early that the steam is expanded more than about five or six times in one cylinder.

Another very necessary point to determine is the pressure at which the exhaust steam is to escape. If the exhaust is to discharge into a feed water heater when there is a pressure of, say, 2 lbs. per square inch, then it is wasteful to make the cut-off so early that when the exhaust valve opens, the pressure in the cylinder is lower than that in the heater. Or if the discharge is directly into the air, there is no economy in having the steam expanded in the cylinder to a pressure below the atmospheric pressure.

The better way to determine the point of cut off is to construct an indicator diagram by fixing the amount to be allowed for each pressure, the pressure at the time exhaust is to open, and by drawing an expansion curve, then the size of cylinder and pressure of steam may be readily found for any required horse power if the speed of piston is known. It will be sufficiently accurate to calculate the points for the expansion curve by the rule that the pressure multiplied by the volume produces a constant quantity. Perhaps it would be better to describe the process of drawing a supposed indicator diagram.

First draw to parallel lines with a distance between them equal to 15 lbs., as measured by whatever scale has been chosen, such as 32 lbs. to the inch; then draw eleven parallell lines at equal distances apart, and at right angles to the first two lines. These eleven lines will divide the diagram into ten *divisions*. *All* measurements and calculation of pressures has to be made from the bottom line of the two first drawn. It represents the line of no pressure, the upper one representing the atmospheric pressure. The length of the diagram represents the length of the cylinder, multiplied by its area, which gives the volume of steam. This may be measured either in inches or feet, and care must be taken not to measure the area by inches and the length by feet.

Let it be determined that at end of stroke the pressure in cylinder is to be two lbs. above the atmosphere, then on the eleventh vertical line mark off two lbs. above the atmospheric line or 17 lbs. above the line of no pressure. Then the pressure of any other line can be found by multiplying 17 lbs. by the volume at end of stroke anddividing by the volume at the line for which the pressure is required. Having marked off the pressure thus found at each line, draw a curved line through all the points, this curved line will represent very nearly the actual expansion of the steam. Then at the first vertical line mark off the pressure of steam which can be admitted to the cylinder, an draw a line parallel to the atmospheric line till it cuts the expansion curve, this will represent the steam admission line of the diagram, and where it cuts the expansion line is the point of cut off required, in order that at end of stroke the presshre shall be 2 lbs. above the atmosphere, if the valves and piston are all right

ERRORS OF SAFETY VALVES.*

THE ordinary lever safety valve in use on ordinary boilers in nearly all sizes of boilers I have had charge of are about all the same class of safety valves; they call them "3-inch." Now we will see what "3-inch" is.

On boiler pressure 75 lbs per square inch, and also the flow of steam in atmosphere, 3×3, that is 7·6. Now then, 75 lbs. per square inch under valve, 7.6×75 570 lbs. dead weight on the valve stem. Now you set your weight on your lever according to your figures, then you test your boiler, and finding your weight is heavy, you say there is something wrong. Well, what is wrong? It is the valve seat, there is a bridge in that seat, ½" × 3", to guide the valve and to keep it in place. When it rises and drops that bridge—½" × 3"—reduces area of valve from 7.6 to 5.94 dead weight on valve, the stem would be about 445 lbs.; therefore, with friction 125 lbs. less than your figures (and that would not be the worst in reducing area of valve); by that bridge in seat you reduce the flow of steam in atmosphere. That is the error.

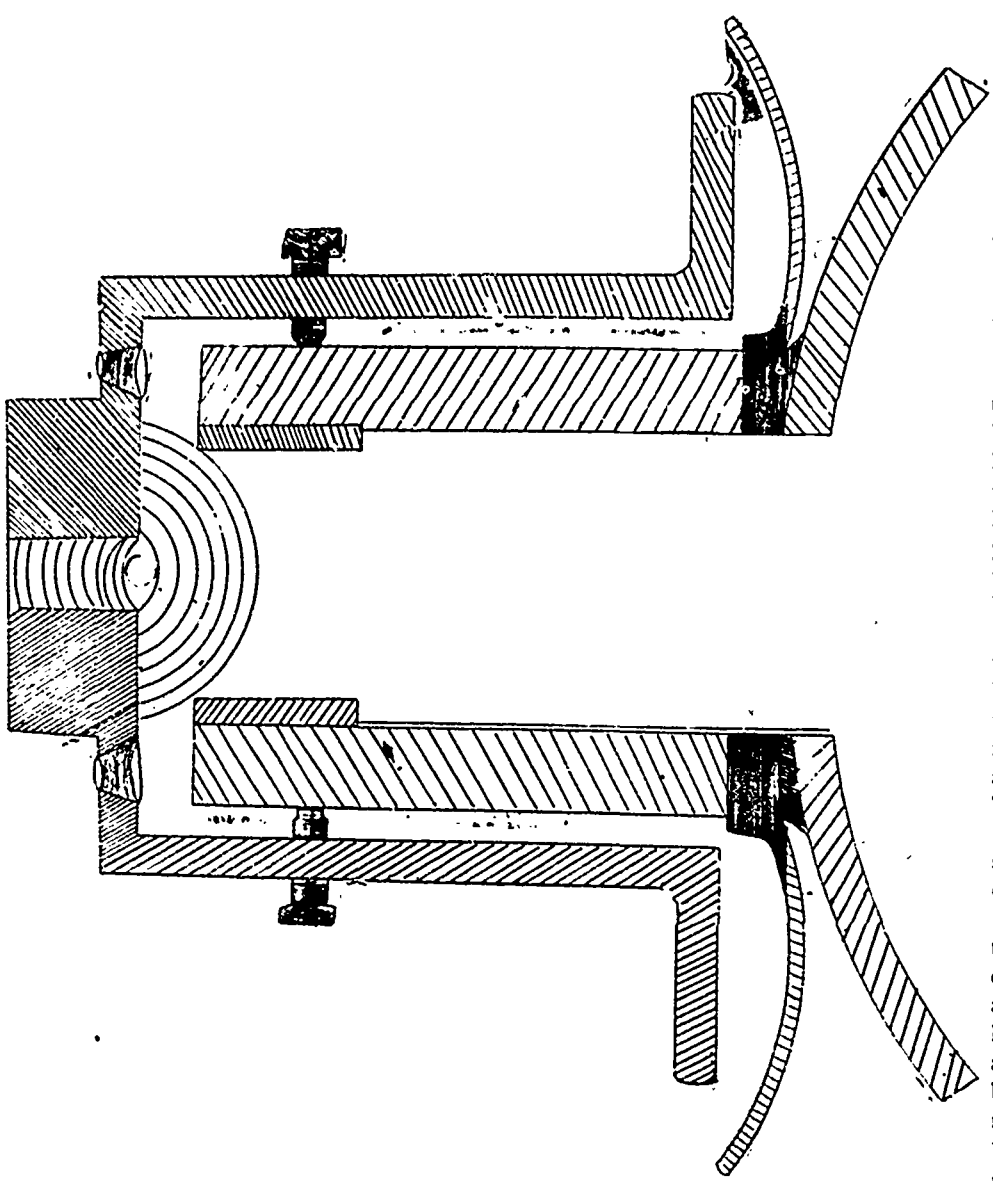

FIG. 1.—VALVE IN OPERATION, SHEWING INSIDE VIEW.

This valve I show you was designed in *England some* time ago. It was designed to do away with the lever and weight, and you will see by the design rivetted on the boiler — in the usual way, double rivetted— it is not only a proper, but what we are figuring on, a 3-inch valve. Should anything occur suddenly, requiring the full area and capacity of flow of steam as quickly as possible, this valve will do all that a 3-inch is called upon to do, for there is no friction. I think we should look after our boilers and safety valves more than we do.

The Edison General Electric Co. will fit up the new Manitoba Hotel at Winnipeg with combination electric and gas fixtures.

The Canada Electric Co., of Amherst, N. S., reports the following central station contracts. The Sydney Gas & Electric Co., 600 incandescent, Antigonish, N. S., Electric Co., 400 incandescent; H. A. Smith, Digby, N. S., 300 incandescent, all the above are direct current system, economic lamps, insulite sockets, using the Canada Electric Co.'s standard dynamos. We also have closed with the Gardiner Mines Co., of Cape Breton, to install a complete wire cutting plant Jeffery undercut machines and C. P. 40,000 watt 220 volt generator will be used

*Paper read before Montreal Branch, C.A S.E., by Mr. John Oades, M.E.