DESIGN OF AN AMMONIA-COMPRESSION REFRIGERATING MACHINE.

Assuming average temperatures of 70 deg. and 0 deg. F. for the ammonia in the condenser and evaporator, and allowing for losses at the regulating valve, influx of heat into the pipe connections and cold parts, and by superheating in the compressor, 450 B.t.u. per lb. of ammonia circulated may be taken as available refrigerating effect. Taking one ton of refrigeration as 322,000 B.t.u. (In the United States 288,000 B.t.u. is the recognized figure, based on a ton of 2,000 lb. and 144 B.t.u. per lb. of ice melted) per day of 24 hours, then 322,000 ÷ (450 × 24 × 60) = 0.497 = pounds of ammonia to be circulated per minute per ton. Taking the volume of 1 lb. of ammonia vapor at 0 deg. F. to be 9.1 cu. ft., volume of ammonia vapor to be circulated per min. = 0.497 × 9.1 = 4.53 cu. ft. = compressor displacement per min. per ton of refrigeration per day. This displacement is for machines of 2 tons of daily ice-making capacity; for machines of from 5 to 100 tons capacity the displacement ranges from 4.4 down to 4.1.

The maximum piston speed, because of the fact that self-acting mushroom valves are used, is about 350 ft. per min. The length of stroke of the piston should be from 2 to 2.4 times the diameter of the cylinder.

The cylinder walls, of cast iron, should be from 1 to 1⅛ in. thick to insure good working with ammonia at the pressures generally employed. With very close-grained iron, the thickness may be as little as ⅞ in. Liners may be used to advantage in cylinders over 8 in. in diameter. These should be not less than 1⅛ in. thick, and in 21-in. cylinders may well be 1½ in. thick to provide for stiffness, as they are supported only at the ends. The pores of compressor castings may be rusted up by subjecting them to a solution of sal ammoniac under a pressure of 200 lb. per sq. in.

The diameter of the suction valve may be made a little above, and the delivery valve a little below, one-third the diameter of the compressor cylinder. The piston rod should be made of steel having a tensile strength of from 78,000 to 90,000 lb. per sq. in., and an elongation of at least 21% over 6 in. The diameter of the rod should be one-quarter the diameter of the cylinder.

The mean effective pressure for an ammonia compressor working under conditions suited for ice-making may be taken as 60 lb. per sq. in.; from this the probable I.H.P. of the compressor may be computed, and that of the engine driving it will be about 25% greater. Also, I.H.P. of engine = (2 × ice-making capacity of machine in tons per 24 hours) + 10. For machines of less than 10 tons daily capacity, add 7 instead of 10.

Assuming the condensing water inlet temperature not to exceed 65 deg. F., then, for each ton of ice-melting capacity (ton of refrigeration) 60 to 70 running feet of 1¼-in. internal diameter pipe will be ample for submerged condenser pipe, and 90 ft. for pipes exposed to the air. The grids of coils for atmospheric condensers may be spaced 12 to 20 in. apart, 12 to 20 ft. long, and 8 to 12 ft. high.

Supposing that the brine is being cooled under conditions similar to those which exist when ice is being made, then for each ton of ice-melting capacity allow 125 to 150 running feet of 1¼-in. internal diameter pipe, it being understood that the greatest possible care is taken to insure an efficient circulation of the brine.—Condensed from a paper read by J. Wemyss Anderson before the Institute of Mechanical Engineers, November 22, 1912.

ARRANGEMENTS OF ROOFS FOR ENGINEERING WORKS.

A paper recently read by Mr. H. N. Allott, M.Inst.C.E., before the Manchester Association of Engineers, dealt with the construction and methods of roofing of engineering works as follows:—

Saw-tooth roofing, where possible, is usually arranged with the glazing facing north so as to prevent the direct glare of the sun through the glass. The principal advantage of the saw-tooth roof is that by its use a more evenly lighted and cooler shop is obtained. The amount of glazing to be allowed for in a roof of the ridge type should be not less than about 50 per cent. of the area of covering, and in districts with an atmosphere like that of Manchester this may be increased with advantage to 60 per cent or 70 per cent. The glass should be equally distributed on both sides of the roof, as by that means a more even illumination is obtained than when all the glass is placed on one side of the roof. Another advantage of distributing the glazing is that the direct glare of the sun and consequent heating of the shops in summer is minimized.

The roof covering in this country usually consists either of slates, asphalt felt, or corrugated iron. For slates or corrugated iron the roof generally is given a rise of not less than a quarter of the span, for if made of a flatter slope rain and snow are liable to blow in at the joints. For felted roofs the roof may be practically flat if the joints are properly made with mastic, and it is only necessary to give a fall of one or two inches to the foot to allow for drainage. Galvanized corrugated iron is usually only used in this country for buildings required for temporary purposes, and when used should be carefully painted before and after fixing, and afterwards properly maintained, as otherwise its life is only short. Slating, when used, may be laid on battens nailed to spars, or to boarding nailed to the purlins. When laid on spars the slates should be pointed on the underside with hair mortar. When laid on boarding the boarding should be covered underneath the slates with sarking felt.

An alternative to natural slates are asbestos slates, formed of a mixture of asbestos and cement, several reliable makes of which are now on the market. These are made about 16 in. square, and are best laid either with the diagonal parallel to the slope of the roof, or in what is termed "honeycomb" fashion. The point of the slate should be cut off, as it is otherwise liable to be broken by anyone walking on the roof. It is necessary in all cases to see that proper lap is given to the slates, and this is especially the case where asbestos slating is used, as owing to its smooth surface the roof is more liable to leakage, where proper attention is not given to this.

An alternative to galvanized corrugated iron sheeting has also recently been supplied by corrugated sheets of asbestos composition, which can be obtained up to 10 ft. in length and 27½ in. in width.

In the author's opinion, asphalt felt laid on thicknessed, grooved, and tongued boarding forms the best covering for engineering shops and similar buildings. Besides being cheaper than slating, it is not damaged like slating by men walking on the roof to attend to skylights, and for similar purposes. The use of felt of good quality is permitted by the building departments of most local authorities, although one or two treat it as not being sufficiently incombustible. The felt is laid in mastic and nailed to the boarding, the joints being lapped about 4 in. One thickness of stout felt will make a satisfactory job, if properly laid and if proper