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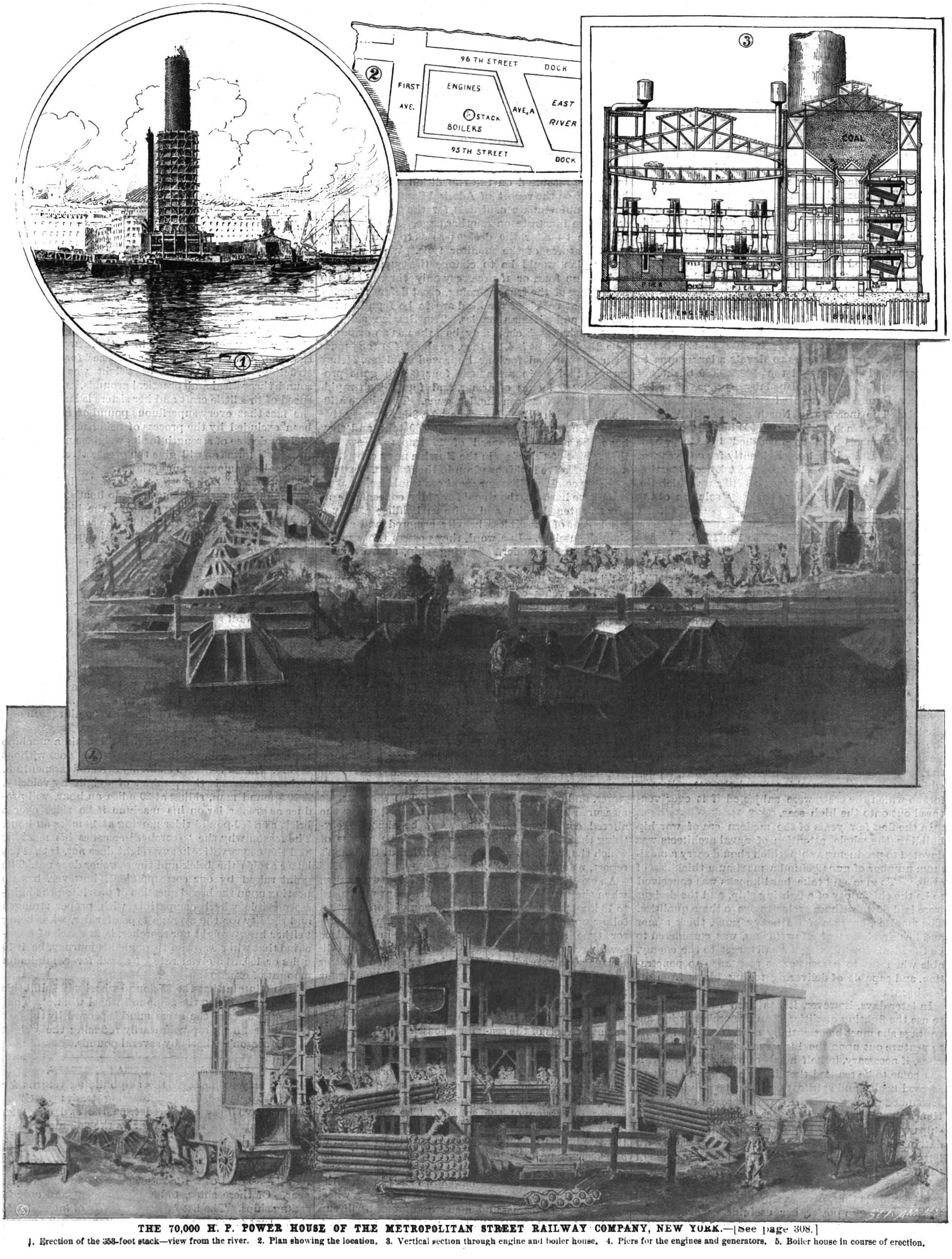
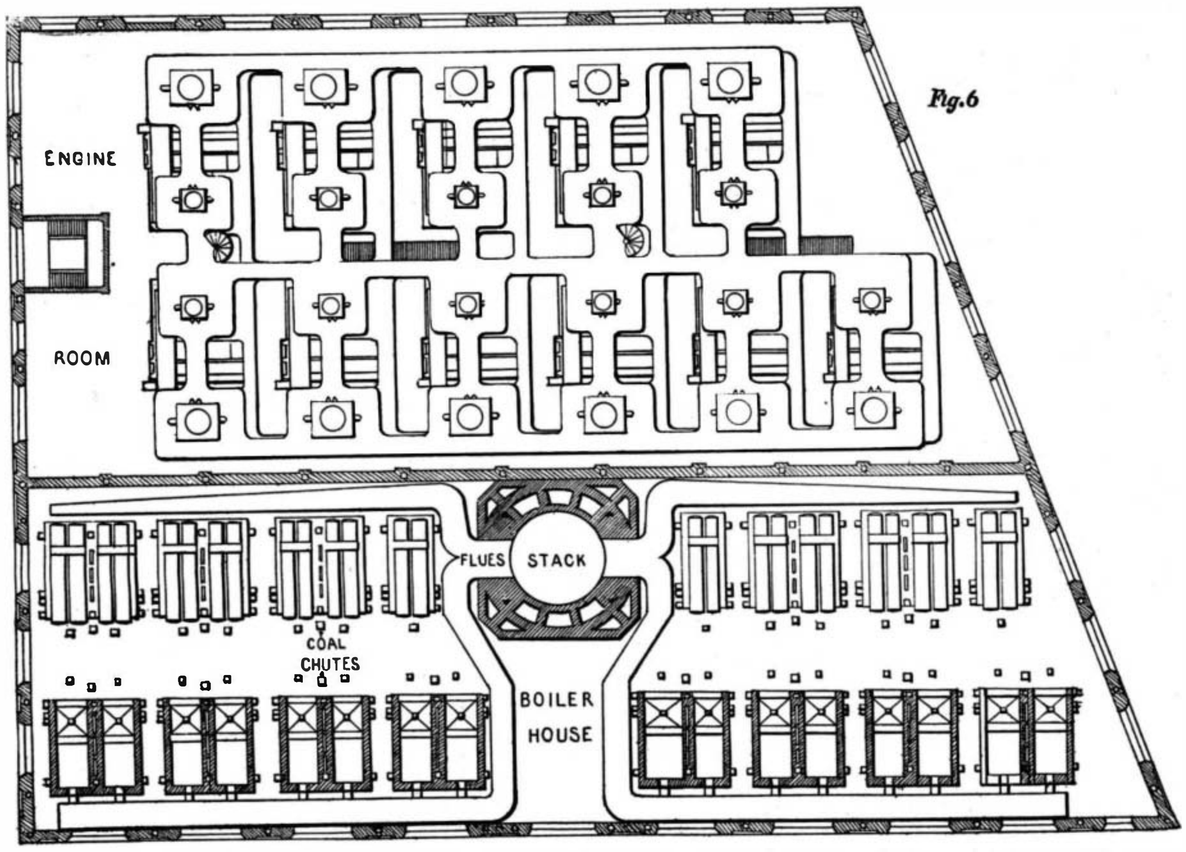


THE 70,000 H. P. POWER HOUSE OF THE METROPOLITAN STREET RAILWAY COMPANY, NEW YORK.—[See page 308.]

1. Erection of the 358-foot stack—view from the river. 2. Plan showing the location. 3. Vertical section through engine and boiler house. 4. Piers for the engines and generators. 5. Boiler house in course of erection.

THE MAMMOTH CENTRAL POWER STATION OF THE METROPOLITAN STREET RAILWAY COMPANY, NEW YORK.

We have from time to time referred to the remarkable system of street railways owned by the Metropolitan Street Railway Company, New York. In our issue of October 22 will be found an account of the extensive changes which are being made by the company in the way of substituting mechanical for horse traction on the 228½ miles of road included in the system. When the reconstruction which is immediately in hand has been completed, there will be a total of 90 miles of road worked by mechanical traction. In this will be included the cable roads on Broadway and Lexington Avenue, the underground trolley systems on Second, Fourth, Sixth, and Eighth Avenues, and on Fifty-ninth and Canal Streets, together with the use of compressed air motors on a few of the other crosstown lines. These are the changes at present under way; but it is intended, ultimately, to abolish the horse car altogether, and operate the whole system of railways electrically, except some of the cross-town lines, which will be served by compressed air motors if the latter continue to give satisfaction.

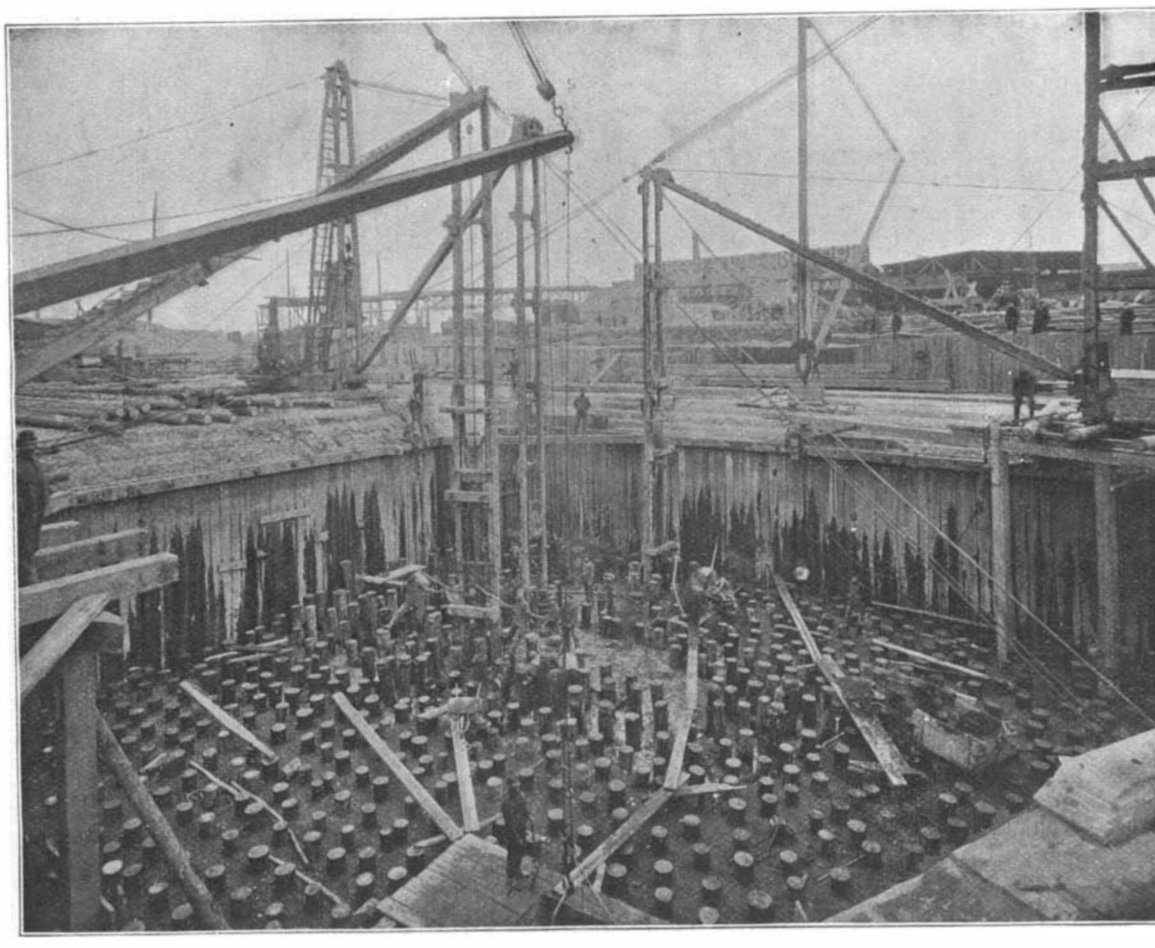


6.—PLAN OF THE 70,000 H. P. POWER STATION OF THE METROPOLITAN STREET RAILWAY COMPANY, NEW YORK.

At present the problem of supplying the increased demand has been met by increasing the capacity of the power stations at One Hundred and Forty-sixth Street and East Twenty-sixth Street; but, with a view to meeting the demand when practically all the lines shall have been electrically equipped, the company determined to erect one great central power station of sufficient capacity to supply the whole system.

The new buildings and plant, as might well be expected, are on a vast scale, the total capacity of 70,000 horse power being far in advance of any other aggregation of steam power in the world. The next largest power station in this country is that of the Brooklyn Heights Railroad, near the Navy Yard, Brooklyn, which has a maximum capacity of 15,000 horse power, and, as far as we know, this is at present the largest in the world. It is a curious fact, too little appreciated, that by far the most powerful aggregations are to be found in the engine rooms of the ocean liners, the "Campania" and "Lucania" having each indicated 33,000 horse power on their trial trips.

The site of the new power house is a block of ground lying, as shown in Fig. 2, upon the East River, between Ninety-fifth and Ninety-sixth Streets. In view of the enormous loads that had to be carried, and the fact that the material of the site consisted of made ground, mud, sand, and underlying gravel, it was decided to drive piling over the whole site with a view to securing an absolutely firm foundation. Accordingly, no less than 7,854 piles were driven, with an average penetration of 35 feet. They were then cut off to a uniform level and the soil was cleared away, leaving the heads of the piles exposed. Concrete was laid and carefully tamped around and over the piles and carried up to a level four feet above the point of cut-off. The finished site now presented a uniform concrete floor for the reception of the engine and boiler foundations.



7.—DRIVING THE 1,300 PILES FOR THE FOUNDATION OF THE 353-FOOT STACK. THESE WERE COVERED WITH A MASS OF CONCRETE 20 FEET IN THICKNESS.

The most striking object at the power house is the great smoke stack, which occupies a mid position between the engine and boiler rooms. It takes rank as one of the largest structures of its kind in existence. Though it is not so lofty as the great stack at the chemical works in Glasgow, which is about 450 feet in height, it is much more massive. The principal dimensions are as follows: Height, 353 feet; base, 55 feet square; outside diameter 80 feet above the ground, where the circular shaft commences, 38 feet 10 inches; diameter at the base of the neck, 26 feet 10 inches; the uniform internal diameter is 22 feet. The neck is 47 feet high and flares outwardly to a diameter of 35 feet. The stack consists of two distinct concentric shells, the inner shell being separated from the outer to allow the former to expand and lengthen under the action of the hot gases. The inner wall varies in thickness from 24 inches at the base to 8 inches at the top. It extends only to a height of 340 feet. The outer wall varies from 28 inches to 20 inches in thickness and extends the full height of 353 feet. It is stiffened by 12 vertical inwardly projecting ribs which extend radially toward the inner shell, but do not touch it. The ribs are 24 inches thick at the base and taper to 8 inches in thickness at the top. It will be seen that this construction gives great stiffness for a minimum amount of material. The inner flue is lined with 9 inches of firebrick up to the 85-foot level, above which the lining is 4½ inches in thickness up to the 115-foot level. Outside staging was used in erecting the stack up to the 125-foot level, and from there up it was entirely erected from the inside, as shown in Fig. 1, on the front page. The batter of the stack is at the rate of $\frac{5}{16}$ of an inch to the foot from the 80-foot to the 306-foot level, at which the neck commences. There are three large flue openings, one above the other, on the east and west sides of the stack, one at the level of each boiler floor.

There are 3,400,000 bricks in the stack and its weight is 8,540 tons. This weight is carried on 1,300 40 foot piles, which were driven to an average depth of 37 feet, and capped with a mass of concrete nearly 60 feet square and 20 feet in thickness.

By reference to the plan view and section, it is seen that the building, covering the entire block, which measures 201 by 270 feet, is divided by an east and west wall into two halves, the southern half being the boiler house and the northern the engine house, the former of which incloses the base of the great stack. The boilers, of which there will be 87 in all, will be arranged in two parallel lines on each of the three floors of the boiler house. They will be grouped in batteries of two each, and the maximum capacity of each boiler will be 800 horse power, making a total for the 87 of about 70,000 horse power. Above the boilers will be a coal storage bin, extending the full length of the house, having a capacity of 9,000 tons. The coal will be transported from the vessels at the dock to the bin by mechanical conveyors, and fed to the fronts of the boilers on each floor by chutes—handling being thus reduced to a minimum, and all the costly trucking which is necessary in power stations in the heart of the city being avoided.

Our illustration, Fig. 5, shows the work of erecting the boilers in progress. The gases will pass from the boilers into large horizontal flues which extend at the back of each line of boilers and are led round to converge at the flue entrance to the stack on each floor, as shown in the plan view, Fig. 6. One of the horizontal flues is seen in Fig. 5.

The engine room will contain the most magnificent group of engines and dynamos ever gathered in a single engine room. Set up in two long rows, the longer of which will extend for 200 and the shorter for 175 feet, will be eleven great cross-compound engines, each of 6,600 indicated horse power. The two high-pressure cylinders will be 46 inches and the two low-pressure 86 inches in diameter, the common stroke being 60 inches.

Each engine will drive, by direct connection, a 3-phase, alternating current generator, the armatures being placed on the main shaft in the center of the engine. The generators will operate at 6,000 volts and the current will be led to eight substations, conveniently situated with reference to the various lines, where static and rotary transformers will convert the current to a pressure of 550 volts, at which it will pass to the conductors. The illustration (Fig. 4) shows the massive character of the foundations for the engines and generators. Each of these piers measures 28 feet by 43 feet on the base and rises to a height of 29 feet above the concrete foundation. It took 450,000 bricks for each pier, or 4,950,000 bricks for the eleven engines. This added to the number of bricks used in the stack makes a total of 8,300,000 bricks for the foundations and stack alone.

Flags of Our Warships.

In the Equipment building at the New York navy yard there is a large manufactory where most of the flags of our navy are made. A large vessel carries forty American flags, and a smaller vessel almost as many. This does not include the fleet and international signal flags and the flags of other countries. There are three rooms in the Equipment building which are given up to flag-making. One of these is very large and the others on either end are much smaller. There are sewing machines, scissors, pincushions, and flatirons scattered around, so that the place does not look unlike a patriotic dressmaker's establishment. The flags are all made by women, though a few men help to cut out the stars and do the finishing. The wind and weather destroy flags so fast, and new vessels are put into commission so rapidly, that it is necessary to employ a number of people even in time of peace. The working hours, during the present war, were extended from eight o'clock in the morning to five o'clock in the evening to eight o'clock in the morning to ten o'clock in the evening. In one week eighteen hundred flags were made at the flag department, and this was when the rush of work was about over. The women cut all the square flags and the devices for them. The men cut the stars and bias pennants and put on the finishing touches and the heading through which the rope runs. They also put in the rope and stencil the flag with the size and nationality. There is a pattern for every flag, and the patterns are put away in paper bags when not in use. There are forty-four flags in a set of general signals used in the navy. These are in three sizes, while the regular flag is made in nine sizes. The largest flag measures 36 feet long, while the smallest is only 30 inches. Pennants are made up to 70 feet long. There are nineteen international signal flags and forty-three foreign flags which are made at the navy yard. There are no specialists in the workroom, and the women make any flag which may be assigned them. Of course it is necessary to have the flag exactly the same on both sides, which makes the work very difficult, especially with foreign flags, where the devices are in much detail. It may be truly said that some of the flags are fancy work on a Gargantuan scale. Here are wonderful landscapes, with round-faced suns with halos coming up from behind gay colored mountains over which run rainbows in four or five lines of outline or chain stitching, making a scene which would surprise an artist. Water must be indicated with some kind of embroidery stitch. Whole menageries of animals have to be represented on some flags. Flags of Costa Rica and San Salvador are considered the most difficult to make, says The New York Times, from which we glean our facts. The German flag is also considered difficult. The largest foreign flag is only 25 feet long. The largest sized American flags are made of 19 inch bunting and the narrow pennants are made of 4¼ inch bunting, which comes on purpose for them. Each flag which is made is measured on the floor over the seams and sewed to insure the exact measurement. There are metal pieces let into the floor and each one is marked for the different flags. It is an inspiring sight to see the manufacturing of these flags, and it seems curiously appropriate that women should be selected to make them. Preparing the colors for gallant warriors who go to fight seems to have always been an essentially feminine duty which has obtained from very early days. In the middle ages fair ladies embroidered the banners under which their knights fought, and although flag-making is now put on a business basis, it has been the work of the women in the United States since the first flag of the country was made down to the present day.

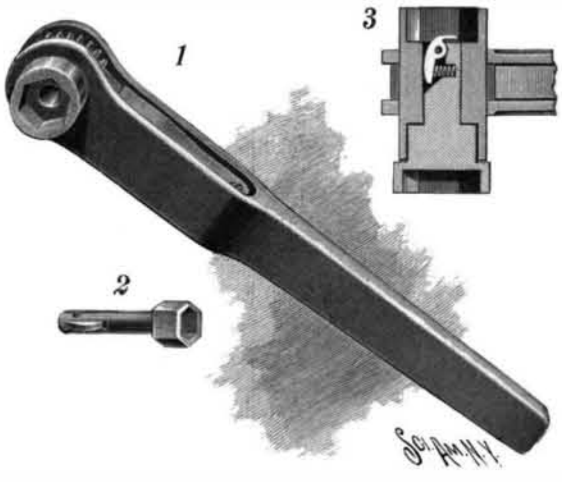
AN ATTACHMENT FOR SOCKET-WRENCHES.

In order to enable a socket-wrench to engage nuts of different diameters, a device has recently been invented which, when applied to a wrench, permits a wider use of that wrench than would otherwise be possible.

Of the annexed illustrations, Fig. 1 represents a ratchet-wrench in perspective; Fig. 2 the removable device or socket piece; and Fig. 3 an enlarged section of the socket-end of the wrench, showing the socket-piece applied.

The ratchet-wrench illustrated is provided at one end with a rotatable barrel having sockets in each end formed to engage nuts of a certain size. These two sockets are connected by a central aperture, circular in cross-section. The auxiliary socket-piece has a stem or shank, which, when the socket-piece is in use, is inserted in the central aperture of the wrench-barrel, as indicated in Fig. 3. On the stem a head is formed which coincides in shape with the socket of the wrench-barrel. The head of the socket-piece is provided with an auxiliary socket, the diameter of which may be smaller or larger than that of the wrench-socket. In Fig. 3 the auxiliary socket is shown projecting from the wrench-barrel to engage nuts of a diameter larger than that of the wrench-socket.

In order that the socket-piece may not be displaced from its position, a spring-pressed friction-block is pivoted in a slot formed in the end of the stem of the socket-piece. The block being pressed against the barrel of the wrench, holds the socket-piece with a



HAGGERTY'S ATTACHMENT FOR SOCKET-WRENCHES.

force sufficient to prevent its dropping out. in whatever position the wrench may be placed.

The attachment forms the subject of a patent controlled by J. Henry Haggerty, of 50 South Street, New York city.

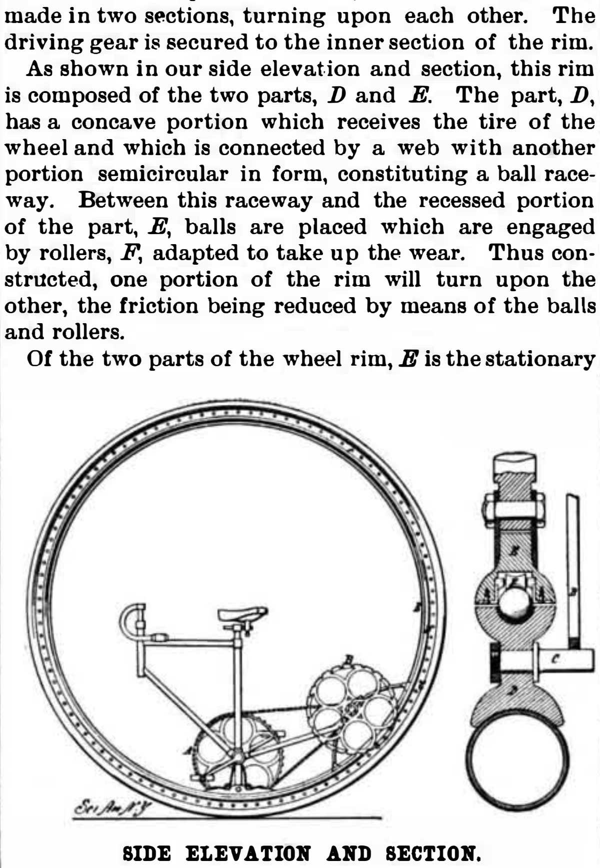
A UNICYCLE OF NOVEL FORM.

In the accompanying engraving we have illustrated a unicycle which, by reason of its novel construction, has attracted not a little attention.

The main feature of this unicycle is found in the formation of the spokeless wheel, the rim of which is made in two sections, turning upon each other. The driving gear is secured to the inner section of the rim.

As shown in our side elevation and section, this rim is composed of the two parts, *D* and *E*. The part, *D*, has a concave portion which receives the tire of the wheel and which is connected by a web with another portion semicircular in form, constituting a ball raceway. Between this raceway and the recessed portion of the part, *E*, balls are placed which are engaged by rollers, *F*, adapted to take up the wear. Thus constructed, one portion of the rim will turn upon the other, the friction being reduced by means of the balls and rollers.

Of the two parts of the wheel rim, *E* is the stationary



SIDE ELEVATION AND SECTION.

THE UNICYCLE IN OPERATION.

section and *D* the traveling section. The web of the traveling section, *D*, is provided with pins, *C*, extending horizontally from one side.

By means of the pedals, the rider drives the sprocket-wheel, *A*, the motion thus produced being transmitted by means of a chain and small sprocket-wheel to the drive wheel, *B*, slotted to engage the pins, *C*, of the traveling section, *D*.

The drive wheel, *B*, and the small sprocket-wheel are mounted on a single shaft moving in a slot concentric with the wheel rim. The shaft is connected with the seat mast by links, the forward ends of which receive the ends of the pedal shaft. By throwing his body toward the front, and thus bringing his center of gravity forward, the rider, it is claimed, is relieved of much of the work necessary to drive the wheel. The movement of the saddle naturally produces a corresponding movement of the drive wheel shaft in its slot. The inventor states that the wheel may be steered by inclining the body to the right or to the left.

The unicycle has been patented by Vernon D. Venable, of Farmville, Va., and has been in actual use for two months.

The Measurement of Sunshine at Health Resorts.

Jones (Lancet) has been measuring the actinic value of the sunshine, in summer and winter, in London and at Llangammarch Wells, a mountain resort in Wales, where the air is particularly pure and clear. He found that the actinic value of the sunshine in the latter place was in an hour of a summer's day from three to five times that of London under similar conditions of clear or clouded skies. In the winter the difference was not so marked, but the Wales sunlight was about twice as strong as that of London. A comparison with the results of similar tests made in the high Alps shows that the air may be just as pure in a mountainous district or far less lofty elevation. These tests are essentially a test of the purity of the air, as the amount of heat in the sun's rays has no effect upon the result. The method employed is briefly as follows:

A solution of potassium iodide is prepared containing 20 grammes to the liter of water; also, a solution of pure sulphuric acid, 11·6 grammes to the liter of water; and a third solution in which a liter of water contains 0·39 gramme of powdered arsenious acid and 1·5 grammes of potassium bicarbonate. To make a test of the sunlight, 10 cubic centimeters of solution No. 1 and an equal amount of No. 2 are placed together in a glass stoppered bottle on a white porcelain plate, and exposed to the action of the sunlight. At the end of an hour the bottle is removed and enough sodium bicarbonate is added to it to just neutralize the acid. The bottle is then placed under a burette containing the solution of arsenious acid, and the latter is run in until the color of the iodine is completely discharged. The results are expressed in milligrammes of iodine liberated per 1,000 cubic centimeters of solution used. Since in practice 200 cubic centimeters of the mixed solution are used, the results obtained were multiplied by five to bring them up to the accepted standard.

Sunlight has a well known inhibitory effect upon the life of pathogenic organisms. Direct sunlight will kill tubercle bacilli in a few hours or perhaps in a few minutes; whereas they will live for days if exposed to a very strong diffused daylight. The exhilarating effect of a burst of sunshine in the spring is probably not due to mere luminosity, but to an increased actinic action, a chemical action which we cannot very well explain, but which every one feels. In estimating, therefore, the value of a health resort, the amount of this actinic value in the sunshine ought to be taken into account, no less than the number of days upon which the sun shines during the month or the year.

The Mitis Patent Sustained.

The United States Circuit Court of Appeals on October 21 affirmed the decision of Judge Acheson in the United States Circuit Court at Pittsburg, sustaining the Mitis patent for the use of aluminum in the manufacture of steel ingots and castings. The litigation has lasted nearly four years, suit having been brought by the United States Mitis Company against the Carnegie Steel Company, to restrain the latter from alleged infringement of patent. The Carnegie Company appealed on decision of the lower court and was enjoined from using the patent, and now that the Court of Appeals has upheld that finding, it is said that the Carnegie Company has taken out a license under the patent and made settlement for the past infringement.

Oscillation of the Eiffel Tower.

According to a report to the Academy of Sciences in Paris, by Colonel Bassot, the Eiffel Tower is subject to variations of inclination. He thinks that this is only due to the contraction and expansion of the enormous mass of iron caused by the changes of temperature. From sunrise to night the difference to and fro amounts to 20 centimeters, but the stability and strength of the iron structure are not influenced thereby.