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S-7 162 p 1/27/06

Report written:

March 1957

W-3-630 (DELETED VERSION)

This document consists of 131 pages
No. 4 of 6 copies. Series A

HP-86 GAS HANDLING FACILITY (DELETED VERSION)

Reviewed/Lab Counsel
Publicly Releasable
WRH 3-2-06-162pp

DELETED VERSION
Classification changed to: Unclassified
Marvin Thompson 1-27-06 ADD/ADD
1st reviewer signature/title/org./date/authority
Mahavir Jain, 1/27/06 ADD
2nd reviewer signature/title/org./date/authority
Derived From: LA-4000 9/2002
(Guide or Source Document and Date)

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INTRODUCTION

Chapter 1

Table 1

Item No.	Name of Equip. Item	Manufacturer	HP-86 Room No.	LASL Dwg. No.
4	Hoskins Electric Furnace, Type FD2046	Hoskins Mfg. Co.	1	
5	Carver Laboratory Press (Total Force 20,000 psi)	Fred S. Carver Inc., Hydraulic Equipment	10	
6	Wabash Hydraulic Press (Total Force 60,000 psi)	Wabash Metal Products Co., Hydraulics Division	10	

Chapter 2

HIGH PRESSURE TEST EQUIPMENT

The oil-gas type of high pressure test equipment is called the Mobile High Pressure Pump System. LASL drawings of the system are listed in Appendix A. A drawing of the system piping is shown in Fig. 2. There are two pumping stages, one stage containing a 10,000 psi Sprague Pump and the other, a 30,000 psi Sprague Pump. In each stage there is an Autoclave Oil-Gas Cylinder, and between the two stages in the gas line is an Autoclave Check Valve.

The drawing of the system, Fig. 2, shows outlets in the hydraulic system of each stage permitting the use of each stage to supply hydraulic pressures. Only the oil-helium system has been equipped with such outlets. The two Mobile High Pressure Pump Systems are located in Room 7 and are thus barricaded behind the one-inch thick steel wall that separates Rooms 11 and 7. Controls of the pump systems pass through ports in the steel wall so that one may operate the pump systems from Room 10. Figure 3 is a photograph of the pump systems, and Fig. 4 is a photograph of the controls. The vessels to be pressurized with gas are also placed in Room 7 behind the one-inch thick steel wall and are kept there during leak tests.

The oil-gas cylinders of the present deuterium pump system are of Type 410 Stainless Steel, a steel more susceptible

to hydrogen embrittlement than an austenitic stainless steel. It is the practice to maintain high pressures in these cylinders only long enough to fill a pressure vessel and to close the valve on the pressure vessel. As soon as the valve is closed, pressures in the cylinders are reduced. With this practice hydrogen embrittlement of the cylinder wall is minimized.

In order to trap any oil vapor put into the deuterium pumped by the oil-deuterium Mobile Pump System, there is a Cold Trap (similar to that shown on LASL Dwg. 32Y-21696) in the high pressure gas delivery line mounted on the wall near the pumping system. The trap allows the deuterium to pass through a tube held at liquid nitrogen temperature. Any oil vapor in the gas condenses and collects at the bottom of the trap, where it can be removed.

The oil system equipped with a high pressure intensifier is called the 10,000 psi Pump and Intensifier. Two views of the equipment are shown in Fig. 5, and a drawing of the layout of the system is shown in Fig. 6. LASL drawings of the system are listed in Appendix A. This equipment consists primarily of a 10,000 psi Sprague Pump, a 100,000 psi Harwood Intensifier, a LASL designed pressure cell, and a Bristol recording potentiometer. The intensifier contains two pressure cylinders, one having a cross sectional area equal to

one tenth of the cross sectional area of the other. The pressure cell contains pressure sensitive wires. Changes in resistance of the wire are recorded by the potentiometer, which is calibrated to give pressure readings. Calibration of the pressure cell and potentiometer can be performed by use of the dead weight gauge described in Chapter 3.

Chapter 3

PRESSURE GAUGE CALIBRATION EQUIPMENT

Two dead weight gauge testers are used in calibration of the pressure gauges associated with the various items of pressure equipment in Building HP-86. One is a portable type of simple piston gauge, an Ashcroft Gauge Tester produced by Manning, Maxwell, and Moore, Inc. It can be used to calibrate gauges which measure pressures ranging up to 4,000 psi. In Fig. 8 the Ashcroft Gauge Tester is shown in place on the Dead Weight Gauge Accessory Rack. The other dead weight gauge is used to calibrate gauges which measure pressures up to 30,000 psi. and it is sometimes used to measure a similar range of gas pressures in a pressure vessel by use of a device separating the hydraulic fluid of the dead weight gauge from the gas of the pressure vessel. This dead weight gauge tester is a controlled clearance piston gauge made by the Harwood Engineering Company. It features an arrangement of measuring piston and fitted cylinder that permits a size adjustment of the cylinder bore to the desired clearance between the measuring piston and the fitted cylinder. A photograph of the Harwood gauge tester is shown in Fig. 7. The loading system has 1,000 pounds of dead weight. There are nine 100 pound platters (g) held on a rod and cable suspension attached to the yoke (f).

The weights are lifted on and off the suspension by the power cylinder (h) on the base. Smaller weights (e) down to increments of 1/30 pound are provided for hand loading on the yoke. The piston is rotated either clockwise or counter-clockwise by means of a pulley (c) and motor arrangement. There have been a few LASL modifications to the machine design in order to decrease the amplitude of the vibrations transmitted from the motor to the suspended weights. These included changes in design of the upper yoke (b), the vertical members of the suspension system (d), and the bearing supporting the upper yoke. The LASL designed yoke is one made of dural and carefully machined for balance with respect to the axis (see LASL drawing 32Y-21615). Each vertical member of the suspension system consists of two sections of steel rod separated by a section of flexible steel cable. The dial indicator (a) was added to detect small changes in the piston height and thereby obtain a detector for small changes in the balance of the loaded piston and the applied hydraulic pressure.

An accessory rack designed by LASL is used with the two dead weight gauge testers. The Ashcroft tester is mounted on a shelf of the accessory rack, and the Harwood tester is mounted beside the accessory rack. A photograph of the accessory rack is shown in Fig. 8. A list of the LASL drawings

for this rack is given in Appendix A. Mounted on the panel of the accessory rack are two pressure generators, one for application of hydraulic pressure to the jacketed cylinder of the Harwood tester, and the other for application of pressure to the oil system under test. The piping associated with these pressure generators includes control valves and four Bourdon pressure gauges, three being oil gauges and one a gas gauge. Two of the oil gauges are used to indicate oil pressures in the system under test, one being the pressure in the test line when it is open to the pressure generator that is used to balance the load of weights on the gauge tester. The third oil gauge measures the pressure applied by the pressure generator that is used to apply hydraulic pressure to the jacketed cylinder of the Harwood tester. The gas gauge indicates the pressure on the gas side of an Oil-Gas Separator, which is mounted on the accessory rack. The Oil-Gas Separator is a device for transmitting gas pressures to the hydraulic system of either gauge tester, and thus it enables the calibration of gas gauges and the measurement of the air pressure in a gas system. The LASL drawings of the Oil-Gas Separator are listed in Appendix A, Sec. 3. The separator contains a stainless steel diaphragm with one face in contact with mercury. The mercury extends above the separator assembly into a standpipe, which is connected directly to the gas system under test.

In order to know the position of the diaphragm with respect to the retainer faces (which limit the deformation of the diaphragm during over-pressure) the change in height of the mercury column in the standpipe is observed by use of a mercury level indicator, described in Sec. 4.4.6. The sensing coil of the indicator is raised or lowered by a screw driven by a reversible motor.

A valved off, permanent line connects the filling equipment in Room 9 to the gas side of the Oil-Gas Separator in the dead weight gauge accessory rack. This line permits the Bourdon tube gauges of the filling system to be calibrated in place. Permanent connections to the deuterium and helium pumping systems in Room 7 permit calibration of the gas gauges in these systems and the measurement of gas pressures in systems that are pressurized by either of these Mobile Pump Systems.

Chapter 4

FILLING EQUIPMENT

Though the high pressure pumping system was designed to compress gas to a pressure of 30,000 psi, it has not been operated at pressures that high.

Before installing any air operated high pressure valve in the high pressure system, it is pressure tested at 25,000 psi. Prior to installation the manually operated high pressure valves are modified so as to have a capability of withstanding pressures as high as 30,000 psi. Tests have been conducted at 32,000 psi, without failure of the modified valves. Though the manually operated high pressure valves (Autoclave) as received are rated to operate at 30,000 psi, it was discovered that the packing in the valves failed at pressures as low as 16,000 psi, and so it was found necessary to modify the packing (see LASL Drawing 32Y-21593 for the packing modification).

The filling equipment is grouped functionally as follows:

1. The Low Pressure System.
2. The High Pressure System.
3. The Liquid Nitrogen Transfer Line.
4. Systems Instrumentation.

The systems instrumentation that is discussed in this chapter includes some of the tritium monitoring equipment, which is treated in more detail in Chapter 5.

Drawings of the filling system are grouped as shown in Table 2. A complete listing of filling equipment drawings is given in Appendix B.

Table 2

FILLING EQUIPMENT

DRAWING SUMMARY

Drawing Description	Drawing No.
Process System	
Manifold Chamber	32Y-21741
Process Chamber	32Y-21640
Mounting Frame	32Y-21920
Piping	32Y-21901
Parts List	32Y-21902
High Pressure System	
Filling Chamber	32Y-21640
Mounting Frame	32Y-21677
Piping	32Y-21903
Parts List	32Y-21904
Safety Box and Projectile Valve Operator	32Y-21720
Nitrogen Transfer Line	
Piping	32Y-21940
Control and Instrumentation Consoles	
Consoles	32Y-21649 D1
Panels	32Y-21651
Instrumentation Diagrams	
Diagram	32Y-21226
Wiring Diagrams	
Chamber Terminal Board Connections	32Y-21921
Mercury Level Indicator, Valve and Pump Control	
Indicator Circuits	32Y-20301
Indicator Diagram	32Y-20302
Control Circuits	32Y-21921 D7-D11
Mass Spectrometer Protective Circuit	32Y-21933

4.1 Low Pressure System

The low pressure system is contained in the Manifold Chambers and the Process Chamber. Each chamber is connected to the Room 9 ventilating system, described in Chapter 5, and any tritium escaping into the chambers will be exhausted through the stack of the ventilating system.

4.1.1 Manifold Chambers

Three Manifold Chambers are located in the hallway of Room 9. Photographs of the chambers are shown in Fig. 9. Their primary purpose is to provide compartments into which the tritium shipping containers are placed and connected to the low pressure system. The chambers are provided with gas tight, arm length gloves, which permit connecting and disconnecting operations to be performed with the chambers closed. Each chamber can contain two tritium containers of the type described by LASL Drawing 26Y-70002, the so-called Hanford Container designed by CMB-7. The volume of the container is about 12 liters. The state of each container connection to the process system (container connected or disconnected, container valve open or closed) is indicated by the Manifold Indicator located on the top of each Manifold Chamber. The Manifold Indicators are also provided with circuitry to show indications on a control panel in Room 10. The equipment contained in the Manifold Chambers is part of the Process System, and the flow diagrams shown in Figs. 11 and 12 include this equipment.

4.1.2 Process Chamber

The Process Chamber is located in Room 9. The chamber consists of a Hood Assembly, described in detail by LASL Drawing 32Y-21640. Contained in the chamber are (1) the equipment used for tritium accountability measurements, (2) the gas traps, and (3) the evacuation and transfer pump systems. A photograph of the Process Chamber and the equipment in it is shown in Fig. 10. A flow diagram of the Process System is shown in Fig. 11.

Associated with each of two groups of three tritium containers (called "triads") is an electromanometer system and a standard volume tank. By allowing gas to expand from a tritium shipping container through lines of known volume into a standard volume tank, and by making electromanometer measurements of the tritium pressure before and after the gas expansion into the standard volume tank, one can obtain information for calculation of the volume of the tritium shipping container.

The gas traps are the charcoal trap and the three cold traps. Charcoal in the charcoal trap adsorbs tritium at liquid nitrogen temperature (77°K) and allows the helium-3, formed by the radioactive decay of tritium, to pass through charcoal to the top of the charcoal trap. A heating coil surrounding the charcoal trap is used to heat the charcoal in order to release the tritium. In the lines leading to the evacuation and transfer pump systems are the cold traps, in which are condensed any vapors that can be condensed at liquid nitrogen temperatures.

There are two evacuation pump systems. One is in the Process Chamber, and the other is located in the hallway of Room 9 next to the Manifold Chamber. The evacuation pump system in the Process Chamber is used to pump on the gas lines of both the low pressure and the high pressure systems before tritium is admitted into the lines. Should it be necessary to evacuate the lines to the shipping containers after tritium has been admitted into the charcoal trap and into most of the lines of the Process System, the evacuation pump system next to the Manifold Chamber is used (e.g., the pump is used to remove air introduced into a connecting line to a container that is substituted for an emptied container).

The transfer pump system is used to pump tritium from the shipping containers into the charcoal trap, to pump helium-3 from the top of the charcoal trap into the helium-3 storage tank, and to pump tritium back into shipping containers. Presently it is also used to pump the D-T mixture from the charcoal trap so as to feed the 3-stage mercury high pressure transfer pump which in turn fills two compression stages of the high pressure system.

In the Process System there have been modifications of the evacuation and the transfer pump systems. Originally the evacuation pump system located in the hallway of Room 9 consisted only of a mechanical pump. Now

in addition to that pump, there are a diffusion pump, a cold trap and a vacuum gauge. The evacuation pump system in the Process Chamber has been modified by the removal of a line for use with a leak detector, the addition of a vacuum gauge, and the substitution of a Welch DuoSeal Vacuum Pump for a Cenco Hyper-Vac to function as a fore pump. The transfer pump system has become one pump instead of the rough pump, diffusion pump and fore pump that were originally used. The present transfer pump is a two stage rotary vane pump designed by CMF-9. Gas can be pumped through it in a forward or reverse direction, whereas with the old pump system, gas could be pumped only in one direction.

4.2 High Pressure System

The high pressure equipment is contained in the Filling Chamber, which is connected to the Room 9 ventilating system described in Chapter 5. The Filling Chamber consists of a Hood Assembly, described in detail by LASL Drawing 32Y-21640. Photographs of the high pressure equipment are shown in Figs. 13 and 14.

Compression of the gas can be accomplished in three successive stages of mercury piston cylinders. As shown in Figs. 15 and 17, each pumping stage consists of a mercury-gas cylinder, a mercury stand pipe, an oil-mercury cylinder containing an "O" ring gasketed piston that separates the oil and the mercury, an air operated high pressure oil pump, and the associated valves and instruments. Stage I uses a 2,000 psi oil pump, Stage II a 10,000 psi oil pump, and Stage III a 30,000 psi oil pump.

Before tritium is admitted into the high pressure system, Stages I, II and III, the vessel to be filled, and the associated piping are evacuated by use of the evacuation pump system in the Process Chamber and the vacuum pump in the Filling Chamber.

The flow diagrams, as represented by drawings 32Y-21901 D1A (Fig. 12) and 32Y-21903 D1A (Fig. 16) show that in the first design tritium was allowed to expand into the mercury-gas cylinder of Stage I and was pumped into Stages II and III. Presently,

as shown in the flow diagrams on 32Y-21901 D1B (Fig. 11) and 32Y-21903 D1B (Fig. 15) a three stage, mercury-piston pump is used to transfer tritium from the charcoal trap into the Stage II and Stage III mercury-gas cylinders. This pump is capable of compressing gas to a pressure of 3,000 psi. The high pressure system has also been modified by replacing manually operated valves with valves operated by compressed air, the air flow being controlled by solenoid operated valves. Formerly mercury was admitted into the standpipes of the Stages I, II and III mercury level indicators through manually operated valves, but now mercury is admitted through valves which can be controlled from Room 10. The gas sampler designated as mass spectrometer Leak No. 6 (MS L-6) has also been modified. Presently, it consists of a sample collector and an expansion chamber. The sample collector consists of a partially plugged length of high pressure tubing with an air operated valve at each end. With one valve closed and the other open to the filling line, a sample of gas is collected in the tubing. When the gas is to be analyzed, the valve to the filling line is closed and the valve to the expansion chamber is opened and a gas sample is admitted to the mass spectrometer.

4.2.2 Traps

The traps are located to trap any condensable vapors before the D-T gas is admitted into the pressure vessel. First the gas

is passed through a gold sump, where mercury vapor can amalgamate with gold wire, and then there is a series of cold traps made up of lengths of the gas line immersed in liquid nitrogen. Just beyond the cold traps there is a straight length of pipe which also contains gold. Thus there is a long length of pipe in which mercury and gold can amalgamate, and there is a long length of chilled pipe in which mercury vapor, or other vapors of heavy molecular composition, can condense.

4.3 Liquid Nitrogen Transfer Line

Liquid nitrogen is transferred from a liquid nitrogen storage dewar to (1) the dewar surrounding the cold traps in the gas line of the high pressure system, (2) the two dewars in the Process System (one surrounds the charcoal trap and the other surrounds the cold traps), and the dewar of the cold trap in the mass spectrometer. The valves in the lines to the dewars in the gas filling system are solenoid operated valves, which are controlled from Room 10. The valve in the line to the dewar of the mass spectrograph is an automatic valve. A flow diagram of the liquid nitrogen transfer line is shown in Fig. 19.

4.4 Systems Instrumentation

Associated with the filling equipment are instruments used in making measurements and in controlling the valves which regulate the flow of gas. A diagram showing the relationship between filling equipment and instrumentation is given in Fig. 20. The instruments are described below.

4.4.1 Instrumentation Panels and Control Consoles

There are two control consoles, the process control console and the filling control console. Above each of these consoles are instrumentation panels which show the flow diagram of the related filling equipment. Photographs of the consoles and panels are shown in Fig. 21. Among the drawings listed in

Table 2 (Sec. 4.1.1) are the numbers of the drawing series for the consoles, panels, and wiring diagrams. A complete listing of the drawings is given in Appendix B.

Controls for the solenoid operated valves in the low pressure system and actuating switches for heaters and motors related to equipment of the low pressure system, are located on the process control console. Controls for the solenoid operated valves of the high pressure system, pilots for pressure regulators, actuating switches for motors and instruments related to the high pressure system are located on the filling control console. In the case of the solenoid operated valves, toggle switches control the power to these valves, and they control the flow of compressed air to air operated valves which control the flow of the gas, the mercury and the oil in the low pressure and high pressure systems. Motors and heaters are controlled by contactors mounted on the outside of the Process and Filling Chambers. These contactors are in turn actuated by the toggle switches on the control consoles (the one exception is the vacuum pump in the Filling Chamber, which is plugged into a wall plug when it is to be used).

The process and filling instrumentation consoles contain lighting systems and meters that show the operational state of the various items of equipment in the low pressure and high pressure systems. These are shown in flow diagrams on the panels of the instrumentation consoles. The panels are made

of translucent plexiglass, the backs of which have been painted with black paint except where schematic lines represent the piping of the systems. Mounted on the panels at appointed locations on the schematic lines are push-to-test pilot lights representing the various valves. The chassis behind each panel is about three inches deep and is compartmentalized so that each section of piping shown on the schematic is backed by a small box. Located in each compartment are two sets of lamp bulbs, one green and the other red. When a toggle switch on a control console is thrown to operate the solenoid valve that in turn operates an air-operated valve in the gas, mercury or oil lines, the corresponding push-to-test pilot light is lit. The opening or closing of an air-operated valve actuates two microswitches mounted on the top of each air-operated valve. The microswitches on each valve are so connected that in the closed position of a valve, the red lights in the console compartment associated with the valve are lit and the schematic lines on the console panel in front of that compartment are red. When an air-operated valve is opened the green lights in the console compartment associated with the valve are lit, and the schematic lines on the console panel in front of that compartment are green. Thus, when power is supplied to the circuits of the instrumentation consoles, the initial condition of the schematic lines on the panels is red. As valves in the various sections of the system are opened corresponding sections of the schematic lines on the console

panels change to a green color. Therefore, red means a non-operating or "stopped" section and green signifies an operating or "going" section. Depending on the work being conducted, a green section of the schematic can mean that either the corresponding section of the filling system is being evacuated or that gas is flowing into the corresponding section of the filling system. For the lighting system to show correctly the state of equipment operation during filling procedures, the manually operated valves in the system must be opened before filling operations are started, as there are no indicators on the consoles to show if the manually operated valves are open or closed.

The process instrumentation panel also contains a consolidated Electrodynamics Corporation Type 37-001 Multi-Channel Adapter, used in making pressure measurements at various places in the Process System. The adapter is further described in Sec. 4.4.3.

4.4.2 Gas Analysis

As is indicated in Figs. 11 and 15, there are eight positions for samples to be removed from the filling system for analysis in the Isotope Ratio Mass Spectrometer.

In the Process System there are five positions for sample removals. Two allow sampling of the tritium removed from the shipping containers. A third permits sampling of the gas in the helium-3 storage tank, a fourth permits sampling of the tritium in the Charcoal trap, and the fifth permits sampling in the line

used to pump helium-3 from the top of the charcoal trap. At these five positions are low pressure gas leaks which allow the gas to leak into lines connected to the mass spectrometer. All of the leaks are pumped on by an auxiliary mercury diffusion pump mounted inside of the mass spectrometer cabinet. The manifold pump in the mass spectrometer is connected so as to function as the fore pump for this diffusion pump. All of the leak lines are pumped on continuously. When it is desired to analyze the gas from one of the leaks, the leak line is connected directly to the tube containing the ion source of the mass spectrometer. Under this condition the leak is pumped on by the diffusion pump associated with the analyzer tube of the mass spectrometer.

In the high pressure system there are two positions for the removal of gas samples. The first position (MS L-5) permits sampling of the gas in Stage I, and the second (MS L-6) permits sampling of the gas in the vessel being filled. All of these leak lines are pumped on by the auxiliary diffusion pump of the mass spectrometer.

The Isotope Ratio Mass Spectrometer which is shown in Fig. 22, is a Consolidated Electrodynamics Corporation Model 21-201 having LASL modifications. The inlet system of the spectrometer has been changed so that either the standard glass inlet system supplied with the machine or a remote leak system, as described above, may be connected into the ion source through an all metal cold trap. The electrical output of the machine

automatically keeps a cold trap dewar filled with a liquid nitrogen from the liquid nitrogen transfer line. In the rack there is also the mass spectrometer protective circuit designed by Group W-3. This circuit is so arranged that if the cold trap dewar is not refilled because of a failure of the liquid nitrogen supply, or if the gas pressure in the mass spectrometer becomes greater than is desirable, the high voltage supply is turned off and, through a sequence of timers, the diffusion pump to the analyzer tube is turned off first, and after the diffusion pump is cooled down, the fore pump is turned off.

4.4.3 Pressure Measurements

Pressures in the lines of the process system are measured at five different places by means of the five pressure cells of a Consolidated Electrodynamics Corporation Type 37-103 Electromanometer System. The system gives a digital readout directly proportional to the pressure under observation, and it

is capable of an accuracy better than 0.1% of the full scale reading. A switching unit (CEC Type 37-001 Multi-Channel Adapter) allows selection of any one of the five pressure pickups for a digital reading of static pressure or pressure change at the position of the pickup. There is provision for the addition of one additional pressure cell should it be desired to measure pressure at another location.

Four of the pressure cells have a pressure range of 0-15 psi. Two of these low range pressure cells are used to make pressure measurements needed in determining the amount of tritium put into the Process System. The third low range pressure cell is used to measure the pressure of gas in the helium-3 storage tank. Outlet pressures from the charcoal trap are measured by use of either the fourth 0-15 psi pressure cell or the fifth pressure cell, which has a range of 0-150 psi.

Gas pressures in the high pressure system are measured by means of three Foxboro gauges having ranges as follows: 0-2,000 psi, 0-15,000 and 0-25,000. These gauges are mounted at the gas end (top) of the mercury-gas cylinders of Stages I, II and III respectively. Each gauge contains a helical bourdon tube made of Type 316 stainless steel. Welded to the free end of each bourdon tube is a capillary, which allows cleaning of the tube. The gauges are so mounted that they can be read at the control desk through the bullet-proof glass window that is in the wall separating Rooms 9 and 10. The gas pressure in the filled vessel

if over 10,000 psi is measured by the Foxboro gauge at the top of Stage III mercury-gas cylinder. The Foxboro gauge is calibrated by using deuterium with the Oil-Gas Separator and the Harwood Dead Weight Gauge Tester described in Chapter 3. For pressures lower than 10,000 psi, auxiliary calibrated gauges may be attached to the manifold as required.

Three Ashcroft gauges, containing bourdon tubes made of Type 431 stainless steel, are used to measure the output oil pressure of the Sprague pumps in the high pressure system.

4.4.4 Charcoal Trap Temperature

The temperature of the charcoal in the trap is measured at two positions, one at the geometric center of the trap and the other at a mid-position near the wall of the trap. The temperature at each position is measured by means of an iron-constantan thermocouple. One end of each thermocouple is in the charcoal trap and the other end is attached to a terminal board in the Process Chamber where it is held at room temperature. Copper leads from the terminal board connect the thermocouples with a thermocouple switch and a multi-range, single pen strip chart recorder in Room 10. The thermocouple switch allows reversal of the polarity at the input of the recorder so that proper records may be made when the charcoal trap is either cooled to liquid nitrogen temperature, -199°C, or heated by the charcoal trap heater to a temperature as high as +427°C.

4.4.5 Piston Position Indicators

At the top of each oil-mercury cylinder (described in Sec. 4.2.1) is a piston-return cylinder from which projects a rod, the piston position indicator. The rod is connected to the piston in the piston-return cylinder and the piston is connected to the piston in the oil-mercury cylinder. When compressed helium is admitted into the piston-return cylinder, the ensuing motion returns the piston in the oil-mercury cylinder to its zero position (no oil in cylinder). In this zero position, the piston position indicator projects a maximum distance beyond the end of the cylinder. As oil is pumped into the oil-mercury cylinder, the piston position indicator is lowered. By observing the location of the piston position indicator relative to a scale mounted behind it, one can determine the position of the piston in the oil-mercury cylinder.

4.4.6 Mercury Level Indicator

On the side of the mercury-gas cylinder of each pumping stage (Figs. 15 and 17) is a standpipe of high pressure tubing connected to the mercury end (bottom) and the gas end (top) of the cylinder. Placed around each standpipe is a coil of wire which is part of an electronic bridge circuit that is excited by a one-thousand cycle oscillator. A spherical Armco iron slug floats on top of the mercury column in each standpipe. When mercury in a standpipe is raised to the level of the preset position of the coil, the iron slug unbalances the bridge circuit

giving a meter indication on the instrumentation console panel and closing valves which stop the flow of mercury into the cylinder and isolate the gas remaining in the cylinder from the rest of the system. The coil on each standpipe is usually set so as to close these valves when the mercury in the mercury-gas cylinder is just short of the top of the cylinder. In the event of a power failure to the oscillator, the oil pump in the pumping stage is stopped and valves close to stop gas flow.

4.4.7 Recorder Racks

Mounted in a line opposite the process and filling system control consoles, are five standard relay racks which contain the various pieces of instrumentation described below. They are referred to here as racks A, B, C, D and E, rack A being the nearest to the recording rack of the mass spectrometer. A photograph of the racks is shown in Fig. 23 with rack A at right.

Rack A. Mounted at the top of rack A is the Room 9 and Room 10 temperature recorder, which contains a strip chart recording, self-balancing potentiometer. The instrument has a 12-second print wheel speed, and it is calibrated to be used with the resistance thermometer bulbs in each of the rooms. It is a Two Pen Type 153 Recorder, Model 153X64W2-X-41, manufactured by the Brown Instrument Division of the Minneapolis-Honeywell Regulator Company.

Below the Rooms 9 and 10 temperature recorder is another recorder that is used with two thermocouples in measuring the

charcoal trap temperatures. The instrument contains a strip-chart, self-balancing potentiometer, and it has a range selector switch for 0 to 1, 0 to 10, 0 to 50 and 0 to 100 millivolts. It is a single point Type 153 Recorder, Model Y153X62V12-X-26(V), manufactured by the Brown Instrument Division of Minneapolis-Honeywell Regulator Company. Below this recorder is a set of three thermocouple switches, one of which is used to reverse the polarity at the input to the recorder. The other switches are spares which can be used to put the recorder to other uses.

Also mounted in rack A is the servo amplifier and the digital readout of the electromanometer system used in making pressure measurements. This instrument was manufactured by the Consolidated Engineering Corporation.

Rack B. Rack B contains equipment which was to be part of a system for making measurements of the gas temperature within a pressure vessel being filled in Room 9. After the equipment was obtained, it was decided that it would be impracticable to make measurements of the gas temperature, and the system was not completed. The rack of equipment remains in place for any future use of the equipment. At the top of the rack is a Brown-Rubicon Precision Indicator, consisting of two sections. The upper section of the assembly contains the measuring components of the Rubicon type B laboratory potentiometer. The lower section essentially consists of a circular scale indicating potentiometer which has a self-balancing scale range of 0 to 1.1 millivolts. The Brown-Rubicon Precision Indicator is a product of the Minneapolis-Honeywell Regulator Company.

Mounted below the precision indicator is a Kay-Lab Absolute D.C. Power Supply, a product of the Kalbfell Laboratories. This power supply was modified by Group W-3 to give an adjustable output of 4 to 300 volts in one volt steps with a long time voltage stability of 0.05% and short time voltage stability of 0.01%.

Below the D.C. power supply is a Rubicon laboratory potentiometer which may be used to reduce output voltages of electrical equipment so that the voltages can be recorded by some recorder selected in the recorder racks.

Rack C. Twelve thermocouple switches are mounted in this rack. They were intended for use with equipment to be used in the gas temperature measurements mentioned above.

Below the thermocouple switches is mounted the control chassis for the 6 logarithmic tritium sniffers located at various points in Room 9 and the penthouse. The sniffers are part of the tritium monitoring equipment described in Chapter 5.

At the bottom of rack C is a circuit breaker for all of the 115 volt A.C. power supplied to the recorder racks.

Rack D. At present the equipment in rack D is not used. It was originally intended to be used with pressure cells, containing pressure sensitive wires. In an early design of the filling equipment the cells were to be used in making pressure measurements of the gas in the pressure vessel being filled in

Room 9, but they were discarded in a later design. At the top of the rack is an adjustable range, single pen strip chart recorder which contains a self-balancing potentiometer. The instrument is a Minneapolis-Honeywell Type 153 Recorder, Model Y153(R)17(VA)-(II)-30A3A8K. Its range is adjustable from a range of 0 to 1 millivolt to a range of 0 to 50 millivolts, and the range can be shifted upward or downward anywhere between -50 and +50 millivolts. Associated with the recorder are a Rubicon Type B laboratory potentiometer and a Minneapolis-Honeywell electronic galvanometer, called a Brown Electronic Null Indicator. These instruments are stacked below the recorder.

Rack E. In rack E is mounted a wind direction and wind velocity recorder. This instrument is a Bendix Aerovane Wind Recorder, Model 141, manufactured by the Friez Instrument Division of the Bendix Aviation Corporation. Associated with this recorder are (1) the Bendix Aerovane Transmitter, which is mounted on the roof of the penthouse, and (2) the Bendix Aerovane Indicator, a combined wind speed and wind direction indicator, which is mounted on the alarm panel of the instrumentation consoles.

Chapter 5

TRITIUM MONITORING EQUIPMENT

Tritium levels are monitored at various locations in Building HP-86 and in areas about the building. In each of the Rooms 9 and 10 the tritium level is measured by an Applied Physics Corporation Vibrating Reed Electrometer to which a CMB-7 ionization chamber has been added. An alarm bell on the chassis of the ionization chamber sounds if the measurement of tritium level exceeds a safe limit setting. The units are connected via telephone cable to a Bristol single pen, strip chart recorder, having a 0-30 millivolt range, located in the Guard Station at the Main Gate of TA-33 (Station 470). By use of the input selector switch on the recorder the output of either unit can be recorded. The output of the Room 9 unit is usually recorded, but if it is desirable to have an indication of the tritium level in Room 10, a record can be obtained by switching to the output of the Room 10 unit. A Room 10 record is usually obtained before entering the room after it has been closed up for a night or a weekend. The alarm circuit of the Vibrating Reed Electrometer in Room 9 is connected by telephone cable to an alarm bell at Guard Station 470.

Tritium levels are also measured at six different locations in Room 9 by means of six sniffers which are part of the six

channel logarithmic sniffer unit made by Group P-1. The control chassis of this unit is located in Room 10 in recorder rack C, and the six sniffers of this unit are located at the following positions: one unit on the Manifold Chamber ventilation duct, one on top of the Process Chamber, one in the top of the Filling Chamber, one on top of the dividing wall in Room 9, one in the penthouse on top of HP-86, and one on the exhaust stack in the penthouse. The output of each of these sniffers is connected to the tritium alarm circuit of the alarm panel in Room 10, described in Chapter 6. The level at which the alarm circuit will cause a sonic alarm is individually adjusted on each of the sniffers.

In addition to the permanently located tritium level monitors described above, there are a number of portable sniffer units. Some are used in Rooms 9 and 10 and in other rooms of HP-86. In the areas about HP-86, there are also located portable sniffers as follows: in the Guard Station at the Main Gate of TA-33 (Station 470), in the Guard Station at the gate to the enclosed area around HP-86 (Station 480), and in Building HP-39 (the Machine Shop).

Chapter 6

ALARM SYSTEMS

Associated with the tritium monitoring equipment and certain of the HP-86 facilities are sonic and visual alarm systems which are set up to attract the attention of operating personnel in Room 10. As described in Chapter 4, instrumentation panels are located above the control consoles. Between the process and filling instrumentation panel, as shown in Fig. 21, is an alarm panel. A close up view of the Alarm Panel is shown in Fig. 24. This is an instrument rack which contains meters, indicating lights, and sonic alarm circuits. At the top of the rack is a Bendix Aerovane Indicator, which shows wind direction and wind speed. The wind direction and the wind speed are considered when a filling operator decides whether or not the scram signals of the alarm system are to be sounded in event of a gas spill from the filling equipment.

Below the wind indicators is the ventilation alarm panel which contains meters and lights for visual alarms and circuits for a sonic alarm. The lights and meters give signals if relative air pressures become undesirable between the interior and exterior of each of the Rooms 9 and 10, and between the interior and exterior of the hoods in Room 9 (i.e., of the Manifold, Process and Filling Chambers). Use of the sonic alarm is optional.

A description of the ventilating system is given in Chapter 7. Below the ventilation alarm there is a panel containing maximum tritium level indicators and indicators of failures of the house supplies of compressed air and chilled water. This panel can be considered as (1) the tritium alarm panel, and (2) the house services alarm panel. The tritium level alarms are associated with the six sniffers of the six channel logarithmic unit described in Chapter 5. Should there be a drop below 130 psi in the pressure of the compressed air supplied to the air lines of the filling equipment, a red light will show on the house services alarm panel and an alarm will sound. Should there be a drop below 1 qt/min in the rate of chilled water flow through the diffusion pumps of the Process System, an alarm will sound and a red light will show on the house services alarm panel.

One of the parts of each Vibrating Reed Electrometer is an alarm box containing a microammeter. If the needle of the microammeter makes contact with the preset element of the dial switch, the alarm bell on the box will sound. In the case of the Room 9 electrometer, the alarm circuit also contains a connection to an alarm bell at Guard Station 470, and this bell will also sound if the alarm system is actuated.

Drawings for the leak alarms and house utility alarms are listed in Appendix C.

A system has been provided to signal an alarm in event of a tritium spill in Room 9. An alarm is given if the operator at the controls in Room 10 decides that personnel are in danger and should evacuate their working areas. Should the operator decide to give the alarm, he throws a three position switch on the Filling Console to the SCRAM position. The other two positions of the switch are designated as Plan 1 and Plan 2.

The SCRAM alarm system is associated with the signaling system which indicates the operating conditions in the Building HP-86 vault. When the vault is open (that is, when personnel are working in the vault) Building HP-86 is on Plan 2, and only people with exchange badges or people authorized by qualified personnel are allowed in the building. When the vault is closed Building HP-86 is on Plan 1, and people authorized to enter TA-33 may enter the building.

The SCRAM alarm box in Room 10 is shown in Fig. 25, and beside the box are shown instructions for sounding the SCRAM alarm. Alarm boxes are located at the other positions indicated in Table 3.

An alarm horn is located in Building HP-20. This horn will sound if the three position switch on the Filling Console is thrown to the SCRAM position.

Drawings of the SCRAM Alarm System are listed in Appendix C.

Table 3

LOCATION OF SCRAM ALARM BOXES AND HORNS

Box Station No.	Location
1	Building HP-86, Room 10
2	Guard Station 470 (at TA-33 Gate)
3	Building HP-86, Room 1
4	Guard Station 480 (at Gate to HP-86 Area)
5	Building HP-39, Shop
6	Building HP-19, Hall

Horn Station	Location
1	Building HP-20

Chapter 7

DESCRIPTION OF BUILDING HP-86 AND ITS UTILITIES

Building HP-86 consists primarily of three parts.

Another part is devoted to laboratories, office space and a machine shop. Another part is devoted to special equipment for building services. The building is of poured concrete construction, with most of the walls being double reinforced concrete twelve inches thick. Only the interior walls of Room 6, Room 4 (the janitor's closet), Rooms 5 and 5A (the two lavatories) and the wall between Rooms 1 and 11 are of pumice block construction.

As shown in Fig. 1, the vault is divided into three rooms, Rooms 9, 10 and 7. Room 9 contains the apparatus used to fill pressure vessels with tritium-deuterium gas, and space is provided in this room for storage of tritium filled shipping containers and for a few tritium filled pressure vessels. In the wall separating Rooms 9 and 10 is a two-inch thick glass plate, through which one can observe operations in Room 9 from the control desks in Room 10.

Controls for the mobile high pressure units are mounted on the wall between Rooms 7 and 10 so that the units can be operated from Room 10. Pressure vessels intended for burst tests with the high pressure intensifier are placed in Room 7 to be tested.

Laboratory space is provided in Rooms 2, 3 and 11. A machine shop is located in Room 1.

The special equipment for building services is located in Rooms 6 and 12, which are designated as equipment rooms. The Room 12 Equipment Room is the penthouse on top of Room 9. The air heating coil, evaporator and ventilating equipment associated with Rooms 7 and 10 and the remaining rooms of the building, is located in the Room 6 Equipment Room along with the boiler and the refrigeration compressor which supply steam and refrigerant, respectively, to the Rooms 6 and 12 heating coils and evaporators. The unit which provides chilled water to various outlets of the building is also located here.

The utilities and special equipment associated with the utilities are described below.

7.1 Heating and Ventilating System

The ventilating system circulates heated or cooled air depending on the demand of temperature controls. Rooms 7, 9 and 10 are temperature controlled to 70°F plus or minus 2°F. Other sections of the building are ventilated with air which is heated if the air temperature drops below the temperature settings of the thermostats in those sections. The heat source for the building is a gas-fired boiler with a capacity of 1,600,000 btu per hour, and it supplies steam to three separate air heating coils for the following sections of the building: (1) Room 9, (2) Rooms 7 and 10, and (3) the rest of the building (Rooms 1 through 8 and Rooms 11 and 11-A). Air is chilled by a refrigeration compressor which supplies refrigerant to separate evaporators for (1) Room 9, and (2) Rooms 7 and 10. The heating, cooling and ventilating systems are thermostatically regulated. Among the thermostats are those which control the air operated dampers in the ducts of the ventilating system.

A ventilation control panel is located in Room 10. It is shown in Fig. 24. Most of the controls are for the Room 9 ventilating system. Controls for the air flow through the Manifold, Process and Filling Chambers can be set for three different conditions: (1) 24 fresh air changes per hour with heating of the incoming air only, (2) 8 fresh air changes per hour with temperature control of the air to the above mentioned

degree and (3) no fresh air changes with temperature control of the air to the above mentioned degree. The third condition means that the air in the room is being recirculated only through the heating and cooling coils to maintain the temperature and that no air is being exhausted up the stack.

7.2 Circulating Chilled Water

Since there are several items of equipment which require a continuous flow of cold water (e.g., diffusion pumps and condensers in the compressed air line) a unit was installed in the Room 6 equipment room to supply chilled water to various outlets throughout the building.

7.3 Emergency Electric Power Generator

Since electric power outages of long duration may occur at TA-33, an emergency power generator is installed in the Room 6 Equipment Room. This generator is capable of supplying electric power for the mass spectrometer, the circulating chilled water supply, the gas handling equipment control circuits, the alarm circuits and several lamps around the building for minimum lighting during an emergency. The unit is a gasoline engine driven generator having a rating of 7.5 KVA at 0.8 power factor, 115/208 volts, 3 phase 60 cycles. The gasoline tank, installed underground outside the building, has a capacity of 50 gallons and a remote fuel level indicating instrument near the motor-generator set.

7.4 Compressed Air Supply

Because of the unusually large demands for compressed air in the operation of Building HP-86 equipment, a 15 horsepower, 3 stage, 200 psi air compressor has been installed in the Room 6 equipment room. This compressor works into a 150 cubic foot air receiver from which the air is piped to the various service outlets around the building.

7.5 House Vacuum System

Installed in the Room 6 equipment room is a vacuum pump which is capable of producing a vacuum of 100 microns (0.1 millimeters of mercury) at the various vacuum line outlets throughout the building. Except for the outlet connected to the liquid nitrogen storage dewar, each outlet is equipped with a removable restricting orifice of 0.073 inches in diameter so that the system will not be flooded with air when a new piece of apparatus is connected to the system.

7.6 Low and High Pressure Helium Supply

Low pressure helium is supplied to the various laboratory benches through the building, for leak detecting, etc., from a 6 tank manifold system on the outside of the east wall of the building. The helium tank pressure, 2,200 psi, is reduced at the manifold to 250 psi and distributed to the various outlets throughout the building at this pressure. Each outlet also has

a regulator through which the pressure may be further reduced to the range of 0 to 125 psi.

High pressure helium at the tank pressure, 2,200 psi, is supplied directly from the manifold to special outlets in Rooms 7-A, 7-B and 10 for various high pressure gas work involving the dead weight gauge, high pressure intensifier and the high pressure pump units.

7.7 High Pressure Hydrogen Supply

High pressure hydrogen is supplied from a manifold outside the east side of the building to Rooms 7-A, 7-B and 10 for use with the mobile high pressure pumps and any other equipment requiring a supply of hydrogen.

7.8 Additional Utilities

Additional utilities serving the building are:

A. Water at ambient temperature from the TA-33 supply tank,

B. Hot water from a hot water heater in the Room 6 equipment room,

C. Propane gas from the TA-33 storage tank,

D. Electric power - 115/208 volt single phase, 208 and 440 volt 3 phase,

E. Sanitary sewer system,

F. Contaminated sewer system.

Appendix A

1. Drawing List of Mobile Pump System

Item Identification and Drawing Number	Title
Pump System:	
32Y-21632 D1A	Mobile Pump System, Assembly
C2A	Mobile Pump System, Piping
C3A	Mobile Pump System, Base Plate Detail
C4A	Mobile Pump System, Mounting Plate
C5A	Mobile Pump System, Oil Reservoir
C6	Mobile Pump System, Cylinder Jacket
Air Operated Valve:	
32Y-21627 C1B	30,000 psi Hydra Spring Valve, N.C.-Air Op. (Details)
C2B	" (Assembly)
Autoclave Valve Mods:	
32Y-21593 C1	30,000 psi Autoclave and Packing Mod.
32Y-21597 B1A	Valve Mounting
Oil-Gas Cylinder:	
Autoclave Engr. Dwg. 20-1594	Assembly Hydraulic Cylinder 2-1/2 I.D. x 30 in. D.

2. Drawing List of 10,000 psi Pump and Intensifier

Item Identification and Drawing Number	Title
Pump System:	
32Y-21591 D1C	10,000 psi Pump and Intensifier, Equipment Frame
D2C	10,000 psi Pump and Intensifier, Piping Layout
D3B	Cover Plates for Pump Frame
Clamps:	
32Y-21592 C1	Cylinder Clamps

Item Identification and Drawing Number	Title
Autoclave Valve Mods:	
32Y-21593 C1	30,000 psi Autoclave and Packing Mod.
32Y-21597 B1A	Valve Mounting
Cylinder of Position Indicator for B2.5 Piston:	
32Y-21601 C1	Variable Volume Cylinder for B2.5
Oil Tank:	
32Y-21213 C1	Air Tank

3. Drawing List for Dead Weight Gauge Accessory Rack and Harwood Dead Weight Tester

Item Identification and Drawing Number	Title
Rack:	
32Y-21643 D1A	Dead Wt. Gauge Accessory Rack Equip. Frame
C2A	Dead Wt. Gauge Accessory Rack Detail Front Panel
C3	Dead Wt. Gauge Accessory Rack System Assembly
Gas-Oil Separator:	
32Y-21925 B1A	Gas-Oil Separator Assembly
B2	" " Cylinder
B3A	" " Head
A4A	" " Diaphragm
A5	" " Slug and Packing
LASL Parts for D.W.G. Tester:	
32Y-21615 C1	Yoke
32Y-21598 B1	D.W.G. Fittings
D.W.G. Tester:	
Harwood Eng. Co. Dwg. F-1013	Dead Weight Tester for Pressure up to 200,000 psi

Appendix B

DRAWING LIST OF FILLING EQUIPMENT

1. Process System

Item Identification and Drawing Number	Title
Manifold Chamber:	
32Y-21741 D1	Manifold Chamber
B2	Manifold Chamber Tool Tray
32Y-21735 D1	Table for Manifold Box
B2	Manifold Indicator, Panel Layout
Process Chamber:	
32Y-21640 D1B	Lab Hood Assembly
D2	Obsolete Sheet
D3	Lab Hood Plenium Detail
D4	Lab Hood Framing Detail
D5	Lab Hood Door Detail
D6A	Lab Hood Sheet Metal Detail
D7	Lab Hood Vent Detail
32Y-21699 D1	Damper Operator Mechanism, Assembly
C2	Damper Operator Mechanism, Details
C3	Damper Operator Mechanism, Details
Mounting Frame:	
32Y-21920 D1-D3	Process Chamber Equipment Mounting Frame
Piping:	
32Y-21901 D1A and B	Process System, Gas Piping
D2A and B	Process System, Air Piping
Parts List:	
32Y-21902 A1-A2A and B	Process System, Parts List
Tritium Shipping Container:	
26Y-70002	Vacuum Tank
Tank Connector:	
32Y-21928 C1	Tank Connector

Item Identification and Drawing Number	Title
Helium-3 Storage Tank:	
26Y-70002	Vacuum Tank
Air Operated Valve:	
32Y-20253 C1A	Vacuum to 150 psi Air Operated Bellows Valve, Assembly
B2A	" Air Cylinder
B3	" Bracket
A4	" Mounting Bracket
A5A	" Piston
A6	" Indicator Rod
A7	" Plug
A8	" Gland
Cold Traps:	
32Y-21691 C1A	Cold Traps No. T1, T2, T3, Assembly
B2	" " Flanges
B3	" " Plugs, Tubes and Flanges
B4	" " Block
B5	" " Glass Jacket
Spectrometer Leaks:	
32Y-21918 B1	Low Pressure Leak
32Y-21938 B1	Low Pressure Leak
Tank:	
32Y-21194 C1A	Standard Volume Tank
Charcoal Trap:	
32Y-21195 D1A	Charcoal Trap
32Y-21622 D1A	Charcoal Trap System, Assembly
C2	Charcoal Trap System, Jacket
C3	Charcoal Trap, Plates and Support Tubes
C4	Charcoal Trap, Supporting Spider
D5	Charcoal Trap, Mechanism Details
C6	Charcoal Trap, Guide Wheels and Pins
C7A	Charcoal Trap, Dewar Support
D8	Charcoal Trap, Heater and Jacket
32Y-21666 D1	Heater Tube Dies for Charcoal Trap

Item Identification and Drawing Number	Title
Autoclave Valve Mod:	
32Y-21593 C1	30,000 psi Autoclave and Packing Mod.
Rotary Vane Pump:	
26Y-70729 (sheets 1-12)	Two Stage Vane Pump

2. High Pressure System

Filling Chamber:	
32Y-21640 D1B	Lab Hood Assembly
A2	Obsolete Sheet
D3	Lab Hood Plenium Detail
D4	Lab Hood Framing Detail
D5	Lab Hood Door Detail
D6A	Lab Hood Sheet Metal Detail
D7	Lab Hood Vent Detail
32Y-21699 D1	Damper Operator Mechanism, Assembly
C2	" " " Details
C3	" " " Details
Mounting Frame:	
32Y-21677 D1	Equipment Frame
Piping:	
32Y-21903 D1A and B	Pressure System Gas Mercury and Oil Piping
D2A and B	Air Piping
Parts List:	
32Y-21904 A1-A3 A and B	Pressure System Parts List
Air Operated Valve:	
32Y-20253 C1A	Vacuum to 150 psi Air Operated Bellows Valve, Assembly
B2A	" Air Cylinder
B3	" Bracket
A5	" Mounting Bracket
A5A	" Piston
A6	" Indicating Rod
A7	" Plug
A8	" Gland

Item Identification and Drawing Number	Title
High Pressure Valve, Normally Closed:	
32Y-21905 C1B	High Press. Valve Norm. Cl. Air Open Assembl
C2B	" " " " Head
C3B	" " " " Details
C4B	" " " " 5-way Head
C5C	Dummy High Pressure Valve, Head
High Pressure Valve, Normally Open:	
32Y-21907 C1B	High Press.Valve, Norm. Op.Air Close Assembl
C2B	" " " " Head
C3B	" " " " Details
B4	" " " " Switch Bracket
Safety Tank:	
32Y-21586 C1	Safety Tank
Sprague Pump Mod's:	
32Y-21916 C1	Check Valve Mod's Sprague Pump Assy. and Details
C2, C3	Check Valve Mod's Sprague Pump Details
Pumping Stages:	
32Y-21927 B1	Assembly Schematic of Stages I, II or III
32Y-21911 D1B	Stage I Oil-Mercury Separator Assy.
D2B	Stage I Cylinder
C3B	Stage I Cylinder Head No. 1
C4B	Stage I Cylinder Head No. 2
C5B	Stage I Oil-Mercury Separator, Piston
C6B	Stage I Oil-Mercury Separator, Helium Cylinder Details
C7B	Stage I Lock Screw, Lock Nut and Packing Details
D8	Stage I Mercury-Gas Separator, Assembly
C9	Stage I Cylinder Head No. 3
32Y-21908 C1A	Clamp, Stage I Cylinder

Item Identification and Drawing Number	Title
32Y-21912 D1B	Stage II Oil-Mercury Separator, Assembly
C2B	" Cylinder
C3B	" Oil-Mercury Separator, Head No. 1 and Packing
C4B	" Oil-Mercury Separator, Piston and Connecting Rod
C5	" Mercury-Gas Separator, Assembly
C6	" " Misc. Details Head No. 2 and Splash Plate
32Y-21909 C1A	Clamp, Stage II Cylinder
32Y-21913 D1A	Stage III, Oil-Mercury Separator, Assembly
C2B	" Cylinder
C3B	" Sleeve
C4B	" Oil-Mercury Separator Piston and Connecting Rod
C5B	" Head and Packing
C6B	" Oil-Mercury Separator Packing Gland and Helium Cylinder
C7A	" Oil-Mercury Separator Misc.Details
C8	" " Assembly
C9	" Head No. 2 and Splash Plate
32Y-21910 C1	Clamp, Stage III Cylinder
Air Reservoir:	
32Y-21213 C1	Air Tank
Oil Reservoir:	
32Y-21930 C1	Oil Reservoir
Gas-Oil Separator:	
32Y-21925 B1-A5	Gas-Oil Separator
Sumps:	
32Y-21929 C1	Gold and Platinum Sumps
32Y-21924 C1	Gold Sumps
Leaks 5 and 7:	
32Y-21926 C1	Gas Sampler No. 5 and 7

[redacted]

Item Identification and Drawing Number	Title
Leak 6:	
32Y-21917 B1	High Pressure Leak
32Y-21939 C1	High Pressure Leak
Autoclave Valve Mod:	
32Y-21593 C1	30,000 psi Autoclave and Packing Mod.
Safety Bos and Projectile Valve Operator:	
32Y-21720 D1	Safety Box and Valve Operator Assembly
C2A	Valve Operator Body
C3A-C5A	Valve Operator Details
C6-7	Safety Box Details

3. Nitrogen Transfer Line

32Y-21940 B1A	Nitrogen Transfer Schematic
B2-B3	Nitrogen Transfer Details

4. Control and Instrumentation Consoles

Consoles:

32Y-21649 D1	Control and Instrumentation Layout
D2	Control Console Assembly
D3	Control Console Sections and Details
D4	Instrumentation Console Left Hand Assembly
D5	" " Sections and Details

Panels:

32Y-21651 D1, D2	Control Panels, Panel Faces
32Y-21900 C1	Lettering for Marco Industries Dual Lamp Indicator Plastic Caps

5. Instrumentation Diagram

32Y-21226 D1C	Building HP-86 Instrumentation

[redacted]

6. Wiring Diagrams

Item Identification and Drawing Number		Title
Chamber Terminal Board Connections:		
32Y-21921	D1-D3	Manifold Chamber Control and Instrumentation Wiring Diagram
	D4-D6	Process Chamber Control and Instrumentation Wiring Diagram
	D7-D10	Filling Chamber Control and Instrumentation Wiring Diagram
	D11	Filling Chamber Control and Instrumentation Controls Console
	D12	Gas Handling System Power Distribution Equipment Control Wiring Diagram
	C13	Process System and Filling System Scram Wiring Diagram
	B14	Filling Chamber Valve Operator Wiring Diagram
32Y-21921	C15	Gas Handling System Damper Control Wiring Diagram
	D16	Alarm Panel Wiring Diagram
	B17	Sniffer and Multi-Air Sampler Schematic
	B18	Charcoal Trap Thermocouple Wiring Diagram
	B19	Electromanometer System Schematic
Mercury Level Indicator Valve and Pump Control:		
32Y-20301	B1	Mercury Level Indicator Circuit Diagram
	B2	" " " System Wiring Diagram
32Y-20302	B1	" " " Dynamic Testing
32Y-21921	D7-D10	Filling Chamber Control and Instrumentation Wiring Diagram
	D11	Filling Chamber Control and Instrumentation Console Controls
Mass Spectrometer:		
32Y-21933	C1	Room 10 HP-86 Mass Spectrometer Protective Circuit

Appendix C

DRAWING LISTS OF ALARM SYSTEMS

1. Alarms for Leaks and House Utilities

Item Identification and Drawing Number	Title
Chassis:	
32Y-21649 D1	Control and Instrumentation Layout
D5	Instrumentation Console, Section and Details
D6	Alarm Console, Assembly and Misc. Details
D7	Alarm Console Details
32Y-21651 D1	Control Panels, Panel Faces
Wiring Diagrams:	
32Y-21921 D16	Alarm Panel Wiring Diagram
32Y-21932 B1	Wind Indicator Schematic

2. Plan and Scram Signals

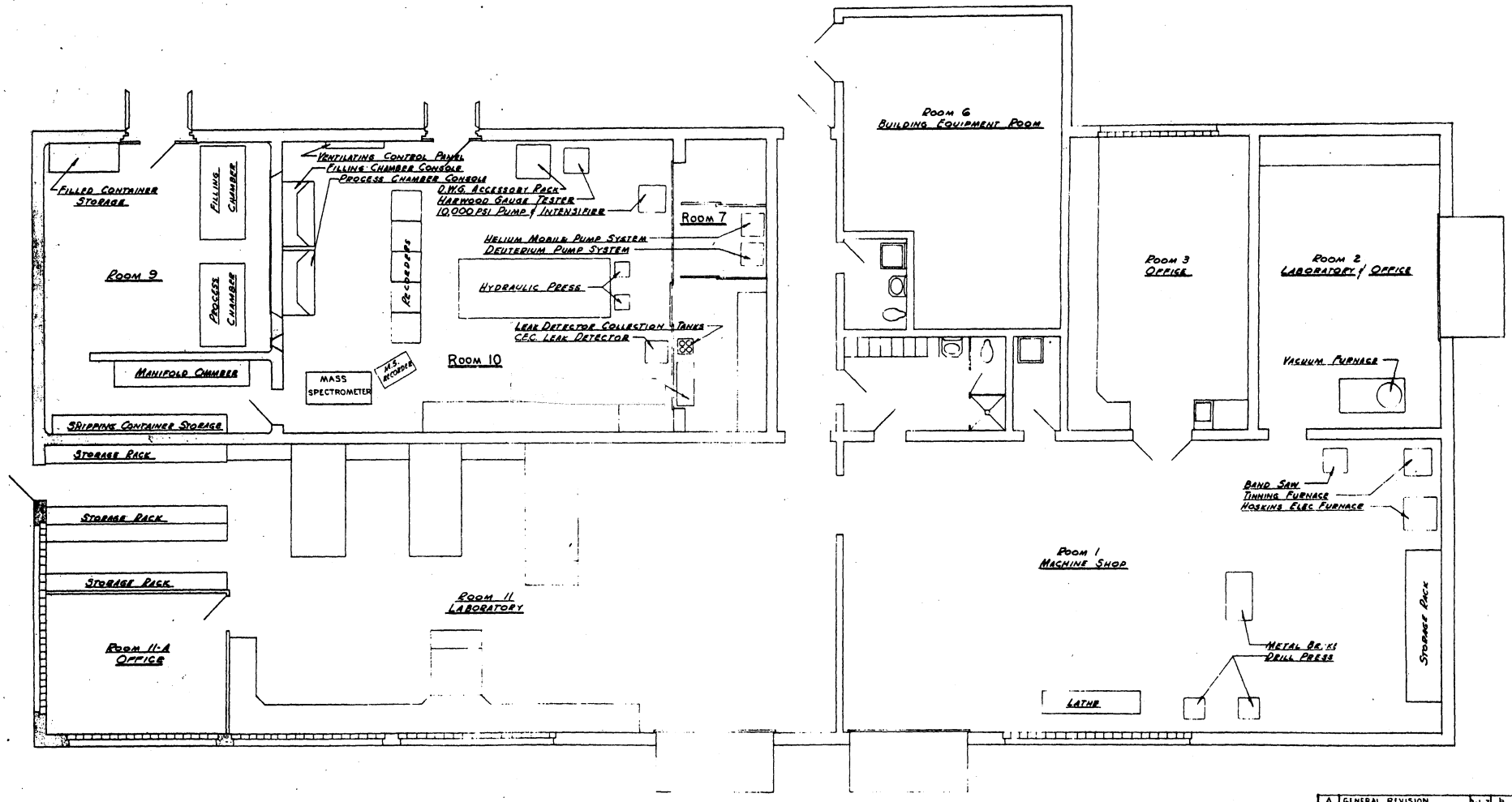
Chassis:	
32Y-21914 D1	Alarm System Lighting Fixture Assembly
D2	" " " " Box
D3	" " " " Details
Wiring Diagrams:	
32Y-21922 D1	Scram Alarm System Wiring Schematic
C2	Scram Alarm System Internal Wiring Diagram

Fig. 1

Building HP-86 Floor Plan

Unclassified

[redacted]AL



[redacted]

[redacted]AL

Unclassified

A	GENERAL REVISION	3-1-7	

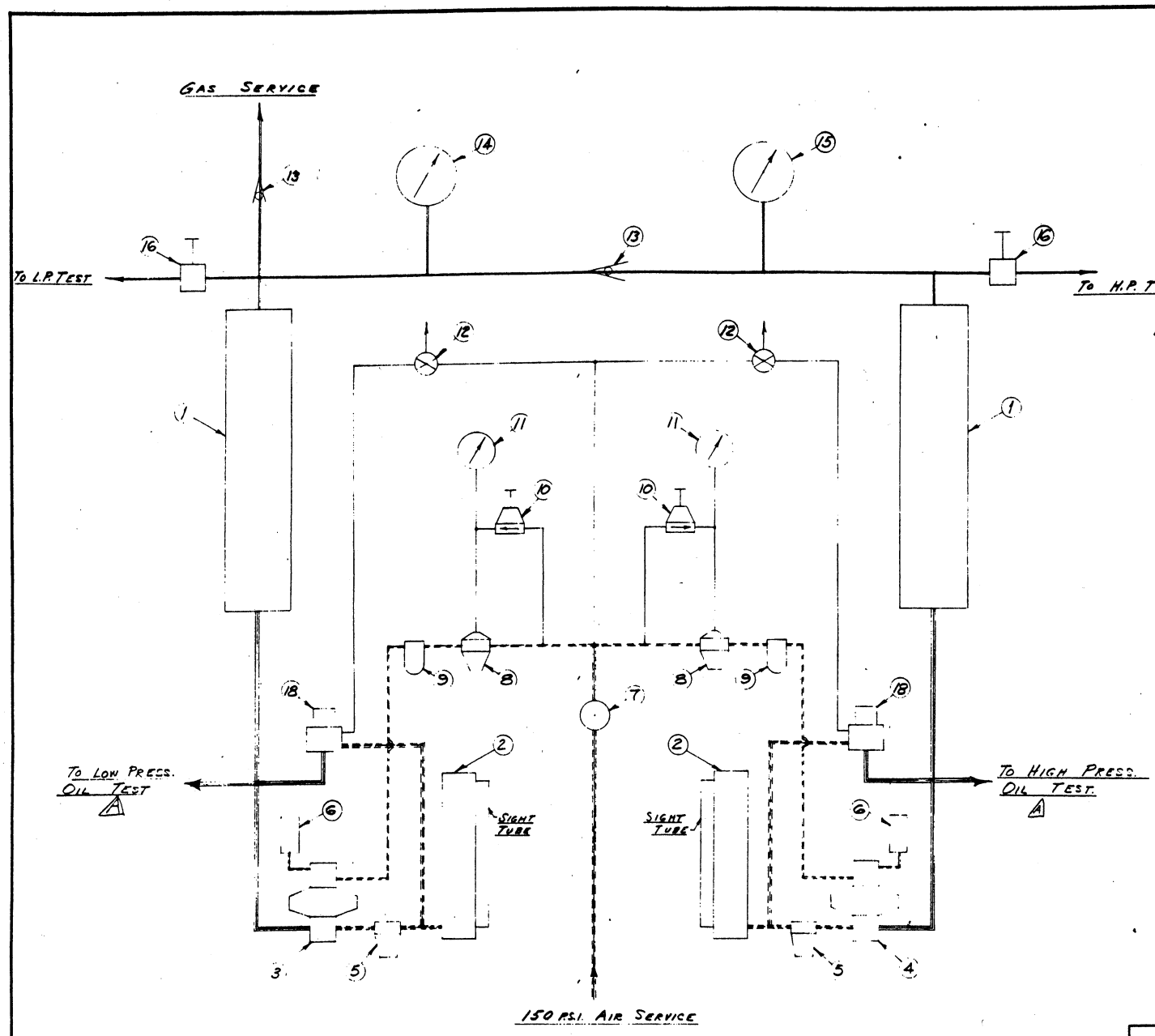
Floor Plan
Building HP-86

32Y-21931 D7

-47-

Fig. 2

Flow Diagram of Mobile Pumping System



BILL OF MATERIAL

PART NUMBER	NUMBER REQ.	PER	DESCRIPTION
1	2		AUTOCLAVE OIL-GAS CYL. (20-150)
2	2		.8 GAL OIL RES. DWG.
3	1		10 KPSI SPRAGUE PUMP
4	1		30 KPSI SPRAGUE PUMP
5	2		PUROLATOR OIL FILTER
6	2		AIR MUFFLER
7	1		AIR FILTER - ½" I.P.S.
8	2		PRESS. REG. PILOT CONTROLLED
9	2		AIR LUBRICATOR
10	2		PILOT AIR REG.
11	2		0-200 PSI AIR GAUGE (3½" DIA)
12	2		3-WAY AIR VALVE - MAN. OP.
13	2		30 KPSI CHECK VALVE. (AUTO. 4C-C)
14	1		0-15 KPSI GAUGE (6½" DIA)
15	1		0-40 KPSI GAUGE (6½" DIA.)
16	2		1C-C2 AUTO. VALVE (2-WAY L)
18	2		HYDRA-SPR. VALVE - DWG. 32Y-21627

PIPING LEGEND

3/8 × 1/8	STAINLESS TUBING		
1/4 × 1/16	Do	Do	
1/2 O.D.	COPPER	TUBING	
1/2	Do	Do	Do
1/2	Do	Do	Do
1/4	Do	Do	Do

REV. LET.	CHANGED ITEM WAS	DATE	CHANGED BY	CHECKED BY
A	CHANGED TO ½ TUBING: ADD OIL TESTS. OMIT SAFETY VALVE	7/14/52	J.W.S	

REVISIONS

TOLERANCES - UNLESS OTHERWISE NOTED
FRACTIONAL: DECIMAL: ANGULAR:

	SIGNATURE	DATE	GROUP NO. & REPRESENTATIVE	DATE
DESIGNATED				
DRAWN	J.W.S	4/17/54	W-3	
CHECKED				
PROJ. ENG.				
APPROVED				

TITLE: - MOBILE PUMP SYSTEM - PIPING

TOT. SHTS.	SCALE	DRAWING NO.	SHEET SIZE AND NO.	PART NO.
6	—	32Y-21632-C2		

W-3-630

Fig. 3

Photograph of the Mobile Pump Systems

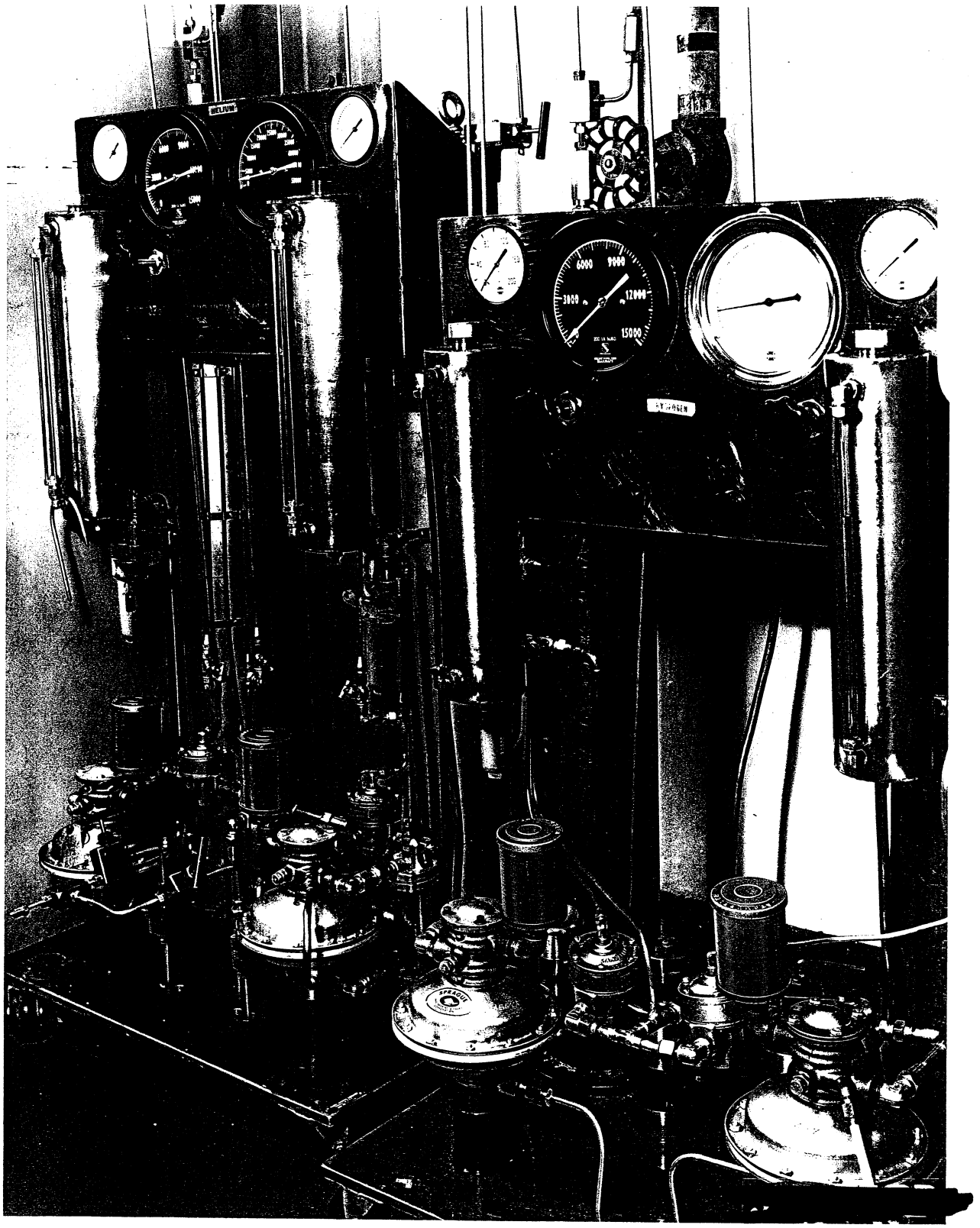
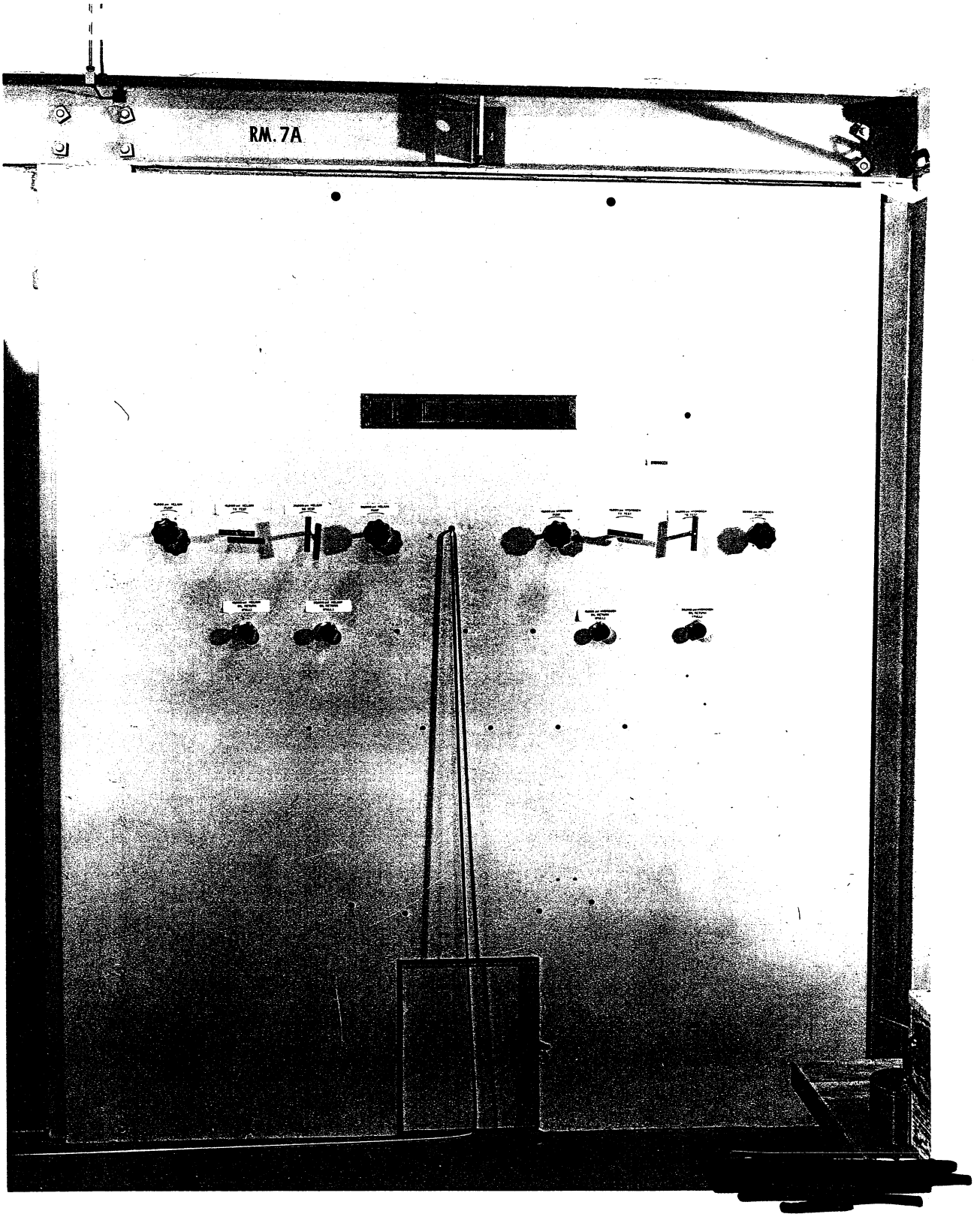

6000
9000
3000
12000
15000
HYDRAGEN

Fig. 4

Photograph of the Controls
of the Mobile Pump Systems


RM. 7A

[redacted]

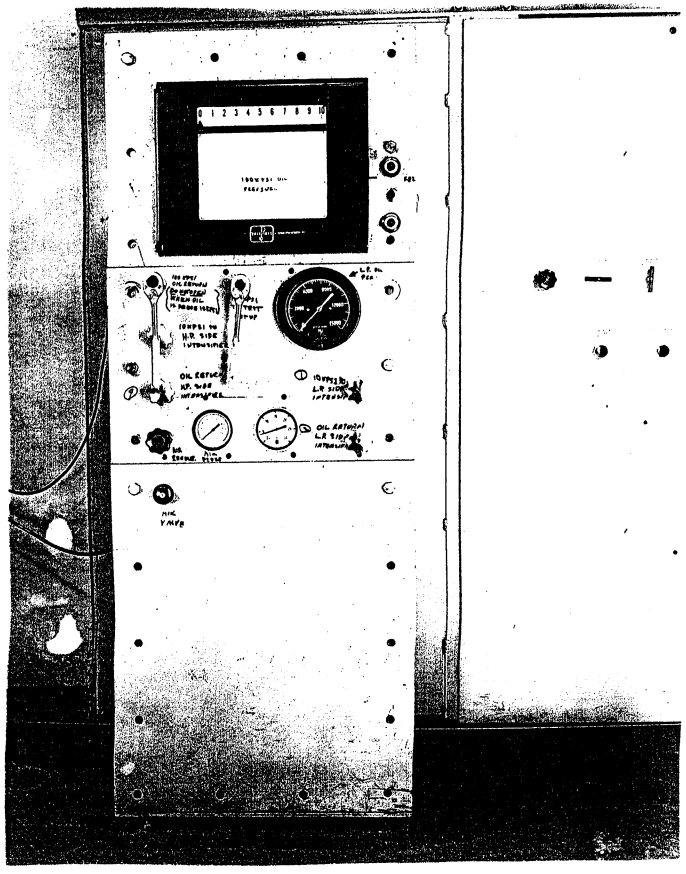
Fig. 5

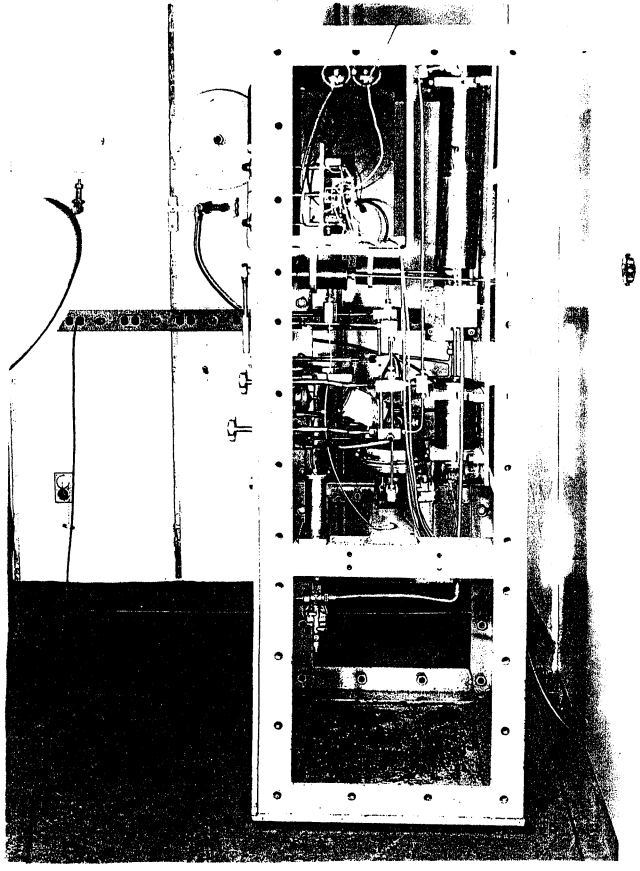
Photographs of the 10,000 psi Pump and Intensifier

Front and Side Views

[redacted]

[redacted]



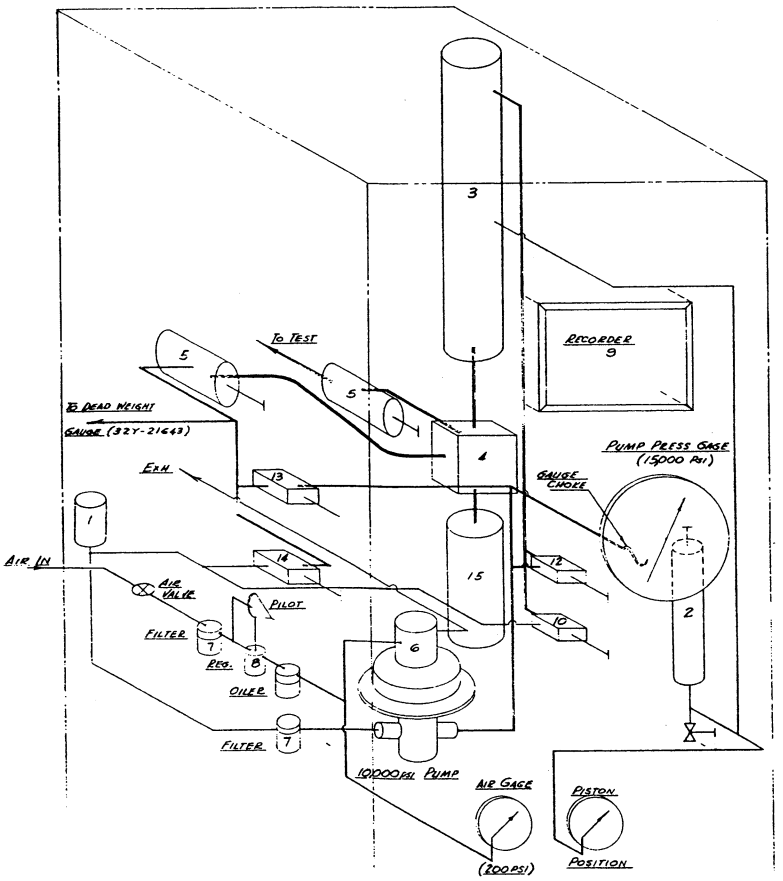


[redacted]

Fig. 6

Layout of 10,000 psi Pump and Intensifier

BILL OF MATERIAL			
PART NUMBER	NUMBER REQD.	MTL	DESCRIPTION
1	1	ASSEM	OIL TANK LASL DWG #32Y-21131
2	1	do	VARIABLE VOLUME CYLINDER LASL DWG #32Y-21601
3	1	do	HARWOOD INTENSIFIER MODEL B-2.5 100,000 PSI DISCHARGE HARWOOD ENGR. CO. LASL PR. 161293
4	1	do	HARWOOD STA CONNECTOR, HARWOOD ENGR. CO. LASL PR 161293
5	2	do	ANGLE VALVE, SERIES H, 100,000 PSI WRENCH OPERATED, HARWOOD ENGR. CO. LASL P.R. 161293
6	1	do	HYDRAULIC PUMP, 10,000 PSI, MOD. NO. S-216-C-100, SPRAGUE ENGR. AND SALES CO.
7	2	do	OIL FILTER, PUROLATOR PRODUCTS PART NO 57320, PUROLATOR PRODUCTS INC.
8	1	do	PRESSURE REGULATING VALVE, PILOT OPERATED, HOKKEN TYPE 204A006 PILOT - HOKKEN TYPE 1140-2
9	1	do	RECORDING POTENTIOMETER, MODEL 1PH 560-51, 0-10 MV. RANGE, THE BRISTOL COMPANY, WATERBURY, CONN.
10 & 12	2	do	VALVE, 30,000 PSI, AUTOCLAVE ENGR INC NO 1C-C2 MODIFIED PER LASL DWG NO 32Y-21593 & 32Y-21591
13 & 14	2	do	VALVE, 30,000 PSI, AUTOCLAVE ENGR. INC. NO 1C-C1 MODIFIED PER LASL DWG NO 32Y-21593 & 32Y-21591
15	1	do	PRESSURE CELL, 100,000 PSI, DESIGN [illegible] PAGE G LA [illegible] NO G748



LEGEND:
- 5/16 x 1/16 Stainless Tubing
- 1/4 x 1/16 Stainless Tubing
- 3/8 O.D. Copper Tubing

C	REDRAWN & GENERAL REVISION	1/26/59	[illegible]
SYM.	CHANGES (TYPE 1200)	DATE	ENGINEER OK	CHECKED OK

REVISIONS

	SIGNATURE	DATE		DATE
ENGINEER				
DRAWN	JWK	7/6/57	W-9	
CHECKED				
FINAL CHK.				
APPROVED				

TITLE: PIPING LAYOUT 10,000 psi PUMP & INTENSIFIER

DWG. NO. 32Y-21591 SHEET NO. D2 PART NO.

SHEET NO. 9 SCALE None

Fig. 7

Photograph of the Harwood Gauge Tester

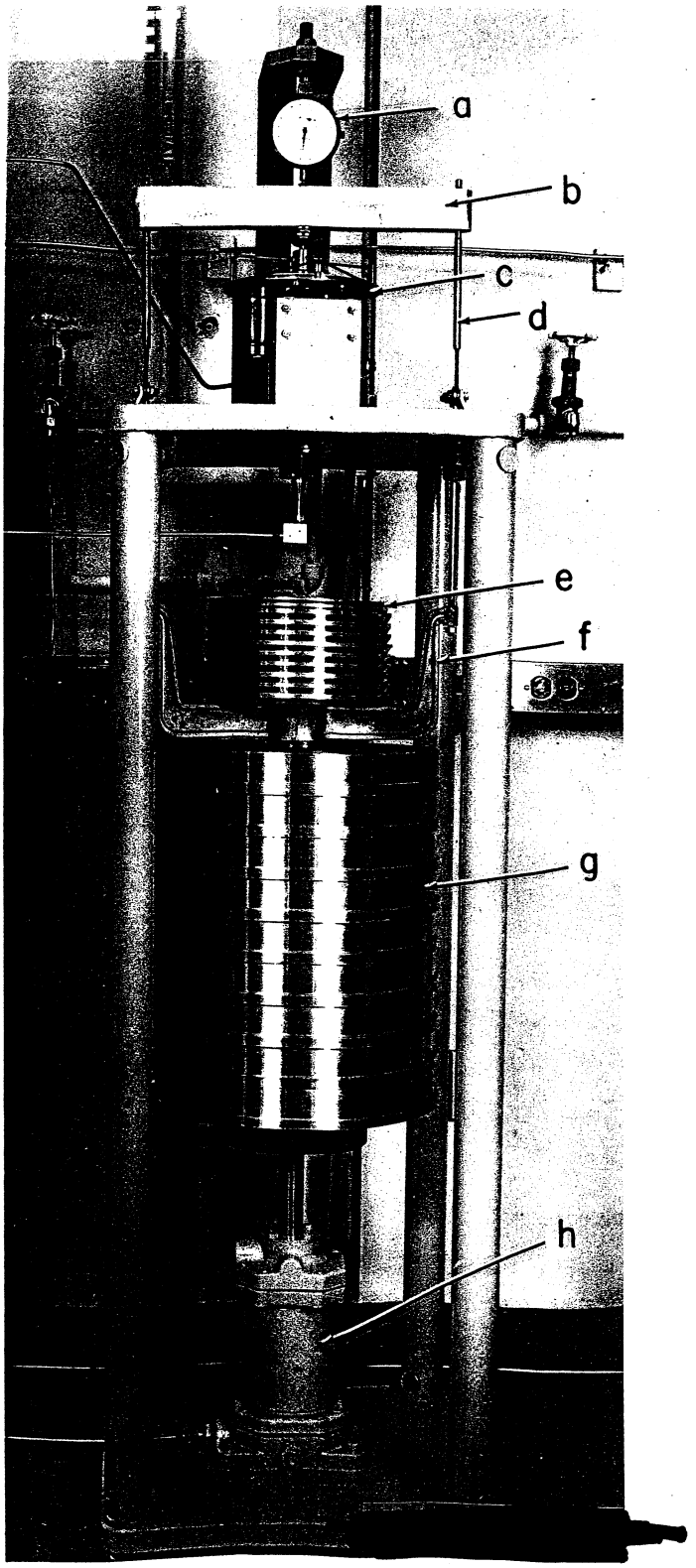
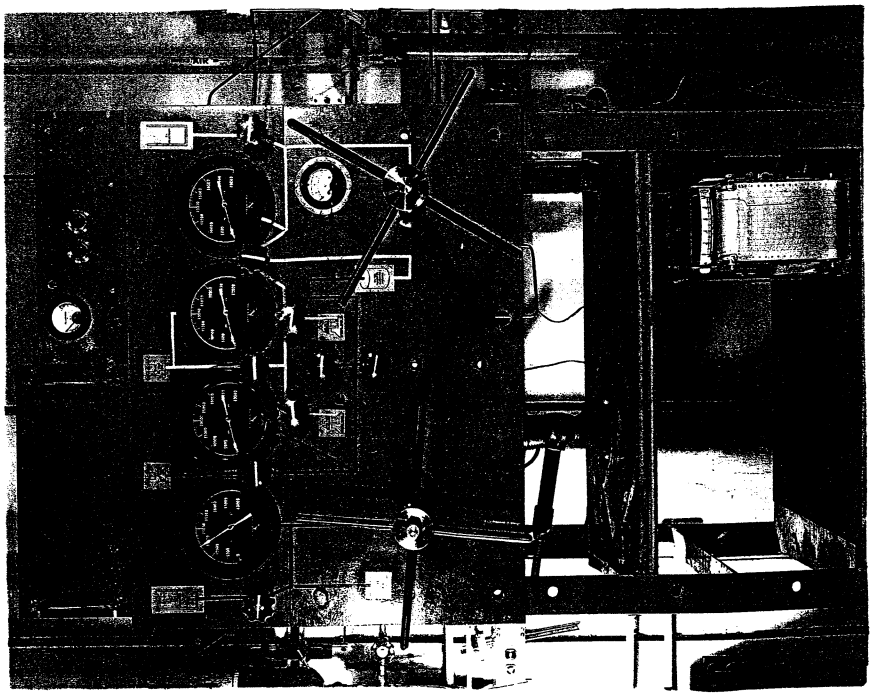

a
b
c
d
e
f
g
h

Fig. 8

Photographs of the Dead Weight Gauge Accessory Rack

Front and Side Views



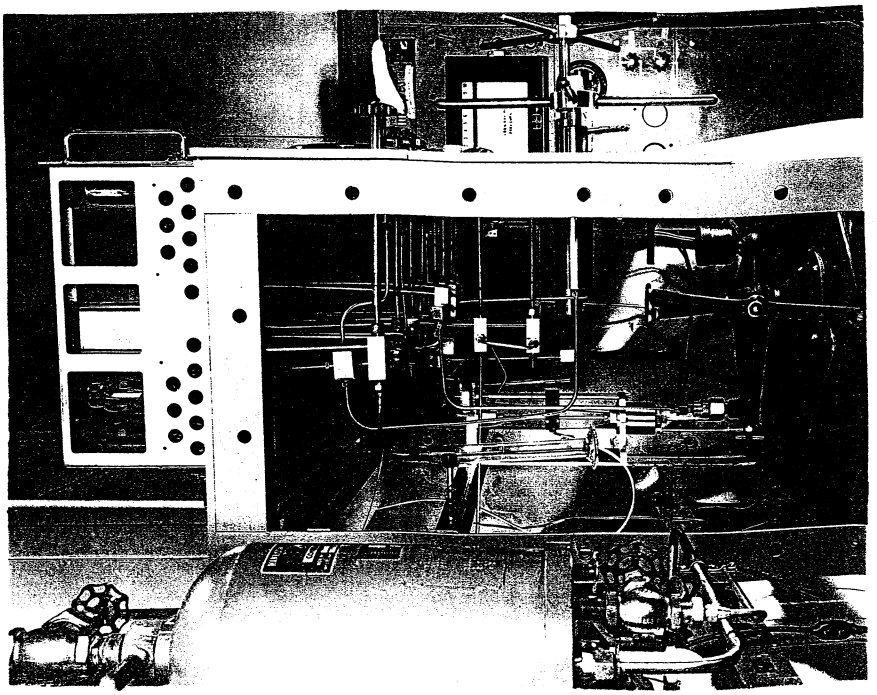
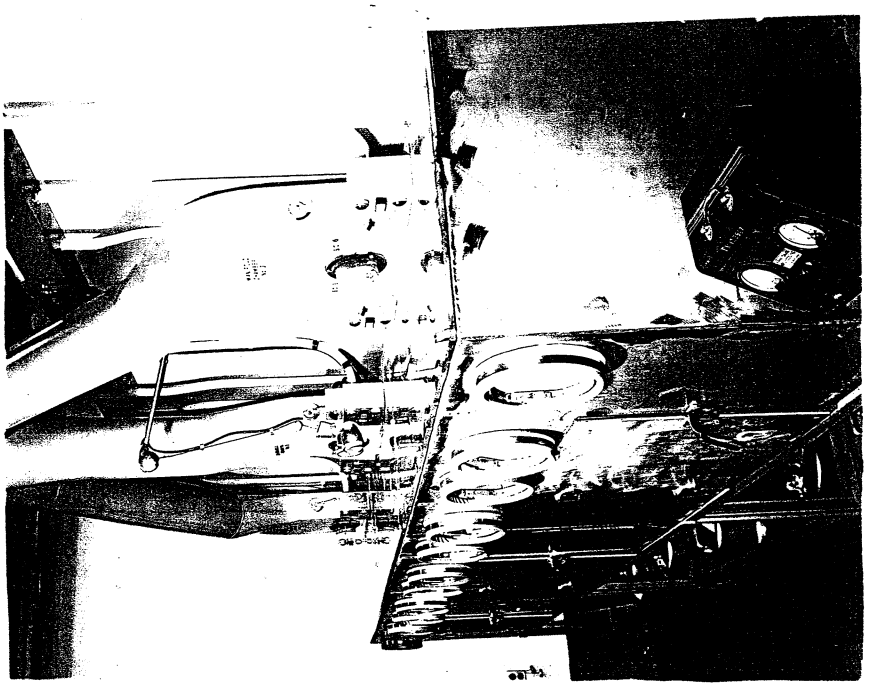


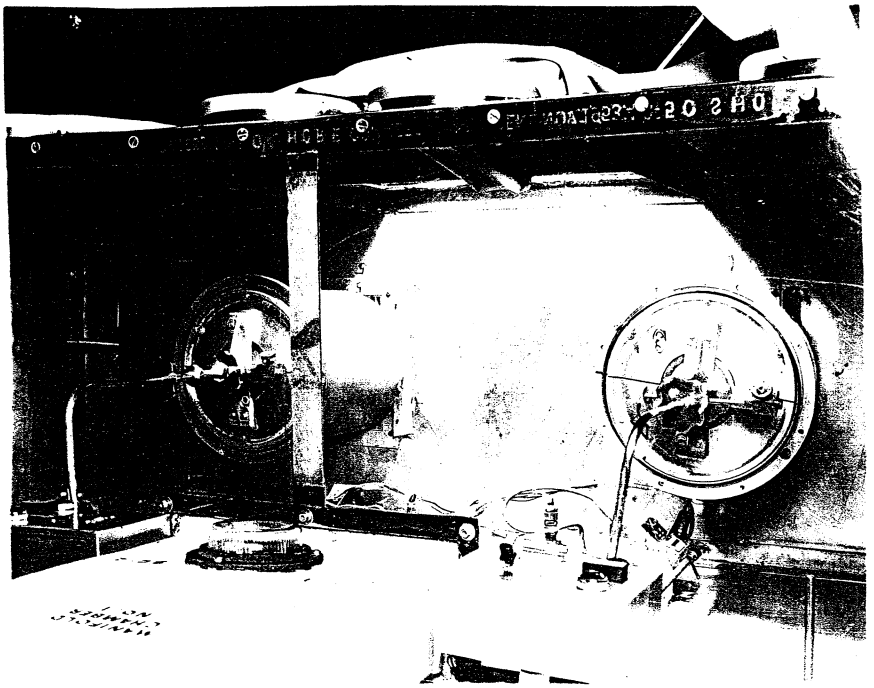
Fig. 9

Photographs of the Manifold Chambers

a. External View of Chambers
b. View Through Top of Chamber No. 1



[redacted]



[redacted]

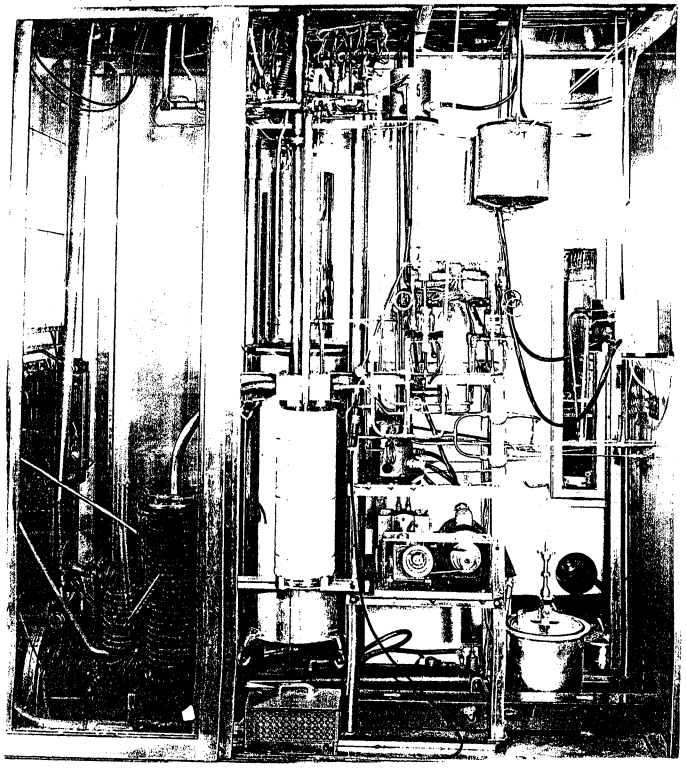
Fig. 10

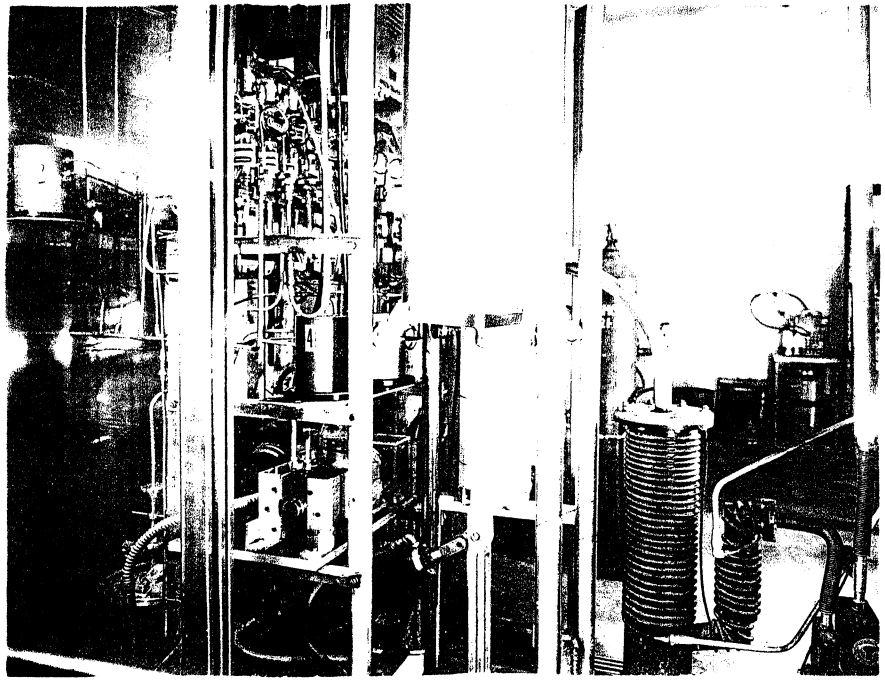
Photographs of Process Chamber and Equipment

a. Rear View With Charcoal Trap Dewar Lowered
b. Front View With Charcoal Trap Dewar Raised

[redacted]

PROCESS CHAMBER





[redacted]

[redacted]

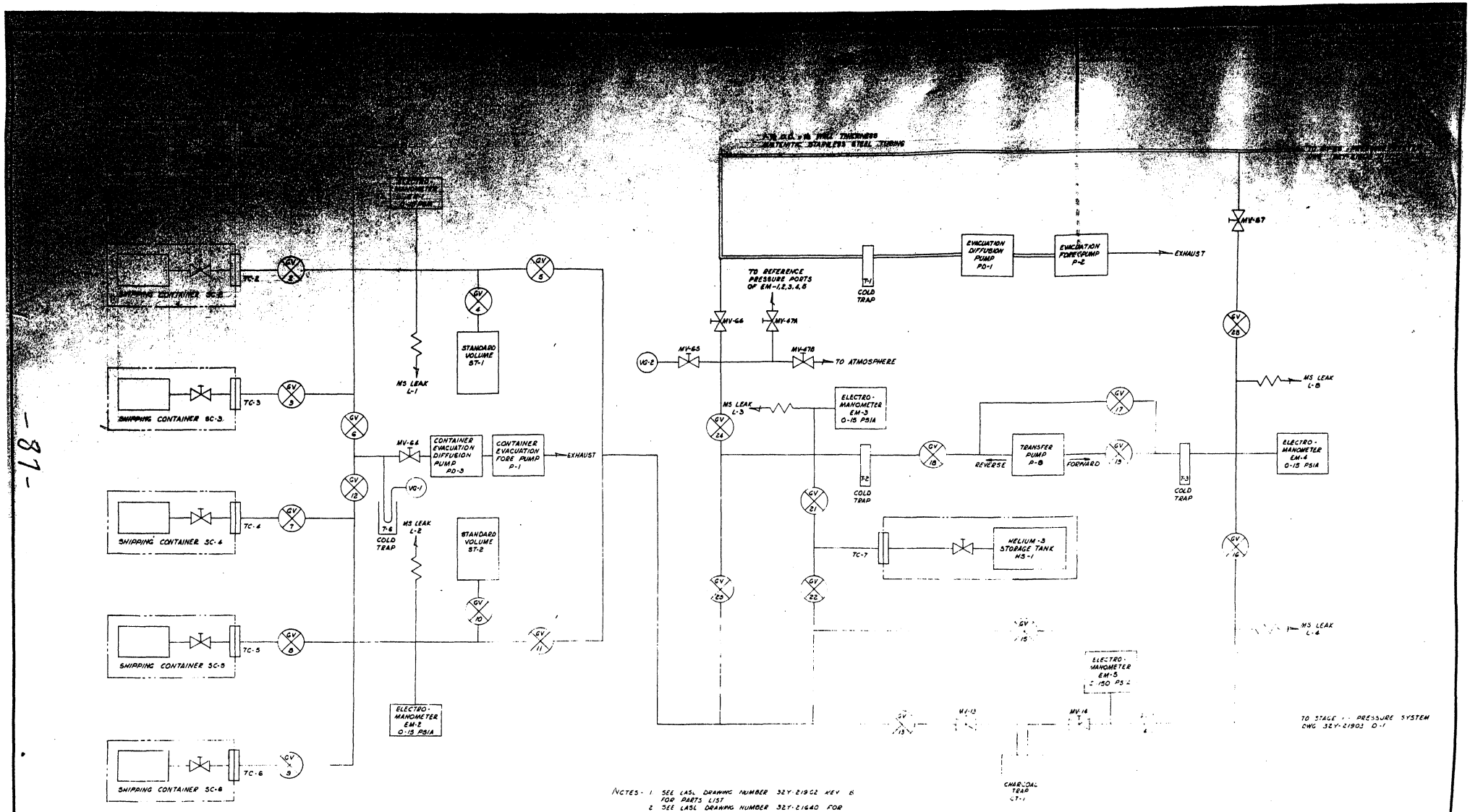
Fig. 11

Flow Diagram of Present Process System

a. Process System Gas Piping
b. Process System Air Piping
c. Process System Parts List

[redacted]

UNCLASSIFIED



NOTES - 1. SEE LASL DRAWING NUMBER 32Y-21902 REV B FOR PARTS LIST
2. SEE LASL DRAWING NUMBER 32Y-21640 FOR HOOD DETAILS
3. SEE LASL DRAWING NUMBER 32Y-21920 FOR EQUIPMENT MOUNTING FRAME
4. ALL PIPING TO BE AUSTENITIC STAINLESS STEEL TYPE 321 3/8 O.D. - .032 WALL THICKNESS, UNLESS OTHERWISE SPECIFIED.
5. ALL VALVES TO BE NORMALLY CLOSED UNLESS OTHERWISE SPECIFIED.
6. ALL MASS SPECTROMETER LEAKS TO BE PIPED FROM LEAK TO MASS SPECTROMETER WITH 3/8 O.D. - .032 WALL STAINLESS STEEL TUBING.
7. ALL CONNECTORS TO BE KONCENTRIC STAINLESS STEEL 3/8" FITTINGS (SPECIAL STEEL PRODUCTS CO. BEDFORD, OHIO) UNLESS OTHERWISE SPECIFIED.

RESTRICTED DATA

REV. NO.	CHANGED ITEM NO.	DATE	CHANGED BY	CHECKED BY
B	REDRAWN WITH REVISIONS	7/1/63	P.J.L.	

REVISIONS

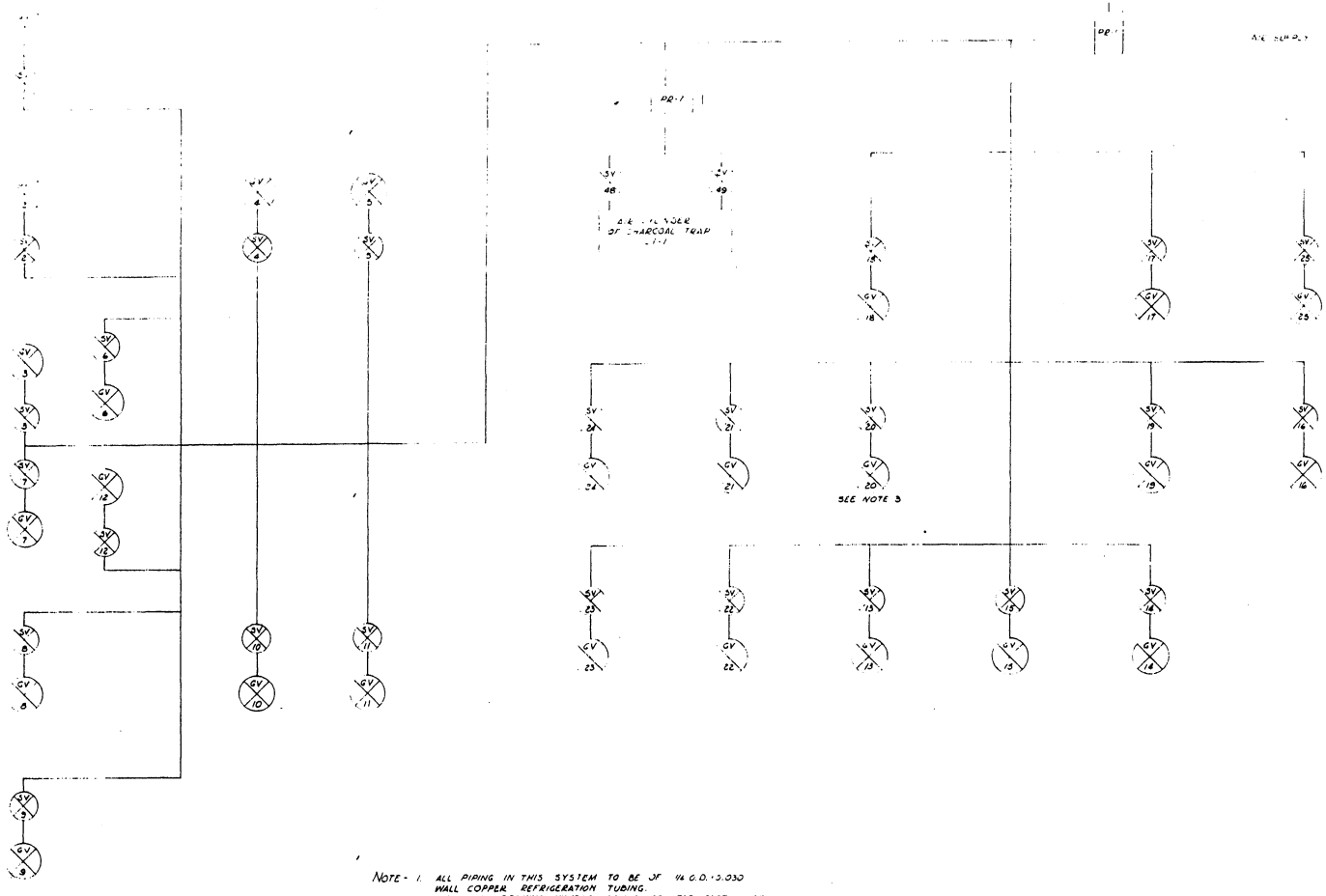
PROFESSIONAL	SIGNATURE	DATE	SIGNATURE	DATE
DESIGNED				
DRAWN	LOPEZ	7/1/63		
CHECKED				
FINAL APPR.				
APPROVED				

TITLE: LOCESS SYSTEM GAS PIPING

SCALE: NONE

DRAWING NO. 32Y-21903 REV. NO. D

UNCLASSIFIED



NOTE - 1. ALL PIPING IN THIS SYSTEM TO BE OF 1/4 O.D. x 0.030 WALL COPPER REFRIGERATION TUBING.
2. SEE LASL DRAWING NUMBER 32Y-21902 FOR PARTS LIST.
3. IN JANUARY 1957 REVISION SV-20 & CV-20 TO BE IN PLACE AS A SPARE VALVE.

BILL OF MATERIAL			
PART DWG.NO.	REQ'D PER UNIT	PER	DESCRIPTION

B	REDRAWN WITH REVISIONS	MAR 57	R.J.L.
REV. SYM.	CHANGED PER	DATE	DRAWN BY / CHECKED BY

REVISIONS

DRAWN	LOPEZ	2-28-57		
TRACED				
FINAL CHK.				
APPROVED				

TITLE: PROCESS SYSTEM AIR PIPING

TOT. CONTS.	SCALE	DRAWING NO.	SHEET SIZE AND NO.	REV. SYM.
2	NONE	32Y-21901	D2	

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
CT-1	1	Charcoal Trap	LASL		32Y-21195 32Y-21622	
EM-1, 2,3,4	4	Electromanometer Pressure Ballance 0-15 psi, CEC Type 4-330	Consolidated Engr. Corp.			194469
EM-5	1	Electromanometer Pressure Ballance 0-150 psi, CEC Type 4-330	Consolidated Engr. Corp.			
GV-1 to 25	25	Valve, Air Operated Vacuum to 150 psi	LASL		32Y-20253	
HS-1	1	Storage Tank	Research Welding & Engr. Company		26Y-70002	
L-1 to 4,8	5	Mass Spectrometer Leak	LASL		32Y-21938	
MV-		Manually Operated Valve, Autoclave 30000 psi Valve (Modified per LASL Dwg):	Autoclave Engr.,Inc.			
13	1	No. 1C-C2				
14	1	No. 1C-C4				
MV-47A, 47B	2	Manually Operated Valve, Diaphragm Type No. 593-C, 3/8" Dia Tube	Imperial Brass Mfg.,Co.			172247 184447
MV-64	1	Manually Operated Valve, Hoke #1368 TY440	Hoke Incorporated			
MV-65 to 71	3	Manually Operated Valve, Hoke #M482	Hoke Incorporated	X		
P-1	1	Container Evacuation Fore Pump, Vacuum Pump - DuoSeal, Welch No. 1405	W. M. Welch Mfg.Co.	X		

REV. LETTER	REVISIONS	DATE
C	Changed MV-67 to MV-71	5/57
B	General	1/57

TITLE: PROCESS SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
[illegible]	3/57	32Y-21902 A1 of 2

DIETZGEN 193M AGEPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
P-2	1	Evacuation Fore Pump, Cenco Hyper-Vac, Model No. 23	Central Scientific Company	X		
P-8	1	Transfere Pump, 2-Stage Rotary Vane Pump	LASL		26Y-70729	
PD-1	1	Evacuation Diffusion Pump, CVC Type MHG-300	Consolidated Vacuum Corp.			184414
PD-3	1	Container Evacuation Diffusion Pump, VMF20-01	Distillation Products Industries	X		
PR-1, 7	2	Pressure Regulating Valve, Norgen Type 1400-2	C. A. Norgen Co.			
RG-1	1	Gas Reservoir	LASL		32Y-21942	
SC-1 to 6	6	Gas Container, Shipping	Research Welding & Engr. Company		26Y-70002	
ST-1, 2	2	Standard Volume Tank	LASL		32Y-21194	
SV-1 to 25, 48, 49	27	Valve, Solenoid, 3Way, Normall Closed, 150 psi, Model V5-D115010, 115 V., 60 Cycle AC	Skinner Electric Valve Division			184418 184446
T-1,2, 3	3	Cold Traps	LASL		32Y-21691	
T-6	1	Cold Trap, U-Tube in Dewar of Liquid Nitrogen	LASL			
VG-1	1	Vacuum Gage, Pirani Gauge, DPl Type PG-1AM	Distillation Productd Industries	X		
VG-2	1	Vacuum Gage, Thermocouple Gauge, Type 501	Engr. Division National Research Corporation	X		

REV. LETTER	REVISIONS	DATE
C	Added RG-1	5/57
B	General	1/57

TITLE: PROCESS SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
[illegible]	3/57	32Y-21902 A2 of 2

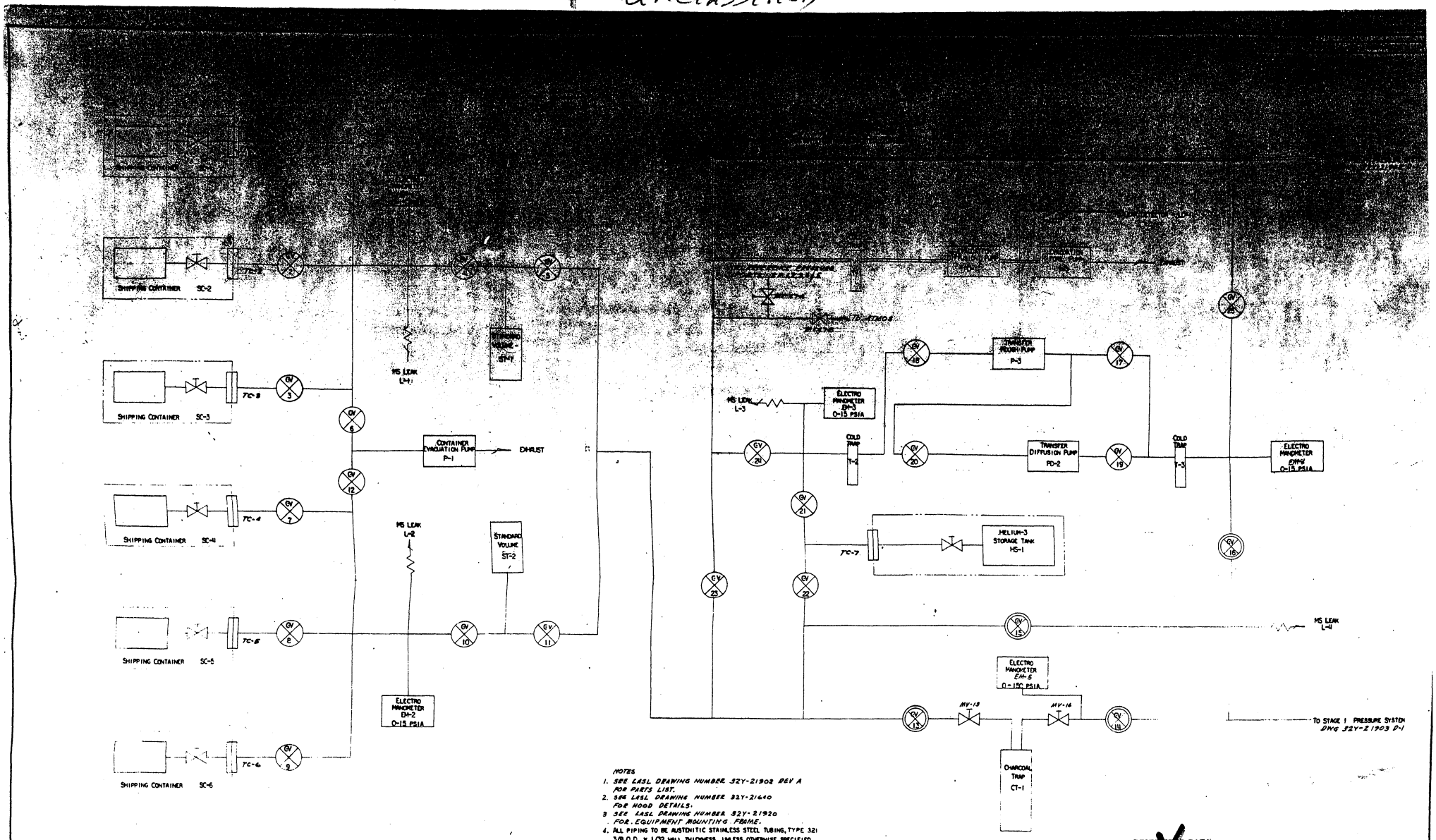
DIETZGEN 144M AGEPROOF

Fig. 12

Flow Diagrams of Original Process System

a. Process System Gas Piping
b. Process System Air Piping
c. Process System Parts List

Unclassified



NOTES

1. SEE LASL DRAWING NUMBER 32Y-21902 REV A FOR PARTS LIST.
2. SEE LASL DRAWING NUMBER 32Y-21640 FOR HOOD DETAILS.
3. SEE LASL DRAWING NUMBER 32Y-21920 FOR EQUIPMENT MOUNTING FRAME.
4. ALL PIPING TO BE AUSTENITIC STAINLESS STEEL TUBING, TYPE 321 3/8 O.D. × 1/32 WALL THICKNESS, UNLESS OTHERWISE SPECIFIED.
5. ALL VALVES TO BE NORMALLY CLOSED, UNLESS OTHERWISE SPECIFIED.
6. ALL MASS SPECTROMETER LEAKS TO BE PIPED FROM LEAK TO MASS SPECTROMETER WITH 3/8 O.D. × 1/32 WALL STAINLESS STEEL TUBING.
7. ALL CONNECTORS TO BE MONCENTRIK STAINLESS STEEL 3/8" FITTINGS, (SPECIAL STEEL PRODUCTS CO., BEDFORD, OHIO) UNLESS OTHERWISE SPECIFIED.

RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmission or the disclosure of its contents in any manner to an unauthorized person is prohibited.

A	GENERAL REVISION	11 DEC 1970	CONNELLY
	CHANGED ITEM WAS	DATE	ENGINEER

REVISIONED

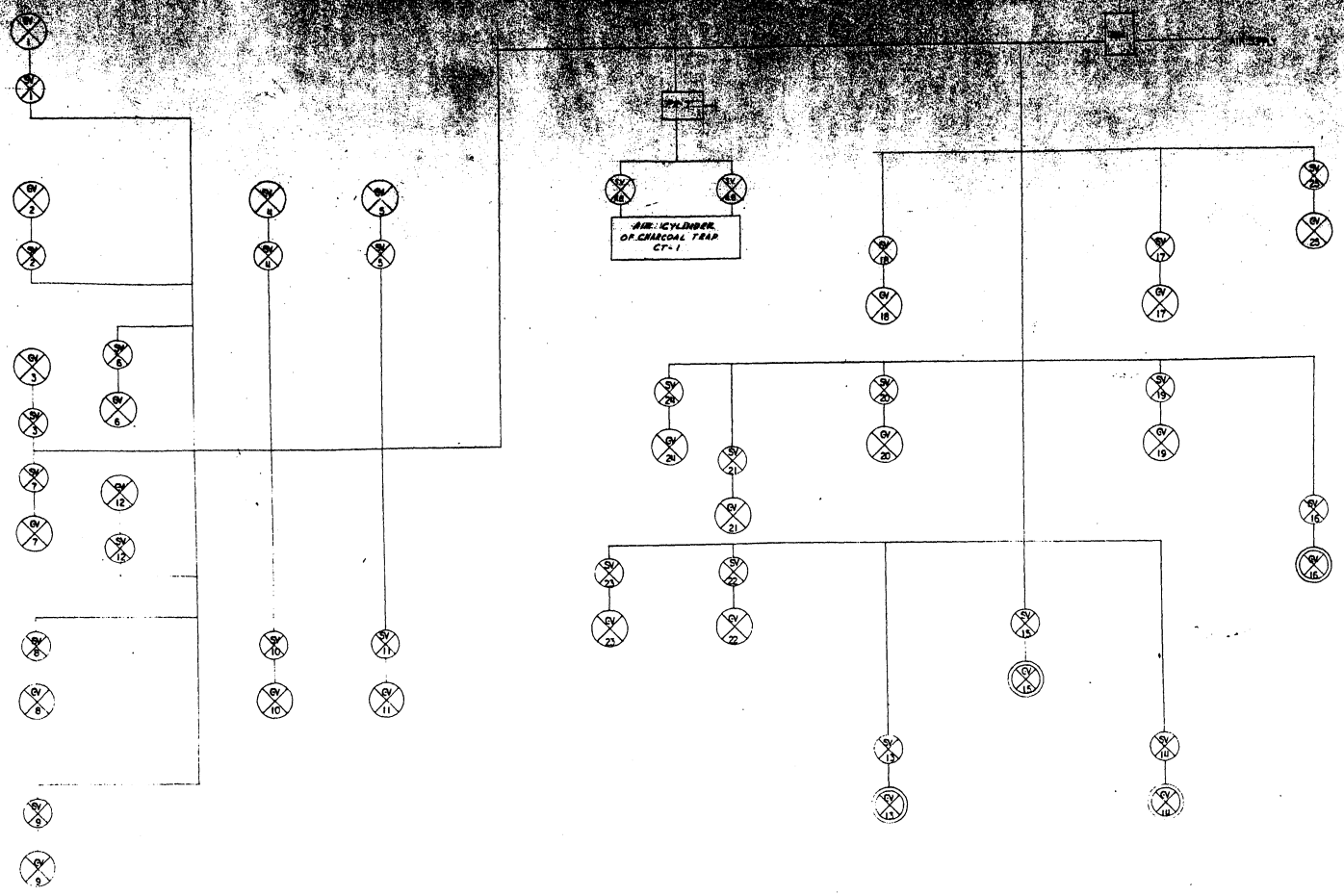
TITLE: PROCESS SYSTEM — GAS PIPING —

DRAWN: 22 JUN 1970

VOL. SECTS.: 2 SCALE: NONE

DRAWING NO.: 32Y-21901 SHEET NO.: D1

Unclassified



NOTE

1. ALL AIR PIPING IN THIS SYSTEM TO BE OF 1/4 O.D. × .030 WALL COPPER REFRIGERATION TUBING.
2. SEE LAST DRAWING NUMBER 32Y-21902 FOR PARTS LIST.

A	GENERAL REVISION		
REV. LTR.	CHANGED ITEM 19	DATE	DRAWN BY / CHECKED BY / ENGINEER BY

REVISIONS

FABRICATED - DRAWN STRESSES WITH FRACTIONAL / DECIMAL	SIGNATURE	DATE	ASSIGN PR. & REPRESENTATIVE	DATE
DESIGNATED				
DRAWN	[illegible]	23 JAN 1952		
CHECKED				
FINAL CHK.				
APPROVED				

TOL. DECS. 2 — SCALE NONE

TITLE PROCESS SYSTEM — AIR PIPING

DRAWING NO. 32Y-21901 — SHEET SIZE D2 — PART NO.

DIETZGEN 1500 ASCPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
CT-1	1	Charcoal Trap	LASL		32Y-21195 32Y-21622	
EM-1,2, 3,4	4	Electromanometer Pressure Ballance, 0-15 psi, CEC Type 4-330	Consolidated Engr. Corp.			194469
EM-5	1	Electromanometer Pressure Balance, 0-150 psi, CEC Type 4-330	Consolidated Engr. Corp.			
GV-1 to 25	25	Valve, Air Operated Vacuum to 150 psi	LASL		32Y-20253	
HS-1	1	Storage Tank	Research Welding & Engr. Company		26Y-70002	
L-1,2, 3,4	5	Mass Spectrometer Leak	LASL		32Y-21918	
LD-1	1	Leak Detector, CEC Model 24-101-A	Consolidated Engr. Corp.			184410
MV-	2	Manually Operated Valve, Autoclave 30000 psi Valve, (Modified per LASL Dwg):	Autoclave Engr.,Inc.		32Y-21593	
13	1	No. 1C-C2				
14	1	No. 1C-C4				
MV-1, 47A, 47B	3	Manually Operated Valve, Diaphragm Type No. 593-C, 3/8" Dia Tube	Imperial Brass Mfg. Company			172247 184447
P-1	1	Container Evacuation Pump, Vacuum Pump Duo-Seal, Welch No. 1405	W. M. Welch Mfg.,Co.	X		184449
P-2	1	Evacuation Fore Pump, Cenco Hyper-Vac Model No. 23	Central Scientific Company	X		

REV. LETTER	REVISIONS	DATE
A	General	12/56

TITLE:

PROCESS SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
A. J. H.	3/57	32Y-21902 A1 of 2

DIETZGEN 199M AGEPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
P-3	1	Transfere Pump, Cenco-Pressovac Vacuum Pump	Central Scientific Company	X		
PD-1	1	Evacuation Diffusion Pump, CVC Type MHG-300	Consolidated Vacuum Corp.			172242
PD-2	1	Transfere Diffusion Pump, CVC Type MHG-S-20	Consolidated Vacuum Corp.			184414
PR-1,7	2	Pressure Regulating Valve, Norgen Type 1400-2	C. A. Norgen Co.			
SC-1 to 6	6	Gas Container, Shipping	Research Welding & Engr. Company (LASL Designed)		26Y-70002	
ST-1,2	2	Standard Volume Tank	LASL		32Y-21194	
SV-1 to 25,48, 49	27	Valve, Solenoid, 3 Way, Normall Closed, 150 psi, Model V5-D11510-115V, 60 Cycle AC	Skinner Electric Valve Division			184418 184446
T-1,2, 3	1	Cold Traps	LASL		32Y-21691	
TC-1 to 7	7	Tank Connectors	LASL		32Y-21928	

Rev. Letter	Revisions	Date
A	General	12/56

TITLE: PROCESS SYSTEM PARTS LIST

Approved	Date	Drwg. No. Sheet Size & No.
J. J. H.	3/57	32Y-21902 A2 of 2

ETZGEN 1944 A-PROOF

[redacted]

Fig. 13

Photograph of High Pressure Equipment, Rear View

[redacted]

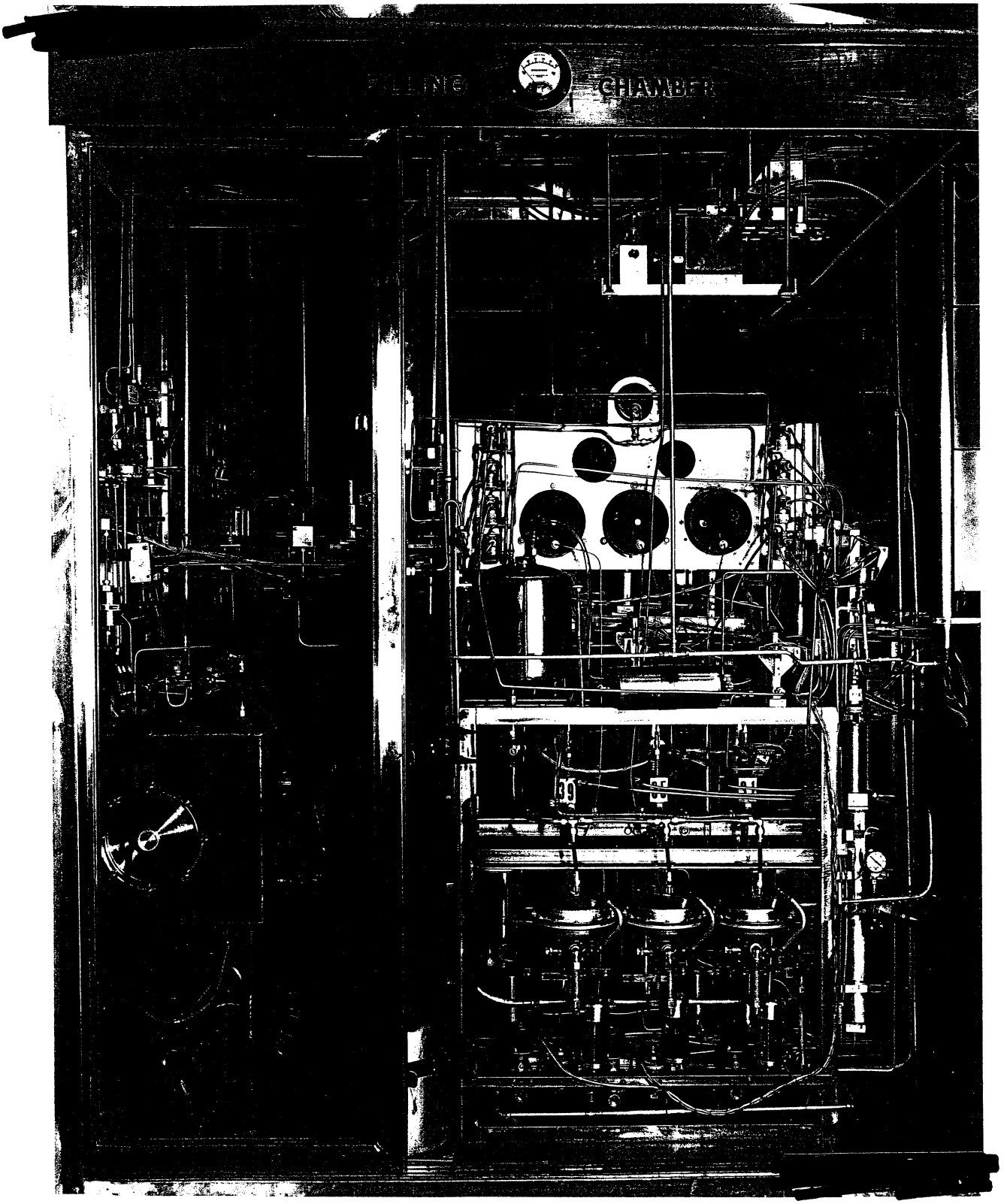

FILLING
CHAMBER

Fig. 14

Photograph of High Pressure Equipment, Front View

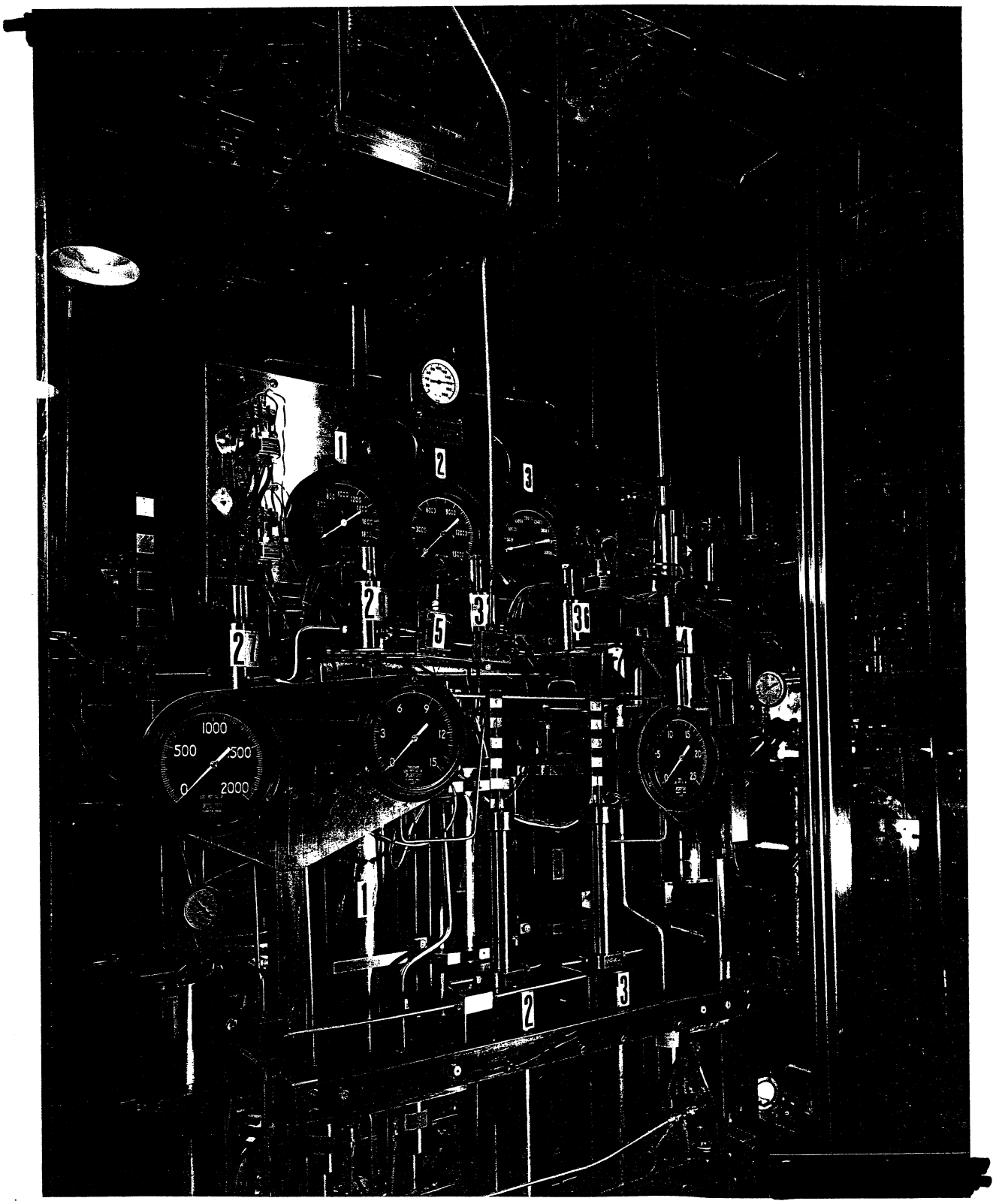
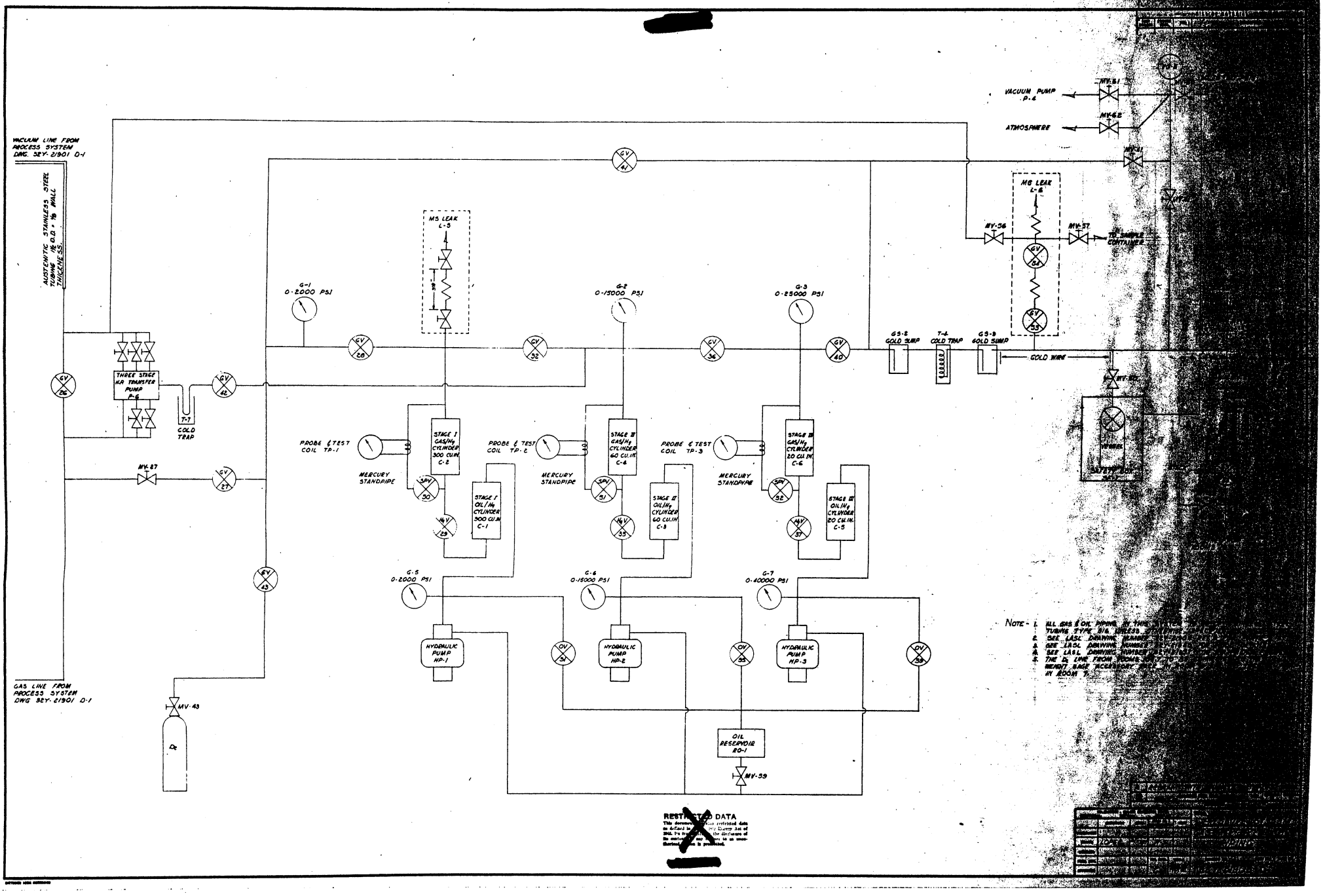

1000
500
500
0
2000

Fig. 15

Flow Diagrams of Present High Pressure System

a. Pressure System, Gas, Mercury, and Oil Piping
b. Pressure System, Air Piping
c. Pressure System Parts List



RESTRICTED DATA

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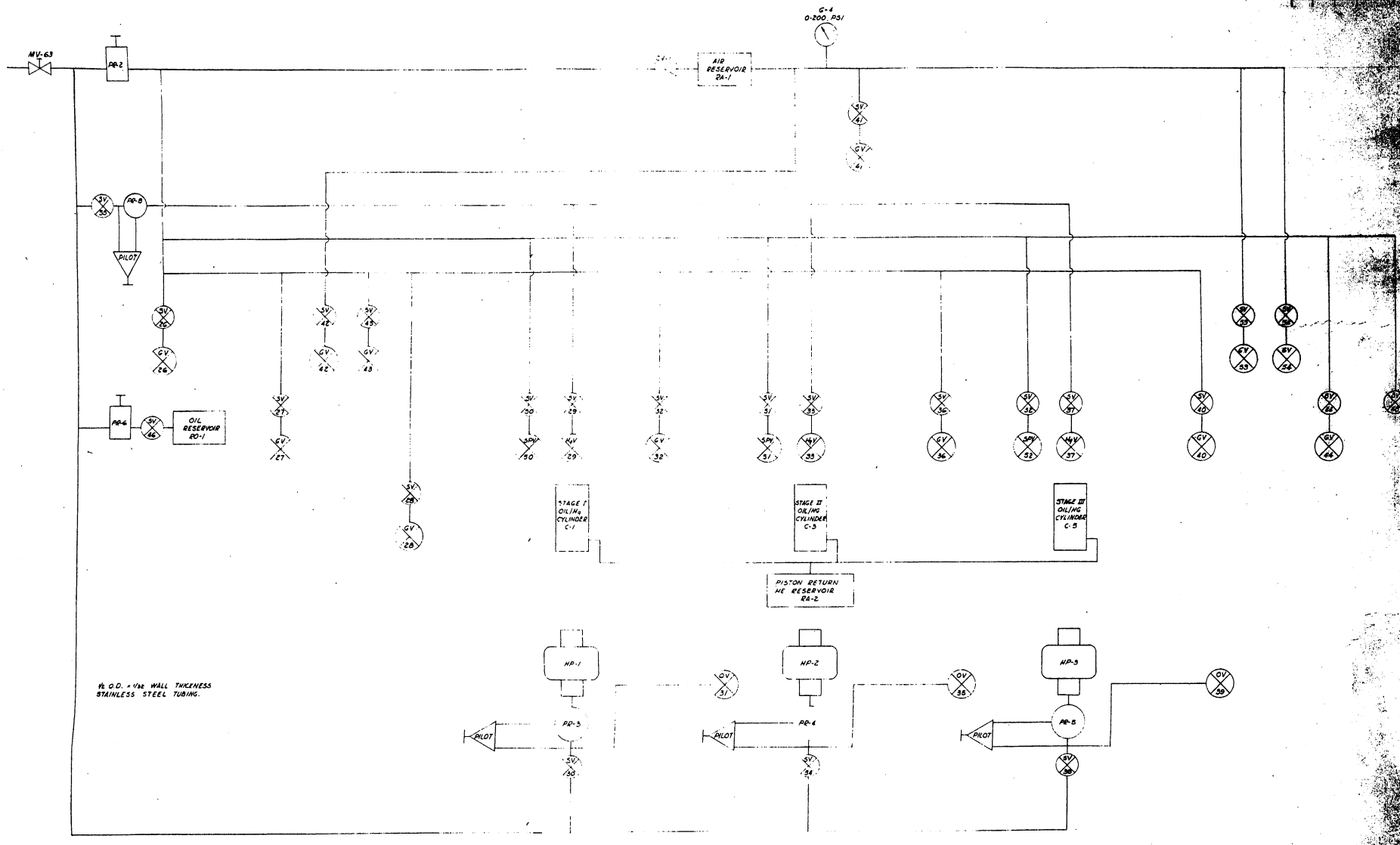


NOTE - 1. ALL AIR PIPING IN THIS SYSTEM TO BE OF 1/4 O.D. x .030 WALL COPPER REFRIGERATION TUBING, UNLESS OTHERWISE NOTED.
2. SEE LASL DRAWING NUMBER 32Y-21904 FOR PARTS LIST.
3. IN JANUARY, 1957, REVISION SV-45 TO BE IN PLACE AS A SPARE SOLENOID VALVE.
4. PILOTS OF PR-3,4,5,8 ARE LOCATED ON THE FILLING CONTROL CONSOLE IN RM. 10.

A	REDRAWN
B	

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
C-1	1	Cylinder, Oil-Mercury, Stage 1	LASL		32Y-21911	
C-2	1	Cylinder, Mercury-Gas, Stage 1	LASL		32Y-21911	
C-3	1	Cylinder, Oil-Mercury, Stage 2	LASL		32Y-21912	
C-4	1	Cylinder, Mercury-Gas, Stage 2	LASL		32Y-21912	
C-5	1	Cylinder, Oil-Mercury, Stage 3	LASL		32Y-21913	
C-6	1	Cylinder, Mercury-Gas, Stage 3	LASL		32Y-21913	
CV-1	1	Check Valve, Norgen Type 426	C. A. Norgen Co.			
G-1	1	Pressure Gage, Gas, 0-2000 psi, 316SS Pressure Element	Foxboro Company			194729
G-2	1	Pressure Gage, Gas, 0-15000 psi, 316SS Pressure Element	Foxboro Company			194729
G-3	1	Pressure Gage, Gas, 0-25000 psi, 316SS Pressure Element	Foxboro Company			194729
G-4	1	Pressure Gage, 0-200 psi, $3\frac{1}{2}$" Dial, $\frac{1}{4}$" Male Pipe Connection		X		
G-5	1	Pressure Gage, Oil, 0-2000 psi, 6" Dial, Ashcroft Gauge No.1077D	Manning, Maxwell & Moore			169345
G-6	1	Pressure Gage, Oil, 0-15000 psi, 6" Dial, Ashcroft Gauge No.1077JS	Manning, Maxwell & Moore			184430

Rev. Letter	Revisions	Date
B	General	1/57

TITLE: PRESSURE SYSTEM PARTS LIST

Approved	Date	Drwg. No. Sheet Size & No.
G. J. H.	3/57	32Y-21904 A1 of 4

DIETZGEN 1234M AGEPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
G-7	1	Pressure Gage, Oil, 0-40000 psi, 6" Dial, Ashcroft Gauge No.1077JS	Manning, Maxwell & Moore			184430
G-8	1	Compound Pressure Gauge, Gas, 0-30 psig Vacuum, 0-60 psig, $\frac{1}{4}$" Male Pipe Connection		X		
GS-2, 3	2	Gold Sump	LASL		32Y-21924	
GV-26	1	Valve, Air Operated, Vacuum to 150 psi			32Y-20253	
GV-27, 28,32, 36,40-44, 53,54	12	Gas Valve, High Pressure	LASL		32Y-21905	
HgV-29, 33,37	3	Mercury Valve, High Pressure	LASL		32Y-21905	
HP-1	1	Hydraulic Pump, 2000 psi, Model S-216C-20 (Modified per LASL Dwg.)	Sprague Engr. & Sales Company		32Y-21916	194739
HP-2	1	Hydraulic Pump, 10000 psi, Model S-216C-100 (Modified per LASL Dwg.)	Sprague Engr. & Sales Company		32Y-21916	172243 194739 194709
HP-3	1	Hydraulic Pump, 30000 psi, Model S-216C-300 (Modified per LASL Dwg.)	Sprague Engr. & Sales Company		32Y-21916	172243 194709 194739
L-5	1	Mass Spectrometer Leak	LASL		32Y-21926	
L-6	1	Mass Spectrometer Leak	LASL		32Y-21939	
MV-		Valve, Manually Operated, Autoclave 30000 psi Valve, (Modified per LASL Dwg.)				
43,56,57	3	No. 1C-C1			32Y-21593	172234
27	1	No. 1C-D1			"	

REV. LETTER	REVISIONS	DATE
B	General	1/57

TITLE: PRESSURE SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO.	SHEET	SIZE & NO.
G.J.H.	3/57	32Y-21904	A2	of 4

DIETZGEN 1234M AGEPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
40	1	No. 1C-C4			32Y-21593	
41,44	2	No. 1H-C5			"	
MV-58	1	Valve, Manually Operated, P.P.I. No.V-130-30 (Modified per LASL Dwg.)	Pressure Products Industries		32Y-21593	
MV-59 to 62	4	Valve, Manually Operated, Diaphragm Type No. 493-C5, 3/8" Dia Tube	Imperial Brass Manufacturing Co.			194711 194733
MV-63	1	Valve, Manually Operated, SS Needle Valve, 30000 psi, 3/8" Pipe		Salvage		
OV-31, 35,39	3	Oil-Valve, High Pressure	LASL		32Y-21907	
P-4	1	Vacuum Pump, Duo Seal, Welch No. 1405	W. M. Welch Manufacturing Co.	X		194719
P-6	1	3-Stage, High Pressure Transfere Pump, CMB-7 Design	LASL		No Drawing	
PR-2	1	Pressure Regulating Valve, Norgen Type 2AX3	C. A. Norgen Co.			
PR-3, 4,5,8	4	Pressure Regulating Valve, Norgen No.20AA004; Pilot: Norgen No. 11402	C. A. Norgen Co.			172203 184438
PR-6	1	Pressure Regulating Valve, Norgen Type 1400-2	C. A. Norgen Co.			
RA-1	1	Air Reservoir	LASL		32Y-21213	
RA-2	1	Helium Reservoir, Gas Cylinder Size D		X		
RO-1	1	Oil Reservoir	LASL		32Y-21930	
SF-1	1	Safety Box	LASL		32Y-21720	

REV. LETTER	REVISIONS	DATE
B	General	1/57

TITLE:

PRESSURE SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
A. J. B.	3/57	32Y-21904 A3 of 4

© ETZGEN 1944M ASEPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR. No.
SPV 50,51 52	3	Standpipe Valve, High Pressure	LASL		32Y-21905	
SV-26 to 29,32, 33,36, 37,40 to 46,50 to 54	15	Solenoid Valve, 3-Way, Normally Closed, 150 psi, 115 V., 60 Cy. AC, Skinner Type V5-3, EN	Skinner Electric Valve Division			184418 184446
SV-30, 34,38, 55	4	Solenoid Valve, 3-Way, Normally Closed, 500 psi, $\frac{1}{2}$ NPT, 115 V., 60 Cy. AC, Crescent No. 103444	Crescent Valve Co.			184419
T-4,5	1	Cold Trap, Coiled SS Tube in Dewar of Liquid Nitrogen	LASL			
T-6	1	Cold Trap on Pump P-6	LASL			
TC-1 to 7	7	Tank Connector	LASL		32Y-21928	
TP-1 to 3	3	Probe & Test Coil of Mercury Level Indicator	LASL		32Y-20301	
VG-3	1	Vacuum Gage, Thermo-couple Gauge, Type 501	Engineering Division National Research Corporation	X		

Rev. Letter	Revisions	Date
B	General	1/57

TITLE: PRESSURE SYSTEM PARTS LIST

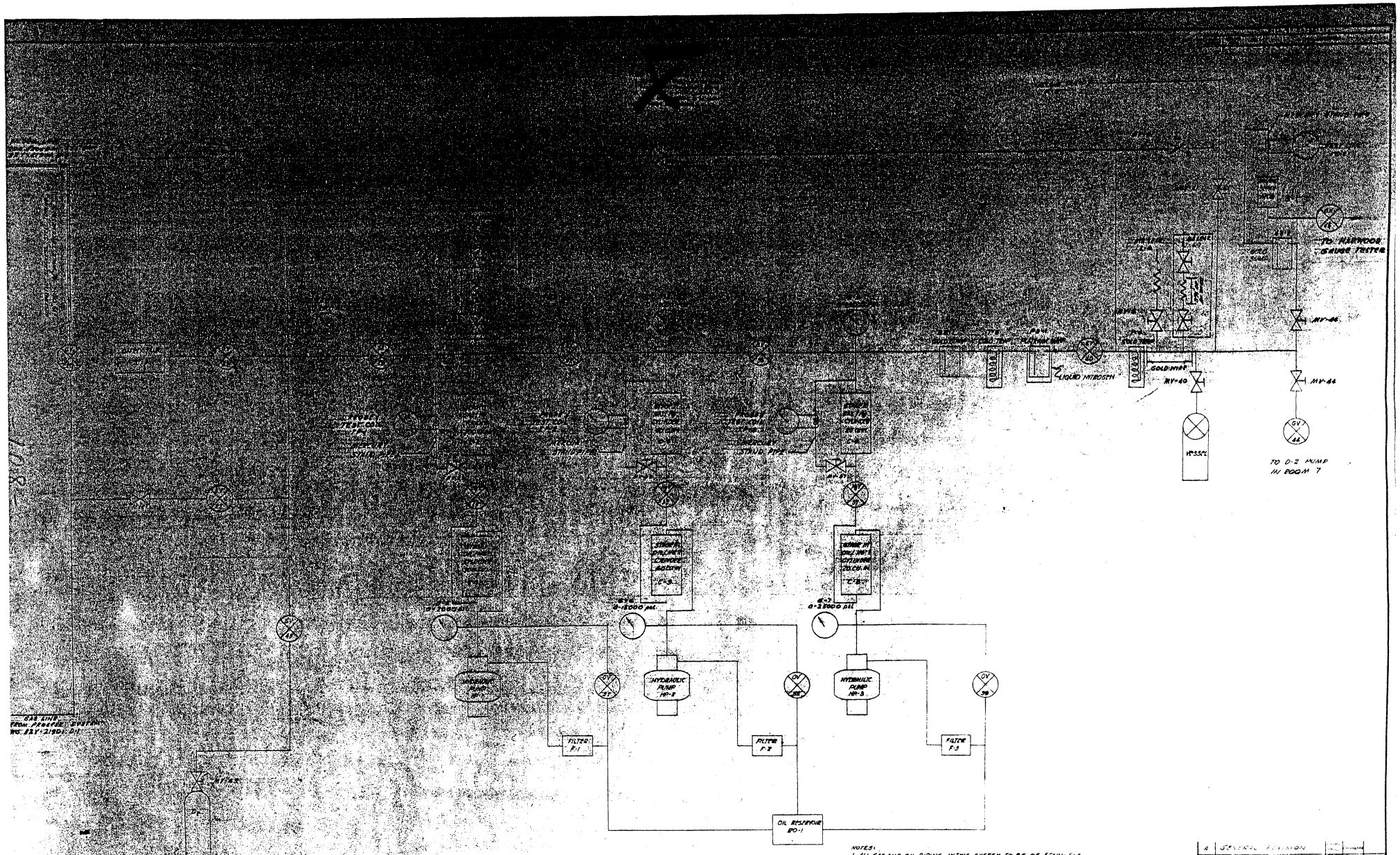
Approved	Date	Drwg. No. Sheet Size & No.
[illegible]	3/57	32Y-21904 A4 of 4

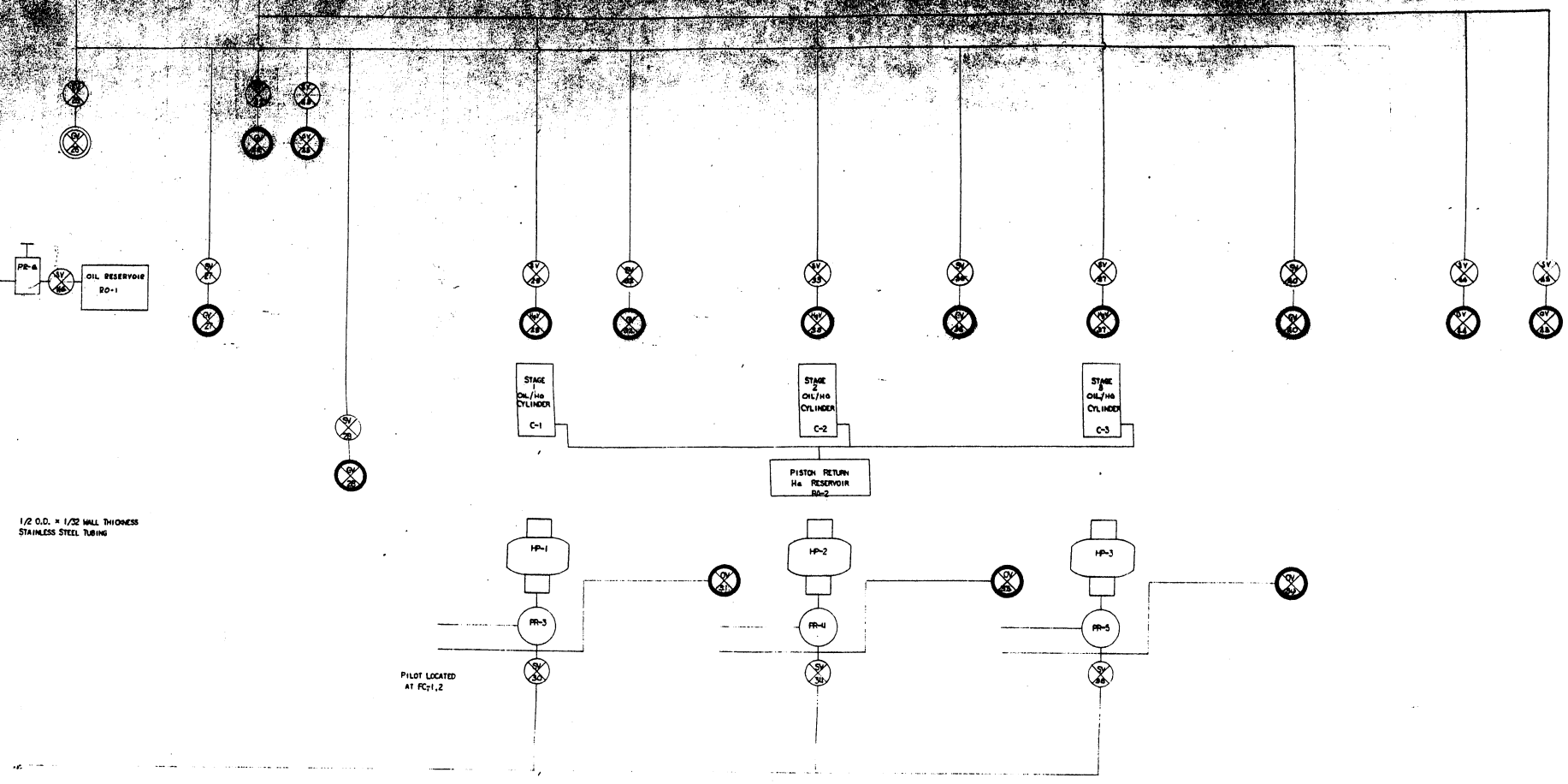
DIETZGEN 194M AGEPROOF

Fig. 16

Flow Diagrams of Original High Pressure System

a. Pressure System, Gas, Mercury and Oil Piping
b. Pressure System, Air Piping
c. Pressure System Parts List


TO HARWOOD GAUGE TESTER
MV-46
MV-44
GOLD WIRE
MV-40
LIQUID NITROGEN
TO D-2 PUMP IN ROOM 7
HYDRAULIC PUMP HP-2
HYDRAULIC PUMP HP-3
FILTER F-1
FILTER F-2
FILTER F-3
OIL RESERVOIR RO-1
GAS LINE FROM PROFILE DIAGRAM NO. 321-21901-01
NOTES:
1. ALL GAS AND OIL PIPING IN THIS SYSTEM TO BE OF STAINLESS STEEL TUBING, TYPE 316 UNLESS OTHERWISE SPECIFIED.
2. SEE LASL DRAWING NUMBER 321-21904 FOR PARTS LIST. REF 4.
3. SEE LASL DRAWING NUMBER 321-21640 FOR HOOD DETAILS.
4. SEE LASL DRAWING NUMBER 321-21677 FOR EQUIPMENT FRAME
RESTRICTED DATA
A GENERAL REVISION
CHANGED ITEM WAS
REVISIONS
TITLE:
GAS RECOVERY SYSTEM
DRAWN
CHECKED
APPROVED
SCALE NONE
DRAWING NO. 321-21903
SHEET NO. D7



NOTE

1. ALL AIR PIPING IN THIS SYSTEM TO BE OF 1/4 O.D. × .030 WALL COPPER REFRIGERATION TUBING, UNLESS OTHERWISE NOTED.
2. SEE LASL DRAWING NUMBER 32Y-21904 FOR PARTS LIST.

REV. NO.	CHANGED ITEM WAS	DATE	CHANGED BY	CHECKED BY
A	GENERAL REVISION	11/21/61		

REVISIONS

TOLERANCES - UNLESS OTHERWISE SPECIFIED
FRACTIONAL ± DECIMAL ± ANGULAR ±

	SIGNATURE	DATE	SIGNATURE	DATE
DRAWN				
CHECKED				
FINAL CHK.				
APPROVED				

TITLE: PRESSURE SYSTEM AND PIPING

TOL. UNITS. | SCALE NONE | DRAWING NO. 32Y-21903 D | SHEET NO. OF NO. | PILOT NO.

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
C-1	1	Cylinder, Oil-Mercury, Stage 1	LASL		32Y-21911	
C-2	1	Cylinder, Mercury-Gas, Stage 1	LASL		32Y-21911	
C-3	1	Cylinder, Oil-Mercury, Stage 2	LASL		32Y-21912	
C-4	1	Cylinder, Mercury-Gas, Stage 2	LASL		32Y-21912	
C-5	1	Cylinder, Oil-Mercury, Stage 3	LASL		32Y-21913	
C-6	1	Cylinder, Mercury-Gas, Stage 3	LASL		32Y-21913	
CV-1	1	Check Valve, Norgen Type 426	C. A. Norgen Co.			
F-1,2,3	3	Filter, Oil, Type PR-93-6	Purolator Prod.			184439 172205
G-1	1	Pressure Gage, Gas, 0-2000 psi, 316 SS Pressure Element	Foxboro Company			194729
G-2	1	Pressure Gage, Gas, 0-15000 psi, 316 SS Pressure Element	Foxboro Company			194729
G-3	1	Pressure Gage, Gas, 0-25000 psi, 316 SS Pressure Element	Foxboro Company			194729
G-4	1	Pressure Gage, 0-200 psi, $3\frac{1}{2}$" Dial, $\frac{1}{4}$" Male Pipe Connection		X		
G-5	1	Pressure Gage, Oil, 0-2000 psi, 6" Dial, Ashcroft Gauge No. 1077D	Manning, Maxwell & Moore			169345

Rev. Letter	REVISIONS	Date
A	General	12/56

TITLE: PRESSURE SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
G.J.H.	3/57	32Y-21904 A1 of 4

DIETZGEN 1334 AGEPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
G-6	1	Pressure Gage, Oil, 0-15000 psi, 6" Dial, Ashcroft Gauge No. 1077JS	Manning, Maxwell & Moore			184430
G-7	1	Pressure Gage, Oil, 0-40000 psi, 6" Dial, Ashcroft Gauge No. 1077JS	Manning, Maxwell & Moore			184430
GS-1	2	Gold Sump	LASL		32Y-21929	
GV-26	1	Valve, Air Operated, Vaccum to 150 psi	LASL		32Y-20253	
GV-27, 28, 32, 36,40-44	10	Gas Valve, High Pressure	LASL		32Y-21905	
HgV-29, 33, 37	3	Mercury Valve, High Pressure	LASL		32Y-21905	
HP-1	1	Hydraulic Pump, 2000 psi, Model S-216C-20 (Modified per LASL Dwg.)	Sprague Engr. & Sales Co.		32Y-21916	194739
HP-2	1	Hydraulic Pump, 10000 psi, Model S-216C-100 (Modified per LASL Dwg.)	Sprague Engr. & Sales Co.		32Y-21916	172243 194709 194739
HP-3	1	Hydraulic Pump, 30000 psi, Model S-216C-300 (Modified per LASL Dwg.)	Sprague Engr. & Sales Co.		32Y-21916	172243 194709 194739
L-5, 7	2	Mass Spectrometer Leak	LASL		32Y-21929	
L-6	1	Mass Spectrometer Leak	LASL		32Y-21917	
MV-		Valve, Manually Operated, Autoclave 30000 psi Valve, (Modified per LASL Dwg.)	Autoclave Engr., Inc.			
6, 43	2	No. 1C-C1			32Y-21593	172234
27	1	No. 1C-D1			"	

REV. LETTER	REVISIONS	DATE
A	General	12/56

TITLE:

PRESSURE SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
a.j.H.	3/57	32Y-21904 A2 of 4

DIETZGEN 133M ADEPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
29,33	2	No. 1C-C2			32Y-21593	
37,40, 47	3	No. 1C-C4			"	
41,44	2	No. 1H-C5			"	
OV-31, 35,39	3	Oil Valve, High Pressure	LASL		32Y-21907	
OV-45	1	Oil Valve, High Pressure	LASL		32Y-21905	
P-4	1	Vacuum Pump, Duo Seal, Welch No. 1405	W. M. Welch Mfg. Co.	X		194719
PR-2	1	Pressure Regulating Valve, Norgen Type 2AX3	C. A. Norgen Co.			
PR-3,4, 5	3	Pressure Regulating Valve, Pilot Operated, Norgen No. 20AA004, Pilot: Norgen No. 1140-2	C. A. Norgen Co.			172203 184438
PR-6	1	Pressure Regulating Valve, Norgen Type 1400-2	C. A. Norgen Co.			
PS-1	1	Platinum Sump	LASL		32Y-21929	
RA-1	1	Air Reservoir	LASL		32Y-21213	
RA-2	1	Helium Reservoir, Gas Cylinder, Size D		X		
RD-1	1	Blowout:				
		(a) Safety Head Ass'y, Straight Type, No. 6-61AF4	High Pressure Equip. Company, Inc.			
		(b) Rupture Disc, 1975 psi	Black, Sivalls & Bryson, Inc.			184421
RO-1	1	Oil Reservoir			32Y-21930	
S-1	1	Gas-Oil Separator			32Y-21925	

REV. LETTER	REVISIONS	DATE
A	General	12/56

TITLE:

PRESSURE SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
A. J. H.	3/57	32Y-21904 A3 of 4

DIETZGEN 194M ARERPROOF

Item No.	No. Req'd.	Nomenclature And Description	Manufacturer or Supplier	LASL Stock Item	LASL Drawing No.	LASL PR.No.
SV-26 to 29, 32,33, 36,37, 40-46	15	Solenoid Valve, 3-way, Normally Closed, 150psi, 115 V., 60 Cy. AC, Skinner Type V5-3,EN	Skinner Electric Valve Division			184418 184446
SV-30, 34,38	3	Solenoid Valve, 3-way, Normally Closed, 500psi, $\frac{1}{2}$ NPT, 115V, 60 Cy. AC, Crescent No. 103444	Crescent Valve Co.			184419
ST-3	1	Safety Tank	LASL		32Y-21586	
T-4	1	Cold Trap, Coiled SS Tube in Dewar of Liquid Nitrogen	LASL			
TP-1 to 4	4	Probe of Mercury Level Indicator	LASL		32Y-20301	

REV. LETTER	REVISIONS	DATE
A	General	12/56

TITLE:

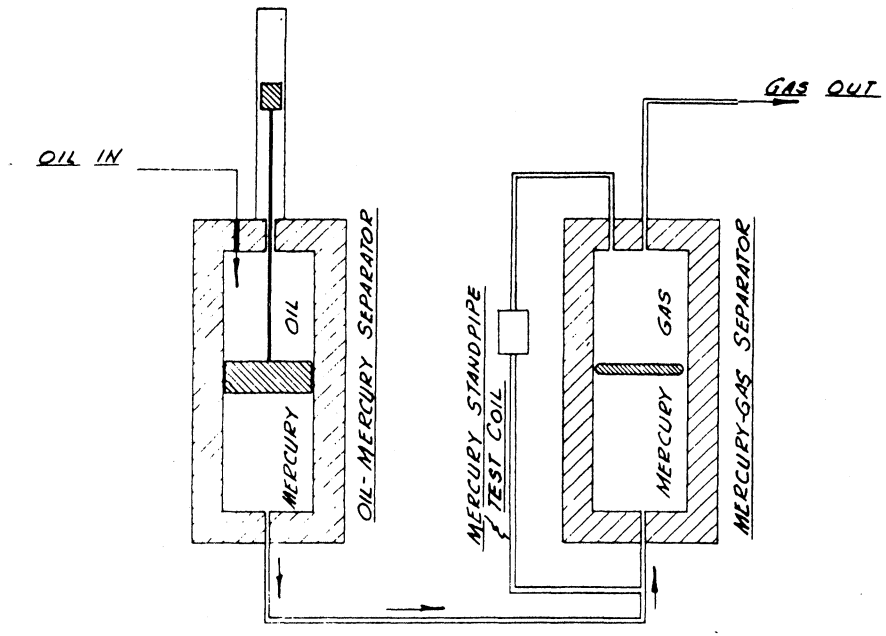
PRESSURE SYSTEM PARTS LIST

APPROVED	DATE	DRWG. NO. SHEET SIZE & NO.
A. J. [illegible]	3/57	32Y-21904 A4 of 4

ETZGEN 194M ASSPROOF

Fig. 17

Schematic of a High Pressure Pumping Stage



BILL OF MATERIAL

PART NUMBER	NUMBER REQD.	PER	DESCRIPTION

REV. LET.	CHANGED ITEM WAS	DATE	CHANGED BY	CHECKED BY

REVISIONS

TOLERANCES - UNLESS OTHERWISE NOTED
FRACTIONAL: DECIMAL: ANGULAR:

	SIGNATURE	DATE	GROUP NO. & REPRESENTATIVE	DATE
ORIGINATED				
DRAWN	CONNELLEE	2/7/57		
CHECKED				
PROJ. ENG.			TOT. SHTS. 1	SCALE NONE
APPROVED				

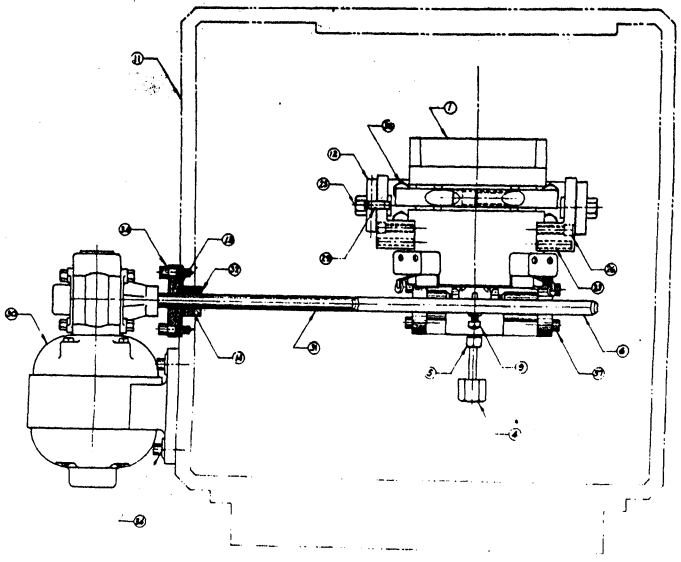
TITLE: ASSEMBLY SCHEMATIC OF STAGES 1, 2 OR 3

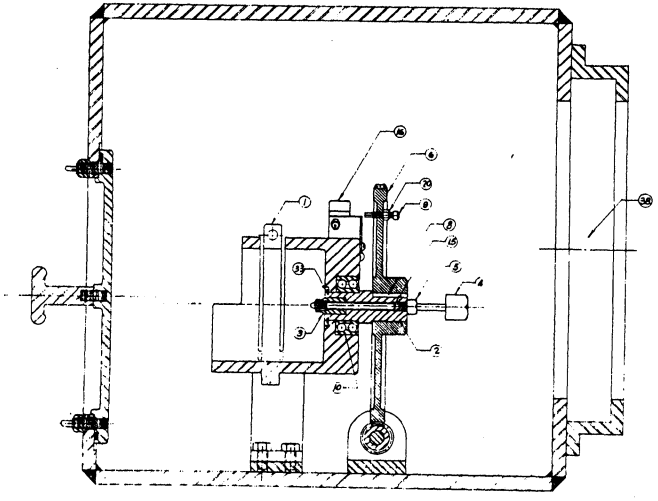
DRAWING NO. 32Y-21927 SHEET SIZE AND NO. B-1 PART NO.

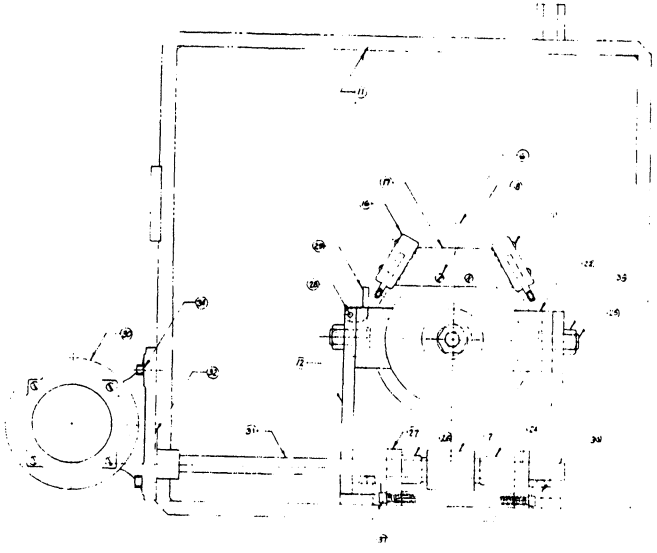
DIETZGEN 199M AGEPROOF

Fig. 18

Assembly Drawing of Safety Box and Valve Operator







BILL OF MATERIAL

ITEM NUMBER	REQUIRED QTY.	MAT'L	DESCRIPTION
1	1	Ass'y	Body 32Y-21720 C-3
2	1		Spindle 32Y-21720 C-3
3	1		Wrench 32Y-21720 C-3
4	1		Stem 32Y-21720 C-3
5	1		Frame 32Y-21720 C-3
6	1		Worm Gear Boston 1088
7	1		Worm Boston # 1L 1088
8	1		Key 32Y-21720 C-3
9	1		Pin 32Y-21720 C-3
10	1		Bearing New Departure 5306
11	1		Safety Rod 32Y-21720 C-4
12	2		Hanger 32Y-21720 C-4
13	2		O-Ring. 1 3/8 x 1/4 Neoprene
14	1		O-Ring. 3/4 x 1/4 Neoprene
15	1		O-Ring. 3/4 x 1/4 Neoprene
16	2		Accro Micro-Switch
17	1		Switch Bracket 32Y-21720 C-5
18	2		#6-32 NC Mach Scr 3/8 Lng
19	4		#8-40 NC Mach Scr 1" Lng
20	1		1/4-28 NF Hex Nut
21	2		3/8-24 NF Allen Head Scr
22	2		Arm 32Y-21720 C-4
23	4		N. Steel Dowel 1/4 Lng
24	1		Spacer 32Y-21720 C-5
25	2		Hanger Pin 32Y-21720 C-4
26	1		Spacer 32Y-21720 C-5
27	2		Block 32Y-21720 C-3
28	2		3/16 Dowel 1/2 Lng
29	1		Stop 32Y-21720 C-4
30	1		Gear Motor Boston # VM8 SB405 GR Frame # EN13
31	1		Shaft 32Y-21720 C-5
32	1		Bushing 32Y-21720 C-5
33	1		Snap Ring Truarc # 5100-87
34	10		1/4-28NF Allen Head Scr 3/8 L
35	2		7/16-20NF Hex Nut
36	4		3/8-24NF M.S. Hex Head 3/4 L
37	4		1/4-28 NF Allen Head Scr 1" L
38	1		Bullet Proof Glass Disc 5 Ply 1 1/4 Thick x 11 1/2 Dia Lab Stock Item LG-983

REV LET	CHANGED ITEM WAS	DATE	CHECKED	CHECKED
A	[illegible]	[illegible]		

REVISIONS

TOLERANCES - UNLESS OTHERWISE NOTED SPECIFIED				
FRACTIONAL	DECIMAL			
	SIGNATURE	DATE	FIRST USE OF REPRESENTATION	DATE
DESIGNATED	[illegible]	[illegible]		
DRAWN	[illegible]	[illegible]		
CHECKED				
PROJ. ENG.				
APPROVED				

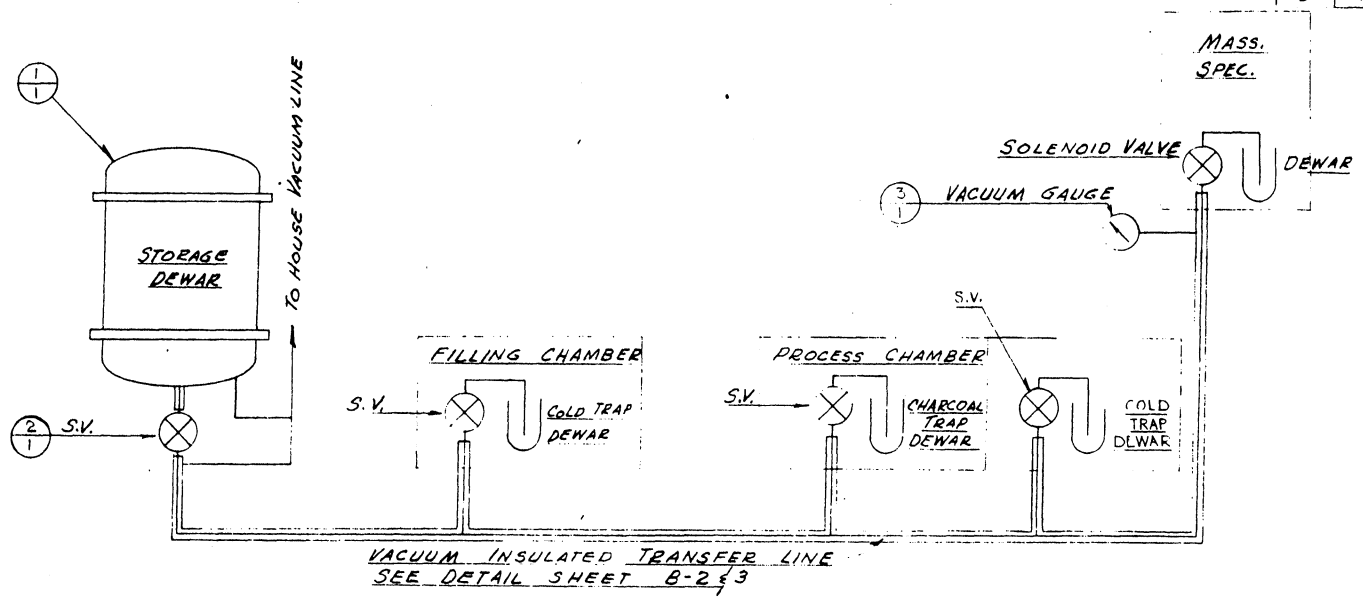
TITLE: VALVE [illegible] (2 CAMS)

TOT. SHTS 7 | SCALE [illegible]

DRAWING NO. 32Y-21720 | SHEET NO. | REV. NO. D | PART NO.

Fig. 19

Schematic of Liquid Nitrogen Transfer Line



BILL OF MATERIAL

PART NUMBER	NUMBER REQD.	PER	DESCRIPTION
1	1		STORAGE DEWAR - 600L 150 GAL MOD. VTT-LO-1725 LINDE AIR PROD. CO.
2	1		SOL. VALVE - ASCO VALVES AUTOMATIC SWITCH CO. CATALOG No. 82685
3	1		VACUUM GAUGE - LASL No. HF-1154

REV. LET.	CHANGED ITEM WAS	DATE	CHANGED BY	CHECKED BY
A	GENERAL REVISION	8-29-7	R	

REVISIONS

TOLERANCES - UNLESS OTHERWISE NOTED
FRACTIONAL: — DECIMAL: — ANGULAR: —

	SIGNATURE	DATE	GROUP NO. & REPRESENTATIVE	DATE
ORIGINATED				
DRAWN	CONNELLEE	3/5/57		
CHECKED				
PROJ. ENG.			TOT. SHTS. 3	SCALE NONE
APPROVED				

TITLE: NITROGEN TRANSFER SCHEMATIC.

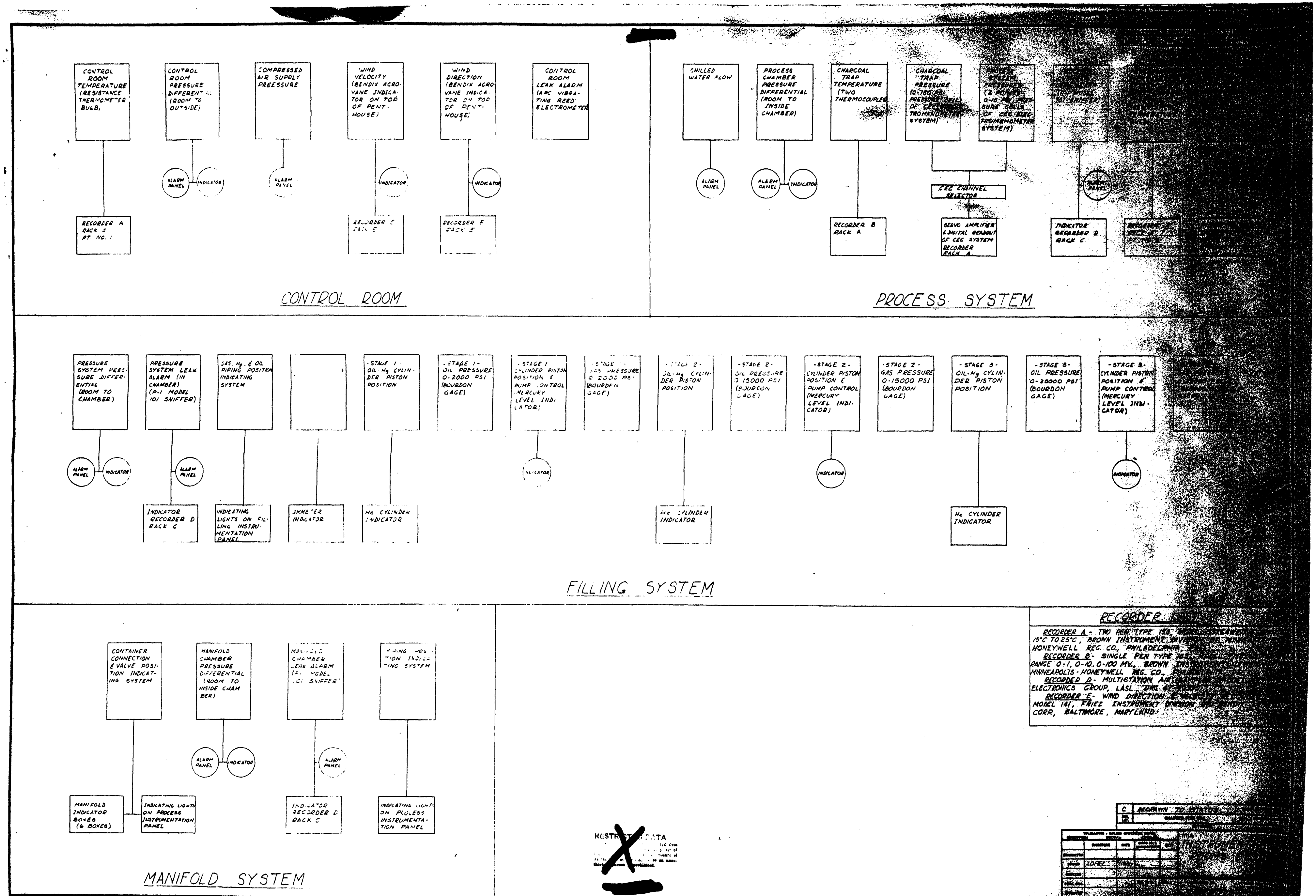
DRAWING NO. 32Y-21940 SHEET SIZE AND NO. B1 PART NO.

DIETZGEN 199M AGEPROOF

Fig. 20

Instrumentation Diagram

-121-



[redacted]

Fig. 21

Photograph of Process and Filling

Instrumentation Panels and Consoles

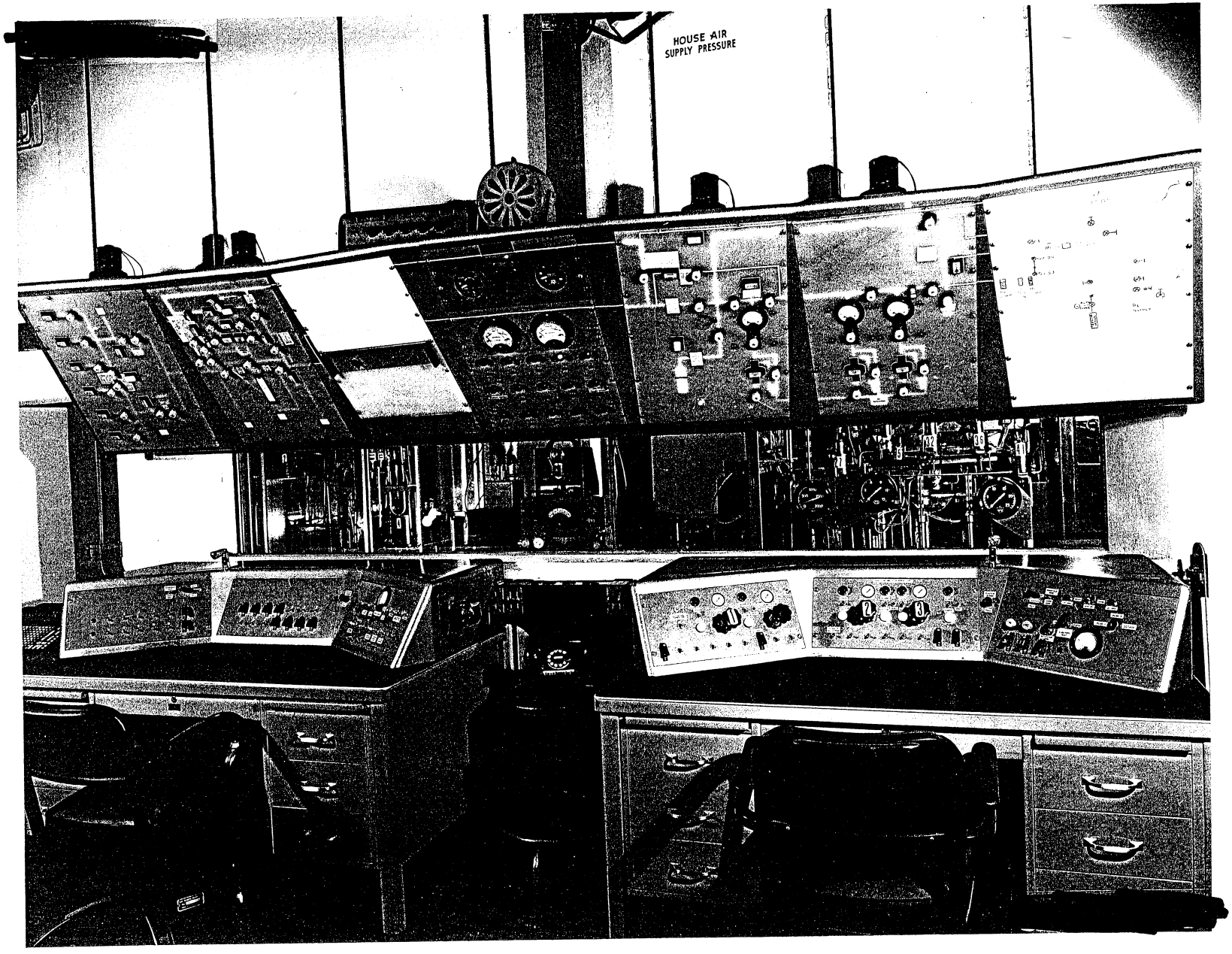
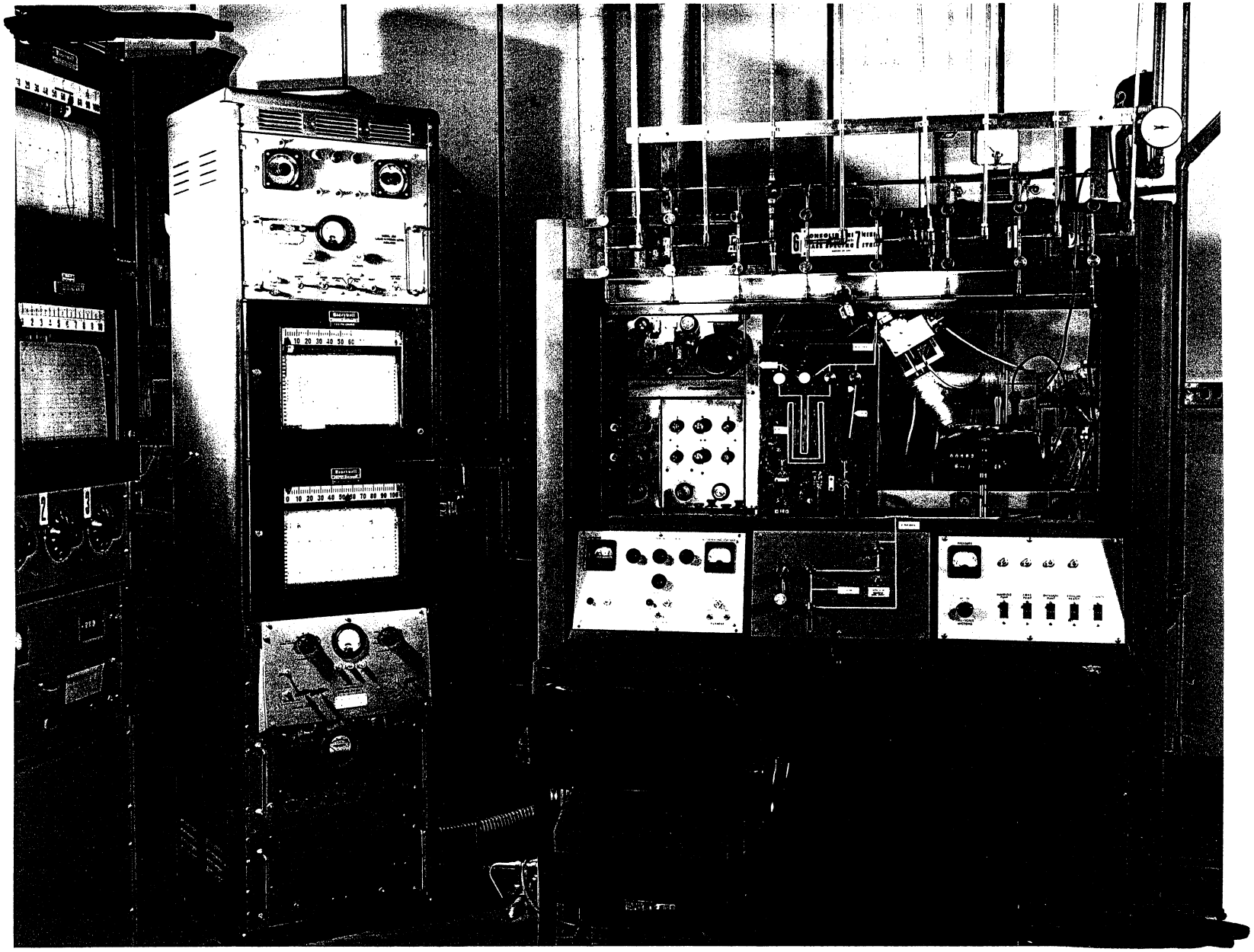

HOUSE AIR
SUPPLY PRESSURE

Fig. 22

Photograph of Mass Spectrometer and Recorder Rack



[redacted]

Fig. 23

Photograph of Recorder Racks A,B,C,D,E

[redacted]

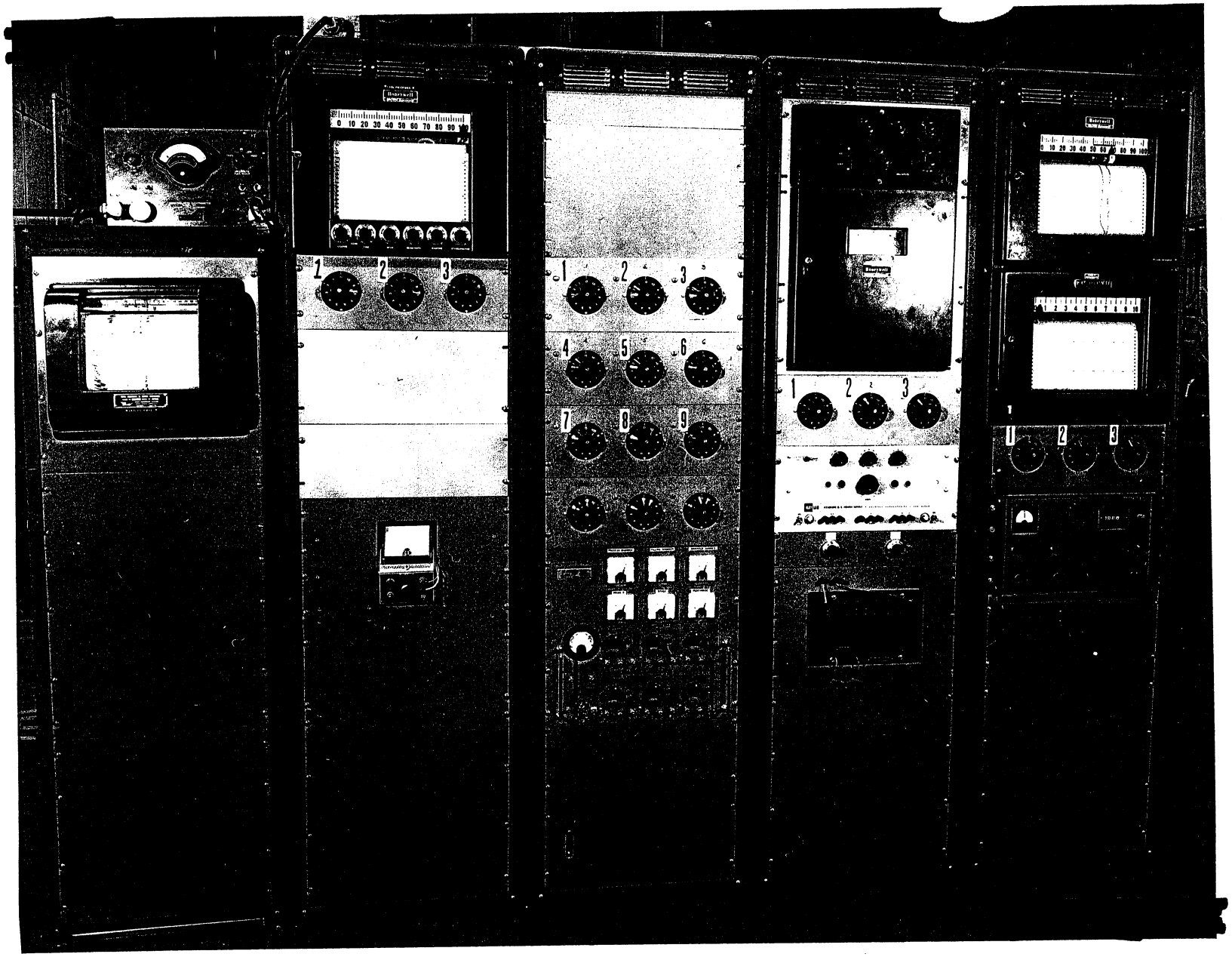
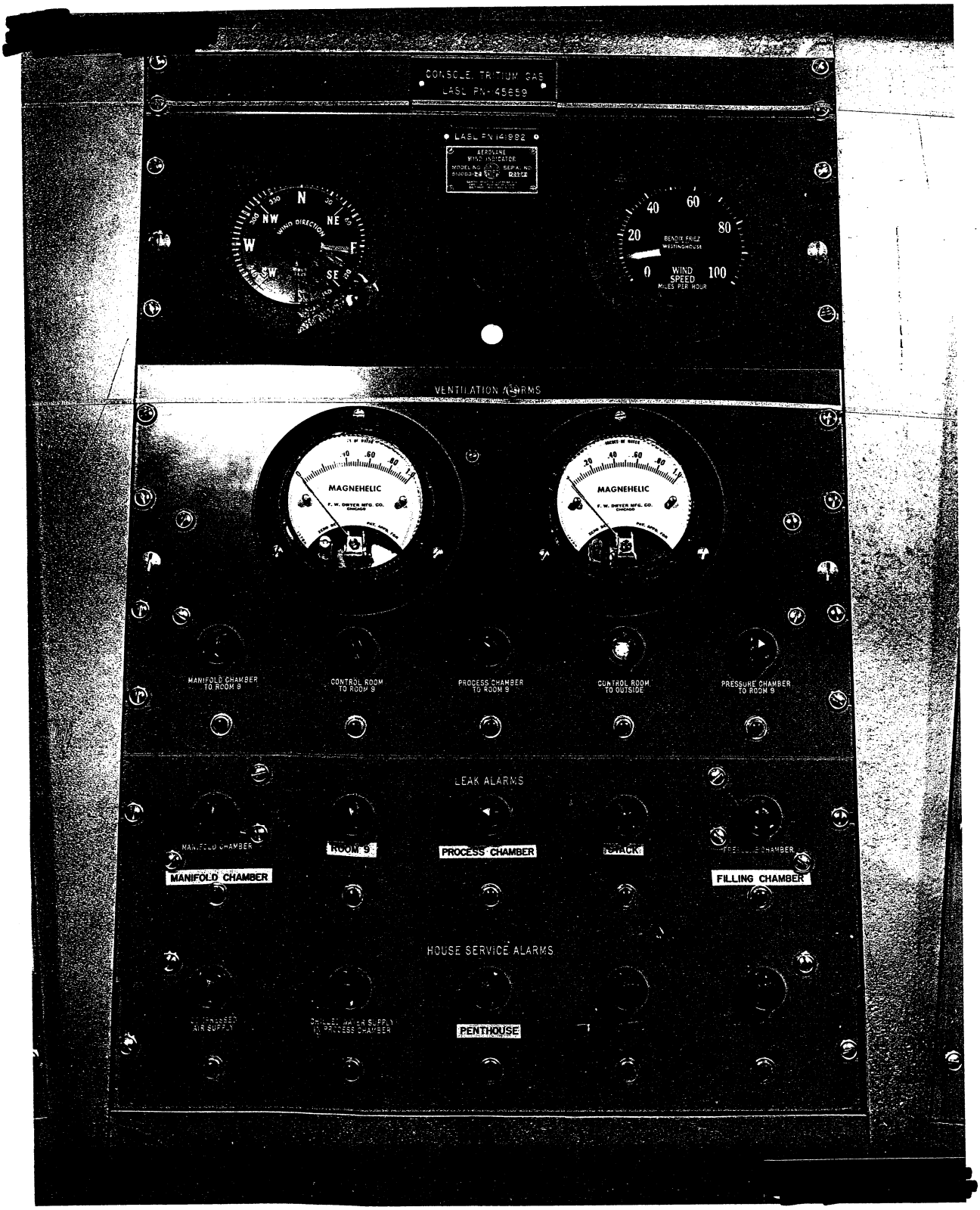

Honeywell
0 10 20 30 40 50 60 70 80 90 100
1 2 3
1 2 3 4 5 6 7 8 9
Honeywell
1 2 3
Honeywell
0 10 20 30 40 50 60 70 80 90 100
1 2 3 4 5 6 7 8 9 10
1 2 3

Fig. 24

Photograph of Alarm Panel


CONSOLE, TRITIUM GAS
LASL PN-45859
LASL PN 14992
AEROVANE
WIND INDICATOR
WIND DIRECTION
N
NE
E
SE
S
SW
W
NW
WIND SPEED
MILES PER HOUR
0
20
40
60
80
100
VENTILATION ALARMS
MAGNEHELIC
F. W. DWYER MFG. CO.
CHICAGO
MANIFOLD CHAMBER TO ROOM 9
CONTROL ROOM TO ROOM 9
PROCESS CHAMBER TO ROOM 9
CONTROL ROOM TO OUTSIDE
PRESSURE CHAMBER TO ROOM 9
LEAK ALARMS
MANIFOLD CHAMBER
ROOM 9
PROCESS CHAMBER
MANIFOLD CHAMBER
FILLING CHAMBER
HOUSE SERVICE ALARMS
AIR SUPPLY
PROCESS CHAMBER
PENTHOUSE

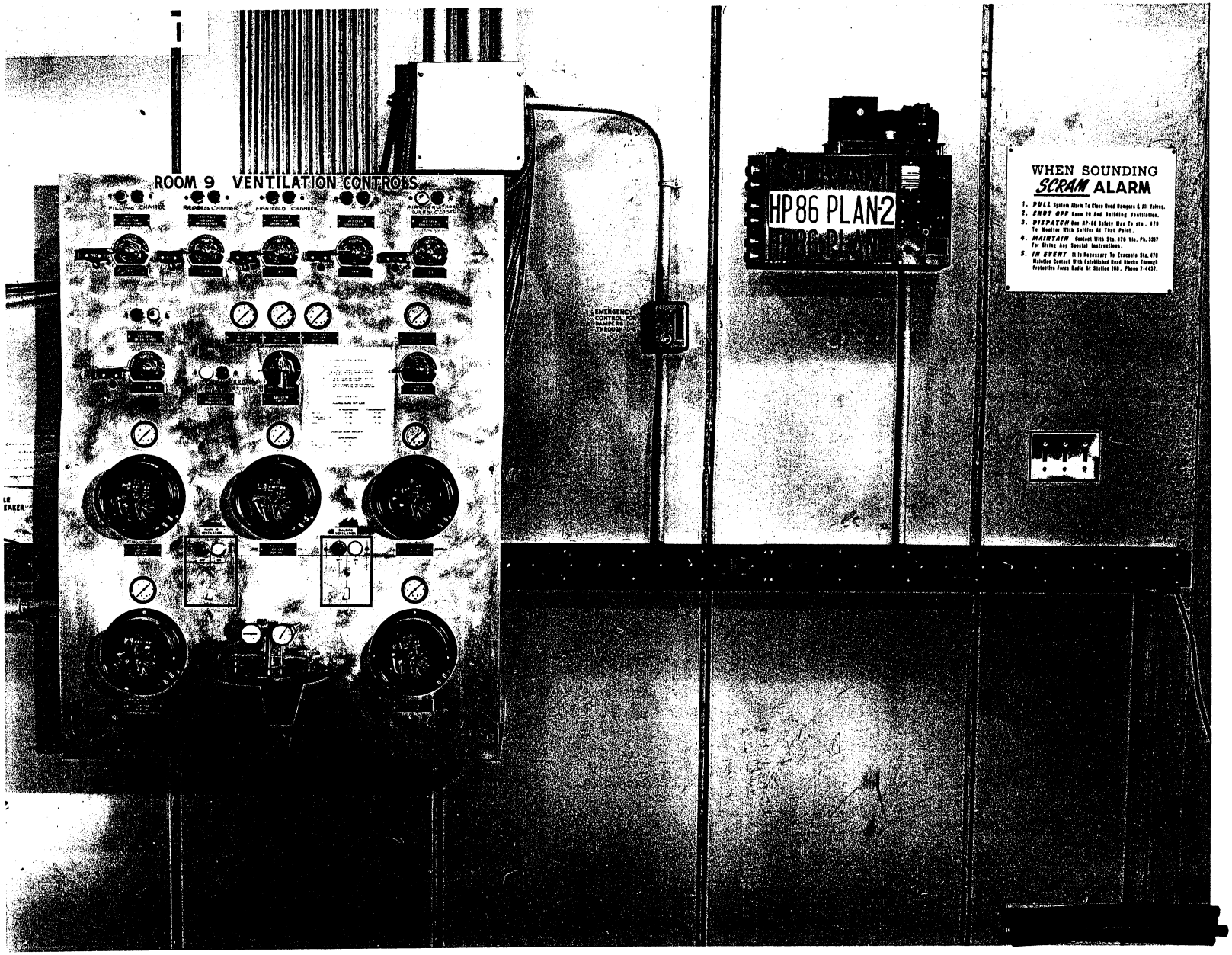
[redacted]

Fig. 25

Photograph of Ventilation Control Panel

and Room 10 Scram Alarm Box

[redacted]


ROOM 9 VENTILATION CONTROLS
HP86 PLAN-2
WHEN SOUNDING
SCRAM ALARM
1. PULL System Alarm To Close Hood Dampers & All Valves.
2. SHUT OFF Room 10 And Building Ventilation.
3. DISPATCH One HP-86 Safety Man To Sta. 470 To Monitor With Sniffer At That Point.
4. MAINTAIN Contact With Sta. 470 Via. Ph. 3317 For Giving Any Special Instructions.
5. IN EVENT It Is Necessary To Evacuate Sta. 470 Maintain Contact With Established Road Blocks Through Protective Force Radio At Station 100, Phone 7-4437.