the absorber. In the rectifier selective condensation occurs, the concentration of the absorbent in the condensate being much greater than its concentration in the entering vapor mixture; rectifier condensate is dripped back to the generator.

The ratio of refrigerating effect to heat input (the performance ratio or commonly used efficiency measure of absorption machines) is only 40 to 45 percent with the ordinary ammonia absorption system and, aside from the inherent disadvantages involved in the use of a toxic and explosive refrigerant, this is not sufficiently high to make it competitive with other types of systems when used in air conditioning applications. Therefore, recently, several absorption systems using hygroscopic brines of salts such as lithium chloride or lithium bromide[3] (solids in the pure state) as absorbents and water as the refrigerant have been developed. Such systems are limited to higher temperature applications but, thermodynamically, have

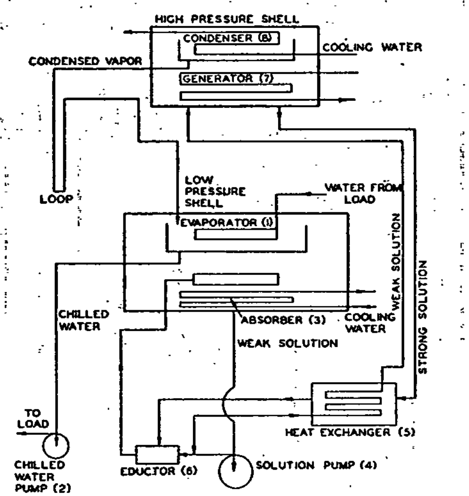

FIG. 7. DIAGRAM OF LITHIUM BROMIDE WATER ABSORPTION SYSTEM

the advantages of a refrigerant with a high latent heat of vaporization and nonvolatile absorbents with a large negative deviation from Raoult's Law. 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. 7 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 to the evaporator 1 from the load where a small portion of it is flashed into vapor thus cooling the remaining water which is then returned by pump 2 to the load. The pressure in the low side shell and, therefore, the temperature of the water passing through the shell is controlled by the temperature and concentration of the lithium

bromide brine sprayed over absorber coil 3. The water vapor flashed 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. From pump 4 a portion of the weak brine is delivered through the heat exchanger 5 to the high pressure shell and the remainder is mixed with the strong solution through eductor 6 and delivered back to the low pressure shell. Heat applied at the generator 7 boils off the water vapor earlier condensed in the absorber and returns the brine to its original concentration. The condenser 8, also located in the high pressure shell, liquifies the water boiled off by the generator and this condensate is returned through a liquid loop to the evaporator. The re-concentrated solution is returned from the high pressure shell through the heat exchanger 5 to the eductor 6 where it is mixed with a portion of the weak solution and pumped to the absorber with the mixture at a still relatively high concentration.

Ice Systems

Cold water systems using ice as the cooling agent have been installed in some theaters, restaurants, funeral homes, churches and other places where short hours of operation and high peaks of cooling demand make this type of system desirable. A comparatively small quantity of ice in the water cooling tank of such a system can release refrigeration at a relatively rapid rate. For instance, neighborhood theaters having a peak demand of 1,200,000 Btu per hr (100 tons refrigeration) have found 8 ton capacity ice bunkers satisfactory.

In operation, the water in the air conditioning system is circulated over ice placed in an insulated box, and is cooled to the 38 or 40 deg range or higher, if desired. This cold water is pumped from the ice bunker to air cooling coils or spray type air washers. The blowers, coils, air washer or air handling sections are the same as those parts in any system employing cold water as a refrigerant.

The ice water cooler or ice bunker is usually built at the installation in a location where it can easily be iced. It can be constructed of any desired material such as concrete, steel, or wood with an adequate amount of insulation to save the ice from one period of use to the next. The basic requirement is that the tank be durable and water-tight.

The temperature of the water is controlled at a predetermined point by a thermostat in the supply line. If the temperature drops too low, a part of the return water is by-passed directly to the sump and is not cooled over the ice. In the larger systems it is customary to install an overflow control which, as the ice melts, discards the excess water through an economizer coil, the surface of which is large in relation to the flow so that the water is warmed to 60 F or more as it is discharged from the system.

In an attempt to lower initial equipment cost and operating expense, or increase the refrigeration capacity of an existing air conditioning system, storage refrigeration has been utilized in a few applications. Some of the methods which have been adopted include the storage of refrigeration in the form of chilled water, chilled brine, ice on evaporator coils[4] and the accumulation of thin sheets of ice on copper plates in a steel tank.[5] If the peak load factor is low as compared with a long period of operation, such as in a restaurant, or if the hours of operation are short but the usage factor high, as in a church, then it is possible to consider storage refrigeration. This method of accumulating refrigeration frequently makes it possible to use low cost off-peak electric power. Power costs may also be reduced by