the pillars, we have $\theta = \frac{2 \times 0{\cdot}00583 \times 8}{2 \times 330} = 0{\cdot}000141$

The coefficient of elasticity being about 2,000,000 kg. per square centimeter = say 28,446,000 lb. per square inch, this θ corresponds to a change of tension of $0{\cdot}000141 \times 2000000 = 282$ kg. $= 619{\cdot}6$ lb., or to a change of $\frac{282}{2} = 141$ kg. $= 309{\cdot}8$ lb. greater and less than the stress at the middle position. Therefore the tensions in the horizontal spring at the vertex will vary between $670 + 141$ and $670 - 141$; or 811 and 529 kg. per square centimeter or 11663 and 8676 lb. per square inch.

As the spring plates are not riveted together, and hence each one may bend separately, the difference in tensions in the uppermost and the lowermost fibers is only ¼ of that above calculated; the other ¾ of the 141 kg. being manifested as a difference of tensions, common to all constructions. There is, then, nothing risky in using springs or plates for hinges, as the materials will sustain the bending without damage, the more so as the maximum temperature changes occur only at long intervals, and the changes caused by load variations are but a small proportion of those caused by temperature changes.

The double vertical plates in the center withstand the shearing stresses caused by loads passing that point. The springs at the abutments have but slight angular motion—that due to flexure of the side span girder by load variations, temperature changes being here without influence.

Similar spring hinges have been applied to small cantilever bridges in Dresden, to prevent lifting of the girder ends on the four points of support.

(3) The vertex hinge has been put below the roadway surface to get the necessary horizontal stiffness by making the roadway framework a nearly straight girder with uninterrupted flanges, connected by the cross beams, which here form the wind bracing. All other suspension bridges have the vertex considerably above the roadway, to get necessary vertical stiffness. Thus in these others the transmission of stresses through the vertex distorts the connecting members and causes injurious horizontal motions of the whole girder.

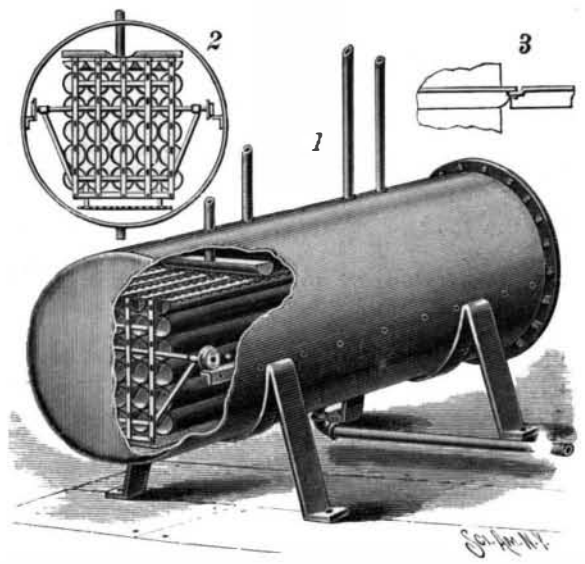
Besides this, there is difficulty in making the hinges as single links (as in the Thames and Monongahela bridges) with pins, for heavy stresses, as the narrowing of the free space between the girders must be avoided. On the contrary, the total breadth of the plates forming the two main springs at the vertex of the Loschwitz bridge is 2·8 m. = 8·5 ft., and besides these, there are also two horizontal plates under the roadway, connecting the hips of the cross beams; and a pair of vertical plates for carrying the vertical stresses caused by moving loads passing the center opening. Thus considerable additional stiffness in the roadway has been obtained. The diagonal cross beams take part of the lengthwise stresses; while they also resist shearing effects, such as those caused by the wind blowing unequally on the different halves of the girder. These connecting springs could only be applied by placing them below the roadway.

(4) Transverse beams crossing each other diagonally so as to make a horizontal lattice which stiffens the bridge against wind and passing loads were recommended as far back as 1860, in the Hannover'sche Zeitschrift; and in 1861 in the Civil Engineer and Architect's Journal of January 1.

The value of this bracing, together with the position of the middle hinge at the level of the lower flanges, in the Loschwitz bridge, may be seen in the fact that its lateral motion during the passage of thirty-six men keeping step was but 0·45 mm. = $\frac{1}{55}$ inch.

Although special diagonal bracing may be strong enough statically, the greater changes of length by tension and compression in such special bracings, which are, of course, weaker than the cross beams, increases the lateral flexure and hence the oscillation period. The matter of oscillation of bridges is more appreciated of late years than formerly, the conviction gaining ground rapidly that horizontal vibrations are as injurious to durability as vertical ones are.

(5) Loaded levers to counteract the push of an arch were applied to the street girder of the bridge over the Elbe at Riesa. The chains or cables of suspension bridges are usually anchored to the natural rock or confined in walled abutments; but there is seldom any precaution taken to permit easy access to all parts of the anchorage system, which last has often been rapidly destroyed by rust. The anchors of the Loschwitz bridge are accessible in every part, so that their coat of coal tar can be readily inspected, and, when necessary, renewed. The anchors bear, in addition to their regular load, the roadway, which covers them, and which is of slag blocks on Monier plate, their ends being inserted into the walls. They cannot give way by any increase of the bridge load within the limits of the bridge strength.



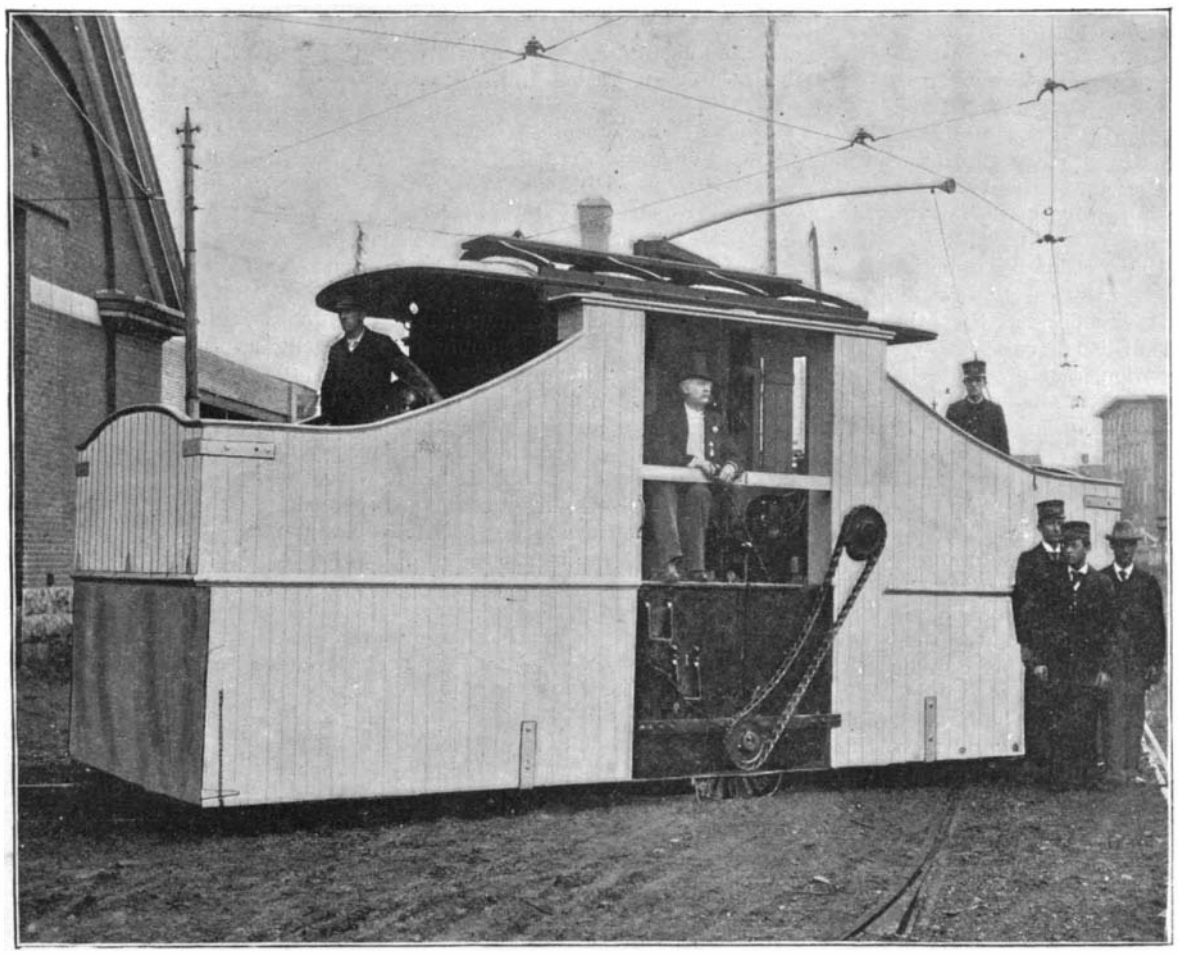
MUNDAY'S FEED WATER HEATER.

(6) The bridge brake consists of clamps which oppose to the sliding or vibratory motion of various parts of a bridge a certain amount of sliding friction, regulatable by springs, by bolts and nuts or otherwise, and thus absorbing much of the vibration or other injurious motion. It is most successfully applied in the bridge here described.

At a trial of the stiffness of this bridge a load of steam and horse road rollers, vehicles, etc., amounting to 150 tons, caused a center deflection of but 9 millimeters, = ⅜ inch, and a company of soldiers marching over it in step caused scarcely perceptible vibration.

AN ELECTRIC SELF-LOADING CAR FOR STREET CLEANING.

Among the many novel applications of electricity one of the latest is that shown in the accompanying illustration, where it is utilized, through the medium of an electric car, for sweeping up and carrying off the street refuse. The car is 8 feet wide by 25 feet long and 11 feet high. It is carried on two axles, and is fitted with the usual equipment of a trolley car. The brakes and the motor are placed above the wheels. The motor is connected by chain and sprocket gear to the driving wheels and to the brush, the brush making five revolutions to one of the car wheels. The brush runs in a cylindrical case which is open at the top and the bottom, and it is arranged to work both ways, a reversible steel deflector being arranged above the brush. The car consists of an upper platform, in the center of which is a shelter or cab containing the motor, and a lower closed section into which the street rubbish is thrown. Its lower floor is formed in parallel sections, which are hinged transversely to the car, and by the operation of a lever can be opened for dumping out the refuse. The broom, which ordinarily, as shown in the illustration, is the full width of the car, can be extended to cover nearly the full width of the street if so desired.



ELECTRIC SELF-LOADING CAR FOR STREET SWEEPING.

In operation these cars are used in connection with manual labor, the sweepings of the gutters and sides of the street being thrown toward the center, where they are picked up by the car, which thus sweeps its own section of the road, and also takes the place of the refuse carts.

The car is the invention of A. Jackson Reynolds, of Montreal, who states that when sweeping it travels at the rate of six to eight miles an hour, and that it carries refuse, snow, etc., out of the city at a cost of $2.50 per mile. For removing snow a car specially wide and long is constructed; and it is claimed that by running the car continuously during a snow storm there is no difficulty in keeping a street open. A self-loading car is now being built which will be one of the largest street cars in the world, being 8½ feet wide and 45 feet in length. It will have a capacity for cleaning 25 miles of street without stopping.

AN IMPROVED FEED WATER HEATER.

The illustration represents a heater in which troughs connected with the supply pipes distribute the water over tubes in thin streams or a thin sheet, within the shell of the heater, with whose upper portion steam inlet pipes are connected. The improvement has been patented by George T. Munday, Brenham, Texas. On opposite sides of the interior of the shell are secured angle irons forming tracks, on which the tubes are removably supported by means of a supporting frame at each end, as shown in Fig. 1, and in the sectional view, Fig. 2, a transverse shaft of the frame carrying rollers which travel on the tracks. The tubes are open at their ends, to permit the free circulation through them of steam admitted to the heater, and extended above the tubes are troughs supported by the end frames, the edges of the troughs being serrated to cause the breaking up and fine distribution of water flowing from them, each feed pipe discharging into transverse troughs. Below the tubes is a wire cloth screen, also supported by the movable frame, designed to receive falling scale, and in the bottom of the shell is an outlet blow-off pipe. When the tubes and troughs are to be removed from the heater, for cleaning and the removal of scale, the head of the shell is taken off and extensions of the angle iron tracks, as shown in Fig. 3, are connected with the ends of the tracks within the heater, the outer ends of the track extensions being supported in any desired manner, when the whole interior mechanism may be readily drawn out. It is designed with this heater to heat the water as nearly as possible to the temperature corresponding with the boiler pressure, and effect the rapid formation of scale, which may be removed with but little trouble.

PROF. WM. H. BREWER contributes to the Yale Scientific Monthly an account of observations during the past 45 years on earth tremors at Niagara Falls. The heaviest vibrations were on either side of and near the Horseshoe Fall. They disappeared in places in the soft shales below the limestone, although they were evident in the harder limestone and sandstones that occur amid these. Passing down along the gorge, the vibrations decreased in intensity, becoming too faint to be perceived between the suspension bridges, but increasing again on nearing the rapids. Persons living near the falls believe that crystals are more common in the rocks there than elsewhere, the texture having been affected by the jar of the cataract, but Prof. Brewer finds no evidence of this.