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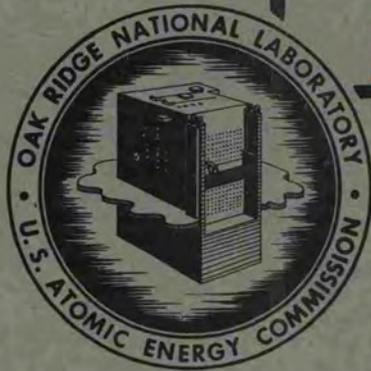
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"AN AUTOMATIC CONTROL VALVE  
FOR FLUORINE STORAGE TANKS"

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Series A

Contract No. W-7405 eng 26

SAFETY AND FIRE CONTROL DEPARTMENT

"An Automatic Control Valve for Fluorine Storage Tanks"

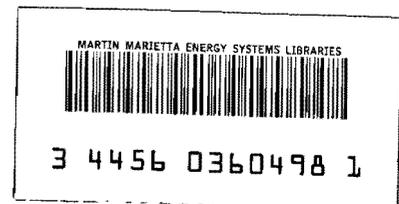
T. W. Hungerford

D. C. Gary

Date Issued: APR 14 1950

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### 1.0 Summary

The use of elemental fluorine in several laboratories at Oak Ridge National Laboratory presented a rather serious hazard because of its toxicity and reactivity. The gas is supplied in nickle cylinders of approximately 45 cubic feet capacity at 45 psi and is supplied with a pressure gauge and manually operated shut-off valve. In order to minimize the exposure to personnel and property, a set of construction standards were devised to cover the installation of the supply cylinder.

It became apparent that in the event of a rupture in the fluorine system it would be necessary to approach the supply cylinder and manually actuate the shut-off valve or the entire contents of the cylinder would be released. In order to minimize this possibility, the Safety Department initiated a study to devise an automatic control valve to shut off the fluorine in the event of an accidental rupture in the system.

## 2.0 Experimental Work

A rupture in the fluorine system will be indicated by both a pressure drop and an increase in flow rate. As most fluorination systems will include pressure gauges and rotameters, it was logical to use these devices as monitors to detect a leak or rupture. In order to test the feasibility of this type of control, a mock-up was constructed utilizing a light source and photronic cell to monitor the rotameter bob to indicate excessive flow. It was also equipped with a pressure gauge containing an adjustable low pressure contact point to indicate excessive pressure drop. Each device was connected to a sensitive relay which, when energized, would sound an alarm and actuate the solenoid operated control valve.

### 2.1 Equipment

#### 2.11 Solenoid Valve

The solenoid operated supply valve was constructed by using a Crane HGP tight shut off valve and adapting the solenoid actuator of an Asco lever type valve No. LQA, Cat. No. 82273. The solenoid coil was rated at 0.63 amperes and 110 volt A. C.

### 2.12 Rotameter

A standard fluorine rotameter was used as manufactured by K-25, with fluorothene tube and bob and nickle fittings. The rotameter was fitted with an adjustable photronic cell and light source. The photronic cell was a replacement unit as supplied for a Coleman No. 11 spectrophotometer.

### 2.13 Pressure Gauge

The pressure gauge was an Ashcraft Duragauge, Cat. No. 1079A, consisting of a silver soldered bronze tube, 0-50 psi working pressure, and an adjustable low pressure contact point connected to an indicating pointer.

### 2.14 Relay

The relay consisted of a Weston sensitive relay, Model 705, type 3-5, with a range of 0-10 microamps D. C. The relay was equipped with high and low adjustable contacts with separate contact adjusting and reset knobs.

## 2.2 Procedure

The apparatus was set up as illustrated in photograph No. 1 (See appendix) and a leak was simulated by cracking the needle valve in the line labeled leak indicator. Using compressed air at 90 psi as a gas supply the solenoid valve was operated several hundred cycles with a positive closure every time. The apparatus was capable of detecting leaks in the order of 5 grams/hour.

## 3.0 Conclusion

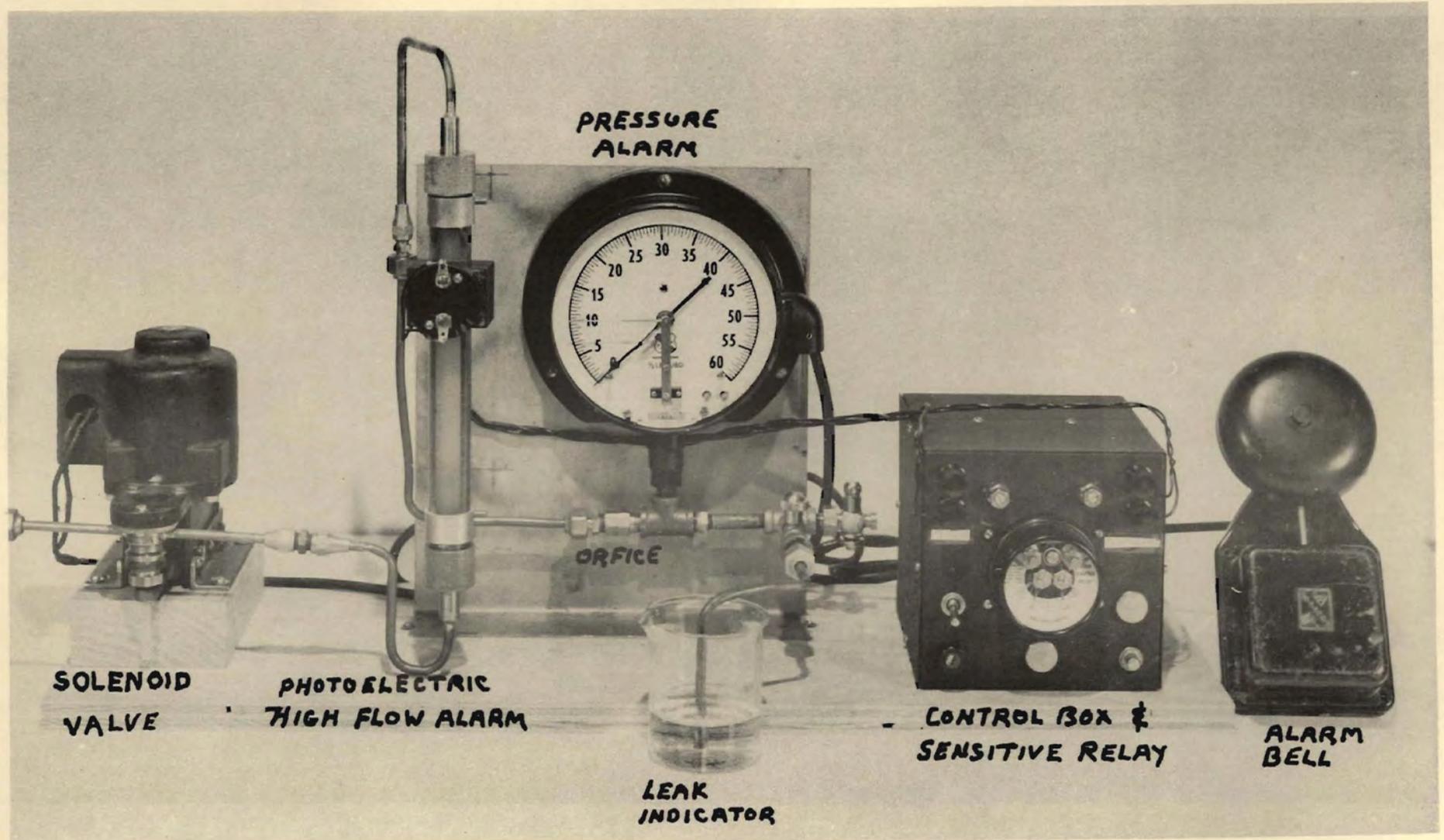
Due to the experimental difficulties of working with elemental fluorine in an instrument laboratory, the gas supply was limited to compressed air. However, all the materials of construction, exposed to the gas flow, have been proven to be fluorine resistant by actual laboratory use and, therefore, no difficulty can be envisioned.

At the present time, two of the research laboratories engaged in fluorination studies are being equipped with automatic control valves on the fluorine storage tank.

## Acknowledgments

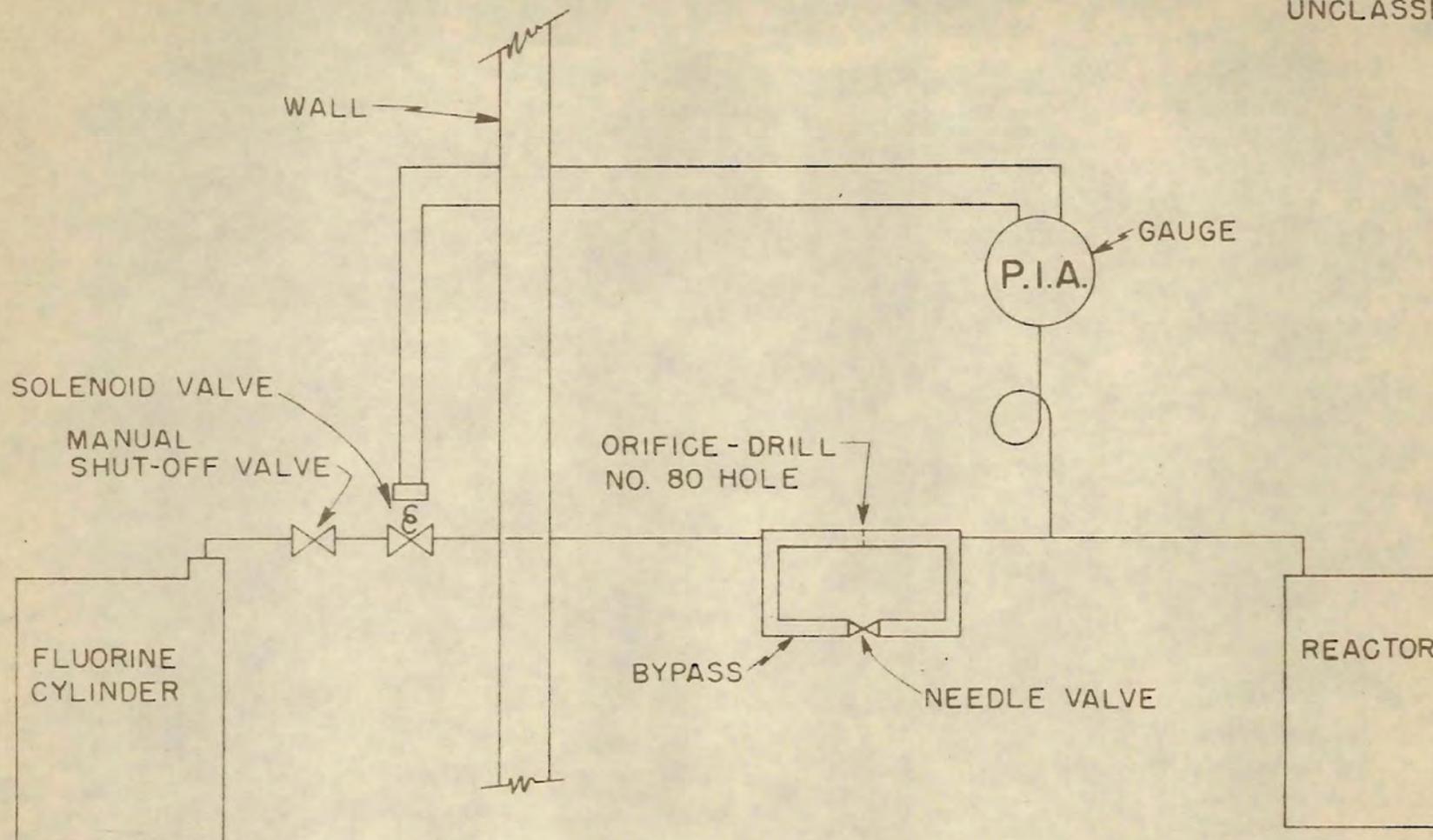
The author is indebted to the following ORNL personnel whose cooperation made this study possible:

S. A. Hluchan  
R. E. Leuze  
P. A. Agron



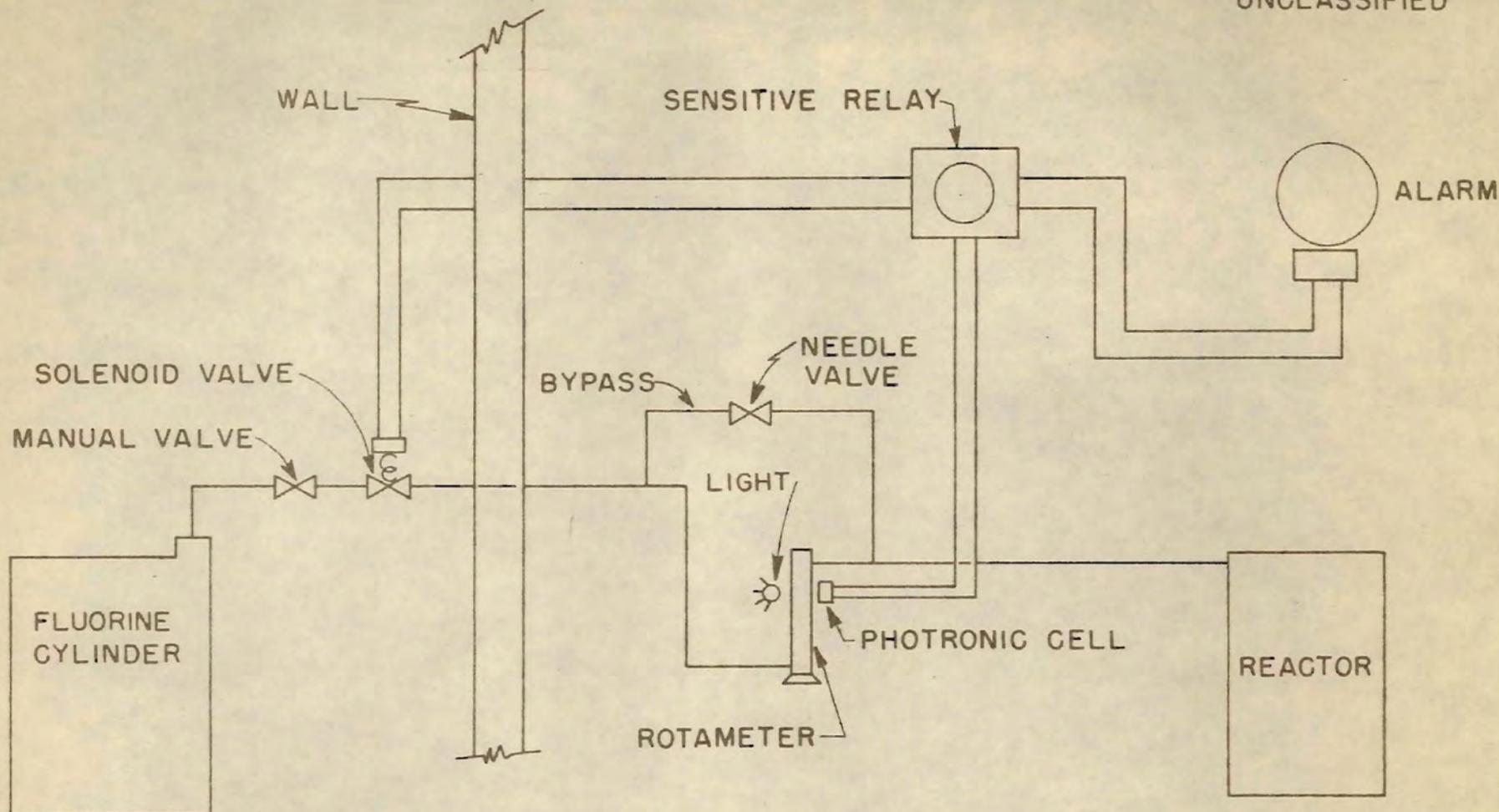
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A break in the reactor system will result in a drop in pressure, this effect being emphasized by an orifice in the line. The pressure gauge has an adjustable low pressure contact point connected to a solenoid valve. When the pressure drops to a pre-determined level, the valve is actuated, shutting off the fluorine supply. The valve remains closed until manually reset. A by-pass allows the system to reach stable conditions before the automatic shutoff apparatus is activated.

PRESSURE ACTUATED ALARM



A break in the reactor system results in a flow increase. The rotameter bob rises and breaks the beam of light actuating the solenoid valve. The valve remains closed until manually reset. The photronic cell and light source are movable, allowing the apparatus to be set for any flow. A by-pass of the rotameter allows the system to reach stable conditions before the automatic shutoff apparatus is activated.

ROTAMETER FLOW ALARM

PARTS USED IN AUTOMATIC SHUTOFF FOR FLUORINE TANKS

Crane HGP tight Shut-off valve

1. Maximum working pressure - 100 p.s.i.
2. Body and plug - nickel
3. Valve stem seal - copper bellows
4. Connections - 1/4" O.D. copper tubing, hard soldered
5. Seat - Fluorothene

Solenoid Operator

1. Asco lever type
2. Type LQA, Cat. No. 82273
3. 110 volt, 0.63 amp A. C.

Rotameter

1. K-25 construction
2. Fluorothene tube and rotar
3. Nickel fittings

Photronic Cell - Replacement unit for Coleman No. 11 spectro-  
photometer

Pressure Gauge

1. Ashcraft Duragauge Cat. No. 1079A
2. 0 to 60 psi working pressure, 1/2 lb. graduations
3. Bronze tube with silver soldered joints
4. Adjustable low pressure contact point
5. Electric alarm contact No. 1163
6. Connections - 1/4" male NPT lower
7. Dial size - 6"

Weston Sensitive Relay

1. Model 705, type 3-5
2. Range 0 to 10 microamps D. C.
3. High and low adjustable contacts with separate contact adjusting and rest knobs