./second (15 m/second) are adequate limits for most applications.
D. Insurance regulations specify that the size of the piping from automatic firechecks to burners must not exceed the firecheck size. Maintain or reduce this size according to allowable pressure losses.
E. Always install a manual shut-off valve ahead of each firecheck.

FIRECHECK

Install firechecks in mixture supply line close to burners.
A. A Selas, type AF-A (without microswitch) can be used when backfire at one firecheck must not interrupt operation of remaining burners and no signal or alarm is necessary.
B. A Selas, type AFS-A (with microswitch) must be used if alarm or signal is necessary, or if all burners of entire system can be shut down in event of backfire at any section. Microswitch must be wired to close the manual reset shut-off valve, shutting off gas supply.

BLOWOUT

Install a Selas blowout for the protection of Combustion Controller. It should be located near the Controller and its microswitch should be wired to close manual reset shut-off valve, stopping Controller motor.

MANUAL RESET SHUT-OFF

The manual reset shut-off valve terminates the fuel supply if electrical power is interrupted. The valve is wired to stop the fuel supply if the firechecks, blowout or pressure switches are activated.

PRESSURE SWITCHES

High and low pressure switches monitor the incoming gas supply. Should gas pressure become too high or too low, the switches signal the manual reset shut-off valve to stop the gas supply. The mixture line–pressure switch assures that compressor output has adequate discharge pressure.

FULL PORT SHUT-OFF

The full port shut-off valves should be full-throated flow valves, to avoid unnecessary pressure loss and to prevent flashback hang-ups at the valve, allowing flashback to reach the firecheck.

VENT VALVE

A normally open solenoid valve which remains closed during operation, opens to vent when manual reset shut-off valve is closed.

LEAK TEST ASSEMBLY

The leak test assembly provides a means for periodic testing of leakage through manual reset shut-off valve.

GAS COCK

Gas cocks function as positive gas shut-off valves wherever full port valves are not required.

OPERATION

STARTING THE MACHINE

The following operating instructions are minimal for a Combustion Controller. Combustion systems which incorporate pilot burners, purge timers, supervisory cocks or other interlocking apparatus obviously will require special instructions provided in other technical literature.

1. Verify that:
   a. Fuel gas supply to machine is shut off;
   b. Mixture outlet valve is fully closed;
   c. All valves at burner positions are closed; and
   d. Ratio adjustment setting is adequate for light-off.
2. Prepare ignition means, whether lighting torch, spark ignition or burner pilots.
3. Start Combustion Controller motor. Add oil as required. See "Lubrication" section in "Maintenance" instructions.
4. Open gas valve.
5. Open mixture outlet valve.
6. Open valves and light burners as required.
7. If necessary, readjust air-gas ratio setting to produce desired burning characteristics. After proper ratio is set, gently tighten ratio adjuster lock screw (#70 in Figure 12) with allen wrench.

FIRST START AND OTHER OPERATING CONSIDERATIONS

The following procedures, not required for routine starting, are very important to the first start-up, after system rework, when troubleshooting, or even after prolonged idle time.

1. Prove flame safety circuits as applicable.
2. Verify stable burning flames at each burner.
3. Perform "dry-out" or curing of refractories as applicable.
4. Establish high fire limit and set controls for the max-

imum allowable firing rate; this is determined by process or equipment limits.

5. Provide a low fire limit which assures a minimum flow rate at which the burners have stable flames and operate above their flashback point; this is usually determined by burner operating limits.

RUNNING THE MACHINE

Once started, the Selas 60-CA Combustion Controller should not require special attention other than regular oiling and operator awareness of process or system variations. Deviations in quality of fuel gas supply are not unusual and such changes can be accommodated by readjusting air-gas ratio dial, even during operation. Ratio adjustments during operation should be made in small increments, perhaps one scale point at 30 second intervals, but only when unit is operating above 5% of Controller rating. Compressor operating temperatures should not exceed 212°F (100°C). Do not run compressor below 5% of rated capacity for extended periods.

Consult "Maintenance" instructions for detailed information and procedures to maintain good performance. Troubleshooting clues are also included.

NOTE

Field repair of the gas governor is not recommended because incorrect assembly could be hazardous. Emergency repairs should be made only by competent repair personnel with thorough knowledge of correct assembly instructions. Assembly instructions can be provided by governor manufacturers or Selas. It is a wise precaution to stock a spare gas governor for emergency replacement.

STOPPING THE MACHINE

Use the following procedure to stop the Selas 60-CA Combustion Controller.

1. Close gas supply valve to machine inlet.
2. Allow machine to run long enough to clear mixture from all pipes to burners.
3. Turn off the Combustion Controller motor.
4. Close all valves at burners.
5. Close mixture valve at machine outlet.

MAINTENANCE

NOTE

Periodic maintenance, assigned for convenient times, can avoid machine downtime. Observations made during start-up, normal operation and shut-down often reveal potential problems to an aware operator. For example, flow or pressure changes might be noticed before they reach a critical point; flame safety and low pressure switch operation can be watched during a normal shut-down. BEFORE PERFORMING ANY MAINTENANCE OPERATIONS INVOLVING MACHINE DISASSEMBLY, CHECK THAT THE FUEL GAS SUPPLY VALVE IS CLOSED AND POWER SUPPLY IS OFF.

See maintenance schedule on page 20.

COMPRESSOR

The compressor is a positive displacement unit using oil wetted sliding vanes. To achieve maximum service life, sliding vanes (blades) require regular lubrication. Additionally, periodic blade inspection is recommended.

The 60-CA compressor is rated for 6000 cfh (170 m^3/hr) at 870 rpm on 60 Hz power. In 50 Hz applications, a compressor speed of 750 rpm will deliver about 5150 cfh (145 m^3/hr), while 1000 rpm will increase capacity to 6900 cfh (195 m^3/hr). Operation at 1000 rpm requires more frequent oiling and blade replacement.

LUBRICATION

SAE 30 grade motor oil was added to compressor before shipment. Maintain oil level between ¼ and ¾ of sight glass on oil level gauge (#14 in Figure 11).

A normal fill requires about 1 pint (0.5 liter) of oil. Oil may be added during operation if the oil pressure shut-off valve (#15) is turned off before removing fill plug (#17). (Remove plug slowly to relieve internal pressure). Replace plug and open valve after filling.

In normal service, a lubrication rate of 30 drops* of oil for every 8 hours of running time is recommended for the Selas Series 60-CA Compressor. Fifteen (15) drops of oil every 4 hours or 8 drops every 2 hours can be used if convenient to operator. Oiling can be done manually or automatically, but only while machine is running. The oil is pumped from bottom reservoir to sight feed oil valve (#19) by the pressure developed during compressor operation. A slight amount of excess oil drains back into the reservoir.

For intermittent service, add oil at the start of each operating cycle unless the starts occur within the same 8 hour period.

Extreme amounts of oil can enter piping and foul flame arrester screens and burners. Decrease amount or frequency of lubrication if oil is noticed in mixture piping mains.

MANUAL OILING

Each manual oil feed system includes a sight feed oil valve (#19) which incorporates a sight window at the point of throttle to facilitate the counting of drops. Close valve tightly after each oiling. Maintain tight gland to avoid loosening from vibration.

AUTOMATIC LUBRICATOR

The automatic lubricator system includes a solenoid valve in the oil line which is operated by an adjustable timing mechanism. An electrically operated timer and an adjustable throttle valve determine the frequency and amount of oil delivered to the compressor. A time relay is incorporated into the timing circuit to limit each lubrication cycle to approximately 5 seconds.

The cycle timer is adjustable for oiling at 2, 4 or 8 hour intervals. If timer cams are set for 2 hour cycle, eight drops of oil dispensed during a 5 second interval should prove adequate. Check timer setting by rotating timer shaft one full revolution (with wrench supplied). The number of audible clicks per revolution should match the number of desired oilings per 8 hour period.

To change the cycle time interval, remove the 3 screws holding timer to chassis and expose timer cams. Using the

two spanner wrenches supplied, adjust cams until the desired number of slots are exposed. Because the timer revolves once in 8 hours, one exposed slot actuates oiler once in an 8 hour period. Two exposed slots (at 180° spacing) produce an oiling cycle at 4 hour intervals; four exposed slots (at 90° spacing) provide oiling at 2 hour intervals.

Whatever lubrication cycle is selected, strive to lubricate at the approximate rate of 30 drops* of oil per 8 hour running period. A push button, located on front of lubricator control box, will open solenoid valve and allow setting of throttle valves. It also serves to bypass the timing mechanism for extra oiling as needed.

Extra oiling is required at first start and when compressor has not been used for several days. For these situations, depress push button on lubricator control box at start of operation, as many times as necessary to supply the equivalent of an 8 hour oil supply. For example, push four times if timer is adjusted to 2 hour cycle, or once for 8 hour cycle.

Gland packing on throttle valve (#19) must be tight to prevent loosening from vibration. Marking position of throttle valve handle may be useful to avoid incorrect adjustment.

Oil pressure shut-off valve (#15) must be open for automatic oiler to operate. See Figure 5 for wiring connections.

FLUSHING THE COMPRESSOR

The compressor should be flushed when oil becomes dirty. During a nonoperating period, remove oil drain plug (#18), drain oil from reservoir and replace drain plug. Remove oil fill plug (#17), and refill with a nontoxic, nonflammable solvent. Replace oil fill plug, and close fuel gas supply and mixture outlet valves. Start compressor and operate for several minutes with sight feed oil valve (#19) fully open. (If automatic lubricator is installed, open sight feed oil valve and press timer bypass button repeatedly to open solenoid and allow free flow of solvent).

CAUTION

DO NOT RUN COMPRESSOR WITH SOLVENT IN OIL RESERVOIR FOR MORE THAN FIVE MINUTES OR WITH MIXTURE OUTLET VALVE OPEN.

Stop compressor, remove oil drain plug (#18), drain solvent and replace drain plug. Remove oil fill plug (#17), refill with 1 pint (0.5 liter) of fresh, SAE 30 grade motor oil and replace fill plug. Readjust sight feed oil valve (#19) to original setting.

Start compressor and lubricate in normal manner. Verify that oil valve setting and oil feed rate is correct before placing unit in normal operation.

NOTE

If combustion controller will be used for backup or standby service, run machine at regular intervals to maintain it in ready operating condition.

ROTOR BLADES (Sliding Vanes)

Rotor blades are subject to wear and damage; therefore, they should be examined:

a. At least once a year;
b. If compressor is noisy after lubrication;
c. If blades do not slide in slots when shaft is turned by hand; and
d. At loss of mixture capacity not attributable to other causes.

For access to rotor blades, see paragraph "A" in the "Compressor Disassembly" section which appears later.

Examine each blade for wear, rough edges or delaminations. Discard blades that are damaged or worn to a width of 3¼ in. (83 mm). Original blade width is 3⅝ in. (92 mm).

***30 drops of oil is approximately equal to ¼ teaspoon or 1.5 ml.**

FIGURE 4
AUTOMATIC LUBRICATOR

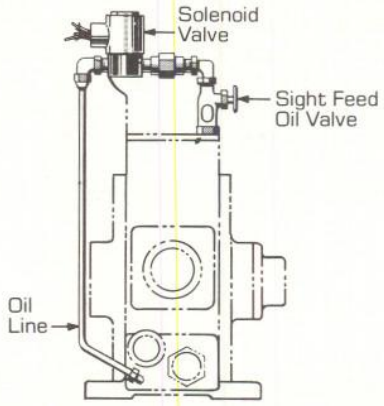
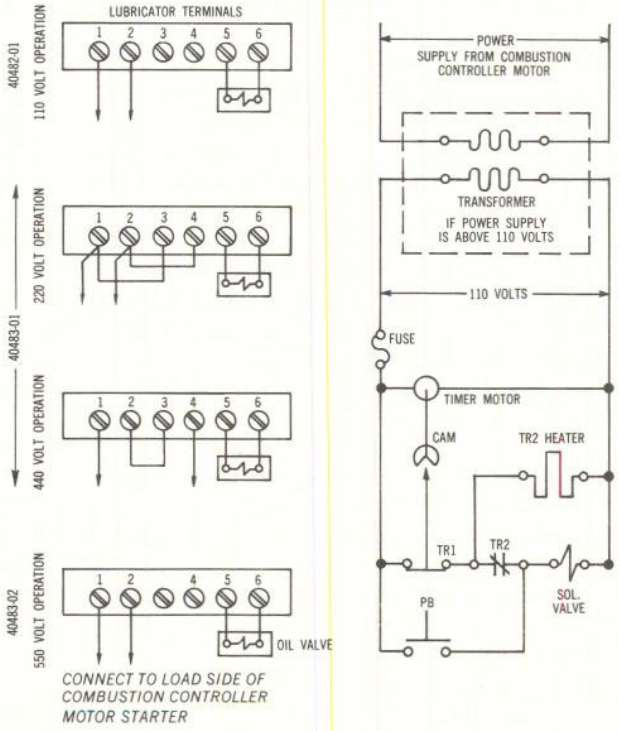


FIGURE 5
AUTOMATIC LUBRICATOR WIRING DIAGRAM



NOTE: If two oil valves are used in parallel, connect to line side of starter or to separate supply.

BROKEN BLADES

If blades break during operation, pieces may be propelled into any cavity of the compressor body, the discharge pipe and even into the check valve at inlet to compressor. Fragments can work back into the revolving rotor and break a new set of blades; therefore, it is necessary that all foreign matter be removed. Remove drum and shaft, and disconnect inlet and outlet connection to search for debris when evidence of broken blades is found. Search all corners and recesses; likely "hiding" places are indicated by small arrows in Figure 11. Vacuum clean entire compressor bore and body. Remove and inspect check valve for debris; clear discharge piping of all loose particles.

BLADE REPLACEMENT

Thoroughly clean all internal parts including compressor bore and slots in rotor before installing new blades.

Coat new blades with a thin film of motor oil and insert them into rotor slots with bevel edges trailing (see Figure 7—square corner is the leading edge). Observe that blades slide freely in slots when shaft is turned by hand before reassembly.

After assembly is completed, operate the combustion controller for 20 minutes with fuel gas and mixture outlet valves closed. This will cause compressor and blades to heat up and expand. If binding occurs (indicated by motor overheating, increased amperage or excessive noise) stop the compressor, remove blades and increase end clearance by filing 0.002 in. (0.05 mm) off the blade lengths. Do not remove more material than this during one test cycle because excessive end clearance reduces pumping capacity of compressor. If two test cycles are necessary, limit blade length reduction to a maximum of 0.004 in. (0.1 mm).

Reassemble and repeat the previously described test procedure until the shaft is free and the compressor runs quietly when heated. Do not operate at temperatures above 212°F (100°C) on bearing bracket, especially at bearing hub.

At full flow, depress weights by hand and check for resiliency. If weights seem to seat on bottom (no bounce), this may signify:

a. Worn pressure governor piston (flow leaks past closed piston to bypass channel);
b. Ruptured diaphragm (#24) or leakage around diaphragm clamp joints;
c. Obstruction under weights causing premature seating; or
d. Overcapacity (expecting more flow than compressor can deliver).

At minimum flow, observe whether outlet pressure is the same with cap (#13) on or off. Increase in pressure can result if cap restricts upward travel of pressure governor assembly.

The discharge pressure of the compressor is transmitted to underside of weighted diaphragm (#24) through two orifices. Plugged orifices will restrict or delay regulation; oversize or missing orifices can result in pressure oscillations (apparent by bouncing weights visible with cap removed).

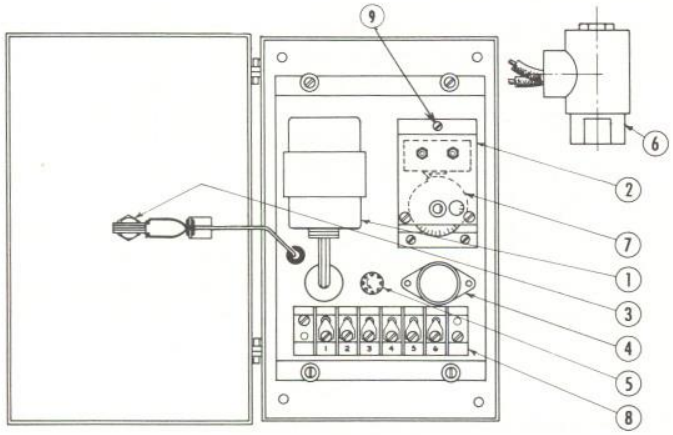
Pressure governor orifice (#35) is accessible through cover (#36). Vent port in cap (#13) always must be open to atmosphere.

Diaphragm repair is accomplished by removing diaphragm ring (#22) and diaphragm spindle nut (#28). Two sets of diaphragm plates (#25), washers (#27) and gaskets (#23 and #26) are required; one set used for each side of diaphragm. Provide uniform slack in diaphragm before fastening ring (#22) to assure full stroke in operation.

Piston (#30) is accessible for cleaning or repair by removing pressure governor body (#20). Clean surfaces with a nontoxic, nonflammable solvent. Do not use oil on the piston; instead, use dry-type lubricant (Dri-Slide or equivalent) or simply wipe dry and reinstall. The fit between piston and bore in the compressor body is critical. Excessive wear of piston might be corrected by a replacement, but excessive wear of bore usually will require a new compressor body.

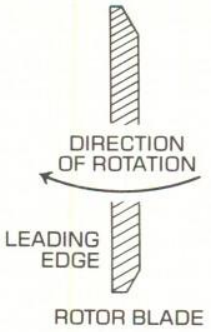
While servicing the piston, also remove spindle (#29) to clean shaft and bushing bore before reassembly.

FIGURE 6
AUTOMATIC LUBRICATOR CONTROL PANEL & PARTS LIST



INDEX NO.	PART	INDEX NO.	PART
1	TRANSFORMER	6	SOLENOID VALVE
2	CYCLE TIMER	7	ADJUSTABLE CAM ASSEMBLY (8 HR., 4 HR. & 2 HR. OILING CYCLE)
3	PUSHBUTTON	8	TERMINAL STRIP
4	TIME DELAY RELAY	9	CYCLE TIMER MOUNTING SCREWS
5	LITTLE FUSE		

FIGURE 7
ROTOR BLADE ORIENTATION



ZERO GAS GOVERNOR

The gas governor, located in the fuel supply line at the inlet to the Selas Mixing Valve, equalizes the incoming fuel supply pressure to match the pressure of the incoming air supply which varies with changes in flow demand.

The upper diaphragm chamber, connected to the air inlet side of the Mixing Valve, senses the system flow requirements. The lower diaphragm chamber responds to governor outlet conditions transmitted through an impulse hole or equalizing tube. With equal pressures in both chambers, the governor achieves zero balance or equilibrium. Changes in system demand create pressure imbalances between the two chambers. When these imbalance conditions occur, the diaphragm adjusts gas flow until the zero balance condition is restored between the chambers. A sensitive spring precisely balances the weight of all internal moving parts within the governor. Figure 15 shows the general construction of the gas governor used with Selas Mixing Valves.

All gas governors are set and sealed when shipped. If adjustment or repair is necessary, the governor should be returned to the factory.

PRESSURE BALANCE TEST (Figure 9)

Performance of the balanced zero gas governor can be verified by making a pressure balance test. Figure 9 shows the arrangement of equipment required for the test.

1. Examine impulse tube to gas governor for soundness and tight connections; leaks will hinder performance. Leak tests with soap solutions are not adequate because this line is normally under suction.
2. During a nonoperating period, replace both pipe plugs at test locations near Mixing Valve inlets with petcocks. Connect a water manometer (or low differential pressure gauge) across both petcocks.
3. During the next operating period, open petcocks simultaneously and examine response of gas supply pressure when flow rates change. The differential pressure between the two test points should not exceed 0.2 inch water column (0.05 kPa). Minor deviation might prove tolerable, but larger deviations require replacement of zero governor.

COMPRESSOR DISASSEMBLY (Figure 11)

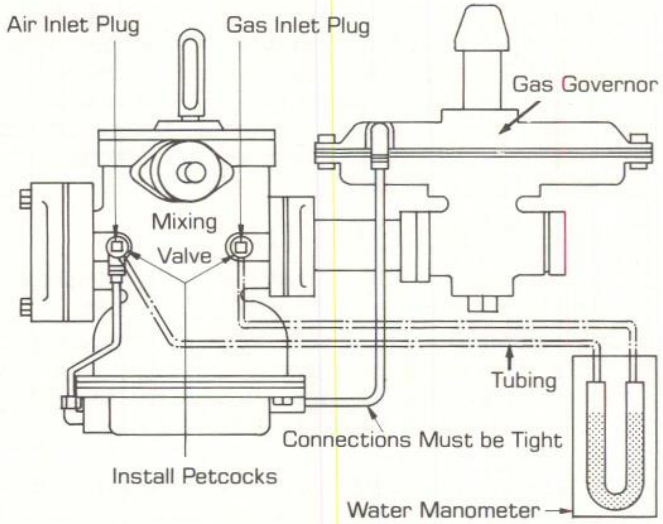
Make certain that machine power and fuel gas supplies are off.

A. Removal of bearing bracket (#2) (opposite of motor shaft end):
Remove bearing cap (#3) and bearing locknut (#11). Remove 8 screws clamping bearing bracket to compressor. Use bearing puller or jack screws to pull bearing bracket with bearing (#6) and oil seal (#7) from shaft.

B. Removal of drum and shaft (#14):
Remove coupling from shaft. Loosen screws on stuffing box gland (#10), unfasten stuffing box (#9) and slide off shaft. Remove bearing locknut (#12) and jack out drum and shaft.

C. Remove second bearing bracket (shaft end) if necessary for service, cleaning or bearing replacement. Use jack screws to free bracket from compressor body.

FIGURE 8
PRESSURE BALANCE TEST ARRANGEMENT



With compressor disassembled, clean all grime and hardened oil residue from blade contact surfaces, especially compressor bore, bearing bracket faces and rotor. Drain and flush oil reservoir. Wipe clean and replace drain plug.

SHAFT PACKING GLAND

Inspect stuffing box (#9) and packing (#8). For replacement, use Garlock braided packing, Style 117 (or equivalent), $^{3}/_{16}$ in. (4.8 mm) diameter. Tighten gradually over first 100 hours of operation (including first start of new machine) to allow gland to be worn in without binding shaft and overheating bearings.

BEARINGS

The bearings (#6) in the compressor (Figure 11) were packed with grease at the factory. They should be inspected and regreased at least twice a year. More frequent inspections may be required if: a) unit is in continuous operation; b) unit is operating in a higher than normal ambient temperature; or c) the compressor is used at low flow rates for extended periods.

Using Unirex-N2 or equivalent high temperature grease, repack bearing full to end of bearing nut. Do not overpack. Leave ample air space, at least 50% of cavity, for expansion. Apply a thin layer of grease on flange face of bearing cap (#3) for pressure tightness.

NOTE

When repacking or servicing bearings, follow these rules:

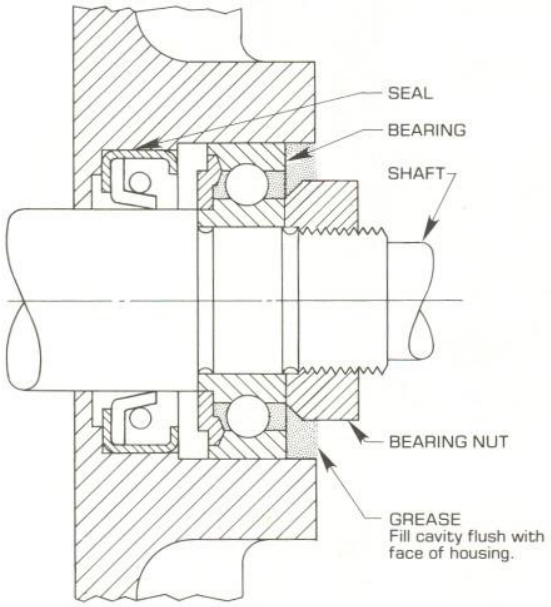
1. **COMPLETELY REMOVE OLD GREASE.**
2. **DO NOT EXPOSE BEARINGS OR GREASE TO DIRTY OR DUSTY ENVIRONMENT.**
3. **DO NOT USE AN EXCESSIVE AMOUNT OF GREASE.**
4. **DO NOT INSTALL GREASE FITTINGS ON BEARING COVERS.**

When servicing bearings, also check condition of oil seals; replace as required.

BEARING REPLACEMENT

The inner ring of bearing is intended to be tightly fitted to shaft. Use a piece of tubing that fits loosely over the shaft and bears evenly against face of inner ring only (absolutely no contact with ball or outer ring) and press ring against shoulder. Lock in place with bearing nut (#11). The outer ring should be a "push" or "slide" fit within bore of bearing bracket (#2) to accommodate axial deviations during installation and operation.

FIGURE 9
BEARING DETAILS



PRESSURE GOVERNOR (Figure 11)

A pressure governor, located at top of compressor, regulates the outlet pressure by means of an internal bypass. The number of weights determines the outlet pressure as explained in the "Pressure Governor" section in "Installation" instructions. If mixture flow is throttled, a rise in compressor outlet pressure will lift weights and open the internal bypass to divert any unused capacity to compressor intake. Conversely, an increase in process flow demand will cause the pressure to decrease, the weights will drop, and the internal flow will decrease until the desired outlet pressure is restored.

The weighted pressure governor assembly should move freely through full stroke from zero to full flow of combustion controller. Check regularly by removing cap (#13) and observing smooth movement. Weights must be suspended on diaphragm by the machine pressure at flow rates between minimum and full capacity. Sluggish response to flow changes suggests a dirty piston (#30); this can be tested at steady flow rates by pushing weights down by hand and observing if they return to original position. When not operating, sluggishness also can be tested by removing weights, lifting spindle (#29) and letting it fall of its own weight.

CAUTION

Close petcocks or replace plugs at end of test. Never operate Selas Mixing Valve with a test connection open to the atmosphere.

SELAS MIXING VALVE

The Selas Mixing Valve is a three-port, adjustable area valve which accurately mixes any two of a wide variety of gases. "Air" and "Gas" ports in a movable piston are matched to complementary ports in a mating sleeve. An adjustment knob can vary gas proportions for any required mixture ratio. The ratio adjustment will simultaneously decrease one port opening as the other port is increased. Increased flow demand causes the Mixing Valve diaphragm to raise the piston, opening both ports simultaneously for greater flow. Figure 10 illustrates a Selas 60-CA Mixing Valve.

CLEANING OF MIXING VALVE (Figure 10)

Due to the close tolerance between the bushing and piston, a regular program of cleaning is required. This cleaning must be a preventive maintenance function. The frequency is dictated by the severity of each particular application. A monthly cleaning schedule is recommended until a satisfactory program is developed.

To expose the internal parts, remove valve cover (#3). Next, remove spindle extension (#24), unscrew piston locknut (#23) from diaphragm spindle (#25) and remove piston (#20).

Remove all debris that has accumulated in the valve. Wipe clean all accessible areas, using a cloth saturated with nontoxic, nonflammable solvent. Do not overlook orifice opening in valve body; it must be free of any obstruction.

Remove loose grit and dirt from the piston (#20) and bushing (#10) and carefully inspect surfaces for corrosion and abrasions. Remove stubborn deposits with crocus cloth dipped in solvent. Never use grit or emery because metal removal can alter fit of components. During this cleaning operation, it is important not to mar or deform the sharp metering edges of both piston and bushing ports in any way.

NOTE

Never coat outside of piston or inside of bushing with oil or grease as this will attract abrasive impurities from the gas or air supply. This will eventually cause sticking or excessive wear. Use dry lubricant and wipe off excess before reassembling.

Remove balancing line tubing and clean by blowing compressed air through the tube. Make sure that both ends of balancing line are disconnected.

A drain plug is located in the diaphragm cap (#2). Remove plug to drain accumulated condensation from the Mixing Valve, then replace drain plug.

Ordinarily, it is not necessary to remove the bushing for cleaning. A grease seal, located between bushing (#10) and body (#1), serves two functions: to ensure free rotation during ratio adjustment, and to simultaneously maintain a seal to prevent unmetered leakage. If the bushing does not

continued on page 14

FIGURE 10
MIXING VALVE, ARRANGEMENT & PARTS LIST: MODEL 60-CA

PARTS LIST

1. Mixer body
2. Diaphragm cap (bottom cover)
3. Top cover
4. Top cover gasket
5. Sight glass housing
6. Sight glass tube
7. O-ring
8. Retaining ring
9. Felt pad
10. Mixer bushing
11. Ratio adjustment ass'y. (See Fig. 6)
12. Adjustment spindle
13. Adjustment pivot
14. Retaining ring
20. Mixer piston
21. Piston guide sleeve
22a. Guide sleeve screw
22b. Washer
23. Piston locknut
24. Spindle extension
25. Diaphragm spindle
26. Diaphragm with gaskets
27. Diaphragm plates (2 req'd)
28. Diaphragm washer (2 req'd)
29. Hex nut
30. Check valve ass'y.
31. Body
32. Valve disc & stem ass'y.
34. Spring
35. Lock ring
38. Impulse tubing connector (3 req'd)
39. Nameplate
40. Air inlet flange
41. Air flange gasket
42. Gas inlet flange
43. Gas flange gasket

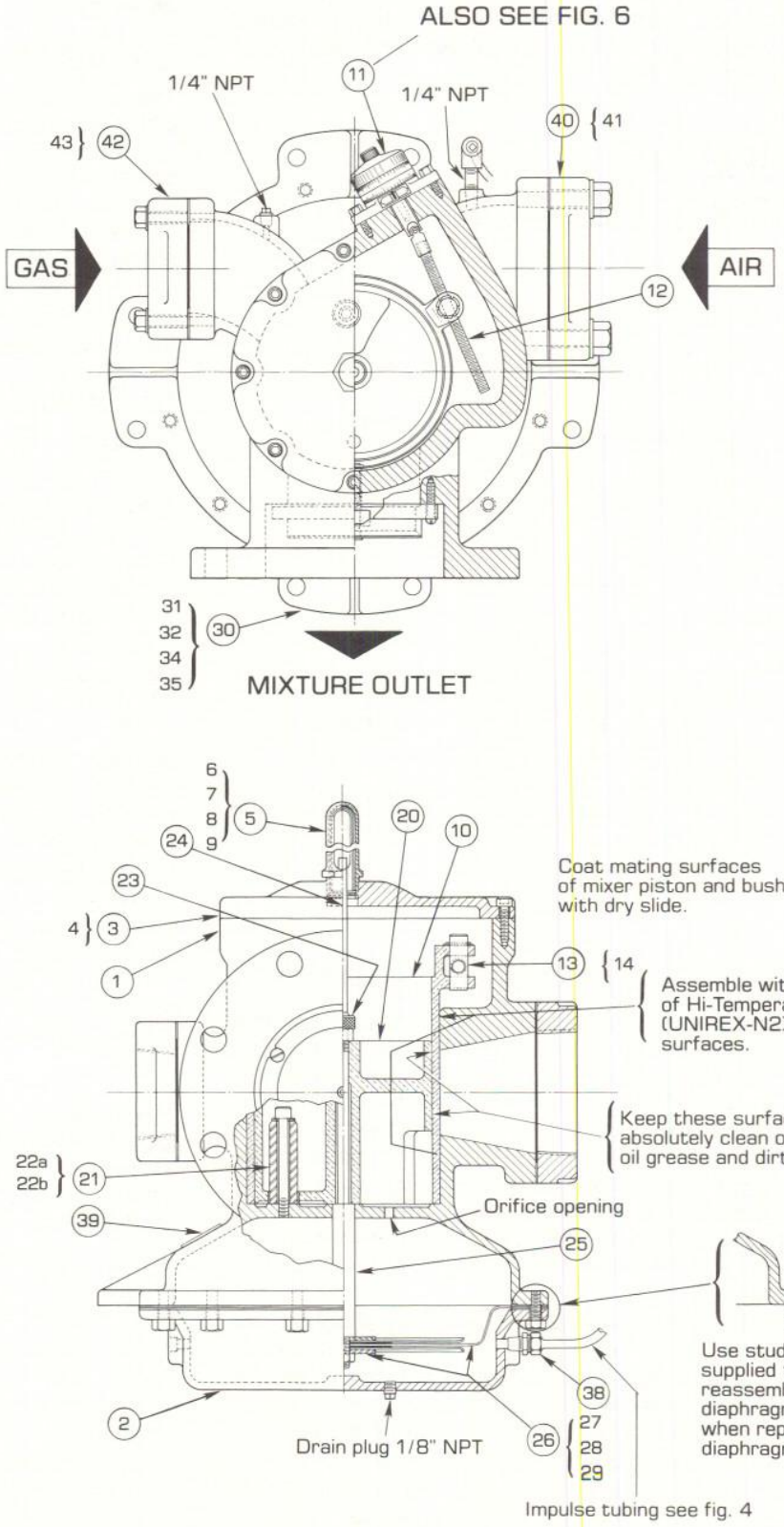
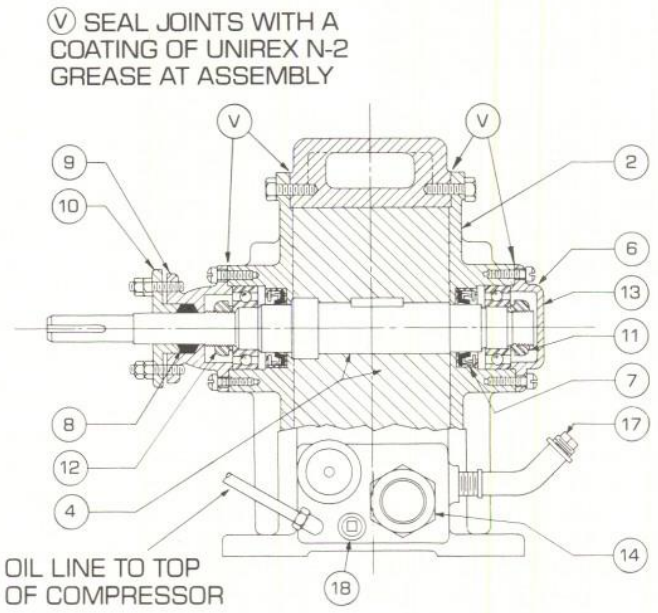


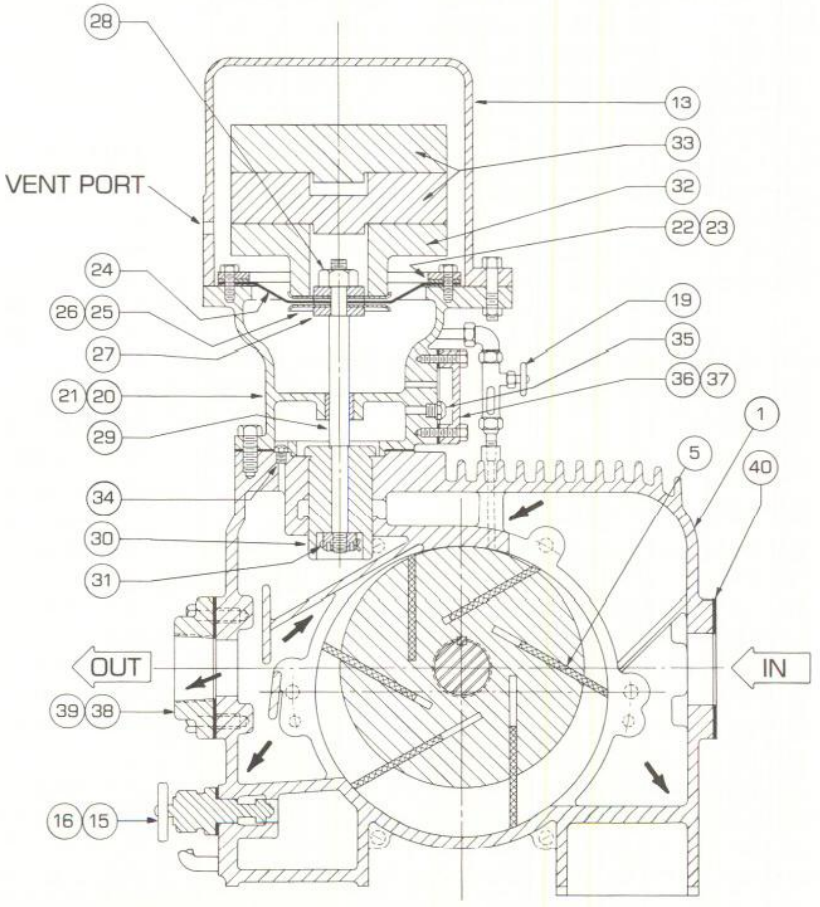
FIGURE 11
COMPRESSOR AND PRESSURE GOVERNOR ARRANGEMENT & PARTS LIST: MODEL 60-CA

PARTS LIST

1. Compressor body
2. Bearing brackets (2)
3. Bearing cap
4. Drum & shaft ass'y
* 5. Blades (6)
* 6. Bearings (2)
* 7. Oil seals (2)
* 8. Packing
9. Stuffing box
10. Stuffing box gland
11. Bearing locknut L.H.
12. Bearing locknut R.H.
13. Pressure governor cap
14. Oil level gauge
15. Oil shut-off valve
16. Oil valve gasket
17. Oil fill plug
18. Oil drain plug
19. Sight feed oil valve
20. Pressure governor body
21. Pressure governor body gasket
22. Diaphragm ring
*23. Diaphragm ring gaskets (2)
*24. Diaphragm
25. Diaphragm plates (2)
*26. Diaphragm plate gaskets (2)
27. Diaphragm washers (2)
28. Diaphragm nut
29. Spindle
30. Piston
31. Locknut & cotter pin
32. Weight (primary)
33. Weights (auxiliary, 2)
34. Orifice (body)
35. Orifice (pressure governor)
36. Orifice cover
37. Orifice cover gasket
38. Outlet flange
39. Outlet flange gasket
40. Inlet gasket

*Recommended spare parts





rotate easily or internal leakage is suspected, disassemble as follows:

Remove ratio adjustment assembly (#11) from adjustment pivot (#13).

Carefully lift bushing from valve body, using a steady vertical lift in order to prevent binding. Clean thoroughly as previously described for piston cleaning.

Before reassembling bushing in valve body, coat outside of bushing and inside of valve body with UNIREX-N2 grease or equivalent. Replace all parts with care. Do not use force to reassemble parts. Remove all grease from metering port area.

To reinstall piston, apply a light coat of molybdenum disulfide base dry film lubricant (Dri-Slide) to the outer surface of piston and the inner surface of the bushing. DO NOT USE OIL OR GREASE ON THESE INTERFACES. Align the piston with guide (#21) being careful not to cock or force the piston while sliding into bushing. Replace piston locknut. Test for free up and down movement.

RATIO SCALE ADJUSTMENT (Figures 12, 13 & 14)

The range-of-port-opening scale (or ratio scale, #48) is set at the factory to correlate the position of the metering ports to the external scale reading. But, if the ratio adjustment sub assembly is ever disengaged, it is then necessary to re-set the ratio scale. The scale reading is correct when the air index indicates 100% at the same time that the gas port scribe marks (Figure #13) on the piston and the bushing are in alignment with each other.

To re-set ratio scale, first turn adjustment knob (#50) to indicate 100 on the "Air" scale. With mounting screws removed, turn entire ratio adjustment sub assembly (including its mounting flange) until scribe marks are aligned when the flange is held against the valve body. When assembly is firmly against the valve body, the scribe marks are aligned and the scales read 100% AIR, the ratio scale register is correct. Fasten ratio adjustment sub assembly to Mixing Valve body at this position. Turn ratio adjustment knob to desired scale reading. To complete Mixing Valve reassembly, replace spindle extension (#24, Figure 10) and install valve cover with gasket.

NOTE

A locking device is provided on the ratio adjustment assembly. After setting ratio, gently tighten locking screw (#70) with allen wrench.

MIXING VALVE DIAPHRAGM REPLACEMENT (Figure 10)

An elastomeric diaphragm in the lower chamber of Mixing Valve serves to raise or lower the mixer piston, changing both air and gas port openings according to flow demand. The diaphragm requires no maintenance, but must be replaced if embrittled or ruptured.

The diaphragm can be serviced after removal of impulse loading tube and diaphragm cap (#2).

Diaphragms supplied are the flat type. Flat diaphragms require pleating at bolt circle to allow slack for full vertical travel (or valve stroke). One or two pleats between bolts will shorten the diaphragm circumference to provide needed interior slack. Do not bunch pleats and avoid pleating at bolt holes. Diaphragm may be stapled to flange gaskets at each pleat to facilitate assembly, however the staples should be outside the bolt circle of the gasket.

Install new gaskets when replacing diaphragms, including the smaller gaskets under the diaphragm plates; coat outer (or flange) gasket with good grade grease. Do not remove piston locknut at other end of spindle (in upper chamber) because it holds spindle in a fixed position during diaphragm assembly.

Always check for full stroke before final fastening of bottom diaphragm cap screws. Reconnect impulse tubing and tighten all connections.

CHECK VALVE (Figure 10)

A check valve is positioned between the Mixing Valve and compressor to protect the Mixing Valve and diaphragm from sudden backpressures; it does not provide positive shutoff.

In normal operation, flow through the system overpowers the light tension of check valve spring and holds it open. Excessive loss in delivery pressure can signal poor check valve operation.

Access to check valves in 60-CA Mixing Valves is at Mixing Valve outlet flange. The check valve spring should be straight and resilient. The disc and stem must be clean and ride freely; clean with nontoxic, nonflammable solvent, if required. Examine stem and disc for wear; replace as necessary. Use dry-type lubricant (Dri-Slide or equivalent) on the shaft or simply wipe dry. Do not use oil.

MOTOR

Motor types and suppliers may vary. For proper care, refer to instructions of motor manufacturer. Most motors have ratings for safe operation up to 176°F (80°C) in typical environments (ambient temperature plus a 104°F [40°C] temperature rise). Higher temperatures might be caused by overloading, improper wiring or high altitude.

COUPLINGS

The coupling most commonly used is the Taper-Lock flexible disc type, consisting of a resilient disc engaging alternate pins of opposed flanges which are locked to their respective shafts. When properly installed, the two are 5/8 in. (16 mm) apart with the flexible disc occupying the space between flanges.

Position of coupling on shaft is locked by wedging a split bushing along a taper with axial set screws. Two set screws, located at 90° angles from the bushing slit, serve to wedge bushing and lock flange to shaft. See the hub flange sketch.

Always allow for space between ends of the shafts to be coupled; a clearance of 3/8 in. ± 3/16 in. (10 mm ± 5 mm) should be sufficient for most applications. Shafts should be flush or protruding from flange bushing when tight; if shaft is recessed in bushing, the friction area for locking to shaft is diminished. Position of couplings from end of shaft should be nearly equal for each half coupling. The friction lock of coupling on shaft is never intended to replace a shaft key for positive transmission of torque.

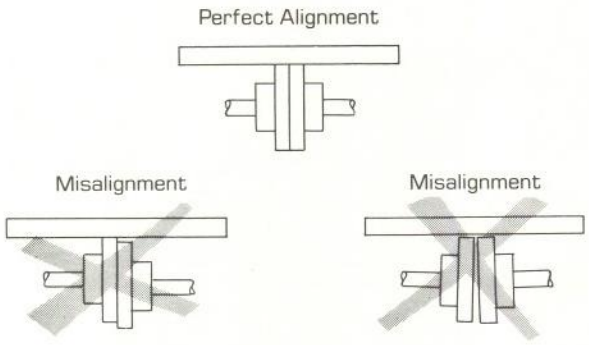
The resilient disc automatically aligns flange pins in alternate holes. The tight fit (slight interference) in holes reduces pin wear and extends coupling life. Position flanges (or move shafts) until flanges almost touch the small spacer button on disc.

Clean shaft, flange bore and bushing (inside and outside) of oil, lacquer and dirt before installing bushing.

Lubrication on threads and points of set screws make it easier to turn set screws for clamping (or removing) bushing.

Check alignment using straightedge across the two flanges.

COUPLING ALIGNMENT



COUPLING REMOVAL

A Taper-Lock flexible disc coupling is disconnected by removing set screws in hub face of coupling. Take one of the set screws, lubricate its threads and point, and insert it into the previously vacant third hole (marked in hub flange sketch) opposite of slit in bushing. Turning screw will withdraw taper wedge and loosen its hold on the shaft.

AIR FILTER

Selas Combustion Controllers should be operated at all times with air filters on air intake piping. This is because air from typical industrial environments generally contains much dirt which would contaminate the mixing valve, compressor and other combustion system components if allowed to enter the machine. The air filter also stops rags and paper from being drawn into the air intake especially during periods of increased suction direction of shaft rotation.

filter element always be kept handy to replace a dirty or damaged air filter. Filter replacement should be made with the Combustion Controller shut down. If the Combustion Controller cannot be stopped, filter replacement can be made during a low fire or idle setting.

The air filter should be cleaned monthly until actual operating conditions determine proper cleaning frequency. Some of the filters can tolerate several cleanings in warm water with mild detergent. Do not use compressed air jets to clean cloth-type filters. Consult the filter supplier for specific cleaning instructions.

NOTE

DO NOT use oil-wetted filters on Selas Combustion Controllers.

HUB FLANGE

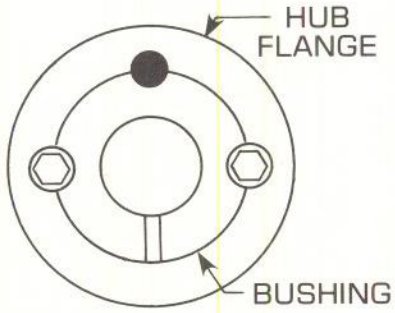
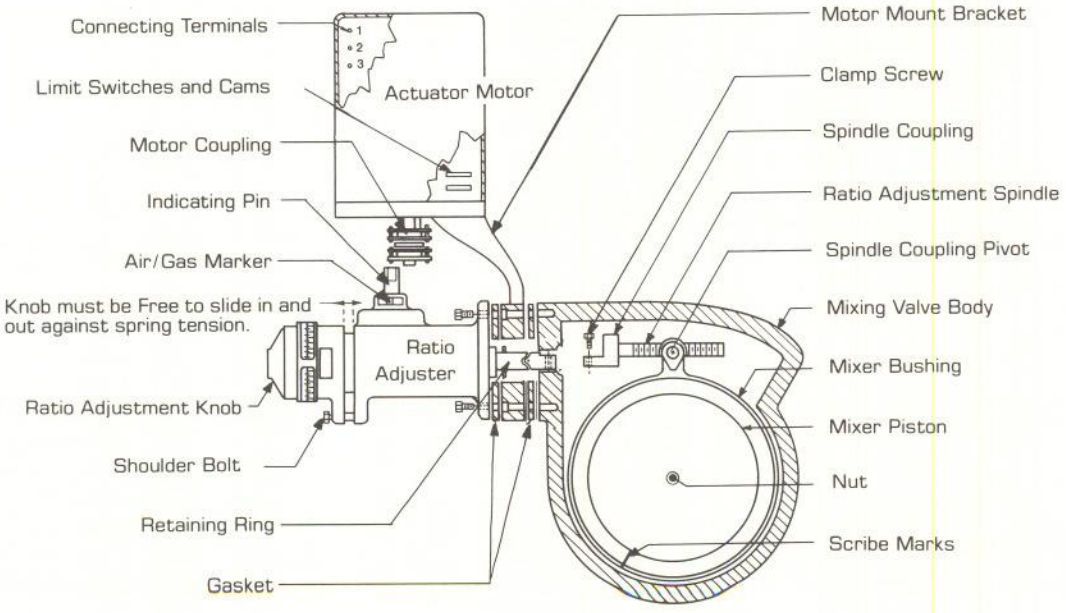
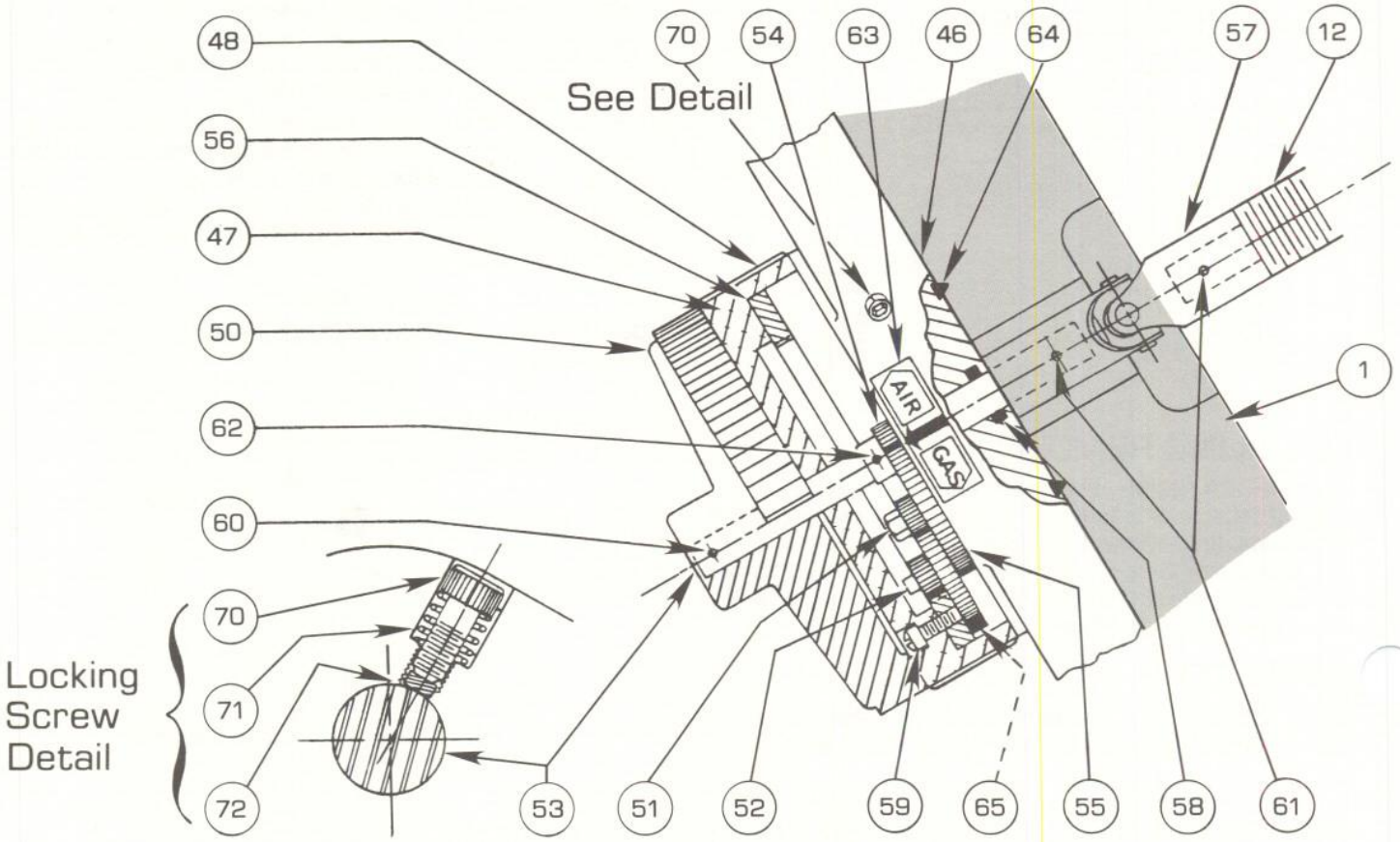


FIGURE 12—AUTOMATIC RATIO ADJUSTER



SEE SELAS INSTRUCTION BULLETIN QARA FOR DETAILED INFORMATION.

FIGURE 13
RATIO ADJUSTMENT SUBASSEMBLY

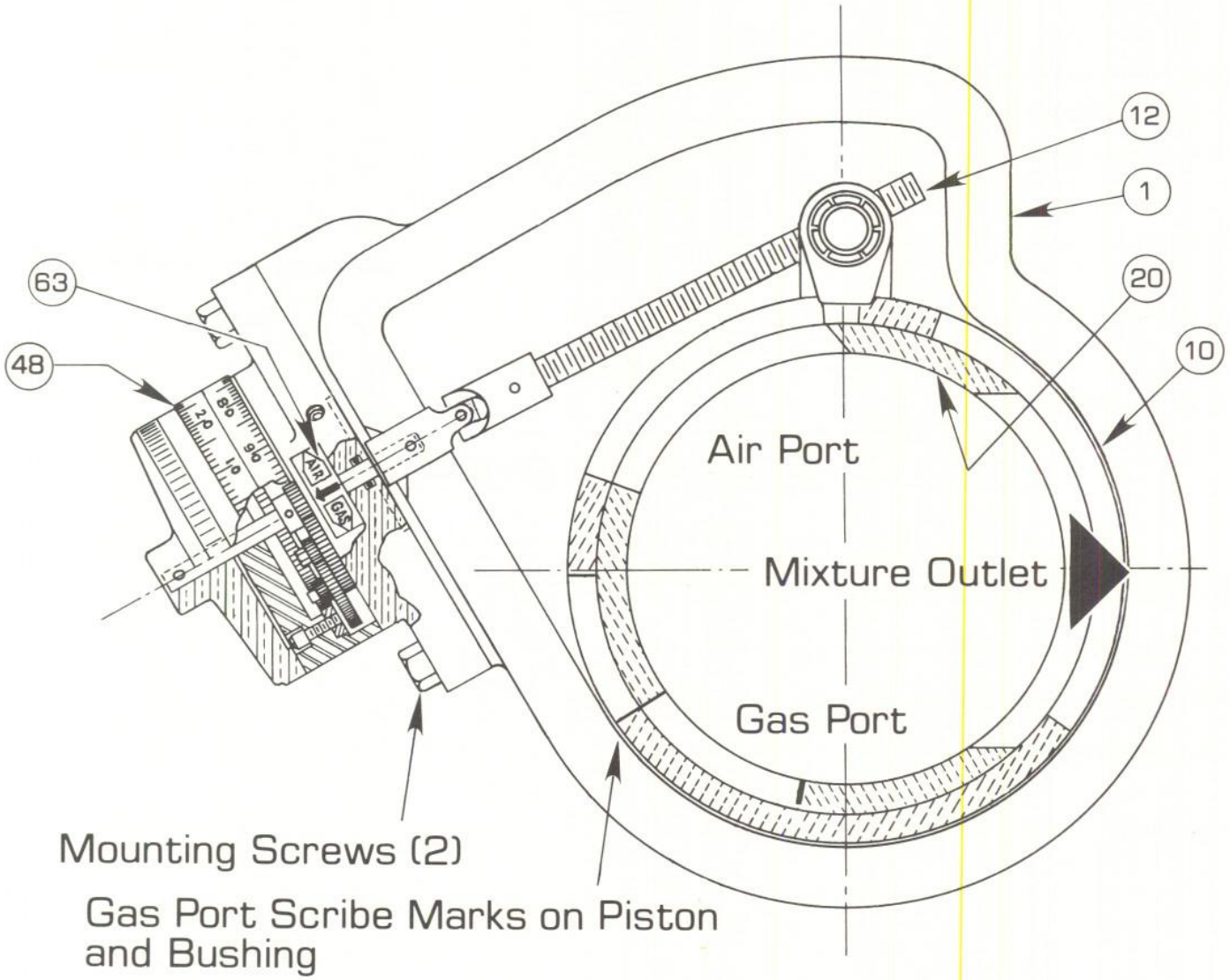


ORIENTATION TO ASSURE ACCURATE RATIO SCALE REGISTER: WITH "100" ON AIR SCALE ALIGNED TO AIR-GAS POINTER, SCRIBE MARKS ON TOP OF PISTON AND BUSHING SHOULD MATCH. IF CORRECTION IS NECESSARY, REMOVE MOUNTING SCREWS AND TURN MOUNTING FLANGE AS REQUIRED.

PARTS LIST

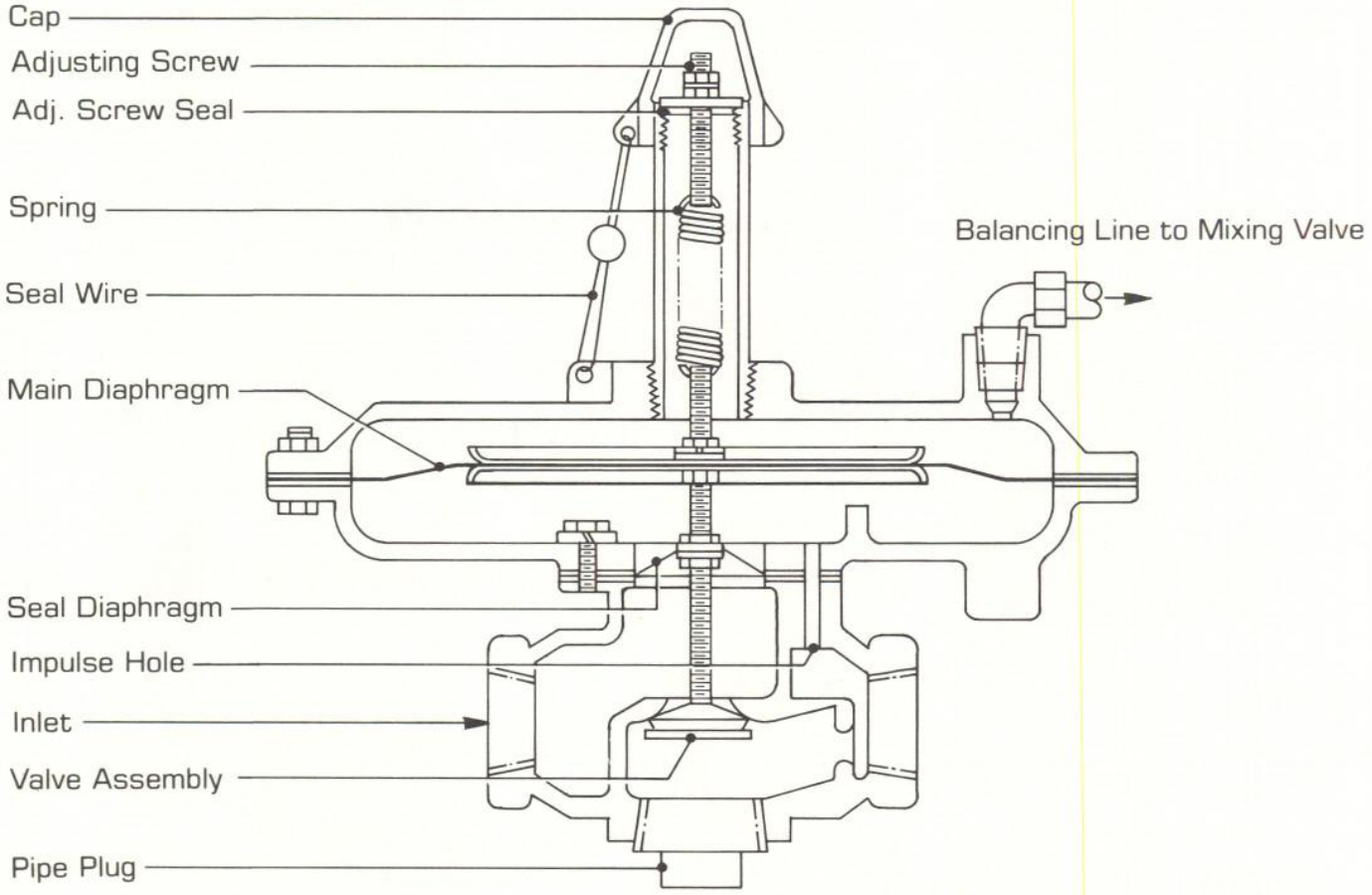
1. Mixer body
10. Bushing
12. Adjusting spindle
20. Piston
46. Mounting flange
47. Internal gear mount
48. Range of port opening scale
50. Adjustment knob
51. Gear mounting shaft
52. Gear mounting shaft
53. Adjustment shaft
54. Drive gear
55. Idler gear (2 each for 800 & 1250 CA)

FIGURE 14
RATIO SCALE REGISTER



56. Internal gear
57. Universal joint
58. O-ring
59. Fillister head machine screw (3 req'd)
60. Roll pin
61. Roll pin (2 req'd)
62. Roll pin
63. Air-gas pointer
64. O-ring
65. Idler gear (150 & 300 CA only)
70. Locking screw
71. Locking spring
72. Locking plug

FIGURE 15
GAS GOVERNOR



OPERATIONAL DIFFICULTIES

TROUBLESHOOTING CLUES

Inadequate Flow or Abnormal Delivery Pressure

1. Check motor rpm (should be about 870 on 60 Hz power) and direction of shaft rotation.
2. Worn or sticking blades in compressor.
3. Worn or sluggish pressure governor piston.
4. Leaking diaphragm in Mixing Valve or pressure governor.
5. Plugged orifice in pressure governor.
6. Check whether linkage at control valve has worked loose.
7. Obstructions in piping, clogged air filter, inadvertent valve closures, tripped firechecks or stuck check valve.
8. Excessive leaks: a) in piping from loose flanges or broken fittings; b) blown burner tips; or c) ruptured blowout disc.
9. Demand exceeds flow capacity of the machine.

Change In Mixture Ratio

1. Check ratio dial setting—perhaps knob was inadvertently moved.
2. Sticky piston—observe whether flow indicator on top of Mixing Valve rises and falls with changes in flow demand.
3. Broken sight glass. Missing or broken sight glass can allow combustion air to enter Mixing Valve without being metered.
4. Damaged diaphragm in gas governor. Proper operation can be verified by making pressure balance test. See test procedure in "Maintenance" instructions.
5. Impulse line obstruction.
6. Clogged orifice in Mixing Valve. Orifice is located in partition above Mixing Valve diaphragm; remove any obstructions.
7. Loose guide pin or guide pin positioner for Mixing Valve piston.
8. Change in quality of fuel supply.
9. Inadequate fuel gas supply pressure.

ORDERING INSTRUCTIONS

When ordering parts, the following information must be supplied in order to accurately identify the items requested.

Information Found On COMBUSTION CONTROLLER NAMEPLATE:

1. Catalog number.
2. Reference number.
3. SERIAL NUMBER.

Information Found In COMBUSTION CONTROLLER INSTRUCTION BULLETIN:

4. Instruction bulletin number.
5. Figure number and title.
6. Part name and index number, from parts list.
7. Quantity.

The Selas 60-CA compressor is rated for 6000 cfh (170 m^3/hr) at 870 RPM, with 60 Hz. For 50 Hz applications, a speed of 750 RPM would deliver about 5150 cfh (145 m^3/hr), while 1000 RPM can increase capacity to 6900 cfh (195 m^3/hr). The higher speed will require more frequent oiling and blade replacement.

MAINTENANCE SCHEDULING

(NORMAL USE — 8 HOURS PER DAY)

	MAXIMUM OPERATING PERIODS				
	8 Hrs.	1 Mo.	3 Mos.	6 Mos.	1 Yr.
Lubricate Compressor	▒				
Check Oil Level	▒				
Clean Air Filter		▒			
Clean Mixer Piston and Bushing		▒			
Check Stuffing Gland for Leaks			▒		
Check Coupling Alignment			▒		
Flush Compressor				▒	
Change Bearing Grease				▒	
Clean Entire Machine (Internally)					▒
Check Oil Seals					▒
Check Blades for Wear etc.					▒

The above schedule is prepared as guide only. Definite maintenance schedule will depend on installation, surrounding conditions and operation.

selas®
The Heat Technology Company

SELAS HEAT TECHNOLOGY COMPANY LLC
130 KEYSTONE DRIVE, MONTGOMERYVILLE, PA 18936
TELEPHONE (215) 646-6600 • (800) 523-6500 • FAX (215) 646-3536