None of the absorbent is carried off with the refrigerant from the generator and the performance ratio ranges as high as 75 percent. Both the refrigerant and the absorbent are non-toxic and non-explosive and the performance ratio does not vary greatly between 20 percent of capacity and full load. This increased efficiency places operating costs in competition with other forms of refrigeration in many high temperature applications such as air conditioning.

One form of lithium-bromide-water absorption system is shown schematically in Fig. 8 with the generator and condenser shown located in a high pressure shell and the evaporator and absorber in a low pressure shell. The water to be cooled flows through coil 1. Water from the evaporator

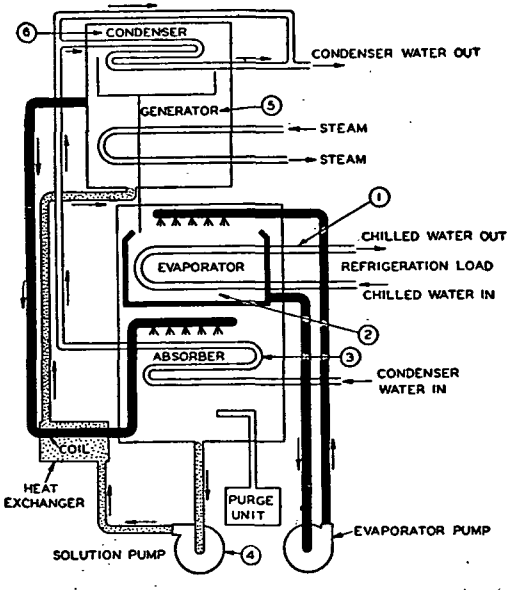

FIG. 8. DIAGRAM OF LITHIUM BROMIDE WATER ABSORPTION SYSTEM

tank 2 is sprayed over the coil. The evaporation and cooling effect of this spray on the surface of the coil chills the water inside of the coil. The pressure in the low side shell and, therefore, the temperature of the spray water is controlled by the temperature and concentration of the lithium bromide brine sprayed over absorber coil 3. The water vapor formed in the evaporator chamber is absorbed by the strong salt solution to form a weak solution which drains from the low pressure chamber and passes through solution pump 4. In the generator 5 heat is used to raise its temperature and boil off the excess water vapor. The reconcentrated salt solution is then returned to the absorber to continue the cycle. Water vapor boiled off from the weak salt solution in the generator is condensed and returned to the evaporator tank. A heat exchanger is added to the circuit to conserve heat in the cycle by using the hot concentrated salt solution from the generator to preheat the cooler weak solution from the absorber. Condensing water from a cooling tower or other available

source is circulated through coils in the absorber and the condenser to remove waste heat from the refrigeration cycle.

Fig. 9 illustrates the performance of atypical lithium bromide absorption machine with varying chilled water and condenser water temperature.

The Heat Pump

It has been almost 100 years since Prof. William Thomson (Lord Kelvin) first proposed the use of a compressor as a "warming engine" and as a means of heating buildings to replace equipment for direct burning of fuels. Several early working models were constructed, but the device has remained essentially of laboratory interest until the last 20 years.

Although frequently referred to incorrectly as the reverse cycle system, the heat pump cycle is identical with the ordinary refrigeration cycle, and differs only in the sense that the desired effect is rejection of the heat from the condenser rather than absorption of heat in the evaporator. A discus-

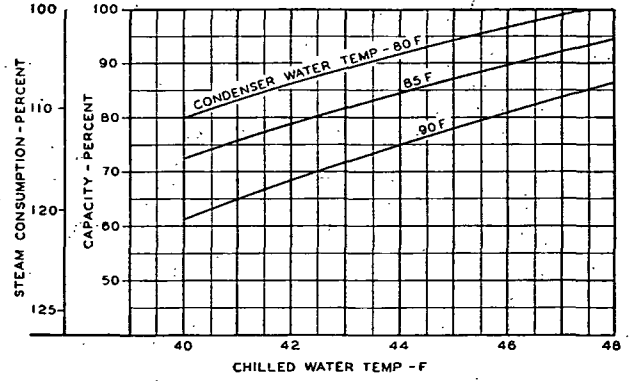

FIG. 9. PERFORMANCE CHARACTERISTICS OF A LITHIUM BROMIDE ABSORPTION REFRIGERATION MACHINE

sion of the coefficient of performance for the heat pump is found earlier in this chapter.

The first actual residential heat pump installation was probably made in Scotland in 1927 and since that time, a number of commercial and residential systems have been made in this country. Both progress and growth of interest have been particularly rapid in recent years and, consequently, at the present time there are several hundred residential installations and probably a greater number of commercial systems. However, much research is needed before the residential heat pump installation can successfully emerge to compete economically and with equal reliability with the more common forms of heating and fuels.

From an analysis of the equation for the coefficient of performance, it is evident that the economical adaption of the heat pump as a practical means of heating, requires that the temperature of the source from which the heat is extracted be as high as possible, and that the temperature of the sink to which the heat is rejected for heating purposes, be as low as possible. Thus, with a small temperature spread between the evaporator and the con-