compressor until a certain point is reached, beyond which the capacity is zero. The steam consumption for the performance characteristic curves shown in Figs. 6 and 7 remains constant for all evaporator and condenser temperatures.

CLOSED ABSORPTION SYSTEMS

Years ago the closed absorption system was in favor for industrial refrigeration and ice making. It is now of little commercial importance, however, except for very special applications (notably the gas-fired refrigerator). The most usual refrigerant has been ammonia, and in some cases water has been used as an absorbent. However, a long list of refrigerant-absorbent combinations have been proposed and quite a number have been tested, either experimentally or commercially. There are some commercial installations using a dry adsorber instead of a liquid absorber.

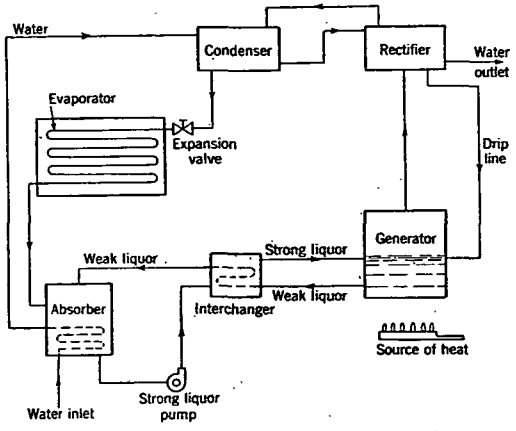

FIG. 8. CLOSED ABSORPTION SYSTEM

Fig. 8 shows a typical diagram of a closed absorption system. A mixture of refrigerant and absorbent is evaporated in the generator, passes to an analyzer and rectifier where it is purified, and then to a condenser where the refrigerant and remaining absorbent is condensed. It then passes through an expansion valve to an evaporator, where heat is absorbed from a cooling load. From the evaporator the vapor and residual absorbent passes to an absorber; where it meets absorbent which is initially low (weak) in refrigerant concentration. The absorbent absorbs the vapor, and the strong absorbent liquor is transferred to the generator through an interchanger with the weak liquor returning from the generator.

Cooling water is ordinarily used in the absorber to remove the heat of absorption and maintain the absorptive power of the absorber at a maximum.

Like the steam ejector system, the absorption system compares most favorably when a cheap source of cooling water and steam or other heat

source is available. Unlike the ejector system, the comparative performance is usually best with a wide range of temperature between the evaporator and absorber, since with a good refrigerant-absorbent combination, the amount of heat and water required for a given refrigerating effect increases slowly with an increase of evaporator-condenser temperature range.

There are innumerable variations on the arrangement shown in Fig. 8 which include multiple absorption systems, parallel absorption systems, systems using inert gas to raise the pressure in the evaporator and absorber to that of the condenser.

OPEN ADSORPTION SYSTEMS

For air conditioning installations, some experimental work and some commercial work has been done, using open adsorption refrigeration systems. The open liquid adsorption system is illustrated diagram-

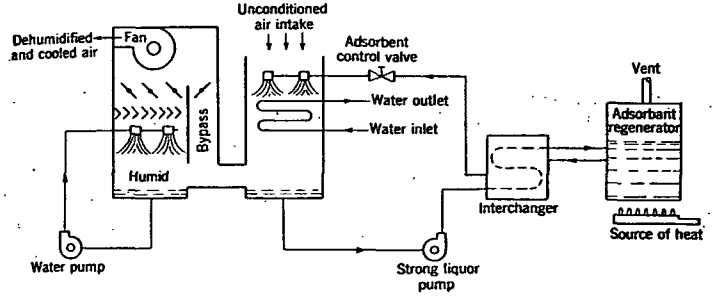

FIG. 9. OPEN LIQUID ADSORPTION SYSTEM

matically by Fig. 9. Air from the outside and from the conditioned space is drawn through an adsorbent spray which, with the air, is cooled by passing over water cooled surfaces. The adsorbent material adsorbs much of the water vapor from the air. The cooling coil removes the heat of adsorption and may cool the air below entering temperature, if the water is cold. The dehumidified and partially cooled air is then passed to a humidifier where water-vapor is added with further cooling by evaporation. A bypass may be provided so that some of the dry air bypasses the humidifier in order to prevent the dew point of the mixture from rising too high. The air then passes through a fan and is delivered to the conditioned space. The adsorbent, rich in water vapor, is discharged through an interchanger to a regenerator, from which it again flows to the adsorber.

The adsorbent materials most commonly considered are solids which are put into solution as brines (see also Chapter 11). The difficulty with most adsorbents is that their adsorptive power is not great enough to dehumidify the air sufficiently. Thus, they have to be used inefficiently or do an inadequate job of dehumidification.

Fig. 10 is a diagrammatic representation of an open solid material adsorption system. The spray and cooling coil of the open adsorber is