circular motion around the centre. The lower end of the mast served as a tail, confined in a well-hole of 3 ft. in diameter, and was left open in the masonry, and thus effectually prevented any tilting of the machine. In all other respects fully equipped for handling and setting, these four safety derricks in connexion with the steam drums accomplished a task which, without those means, would not only have consumed a great deal more time, but would also have been attended with a much greater cost and a great deal of risk. With these great facilities, however, the cost of laying the upper masonry exceeded that of the lower by but a small fraction; the difference being only in the amount of steam consumed. In fact, Mr. Roebling considered that towers of 1000 ft. elevation might in this way be raised nearly as cheaply per rod as those of 100 ft., and with equal safety.

For the support of the cables and saddles, cast-iron bedplates 11 ft. long and 8 ft. wide, are carefully bated in the upper courses. Care was taken to spread their weight upon a large section of the masonry below, by blocks of large dimensions, and by good bonding. By the inclination and cradling of the cables, their pressure is directed inside towards the arch. By this arrangement the stability of the towers is greatly increased.

The anchor walls above the floor form two parallel walls, each 75 ft. long, 12 ft. wide, and 25 ft. high. They enclose the roadway, leaving the space of 24 ft. in the clear. The distance between the cables is 36 ft. from centre to centre. On the summit of the tower, their distance apart is 60 ft. Their tendency to spread is met by connecting cables near the anchor walls, and by the inclined action of the suspenders. The cables being composed of seven smaller cables or strands, six around a centre, the last link of the anchor chain is spread out in two parts, the lower one connecting with four strands, the upper one with three. Each wire strand is manufactured upon a double shoe and held by a pin of 4½ in. diameter. The adjustment of the strands was effected by segments.

Each chain is composed of nine links, of an aggregate length of 92 ft. The lower links consist of fourteen and fifteen bars, alternately, each bar 10 ft. long from centre to centre of eye, 9 in. wide, and 1½ in. thick, making a solid section of 12 square inches. The eighth and ninth links are formed of seventeen bars, with an aggregate section of 190 square inches, while the lowest link has a section of only 168 square inches. The upper link is the proper measure of the strength of the chain. As the chain curves over the masonry, a portion of its tension is converted into pressure by the knuckles resting upon plates, which are supported by large and solid blocks of limestone.

A contract was concluded with the firm of Mr. Charles A. Wolf, for the manufacture of these bars. Each bar was hammered without a weld out of one pile, large enough in section to form a solid head, ample allowance being made for clipping. As the quality of this iron was of great importance, previous experiments were made with a view of obtaining the greatest possible strength. The material of which they are manufactured forms a mixture of three-fourths of cold blast charcoal Merriamack pig from Missouri, and one-fourth of superior cold blast charcoal Tennessee pig. The Merriamack is noted as the strongest iron in the west. From various tests which Mr. Roebling made with this mixture in various shapes, he stated that he felt warranted in estimating the average strength of the bars at 60,000 lb. per square inch. The section of the link which connects with the cable being 190 square inches, its strength is therefore equal to 190 × 25 = 4750 tons. As will be shown hereafter, the ultimate strength of each cable is 4212 tons, and therefore less than that of the chain.

By the curvature of the chains the two lowest links are brought into a vertical position, and are attached to massive anchor plates, cast of a superior quality of cold blast charcoal metal. These plates are of an elliptical shape, one axis measuring 17 ft., the other 14 ft., but radiating in form, like a spoke wheel without rim, which arrangement leaves the extremities free in their contraction while cooling. Leaving the casings for one week in their moulds well covered up, made them as free from strains as is possible with such heavy and irregular shapes. These and some other heavy pieces were manufactured at the Niles Works, the metal being melted in a reverberatory furnace.

Both anchorages being hid above low water, no rock could be found available for that purpose. Solid rock, when at a convenient depth, furnishes an effective mode of anchorage. But, in most localities, this part of the work has to be formed artificially. All that is wanted is sufficient weight to resist a maximum tension. If the total resistance of the anchor masonry is equal to the breaking strain of the chains, the anchorage may be considered safe under all conditions.

The anchor walls on the Cincinnati side are 104 ft. deep, with a front of 58 ft. on Water-street. The body of masonry, which may be considered as resting immediately upon the two anchor plates, and including that portion above the floor which adds to its weight, may be estimated at 112,000 cubic feet. Most of the backing being composed of limestone, the average weight of this mass is 150 lb. per cubic foot, consequently the total weight 112,000 × 150 = 16,800,000 lb. = 8400 U. S. tons. The ultimate strength of the cables is 8424 tons; but this tension, when transferred to the lowest link, is, by the curvature of the chains, reduced one-third, which leaves 5616 tons as the greatest possible lift which the