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CONVAIR (ASTRONAUTICS) DIVISION
GENERAL DYNAMICS CORPORATION

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REPORT NO. 57A332
DATE 27 January 1961
NO OF PAGES 18

CONVAIR ASTRONAUTICS

CONVAIR DIVISION OF GENERAL DYNAMICS CORPORATION

REPORT NO. 57A332

Astronautics

Centaur Separation System Evaluation Test

P/N 57-80014

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INTRODUCTION:

The Centaur separation system separates the Centaur missile from its booster, the Atlas missile. This system is a new design based on a similar separation system presently used on the Atlas missile.

The Centaur system differs from the Atlas system in that it has fewer separation latches and uses a ten (10) foot diameter ring of 3/4 inch stainless steel tubing as a reservoir instead of a stainless steel sphere.

To save weight, it was decided to charge the system, while the missile was in the Gantry Tower, with a portable charging unit rather than run tubing down the side of the missile to the ground charging system. This necessitates charging the system twenty-four (24) hours prior to launch.

It was therefore necessary to test the new design and charge procedure.

OBJECTIVES:

The objectives of this test were:

1. To determine the satisfactory operation of the separation latches under the following conditions:

   a. With the system initially charged to 3975 psig with helium gas at 125° F., then cooled to zero degrees Fahrenheit before actuation.

   b. With the system initially charged to 2975 psig at -35° F., then heated to +120° F. before actuation.

2. To determine the twenty-four (24) hour leakage of the reservoir with it initially charged to 3650 psig at 70 ± 5° F.

CONCLUSION:

The latches operated satisfactorily when the system was "hot charged" and "cold charged". No apparent leakage of the reservoir over a twenty-four (24) hour period was measured using a pressure decay method.

DESCRIPTION OF THE TEST SPECIMEN:

The test specimen consisted of three components:

The Separation Latch	Figures 13 and 14
The Reservoir Ring	Figures 1, 3, 6, and 7
The Manifold	Figures 6 and 7

A detailed description of each of the three components is shown in Convair Drawings as follows:

Separation Latches	Convair Drawing Number 27-45402
Reservoir Ring	Convair Drawing Number 57-80014
Manifold	Convair Drawing Number 57-45000

The explosive valve P/N 27-04304-3 called out in Convair Drawing Number 57-45000 was not available for the test, however, a larger valve of the same type was obtained. A 0.281 inch diameter orifice, Figure 6, was installed in the line to simulate the effective orifice size of the valve called out by Drawing Number 57-45000. The valve used was manufactured by Conax, M/N 2702259, P/N 2888-A.

The operation of the specimen is briefly described as follows:

The reservoir ring contains high pressure helium gas. When it is desired to separate the Centaur missile from the Atlas booster the explosive valve is fired. The helium gas is then allowed to pass from the reservoir into the manifold, which evenly distributes the gas to each of four (4) separation latches. When the helium gas reaches the latches, it forces the latches to release. There is enough force between Centaur and Atlas to force the two (2) missiles apart. This force is 10,000 pounds and is caused by the various disconnecting valves between Atlas and Centaur.

THIS IS INCORRECT (REF. W. BUEVENS 7-20-62)

DESCRIPTION OF THE TEST SET UP:

A schematic of the test setup is shown in Figure 1. The reservoir ring, explosive valve, manifold, and separation latches were mounted on the drop assembly of the test jig. The drop assembly consisted of I beams welded in the form of an X. A separation latch was connected to each of the four corners of the X member. The drop assembly was then connected to the test jig through the latches.

DESCRIPTION OF THE TEST SET UP: (Continued)

In Figure 8, the latch is shown connected to the test jig. In Figure 9, the latch is shown in the disconnected position. The drop assembly, when released, fell four (4) inches to the ground.

TEST SET UP:

The pre-load of 10,000 pounds was applied to the drop assembly through four pneumatic cylinders, one mounted at the end of each leg of the X member. Figure 2 shows a calibration curve of force versus pressure for these cylinders. These cylinders were calibrated in the Tenicus Olsen Material Testing Machine. Each cylinder applied a load of 2500 ± 40 pounds between the drop assembly and the test jig when pressurized to 125 ± 3 psig.

The temperature of the reservoir ring was controlled by passing either a hot or cold fluid through the vinyl sleeving, that surrounded the reservoir ring. To raise the temperature of the reservoir, a mixture of ambient air and hot water was emitted into the vinyl sleeving. The water was heated by passing it through coils submerged in boiling water. The temperature of the fluid was controlled by adjusting the air to water ratio. To lower the temperature, a mixture of ambient air and liquid nitrogen boil-off was forced into the sleeving. Here the temperature was controlled by adjusting the ambient air to cold LN_2 mixture and by adjusting the pressure of the LN_2 dewar.

The temperature of the gas inside of the reservoir was measured by three thermocouples spaced equal distant around the periphery of the ring. These thermocouples were inserted into the reservoir so as to be in direct contact with the gas.

The following is a list of instrumentation used in performing this test:

1. Pressure Gage, Heise, S/N H13387, 0-300 psi. ± 0.25%
2. Pressure Gage, Heise, S/N H23537, 0-5000 psi. ± 0.25%
3. Pressure Gage, Ashcraft, S/N 1581, 0-1000 psi. ± 2%
4. Pre-load Pneumatic Cylinders, Miller, (4) S/N N94050
5. Samborn Oscillograph S/N 143

TEST SET UP: (Continued)

Channel Number	Amplifiers	Transducer
1	Carrier pre-amp S/N 3243	Wianko, S/N 48654 0-5000 psig ± 1.0%
2	Carrier pre-amp S/N 3255	Wianko, S/N 48686 0-5000 psig ± 1.0%
3	Low Level pre-amp S/N 1376	Thermocouple (Chromel-Alumel)
4	Low Level pre-amp S/N 1359	Thermocouple (Chromel-Alumel)
5	Low Level pre-amp S/N 1202	Thermocouple (Chromel-Alumel)

TEST PROCEDURE:

The test was conducted according to the following procedure:

The reservoir was charged to 3975 psig at 125° F. with helium gas, then cooled to zero degrees Fahrenheit. The pressure of the reservoir was measured and recorded. A pre-load of 2500 pounds was applied to each latch. The explosive valve was fired causing the latches to release the drop assembly. The pressure decay and temperature of the reservoir and the pressure increase of the manifold were measured and recorded.

The latches were re-connected and a new explosive valve installed. The reservoir was charged to 2975 psig at -35° F. with helium gas and then heated to 120° F. During this time the pressure of the reservoir was recorded. Each latch was pre-loaded to 2500 pounds. The explosive valve was fired causing the latches to release. The pressure decay and temperature of the reservoir and the pressure increase in the manifold were measured and recorded.

The twenty-four (24) hour leakage test was set up as shown in Figure 12. The reservoir was charged to 3650 psig with helium gas. At the end of twenty-four (24) hours the pressure and temperature in the reservoir were recorded.

RESULTS:

The pressure of the reservoir after cooling it from 125° F. to 0° F. decreased from 3975 psig to 3170 psig. The equalization pressure of the manifold and reservoir after the drop was 2600 psig. The temperature of the reservoir after drop was -8° F. All of the latches worked satisfactorily.

RESULTS: (Continued)

The pressure of the reservoir after heating it from -35° F. to 120° F. increased from 2975 psig to 3880 psig. The equalization pressure of the manifold and the reservoir, after "drop", was 3000 psig. The temperature of the reservoir after "drop" was 100° F. All of the latches worked satisfactorily.

The pressure of the reservoir at the end of the twenty-four (24) hour leakage test was 3650 psig for a pressure drop of 0 psig. The temperature of the reservoir prior to start of the leak test and at the end of the leak test was 73 ± 2° F.

All of the data from which this report was prepared are recorded in Components Test Lab Engineering Notebook Number 7491.

RESULTS OF SEPARATION TEST

Hot Charge:

Initial charge pressure of reservoir ring	3975 psig
Reservoir pressure after temperature drop	3165 psig
Net Pressure drop after temperature drop	810 psig
Temperature of the reservoir before separation	0 °F.
Equalization pressure of reservoir and manifold after latch separation	2600 psig
Temperature of the reservoir after separation	-8 °F.

Cold Charge:

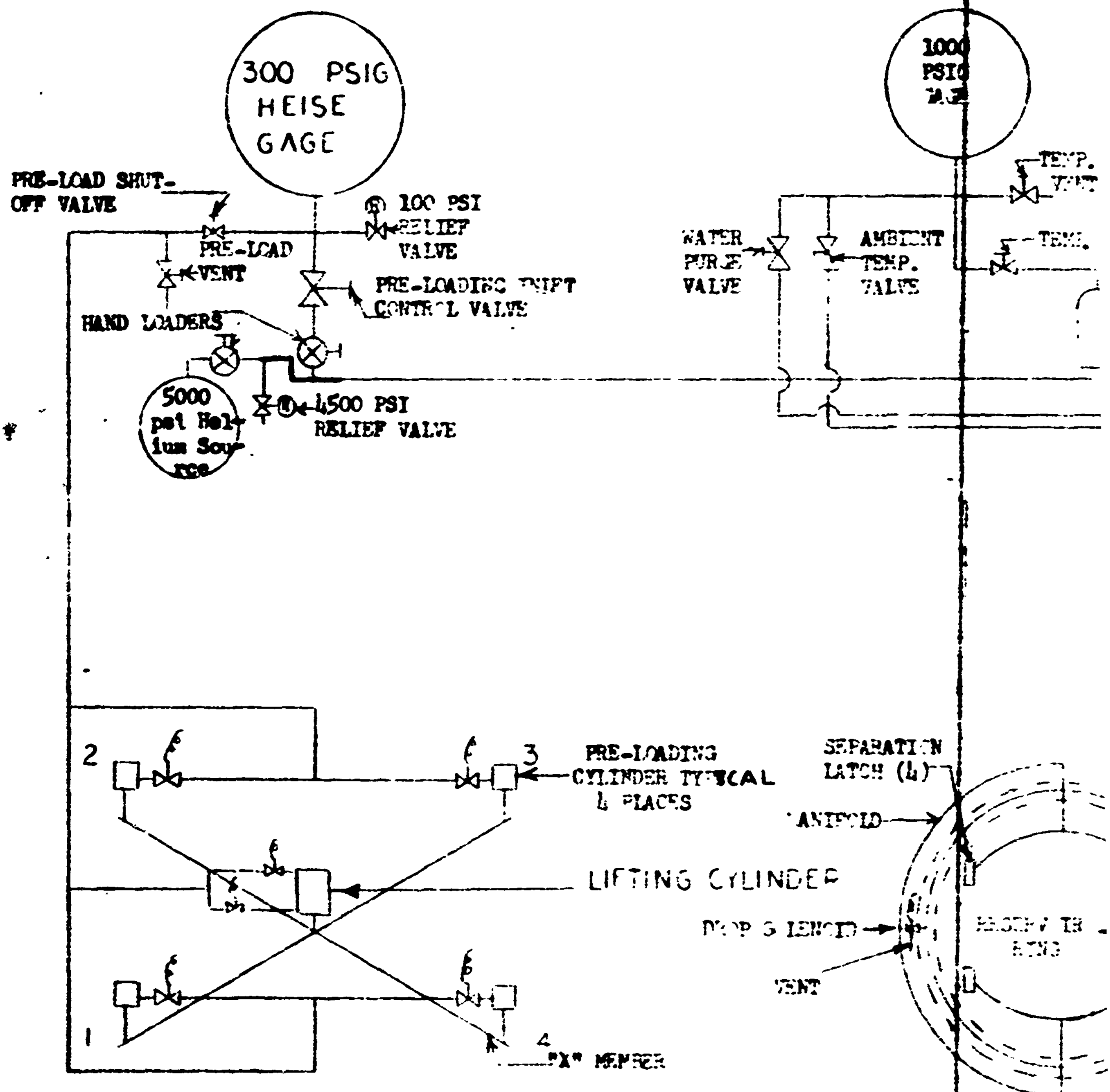
Initial charge pressure of reservoir ring	2975 psig
Reservoir pressure after temperature increase	3875 psig
Net pressure increase after temperature increase	900 psig
Temperature of the reservoir before separation	120 °F.
Equalization pressure of reservoir and manifold after latch separation	3000 psig
Temperature of the reservoir after separation	100 °F.

Leak Test:

Initial pressure	3650 psig
Final pressure	3650 psig
Reservoir leakage over 24 hour period	0

CONVAIR ASTRONAUTICS

CENTAUR SEPARATION
PNEUMATIC SCHEM



FORM NO. A

A,

RATION SYSTEM
SCHEMATIC

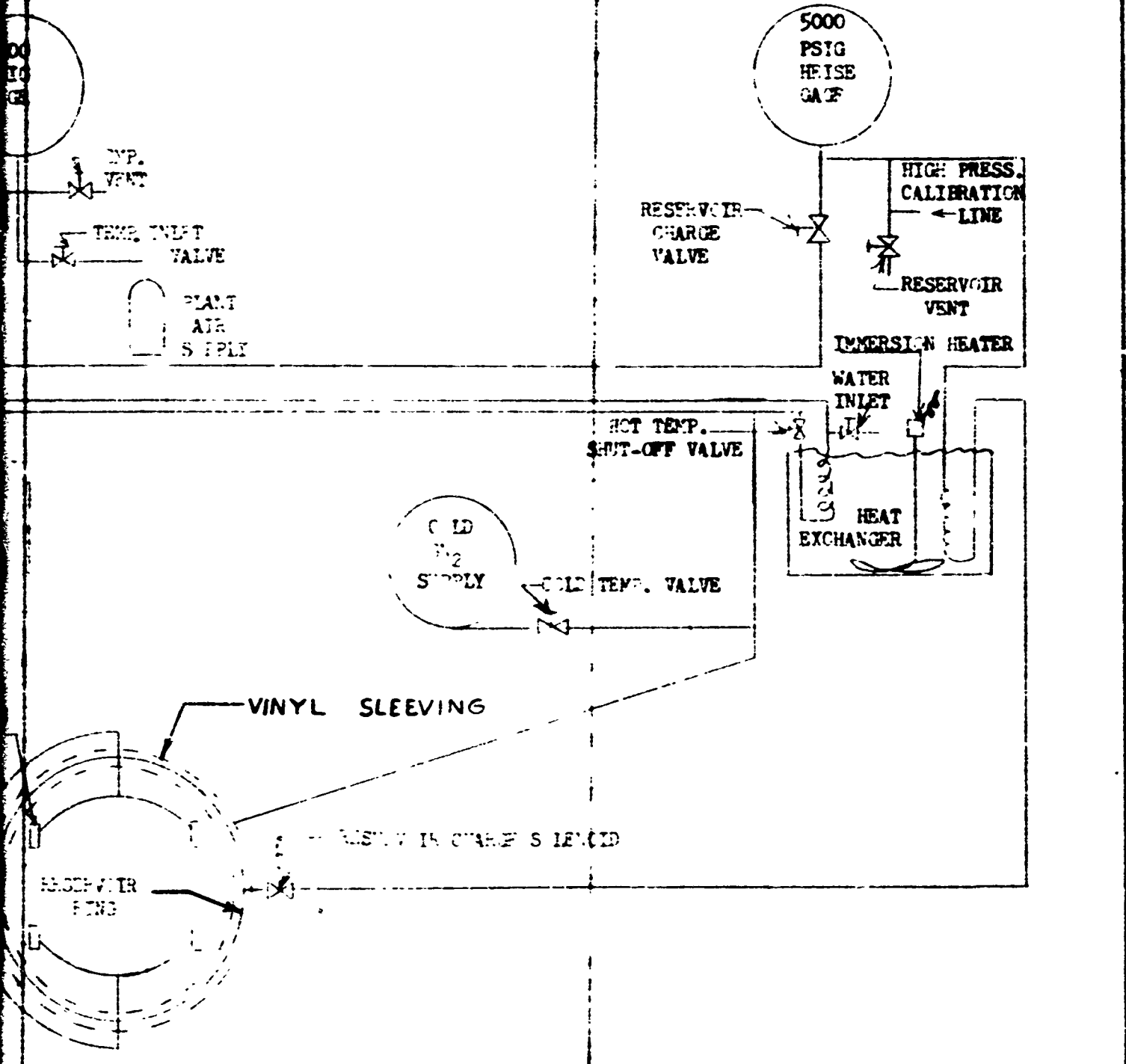


FIG. 1

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B.

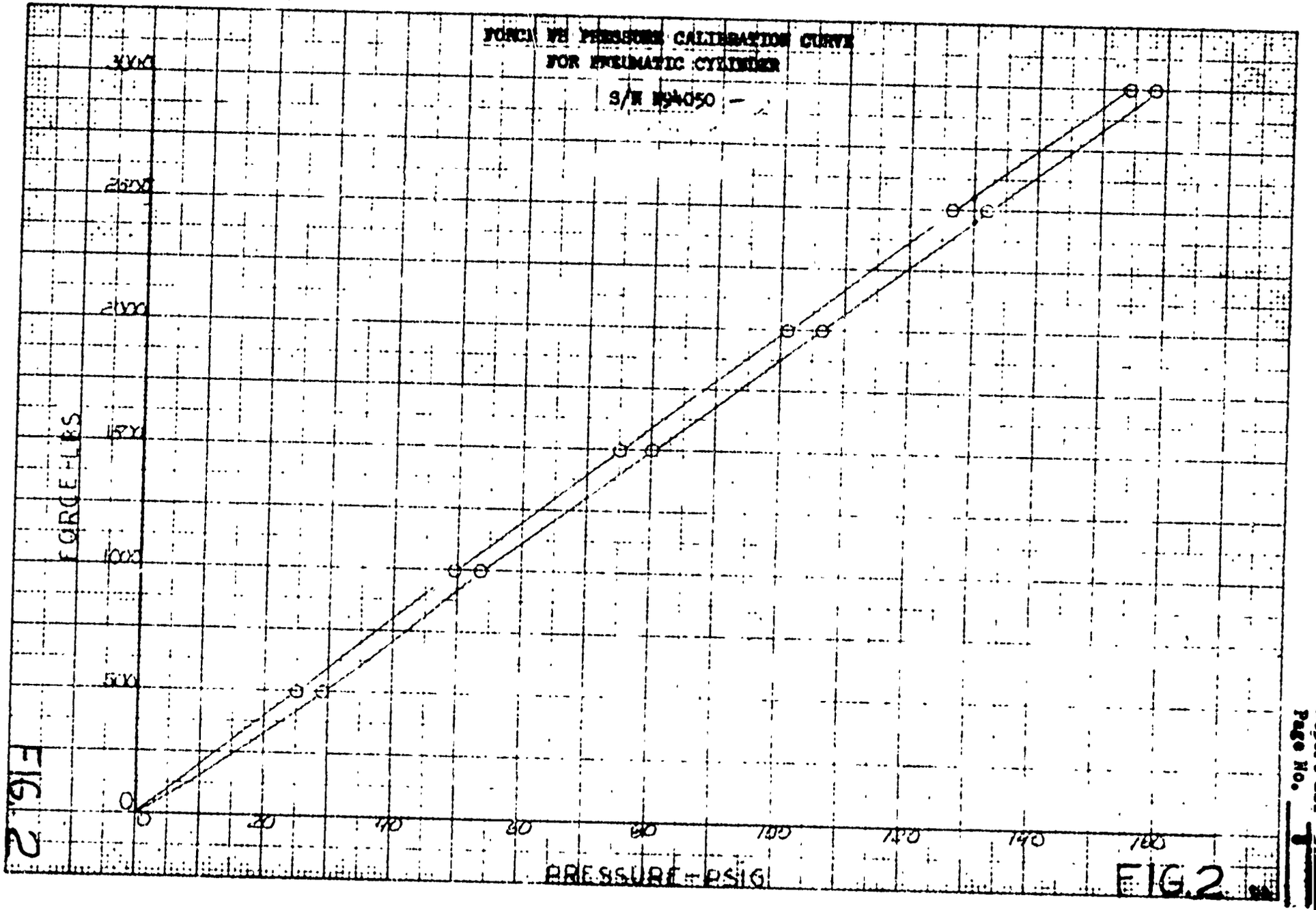

FIG. 2

FIG.2

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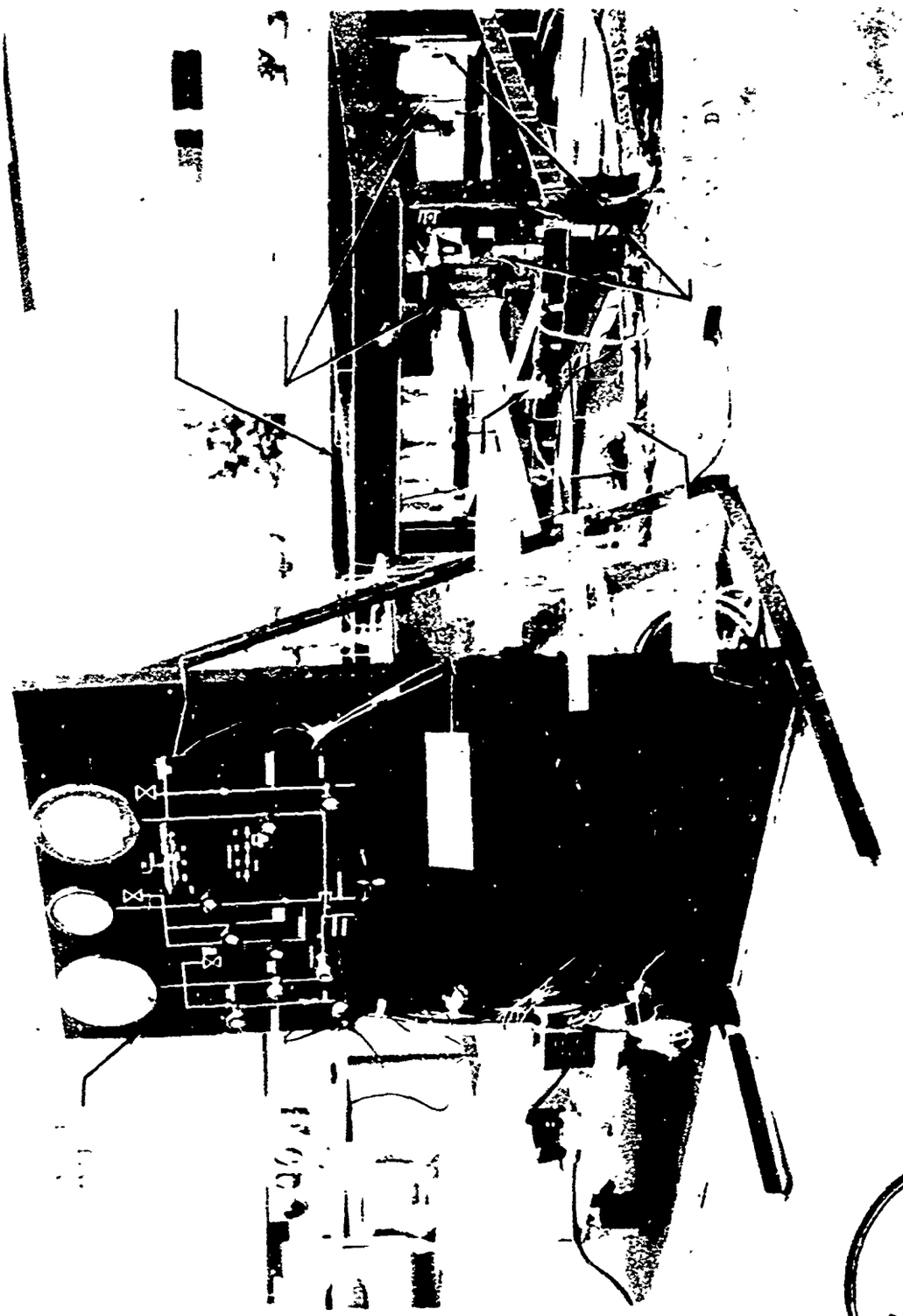
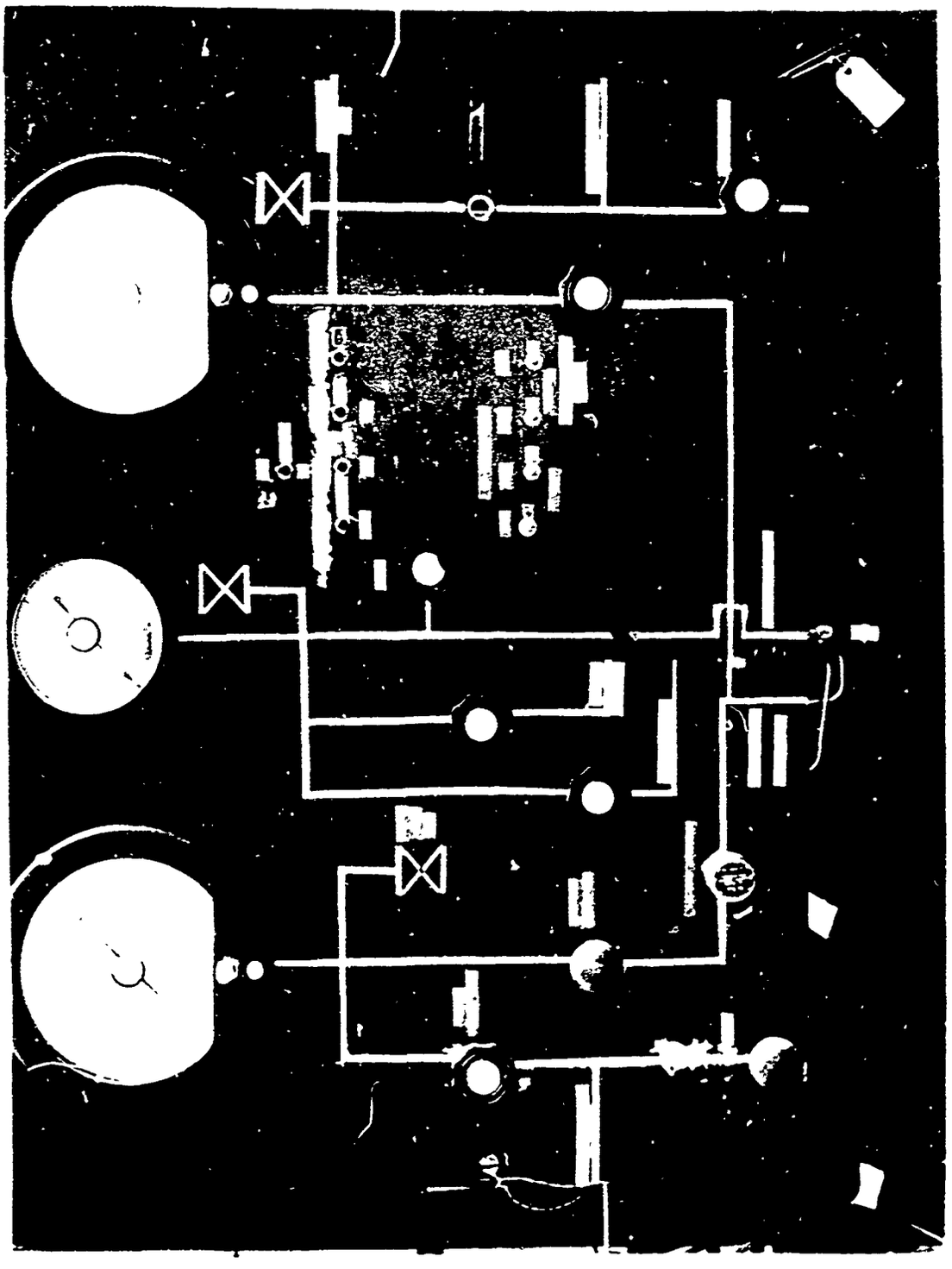
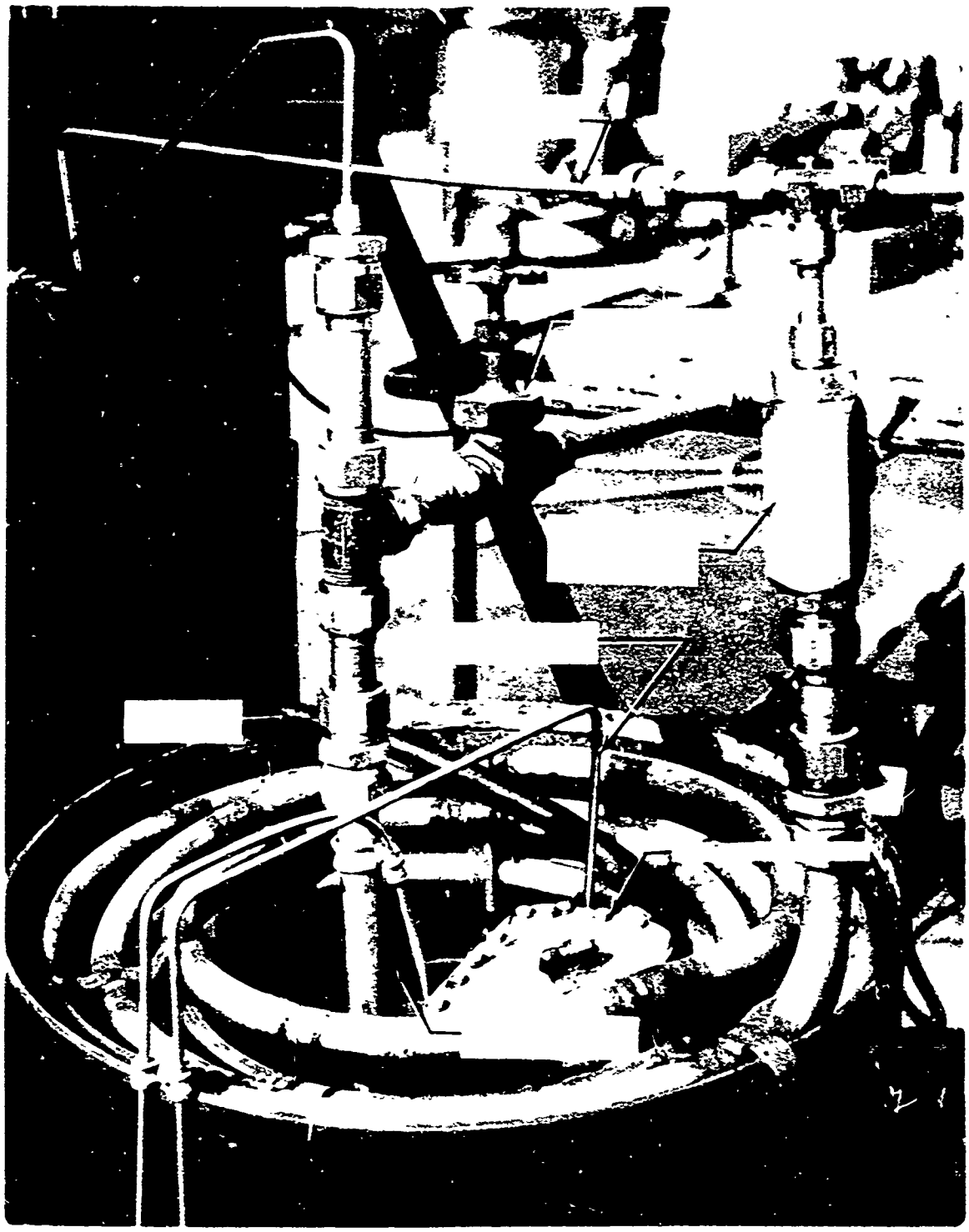


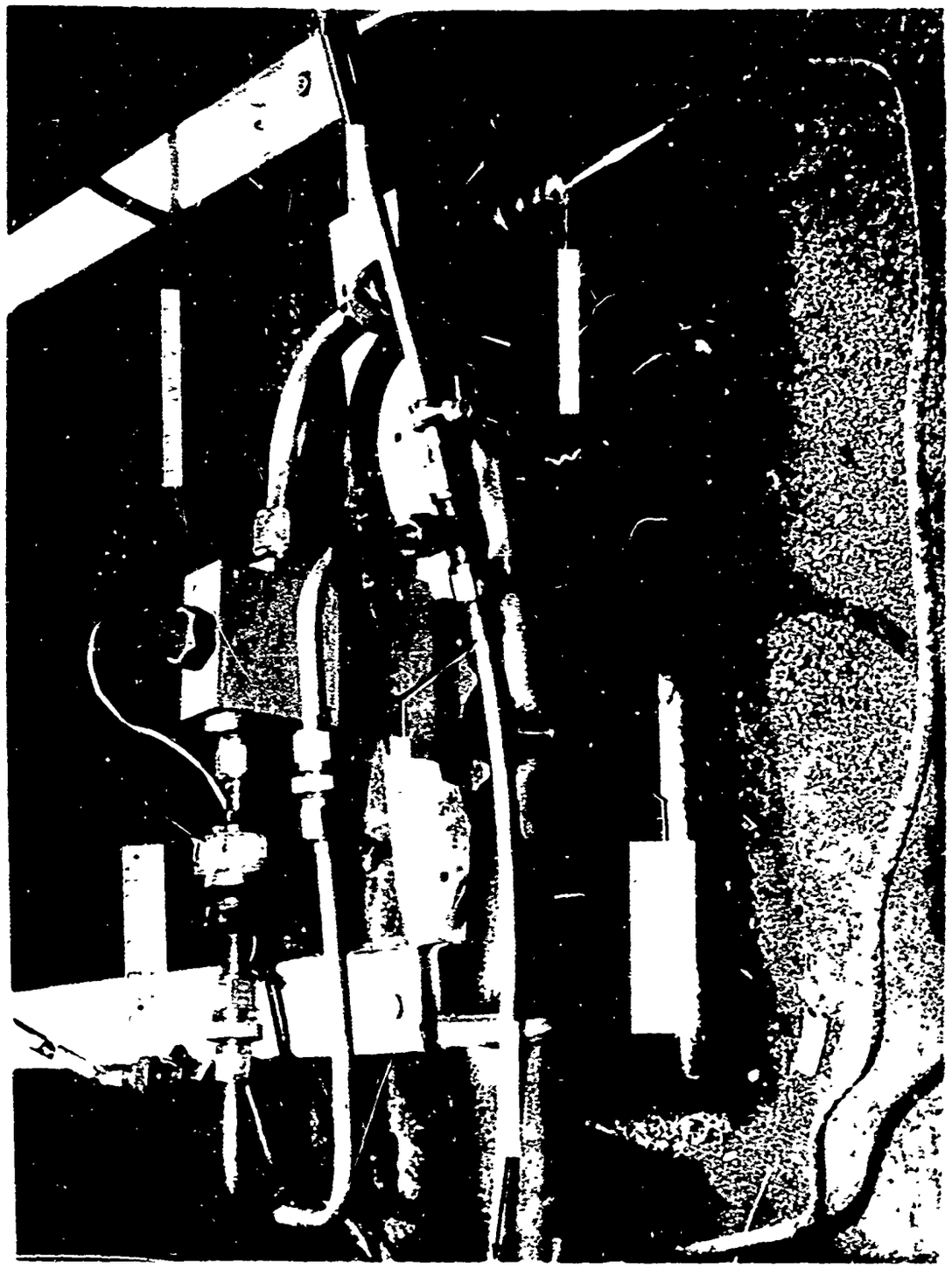
OVERALL VIEW OF THE TEST SETUP
FIGURE 3



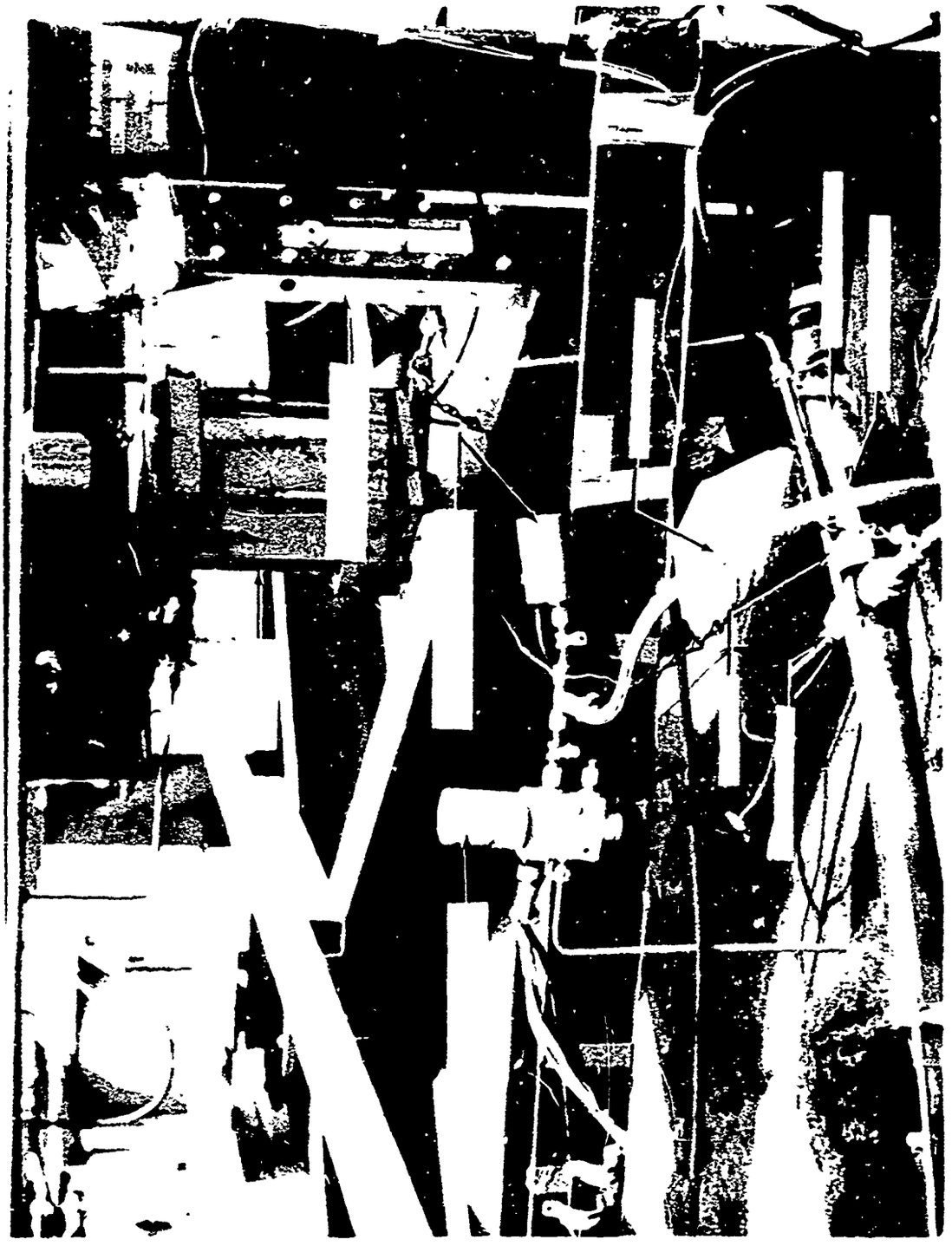
TEST CONTROL PANEL
FIGURE 4



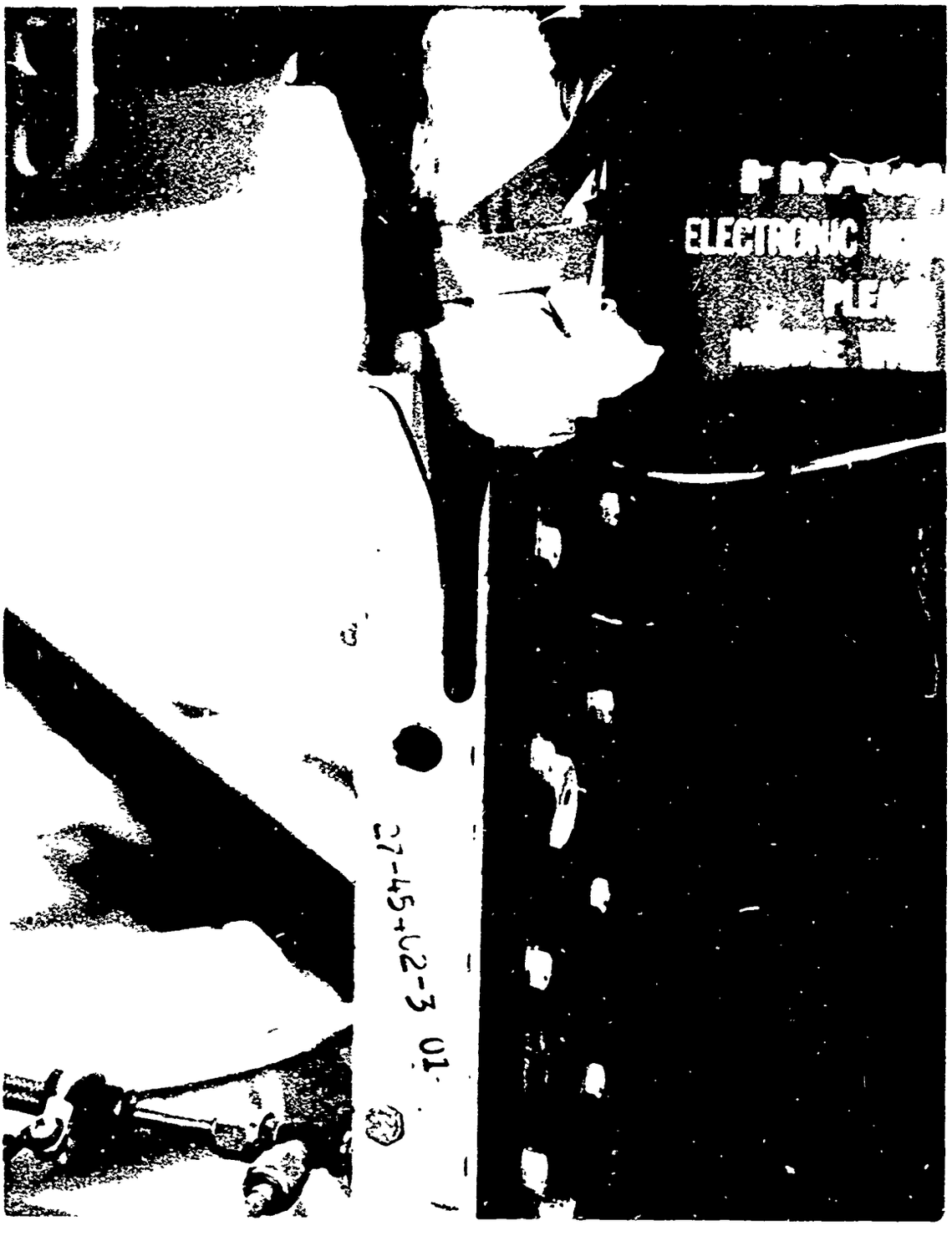
HEAT EXCHANGER
FIGURE 5



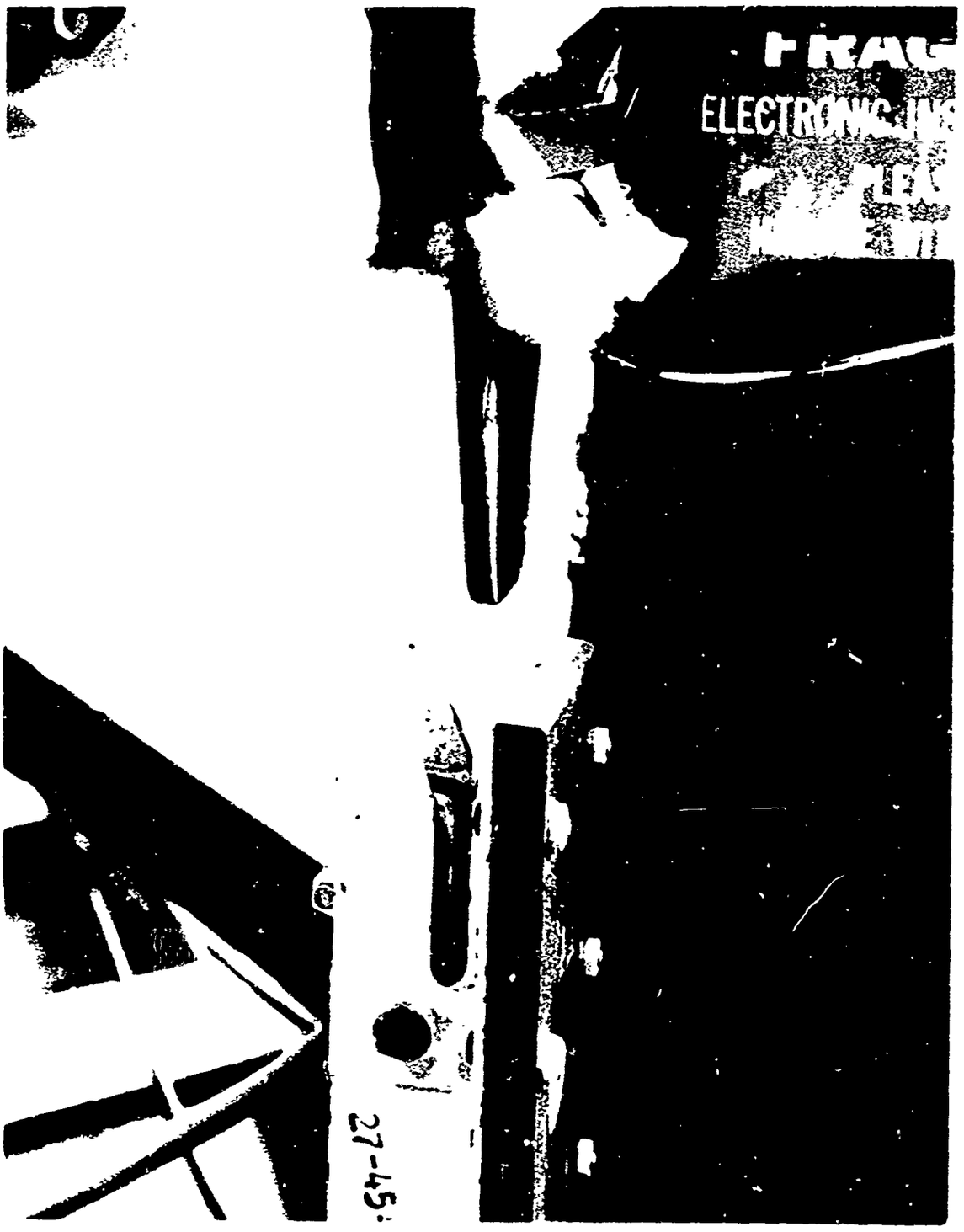
EXPLOSIVE VALVE
FIGURE 6



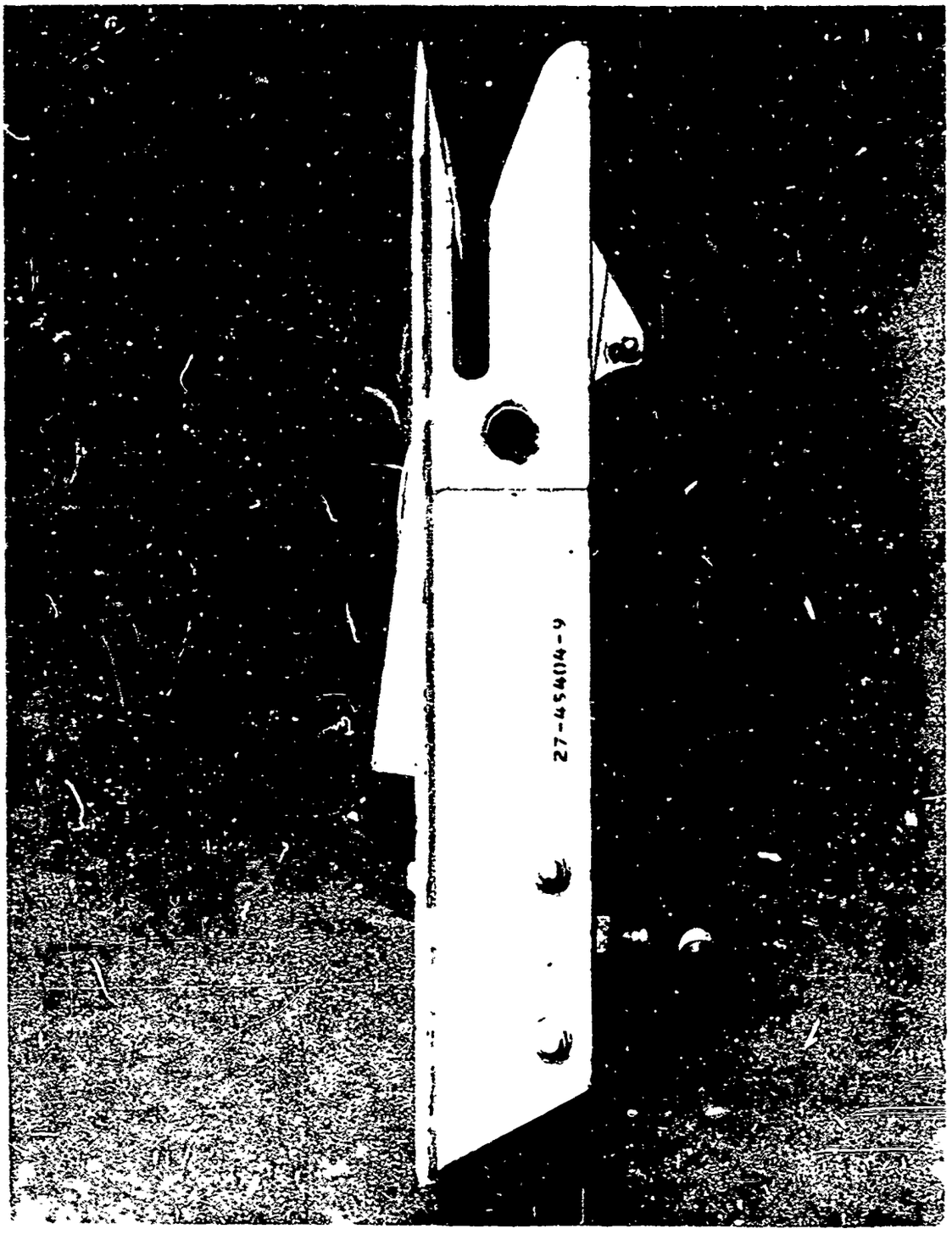
RESERVOIR CHARGE VALVE
FIGURE 7



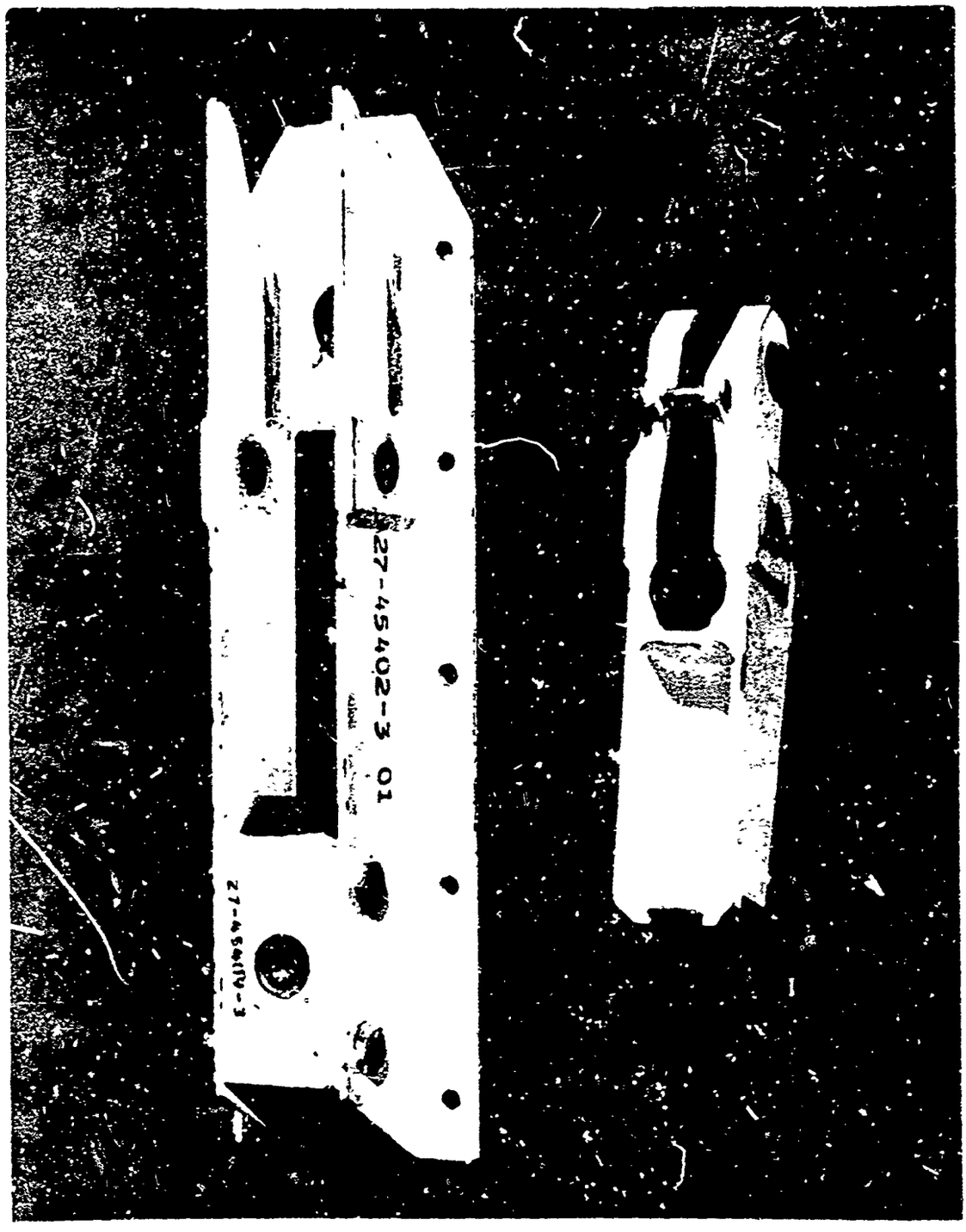
SEPARATION LATCH CONNECTED
FIGURE 8



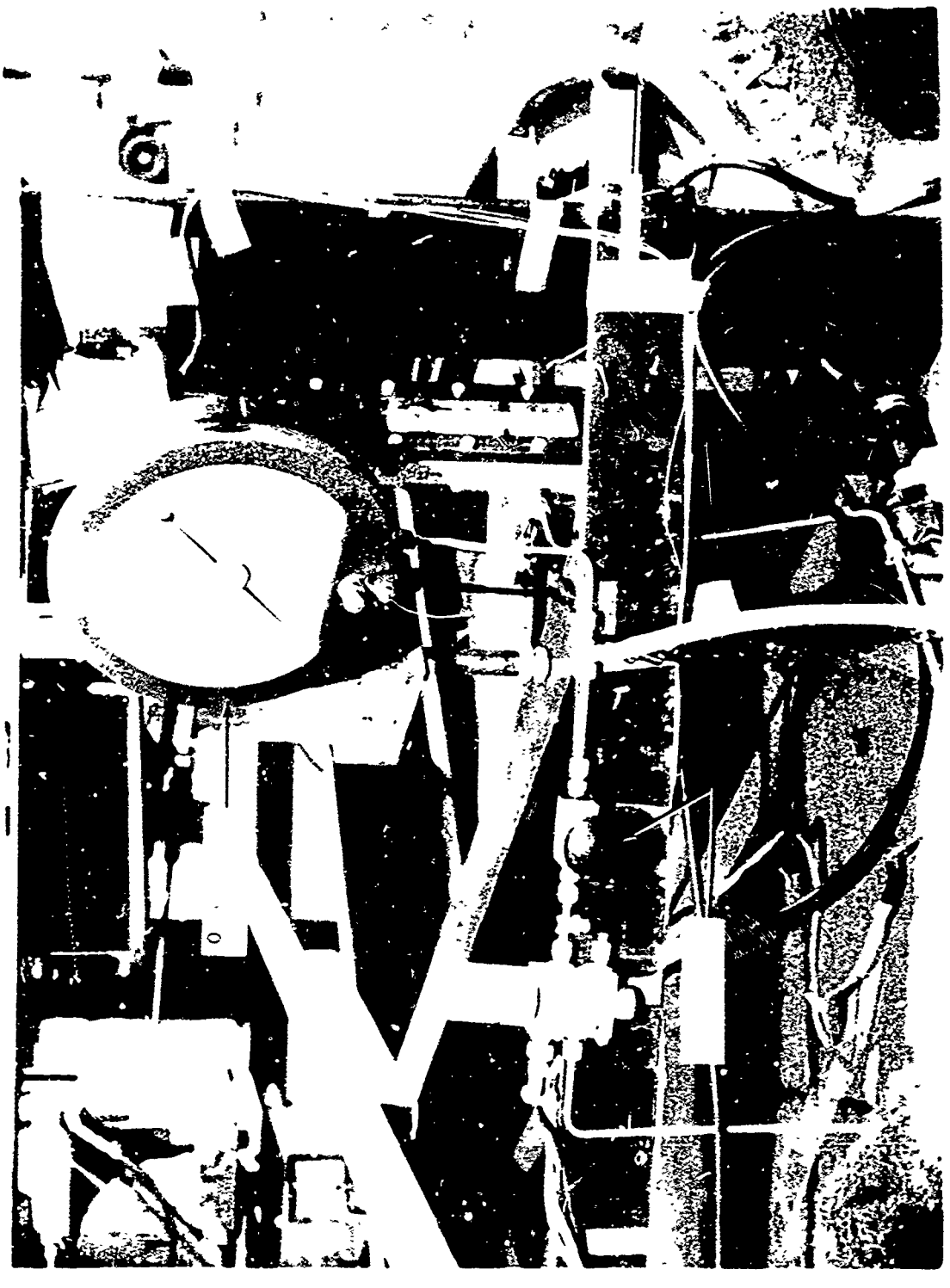
SEPARATION LATCH AFTER "DROP"
FIGURE 9



SEPARATION LATCH ASSEMBLED
FIGURE 10



SEPARATION LATCH DISASSEMBLY
FIGURE 11



24 HOUR LEAKAGE TEST
FIGURE 12