engine. L A and H A are the low pressure and high pressure air cylinders, L S and H S the low pressure and high pressure steam cylinders. C represents the intercooler and R the receiver, through which the air passes before entering the distributing pipes. The dotted lines indicate the path of the air through the machine. Fig. 27 shows a compressor of this design, as built by the Canadian Rand Drill Company.

The terminal resistance of the air in the low pressure cylinder L A is (in our assumed case) 26.4 x 100 = 2,640 pounds. The terminal resistance of the air in the high pressure cylinder H A is (100 – 26.4) × 36 = 2,650 pounds, practically the same. Either of them is but a little more than $\frac{1}{2}$ of the corresponding terminal resistance of a duplex single-stage compressor of the same capacity.

From the mean effective pressures previously found we get the work per stroke for each cylinder, as follows :

L. P. cylinder = 17.6 × 100 × 1.44 = 2,534 foot pounds.
H. P. cylinder = 49.2 × 36 × 1.44 = 2,441 "

These also are practically the same.

We can see from our general equations that the terminal resistance and the work per stroke for each cylinder should be the same, in our assumed case. The ratio of the piston areas is $\frac{p_a}{p_c}$ but this equals $\frac{p_a}{\sqrt{p_a p_1}} = \frac{\sqrt{p_a p_1}}{p_1} = \frac{p_c}{p_1}$, that is, the areas are inversely as the terminal pressures, so that the terminal resistances are equal. Also, in calculating the work of compression from equation (6), there being the same weight of air in each case, the only difference is that we have $\frac{p^c}{p_a}$ for the L. P. cylinder, and $\frac{p_1}{p_c}$ for the H. P. cylinder. But $\frac{p_c}{p_a} = \frac{p_1}{p_c}$ so that the work per stroke is the same in each case.

In single stage adiabatic compression to 100 pounds gauge the lost work is 36.7% of the work of isothermal compression, while for two-stage adiabatic, with perfect intercooling, the lost work is 16.5% of the work of isothermal compression. Hence the maximum possible saving by two stage compression is about 20%. The saving practically possible is considerably less, for the following reasons :—(1) The intercooler does not usually reduce the air to the initial temperature. (2) Considerable saving over adiabatic compression can be affected in single-stage compression, hence there is not so much lost work to be