

the Harbor Commissioners decide to build one elevator in the centre of the harbor of 1,000,000 bush. capacity, suitable for steamships and the railways, and costing about \$500,000; that a smaller elevator and terminal facilities be provided at Windmill Point at a cost of about \$400,000, the same to be leased for 10 or 20 years to Captain Wolvin or some one else who was able to supply the traffic, from 5 to 5½% to be charged, so as to provide a renewal fund. This would leave from \$50,000 to \$100,000, which might be used to supply floating elevators. The further consideration of the matter was adjourned until July 15.

In his report Mr. Kennedy said: "For convenience of description and consideration the elevators examined may be divided as regards bin construction into four types: (1) Those having rectangular grain bins built of steel plates. (2) Those having cylindrical bins, commonly called tank bins, built of steel plates. (3) Those having cylindrical bins built of tiles strengthened by steel hoops; and (4) those having cylindrical bins built of concrete strengthened with steel hoops. Of the first type, a notable example is the Great Northern elevator at Duluth. It is of 3,000,000 bush. capacity, and is the largest and amongst the first of its kind. The bins are 14 ft. 9 in. square by 85 ft. high, holding 14,500 bush., except a few which are of two-thirds, half or quarter capacity. The bins are arranged in straight rows lengthwise and crosswise, and they are formed of steel plates of such lengths as to reach from corner to corner, the corner junctions being formed with four angle bars and rivet fastenings. The plates are stiffened by angle bars riveted to each side and by flat tie bars reaching across the bins, placed edge up. For the smaller bins, the space of the standard bins is divided into three, one is divided into two, or one into four. The bins have steel plate hopper bottoms, at suitable height for allowing cars to pass beneath, and they are carried on steel columns reaching through the ground floor to foundation piers beneath. The floor which covers the heads of the bins and the next above it are, for some unexplained reason, of wood plank on steel joists, but all other floors are of steel or other fire-proof materials. There is no framing or walls surrounding the bins, but they are protected from the sun and weather by corrugated iron sheeting attached to them in such way as to give a 6 in. air space all round between the sheeting and the outside plates of the bins. The framing of the building above the bins is of steel covered with iron sheeting and fire-proof roofing. The elevator legs and heads, the garner, weighing hoppers and spouting are all of steel. With the exception of the two wooden floors, the wooden casings and frames of the cleaning machines, the elevator belts, driving ropes, and a few small wooden sills for machinery, everything worth noting, of both building and machinery, is of non-combustible material. The elevator is fitted for receiving from cars and delivering into large boats. For receiving it has two tracks extending through the building lengthwise, and holding nine cars each, and for delivering it has telescope spouts supported by cranes and convenient tackle. The machinery is all of the most improved description and largest capacity, and is driven by electricity.

"At Minneapolis there are also examples of elevators having square steel bins, in which the square bins are essentially the same as those in the Great Northern elevator of Duluth, but the Minneapolis elevators as a whole differ from the Great Northern in having only part of their storage capacity in square bins and the remainder in round bins. In the Pioneer steel elevator of Minneapolis, for instance, finished about a year ago, and of about 1,200,000 bush. capacity, there is a central working house which contains the receiv-

ing and delivering machinery, which is fitted with square steel bins, but they are of only 200,000 bush. aggregate capacity, and the main storage capacity of the elevator is in 10 circular steel bins of 100,000 bush. each, arranged in two annexes of 5 bins each. The square bins of the Pioneer are built and supported in substantially the same way as those of the Great Northern, but their outer sides stand open to the weather, without walls or sheeting of any kind. In the working house containing the square bins, the ground floor is of concrete, and the upper house floors, frames and sidings are of steel. Everything about the whole elevator and annex bins is of non-combustible material, except the belts and cleaning machines.

"Another Minneapolis elevator, of 1,800,000 bush. capacity, under construction, is to be of practically the same construction as the Pioneer, except that the tank annex is to be all at one end and everything but the belts will be non-combustible. Even the cleaning machinery will have steel casings and frames. The elevator is notable as being mainly owned by its builders, who are known as elevator builders of great skill and experience, and who may be considered as building that which their skill dictates as best suited to the requirements of the place, and most likely to be profitable as a venture.

"Of the second type of steel elevators, or those having circular bins of steel plates, amongst the early examples are the electric elevator at Buffalo, and the C.P.R. elevator at Fort William, Ont. Later examples are the Great Northern of Buffalo, and the storage annex of the Pioneer steel elevator at Minneapolis, and the latest are the American Linseed Co. and the Buffalo Elevating Co.'s elevators under construction in Buffalo, and the annex of another under construction in Minneapolis. In all of these, except the Great Northern and the Buffalo Elevating Co., under construction in Buffalo, the bins are simple cylindrical tanks built of steel plates and placed in rows with their bottoms at ground level. The grain is taken in from grain boats or cars by machinery, placed in a house at the end of the rows or groups of bins, and is sent to the bins by overhead conveyers which carry and drop it into any desired one. Beneath each row of bins is also a conveyer by which the grain is carried from any bin back to the working house, where it is elevated and shipped or restored as may be desired. The bins are roofed overhead, but the sides are not covered. In the Buffalo examples, the bins are of various sizes, but in those at Minneapolis they are all of about 50 ft. diameter and 100,000 bush. capacity each.

"In the Great Northern elevator of Buffalo the circular bin system is quite differently treated. In it the bins are all supported on steel columns with their hopper bottoms at about the usual spouting height above the ground floor, and the elevator legs and working machinery, instead of being all at one end, is distributed throughout the house, and the grain is spouted from the bins to the boots and from the heads to the bins as in ordinary elevators. There are 30 circular bins of about 39½ ft. diameter and 75,000 bush. capacity each, and in their interspaces 27 circular bins of about 15½ ft. diameter and 12,000 bush. capacity. A number of irregular shaped interspaces formed between the small and large cylinders have been further utilized by connecting the cylinders by steel plates, thus making little bins of about 2,000 bush. capacity. The bins are housed around by steel framing and sheeting, and are surmounted by the usual upper stories and cupola for containing the elevator heads, spouting, weighing hoppers, etc. The elevator has a storage capacity of about 2,600,000 bush., and it is fitted for receiving from boats and for delivering to cars on tracks outside the house.

"In the elevator of the Buffalo Elevating

Co. (practically the Lehigh Valley Ry. Co.) the round steel bin system is being skilfully used in still another way. It is yet in the early stages of construction, but it is intended to be a working and storage house for receiving from lake boats and delivering into canal boats and cars. The circular bins are supported on steel columns, with their bottoms at spouting height above the ground floor. They are 15½ ft. diameter by about 70 ft. high, and placed a foot apart, which gives circular bins of about 10,500 bush. capacity and interspaces of about 5,000 bush. capacity, which are utilized as bins.

"The third type of fireproof construction, or that in which the bins are of tiles, has thus far been used only for storage annexes, and the only examples seen are two in Minneapolis. In these the bins are circular, of 50 ft. diameter and 100,000 bush. capacity each; their bottoms are at ground level, or concrete foundations, and they are filled and emptied by conveyers overhead and underneath. The walls of the bins are of specially moulded glazed hollow tiles laid in two thicknesses, with steel hoops built in to resist the internal pressure of the grain. Only the inside of the bins is used for storage; the interspaces are not utilized.

"Of the fourth, or concrete type, there is only one example, and that is an unfinished elevator at Duluth. The bins proper are being built in circular form, and in rows at about 4 ft. clear distance apart, with connecting walls to separate the interspaces. The bins are 50 ft. diameter and 100,000 bush. capacity, and the interspaces which are also intended to be utilized, are of about 30,000 bush. capacity each. The walls of the bins are of high class concrete, 12 in. in thickness at the lower part and about 9 in. at the top, and they are strengthened by steel hoops and diagonal wire lacing built in. The bins are being roofed over, but they are to have no housing around them.

"It is obvious, on considering the main characteristics of the elevators described, that the new materials which have been adopted in order to make them fireproof, have in great measure governed the larger features of the elevators, as well as the details of construction. When wood alone was used the rectangular plank bin was so clearly the best that no other was used, and the limitations of the material and mode of construction practically limited the general arrangement to groups of rectangular bins of 15,000 bush. or less capacity each. Bins of such material and size have the advantage of suitability for the storage of grain of all sorts and conditions, and lots of all usual sizes, but being of inflammable material, the risk of fire made it prudent to keep the aggregate capacity of the group, or single elevator building to something like a million bushels. On the other hand, steel, the first and most generally adopted material for wholly fireproof elevators, is best suited to the construction of bins of large size, of, say, 100,000 bush. capacity."

The main questions which have to be considered, Mr. Kennedy points out, are whether the elevator be built of wood or of fireproof materials; what are the chief requirements to which an elevator for the central part of the harbor should comply as regards its machinery and storage arrangements; and what are the materials of which the bins should be built. After going into some elaborate calculations as to cost of building, insurance and other charges, Mr. Kennedy recommends that any elevator built by the Commissioners for general use be made fireproof; that an elevator resembling the Great Northern at Duluth in its main features, but greatly reduced in size, and modified in structural details, with bins of about 12,000 bush. capacity each, would best answer the requirements of Montreal, and that steel would be altogether the most suitable and economical material.