section provided. The Transcontinental Railway also prescribes that the Government formula for free-ended compression members shall be used for their vertical struts, whilst for the compression diagonals the intermediate formula $16,000 \div 1 + \frac{l^2}{12,000\,r^2}$ is used, the constant before r^2 being 9,000 for free ends. By this means the units indicated in Fig. 3 are obtained, and by their aid the necessary cross section is calculated. The tension unit is 16,000 lbs. per square inch throughout.

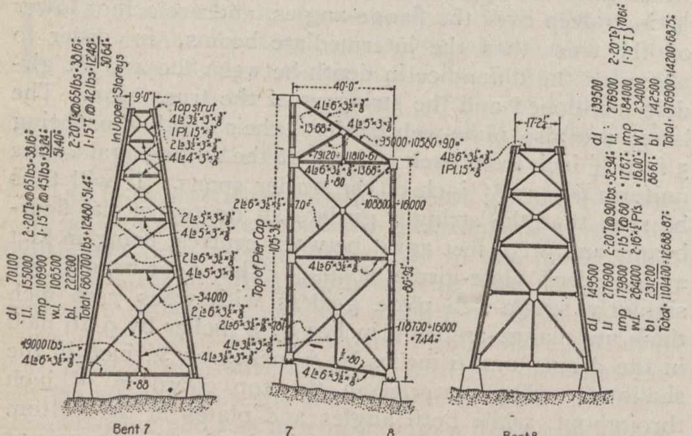

Fig. 4.—Typical Compression Stresses.

The trusses are braced together horizontally by both top and bottom lateral systems, the top consisting of crossed single diagonal angles in each panel, connected to the underside of the chord-angles and to the bottom flange of the stringers. The bottom lateral bracing consists of transverse horizontal struts of four angles laced in pairs and of cross diagonals similarly constructed. They are made the full depth of the chord, for the sake of simplicity and efficiency in connection. Undtr each floor-beam there is a sway-brace consisting of cross diagonals connected to the vertical members of the trusses and to the bottom struts.

An interesting feature of the specification, perhaps, is the clause governing the dimensions of the lattice bars. The lower side of the top chord is, of course, latticed between gusset-plates, and here 5½-inch by 9/16-inch single lacing is used. The bottom chord is laced in both its upper and lower faces with 3-inch by ½-inch double lacing, whilst the lacing of all the lateral struts and diagonals is 2½ inches by ⅜ inch. The specification requires that the thickness of the bars shall be at least 1/40 of the distance between the rivets that connect their ends to the two leaves of the members which they lace, if singly laced, and 1/60 of that distance if doubly laced. On the upper chord, the web-plates being 14¼ inches apart, the gauge-lines on the angles are 20¼ inches, which with approximately 60° lacing gives 23 inches between rivets and 23/40 inch or 0.575 inch as the required thickness, for which 9/16 inch was used. The width is governed by the fact that two rivets were required at each end, and these could not be obtained with the necessary edge distances on the lattice bar under 5½ inches. Similarly on the bottom chord, the same 20½ inches with 45° lacing gives 28½ inches between end rivets and calls for bars $\frac{28.5 \text{ inches}}{60}$ or 0.48 inch in thickness. One rivet being sufficient connection, a 3-inch bar was adopted here. The latticing in the bracing members need only be made 75 per cent. as heavy as the above specification, and so ⅜ inch is the usual dimension.

The stresses permitted in rivets are 10,000 lbs. per square inch in single shear and 20,000 lbs. per square inch bearing stress. These figures are for shop-driven rivets: for rivets driven by power in the field a reduction of 10 per cent., and for hand-driven rivets a reduction of 25 per cent. is prescribed. The gusset-plates in the main truss were principally ⅝ inch thick, and the minimum thickness of material allowed throughout the bridge was ⅜ inch.

The towers are of the usual viaduct construction, and consist of two "bents" braced together longitudinally. Each bent consists of two inclined posts with sway-bracing between them. As indicated in Fig. 4, the sway-bracing is made up of panels of crossed diagonals and horizontal struts. This is the type most usually adopted, although occasionally the struts are omitted except at the extreme top and bottom, and the diagonals are made rigid enough to resist compression effectively. In the usual design, typified by the Boucanne River Viaduct, the diagonals, although made of stiff shapes, are proportioned for tension with a limit of slenderness determined by making the maximum permissible ratio of unsupported length to radius of gyration equal to 200. The horizontal struts are then calculated as compression members, and their stiffness is governed in turn by a clause limiting l/r to 120. Under these conditions the choice of sections is governed more generally by the stiffness than by the calculated stress.

The longitudinal bracing between the bents is calculated to take any stress that might occur from applying or releasing suddenly the brakes on the train. Here again, however, with the National Transcontinental Railway, the same stiffness clauses operate: in the smaller towers they determine the dimensions of the diagonals and struts, whilst in the larger towers carrying the ends of long spans the calculated stresses often call for thicker metal. A typical diagram is given (Fig. 4) showing the stresses computed and the material supplied for the particular tower to be considered in this paper.

As shown in Fig. 4, the posts are made up of three I-beams riveted together to form an **H** section, reinforced by side plates where necessary. This form of section for posts entails the minimum of shop-work, and secures reasonable connections for all bracing. When the two I's

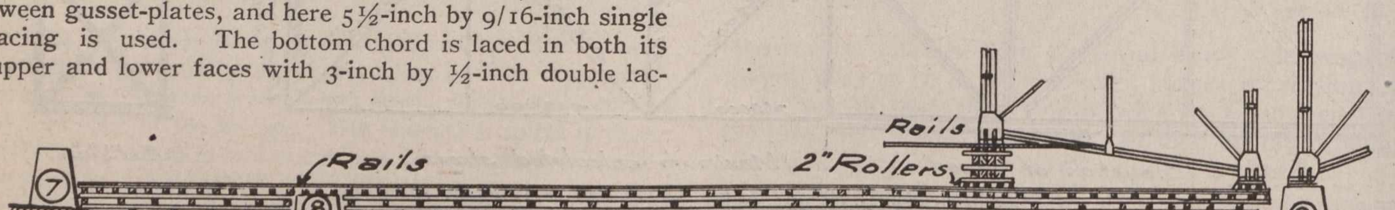

Fig. 5.—Staging Track for Moving Towers Into Place.