Consideration must also be given to the probable frosting of the outdoor-air heat-source coil at outdoor temperatures of approximately 36 F or below. Defrosting of these coils can be accomplished automatically without discomfort to the occupants in the conditioned space. One commonly used defrosting method is to revert periodically to the cooling cycle, for short periods of time, so that the outdoor-air coil will be the condenser and the indoor coil the cooling surface.

*Ground*, in contrast to well water and outdoor air, has not been extensively used as a heat source and heat sink. A considerable number of laboratory and field investigations have been made, but as yet no known dependable relationship has been found between the primary factors in-

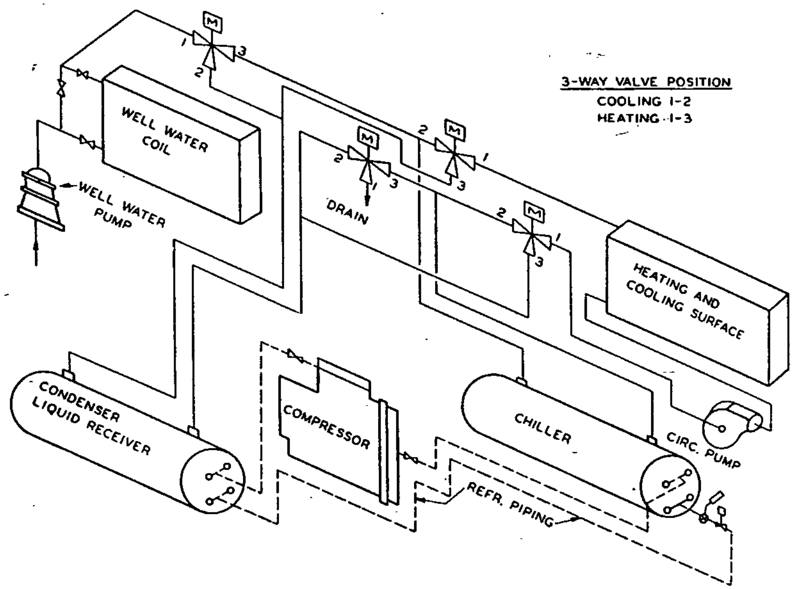


FIG. 12. HEAT PUMP DIAGRAM SHOWING WELL WATER USED WITH FIXED REFRIGERANT CIRCUIT

fluencing design, such as climatic conditions, geological formation, and moisture content of the soil. The unattractiveness of ground coil installations can be attributed to the relatively high installation cost of embedding the surface in the ground and to the large amount of piping needed for a typical installation.[5, 6,7]

## Coefficient of Performance and Performance Factor

The coefficient of performance (CP) and the performance factor (PF) are very useful in evaluating the operation of a heat-pump system. It must be indicated, in defining these terms, whether the system is on the heating or cooling cycle.[8]

The heating coefficient of performance of an installed heat pump may be defined as the ratio of the total instantaneous useful heating effect produced by the heat-pump system at stated conditions, to the heat equivalent of the total energy input rate required to drive or operate the system.



The cooling coefficient of performance of an installed heat pump may be defined as the ratio of the instantaneous refrigeration effect produced by the heat-pump system at stated conditions to the heat equivalent of the total energy input rate required to drive or operate the system.

The term *performance factor*, instead of coefficient of performance, is used when referring to values based on an extended period of time, such as a day, month, or season. The period of time covered should be given when using this term.

## Heating and Cooling Load Determinations

The accepted procedures in Chapters 12 and 13 for computing the heating and cooling loads of a structure can be followed in sizing a heat pump

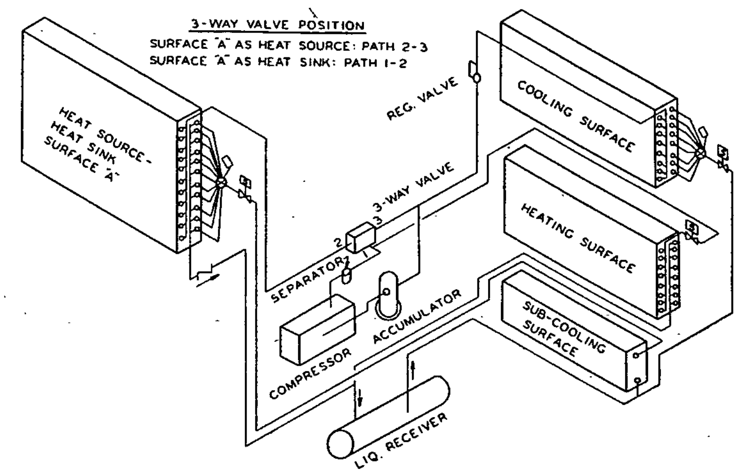


FIG. 13. HEAT PUMP DIAGRAM FOR SIMULTANEOUS HEATING AND COOLING
(*System to be arranged for complete gravity drainage of liquid refrigerant from heating and cooling surface, and from heat source-heat sink surface "A", to liquid receiver.*)

system. It is necessary to determine accurately the maximum cooling load as well as the heating load. This is important, because the available heating capacity of a heat pump is directly dependent on the installed cooling equipment. It is generally uneconomical to oversize the cooling equipment in order to obtain additional heating capacity.

Experience has indicated that a high percentage of the internal heat gain in commercial or industrial establishments can be considered as supplemental to the heating capacity of the heat pump equipment. This heat gain includes the heat equivalent of the electric energy to the lights, sensible heat from occupants, and heat dissipated by computers, fans, and other electrical or mechanical equipment. Some judgment must be exercised in estimating the portion of the internal heat gain that can be safely considered as useful at design heating conditions. It is equally important to determine the amount that will coincide with the other design cooling loads during the summer, in order to properly size the cooling equipment. For instance, 75 percent of the heat equivalent of the electric lighting consumption has been used advantageously during the heating cycle