

of 420 feet per minute. The compressors have cylinders 26 x 42 and run at half the speed of the engines, the gearing ratio being two to one. Both steam and air valves are different from the kinds in ordinary use on compressors. The steam valves are piston valves, moved by a cam on the crank-shaft. The valve rod is held up against the cam by an auxiliary steam cylinder. The cut-off is at one-tenth stroke. The inlet valves of the air cylinders are $21\frac{1}{2}$ inches in diameter (the cylinders are 26 inches in diameter), and give an opening of 10% of the cylinder area. They are moved by the piston rods, which pass through the centres of the valves and open and close them at the turn of the stroke. The delivery valves are poppet valves, having a vertical lift, and are apparently without springs. Steam and air cards from this compressor are given in *Engineering* of Aug., 1894. An inspection of the air cards showed a considerably smaller volume of air for one cylinder than for the other, at the same pressures. A few measurements were taken and the following results obtained. There was very little throttling of the inlet, and yet the compression line did not leave the atmospheric line until about 10% of the stroke for one end (call it the head end) and 14% of the stroke for the crank end. It appears quite evident that the inlet valves close much too slowly. Taking the volume to the point where the compression line leaves the atmospheric line as the initial volume, the following results are obtained:

Pressure.	Vol. h. end.	Vol. c. end.	Vol. Iso.	Vol. Adia.
0	1.00	1.00	1.00	1.00
15	.60	.55	.50	.61
26	.45	.37	.35	.49
60	.26	.20	.20	.31
70 (Receiver P.)	.23	.18	.17	.29

There is no apparent reason for better cooling in one end of the cylinder than in the other, and even if there were, the compression line for the crank end lies nearer the isothermal than it is reasonable to expect from a simple water-jacketed cylinder. The most obvious conclusion is that the inlet valve for that end leaked.

The I.H.P. for one half was: steam cylinder 81 I.H.P., air cylinder 69 I.H.P., giving a mechanical efficiency of 85%. This is fairly high, considering that all the power is transmitted through two crank shafts and a pair of spur gears.

We have considered various arrangements of belted and of geared compressors. The third and by far the largest class comprises direct-connected compressors. The advantages of direct