TABLE 9. PRESSURE LOSSES IN DICHLORODIFLUOROMETHANE SUCTION REFRIGERANT LINES (CONCLUDED)

| COPPER PIPE ACTUAL O.D. INCHES | CAPACITY BTU PER HOUR | PRESSURE DROP IN POUNDS PER SQUARE INCH PER 100 FTa | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | REFRIGERANT TEMPERATURE DEG F | | | | | | |
| | | −10 | 0 | 10 | 20 | 30 | 40 | 50 |
| 4⅛ | 400,000 | 1.0 | 0.8 | 0.6 | 0.4 | 0.4 | 0.3 | 0.3 |
| | 600,000 | 2.4 | 1.8 | 1.4 | 1.1 | 0.9 | 0.7 | 0.6 |
| | 800,000 | 4.1 | 3.1 | 2.4 | 2.0 | 1.6 | 1.3 | 1.1 |
| | 1,000,000 | 6.6 | 4.8 | 3.7 | 3.0 | 2.5 | 2.0 | 1.6 |
| | 1,200,000 | 10.0 | 7.1 | 5.4 | 4.4 | 3.5 | 2.9 | 2.4 |
| | 1,400,000 | | 10.0 | 7.5 | 5.9 | 4.8 | 3.9 | 3.3 |
| | 1,600,000 | | | 10.0 | 7.7 | 6.2 | 5.1 | 4.2 |
| | 1,800,000 | | | | 10.0 | 7.9 | 6.4 | 5.3 |
| | 2,000,000 | | | | | 9.7 | 7.9 | 6.6 |
| | 2,200,000 | | | | | | 9.5 | 7.9 |

aLength of tubing includes the average number of fittings.

## ICE SYSTEMS

Cold water systems using ice as the cooling agent have been installed in many 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 hour (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 F 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 on the job in a location where it can easily be iced. It can be built of any desired material such as concrete, steel, or wood with a 4 in. thickness of standard 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. A typical bunker with connections to a coil type air conditioning system is shown in Fig. 9. About 60 cu ft of gross bunker volume is allowed per ton of ice capacity.

The shape of the bunker usually conforms to the available space. The one illustrated has overhead sprays, but if head-room is lacking the ice is placed on the floor of the bunker with the water returned around the lower part of the blocks from a perforated distribution pipe run along one side of the bunker. To secure good circulation the supply water is extracted from a similar perforated pipe on the opposite side of the bunker.





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 the economizer 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.

## EQUIPMENT SELECTION

The selection of proper refrigeration equipment for any air conditioning job is of utmost importance for satisfactory results. The most important factors in the selection of the equipment are:

1. Loads (as determined by the conditions of the space to be cooled).
2. Economics (both initial and operating costs).

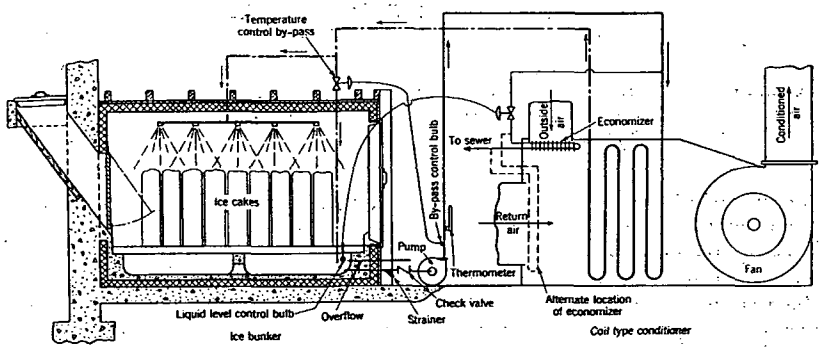



FIG. 9. TYPICAL ICE SYSTEM SHOWING BUNKER DETAILS

3. Codes (local safety codes must be adhered to and influence the type of system to be used).

A broad division of equipment to be used may be made on the basis of the magnitude of the load. Current general practice is outlined in Table 10.

Unit or *packaged* systems, consisting of a reciprocating compressor, condenser, evaporator and fans, are generally used in the smaller sized jobs where electric power is available, as they are manufactured complete ready to install and are the most economical.

The reciprocating compressor in the built up central system covers the widest range of application since it is applicable to either the direct expansion or indirect systems and can be driven by steam or gas engines, or by electric motors. The quantity of condensing cooling medium required is also less than for any other system with the exception of the centrifugal compressor, which uses the same amount.

Centrifugal compressors are used for large installations, and usually where the indirect system is required. The driving mechanism can be