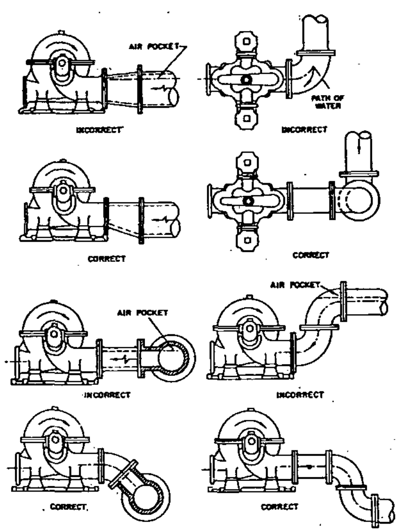


Fig. 3 .... Pump Suction Connections[3]

the possibility of contaminated water backing up into the city water system. Fill connections are sized to provide a reasonable filling time, and, if possible, are located so as to minimize air trapping. If the fill line does not discharge into the system above the water level, such as into a cooling tower basin, a removable spool piece should be provided between two gate valves (and removed except when in use) so the two systems can be completely separated except during filling. A float valve is generally provided in open expansion tanks and cooling towers to permit automatic make-up above the water level. Closed systems, especially those with mechanical pump shaft seals, require very little make-up, and this can be added periodically through a removable spool piece. Some codes permit a permanent direct connection to city water through a check valve and pressure reducing valve. Cooling tower make-up water quantity (not including constant bleed loss) for pipe sizing is about 4 gpm per 100 tons for compression refrigeration and 7.5 gpm per 100 tons for absorption refrigeration. Constant bleed loss will vary with quality of make-up water and type of water treatment used. With cooling towers located on a roof it is sometimes necessary to install a booster pump for make-up water because of the low water pressure available at the roof.

Water Treatment

A water treatment program is absolutely essential to prevent deterioration of equipment and piping due to scaling or corrosion, with resulting loss of capacity, efficiency, and equipment life. A water treatment program should be recommended and supervised by a competent water treatment specialist and should include, but not necessarily be limited to, the following items:

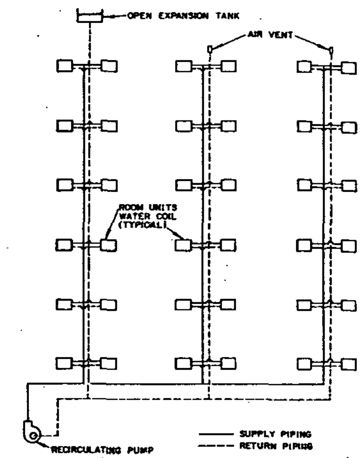


Fig. 4 .... Direct-Return Piping System

1. Evaporative spray systems (cooling towers, evaporative condensers, recirculating spray systems)—corrosion, scale, and algae control using chemical treatment and continuous bleed.
2. Systems with negligible evaporation (recirculating chilled or hot water systems)—corrosion control using chemical treatment.

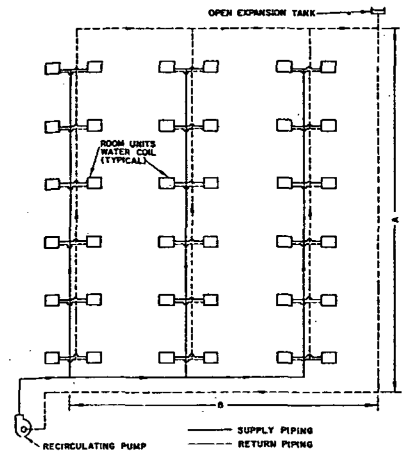
For further information, see Chapter 15 of the 1961 GUIDE AND DATA BOOK.

Piping Arrangements

Direct and Reversed-Return Systems. Figs. 4 and 5 show schematic flow diagrams for direct and reversed-return systems. In the direct return system the water flowing through each coil travels a different distance, and a balancing valve is usually required at each coil to balance the pressure drops and obtain design water flow through each circuit. The reversed-return system provides a flow path of equal length for all coil circuits, but requires additional length of main piping.

Central station systems usually require balancing valves at each unit to compensate for rather widely varying pressure drops resulting from differences in coil sizes, loading rate, and circuiting. In addition, the units are usually quite remote from each other and the additional piping cost to provide reversed returns would be substantial. For these reasons, such systems usually employ direct returns.

Room unit systems, however, present different problems. If the system includes automatic water throttling valves at each unit, it is sometimes assumed that manual balancing valves are not required. If fan or bypass valve control is used, however, individual unit balancing valves are required to obtain design water flow at each unit. Because the large number of small units make it expensive and difficult to adjust each unit individually, some manufacturers design and rate all sizes of units for the same pressure drop, which eliminates the need for balancing individual units if the piping system is designed correctly. In such cases, the labor and material cost savings of omitting balancing valves is much greater than the additional cost of piping to provide a reversed-return sys-



A—ADDITIONAL PIPING RISER REQUIRED TO OBTAIN REVERSED—RETURN
B—ADDITIONAL HEADING LENGTH REQUIRED TO OBTAIN REVERSED—RETURN

Fig. 5 .... Reversed-Return Piping System

tem. On small systems where the distance between the first and last takeoffs on a piping run is less than 100 ft, it is sometimes more practicable to use a direct return instead of a reversed-return system, but oversize the piping to minimize unbalance between coils.

Loop-Zone Systems. The loop-zone piping arrangement shown in Fig. 6 has the following uses:

1. It provides several different water temperatures from the same heating or cooling source by modulating control valve *A* to obtain desired mixed water temperature for zone.
2. The zone can circulate hot water while the loop provides chilled water for other zones which require cooling.
3. The zones can handle widely varying pressure drops and piping length with minimum pumping horsepower.
4. The zone pumps need be operated only when zones are in use, with resultant savings in power cost if all zones are not required at same times.

It should be recognized that large installations are required to economically justify the additional investment to save power cost in items 3 and 4. Also, the pumping rate of the loop pumps must always be greater than that of the zone pumps to prevent reverse flow in the relief portion of the loop.

Open Systems with Multiple Reservoirs

Special attention should be given to the design of *Multiple-Reservoir Systems.* Fig. 7 shows such a system which demonstrates the use of a pumped return, gravity return, chilled water return storage tank, and recirculating spray pump. Some of the precautions which should be observed are:

1. Avoid siphons or piping arrangements which unnecessarily drain piping on shutdown.
2. Size and pitch gravity returns and pump suctions to operate satisfactorily with the low submergence usually available.
3. If lint or other foreign material will contaminate water, provide adequate clean-outs and arrange piping and fittings to avoid any traps, projections or partial obstructions at which accumulation of trash might occur. Provide adequate filtering or straining of water to avoid spray nozzle clogging.
4. Storage tank must be of adequate size to hold all water in system which can drain into tank on shut-down. Return water

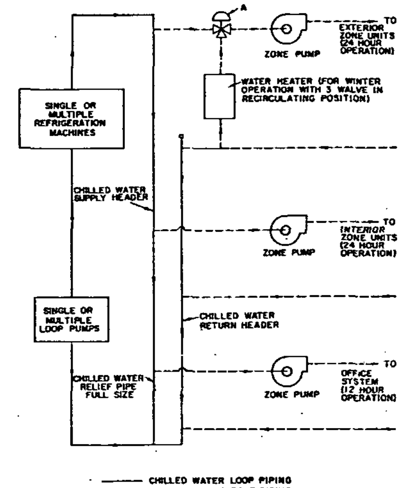
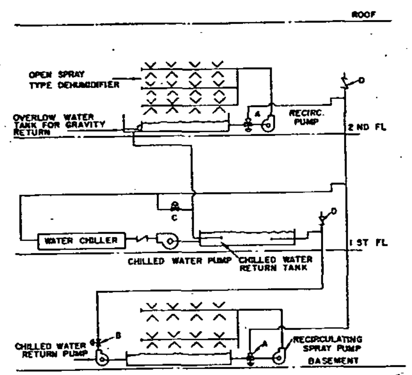


Fig. 6 .... Typical Loop-Zone System



A - CHILLED WATER CONTROL VALVE - NORMALLY CLOSED TO CHILLED WATER AND ARRANGED FOR QUICK CLOSING ON SHUT-DOWN TO PREVENT FLOODING.
B - CHILLED WATER RETURN VALVE - NORMALLY CLOSED AND ARRANGED FOR QUICK CLOSING ON SHUT-DOWN. CONTROLLED FROM DEHUMIDIFIER TANK WATER LEVEL.
C - CHILLED WATER BYPASS VALVE - NORMALLY CLOSED AND QUICK-CLOSING ON SHUT-DOWN - TO PROVIDE FLOW THROUGH WATER CHILLER WHEN CHILLED WATER CONTROL VALVES NEAR CLOSING POSITION.
D - REVERSED CHECK VALVE TO BREAK VACOOM AND PREVENT SIPHON IF CHILLED WATER CONTROL VALVES LEAK DURING SHUT-DOWNS.

Fig. 7 .... Typical Multiple Reservoir System