THE THIRD RAIL SYSTEM ON THE NEW HAVEN RAILROAD.

The third rail system of electric traction is now in permanent operation on an important section of a leading steam railroad. The recent opening of the line from Berlin to New Britain and from New Britain to Hartford, while it is by no means the first successful operation of third rail traction, is notable as being its first application in a permanent way to the lines of a standard steam railroad.

The first extensive test of this system took place within the grounds of the World's Fair, at Chicago, where its operation was very satisfactory. It was then adopted on the elevated roads of Chicago, where it has given reliable service. The Brooklyn Bridge trustees decided that it was adapted to the requirements of bridge traffic, and laid a third rail on the outside of the tracks. The equipment has given a good account of itself, especially in the switching operations at the terminal stations.

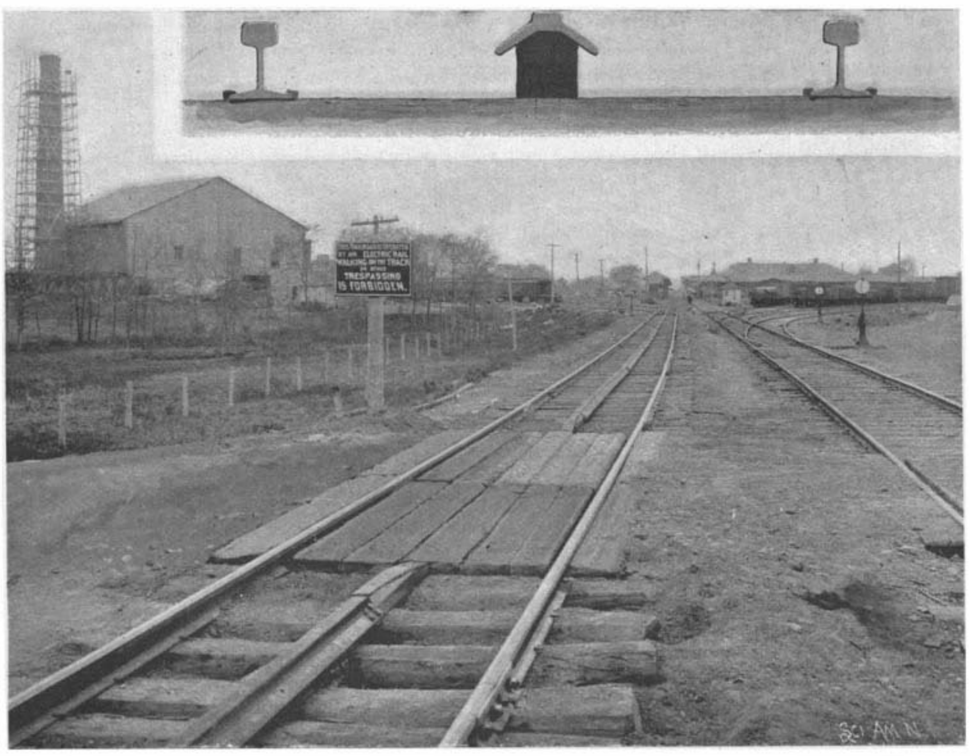
It is stated by Col. N. H. Heft, chief of the electrical department of the New York, New Haven & Hartford Railroad, who has afforded us every facility in the preparation of the present article, that the probability of electricity entering largely into the operation of steam railroads was suggested to the directors by Mr. Clark in his annual presidential report made in 1891. It was natural that the attention of this company should be turned to the question of electric traction, for the reason that their passenger traffic was being exposed to severe competition from the network of suburban and interurban trolley lines which have sprung up throughout the country served by the New Haven road. Fully one-half of the gross receipts of this road is realized from passenger traffic, and a large proportion of this is obtained from local traffic, of a character for which suburban trolley car service has most attraction.

The first step taken by the company was to form an electrical department, and give orders for the electrical equipment of a stretch of their road which runs from Nantasket Junction to Pemberton, Mass. This equipment, which is commonly known as the Nantasket Beach line, was put in operation in 1895. Overhead conductors were used and the experiment was highly successful. The company then determined to test the third rail system of transmission, and a trial line was laid down in 1896, when an additional 3½ miles of road was placed in service. The operations at Nantasket were regarded by the company as being experimental and preparatory to a further extension of the system. The results were so promising that it was determined to apply the system on a larger and more permanent scale, embodying in the new line the results of previous experiments.

The equipment which has recently been put in operation is applied to two lines of steam railroad, one extending from New Britain to Berlin and the other from Hartford to New Britain, the total length of the line from Hartford to Berlin being 12·3 miles.

The power station has been built with a view to its enlargement as the electric equipment is extended. The building shown in the accompanying engraving is 106 feet wide by 117 feet in length, the end on which the extension will be added being temporarily walled in with wood planking. The present building contains two stories in the front devoted to the engine and generators, etc., and a boiler room in the rear extending the full height of the building. A 1,200 horse power engine is already in place and the foundations have been built for a second. There is room in the building for a third engine when the extension of the line calls for it. Further details regarding the engines and the boilers will be given in a later issue. The engine is direct connected to a General Electric Company's standard 10 pole, 850 kilowatt generator of the well known ironclad type, which furnishes current at 600 volts no load and 650 volts full load.

The third rail conductor is of a special section rolled for this purpose. It resembles somewhat a flattened A, the flanges forming a protection to the insulating blocks upon which it is laid. The rail is heavy, weighing ninety-three pounds to the yard, and it is found that wooden blocks saturated with insulating material give excellent service, and three to the rail are found to be sufficient. The flanges of the rail come within 1½ to 1⅝ inches of the top of the ties, the head of the rail being one inch higher than the main rails. It will be seen that this conductor is carried much lower than that on the Nantasket line, the difference being due to the height of the main rails. The ends of the rail are bonded by sheet copper plates ⅛ inch thick, 4½ inches wide and 12 inches long, which are held against the under side of the flanges at the rail ends by iron plates. The latter are bolted to each rail by sixteen bolts, eight for each plate, the copper bonds being sandwiched between the iron plates and the rail. The capacity of each bond is 900,000 circular mils, the double bond having more than the carrying capacity of the rail itself.



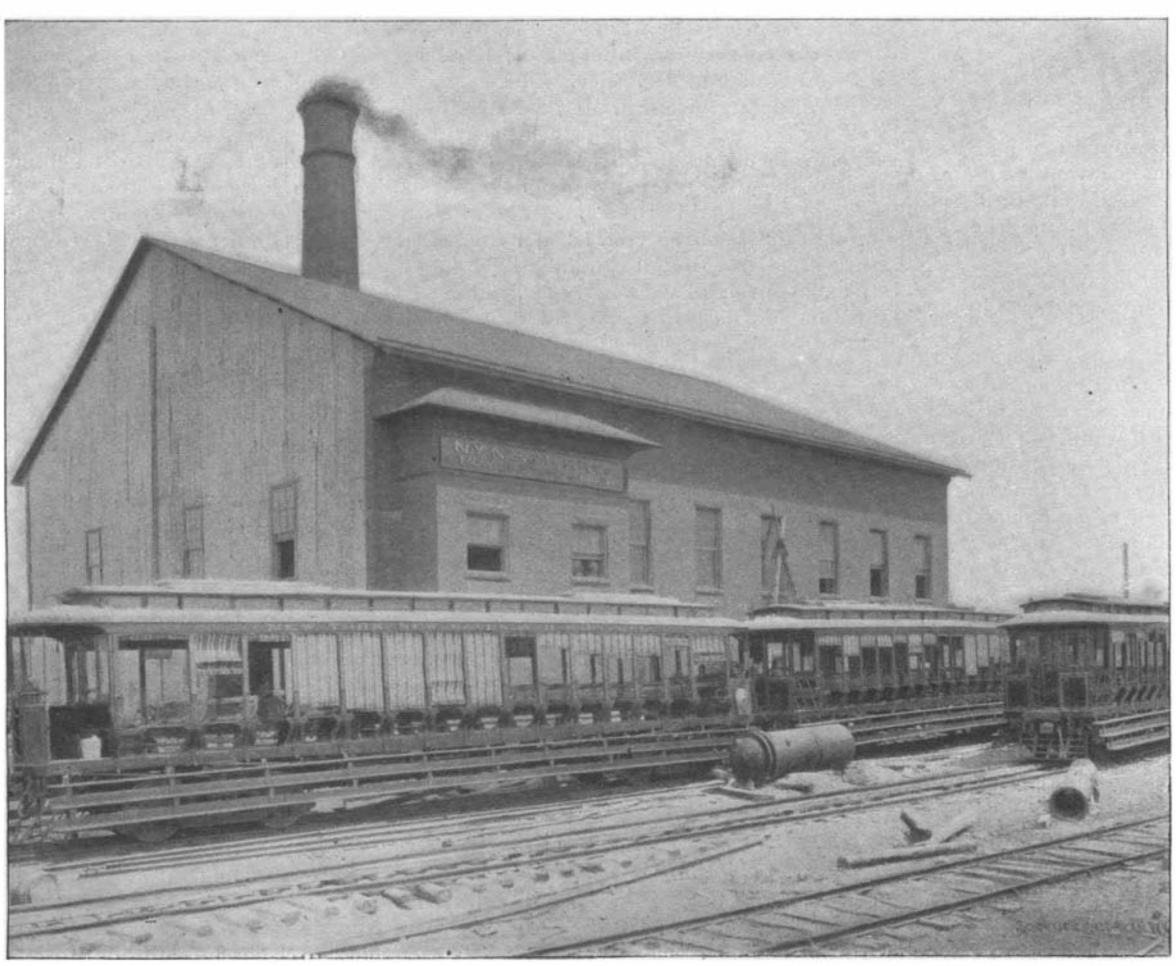
THE N. Y., N. H. AND H. RAILROAD THIRD RAIL EQUIPMENT—VIEW OF ROAD CROSSING AND CROSS SECTION OF TRACK.

On the whole line there are twenty-two grade crossings, at each of which the third rail is replaced by underground cables of 850,000 circular mils. The cables are drawn into creosoted wooden conduits filled with an insulating material made of residuum and asphalt. The conduits are laid in creosoted wooden troughs filled with the same material, which are buried in the earth. Special attention has been paid to the return circuit, as it is the opinion of Col. Heft that the importance of this element is too often overlooked in the construction of electric roads. The company has put in leaf bonds of 550,000 circular mils, and these are attached to the base of the rail in preference to the web, and are secured by wedge fastenings. In order to prevent any interruption to the current when a train is passing over switches and crossings a shoe is provided on the rear car of a two-car train. This insures that connection will be made by the shoe of the motor car before the shoe of the second car has entered the gap.

The general appearance and mechanical details of the open cars are shown very clearly in our front page and other illustrations. They are 51 feet long, and are provided with sixteen seats, each of which can accommodate six passengers, the capacity of a two-car train being, therefore, 192 passengers. The current is taken from the third rail by means of a sliding contact shoe, which consists of a simple cast iron plate 5 inches wide by 12 inches long, weighing about 12 pounds. It is carried by an insulated support, to which it is fastened by jointed links, which allow it to bear upon the rail at all times with a pressure due to its own weight. Each train is made up of a motor car and a trailer. Each motor car has two 125 horse power motors, both of which are mounted upon one track, as shown in the accompanying engraving, in which the casing has been removed to show the gearing of the forward motor.

It can well be understood that in a service of this kind, where the high speeds which are customary in the steam service are to be regularly made, special attention had to be given to the question of braking. As hand-operated brakes were out of the question and steam was not available, it was determined to equip the motor cars with a separate electrically driven air brake plant. The details of this successful and highly creditable work are shown in the upper front page engraving, and its position on the front platform is shown in the side view of the car.

The two cylinder, single acting compressor is driven by a direct connected 10 horse power motor. The compressor has a capacity of 52½ cubic feet of air per minute under a gage pressure of 90 pounds per square inch. The speed is 250 revolutions per minute and the consumption 16 amperes at 600 volts. The standard Westinghouse air brake equipment of the company is used on the cars, and it is controlled by the usual engineer's valve, as shown in the engraving. One of the most ingenious features is the automatic valve and switch for starting and stopping the compressor, of which a sectional view will be found on the front page. By reference to the engraving it will be seen that air is led in above a small piston, which works in a vertical cylinder and is pressed upward by a coil spring. The spring is set at the working pressure of 90 pounds to the square inch. As soon as the air pressure exceeds 90 pounds, the piston is forced down, carrying with it a small vertical valve stem and allowing the air to pass up into a small cylinder located beneath the electrical switch which controls the motor of the air compressors. Here it pushes up a piston which throws over the electrical contacts and opens the switch. As the air pressure falls it releases the lower piston, which rises to its normal position. As it rises, a catch on the piston rod lifts the small lever shown



THE POWER HOUSE AT BERLIN.

SCIENTIFIC AMERICAN

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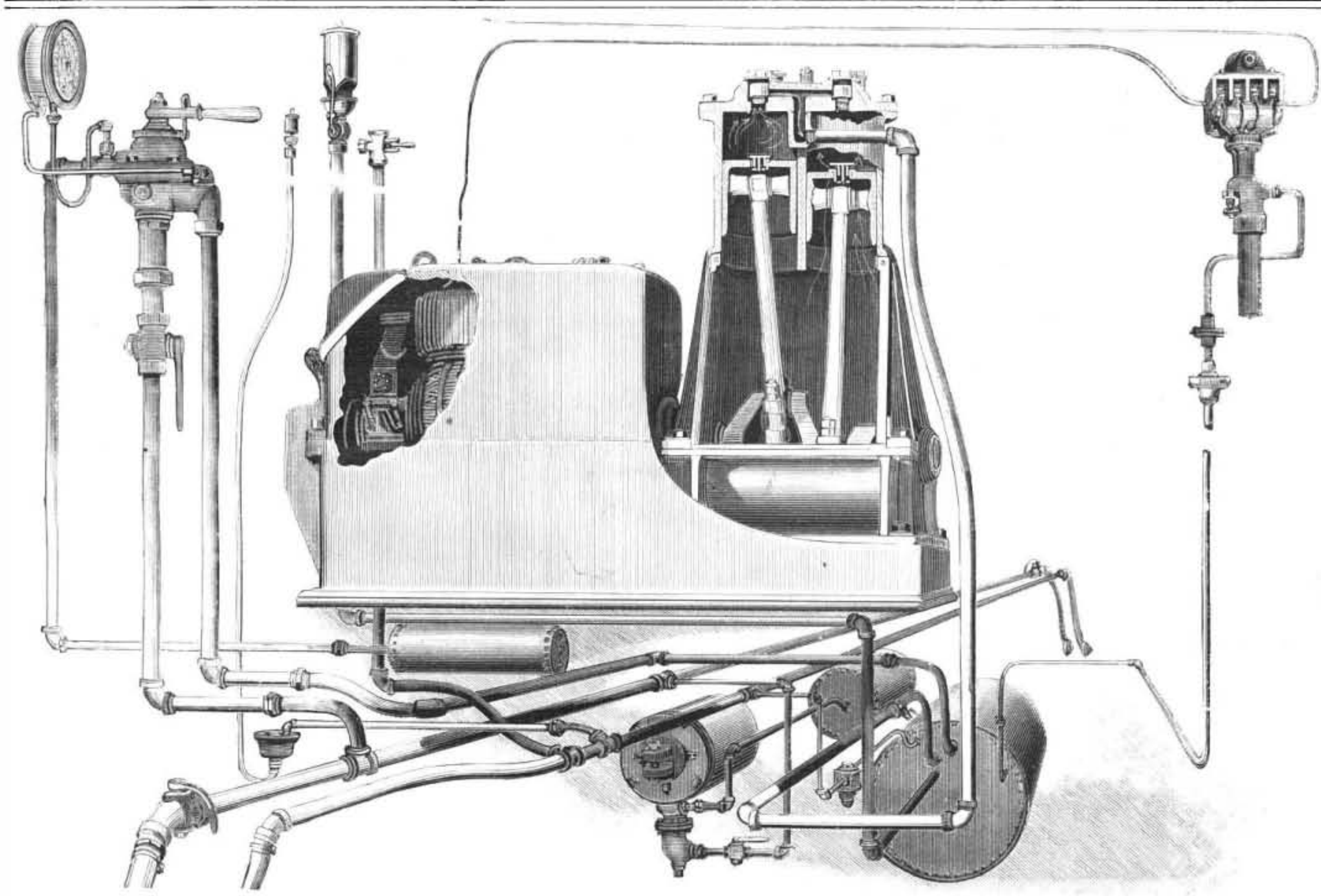
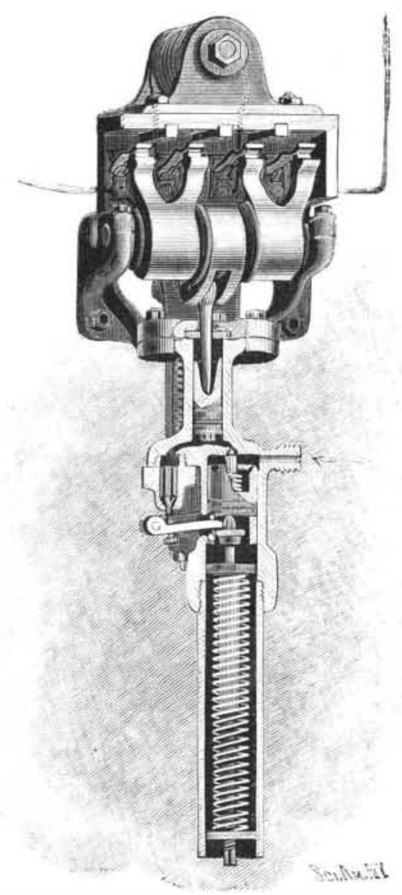


PERSPECTIVE VIEW OF AIR BRAKE EQUIPMENT.



AUTOMATIC AIR VALVE AND SWITCH.

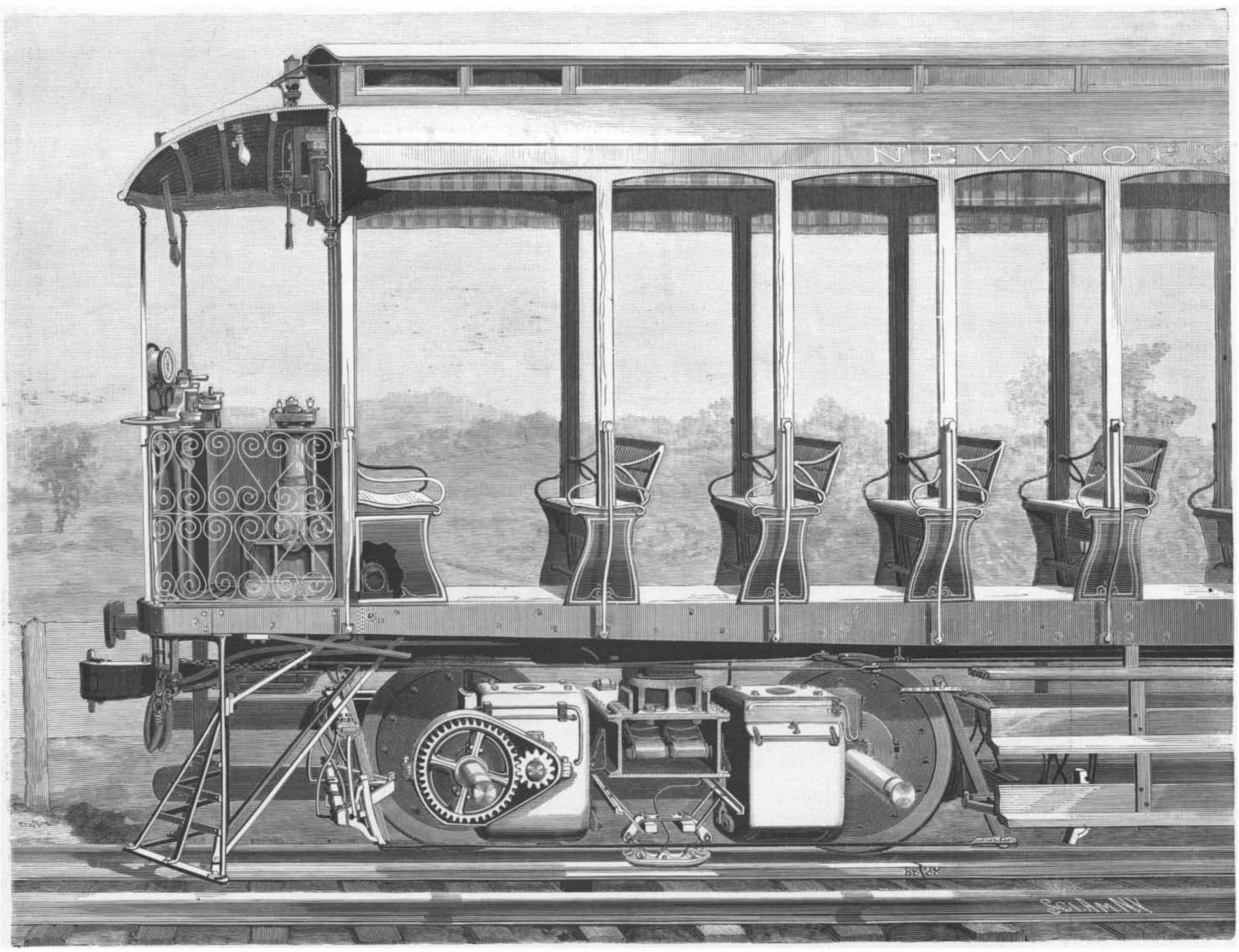
TRAIN CONSISTING OF A MOTOR CAR AND ONE COACH RUNNING AT FULL SPEED.

THIRD RAIL ELECTRICAL EQUIPMENT OF THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.—[See page 376.]

to the left and opens a release valve below the switch cylinder above mentioned. The upper piston now falls and closes the switch, thereby starting the motor of the air compressor. The device has given complete satisfaction. It may be set to work at from 45 to 100 pounds pressure, and on a variation of from 5 to 7 pounds pressure.

The air compressor is placed, as shown, on the front platform of the car to the left of the motorman. In front of the compressor is the wheel of the hand brake, and conveniently arranged in front of the motorman are the pressure gage, the engineer's air valve and the controller. The lever for operating the air chime whistle passes through the hood just above the motorman's head. Beneath the hood on the front of the car above the door are the current breaker and the main switch. On the front rail of the platform there is also a conductor's signal whistle.

The current passes from the shoes through flexible copper cables to the circuit breakers. After passing through these it is led through a lightning arrester and a "kicking coil." It then divides, passing to the controllers on each platform. At each controller it passes through a magnetic blow-out coil, and is led by cable to the resistance situated in the center of the car. It then returns through the resistance contacts to the controller cylinder and the motors.



THIRD RAIL SYSTEM ON THE N. Y. N. H. & H. RAILROAD—FRONT END OF MOTOR CAR.

The danger to the public from the use of the third rail is considerably less than is popularly supposed, and in view of the precautions which have been taken to safeguard the ignorant or unwary, the chance of accident is very small. At the Berlin and Hartford stations the third rail section is fenced in on both sides. At New Britain, where the two lines converge, a switchman's tower has been built in the Y where the roads converge. Underground cables connect the rail where it enters the station with a switchboard in the tower. When a train has stopped in the station the third rail is cut out, and it is not thrown in until the train is ready to start again.

When the road which has now been electrically equipped was operated by steam, eight trains a day were run each way between Hartford and New Britain, and fourteen trains a day between New Britain and Berlin. Under the present system two-car trains will be run every half hour between Hartford and New Britain from six in the morning till twelve at night. The run of 9·3 miles will be made in something under twenty minutes, and the fare will be ten cents each way. Sixteen trains a day will be run between New Britain and Berlin, a distance of three miles, the fare being five cents for a single trip.

We reserve further particulars and illustrations of this interesting plant for a later issue.

How to Make an Actinometer.

Make, in any way you like, some apparatus by which you can make a strip of sensitized paper pass behind a narrow slit in some opaque material. An old watch case can easily be made to do this with a little fixing up. Then place a circular piece of any P. O. P. in the watch case, so that on turning the handle, or by other means, according to the way you have made it, fresh portions of the paper are brought before the slit, till the whole piece is used up. Then you have to find the correct exposure, with a certain stop, and a certain bromide paper. This you can easily do by making trials on small strips of the bromide paper. While you are exposing the paper for the correct time, hold the watch case with a fresh piece of P. O. P. under the slit in the light for the same time as you expose the bromide paper. Then take the watch case and paint by the side of the slit, or on each side of it, with water or oil colors, a color to match the tint of the paper. All you have then to do, when you wish to make an enlargement, is to expose it for the same time as the P.O.P. takes to go to the match tint and you will have it correctly exposed. This simple piece of apparatus does away with the difficulty of judging the light for enlarging. With a little adaptation, it can also be used for an actinometer for ordinary outdoor photography. For you can find the correct exposure with a certain stop, and the plate you usually use matching the tint on the paper as before or else using the same tint as you used for enlarging, and suiting the stop to the exposure. Most plates of the same brand are often compared in speed by their makers (as for instance the Ilford), and so you can tell the exposure necessary for any of the same make. If you do not use plates of the same maker, you can buy at almost any large dealer's a small list giving the comparative speeds of all the well known dry plates in the market. For using the actinometer you have to hold it in the shade if you are taking a landscape, or, indeed, almost every kind of subject, for clouds are the only subjects the exposure for which you may find by holding the paper in the direct sunlight.—Photographic News.

Costliest of Fish Hooks.

The most costly of fish hooks are those for tarpon. They are sold at retail at various prices from $1 a dozen for bare hooks up to $7 a dozen for hooks fitted up. The standard tarpon hook is four inches in length. Some tarpon fishermen prefer to mount their own hooks. They have ideas of their own as to the best way and the best materials. A swivel is always used. Some of the hooks that are sold fitted up have snells of German silver chain. Sometimes laces of rawhide or porpoise skin are used for snells. Some hooks are fitted with snells of piano wire two feet long, made in three lengths of eight inches each, linked, to prevent kinking. Fitted up tarpon hooks that are sold at $7 a dozen are provided with thirty-six inch braided or plaited linen snells, wound for two-thirds of their length, from the upper end downward, with copper wire. The tarpon swallows the hook and its teeth are brought up on the snell, where it is protected by the copper wire. Sometimes a shark takes the bait. It is desired to lose the shark without the trouble of hauling it in and casting it off, and the shark is likely to free itself by biting through the unprotected lower third of the snell.

While the tarpon hook is the costliest of hooks, there are flies that sell for more. There are some salmon flies that retail as high as $9 a dozen.—New York Sun.

IN view of the anticipated exhaustion of the quarries of lithographic stone at Solenhofen, Bavaria, the use of aluminum as a substitute in engraving has been suggested, and the German journal Neueste Erfindungen und Erfahrungen enumerates the qualities that may render that metal suitable for the purpose. The National Druggist, of St. Louis, points out, however, that there are lithographic quarries in Tennessee which can furnish immense quanties of stone fully equal, for all the purposes of engraving, to the very best Solenhofen.

Science Notes.

M. Levassor, who was widely known in connection with the horseless carriage movement, died recently, at the age of 54. He drove the winning vehicle from Paris to Bordeaux and back in the famous race.

There is certainly something odd about the element cerium, says the Progressive Age. M. Schutzenberger, a well-known French chemist, has shown the Academie des Sciences that monazite sand yields three different ceriums, agreeing in spectroscopic character and in the ordinary reactions of cerium, but not in all chemical respects, and having the respective atomic weights of 138, 148 and 157.

The buildings of the New York Botanical Garden, with approaches and surroundings, cover twenty-five acres. The pines and other coniferous trees will occupy thirty acres; seventy acres will be devoted to deciduous trees; twenty-five acres will be left as a natural forest; shrubs and small trees will occupy fifteen acres; eight acres will be devoted to herbaceous ground for scientific arrangement; the bog garden will occupy five acres; lakes and ponds six acres; and meadows ten acres. The museum building will have a frontage of 304 feet, with two wings, each 200 feet in length.

Mr. Oliver C. Farrington writes to Science, sending a reproduction of a school geography's picture of Popocatepetl, and by the side of it an outline of the actual mountain. The difference is quite startling. The slope of Popocatepetl as found by Mr. Farrington to be never more than 30 degrees, while the picture represents a snow-capped peak with a slope of from 40 to 50 degrees. "A tall cross, such as no traveler in Mexico ever saw, and luxuriant palms, such as never grow at the altitude from which Popocatepetl can be seen," furnish a fitting foreground for a picture so unfaithful to the literal facts of the region.

A fur seal has none of the altruistic instincts of some other animals, for she will never feed any pup but her own, says the Popular Science Monthly. Not a very affectionate mother at best, she yet unerringly knows her nurseling's voice, and he in turn learns to find her. When they meet and recognize each other at meal time, it is easy to see that they belong together. Her duty done, however, she lets it shift for itself till the next feeding time. She instantly knows any little hungry intruder that is stealing up to her to get a meal on the sly. She cuffs and bites, until the starveling, intimidated, slinks away to die. These orphaned younglings are the fruit of the indiscriminate "pelagic" sealing. Their mothers being killed, and they unable to obtain another nurse, they perish by the thousands. A United States report estimates the number for 1896 at 20,331.

Considerable misconception prevails as to the manner in which the ostrich runs, says the Zoologist. It seems to be still generally held that when running it spreads out its wings, and, aided by them, skims lightly over the ground. This is not correct. When a bird really settles itself to run, it holds its head lower than usual, and a little forward, with a deep loop in the neck. The neck vibrates sinuously, but the head remains steady, thus enabling the bird, even at top speed, to look around with unshaken glance in any direction. The wings lie along the sides about on a level with, or a little higher than, the back, and are held loosely just free of the plunging "thigh." There is no attempt to hold them extended or to derive any assistance from them as organs of flight. When an ostrich, after a long run, is very tired, its wings sometimes droop; this is due to exhaustion; they are never, by a running bird exerting itself to the utmost, held out away from the sides to lighten its weight or to increase its pace. But the wings appear to be of great service in turning, enabling the bird to double abruptly even when going at top speed.

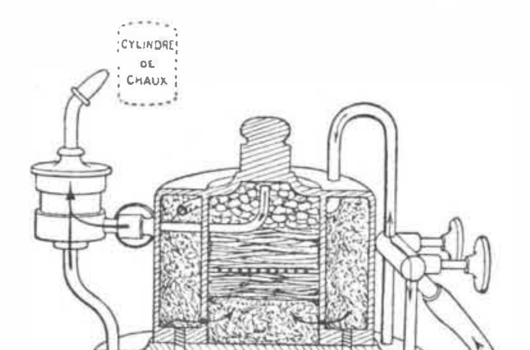
According to the Bulletin of the Belgian Astronomical Society, says the Literary Digest, recent experiments in Styria on the breaking up of hail storms by the firing of guns have met with remarkable success. "M. A. Stiger, burgomaster of the city of Windisch-Feistritz, and proprietor of extensive vineyards, having replanted a part of his land on the Schmitzberg, took the following precautions to preserve the young plants from hail storms, to which this region is exposed. Over an extent of about six kilometers (3·7 miles), at elevated points, he built six iron structures, each holding ten large mortars; at some distance from each of the structures he located a hut to be used as a powder magazine. M. Stiger then organized a body of volunteers composed of the inhabitants of the neighborhood, so that each post could in case of necessity be manned by six persons. In the course of last summer the residents of Windisch-Feistritz were able to make their first experiment. Masses of black and threatening clouds approached from the neighboring mountains. At a given signal the discharge of the sixty mortars began. After some minutes the clouds could be seen to pause, break up and disperse without letting down either hail or rain on the protected region. The experiment was repeated in the course of the same summer, taking place six times and always with the same success. The efficacy of the discharge extended over about one square mile."

THE PROBABLE CAUSE OF THE GREAT PARIS FIRE.

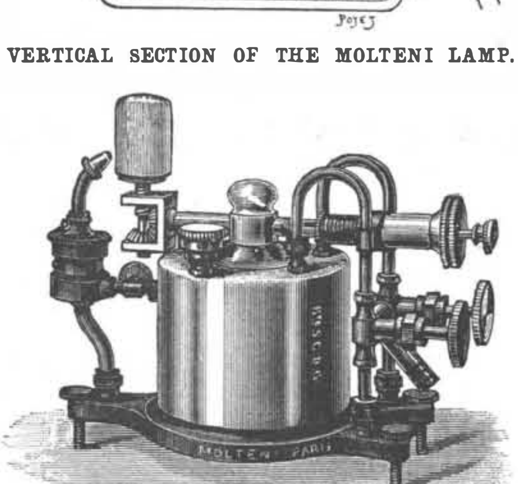
If the most contradictory, most fantastic and uselessly complicated theories have been conceived regarding the way in which the fire of the charity bazar at Paris could have arisen in the cinematograph room, it is surely because the action of the lamp which was used to project the images on the screen was not sufficiently considered.

The management of the cinematographic performances of the charity bazar had at its disposal neither electric light nor a gas supply for the oxyhydrogen flame. They had then to resort to a Molteni lamp, whose flame can be fed indifferently, either with ether or with gasoline. Our cuts represent the aspect of the externally visible parts of the lamp, and also a vertical section.

Such a lamp consists first of a cylindrical bronze box, ten centimeters in diameter, filled with some absorbent, such as pieces of pumice stone or felt, intended to store and keep the liquid used. Since the apparatus is completely stuffed with such material, no space in the interior can, by permitting the collection of free liquid, form a reservoir for explosion in case the flame should beat back. This is simply the principle of the Pigeon lamp, and of all lamps for home use with mineral fuel. The only difference lies in the method of bringing the combustible fluid to the jet where the flame is to burn. In the Molteni lamp, instead of a wick acting by capillary attraction, we have a stream of oxygen, provided from a cylinder which supplies it under the required pressure. The oxygen passes



VERTICAL SECTION OF THE MOLTENI LAMP.



THE MOLTENI LAMP FOR ETHER AND OXYGEN.

through the box, which, for saturating purposes, is divided into two concentric compartments, circulates through the absorbent, saturated with gasoline or ether, and, charged with inflammable vapor, escapes by a blowpipe. After passing through the saturator at the top, as shown by the curved pipe in the upper illustration, the enriched gas is mixed again with a second stream of pure oxygen coming directly from the cylinder, and shown in the lower pipe under the saturator, which, when ignited at the end of the blowpipe nozzle, produces a blue flame of intense heat. The flame, impinging upon the lime cylinder, heats it to incandescence at a temperature of 2,000° Centigrade, producing an intense light, equal to the well known oxyhydrogen lime light.

In using a lamp designed to burn the lighter mineral oils, greater precautions are required than those for ordinary kerosene oil.

The method of filling the Molteni lamp is to unscrew the stopper on the top, and slowly pour in 150 cubic centimeters of the liquid chosen. The lamp is then left to stand for some time, so that the absorption of the liquid may be as complete as possible. The lamp is then turned over, so that any liquid not absorbed, but freely running in the reservoir, may drain off to the last drop.

Should too much liquid be put in, when filling, there is a risk of its running over into the tubing of the lamp. Before filling there might be also some liquid left over. Finally, before lighting, it is necessary to let the oxygen pass freely for a while to dry the pipes, which might have kept some moisture.

The oxygen ether lamp—ether was used at the bazar—gives light for an hour and a half. Perhaps the one that caused the catastrophe on the 4th of May had worked beyond that time. The operators moved in a restricted space, they were unused to the locality, and hindered in their movement. Which of the precautions mentioned above did they omit? What accident, as commonplace as that which may happen in our kitchen any night, fell upon them? It is difficult to tell. Possibly as the ether in the saturator was used up faster than was expected, and as the light became weaker in consequence, the operators determined to shut off the oxygen and recharge the saturator with a fresh supply of ether.

Bearing in mind that the lime was still hot and had not been removed from its place and was quite near to the filling aperture, a drop of the ether might have spattered unnoticed on the lime and ignited.

Whether such was the case can never be known. Certain it is that those who knowingly allowed the storage of even a small amount of such an inflammable fluid as ether in such a place are open to censure.

On the other hand, the people who had raised those cardboard decorations, those hangings of light stuff, and those casements of varnished wood had not foreseen the placing there of the ether lamp. It is difficult indeed to learn just who was responsible for the catastrophe.—L'Illustration.

The Effect of Removing the Ends of a Magnet.

It is well known that when a magnet is cut so as to divide it into two parts, two complete magnets are formed, whose poles are arranged in the same way as in the large magnet before cutting. It has occurred to J. F. Smith to ascertain the effect of cutting from the ends of a wide thin magnet strips whose width is small compared with their length. His experiments are described in a recent issue of the Western Electrician, and are illustrated by diagrams showing the effect of removing the ends of the magnet in various ways. These experiments seem to indicate that when a wide thin magnet is cut or broken so that the part removed has a length greater than its width, the arrangement of the poles is different from that ordinarily obtained by cutting the magnet. On a consideration of the nature of the behavior of Faraday's lines of force, the explanation seems to be as follows: At the regions where the lines of force enter or leave the magnet the poles are located. Each line of force is a closed circuit running from pole to pole through the magnet, and making the return circuit through the air. When the magnetized strip of steel has got almost across, the lines of force are diverted from their usual path through the magnet, and are crowded together, the narrow portion joining the small strip at the end to the larger magnet. Since the strip furnishes a better path for the lines of force than the air in the gap where the metal is cut, the lines are thus shifted, so that they run lengthwise of the strip instead of crosswise. The lines of force then leave the strip at the ends or near the ends. When the small strip is being broken from the main strip, the lines of force leap across from the larger strip to that point of the small strip which is nearest the large one, and thus the formation of a separate pole begins. When they are completely separated, this lost point, at which the strips were joined, becomes a separate induced pole, permanent and of opposite kind to the adjacent pole of the larger magnet. Essentially the same thing takes place when the strip is cut from the sides toward the middle, the results being the formation of a north seeking pole at each end, while the consequent south seeking pole is induced at the middle, where the lines of force leap across from the larger magnet.

Is there any "Best" Time for Sleeping?

Does the time at which the sleep is obtained, provided it is sufficient in amount, make any change in the result? In brief, is there any truth in the old adage that an hour before midnight is worth two hours after midnight? I had an opportunity to make some study of this subject in my naval service during the late war. On shipboard, as is undoubtedly known to most of you, the ship's company—officers and men alike—stand four-hour watches day and night, and to get the required amount of rest are obliged to get their sleep irregularly; to so arrange it that the same man shall not be obliged to take early or late watches continuously, the "dog watch" of two hours is interpolated, thus adding to the irregularity. In watching the results for over two years I could never discover that the watch officers and the men were not as fully refreshed by their sleep as were the medical and pay officers, who stand no watch, and have hours as regular as those of any householder.—Dr. E. P. Colby, in the New England Medical Gazette.

IN 1896 there were imported into Germany 591,500 kilos of crude aluminum. Of these, 467,600 came from Switzerland, 55,000 from France, and 8,400 from Austria. In the first two months of the current year 138,900 kilos were imported, as against 65,900 for the corresponding month of the previous year. The importation of sheet aluminum also is rising, and the customs duties on the metal on the Swiss frontier have consequently been lowered.—Stahl und Eisen.