



ORENDA LIMITED

TORONTO • ONTARIO

TRAINING COURSE
ON
OT-F-3 AND OT-F-2100 GAS TURBINE
COMPRESSOR SETS
FOR
ALBERTA GAS TRUNK LINE COMPANY

Revised
MAY 1970

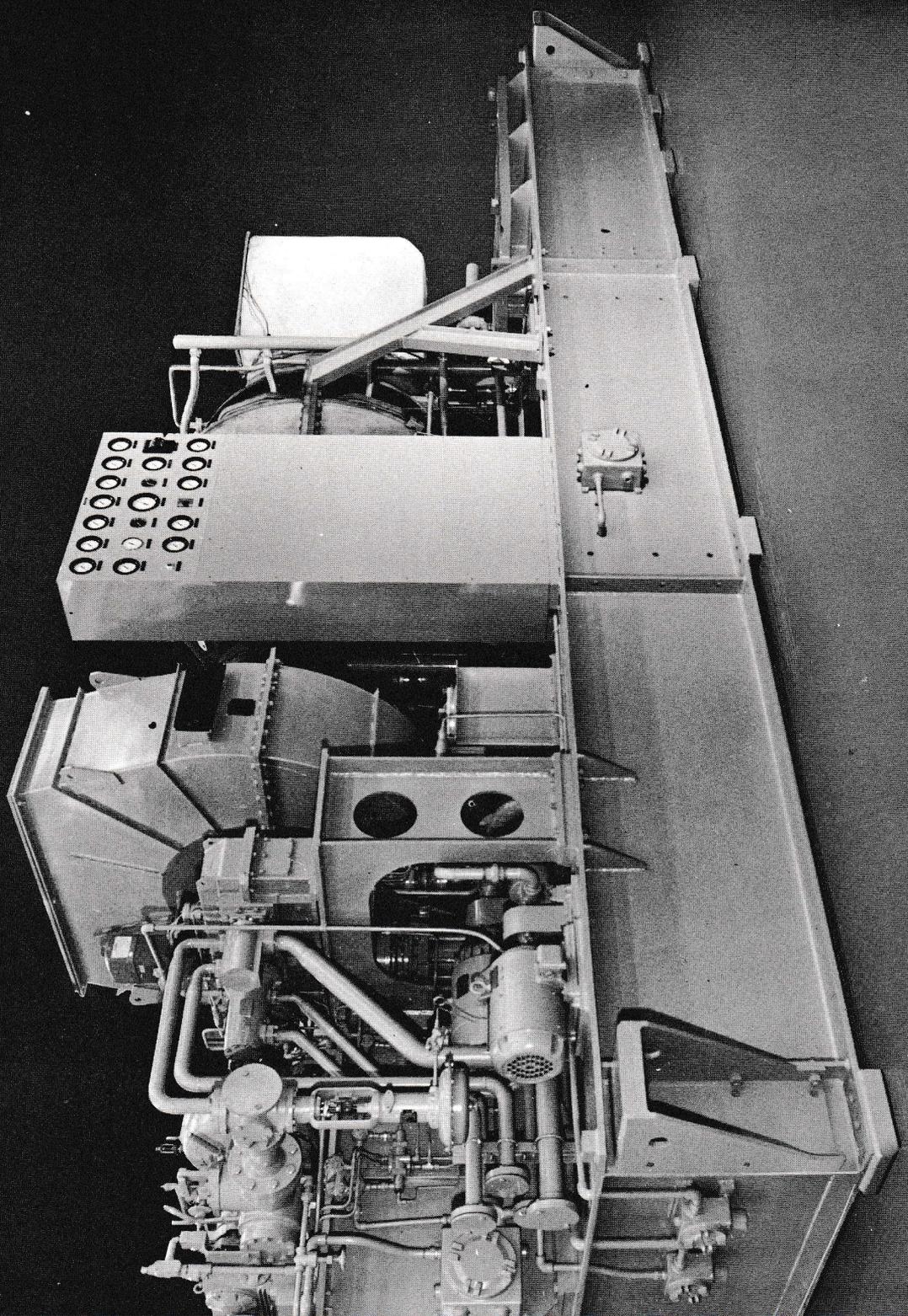




TABLE OF CONTENTS

SECTION	DESCRIPTION	P.
INTRODUCTION		
GLOSSARY		
1.	OT-F-3 GAS PRODUCER AND POWER TURBINE COMPONENTS	
1.1	General	
.2	Overspeed Trip	
.3	Gas Flow	
2.	OT-F-2100 GAS PRODUCER AND POWER TURBINE COMPONENTS	
.1	OT-F-2100 Gas Flow	
3.	POWER PLANT ASSEMBLY COMPONENTS	
3.1	General	
.2	Base	
.3	Power Plant Mounting	
.4	Lube System	
.5	Starting System	
.6	Fuel System	
.7	Instrumentation	
.8	Other Components	
4.	LUBRICATION SYSTEMS	
4.1	Main Lubrication System	
.2	Gas Producer (OT-F-3)	
.3	Booster	
.4	Pressure Switch and Gauge Panel	
4A.	HYDRAULIC SYSTEM	
5.	PNEUMATIC CONTROL SYSTEM	
.1	Fuel and Pneumatic Control	
.2	Air Supply (Orenda Limited)	
.2A	Air Supply (Customer)	
.3	Starting and Fuel Control Valves	
.4	Gas Produce Speed Sensing	
.5	Governor	
.6	Power Turbine Pneumatic Control Panel	

TABLE OF CONTENTS (Cont'd)

5.7	Ramp Generator
.7A	Unloading Ramp
.8	Surge Control
.9	Booster Network
.10	OT-F-2100 Axial Compressor Bleed Control System
6.	CONTROLS BUILDING
.1	General
.2	Motor Control Centre
.3	Unit Control Panel
.4	Station Control Panel
7.	AUTOMATIC CONTROL
.1	Electrical - General
.2	Sequence Diagrams
7A	ELECTRICAL SYMBOLS AND CODES
7A.1	Codes
.2	Symbols
8.	OPERATING INSTRUCTIONS - SINGLE AND DUAL UNIT STATIONS
.1	General
.2	Gas Turbine Air Intake Icing
.3	Vibration
.4	Gas Detection
.5	Fire Detection
8A	OPERATING INSTRUCTION - THREE UNIT STATION
8A.1	General
.2	Installation Requirements
.3	Operating
8B	MOBILE OT-F-3 GAS TURBINE - POWERED COMPRESSOR SET
8B.1	General
.2	Power Package Trailer
.3	Booster Package Trailer
.4	Installation
.5	

TABLE OF CONTENTS (Cont'd)

8B.8	Package Ventilation and Lube Oil Temperature Control
.9	Fire Detection and Extinguishing System
9.	CONTROL SETTINGS
10.	SERVICE MANUAL

LIST OF ILLUSTRATIONS

FIGURE	TITLE
FRONTISPIECE	OT-F-2100 GAS TURBINE
FRONTISPIECE	OT-F-3 GAS TURBINE
FAMILY TREE (TYPICAL)	
1.	Cut-Away View of Gas Producer and Power Turbine
2.	Power Turbine Overspeed Trip Mechanism
2A.	Power Turbine Overspeed Trip - Electronic
3.	Gas Flow Diagram (OT-F-3)
4.	Exploded View of OT-F-2100 Gas Turbine
5.	OT-F-2100 Gas Producer Rotor Assembly OT-F-2100 Power Turbine Rotor in Dynamic Balancing Machine
6.	OT-F-2100 Gas Flow Diagram
7.	OT-F-2100 Power Plant OT-F-3 Power Plant
7A.	Gas Producer Lifting Sling
7B.	Gas Producer Change
8.	OT-F-3 Lube System Components
9.	OT-F-2100 Lube System Components
10.	Fuel System Components (OT-F-3 and OT-F-2100)
11.	Instrumentation and Controls (OT-F-3 and OT-F-2100)
12.	Exhaust and Intake Ducting
13.	Lube System Schematic (OT-F-2100)
13A.	Lube System Schematic (OT-F-3)
14.	Gas Booster Lube and Seal Oil System
15.	Hydraulic System Schematic
16.	Pneumatic Control System (Fuel and Starter Valves)
16A.	Governor Signal Network Block Diagram
17.	Governor and Speed Switch Panel
18.	Power Turbine Control Panel

LIST OF ILLUSTRATIONS (Cont'd)

- | | | |
|------|--|---------|
| 19. | Power Turbine Control Panel (Photo) | |
| 20. | Surge Control | |
| 21. | OT-F-2100 Pressure Switch and Gauge Panel | |
| 22. | Station Control Panel Schematic | |
| 22A. | Bleed Valve Operation - Ambient Temp. vs RPM) |) OT-F- |
| 22B. | Compressor Bleed Valve Control Panel | |
| 23. | OT-F-3 Unit Control Panel (Photo) | |
| 23A. | Event Recorder Chart | |
| 23B. | Fault and Alarm Event Recording Table (UCP)(Typical) | |
| 24. | OT-F-3 Station Control Panel (Photo) | |
| 24A. | Fault and Alarm Event Recording Table (SCP)(Typical) | |
| 25. | Unit Control Operating Schematic | |
| 25A. | Circuit Action Following Powering-up (UCP)(Typical) | |
| 26. | Unit Control Start Permissive Schedule | |
| 26A. | Unit Lockout Control | |
| 27. | Unit Run-up Block Diagram | |
| 28. | Unit Run-down Block Diagram | |
| 29. | Station Run-down Block Diagram | |
| 29A. | Recorder Chart Set | |
| 29B. | Not Used. | |
| 29C. | Vibration Monitor (UCP) | |
| 29D. | Vibration Monitor Power Supply (Slide Pak) | |
| 29E. | Vibration Monitor Channel (Slide Pak)(Typical) | |
| 30. | Station Control Panel (Schematics 3 Unit) | |
| 31. | Station Run-up (3 Unit) | |
| 32. | Station Run-down (3 Unit) | |
| 33. | Not Used. | |

MOBILE

- | | |
|--------------|---|
| Frontispiece | OT-F-3 Mobile Unit |
| 34. | Generator and Motor Control Centre - Electrical Schematic |
| 35. | Power Train |
| 36. | Installation Details |
| 37. | Governor Signal Network - Block Diagram |
| 38. | Generator and Motor Control Centre |
| 39. | Package Ventilation and Oil Temperature Control (Cooli |

GLOSSARY

GLOSSARY

This glossary clarifies and standardizes the terminology used throughout the Service Manuals for both power generating and pumping units.

TERMINOLOGY

DEFINITION

MAJOR COMPONENTS

AUXILIARY POWER UNIT (APU)	Is a machine used to provide a standby supply of electrical power and is driven by a separate and normally self-contained 'prime mover'.
BOOSTER	The term booster generally refers to an axial or centrifugal compressor which is driven by the 'prime mover' to boost natural gas pressure in a pipeline. See also 'Gas Compressor'.
ENGINE	See 'Gas Turbine'.
EXCITER	The term 'Exciter' normally refers to a machine which provides an electrical current used to form an electro-magnetic field around the main windings of a generator (Alternator). This term is also applied to a device which produces a high voltage to supply an igniter plug. The igniter plug is used to ignite compressed gases in a 'gas producer' combustion section.
FREE POWER TURBINE	Consists of single or multiple bladed discs mounted on a shaft. The bladed shaft may be mounted in close proximity to and driven by a source of hot expanding gases. The free power turbine is normally used to drive a pumping unit or generator set, see Power Plant.
GAS COMPRESSOR	See Booster
GAS GENERATOR	Same as Gas Producer below.
GAS PRODUCER	Consists of a compressor (axial or centrifugal), a combustion section and a turbine. The 'turbine' is integral with and drives the compressor. Hot expanding gases emitted by the 'gas producer' may be used for power and regenerative purposes.
GAS TURBINE	An assembly consisting of a 'gas producer' and a 'power turbine'; it may include auxiliary equipment and can be of 'single shaft' or dual shaft configuration.
POWER PLANT	Comprises a complete pumping or generating unit (less the control panels), mounted on one or more bases and containing the following: <ul style="list-style-type: none">- Prime mover 'gas turbine').- Sufficient systems (Fuel, lube, cooling, etc.) to supply prime mover requirements. The base and mounted equipment may be enclosed to provide weather protection and temperature control. The power plant may be controlled locally or from a remote source by control devices remote-mounted from power plant.

TERMINOLOGY

PRIME MOVER

A device which converts a natural source of energy into mechanical power.

REGENERATIVE CYCLE (Also Called RECUPERATIVE CYCLE)

Involves the use of hot gases emitted by a gas turbine to pre-heat compressed air from the 'gas producer' compressor before its entry into the gas producer combustion section.

DUAL SHAFT UNIT

Is a 'gas turbine' configuration made up of two separately-mounted shafts, not physically connected, but jointly encased. One shaft, the front shaft is the compressor and turbine of a gas generator. The second (rear) shaft on which bladed discs are mounted is referred to as a 'Free Power Turbine'. The main drive is normally taken from the rear of the Free Power Turbine.

SINGLE SHAFT UNIT

Is a gas turbine configuration consisting of a compressor and a turbine mounted on one shaft. Drives may be taken from either or both ends of the shaft.

TURBINE

Is a device which converts the energy from expanding gases to a rotary movement which will produce useful work, consisting of a shaft on which are mounted one or more bladed discs.

OPERATING TERMINOLOGY

ABORTED START

Is a non-scheduled shutdown which takes place before a 'prime mover' has reached self sustaining speed and may be brought about by a signal from automatic fault detection circuits or by a manually applied signal.

ANNUNCIATION

Is a visual or audible warning of a fault condition and is usually initiated automatically by fault detection or monitoring devices.

BURNER

See Fuel Nozzle.

FUEL NOZZLE

Is a device used to convert a metered supply of fuel into an evenly distributed cone-shaped pattern at its entry into a combustion chamber.

HOT START

Refers to a condition when exhaust temperatures are excessive during start-up. ?

IGNITION SPEED

Is the speed that the gas producer must attain before fuel and ignition are applied to the gas producer combustion section.

LIGHT-UP

Is the condition when the fuel/air mixture in a gas turbine is burning continuously at a temperature sufficient to maintain continuous combustion.

LOCKOUT

Is a condition under which the power plant cannot be restarted until a latching relay or other types of tripped mechanisms have been manually reset to permit start and run circuits to be energized.

TERMINOLOGY

DEFINITION

POST LUBE PERIOD

Post lube is a timed period, during which time pressurized oil is supplied to bearings. This permits heat to dissipate. The gas producer may be rotated slowly during this period.

RAMP GENERATOR

Is a system or device used to load or unload a power plant at a controlled rate by gradually increasing or decreasing the governor signal up to or down from the load required set-point.

RUNDOWN

Is a timed period which commences when the fuel valve has been closed after receipt of any shutdown signal and continues until the 'prime mover' and driven component have ceased to rotate. During this period, the bearings are supplied with pressurized lube oil and power plant re-starting is prevented.

SELF SUSTAINING SPEED

Is the speed at which the 'gas producer' can maintain operation without the use of applied torque from auxiliary 'prime movers'.

SHUTDOWN

Shutdown is the term used to cover a period of 'power plant' operation following the receipt of any stop signal. This period normally includes:

- A cooldown and 'rundown' timed cycle, during which time various services (lube, cooling, etc.) are retained in operation until the 'prime mover' and the driven component have stopped rotating.
- A 'post lube' period. (*2 hrs. or so*)
- A unit Downtime period, during which time various services may be restarted automatically or may be retained in operation until the next start.

STEADY-STATE

Is a condition, when associated with electrical power generation, when gas turbine speed is held constant to synchronize with line frequency. In this condition, while speed is constant, the power output will vary due to load demands. When associated with a compressor (booster) unit, refers to a condition when the turbine is operating at a constant speed and load.

SYNCHRONOUS CONDITION

Is the term used in power generation and is the condition when the driven alternator output, voltage frequency and phase match the same parameters of the incoming line. When this condition is attained, the line circuit breaker can be closed.

TRIP (FAULT)

Is an unscheduled 'shutdown', brought about automatically by fault detection circuits or by a manually applied signal, both of which by-pass normal rundown sequencing circuits. A trip shutdown is normally accompanied by unit 'lockout'.

SECTION 1

OT-F-3 GAS PRODUCER AND POWER
TURBINE COMPONENTS

INTRODUCTION

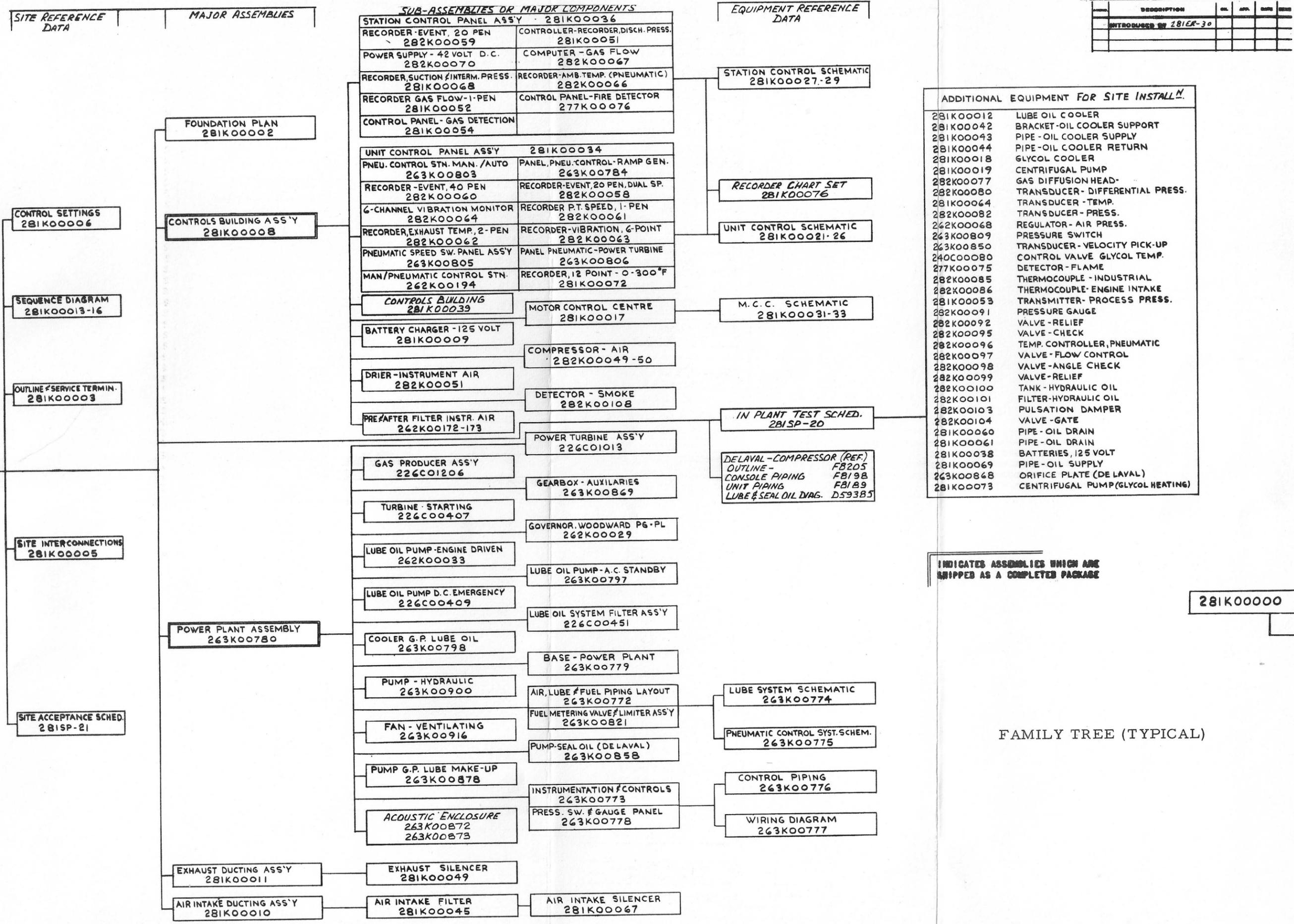
The "Operation and Maintenance Training Course" for the OT-F-3 and OT-F-2100 "Gas Turbine Units driving Centrifugal Compressors", as installed by Alberta Gas Trunk Line Company, covers the following main areas.

- Component arrangement.
- Control system - pneumatic.
- Control system - electric.
- Operating and servicing (2 unit station).
- Operating (3 unit station).
- Mobile compressor sets.

The purpose of the course is to familiarize the operator with the components and systems associated with the units and impart a working knowledge of the schematic drawings. To this end, drawings and photographs for the main part used in the course pertain to the actual units.

Further, as each area of the installation is covered, a detailed breakdown of each system or component along with servicing and maintenance instructions will be discussed by the representative of the company supplying such items. Included will be sessions on the gas turbine principle, the booster unit (centrifugal compressor), the pneumatic components, controllers, governor and recorders. Notes of these discussions will not be part of this text.

NOTE: The OT-F-3 and OT-F-2100 gas turbine-powered gas compressor units are normally static base-mounted. The gas turbine sections of the units are housed in weatherproof covers. Some OT-F-3 units, however, are mounted in box car type containers on tractor prime movers. These are referred to as mobile units, and they are similar in design and construction to a standard base-mounted OT-F-3 unit. Differences between the two types are described separately in Section 8B.



FAMILY TREE (TYPICAL)

281K00000

SECTION 1.

OT-F-3 GAS PRODUCER AND POWER TURBINE COMPONENTS

1.1 GENERAL

Refer to Fig. 1.

The OT-F-3 two-shaft gas turbine power plant combines the aircraft version of the Orenda (light weight) jet engine with a heavy duty, free shaft power turbine. The gas producer is approximately 2.5 feet in diameter and 7 feet long. The power turbine is approximately the same diameter and 3.5 feet long.

The two shaft unit is ideally suited for driving a centrifugal compressor for gas line boosting, since it gives almost unrestricted flexibility of operation. Power changes are achieved by speed changes of the gas producer and because the two shafts are independent, the power turbine can operate over a range of speeds to match changes in line conditions.

Starting and bringing a two-shaft unit to operating speed is easily carried out since the turbine, when at low speed and hence low power output, is not affected by the high torque characteristics of the driven unit at low speed.

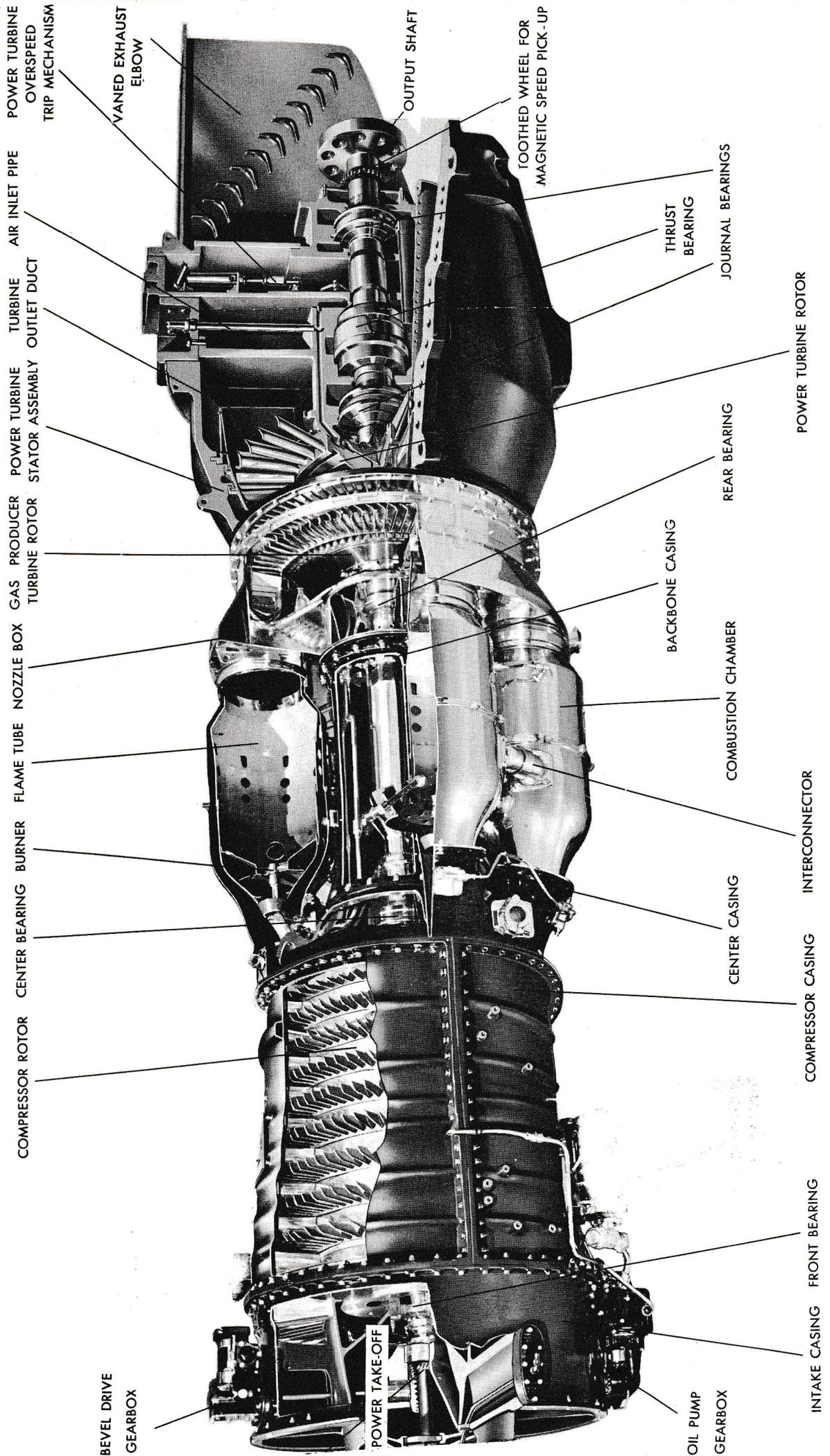
The power plant is broken down into two basic sections:

- (1) The rotating hardware consisting of the gas producer ten-stage axial compressor and two-stage axial turbine, and
- (2) The single stage power turbine and associated shafting.

The fixed hardware consists of the support frames, stator casings and combustion cans; the physical contact between the two being a set of three roller bearings on the gas producer and three Kingsbury type sleeve bearings on the power turbine. Both shafts incorporate a bearing to accommodate end thrust loads.

Major fixed assemblies of the OT-F-3 are as follows:

Intake Casing (or forward frame), being the front structural member of the gas producer, supports the front bearing, the inlet guide vanes (air flow management equipment), scavenge and delivery oil pumps, power take-off, bevel G/B and fibre-glass intake fairing. To maintain auxiliary shaft alignment with the power take-off, a ring support connects this casting to the base. The gas producer speed signal and electronic overspeed signal are taken from magnetic pick-up heads located in the bevel drive gearbox.



Cut-Away View of Gas Producer and Power Turbine

FIG. 1

The Compressor Stator Case contains the air flow, supports the fixed stator blades and provides the pickup point for the vibration sensor.

The Centre Frame provides six separate passages which distribute air from the tenth stage compressor blades to the combustion chambers, and provides mounting support for the centre and thrust bearing. The gas producer is supported by the base at this point through two spring hangers. In this section two one-inch diameter ejectors at top dead centre and bottom dead centre are provided to dump a controlled amount of air, to minimize the load on the centre bearing. Also in this section is the "Compressor Delivery Pressure" tapping required for governor acceleration control.

Combustion Section - The six straight-through flame tubes (combustion cans) are floating to take care of heat expansion, and the engine structural support in this area is transferred to the backbone casting, visible between the combustion chambers. The chambers are joined by interconnectors to provide pressure balance and flame propagation. Chambers 2 and 5 contain ignitors.

Nozzle Box - The nozzle box is a fabricated section, instead of a casting, providing support for the rear bearing and containing a diffuser section and nozzle guide vanes to most efficiently direct the hot gases into the gas producer two-stage turbine. A connection at bottom dead centre is provided to vent waste air from the centre and rear bearing cavities.

An adaptor ring fits between the gas producer and power turbine, and it is this flange that is broken for gas producer removal.

Power Turbine Stator Case - Physically this appears as a heavy casting and supports the guide vanes required for directing the hot gases at the proper angle, and externally serves as the main support frame for the power turbine. Also secured to this casing is the bearing support housing and the power turbine overspeed trip mechanism. For ease of dismantling, a horizontal split is provided.

1.2 OVERSPEED TRIPS (MECHANICAL AND ELECTRONIC)

Refer to Figs.2 and 2A.

The overspeed trip mechanism is housed in the casing adaptor of the power turbine rear casing assembly and is comprised of a pneumatic reset cylinder, a limit switch, a pressure relief valve and the requisite linkage for the trip operation.

POWER TURBINE OVERSPEED TRIP MECHANISM

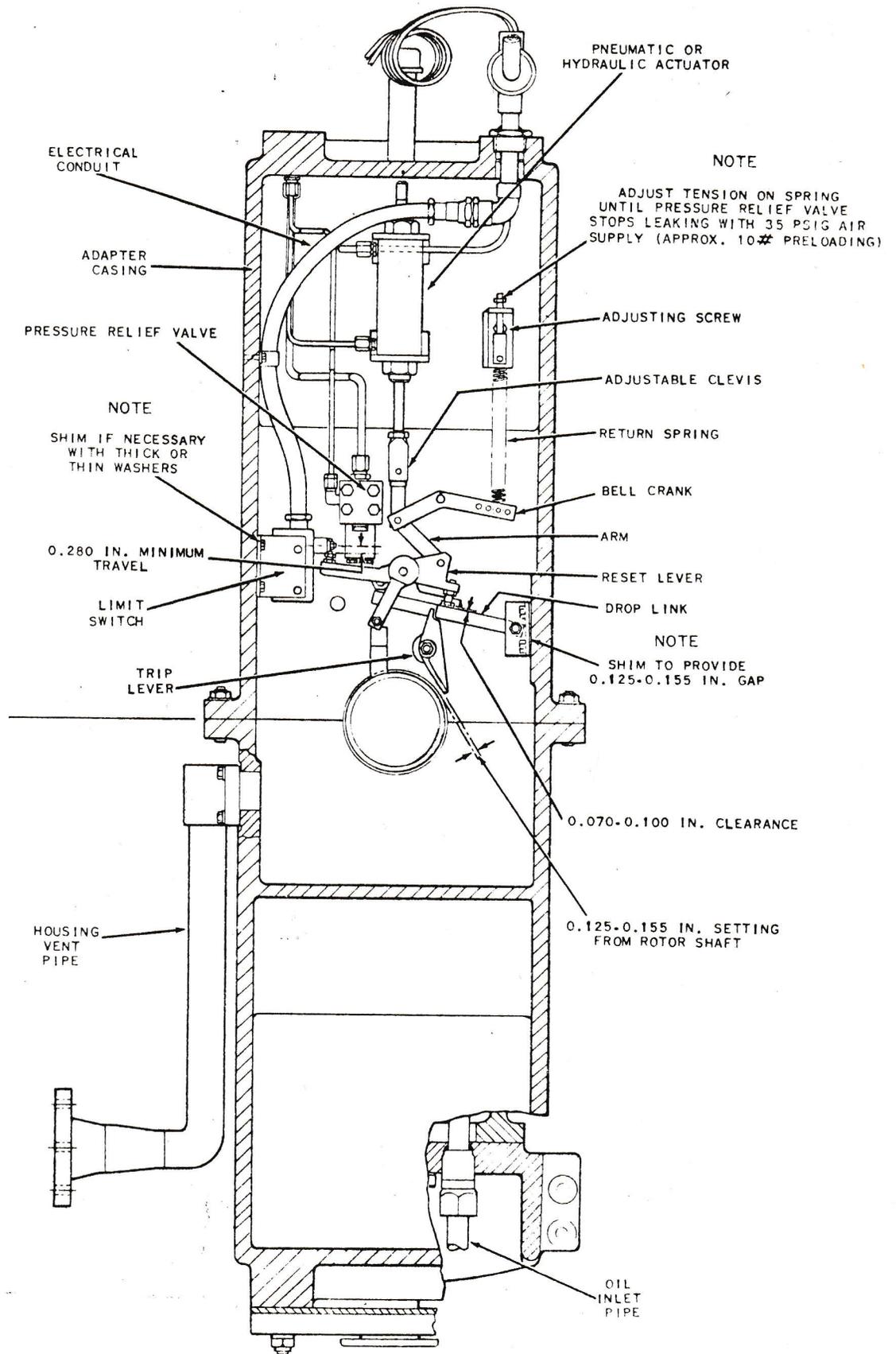


FIG. 2

A drilled hole in the power turbine shaft houses a piston and spring assembly for the overspeed trip mechanism. Should the turbine speed attain the overspeed set point, centrifugal force will be such that the spring-loaded piston is moved out of the orifice to operate the linkage of the trip mechanism.

When the spring-loaded piston flies outward, the stem of the piston bears on the trip lever of the mechanism which releases a drop link. The resultant linkage movement operates the overspeed limit switch and opens the pressure relief valve to actuate the electric switch and annunciate the fault and trips the unit off the line.

The trip mechanism on the OT-F-3 installation is reset by applying the requisite pressure to the pneumatic reset cylinder, thus effecting movement of the piston which resets the linkage. The offset weight design of the trip lever moves it independently into the locking position. A mechanical reset opening is provided if the pneumatic reset fails to operate.

The OT-F-2100 does not provide for pneumatic reset. A grip handle located on the top of the housing is used to reset the trip mechanical linkage.

A power turbine electronic overspeed trip switch is used in addition to and as a backup to the mechanical overspeed trip device. The switch receives frequency signals proportional to 0-10,000 rpm from a pick-up head located adjacent to a toothed wheel on the power turbine driveshaft, see Fig.17. If sensed PT speed exceeds the switch set-point, unit trip is initiated through the unit control circuits, see also Fig.2A.

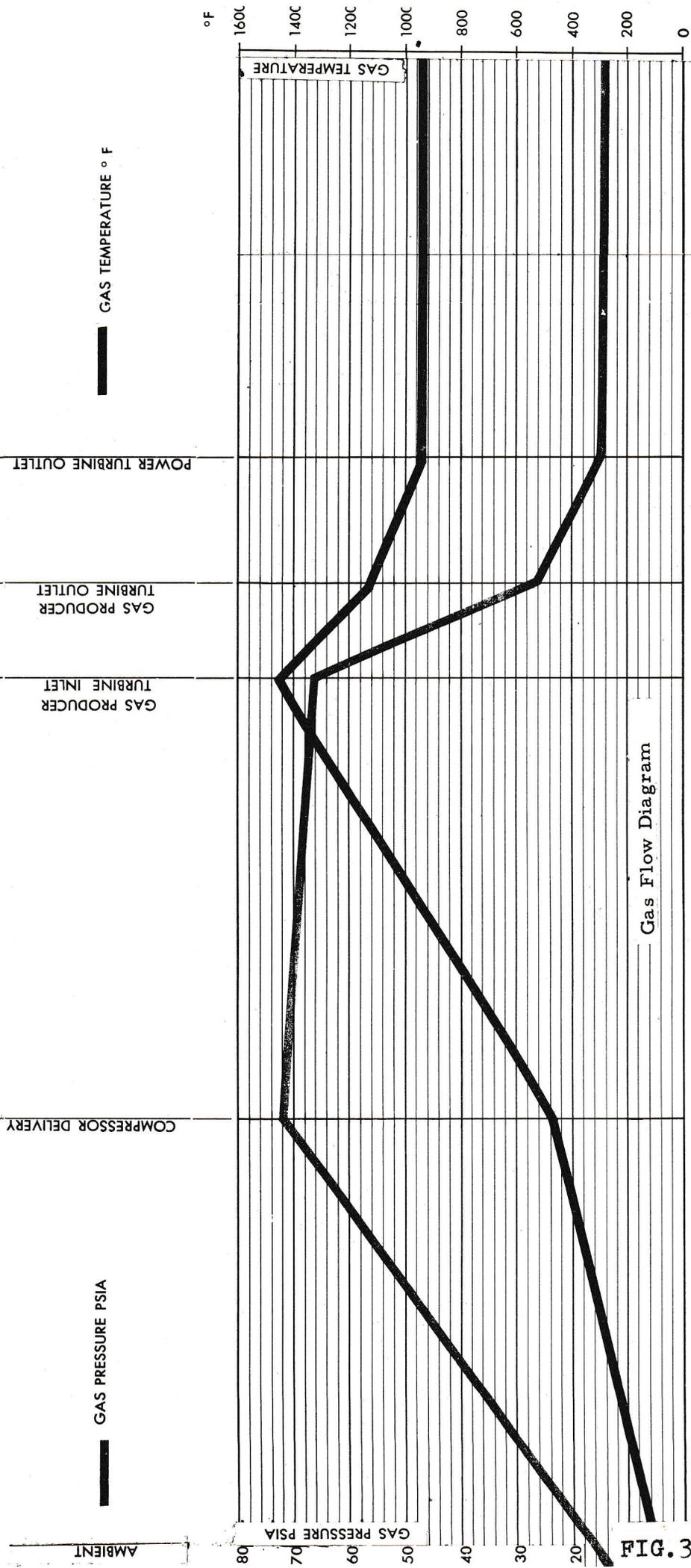
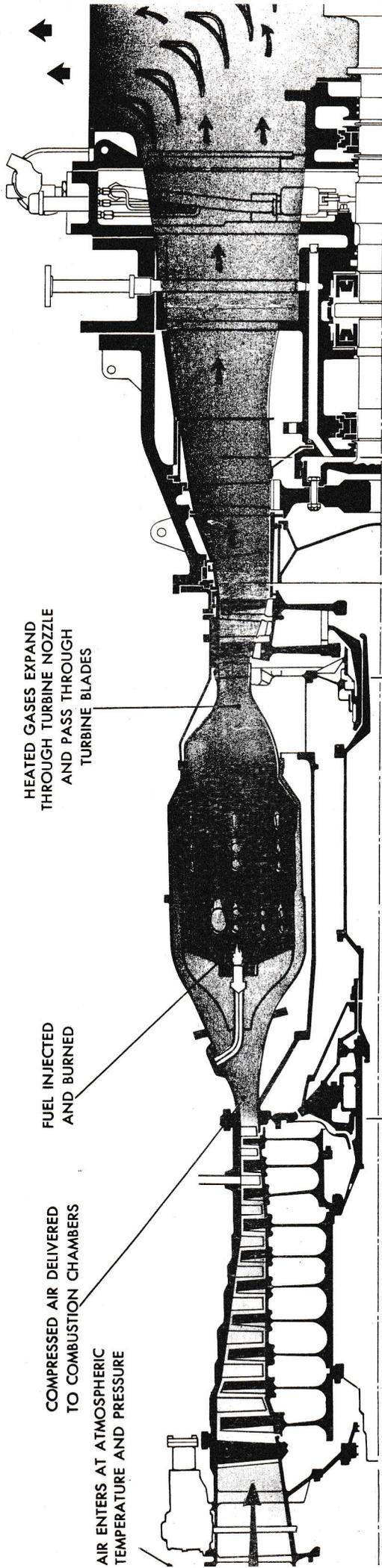
1.3 OT-F-3 GAS FLOW

Refer to Fig. 3.

When the gas producer is rotated by the gas expansion type starter motor through the auxiliaries gearbox, filtered air is drawn in toward the gas producer through an intake bellmouth designed to maintain a smooth flow of air. The air is further straightened by the gas producer inlet guide vanes and directed at the proper angle into the compressor first stage blades, and then progressively compressed through each of ten stages. Each of the ten stages comprises a row of rotating blades and a row of stationary blades, and the air is compressed to approximately five times the pressure entering the first stage. As the air is compressed, its temperature rises and reaches a level of approximately 500° F.

Compressed air is bled off at the third stage at about 300° F to provide cooling air for the centre bearing, the main drive shaft and the rear bearing. This air is then ejected through the waste air vent at the bottom rear of the gas producer.

A take-off point for extraction of eighth stage air is provided. This air at approximately 60 psi. is used for cooling and pressurizing the forward power turbine bearing.



Gas Flow Diagram

The tenth-stage air pressure is designated "Compressor Delivery Pressure" (CDP) and is supplied to the governor system as a control parameter.

The air is forced from the tenth-stage of the compressor through a diffuser section in the centre frame into six straight through combustion chambers spaced evenly around the gas producer axis. A set of interconnectors between each chamber is provided to maintain pressure balance, even burning and flame propagation on light-up.

A portion of the air that enters the chamber is used for combustion while the remainder passes around the outside of the flame tube and through cutouts in the flame tube to provide cooling air to metal surfaces and a flow pattern to aid in light-up and produce even burning.

Another portion of the tenth-stage air is used to cool and maintain an air balance condition in the centre bearing area. It is part of this air that is dumped into the cubicle through two ejectors located between the two upper and two lower combustion chambers. This air blast is rearward and forms part of the cooling air flow over the outside surfaces of the power turbine.

Fuel enters the front end of each flame tube symmetrically at a predetermined rate, to give the proper mixture for the amount of air passing through the flame tube. After the sparking type igniter ignites the fuel, burning is continuous until interruption of the fuel supply occurs.

A portion of the energy generated by the burning and expanding gases (maximum temperature approximately 1500° F.) is converted by the gas producer two-stage turbine into rotary motion to drive the gas producer compressor. The remainder of the energy is released to drive the free power turbine. The single stage free power turbine extracts a large percentage of the remaining energy from the gas stream and converts this energy to mechanical work to drive the output shaft.

As the gas leaves the gas producer, it is directed through a set of heavy duty nozzle guide vanes (NGV's) into the power turbine blades. The NGV's and blades can be seen clearly when the gas producer is removed. The air expelled through the power turbine is then carefully diffused through ductwork elbows and silencer to maintain maximum operating efficiency. The temperature of the gas as it leaves the elbows is the controlling temperature for the unit.

Air directed through the centre hollow shafting of the gas producer dumps air into the gas producer turbine and power turbine disc area to reduce material operating temperatures.

SECTION 2

OT-F-2100 GAS PRODUCER AND POWER
TURBINE COMPONENTS

SECTION 2.

OT-F-2100 GAS PRODUCER AND POWER TURBINE COMPONENTS

Refer to Fig. 4.

The arrangement of the OT-F-2100 components in relation to airflow management is similar to the OT-F-3. That is, the rotating blades are located between sets of fixed blades (stator vanes), provided to direct the air at the correct angle into the first stage of the compressor and turbine rotors. The combustion cans are fixed at one end only to compensate for expansion and the power turbine produces shaft horsepower.

The gas producer for the OT-F-3 installations is of aircraft-type design and is easily replaced by complete changeout, whereas, the gas producer section of the OT-F-2100, of heavy industrial design, is an integral part of the gas turbine and is normally serviced or repaired in situ. The power turbine section of both the OT-F-3 and OT-F-2100 and the mechanical overspeed trip mechanism are also manufactured as heavy duty industrial components.

NOTE: Both types of units are equipped with an electronic overspeed trip back-up system, see 1.2.

The higher rating of the OT-F-2100 is accomplished by increasing the number of working stages in both the compressor and the power turbine. The compressor is of 12-stage construction, two more than the OT-F-3, and the power turbine consists of 2 stages instead of a single stage. On the OT-F-2100, the compressor stator casing is provided with two openings to bleed air from the 4th and 5th stages to prevent surge conditions in the compressor section during start up. When the unit is operated at very low load conditions these valves will also open; however, operating the unit for sustained periods with the bleed valves open is not recommended.

A diffuser section located between the compressor outlet and the combustion cans serves two main purposes.

1. Channels the air to the combustion area at the correct pressure and location.
2. Supports the compressor rotor rear bearing.

The eight combustion cans, housed in a heavy casting, although of a heavier gauge material and a somewhat different design, have several features similar to the OT-F-3. Four of these are:

1. Fuel is supplied on the upstream end of the can at geometric centre.
2. Interconnectors join each can.

Exploded View of OT-F-2100 Gas Turbine

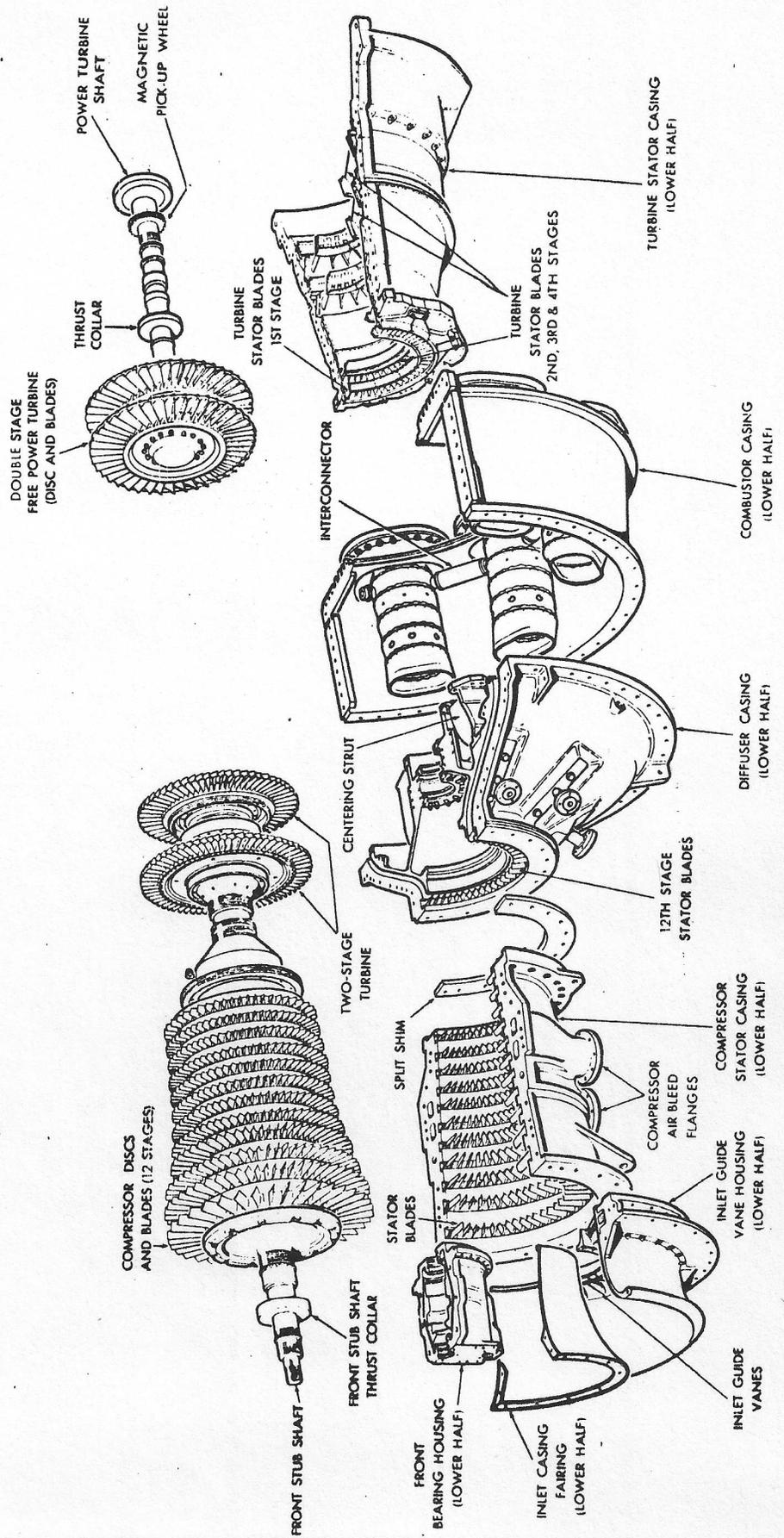


FIG. 4

3. Downstream ends are floating to take care of expansion.
4. Ignition plugs are inserted in two cans.

All fixed components surrounding the rotating portions, such as the stator case, bearing housing, diffuser, combustor housing and turbine stator are split at the horizontal centre line for ease of maintenance.

The gas producer and power turbine rotors each ride on two Kingsbury type sleeve bearings. Each rotor is provided with a thrust collar, machined as part of the shaft, and working on a Kingsbury thrust bearing, to minimize axial displacement. The blading is retained in the discs by means of a fir tree section and a locking strip and each disc is retained by means of long bolts running the entire length of the rotor. The blades tips are shrouded to dampen blade flutter at operating temperatures and improve their operating efficiency.

Refer to Fig. 5 for a closer examination of the power turbine in a balancing rig and the gas producer rotor on a maintenance stand prior to being lowered into the bottom half of the bearing shells during engine build.

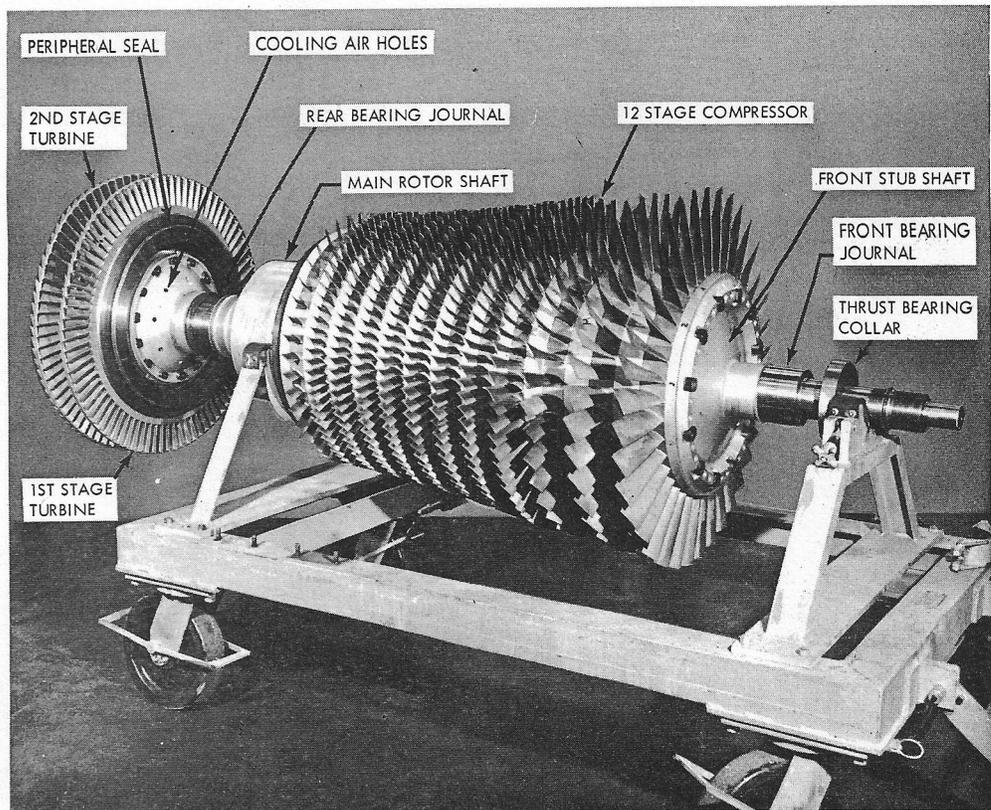
2.1 OT-F-2100 GAS FLOW

Refer to Fig. 6.

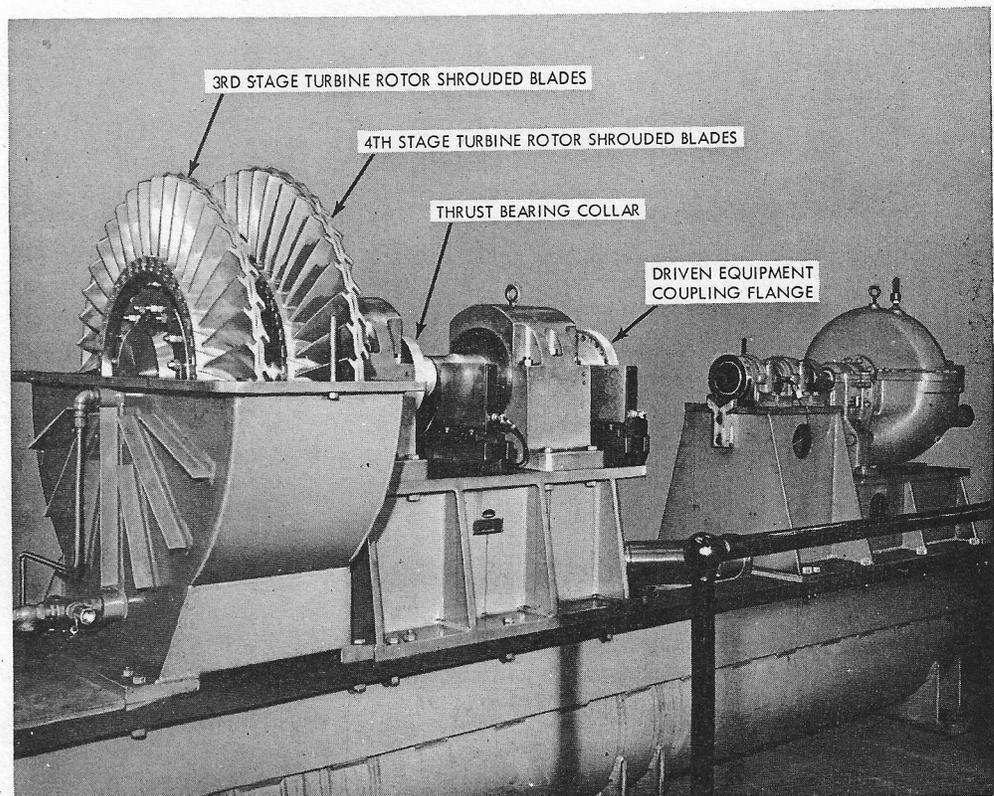
Thermodynamically the air through an OT-F-2100 is treated the same way as the OT-F-3 and energy is expended at the same points. The main difference occurs in the combustion area where the compressor discharge air is reversed going through the combustion cans and then turned approximately 90° to go through the turbine for purposes of reducing the overall length of the unit.

Figure 6 indicates the gas pressure and temperature conditions when operating at 7200 rpm at 80° F. ambient. Bleed air out of the 4th and 5th stages is not shown as the dump of air is only required during the acceleration period below approximately 5800 rpm. Other air in small quantities is tapped at the diffuser section to provide for bearing cooling and air balance across bearing seals.

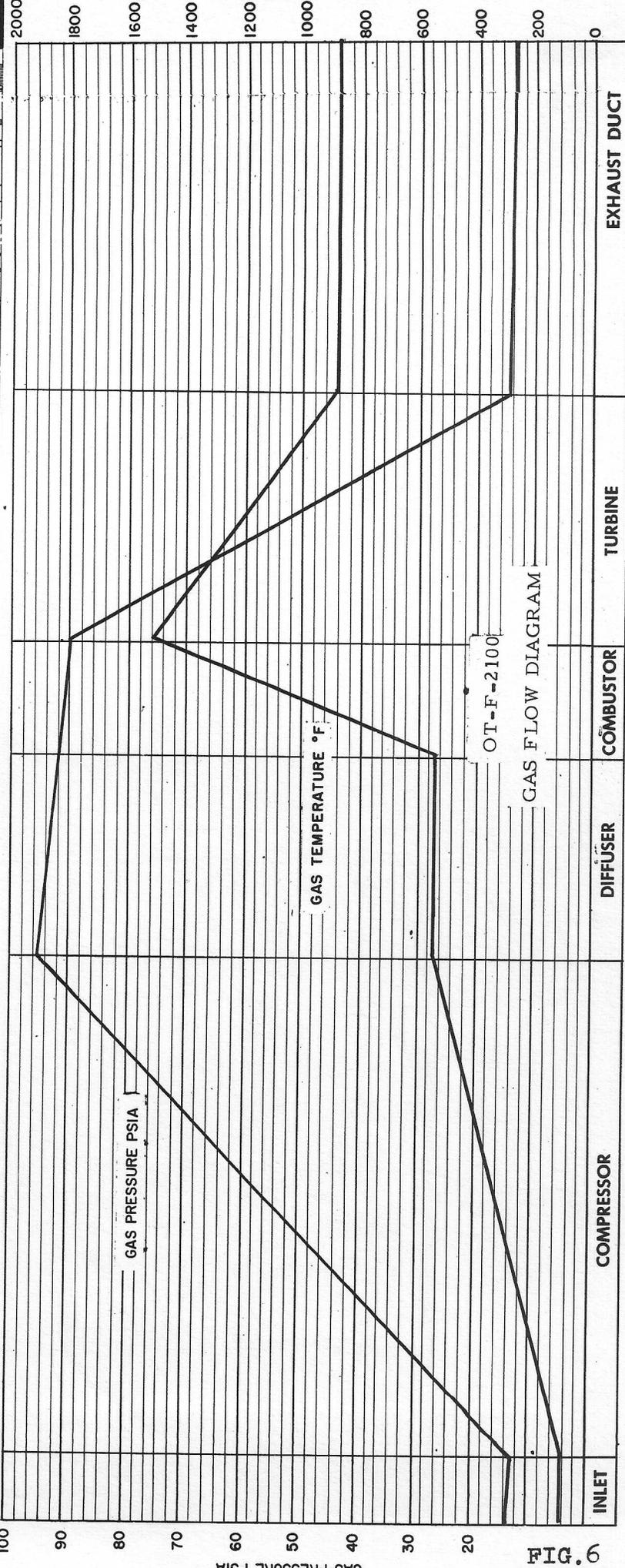
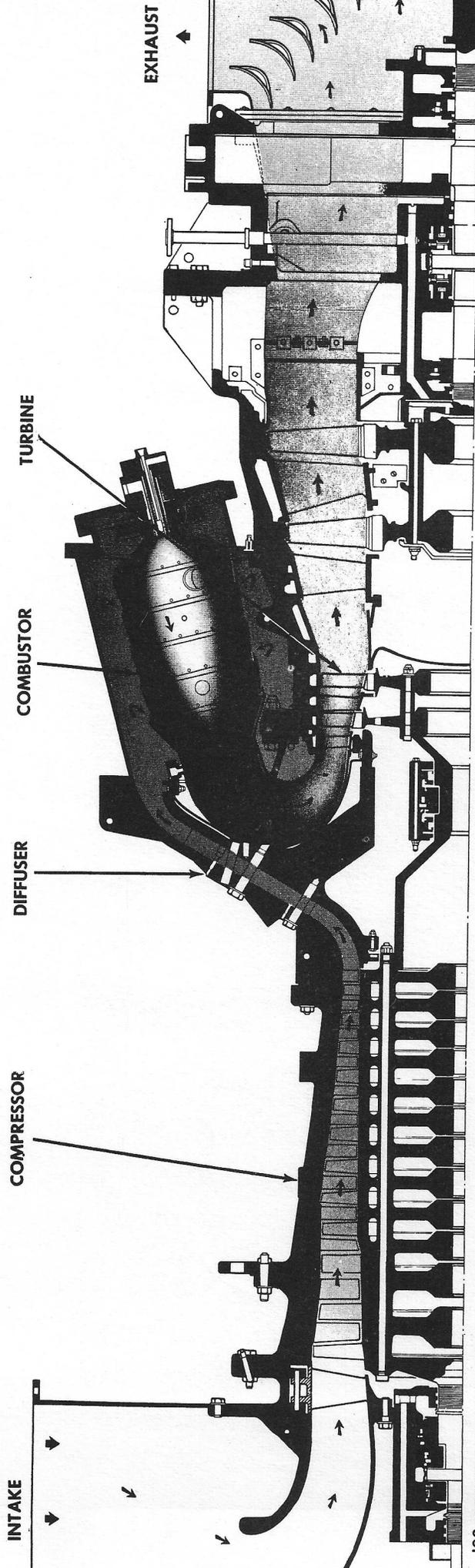
The air is compressed approximately seven times atmospheric pressure going through the gas producer rotor and a temperature of 1520° F. is the maximum calculated temperature at full load. The exhaust gas temperature used for control is recorded further downstream and is set for 925° F, and represents the gas producer turbine inlet limit.



OT-F-2100 Gas Producer Rotor Assembly



OT-F-2100 Free Power Turbine Rotor
in Dynamic Balancing Machine



9. FIG

SECTION 3

POWER PLANT ASSEMBLY COMPONENTS

SECTION 3.

POWER PLANT ASSEMBLY COMPONENTS

3.1 GENERAL

Refer to Fig. 7.

The "Power Plant Assembly" is comprised of the base and all hardware attached to the base. Figure 7 shows both the OT-F-3 and the OT-F-2100 power plant assemblies. These drawings are not exactly to the same scale, therefore the physical dimensions are not comparable. In actual practice both units have the same centre line dimension above the booster pad, as is shown by the 44.875" dimension to the power shaft centre line. Figure 7 is useful in comparing the general arrangement of hardware on the base and the support structure that is heavily shaded for clarity. Because of the difference in weight between the OT-F-2100 and OT-F-3 the physical size of structural members will differ and the lube oil pump capacity will vary due to the different rating of each unit.

When "front end" is used in text or discussion it refers to the air intake end, and the "rear end" refers to the booster end. The general hardware layout as mounted on the base shows the lube oil storage supply tank at the front of the base and all relevant lube pumps and filters, etc., immediately above, along with the auxiliaries gearbox and starting and turning hardware. Immediately behind the auxiliaries gearbox is the air inlet casing. Centrally located is the power plant consisting of the gas producer and the power turbine and at the rear end the main power shaft, exhaust elbows and booster, or driven machine.

3.2 BASE

The bases for both the OT-F-3 and the OT-F-2100 are of a similar I-beam and welded plate construction, but because of the heavier weight of the OT-F-2100 power plant (20 tons vs. 6 tons) the beam strength requirement is naturally greater.

The requirement for two types of oil for the OT-F-3 power plant made it necessary to build an additional storage tank into the OT-F-3 base, otherwise the base layouts are similar, with the power turbine lube storage located at the front of the base in both cases.

3.3 POWER PLANT MOUNTING

The power plant axial position in relation to the booster unit is maintained by means of a flexure plate attached to the lower rear casting of the power turbine on both the OT-F-3 and the OT-F-2100. This flexure plate also maintains the correct centre line relation between the base, booster and power plant. All thermal growth of the power plant is from this point forward.

The weight of the OT-F-3 power turbine is taken on four (4) struts located between the base and the corners of the stator case split line. In order to prevent vertical misalignment of the power turbine shaft in relation to the booster shaft, the struts are cooled and maintained at a relative constant temperature by circulating the power turbine lube through the hollow struts. A flexible portion is built into the top and bottom of each strut to provide for thermal adjustment. Because of the more rigid construction of the OT-F-2100 stator cases, the support of the entire power plant is taken on four struts constructed the same way as the OT-F-3 power turbine struts but designed to take the extra weight.

A centering pedestal located in line with the front flange of the OT-F-3 power turbine mates with a centering member fixed to the lower stator case. This is a sliding joint and helps to limit side movement and, at the same time, allows for forward thermal growth. The OT-F-2100 has an A-frame and flexure rod at the forward end of the gas producer compressor to maintain lateral control.

The OT-F-3 gas producer whose installation provides for quick gas producer changeover, Figs. 7A and 7B, is supported at two points:

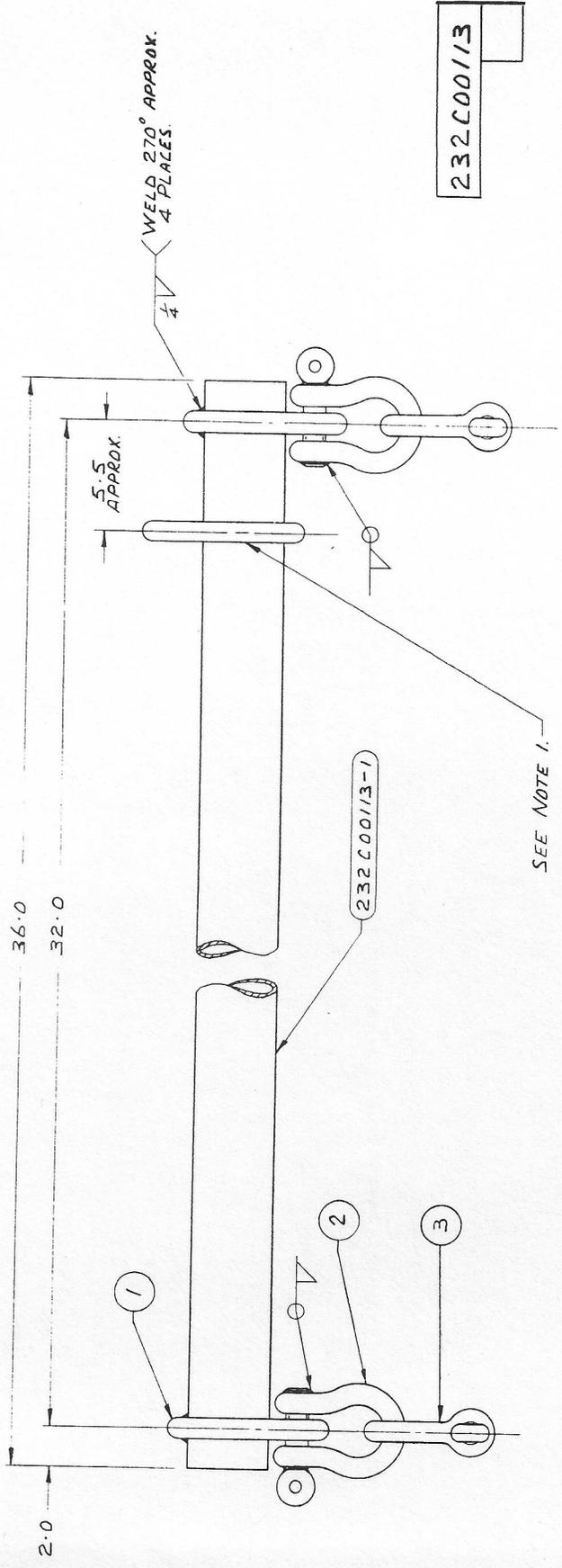
NOTE: A complete gas producer changeover can be accomplished with an eight-hour shift.

1. A set of spring hangers support the gas producer at the centre casting and are adjusted to take roughly three quarters the weight of the gas producer. This support relieves the strain on the nozzle box section of the gas producer and damps out any harmonics that may develop.
2. A ring, spigotted to the front frame of the gas producer, maintains the proper alignment between the auxiliaries gearbox and the gas producer power take-off. Flexure plates are also built into the legs of this support to provide a forward thermal growth of approximately 0.500". As adverse heat conditions are not a problem in this area these support legs do not require lube circulation through the hollow portion.

The booster unit is secured to a machined surface that is tied directly to the sole plates through "I" beams.

NO.	DESCRIPTION	CH.	APP.	DATE	ZONE
1	232C00113				

UNLESS OTHERWISE SPECIFIED
 TOLERANCE ON ONE PLACE DIMENSIONS ± .06
 TOLERANCE ON TWO PLACE DIMENSIONS ± .01
 TOLERANCE ON THREE PLACE DIMENSIONS ± .005
 FINISH ON ANGLES 1°
 FINISH ON SURFACES 018-028
 INTERNAL CORNERS RADIUS
 FINISH V AA MICRO FINE
 CAST FILLET RASH TO BE



232C00113

- NOTE:-**
- ADJUST TO 5.5" APPROX. & SECURE TEMPORARILY. CHECK-LIFT ENGINE TO FIND C.G. ADJUST AS NECESSARY UNTIL ENGINE IS HORIZONTAL. FINALLY WELD 270° APPROX. x 1/4" FILLET EACH SIDE.
 - PIPE TO BE CLEARLY MARKED IN 1 1/2" RED LETTERS ON FAR & NEAR SIDES AS FOLLOWS:-
 MAXIMUM LOAD 3000 LBS.
 - PAINT WITH 1 COAT OF RUST RESISTING PRIMER FOLLOWED BY 2 COATS OF AIR DRYING ALLOY MACHINERY PAINT. COLOUR OF PAINT:- GREY 1-117 TO SPEC 1-0P-128

FIG. 7A GAS PRODUCER LIFTING SLING

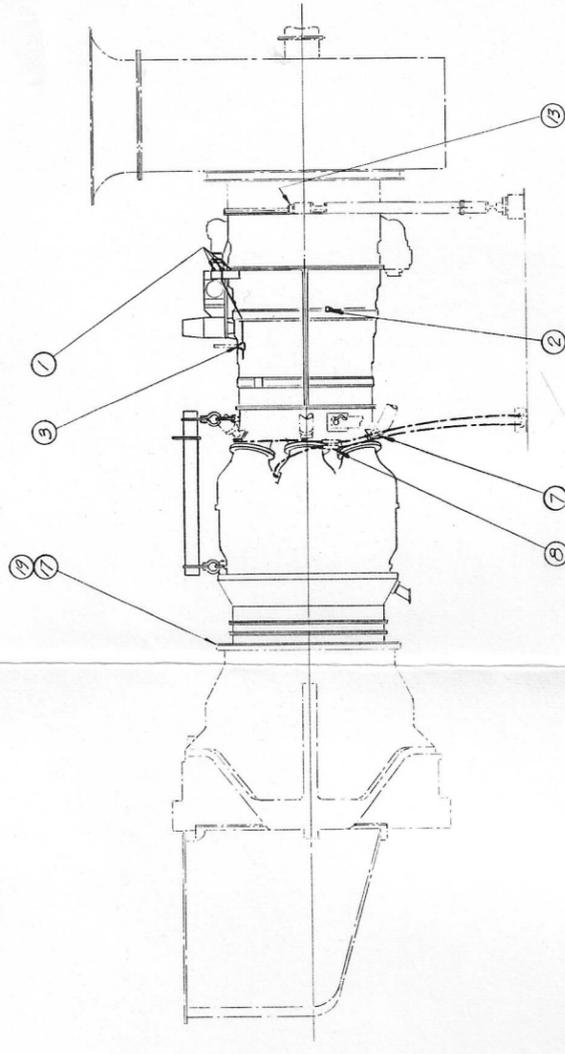
ITEM	DISCONNECTION LOCATION	TYPE OF CONNECTION	SPECIAL INSTRUCTIONS
1	REMOVE 263K00363 (2 off) & 263K00882 AT ENGINE.	FEMALE FLARED TUBE END.	PLUG TUBE ENDS WITH H 53439.
2	REMOVE 263K00360 AT ENGINE.	FEMALE FLARED TUBE END.	PLUG TUBE END WITH H 53339.
3	LUBE OIL PRESSURE INDICATOR	MALE FLARED TUBE END	PROTECT WITH CAP AN29-4; LOOSEN FIRST DOWN STREAM FITTING & ROTATE LINE CLEAR OF ENGINE DIAMETER.
4	WASTE AIR OUTLET	1/4" BAND CLAMP H 51886	SUPPORT BELLOWS BEFORE REMOVING CLAMP. BLANK WITH MASKING TAPE CLAMP REMAINS WITH POWER PLANT.
5	SEAL AIR SUPPLY TO P.T. FRONT & CENTRE BEARING SEALS.	3 BOLT FLANGE	REMOVE FLANGE AS PART OF HOSE ASSY. PROTECT COMPRESSOR CASING FORT WITH 226650663 USING EXISTING BOLTS & GASKETS.
6	H.P. AIR TO FUEL CONTROL VALVE (G.D.P.)	MALE FLARED TUBE END.	PROTECT WITH CAP, AN29-4.
7	GASEOUS FUEL SUPPLY LINE	4 BOLT FLANGE (6 PLACES)	PROTECT WITH PARTS 22600084, BOLT H 53381 AND NUT H 50426.
8	GAS PRODUCER IGNITION CABLES	BENDIX CONNECTOR	DISCONNECT GAS PRODUCER IGNITION CABLES AT JUNCTION OF IGNITION EXTENSION CABLES, 263K00977 (2 off.)
9	THERMOCOUPLE CONNECTOR	1 CANNON CONNECTOR	PROTECT WITH CAPLUS NO. EC-20.
10	BRACKET - VIBRATION SENSOR	4 BOLTS 3 CAP SCREWS	REMOVE BRACKET WITH VELOCITY PICK-UP FROM BRACKET (2 off). RETAIN HARDWARE. FORWARD COMPRESSOR FLANGE BOLTS, NUTS AND WASHERS, AM10224 (4 off) AN365-524C (4 off), AN960-516L (8 off) FROM REPLACEMENT GAS PRODUCER TO BE TRANSFERRED TO "OUT OF SERVICE" ENGINE.
11	MAGNETIC PICK-UP	TAPPED FEMALE THREAD 3/4-20 UNF-2B	REMOVE MAGNETIC PICK-UP (2 off) FROM BEVEL DRIVE GEARBOX ASSY. PROTECT WITH CAPLUS NO. 9.
12	ATTACH GAS PRODUCER LIFTING SLING, 23200013.		
13	FRONT FRAME EXTENSION & ADAPTOR.	BOLTS & NUTS	REMOVE 2 NUTS AT INTAKE CENTRE LINE (RIGHT & LEFT SIDE). RETAIN HARDWARE. REMOVE FRONT FRAME EXTENSION. REMOVE HARDWARE AT INLET CASING FAIRING FLANGE. SLIDE FAIRING TOWARD 9' BOX. RETAIN HARDWARE.
14	COUPLING GUARD	BOLTS & NUTS	REMOVE OUTER RING OF BOLTS (8 off) FROM SUPPORT RING AT REAR SECTION OF COUPLING GUARD. RETAIN HARDWARE. SLIDE REAR SECTION FORWARD TO PERMIT REMOVAL OF COUPLING. REAR END OF AUXILIARIES DRIVE COUPLING.
15	AUXILIARIES DRIVE COUPLING	BOLTS & NUTS	UNDO COUPLING FROM COUPLING ADAPTOR, 6 BOLTS. RETAIN HARDWARE.
16	GAS PRODUCER TRUNNIONS	GIMBAL HOUSING (2 PLACES)	UNDO LOWER HALF OF GIMBAL HOUSING - BOTH SIDES OF GAS PRODUCER.
17	FRONT FLANGE OF P.T. & REAR FLANGE OF ADAPTOR CASING.	1/2" BOLTS - 32 REQ'D. NUTS - 2 UNF-2B BOLTS INSTALLED AT CENTERING MEMBER	MOVE GAS PRODUCER FORWARD TO CLEAR POWER PLANT. REMOVE CASING SPAGOT. BEWARE OF SPRING LOADED SUPPORT STRUTS.
18	REMOVE GAS PRODUCER FROM ENCLOSURE.	REMOVE FRONT FRAME ADAPTOR 263K00363.	RETAIN HARDWARE.
19	REAR FLANGE OF ADAPTOR CASING	4-1/2" BOLTS	PROTECT WITH 22600800 BEFORE PLACING UNIT IN CONTAINER.
20	FRONT FLANGE - GAS PRODUCER		PROTECT WITH 226008031 BEFORE PLACING UNIT IN CONTAINER.
21			THE REPLACEMENT GAS PRODUCER IS INSTALLED BY REVERSING THE PROCEDURE OUTLINED ABOVE. REMOVE LIFTING SLING AFTER GAS PRODUCER IS REMOVED. THERE MUST BE NO FOREIGN OBJECTS, DIRT, ETC., REMAIN IN THE INTAKE DUCT PRIOR TO "START UP". PROTECTIVE COVERS TO BE RETAINED FOR FUTURE USE.

NOTE: FOR FULL DETAILS OF COMPONENTS REFERRED TO ON THIS DRAWING, SEE THE FOLLOWING:

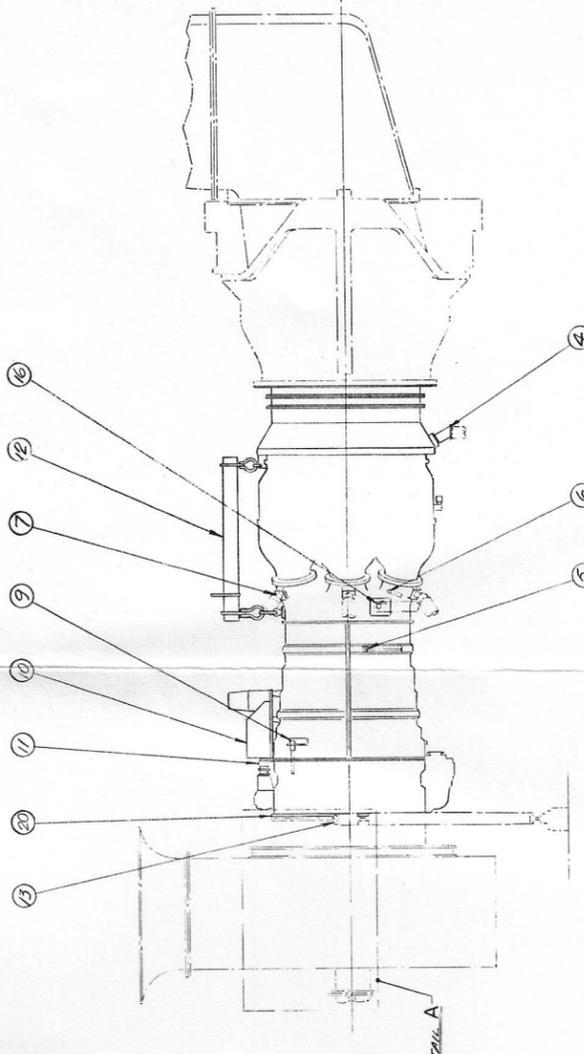
- 263K00780 POWER PLANT - HUSSAR 'B' & TORRINGTON
- 289K00020 POWER PLANT - CARSTAIRS & BRAZEAU.
- 226001206 GAS PRODUCER ASSEMBLY, MODEL -1K.
- 226001502 GAS GENERATOR ASSEMBLY, MODEL -2K.
- 226000150 SYSTEM ARRANGEMENT - GASEOUS FUEL.
- 263K00773 INSTRUMENTATION & CONTROLS - HUSSAR 'B' & TORRINGTON.
- 263K00772 AIR, FUEL & LUBE PIPING SYSTEMS - HUSSAR 'B' & TORRINGTON.
- 289K00050 AIR, FUEL & LUBE PIPING SYSTEMS - CARSTAIRS & BRAZEAU.
- 289K00051 INSTRUMENTATION & CONTROLS - CARSTAIRS & BRAZEAU.
- 2266P-22 PREPARATION FOR INHIBITTING & SHUTTING AN OT-F-3 BASIC GAS GENERATOR.

IN 'SPECIAL INSTRUCTIONS' COLUMN, WHERE SHOWN THIS USE PROTECTIVE PARTS AS SPECIFIED OR EQUIVALENT.

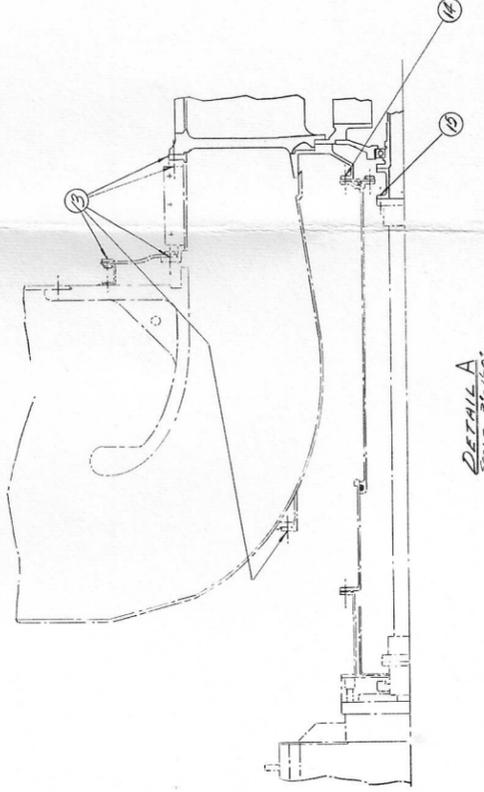
NOTE: WHERE TERM 'GAS PRODUCER' IS USED, SUBSTITUTE 'GAS GENERATOR'.



RIGHT SIDE VIEW



LEFT SIDE VIEW



DETAIL A
SCALE 3/16"

3.4 LUBE SYSTEM

Refer to Fig.8.

The electrical and mechanically-driven components located on the front end of the assembly above the lube tank, on both the OT-F-3 and OT-F-2100 units, are used to pump lube from the tank to bearings, seals and hydraulic equipment.

The main lube pump, supplying all sleeve bearings, is a positive displacement driven by a shaft extending downwards through the auxiliary gearbox. Except for capacity this arrangement is the same for both the OT-F-3 and OT-F-2100 units. The seal oil and hydraulic pumps are horizontally mounted on the forward face of the gearbox and, again, the arrangement is similar for each unit. The bearing supply back-up system is handled by an A.C. motor-driven gear-type standby pump and a much smaller capacity D.C. motor-driven emergency supply. The duplex type filter is located in this area and the liquid cooler (not shown) is mounted on the side of the base.

Due to the dual lube system required for the OT-F-3 assembly a mechanically-driven oil make-up pump is mounted on the forward face of the auxiliary gearbox. This same drive on the OT-F-2100 is used for the magnetic pick-up geared tooth rpm signal.

The OT-F-3 gas producer cooler is located in a well in the base directly below the gas producer compressor.

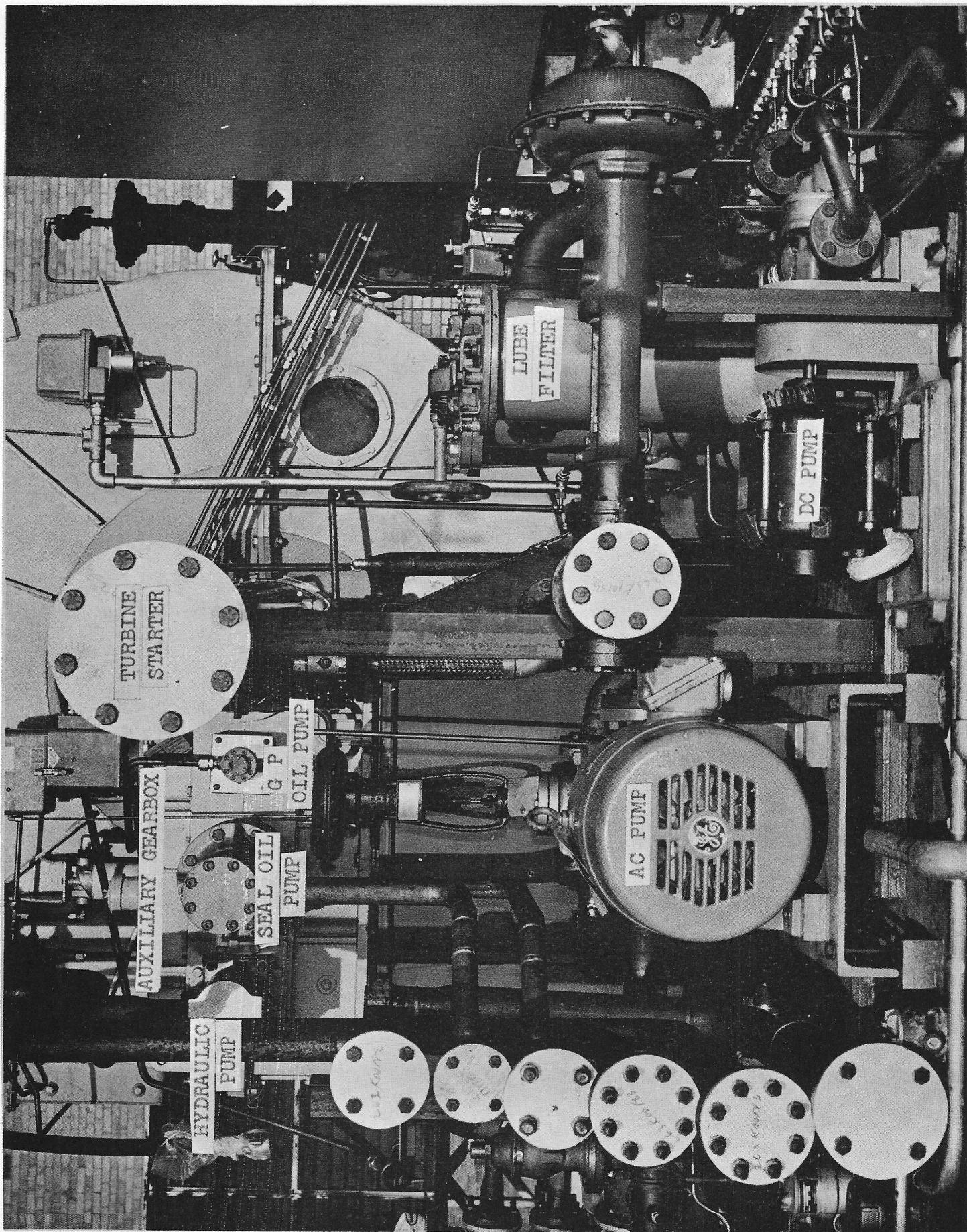
An electrically-powered circulating pump is installed on some OT-F-3 power plants (at customer's request) to maintain the temperature in the main lube oil tank (assisted by electric heaters) during unit 'Downtime'. The pump and its associated heat exchanger are mounted in the area at the front RH side of the power plant base.

3.5 STARTING SYSTEM

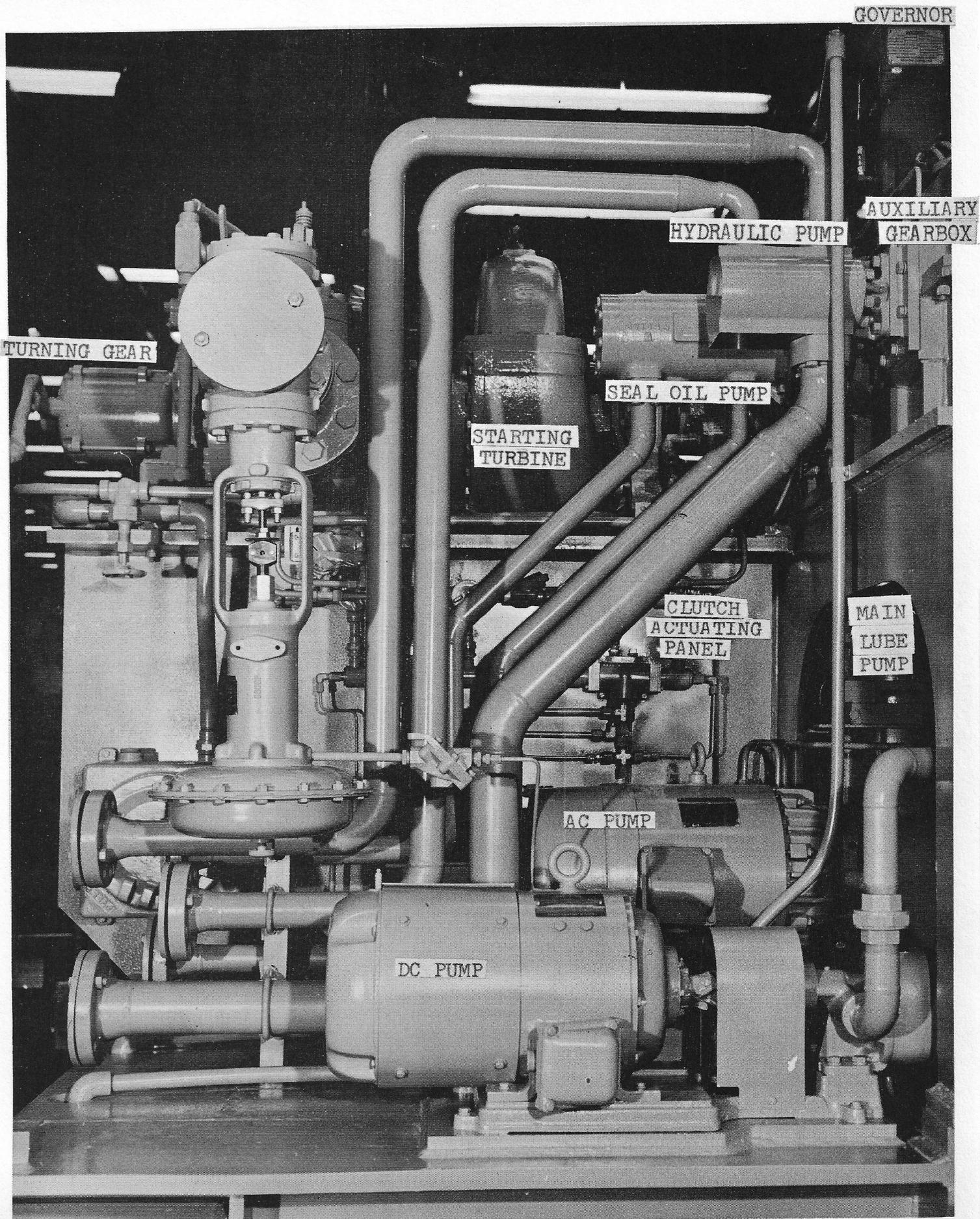
Refer to Fig.9 (Photograph of OT-F-2100)

The most obvious difference between the OT-F-3 and the OT-F-2100 in this forward area is in the starting and turning gear equipment and the support structure required to mount this equipment. The difference, of course, in requirements is due to the difference in the masses of the heavy duty long-life gas producer rotor of the OT-F-2100 as opposed to the lighter weight OT-F-3 rotor assembly.

In each case the starter is located on the assembly axial centreline and is a direct drive through the gearbox. The OT-F-2100 turning gear is located directly forward of the starter. Associated with the turning gear and turbine starter of the OT-F-2100 are two hydraulically operated dog clutches operated through a clutch panel mounted on the side of the pedestal.



OT-F-3 LUBE SYSTEM COMPONENTS



OT-F-2100 LUBE SYSTEM COMPONENTS

The OT-F-3 uses an integral AiResearch turbine starter/clutch and the rotor does not require turning after shutdown.

3.6 FUEL SYSTEM

Refer to Fig. 10.

The fuel system components are basically the same for each unit and consist of:

1. Shut-off Valve.
2. Isolating and Vent Valve.
3. Metering Valve and Limiter.
4. Fuel Headers and Associated Piping
5. Governor.

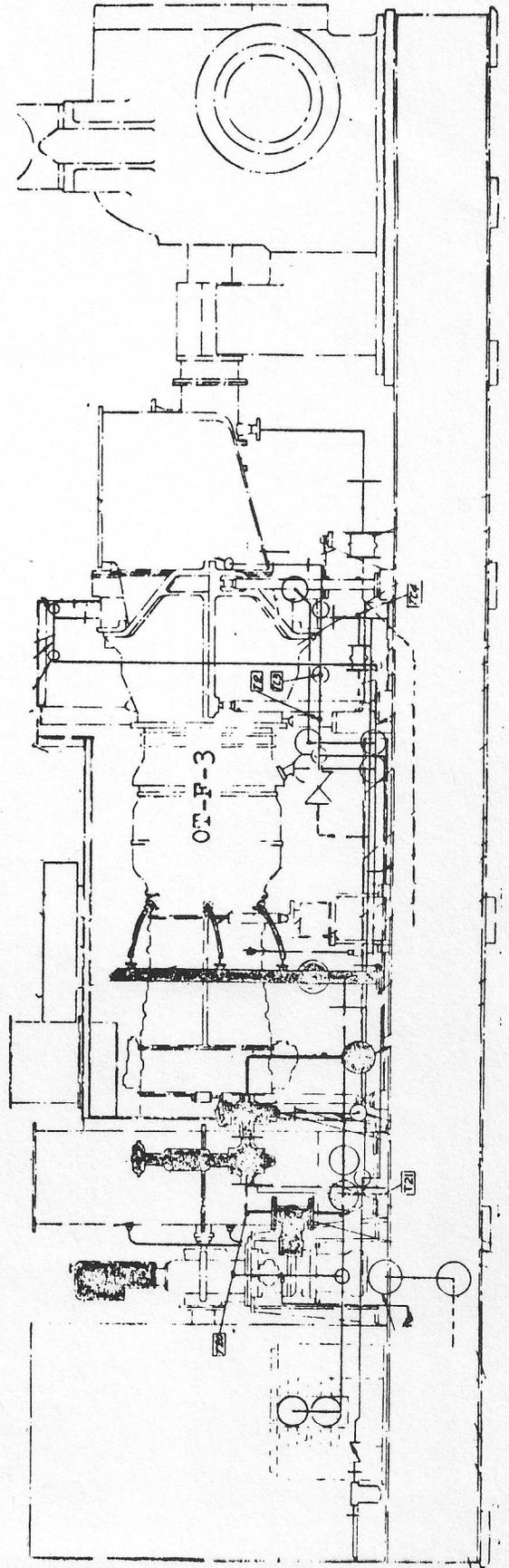
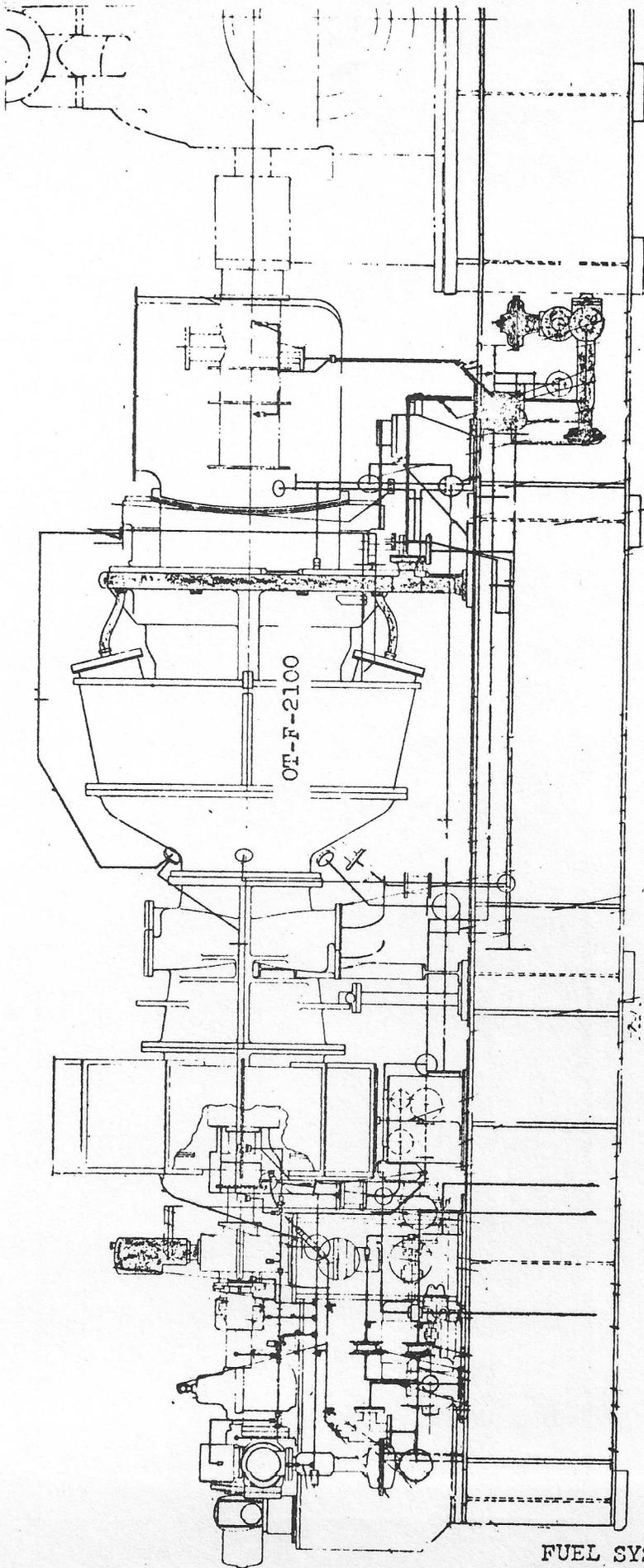
The mechanically-driven governor for both units is located on the top side of the auxiliary gearbox, but the other components, mainly due to the location of the combustion chambers, are located differently. On the OT-F-3 they are fixed outboard, on top of the base in the vicinity of the air intake, and on the OT-F-2100, in a well in the base immediately below the exhaust gas elbows.

3.7 INSTRUMENTATION

Refer to Fig. 11.

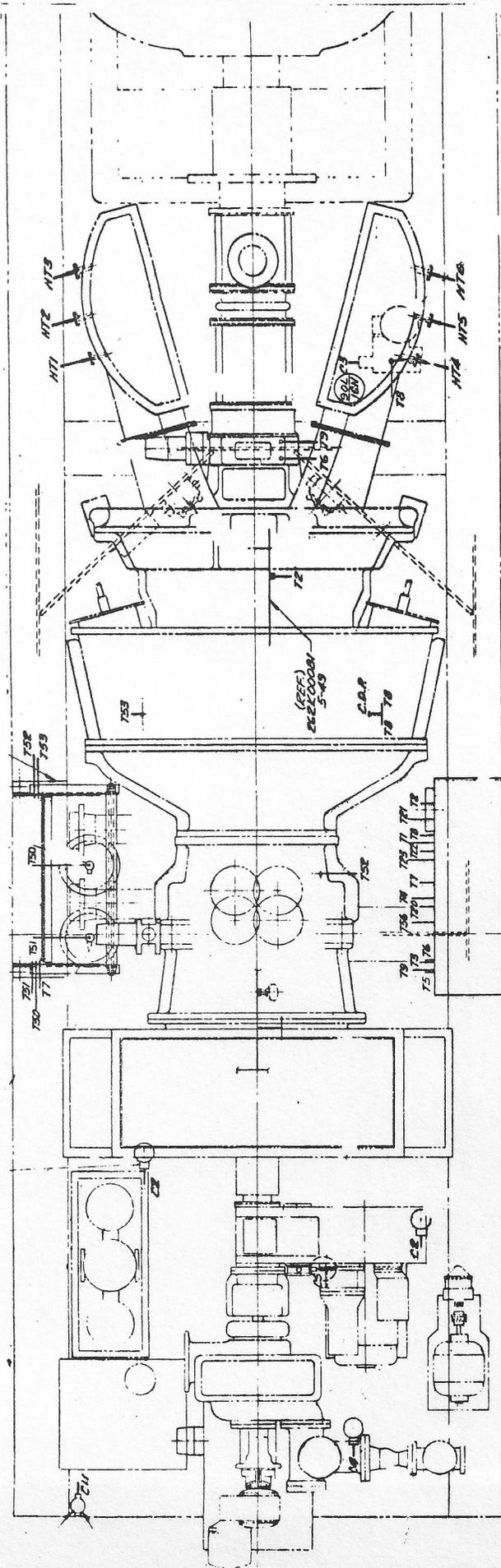
The protective circuit hardware for both the OT-F-3 and OT-F-2100 are basically the same, that is, they both have exhaust gas temperature probes in the elbows, bearing lube drain temperature probes, speed signal pick-up, pressure points, pneumatics, lube tank heaters, vibration sensors and lube level indicators.

For easy reading and comparison of the operating parameters and setting up of the systems, most of the gauges, switches and controllers have been housed in a single panel and mounted outboard of the trough around the gas turbine bed (OT-F-2100) or against the Compressor Building wall (OT-F-3). This panel is called the "pressure switch and gauge panel".



FUEL SYSTEM COMPONENTS

FIG. 10



OT-F-2100

Instrumentation and Controls

OT-F-3

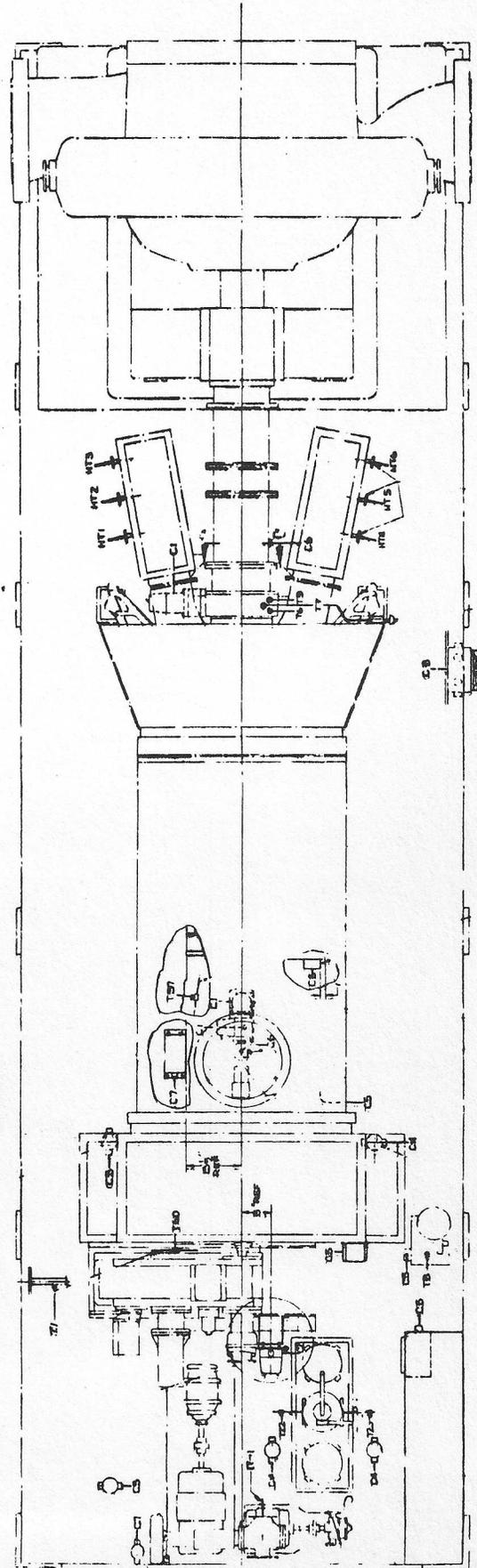


FIG. 11

In the case of the OT-F-2100 an additional panel and valve assembly is installed on the opposite side of the base to control compressor bleed-off.

Both units have all the wiring terminating in terminal boxes located on the vertical outside web of the base I-beam.

3.8 OTHER COMPONENTS

Refer to Fig. 12.

To complete the power plant assembly hardware description, an acoustic cover is fitted over the OT-F-3 power plant and is attached to the base with quick release fasteners. Access doors are provided for servicing and an hydraulically-driven fan is installed on the top forward end of the cover to provide a cooling airflow over the outside surface of the power plant. This air is expelled at the open end of the cover in the region of the exhaust gas elbows.

This cover is lifted straight upwards when the gas producer is required to be removed.

The intake and exhaust systems are usually considered as part of the site installation but as they are partly supported by the base and attached to mating intake and exhaust elbows, they will be considered here as part of the power plant assembly.

The intake system consists of an inertial type separator filter, silencer, flex joints, plenum and support structure. The filter is equipped with blow-in doors which operate when the differential pressure exceeds 2 inches of water, and an electrically-powered fan to remove spent particles. The silencer is acoustically treated to reduce intake noise to an acceptable level. A rubber fibre flex joint is fitted immediately above the power plant assembly inlet casing and the strut supporting the elbow is shimmed to take all the weight of the flex joint. The pressure drop through the above system affects turbine performance, hence the advantage of a clean intake system.

The exhaust system is designed to withstand a high velocity gas flow at approximately 1000° F and to control the pressure through the system through careful diffusion to maintain the correct turbine outlet conditions. The system consists of two sets of vaned elbows, a stack silencer and a support structure with two spring-loaded hangers to remove the weight from the power turbine elbow flanges.

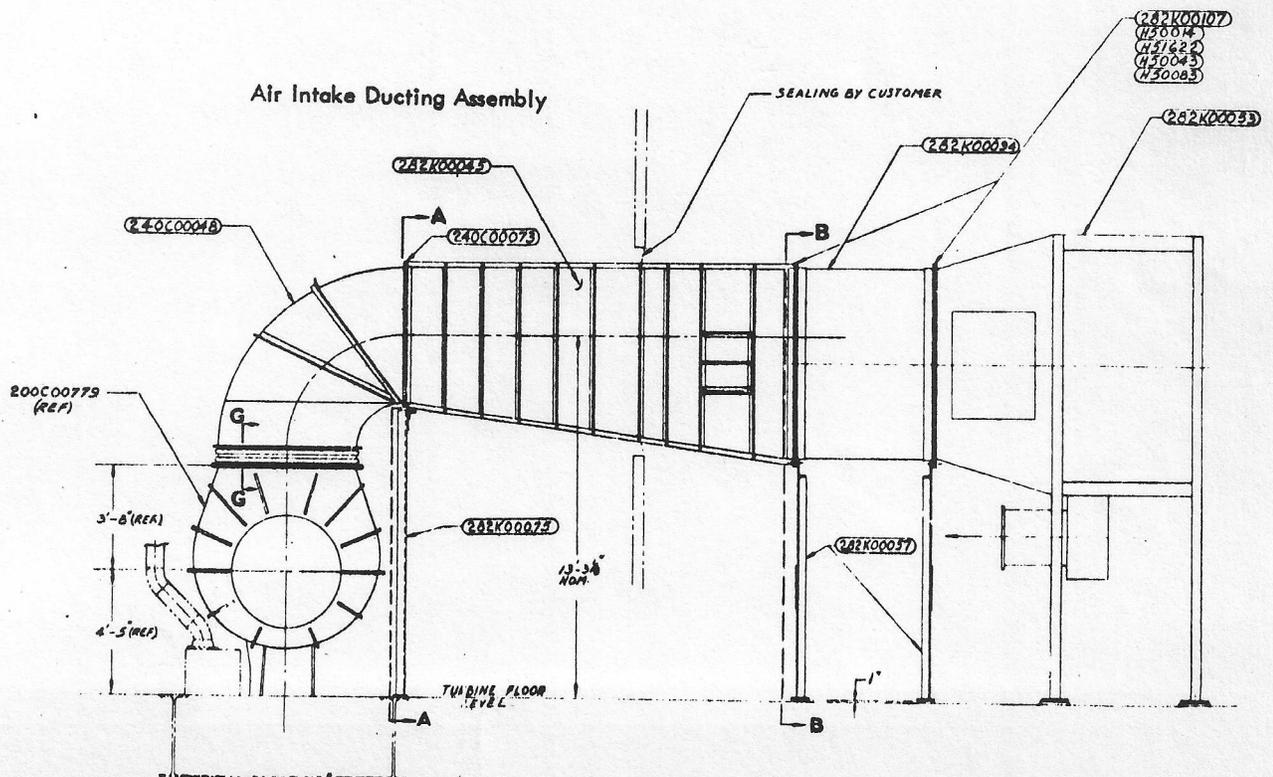
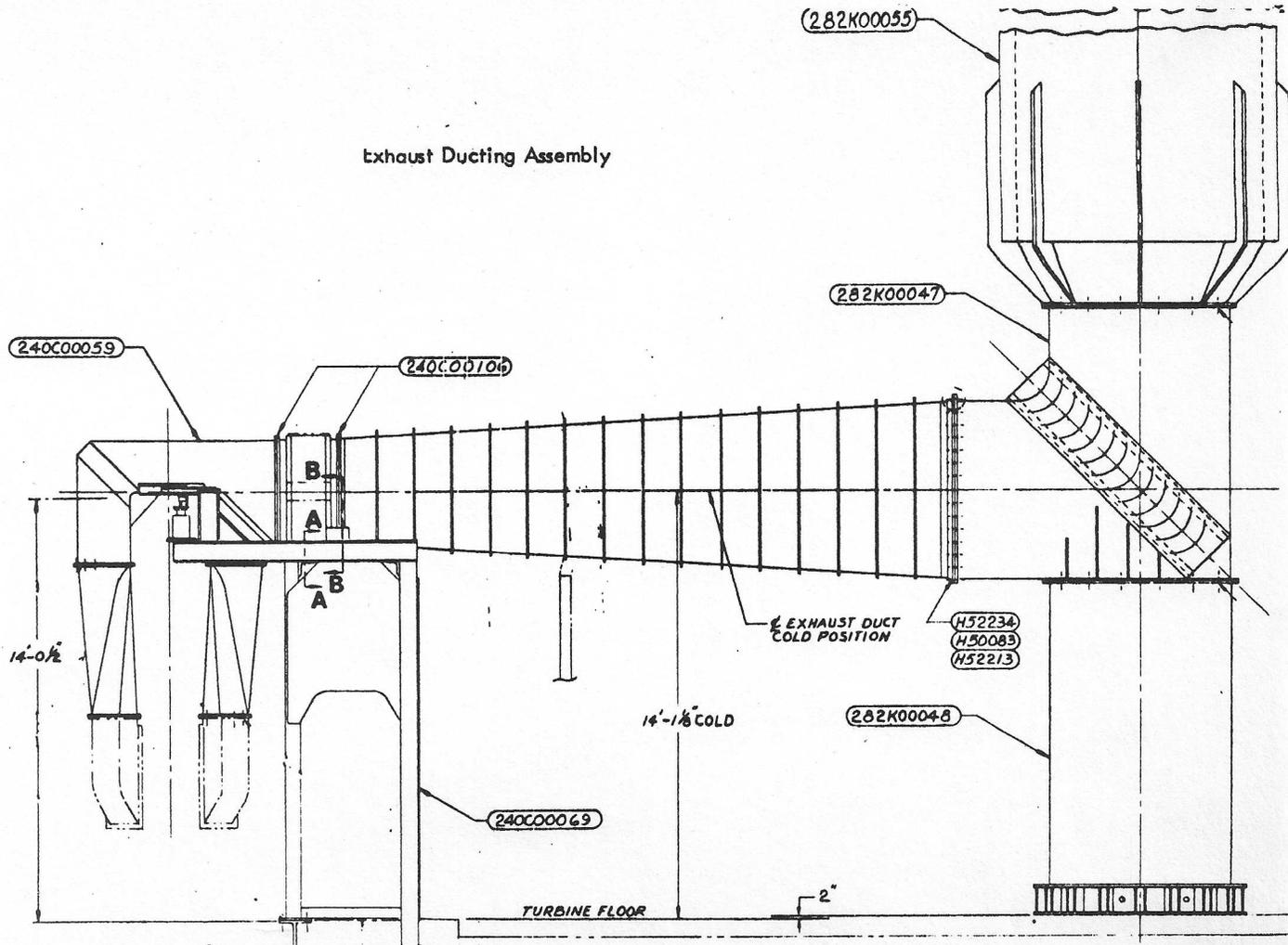


FIG. 12

SECTION 4

LUBRICATION SYSTEMS

SECTION 4.

LUBRICATION SYSTEMS

4.1 MAIN LUBRICATION SYSTEM

The power plant assembly lubrication systems are shown schematically on Figs.13 and 13A. The circled numbers on this schematic relate each component in the system to a portion of the tabulation on the top left hand corner of the drawing. On the drawings this table gives you the part number, name and location for each numbered circle, e.g. Circle 1 is the lube oil pump - engine driven, Part No. 262K00033, located on the power plant assembly. The exact location can then be found by referring to the power plant assembly drawing.

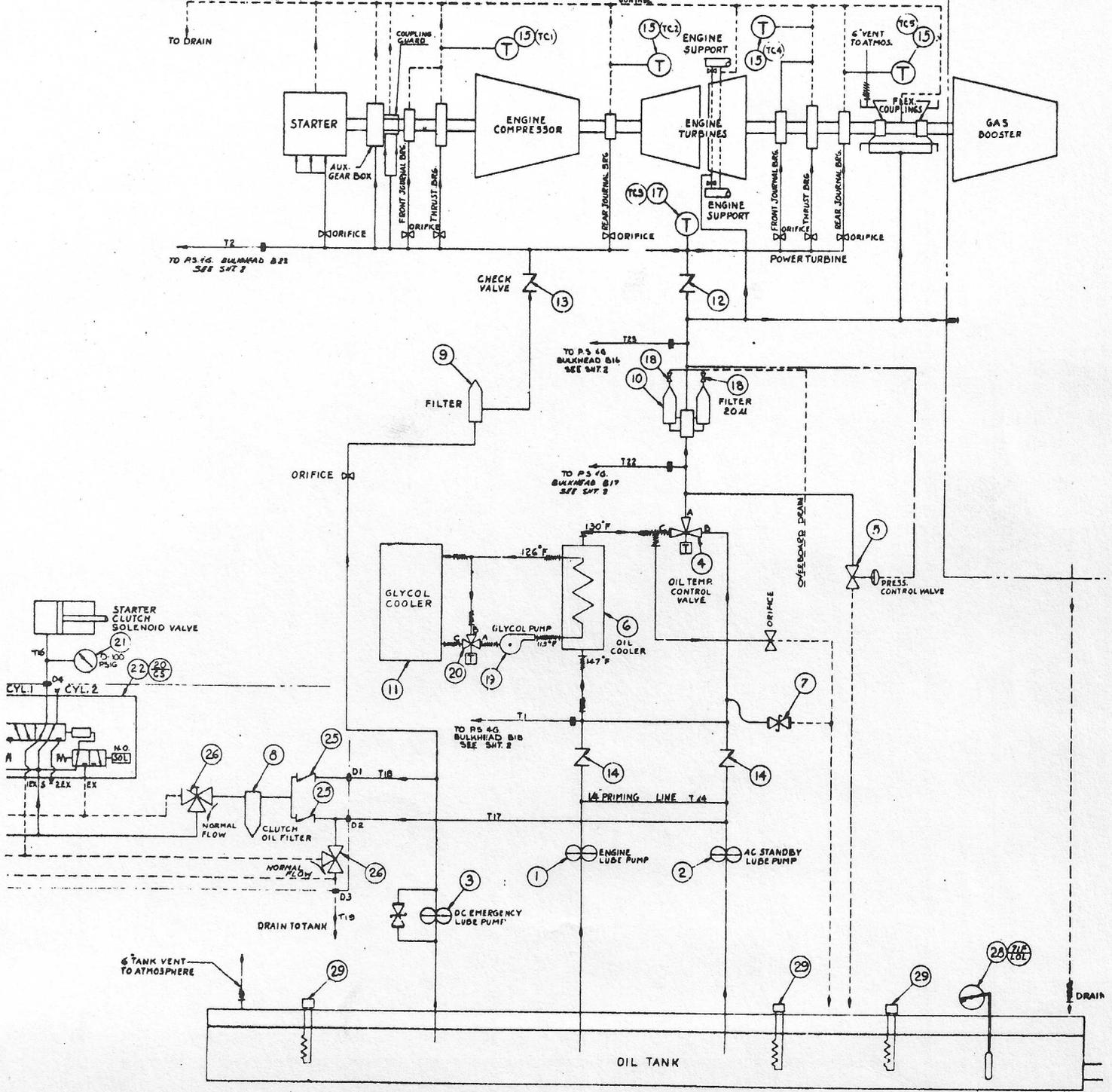
The prime function of the lubrication system is to maintain a constant supply of lubricant to bearing surfaces at the correct pressure and temperature. The power turbine system of the OT-F-3 and the complete OT-F-2100 use a synthetic oil, regulated to 30 psi. and a maximum inlet temperature of 130° F. The OT-F-3 gas producer uses a grade 1010 aircraft jet engine lubricant at 20 psi. and 130° F inlet. The booster system is supplied from the power turbine system.

To describe the system, under normal running conditions, oil is drawn from the 900 gallon base storage tank by the gearbox-driven main lube pump, passes through a temperature control area, passes through a filter unit and into a common manifold to supply the turbine bearings and the booster bearings.

An AC electrically-driven pump of approximately the same capacity (approx. 100 GPM) is installed to perform the same function at speeds below 6500 rpm.

A low capacity DC electrically-driven pump supplies lube to the manifold through an entirely independent system and is termed the "emergency lube pump". The main function of this pump is to supply a small quantity of oil to the power turbine bearings only on the OT-F-3 and to all the bearings on the OT-F-2100 in the event that the lube pressure drops below 20 psi. On some OT-F-3 units, a second DC pump is installed for compressor bearing lubrication whenever the lube system pressure falls below 20 psi.

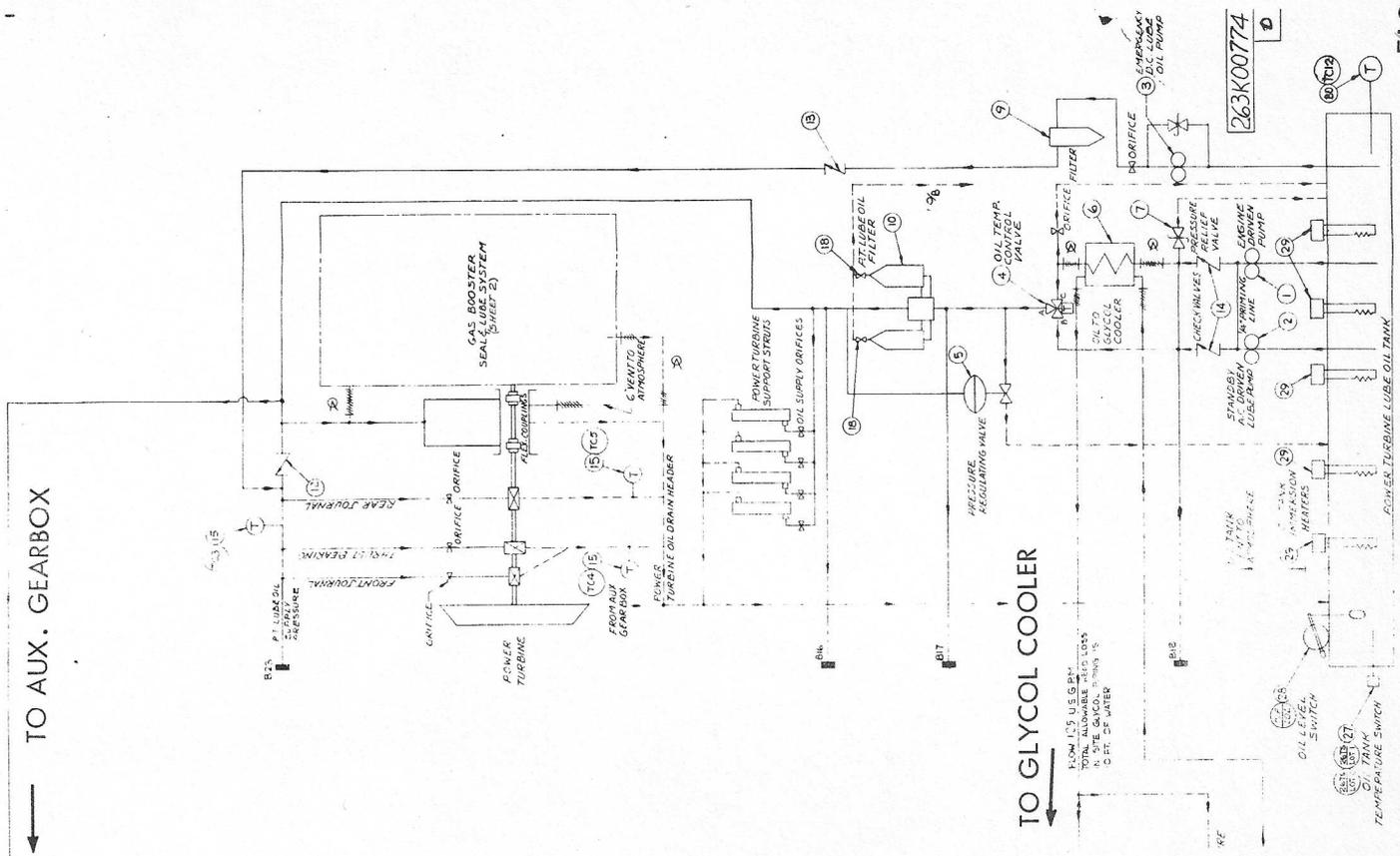
ITEM	PART NO.	DESCRIPTION	LOCATION
1	262K00033	LUBE OIL PUMP - ENGINE DRIVEN.	P.P.
2	262K00015	LUBE OIL PUMP - A.C. STANDEY.	P.P.
3	200C01002	LUBE OIL PUMP - D.C. EMERGENCY	P.P.
4	200C0079	VALVE - LUBE OIL TEMP. CONTROL	A.F. & L.
5	262K00192	LUBE OIL PRESSURE CONTROL VALVE	A.F. & L.
6	232K00012	LUBE OIL COOLER	SITE
7	200C00381	VALVE - OIL PRESSURE RELIEF.	A.F. & L.
8	226C00443	FILTER - EMERGENCY LUBE OIL	CLUTCH SYST.
9	200C01004	FILTER - EMERGENCY LUBE SYSTEM	A.F. & L.
10	226C00451	LUBE OIL SYSTEM FILTER ASSEMBLY	P.P.
11	282K00018	GLYCOL COOLER	SITE
12	200C00936	CHECK VALVE - GAS TURBINE LUBRICATION SYSTEM.	A.F. & L.
13	200C01093	CHECK VALVE - EMERGENCY LUBE SYSTEM.	A.F. & L.
14	200C00935	CHECK VALVE - LUBE OIL PUMP DISCHARGE	A.F. & L.
15	200C01324	THERMOCOUPLE ASSEMBLY - BEARING DRAIN	INST. & CONTROL
16	262K00058	PRESSURE SWITCH	P.S. & G.
17	200C01128	THERMOCOUPLE ASSEMBLY - LUBE SUPPLY	INST. & CONTROL
18	263K00196	VALVE - BALL, MANUAL	A.F. & L.
19	232K00019	CENTRIFUGAL PULF	SITE
20	240C00030	CONTROL VALVE - GLYCOL TEMPERATURE.	SITE
21	200C01132	PRESSURE GAUGE	INST. & CONTROL
22	200C01562	VALVE - HYDRAULIC, SOLENOID OPERATED	CLUTCH SYST.
23	226C00473	NEEDLE VALVE	P. S. & G.
24	262K00065	CLUTCH ACTUATING SYSTEM ASSEMBLY	INST. & CONTROL
25	200C01075	VALVE - BALL CHECK	CLUTCH SYST
26	262K00064	VALVE - 3-WAY SELECTOR	CLUTCH SYST
27	262K00030	DUAL TEMPERATURE SWITCH	INST. & CONTROL
28	200C01016	LEVEL SWITCH - LUBE TANK.	INST. & CONTROL
29	200C01212	LUBE OIL HEATER - 440V. A.C.	INST. & CONTROL



ELECTRICAL CONTROL FUNCTION

Lube System Schematic (OT-F-2100)

LUBE SYSTEM SCHEMATIC (OT-F-3)
SHEET 1 (MAIN (PT) LUBE)



ITEM	PART NO.	DESCRIPTION	LOCATION
1	262K00033	LUBE OIL PUMP - ENGINE DRIVEN	P.P.
2	263K00797	LUBE OIL PUMP - A.C. STANDBY	P.P.
3	226C00409	LUBE OIL PUMP - D.C. EMERGENCY	P.P.
4	200C00879	VALVE - LUBE OIL TEMP. CONTROL	A.F. & L.
5	262K00192	LUBE OIL PRESSURE CONTROL VALVE	A.F. & L.
6	281K00012	LUBE OIL COOLER	SITE
7	200C00881	VALVE - OIL PRESSURE RELIEF	A.F. & L.
8	263K00798	COOLER - GAS PRODUCER LUBE OIL	A.F. & L.
9	226C00443	FILTER - EMERGENCY LUBE SYSTEM	P.P.
10	226C00451	LUBE OIL SYSTEM FILTER ASSEMBLY	P.P.
11	281K00018	GLYCOL COOLER	SITE
12	226C00413	LUBE OIL SYSTEM LUBE SYSTEM	A.F. & L.
13	226C00414	CHECK VALVE - EMERGENCY LUBE SYSTEM	A.F. & L.
14	200C00935	CHECK VALVE - LUBE OIL PUMP DISCHARGE	A.F. & L.
15	200C01324	THERMOCOUPLE ASSY - BEARING DRAIN PRESSURE SWITCH	INST. & CONTROL
16	262K00058		P.S. & G.
17			
18	263K00196	VALVE - BALL, MANUAL	A.F. & L.
19	281K00019	CENTRIFUGAL PUMP	SITE
20	240C00080	CONTROL VALVE - GLYCOL TEMPERATURE	SITE
21	244C00014	VALVE - OIL TEMPERATURE REGULATING	A.F. & L.
22	226C00754	THERMOCOUPLE - OIL TEMP.	GAS PROD.
23	226C00473	NEEDLE VALVE	P.S. & G.
24	263K00878	PUMP - LUBE OIL MAKE-UP	P.P.
25	263K00432	TANK - HEADER	SITE
26			
27	262K00030	DUAL TEMPERATURE SWITCH	INST. & CONTROL
28	200C01016	LEVEL SWITCH - LUBE TANK	INST. & CONTROL
29	263K00919	IMMERSION HEATER	INST. & CONTROL
30	200C01115	THERMOCOUPLE ASSY. - LUBE TANK	INST. & CONTROL
31	263K00804	PRESSURE TRANSMITTER - 1:1	P.S. & G.
32	263K00887	PRESSURE GAUGE	P.S. & G.
33	262K00092	DIFFERENTIAL PRESSURE GAUGE	P.S. & G.
34	226C00540	SWITCH - DIFFERENTIAL PRESSURE	P.S. & G.
35	263K00860	SWITCH - PRESSURE	P.S. & G.
36	263K00889	PRESSURE GAUGE	P.S. & G.
37	263K00886	PRESSURE GAUGE	P.S. & G.
38	263K00859	SWITCH - DIFFERENTIAL PRESSURE	A.S. & G.
39	263K00863	PNEUMATIC RELAY VALVE	P.S. & G.
40	263K00861	PNEUMATIC RELAY VALVE	P.S. & G.
41	263K00862	TRANSMITTER - DIFFERENTIAL PRESSURE	P.S. & G.
42	263K00865	VALVE - CHECK	P.S. & G.
43	263K00867	SWITCH - PRESSURE	P.S. & G.
44	263K00149	PRESSURE SWITCH	P.S. & G.
45	262K00150	RECEIVER GAUGE (3-15 PSI)	P.S. & G.
46	262K00124	VALVE MANIFOLD BLOCK	P.S. & G.
47	263K00858	PUMP - SEAL OIL	P.P.

LUBE SYSTEM SCHEMATIC (OT-F-3)
SHEET 2 (GAS PRODUCER)

FROM MAIN
LUBE SYSTEM

ITEM	PART NO.	DESCRIPTION	LOCATION
1	262K00033	LUBE OIL PUMP - ENGINE DRIVEN	P. P.
2	263K00797	LUBE OIL PUMP - A. C. STANDBY	P. P.
3	226C00409	LUBE OIL PUMP - D. C. EMERGENCY	A. F. & L.
4	200C00879	VALVE - LUBE OIL TEMP. CONTROL	A. F. & L.
5	262K00192	LUBE OIL PRESSURE CONTROL VALVE	SITE
6	281K00012	LUBE OIL COOLER	A. F. & L.
7	200C00881	VALVE - OIL PRESSURE RELIEF	P. P.
8	263K00798	COOLER - GAS PRODUCER LUBE OIL	A. F. & L.
9	226C00443	FILTER - EMERGENCY LUBE SYSTEM	P. P.
10	226C00451	LUBE OIL SYSTEM FILTER ASSEMBLY	A. F. & L.
11	281K00018	GLYCOL COOLER	P. P.
12	226C00413	CHECK VALVE - GAS TURBINE LUBE SYSTEM	A. F. & L.
13	226C00414	CHECK VALVE - EMERGENCY LUBE SYSTEM	A. F. & L.
14	200C00935	CHECK VALVE - LUBE OIL PUMP DISCHARGE	A. F. & L.
15	200C01324	THERMOCOUPLE ASSY - BEARING DRAIN	INST. & CONTROL
16	262K00058	PRESSURE SWITCH	P. S. & G.
17			
18	263K00196	VALVE - BALL, MANUAL	A. F. & L.
19	281K00019	CENTRIFUGAL PUMP	SITE
20	240C00080	CONTROL VALVE - GLYCOL TEMPERATURE	SITE
21	244C00014	VALVE - OIL TEMPERATURE REGULATING	A. F. & L.
22	226C00754	THERMOCOUPLE - OIL TEMP.	GAS PROD.
23	226C00473	NEEDLE VALVE	P. S. & G.
24	263K00878	PUMP - LUBE OIL MAKE-UP	P. P.
25	263K00492	TANK - HEADER	SITE
26			
27	262K00030	DUAL TEMPERATURE SWITCH	INST. & CONTROL
28	200C01016	LEVEL SWITCH - LUBE TANK	INST. & CONTROL
29	263K00919	IMMERSION HEATER	INST. & CONTROL
30	200C01115	THERMOCOUPLE ASSY. - LUBE TANK	INST. & CONTROL
31	263K00804	PRESSURE TRANSMITTER - 1:1	P. S. & G.
32	263K00887	PRESSURE GAUGE	P. S. & G.
33	262K00092	DIFFERENTIAL PRESSURE GAUGE	P. S. & G.
34	226C00540	SWITCH - DIFFERENTIAL PRESSURE	P. S. & G.
35	263K00860	SWITCH - PRESSURE	P. S. & G.
36	263K00889	PRESSURE GAUGE	P. S. & G.
37	263K00886	PRESSURE GAUGE	P. S. & G.
38	263K00859	SWITCH - DIFFERENTIAL PRESSURE	A. S. & G.
39	263K00863	PNEUMATIC RELAY VALVE	P. S. & G.
40	263K00861	PNEUMATIC RELAY VALVE	P. S. & G.
41	263K00862	TRANSMITTER - DIFFERENTIAL PRESSURE	P. S. & G.
42	263K00865	VALVE - CHECK	P. S. & G.
43	263K00867	SWITCH - PRESSURE	P. S. & G.
44	263K00149	RECEIVER SWITCH	P. S. & G.
45	262K00150	RECEIVER GAUGE (3-15 PSI)	P. S. & G.
46	262K00124	VALVE MANIFOLD BLOCK	P. S. & G.
47	263K00858	PUMP - SEAL OIL	P. P.

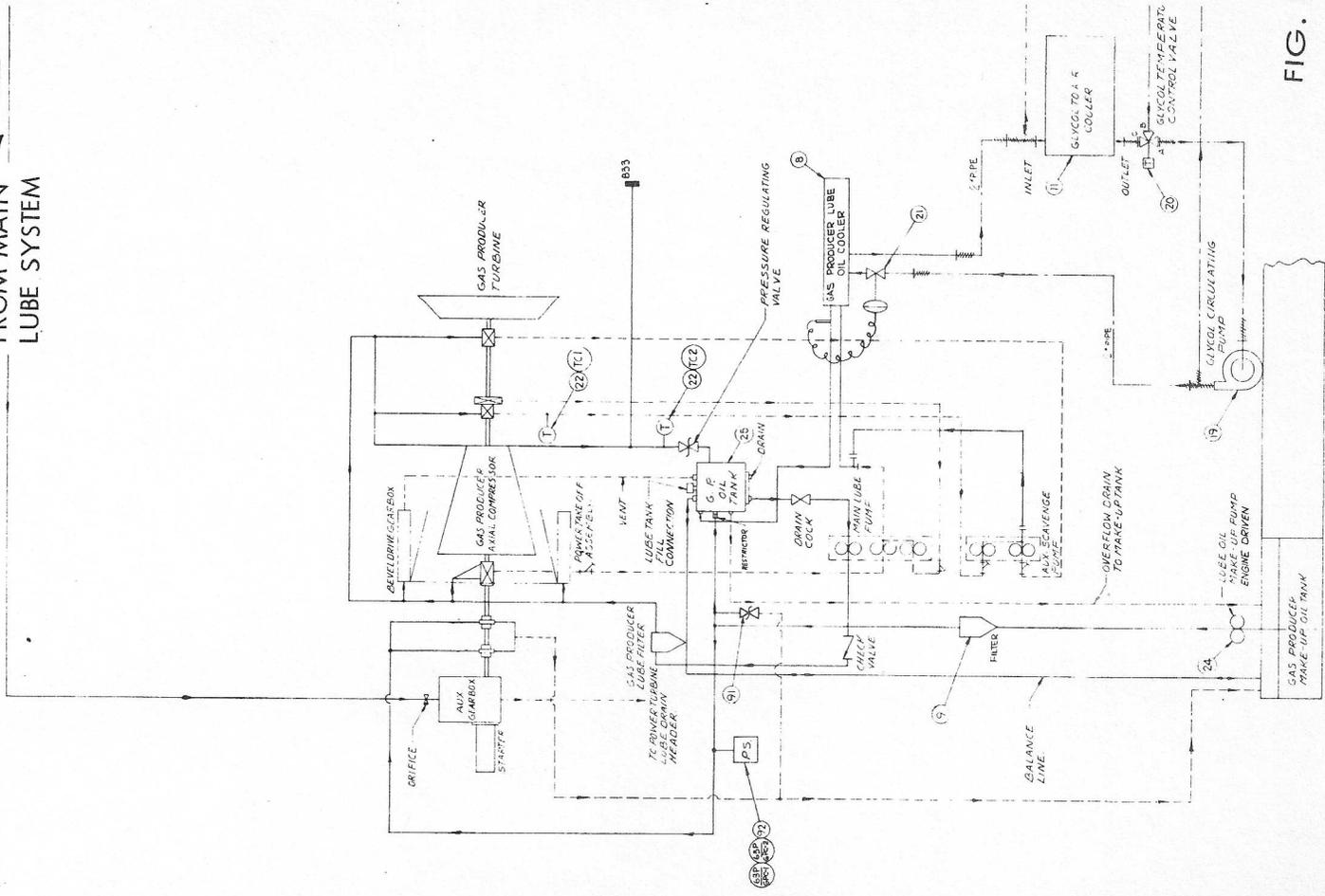


FIG. 13A

The cooling area referred to above, consists of an independent cooling cycle made up of the lube-to-glycol tube bank mounted on the base, a glycol-to-air cooler remotely installed, a pump to circulate the fluid and a thermostatic controller. This system is sized to cool the lube oil to 130° F. under all running and prescribed ambient conditions. The OT-F-3 system is the same as described above except the glycol is also circulated through the gas producer tube bank to cool the grade 1010 oil. This cooler is located in a well in the base directly under the gas producer compressor section. Other features of the system are as follows:

1. Tank immersion heaters controlled to maintain a temperature of 75° F.
2. A pressure control valve and pressure relief valve to maintain a system pressure of 30-35 psi, and relief pump pressure in the event of blockage or suchlike at 80 psi. The small emergency DC driven pump contains its own relief valve.
3. The filter is a two element filter with a selector valve between them to select a clean filter if blockage occurs during running.
4. Check valve to prevent cross flows.
5. Orifice plates to control flow.
6. A primer line for the Imo pump.
7. Take-off points for pressures and temperatures.
8. Feed lines to clutch panel, booster, flex couplings and support legs.

The clutch panel(not shown) consists of two solenoid valves hydraulically controlling the two dog clutches in the turning gear-starter-gearbox train on the OT-F-2100. The supply in this case is taken from the two electrically-driven pump lines.

4.2 OT-F-3 GAS PRODUCER LUBRICATION SYSTEM

The OT-F-3 lube system consists of a gear-driven pump supplying oil to a small tank adjacent to the gas producer. This tank is elevated to supply a required head pressure to the self-contained lube pump on the gas producer. An auxiliary gearbox-driven pump also supplies oil through an orifice to the auxiliary gearbox flex couplings.

4.3 BOOSTER

Refer to Fig. 14.

Consider the lube system connected with the booster unit and the "Pressure Switch and Gauge Panel". Both the OT-F-3 and the OT-F-2100 units are identical in this area.

The power turbine lube oil supply for the gas compressor (booster) lube and seal oil system is delivered at a pre-determined flow rate (60 gpm U.S.) and a controlled temperature (120 to 130°F) via a 'T' connection, from which it is routed to:

- The seal oil console.
- The centrifugal gas compressor thrust bearings. An orifice in this supply controls the flow-rate to that desired for the thrust bearing and that for the seal oil console - lubrication and cooling function only.

The supply to the seal oil console is filtered through the operating side of a dual (on-line sensing) filter before delivery to the inlet side of the main (gearbox driven) and the (electrically-powered) auxiliary seal oil pumps.

In operation, the supply pressure to the seal oil console is boosted by the auxiliary and main seal oil pumps (operating in sequence, in relationship to gas producer speed and seal oil to gas differential pressure) to provide a sufficient oil to gas pressure differential at the gas compressor inner bearing seal to prevent gas leakage into the lubrication system. The seal oil supply also performs a lubrication and cooling function.

At start-up, the auxiliary seal oil pump starts and runs continuously until the gearbox driven main pump has accelerated sufficiently to provide the required oil to gas ΔP .

The auxiliary seal oil pump will restart:

1. If the seal oil to gas ΔP falls below medium pressure.
2. If the gas producer speed falls below 4500 rpm at any time during unit operation.
3. When the gas producer speed falls below 4500 rpm following a shutdown.

All OT-F-3 (except the Mobile units) and OT-F-2100.

At shutdown, the auxiliary seal oil pump continues to operate until the gas compressor casing is depressurized (< 20 psi).

The gas compressor seal and lube oil system pressures and temperatures are continuously monitored by unit control fault detection circuits. If these do not meet requirements, the unit in most cases is shutdown and locked out. Some faults however initiate warning signals only, see Fig.22D (Fault Chart).

For a full description of the seal and lube oil system, refer to the DeLaval handbook.

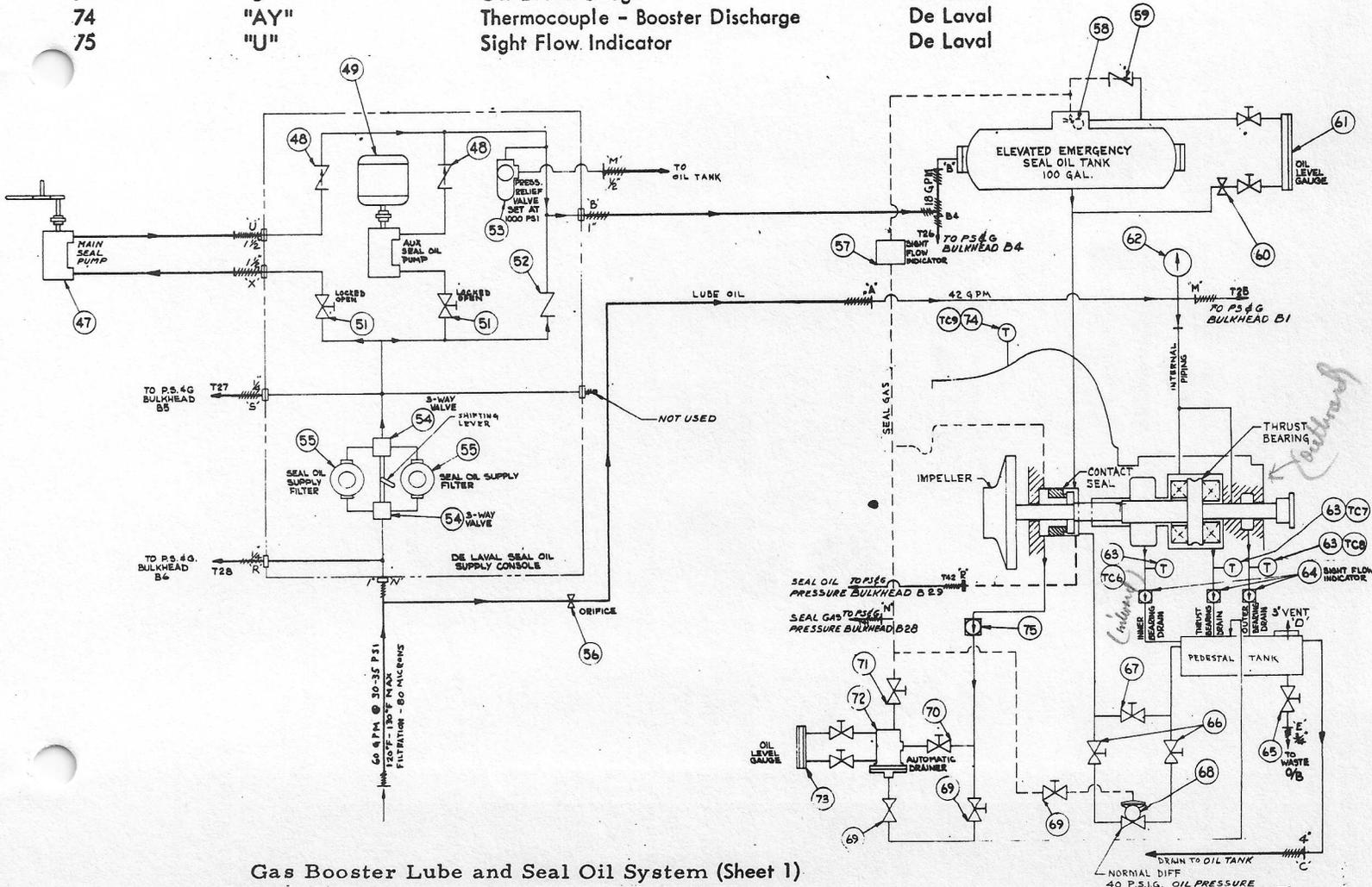
4.4 PRESSURE SWITCH AND GAUGE PANEL

Refer to Fig.14.

The gauge panel section, shown schematically, can be broken down into four sections.

1. The power turbine lube pressure switches that are used primarily for pump sequencing, and the control go-or-no-go circuits and control relays 63/LPL, 63/LPM and 63/LPH.
2. The lube system operating pressure gauges, i.e. pump discharge, filter differentials and boost lube supply. Relay 63/LH Δ H is controlled by a pressure switch reading filter differential pressure.
3. Seal oil pressures and pressure switch 63P/SF Δ H reading the seal oil console differential lube pressure.
4. Seal oil/seal gas pressure differential transmitter and pressure switches control relays 63/SO Δ L, 63/SO Δ M and 63/SO Δ H. The 20 psig air supply for these switches is shown on the starting and fuel valve pneumatic schematic.

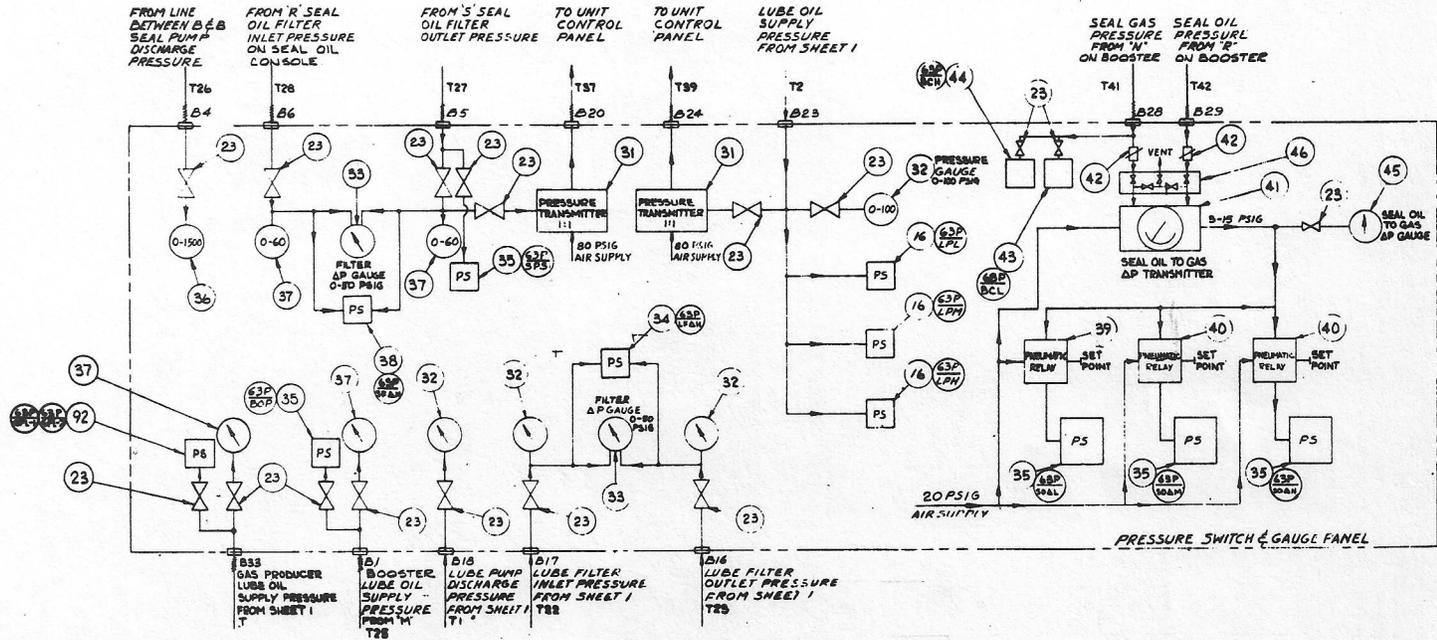
48	"AX"	Check Valve	De Laval
49	"B" & "C"	Aux. Seal Oil Pump and Motor	De Laval
50			
51	"M"	Gate Valve	De Laval
52	"L"	Check Valve	De Laval
53	"S"	Relief Valve	De Laval
54	"BF"	3-Way Valve	De Laval
55	"AH"	Filter-Seal Oil Pump Supply	De Laval
56	263K00868	Orifice Plate* 3/4" Hole	De Laval
57	"D"	Sight Flow Indicator	De Laval
58	"F"	Vent Trap	De Laval
59	"T"	Check Valve	De Laval
60	"AF"	Orifice Plate - 3/16" Hole	De Laval
61	"H"	Oil Level Gauge	De Laval
62	"X"	Thermometer - 0-200°F	De Laval
63	"AC"	Bearing Thermocouples	De Laval
64	"AK"	Sight Flow Indicator	De Laval
65	"AW"	Gate Valve	De Laval
66	"AV"	Gate Valve	De Laval
67	"O"	Globe Valve	De Laval
68	"G"	Differential Control Valve	De Laval
69	"P"	Globe Valve	De Laval
70	"R"	Gate Valve	De Laval
71	"N"	Gate Valve	De Laval
72	"E"	Automatic Drainer	De Laval
73	"J"	Oil Level Gauge	De Laval
74	"AY"	Thermocouple - Booster Discharge	De Laval
75	"U"	Sight Flow Indicator	De Laval



Gas Booster Lube and Seal Oil System (Sheet 1)

FIG. 14

18	262K00058	PRESSURE SWITCH	P.S. & G.
23	226C00423	NEEDLE VALVE	P.S. & G.
30	200C01115	THERMOCOUPLE ASSY. - LUBE TANK	INST. & CONTROL
31	263K00804	PRESSURE TRANSMITTER - 1:1	P.S. & G.
32	263K00807	PRESSURE GAUGE	P.S. & G.
33	263K00808	DIFFERENTIAL PRESSURE GAUGE	P.S. & G.
34	226C00840	SWITCH - DIFFERENTIAL PRESSURE	P.S. & G.
35	263K00880	SWITCH - PRESSURE	P.S. & G.
36	263K00889	PRESSURE GAUGE	P.S. & G.
37	263K00886	PRESSURE GAUGE	P.S. & G.
38	263K00889	SWITCH - DIFFERENTIAL PRESSURE	A.S. & G.
39	263K00883	PNEUMATIC RELAY VALVE	P.S. & G.
40	263K00881	PNEUMATIC RELAY VALVE	P.S. & G.
41	263K00882	TRANSMITTER - DIFFERENTIAL PRESSURE	P.S. & G.
42	263K00885	VALVE - CHECK	P.S. & G.
43	263K00867	SWITCH - PRESSURE	P.S. & G.
44	262K00149	PRESSURE SWITCH	P.S. & G.
45	262K00150	RECEIVER GAUGE (3-15 psi)	P.S. & G.
46	262K00124	VALVE MANIFOLD BLOCK	P.S. & G.
47	263K00858	PUMP - SEAL OIL	P.M.



Gas Booster Lube and Seal Oil System (Sheet 2)

SECTION 4A

HYDRAULIC SYSTEM

SECTION 4A.

HYDRAULIC SYSTEM

Refer to Fig. 15.

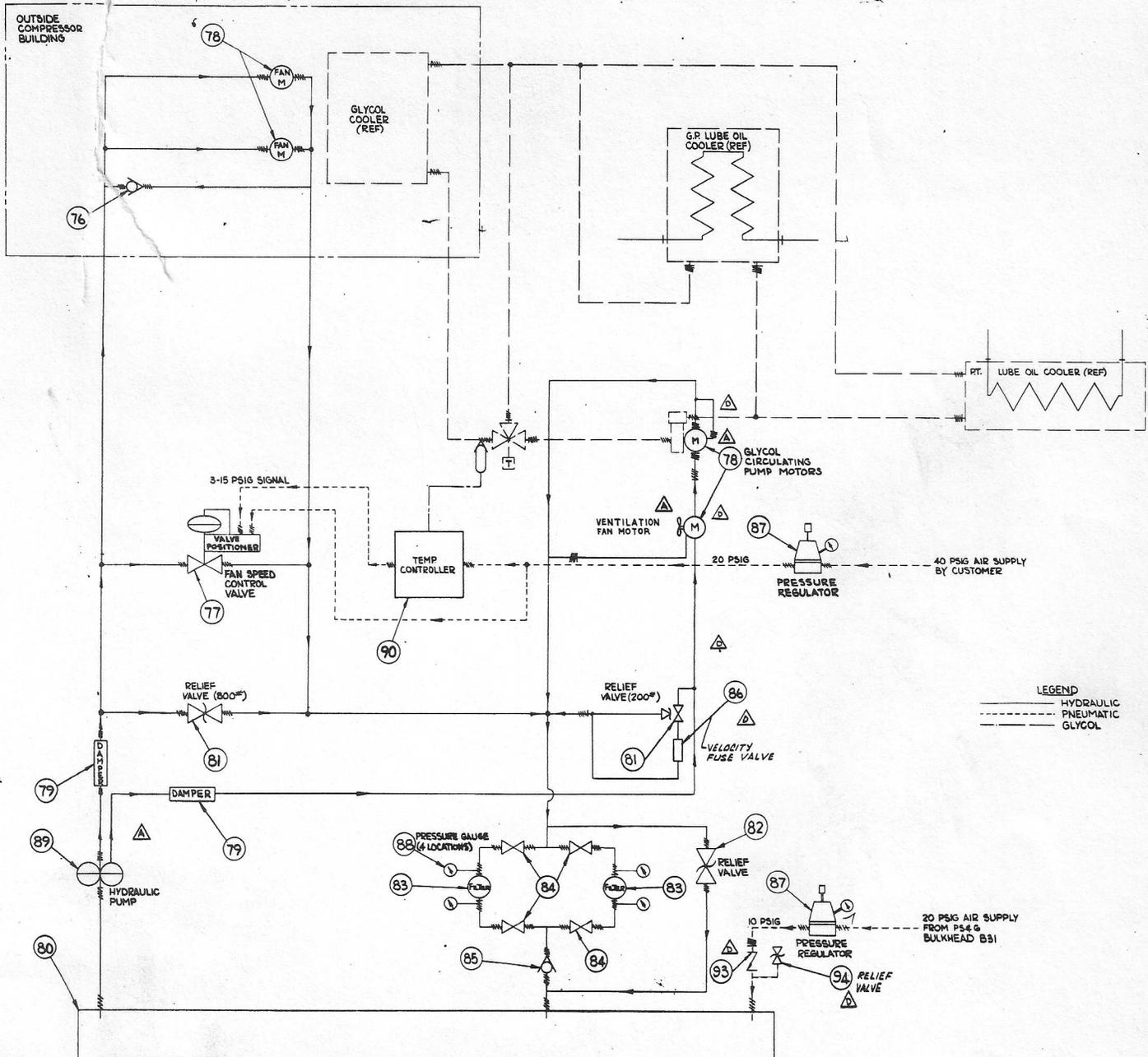
This schematic outlines the basic hydraulic system as installed on both the OT-F-3 and OT-F-2100 units. In addition, the OT-F-3 is fitted with an extra hydraulic motor driving the acoustic cover ventilating fan.

The system basically consists of a hydraulic pump, mounted on the power plant assembly auxiliary gearbox, driving three hydraulic motors connected with the lube oil/glycol cooling system. One motor drives a centrifugal pump that circulates the glycol throughout the system while the other two hydraulic motors drive two cooling fans on the air-to-glycol cooler. Cooling rate is a function of fan speed and is controlled through a temperature controller sensing glycol temperature.

A dual element filter unit permitting "on-line" servicing, is installed in the return line to the hydraulic reservoir located in the compressor building. A relief valve which relieves excess pressure in the reservoir is set to crack at 50 psi.

Hydraulic motor starting is assisted by a small velocity fuse valve, which closes when the flow to the system reaches a pre-determined level. Fuse valve closing produces a jolt throughout the system to aid in overcoming motor inertia.

76	282K00098	Valve - Angle Check	Site
77	282K00097	Valve - Diaphragm Oper. Flow Control	Comp. Room
78	282K00090	Motor - Hydraulic	Site/Comp. Room
79	282K00103	Pulsation Damper	Comp. Room
80	282K00100	Tank Hydraulic Oil	Comp. Room
81	282K00099	Valve - Relief	Comp. Room
82	282K00092	Valve - Relief	Comp. Room
83	282K00101	Filter - Hydraulic Oil	Comp. Room
84	282K00104	Valve - Gate	Comp. Room
85	282K00095	Valve - Check	Comp. Room
86	263K01242	Valve - Velocity Fuse	Comp. Room
87	262K00068	Regulator - Air Pressure c/w Gauge	Comp. Room
88	282K00091	Pressure Gauge	Comp. Room
89	263K00900	Pump - Hydraulic	Eng. B/P
90	282K00096	Temperature Controller - Pneumatic	Comp. Room
93	263K01378	Valve, Check	Comp. Room
94	263K01379	Valve, Relief	Comp. Room



Hydraulic System Schematic

FIG. 15

SECTION 5

PNEUMATIC CONTROL SYSTEM

SECTION 5.

PNEUMATIC CONTROL SYSTEM - GENERAL

5.1 FUEL AND PNEUMATIC CONTROL

Refer to Fig. 16.

The control system is an electric/pneumatic system designed to operate automatically from a remote control station. Manual controls are kept to a minimum and are basically maintenance functions, but sufficient control is available to operate the unit within the set points in the event of an emergency. The pneumatics control the operating parameters of the booster network and turbine using a basic "Moore" closed loop system, while the electrics handle the command signals, readout and protection.

For ease of maintenance and setting up, each of the control sub-systems, such as the power turbine control, surge control, ramp generator control or pressure switches, are manufactured as modules. Each is located to reduce wet line runs and convenient to the controlled unit to minimize line length. The electrics are treated in much the same way, with all power plant instrumentation wiring complete to terminal boxes located on the base.

In the case of two unit stations "Unit Control Panels" are identical, with the difference showing in the "Station Control Panel" in the form of such things as increased flow ranges on the gas flow computer and additional fire protection heads.

Briefly, the gas fuel and pneumatic control system performs the following specific functions:

1. Provides start/stop control (starter gas and fuel control valves).
2. Provides for gas turbine speed sensing, monitoring and sends speed signals to unit sequencing circuits.
3. Provides exhaust gas temperature limiting and power turbine speed limiting functions.

4. Establishes maximum safe fuel limits for starting and for acceleration up to gas producer minimum governor speed (4,500 rpm) as a function of speed which is measured by gas compressor discharge pressure (CDP) (Metering Valve and Limiter). Acceleration rate above minimum governed speed is controlled on start-up by a ramp generator which also controls deceleration during a normal shutdown.
5. Provides load, thus speed, set points (Discharge Pressure Controller) and regulates gas fuel flow to meet the load demanded. (Pneumatic reset signals to the governor).

The part of the pneumatic control system schematic, Figure 16, which contains the fuel on/off and starting turbine control part of the pneumatic control system is interpreted the same as the lubrication schematic in that each circled item number can be referred to a part number, description and location. To repeat an example, circle 23 is the manual trip valve, part number 226C00096, and is located in the "Pressure Switch and Gauge Panel" which is part of the power plant assembly. Each component in the "Pressure Switch and Gauge Panel" is identified accordingly and can therefore be easily located.

5.2 AIR SUPPLY (Supplied by Orenda Limited)

An air compressor network, located in the mechanical section of the control building, supplies clean dry air to the pneumatic control system on the station. The network consists of two air compressors, a storage tank, a pre-filter, air dryer and an after-filter. The main compressor is mounted on the tank and is powered by a 460V AC 3-phase, 60 Hz. electric motor. The standby compressor is driven by a natural gas fueled industrial engine which is provided with a self-contained control system and power supply.

The main AC-powered compressor starts automatically when the pressure in the storage tank falls below 155 psig and normally supplies the system. In the vent of AC failure or main compressor malfunction, the standby compressor will start automatically when the tank pressure falls below 150 psig.

When the pressure in the storage tank is 175 psig, the operating compressor will automatically shut down. In operation the pressure from both compressors is passed through the aftercooler before pressurizing the main storage tank. From the main storage tank, the compressed air is passed through the pre-filter, air dryer and after-filter before supplying the Pneumatic Control System.

5.2A PNEUMATIC SYSTEM - AIR SUPPLY (Customer)

On some installations, the required 175 psig instrument air is supplied by the customer. This supply should meet the same standards of filtration, and drying as the Orenda supplied systems.

5.3 STARTING AND FUEL CONTROL VALVES

Referring to Figure 16, the air supply described above is fed into a system pressure regulator then to the other components in the system. Gas at 200 psi. is available at the starter control valve and at 150 psi. at the isolating and vent valve.

Two solenoid valves 20/S and 20/F are controlled through the control panel relays to open and close the starter control valves, isolating and vent valve and fuel stop valve in the proper sequence. The fuel supply system is an 80 psi. working pressure triggered by a 35 psi. signal acting on a relay valve for quick trip action. The starting valve is opened and closed using 35 psi. on the diaphragm.

The overspeed trip valve located on the rear casting of the power turbine is piped directly into the stop valve circuit and when the power turbine shaft overspeed piston extends and bleeds off pressure in this line, the stop and vent valves slam shut. A manual trip is also fitted in this line. This trip is the red trip button located on the front face of the "Pressure Switch and Gauge Panel" fitted to the power plant base. On the OT-F-3 the overspeed trip is set by means of a reset button located on the intake fairing split line.

The 20 psi. pressure supply for the hydraulic supply tank located in the compressor building (mechanical section of the control house), and the air supply to the surge control system, seal oil ΔP transmitter, lube and fuel transmitter is tapped off this system immediately after the 80 psi. pressure regulator.

A gas pressure sensing switch and a pressure gauge situated in the "Pressure Switch and Gauge Panel" are teed into the main gas line downstream of the fuel stop valve. The pressure switch is calibrated to sense low fuel pressures and is effective in unit trip and annunciation circuits.

Except for the starter control, isolating and vent, stop and vent valves, all components shown on Figure 16 are located in the "Pressure Switch and Gauge Panel".

5.4 GAS PRODUCER SPEED SENSING

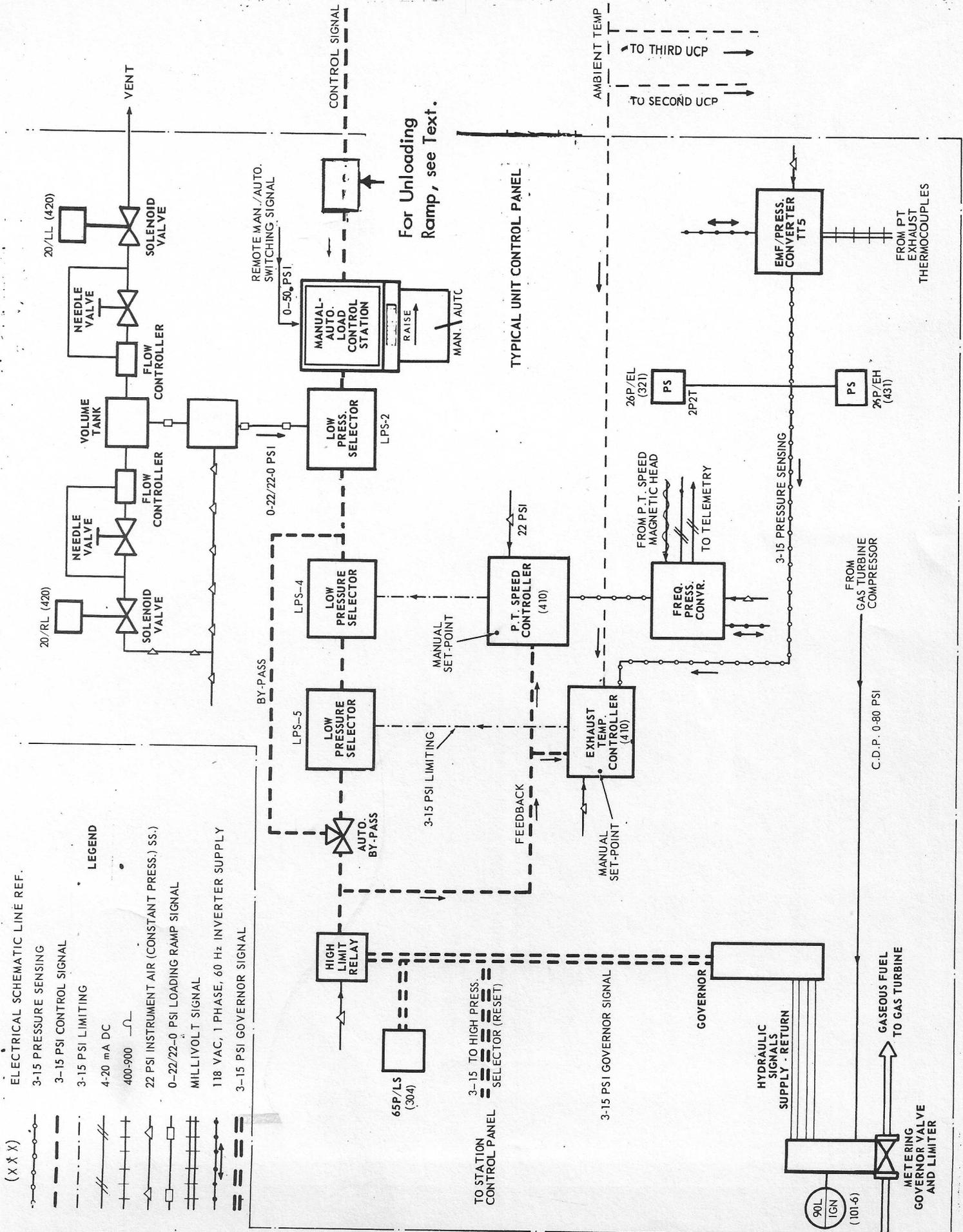
Refer to Fig. 17.

The gas producer speed is used to sequence control events such as valves open/closed, lube pumps on/off, ignition on/off etc. By using three pressure switches on the OT-F-2100 and four in the case of the OT-F-3 all necessary functions are satisfied in the control system.

The gas producer speed is sensed by a magnetic pick-up that is mounted to look at the outside diameter of a toothed gear that is rotated by an auxiliaries gearbox drive. As the magnetic head is basically a permanent magnet sensing the change in the magnetic field as each tooth on the rotating gear passes, the number of teeth on the gear must be related to the speed it turns at in relation to the engine speed. The pick-up output frequency is always equal to the rpm of the rotating gear times the number of teeth on the gear divided by 60. This accounts for the power turbine toothed gear, that is machined as part of the shaft, having a different number of teeth than the gas producer pick-up where the speed is reduced through the auxiliaries gearbox. This system is designed for a magnetic pick-up head frequency of 0-2000 cps linearly equivalent to 0-10,000 rpm engine speed.

This frequency output is converted to a 3-15 psi air signal by a frequency/pressure transmitter mounted as part of the pneumatic speed switch panel. The 3-15 psi. air signal is therefore equal to 0-10,000 rpm and this is indicated by a dial gauge mounted on the front face of the "Unit Control Panel".

The speed pressure switch is simply a device that opens and closes a set of electrical contacts at a pre-determined set point. These contacts in turn energize or de-energize an electrical relay mounted on the front face of the "Unit Control Panel". Following the ASA code the switches are designated 12P/L, 12P/M, 12P/MH and 12P/H. The "P" in this case refers to the pressure switch and the relays carry the same designation without the P.



GOVERNOR SIGNAL BLOCK DIAGRAM

FIG.16A (SHEET 1)

GOVERNOR SIGNAL BLOCK DIAGRAM

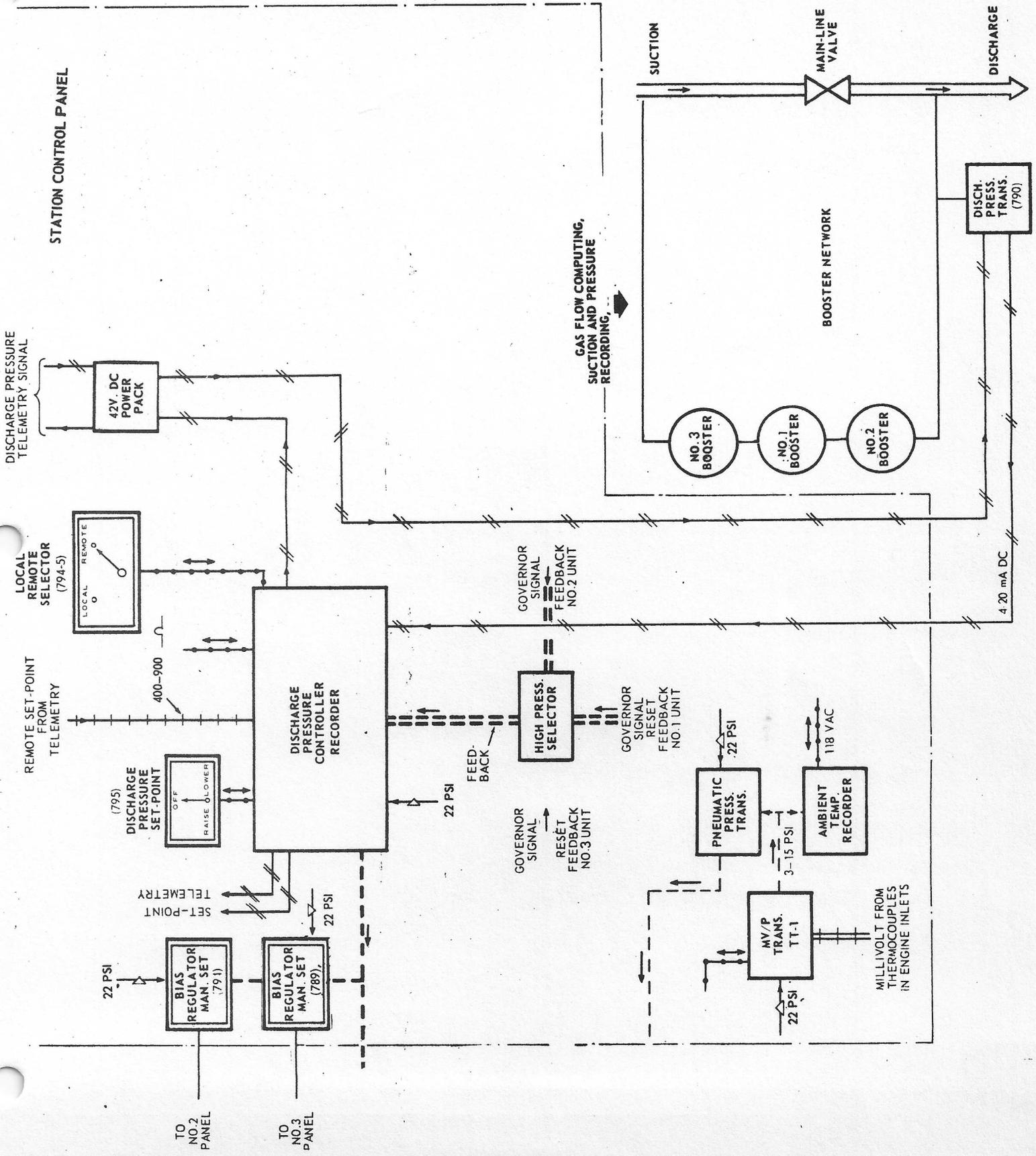


FIG. 16A (SHEET 2)

5.5 GOVERNOR

The function of the governor valve is to meter the correct amount of fuel to the gas producer under all operating conditions. This includes fuel flow during ignition, acceleration, on-load and minimum flow during deceleration.

1. Minimum and maximum flows are set by means of adjustable stops.
2. On-load flows are determined by hydraulic inputs from the power turbine control panel.
3. The limiter schedules fuel flow during acceleration or deceleration as a function of gas producer discharge pressure (CDP) at speeds below 'Governor Minimum'.

A limit switch 90L/IGN indicating that the meter valve is on its minimum stop is incorporated into the permissive start circuit. This will prevent starting if the governor metering valve is not on the minimum stop.

The governing system consists of a PG/PL type governor and a metering valve and limiter which controls the gas producer speed. The governor, mounted on and driven by a vertical shaft in the auxiliaries gearbox, is connected by four hydraulic control lines to the metering valve and limiter which is mounted on the main gas fuel line.

The governor receives a 3-15 psi air signal (demand) from a discharge pressure controller (Auto) or from a pneumatic control station (Manual). The demand signal is limited by a limiting valve to a preset level and is modified to suit power turbine speed and exhaust gas temperature limiting requirements. The routing of the demand signal through the various low and high pressure selector valves is shown in block diagram, Figure 16A.

Figure 16A shows the origins and override and limiting action required to maintain the gas turbine operation within a fixed operating envelope. These features are described in subsequent paragraphs.

As load is a function of gas producer speed the governor basically controls this speed. A pressure range of 3-15 psig, changes the gas producer speed from 4,500 to 7,600 rpm. Adjustable mechanical stops on the speed setting mechanism are set to limit gas producer speed to approximately 6,000 rpm minimum (governor speed) and 7,500 rpm maximum.

An indication of gas pressure to the burners (fuel nozzles) is provided by a gauge mounted on the front face of the "Unit Control Panel".

5.6 GOVERNOR CONTROL SIGNAL

Refer to Fig. 16A

Auto Operation (Remote or Local Operating Mode)

In the Auto mode of operation, the governor control signal (3-15 psi air signal) is provided by a Discharge Pressure Controller, located in the Station Control Panel. The controller set-point is set by a telemetering system (Remote) or by a Raise/Lower switch on the Station Control Panel (Local), see 5.9, 'Booster Network'.

The signal from the discharge pressure controller is received by an Auto/Manual Load Control Station in the Unit Control Panel. When the load control station is set at Auto, the signal is compared with a ramp generator signal before entering a limiting network on the Turbine Control Panel (located inside the UCP).

Manual Operation (Local)

With the Load Control Station selected to Manual the signal from the Discharge Controller is blocked and the 3-15 psig governor load signal can be applied manually at the Load Control Station. The signal follows the same path to the turbine control panel.

The Load Control Station is automatically switched to the Manual Mode of the operation if:

- The control mode (local/remote) selector on the SCP is at 'Local' and the mode selector switch is at 'Manual' or 'Purge'.

OR

- The Uncoupled/Run switch is at 'Uncoupled'.

5.6A RAMP GENERATOR

The pneumatic ramp generator control panel is located immediately above the power turbine control panel on the back wall of the "Unit Control Panel". The function of this panel is to control the acceleration between 4500 rpm and load set-point and deceleration rate from load set-point to governor minimum stop at a pre-set rate (approx. 10 minutes), during run-up and following shutdown.

The power turbine control components, the ramp generator components and the speed switches as mounted on the rear wall of the "Unit Control Panel" are shown in Fig. 19.

5.6B POWER TURBINE CONTROL PANEL

Refer to Fig. 18

The power turbine control panel basically converts temperature and speed millivolt signals into useful pneumatic pressures.

The exhaust gas temperature is sensed by six dual element thermocouples penetrating into the gas stream at the outlet of the vaned exhaust gas elbows. To withstand the possible 1000° F. temperatures or higher and accurately sense the gas temperature, the thermocouples are manufactured from the metals chromel and alumel. Due to the difference in the electromotive force of these two metals, the thermocouples provide a millivolt signal that is proportional to the temperature of the gas. Due to the high velocity of the gas travelling through the ninety degree vaned elbow and the variation in the temperature of the gas as it leaves the power turbine outlet, the gas is not completely mixed by the time it passes the thermocouples. The problem of obtaining two sets of average temperature within a few degrees of each other is done by paralleling the 12 sensing points and feeding three from each elbow into the temperature pneumatic transmitter and three from the RH elbow to one pen and three from the LH elbow to the second pen on the indicator/recorder mounted on the front panel of the "Unit Control Panel". A spread in temperatures between these two pens is usually observed but a spread exceeding 25 degrees usually indicates a combustion problem. Besides providing indicated temperature readout between 0 and 1200 degrees, the indicator/recorder also provides an overtemperature trip function. The exhaust gas temperature is continuously recorded by the separate pens and monitored by two separate relays both set at 975° F. Temperature in excess of this set-point or a broken circuit initiates unit trip and an alarm event recording.

The Millivolt/Pressure (E/P) transmitter converts the millivolt signal from the six paralleled thermocouples (3 in each elbow) into a 3-15 psig air signal, proportional to a sensed temperature of 0-1200°F. The 3-15 psig air signal is applied to:

- Exhaust temperature controller.
- Light-up sensing - pressure switch 26P/EL.
- Exhaust temperature trip sensing - pressure switch 26P/EH.

POWER TURBINE CONTROL PANEL

31	200001520	RELAY - LOW PRESS. SELECTING	UCP
32	263000803	PNEUMATIC CONTROL STATION	UCP
33	263K00147	SOLENOID VALVE - 3-WAY	UCP
39	238K00062	RECORDER - EXHAUST TEMPERATURE	UCP
43	200002070	PNEUMATIC CONTROLLER - SPEED	UCP
44	263K00323	DUAL THERMOCOUPLE - EXHAUST	UCP & CONTR.
49	263K00792	RECEIVER GAUGE	UCP
43	263K00792	PNEUMATIC CONTROLLER - AIR	UCP
61	282K00061	RECORDER - POWER TURBINE SPEED	UCP
62	263K00784	PANEL - PNEUMATIC CONTROL	UCP
63	263K00106	PANEL - PNEUMATIC, POWER TURB	UCP
64	263K00785	VALVE - SOLENOID - 2-WAY	UCP
65	263K00736	VALVE - NEEDLE	UCP
66	263K00737	CONTROLLER - LOW FLOW	UCP
67	263K00738	CONTROLLER - LOW FLOW	UCP
68	263K00739	CONTROLLER - LOW FLOW	UCP
69	263K00740	CONTROLLER - LOW FLOW	UCP
70	263K00741	CONTROLLER - LOW FLOW	UCP
71	263K00742	CONTROLLER - LOW FLOW	UCP
72	263K00743	CONTROLLER - LOW FLOW	UCP
73	263K00744	CONTROLLER - LOW FLOW	UCP
74	263K00745	CONTROLLER - LOW FLOW	UCP
75	263K00746	CONTROLLER - LOW FLOW	UCP
76	263K00747	CONTROLLER - LOW FLOW	UCP
77	263K00748	CONTROLLER - LOW FLOW	UCP
78	263K00749	CONTROLLER - LOW FLOW	UCP
79	263K00750	CONTROLLER - LOW FLOW	UCP
80	263K00751	CONTROLLER - LOW FLOW	UCP
81	263K00752	CONTROLLER - LOW FLOW	UCP
82	263K00753	CONTROLLER - LOW FLOW	UCP
83	263K00754	CONTROLLER - LOW FLOW	UCP
84	263K00755	CONTROLLER - LOW FLOW	UCP
85	263K00756	CONTROLLER - LOW FLOW	UCP
86	263K00757	CONTROLLER - LOW FLOW	UCP
87	263K00758	CONTROLLER - LOW FLOW	UCP
88	263K00759	CONTROLLER - LOW FLOW	UCP
89	263K00760	CONTROLLER - LOW FLOW	UCP
90	263K00761	CONTROLLER - LOW FLOW	UCP
91	263K00762	CONTROLLER - LOW FLOW	UCP
92	263K00763	CONTROLLER - LOW FLOW	UCP
93	263K00764	CONTROLLER - LOW FLOW	UCP
94	263K00765	CONTROLLER - LOW FLOW	UCP
95	263K00766	CONTROLLER - LOW FLOW	UCP
96	263K00767	CONTROLLER - LOW FLOW	UCP
97	263K00768	CONTROLLER - LOW FLOW	UCP
98	263K00769	CONTROLLER - LOW FLOW	UCP
99	263K00770	CONTROLLER - LOW FLOW	UCP
100	263K00771	CONTROLLER - LOW FLOW	UCP

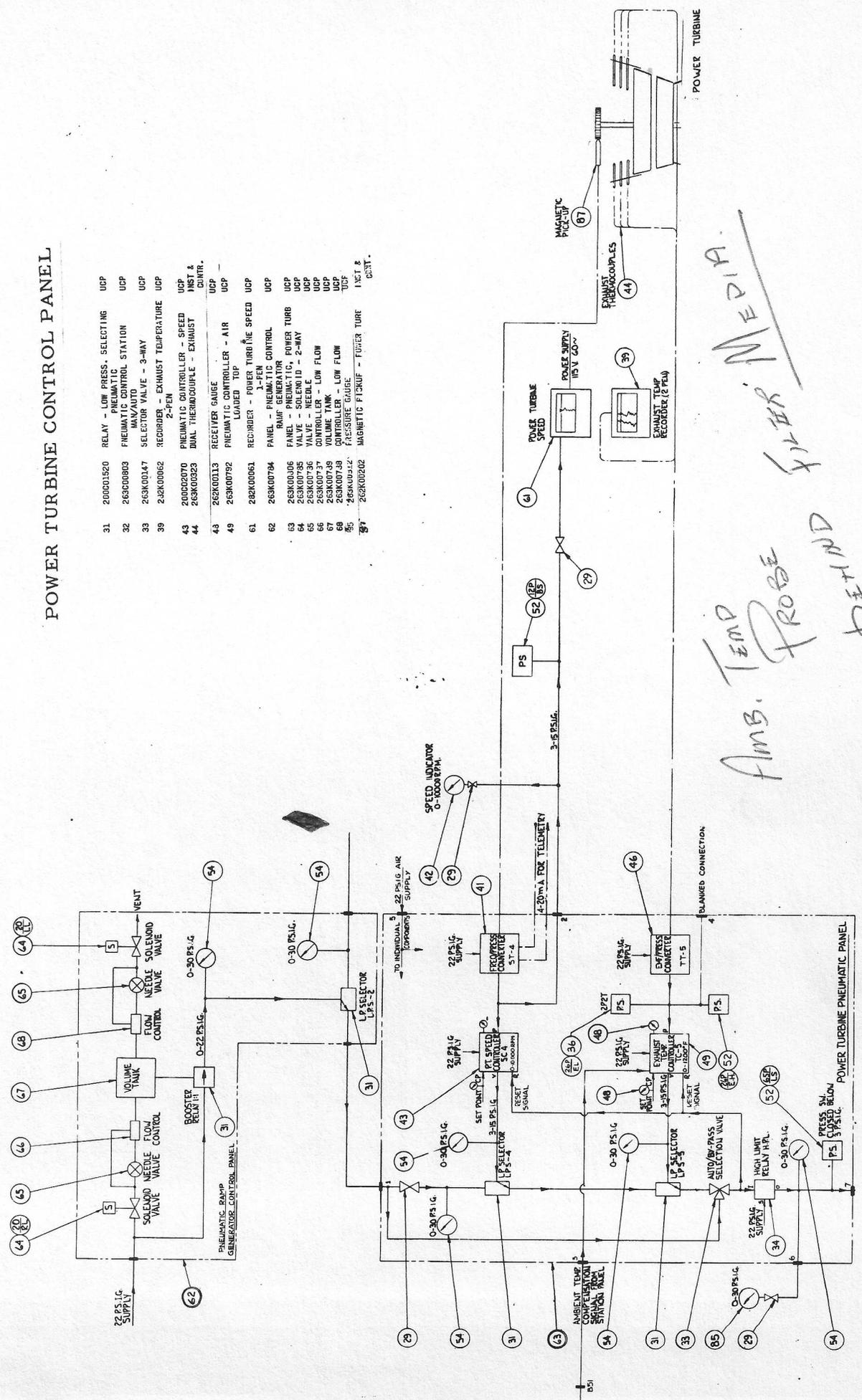


FIG. 18

The exhaust temperature controller compensates for ambient temperature conditions in response to an air signal from an ambient temperature transmitter and contains a reset feature based on a governor feedback signal to prevent overshooting the temperature set-point.

The speed signal is handled in the same manner as the above temperature signal except that the signal converted to a 3-15 psig air signal originates from a magnetic pick-up head similar to the gas producer speed, sensing power turbine speed through a toothed wheel machined as part of the power turbine shaft. In addition to the power turbine controller the air signal is sensed by the power turbine speed recorder and a pressure switch used to open the booster valve - 12P/BS.

The two 3-15 psi air signals (exhaust gas temperature and PT speed) from the panel are compared with the demand signal to the governor and lowest of the three signals becomes the signal to the governor.

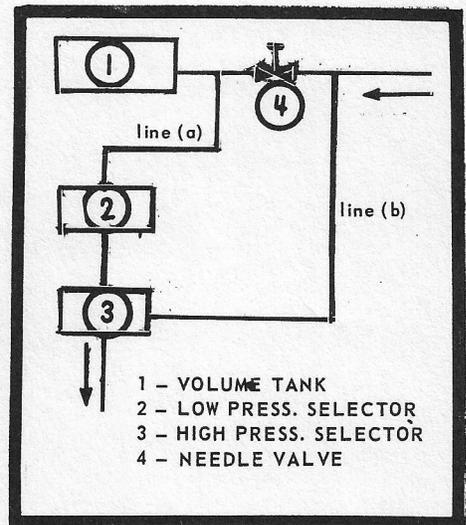
5.7 GOVERNOR UNLOADING RAMP

The governor unloading ramp, described below, is installed on a trial basis. In the Auto mode only the system provides a controlled decrease in air signal to the governor, in response to a significant lowering of discharge pressure requirements and overrides the rate of charge normally governed by the discharge pressure controller.

System Operation (see inset)

(i) With an increasing control signal from the Discharge Pressure Controller (Station Control Panel), the increased air signal passes through line "b" immediately, whilst the pressure in line "a" increases at a rate set by the needle valve. The high pressure selector thus selects the pressure in line "b" (P_b) as the signal to the governor. Pressure in line "a" (P_a) will eventually rise to match P_b , assuming no further change in D.P.C. output.

(ii) Following a decrease in D.P.C. output (caused by reduction in set-point below the process) P_b drops correspondingly, so that, at the High Pressure Selector, $P_a > P_b$, the selector operates in reverse, bleeding the downstream pressure back through line "a", as P_a decreases at a rate set by the needle valve.



Governor Unloading Ramp

5.8 SURGE CONTROL

Refer to Fig. 20.

A "surge" condition in a centrifugal gas compressor occurs when the inlet flow decreases sufficiently to cause a momentary reversal of flow. As flow reduces, the discharge pressure becomes greater than the pressure developed by the compressor resulting in flow reversal. Subsequently the discharge pressure decreases, normal compression resumes and the cycle is repeated. Intense surges may cause compressor blade or seal destruction.

To prevent a surge condition, a recycle process is adopted to recirculate the gas from the discharge side of the compressor back into the suction side and so increase total flow through the compressor without increasing station flow. The recycle valve position, or opening, is controlled by a surge control system located in the Pressure Switch and Gauge Panel. The signal to the recycle valve may come from the Station Control Panel or be manually applied by an independent control station.

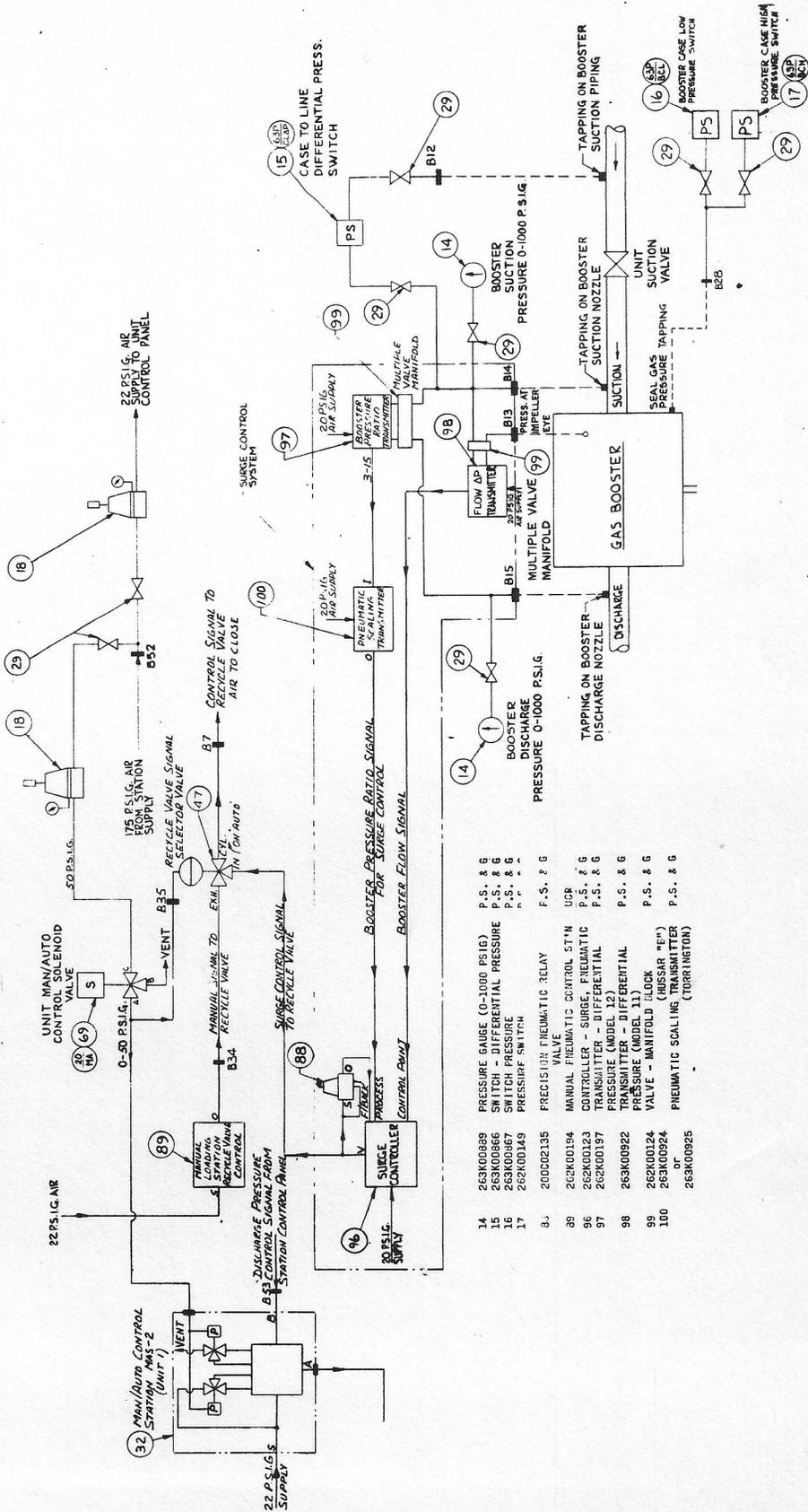
The Surge Control system is shown in Figure 20 and consists of six basic components.

1. Flow differential transmitter.
2. Booster pressure ratio transmitter.
3. Pneumatic scaling transmitter.
4. Surge controller.
5. Reset relay valve.
6. Manual loading station.

The surge controller is operated by 22 psig air pressure and has three input signals.

1. The signal from the reset relay valve prepares the controller for immediate action when the set-point is reached.
2. The control signal is measured as a differential pressure between the booster suction and discharge pressures. The signal is transmitted via the booster pressure ratio and pneumatic scaling transmitters.
3. The measured variable or process signal originates as a differential pressure signal between the booster suction and impeller and is processed through a flow differential transmitter.

SURGE CONTROL



14	263K00939	PRESSURE GAUGE (0-1000 PSIG)	P.S. & G
15	263K00986	DIFFERENTIAL PRESSURE SWITCH	P.S. & G
16	263K00967	PRESSURE SWITCH	P.S. & G
17	262K00149	PRESSURE SWITCH	P.S. & G
89	200002135	PRECISION PNEUMATIC RELAY	F.S. & G
99	262K00194	MANUAL PNEUMATIC CONTROL STATION	UPP
96	262K00123	CONTROLLER - SURGE, PNEUMATIC	P.S. & G
97	262K00197	TRANSMITTER - DIFFERENTIAL PRESSURE	P.S. & G
98	263K00922	TRANSMITTER - DIFFERENTIAL PRESSURE (MODEL 11)	P.S. & G
99	262K00124	VALVE - MANIFOLD (LOCK)	P.S. & G
100	263K00924	PNEUMATIC SCALING TRANSMITTER (HUSSAR "E")	P.S. & G
		OF	
		263K00925	(TORRINGTON)

FIG. 20

The controller, which is set for reverse action (an increase in input giving a decrease in output) has two adjustments.

(a) Proportional Band

Adjustment is made over the range 2-200%. At a setting of 2%, a small deviation in process signal causes a large variation in controller output, resulting in almost ON-OFF action. At 200% setting the proportional band needle valve is fully closed, and a large deviation in process signal gives a small change in output.

For surge application, a relatively large increase in output is required for a small deviation in process signal and an initial setting of 50% is recommended.

(b) Reset

The controller includes the fast reset option, range 0.01 to 5 minutes/ repeat. Recommended setting - 0.02 minutes/ repeat. Check that reset mode plate is set at "MANUAL BYPASS" position.

During normal running, the recycle valve will be closed, the control signal will be above the set-point and therefore the surge controller will not be operating.

At the approach of a surge condition, i. e. reduction in flow or increase in head, the controller output decreases before the process reaches the set-point, thus giving fast response before surge occurs. However, as the controller output drops below 15.1 psig, the reset relay opens allowing the feedback or reset signal is fed into the reset reference chambers of the controller which modulates the output to bring the process to match the set-point. As the controller output drops below 15 psig, the recycle valve opens, reducing the pressure head drop over the compressor or increasing flow through the compressor, thus correcting the surge condition.

In a surge condition the process signal exceeds the set-point of the controller, the output of which is between 3-15 psig, and therefore, the recycle valve is proportionally set between the open and closed position, This remains until the surge condition has passed and the controller output again rises above 15 psig.

By positioning the Local/Remote selector on the station control panel to Local and the Auto/Manual/Purge selector to MANUAL or PURGE, the knurled knob, on the manual recycle valve control station, can be used to open and close the recycle valve.

Figure 21 shows the location of the surge control components as installed in the pressure switch and gauge panel.

5.9 BOOSTER NETWORK

Refer to Fig. 22.

The booster network is equipped with four transmitters. The three on the suction side, (two pressure and one temperature) are fed into the station gas flow computer. The fourth transmitter is on network discharge and is fed into "Discharge Pressure Controller".

The electrically-powered "Discharge Pressure Controller/Recorder" is provided with Remote/Off/Local control by means of an external switch.

Selected to 'Remote', the controller receives telemetered command set-point adjusting signals of 500 to 1,000 ohms proportional to 500 to 1,000 psi. discharge pressure. The controller converts the resistance signals to a 3-15 psi. pneumatic signal and a 4-20 Ma signal.

The foregoing resistance/pressure figures quoted refer to OT-F-2100 installations, like figures for the OT-F-3 installations are 400/900 ohms proportional to 400/900 psig.

The 3-15 psi signal is applied to the governor load signal network and the 4-20 Ma current signal is fed-back to the remote station via the telemetering system.

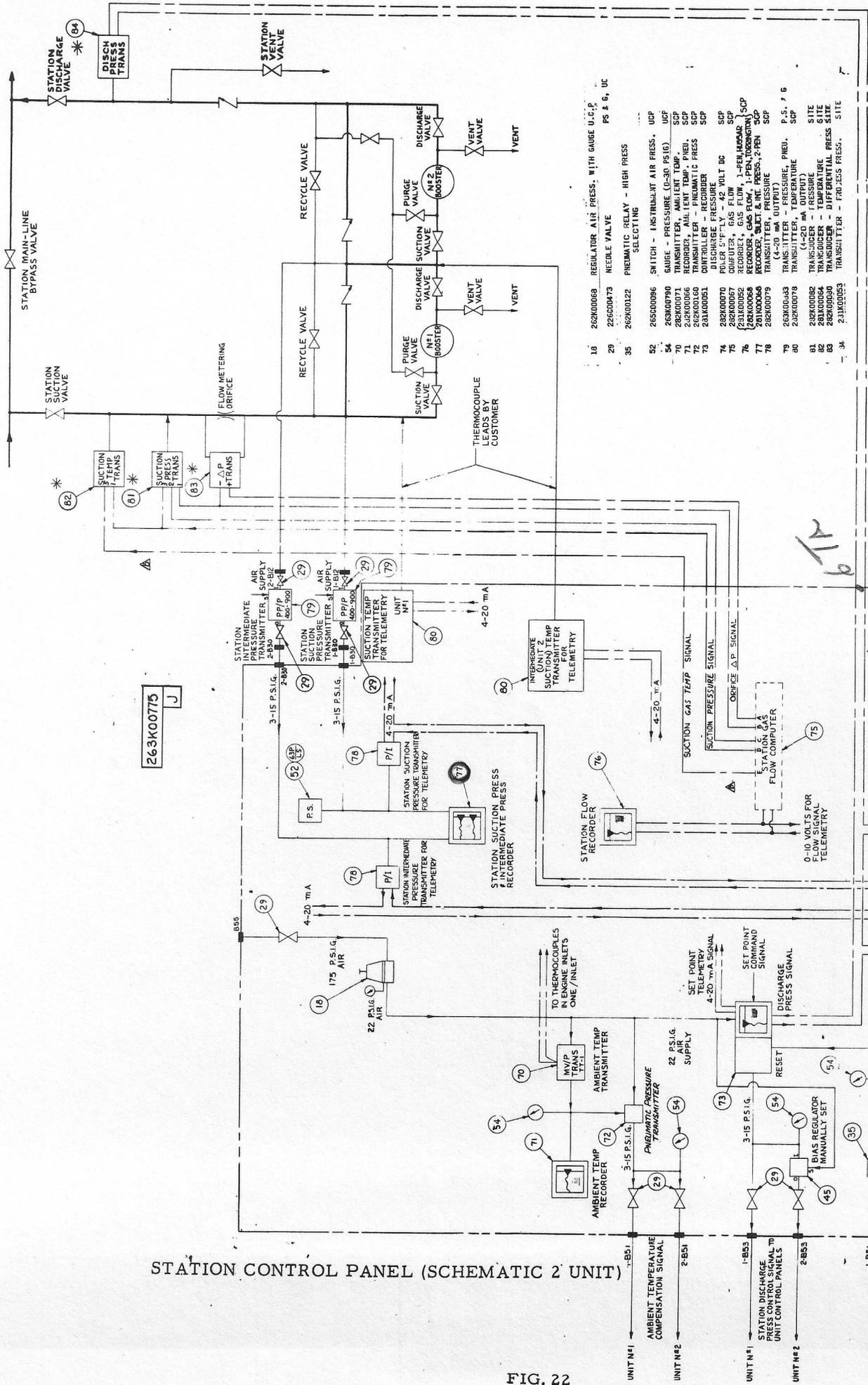
Selected to "Local" the controller is ready to receive a manual Raise/Lower set-point signal from a discharge pressure set-point switch on the "Station Control Panel". The function of the controller on receipt of a local set-point is the same as that described above for 'Remote'.

Actual discharge pressure signals are received by the Discharge Pressure Controller/Recorder. These signals are provided by the station discharge pressure transmitter.

Discharge pressure and set-point are recorded on a strip chart and are also telemetered to the remote station.

The electrically-powered "Suction and Intermediate Pressure Recorder" receives and records two 3-15 psi pneumatic signals, one from the "Station Suction Pressure Transmitter" and one from the "Station Intermediate Pressure Transmitter" each proportional to (500-1,000 psig OT-F-2100) line suction pressure. Both 3-15 psi signals are also converted to 4-20 Ma signals by pressure transmitters for telemetering.

BOOSTER NET-WORK



STATION CONTROL PANEL (SCHEMATIC 2 UNIT)

FIG. 22

- 18 26200069 REGULATOR AIR PRESS. WITH GAUGE U.C.P. PS & G, UC
- 29 22600073 NEEDLE VALVE
- 35 26200022 PNEUMATIC RELAY - HIGH PRESS SELECTING
- 52 26500096 SWITCH - INSTRUMENT AIR PRESS. UDP
- 54 263000790 GAUGE - PRESSURE (0-30 PSIG) UCP
- 70 28200071 TRANSMITTER, AMBIENT TEMP. SCP
- 71 24200066 RECORDER, AMBIENT TEMP. PNEI. SCP
- 72 26200060 TRANSMITTER - PNEUMATIC PRESS SCP
- 73 23100051 RECORDER - AMBIENT TEMP. SCP
- 74 28200070 RECORDER - AMBIENT TEMP. SCP
- 75 28200067 RECORDER, GAS FLOW, 1-PHASE SCP
- 76 28100052 RECORDER, GAS FLOW, 1-PHASE SCP
- 77 28100049 RECORDER - AMBIENT TEMP. SCP
- 78 28200079 TRANSMITTER, PRESSURE SCP (4-20 mA OUTPUT)
- 79 26300049 TRANSMITTER - PRESSURE, PNEI. P.S. & G
- 80 23800079 TRANS (4-20 mA OUTPUT) SCP
- 81 23200082 TRANSDUCER - PRESSURE SITE
- 82 28100064 TRANSDUCER - TEMPERATURE SITE
- 83 28200090 TRANSDUCER - DIFFERENTIAL PRESS SITE
- 84 23100053 TRANSMITTER - FRO-255 PRESS. SITE

* ORENUA SUPPLIED
* CUSTOMER INSTALLED

NOTE:
STATION SCN PRESSURE PROCESS PRESSURE TO PNEUMATIC TRANSMITTER IS IN P.S.I.G.
PANEL FOR UNIT NO.1
STATION INTERMEDIATE PRESSURE PROCESS PRESSURE TO PNEUMATIC TRANSMITTER IS IN P.S.I.G. PANEL FOR UNIT NO.2
DASH PREFIX ON BULKHEAD DESIGNATION INDICATES UNIT NO.1 OR UNIT NO.2 EG. I-851

STATION CONTROL PANEL

5.10 OT-F-2100 AXIAL COMPRESSOR BLEED CONTROL SYSTEM

The axial compressor bleed air system on the OT-F-2100 unit is mounted on the Compressor Building wall on the opposite side to the "Pressure Switch and Gauge Panel".

The function of this panel is to control the opening and closing of the butterfly type valves to bleed off air at the 4th and 5th stage axial compressor bleed-off points at the proper engine speed and to suit ambient temperature, see Fig.22A, in order to prevent compressor stall and surge. An orifice plate is installed in the bleed piping of the 4th stage to control the flow of bleed air. This bleed operation is carried out at a speed usually below the operational speed of the unit.

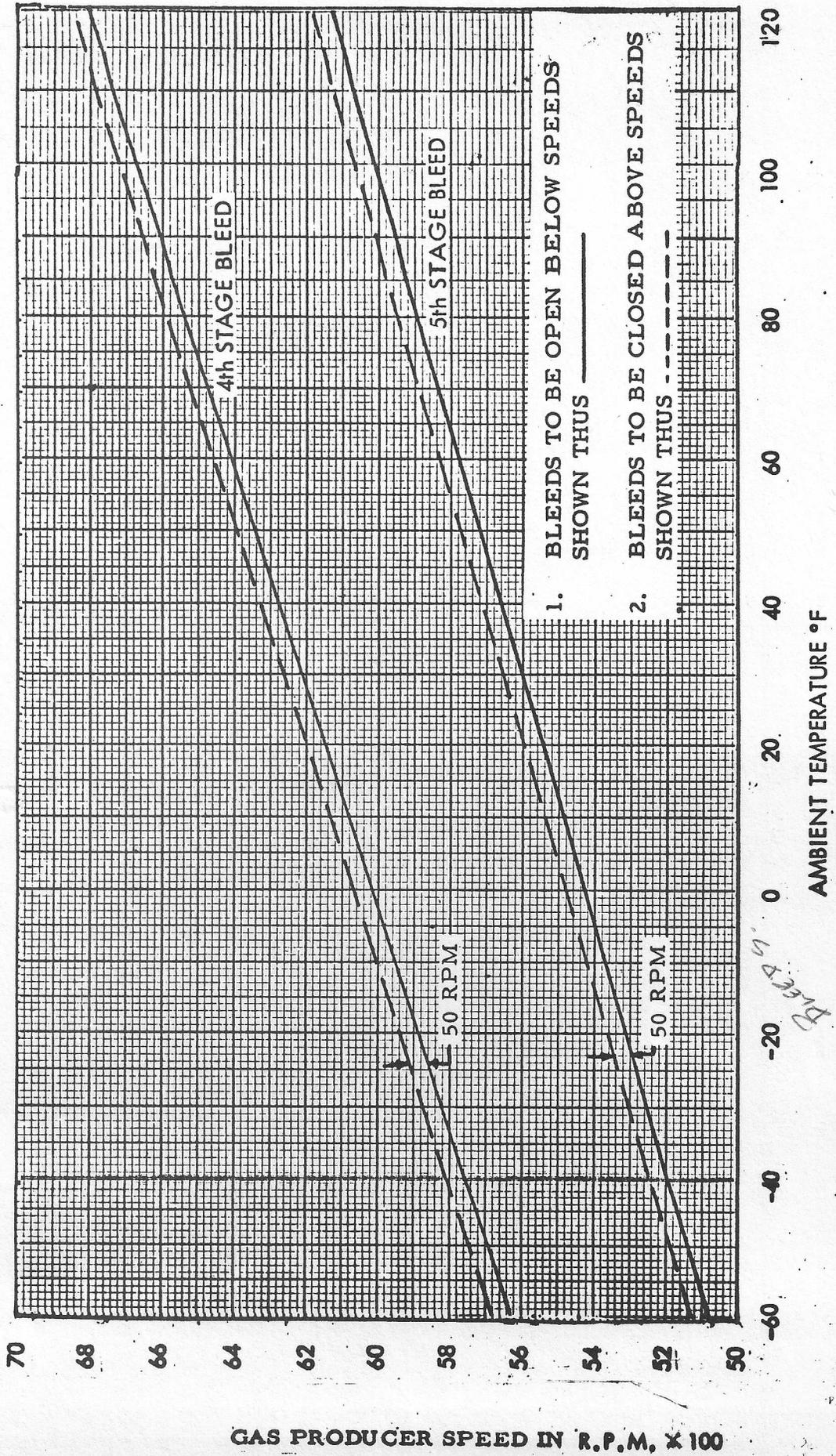
The 7th stage air pressure is used as the control signal pressure and the higher 10th stage as the 6" butterfly valve (2 off) working pressure. Both pressures are managed by a series of regulators and relays to produce a repeatable smooth valve operation at the exact speed set-point, see Fig. 22B.

On speed increase the 7th stage air pressure increases and on reaching the set-point of the precision relay, closes the 5th stage bleed valve, e.g. 60°F ambient this valve starts to close at 5780 rpm. As the speed increases the 4th stage valve starts to close at 6410 rpm, see Fig.22A.

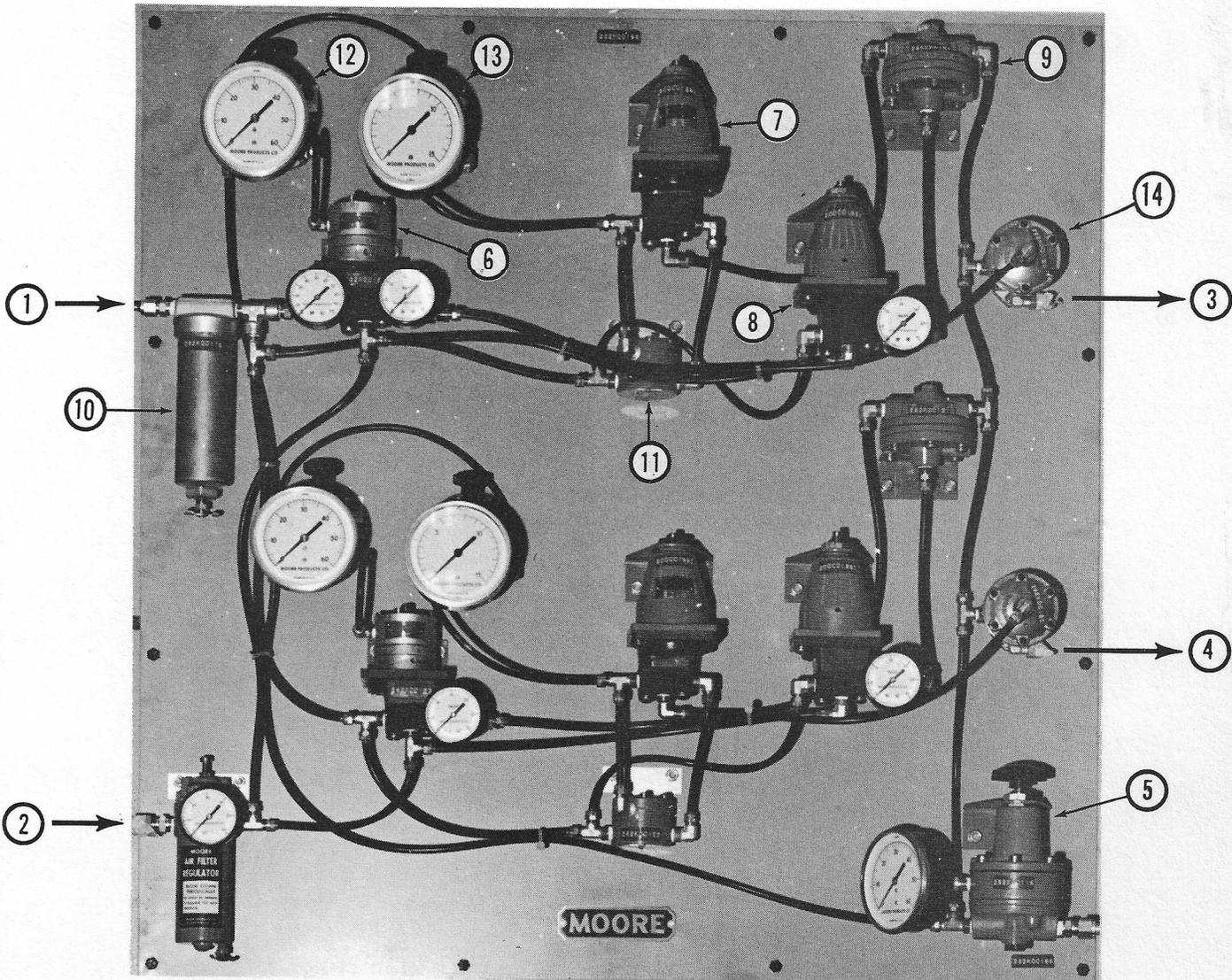
On decreasing speed, except for hysteresis, the reverse action occurs.

NOTE

The gas turbine may be operated continuously at gas generator speed ranges in which the 4th stage bleed valve is open. Running with the 5th stage bleed valve open should be avoided except during run-up and shutdown.



BLEED VALVE OPERATION - AMBIENT TEMP. VS RPM (OT-F-2100)



282-1

ITEM NO.	DESCRIPTION
1	7TH STAGE CONTROL SIGNAL (REF. ONLY)
2	10TH STAGE AIR (REF. ONLY)
3	4TH STAGE OUTPUT (REF. ONLY)
4	5TH STAGE OUTPUT (REF. ONLY)
5	PRESSURE REGULATOR (40 PSIG OUTPUT)
6	PRECISION RELAY WITH PNEUMATIC SET-POINT - BLEED VALVE OPEN/CLOSE (262K00123)
7	PRECISION RELAY - BIAS (200C01992)
8	PRECISION RELAY - RESET (200C01992)
9	AMPLIFYING RELAY
10	AIR FILTER
11	HIGH PRESSURE SELECTOR
12	AIR-LOADED PRESSURE REGULATOR (262K00117) WITH GAUGE (262K00071)
13	PRESSURE REGULATOR - BIASING (262K00069)
14	PNEUMATIC PILOT VALVE - THREE-WAY (262K00120)

ITEMS SHOWN ARE THOSE WHICH CONTROL THE 4TH STAGE BLEED VALVE WITH THE EXCEPTION OF ITEM 5 WHICH IS COMMON TO BOTH. THE REMAINING ITEMS WHICH CONTROL THE 5TH STAGE BLEED VALVE ARE SIMILAR.

COMPRESSOR BLEED VALVE CONTROL PANEL (OT-F-2100)

FIG. 22B.

SECTION 6

CONTROLS BUILDING

SECTION 6.

CONTROLS BUILDING (ALL UNITS EXCEPT MOBILE)

6.1 GENERAL

This section describes the layout and components in the control building with the emphasis placed on the "Unit and Station Control Panels".

The controls building is constructed in two sections. Each section measures 36 feet by 12 feet and is joined end to end.

The "Mechanical Section" contains:- (All units except Carstairs and Nordegg)

1. The compressor air supply for the pneumatic control system. This consists of one electrically and one gas fired driven compressor.
2. The hydraulic tank for the glycol cooler and power plant enclosure fan hydraulic motors.
3. Most installations are provided with an auxiliary source of 460 VAC, 3 phase 60 Hz power, which will cut in to supply the station requirement in the event of purchased power failure.
 - OT-F-2100 - gas fired engine and a low voltage switchgear. (Orenda Limited supply)
 - OT-F-3 - The aux. power supply for some units is customer supplied. However in some cases (Carstairs and Nordegg) Orenda Limited provides the switchgear for customer - supplied and operated generating sets.
4. The steam boiler equipment used for heating.
5. The access to the 125V DC battery storage area located under the control building.

The "Control Section" contains:-

1. The "Motor Control Centre".
2. The "Station Control Panel".
3. The "Unit Control Panel" or "Panels" in the case of a Z-station installation.

All services enter the control building through the floor and the terminal strips and the pneumatic centre line connection points of the "Control Panels" and "Motor Control Centre" are located at floor level.

Each section is fitted with steam and electric heating equipment, air conditioning units and a DC and AC light source.

6.2 MOTOR CONTROL CENTRE

The "Motor Control Centre" is made up from standard components and consists basically of two units back-to-back.

The side of the centre facing the control house wall contains breakers for the yard lighting, heating pumps etc., the 24 volt DC battery charger for communication etc., and the AC, DC and inverter distribution panels.

The side facing the "Unit Control Panel" contains the circuit breakers connected with the power plant, namely the seal oil and lube pumps, lube heaters, suction and discharge valves 125V DC battery charger for unit station control and AC to DC inverter for recorders, etc.

The "Motor Control Centre" provides for the following:

1. Control for all motors on the site installation.
2. 125V DC battery charger. A 24V battery charger is installed in single OT-F-3.
3. Power conversion, i. e. 460V AC to 208V AC and 118V AC.
4. Distribution services.
5. DC to AC inverter as a constant 118V AC source for instrumentation.

The only outside power required for the installation is 460V AC and this is stepped down to 208 and 120V as required.

The DC control requirement is 125V and is supplied by a set of nickel-cadmium batteries located in the basement. A 24V DC battery charging unit is the only 24V equipment in the control house and will be a requirement for the telemetry system.

For each electric AC and DC motor a combination circuit breaker/starter is provided. When a selector on each individual motor compartment is selected "Hand" power is fed directly to the particular motor and on "Auto" is controlled by a relay signal from the "Unit Control Panel".

A red light indicates that the motor circuit is complete and a green light indicates the breaker is closed and the starter de-energized.

A DC to AC inverter is included and supplies an accurate and steady 118V AC from the 125V DC source for the control panel timers, recorders, speed indicators, etc.

6.3 UNIT CONTROL PANEL

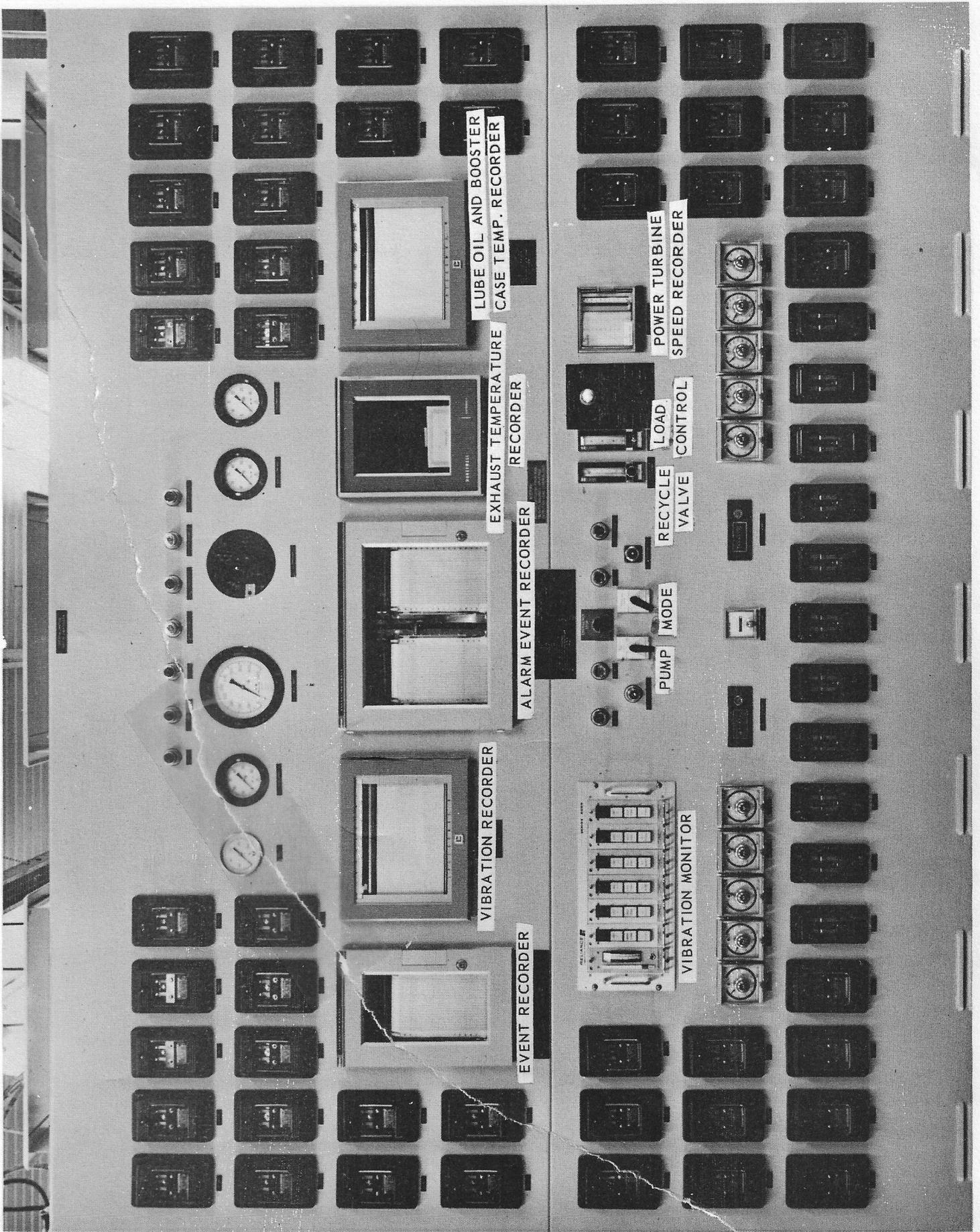
Refer to Fig. 23 (Photograph of OT-F-3 Unit Control Panel)

The OT-F-3 "Unit Control Panel" is a walk-in type cabinet with the following components front mounted.

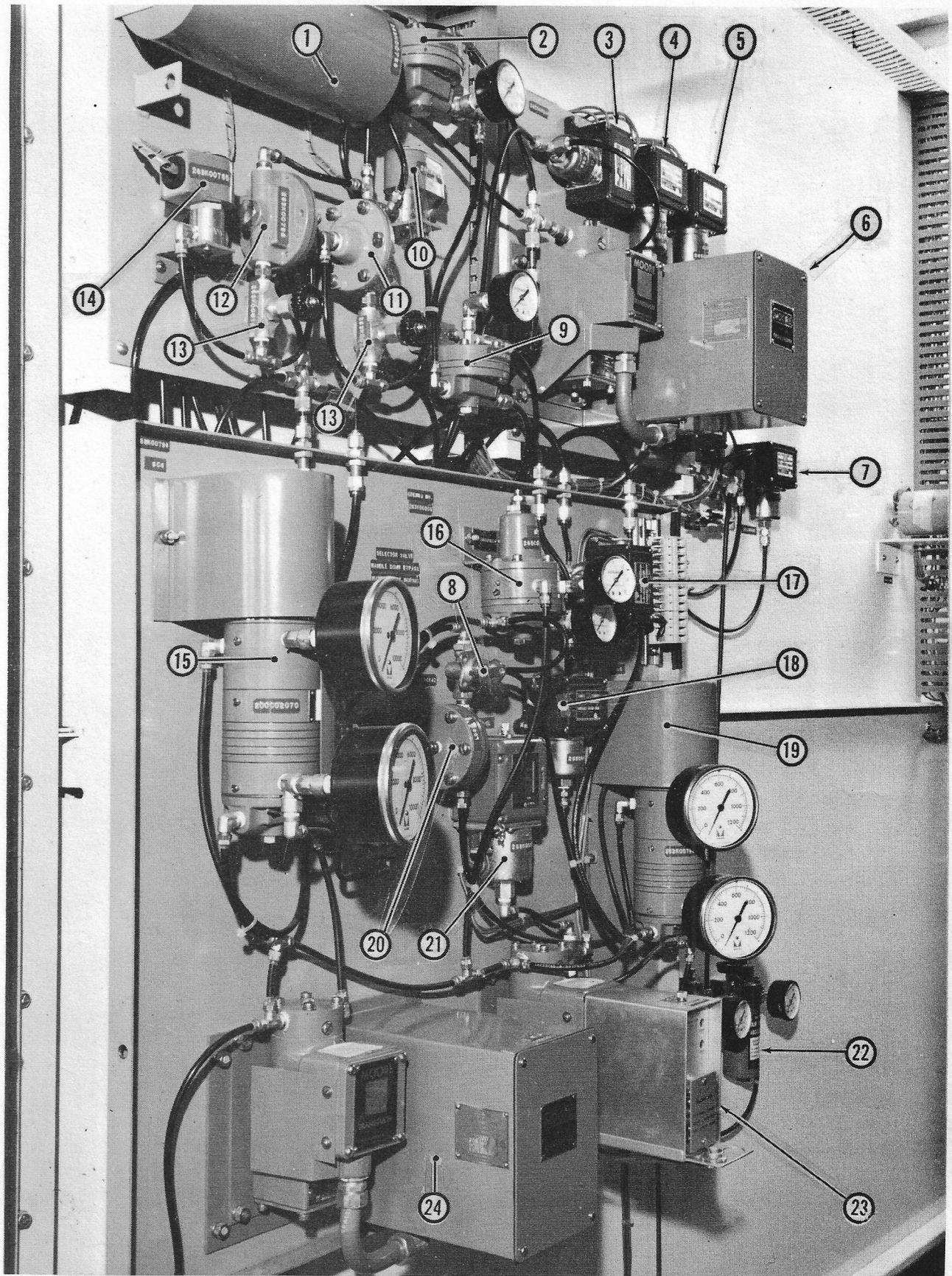
1. Control system relays - Westinghouse MG-6 and SG Type.
2. Timers - Key operated Eagle Bliss.
3. Start and Time meters - Eagle Bliss.
4. Vibration monitor - The Reliance system with the levels traced on a Leeds and Northrup recorder.
5. Two Esterline/Angus event recorders.

The recorders, one a 20 pen event recorder and the second a 40-pen alarm event recorder, continuously monitor the unit during operation and 'down-time' and provide a record of unit events (event recorder) and faults (alarm event recorder) each on a motor-driven strip chart. The motors for each recorder are powered by 118 VAC from the inverter system. Provision is made in each recorder for emergency operation by means of a motor-loaded spring which will operate the chart for a period of 4 hours in the event of a power failure. (This spring should be re-set by pushing a button inside the recorder following any power failure or power off condition.)

The event recorder indicates sequence functions against time and gas generator speed, see Fig.22A. The chart motor on this recorder has a two-speed feature and runs at an increased rate between receipt of a start signal and 'Unit on Line'.



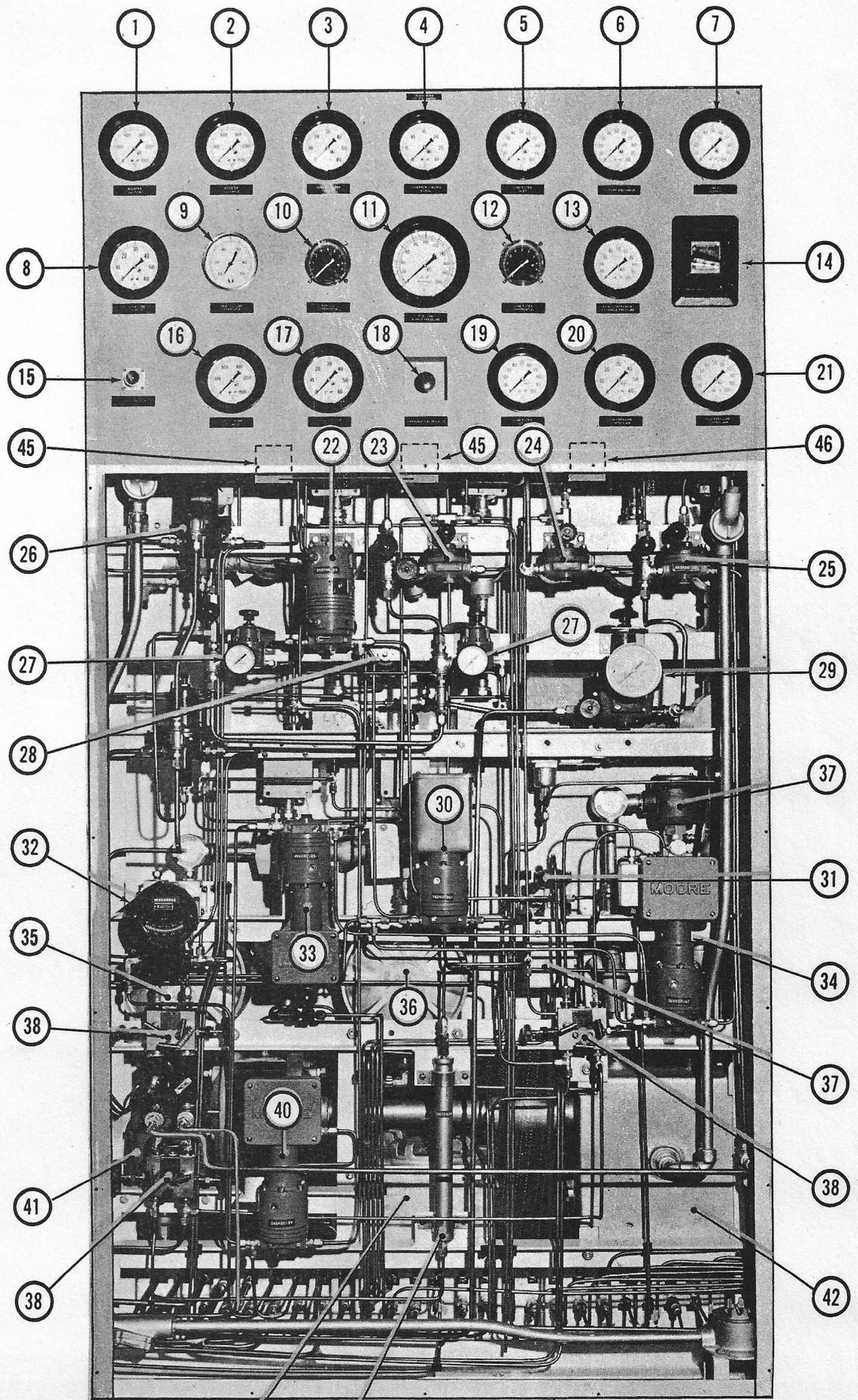
CT-F-3 UNIT CONTROL PANEL



POWER TURBINE CONTROL PANEL

ITEM NO.	DESCRIPTION	CODE	ELECTRICAL SCHEMATIC LINE NO.
1	VOLUME TANK	(263K00789)	-
2	LOW PRESSURE SELECTOR	(200C01520)	-
3	PRESSURE SWITCH, HIGH SPEED	(265C00096)	-
4	PRESSURE SWITCH, SELF-SUSTAINING SPEED	(265C00096)	12P/H (518 & 404)
5	PRESSURE SWITCH, IGNITION SPEED	(265C00096)	12P/M (307 & 404)
6	PNEUMATIC SPEED TRANSMITTER	(200C01525)	12P/L (306 & 404)
7	PRESSURE SWITCH, GP LUBE OIL PRESS	(265C00096)	ST-6 (404)
8	SELECTOR VALVE - 3-WAY	(263K00147)	12P/MH (309 & 404)
9	LOW PRESSURE SELECTOR	(200C01520)	-
10	SOLENOID VALVE - 2-WAY	(263K00785)	LPS-2 -
11	LOW FLOW CONTROLLER	(263K00787)	20/LL (363)
12	LOW FLOW CONTROLLER	(263K00788)	-
13	NEEDLE VALVE	(263K00786)	-
14	SOLENOID VALVE - 2-WAY	(263K00785)	-
15	PNEUMATIC SPEED CONTROLLER	(200C02070)	20/RL (362)
16	HIGH LIMIT RELAY	(265C00199)	ST-4 (410)
17	PRESS. SWITCH - GOVERNOR MINIMUM	(265C00096)	-
18	PRESS. SWITCH - EXHAUST TEMP.	(265C00096)	65P/LS (304)
19	EXHAUST TEMP. CONTROLLER	(263K00792)	26P/EH (354)
20	LOW PRESSURE SELECTOR	(200C01520)	TC-5 (410)
21	PRESSURE SWITCH - EXHAUST TEMP.	(263K00807)	LPS-5 (412)
22	AIR FILTER REGULATOR	(262K00068)	26P/EL (415)
23	EXHAUST TEMP. TRANSMITTER	(262K00157)	-
24	PNEUMATIC SPEED TRANSMITTER	(262K00111)	TT-5 (416)
			ST-4 (407-410)

KEY TO FIG. 19



OT-F-2100 PRESSURE SWITCH AND GAUGE PANEL

(43)

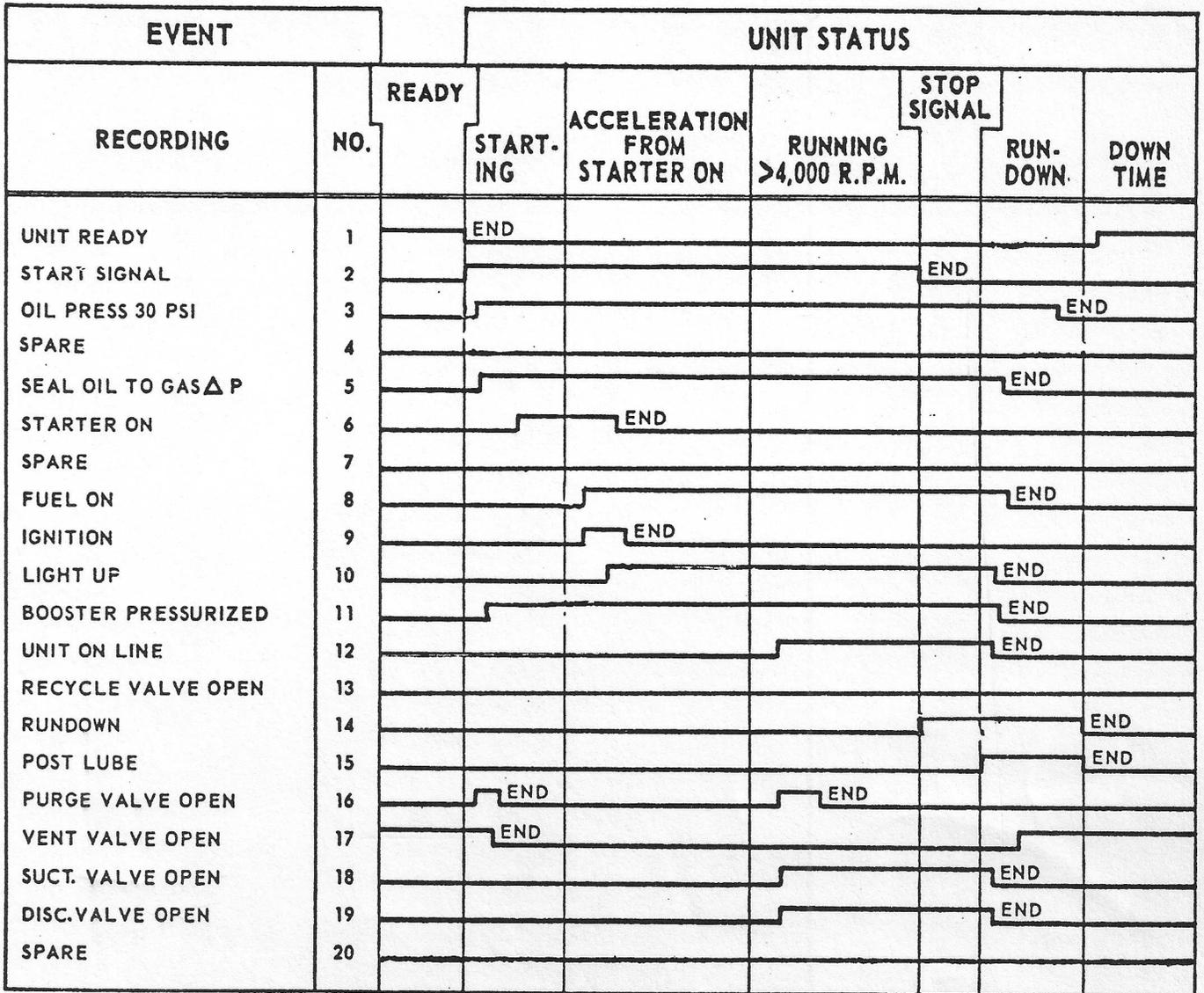
(44)

FIG. 21

LEGEND

1. BOOSTER SUCTION
2. BOOSTER DISCHARGE
3. SEAL OIL FILTER INLET
4. GOVERNOR LOADING SIGNAL
5. LUBE FILTER INLET
6. OIL PUMP DISCHARGE
7. LUBE OIL SUPPLY
8. BOOSTER LUBE OIL SUPPLY
9. SEAL OIL/GAS DIFFERENTIAL
10. SEAL OIL DIFFERENTIAL
11. FUEL GAS SUPPLY PRESSURE
12. LUBE FILTER DIFFERENTIAL
13. AXIAL COMPRESSOR DISCHARGE PRESSURE
14. TURBINE SAFE-RUN SWITCH
15. TELEPHONE JACK
16. SEAL OIL PUMP DISCHARGE
17. SEAL OIL FILTER OUTLET
18. EMERGENCY STOP VALVE
19. LUBE FILTER OUTLET
20. LOW PRESSURE CONTROL AIR
21. HIGH PRESSURE CONTROL AIR
22. NULLMATIC CONTROLLER (262K00128)
23. PRESSURE TRANSMITTER (263K00804)
24. PRESSURE TRANSMITTER (263K00804)
25. PRESSURE TRANSMITTER (262K00109)
26. PNEUMATIC RELAY (200C00940)
27. REGULATOR AIR PRESSURE (262K00107)
28. PRECISION PNEUMATIC RELAY VALVE (200C02135)
29. NULLMATIC PRESSURE REGULATOR (262K00108)
30. PNEUMATIC SCALING TRANSMITTER (262K00201)
31. VALVE 3-WAY, DIAPHRAGM-OPERATED, SPRING RETURN (262K00120)
32. PRESSURE TRANSMITTER (263K00862)
33. DIFF. PRESS. TRANSMITTER (262K00125)
34. DIFFERENTIAL PRESS. TRANSMITTER (262K00197)
35. SWITCH, DIFFERENTIAL PRESSURE
36. SWITCH, DIFFERENTIAL PRESSURE
37. EXPLOSION PROOF SOLENOID
38. FIVE VALVE MANIFOLD BLOCK
39. NOT USED
40. DIFFERENTIAL PRESS. TRANSMITTER (262K00126)
41. PRESSURE-SWITCH (DPDT) 262K00059
42. ELECTRICAL TERMINAL BOX (262K00105)
43. DIFFERENTIAL PRESSURE SWITCH ASSY. (262K00060)
44. ACCUMULATOR (226C00399)
45. PNEUMATIC RELAY VALVE (263K00861)
46. PNEUMATIC RELAY VALVE (263K00863)

KEY TO FIG.21



KEY

 PEN DEFLECTED - INDICATES BEGINNING OF EVENT
 END — INDICATES THE TERMINATION OF THE PARTICULAR EVENT.

NOTE: THE ABOVE CHART PROVIDES A READY REFERENCE FOR EVENT RECORDER OPERATION. PEN DEFLECTION PERIODS SHOWN ARE NOT TIME RELATED. THE ACTUAL OPERATIVE POINT CAN BE DETERMINED BY REFERRING TO BLOCK DIAGRAMS AND ELECTRICAL SCHEMATIC DIAGRAMS

The alarm event recorder provides a recording to facilitate trouble shooting. In the event of a fault detected by any circuit connected to the recorder a cathode bus is energized to operate Local and Remote alarm devices, see Fig.23B.

Each pen of the event recorder serves a particular control device and is connected to the negative side of the device monitored. The pens of the alarm event recorder are similarly connected each to a fault detection device.

When a device connected to a pen is energized, the appropriate pen is connected to DC positive and the pen control circuit operates to deflect the pen approx. 1/10 inch off its continuous line. The pen remains deflected until the device is de-energized.

6. Power turbine speed recorder - Moore.
7. Exhaust gas temperature recorder - Honeywell.
8. Leeds and Northrup - Lube temperature recorder.
9. Pre-start check selector. In the event that the "Unit Ready" light does not come on after rundown, the fault area can be determined by counter clockwise rotation of the switch.
10. Pneumatic load control - Moore.
11. Recycle valve control - Moore.
12. Control mode selector - off, purge, manual, auto.
13. Lube pump control, restart-auto-off and spring loaded to auto. This is basically a maintenance function.
14. Uncoupled/Run switch. This key operated switch isolates the power plant assembly electrical circuits from the booster network circuits to enable running the unit with the power shaft removed. This is a maintenance function.
15. Five buttons - start, stop, reset, acknowledge and emergency stop. The acknowledge button confirms available power on the trouble circuit by illuminating the trouble light.

● In addition to being a pre-start requirement, any one or more of these conditions could terminate the start.

CONDITIONS

CONDITIONS	● Start Permissive (Contacts to be Closed in) (102) to (107)	Trip	Lockout Immediate	Lockout Delayed Before Start Relay Energized	Lockout Immediate After Start Relay Energized	Alarm Event Recording (AER) Number
Lockout (SCP) and (UCP)	x	x	x	-	-	-
Fail-to-Light	-	x	x	-	-	1
Overcrank	x	x	x	-	-	2
Overspeed	x	x	x	-	x	4
Turbine Enclosure Temperature High	x	x	-	-	x	30
Booster Case Overtemperature*	x	x	-	-	x	-
PT Lube Oil Temperature High	x	x	-	-	x	5
Exhaust Temperature High	x	x	-	-	x	6
Vibration Trip	x	x	-	-	x	27
Lube Oil Level Low	x	x	-	x	x	9
Control Air	x	x	-	x	x	10
Inverter Failure	x	x	-	x	x	12
Auxiliary Motor Circuit Breakers	x	x	-	x	x	14
Suction Valve Closed	x	-	-	x	x	-
Discharge Valve Closed	x	-	-	x	x	-
Lube Oil Temperature Low	x	-	-	x	x	-
Governor at Minimum	x	-	-	x	x	-
Metering Valve at Minimum	x	-	-	x	x	-
Rundown Timer	x	-	-	x	x	-
Vent Valve Closed	x●●	-	-	x	x	-
Purge Valve Closed	x●●	-	-	x	x	-
Lube Oil Pressure < 30 psig	x●●	-	-	x	x	-
Underspeed < 4,000 rpm	-	-	-	-	-	21
Seal Oil to Gas Δ P Low	-	x	-	-	x	13
Fuel Pressure Low	-	x	-	-	x	11
Lube Oil Pressure < 20 psig; or Booster Lube < 8 psig	-	x	-	-	x	15
GP Lube Oil Pressure Low > 4,500 rpm	-	x	-	-	x	28
Booster Purge Sequence	-	x	x	-	-	16
Valve Sequence Incomplete Shutdown	-	x	x	-	-	17
Valve Sequence Start-up	-	x	x	-	-	3
Station Fault	x	x	-	-	-	25
Seal Oil Filter Δ Pressure High	-	-	-	-	-	19
Intake Air Filter Δ Pressure High	-	-	-	-	-	18
Seal Oil to Gas Δ Pressure High	-	-	-	-	-	20
Vibration Alarm	-	-	-	-	-	8
Seal Oil to Gas Δ Pressure Low	-	-	-	-	-	7
Lube Oil Filter Δ Pressure High	-	-	-	-	-	22
Interlock Shutdown (Restart prevented until rundown of all station units completed).	-	x	-	-	-	29

●● Starter On Requirement.

* Overtemperature sensed by the lube oil temperature recorder (426). In case of overtemperature the recorder initiates unit trip and lockout (315).

TYPICAL UNIT CONTROL FAULT AND ALARM EVENT RECORDING TABLE

16. Gauges indicating speeds, governor loading, oil and fuel pressures.

Except for the smaller more compact control relays mounted inside the control cabinet, the "Unit Control Panel" for the OT-F-2100 is the same as the OT-F-3.

Major components mounted on the rear wall inside the cabinet consist of:

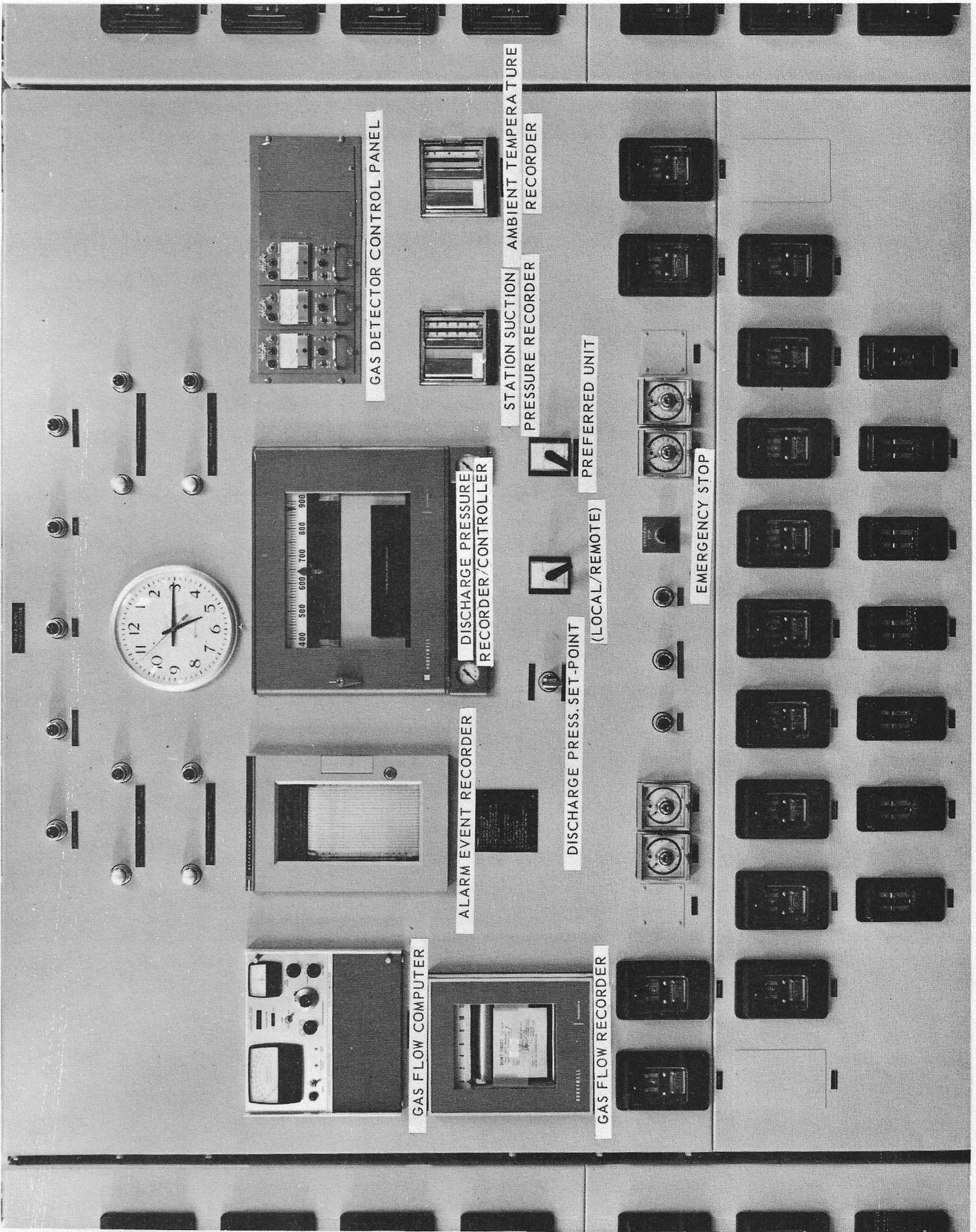
1. Power turbine control panel, ramp generator controller, ambient temperature and speed signals.
2. Isolating transformer for the lube temperature and vibration recorders.
3. Timers.
4. Overspeed monitor.
5. Control relays (OT-F-2100).

6.4 STATION CONTROL PANEL

Refer to Fig.24.

The front mounted components are as follows:

1. Relays - Westinghouse.
2. Timers - Eagle Bliss.
3. Ambient temperature recorder - Moore.
4. 20-pen alarm recorder - Esterline-Angus (operates in a similar manner to that described for the alarm event recorder in the UCP, see para 6.3).
5. Discharge pressure recorder/controller - Honeywell.
The two small gauges directly under the recorder indicate discharge pressure and set-point.



GAS DETECTOR CONTROL PANEL

STATION SUCTION PRESSURE RECORDER
 AMBIENT TEMPERATURE RECORDER

DISCHARGE PRESSURE RECORDER/CONTROLLER

PREFERRED UNIT

EMERGENCY STOP

ALARM EVENT RECORDER

DISCHARGE PRESS. SET-POINT (LOCAL/REMOTE)

GAS FLOW COMPUTER

GAS FLOW RECORDER

OT-F-3 STATION CONTROL PANEL

CONDITION	AER NO.	Station Lockout	Unit Lockout	Fault Shutdown (No Lockout)	Annunciator (Red Flasher)
Emergency Shutdown	1	X	X	-	X
Fire	2	X	X	-	X
Gas Lockout	3	X	X	-	X
Station AC Fail	4	-	-	-	-
Scrubber High Level	5	-	X	-	X
Scrubber Alarm	6	-	-	-	X
Gas Detector Malfunction	7	-	-	-	X
Sustained AC Failure	8	X	X	-	X
Fire Detector Malfunction	9	-	-	-	X
Unit Alarm	10	-	-	-	X
Gas Warning	11	-	-	-	X
Battery Fail (Charger)	12	-	-	-	X
Discharge Press. Set Point Deviation	13	-	-	-	-
Boiler	14	-	-	-	X
Starting Gas Pressure Low	15	-	-	-	X
Discharge Pressure High	16	-	-	X	X
Suction Press. Low	17	-	-	X	X
Station Valves	18	-	X	-	X
Gas Alarm Metering	19	-	-	-	X
Spare	20	-	-	-	-

TYPICAL STATION FAULT AND ALARM EVENT
RECORDING (AER) TABLE

6. Gas Flow computer - "Daniel" with the flow traced on a Honeywell recorder.
7. Suction and Intermediate pressure recorder - Moore.
8. Gas detector system.
9. Push-to-test lights indicating booster network valve positions, electrical power supplies, trouble and lockout.
10. Local/Remote selector.
11. Preferred unit selector.
12. Discharge pressure set-point raise/lower with spring return to "off".

Inside the cabinet the following major components are mounted:

1. Ambient temperature pneumatics - Moore.
2. Pneumatic equipment to match the front mounted readout.
3. 42V DC supply - Honeywell.
4. Fire detection equipment.

The "Unit Control Panels" for a single or double unit installation are identical in hardware and control circuitry. The "Station Control Panel" differs only in the number of fire and gas protection heads in the circuit and the range of the gas flow computer. The preferred unit selector and load biasing pneumatic relay, although installed on both single and double installations, are rendered ineffective on the single unit.

The control points on the "Unit and Station Control Panels" are as follows:

1. The local/remote selector switch on the "Station Control Panel" when selected remote transfers all control except the "emergency" stop and preferred selection to telemetry control. Emergency stop buttons are located on the "Unit Control Panel", the "Station Control Panel" and the "Pressure Switch and Gauge Panel".

2. The preferred unit selector switch permits the operator to select the unit which is to be started first and stopped last. This selection can be changed during running to the desired preferred unit for shutdown. On receipt of a start signal, the preferred unit will start, run up automatically and load. When the preferred unit valves are positioned for loading, the second unit "Ready" light (Local) and the "Unit Available" light (Remote) come on. On receipt of a second telemetered start signal, the second unit will start and run up to share load with the preferred unit.
3. The third control switch on the "Station Control Panel" is the discharge pressure set-point and provides for adjustment of the discharge pressure set-point only when the control mode on the "Unit Control Panel" is selected "Local" and "Auto". The discharge pressure set-point cannot be adjusted locally when under telemetry control.
4. The "Control Mode" selector switch. This switch on the "Unit Control Panel" is a make-before-break and has four positions - Off, Purge, Manual and Auto.

When on "Manual" the unit will start and accelerate up to governor minimum speed automatically, but above that speed the unit must be controlled manually using the manual "Pneumatic Control Station".

5. The "Uncoupled/Run" switch is used when the unit is required to be run when the main drive shaft is not connected to the booster. This is a maintenance function.
6. The lube pump control switch is spring loaded in the "Auto" position but can be turned "Off" or restarted. This again is basically a maintenance function.
7. The "Prestart Check Switch" is normally left in the run position unless a fault exists in some of the go-no-go circuits and narrowing down the problem area is required. This again is basically a maintenance function.

8. Two "Moore" pneumatic control stations.

- (1) The "manual recycle valve control" is only functional when the control mode is "manual" and is controlled by means of a knurled knob on the front of the controller. The bar located immediately below the knob is not used in this system.
- (2) The "load control" station consists of an auto/manual selector and a control bar immediately below it and controls the load by varying the power turbine speed through governor control.

Neither of the above controls are effective during remote station operation.

9. The discharge pressure set-point selector is only effective on local control when the load control station is selected "Auto". This switch forms part of the discharge pressure recorder/controller and varies the 3-15 psi. signal going through the load control station to the governor.

SECTION 7

AUTOMATIC CONTROL

SECTION 7. AUTOMATIC CONTROL

7.1 ELECTRICAL - GENERAL

Refer to Fig. 25 and Section 7A for interpretation of symbols and codes.

The electrical part of the control system provides for:

1. Sequencing of events during run-up, loading and run-down through relays and timers.
2. Recording of events during running and after shutdown.
3. Turbine and booster protection that will shut down the unit, with a trouble indication, when predetermined set-points are exceeded.

The fail safe system is designed for fully automatic operation with sufficient manual controls to handle maintenance functions and emergency line loading.

A 460V AC station failure for a period of 4 hours will not cause a running unit to shutdown.

The "Control System Schematic Diagrams" tie-in every electrical component in the complete installation and indicate exactly how each component fits into the control system. It therefore becomes most important to have an understanding of the system used in formulating these schematics.

The system starts with the power supply indicated by two horizontal grids. This power supply is either 125V DC, 118V AC or inverter 118V AC.

NOTE

All schematic drawings show the electrical circuits in their de-energized condition. When power supplies are applied, various relays energize and various timers time in. Refer to Fig. 25A for typical circuit action following application of power.

UNIT CONTROL OPERATING (SCHEMATIC)

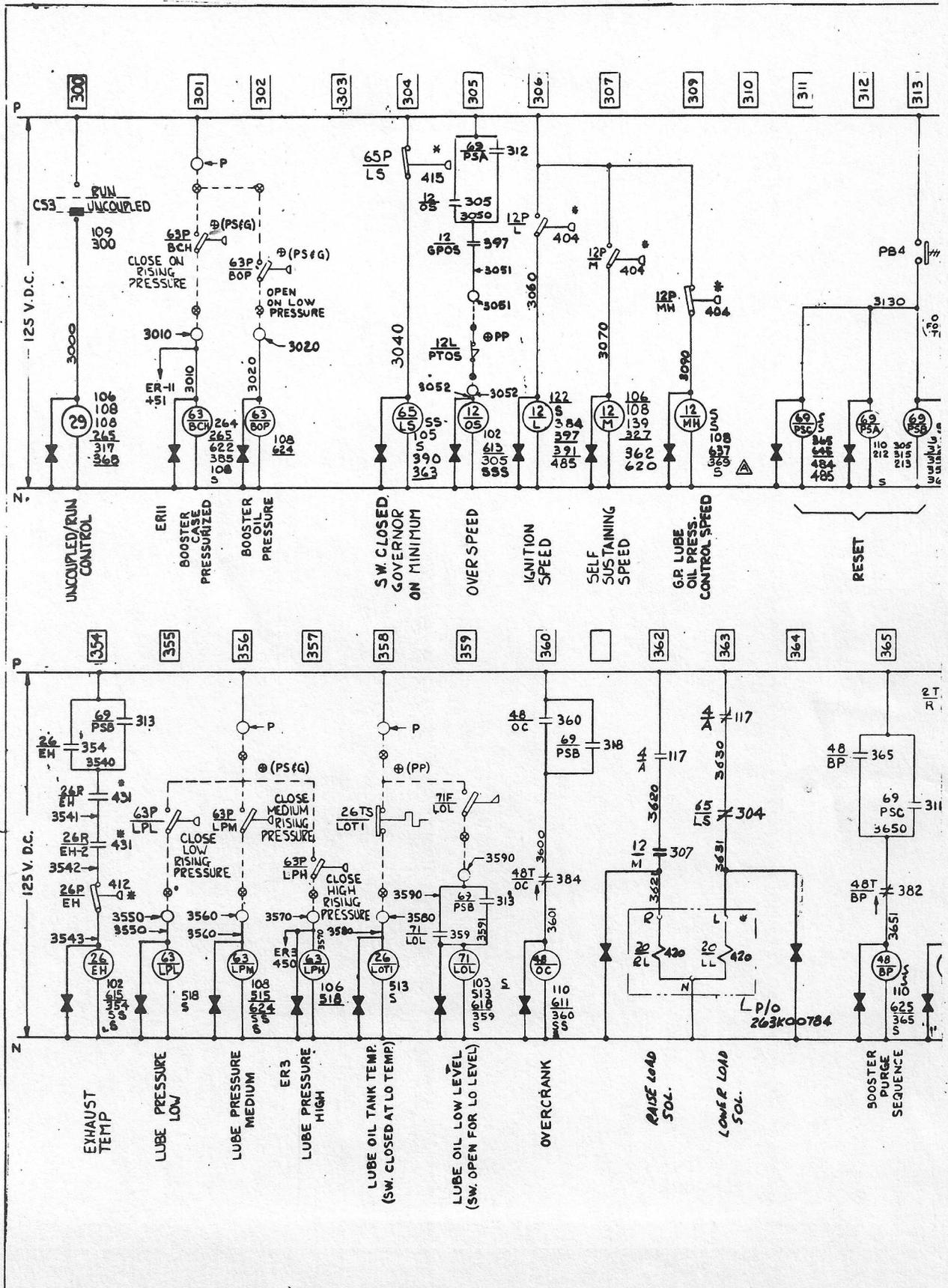


FIG. 25

TYPICAL CIRCUIT ACTION IN THE UCP WHEN CIRCUITS ARE POWERED-UP

Control and fault detection circuits in the UCP are always effective providing the following power is available - 125 VDC, and 118 VAC, single-phase 60 Hz inverter power. A supply of 460 VAC, 3-phase, 60 Hz is required for normal operation.

Immediately after any type of shutdown, automatic, manual (including emergency) or fault, a post-lube timed period is sequenced, see below. Lubrication tank heaters are sequenced in relation to oil temperature during 'Downtime',

POWER ON

PLUS ADDITIONAL REQUIREMENTS

Lockout Reset
UCP & SCP

Time for Control
Air to Build Up

Lube Oil Temp.
Above 75°F

Start/Run Switch
at 'Run'

Time for Station
Valves to Position

When power as detailed above is applied to unit control sequencing circuits and to circuits powered by Station AC power, the following takes place providing the pre-start conditions shown in Fig 26 are met.

- Post-lube timer starts to time (393). Picks up after 2 hours (ER-15).
- Emergency DC lube oil pump starts (515).
- Standby AC lube oil pump runs as sequenced in relation to pressure and time.
- AC restored timers (various), time and pick-up.
- All recorders and instrumentation energized.
- Rundown timer starts to time (391). (Picks up after 8 minutes). 'Unit Ready' light (Local) and the 'Unit-Available' light (Remote) illuminate after reset.
- Valve sequence shutdown timer (392) starts to time if any unit valve is not positioned correctly.
- Emergency DC lube oil pump drops out at 20 psig.
- Event Recorder chart motor runs at slow speed.
- Alarm Event Recorder chart motor runs.

POST-LUBE TIMER - PICKS-UP

- AC standby pump stops.

If desired, the above sequence can be shortened by turning the Pump 'Restart/AUTO/OFF' switch CS-2 to 'OFF'. Conversely the sequence can be repeated by turning CS-2 to 'Restart'.

Along this power grid is positioned each circuit required in the system. Each circuit carries a name and a number and this number is used for all wiring connected with the circuit throughout the unit, e.g. if a wire observed in a terminal box in the power plant assembly has number 3070, the first 3 digits indicate the circuit number. This number referred back to the schematic drawing indicates the self sustaining speed circuit.

Each circuit contains contacts, switches, relays, solenoids, etc., or a combination of all. As the control is basically by relay, we will discuss a circuit having a relay installed. The ASA code, see Section 7A, is used throughout for the identification of all functions and symbols.

Consider circuit 307 with a relay having six contacts, required to work a self sustaining speed signal into the control system in the proper sequence. Following the ASA code, this relay will appear as a circle with the identification 12/M appearing inside the circle. Immediately to the right of this relay is a set of six three-digit numbers. These numbers indicate the circuits effected by this relay. For example, one of the contacts is indicated as being wired into circuit 362. If we check circuit 362 we see a contact identified as 12/M in the "Raise Load" solenoid circuit.

This set of contacts are shown normally open. A set of contacts on circuit 363 the "Lower Load" solenoid are shown normally closed. All contacts in the position shown on the schematic are with the power grid dead, i. e. all power "off" and therefore all relays de-energized.

Examining circuits 362 and 363, two solenoids identified as 20/RL and 20/LL are incorporated in circuit 420. This circuit appears on another sheet of the schematic and is the solenoid located in the pneumatic panel ramp generator described earlier. Also circuits 362 and 363 are shown additional contacts 4/A which are the contacts affected when the start button (relay 4A) is pushed, and 65/LS in circuit 304 which is identified as the "governor on minimum" switch.

To follow the circuit through then we see that when the start button is pushed contact 4/A closes and when the speed switch 12P/M (approximately 4,000 rpm) in circuit 307 closes it energizes relay 12/M which in turn closes contact 12/M in circuit 362. This puts 125V DC across the solenoid and the engine continues to accelerate under the control of the pneumatic ramp generator. At the same time the normally closed 4/A contact on circuit 363, "Lower Load" solenoid opens when the start button is pushed and renders that circuit redundant until shutdown.

On shutdown, contact 4/A therefore is closed because relay 4/A is de-energized, contact 65/LS is closed because switch 65P/LS is open and therefore the unit will decelerate under pneumatic ramp generator control until "governor on minimum" switch 65P/LS is closed. This opens contact 65/LS on circuit 363 to cut off the ramp generator lower load solenoid and starts the 10 minute cooldown timer indicated by the 390 circuit associated with 65/LS relay in circuit 304.

Refer to Fig. 26.

To further define the system, the "Pre-start Check Switch" operation referred to under the description of the "Unit Control Panel" will be considered. Here again we see the 125V DC power grid with circuit 101 to 106 showing the control of start relay 1/A and 5/A the trip relay. The permissive circuit indicates the conditions to be met before starting the unit and each position of the "Pre-start Check Switch" is indicated by contacts PCS-1, PCS-2, PCS-3 to PCS-11.

If the green "Unit Ready" light does not come on when the 5 minute rundown timer times out, it indicates that the "Unit Ready" circuit as shown on Fig. 26 is not complete. Rotating the "Pre-start Switch" counter-clockwise until the white light comes on, indicates the point to which the start circuit is serviceable. In other words, if the white light comes on at "Overspeed" we know that the contacts within the area of permissive switch PCS-1 and PCS-2 are closed, but that one or more contacts in PCS-3 must be open or the white light would be illuminated when "Pre-start Switch" was selected to "Temperature".

By checking the schematic we see the problem involves 26/EH - exhaust temperature, 38/LOH lube oil temperature or in the case of the OT-F-3 installation 26/TE - turbine enclosure. To further analyze the fault the circuits indicated by the number opposite each of the above contacts (i. e. 398, 315 and 354) can be checked.

The trip circuit is also shown on Fig. 26 and includes permissive circuits PCS-1 to PCS-6. Relay 1/A initiates the start and when the speed reaches approximately 4,000 rpm, relay 12/M is energized and drops out relay 1/A and, if conditions are right, energizes relay 5/A, the trip relay. This relay remains energized during all running unless a fault occurs or a stop command signal is initiated. To keep 5/A energized preset conditions of 21 relays or switches have to be maintained. A fault on any of the 21 will break the circuit, de-energize relay 5/A locking out the unit. The faults appear in tabulated form on "Unit Rundown" sequence diagram Fig. 28, see also Fault Tables, Figs. 22D and 22E.

UNIT CONTROL START PERMISSIVE

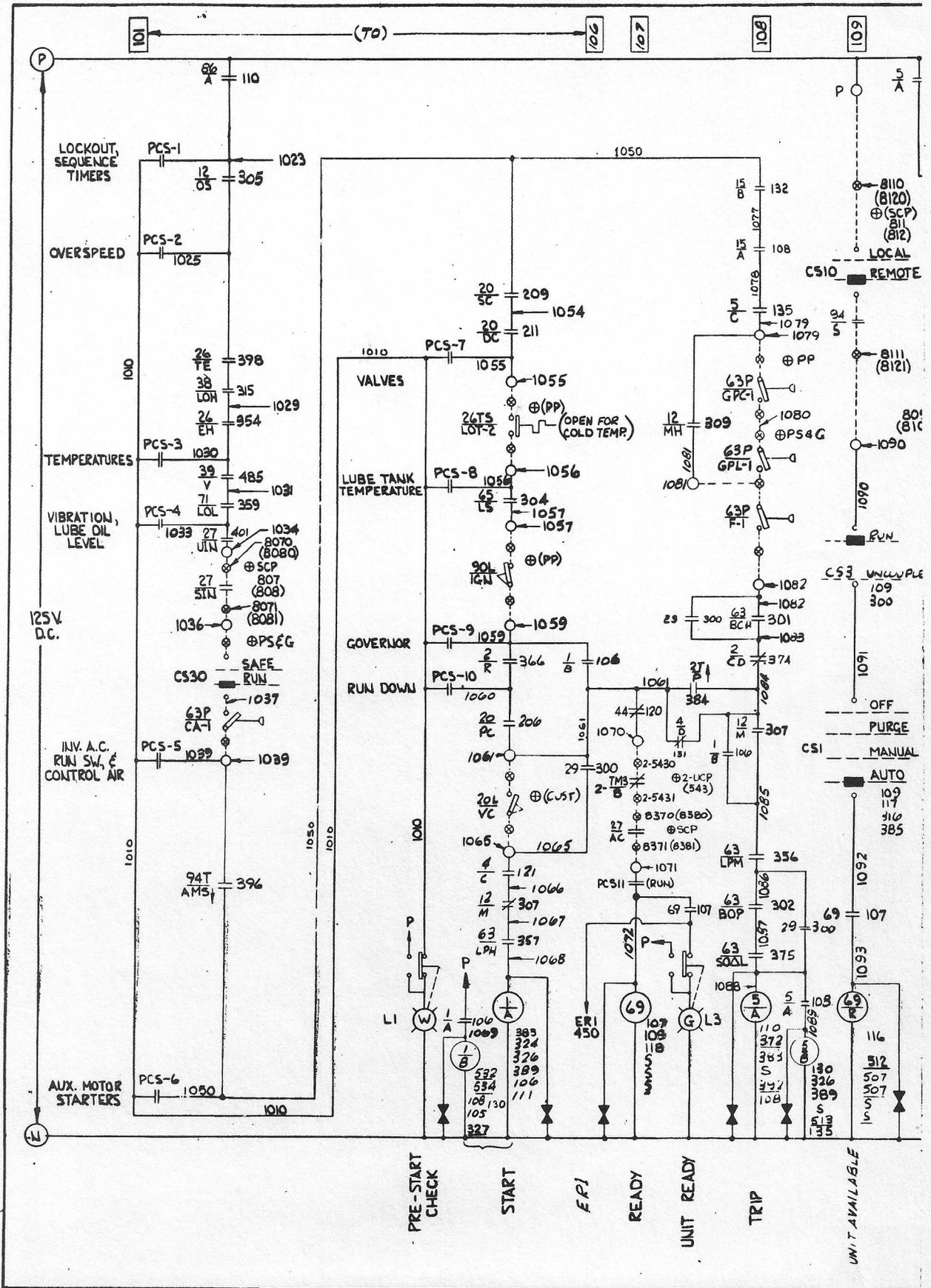


FIG. 26

LOCKOUT RELAY (TYPICAL)

The unit lockout relay must be energized at all times to enable the unit to accept a start signal, and when running to maintain operation. Unit sequencing, run and trip relays and selected fault detection relays, control the power supply to the lockout relay. The fault circuits de-energize the lockout relay if an operating condition is not satisfactory. The faults are shown schematically (102 to 108), in Fig.26 and are detailed in the Fault Condition Table, Fig. 23B

With the lockout relay de-energized, the supply circuits to the 'Master' relay to 'Unit Ready' relay (101 to 107), to the 'Start' relay (106) and to 'Trip' relay (108) are held open. Before these circuits can re-energize, the lockout reset must be manually reset at the UCP (first ensuring that the Station is not locked out).

LOCKOUT ANALYSIS

As stated above, the lockout relay is controlled by two type of circuits arranged in separate portions as follows:

1. Parallel Portion - Contacts of sequencing devices arranged in series/parallel in the lockout relay power supply.

This portion is used to trip and lockout the unit after the 'Start' relay (106) is energized and is effective during operation and until the end of the cooldown period.

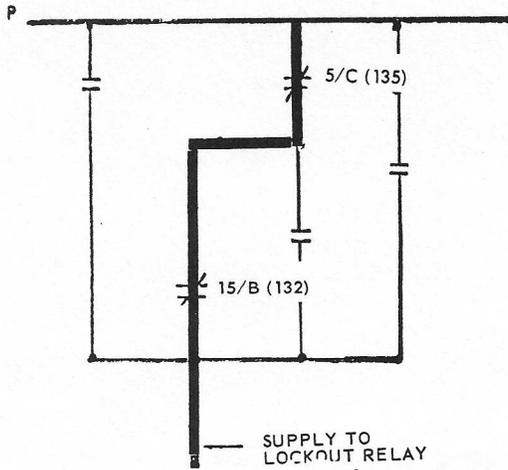
2. Series Portion - Operates at all times.

This portion is controlled by:

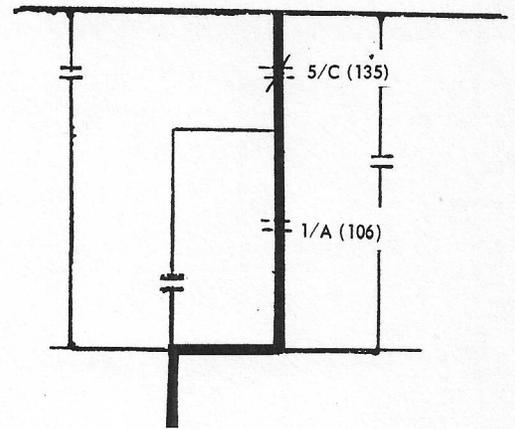
- Emergency shutdown provision.
- Fault detection and sequence timers.
- Station lockout control devices.
- Unit lockout relay contacts.

LOCKOUT CONTROL DETAILS

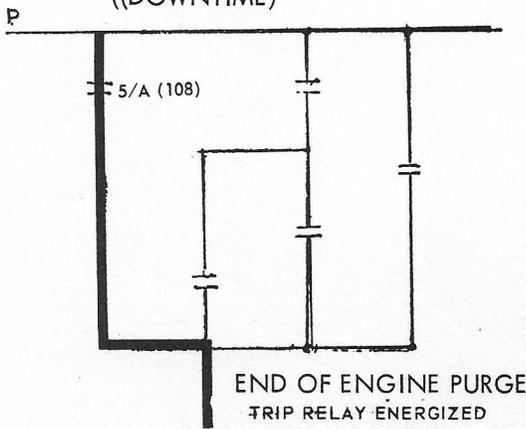
Unit lockout control is sequenced in relation to time and speed as described in Fig.26A.



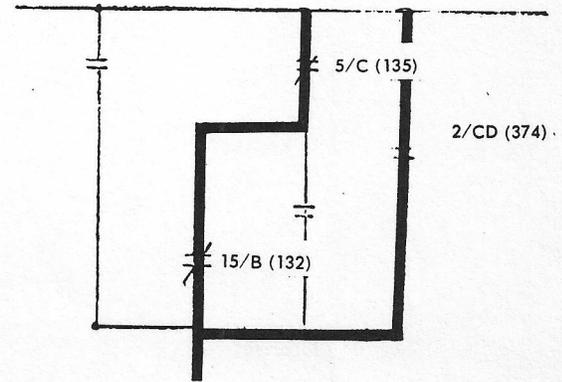
STANDBY
(DOWNTIME)



END OF BOOSTER PURGE
START AND RUN RELAY ENERGIZED



END OF ENGINE PURGE
TRIP RELAY ENERGIZED



END OF COOLDOWN TO SHUTDOWN

<u>TIMING CONTROL</u>	<u>RELAY AFFECTED</u>	<u>TRIP CURRENT PATH</u>	<u>CAUSE OF LOCKOUT</u>
Standby	-	5/C (N.C.) and 15/B (N.C.)	
End of Booster Purge	1/A, 15 en.	5/C (N.C.) and 1/A (N.O.)	Loss of 1/A
End of Engine Purge	5/A, 5/B, 5/C en.	5/A (N.O.)	Loss of 5/A.
Light-up and during Running	-	Same as above.	Same as above.
End of Cooldown	2T/CD picked up 2/CD en. 5/A, 5/B, 5/C, and 15 de-en.	2/CD and 5/C (N.C.) 15/B (N.C.)	None
Final Shutdown	2T/CD de-en. 2/CD de-en.	5/C (N.C.), 15/B (N.C.) (Same as Standby)	None

7.2 SEQUENCE DIAGRAM

Refer to Fig. 27.

The sequence of events as specified by the above control system schematics has been simplified on a block sequence diagram. This set of diagrams appear in the "Service Manual" and include "Unit Control" run-up and run-down.

As an example, part of the start-up sequence is shown on Fig. 27. Arrows indicate the flow direction and each block is related to the control system schematic by circuit number and relay number.

"Pre-start Requirements" include the permissive control switches PCS-1 to PCS-11, mentioned earlier, and are itemized in the block on the centre left-hand side of Fig. 27. The green "Unit Ready" light will come on only when these conditions have been achieved.

The automatic sequence of events from "Unit Ready" light "green" to unit loading as contained in the "Sequence Diagram" for a dual station OT-F-3 is as follows:

START-UP (PRIOR TO STARTER ON)

- 'Unit Ready' - light on (Preferred Unit).
- 'Unit Available' - light on (Preferred Unit).
- 'Master' relay energized - Relay 4/A.
- 'Total Starts' counter records start signal.
- 'Unit Running-up' - light on - event recorder fast speed.
- 'Unit Ready' - light off (Preferred Unit).
- 'Unit Available' - light off (Preferred Unit).
- Emergency DC Lube Pump - Running light.
- 'Power Turbine Lube Pressure' at 5 psig.
- AC Standby Lube Pump - 'Running' light.
- Aux. Seal Oil Pump - 'Running' light.
- Gas Turbine Lube Pressure at 30 psig.
- Seal Oil to Gas Differential Pressure at 30 psig.
- Purge Valve opens.
- Gas Compressor (Booster) pressure at 150 psig.
- Vent Valve closes.
- Purge Valve closes.

START RELAY ENERGIZED - Relay 1/A

- Intake Air Filter Fan - 'Running' light.
- Starting Turbine "ON" - Audible with increasing rpm.
- Gas Producer accelerates to approximately 800 rpm.
- Aux. Seal Oil Pump - 'Motor Off' light (engine-driven seal oil pump flow above 13 gpm).
- Gas Producer Lube Pressure rising.

SEQUENCE HOLD DURING ENGINE PURGE - 2 Minute Delay

Trip Relay energized - Relay 5/A

- Lube Tank Heaters - light off.
- Elapsed Time Meters start.
- Fuel "ON".
- Ignition "ON".
- Light-up at approximately 500° F. exhaust temperature.
- Purge Valve opens - PT at approximately 1,500 rpm.
- Gas Producer accelerates to self-sustaining speed (approximately 4,000 rpm).
- Successful Engine Start counter records start.

ACCELERATION ABOVE SELF-SUSTAINING SPEED

- Starting Turbine "OFF".
- Gas Producer Lube Pressure - above 13 psi.
- Governor load signal pressure increasing at a predetermined rate to meet load demand.
- Gas Compressor Suction Valve - "OPEN".
- Gas Compressor Discharge Valve - "OPEN".
- Successful Unit Start counter records start.
- Purge Valve closes.
- 'Unit Running Up' - event recorder at slow speed.
- Non-preferred unit ready.
- Preferred 'Unit on Line'.

ACCELERATION TO 6,500 RPM

- AC Standby Lube Pump - 'Motor Off' light (MCC).

Refer to Fig. 28.

Figure 28 shows the initial part of the "Unit Run-down" sequence diagram, but more important, has tabulated for easy reference the alarms and faults that will shut the unit down and lockout. These appear in the 3 blocks located on the left-hand side of Fig. 28.

Refer to Fig. 29.

This figure shows the initial part of the "Station Run-down" sequence diagram. Here again are the faults that will shut the unit down and lockout the station.

UNIT RUNDOWN BLOCK DIAGRAM

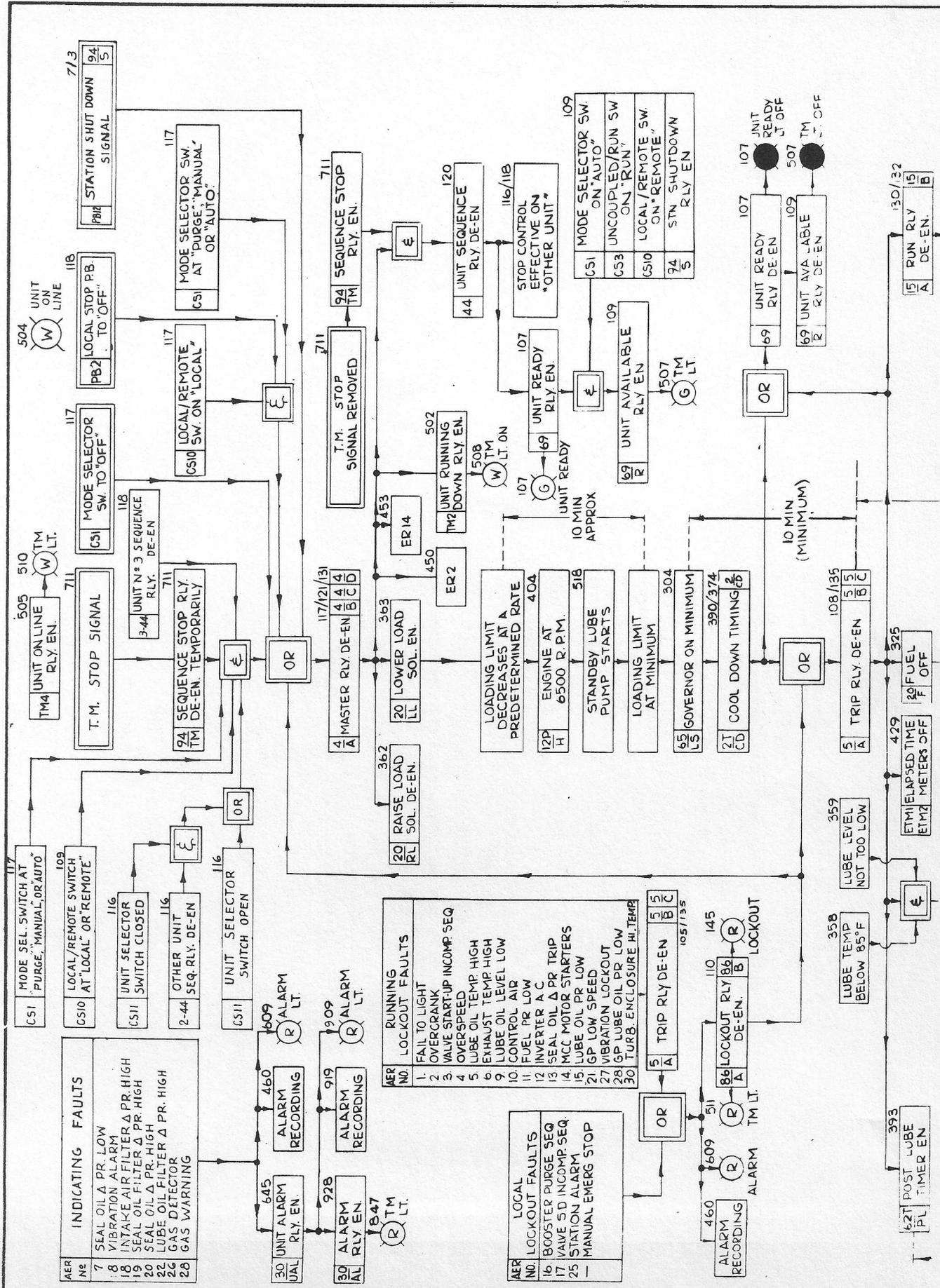


FIG. 28

SECTION 7A

ELECTRICAL SYMBOLS AND CODES

SECTION 7A.

ELECTRICAL SYMBOLS AND CODES

CODES This section provides information to aid in interpretation of electrical schematic diagrams. The section includes:

- An illustrated list of symbols.
- A tabulated list of device identification codes.

All devices that have an electrical function are identified by a two-part code based on the recommendations in ASA 37.2 - 1962. Each code consists basically of a number above the line and a letter below the line. Variations are built up by using number and letter prefix and suffixes to both parts of the code. Excerpts from the previously mentioned standard are provided below.

SYMBOL	TERMINOLOGY
	RELAY COIL
	SOLENOID
	RELAY CONTACT, NORMALLY CLOSED AND NORMALLY OPEN
	TIME DELAY CONTACTS, DELAY ON DROP OUT OR DE-ENERGIZE
	TIME DELAY CONTACTS, DELAY ON PICK UP OR ENERGIZE
	FLOW SWITCH, N.C. AND N.O.
	FLOAT OR LEVEL SWITCH, N.C. AND N.O.
	TEMPERATURE SWITCH, N.C. AND N.O.
	PUSH BUTTON SWITCH, N.C. AND N.O.
	PRESSURE SWITCH, N.C. AND N.O.
	CONTROL SWITCH, OR CAM SWITCH 2 POSITION, 3 POSITION AND 4 POSITION. - - INDICATES CONTACTS ARE CLOSED IN THE POSITION INDICATED, AND IS OPEN IN POSITIONS NOT SO DESIGNATED.
	LIMIT SWITCH N.C. AND N.O.

A tabulation of code numbers arranged in alpha-numerical code order and in columns according to the type of device, is given in general.

Suffix letters used above the line denote:

- On Sensing devices

- P - Pressure
- F - Float
- L - Limit
- M - Monitoring
- R - Readout
- S - Speed
- TS - Temperature Switch

On Relay Coils and Contacts

- T - Timing Function
- X - Relay controlling an external function

Letter idents below the line - These with few exceptions are an abbreviation of the specific function served or the circuit of which the device is a part. Occasionally, a letter is suffixed to the functional letters. Where used, such suffix letters denote:

- A, B, C, etc. - Repeat Relays
- L - Low or Lower
- M - Medium
- H - High
- O - Open)
- C - Closed) When associated with valve operation
- R - Raise
- a - Contact Open
- b - Contact Closed

DEVICE
FUNCTION
TABLE

Purpose of Device Function Numbers

A device function number, with appropriate suffix letter or letters where necessary, is used to identify the function of each device in all types of partial automatic and automatic, and in many types of manual, switchgear. These numbers are to be used on drawings, on elementary and connection diagrams, in instruction books, in all publications, and in specifications. In addition, for automatic switchgear, the number may be placed on, or adjacent to, each device in the assembled equipment so that the device may be readily identified.

NOTE: These device function designations, which have been developed as a result of usage over many years, may define the actual function the device performs in an equipment or they may refer to the electrical or other quantity to which the device is responsive. Hence, there may be in some instances a choice of the function number to be used for a given device. The preferable choice to be made in all cases should be the one which is recognized to have the narrowest interpretation so that it most specifically identifies the device in the minds of all individuals concerned with the design and operation of the equipment.

Standard Device Function Numbers

Standard device function numbers, each with its corresponding function name and the general description of each function, are listed below:

NOTE: When alternate names and descriptions are included under the function, only the name and description which applies to each specific case should be used. In general, only one name for each device, such as relay, contactor, circuit breaker, switch, monitor, or other device is included in each function designation. However, when the function is not inherently restricted to any specific type of device and where the type of device itself is thus merely incidental, any one of the above listed alternative names, as applicable, may be substituted. For example, if for device function 6 a contactor is used for the purpose in place of a circuit breaker, the function name should be specified as Starting Contactor.

Numbers from 95 to 99 should be assigned only for those functions in specific cases where none of the assigned standard device function numbers are applicable. Numbers which are 'reserved for future application' should not be used.

1. MASTER ELEMENT is the initiating device, such as a control switch, voltage relay, float switch, etc., which serves either directly or through such permissive devices as protective and time-delay relays to place an equipment in or out of operation.
2. TIME-DELAY STARTING OR CLOSING RELAY is a device that functions to give a desired amount of time delay before or after any point of operation in a switching sequence or protective relay system, except as specifically provided by device functions 48, 62 and 79.
3. CHECKING OR INTERLOCKING RELAY is a relay that operates in response to the position of a number of other devices (or to a number of predetermined conditions) in an equipment, to allow an operating sequence to proceed, or to stop, or to provide a check of the position of these devices or of these conditions for any purpose.
4. MASTER CONTACTOR is a device, generally controlled by device function 1 or the equivalent and the required permissive and protective devices, that serves to make and break the necessary control circuits to place an equipment into operation under the desired conditions and to take it out of operation under other or abnormal conditions.

5. **STOPPING DEVICE** is a control device used primarily to shut down an equipment and hold it out of operation. (This device may be manually or electrically actuated, but excludes the function of electrical lockout, see Device Function 86, on abnormal conditions.)
6. **STARTING CIRCUIT BREAKER** is a device whose principal function is to connect a machine to its source of starting voltage.
7. **ANODE CIRCUIT BREAKER** is a device used in the anode circuits of a power rectifier for the primary purpose of interrupting the rectifier circuit if an arc-back should occur.
8. **CONTROL POWER DISCONNECTING DEVICE** is a disconnecting device, such as a knife switch, circuit breaker, or pull-out fuse block, used for the purpose of respectively connecting and disconnecting the source of control power to and from the control bus or equipment.

NOTE: Control power is considered to include auxiliary power which supplies such apparatus as small motors and heaters.

9. **REVERSING DEVICE** is a device that is used for the purpose of reversing a machine field or for performing any other reversing functions.
10. **UNIT SEQUENCE SWITCH** is a switch that is used to change the sequence in which units may be placed in and out of service in multiple-unit equipments.
11. Reserved for future application.
12. **OVER-SPEED DEVICE** is usually a direct-connected speed switch which functions on machine overspeed.
13. **SYNCHRONOUS-SPEED DEVICE** is a device such as a centrifugal-speed switch, a slip-frequency relay, a voltage relay, an undercurrent relay, or any type of device that operates at approximately the synchronous speed of a machine.
14. **UNDER-SPEED DEVICE** is a device that functions when the speed of a machine falls below a predetermined value.
15. **SPEED OR FREQUENCY MATCHING DEVICE** is a device that functions to match and hold the speed or the frequency of a machine or of a system equal to, or approximately equal to, that of another machine, source or system.
16. Reserved for future application.
17. **SHUNTING OR DISCHARGE SWITCH** is a switch that serves to open or to close a shunting circuit around any piece of apparatus (except a resistor), such as a machine field, a machine armature, a capacitor, or a reactor.

NOTE: This excludes devices that perform such shunting operations as may be necessary in the process of starting a machine by devices 6 or 42, or their equivalent, and also excludes device function 73 that serves for the switching of resistors.

18. **ACCELERATING OR DECELERATING DEVICE** is a device that is used to close or to cause the closing of circuits which are used to increase or decrease the speed of a machine.

19. **STARTING-TO-RUNNING TRANSITION CONTACTOR** is a device that operates to initiate or cause the automatic transfer of a machine from the starting to the running power connection.
 20. **VALVE** is one used in a vacuum, air, gas, oil, or similar line, when it is electrically operated or has electrical accessories such as auxiliary switches.
 21. **DISTANCE RELAY** is a relay that functions when the circuit admittance, impedance, or reactance increases or decreases beyond predetermined limits.
 22. **EQUALIZER CIRCUIT BREAKER** is a breaker that serves to control or to make and break the equalizer or the current-balancing connections for a machine field, or for regulating equipment, in a multiple-unit installation.
 23. **TEMPERATURE CONTROL DEVICE** is a device that functions to raise or lower the temperature of a machine or other apparatus, or of any medium, when its temperature falls below, or rises above, a predetermined value.
- NOTE:** An example is a thermostat that switches on a space heater in a switch-gear assembly when the temperature falls to a desired value as distinguished from a device that is used to provide automatic temperature regulation between close limits and would be designated as device function 90T.
24. Reserved for future application.
 25. **SYNCHRONIZING OR SYNCHRONISM-CHECK DEVICE** is a device that operates when two AC circuits are within the desired limits of frequency, phase angle, or voltage, to permit or to cause the paralleling of these two circuits.
 26. **APPARATUS THERMAL DEVICE** is a device that functions when the temperature of the shunt field or the amortisseur winding of a machine, or that of a load limiting or load shifting resistor or of a liquid or other medium, exceeds a predetermined value; or if the temperature of the protected apparatus, such as a power rectifier, or of any medium decreases below a predetermined value.
 27. **UNDERVOLTAGE RELAY** is a relay that functions on a given value of under-voltage.
 28. **FLAME DETECTOR** is a device that monitors the presence of the pilot or main flame in such apparatus as a gas turbine or a steam boiler.
 29. **ISOLATING CONTACTOR** is a device that is used expressly for disconnecting one circuit from another for the purposes of emergency operation, maintenance, or test.
 30. **ANNUNCIATOR RELAY** is a nonautomatically reset device that gives a number of separate visual indications upon the functioning of protective devices, and which may also be arranged to perform a lockout function.
 31. **SEPARATE EXCITATION DEVICE** is a device that connects a circuit, such as the shunt field of a synchronous converter, to a source of separate excitation during the starting sequence; or one that energizes the excitation and ignition circuits of a power rectifier.

32. DIRECTIONAL POWER RELAY is a device that functions on a desired value of power flow in a given direction or upon reverse power resulting from arc-back in the anode or cathode circuits of a power rectifier.
33. POSITION SWITCH is a switch that makes or breaks contact when the main device or piece of apparatus which has no device function number reaches a given position.
34. MASTER SEQUENCE DEVICE is a device such as a motor-operated multi-contact switch, or the equivalent, or a programming device, such as a computer, that establishes or determines the operating sequence of the major devices in an equipment during starting and stopping or during other sequential switching operations.
35. BRUSH-OPERATING OR SLIP-RING SHORT-CIRCUITING DEVICE is a device for raising, lowering, or shifting the brushes of a machine, or for short-circuiting its slip rings, or for engaging or disengaging the contacts of a mechanical rectifier.
36. POLARITY OR POLARIZING VOLTAGE DEVICE is a device that operates, or permits the operation of, another device on a predetermined polarity only, or verifies the presence of a polarizing voltage in an equipment.
37. UNDERCURRENT OR UNDERPOWER RELAY is a relay that functions when the current or power flow decreases below a predetermined value.
38. BEARING PROTECTIVE DEVICE is a device that functions on excessive bearing temperature, or on other abnormal mechanical conditions associated with the bearing, such as undue wear, which may eventually result in excessive bearing temperature of failure.
39. MECHANICAL CONDITION MONITOR is a device that functions upon the occurrence of an abnormal mechanical condition (except that associated with bearings as covered under device function 38), such as excessive vibration, eccentricity, expansion, shock, tilting, or seal failure.
40. FIELD RELAY is a relay that functions on a given or abnormally low value or failure of machine field current, or on an excessive value of the reactive component of armature current in an AC machine indicating abnormally low field excitation.
41. FIELD CIRCUIT BREAKER is a device that functions to apply or remove the field excitation of a machine.
42. RUNNING CIRCUIT BREAKER is a device whose principal function is to connect a machine to its source of running or operating voltage. This function may also be used for a device, such as a contactor, that is used in series with a circuit breaker or other fault protecting means, primarily for frequent opening and closing of the circuit.
43. MANUAL TRANSFER OR SELECTOR DEVICE is a manually operated device that transfers the control circuits in order to modify the plan of operation of the switching equipment or of some of the devices.
44. UNIT SEQUENCE STARTING RELAY is a relay that functions to start the next available unit in a multiple-unit equipment upon the failure or nonavailability of the normally preceding unit.

45. **ATMOSPHERIC CONDITION MONITOR** is a device that functions upon the occurrence of an abnormal atmospheric condition, such as damaging fumes, explosive mixtures, smoke, or fire.
46. **REVERSE-PHASE OR PHASE-BALANCE CURRENT RELAY** is a relay that functions when the polyphase currents are of reverse-phase sequence, or when the polyphase currents are unbalanced or contain negative phase-sequence components above a given amount.
47. **PHASE-SEQUENCE VOLTAGE RELAY** is a relay that functions upon a predetermined value of polyphase voltage in the desired phase sequence.
48. **INCOMPLETE SEQUENCE RELAY** is a relay that generally returns the equipment to the normal, or off, position and locks it out if the normal starting, operating, or stopping sequence is not properly completed within a predetermined time. If the device is used for alarm purposes only, it should preferably be designated as 48A (alarm).
49. **MACHINE OR TRANSFORMER THERMAL RELAY** is a relay that functions when the temperature of a machine armature or other load-carrying winding or element of a machine or the temperature of a power rectifier or power transformer (including a power rectifier transformer) exceeds a predetermined value.
50. **INSTANTANEOUS OVERCURRENT OR RATE-OF-RISE RELAY** is a relay that functions instantaneously on an excessive value of current or on an excessive rate of current rise, thus indicating a fault in the apparatus or circuits being protected.
51. **AC TIME OVERCURRENT RELAY** is a relay with either a definite or inverse time characteristic that functions when the current in an AC circuit exceeds a predetermined value.
52. **AC CIRCUIT BREAKER** is a device that is used to close and interrupt an AC power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.
53. **EXCITER OR DC GENERATOR RELAY** is a relay that forces the DC machine field excitation to build up during starting or which functions when the machine voltage has built up to a given value.
54. Reserved for future application.
55. **POWER FACTOR RELAY** is a relay that operates when the power factor in an AC circuit rises above or falls below a predetermined value.
56. **FIELD APPLICATION RELAY** is a relay that automatically controls the application of the field excitation to an AC motor at some predetermined point in the slip cycle.
57. **SHORT-CIRCUITING OR GROUNDING DEVICE** is a primary circuit switching device that functions to short-circuit or to ground a circuit in response to automatic or manual means.
58. **RECTIFICATION FAILURE RELAY** is a device that functions if one or more anodes of a power rectifier fail to fire, or to detect an arc-back, or on failure of a diode to conduct or block properly.
59. **OVERVOLTAGE RELAY** is a relay that functions on a given value of overvoltage.

- 60. VOLTAGE OR CURRENT BALANCE RELAY is a relay that operates on a given difference in voltage, or current input or output, of two circuits.
- 61. Reserved for future application.
- 62. TIME-DELAY STOPPING OR OPENING RELAY is a time-delay relay that serves in conjunction with the device that initiates the shutdown, stopping, or opening operation in an automatic sequence or protective relay system.
- 63. LIQUID OR GAS PRESSURE OR VACUUM RELAY is a relay that operates on given values of liquid or gas pressure or on given rates of change of these values.
- 64. GROUND PROTECTIVE RELAY is a relay that functions on failure of the insulation of a machine, transformer, or of other apparatus to ground, or on flashover of a DC machine to ground.

NOTE: This function is assigned only to a relay that detects the flow of current from the frame of a machine or enclosing case or structure of a piece of apparatus to ground, or detects a ground on a normally ungrounded winding or circuit. It is not applied to a device connected in the secondary circuit of a current transformer, or in the secondary neutral of current transformers, connected in the power circuit of a normally grounded system.

- 65. GOVERNOR is the assembly of fluid, electrical, or mechanical control equipment used for regulating the flow of water, steam, or other medium to the prime mover for such purposes as starting, holding speed or load, or stopping.
- 66. NOTCHING OR JOGGING DEVICE is a device that functions to allow only a specified number of operations of a given device, or equipment, or a specified number of successive operations within a given time of each other. It is also a device that functions to energize a circuit periodically or for fractions of specified time intervals, or that is used to permit intermittent acceleration or jogging of a machine at low speeds for mechanical positioning.
- 67. AC DIRECTIONAL OVERCURRENT RELAY is a relay that functions on a desired value of AC overcurrent flowing in a predetermined direction.
- 68. BLOCKING RELAY is a relay that initiates a pilot signal for blocking of tripping on external faults in a transmission line or in other apparatus under predetermined conditions, or co-operates with other devices to block tripping or to block reclosing on an out-of-step condition or on power swings.
- 69. PERMISSIVE CONTROL DEVICE is generally a two-position, manually-operated switch that, in one position, permits the closing of a circuit breaker, or the placing of an equipment into operation, and in the other position prevents the circuit breaker or the equipment from being operated.
- 70. RHEOSTAT is a variable resistance device used in an electric circuit, which is electrically operated or has other electrical accessories, such as auxiliary, position, or limit switches.
- 71. LIQUID OR GAS-LEVEL RELAY is a relay that operates on given values of liquid or gas level or on given rates of change of these values.
- 72. DC CIRCUIT BREAKER is a circuit breaker that is used to close and interrupt a DC power circuit under normal conditions or to interrupt this circuit under fault of emergency conditions.

73. **LOAD-RESISTOR CONTACTOR** is a contactor that is used to shunt or insert a step of load limiting, shifting, or indicating resistance in a power circuit, or to switch a space heater in circuit, or to switch a light or regenerative load resistor of a power rectifier or other machine in and out of circuit.
74. **ALARM RELAY** is a relay other than an annunciator, as covered under device function 30, that is used to operate, or to operate in connection with, a visual or audible alarm.
75. **POSITION CHANGING MECHANISM** is a mechanism that is used for moving a main device from one position to another in an equipment; for example shifting a removable circuit breaker unit to and from the connected, disconnected, and test positions.
76. **DC OVERCURRENT RELAY** is a relay that functions when the current in a DC circuit exceeds a given value.
77. **PULSE TRANSMITTER** is used to generate and transmit pulses over a telemetering or pilot-wire circuit to the remote indicating or receiving device.
78. **PHASE-ANGLE MEASURING OR OUT-OF-STEP PROTECTIVE RELAY** is a relay that functions at a predetermined phase angle between two voltages or between two currents or between voltage and current.
79. **AC RECLOSING RELAY** is a relay that controls the automatic reclosing and locking out of an AC circuit interrupter.
80. **LIQUID OR GAS FLOW RELAY** is a relay that operates on given values of liquid or gas flow or on given rates of change of these values.
81. **FREQUENCY RELAY** is a relay that functions on a predetermined value of frequency (either under or over or on normal system frequency) or rate of change of frequency.
82. **DC RECLOSING RELAY** is a relay that controls the automatic closing and reclosing of a DC circuit interrupter, generally in response to load circuit conditions.
83. **AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY** is a relay that operates to select automatically between certain sources or conditions in an equipment, or performs a transfer operation automatically.
84. **OPERATING MECHANISM** is the complete electrical mechanism or servomechanism, including the operating motor, solenoids, position switches, etc., for a tap changer, induction regulator, or any similar piece of apparatus which otherwise has no device function number.
85. **CARRIER OR PILOT-WIRE RECEIVER RELAY** is a relay that is operated or restrained by a signal used in connection with carrier-current or DC pilot-wire fault directional relaying.
86. **LOCKING-OUT RELAY** is an electrically operated hand, or electrically, reset relay or device that functions to shut down or hold an equipment out of service, or both, upon the occurrence of abnormal conditions.
87. **DIFFERENTIAL PROTECTIVE RELAY** is a protective relay that functions on a percentage or phase angle or other quantitative difference of two currents or of some other electrical quantities.

- 88. **AUXILIARY MOTOR OR MOTOR GENERATOR** is one used for operating auxiliary equipment, such as pumps, blowers, exciters, rotating magnetic amplifiers, etc.
 - 89. **LINE SWITCH** is a switch used as a disconnecting, load-interrupter, or isolating switch in an AC or DC power circuit, when this device is electrically operated, or has electrical accessories, such as an auxiliary switch, magnetic lock, etc.
 - 90. **REGULATING DEVICE** is a device that functions to regulate a quantity, or quantities, such as voltage, current, power, speed, frequency, temperature, and load, at a certain value or between certain (generally close) limits for machines, tie lines or other apparatus.
 - 91. **VOLTAGE DIRECTIONAL RELAY** is a relay that operates when the voltage across an open circuit breaker or contactor exceeds a given value in a given direction.
 - 92. **VOLTAGE AND POWER DIRECTIONAL RELAY** is a relay that permits or causes the connection of two circuits when the voltage difference between them exceeds a given value in a predetermined direction and causes these two circuits to be disconnected from each other when the power flowing between them exceeds a given value in the opposite direction.
 - 93. **FIELD-CHANGING CONTACTOR** is a contactor that functions to increase or decrease, in one step, the value of field excitation on a machine.
 - 94. **TRIPPING OR TRIP-FREE RELAY** is a relay that functions to trip a circuit breaker, contactor, or equipment, or to permit immediate tripping by other devices; or to prevent immediate reclosure of a circuit interrupter if it should open automatically even though its closing circuit is maintained closed.
 - 95.)
 - 96.)
 - 97.)
 - 98.)
 - 99.)
- Used only for specific applications in individual installations where none of the assigned numbered functions from 1 to 94 are suitable.

SECTION 8

OPERATING INSTRUCTIONS
SINGLE AND DUAL UNIT STATIONS

SECTION 8

OPERATING INSTRUCTIONS - SINGLE AND DUAL UNIT INSTALLATIONS

8.1 GENERAL

The following operating instructions apply to dual unit installations. The single OT-F-3 or OT-F-2100 installations differ only in areas that involve such items as load sharing, intermediate pressure functions, turning gear and number of gas detection heads, (station interlock shutdown, multiple unit stations only), etc.

The OT series gas turbine compressor installations are designed to operate on a pressurized gas main line. Starting is prevented if the pressure requirements are not met and units when running are shutdown if the pressure does not meet the requirements for a timed period.

Provision is made on the "Station Control Panel" for 'Preferred Unit' operation and permits the operator to select the unit that is to be started first and stopped last.

Under remote control the starting of a unit is fully automatic in response to a telemetered signal from the remote station.

Starting and stopping is controlled as follows:

1. Remote signal via the telemetering system.
2. Manually-applied signals at the "Unit Control Panel" and "Station Control Panel" (emergency stop only).

Any one of the following operating modes may be selected:

- | | |
|-----------------|---|
| 1. Remote | With discharge pressure control from station discharge pressure controller (set-point from telemetering). |
| 2. Local (Auto) | As above, except controller manually set. |

- | | |
|----------------------------|--|
| 3. Local (Manual) | With discharge pressure control from Man/Auto loading station on the "Unit Control Panel". Pressure is controlled by varying the engine speed at this control station. |
| 4. Engine Purging (Manual) | Normal starting sequence interrupted. |
| 5. Uncoupled Run | The gas turbine can be run with the booster uncoupled. Speed controlled manually as Local/Manual above. |

8.1.1 PRE-START

Before permitting any start, perform a walk-around inspection to ensure that all tools, covers, etc. have been removed. Ensure that the gas producer air intake and exhaust ducting are free from obstruction or foreign objects. Ensure that the intake filter access doors are closed.

NOTE

For Remote operation, the above should be performed before leaving the station.

When all necessary power circuits are selected "on" and "auto" on the motor control centre, the control panel selectors on "auto" and "remote", other routine checks such as light bulbs serviceable, pre-start check switch at "run", battery charger on "float", and lockout relays on the SCP and UCP reset, the preferred unit is ready to receive a remote telemetry start signal (Unit Ready and Unit Available lights 'On').

8.1.2 REMOTE STARTING

On receipt of a start signal from the remote station, the preferred unit will start, run up automatically and load. When the preferred unit valves are positioned for loading, the second unit 'Unit Available' light comes on. On receipt of a second telemetered start signal, the second unit will start and run-up to share load with the preferred unit.

When starting is initiated, succeeding operations are then automatic. That is, the gas valves are positioned for booster purging, and the unit sequencing circuits provide a timed period for purging. When the gas turbine reaches a speed pre-determined by the sequencing circuits, the booster is pressurized, then loaded. The gas turbine under the control of the governor will then be driven to the speed and power output required to accommodate the load selected.

An event recorder on the "Unit Control Panel" records significant events as they occur, of unit run-up, run-down and valve positions, see Fig.22A.

8.1.3 LOCAL STARTING

Locally the unit can be started from the appropriate "Unit Control Panel" with the speed controlled by the discharge pressure set-point or the load control station.

With the "Station Control Panel" selected to local and the start button on the appropriate UCP is momentarily pressed, the unit will start and accelerate automatically to the speed set-point. Indication of starting, acceleration and loading are the same as those described for a remote start.

8.1.4 LOADING/UNLOADING

Station and unit loading in remote or local as desired is automatic at a pre-determined rate, up to the set-point of the discharge pressure controller or pneumatic control station, as selected. Unloading is automatic at ramp rate for normal shutdown or at a manually set rate.

NOTE

In all modes of operation unloading takes place automatically at ramp rate, i.e. approximately 10 minutes from full load to governor minimum (15 to 3 psi demand signal to the governor). However, if desired, the ramp can be over-ridden in the Local-Manual mode at the Load Control station on the UCP by inserting a lower signal than that provided by the ramp generator.

If one unit is already on the line, the discharge pressure controller output must be biased. When the line is not available for loading, the load must be recycled, to permit load sharing. Biasing must always be carried out so as to subtract from the incoming signal, i.e. the bias control, see Fig. 22 adjustable between -18 and +18 psi should only be adjusted between 0 and -18.

Switching from AUTO to MANUAL at the Load Control Station is a bumpless transfer. Load set-point changes manually set after transfer are at the rate set by the control station proportional band or by the ramp generator (whichever setting is the lower).

Before switching from MANUAL back to AUTO, the output signal (red pointer) at the Load Control Station must be balanced with the input signal (black pointer) to ensure a bumpless transfer.

NOTE

During loading or operation on 'Load', the signal to the governor may be reduced automatically, for a period, due to high exhaust gas pressure or PT speed. Following correction of the condition, the load demand to the governor will be restored to its original value.

8.1.5 RE-CYCLING

The output of the units can be recycled automatically or manually. When the operating mode is auto, the surge control system sends a 15-3 psi signal to open the re-cycle valve as required to suit the booster network operating conditions. When selected manual and local, the knurled knob on the recycle valve can be adjusted to give the desired load. When the re-cycle valve moves from closed to open, the amber light will go out and the white light will come on.

Before changing over from Manual re-cycling to Automatic, adjust the recycle station output to match the automatic signal on the control station to obtain a 'bumpless' transfer. Changeover from Auto to Manual is automatically 'bumpless'.

CAUTION

Care should be taken when re-cycling to avoid overloading and tripping the unit due to excessive exhaust gas temperature or booster casing temperature.

8.1.6 OPERATING

Recorder Charts (See Fig.29A)

The recorder charts on the SCP and the UCP must be changed out after approx. 30 days of operation. The charts should be analyzed to ensure that unit operation is satisfactory, see limits, Section 9.

On OT-F-3 sets, check that the exhaust gas temperature recorded for the LH and RH exhaust elbows do not deviate from each other by more than 25°F. Deviations above this temperature for a prolonged period indicates unbalanced operation due to faulty fuel nozzles, combustion system or turbine blade defects.

Running Checks

It is recommended that a complete set of readings, speed, temperature, load, etc., be taken once every shift or daily, whichever is shorter. The vibration levels should be checked. Time-to-light should be recorded for each start.

8.1.7 UNIT SHUTDOWN

The unit can be shutdown by:

Normal :

- Telemetry signal (via SCP) or by depressing stop button on the UCP
 - No Lockout.
- Units shutdown sequentially - Preferred unit last.

Emergency:

- Depress emergency stop button on SCP (All station units locked out).
- Depress emergency stop button on UCP (Unit Lockout).

Station Fault Shutdown:

- Automatic due to (a) High station discharge pressure

OR

(b) Low station suction pressure

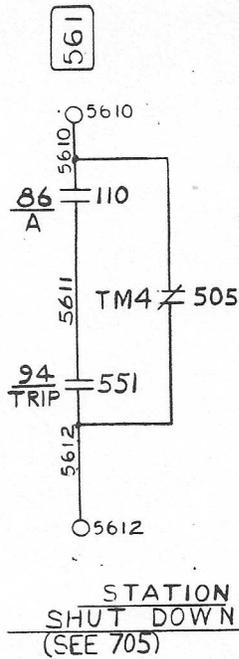
OR

(c) Interlock shutdown (OT-F-3 unit stations). When any station unit is tripped and locks out, the other station units are automatically shutdown, see para 8.1.7A following.

NOTE

Following a 'Station Fault' shutdown, the units can be restarted when the condition has cleared (a) and (b) or whenever the run-down of all station units has been completed (approx. 8 minutes duration).

8.1.7A INTERLOCK SHUTDOWN



When one of the operating units is tripped with lockout, the other operating unit(s) is tripped by an 'Interlock Shutdown' relay (Station Interlock Shutdown), without lockout and can be restarted, see Restarting and Loading below.

A 'Station Interlock Shutdown' is controlled by 'Interlock Shutdown' relay (704) (located in the Station Control Panel), which must be energized at all times to permit station operation.

STANDBY

The supply circuit to the 'Interlock Shutdown' relay is controlled by a series circuit which contains N.O. contacts of the 'Lockout' relay (110) of the Station units and the associated 'Trip Control' relay (551) arranged in sets. Each set of two contacts is shorted out during unit 'Run-up' to 'Unit on Line' by a paralleled contact of the appropriate unit, 'Unit on Line' relay (505). The parallel supply prevents a station interlock shutdown in the event of any unit trip and lockout during run-up and permits the units to be restarted following a station interlock shutdown, see 'Restarting' below.

When the 'Interlock Shutdown' relay is energized, a N.O. contact of this relay is closed in the supply to the 'Lockout Control' relay (550) of each control panel to energize the 'Lockout Control' relay and the 'Trip Control' relay (551).

The trip control relay of each unit is effective when energized to arm the 'Supply' circuits to the 'Trip' relay (107-8) and the 'Master' relay (117) and the series circuit of the 'Station Interlock Shutdown' relay. The 'Lockout Control' relay of each unit is effective when energized to remove an alternative supply to the 'Unit Lockout' relay (110).

RUN-UP TO UNIT ON LINE

When the run-up sequence of any starting unit has advanced to 'Unit on Line' status, the appropriate contact (505) in line (703) or (705) opens to transfer the control of the 'Interlock Shutdown' relay supply to the 'Lockout' relay (110) of the starting unit(s).

OTHER UNIT TRIP AND LOCKOUT (Two or more units 'On Line')

In the event of any unit trip and lockout, the 'Interlock Shutdown' relay is de-energized and operates through crossover circuits (8000, etc.) to de-energize the 'Lockout Control' relay (550) which in turn de-energizes the 'Trip Control' relay (551).

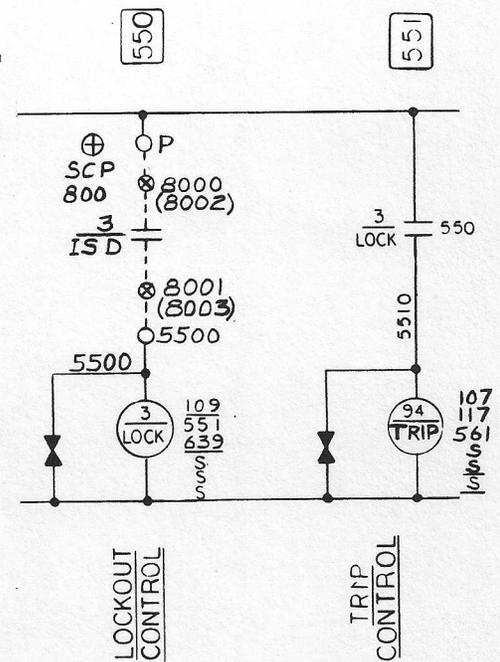
The operating unit(s) is shutdown by the 'Trip Control' relay, while the 'Lockout Control' relay operates to establish an alternative supply circuit to the 'Lockout' relay (109) to prevent lockout of the serviceable unit(s) and to initiate annunciation (638). Another function of the 'Trip Control' relay is to isolate the 'Interlock Shutdown' relay to prevent restarting until the unit valves on the locked unit have closed (Unit on Line relay (505) energized).

SINGLE UNIT TRIP AND LOCKOUT (One unit only 'On Line')

With only one unit operating the other serviceable unit(s) is prevented from starting by the fact that the 'Interlock Shutdown' relay (704) is de-energized until the tripped unit valves are closed.

RESTARTING AND LOADING

As soon as the units have completed their rundown, (Unit Ready light on Local or Unit Available light on Remote), the serviceable units can be restarted and loaded using the desired operating mode. Before restarting the locked out unit, the fault(s) must be remedied and the 'Unit Lockout' relay reset.



Station Lockout

Station lockout brought about by a variety of causes including Fire, Gas detected or Sustained AC Failure (period in excess of 4 hours) will shut down and lockout all station units.

Restarting delayed until - rundown completed, fault cleared, lockout relay reset (SCP) and (UCP). Station valve re-opened.

Unit Fault Shutdown

Fault shutdowns occur when an operating condition occurs which is not within limits. These faults are normally accompanied by unit lockout. Before a unit can be restarted, the unit lockout relay must be reset, when the 'Unit Ready' or 'Unit Available' lights will come on.

Following an emergency or fault shutdown, see above, the normal controlled shutdown consisting of a generator ramp deceleration rate to the governor minimum stop and cooldown period is bypassed and a lockout occurs. The alarm event recorder indicates the cause of lockout.

8.1.8 ALARM EVENT RECORDING

Alarm event recorders are provided, one on each of the "Unit Control Panels" and one on the "Station Control Panel". When an operating condition is not within limits, the alarm event is recorded and warning is given in the form of a flashing red trouble light on the applicable panel. Since in most cases the station or unit is tripped and locked out, the recording serves primarily to facilitate trouble shooting, see Figs. 23B. and 24A. Some alarms provide early warning of impending faults and give the operator time to carry out remedial action to prevent a trip condition. Indication of trouble is transmitted to the remote station by a telemetering signal.

STATION RUNDOWN BLOCK DIAGRAM (2 UNIT)

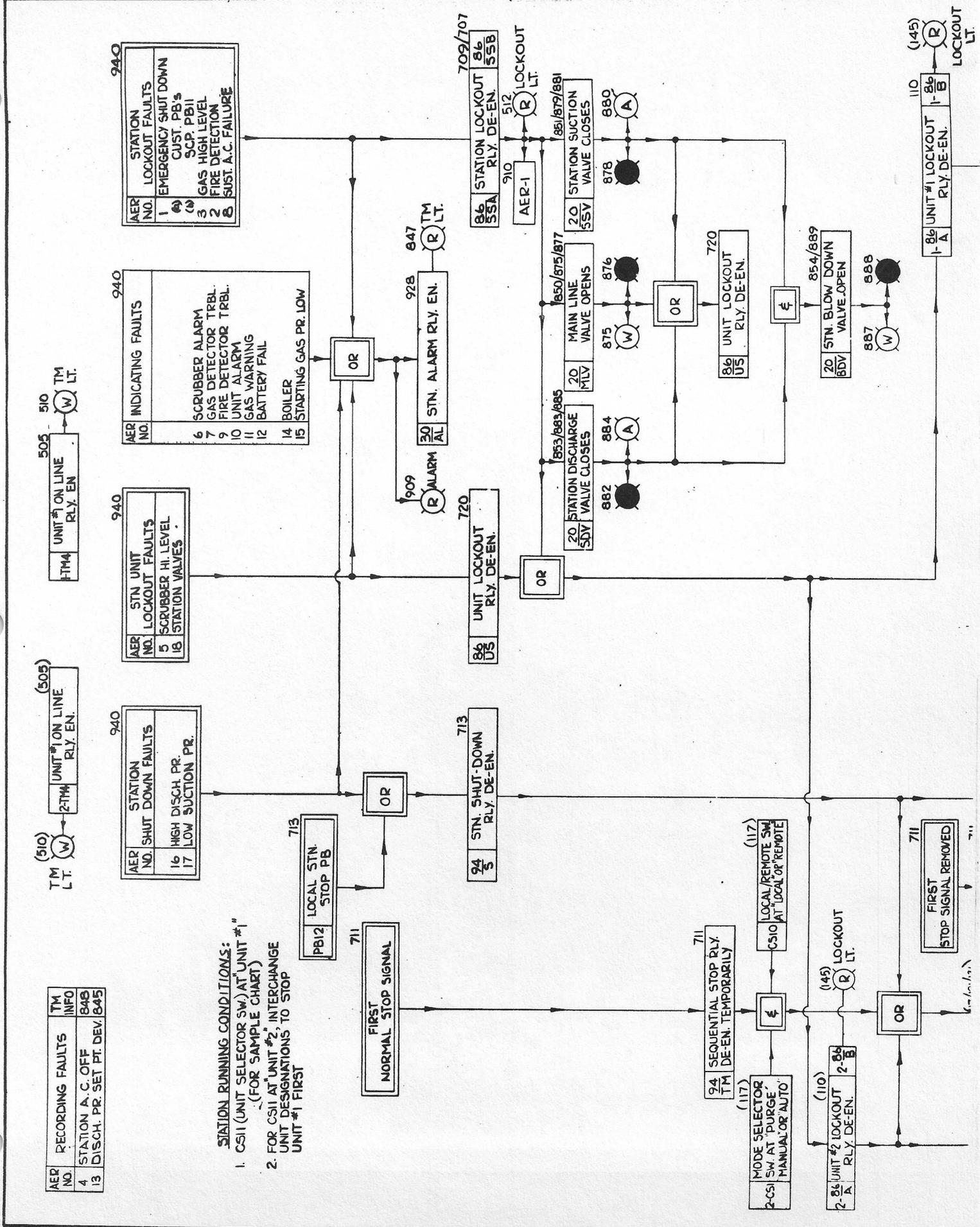


FIG. 29

INTRODUCED BY 26364-403

281K00076

DRAWING NO.	TITLE	QTY/ STN	MAKE	MAKERS MODEL NO.	CHART			TOOL SET	INK COLOUR	INK CODE
					NO. NO. ROLLS/ 6" STRIP	NO. ROLLS/ 12" STRIP	CALIBRATED			
281K00052	RECORDER 1 PEN GAS FLOW	1	HONEYWELL	18301-336	3	0-1200	352L4/2	RED	366316/1	
281K00051	CONTROLLER RECORDER DISCHARGE PRESSURE	1	HONEYWELL	Y 15314-216	3	400-900 psi.g.	352L4/2	RED	366316/1	
281K00072	RECORDER 12 POINT 0-300° F	2	LEEDS & NORTHROP (SPEEDOMAX W)	515-901-515-0048-6- 001-001-351-006	4	0-300° F	124492	MULTI	WHEEL INK PAD 125078	
282K00059	RECORDER ALARM EVENT 20 PEN	1	EST. ANGUS	A620-X	2		5875-R	RED	61100-R	
282K00060	RECORDER ALARM EVENT 40 PEN	2	EST ANGUS	A620-X	4		5875-R	RED	2 BOTTLES 61100-R	
282K00061	RECORDER- POWER TURBINE SPEED 1 PEN	2	MOORE	5310	6	0-10,000	---	RED	10700/183	
282K00062	RECORDER EXHAUST TEMP. 0-1200° F.	2	HONEYWELL	17320-314-1111-911- 31-40-00-00	6	0-1200° F.	352L4/2	RED PURPLE	366316/1 366316/2	
282K00063	RECORDER 6 POINT VIBRATION	2	LEEDS & NORTHROP SPEEDOMAX W	514-979-000-1656- 6-001-006-S	4	0 to 1"/sec 0 to 3"/sec	124492	MULTI	WHEEL INK PAD 125078	
282K00058	RECORDER EVENT 20 PEN DUAL SPEED	2	EST. ANGUS	A620-X	4		5875-R	RED	61100-R	
282K00066	RECORDER AMBIENT TEMP. PNEUMATIC	1	MOORE	5310	3	-50 to 130° F.	---	RED	10700/183	
281K00068	RECORDER- SUCTION & INTERMEDIATE PRESSURE 2 PEN	1	MOORE	5320	3	400-900	---	RED BLUE	10700/183 10700/184	

NOTE: THIS DRAWING IS FOR KIT MARSHALLING PURPOSES ONLY.

C.V. HARDING PAPER RECORDER CHARTS SET 281K00076
 A.G.T.L. HUSSAR "B"
 F.P.B. 2/1/69
 1/8/69
 23/1/69

FIG. 29A RECORDER CHART SET

8.1.9 POST LUBRICATION AND COOLING

Following any of the above shutdowns, Normal, Emergency or Fault, a post lube period is sequenced. Post lube is effective for a 2 hour period after the compressor unit has stopped and is provided to enable the Kingsbury sleeve bearings to cool down evenly and prevent shaft distortion. This is achieved by circulating lube oil under pressure through the power turbine and seal oil system.

8.1.10 PURGING

When the control mode is "purge" the starting turbine can be operated to turn the gas producer to remove residual gas inside the combustion area of the gas producer. Purging will continue until:

- The unit receives a stop signal (UCP)

OR

- The control mode selector is moved to Manual or Auto. The unit start sequence will pick-up after the timing out of the purge timer.

8.1.11 UNCOUPLED OPERATION

One unit can be operated when the main drive shaft is removed from between the power turbine and booster regardless of the operating mode of the second unit by turning the key in the Uncoupled/Run switch in the counter-clockwise direction. The unit will operate to the speed set at the Pneumatic Control Station on the UCP. The unit will operate normally except for loading and the normal sensing for the lube and seal oil system functions associated with compressor operation.

8.2 GAS TURBINE AIR INTAKE ICING

Operation of a gas turbine during particular atmospheric conditions will always present the possibility of ice ingestion damage.

Experience has shown that the damaging ice forms on surfaces upstream from the intake surfaces of the basic gas turbine unit, and upon becoming dislodged, may be drawn by the airflow into the compressor.

Normal precautions have been taken on this installation against this possibility. These include an inertial type air filter, having a sharp flow redirection to extract water droplets, pressure differential sensing to indicate icing build-up, tight joints in the intake ducting and a screen placed directly upstream of the turbine inlet to catch any ice which may have built up and broken loose.

It is therefore recommended that when icing is likely to occur, the unit be shutdown. If this is not convenient, close watch on ice formation in the gas turbine intake should be carried out at frequent intervals by viewing through windows or viewing ports in the intake section.

8.3 VIBRATION - GENERAL

Symptoms of mechanical trouble related to gas turbine, power turbine or booster rotors can be detected in its early stage of development by either an increase in temperature or vibration, or a combination of both. Temperature protection and readout have already been considered.

The OT-F-3 and OT-F-2100 installations use the "Reliance" protective system. This system is solid state and consists of a monitor that receives inputs from six pick-up heads and a recorder for a continuous record.

The monitor provides for selective readout of vibration in inches per second, operating limit, a warning limit and a trip set-point.

Two pick-up heads to record horizontal and vertical movement are mounted at each of the following locations.

1. On the front end of the gas producer casing at top dead centre.
2. On the power turbine rear bearing support casting lower right-hand side.
3. On the booster unit.

The gas producer and booster heads provide a signal proportional to the speed of the movement of the heads while the power turbine signal is proportional to the acceleration of the movement of the heads. The power turbine is fitted with the accelerometers because they are better suited to the high temperatures encountered.

There are three basic parameters which are used to measure vibration.

1. Displacement - Displacement is the distance that the sensing head moves from side to side, called lateral or horizontal vibration, or up and down called vertical vibration. This movement is measured in "mils" or thousandths of an inch and when the full travel is measured each time it moves it is termed a "peak-to-peak" displacement. Displacement measurement is independent of any influence from frequency and wave forms that are simple harmonic motion are not differentiated from those containing complex frequency orders. Amplitudes which are allowable at low frequencies are generally not acceptable at higher frequencies.
2. Velocity is defined as the rate of change of displacement with respect to time, hence frequency has an influence on the measurement. Vibration velocity is normally expressed in units of inches/second. The "Reliance" system senses average velocity but indicates a peak value computed from the detected average value. As turbines operate in a medium frequency range, average velocity sensing is a satisfactory measurement. A constant velocity limit eliminates the problem of relatively high amplitude, low frequency displacements causing premature trips and permits a decreasing displacement limit directly proportional to increasing speed.
3. Acceleration - Acceleration is termed the rate of change of velocity with time and is measured in inches/second squared or 'g' units. This type of measurement is normally used when investigating high frequency vibration. Accelerometers have been used to measure power turbine vibration simply because they are able to withstand the high temperatures normally experienced at the monitoring location.

8.3.1 VIBRATION MONITOR

A solid state Reliance vibration monitor located in each Unit Control Panel is powered by 118 VAC, single-phase 60 Hz which is converted to a regulated DC output by a power supply unit in each monitor, see Fig.29D. The DC output is used to power six vibration channel indicating circuits, also contained in the monitor.

The monitor receives inputs via the six transducers, one serving each of the six vibration channels (see Fig.29E). The transducers are mounted, one for vertical sensing and one for horizontal sensing on the: Gas Producer (Transducer,

NOTES:

- 1 ○ OUTGOING TERMINAL.
- 2 ⊗ TERMINAL ON REMOTE EQPT.
- 3 ⊕ REMOTE EQPT.
- 4 * EQPT. SUPPLIED BY ORENDA.
- 5 MCC - MOTOR CONTROL CENTRE.
- 6 PP - POWER PLANT
- 7 SCP - STATION CONTROL PANEL
- 8 PS&G - PRESSURE SWITCH & GAUGE PANEL
- 9 2-UCP - UNIT CONTROL PANEL OF OTHER UNIT. SUBSTITUTE "1-UCP" TO CONVERT NOMENCLATURE TO #2 UNIT.
- 10 CUST. - CUSTOMER'S EQPT.
- 11 SCP LOCATION AND TERMINAL NUMBERS ARE SHOWN FOR UNIT #1 & #2. NUMBERS APPLYING TO UNIT #2 ARE IN BRACKETS.

REV.	DESCRIPTION	CH.	APP.	DATE	BY
	SEE SHEET 1				

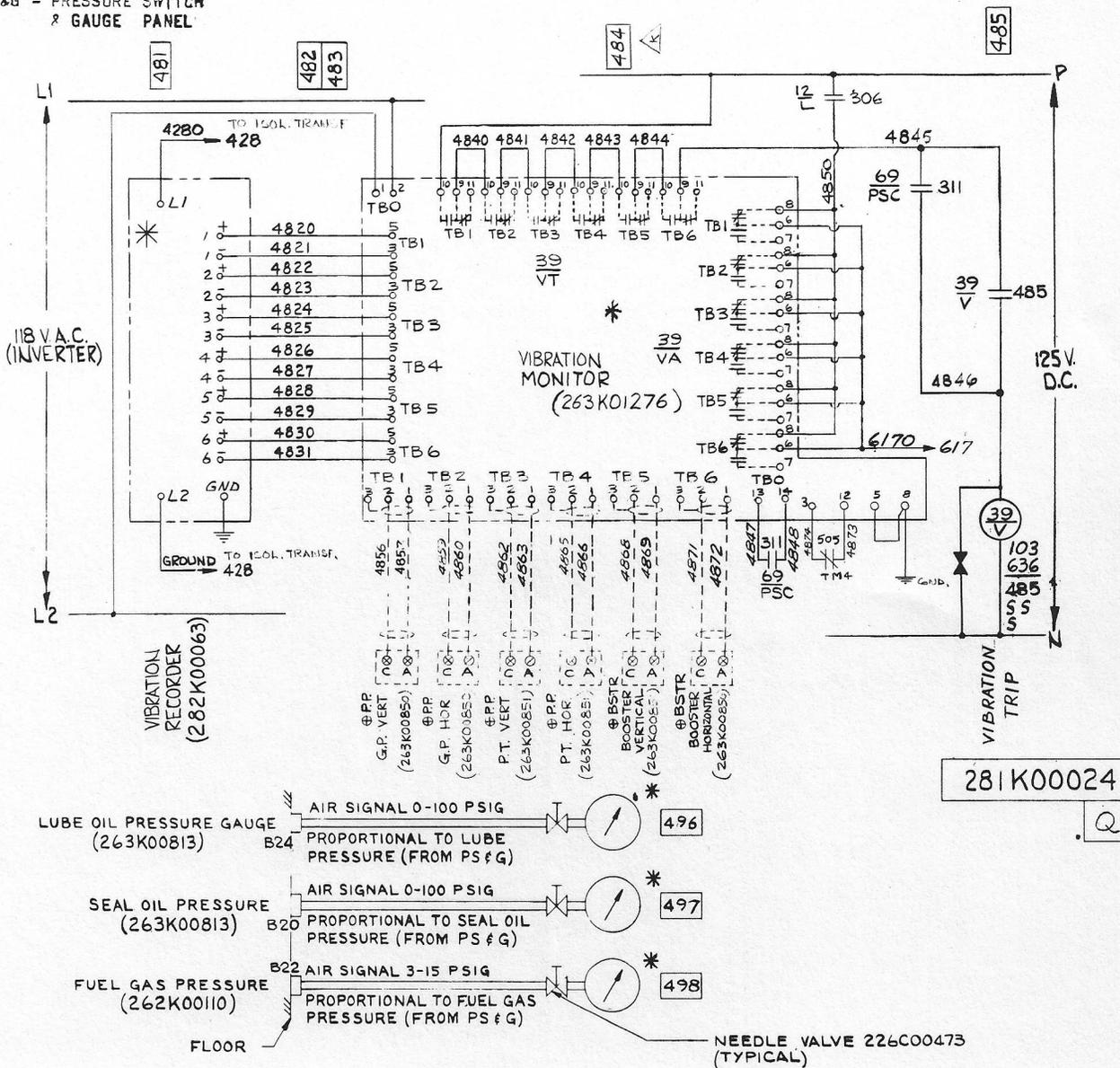
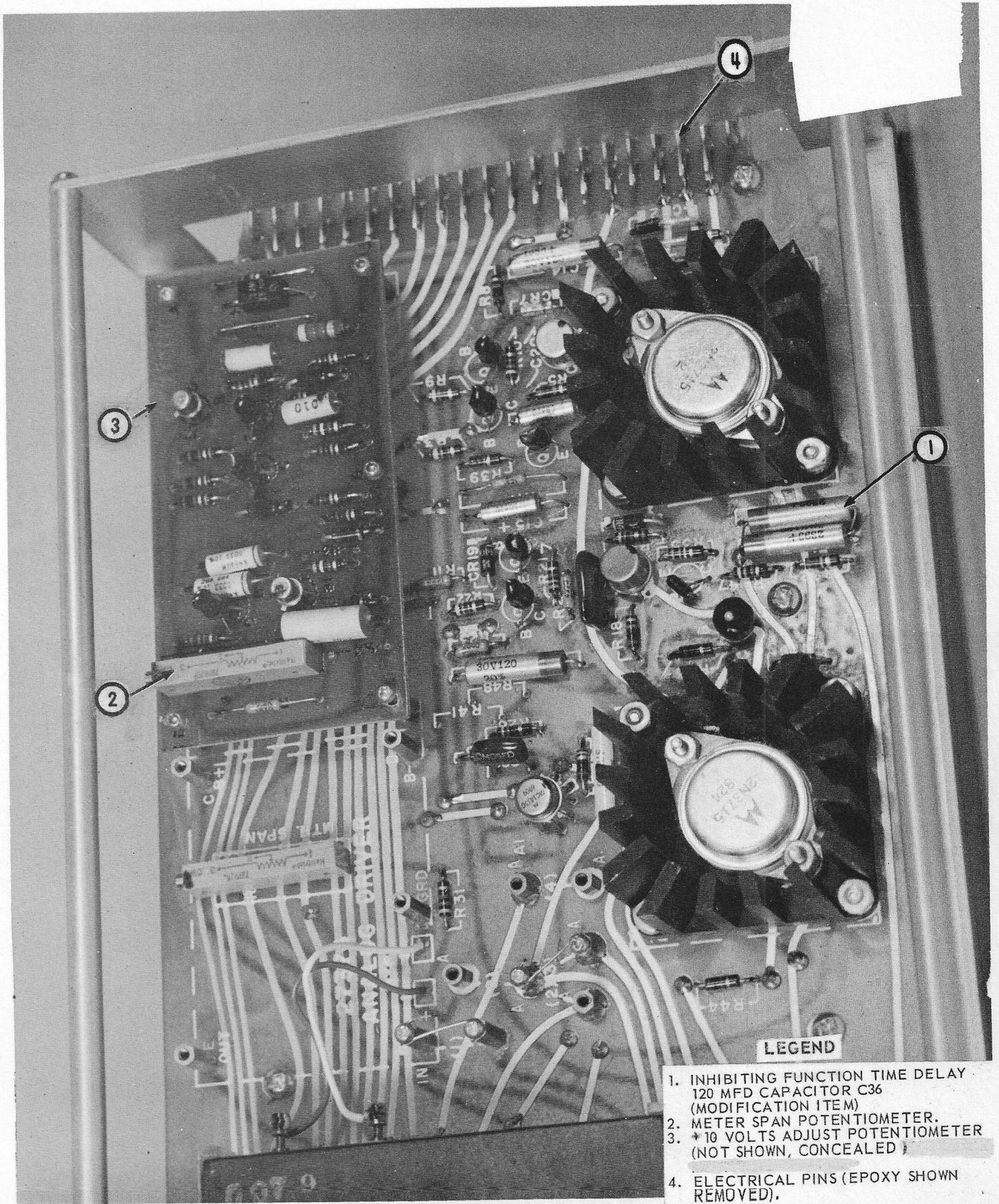


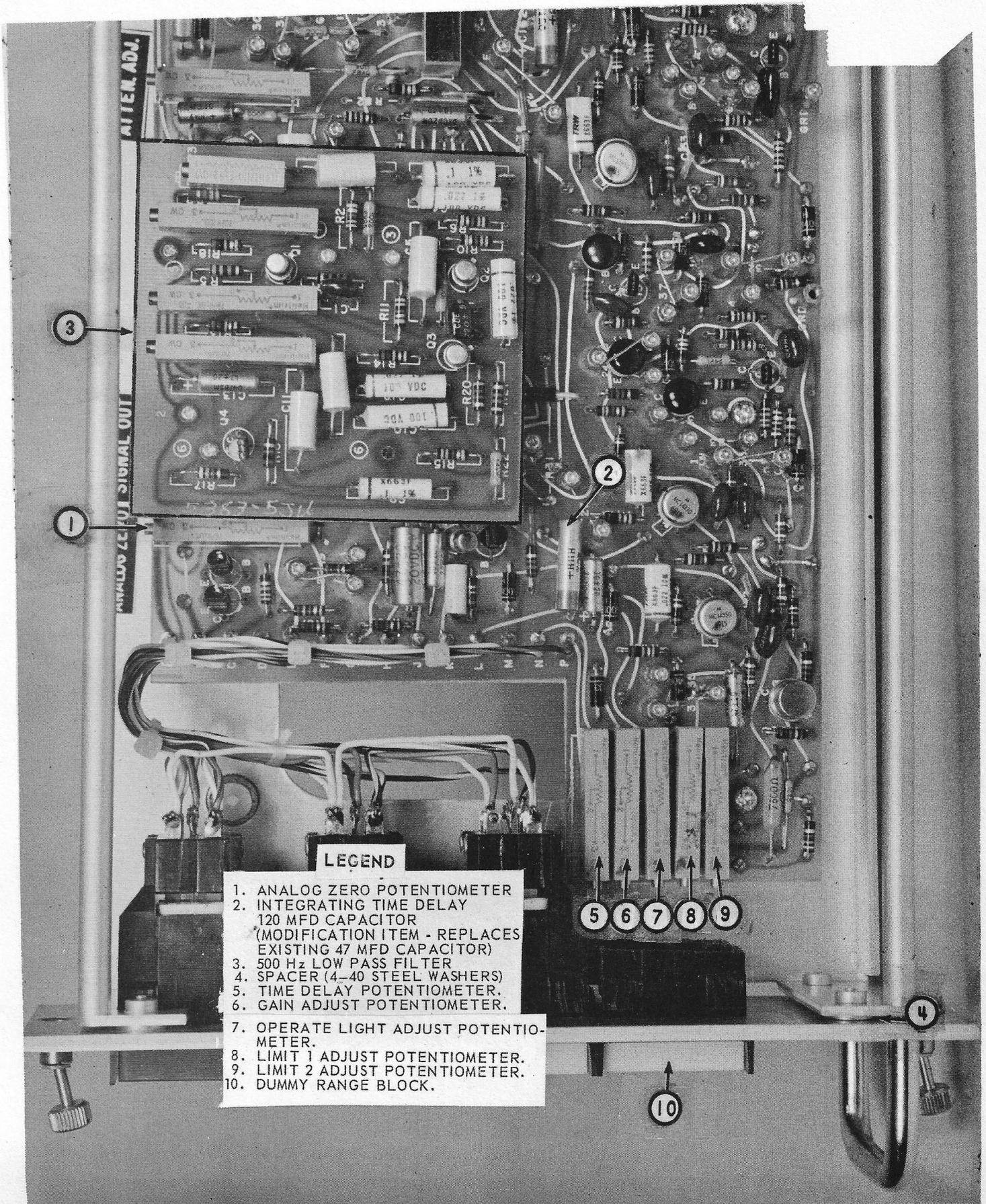
FIG. 29C

VIBRATION MONITOR (UCP)



- LEGEND**
1. INHIBITING FUNCTION TIME DELAY 120 MFD CAPACITOR C36 (MODIFICATION ITEM)
 2. METER SPAN POTENTIOMETER.
 3. +10 VOLTS ADJUST POTENTIOMETER (NOT SHOWN, CONCEALED)
 4. ELECTRICAL PINS (EPOXY SHOWN REMOVED).

FIG. 29D VIBRATION MONITOR POWER SUPPLY (SLIDE PAK)



LEGEND

1. ANALOG ZERO POTENTIOMETER
2. INTEGRATING TIME DELAY
120 MFD CAPACITOR
(MODIFICATION ITEM - REPLACES
EXISTING 47 MFD CAPACITOR)
3. 500 Hz LOW PASS FILTER
4. SPACER (4-40 STEEL WASHERS)
5. TIME DELAY POTENTIOMETER.
6. GAIN ADJUST POTENTIOMETER.
7. OPERATE LIGHT ADJUST POTENTIO-
METER.
8. LIMIT 1 ADJUST POTENTIOMETER.
9. LIMIT 2 ADJUST POTENTIOMETER.
10. DUMMY RANGE BLOCK.

FIG. 29E

VIBRATION MONITOR CHANNEL (SLIDE PAK) (TYPICAL)

Velocity); Power Turbine (Transducer Accelerometer) and Booster (Transducer, Velocity).

The velocity transducers provide signals in the range 8-1000 Hz proportional to vibration velocity sensed, while the accelerometer transducers provide signals in the range 10-1500 Hz proportional to vibration acceleration sensed. Filters are provided in each channel to filter out frequencies above 500 Hz.

Continuous vibration above the set-points (which are preset in each of the six channels) for a period in excess of 5 seconds, sensed by one or more of the pick-ups will:

- Alarm and record the condition (Low set-point) Limit 1.
- Initiate trip and lockout (High set-point) Limit 2.

The fault areas will be visually indicated by a light on the vibration monitor in the channel(s) affected.

In the event of Limit 2 being reached causing trip, the vibration monitor must be reset by pressing the lockout reset push-button on the UCP.

During unit run-up the sensitivity of the monitor is reduced by unit sequencing circuits until the unit is loaded (Suction and Discharge valves open).

8.3.2 PRE-INSTALLATION INSPECTION

Visual Inspection

The following visual checks should be carried out prior to switching power on to the monitor:

- Remove each channel individually and ensure that the links required to provide the necessary functions of the monitor are correctly installed. A link should be inserted at position 40, on monitors which do not employ 500 Hz low pass filters. In the event that 500 Hz filters are incorporated, these will be mounted on the main circuit board. Note that channels which are set up for accelerometer input signals have a 10 k Ω resistor installed at position 2.
- Inspect the electrical pins on the rear of each channel to ensure that the split portion of each pin is separated enough to ensure

proper electrical contact with the sockets which are mounted within the chassis of the monitor. If it is found that the split portion of any of the pins are squeezed together, these should be separated slightly to ensure proper engagement.

8.3.3 'POWER ON' AND INITIAL SET-UP PROCEDURE

Pre-Start Adjustments

With all channels inserted in the chassis and power switched on to the monitor, the following adjustment procedure is to be carried out.

Limit Settings

Select channel No.1 by depressing the appropriate pushbutton on the indicating power supply.

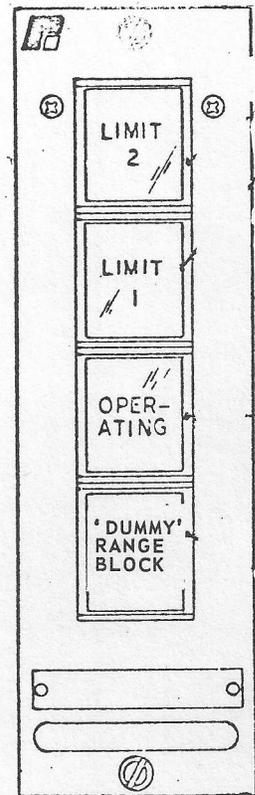
Remove the white 'dummy' range block from the front face of the channel to expose the five potentiometer adjusting screws. The function of each of these potentiometers is indicated on the rear of this range block.

Depress the limit 1 pushbutton on the front face of the channel while adjusting the limit 1 potentiometer until the desired warning level is indicated on the meter.

Adjust the limit 2 setting to the required level in a similar manner.

When adjusting the limit settings, it must be ensured that the limits are set up on that portion of the indicator scale which corresponds to the channel range. For a channel with a range of 0-0.3 in./sec., the 0-3.0 portion of the scale must be used. This actually represents a range of 0-0.3 in./sec. for that specific channel, and a level specified as 0.15 in./sec. should be set at an indicated level of 1.5 on the meter. Similarly for a channel with a range of 0-1.0 in./sec. the 0-10.0 portion of the scale, which actually represents 0-1.0 in./sec., must be used.

NOTE: Channel ranges are in units of peak velocity.



Vibration Channel
(Typical)

Operating Level

No specific value is ever specified for this level in the control settings drawing since no control functions are dependent on it. It is advisable, however, to have the operating lights on when the turbine is running. This can be achieved by adjusting the operating level to a value which is slightly lower than the vibration level present on each channel under normal running conditions. This indication at least will tell the operator that each channel is functioning and an input signal is present.

Gain Control

This potentiometer should not be adjusted unless it is found, during calibration of the monitor, that adjustment is necessary to obtain the correct gain setting. The gain control, however, is factory adjusted and should not normally require adjustment.

Time Delay

The time delay adjustment is to be set to its maximum value, i.e. 5 seconds. This is achieved by turning the time delay potentiometer fully clockwise.

8.3.4 FIELD CALIBRATION

Field calibration requires the use of a signal generator and an AC/DC voltmeter. Instructions for field calibration are contained in the appropriate service manual and relevant Service Bulletins.

8.4 GAS DETECTION SYSTEM

Gas and fire detection equipment is provided to ensure safe operating conditions on the site. Sensors are located in areas which are most vulnerable to the presence of extraneous gas or to overheating to the point of combustion.

Gas detector heads connected in series are located, one in the Metering Building and one in each compressor building. When gas is detected, the head provides an electrical signal which represents the gas level in that area.

Two heated catalytic elements and two inactive elements form a balanced electrical circuit. When a mixture of flammable gas in air comes into contact with the heated catalytic elements, a rapid combustion takes place on the element surface which increases the temperature of the elements. This causes a change in resistance and creates an imbalance in the bridge circuit, resulting in a signal.

If gas is detected in a compressor building, the signal is conducted to the Gas Detector Unit on the "Station Control Panel" by shielded cables and appears as a visual indication on a meter calibrated as a percentage of the lower explosive limit in air of the detected flammable gases.

A signal representing 25% gas de-energizes a relay which initiates gas warning alarm and recording on the "Station Control Panel", and also operates No.1 and No.2 vent fans. When the fault is cleared, the alarm relay is automatically reset.

8.4 (Cont'd)

A signal representing 75% gas de-energizes a relay which initiates station trip and lockout, (all station units shut down and locked out), alarm event recording (station panel) and lights a red alarm light on the gas detector control unit.

8.5 FIRE DETECTION SYSTEM

Two flame detector heads are located in each compressor building and one in the basement of the controls building.

The flame detectors sense infra-red radiation emanating from flames flickering at frequencies between 5 and 30 cps. through a photo-electric cell behind an infra-red filter lens. (There is no response to constant infra-red radiation). A sustained variation of radiation at these low frequencies for a period of 10 seconds generates a voltage in the cell and this is amplified to activate a cold cathode tube that locks in the alarm signal. The smoke detector reacts to invisible products of combustion disturbing the balance between two ionization chambers to trigger a highly sensitive cold cathode tube.

All six heads are connected in series and a signal from any one is conducted through shielded cables to the Fire Detection Panel on the inside rear wall of the "Station Control Panel".

In the event of fire or smoke being detected, relays are actuated to initiate station shutdown and lockout, and to alarm and record the condition.

A key-operated 'Reset' switch is provided on the Fire Detection Panel so that the system may be reset when the fire and gases have been cleared from the area.

SECTION 8A

OPERATING INSTRUCTION

THREE UNIT STATION

SECTION 8A.

OPERATING INSTRUCTION - THREE UNIT INSTALLATIONS

8A.1 GENERAL

Provision is made in OT-F-3 dual unit stations control panels for the addition of a third unit, which is normally a mobile OT-F-3 gas turbine pumping set. The three gas boosters are connected in series as shown in Figure 30.

The following operating instructions are provided to complement, but do not supersede, the instructions for a dual unit station described previously in Section 8.

The unit control panel provided for the mobile unit contains all the main features of the dual station UCP's including:

- Automatic sequencing circuits - which are, where necessary, subject to station control (SCP)
- Alarm and event recording
- Recycle controls
- Surge control
- The selectable operating mode features listed for the dual units.
- Telemetering provisions
- Rundown and cooldown sequencing provisions

8A.2 INSTALLATION REQUIREMENTS

The mobile unit to be installed as generally described in Section 8B.

The station control panel to be electrically and pneumatically-connected to provide:

- Station sequencing control

- Remote discharge pressure demand set-point control
- Load biasing control
- Station fault and lockout control.

NOTE

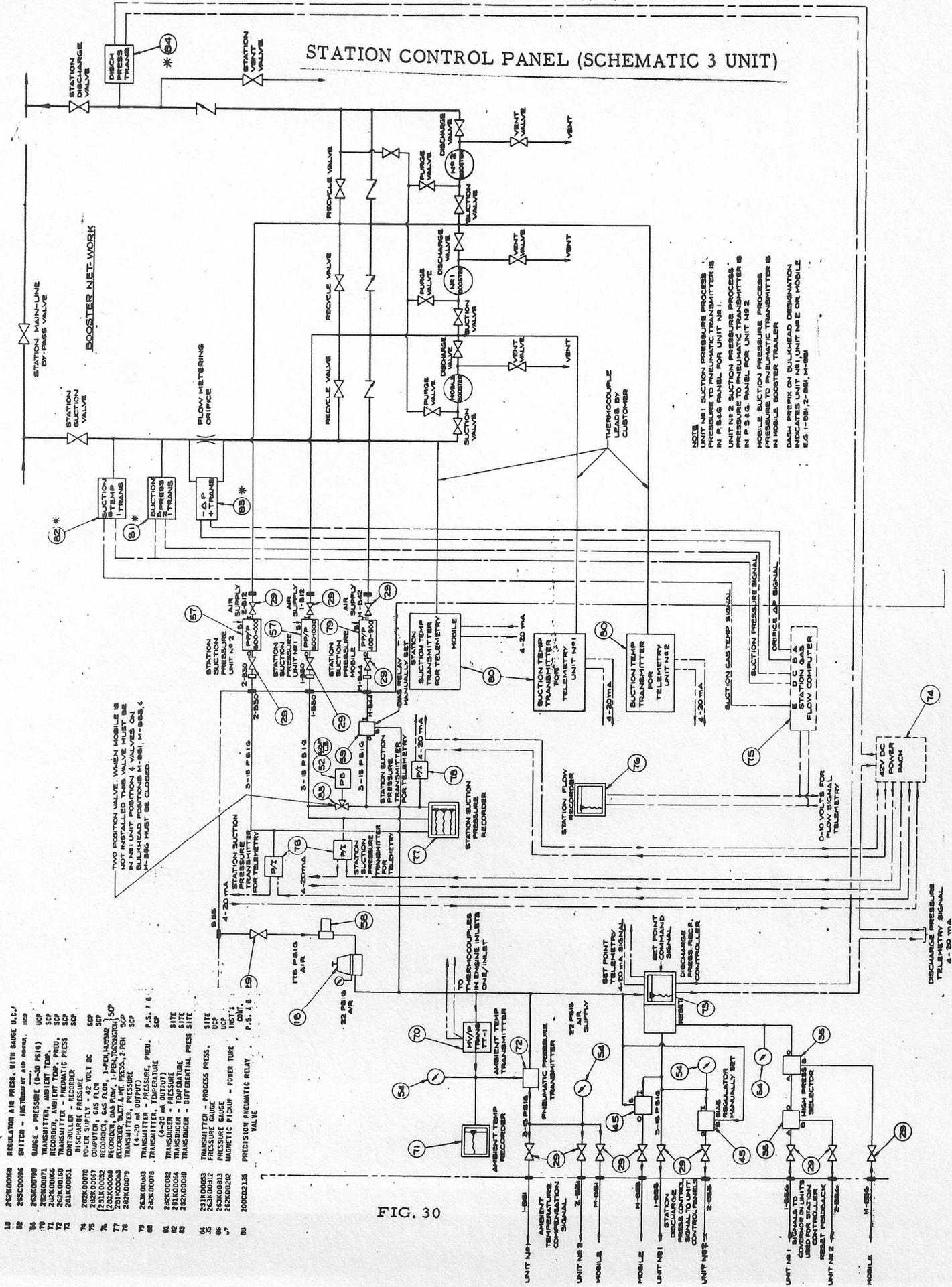
Station control panel electrical circuits are, where necessary, jumper wired and pneumatic signal outputs blocked when the mobile unit is not installed.

8A.3 OPERATING

The instructions for operating a three unit station are the same as those described in Section 8 with the following exceptions:

- Station Control Panel (SCP) sequencing circuits are arranged so that the mobile unit starts last and stops first.
- Load biasing is applied from a separate bias regulator in the SCP.
- Operating instructions for the mobile unit are contained in a separate Service Manual provided for the mobile unit.

STATION CONTROL PANEL (SCHEMATIC 3 UNIT)



TWO POSITION VALVE WHEN MOBILE IS NOT INSTALLED THIS VALVE MUST BE IN MOBILE POSITION. BULK-HEAD POSITIONS M-55, M-55-4 M-55-5 MUST BE CLOSED.

- 29 262K00068 REGULATOR AIR PRESS. WITH RANGE U.C./
- 30 265C00096 SWITCH - INSTRUMENT AIR SUPPLY
- 31 262K00078 BARGE - PRESSURE (0-30 P.S.I.)
- 32 262K00074 TRANSMITTER - AMBIENT TEMP. PRED.
- 33 262K00066 RECORDER - AMBIENT TEMP. PRED.
- 34 262K00160 TRANSMITTER - PNEUMATIC PRESS
- 35 262K00160 RECORDER - PNEUMATIC PRESS
- 36 262K00051 CONTROL - RECORDER
- 37 262K00070 POWER SUPPLY - RESERVE
- 38 262K00070 COMPUTER, GAS FLOW, 1-PEN, 4-20 MA
- 39 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 40 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 41 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 42 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 43 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 44 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 45 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 46 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 47 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 48 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 49 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 50 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 51 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 52 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 53 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 54 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 55 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 56 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 57 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 58 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 59 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 60 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 61 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 62 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 63 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 64 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 65 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 66 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 67 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 68 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 69 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 70 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 71 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 72 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 73 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 74 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 75 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 76 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 77 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 78 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 79 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 80 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 81 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 82 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 83 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 84 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 85 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 86 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 87 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 88 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 89 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA
- 90 262K00067 RECORDER, GAS FLOW, 1-PEN, 4-20 MA

FIG. 30

STATION RUN-UP (3 UNIT)

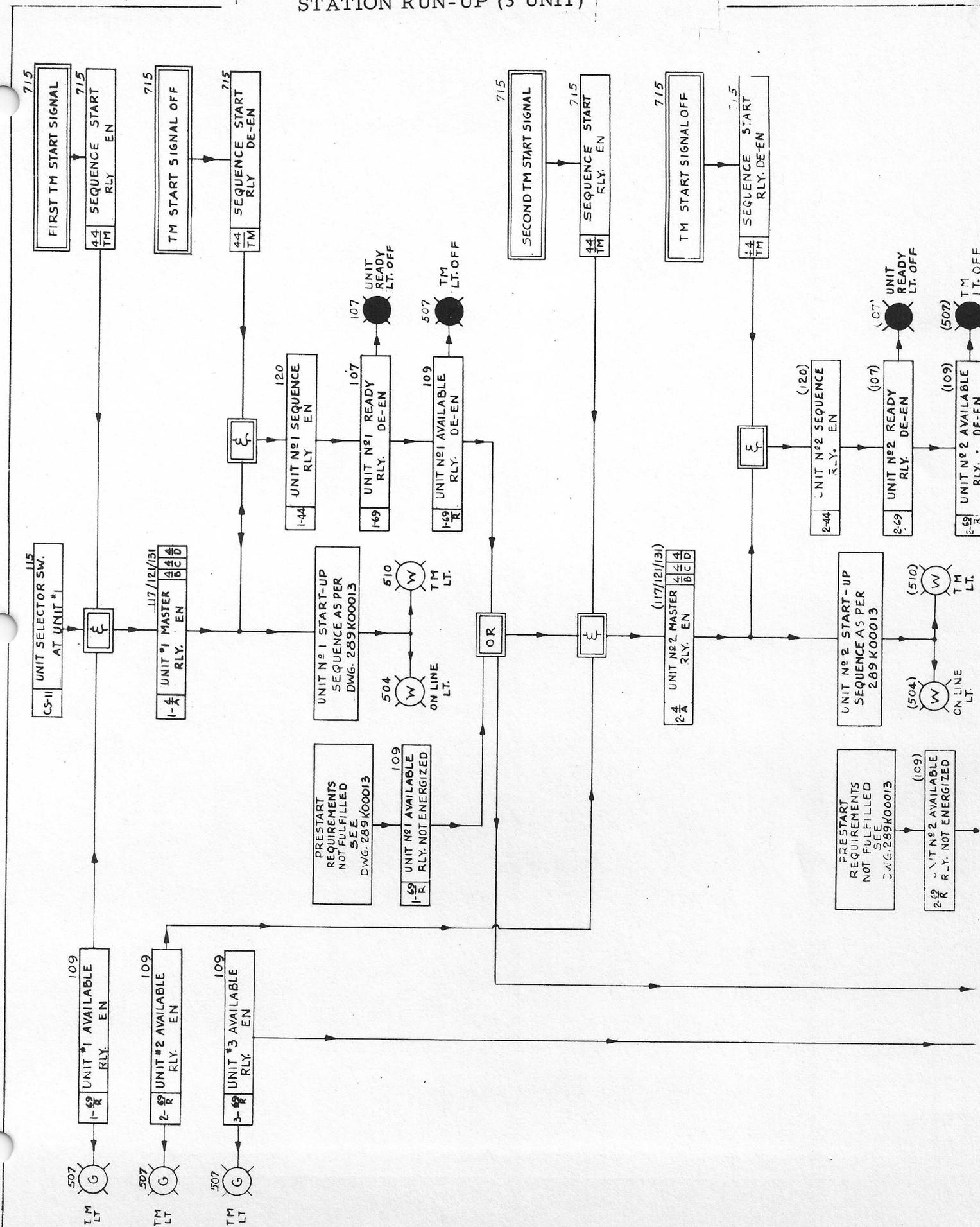
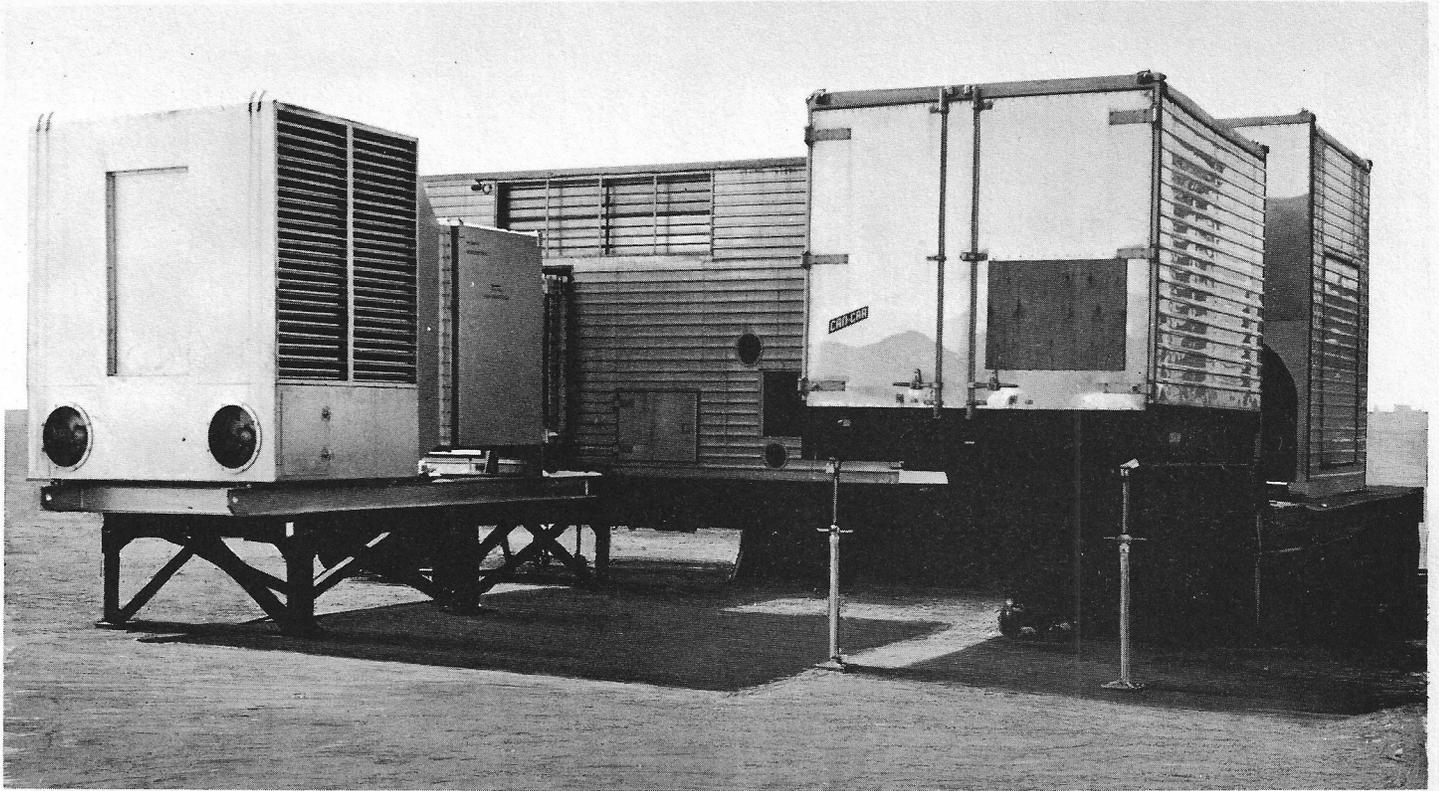
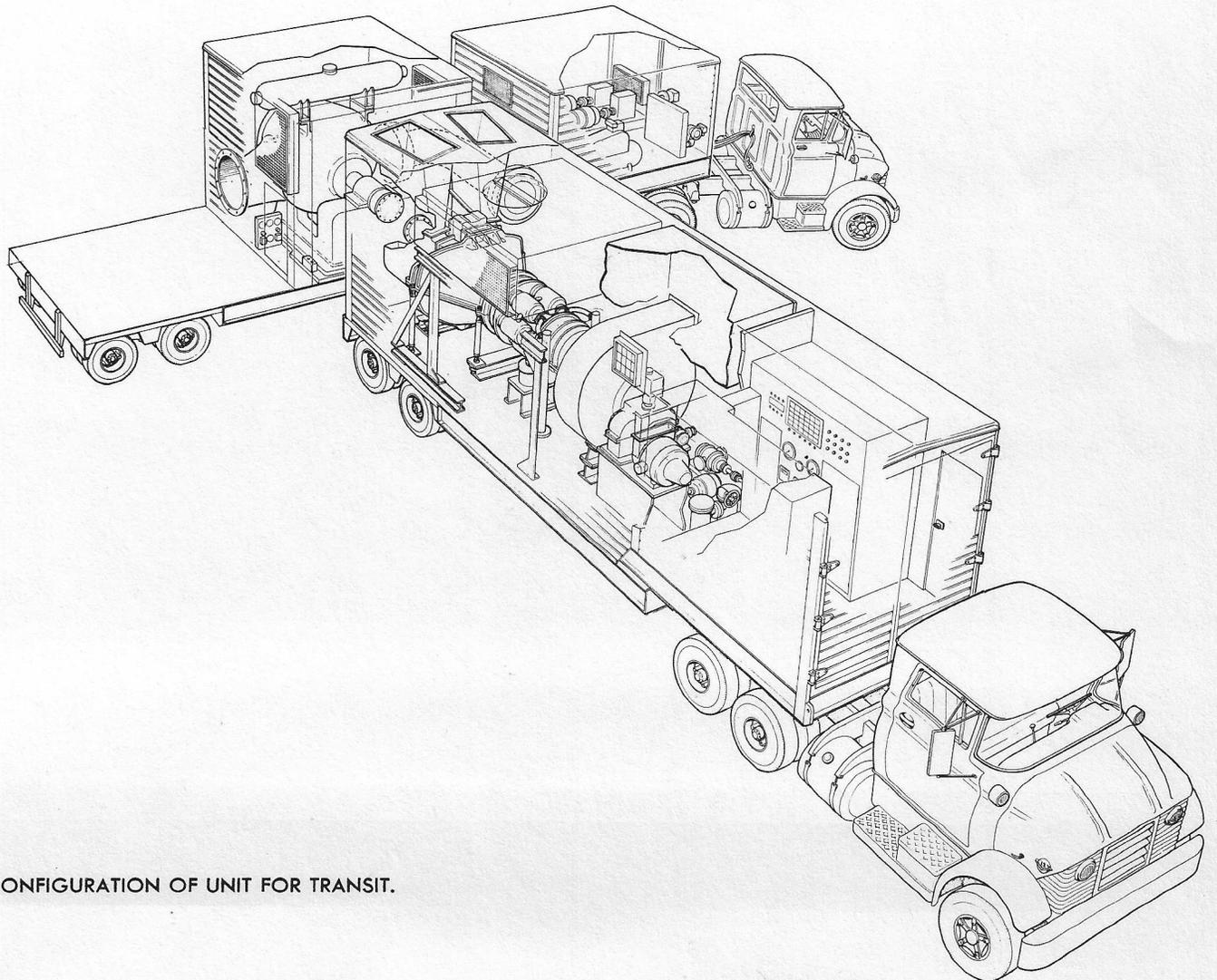


FIG. 31



INSTALLATION ON SITE.



CONFIGURATION OF UNIT FOR TRANSIT.

SECTION 8B

MOBILE OT-F-3 GAS TURBINE
POWERED COMPRESSOR SET

SECTION 8B

MOBILE OT-F-3 GAS TURBINE POWERED COMPRESSOR SET

8B.1 GENERAL

The mobile OT-F-3 gas turbine-powered gas compressor set is of similar design to static base-mounted OT-F-3 sets, and includes the same type driving and driven equipment. The equipment is arranged for packaging into two separate highway trailer units each forming a tractor-trailer combination in transit.

In order to make the mobile units as self-contained as possible, a 75KW generator provides an emergency source of 460VAC, 3 phase 60 Hz power and the two containers are protected by a common fire detection and fire extinguishing system.

8B.2 POWER PACKAGE TRAILER

This package is divided into two sections, one section at the front of the container houses the unit control panel, the DC power supply and a 75KW generator and motor control centre.

The second section at the rear of the container houses all components and equipment forward of and including the main drive shaft and the 75KW Aux generator. This section also contains fire detection, discharge nozzles and piping runs.

8B.3 BOOSTER PACKAGE - TRAILER

The second trailer-mounted package contains the DeLaval booster, the booster seal oil reservoir and booster monitoring equipment, under one cover; and the fire extinguishing system CO₂ bottles, an air compressor and drying system installation and seal oil system pumps and other components under a second cover.

8B.4 INSTALLATION

At installation on site, the two trailers are joined in a T formation, and the booster oil system piping; main drive shaft; pneumatic system, electrical system and fire extinguishing system and the gas fuel system are joined.

8B.5 GENERATOR AND MOTOR CONTROL CENTRE

The 75KW generator and motor control centre is connected to the 460 VAC 60 Hz purchased power and to the output of the 75 KW generator. The incoming power supplies are monitored for frequency and voltage by two identical transfer control circuits.

The mechanically interlocked transfer control circuits are biased so that the purchased power is the preferred source. The mechanical interlock prevents parallel operation of the two power sources.

8B.6 75KW GENERATOR

The generator is driven by the auxiliaries gearbox and while purchased power is available, runs off-load. The generator is ventilated and cooled by a ducted electrically powered ventilating fan which runs throughout unit operation from start relay energized. A pressure switch in the ducting is set to operate at a pre-determined pressure. If the pressure in the ducting does not meet requirements during starting the unit is shut down and locked out. If the pressure fails during operation a warning is provided.

8B.7 POWER TRANSFER

When purchase voltage or frequency do not meet requirements the transfer control circuits operate to cut-off the purchased power supply and, providing the output of the 75KW generator is satisfactory, automatically switch over after a timed period (2 seconds) to load the generator.

When the purchased power supply is restored, the transfer circuits again operate to unload the generator and bring in the purchased power after a timed period (2 seconds).

8B.8 PACKAGE VENTILATION AND LUBE OIL TEMPERATURE CONTROL

Package ventilation and temperature control of lube oil is achieved by the use of two electrically-driven cooling fans, pneumatically operated cooling louvers and a glycol/oil cooler.

During normal operation, with sensed PT lube oil temperature above 110°F at the cooler outlet, number 1 cooling fan runs, drawing cooling air in through the cooling louvers in the power package across the oil cooler. The air is circulated to ventilate the power package and booster package. The louvers of the power package are positioned according to sensed lube oil temperature, while those of the booster package are opened by unit sequencing control.

If the sensed lube oil temperature exceeds 135°F, number 2 cooling fan starts to augment the action of number 1 cooling fan and runs until the oil temperature falls below 125°F. When the PT lube oil temperature is below 105°F, number 1 cooling fan runs in reverse to draw warm air from the power cubicle to warm the oil in the cooler.

Fan motor operation (from 'Heat' to 'Cool') is controlled by a timer which allows the fan motor to stop before reversing.

8B.9 FIRE DETECTION AND EXTINGUISHING SYSTEM

The CO₂ fire detection and extinguishing system normally operates automatically to protect the power and booster trailer packages. Provision is made for manual operation of the extinguishing system, if required.

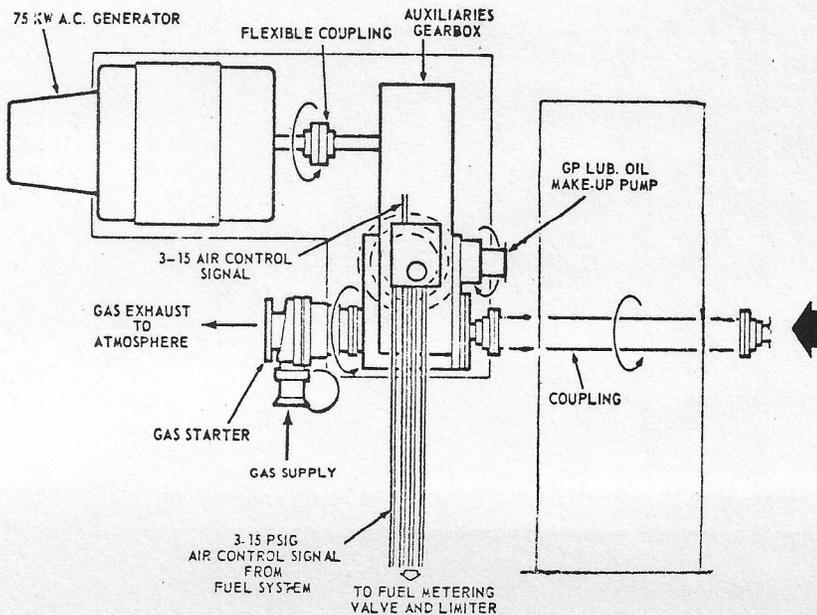
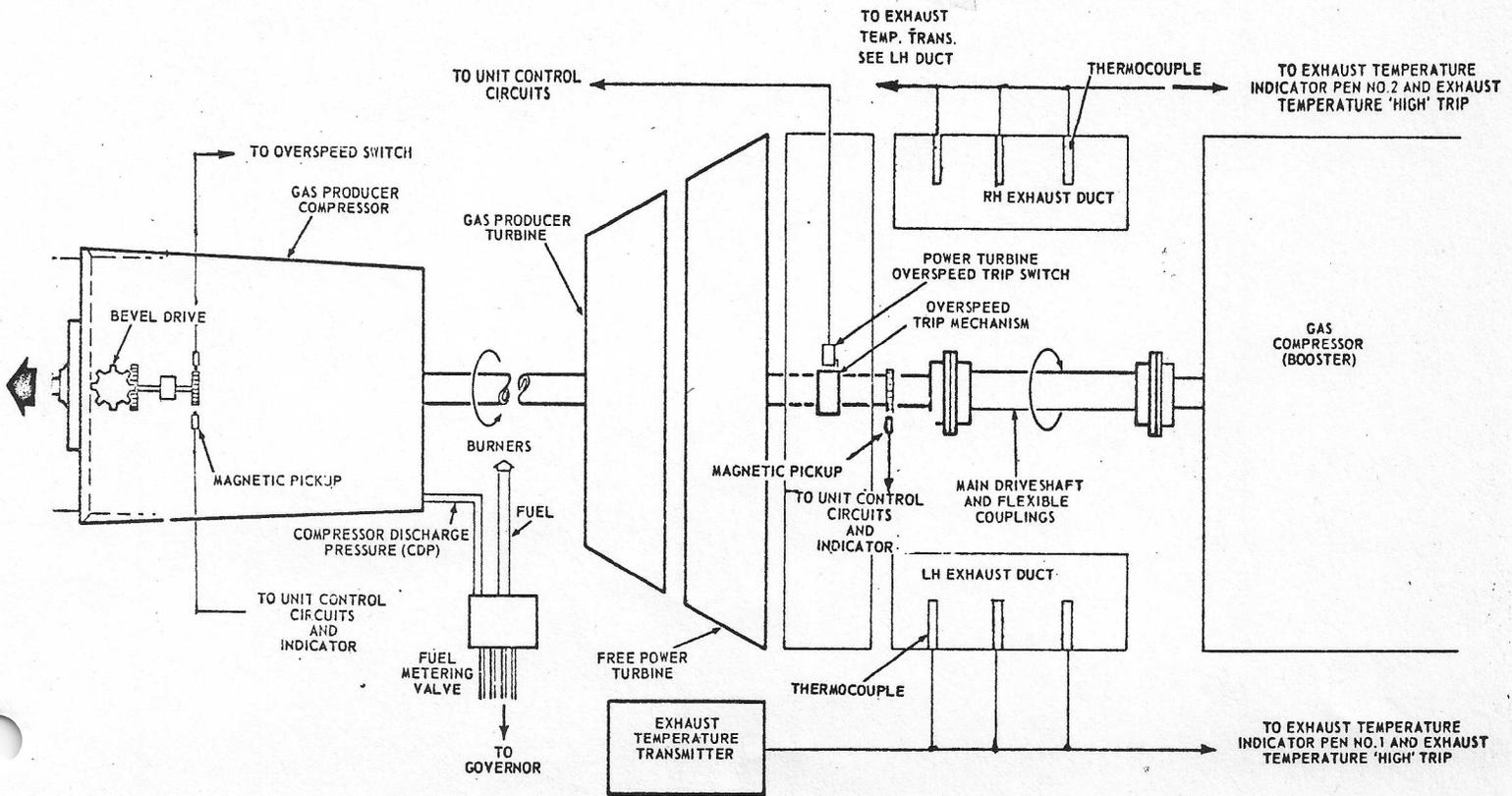
The complete system consists of four thermostats, two control heads and, fans discharge heads, one mounted on each CO₂ cylinder. Three discharge nozzles are located at strategic points in each trailer and one connected to the CO₂ discharge manifold by steel piping with a flexible hose connection at the junction of the two trailers when these are erected.

During normal operation, the system is controlled by thermostats with normally open contacts calibrated to close at 225°F. The CO₂ bottles are fired by 20 psig instrument air when the contacts close and unit trip, station lockout, fire alarm and alarm event recording are also initiated.

Emergency firing of the CO₂ cylinder can be accomplished by manually pulling the handle on the manual pull box, located on the R. H. side of the booster trailer, or by removing the control head release pins.

The system can be tested by placing the test switch (UCP) to Test, which indicates satisfactory operation of the system, while preventing the discharge of the CO₂ cylinders.

POWER TRAIN



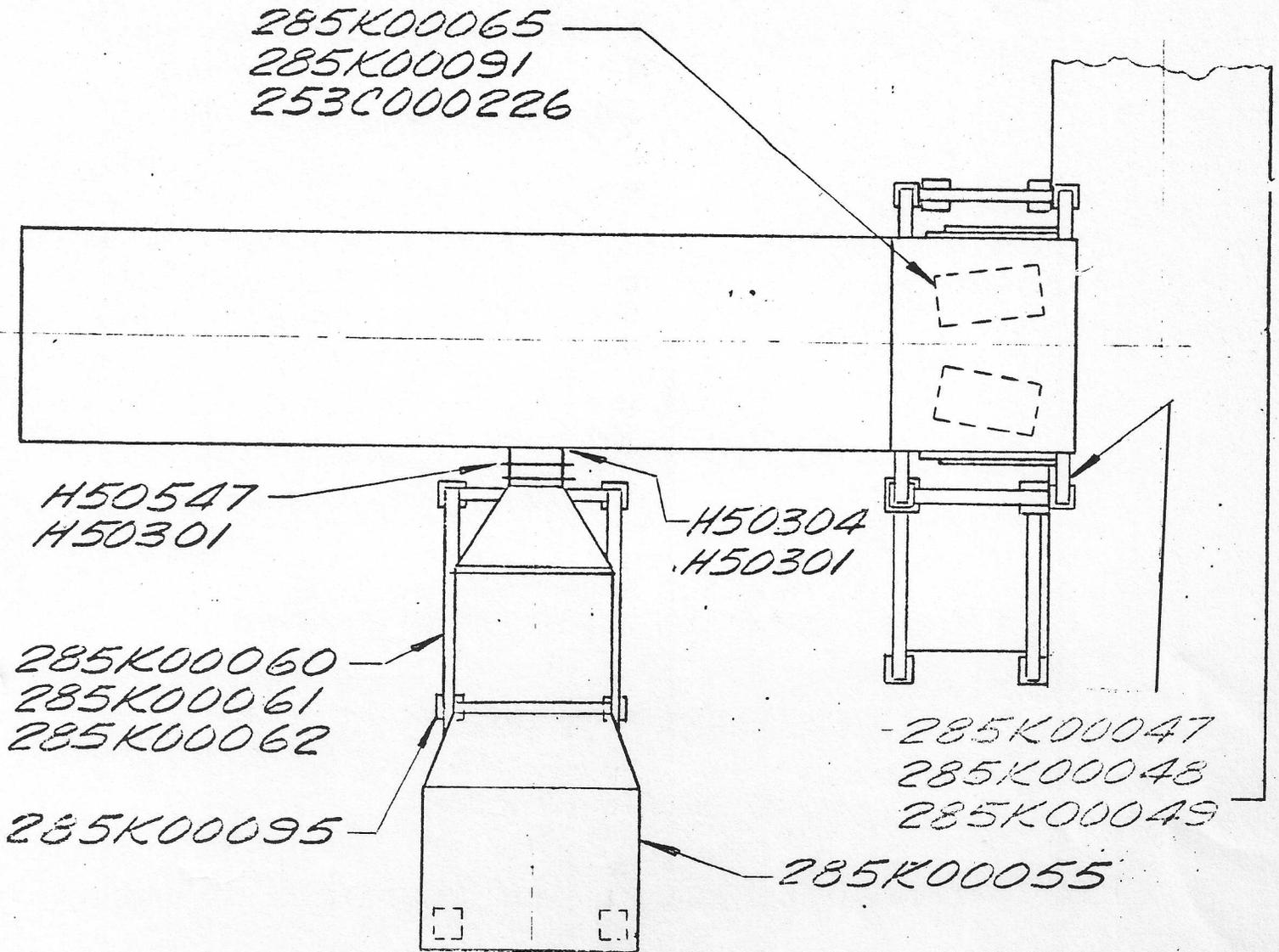
GEARBOX COUPLING
CONNECTED TO GAS
PRODUCER COMPRESSOR
ROTOR SHAFT (See above)

FIG. 35

INSTALLATION DETAILS (MOBILE)

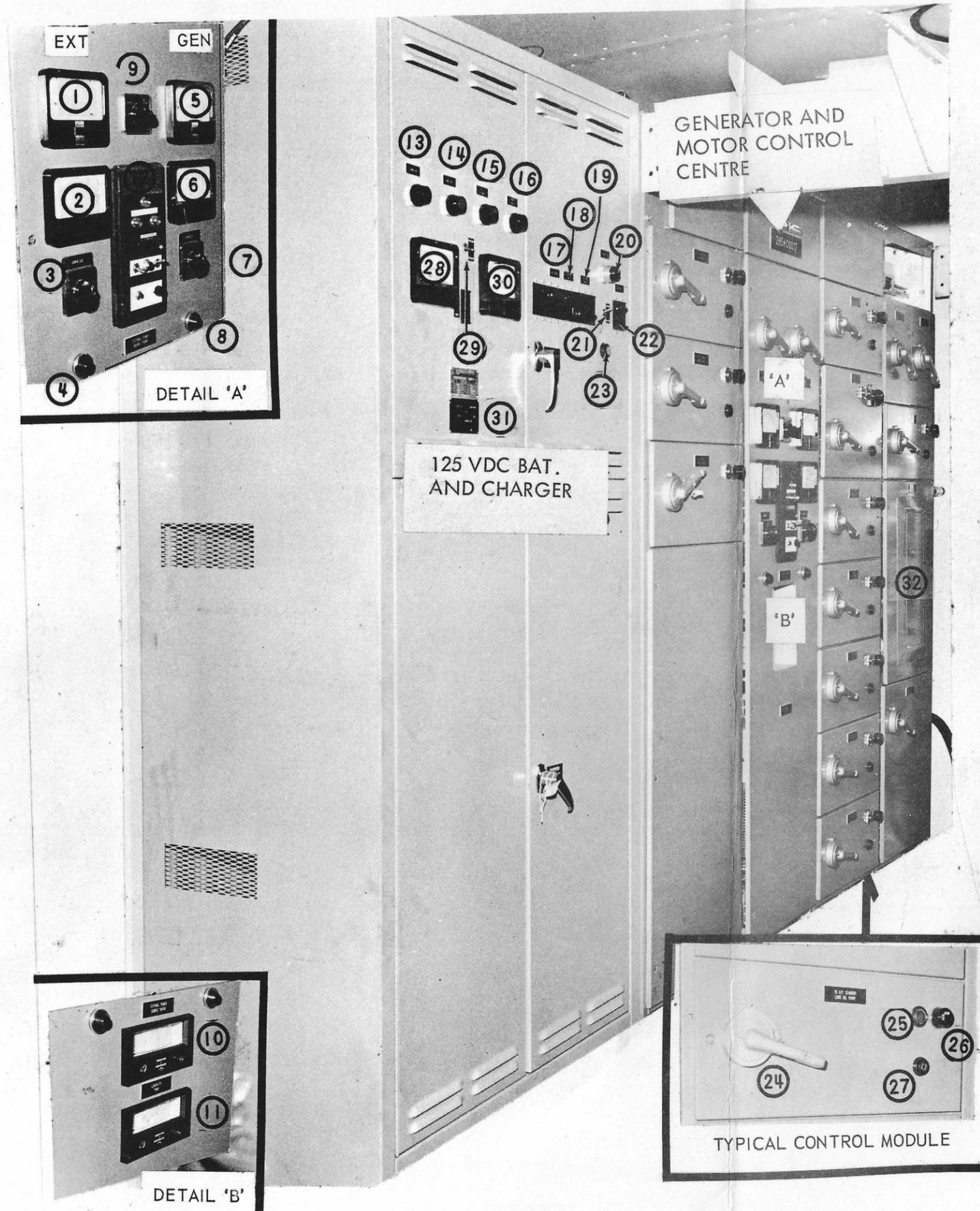
1. REMOVE AND STORE PROTECTION COVERS 253C00236 FROM SOLE PLATES OPPOSITE AIR INLET CASING ON DRIVE UNIT.
 2. ASSEMBLE AIR INTAKE SUPPORT FRAME 285K00060-62 IN POSITION FOR AIR INLET CASING. MOUNT AIR INTAKE ASSY. 285K00055 ON FRAME AND BOLT TOGETHER. CHECK DUCT FOR DEBRIS.
 3. DETERMINE THE DIFFERENCE IN HEIGHT OF BOLT HOLES IN AIR INLET CASING FLANGE & MATING FLANGE IN AIR INTAKE ASSY. GRIND SHIM 285K00095 TO SUIT.
 4. JACK UP AIR INTAKE SUPPORT FRAME OFF ANCHOR BOLTS AND PLACE SHIMS 285K00095 ON SOLE PLATE. LOWER FRAME DOWN ON SHIMS.
 5. BOLT AIR INTAKE ASSEMBLY TO AIR INLET CASING. REMOVE BOLTS H50547 & WASHERS H50301 FROM FLEXIBLE JOINT ON AIR INTAKE ASSEMBLY. BOLT AIR INTAKE SUPPORT FRAME TO SOLE PLATES USING EXISTING NUTS & WASHERS.
 6. REMOVE AND STORE PROTECTION COVERS 253C00236 FROM SOLE PLATES FOR EXHAUST STACK AND SILENCER.
 7. ASSEMBLE EXHAUST SILENCER SUPPORT FRAME 285K00047-49 IN POSITION FOR EXHAUST STACK AND SILENCER.
 8. MOUNT EXHAUST DUCTS 285K00065 AND SEALING PLATES 285K00091 ON DRIVE UNIT EXHAUST DUCT AND CLAMP WITH 253C00226.
 9. MOUNT EXHAUST STACK & SILENCER 285K00104 ON EXHAUST SILENCER SUPPORT FRAME, ENSURING THAT EXHAUST DUCT 285K00065 FITS AGAINST FORWARD SIDES OF SILENCER DUCTS°
- NOTE: ALL BOLTS TO BE LEFT LOOSE TO ALLOW FOR ADJUSTMENT OF COMPONENTS.
10. TIGHTEN ALL BOLTS & NUTS AFTER ADJUSTMENTS.

INSTALLATION DETAILS (MOBILE)



BOOSTER REAR SIDE DOOR
TO BE REMOVED TO
PERMIT INSTALLATION OF
SILENCER STAND

Generator and Motor Control Centre



EXTERNAL POWER SOURCE 150 KW (CB AND INDICATIONS)

1. VOLTMETER (AC)
2. AMMETER (AC)
3. LINE SELECTOR SWITCH (AMPS)
OFF L1, L2, L3
4. ON LIGHT

GENERATOR 75 KW (CB AND INDICATIONS)

5. VOLTMETER (AC)
6. AMMETER (AC)
OFF L1, L2, L3
7. LINE SELECTOR SWITCH (AMPS)
8. ON LIGHT
9. AUTO-TEST TRANSFER SWITCH
10. INDICATING CONTROLLER (FREQ. Hz) EXTERNAL POWER, 150 KW
11. INDICATING CONTROLLER (FREQ. Hz) GENERATOR 75 KW
12. PROTECTIVE GROUND RELAY - 3-PHASE
SELF-RESET - MAN. RESET-SILENCE
13. POWER ON)
14. EQUALIZE ON)
15. HI, LOW VOLTS ALARM) Indicator Lights
16. GROUND FAULT)
17. UNIT CONTROL CIRCUIT BREAKER (125 VDC SUPPLY)
18. DC EMERGENCY LIGHTS CIRCUIT BREAKER
19. DC EMERGENCY LUBE PUMP CIRCUIT BREAKER
20. STARTER MOTOR ON LIGHT
21. SELECTOR SWITCH (AUTO-HAND) (DC EMER. LUBE PUMP CONTROL)
22. BATTERY CIRCUIT BREAKER
23. RESET (DC LUBE PUMP CIRCUIT BREAKER)
24. COMBINATION STARTER (ON/OFF)
25. 'RUNNING' OR 'ON' LIGHT
26. AUTO-HAND SELECTOR
27. RESET (CIRCUIT BREAKER)
28. DC VOLTS
29. FLOAT/EQUALIZE SELECTOR
30. DC AMPS
31. AC CIRCUIT BREAKER
32. AC DISTRIBUTION PANEL

Fig. 38

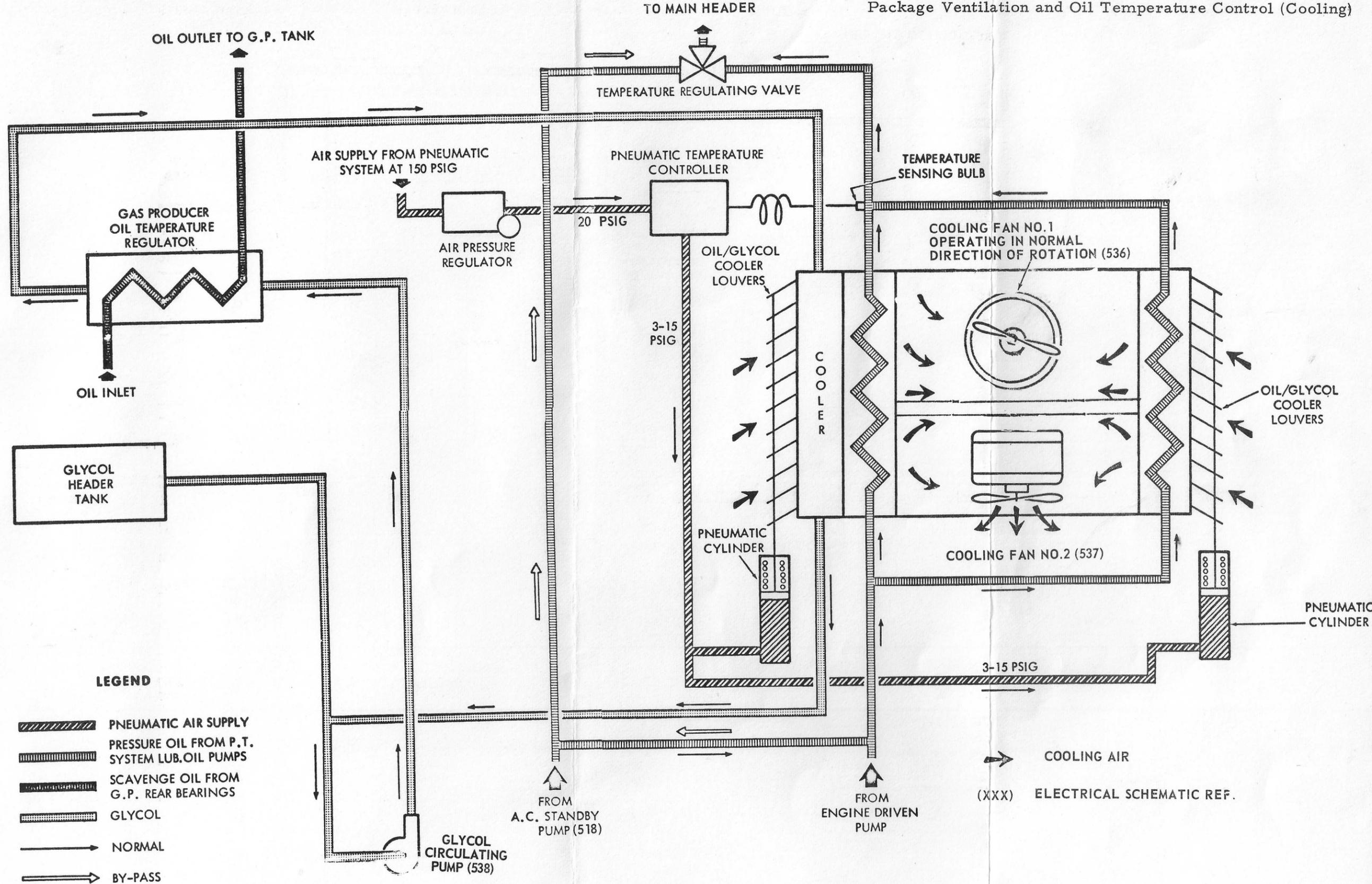
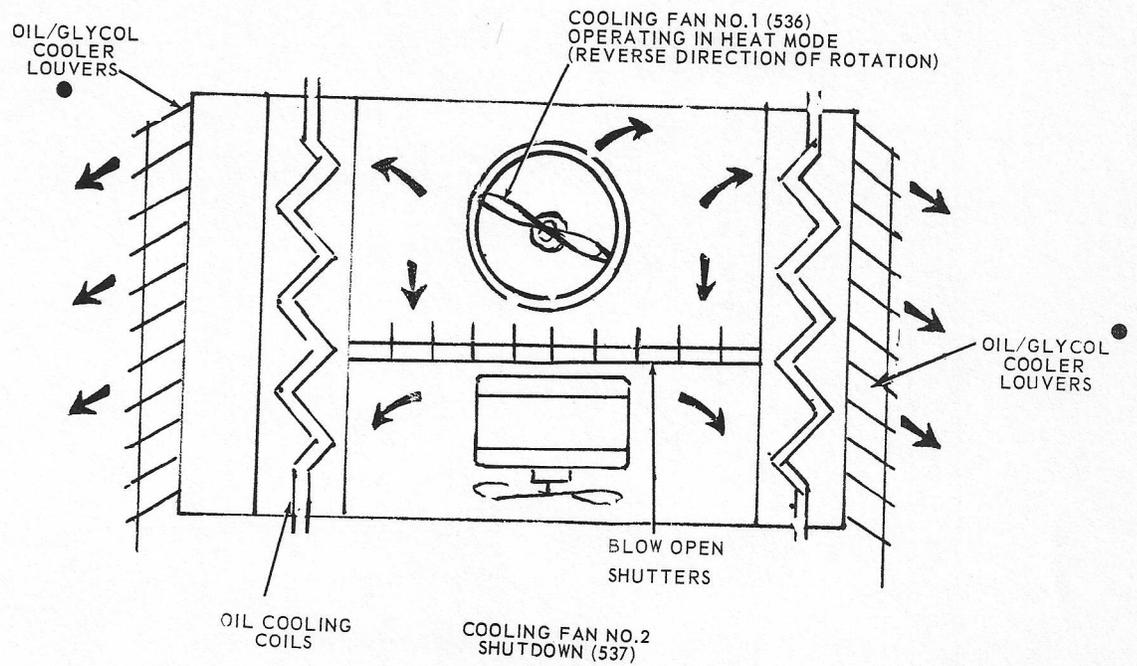


Fig. 39

Cooling Fan Reverse Operation (Heating)



➔ WARM AIR FROM PACKAGES

(XXX) ELECTRICAL SCHEMATIC REF.

LEGEND

● POSITIONED BETWEEN OPEN AND CLOSED TO SUIT SENSED PT LUBE OIL TEMPERATURE

Fig. 40

FIRE DETECTION AND EXTINGUISHING SYSTEM

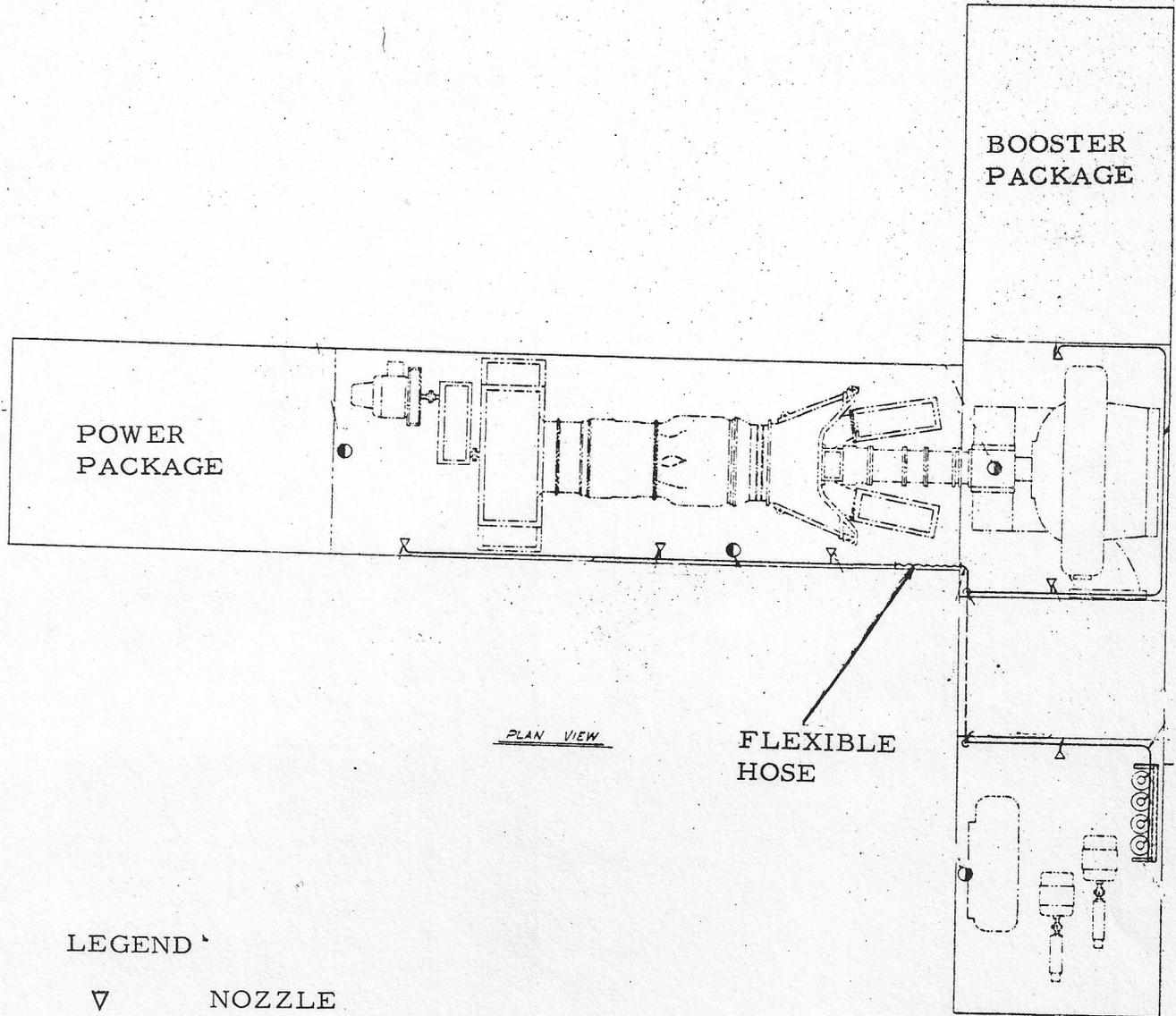
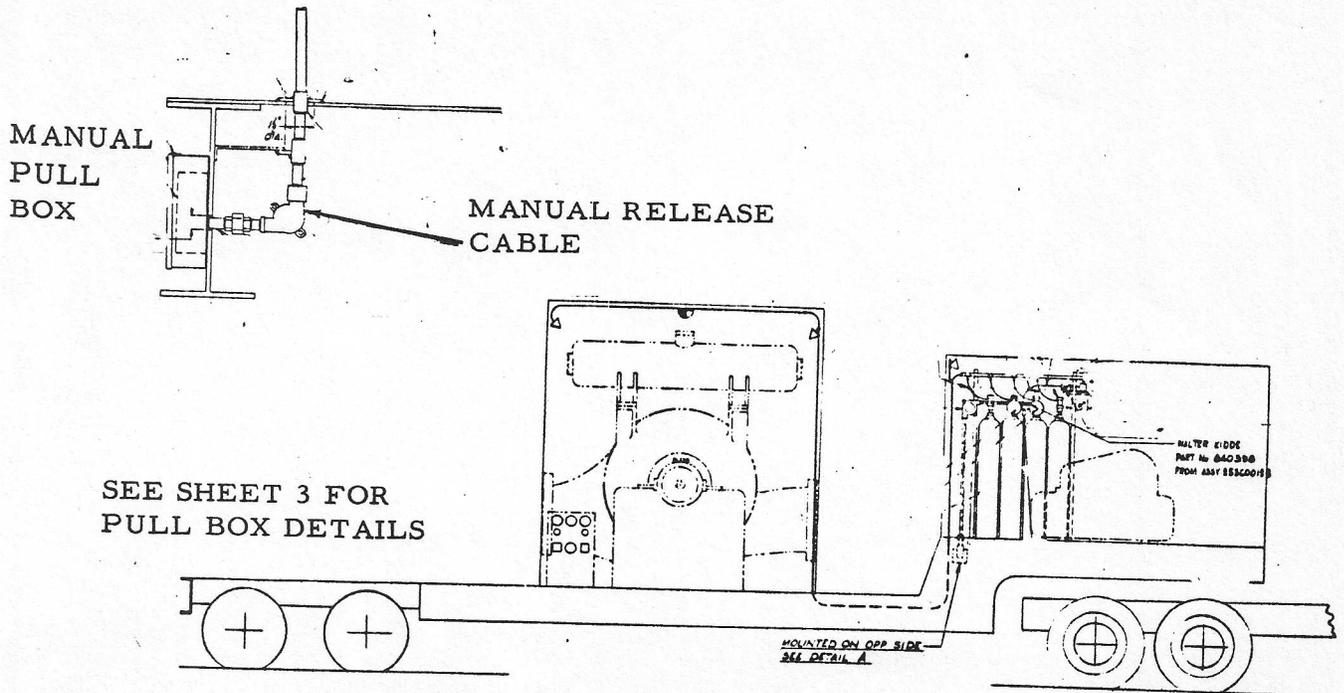


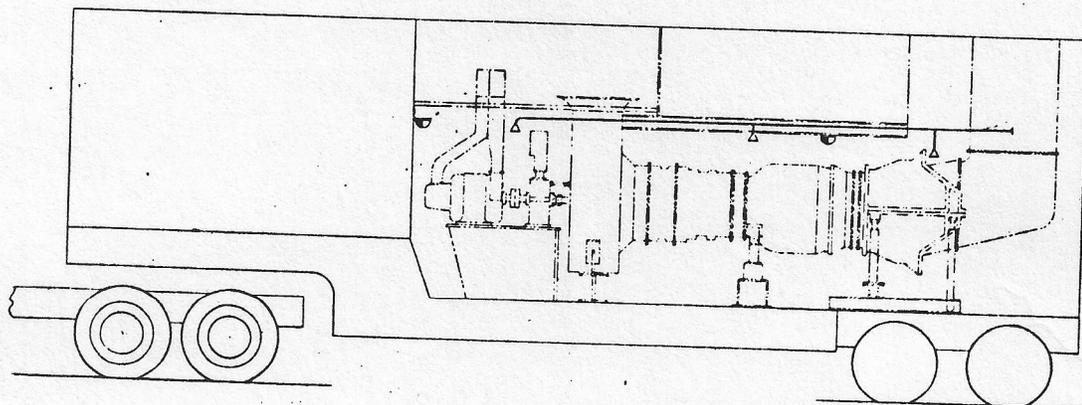
FIG. 41 (SHEET 1)

FIRE DETECTION AND EXTINGUISHING SYSTEM



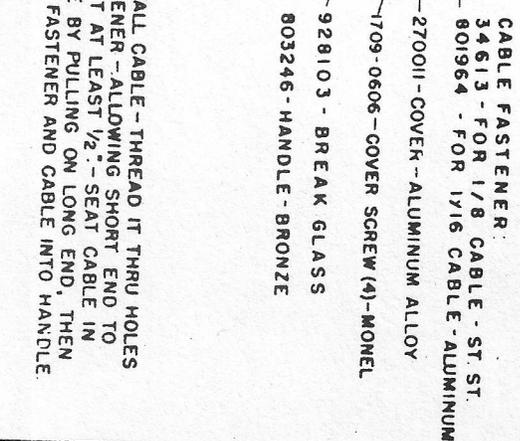
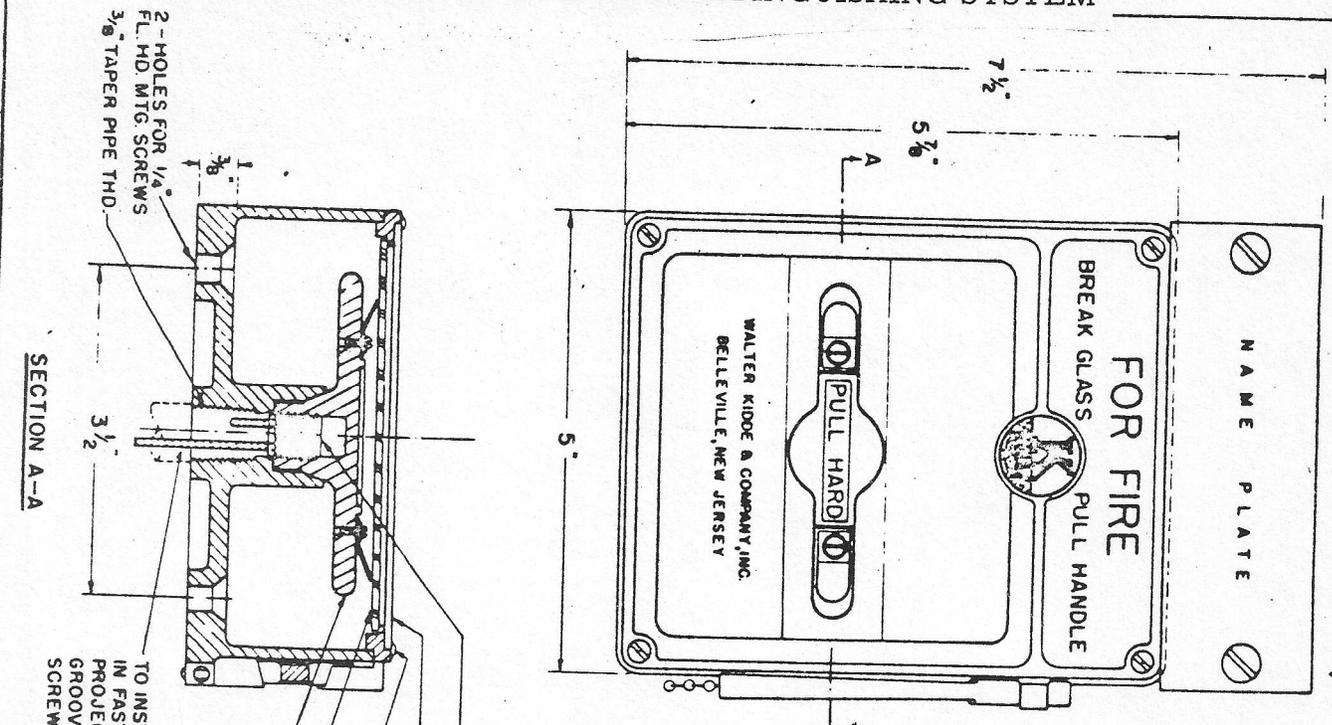
SIDE ELEVATION OF BOOSTER PACKAGE

- ▽ NOZZLE
- THERMOSTAT 225°F



SIDE ELEVATION OF POWER PACKAGE

FIRE DETECTION AND EXTINGUISHING SYSTEM



CABLE FASTENER:
 34613 - FOR 1/8 CABLE - ST. ST.
 801964 - FOR 1/16 CABLE - ALUMINUM

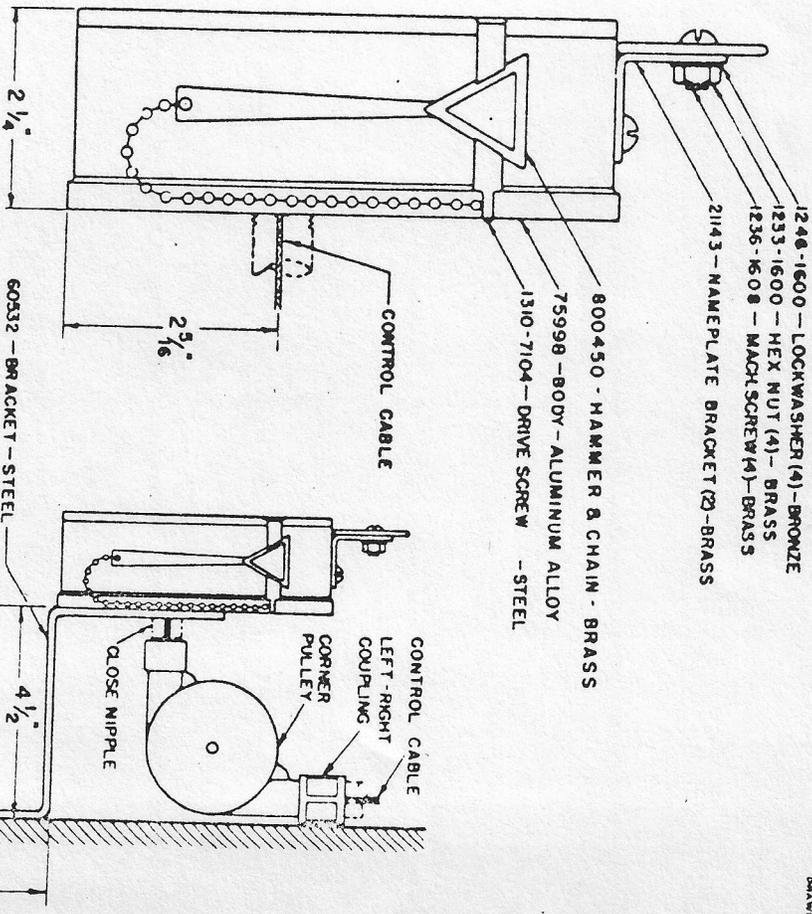
270011 - COVER - ALUMINUM ALLOY

1709-0606 - COVER SCREW (4) - MONEL

928103 - BREAK GLASS

803246 - HANDLE - BRONZE

TO INSTALL CABLE - THREAD IT THRU HOLES IN FASTENER - ALLOWING SHORT END TO PROJECT AT LEAST 1/2" - SEAT CABLE IN GROOVE BY PULLING ON LONG END, THEN SCREW FASTENER AND CABLE INTO HANDLE



1248-1600 - LOCKWASHER (4) - BRONZE

1233-1600 - HEX NUT (4) - BRASS

1236-1608 - MACH. SCREW (4) - BRASS

21143 - NAMEPLATE BRACKET (2) - BRASS

800450 - HAMMER & CHAIN - BRASS

75998 - BODY - ALUMINUM ALLOY

1310-7104 - DRIVE SCREW - STEEL

CONTROL CABLE

CONTROL CABLE LEFT-RIGHT COUPLING

CORNER PULLEY

GLOBE NIPPLE

60332 - BRACKET - STEEL (OPTIONAL AS REQUIRED)

PULL-BOX MOUNTED ON 2" BRACKET 1/2 SCALE

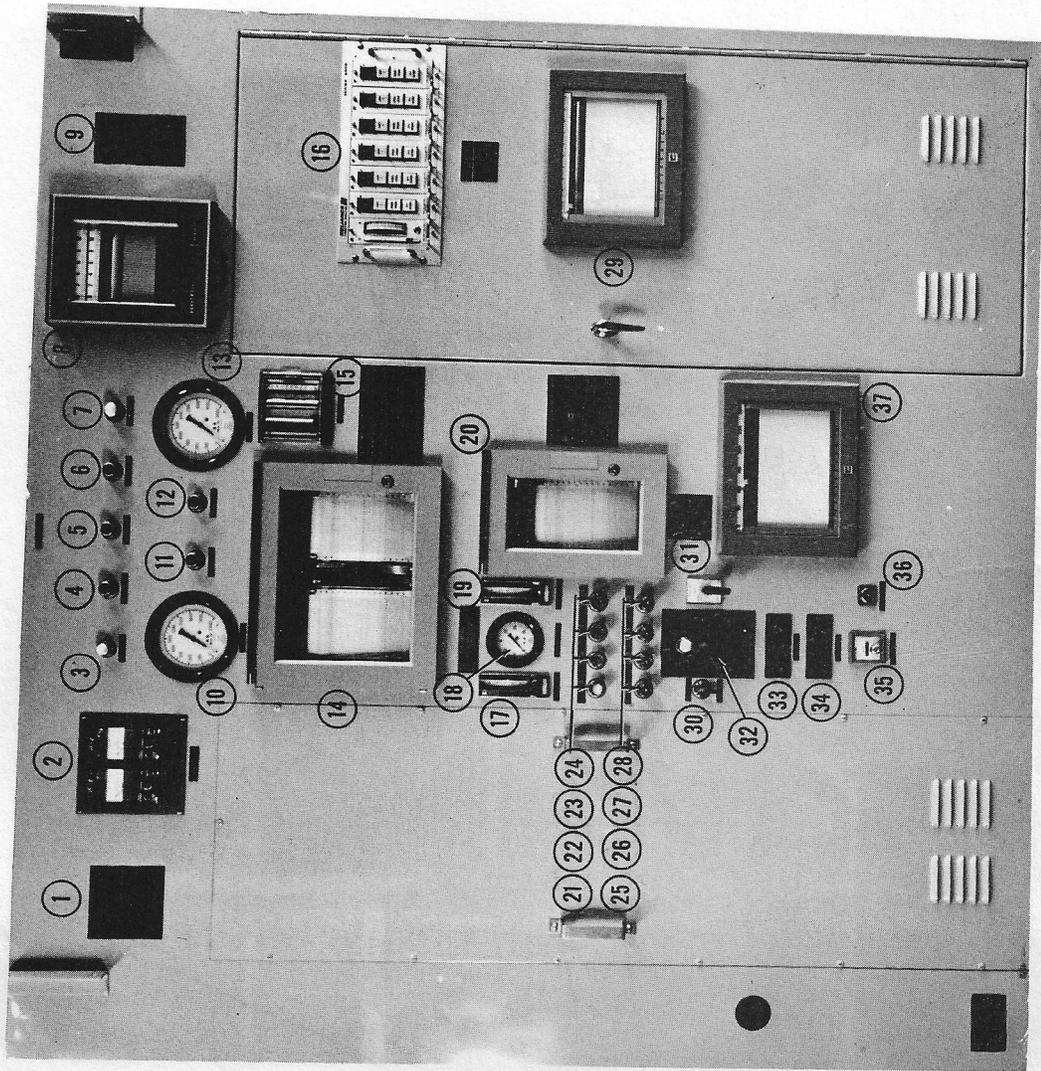
3-HOLES FOR 1/4" MOUNTING BOLTS

NOTE
 MOUNT PULL BOX IN ACCESSIBLE LOCATION AND APPROXIMATELY 4' TO 5' FROM FLOOR

REVISION	DATE	BY	CHKD.	APP'D.
0		J.C.M.		

KIDDE CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM Walter Kidde & Company, Inc. 200 West 21st Street, New York, N.Y.	INSTALLATION OF BREAK GLASS PULL-BOX SURFACE TYPE
---	---

FIG. 41 (SHEET 3)



Unit Control Panel

**ELECTRICAL
SCHEMATIC
LINE NO.**

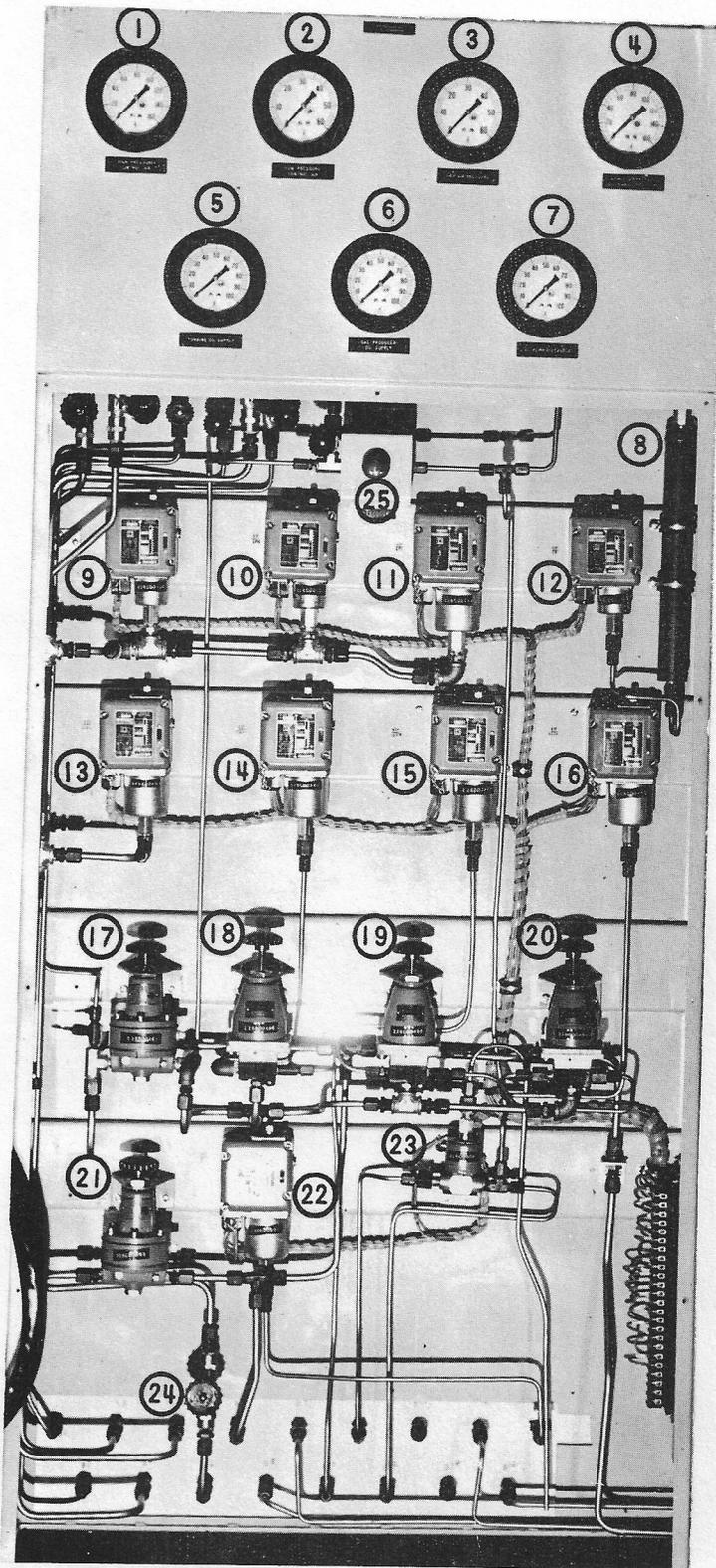
DESCRIPTION

ITEM NO.

1	GAS FLOW COMPUTER	(490)
2	GAS DETECTOR	(436)
3	RECYCLE VALVE OPEN (LIGHT)	(267)
4	RECYCLE VALVE CLOSED (LIGHT)	(268)
5	DC 'ON' LIGHT	(146)
6	UNIT READY (LIGHT)	(107)
7	UNIT ON LINE (LIGHT)	(904)
8	EXHAUST TEMP. RECORDER	(431)
9	GAS FLOW RECORDER	(491)
10	GAS PRODUCER SPEED	(406)
11	TROUBLE (LIGHT)	(610)
12	LOCKOUT (LIGHT)	(145)
13	POWER TURBINE SPEED INDICATOR	(407)
14	ALARM EVENT RECORDER INDICATOR	(460)
15	POWER TURBINE SPEED RECORDER	(482)
16	VIBRATION MONITOR	(484)
17	RECYCLE VALVE CONTROL	(417)
18	GOVERNOR LOAD INDICATOR	(419)
19	LOAD CONTROL	(457)
20	EVENT RECORDER	(457-456)
21	LOCKOUT RESET (PUSHBUTTON)	(313)
22	START (PUSHBUTTON)	(118)
23	STOP (PUSHBUTTON)	(118)
24	EMERGENCY STOP (PUSHBUTTON)	(118)
25	LOCAL/REMOTE MODE SELECTOR	(118)
26	UNCOUPLED/RUN MODE SELECTOR	(109)
27	TEST/RUN GAS DETECTOR	(132)
28	TEST/RUN FIRE DETECTOR	(132)
29	VIBRATION RECORDER	(481)
30	POST LUBE (RESTART/AUTO-OFF) SWITCH	(372)
31	CONTROL MODE (AUTO/OFF/PURGE/MANUAL) SELECTOR	(117)
32	PRE-START CHECK SWITCH	(138)
33	TOTAL START COUNTER	(139)
34	SUCCESSFUL STARTS COUNTER	(429)
35	ELAPSED TIME METER	(528)
36	TELEPHONE JACK	(426)
37	LUBE TEMP. RECORDER	(426)

Fig. 42

Pressure Switch and Gauge Panel



LEGEND

1. HIGH PRESSURE CONTROL AIR
2. LOW PRESSURE CONTROL AIR
3. TRIP AIR PRESSURE
4. AXIAL COMPRESSOR DISCHARGE PRESSURE (CDP)
5. POWER TURBINE OIL SUPPLY
6. GAS PRODUCER OIL SUPPLY
7. POWER TURBINE SYSTEM OIL PUMP DISCHARGE PRESSURE
8. ACCUMULATOR (PNEUMATIC CONTROL SYSTEM SUPPLY)
9. PT LUBE OIL PRESSURE SWITCH (63P/LPH)
10. PT LUBE OIL PRESSURE SWITCH (63P/LPM)
11. PT LUBE OIL PRESSURE SWITCH (63P/LPL)
12. CONTROL AIR PRESSURE SWITCH (63P/CA)
13. GAS PRODUCER LUBE OIL PRESSURE SWITCH (63P/GPL)
14. SEAL OIL/GAS DIFF. (LOW) PRESSURE SWITCH (63P/SO Δ L)
15. SEAL OIL/GAS DIFF. (MEDIUM) PRESSURE SWITCH (63P/SO Δ M)
16. SEAL OIL/GAS DIFF. (HIGH) PRESSURE SWITCH (63P/SO Δ H)
17. AIR PRESSURE REGULATOR (226C00461)
18. AIR PRESSURE REGULATOR (226C00466)
19. AIR PRESSURE REGULATOR (226C00465)
20. AIR PRESSURE REGULATOR (226C00464)
21. AIR PRESSURE REGULATOR (226C00462)
22. GAS PRODUCER TO AUXILIARIES GEARBOX COUPLING LUBE OIL PRESSURE SWITCH (63P/GPC)
23. STARTING TURBINE SOLENOID VALVE (20/S)
24. NEEDLE VALVE (226C00472)
25. MANUAL STOP VALVE

Fig. 43

SECTION 9

CONTROL SETTINGS

SECTION 9.

Six sub-headings describe the device with the ASA number code, defines the operation and range, gives the set and location and classifies when the set-point may be changed.

There are approximately 95 devices that require setting. The drawing is part of the "Service Manual", but because the devices and their set-point form such a critical part of the operation and are necessary for a better understanding of the units, typical copy of a "Control and Setting" drawing for a single unit OT-F-3 installation is included in this text under Figures 30 to 38 inclusive.

The "Control Settings" for each unit are on a single drawing under the following main heading:

1. Timers.
2. Pressure sensing devices.
3. Differential pressure switches.
4. Temperature sensing devices.
5. Governor, fuel, float and flow switches.
6. Gas and vibration detectors, battery charger.
7. Speed sensitive devices, magnetic pick-ups.
8. Miscellaneous devices.

TIMERS		DELAY PERIOD		DEVICE NO.	DESCRIPTION	RANGE	SETTING	CLASS	LOCATION
289K0006	5	PICK-UP	DROP-OUT						
		COOL DOWN	P.U.	1 to 30 MIN.	10 MIN.	2T/CD			
PURGE	P.U.	20 SEC. to 10 MIN.	1 MIN.	2T/P				2	UCP
RUN DOWN	P.U.	1 to 30 MIN.	8 MIN.	2T/R				2	UCP
SUSTAINED AC. FAILURE	P.U.	20 MIN. to 10 HRS.	4 HRS.	27T/AG				2	SCF
STANDBY LUBE PUMP CONTROL	P.U.	4 1/2 TO 150 SEC.	30 SEC.	27T/LO				3 (+60)	UCF
VOLTAGE RESTART	P.U.	9 SEC. TO 5 MIN.	2 MIN.	27T/VR				3 (+10)	SCF
BOOSTER PURGE SEQ.	P.U.	20 SEC. to 10 MIN.	3 MIN.	48T/BP				2	UCP
FAIL TO LIGHT	P.U.	2 to 60 SEC.	30 SEC.	48T/FL				2	UCP
OVERCRANK	P.U.	20 SEC. to 10 MIN.	2 MIN.	48T/OC				2	UCP
VALVE SEQUENCE, SHUT DOWN	P.U.	20 SEC. to 10 MIN.	2 MIN.	48T/VSD				2	UCF
VALVE SEQUENCE, START UP	P.U.	20 SEC. to 10 MIN.	6 MIN.	48T/VSU				2	UCF
POST LUBE	P.U.	20 MIN. to 10 HR.	2 HR.	62T/PL				2	UCP
HIGH DISCHARGE PR.	D.O.	1 to 30 SEC.	10 SEC.	63T/HD				4	SCP
LOW SUCTION PR.	D.O.	1 to 30 SEC.	10 SEC.	63T/LS				4	SCP
AUX. MOTOR STARTER	D.O.	1 to 30 SEC.	5 SEC.	94T/AMS				3 (+±)	UCP

CLASS SET POINT ADJUSTMENT INSTRUCTIONS

- DO NOT CHANGE SET POINT.
- PRIOR WRITTEN CONSENT FROM ORENDA REQ'D. IF CHANGED
- NOMINAL SET POINT, MAY BE CHANGED WITHIN BRACKETED LIMITS IF ORENDA IS ADVISED.
- SET POINT MAY BE CHANGED TO SUIT CUSTOMER REQUIREMENTS.

NOTICE

THIS DRAWING IS THE PROPERTY OF ORENDA LIMITED AND IS ONLY CONDITIONALLY ISSUED AND DOES NOT CONFER OR TRANSFER ANY RIGHT IN OR LICENSE TO USE THE SUBJECT MATTER OF THE DRAWING OR ANY DESIGN OR TECHNICAL INFORMATION SHOWN THEREON. THIS DRAWING OR ANY PART THEREOF SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF AN AUTHORIZED REPRESENTATIVE OF ORENDA LIMITED.



ORENDA LIMITED

Canada

DRAWING REFERENCE DATA		SCALE	
FIRST RELEASE - ENGINE TYPE	LAYOUTS	DRAWING NO.	289K00006
REF PART NO.	PROTECTIVE TREATMENT	SHEET 1 OF 9	SIZE B
HEAT TREATMENT		TITLE: CONTROL SETTINGS	
APPROVALS		DATE	
DRAWN			
CHECKED	<i>AD</i>		
APPROVED	<i>John H. Drey</i>	30.10.69	
APPROVED	<i>Albanus J. J. Jellema</i>	23.6.69	
APPROVED	<i>J. J. Jellema</i>	25.10.69	

FIG. 44

DEVICE SETTINGS

PRESSURE SENSITIVE DEVICES.		DESCRIPTION		DEVICE OR PART NO.	RANGE	SETTING AND TOLERANCE (PSIG)	CLASS	LOCATION
BOOSTER CASE PR. HIGH		63P/BCH	50-100 PSIG	CLOSE 150 (+ 3) RISING	2	PS&G.		
BOOSTER CASE PR. LOW		63P/BCL	20-100 PSIG	OPEN 20 (+ 2) FALLING	2	PS&G.		
BOOSTER OIL PR.		63P/BOP	0-50 PSIG	OPEN 8 (+ 1/4) FALLING	2	PS&G.		
GAS PRODUCER LUBE OIL SUPPLY PRESSURE		63P/GPL-2	1-20 PSIG	OPENS 13 (+ 1/2) RISING	2	PS&G.		
CONTROL AIR PR. - PERMISSIVE START		63P/GA-1	0-75 PSIG	OPENS 27 (+ 2) RISING	2	PS&G.		
CONTROL AIR PR. - ALARM		63P/GA-2	0-75 PSIG	CLOSES 27 (+ 2) FALLING	2	PS&G.		
FUEL GAS PR. - TRIP		63P/F-1	20-130 PSIG	OPENS 110 (+ 5) FALLING	2	PS&G.		
FUEL GAS PR. - TRIP ANNUNCIATION		63P/F-2	20-130 PSIG	CLOSES 110 (+ 5) FALLING	2	PS&G.		
DISCHARGE PR. HIGH - TRIP		63P/HD	1-20 PSIG	OPENS ON HIGH PR. RISING. SETTING BY CUST.	4	CUST.		
GAS PRODUCER LUBE OIL SUPPLY PRESS.		63P/LPL-1	0-50 PSIG	CLOSES 13 (+ 1/2) RISING	2	PS&G.		
LUBE OIL PR. LOW		63P/LPM	0-50 PSIG	CLOSES 5 (+ 2) RISING	2	PS&G.		
LUBE OIL PR. MED.		63P/LPH	0-50 PSIG	CLOSES 20 (+ 2) RISING	2	PS&G.		
LUBE OIL PR. HIGH		63P/LPH	0-50 PSIG	CLOSES 30 (+ 2) RISING	2	PS&G.		
LOW SUCTION PR.		63P/LS	500-1000 PSIG	OPENS ON LOW PR.. FALLING SETTING BY CUSTOMER	4	SCP		
STARTING GAS PR. LOW - ALARM		63P/SG	0-200 PSIG	CLOSE 150 (+ 5) FALLING	2	CUST.		
SEAL OIL PR. SW.		63P/SPS	0-50 PSIG	CLOSE 8.5 PSIG RISING	2	PS&G.		
LUBE OIL SUPPLY PRESS. RELIEF VALVE		200C00881	0-100 PSIG	80 PSIG.	2	P.P.		
LUBE OIL SUPPLY PRESS. CONTROL VALVE		262K00192	0-125 PSIG	35 PSIG AT 40 USGPM.	2	P.P.		
LUBE OIL TO 6P COUPLING		63P/GPC-2	1-20 PSIG	OPENS 5 RISING	2	P.P.		
		63P/GPC-1	1-20 PSIG	CLOSES 5 RISING	2	P.P.		

NOTICE

THIS DRAWING IS THE PROPERTY OF ORENDA LIMITED AND IS ONLY CONDITIONALLY ISSUED AND DOES NOT CONFER OR TRANSFER ANY RIGHT IN OR LICENSE TO USE THE SUBJECT MATTER OF THE DRAWING OR ANY DESIGN OR TECHNICAL INFORMATION SHOWN THEREON. THIS DRAWING OR ANY PART THEREOF SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF AN AUTHORIZED REPRESENTATIVE OF ORENDA LIMITED.

 ORENDA LIMITED Canada		SCALE	DRAWING NO	SIZE
		289K00006	289K00006	B
TITLE: CONTROL SETTINGS		APPROVALS	DATE	
DRAWN				
CHECKED				
APPROVED	<i>[Signature]</i>		JUNE 23-68	
APPROVED	<i>[Signature]</i>		JUNE 25/68	
APPROVED	<i>[Signature]</i>		JULY 26/68	
FIRST RELEASE - ENGINE TYPE _____ LAYOUTS _____ REF PART NO. _____ HEAT TREATMENT _____		PROTECTIVE TREATMENT _____ MATERIAL _____		
SHEET 2 OF 9		SHEET 2 OF 9		

FIG. 45

DEVICE SETTINGS

PRESSURE SENSITIVE DEVICES		DESCRIPTION		DEVI	RANGE	SETTING & TOLERANCE (PSIG)	CLASS	LOCATION
DESCRIPTION	DEVICE OR PART NO.							
HYDRAULIC OIL RELIEF VALVE(FAN MOTORS)	282K00099	0-1000 PSIG	800 PSIG (± 25)	1	COMP. ROOM			
HYD.OIL RELIEF VALVE(GLYCOL PUMP MOTOR)	282K00099	0-1000 PSIG	525 PSIG APPROX., SET ON SITE TO GIVE MOTOR SPEED OF 1750 RPM.	1	COMP. ROOM			
HYD.OIL RELIEF VALVE(BY-PASS TO TANK)	282K00092	0-300 PSIG	140 PSIG ± 5	1	COMP. ROOM			
RELAY VALVE(STOP VALVE & ISOLATING VALVE CONT.)	200C00940	5-35 PSIG	RELAY CLOSES(VENTS) AT 30 PSIG FALLING	1	PS&G.			
HIGH LIMIT RELAY(LIMITER CONTROL)	265K00199	3-15 PSIG	SET TO PASS MAX. PRESS OF 15.0 PSIG.	1	UCP.			
PNEUMATIC RELAY VALVE(SURGE CONTROL)	200C02135	2-16 PSIG	SET AT 15.1 PSIG ON DECREASING PRESSURE	1	PS&G			
AIR SUPPLY PRESSURE REGULATING VALVE	VARIOUS		SET AS SHOWN ON PNEUMATIC SCHEMATIC	2				
BIAS RELAY (STATION SECTION Pr. - Mobile)	289K00079	± 18 PSIG	SET AT -2.4 Psi	1	S.C.P.			

289K00006
5
DESCRIPTION
SEE SHEET 1

CLASS SET POINT ADJUSTMENT INSTRUCTIONS

- DO NOT CHANGE SET POINT.
- PRIOR(WRITTEN)CONSENT FROM ORENDA REQ'D.BEFORE CHANGING.
- NOMINAL SET.POINT MAY BE CHANGED WITHIN BRACKETED LIMITS IF ORENDA IS ADVISED.
- SET POINT MAY BE CHANGED TO SUIT CUSTOMER REQUIREMENTS.

NOTICE

THIS DRAWING IS THE PROPERTY OF ORENDA LIMITED AND IS ONLY CONDITIONALLY ISSUED AND DOES NOT COVER OR TRANSFER ANY RIGHT IN OR LICENSE TO USE THE SUBJECT MATTER OF THE DRAWING OR ANY DESIGN OR TECHNICAL INFORMATION SHOWN THEREON. THIS DRAWING OR ANY PART THEREOF SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF AN AUTHORIZED REPRESENTATIVE OF ORENDA LIMITED.



ORENDA LIMITED

Canada

DRAWING REFERENCE DATA		APPROVALS		DATE	SCALE
FIRST RELEASE: ENGINE TYPE		CHECKED			
LAYOUTS		APPROVED			
REF PART NO.		APPROVED			
HEAT TREATMENT		APPROVED			
PROTECTIVE TREATMENT					
MATERIAL					
TITLE:		DRAWING NO.			
CONTROL SETTINGS		289K00006			
		3 of 9			

FIG. 46

DEVICE SETTINGS

DIFFERENTIAL PRESSURE SWITCHES		DESCRIPTION	DEVICE OR PART NO.	RANGE	SETTING & TOLERANCE (PSIG)	CLASS	LOCATION
1	BOOSTER CASE TO LINE Δ PR.	63P/CLΔP	0-900 psig	CLOSE (100 ± 0) FALLING	3 (+0)	PS&G	
2	INTAKE AIR FILTER Δ PR. HI - WARNING	63P/IFΔH	1.5" - 5.0" W.C.	TO OPEN AT A ΔP OF 1.0" W.C. ABOVE NORMAL ΔP	2 (-50)	PS&G	
3	LUBE OIL FILTER Δ PR. HI. - WARNING	63P/LFΔH	0-40 PSIG	CLOSE 15 ± .5 PSIG RISING AT MAX. GP. SPEED	2	PS&G	
4	SEAL OIL FILTER Δ PR. HI. - WARNING	63P/SFΔH	30" VAC-60psig	CLOSE 8 ± 1 -0 PSIG RISING	2	PS&G	
	SEAL OIL Δ PR. HIGH - WARNING	63P/SOΔH	0-50 psig	CLOSE 5 (+.5) PSIG RISING	2	PS&G	
	SEAL OIL Δ PR. LOW - TRIP	63P/SOΔL	0-50 psig	CLOSES 5 (+.5) PSIG RISING	2	PS&G	
	SEAL OIL Δ PR. MED.	63R/SOΔM	0-50 psig	CLOSE 5 (+.5) PSIG RISING	2	PS&G	
	MAINLINE VALVE PRESSURE EQUALISE	63P/PE	0-20 psig	.10. PSIG FALLING PRESSURE	4	CUST.	
	SEAL OIL Δ PR. LOW - PNEUMATIC RELAY	63P/SOΔL (REF)	0-20 psig	SET TO GIVE 20 PSIG OUTPUT AT INPUT OF 4 PSIG (RISING)	2	PS&G	
	SEAL OIL Δ PR. MED. - PNEUM. RELAY	63P/SOΔM (REF)	0-20 psig	SET TO GIVE 20 PSIG OUTPUT AT INPUT OF 5.5 PSIG (RISING)	2	PS&G	
	SEAL OIL Δ PR. HIGH - PNEUM. RELAY	63P/SOΔH (REF)	0-20 psig	SET TO GIVE 20 PSIG OUTPUT AT INPUT OF 15 PSIG (RISING)	2	PS&G	

289K00006

DIFFERENTIAL PRESSURE SWITCHES

DESCRIPTION
SEE SHEET 1

DATE	ZONE

CLASS SET POINT ADJUSTMENT INSTRUCTIONS

- DO NOT CHANGE SET POINT
- PRIOR WRITTEN CONSENT FROM ORENDA REQ'D. BEFORE CHANGING.
- NOMINAL SET POINT MAY BE CHANGED WITHIN BRACKETED LIMITS
IF ORENDA IS ADVISED.
- SET POINT MAY BE CHANGED TO SUIT CUSTOMER REQUIREMENTS.

NOTICE

THIS DRAWING IS THE PROPERTY OF ORENDA LIMITED AND IS ONLY CONDITIONALLY ISSUED AND DOES NOT CONFER OR TRANSFER ANY RIGHT IN OR LICENSE TO USE THE SUBJECT MATTER OF THE DRAWING OR ANY DESIGN OR TECHNICAL INFORMATION SHOWN THEREON. THIS DRAWING OR ANY PART THEREOF SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF AN AUTHORIZED REPRESENTATIVE OF ORENDA LIMITED.



ORENDA LIMITED

Canada

DRAWING REFERENCE DATA		SCALE	TITLE:	
FIRST RELEASE - ENGINE TYPE			CONTROL SETTINGS	
LAYOUT		DRAWING NO.	289K000006	
REF PNT NO.		SHEET 4 OF 9	SIZE B	
PROTECTIVE TREATMENT		APPROVALS		
		DATE		
		DRAWN		
		CHECKED		
		APPROVED		
		APPROVED		
		APPROVED		

FIG. 47

DEVICE SETTINGS

TEMPERATURE SENSING DEVICES		DESCRIPTION		DEVICE OR PART NO.	CONTACT OPERATION	RANGE (°F)	SETTING (°F)	CLASS	LOCATION
EXHAUST TEMP. SWITCH - LIGHT UP		26P/EL	CLOSES AT SET POINT	0-1200	425 ± 10°F	3(±50°F)	UCP		
EXHAUST TEMP. SWITCH - TRIP		26F/EH	OPENS AT SET POINT	0-1200	975 ± 50°F at 90°F Amb.	1	UCP		
LUBE OIL TANK TEMP. - HEATER		26TS/LOT -1	OPENS AT SET FT. (RISING)	0-225	95 ± 2°F	3(±100°F)	PP		
LUBE OIL TANK TEMP. - PERMISSIVE START		26TS/LOT -2	OPENS AT SET PT. (FALLING)	0-225	75 ± 2°F	2	PP		
P.T. LUBE OIL TEMP. - RECORDER		38R/LOH-1	OPENS AT SET POINT	0-300	200 ± 5°F	1	UCP		
BOOSTER LUBE OIL TEMP. - RECORDER		38R/LOH-2	OPENS AT SET POINT	0-300	200 ± 5°F	1	UCP		
EXHAUST TEMP. LEFT - RECORDER		26R/EH-1	OPENS AT SET POINT	0-1200	975 ± 50°F AT 	1	UCP		
EXHAUST TEMP. RIGHT - RECORDER		26R/EH-2	OPENS AT SET POINT	0-1200	80°F AMBIENT	1	UCP		
GLYCOL CIRCULATING TEMPERATURE VALVE		240C00080	'B' PORT CLOSURES AT 115°F	95-115	105 ± 10°F	2	UCP		
LUBE OIL TEMPERATURE CONTROL VALVE		200C00879	'B' PORT CLOSURES AT 130°F	110-130	120 ± 10°F	2	P.P.		
GLYCOL COOLER FAN SPEED CONTROLLER		282K00096	VALVE OPENS ON DECR. TEMP.	50-150	115 ± 5°F	2	P.P.		
EXHAUST TEMP. CONTROLLER		263K00792		0-1200°F	SET POINT: 93°F AT 80°F AMB.	3(±15°F)	COMP. ROOM		
TURBINE ENCLOSURE TEMP.		26TS/TE		0.1-50 MIN/REP.	SET POINT: 93°F AT 80°F AMB.	1	UCP		
G.P. BEARING DRAIN TEMP. - RECORDER		38R/LOH-3		2-200 %	1.0 MIN/REPEAT	4			
G.P. LUBE OIL TEMP. REGULATING VALVE		244C00014		70-370	PROPORTIONAL BAND: 30%	4			
				0-300	160°F (±5)	3(±10°F)	P.P.		
					280°F ± 5°F	1	UCP		
					SET POINT 120°F ± 5°F				

289K00006

5

DESCRIPTION
SEE SHEET 1

REV.	DATE

NOTICE

THIS DRAWING IS THE PROPERTY OF ORENDA LIMITED AND IS ONLY CONDITIONALLY ISSUED AND DOES NOT CONVEY OR TRANSFER ANY RIGHT IN OR LICENSE TO USE THE SUBJECT MATTER OF THE DRAWING OR ANY DESIGN OR TECHNICAL INFORMATION SHOWN THEREON. THIS DRAWING OR ANY PART THEREOF SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF AN AUTHORIZED REPRESENTATIVE OF ORENDA LIMITED.



ORENDA LIMITED

Canada

TITLE:

CONTROL SETTINGS

SCALE

DRAWING NO.

289K00006

SHEET 5 OF 9

SIZE B

APPROVALS

DRAWN	CHECKED	APPROVED	DATE

DRAWING REFERENCE DATA

FIRST RELEASE - ENGINE TYPE

LAYOUTS

REF PART NO.

HEAT TREATMENT

PROTECTIVE TREATMENT

MATERIAL

FIG. 48

DEVICE SETTINGS

GOVERNOR, FUEL, FLOAT, & FLOW SWITCHES		REVISION	DESCRIPTION	CH	APP	DATE	TIME
289K00006		5	SEE SHEET 1				
DESCRIPTION	DEVICE NO OR PART NO.	RANGE	SETTING (& TOLERANCE)	CLASS	LOCATION		
FUEL VALVE AT LIGHT-UP FLOW	90L/16N.	1.1x10 ⁷ to 1.8x10 ⁸ BTU/HR	SET AS REQUIRED ON SITE TO GIVE GOOD LIGHT-UP	4	POWER PLANT		
GOVERNOR MINIMUM SETTING	65P/LS	0-18 PSIG	CLOSES AT 3 PSIG FALLING	1	UCF		
GOVERNOR RESET RANGE	262K00029	3-15 PSIG	3 to 15 PSIG CORRESPONDS TO 4500 to 7500 RPM	2	P.F.P.		
FUEL VALVE MAXIMUM STOP	263K00021		SET TO LIMIT FUEL FLOW TO PREVENT OVERFUELING & OVERTEMPERATURE.	4	P.P.P.		
LUBE OIL LEVEL	71F/LOL		OPENS ON FALLING LEVEL AT 10" OF OIL IN TANK (FULL LEVEL IS 18" OF OIL IN TANK)		P.P.P.		
CLASS 1 DO NOT CHANGE SET POINT. 2 PRIOR (WRITTEN) CONSENT FROM ORENDA REQUIRED IF CHANGED. 3 NOMINAL SET POINT MAY BE CHANGED WITHIN BRACKETED LIMITS IF ORENDA IS ADVISED. 4 SET POINT MAY BE CHANGED TO SUIT CUSTOMER REQUIREMENTS.		NOTICE THIS DRAWING IS THE PROPERTY OF ORENDA LIMITED AND IS ONLY CONDITIONALLY LOANED AND DOES NOT CONVEY OR TRANSFER ANY RIGHT IN OR LICENSE TO USE THE SUBJECT MATTER OF THE DRAWING OR ANY DESIGN OR TECHNICAL INFORMATION SHOWN THEREON. THIS DRAWING OR ANY PART THEREOF SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF AN AUTHORIZED REPRESENTATIVE OF ORENDA LIMITED.					
DRAWING REFERENCE DATA FIRST RELEASE - ENGINE TYPE _____ LAYOUTS _____ REF PART NO. _____ HEAT TREATMENT _____ PROTECTIVE TREATMENT _____ MATERIAL _____		APPROVALS DRAWN _____ CHECKED _____ APPROVED _____ APPROVED _____ APPROVED _____		DATE _____ _____ _____ _____		TITLE: CONTROL SETTINGS	
ORENDA LIMITED Canada		SCALE ---		DRAWING NO 289K000006		SHEET 6 of 9 SIZE B	

FIG. 49

DEVICE SETTINGS

GAS & VIBRATION, DETECTORS, BATTERY CHARGER		DESCRIPTION	DEVICE OR PART NO.	SETTING & TOLERANCE	LOCATION
9000000682 5 SEE SHEET 1		GAS DETECTORS: CONTROL UNITS	281K00054	FOR SETTING UP PROCEDURE SEE SERVICE MANUAL GAS WARNING : PRESET GAS LEVEL SET AT 25% LOWER EXPLOSIVE LIMIT (L.E.L.) OF NATURAL GAS (APPLIES TO 281K00055 ONLY) GAS ALARM : PRESET GAS LEVEL SET AT 75% LEL OF NATURAL GAS (281K00055) PRESET GAS LEVEL SET AT 25% LEL OF NATURAL GAS (281K00058)	SCP
VIBRATION MONITOR			263K01277	FOR SETTING UP PROCEDURE SEE SERVICE MANUAL G.P. VERTICAL VIBRATION WARNING LEVEL: 1.0 INCHES/SEC. VIBRATION ALARM LEVEL: 1.5 INCHES/SEC. G.P. HORIZONTAL VIBRATION WARNING LEVEL: 1.0 INCHES/SEC. VIBRATION ALARM LEVEL: 1.5 INCHES/SEC. P.T. VERTICAL VIBRATION WARNING LEVEL: 0.785 INCHES/SEC. VIBRATION ALARM LEVEL: 0.99 INCHES/SEC. P.T. HORIZONTAL VIBRATION WARNING LEVEL: 0.785 INCHES/SEC. VIBRATION ALARM LEVEL: 0.99 INCHES/SEC. BOOSTER VERTICAL VIBRATION WARNING LEVEL: 0.246 INCHES/SEC. VIBRATION ALARM LEVEL: 0.492 INCHES/SEC. BOOSTER HORIZONTAL VIBRATION WARNING LEVEL: 0.246 INCHES/SEC. VIBRATION ALARM LEVEL: 0.492 INCHES/SEC.	UCP
BATTERY CHARGER 125 VOLT			281K00009	VOLTAGE SETTING FOR 1) FLOAT CHARGE 129 (+1%) VOLTS, RANGE 127-129 VOLTS 2) EQUALISE CHARGE 140 (+1%) VOLTS, RANGE 138-148 VOLTS	CONTROLS BLDG.
ORENDA LIMITED Canada					
DRAWING REFERENCE DATA FIRST RELEASE - ENGINE TYPE _____ LAYOUT _____ REF PART NO. _____ HEAT TREATMENT _____		APPROVALS DRAWN _____ CHECKED _____ APPROVED _____ APPROVED _____ APPROVED _____		TITLE: CONTROL SETTINGS	
MATERIAL		DATE: JULY 23 1988 JULY 23 1988 JULY 23 1988 JULY 23 1988		SCALE: _____ DRAWING NO. 289K00006 SHEET 7 OF 9 SIZE B	

FIG. 50

DEVICE SETTINGS

SPEED SENSITIVE DEVICES, MAGNETIC PICK-UPS.

DESCRIPTION		DEVICE OR PART NO.	RANGE	SETTING & TOLERANCE	CLASS	LOCATION
P.T. SPEED CONTROLLER		200C02070	0-10,000 RPM 0.1-50 MIN/REPEAT 2-200% 0-10,000 RPM	SET POINT: 7500 RPM. RESET RATE: 1.0 MIN./REPEAT PROPORTIONAL BAND: 20% OPEN 7500 (+50)	1 4 4 1	UCP UCP UCP P.P.
P.T. OVERSPEED (ELECTRONIC)		12/PTOS	0-10,000 RPM	OPEN 7800 (+50) RPM RISING OPEN 7850 (+50) RPM RISING	1 1	P.P. UCP
POWER TURBINE OVERSPEED		12L/PTOS	0-10,000 RPM	CLOSE 1500 (+100) RPM RISING OPEN 6500 (+100) RPM RISING	3(+100) 3(+0-100)	UCP UCP
G.P. OVERSPEED		12L/GPOS	0-10,000 RPM	CLOSE 1200 (+100) RPM RISING CLOSE 3000 (+100) RPM RISING	2 3(+200)	UCP UCP
POWER TURBINE (BOOSTER) SPEED		12P/BS	0-10,000 RPM	OPEN 4350 (+50) RPM RISING GAP 0.005 (+.003) INS. (-.0)	3(+200) 3(+200)	UCP UCP
G.P. HIGH SPEED		12P/H	0-10,000 RPM	MIN. VOLTAGE OUTPUT AT 7500 RPM - 0.5 VRAS.		
G.P. IGNITION SPEED		12P/L	0-10,000 RPM	MIN. VOLTAGE OUTPUT AT 1500 RPM - 0.5 VRMS. MAX. OUTPUT AT 7500 RPM - 5.0 VRMS.		
G.P. SELF SUSTAINING SPEED		12P/M	0-10,000 RPM			
G.P. LUBE PRESS CONT. SPEED		12P/MH	0-10,000 RPM			
G.P. GAS PRODUCER SPEED MAG.P.U.		265K00213	0-10,000 RPM			
POWER TURBINE SPEED MAG.P.U.		262K00202				
G.P. OVERSPEED(MAG. P.U.)		12/GPOS 265K00213		GAP 0.005 (+.003) INS. (-.0)		

CLASS SET POINT ADJUSTMENT INSTRUCTIONS

- DO NOT CHANGE SET POINT.
- PRIOR (WRITTEN) CONSENT FROM ORENDA REQUIRED BEFORE CHANGING.
- NOMINAL SET POINT MAY BE CHANGED WITHIN ERACKETED LIMITS IF ORENDA IS ADVISED.
- SET POINT MAY BE CHANGED TO SUIT CUSTOMER REQUIREMENTS.

NOTICE

THIS DRAWING IS THE PROPERTY OF ORENDA LIMITED AND IS ONLY CONDITIONALLY ISSUED AND DOES NOT CONVEY OR TRANSFER ANY RIGHT IN OR LICENSE TO USE THE SUBJECT MATTER OF THE DRAWING OR ANY DESIGN OR TECHNICAL INFORMATION SHOWN THEREON. THIS DRAWING OR ANY PART THEREOF SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF AN AUTHORIZED REPRESENTATIVE OF ORENDA LIMITED.



ORENDA LIMITED

Canada

APPROVALS DATE

DRAWN	
CHECKED	
APPROVED	<i>[Signature]</i>
APPROVED	<i>[Signature]</i>
APPROVED	<i>[Signature]</i>

DRAWING REFERENCE DATA

FIRST RELEASE - ENGINE TYPE	
LAYOUTS	
REF PART NO.	
HEAT TREATMENT	PROTECTIVE TREATMENT
	MATERIAL

SCALE

DRAWING NO.

289K00006

SHEET **8** OF **9**

FIG. 51

DEVICE SETTINGS

SECTION 10

SERVICE MANUAL

SECTION 10

SERVICE MANUAL

The "Service Manual" documents all technical data pertaining to the compressor set installations and is presented in a form that enables desired data to be quickly located. This is achieved by an accurate and comprehensive master index at the beginning of Volume 1 and a detailed index at the beginning of each of the four parts.

The "Service Manual" consists of four parts fitted into two or more volumes depending upon the amount of literature supplied by the supplier of the components.

- Part 1 - describes in detail the compressor set installation by means of the schematics, covering in detail the general information presented in this course.
- Part 2 - contains the description of the power plant and the parts list of all items built into the gas producer and power plant of the OT-F-2100. In the OT-F-3 manual the gas producer is treated as a unit under one part number.
- Part 3 - contains the parts list for the compressor set installation.
- Part 4 - contains the Orenda specification and data information concerning the sub-contracted components. The specification and part number appear on the pink sheet in Part 4, followed by the supplier's literature. The part number of a component located on the schematics or parts list can be located in this section along with details of supplier's part number, servicing and maintenance recommendations.

Changes to the installation are implemented by means of modification notices issued for quick action and these notices are incorporated into the manual under a revision system periodically.