above it. The upper end of the tube is corked with an India rubber cork, to which, by means of a piece of platinum wire, a thermometer is suspended. This hangs down within the tube above the solution, and may be assumed to give a very close indication of its temperature. The funnel holds some metallic mercury, which is used to insure the tightness of closing of the upper end of the tube.

The tube contains Sonstadt's solution. The same is placed in the cistern to a depth of about one inch, so as to cover the end of the tube. The Torricellian vacuum, less the tension of the vapor of water, exists above the solution in the tube, so that a true barometer is constituted.

The filling was thus effected: The tube and cistern were put in place, and the lower end of the tube was corked. Solution was poured into the cistern until the end of the tube was immersed. Next the solution was poured into the upper end of the tube until it rose in the funnel. After standing a sufficient time to be sure that no bubbles existed in the liquid, the India rubber cork, with the thermometer hanging from it, was introduced, the thermometer descending into the tube. As the cork was depressed, it entered the solution in the funnel, and while thus immersed was pressed hard into its seat. The long column of difficultly compressible liquid acted like a solid body and forced out the cork at the bottom, and the column at once dropped to the height due to atmospheric pressure. Some metallic mercury was poured around the cork, and the lower cork floating about in the solution was removed, the plate and cistern were adjusted, and the filling was complete.

The scale was determined by comparison with a mercurial barometer. An arbitrary scale of equal parts was first attached, and its readings were compared with those of a mercurial barometer. A great many readings were taken at varying heights, and from them two average readings for extreme height and depression were deduced. Not only did this give a ratio of parts, but it also fixed the initial point corresponding to thirty inches.

On the basis thus determined a scale marked as for inches and hundredths was constructed and put in place. A number of readings were taken, and an error constant in size, the readings being always too low, showed that the 30 inch point was wrong. The scale was then shifted a fraction of an inch, and a new series of readings were taken. These showed that the instrument was at last correct.

At first the thermometer was read at every observation, and corrections for temperature and tension of aqueous vapor were applied. But it was found that the slight discordance existing between it and the mercurial barometer was not lessened by this correction. Practically both instruments read alike, without any correction, so it came to be regarded as unnecessary.

It is proposed ultimately to cement the glass plate to the cistern and to fill with cement the joint between the tube and plate. Then a small glass tube is to be secured in a second hole in the cover, to the outer end of which tube an India rubber balloon is to be attached. This will exclude air and prevent all evaporation, and yet will allow the atmospheric pressure to act freely upon the liquid in the cistern.

By calculation from the relations of its scale to the true inch, the specific gravity of the fluid is found to be 10-51 that of mercury, or, referred to water, 2·662.

The method of construction adopted has been found exceedingly convenient. On one or two occasions it has been found necessary to open and refill the tube, but no trouble has ever been experienced in doing this. In a long series of readings the greatest difference from a mercurial barometer was 0·055 inch. The general error was about one-third this amount, and a number of readings practically coincided. These comparisons are made with the Draper registering barometer, which is also located in these offices.

TEN-TON LOCOMOTIVE CRANE.

The ten-ton permanent way locomotive crane which we illustrate on preceding page was constructed for the Swedish and Norwegian Railway by Grafton & Co., London. It is driven, says *Engineering*, by a pair of engines having cylinders 9 in. in diameter by 12 in. stroke, and fitted with link motion. The chain barrel is 11 in. in diameter and 4 ft. long between the flanges. The chain is of ⅞ in. iron, and was proved to 25 per cent above the Admiralty strain.

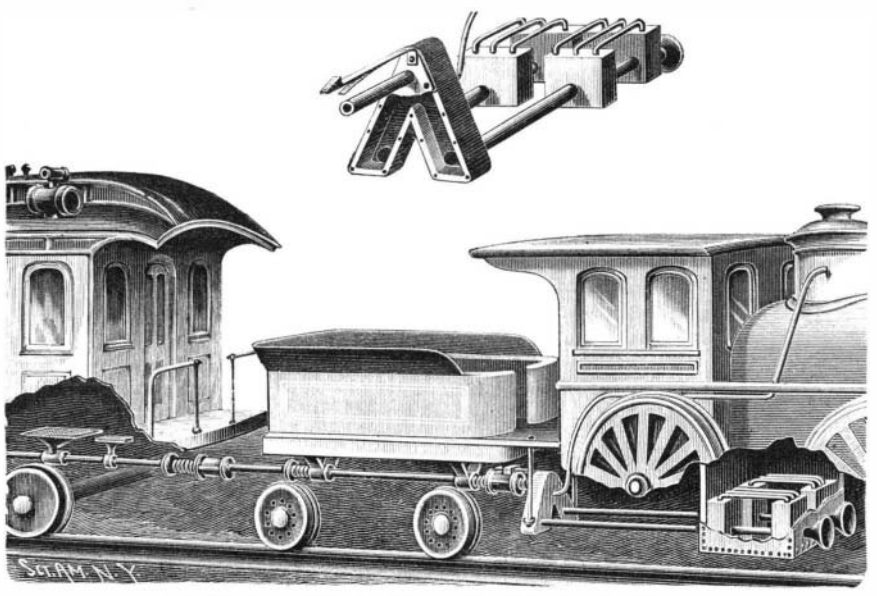
The slewing gear is constructed according to an arrangement patented by Mr. Alexander Grafton. The roller path and the toothed ring, or circular rack, are made in one piece, the anti-friction rollers running on its upper surface, while the pinion travels round its circumference. This combined ring is not fastened to the carriage, but merely lies on a circular turned surface, on which it is retained against lateral motion by a raised ring or flange which fits its interior diameter. When the slewing pinion is rotated, the ring remains stationary, since there is more friction between its lower surface and the carriage than between its upper surface and the rollers. But should any shock come upon the gear, as, for instance, if the jib of the crane should be struck by any moving object, or if the engines should be suddenly reversed in the act of slewing, then the ring will slip on the carriage, and the breakage of the gear, which would otherwise occur, will be avoided. The carriage is mounted on six wrought iron wheels with steel tires. The boiler is 4 ft. in diameter and 7 ft. 6 in. high.

Coal in the Argentine Republic.

According to a consular report, discoveries of coal have been made in the Argentine Republic. A company is now working the Dehera and Colorado coal mines, about sixteen miles from San Juan, in the province of the same name. It is stated that a seam nearly two feet thick has been discovered. Another bed has been discovered and works undertaken at Loude. It is reported that the coal is large, firm, and gives a great heat, suitable for the manufacture of coke and gas. This news has been received with satisfaction at Buenos Ayres, the want of coal in the Argentine Republic and the necessity to obtain supplies from abroad, chiefly in England, having been hitherto considered one of the chief obstacles to the establishment of a native industry able to compete with foreign products.

IMPROVED APPARATUS FOR HEATING CARS.

An apparatus designed to convey heated air from the locomotive to the several passenger cars of a train is illustrated herewith, and has been patented by Mr. Marshal Wood, of Alderson, West Va. Air tubes, having funnel-shaped front ends, open into boxes or reservoirs in the fire box, these boxes being connected to rear ones by a series of small pipes designed to serve as grate bars. From the rear boxes the hot air pipes connect with a triangular-shaped heating drum, shown in the small figure, suspended beneath the cab and connected with a coupling. Each car is preferably provided with two registers. To aid in carrying the heated air to the several cars, the hot air drum is connected by means of a tube with the steam dome, and sufficient steam used to drive the air through the train and afford all the heat desired.



WOOD'S APPARATUS FOR HEATING RAILWAY CARS.

The St. Louis Bridge.

The beautiful bridge built by Captain Eads over the Mississippi River at St. Louis, bold in its design and excellent in its execution, is an object of admiration to all who visit it, but the impression of its importance would be greatly magnified if the part below the surface of the water, which bears the massive towers, and which extends to a depth twice as great as the height of the pier above the water, could be visible. There are three steel arches, the center one having a span of 520 feet, and each side arch a span of 502 feet. Each span has four parallel arches or ribs, and each arch is composed of two cylindrical steel tubes, 18 inches in exterior diameter, one acting as the upper and the other as the lower chord of the arch. The tubes are in sections, each 12 feet long, and connected by screw joints. The thickness of the steel forming the tubes runs from 1 3-16 to 2⅛ inches. These upper and lower tubes are parallel and 12 feet apart, connected by a single system of diagonal bracing.

The double tracks of the railroad run through the bridge adjacent to the side arches at the elevation of the highest point of the lower tube. The carriage road and footpaths extend the full width of the bridge, and are carried, by braced vertical posts, at an elevation of 23 feet above the railroad. The clear headway is 55 feet above ordinary high water. The approaches on each side are masonry viaducts, and the railway connects with the city station by a tunnel nearly a mile in length. The great tubular ribs were built out from each side of a pier, the weight on one side acting as a counterpoise for the construction on the other side of the pier. They were thus gradually and systematically projected over the river, without support from below, till they met at the middle of the span, when the last central connecting tube was put in place by an ingenious mechanical arrangement, and the arch became self-supporting.—*Scribner's Magazine.*

Labor in State Prisons.

The Committee on Political Reform, of the State of New York, have recently issued a report on the above subject. For a number of years the prisoners in the prisons of this State were kept at work during the period of their incarceration. They were employed on the contract system. The labor of the prisoners was farmed out to manufacturers of shoes, stoves, and other goods, who made large quantities of manufactured material in the prisons. Much of the work was done by machinery, so that so far as the convicts were concerned, they were only taught a trade in the most limited sense of the term. Many articles were only partly completed in the prisons. The reformatory or educational aspects of labor were really subordinated to considerations of profit to the contractors.

The labor interest of the State, rightly or wrongly, looking upon prison labor as an injurious form of competition, succeeding in bringing about legislation practically abolishing prison labor, and reducing nearly all the prisoners to idleness. The results are described by the wardens of the different prisons as horrible. The body of criminals are left the greater part of their time in idleness, if a walk for exercise cannot also be described as such. The mind and body alike become unhealthy. Restlessness and ennui, leading to death, disease, and insanity, ensue, and the ultimate consequences may be very grave. Already the consignments to the insane asylum have begun to increase. The workers of this great State need protection at no such cost as this.

A prison should be a reformatory. At the best, but little reformation can be effected, but even a neutrality of operation is better than inflicting bodily and mental injury upon criminals. The plea of the committee is for employment for these wards of the State, which shall be so regulated as to have little or no effect upon general industrial occupations.

Assuming all the prisoners to be employed, their proportion to the total labor list of the State is put at fifty-two one-hundredths of one per cent. The committee hold that such competition, properly distributed, can do no harm. It is true that, under the old system, where the occupations covered a very restricted field, it might be felt. Admitting this, anything seems better than to maintain prisons as hot-beds for the fostering of evil habits, indolence, and some of the lowest forms of vice, and it seems perfectly clear that so small a proportion of laborers can be kept busy without perceptible effect upon the true interests of workmen. As compared with outside labor, prisoners are reckoned as having an efficiency of only sixty per cent. This reduces their competition to about three-tenths of one per cent—an infinitesimal amount.

To restore industrial occupation to prisoners, legislation is needed. It is proposed that a law shall be passed directing that prisoners be made to work. To prevent injurious competition, the number of prisoners employed in manufacturing any one kind of goods, according to the terms of the proposed law, shall not exceed ten per cent of the number of free workmen employed in manufacturing the same goods within the State. If this numerical ratio be further reduced by the coefficient of efficiency of prisoners, it will diminish to six per cent effective labor. By proper distribution of employments it can be reduced still lower, so as to approximate to the labor ratio of one in two hundred. The passage of such a law will undoubtedly do the prisoners much good, increase their chances of reformation, and will not perceptibly affect the prospects of outside workmen.

Salt Water in the Gas Wells.

Salt water is beginning to be a great nuisance to the oil and gas resources of Northwestern Ohio. It is invading nearly all the wells and making an immense amount of trouble, some property having been altogether abandoned on account of its presence. Salt water is affecting the gas wells of Findlay to a large extent, more noticeably in the famous "Karg," which at times cannot be used for several days. After a period of rest, however, the disturbing element seemingly disappears, but under high pressure upon the well returns again.