PARALLEL & DOUBLE FLOW COMPRESSORS

A common method of increasing capacity of a system is using two or more compressors in parallel. However, it is feasible, since the "identical" units are always somewhat different and system resistance varies, that both units will not be operating at the same point on the performance curve. It is therefore always recommended that each unit have a separate anti-surge system. For a double flow compressor this is not so simple due to the common discharge nozzle. The design of the inlet piping must be such to achieve a well-balanced, distortion-free flow into each inlet of the compressor. Otherwise, as with the parallel compressors, the flow rates to each side may not be balanced and premature surging will occur.

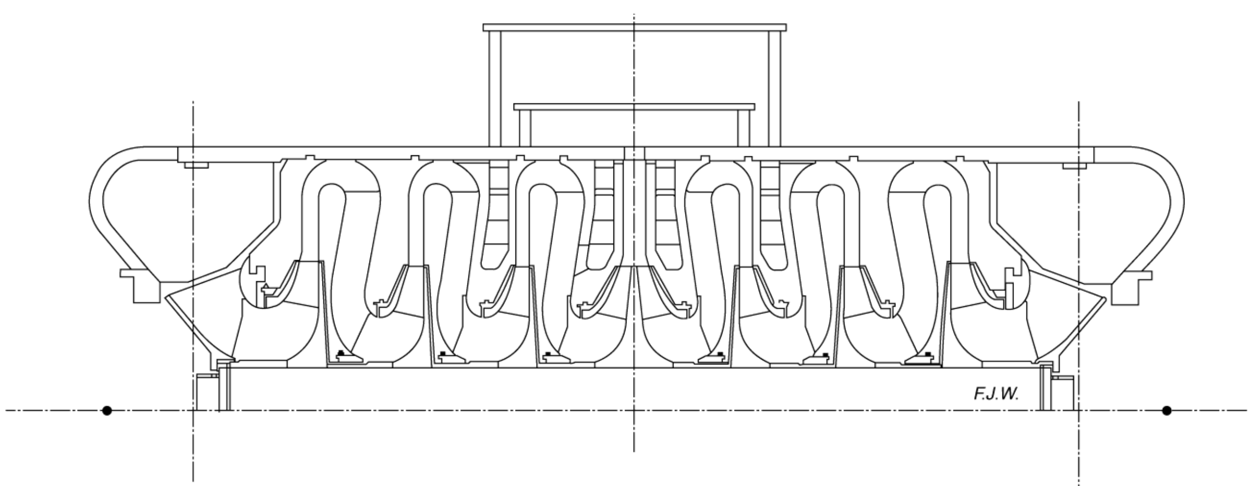
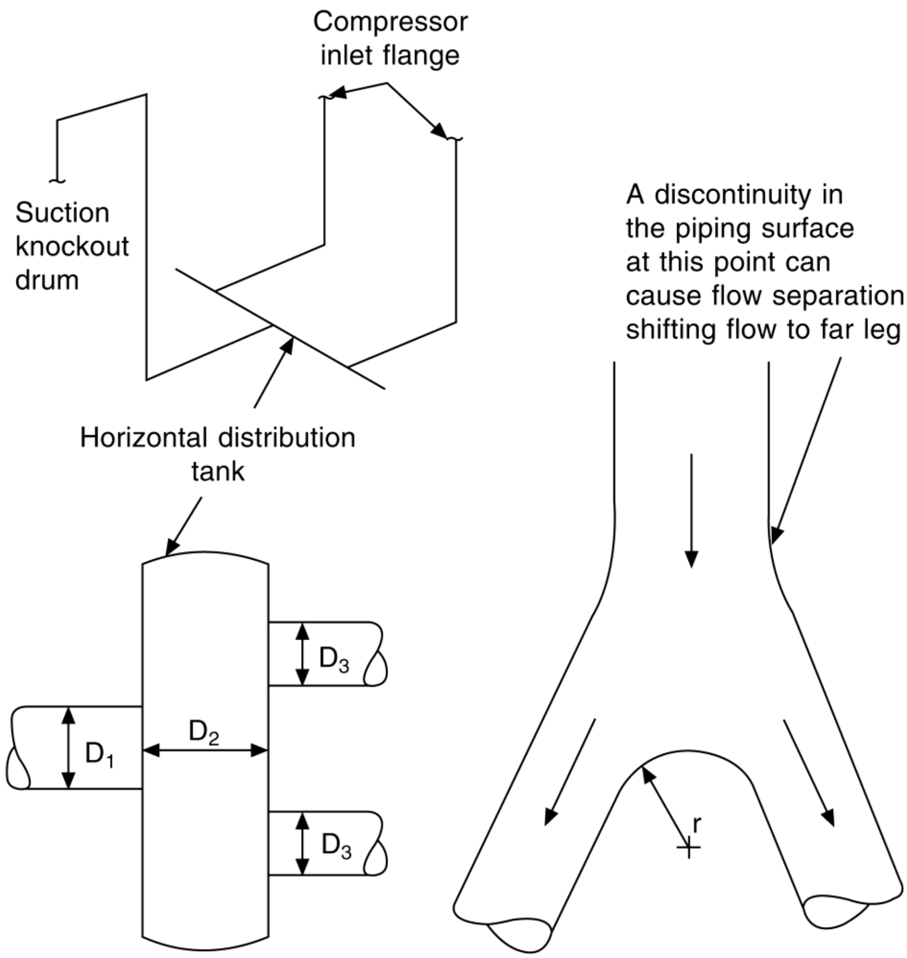


Figure 1. Double flow compressor.

The most reliable inlet piping design for a double flow compressor utilizing a drum to split the flow is shown in Figure 2. While a Y with a proper upstream straight run of pipe may seem like a good design, it should be noted that even the smallest disturbance in the piping upstream of the Y will cause the flow to shift to one leg of the Y or the other.

More often than not, some type of trimming device (orifice plate, butterfly valve, or others) is used in one or both legs of double flow compressors to equalize the flow. For this reason, the most economical method may be to simply install a butterfly valve upstream of a Y connection.



The horizontal distribution tank shown on the left is the suggested piping for double flow compressors. D_3 and D_1 are sized according to Figure 6.17. Size D_2 to achieve a velocity $^1/_4$ of that in Figure 6.17. Note that the anti-surge line should be fitted to the knockout drum further upstream and not to this distribution drum. Piping legs from the distribution drum to each inlet must be identical mirror image of each other.

A suggested design for a Y type splitter is shown on the right. Note the large radius at the dividing point. A mitered type joint with a sharp, pointed dividing geometry could cause flow separation and uneven distribution. A minimum of 10 pipe diameters is required upstream of a Y joint. Low velocity (relative to Figure 6.17) will help assure equal flow distribution. This same Y joint geometry is suggested for rejoining the flow from the discharge of two parallel compressors.

Figure 2. Recommended inlet piping for a double flow compressor. (Note, Figure 6.17 can be located in “Compressor Performance, Aerodynamics for the User” Third Edition.)

Field Problems

Following are some actual case histories where inlet piping alone was the source of some serious performance problems.

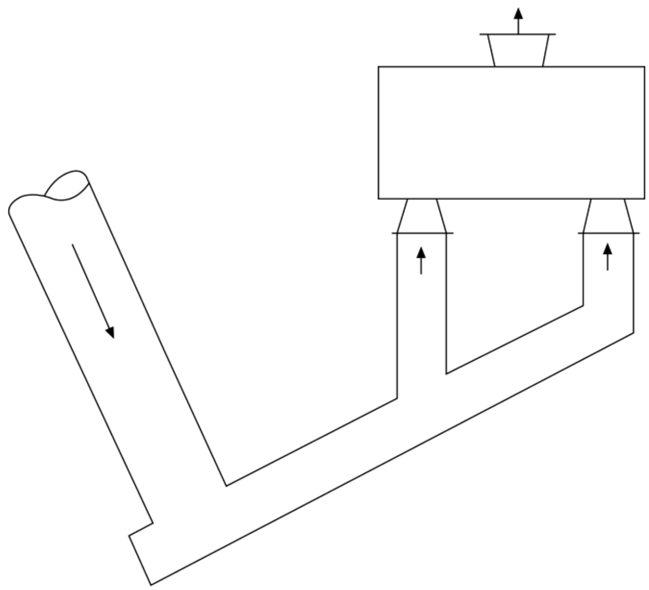


Figure 3. Double flow compressor inlet piping.

Case A. During commissioning, a double flow compressor was found to be low in head. Also, the unit surged prematurely.

The inlet piping caused unequal flow distribution to the compressor inlet. This resulted in one section running near surge while the other section was operating near the overload region.

The inlet piping to the compressor was modified utilizing a mitered elbow at the tee, a flow equalizer, and a trim valve to improve flow distribution.

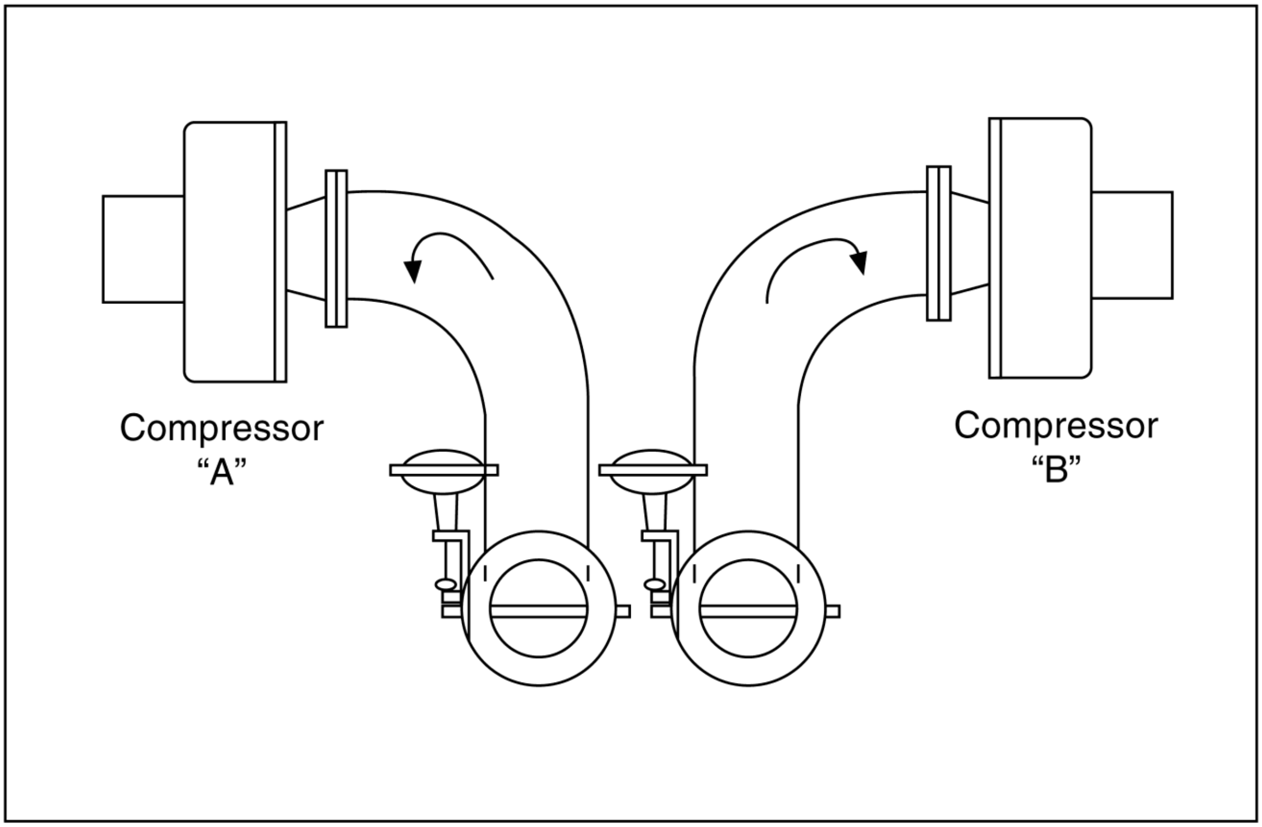


Figure 4. Two duplicate mirror image single stage air compressors.

Case B. Two duplicate single stage air compressors were found to have a significant capacity difference during commissioning.

Both compressors had been performance tested at the factory and were within 1.0% of each other. The suction piping for each unit was identical to the other except that they were mirror images. The axial inlet compressors had two elbows at different planes and a suction throttle valve. This piping arrangement caused flow swirl which caused prewhirl at the impeller and effected the head output.

The inlet piping was modified to include mitered elbows which minimized the problem.

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References:

Compressor Handbook, Paul C. Hanlon, McGraw Hill, 2001, Chapter 4.

Compressor Performance, Aerodynamics for the User, 3rd Edition, MT Gresh, Butterworth Heinemann, 2018