road, from whence it is distributed by graders of the ordinary type.

The construction of macadam roads on a large scale has naturally imparted a great impetus to the development of rock crushing apparatus. The first steel rock crusher was built ten years ago and a gradual improvement has since gone hand in hand with an increase of capacity. The most modern plants not only crush the stone but elevate it and separate it into sizes. The stone crushers weigh from two to eight tons each, require for their operation engines of from twelve to twenty-five horse power and give a product of from eight to thirty tons of crushed stone per hour. For separating the crushed stone into different sizes road makers usually use a portable storage bin which weighs 2,500 pounds and has three compartments, each of which will hold four tons of stone and which are provided with discharging chutes on either side so that wagons can load from both sides if necessary. For separating the crushed material into various sizes screens of different types are available. One of the most interesting forms of this apparatus is the revolving screen, which revolves on either a shaft or on rollers and into which the stone passes. Some of these screens are fifty-six inches in diameter, and inasmuch as each screen is punched with holes of two different sizes, three different sizes of product are obtained, one size passing through the one-inch holes, a second size passing through the two-inch holes, and the largest size passing out at the end of the screen.

Another class of machine in which great improvement is noticeable is the steam road rollers. The principle on which the newest machines are constructed is to make the wheels, which are absolutely necessary to carry the machine, act as the rollers proper. Road rollers range in weight from five to nineteen tons, and on the larger sizes the driving wheels are about 76 inches in diameter and have a facial measurement of from twenty to twenty-six inches. Rapid road building is still further facilitated by the use of spreading wagons, dump wagons, road plows and other improved forms of apparatus which are largely automatic in their operation and which contribute to an economy of time and money.

THE NERNST LAMP.

The Nernst lamp, as commercially developed by the Nernst Lamp Company, of Pittsburg, Pa., a Westinghouse interest, while not as simple in construction as the incandescent lamp, is much less complex than the arc lamp. Like the incandescent lamp, the radiating body is a filament heated by the passage of a current, either alternating or direct. The filament is a composition formed by mixing rare earths with a highly infusible body. As is well known, rare earths when heated to the approximate temperature of the incandescent lamp give a blinding, brilliant light, comparable in whiteness with the lime light or carbon in an arc. The quality of the light is remarkable for its beauty and close approximation to daylight, giving to colored objects their true appearance. This property makes the lamp especially desirable in stores, art galleries, drawing-rooms and the like. The absence of shadow, the steadiness of the light, the simplicity and low cost of maintenance,

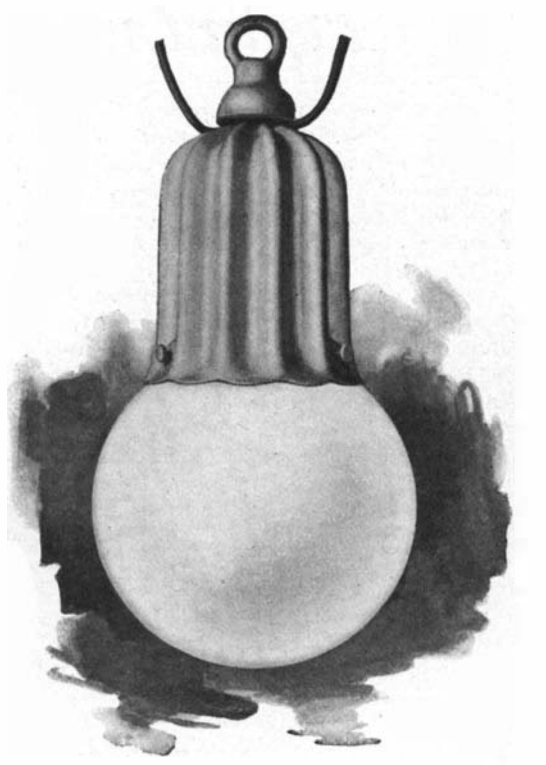

Fig. 5.—Six Glower Lamp—Out-Door Type.

together with its high efficiency, commend the Nernst lamp strongly to the lighting world. Depending as it does solely upon the heating power of the current, it can be used on circuits of 3,000 alternations. This

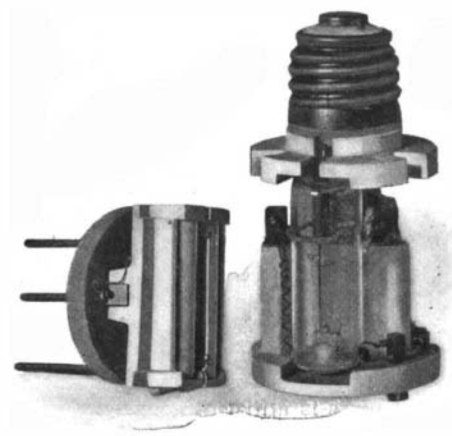

Fig. 3.—Parts of the Single Glower Lamp.

more than any other fact will cause it to displace the arc lamp.

The incandescent filament is a non-conductor at a low temperature, and therefore some device must be employed to raise its temperature before current can pass through it. Accordingly, a platinum resistance called a "heater" is provided for bringing the filament to a conducting temperature. The peculiar behavior of the filament or "glower," as it is commonly called, with reference to voltage and current, has given rise to the necessity of a steadying resistance. As the current in the glower is increased, the voltage across its terminals rises; at first rapidly, and then more and more slowly to a maximum, beyond which it again drops off with increasing rapidity as the current and resulting temperature through the glower continue to increase. Beyond the point of maximum voltage the decrease in resistance of the glower is so rapid as to make the current difficult of control. In fact, without the employment of a steadying resistance the conducting filament would rapidly develop a short-circuit and flash out. This tendency is counteracted by placing a steadying resistance, or "ballast" as it is called, in series with the glower. Such an arrangement keeps two points, between which is the glower and steadying resistance, at a constant potential and consequent steady current; in other words, the steadying resistance as placed in the actually constructed lamp rises in temperature and increases in resistance by as much as the glower diminishes. There are then three elements to be described—the glower, ballast and heater.

The glower for a 220-volt lamp is about 25 millimeters long and 0.63 of a millimeter in diameter. It is made by expressing from a die a dough made of the rare earth mixed with a suitable binding material, cutting the porcelain-like string thus made into convenient lengths, drying, roasting and finally attaching lead-in wires. Embedded in the ends of the glower are platinum wires ending in beads, so that any tendency on the part of the glower material to shrink—repeated heatings produce this effect; clay is the common substance that exhibits this property—can only result in tightening the contact, and maintaining intimate union between the platinum bead and the glower. To the platinum beads are fused short lead wires of platinum, to which in turn are fastened conducting wires ending in aluminium plugs. A bundle of the glowers is shown in Fig. 1. The glower is about as strong as a piece of porcelain of the same size, and it is difficult to break a short section. When properly made the voltage of the glower changes but slightly during its life, the tendency being to rise from two to four per cent in eight hundred hours.

It has been mentioned that the use of a steadying resistance is to keep the current in the filament constant; it must, therefore, act immediately or it is useless. As designed to meet this exacting requirement it is unique in construction and wholly effective in keeping the glower at a constant temperature. Iron wire is mounted in a small glass tube filled with an inert gas, so that no matter what temperature the iron takes it will not be affected. It would oxidize were not the air in the tube replaced by a chemically inactive gas. One of these is employed for each glower.

As already mentioned, the glower is non-conducting when cold, and means must be provided for bringing

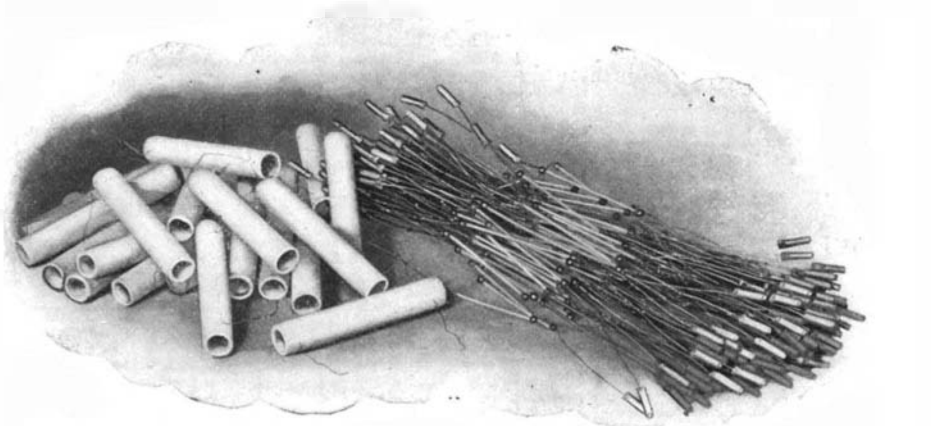

Fig. 1.—Heater Tubes and Glowers.

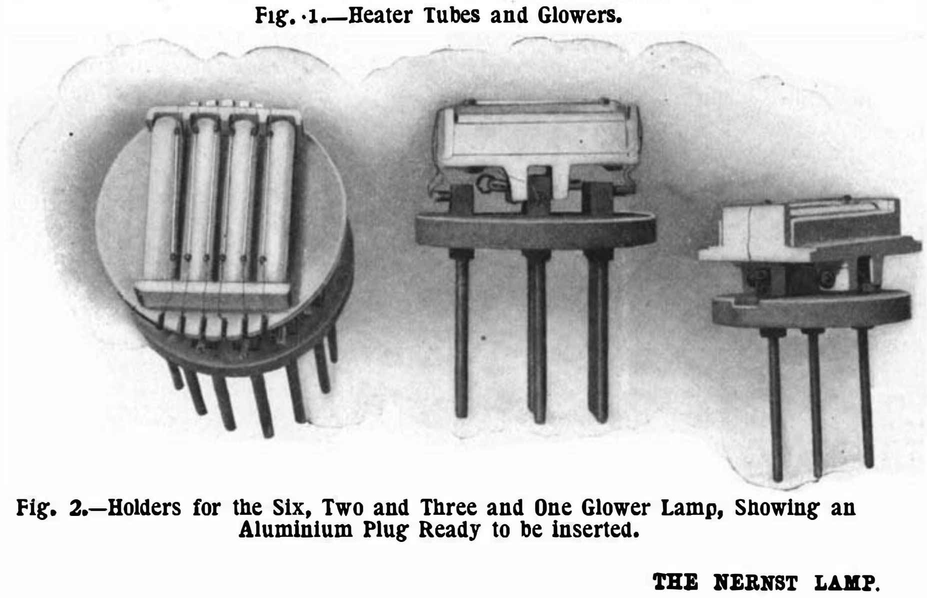

Fig. 2.—Holders for the Six, Two and Three and One Glower Lamp, Showing an Aluminium Plug Ready to be inserted.

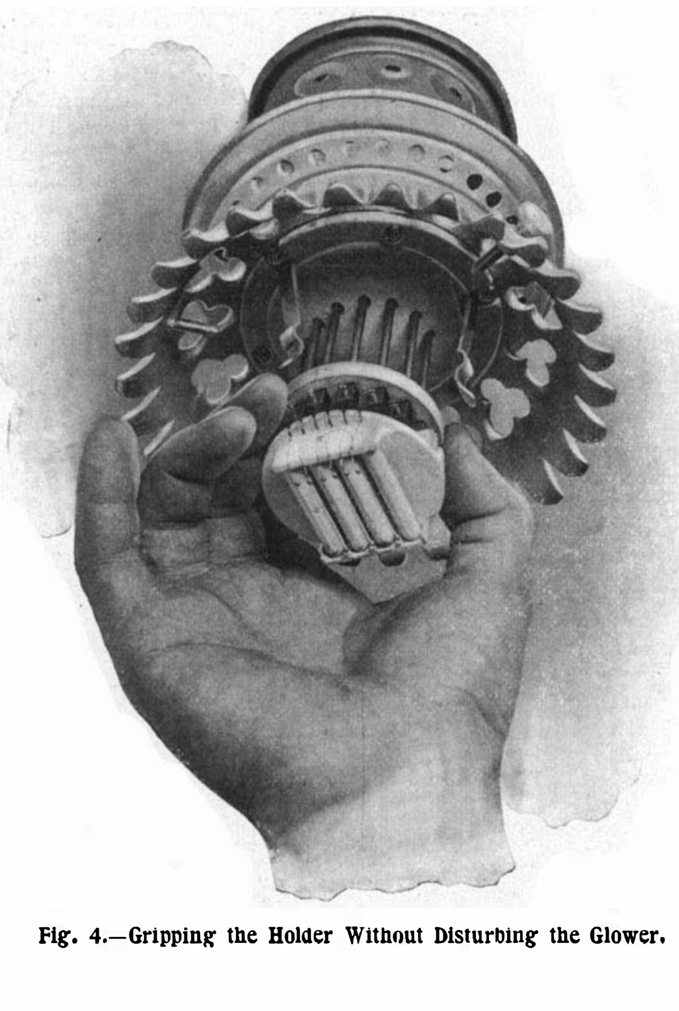

Fig. 4.—Gripping the Holder Without Disturbing the Glower.

THE NERNST LAMP.

it to a conducting temperature. The heater as now constructed consists of a thin porcelain tube, overwound with a fine platinum wire, pasted with cement, the latter serving to protect the platinum from the intense heat of the glowers. These tubes are wound for 110 volts and are connected in pairs of two in series according to the service; the one, two and three-glower lamps taking one pair, and the six-glower two pairs. These heater tubes are mounted on a porcelain support in such a manner as to be readily accessible. The life of the heater is surprisingly long; in fact, is so lasting that it cannot be considered as a repair part. Fig. 1 shows a number of heater tubes. In Fig. 2 the left-hand illustration shows four heaters and the overlying glowers in close proximity.

The lamp is automatic—a necessity in the lighting world. It requires a cutout to disconnect the heater from the circuit as soon as the glower shall have lighted. The cutout is a magnet-coil which actuates a pair of keepers, breaking the circuit. From the position in which the cutout is placed in the lamp it must operate at rather a high temperature and without possibility of failure. It must, therefore, be heat-proof, the contact must not weld, and the moving member should not hum on alternating current. Severe as these requirements are, they have been met in a most effective and satisfactory manner by embedding the coil in cement, by making the contact of silver, and by suspending the moving member from a single point of support.

The lamp is suspended by an I-bolt, which being removed allows of immediate access to the inner part of the lamp. On removing the I-bolt the housing comes off and we find the steadying resistance-bottles placed in a semicircle around the cutout. The connections are made with small aluminium plugs on the ends of the inner connecting wires, a procedure which avoids the troublesome setscrew. All parts are mounted on porcelain; in fact, the lamp contains no combustible material whatever. The heaters and glowers are attached to a removable piece or "holder." The design is such that the heaters backed by a porcelain disk are immediately above the glowers, a disposition of parts that is conducive to efficiency in service. The glowers and heaters are attached to the binding posts of the holder by means of small aluminium plugs. The holder carries the heaters and the glowers. Electrical contact is provided for these by contact-prongs, which, when the holder is pushed up into the lamp, automatically makes the desired connections. A small glass globe, called the heater-case, is held by spring clamps around the glowers, and serves to retain the heat and thereby decreases the efficiency of the glower. The lamps are made of from 50 to 2,000 candle power. There is one glower in all lamps of 50 candle power, and the number increases up to 30 for the 2,000 candle power.

Engineering Notes.

Two compressed air cars have been placed in service on the North Clark Street line, Chicago, Ill. They are used after 1 P. M. when the cable stops running. The reservoirs in these cars are charged to a pressure of 2,500 pounds to the square inch. The working pressure is 150 pounds to the square inch. The cars are charged on every downtown trip.

The much-discussed question of American versus English locomotives, which occupied a great deal of attention the past summer, is dismissed, for a time at least, by The Engineer, London, in these words: "In the United States economy of fuel is a secondary consideration. There has been a large consumption of oil, and rather heavy repairs because the workmanship is not equal to that of British locomotives, nor does it pretend to be. In a very short time trouble will begin with the fireboxes because of the intense combustion required to make steam, but there is nothing inconsistent in this with American practice. The engines were very cheap, they have done their work, and have tided the company over by prompt delivery, but it is unfair to compare them with English locomotives made to use little coal and oil, to last long and require few repairs. Probably price for price, the American engines are as good as anything that can be made in this country."

English railway men recently visiting us say that there will have to be a great change in their own management as regards loads hauled by one engine, citing the case of American engines pulling 1,500-ton loads as against their own with capacity for only 300 tons. Fifteen hundred tons is no load for an American engine built for the work; more than double this quantity has been hauled at 15 miles per hour by engines built at Schenectady. As to the heating surface of American engines, it was thought that the limit had been reached in these same engines, 3,500 square feet, but the "Soo" line is having 74 "decapods" built which will be the largest in existence, weighing 236,000 pounds, with 5,400 and 5,800 square feet of heating surface.

Patent Department

Prof. Rowland's Telegraphic Inventions.

The late Prof. Henry A. Rowland filed in the United States Patent Office applications for patents on telegraphic improvements, which have recently issued.

The one invention provides an improved method of transmitting messages over an alternating-current circuit by selecting for each signal or character a predetermined number of the current impulses and modifying them by changing their polarity, but otherwise maintaining their form and characteristics. Prof. Rowland also contemplated the division of the line current impulses into groups, each of which corresponds to a character or signal. A predetermined number of the impulses are reversed in sign, the order and relation of the reversed with respect to the normal impulses of a group determining the signal or the character of the code. In carrying out this invention a mechanism is introduced into the alternating-current circuit by which the connections of the source of alternating currents may be reversed at any moment, so as to reverse the polarity of any desired impulse or any number of impulses. By reversing the wave instead of cutting it out, as Prof. Rowland formerly did, two or more adjacent impulses of a group may form a combination when received upon a polarized relay—a result which could not be obtained with the cut-out wave.

Another invention of Prof. Rowland's is a multiplex printing telegraph of the synchronous type, in which the local transmitting and receiving instruments are controlled by synchronously-operating mechanism. The system is adapted to be used with an alternating line-current, which is employed both for transmitting signals and for producing synchronous motion. The advantages to be derived from such an adaptation of the alternating current are many. An alternating current can be sent over a line to a greater distance without any change of form of its waves or impulses than any other current. Consequently messages can be transmitted to great distances without relaying or repeating them. Moreover, there will be practically no diminution of speed with increase of distance. The synchronous motion is produced by and maintained between continuously moving or rotating parts as contradistinguished from the intermittent motion of "step-by-step" telegraphs. In Prof. Rowland's invention the inertia of the moving parts is utilized in steadying their motion and in maintaining synchronism, whereas in the step-by-step devices the inertia is entirely gotten rid of, so that if for any reason the current which operates the step-by-step devices should be interrupted, the motion of these devices would be arrested accordingly.

Prof. Rowland also invented an improved form of printing machine by which telegraphic signals can be translated into typographical characters and printed in page form on sheets of paper. The paper upon which the characters are printed is delivered to the printer-carriage either from a roll, in single sheets, or in any other convenient manner. The printer-carriage, actuted by suitable spacing mechanism, moves the paper step-by-step under a continuously-rotating type-wheel until the end of a line is reached, when, by the operation of a lining mechanism, the paper is fed up, a new line is formed, and the carriage is returned to its original position. The carriage may, however, be caused to reverse its motion or return to its original position at any desired point of its travel. The characters are printed by an electrically-operated platen, which is caused to strike the paper and bring it in contact with the proper character on the type-wheel for each combination of signals received. In order to accomplish this, as well as to actuate the spacer, liner and other electrical devices of the printer, Prof. Rowland employed circuit-combining devices somewhat similar to those described in connection with his multiplex printing-telegraph. Owing to the weight of the printer-carriages and paper-carrying devices hitherto used in printers of this general character, some difficulty has been encountered in moving these devices fast enough, since they are usually slow in starting. Prof. Rowland obviates this difficulty by making the carriage and other traveling parts extremely simple and light.

At the entrance to the harbor of Genoa, Italy, there is an acetylene lighthouse, which has been established two years. In that time many experiments have been tried which go to prove that it is superior to electricity. There is one of this type at Tino, forty miles from Genoa, which cannot be seen from there, whereas the acetylene is plainly visible; the latter is by far the cheapest, costing only $250 per annum, against $5,000 for electricity.

Brief Notes Concerning Patents.

Prof. William Duane, Professor of Physics at the Colorado State University at Boulder, has been recently granted a patent on an improved system of transmitting messages over a wire. It is said that as many as eighteen messages can be sent back and forth at the same time by this new method.

Cassius A. White, of Rome, N. Y., the inventor of the mop-wringer which bears his name and which reaped him a fortune, died on December 8, aged 57 years. The mop-wringer business established by him at Jamaica, Vt., is still carried on, having been organized into a corporation on his retirement over a year ago.

George De Groat, a letter-carrier connected with the post office at Morristown, N. J., has been granted a patent on a recording device for letter boxes. This consists of an electrical connection maintained with the main office, by means of which it can be ascertained at all times if the collections have been made according to schedule. An alarm is given when any effort is made to rifle the box of its contents.

Jacob Olinger, a farmer living on the National Pike not far from Springfield, Ohio, is the inventor of an automatic oiler to be applied to the disks of grain drills, harrows and similar machinery, which is said to be a great convenience to those making use of these implements. Briefly, it consists of a hollow bearing which is kept at all times filled with oil. Mr. Olinger recently sold a shop-right to the Thomas Manufacturing Company for $3,000 and a royalty on each machine equipped with the device.

Anna Catherine Draper, who died on December 12 at her home in Hastings, N. Y., is said to be the first woman to have her photograph taken. Her brother, Dr. John W. Draper, invented an improvement on the Daguerre process by which the time of exposure was cut down from one hour to six minutes, and this made photography available for portraiture. Upon the completion of his process the first picture made was that of his sister, which was examined with great interest. The original is now in the possession of the heirs of Lord Herschel.

Prof. Charles Washington Wynn, who attracted a great deal of attention in mining circles in Denver by his claim of having discovered a process for profitably extracting fine gold from extremely low-grade ores, died very suddenly a few weeks ago, just as preparations were being completed to put his process into commercial use. He had fifty-four patents covering his discovery, and at the time he was stricken he was superintending the installation of the new plant. His secret, however, is not lost altogether, for a description of it written by himself was deposited in the safe of the company.

William Gee, of No. 1885 Bockius Street, Philadelphia, who was the inventor of one of the earliest power looms for weaving carpets, was found dead on December 6 beside an invention on which he was putting the finishing strokes. This device was for knotting fringes in upholstery manufacture, an operation which has been done exclusively by hand. On the day before he had told a friend named Ewing about the wonders of this machine, and invited him to come around the next day, when he said the machine would be in operation. Ewing called according to the engagement and found the inventor dead on the floor, where he had just been discovered by his wife. The deceased was the inventor of a number of other loom improvements.

Josef Hofmann, the pianist, takes his recreation in the shape of automobiling. He has developed not only into an experienced chauffeur, but also into a designer of several automobile improvements. On his arrival in this country a short time ago he at once applied for a patent on a new form of engine. Gasoline and steam are combined in a somewhat peculiar way in this design. He recently said in relation to his invention: "While gasoline is used, it is not a primary power. It is used to generate a high steam power, which steam is itself the motive power of the vehicle. In the steam boiler of the ordinary type the heat surrounds the coils of pipe containing the water. Gasoline exploded in these pipes creates a tremendous heat, transforming the water instantly into steam."

A company has been organized at Hartford, Conn., for the purpose of manufacturing a "yearly-wind" clock, the invention of David Vauthier, a Frenchman who has been residing in Hartford for several years. H. D. Mildeberger, a well-known lawyer of that city, is the president of the company, and he has in his office a clock of this kind which was wound on January 4, 1900. It has been running without an intermission ever since. The movement is said to contain but one heavy spring, which is placed within a drum or barrel. This drum is equipped on the outside with a ratchet-gear connecting with the train. The drum revolves but once a month, and consequently makes but twelve revolutions in the course of the year.