bilge as being unfit for boiler feed and other requirements. The condensed steam lines from the main turbine condensers are similarly equipped with signal-light controllers to indicate leakage of the circulating water into the condensate.

A new instrument for recording turbidity of solutions has been recently developed that may have considerable application in automatic process control. Fig. 4 shows the apparatus used in making a turbidity measurement. The solution is interposed between a high candle-power lamp and a photoelectric cell. A 220-volt, d. c. circuit is connected to the photoelectric cell, and a recording potentiometer and shunt used to measure the current flow through the cell. Variations in the intensity of the light falling on the sensitized plate of the cell will vary the number of the electrons emitted and alter the current flow through the cell. It can be seen, therefore, that variations in turbidity of the liquid interposed between the light and the photoelectric cell will result in variations of light transmitted through the liquid, and produce changes of current in the cell circuit. The recording instrument can then be made to effect any suitable control to vary the turbidity and, if desired, maintain it at a constant value.

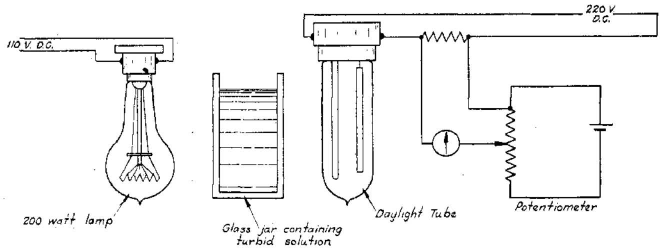

FIG. 4

Control Devices Employed in Testing Ammonia Catalysts[1]

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IN THE testing of ammonia catalysts, close regulation of temperature and pressure is essential if the results are to have any comparative value. As a general rule, catalysts do not respond quickly to changes in temperature and pressure, and therefore observations made while either or both factors are fluctuating are not reliable. It will be the purpose of this paper to describe a method of controlling one of these factors—namely, the pressure.

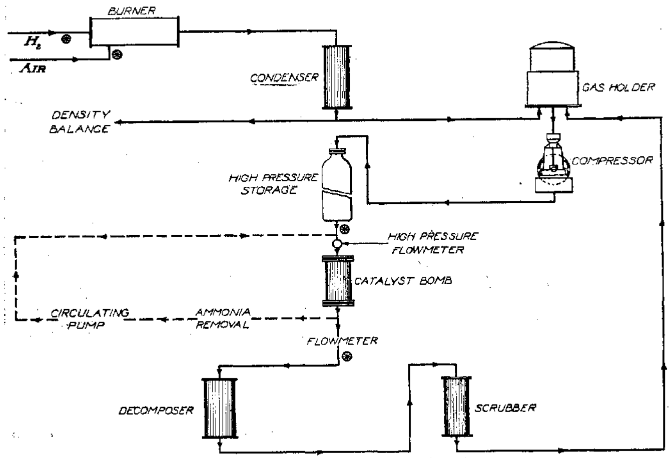

FIG. 1—FLOW SHEET OF CATALYST PLANT

The high-pressure equipment employed in this laboratory for the testing of ammonia catalysts is shown diagrammatically in Fig. 1. It consists essentially of a gas mixer or burner, a gas holder, a compressor, a high-pressure storage, a gas-purifying train (not shown in figure), an electrically heated catalyst bomb, a low-pressure flowmeter, and an ammonia scrubber or decomposer. This circuit requires close regulation of pressure at three places, the first being at the gas burner where hydrogen and air are mixed in such proportions that the residual gas contains three parts of hydrogen and one part of nitrogen. The burner, together with its control apparatus, will be described in the second article of this series.

The catalyst bomb and purification system operateat 1495 lbs. (100-atm.) pressure, while the high-pressure storage may vary from 1600 to 3000 lbs. Between the storage cylinders and the purification towers, therefore, there must be provided a regulatory device capable of delivering gas at a constant pressure (1495 lbs.), while the storage or supply pressure varies between the limits mentioned.

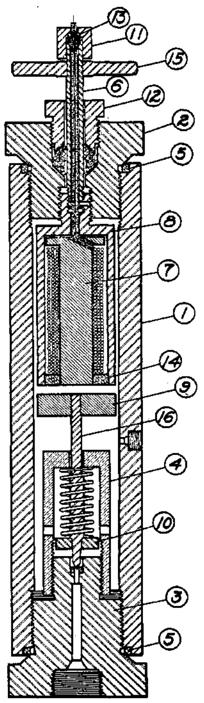

FIG. 2

To meet the requirements of high-pressure gas regulation, a type of valve differing somewhat from the common commercial valves has been devised, the details of which are shown in Fig. 2. It consists essentially of a valve seat cut in a steel plug (3), a valve stem (16) held in place by means of a coiled spring, and an electromagnet to lift the valve stem from its seat. Attached to the delivery pipe of the valve is a pressure gage which has an electric contact attached to its Bourdon tube, as shown in Fig. 3. The opening and closing of this contact operates a suitable relay, which in turn opens and closes the electric circuit that energizes the electromagnet. The closeness with which the gas pressure can be regulated is, of course, determined in large part by the sensitivity of the gage.

The valve as designed and built for delivering the gas at 100-atm. pressure has essentially the following dimensions: The supporting shell (1) is a piece of extra heavy tubing

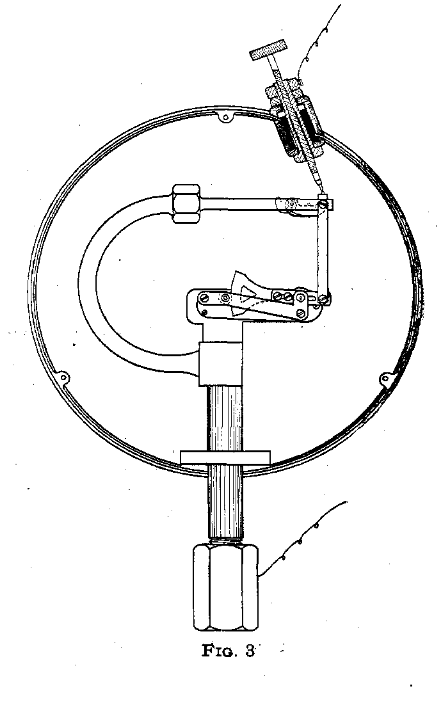

FIG. 3

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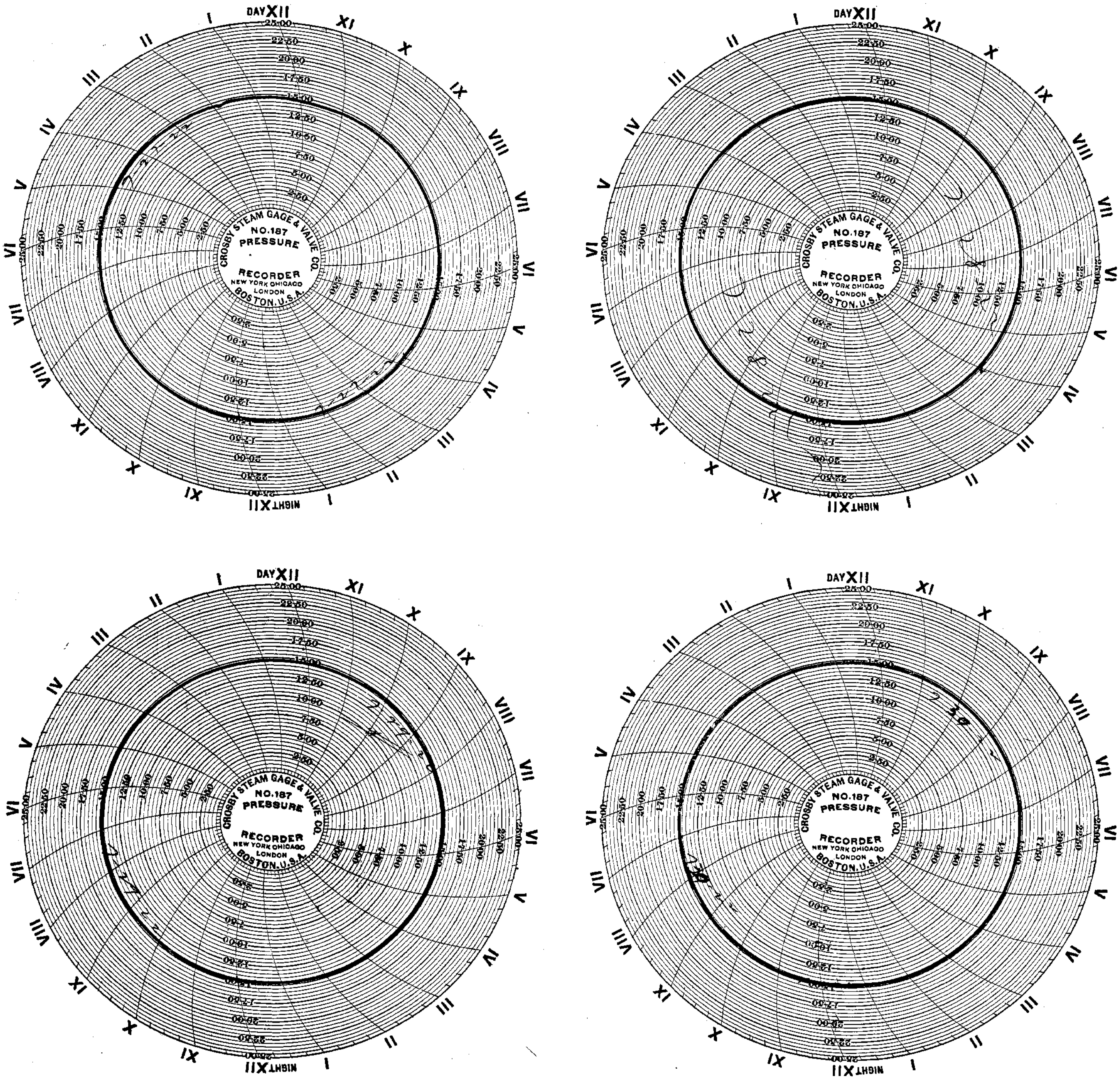

FIG. 4

(length, $11\,^1/_2$ in.; o. d., $2\,^7/_8$ in.; i. d., $1\,^1/_7$ in.), threaded at both ends as indicated in the figure. Into the lower end is fitted a steel plug which serves as a gas inlet and as a valve seat, and also carries the support and guide for the valve stem (16). A $^3/_{16}$-in. hole is drilled up to the constriction indicated in the drawing, at which point the hole is reduced to $^1/_{32}$ in. A $^1/_4$-in. drill is run in from the top, leaving the constricted portion approximately $^1/_4$ in. in length. Into this $^1/_4$-in. opening is inserted a plug of copper which approximately half fills this hole. The $^1/_4$-in. drill is now dropped into the hole to smooth the top surface and the $^1/_{22}$-in. drill is run through from the bottom. With the valve stem (16) and its support (4) in place, the point of the valve stem is inserted into the copper plug and a seat produced by tapping with a hammer. It was found that a steel valve seat is extremely difficult to make and to maintain gastight, whereas a copper seat requires no grinding and is easily repaired if excessive leakage develops. Most ordinary leaks can be remedied by disassembling the valve and striking the top of the valve stem in a manner similar to that employed at the time when the seat was initially made.

The valve stem (16) was made from a hammered steel rod $4^1/_8$ in. in length and $^5/_{16}$ in. at its greatest diameter. Threaded to the lower portion is a 1-in. iron disk having a thickness of $^1/_4$ in. and serving as a support for the coiled spring. To the top of the valve stem is threaded a soft iron disk (9), $1^3/_4$ in. in diameter and $^1/_2$ in. in thickness. The support for the valve stem (4) is made of brass and is threaded to fit the upper end of 3. This brass shell not only serves as a support for the upper end of the valve stem, but also makes possible the adjustment of the spring which holds