lation with long panels, and consequently small number of parts, great simplicity of details, and the use of "Phoenix" columns as compression members. The long panels reduce the number of parts, and hence the tendency to vibration, to a minimum, while the economy of inclined end-posts is considerably increased.

The top and bottom lateral bracing is designed for a total wind pressure of 550 pounds per lineal foot, in addition to which there are heavy transverse knee-braces. The lateral stability is still further materially increased in an incidental manner, both by the floor-beams being drawn tightly up against and into recesses at the bottom of the posts, and by the ties and struts between the stringers, which really constitute an independent lateral system. These latter give the requisite lateral stiffness to the long track-strings. Both the truss and floor system are thus seen to be peculiarly well adapted to a heavy and rapidly-moving traffic.

**DESIGN "E."**

The adaptation of our system of construction to an extraordinarily heavy structure is shown by this span of a two truss double-track railway bridge, with a span of 264 feet and \( \frac{1}{4} \) of an inch from centre to centre of end-pins. It forms one span of the Residnet Bridge, on the line of the New York, West Shore and Buffalo Railway; the complete structure will receive a full description on another page.

As the total load is divided between two trusses only, the members of each are unusually heavy; consequently, the economic depth of truss takes a comparatively high value.

The depth of 45 feet fixed upon in the design involves the incidental but important advantage in such a length of span of a small deflection and correspondingly increased stiffness.

Heavy upper and lower lateral systems of bracing are provided, in connection with transverse bracing, in the vertical planes of each pair of opposite panel-points, besides portals of unusual stiffness. The general stability of the bridge is still further increased by bracing the upper half of the third panel from either end in each truss, and connecting the lower transverse bracing-points of all the posts.

There are fifteen panels of 17 feet 7\( \frac{1}{2} \) inches each, which, in connection with the three systems of triangulation, unites the advantages of an economical angle of ties for the ties with those of long panels.

The converging of a large number of eye-bars at the upper extremity of the end-post presented a problem which is effectually solved in a very simple manner by a massive plate hung on the end-pin in the manner shown.

The transverse floor-beams are necessarily of unusual depth, and their lower chords are held rigidly in place by tie-rods reaching from each pin to the lower extremity of each adjacent pair of hanger-loops.

In the centre panel of each truss there are ten eye-bars, giving rise, unless properly designed and arranged, to excessive pin bending. As in all our designs, the eye-bars and pins were here so proportioned that the extreme fibre stress does not exceed 15,000 pounds per square inch.

**DESIGN "F."**

In many cases it is desired to connect masonry piers across an opening where the clear space below is not limited. Under such circumstances this type of truss can be most economically employed.

There are six panels of 13 feet 4 inches each, and the depth of truss is equal to the panel length. The trusses are placed 10 feet apart centres, so that the ties rest directly on the upper chord. The latter is so proportioned as to resist the consequent bending in combination with the direct compression. A judicious selection of panel length enables the proper balance to be maintained between chord-bending on the one hand and the advantage of a long panel on the other. Effective systems of upper and lower lateral and transverse bracing are easily secured in such a bridge, and give the requisite general stability.

This bridge carries the line of the Chesapeake and Ohio Railway over Dunlap's Creek.

**DESIGN "G."**

The application of our system of construction to a long deck span is well shown by this bridge, built for the Gulf, Mobile and Ohio Railroad. The length of span, which is 300 feet, necessitates such a distance between the trusses that it is impracticable to place the ties directly on the upper chords. The usual transverse floor-beams are placed directly at and over the panel-points, and held rigidly in place by inverted loops.

Two lines of longitudinal stringers, 6 feet apart centres, carry the single line of rails, while two other lines over the two trusses make ample provision for the sidewalks.

The stringers are placed on the floor-beams, and braced firmly in position and stiffened by the heavy brackets, as shown.

The depth of the truss is 37 feet 8 inches, and length of panel 17 feet 8 inches. The advantages of a long panel, combined with an economical angle of ties, are thus secured by employing two systems of triangulation.

Complete transverse and lateral stability, both upper and lower, are effectually obtained in the usual manner.

Although there are eight lower chord eye-bars in the centre panel of each truss, they are so proportioned and arranged that the stress on the extreme pin-fibre does not exceed the proper limit.

**DESIGN "H."**

The distribution of material in a long span drawbridge, so as best to subserve the purposes of its construction, is a problem requiring the most careful consideration in all its details. It may be safely asserted, however, that the object of structural design has rarely, if ever, been accomplished in a more satisfactory manner than in this particular case.

The heavy bending over the centre pier is controlled by a comparatively small amount of metal, in consequence of the increased depth of the truss at that point; while the stresses in the web members in the vicinity of the centre are materially relieved by the greater chord inclination at the same place. The outer portions of the two arms, in which the stresses change in kind under the passage of the moving load, possess a depth of comparatively small and nearly uniform value. This meets in a most rational and effective manner the requirements of the relatively small stresses existing in these parts.