

to promote the selection of an economical velocity. If a system is designed to handle a load of 96 Mbbh with a 20 F drop allowable in the system, a circulating pump will be required, handling about 10 gpm and at a head pressure high enough to allow a satisfactory friction drop in the system.

Frequently water velocities are selected which produce objectionable noises in the system. A velocity of over 4 fps is apt to cause noise in the smaller pipes and tubes. Velocities higher than this value will cause no objectionable trouble in industrial applications.

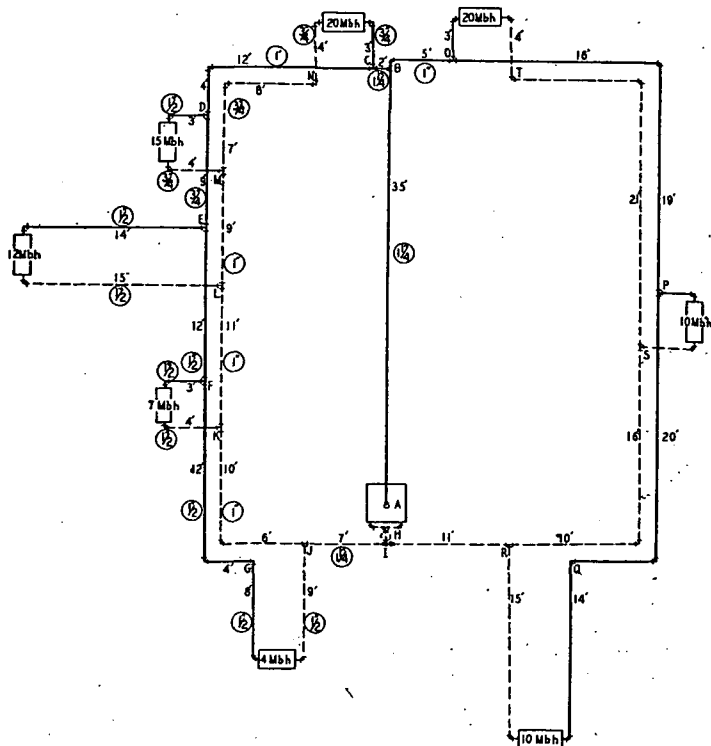


FIG. 3. A FORCED CIRCULATION REVERSED RETURN SYSTEM^a

^aNote that the numbers on the radiators indicate thousands of Btu per hour (Mbbh) and not square feet.

Low head centrifugal pumps especially designed for hot water systems are used to provide the necessary head pressure for forced circulation and to improve the operation of an improperly designed or installed gravity system. These pumps are designated by the nominal pipe size of their connection, but the selection of the pump should be governed by the capacity curves and not by the nominal pipe size. These pumps operate with little noise and low power consumption, both of which are features of prime importance to the satisfactory operation of a forced

circulation system. They are designed for installation directly into the heating main and require no other support. The common practice is to install them in the return line but where desirable there is no objection to their location in the supply line. Gate valves should be installed in either side of the pump so that it can be removed without draining a system. A by-pass is not necessary as the friction drop through the pump is not sufficient to prevent gravity recirculation if the pump should become inoperative.

Propeller type pumps are also available for hot water service, generally being built into a fitting and are made in all of the commercial pipe sizes commonly used in heating. They are installed in the same manner as a centrifugal pump.

Forced circulation lends itself to automatic control and the arrangement of the circuit depends entirely on the design of the system. The control may consist of a thermostat controlling both the automatic firing device and the circulator with the same type of limit control, as a safety switch. This type of control can be satisfactory, provided the radiation is properly selected and accurately located in the building. A circuit using flow control valves to regulate the gravity flow of the water when the pump is not running allows the temperature to be maintained closer to the desired setting. Under these circumstances, the circulator motor is controlled by a room thermostat while the automatic firing device is controlled by a limit switch with a safety device in series.

For exceptionally large installations, such as central heating plants circulating pumps of the centrifugal single stage type having an average operating efficiency of 70 per cent against heads up to 125 ft are sometimes used. In some cases it is advisable to install pumps in duplicate to provide for contingencies and to insure continuous operation. In such cases, each pump should be made equal to the maximum capacity required.

PIPE SIZES

The pressure heads available in forced circulation systems are much greater than those in gravity circulation systems, consequently, higher velocities may be used in designing the system, with the result that smaller pipes may be selected and the first cost of the installation reduced. As the pipes of a heating system are reduced in size, the necessary increase in the velocity of the water increases both the cost of operation and the initial cost of the circulating equipment. The increased velocity of a forced circulation system offers a number of advantages, such as a much shorter heating-up period and a more flexible control of hot water circulation. This improved performance merits the small increase in operating cost necessary to mechanically circulate the system. The velocity required should be determined by calculation for the particular system under consideration.

Since the velocities in forced circulation systems are higher than those in gravity circulation systems, and since the friction heads in a heating system vary almost as the squares of the velocities, a given error in the calculation or assumption of a velocity is less important in a forced circulation system than in a gravity circulation system and, consequently, it