EXHIBIT OF BRUSH ELECTRIC COMPANY.

Near the southwestern corner in the Electricity building, at the World's Columbian Exposition, is a small staff structure of Greek architecture, apparently built of the purest Italian marble. This structure is surrounded by generators, dynamos, motors and a variety of electrical apparatus displaying all the manufactures of the Brush Electric Company, of Cleveland, Ohio, while the structure itself serves as the office of this company. A general view of this exhibit and of the structure is seen in our first page illustration.

The lighting of this office is one of the prettiest pieces of interior illumination at the Exposition. The room is circular in form, with a diameter of eighteen feet, and with a semicircular domed ceiling. In the center is a column rising through the ceiling. The entire interior is richly colored, and the domed ceiling is so painted as to give it a cloud effect, with a deep blue sky background. An artistic cornice marks the joining of the wall with the ceiling, and the incandescent lamps that furnish the light for the room are concealed behind this cornice and out of the line of vision. There are altogether fifty-two lamps used for this purpose, connected to four circuits, so that the amount of light can be readily regulated, as is frequently required in theaters and other large halls This plan of lighting was devised by Mr. I. R. Prentiss, of the Brush Company, and as adapted to this room has twelve lamps on two circuits and fourteen on the other two. By this manner of illumination there is no need of large resistance coils when the amount of light is reduced, and there is a corresponding saving in the amount of power required when a lesser amount of light is used. The only reflector used is a piece of tin on the inside of the cornice. The rays of light, as shown in the illustration, are thrown on the domed ceiling, and from there diffused throughout the room, giving an exceedingly bright yet soft, mild light that is not in the least trying to the eyes.

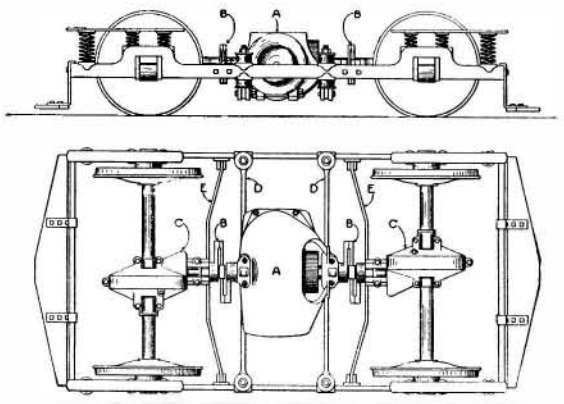
The Brush Company is known the world over for its arc lighting apparatus, and all systems of arc lighting now used are outgrowths of the inventions of Mr. Brush. This is the pioneer company in arc lighting, and it is a remarkable fact that the first Brush dynamo, built in 1876, an illustration of which is given, does not differ, except in unimportant features, from the very last Brush dynamo shown in the lower left hand corner. The chief difference is that the early machine had a Gramme armature, while now a laminated iron core armature is used and open coils. This latest dynamo is the largest arc dynamo ever constructed in this country, and probably in any other. It has a capacity of 120-125 full arc or 2,000 candle power lights. It makes 525 revolutions a minute, and gives 9·6 amperes at 6,250 volts. It is a four-pole machine, and uses two sets of brushes. There are 24 bobbins, and the commutator has 3 rings of 8 segments each. The field magnets are of soft steel and the frame is of cast iron. The shaft is directly connected to a Willans engine, which is set upon the same base, and which works at a steam pressure of 160 pounds. This is believed to be the first direct-coupled arc machine ever built. Heretofore the largest sizes of arc dynamos that have been built have been 65 lights, and several machines of this capacity are shown in this exhibit, as well as the smallest, which has a capacity of one full arc light. Distinguishing features of the Brush dynamos are flexibility, simplicity, and ease of repair. The usual sizes of dynamos have 12 bobbins, making practically three machines in one.

Several dynamos are displayed in this exhibit other than those already mentioned, which are of particular interest, especially the first one that Mr. Brush constructed. Other dynamos are shown that have been run for twelve or fifteen years and have required no further repairs than new brushes and new packing for the bearings.

The display of arc machines comprises twelve sizes—all of the regular sizes manufactured by this company. In addition to this display, the Brush Company has a very handsome working exhibit in the electric plant in the Palace of Mechanic Arts, where there are 16 dynamos, each of 65 lights capacity, forming part of the plant used for lighting the Exposition grounds.

The same system of flexibility that is made such a feature in the Brush arc lighting apparatus is adapted to the alternating system of incandescent lighting, which is now an important feature of this company's business. In the lower right hand corner of our illustration is shown an alternating dynamo of 3,000 lights capacity, giving a current at 2,000 volts and coupled direct to a 250 horse power Brush motor. The armature in this dynamo is stationary. There are ten bobbins, and when coupled in series, give the full output. But this machine as exhibited has the bobbins connected in multiple arc. The incandescent lamps used to illuminate the interior of the office structure derive their current from this dynamo without the intervening use of a transformer. The motor used to run this alternator is a 250 horsepower, 220 volt four pole direct current machine, which derives its energy from the Exposition circuits. This alternator has iron segments and uses carbon brushes, and is so constructed as to have great ventilating capacity. Two other alternators are exhibited, one of 1,000 light capacity, the other of 720 lights, and there is also a display of transformers varying from five lights to 225 lights in capacity.

Still another feature of this exhibit, and which illustrates an important feature of the manufactures of the Brush Company, is direct current incandescent lighting apparatus. Four sizes of these machines are shown, the largest one being a 2,000 lighter. A special feature of this machine is that there is only one turn of wire on each bobbin, giving what has always been regarded as a perfect type of such a machine. The 1,000

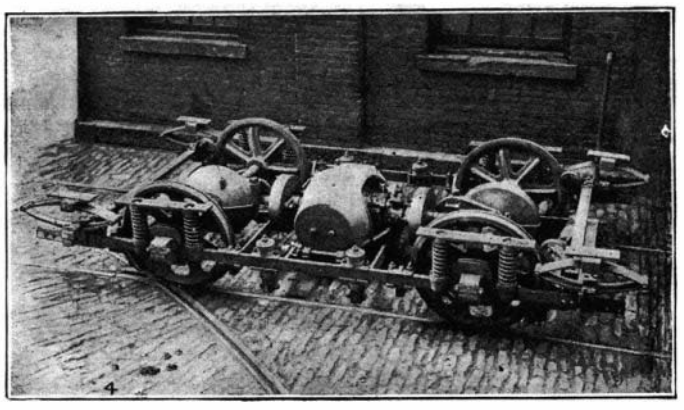


THE SPERRY ELECTRIC RAILWAY SYSTEM, PLAN AND SECTION.

lighter has two turns of wire and the smaller machine more. This 2,000 lighter has great efficiency and generates a very small degree of heat, because of this and other new features in its construction.

The demand for electric power has led to the introduction of power generators and to the making of motors adapted to various purposes to be used in connection with their generators. In the rear of the office structure, but not shown in the illustration, is displayed a generator of 130 horse power capacity. It is compound wound and gives a direct current at a potential of 1,000 volts. It is a type of generator that has come into extensive use for heavy work—the Calumet and Hecla Mining Company using five of them in its mine pumping plant. Several types of motors are shown, one of which, called the mining motor, is very compact and is steel-clad. It is a 220 volt machine and is of very slow speed, the one exhibited being 9 horse power and running at only 700 revolutions. Motors for crane and elevator service, as well as motors adapted to other uses, are also to be seen here.

The exhibition of switchboards is a very fine one. There is a large switchboard adapted to an alternating current plant of 30,000 lights capacity. This board is complete in all of its apparatus, and has just been sold to go to Manila, Philippine Islands, in a plant which the Brush Company is now equipping there. Arc and direct incandescent switchboards are also shown. The principle of flexibility which pervades the Brush apparatus is to be found in the switchboards,



TRUCK AND MOTOR OF SPERRY ELECTRIC SYSTEM.

as everywhere else. These boards are made in panels, each panel representing a dynamo. When another machine is added to the plant, the end panel containing instruments and other apparatus is moved along far enough to permit another panel being placed between that and the panels already in position, so that no change of wires or other unnecessary work need be done to connect up. Another feature and one of much importance, especially on an arc switchboard, is the placing of all live currents on the back of the board, so that the veriest tyro could handle this switchboard and not risk receiving a shock, unless he were careless enough to touch the terminals at the switch.

The space occupied by the entire Brush exhibit is surrounded by a string of arc lamps, and in the evening when these lamps, all of which are of 2,000 candle power, are lighted this exhibit is one of the most highly illuminated sections in the Exposition. The importance and value of the Brush patents on double arc lamps to the commercial world is briefly stated by a modest sign board shown at the right of the office structure, which says, "All double arc lamps used by the Columbian Exposition are furnished by the Brush Company." Another sign board, equally modest, hints at another line of work which has received a great deal of thought and which owes a great deal to the fertile brain of Mr. Chas. F. Brush. This sign reads, "All storage batteries used in electric launches and in the Columbian Exposition are manufactured under Brush patents."

Nearly all the Brush apparatus in Machinery Hall and in their exhibit was sold early in the summer for delivery immediately on the closing of the Exposition, which shows that this apparatus has lost none of its popularity.

The Brush Electric Company does not sell street railway apparatus, but it has allied with it, though independent so far as organization is concerned, two companies that have distinctive apparatus, each of its own peculiar type. In the foreground at the extreme left of the illustration of the general exhibit is seen the exhibit made by

THE SPERRY ELECTRIC RAILWAY COMPANY.

The Sperry system represents a radical departure in electric railway work. This system consists of a single motor mounted flexibly upon a truck frame in the center of the truck. This flexible mounting consists of four rubber cushions between the motor supports and the frame of truck. The motor is thus relieved of all strain and jars and concussion of the axle incident to street railway traffic. By mounting the motor in the center of the truck, the weight on the axle is reduced to a minimum. There is only about two hundred pounds of weight over each axle. It will be acknowledged by all engineers, or those acquainted with railway traffic, that if both axles of the truck are connected with one source of power instead of two, a large increase in traction is thereby gained. This method will soon become indispensable with electric street railway construction, because all of the traction that is possible must be secured. A coupling between each axle and the motor is required, and, from necessity, the coupling must be flexible under some conditions and rigid under others. Mr. Sperry has perfected a coupling that meets these requirements, and a number of them are exhibited. This coupling will allow the pinion shaft, on which is located the "driven," and the motor shaft, on which is located the "driver," to become thrown out of alignment to a considerable extent, while at the same time all of the torque delivered by the driver is transmitted to the driven. This is a very important feature of this equipment, and answers all the objections which have been made heretofore regarding a single motor equipment. In fact, this equipment will round the shortest curves with great ease and with less power required than with any other system.

To show its superior qualities as a hill climber, a grade was constructed on one of the tracks at the World's Fair, and a dynamometer test was held, at which the Sperry car pulled 4,700 pounds on the drawbar before the wheels slipped. A double motor equipment, weighing considerably more, and thereby having that much advantage, was tried, but this equipment only pulled 2,075 pounds before the slipping point was reached. The grade was 12·4 per cent, and the test was witnessed by all the judges of the Electrical Department.

The Sperry Company claim that they rate their motor very conservatively, and that it is built to stand any sudden excess of work which it may be called upon to perform, which in some emergencies amounts to two or three times the rated capacity of the motor.

Street railway traffic is the most severe traffic in the world on machinery. In the first place, the electrical machinery placed under a car is always in crude hands. No special electrical education is considered necessary for a motorman. A man may be a farmhand for forty-five years, and after a few days' run on the road with another motorman he is considered capable of handling and manipulating the electrical apparatus designed to propel a street car. Again, very little grading is done in laying a road, and the machinery must be so designed as to go up hill and down hill continuously. Practically no limit to the load is prescribed, and in most cases the roadbed is allowed to become sadly out of repair before any steps are taken to improve same. Taking these conditions together with the speed at which electric cars are being run, short curves and frequent railway crossings, it is no wonder that the strains incident to street railway traffic are more severe than on any other class of machinery.

The motor designed by the Sperry Company is made so as to stand all the possible strains that can be put upon it, and every feature of the equipment is designed and built with a clear understanding as to the uses to which it is to be put.

THE SHORT ELECTRIC RAILWAY COMPANY'S EXHIBIT.

The special feature of this display, as you will readily see, is a generator in the center. This is a 450 horse

power 500 volt six pole machine, designed especially for electric railway work. The comparative size of the armature of this generator is readily seen from the armature exhibited in the foreground. This shows the manner of its construction and also illustrates one of its striking features, which is a thrust bearing of the same type that is used on the large ocean steamships. This bearing is so constructed that the shaft runs in oil. It is provided with a device by which the position of the armature in relation to the poles can be regulated to the smallest fraction of an inch. The speed of this generator is 300 revolutions in a minute. Its framework is one immense casting 16 feet long.

The railway motor, which the Short Company believes will be the motor of the future, is one that is so constructed as to be practically flexibly suspended in the truck, which relieves it of all strain and jars incident to the ordinary single and double reduction motors. Another very important point is gained by this flexible suspension, and that is, the doing away with the tremendous hammer blows upon the track. The wear and tear on the track by the ordinary motors in use is so great that it would seem that the Short Company are moving along in the right line. The abandonment of all gears is a special feature of the motor, and a very important one from a standpoint of repairs. The development of this motor is rapidly traced in the various stages, from the first one that was built in 1890 to the latest type. This latest type is a six-pole 20 H. P. motor. It is incased, protected from mud and dirt. The working parts are readily reached. This motor is suspended by spiral springs on the car truck. The armature is attached direct to the axle. It has but two brushes and runs without noise.

The rest of the Short exhibit comprises rheostats, motor and generator parts and all other electric street railway supplies.

There are a number of single reduction and double reduction motors exhibited.

DISAPPEARING GUN CARRIAGE.

The question of coast defense has been agitated in this country for many years, without material results so far as fortifications are concerned. The government is partly supplied with heavy guns, with a prospect of more to come, but the mounting and placing of these guns seems, as yet, to be an unsettled matter.

The government has been experimenting at Sandy Hook with a 10 inch breech loading steel rifle which throws a projectile weighing 575 pounds with a velocity of about one mile in 2·6 seconds, the gun being mounted upon Captain Gordon's disappearing gun carriage. The pressure on the breech of this gun is about 3,000,000 pounds, and the problem is to resist the recoil without producing undue strains or shock, and to store and use the power for raising the gun. In the Gordon carriage the gun is mounted on four heavy double cranks journaled on the top of the frame, the arms of each crank being arranged opposite each other. The longer arms support the gun, while the short arms extend downward outside of the frame, and are pivoted to a counterweight frame which surrounds the main frame of the carriage. The counterweight balances the gun and top carriage, so that the only resistance to be overcome in the maneuvering of the gun is the friction on the journals. When the gun is fired, the upper arms swing rearwardly and the lower arms swing upwardly, carrying up the counterbalance. The carriage is brought to rest by pistons working in two hydraulic cylinders provided with an air chamber. By means of this construction, the air pressure, which in the beginning of the movement of the gun is 80 pounds in the air pump, increases at the end of the movement to about 275 pounds per square inch. This energy is stored and utilized in raising the gun preparatory to firing.

In Fig. 1 the gun is shown elevated in position to fire over a parapet; in Fig. 2 it is shown depressed in position for loading.

STATUE OF DUHAMEL DU MONCEAU.

Recently, this carriage has been tried in rapidity tests. Ten rounds were fired in 36 seconds less than an hour, with full service charges of 250 pounds. The weight of the projectile was 575 pounds. The carriage was worked by hand throughout, no power appliances of any kind being used. The value of guns of this character can scarcely be overestimated in the defense of low-lying coast. The guns are exposed only when ready to fire. While being loaded, and at all other times except while actually firing, they are protected by the parapet, and are thus proof against the enemy's fire, and hidden so as to elude discovery.

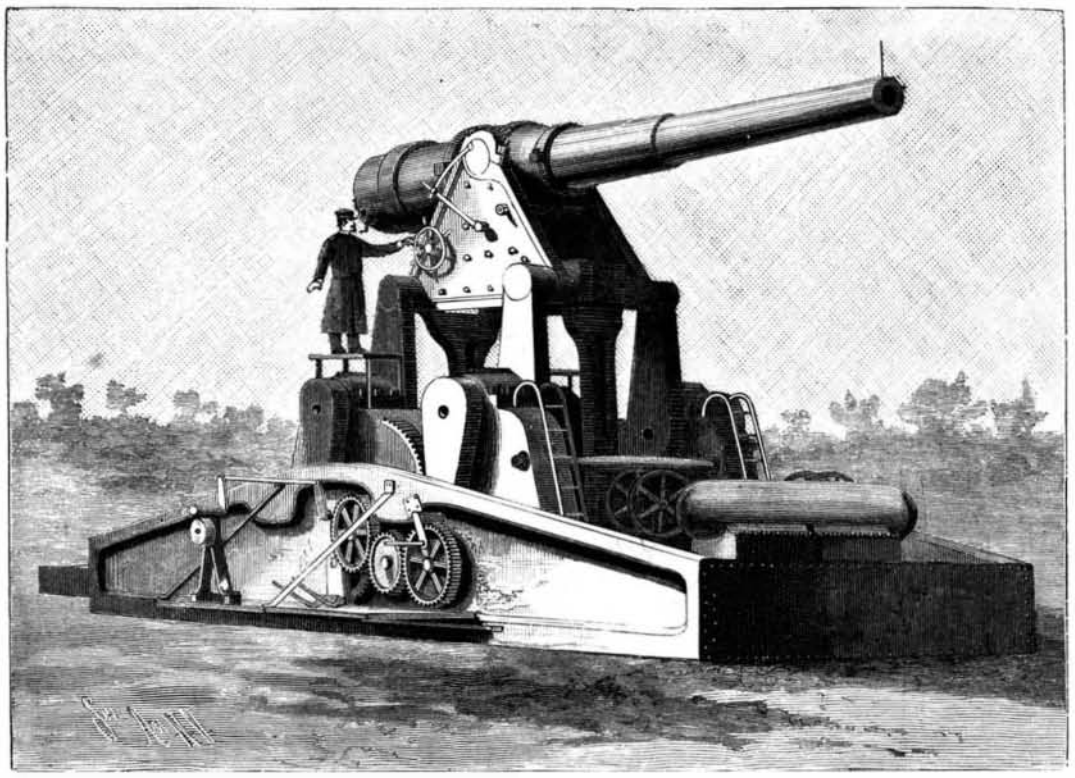


Fig. 1.—CAPTAIN GORDON'S DISAPPEARING GUN CARRIAGE.

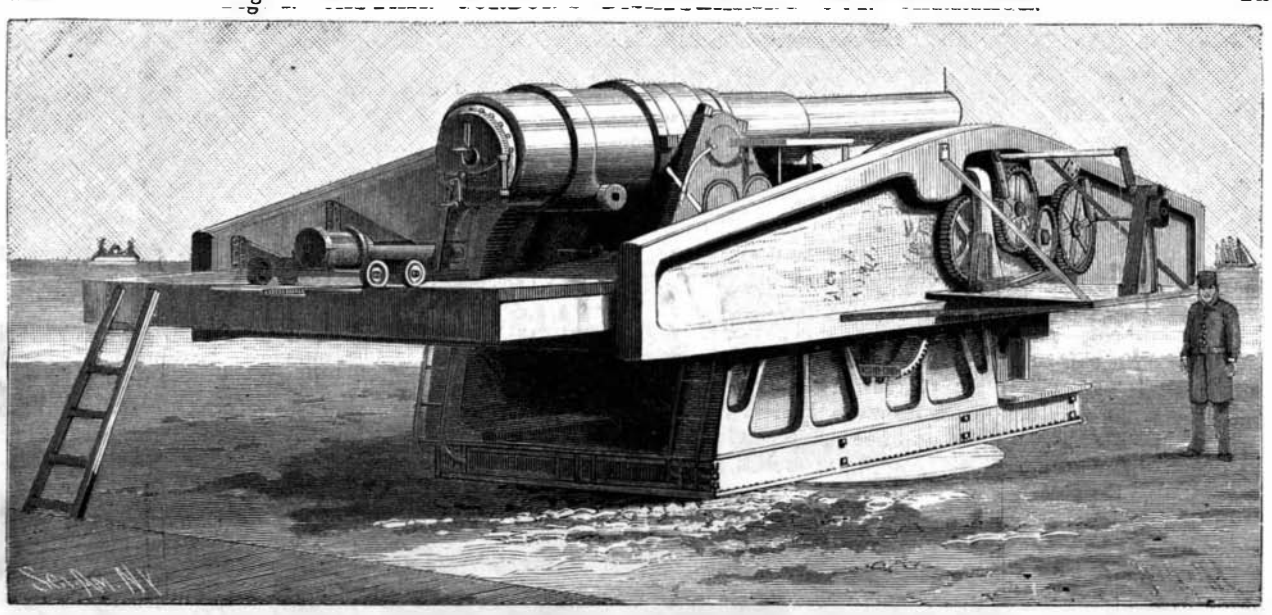


Fig. 2.—DISAPPEARING GUN CARRIAGE—GUN DEPRESSED.

DUHAMEL DU MONCEAU.

On Sunday, the first of October, the city of Pithiviers solemnly inaugurated the statue of Duhamel du Monceau. On this occasion, an agricultural exhibition, with a special competition of dairy apparatus, was organized by the Society of Agriculture, and proved very interesting.

Henri Louis Duhamel du Monceau, who was born at Paris in 1700 and died in 1782, was one of the principal agriculturists of the eighteenth century. Inspector of the marine, he devoted his studies principally to forests. In his *Physique des Arbres*, he was the first to describe with accuracy the laws of the growth of plants, of the formation of wood and bark, of the double circulation of sap, etc. He discovered the *Oidium*, one of the most destructive parasites of the grapevine, and for a long time studied the disease of the saffron. It was in the train of these labors that he entered the Academy of Sciences. He was also a member of the National Society of Agriculture. This learned author of numerous agricultural treatises passed the greater part of the year on his family estate near Pithiviers experimenting upon new agricultural theories, studying fertilizers practically, and occupying himself with perseverance with the enriching of the flora of France through the importation and acclimation of exotic plants.

He was an indefatigable worker, and imposed upon himself the task of laboring twelve hours a day—a rule that he observed during the whole course of his existence. His fortune, which was sufficient to assure him independence, permitted him to devote himself freely to his studies, and to make experiments, which were often very costly, in physics, chemistry, botany, the culture of trees, and meteorology.

He was a philanthropist, and, in his passage to the marine, not content with occupying himself with the improvement of the *materiel* and of the service, and with the construction of posts, lighthouses, etc., he greatly interested himself in the condition of the *personnel*, and published his "Instructions upon the Manner of Preserving the Health of the Crews upon Vessels under Way," a work in which he gives the most practical advice as to the hygiene on board and the preservation of food, and points out one of the simplest of methods of aerating holds by means of a draught of air through the galley stove.

The following is an anecdote concerning him: One day a young naval officer asked him a few questions, to which the scientist answered: "I do not know." "What is the use, then, of being an academician?" replied the young man. Duhamel preserved silence, but, shortly afterward, the officer having become involved in an argumentation that proved his ignorance of the subject, Duhamel retorted: "You see now, sir, of what use it is to belong to the Academy; it is to speak only of what one knows."

The beautiful statue that we reproduce herewith is due to the chisel of the sculptor Blanchard. The pedestal is by Mr. Ratouin, an architect attached to the School of Fine Arts. The savant is represented standing in the attitude of a professor giving a demonstration, and the monument does the greatest honor to the artists who conceived and executed it.—*L'Illustration.*

THE walls of Babylon are said by Herodotus to have been 350 ft. high and 100 ft. thick at the base.