The next case illustrates the violent effects which excessive heat may have upon a person not accustomed to it: "On Friday, October 11th, 1878, John McCauley went to work for the first time in the Imperial Mine. He was cautioned against over-exerting himself in the extreme heat of the lower levels. He replied that he thought he was strong enough to stand anything and paid no attention to the advice. At half past two in the afternoon he was brought to the surface in an unconscious state, and died the next morning at half past ten o'clock."

Two other cases very similar to this have occurred in the Imperial within a few years. This mine is excavated in one of the hot spots of the Comstock.

The hot drift on the 1,900 level of the Gould and Curry is the scene of the most serious of these casualties due to heat. Five men were sent there in June, 1878, to load a donkey pump on a car. The work was so exhausting that when the pump caught on a plank they were not able to move it. They seem to have been in a state of mental confusion, but felt that they could not remain longer. Starting up a winze which connects with the 1,700 level one man fell on the way, and the others were afraid to stop to help him, but pressed on, reaching the 1,700 level in half an hour from the time they left it. They were very confused and nearly speechless, and hardly realized what had occurred. Three men went down to the rescue and found the fallen man still alive. Clearing the pump they got into the car and signaled to hoist, but on the way up the winze the man they had gone to rescue reeled and fell off. The car was stopped at once, but he was jammed between it and the brattice so fast that the others left him and went for help. They all gave out, two half way up, and the other just as he reached the 1,700 level, where a friendly hand pulled him up. A new rescue party went down and found two men dead, and the third died soon after. The shift boss reports that "the accident was due solely to the heat, as the air is good enough and pure enough, barring the heat." The winze was not an abandoned one, but in daily use. A heavy volume of steam is reported to rise through it from the 1,900 level, the temperature of which, at the time of this accident, is given at 128° Fah. Mr. Church gathers from the detailed account that the death of the men is possibly attributable to the fact that when the miner fell off the car the latter was stopped in a place that was hotter than the rest of the winze.

It is to be regretted that no adequate studies have been made upon the precise physiological phenomena presented by death under these circumstances. The legal requirements are satisfied when it is proved that the casualties are due to heat.

PUSHING AN IRON BRIDGE ACROSS A RIVER.

A notable feat in engineering was brought to successful issue in the latter part of September, at Dinard, in the department of Ille and Vilaine, France. In carrying a railway across the river Rance, the novel plan was adopted of building the bridge on shore and boldly pushing it bodily across the stream. The bridge weighed 2,600,000 pounds; its height above the river was 100 feet, and the length of the main span 314 feet. Twelve windlasses were used in rolling the bridge into position. It was calculated that four or five days would suffice for the work of putting the bridge in place, but owing to the breakage of chains, it took two weeks.

Our correspondent, Mr. Geo. Quincy Thorndike, who furnishes these details, also favors us with a photograph of the bridge, taken just before the end touched the west bank. For two hundred and fifty feet or so, the western end of the bridge is comparatively light in structure, so that only about fifty feet of the main span projected over the river before connection was made with the further side.

We do not recall any previous instance of the pushing of a long and heavy bridge into position in this manner. The nearest approach to it—and quite as notable as a specimen of engineering skill—is the splendid bridge of the Cincinnati Southern Railway across the Kentucky river, a full description of which, with several illustrations of the structure at different stages of construction, appeared in the SCIENTIFIC AMERICAN SUPPLEMENT for October 27, 1877. In the latter case the chasm to be crossed was 1,138 feet wide, with almost vertical walls of limestone from 280 feet high. The bridge was made of three spans of 375 feet each, resting on the bluffs and on two iron piers supported by stone piers. During erection the truss was a continuous girder, 1,125 feet long, of the Whipple type, but after erection it was converted into one continuous girder, 525 feet long, projecting at each end 75 feet over its points of support, and carrying from each of these cantilevers a 300 foot span, bridging the distance from the cantilever to the bluff.

Taking advantage of two towers and two sets of anchorage, which had been constructed at the point of crossing for a wire suspension bridge, and abandoned, the engineer in charge, Mr. C. Shaler Smith, bolted to the towers the first panel of the bridge on each side, and then pushed forward the construction of the bridge by corbeling out panel by panel. The towers were calculated to be strong enough to carry 196 feet of projecting spans, and at that distance temporary towers of wood were built to furnish an intermediate support. The corbeling process was then continued until the shore spans each reached the main iron piers, which were built up simultaneously, so that the projecting bridge and piers met in mid-air. Each half of the center span was then corbeled out as before until they met in the center, where they were joined.

This is regarded as not only one of the boldest and most original pieces of bridge engineering in America, but one of the best in the world when judged by the crucial test of accomplishing a great work at the least possible cost. How the French bridge will compare in the latter respect cannot be told without more detailed information.

THE ELEVATED RAILWAY EXTENSION.—DETAILS OF CONSTRUCTION.

The constructors of the iron work of the Second Avenue Metropolitan Elevated Road and the extension of the west side line to Harlem, Messrs. Clarke, Reeves & Co., furnish the following figures, supplementing those given in our description of that work last week. It is proper to add that we are indebted to the same gentlemen for the photograph from which the large engraving of the 110th street curve was made.

The new structure on the east side has a length of seven and thirty-six hundredths miles, and required 28,000 tons of iron. The west side extension, from 83d street to Harlem river, four miles in length, required 16,200 tons of iron. In the 44,200 tons of iron used in building the two sections of the road, there are 971 miles of angles, 314 miles of flat bars, 20 miles of Phœnix columns, 2 acres of plates, 5¼ million rivets, and 21 million punched holes. The preparatory work was done at the Phœnixville rolling mills and shops, the average day's work being 3 miles of angles and 1¼ miles of flat bars, at the mills; and 66,600 holes punched and 17,430 rivets driven, at the shops.

The high viaduct shown in our engravings is 4,000 feet long, with an average height of 45 feet. At 8th avenue and 110th street the road is 59 feet above the pavement, and the foundation extends 36 feet below the pavement, making the total height of the structure 95 feet. The foundations are from 30 to 40 feet deep, and cost $200,000 a mile. Each pair of high piers contains as many bricks as a house 20 by 50 feet and three stories high.

If the grades had followed the streets a maximum grade of 170 feet to the mile would have been required. Now the maximum grade is 75 feet. The foundations and general design and arrangement of the iron work were planned by John Baird, General Manager, and W. F. Shunk, Chief Engineer of the Metropolitan Elevated Railway Company. The special design and construction of the iron work was by Clarke, Reeves & Co., of Phœnixville, Pa.

AMERICAN INDUSTRIES.—No. 21.

THE BROWN & SHARPE MANUFACTURING COMPANY.

For accuracy of workmanship, order, cleanliness, and completeness, no establishment is more justly noted than that represented in our leading illustration this week, and the work turned out at this shop is recognized everywhere as being as near perfection as it is possible to make it. Only accurate tools, skilled workmen, and good materials, supplemented, of course, by capital and experience, can produce these results, and these are found in the works of the Brown & Sharpe Manufacturing Company, of Providence, R. I.

The business of the company was begun in 1833 by David Brown and his son, Joseph R., and has been conducted under the style of David Brown & Son, Joseph R. Brown, J. R. Brown & Sharpe, and is now managed under the style of the Brown & Sharpe Manufacturing Company. From the first its aim has been to develop mechanical perfection by producing machinery of superior design and finish, and to furnish tools of such quality to the users as would enable them also to carry a just system practically into their work.

In 1866 the rule and gauge making branch of J. R. Brown & Sharpe's business combined with Samuel Darling, adding the business formerly known as Darling & Schwartz, of Bangor, Maine. The new firm adopted the style of Darling, Brown & Sharpe, and have since carried on the manufacture of U. S. standard rules, Ames' universal squares, patent hardened cast steel try squares, the American standard wire gauge, bevel protractors, hardened T squares and bevels, and a great variety of steel and boxwood rules and scales, and other small tools for machinists, draughtsmen, and wood-workmen's use. Darling, Brown & Sharpe occupy premises in the new factory of the Brown & Sharpe Manufacturing Company, and partake of the same high character in respect to the superiority of their productions.

The building occupied by this company in Providence, R. I., is architecturally handsome, and its plan admirably provides for light, ventilation, and security. It is not only adapted in its particular appointments and on account of its size, the area of floors equaling 60,000 feet, to their purpose as manufacturers, but it is fireproof and every way calculated to preserve the patterns and machines, the drawings and plans that years of study and labor have perfected.

The machines made by this company are so well known that they need no special description. We have represented two of the more important ones in our engraving, the one on the right being the universal milling machine, the producer of tools, a machine that is indispensable in any well equipped shop; that on the left is the universal grinding machine, designed for doing a large variety of work by the use of solid emery and corundum wheels. It is especially adapted for grinding soft or hardened spindles, arbors, cutters, either straight or angular, reamers, and standards, also for grinding out straight and tapered holes, standard rings, hardened boxes, jeweiers' rolls, and other work.

Besides these machines this company make surface grinding machines, small milling machines, screw machinery, gear cutting attachments for milling machines, index plates for gear cutting machines. In addition to this they make a lathe which is not designed to compete with other lathes in the matter of price, but to supply a want felt by those who require a lathe that is as near absolute perfection as the most skilled workmen can make it. Besides this they are the makers of the Willcox & Gibbs sewing machines, and have filled the orders of that company for nearly 300,000, complete for market. This sewing machine among experts bears the reputation of being among the finest pieces of well executed mechanical work. They are the inventors of machinery as well as the users of it, by which the most mathematically correct instruments that are furnished to draughtsmen and others are manufactured.

Their weighing scales turn upon the accession of the thousandth part of a pound. Their sheet metal gauge determines thickness to the thousandth part of an inch. From tiny and light instruments to the universal milling machine with gear cutting attachment, their great factory produces in mathematical correctness of detail the tools that are in constant use in the different manufacturing establishments throughout the country.

Our engraving shows in the central figure the exterior of the buildings of the Brown & Sharpe Manufacturing Company, and the two upper figures show the lathe and planer room, and the gear cutting and milling room. The lower and larger view represents the department devoted to the manufacture of the Willcox & Gibbs sewing machine. These views serve to give an idea of a part of the works only; it would require a volume to illustrate and describe in detail the various departments of this establishment. There is of course a similarity between machine shops the world over; but in the matter of system and cleanliness we do not know of an establishment that excels this.

From storerooms situated upon the respective floors small tools are furnished for especial use to workmen, who deposit checks therefor, to be redeemed upon the return of the article taken. There is a library of interesting and valuable books free to all employes, and it is prized by them, as is made evident by their constant use of it. Every man employed, in an apartment for the purpose, finds accommodation for clothing and even dinner pail, if he brings one, under a registered number. Each man of all the large force has his appointed place for washing after work, even the soap that he uses not being interfered with by any one else. A little river of clear rinsing water flows through the center of the best devised washing accommodation for hundreds of men we have ever seen inside a building. One may judge what class of mechanics are at work in an establishment so ordered, and what may be expected from their hands.

The Egyptian Obelisk for New York.

Lieutenant Commander Gorringe, U.S.N., and his assistant, Lieutenant Schroeder, have sailed for Liverpool, on their way to Egypt, to superintend the removal and shipment of the Cleopatra Needle presented by the late Khedive to this city. The machinery to be used in handling the monolith has been prepared at the Roebling Works, Trenton, under the direction of Mr. Gorringe. The *World* says that this machinery will aggregate about eighty tons in weight. It consists of two towers, each 26 feet in height (which are to be shipped in sections and put together after their arrival in Alexandria), two steel castings, each weighing over six tons, and a cradle 60 feet in length. The towers correspond to the sides of a gun carriage, and the castings to the trunnions on a gun. Like the machinery for handling the monster gun of the colossal Italian ironclad Duilio, this machinery for moving the Alexandrian obelisk will command the critical attention of machinists and engineers; and it is satisfactory to know that the work of transferring to the New World this great Egyptian monument will be carried out entirely under American auspices.

The method of embarking the obelisk is described as follows: A steam collier having a water ballast compartment will be secured alongside of the pier, and the necessary preparations made for heaving her down to careening lighters placed alongside on the side opposite to the pier. The water ballast compartment will be filled. A port having been opened to admit the obelisk into the fore-hold, it will be launched in. The listing of the steamer from taking its weight will be overcome by heaving down on the careening lighters, and the sinking due to both operations will be counteracted by pumping out the water ballast compartment, thus removing a weight of water corresponding to that of the obelisk. Tidal and wind-drift differences of level will be overcome by means of a float secured at the shore end after the fashion of a ferry slip.

An Extensive Beard.

The Detroit *Post and Tribune* has been interviewing the possessor of the longest beard on record, Mr. Edwin Smith, of Fairfield, near Adrian, Mich. The beard measures 7 feet 6½ inches. Mr. Smith is a farmer, forty-seven years old, 6 feet high, and weighs only 145 pounds; hair and beard sandy and tinged with gray. His twin brother, less bearded, is stouter and enjoys much better health. No unusual growth of hair is noticeable in any other member of the family. Mr. Smith had a fuzzy face in childhood, began to shave at the age of thirteen, but stopped shaving eighteen years ago. His hair is thick and strong, and has to be cut fortnightly.

Experimental Ballooning.

We learn from our London contemporaries that ballooning will henceforth form a part of the art of war, for, by order of the War Office, a balloon equipment has been placed in the Royal Arsenal, Woolwich. Two balloons for experimental purposes, and a portable furnace for the manufacture of hydrogen gas, are in commission; and a party of men and officers of the Royal Engineers have been instructed in aerestatics, and in the preparation of network and other appliances required in actual service. The balloons and all the appurtenances have been made within the arsenal, so that ample supplies can be produced as required in working out the important aeronautical question. That balloons may be employed with great advantage in war has already been demonstrated. To look down into an enemy's camp, or to spy out his movements behind a ridge or in the rear of a wood, may tend to the defeat of his plans and the shortening of a campaign; and this may be done by means of a captive balloon. But very much more might be done if a free balloon could be made to sail in any direction; this is the problem which the Royal Engineers and the Aeronautical Society have now to work out, and it is hoped they may be successful in solving it.

THE BLAKE TRANSMITTER.

The Blake telephonic transmitter, now so largely used in connection with the Bell telephone, is in some respects quite similar to Mr. Edison's transmitter, figured in our pages a few weeks since, and both are, in principle, like a comparatively old invention of Mr. Edison's, which he calls the inertia telephone.

This transmitter is in extensive use and is very efficient, notwithstanding its apparent clumsiness. There is, in fact, nothing delicate or fine about its construction. Those at present in use are securely inclosed in boxes which shield them from the eyes of the curious, nothing being exposed save a small portion of the diaphragm, which is seen through a $\frac{1}{2}$ inch hole in the mouthpiece formed in the cover.

The transmitter is generally attached in a vertical position to a board, which also supports the switches and other accessories. To the hinged cover of the box is secured the annular cast iron frame, A, in which is placed a 3 inch circular diaphragm, B, made of common Russia iron of medium thickness, bound around the edges by a soft rubber band, stretched over it so that it covers about a quarter of an inch of its edge. The diaphragm is held in place by a small clip just touching the rubber binding upon one edge, and by a steel spring upon the other edge, which is rubber tipped and touches the diaphragm about $\frac{3}{4}$ inch from the center with a pressure of several ounces. Short arms are cast on the ring, A, one at the bottom, the other at the top, and to the upper arm is attached a spring, which is riveted to the casting, C. This casting supports two delicate springs, D E (watch springs). The spring, D, has an insulated support, and is connected by a wire with the upper hinge of the box cover, the hinge being connected with the binding post, *d*, at the top of the box.

The free end of the spring, D, rests against the diaphragm, and is provided with a convex platinum button, which is pressed by a carbon button inserted in a piece of brass weighing two or three pennyweights and fastened to the free end of the spring, E.

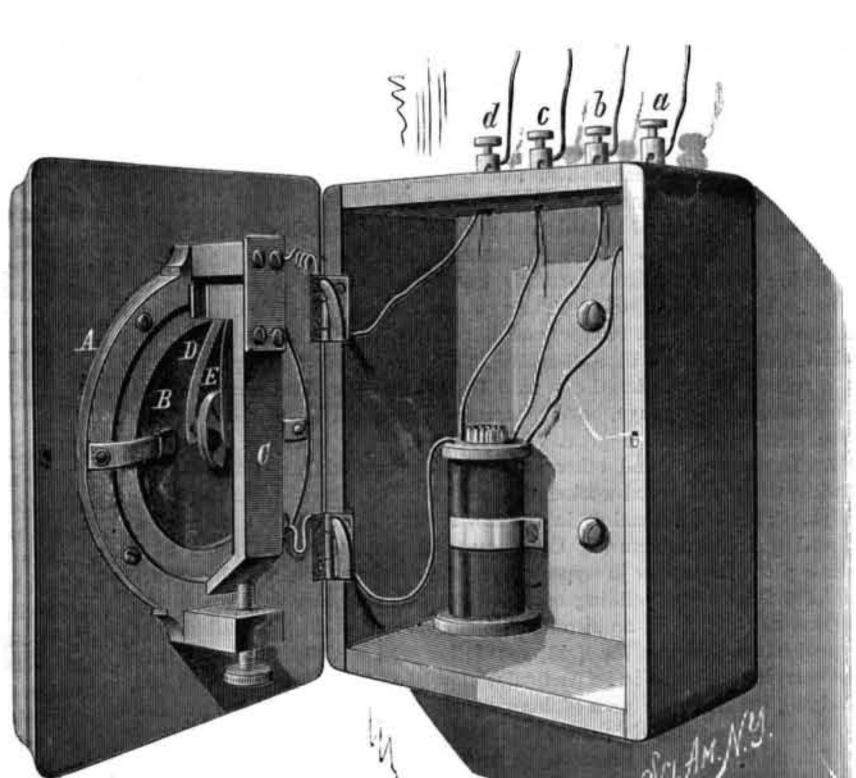
The spring, E, is in metallic contact with the casting, C, and the latter is in electrical communication with the frame, A, which is connected by a wire with the lower hinge of the box, and the hinge is connected with the bending post, *c*, by a wire that includes the primary wire of the small induction coil, seen in the corner of the box. The secondary wires of the induction coil are connected with the binding posts, *a b*.

The inclined surface of the lower end of the casting is engaged by an adjusting screw which passes through the lower arm of the frame, A. By turning this screw one way or the other the springs, D E, are made to press with more or less force upon the diaphragm, and the contact between the platinum button and the carbon is varied.

The binding posts, *c d*, are connected with a battery. The binding posts, *a b*, are connected with a telephone line, including the receiving telephones, usually of the Bell form.

The primary current passes through the springs, D E, and the primary wire of the induction coil. The vibrations of the diaphragm vary the contact between the platinum button and the carbon, and produce a variation in the current, which induces a corresponding current in the secondary wire of the induction coil and in the line including the telephones. A single cell of Leclanché or Fuller battery is sufficient to work this transmitter. It will be noticed that while the spring, D, is in contact with the diaphragm the latter is insulated from everything else by the rubber binding and the rubber tip of the spring.

The box hinges are provided with springs soldered to one half, and pressing upon the other half to insure a good electrical contact. A closed circuit bell is extensively employed in connection with this transmitter for calling attention. Magneto bells are generally used on isolated lines.

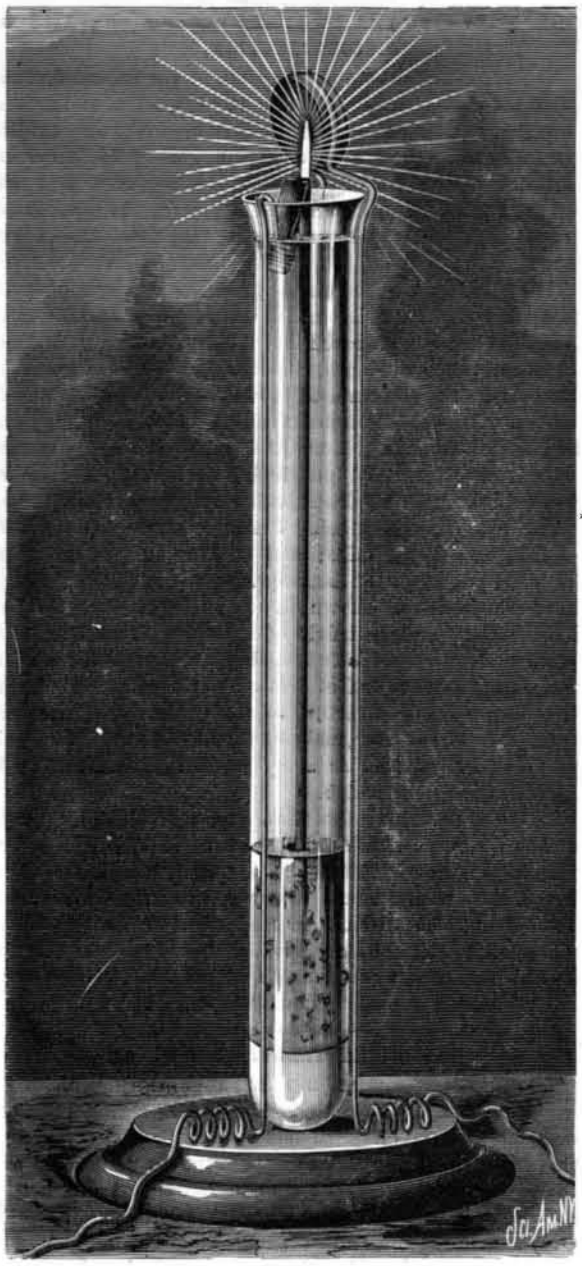


THE BLAKE TELEPHONIC TRANSMITTER.

MODIFICATION OF THE REYNIER AND WERDERMANN ELECTRIC LAMP.

BY GEO. M. HOPKINS.

In the Reynier and Werdermann systems of electric lighting the light is produced by the incandescence of a slender pencil of carbon and by a small voltaic arc between the end



SIMPLE ELECTRIC LAMP.

of the pencil and the carbon block forming one of the electrodes. In the Reynier system the carbon block is in the form of a wheel that revolves slowly by contact with the end of the carbon pencil. In the Werdermann system the carbon block is stationary. In both systems the pencil is carried forward as it is consumed, by gravity of a simple weight or of the parts of the lamp and the pencil, and Mr. Reynier, in a recent description of his lamp, proposes to employ hydrostatic pressure as a means of carrying forward the pencil. This is not a new idea, the principle having been already applied to feeding carbons in electric lamps.

The lamp shown in the accompanying engraving embodies the principle of the Werdermann and the Reynier, and the carbon pencil is carried upward by a float which creates the required pressure between the electrodes and presents a ready means of moving the carbon with a gentle, continuous pressure.

This lamp is as simple in its construction as any having means of feeding the carbons, and it is as inexpensive as it is simple. With appropriate battery power it will give a light equal to at least two five-foot gas burners.

The test tube which contains the water and the cork float, is 9 inches high and about $1\frac{1}{8}$ inch in diameter. From the base rise two wires, which are formed into a circular loop at the top for receiving the carbon button forming one of the electrodes. This carbon button is circular and somewhat conical, and is held in place by simply crowding it into the loop. It is arranged eccentrically in relation to the top of the test tube, to admit of turning it so as to present a new surface to the end of the carbon pencil, and it is inclined so that the upward pressure of the carbon pencil will insure a contact between the button and the pencil, and between the pencil and the small carbon block below and in front of the button. This block is inserted in the coil formed on the end of the wire which extends over the side of the test tube and downward to the base, where it is connected with one of the battery wires.

The looped wire that supports the carbon button and the wire supporting the carbon block are inserted in the base, and form a support for the test tube.

The carbon pencil is $\frac{1}{16}$ inch in diameter and 9 inches long. The cork that buoys it up has in its center a small tube for receiving the lower end of the carbon pencil; for this tube a very small quill answers well.

The carbon button and the carbon block are cut from a hard piece of battery carbon or from a piece of gas retort carbon.

The test tube is nearly filled with water, which bears up the cork float and brings the upper end of the carbon pencil into contact with the carbon button; the pressure of the pencil against the inclined surface of the button throws the pencil into contact with the carbon block, completing the electrical circuit.

Six cells of Grenet battery, each consisting of a zinc plate, 3x6 inches, placed between two carbon plates of the same size, will afford a splendid light for a short time, but this form of battery soon polarizes. For a continuous light some form of constant battery is desirable, although a greater number of elements will be required.

In the published descriptions of the Reynier lamp it is stated that four Bunsen elements will afford a clear white light, and that with a battery of thirty-six elements, grouped in two series of eighteen elements each, four lamps may be placed in a single circuit. The writer's experience has been that this lamp, as well as most of the other simple lamps, requires more battery power than the inventors claim to use.

To obtain the maximum result from one of these simple lamps it is probably safe to say that at least eight Bunsen elements will be required.

The lamp shown in the engraving seems to yield results equal to those obtained from the more expensive apparatus, and by a comparison with another lamp of more complicated and costly construction the writer was forced to believe that the results were even better. Whether this is attributable to the combustion of the gases resulting from the decomposition of steam by the intense heat of the incandescent carbon remains to be determined by future experiment.

MECHANICAL INVENTIONS.

An improved elevator for use in manufactories, shops, planing mills, storehouses, warehouses, and other places where lumber and other articles are to be taken from higher to lower floors, has been patented by Mr. Latham W. Greenleaf, of Terre Haute, Ind. It is so constructed as to load and unload itself while in motion.

Messrs. Myron A. Culver, William A. Jones, and Myron C. Briggs, of Bairdstown, Ohio, have invented an improved machine for lapping patent hoops, which will form the laps rapidly, evenly, and without danger of splitting the hoops, which may be adjusted to operate upon hoops of different lengths.

An improvement in carpet sweepers has been patented by Mr. Frederick Cook, of New Haven, Conn. The object of this invention is to provide a carpet sweeper whose brush is made to revolve by means of adjustable cord and pulleys, and is also vertically adjustable in its box.

Mr. John Hyslop, Jr., of Abington, Mass., has patented an improved machine for tonguing and grooving the edges of boards, and at the same time jointing them, which may also be used for forming moulding. The invention consists in combining with a transversely slotted frame, the table having median rib, and spring-supported rolls, a rotary shaft having two heads, one arranged on each side of the rib, and provided with cutters.

Mr. John P. Cotaya, of New Orleans, La., has invented an improved device for attachment to the shutters of warehouses, storehouses, etc., to open the shutters automatically in case of fire, and thus allow the firemen to have access to the interior of the building.