raulic cylinder and ram, but to introduce a second chain into the multiplying gear. By doing so there is the additional risk due to the second chain and its attachments; but this extra risk is far less in proportion than that of the lift chain itself, owing to the diminished speed and greater absolute strength of the first motion chain.

Figs. 7 and 8, Page 9, illustrate a low-pressure hoist, suitable for pressures of 25 to 50 lbs. per sq. in., constructed as above described. In dealing with such low pressures it is essential to economy to save every foot of head, and to be very careful in the arrangement of the pipes, so as to avoid unnecessary bends. By putting the cylinder A below ground, and letting the ram work vertically upwards, the greatest economy is secured. The whole of the available head is then utilized, and the extra head of water at the beginning of the stroke of the ram compensates for the extra weight of the lifting chains which have then to be raised. It is necessary to balance the weight of the ram by counterweights B, both to save power, and also to ensure the ram being pulled down by the descending cage, and so to prevent the possibility of an accident from the cage sticking fast. The winding drum C of this hoist has two diameters, as shown in Fig. 14, Plate 14; on the smaller is coiled the lifting chain, and on the larger the cage chain, passing up to the bottom of the counterweights. The drum winds itself along a screw thread cut in the fixed supporting shaft, the pitch of the screw being equal to the pitch of the lifting chain wound on the drum. The lead of the chain is thus kept fair.

It will thus be seen that in properly constructed hydraulic chain lifts there is practically no element of danger beyond that incurred by the use of the chain or rope; and that on the score of safety, even in chain lifts, hydraulic power is to be preferred to any other.

Any of the chain lifts which have been considered may obviously be adapted for passenger use, without any modification of the mechanism in itself; but, in order to secure greater steadiness of working, and comfort to the users, the guides and working parts should be more carefully constructed. The controlling gear is arranged so as to prevent the too sudden starting and stopping of the lift; and the cage is furnished with seats, and is of a more or less ornamental character. Double chains and safety apparatus are often introduced; but even where hydraulic gear is used, and all is done that is possible to secure safety, there still remains, in lifts so constructed, the considerable risk attaching to the use of chains or ropes for hoisting the cage. It is accordingly imperative, if passenger lifts are to come into more extended use, that some safer means should be adopted.

(To be continued.)

DIVISION D OF THE ONTARIO & QUEBEC RAILWAY.

BY DONALDSON EDGART DOWLING.

Division D of the Ontario and Quebec Railway, now in process of construction, lies about thirty miles north of the shore of Lake Ontario, in the counties of Hastings and Addington. The division is subdivided into seven sections, each five miles in length, and numbered from the west towards the east, beginning with 24 and ending with 31. Section 24 runs through a very well settled country, and, although the ground is rather hilly, the soil to be moved has not as yet been found to be very hard but contains a large number of boulders which render its manipulation rather more costly than was at first anticipated. The line in this section crosses, *on the level*, the Ontario Central which is now under construction and runs northward to newly discovered iron mines. Although the Ontario Central,—a continuation of the Prince Edward Railway—is merely a local line, a union station at the crossing would have been convenient, but has been found impracticable owing to the heavy grade which is something like ninety-three hundredths of a foot in one hundred (93 per 1,000). The only suitable site for a station *is about one mile further east.*

Continuing eastward from section 24 we find the nature of the country still hilly, but the line is so located that very few large cuttings are necessary and considerable cost is thereby saved as the soil here is not of a kind to be moved cheaply, being filled with a great number of boulders so large as occasionally to require blasting. The rock formation from section 24 to about section 29, is Trenton limestone which affords excellent material for the construction of stone drains and culverts at almost every point, obviating the necessity of a lengthy haulage. In section 26 the line crosses by an overhead bridge (a proposed design for which is shewn on page 13) the Belleville and North Hastings Railway which runs along a narrow valley here bounded by banks more than twenty feet high (I). The bridge site is approached on both sides by cuttings, and the creek shown on page 16, is to be diverted. The chords of the bridge are composed of four timbers, those in the top chord having a scantling of 10 ins. by 6½ ins. and those in the bottom chord of 12 ins. by 6½ ins. The timbers are bolted together by ¾ in. bolts and are kept one inch apart by white oak keys, 3 ins. thick, let one inch into each member. The joints fall between two sets of keys and those in the lower chord are formed as shewn on the drawing. The braces are double, that is, are composed of members between which the counter-braces pass. The braces vary in size with the distance from the centre, being 8-ins. x 10-ins., 8-in. x 9 ins., 8-ins. x 8-ins. and 8 ins. x 7-ins. in the first, second, third and fourth bays respectively.

The corresponding counter-braces are 7-ins. x 7-ins., 7-ins. x 8 ins., 7-ins. x 9-ins., and 7-ins. x 9-ins. The end verticals consists of two 1⅛ ins. rods, the next set consists of three 1⅛ in. rods, the third of three 1½ in. rods, the fourth of three 1⅜ in. rods, and the fifth of three 1¼ in. rods. The braces and counter-braces abut against cast iron angle blocks with surface ridges which are let into the braces and so prevent lateral displacement. The tie rods pass through the chords and angle blocks, and are secured at the top by nuts, the surface of the timber being protected, wherever necessary, by wrought iron washers. In order to provide for wind pressure, timber braces are introduced between the chords both at the top and bottom. These braces have a scantling of 6 ins. x 7-ins. and their ends are kept in place by the 1¼ in. tie rods, which are spaced about fifteen feet apart. Between the lower chords are placed the needle beams upon which are laid 10-ins. x 12 ins. track stringers to receive the cross ties and rails.

The clear width between the trusses is 14 ft. and the clear height above the rails is 17 ft., 6 in., allowing ample headway for the passage of trains. The abutments are being built according to the designs shown on page 16. The excavations are carried down to