in position in this tube, four others will be carried. The boat is provided with a hull of sufficient strength to permit the submarine to descend to a depth of 100 feet, and the water tanks are of small dimensions, so that the size of the moving masses of water is considerably reduced, while at the same time there is every facility for filling and discharging them to readjust the balance necessary for stability when the vessel is diving or returning to the surface. The boat is fitted with four rudders, two of which are for steering on the surface, and the other two to be employed for diving. The official trial is to consist of a surface run of 10 knots, which is to be covered within the hour, while the submerged run will be 2 knots, to be accomplished at an hourly speed of 7 knots. When the runs have been undertaken a surface torpedo will be discharged at a target 150 feet in length by 16 feet deep, the upper edge of the target being awash and placed at right angles to the course of the submarine. While the boat is undertaking her submerged trials she will not rise to the surface on more than three occasions from the time of starting until the firing of the torpedo, the duration of each appearance not to exceed one minute.

BELLEVILLE VERSUS CYLINDRICAL BOILERS.

PRESIDENT OF BRITISH ADMIRALTY COMMITTEE'S REPORT.

Vice-Admiral Compton-Domville, the president of the committee appointed by the English Admiralty to investigate the efficiency and reliability of the Belleville boilers in comparison with the cylindrical boilers, has issued his report concerning the trial run that was undertaken from Portsmouth to Gibraltar and back by the two sister ships "Hyacinth" and "Minerva" at full speed. The former vessel is fitted with the Belleville boilers, while those of the latter are of the Scotch cylindrical type.

Representatives of the boiler committee embarked on board these two vessels at Devonport on July 6 last. Both vessels started from that port for Gibraltar at 3 o'clock in the afternoon of the same day and commenced working up to 7,000 horse power. It was intended that the ships should maintain 7,000 horse power till all the coal, except the 82 tons in the reserve bunkers, was exhausted. Three-quarters of an hour from the start the revolutions of the "Hyacinth" were 152 per minute and the horse power 6,994, and her trial started from this time. The "Minerva's" trial commenced a quarter of an hour later. The latter vessel soon showed that she was the faster ship, and steadily drew away from the "Hyacinth." By midnight on the 7th she was about four and a half miles ahead.

It had been arranged that the water in the reserve tanks of both ships should be used as the only make-up feed-water until it was reduced to 20 tons, in order that the amount of make-up feed used per day might be accurately determined. When the reserve had been reduced to 20 tons, this water was to be kept intact in the tanks ready for use in case of emergency, and all make-up required was to be obtained from the evaporators. Special reserve tanks had been fitted on the "Hyacinth" to hold about 100 tons; this, added to the original tank stowage, gave a total reserve tank stowage of about 140 tons. The total reserve tank stowage on the "Minerva" was about 170 tons.

When the amount was reduced to 35 tons on the "Hyacinth," the staff engineer asked to be allowed to start the evaporators, on account of the difficulty of getting the water out of the tanks by the special pump fitted for these trials. Two Weir's evaporators working with exhaust steam were started for the purpose.

At 1:15 A. M. on July 11, the staff engineer of the "Hyacinth" reported the engines would have to be eased on account of the large loss of water, and the trial was abandoned from 1 A. M. All the evaporators were working at this time, and in addition to the water from the reserve tanks, 25 tons of drinking water had been used for boiler make-up. The "Hyacinth" steamed into Gibraltar at slow speed, arriving there on the 11th, in the evening.

The "Minerva" continued steaming at 7,000 horse power till 11 P. M. on the 12th, at which time there were still 39 tons of coal in the bunkers, not including the reserve, and 20 tons of water remained in the reserve tanks.

The average horse power of the "Hyacinth" was 7,047 for 103¾ hours, with a coal consumption of 1.97 pounds, and the distance run was about 1,810 miles at an average speed of 17.6 knots. The "Minerva's" horse power was 7,007 for 147 hours, with a coal consumption of 2.06 pounds, and the distance run was about 2,640 miles at an average speed of 17.96 knots.

On the night of the 10th flaming occurred at the after funnel of the "Hyacinth," but no such flaming occurred on the "Minerva." When the boilers of the latter vessel were examined upon arrival at Gibraltar the openings in the Admiralty ferrules were seriously choked, the sizes of the openings in some cases being reduced to about one-third of the original.

The boilers and engines on both vessels worked well on the way out, with the exception of the breaking of the eccentric-strap bolt of the starboard intermediate engine of the "Minerva," which delayed her for about two hours. A number of leaks developed in the "Hyacinth's" boilers, which became worse when the vessel was eased up when entering a fog, on which occasion the steam pressure became sufficiently high to lift the safety valves. The loss of water was at first attributed to leaky feed-suction pipes, but during the stay at Gibraltar these pipes, the feed, and the hot well tanks, and the boilers and boiler blow-outs, were water-pressure tested, and no leaks, beyond those already known to exist in the boilers, were discovered. The leaky joints were remade by the ship's staff while at Gibraltar, and on the 16th the ship was taken out for a run at about 7,000 horse power, to test the amount of feed-water being lost. This was found to be at the rate of 55 tons a day, according to the record of the six hours' run. The boilers of both ships were thoroughly cleaned out at Gibraltar, so that the race home might be determined under the most advantageous conditions.

Both ships lay at anchor—the "Hyacinth" with two boilers alight for auxiliary purposes, and the "Minerva" with one alight. The homeward run was commenced at 4:27, by a previously unknown signal, on the 20th. Directly the signal was given the fires were lighted in the boilers not at work and the ships were headed for Portsmouth. Both ships started punctually at 4:30—three minutes after the signal. The "Hyacinth's" engines were worked slowly in accordance with orders from the deck, steam being supplied by the two boilers which were alight. At 4:52 the after group of boilers was connected up; at 5:05 the forward group; and at 5:09 the middle group were connected up, the steam pressure being 22 pounds. At 5:20—less than one hour from weighing anchor—the "Hyacinth" was proceeding at 150 revolutions per minute, the horse power being nearly 7,000.

When the "Minerva" set sail the boilers were also worked slowly. The second boiler was connected up at 4:55; the third at 5:02; the fourth at 5:07; the fifth and sixth at 5:10; seventh at 5:12; the eighth at 5:15. The engines were working up to full power at 5:16, but had to be eased several times during the next three hours, owing to the eccentric straps warming up.

At 5:15 on the 18th the "Hyacinth" was about six miles ahead of the "Minerva." Both ships, however, ran into a fog, and the "Minerva" caught up to the "Hyacinth," and at 9:30 A. M., on emerging from the fog, the "Minerva" was still ahead. Both ships then worked up to the maximum, but throughout the day the "Minerva" gained one-third of a knot per hour on the "Hyacinth." At 7 P. M. another fog was encountered, and the ships went slow through the night, keeping close to each other.

At 9 A. M. on the 19th they were again level, but during the day the "Minerva" again gradually drew ahead, traveling a quarter of a knot per hour faster. At 7 P. M. the "Hyacinth" again eased, owing to a fog, and went slow till 5 A. M., the "Minerva" being out of sight ahead. The "Hyacinth" then steamed at over 9,000 horse power till 6:10 on the 20th, when the fires of 10 boilers were drawn on account of a burst steam tube. At 9:50 P. M. the trial finished, the ship then being off St. Catherine's, and she arrived at Spithead at 11:30 P. M. The "Minerva" had anchored at Spithead 1 h. 45 m. previously. The coal consumed in the "Hyacinth" on the way home was 550 tons; on the "Minerva" it was 451 tons. The "Hyacinth" used her evaporators all the way; the "Minerva" utilized hers but very little.

The maximum power developed by the "Minerva" was 8,700 horse power, while that developed on the "Hyacinth" was nearly 10,000 for at least two hours, during which time the "Hyacinth" did not perceptibly gain upon the "Minerva." The "Hyacinth's" average power while running clear of fog was about 9,400 horse power, and the "Minerva's" about 8,400 horse power. From the results of the outward run it appears that the radius of action of each of these vessels at 7,000 horse power, as far as the coal is concerned, should roughly be: "Hyacinth," 2,930 miles; "Minerva," 3,000 miles. No difficulty was experienced in either ship during any part of either the outward or homeward runs to maintain a sufficient supply of coal to the fires.

Following the report of the president of the committee is one by Rear-Admiral W. H. Hay, Controller of the Navy, relating to the condition of the boilers after their unusual exertions. He draws the attention of the Admiralty to the following points in this trial:

(1) The very serious loss of water in the "Hyacinth," as pointed out by the president of the committee. This was due to leaky joints. A certain number were located at Gibraltar, and on examination at Portsmouth other leaks were discovered and reported.

(2) The state of the "Minerva's" tubes at the end of each run. On arrival at Gibraltar the cup ferrules were discovered to be partially choked, due to bird-nesting, and the ship could not have gone any further at that power (7,000). As it was, she was using up to 1.7 inches of air pressure, instead of ½ inch, to maintain the necessary combustion for this power. On arrival at Portsmouth practically the same thing occurred.

(3) The "Hyacinth" developed an average of 1,000 more indicated horse power than the "Minerva" on the run home. This should have given the former a substantial increase in speed, whereas there was a slight decrease. This extra indicated horse power must have been absorbed either in the engines, or on the main shaft's bearings, or in the hull. It is possible that the shape of the hull may have had something to do in the matter, but former trials do not bear this out. For example, when the "Highflyer" (same class) was tried against the "Minerva" last year, the former maintained a higher power and speed, except at 10 knots, when she had to exert more indicated horse power to obtain the speed.

The Controller of the Navy, in his conclusion, significantly remarks that this last feature of the Belleville boilers requires investigation. Although these trials were not conducted under the most satisfactory conditions, yet they conclusively established the relative merits and disadvantages of the two types of boilers, and the cylindrical boiler appears to have issued from the ordeal with the greatest success. It has been proved to be far more economical, in every respect, than the water-tube boiler.

SCIENCE NOTES.

The contest for the Pollok prize is now open, and it is to be hoped that this competition will result in the award of the prize to some American inventor.

An exhibition for accident, sanitary, and life-saving service is to be held at Frankfort October 5 to 21. It is to be exclusively scientific. Visits of workingmen will be arranged, as the chief aim will be to benefit those engaged in industrial pursuits.

Consul Haynes, of Rouen, under date of August 26, 1901, says that the metric system is to-day compulsory in twenty countries, representing more than 300,000,000 inhabitants—Germany, Austria-Hungary, Belgium, Spain, France, Greece, Italy, Netherlands, Portugal, Roumania, Servia, Norway, Sweden, Switzerland, Argentine Republic, Brazil, Chile, Mexico, Peru, and Venezuela—and advises American exporters in dealing with any of these countries to adopt the system.

The Italian government has definitely decided to restore Leonardo da Vinci's "Last Supper." Ordinarily the restoration of a masterpiece of painting would be regarded as dangerous in the extreme, but in this instance the conditions are peculiar. The picture is in such a bad condition that it would be difficult to spoil it, and the work will be done in the most careful and scientific manner. A celebrated expert has been engaged to give his services, and the first work will be to destroy the micro-organisms which are eating up the paint. The wall will then be treated so that it will not be damp in the future, and then the work will be "restored" with the help of the old copies of the fresco and the engravings of it.

The dangers attending laymen who undertake to act as judge, jury, and advocate in legal matters are well shown in a recent trial for infringement in England. A party had invented a pneumatic hammer and established a business in it, when other parties also embarked in the manufacture, having patented the same device. These last were sued, when they set up a defense of prior publication before the first, or original, patent was issued. The judge required the alleged infringers to prove the prior publication—they having admitted the infringement. It then appeared that the ostensible prior publication was not a fact; there had been no publication whatever in the legal meaning of the word, but merely a conversation between two tradesmen as to the commercial value of the hammer. Upon such a slender base as this the defendants had gone to considerable outlay with the belief that their view of the situation was correct. In cases of this kind it is much better to take professional advice than to act upon intuitions or beliefs.

THE "FOOL KILLER" TAKING SOUNDINGS.

In our last issue we described Peter Nissen's "Fool Killer," which is intended to be used in taking soundings in the Niagara River, and, if possible, pass through the Whirlpool Rapids. Nissen began making soundings on September 21. He maneuvered the "Fool Killer" in a satisfactory manner, showing that it was a very stanch craft. The boat was run repeatedly into the spray so that it was hidden for several seconds. Then it would emerge, and under a full head of steam would toss among the waves with the water dashing over it and threatening to capsize it. He found the rocky bottom of the river very uneven, its depth varying from 15 to 100 feet.

Crude Attempts at Telegraphy.

About seventy years ago, perhaps before the present mode of telegraphy had been thought of, an attempt in that direction was made by a Mr. Porter, a man of inventive faculties, who afterward became originator, proprietor, and conductor of The American Mechanic, the pioneer publication in that direction, and the predecessor of the present SCIENTIFIC AMERICAN.

The southern and ocean terminus was on Rhode Island on Rocky Farm, and the place of its location has since been known as Telegraph Hill. It was constructed wholly of wood, was in part a species of wireless telegraphy. It consisted of a series of upright posts, with a number of arms secured to the post at one end by pivots, permitting the arm to be moved in any direction desired, at the liberated part, up or down, and the information was derived from the relative position of these arms. The signals were placed on the summits of the highest hills, at desired intervals, an operator being required at each signal post to convey the signals to the next station.

To reach Boston, as was intended, would require a large number of signal stations and operators, and the execution would have been necessarily slow and expensive. Of course, no approach could have been made toward the present manner and matter of telegraphy, at best being confined to the briefest expression of important information, to carry which to Boston, for instance, would have required a comparatively long time. It was put in operation, if the writer mistakes not, and for a sufficient length of time to test its availability, but not its practical value, and it was early abandoned. It is only within a few years that the southernmost signal post disappeared from Telegraph Hill.—Newport News.

EIGHTY-TON FLOATING CRANE FOR THE SANTOS HARBOR WORKS.

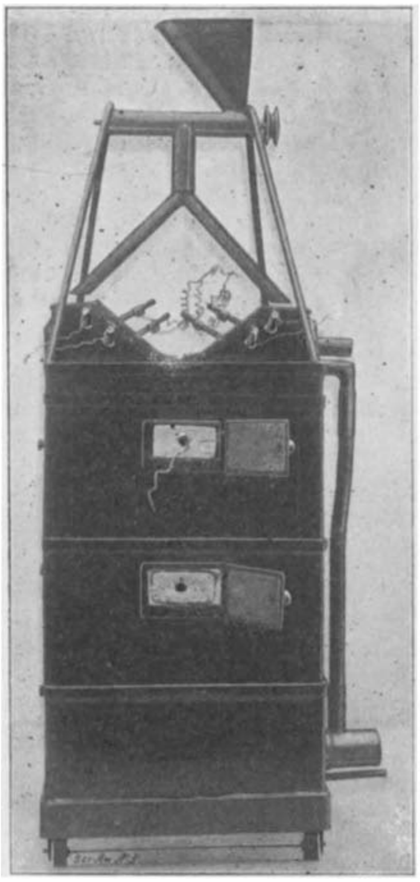
We present an illustration of an 80-ton floating crane which has been built by the Royal Dutch Forge Company at Leyden, Holland, for the Santos Harbor Works. Its principal dimensions are: Length of vessel, 100 feet; beam, 35 feet; depth, 7 feet 3 inches; outward overhang of shearlegs, 35 feet 3 inches; height of top of shearlegs above water level, 50 feet. The power needed is supplied by a vertical high-pressure engine, with two cylinders, each 12 inches in diameter by 15-inch stroke, and taking steam at an initial pressure of 120 pounds per square inch. The general appearance of the craft is shown by the accompanying engraving. The hoisting gear consists of two sets of wormwheel gearing and two sets of spurwheels. The worms, of forged steel, are driven from the steam engine. The wormwheels are fitted on intermediate shafts, on which, on the other end, are fixed cast-steel pinions, driving the cast-steel spurwheels, and bolted to the drums. Each drum, of cast iron, has a diameter of 3 feet 7 inches by a length of 3 feet 7 inches between the flanges, and weighs about 4 tons. All shafts are of forged steel; the bearings have large surfaces, and are lined with white metal.

The shearlegs are constructed of mild steel plates, the diameter in the middle being 2 feet 8 inches. The upper ends of the shearlegs are provided with cast-steel top pieces to take the upper shaft, which is of forged steel, 12 inches in diameter. The water-ballast tank, having a capacity of 130 tons, is divided into four compartments. Each compartment can be filled separately, and also all compartments together, by a duplex ballast pump, placed in the engine room. The hull of the vessel is built of mild steel, and special attention has been paid to the longitudinal stiffness of the vessel. The crane has been tested on the works with full load by a commission of engineers, and proved satisfactory in all respects.

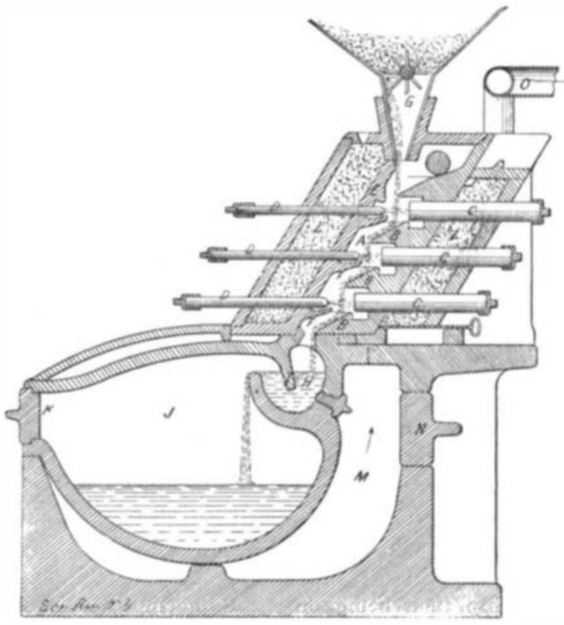
A mixture of two parts olive oil and one part turpentine gives an excellent furniture polish. It at once removes all finger marks, etc., from the furniture.

AN ELECTRICAL GLASS-FURNACE.

Most varieties of glass are largely composed of silica, often mingled with oxides of sodium and calcium. The glass from which ordinary tumblers, for example, are made is composed essentially of white sand (silica), soda (sodium carbonate) and lime (calcium carbonate). The raw materials are pulverized, intimately mixed, and subjected for 20 to 30 hours to an intense heat either in clay crucibles (glass-pots) or in large basins (tubs). However economical the most improved forms of glass-furnaces may be in the consumption of fuel, and however small the percentage of loss in glass, the fact still remains that the amount of fuel required and the quantity of heat radiated without any effect on the contents of the furnace are enormous. Moreover, the installation of a glass-furnace is exceedingly costly; valuable space is taken up both below and above ground; the health of the workmen is endangered by the fierce heat radiated by the furnace; and the plant must be worked continuously, so that the loss in heat may be reduced to a minimum.



AN ELECTRIC GLASS-MAKING FURNACE.

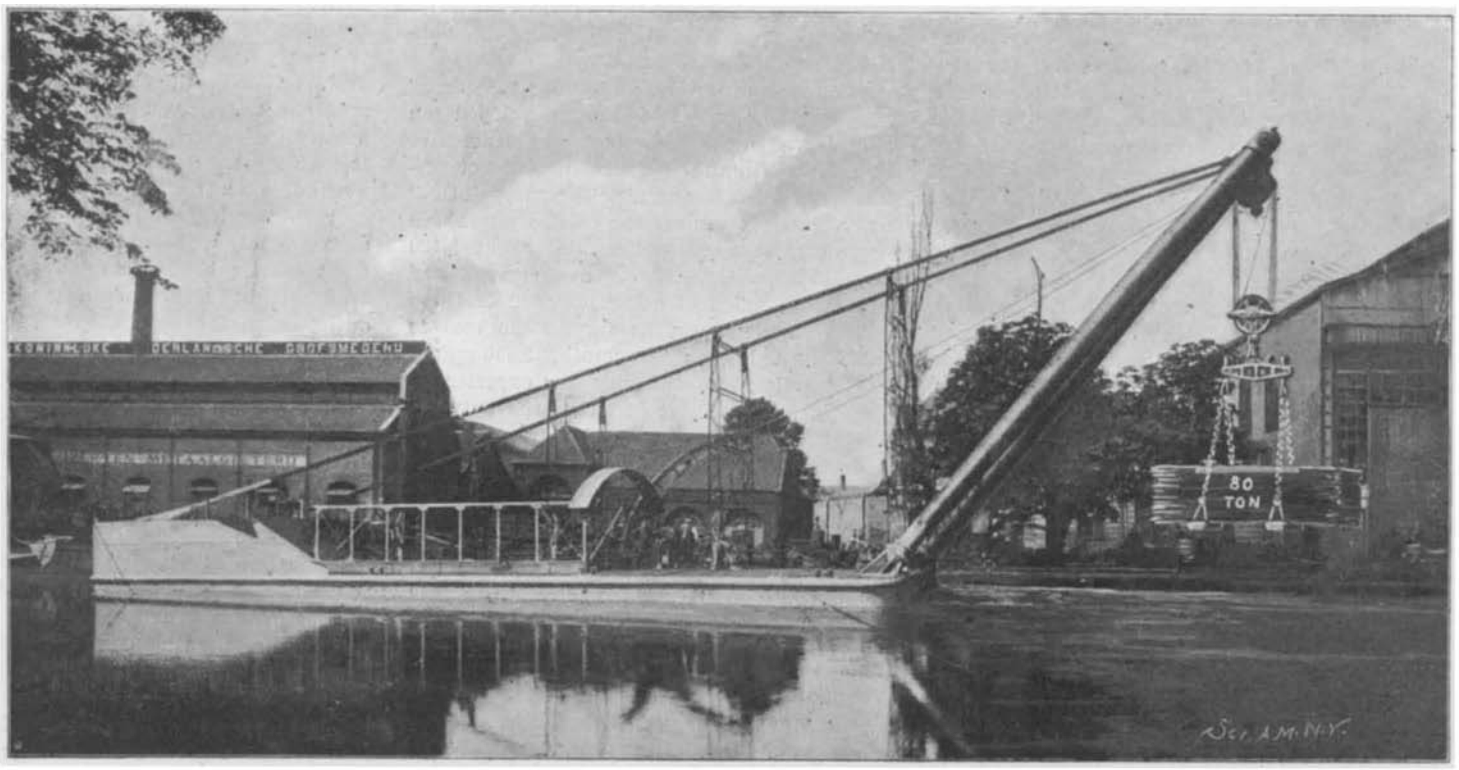


VERTICAL SECTION OF ELECTRIC GLASS-MAKING FURNACE.

A new type of glass-furnace recently attracted our attention, which seemed to mark a great onward step in the manufacture of glass and which seemed to be singularly free from the defects enumerated. Through the courtesy of Dr. Voelker of the Société Anonyme, L'Industrie Verrière et ses Derivés, Brussels and Cologne, we are enabled to present to our readers a clear account of this departure in one of the most important industries.

The invention is an electric furnace which can be made in various forms, and one type of which is pictured in our sectional view. The silica and other ingredients are finely pulverized, intimately mingled, and introduced into a hopper, in the discharge-opening of which a feed-wheel is mounted. If the hopper be long and the discharge-opening located at one end, a screw-conveyor is used. From the hopper the material to be fused is fed to an inclined melting-chamber, *A*, which is formed by the wall, *E*, and by a continuous series of hearths, *B*, so situated that one is placed above and slightly to one side of the one immediately below. The surfaces of the hearths are inclined to permit the fused material to flow off; and the edges of the hearths are made as sharp as possible to permit the escape of the bubbles of carbon dioxide gas. Through perforations in the wall, *E*, and in the hearth-wall, carbons, *D* and *C*, are respectively passed. Beneath the carbons, *D*, the wall, *E*, is formed, with pan-like projections, *F*, which receive the ashes and unconsumed portions of the carbons. The carbons, *C*, are mounted immediately above the corresponding hearths, *B*. Direct current generated by a 360-ampère dynamo with a voltage of 120 is passed through the carbons. The intense heat of the first arc melts the raw material fed from the hopper. The molten glass trickles down the first hearth; drops upon the second hearth; is there subjected to the heat of the second arc; falls upon the third hearth; and finally reaches the collecting cup, *H*, as an exceedingly liquid glass, free from all gases and impurities. Since it is of the utmost importance that no air be allowed to enter the melting-chamber, *A*, during the operation of fusing the silica, a compartment, *L*, is provided at the side of each wall, which compartment is filled with refractory material, packed so closely around the electrodes that no air can possibly enter. The gases which bubble from the molten glass are led through several passageways into the air space, *M*, surrounding the pot, *J*. In the air space, *M*, the gases are mixed with hot or cold air and burnt, the heat thus generated serving to warm the walls of the pot. The products of combustion pass through suitable channels to the out-take, *O*.

It is claimed for this electrical method of fusing silica that 60 per cent of the fuel formerly required is saved. But, even if this figure be possibly modified when accurate data are obtained, it cannot be denied that the remarkable compactness of the furnace, the unprecedented rapidity with which the materials are fused (bottles can be blown within half an hour after the hopper is charged), and the very small amount of heat lost by radiation are sufficient to predict a bright future for the electrical system. The pots, besides being small, and cheap in cost, last longer than has ever been the case in glass-making. The workmen are subjected to no



EIGHTY TON FLOATING CRANE FOR THE SANTOS HARBOR WORKS.