BPS SERIES PUMPS IN SERIES FOR HIGH PRESSURE APPLICATIONS

PL-2024-02 Rev00 Application Note

Introduction

In contrast to positive displacement pumps like diaphragm or bellows pumps, centrifugal pumps can be put in series to increase pressure. A series arrangement also provides redundancy. In case of a pump failure the pump design allows the flow to go through the defective pump and the remaining pumps can still deliver pressure.

Putting BPS Pumps Systems in Series

If the pressure that can be achieved with one pump is not high enough, it can be raised by putting additional pumps in series. The total differential pressure of the series arrangement is the sum of the differential pressures of all pumps (in Figure 1 the pressure that can be measured with PM2 is the sum of the pressure of PM1 and the differential pressure of pump P2)

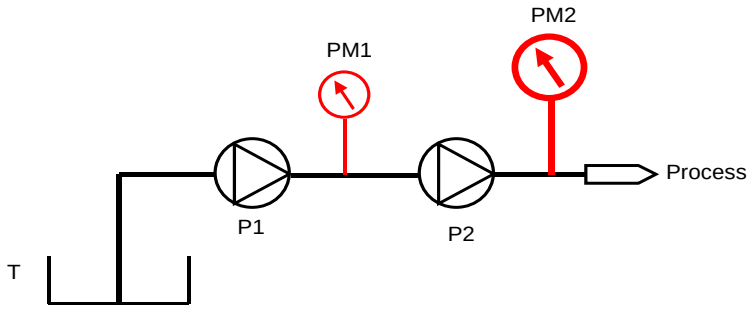

Figure 1: Two Pumps in Series

T: Tank
P1-P2: Levitronix pump (BPS Series)
PM1-PM2: Pressure Measurement

Characteristic Curve of a Series Arrangement

Figure 2 shows the characteristic curve of two BPS-3 pump systems in series. To get uniformly distributed pump power, both pumps are running at the same speed.

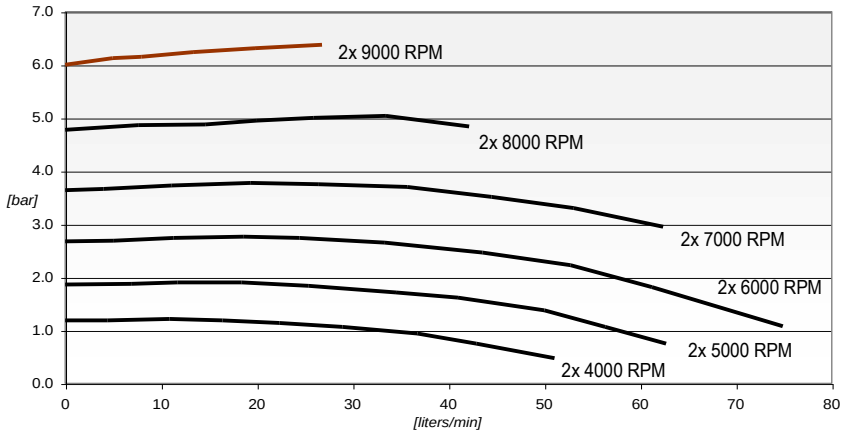

Figure 2: Characteristic curve of two BPS-3 pumps in series (both running at the same speed)

Control Method

The preferable method to control a system of BPS pumps in series is controlling the speed, which should be the same for all pumps. Although it is possible to run the pumps at different speeds, the distribution of pump power among the pumps and therefore also the heat distribution is at its optimum if the pumps are running at the same speed (sometimes a slightly higher power consumption of the first pump can be observed, which is negligible in most cases).
If the pressure has to be set with a very high resolution, it is still possible to change the speed of just one pump. A small difference of the pump speed won't have a significant effect on the heat distribution.

Redundancy of BPS Pumps in Series

Redundant Systems

An important aspect of a series arrangement is redundancy. In case of a pump failure the pump design allows the flow to go through the defective pump without a significant pressure drop and the remaining functional pumps still deliver pressure to the system. The loss of pressure due to the failure can be compensated by ramping up the speed of the remaining pumps. Depending on the point of operation the loss of pressure can be partly or completely compensated. Since the pump power of the remaining pumps goes up in that case, careful thermal design must be considered to avoid overheating.
Figure 3 picture A.) shows three pumps in series running at 5100RPM, which results in a pressure of 3 bar at the end of the series arrangement. Picture B.) shows the same series arrangement with a pump failure of pump P2. The two remaining pumps P1 and P3 can compensate the loss of pressure if their speed is changed to 6200RPM. The overall pressure remains 3 bar.

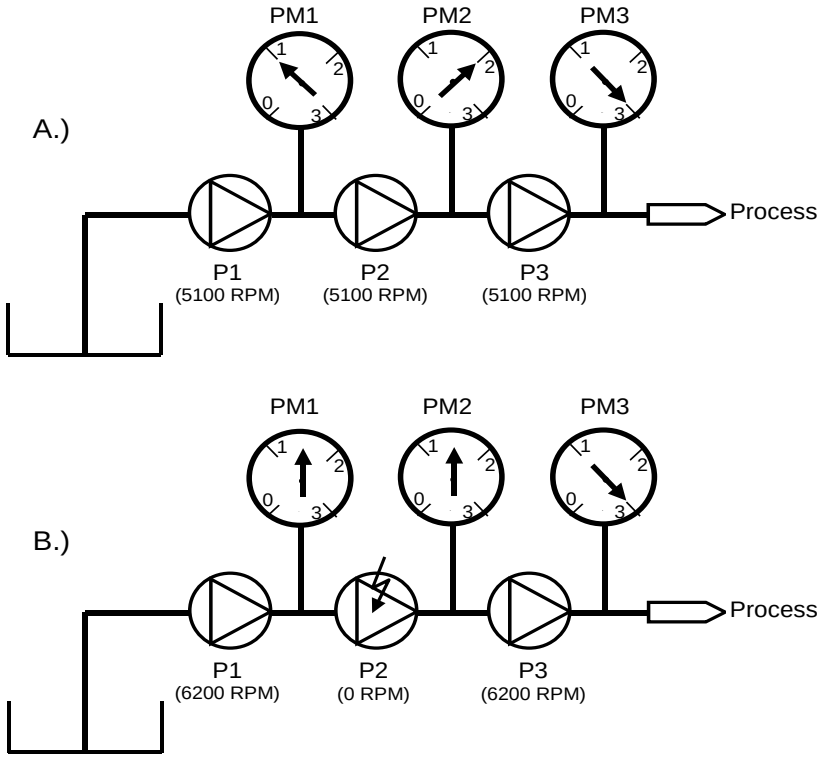

Figure 3: Three pumps running at same speed (A.)
Two pumps running at higher speed to compensate loss of pressure (B.)

P1-P3: Levitronix pump (BPS-3 Series)
PM1-PM3: Pressure Measurement

Technical Support

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