inspection and cleaning. All branch pipes should join the main at an acute angle. The junction being at the side or top and never at the bottom of the main. Branch pipes should not join the main pipes at points such that the material from one branch tends to enter the branch on opposite side of main.

Cleanout openings having suitable covers should be so placed in the main and branch pipes that every part of the system can be easily reached in case the system clogs. Either a large cleanout door should be placed in the main suction pipe near the fan inlet or a detachable section of pipe, held in place by lug bands, may be provided.

Elbows should be made at least two gages heavier than straight pipe of the same diameter, the better to enable them to withstand the additional wear caused by changing the direction of flow. They should preferably have a throat radius of at least one and one-half times the diameter of the pipe.

Every pipe should be kept open and unobstructed throughout its entire length, and no fixed screen should be placed in it, although the use of a trap at the junction of the hood and branch pipe is permissible, provided it is not allowed to fill up completely.

The passing of pipes through fire-walls should be avoided wherever possible, and sweep-up connections should be so arranged that foreign material cannot be easily introduced into them.

Where considerable quantities of explosive dust or inflammable materials pass through the exhaust fan, the blast wheel should be constructed of brass composition, copper or other soft metal and in all cases ample clearance should be provided between blast wheels and housings.

MAINTENANCE OF SYSTEM

Because of its simplicity the exhaust system usually receives but little attention once it is installed; however, to obtain the best results, it should be inspected at suitable intervals and necessary adjustments made.

The exhaust fan should be given proper attention the same as any other high-speed machine. It should be kept in proper alignment and tightly bolted to its foundation.

Suction hoods, which have been removed to adjust the machines, should be replaced as soon as the adjustments are completed.

Never start a machine with the blast gate closed, as the slight air leakage past the blast gate may draw material into the pipe and clog it.

Disconnect furnace feeders from the furnaces when not in operation, and do not overload the system by ill-advised additions.

CHAPTER XXIV

REFRIGERATION

REFRIGERATION may be accomplished mechanically, as in the case of anhydrous ammonia, sulphur dioxide, carbon dioxide, ethyl chloride, etc., or chemically by the use of aqueous ammonia, known as the absorption system.

In the use of mechanical refrigeration in the United States anhydrous ammonia is the most popular refrigerant. Authorities estimate that anywhere from 95 to 98 per cent is accomplished by this method.

The ammonia in the form of vapor is drawn from the cooling pipes located in the cold storage rooms or brine tank through a pipe line called the suction line by the action of the compressor. It is then converted into a super-heated gas and discharged from the compressor through a line called the pipe line into the ammonia condenser. The gas as it enters the condenser is quite hot and contains heat generated by compression as well as heat taken from the goods in storage. In the condenser the gas is cooled by the use of water and converted into ammonia liquid under pressures which vary according to the temperature of the cooling water. The ammonia liquid is then condensed under the pressure of the condenser and the cooling pipes in the storage rooms or brine tanks as the case may be, where it is expanded into the cooling pipes, reducing the pressure as the volume increases. The liquid ammonia at the reduced pressure boils inside of the cooling pipes at a low temperature and thereby produces the desired cooling effect in the space surrounded by the cooling pipes. As the ammonia boils it is again converted into a vapor and drawn back to the compressor through the suction line. This completes the cycle of operation.

CONDENSERS

Condensers are classified in practically three classes: *atmospheric*, *double pipe*, and *submerged*.

The atmospheric condenser consists of a coil of pipe standing vertically with a water distributing trough over the top pipe, the ammonia is on the inside of the pipe. The water running down over the outside of the condenser, condenses the ammonia on the inside of the pipe. Most atmospheric condensers are constructed of 2-in. pipe. Atmospheric condensers must be placed in open places where the outside air has free access to the same, preferably the roof of a building.

Double pipe condensers consists of two concentric pipes also in the form of a coil, the inner pipe containing the water and the surrounding or outer pipe the ammonia. Most double pipe ammonia condensers consist of 2-in. for the outer pipe and 1¼-in. for the inner pipe, although some condensers have been made of 2½-in. and 1½-in. pipes, and some of 3-in. and 2-in. pipes.

Material for this section was prepared especially for THE GUIDE by Lee Nusbaum, Philadelphia, Pa.