Pumps operating in series

To connect two pumps in series means that the discharge from the first pump is piped into the inlet side of the second pump (Figure 13). In this type of arrangement all the flow successively passes from one pump to the next with each pump adding more energy to the water. This is a typical arrangement in multi-stage turbine or submersible pump where the same discharge passes through all stages and each builds additional head. Often, series configurations are used when head requirements of the system exceed that which can be supplied by individual pumps. They are also used in systems with variable head requirements. A typical example is a small centrifugal pump used as a booster pump for corner irrigation on a center pivot system or, for that matter, any booster pump, in any water system, which works in addition to the main water pump. Figure 14 shows head-discharge curves for two pumps operating in series.

Pumps operating in parallel

Figure 15 presents a parallel configuration of two pumps. A typical example of this arrangement is a situation where two or more pumps draw water from a single source and all the flows are discharged into a single pipe. Another example is a situation where several small wells are providing the required discharge. Parallel arrangements are also common methods of meeting variable discharge requirements of the system. Figure 16 shows a head-discharge characteristic curve for two pumps operating in parallel.

 Efficiency considerations

During the pump selection process, only pumps having high efficiencies (above 70%) for the design discharge should be considered for a system. It is common practice to select a pump capable of pro-

![Figure 13. Two pumps connected in series.](image)

![Figure 15. Two pumps connected in parallel.](image)

![Figure 14. Head versus discharge characteristic curves for two pumps operating in series.](image)

![Figure 16. Head versus discharge characteristic curves for two pumps operating in parallel.](image)