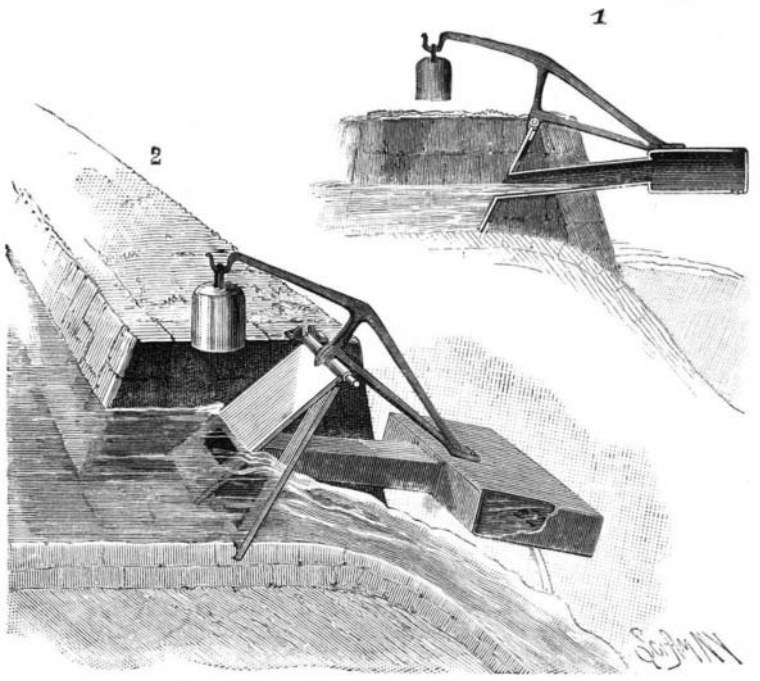
### AN IMPROVED AUTOMATIC WATER GATE.

A waste gate which works automatically to control the overflow of wasteways or sluiceways of canals is shown in the accompanying illustration. The gate is designed to normally stay closed, opening automatically only when the water has risen to a certain predetermined height, when, by permitting the surplus water to escape through a suitable raceway, any damage likely to be caused by the water overflowing the banks is prevented. The improvement has been patented by Mr. George W. Norton, of Mohawk, Arizona Territory. Fig. 1 is a vertical section of the improvement, as applied in practice, the gate being closed, while Fig. 2 is a view in perspective, showing the gate opened by the rise of the water. In the wasteway is fitted an open gate frame, the top of the frame at the sides having bearings in which is journaled a cross-shaft to which is rigidly attached a swinging gate, and a counterpoise whose balance is changed by the rise and fall of the water. The counterpoise is secured at one end to a tank connected by a pipe to an opening in the gate, and on its other end is suspended a weight, whereby the gate will be held closed when the water is at a normal height, the tank at such times being empty. But with the rise of the water the tank fills, as shown in Fig. 2, and it then overbalances the weight and swings downward, thus opening the gate. The gate will remain open until the water falls below the opening leading to the tank, a small aperture in the bottom of the latter soon discharging it of its weight of water after the inflow has ceased, when the weight on the other end of the counterbalance pulls it down and closes the gate.




NORTON'S AUTOMATIC WATER GATE.

### DR. WERNER VON SIEMENS.

It is with the deepest regret that the announcement has been received of the death of Dr. Werner von Siemens, which took place on December 6, 1892. A brief sketch of his life was given in the SCIENTIFIC AMERICAN of December 17, and we now add the following details:

It was in 1839, at Magdeburg, at the age of 23, that he began his scientific investigations. His first experience was unfortunate, for an explosion, caused by a preparation of phosphorus and chlorate of potash, burst the drum of his right ear. As he had met with a similar accident to his other ear some time before, he was for a time stone deaf. His studies were fated to be again interrupted, for in the autumn of 1840 he was sentenced to five years' imprisonment for acting as second in a duel.

"Stone walls do not a prison make" was more than exemplified in his case, for being allowed to continue his experiments, he successfully plated a silver spoon with gold. The silver spoon was connected to one pole of a Daniell cell, a *louis d'or* to the other. It was a great disappointment to him when, after a month's imprisonment, he was pardoned, and begged that he might be allowed to use his cell to complete some experiments.

A patent was granted him in Prussia, in 1841, for electro-gilding and silvering. In 1842 he and his brother, William Siemens, took out a patent for a differential regulator.

In 1844 he was appointed to the artillery workshops in Berlin, where he turned his attention earnestly to telegraphy, and in 1845 patented his dial and printing telegraph instruments, which were based on the self-breaking principle of the Neef's hammer.

In 1848, at Kiel, he laid down the first electric submarine mines. They served to protect the town of Kiel, and saved it from being bombarded by the Danish fleet.

The Prussian government, in the autumn of 1848, deputed him to lay the first great underground telegraph line from Berlin to Frankfort-on-the-Main, and in the following year another from Berlin to Cologne, Aix-la-Chapelle, and Verviers. Werner von Siemens now left the army and government service and devoted himself henceforth to scientific pursuits and the management of a telegraph factory, which he and Mr. Halske established in 1847. The firm has since then acquired a world-wide reputation, and is indissolubly connected with the growth and progress of telegraphy. During the laying of the first underground lines Werner von Siemens had observed the then remarkable phenomenon of electrostatic induction, which exercised so retarding an influence in the working of those lines. He described the phenomena in a paper communicated to the Paris Academy of Sciences in the year 1850. The underground system of telegraphs had, however, to give place to the overground, on account of the technical difficulties mentioned. But the experience gained from these failures resulted in overcoming the difficulties, with the result that the lines were relaid underground about 1878.

From the period of 1845 an almost uninterrupted series of scientific and technical discoveries and inventions emanated from him and from the factory under his direction.

In 1845 he devised a machine for the measurement of small intervals of time, and the speed of electricity by means of electric sparks, and its application, in 1875, for measuring the speed of the electric current in overland lines.

The firm of Siemens & Halske, in 1851, erected the first automatic fire telegraphs in Berlin. The difficulty of communicating through long underground lines led him to the invention of automatic translation, which was afterward improved upon by Steinheil; and in 1852 he furnished the Warsaw-Petersburg line with automatic fast-speed writers. The messages were punched in a paper band by means of the well-known Siemens lever punching apparatus, and then automatically transmitted in a clockwork instrument.

In 1854 the discovery (contemporaneous with that of Frischen) of simultaneous transmission in opposite directions and multiplex transmission by means of electro-magnetic apparatus was made, and two years later the Siemens magneto-electric dial instrument, giving alternate currents, was constructed. From this apparatus originated the well known Siemens armature, and from the receiver was developed the Siemens polarized relay, with which the working of submarine and other lines could be effected with alternate currents; and in the same year, during the laying of the Cagliari Bona cable, the construction and first application of dynamometers, also the development of the theory of submerging cables in deep water, took place.

DR. ERNST WERNER VON SIEMENS.

In researches on the subject of electrostatic induction and the retardation of the current in insulated wires representing Leyden jars, Werner von Siemens developed mathematically Faraday's theory of molecular induction, and thereby paved the way in great measure for its general acceptance. The construction of the ozone apparatus, telegraph instruments with alternate currents, and translation and automatic discharge for cable lines, were devised in 1857. The Sardinia, Malta, and Corfu cable was in the same year worked with such instruments.

In 1859 came the construction of an electrical log; the discovery of the heating of the dielectric by induction; the introduction of a reproducible standard resistance measurer (Siemens unit); the construction of resistance bobbins and the testing of insulated wires by systematic methods were also effected by him; also researches on the influence of heat on the electrical resistance of metals, and the establishing of methods and formulæ for testing resistances, and for the determination of faults by means of resistance measurements instead of with current measurements as formerly used.

In 1866 the establishing of the theoretical principle of dynamo-electric machines, which led to the construction of dynamo-electric mine exploders and light apparatus. In 1874, a treatise on the theory of the laying and testing of submarine cables; and in May, 1875, researches on the influence of light on crystalline selenium; and in 1876 and 1877 on the change of conducting power of selenium by heat and light.

He had continued reading papers and addresses down to the present time, and had contributed of late years much to the theory of electro-magnetism.

Werner von Siemens' scientific knowledge and inventive genius, combined with the great mechanical ability of his partner, Mr. Halske, soon developed the telegraph works of Siemens & Halske, in Berlin, into a large establishment, from which Mr. Halske retired in 1867.

In 1865 Werner von Siemens introduced pneumatic dispatch tubes into Berlin; the system adopted there served as a model for that laid down in London by Siemens Bros., in 1871. The railway signaling and block system of Siemens & Halske, which has been adopted by many Continental railways, was the first to ensure a forced dependence between the electric and semaphore signals and the position of the points.

In 1879 Werner von Siemens constructed an electric railway in Berlin. The electric energy was transmitted to the moving carriage, or train of carriages, through the two rails upon which it moved, these being sufficiently insulated from each other by being placed upon well creosoted cross sleepers. This railway, which was much used during the Berlin Exhibition of 1879, was the direct progenitor of the Lichterfelde line, one rail serving as the conductor from the dynamo, the other as the return. This railway has continued with success from 1881 down to to-day.

The alcoholometer ranks as one of the most ingenious of Werner von Siemens' inventions. This apparatus registers with perfect accuracy the actual quantity of absolute alcohol contained in the spirit which is passed through it.

About 1,000 workmen were employed at the Berlin telegraph and cable works as early as 1879. Siemens & Halske were among the first to construct telegraph lines in Germany and other countries. In 1854 a branch firm was established at St. Petersburg, under the direction of Carl Siemens, who became a partner. A complete network of government telegraph lines for Russia was constructed and erected by this firm. In the year 1857 a branch of the firm was established in London, the well known Siemens Bros. of to-day. The development of Siemens & Halske's business since the introduction of electric light and traction is one of the most remarkable facts in industrial enterprise. They have carried out much of the electric light and traction work on the Continent, and the latest development is the opening of a large branch house in America, where it is expected they will compete with advantage with the American manufacturers.

For his scientific labors, Werner von Siemens had in the year 1860 the degree of Doctor (*honoris causa*) of the Berlin University conferred upon him, and in the year 1873 he was elected member of the Berlin Royal Academy of Sciences. The Patent of Nobility was bestowed upon him in 1888 by Frederick III. He was for a long time member of the Prussian Parliament and the vice-president of the Society for the Advancement of Industry in Berlin; he was also member of the Asiatic Society in Calcutta, and honorary secretary for Germany of the London Society of Telegraph Engineers (now the Institution of Electrical Engineers), and was honorary member of the Institution of Civil Engineers, London, etc.

Not the least important of his many labors was the

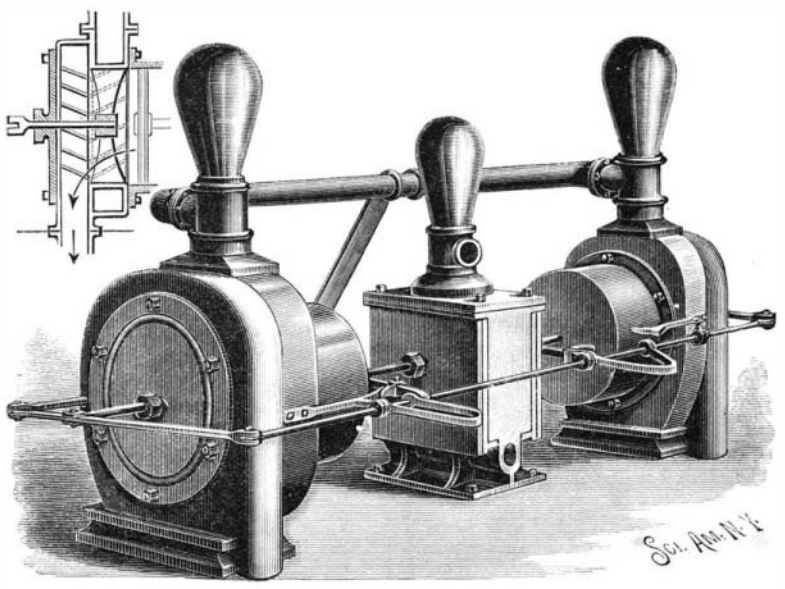
obtaining for Germany a practical patent law, after agitating this subject for a number of years, in connection with the Society for Patent Protection, which he founded, and of which he was appointed permanent president.

For the foregoing particulars we are indebted to the *Electrical Review*, London, and for our portrait to the *Street Railway Review*.

The funeral took place at Berlin, December 10. Chancellor Von Caprivi, Dr. Von Boetticher, Secretary of the Home Office; Herr Von Berlepsch, Prussian Minister of Commerce; Dr. Hermann von Schelling, Prussian Minister of Justice; the municipal authorities, and a large number of scientific men and artists were present. The funeral was conducted with much pomp. The route to the cemetery was lined with thousands of people. Four thousand workmen from the Siemens factory followed the hearse. Among the floral offerings was a wreath from Thomas A. Edison, inscribed "To my friend."

## AN IMPROVED MOTOR.

The motor shown in the engraving is more especially designed for use on artesian wells, etc., to obtain, with a low pressure of water as a driving medium, a large amount of power for actuating other machinery. The improvement has been patented by Mr. B. S. Partridge, of Jacksonville, Fla. The machinery to be actuated may be of any desired construction, the improvement being represented as applied to a double-acting pump, the piston in the middle pump being on a piston or power rod carrying pistons in cylinders near its ends, these cylinders being open at their inner ends and connected at their outer ends with the valve chests of inlet chambers through which the motor agent enters. In these chests slide cylindrical valves, whose rims open and close the inlet and the outlet ports alternately, the valves having each a central hub and radial spokes, as shown in the sectional view, to form a discharge opening for the cylinders at the time the valves are seated over the inlet ports of the inlet chambers. The valves are at all times entirely surrounded or filled with the motive agent, and thus are constantly and perfectly balanced. Outwardly extending valve stems are pivotally connected with transverse pivoted arms, whose free ends are pivotally connected with each other by a rod extending at one side from one outer end to the other of the motor. This rod slides in bearings formed on arms secured to the power rod, the bearings engaging collars on the ends of V-shaped springs, which have at their other ends collars abutting against collars secured to the rod, while the latter collars abut against spring arms secured to the valve chests. In operation, as the power rod moves in either direction, one of the springs is first compressed and then released, to force in one direction or the other the rod connected with the valve stems at the ends, thus alternately opening and closing the outlet and inlet ports in each chamber. A practical test of this improvement has been made before the Board of Public Works and the fire department of Jacksonville, Fla., in which water was taken at 20 pounds pressure through a 6 inch pipe, and, using a 2½ inch hose and ¾ inch nozzle, a stream was thrown 107 measured feet, the pressure varying from 40 to 60 pounds, and when the valve was closed the pressure rose to over 100 pounds. As this was effected with an experimentally made motor, it is claimed that much better results can be obtained with a motor specially manufactured after approved patterns in accordance with this invention.



PARTRIDGE'S WATER MOTOR.

## Ocean Mails Under the American Flag.

The new foreign mail service so far contracted for under the recent act of Congress is as follows:

| Beginning of Contract. | Termini of Routes. | Number of Trips. | Period of Contract. |
|---|---|---|---|
| Apr. 26, 1893.. | Galveston to La Guayra | 3 times a month..... | 5 years. |
| Mar. 1, 1892.. | New York to La Guayra | 3 times a month..... | 10 years. |
| Feb. 1, 1892.. | New York to Colon.... | 3 times a month first 2 years; once a week 8 years ..... | 10 years. |
| Feb. 1, 1892.. | San Francisco to Panama ..... | 3 times a month first 3 years; once a week 7 years..... | 10 years. |
| Feb. 1, 1892.. | San Francisco to Hong-Kong..... | Once every 28 days; once in 2 weeks..... | 10 years. |
| Oct. 12, 1895.. | New York to Southampton ..... | Once a week ..... | 10 years. |
| Oct. 12, 1895.. | New York to Antwerp. | Once a week..... | 10 years. |
| Dec. 10, 1892. | New York to Buenos Ayres..... | Once a week with calls; 28 days without..... | 5 years. |
| Dec. 1, 1892.. | New York to Rio..... | Once in 24 days..... | 5 years. |
| Nov. 1, 1892 . | New York to Tuxpan.. | Once a week..... | 5 years. |
| Nov. 1, 1892.. | New York to Havana... | Once a week..... | 5 years. |

The new service applies to eleven lines, comprising, when completed, forty-two ships of 165,802 tonnage, and the contractors will be required to spend $14,000,000 to provide ships necessary to make the service contracted for frequent enough and quick enough to comply with the terms agreed upon.—*Report of the Postmaster-General.*

## The Manufacture of Small Arms.

At a recent meeting of the Institution of Civil Engineers a communication on "The Manufacture of Small Arms" was read by Mr. John Rigby, M.A., superintendent, Enfield factory.

The author traced the history of the interchangeable system of manufacturing small arms, from the date of the first factory in England, set up in 1852 at Pimlico by Colonel Colt, who imported the machinery from America. He then proceeded to describe the various processes of manufacture of the components of the Lee-Metford Mark I. magazine rifle, of 0·303 in. bore, the weapon adopted for the British army, prefacing the account with a general description of the Enfield factory.

The most important part of a rifle was the barrel, which had always engaged the special attention of gunmakers. Up to the time of the Crimean war it was, for the bulk of British troops, a comparatively rude tube of iron, lap-welded under rolls and tapering externally, with a cylindrical bore of about ¾ in. diameter. The barrel of the present day was a steel tube of accurate workmanship, only $\frac{8}{10}$ in. bore, almost perfectly true and straight, rifled to $\frac{1}{8000}$ in., and so closely inspected that the existence of the most minute gray or seam in the bore, requiring a highly practiced eye to detect it, was sufficient to condemn it. The material used was produced either by the Siemens-Martin or the crucible process of manufacture, and was supplied to Enfield as a solid round bar 1⅜ in. diameter and 15½ in. long. After severe testing, this bar was passed through a rolling mill to draw it to its full length; it was then taken to the forge, the swell at the breech end was stamped to the required shape by a steam hammer, and afterward straightened cold. The next step was to submit the bar, without annealing, to the turning and drilling machines. The latter were horizontal, the drills operating from each end. In the process of drilling the barrel revolved at nearly 1,000 revolutions a minute against half-round bits held flat down, a capillary tube of brass supplying soap and oil emulsion, at a pressure of 80 lb. to the square inch, to wash out the swarth and cool the cutting edge. The drills advancing from each end continued boring until a small disk about $\frac{1}{100}$ in. diameter broke out, and the two holes met. The tendency of the drills to follow the line of axis of a revolving bar was one of those curious occurrences in practical mechanics which might be accounted for after observation, but which no one would predict. Occasionally, through some defect in the steel, a drill wandered from the axial line; in this case the barrel was taken from the machine and reset sufficiently to bring the hole true again. To test its truth, a ray of light was made to illuminate the flat bottom of the hole while the barrel slowly revolved. It was very rarely that a barrel was rendered waste from bad drilling. Rough boring followed with a three-edged bit, the blade being about 4 in. long. The rough external turning was effected in self-acting lathes, which gave the required curved taper. Three or four cutters acted simultaneously, each producing a long cutting that attested the quality of the metal of the barrel. The operation of barrel setting followed. Previous to rough turning, the barrels were fairly straight internally, but the removal of the metal caused slight inequalities which were tested by the eye of the barrel setter, and corrected by transverse blows. This constituted skilled labor of a peculiar character, and was performed by young men of good sight, who were specially trained for that purpose. After middle life the eye generally lost some of the quality necessary for this work, and it was rare to find a man excel in it after that period. Many mechanical devices had been contrived to supersede the simple ray of light laid, as if it were a straight edge, along the surface of the bore; but the eye still remained the arbiter of straightness and could be relied on for very accurate results. The construction of the barrel was completed by the important operation of rifling. In British small arm factories the system was followed of planing out each groove separately with a hooked cutter, and had been brought almost to perfection. In Continental and American factories the grooves were plowed out by cutters with several cutting or knife edges set at an angle and following one another in the manner of a single-cut file or float. Similar machines have been tried at Enfield, but did not give as smooth a cut as the slower moving single-tooth machines. A few passes of a lead lap fed with fine emery removed any burr that might remain, and completed the polish; a cylindrical lap, spinning rapidly, was then passed through, and gave the final finish to the barrels. The limits of gauging were from 0·303 in. to 0·305 in. Next in importance to the barrel was the mechanism of the breech, for which the material preferred was crucible cast steel of a mild character, but capable of being hardened in those parts exposed to the pressure of the bolt. The body was forged in two operations under the steam hammer; it was then drilled and subjected to a long series of operations, in the course of which the end was recessed to receive the screwed end of the barrel, and the corresponding thread in the recess was milled out in a specially contrived machine, which insured that the thread should always start in the same place relative to the gauged part of the body, a point of great importance. The bolt, also of crucible cast steel, was forged under the steam hammer. A special machine, invented at Enfield, was used to finish the bolt after shaping. After machining, the bolts, packed in wood charcoal in iron cases, were heated and hardened by immersion in oil. The temper of the handle was then reduced in a lead bath. The rest of the bolt was tempered straw color. The bolt head was similarly hardened and tempered.

The other components of a complete rifle were mostly shaped by mills built up to the proposed profile, or by copy milling machines. The process of drifting was used with good results at Enfield. All such slots or perforations as had parallel sides, and were not cylindrical, were so finished. The common practice in drifting was to push the drift, but at Enfield much better work was accomplished by pulling. It was found that used in this way drifts were very valuable for interchangeable work. The sides were cut with successive teeth, each slightly larger than the preceding one, and the whole length of the drift was drawn through. Emery wheels were also largely used at Enfield, as a substitute for finish milling and filing. The wheels ran under hoods connected with a pneumatic exhaust that carried away the heated particles of steel and grit. It was popularly supposed that a machine once adjusted to turn out a component of a certain size and shape was capable of reproducing such in large numbers, all absolutely identical. This was so far from being the case that no die, no drill, and no milling cutter actually made two consecutive articles of the same size. The wear of the cutters or dies proceeded slowly but surely, and it was only possible to produce in large numbers components of dimensions varying between a superior and an inferior limit. In small arm manufacture a variation of about one two-thousandth of an inch was about the amount tolerated, but it varied according to the size of the piece. A difference of diameter of one two-thousandth of an inch in the sight axis hole, and in the size of the pin or axis, would cause a serious misfit, whereas a similar difference in the measurement of the magazine, or of the recess in which it lay, would be quite immaterial. The operations of gauging, proving the barrel, and sighting, were successively described, as also the manufacture of the stock, which was of the wood known as Italian walnut, though largely grown in other countries. Among the smaller components, the screws were mentioned as being rapidly produced by the automatic screw-making machines of Pratt & Whitney.

The component store received the various finished parts, which numbered 1,591, or, including accessories, 1,863, and issued them to the foreman of the assembling shop. Theoretically, the assemblers should have nothing to do but to fit and screw them together, but in practice small adjustments were found necessary. The amount of correction was generally exceedingly small, and was done wherever possible with the aid of emery wheels. The completed arms were submitted to inspection and then issued in cases of twenty each to the Weedon government store or elsewhere.

The paper concluded with an account of the manufacture of swords and sword bayonets, which had recently been resuscitated in England.

ILLUMINATED walking sticks are among the latest applications of electricity. A small incandescent lamp is concealed in the head of a cane and can be ignited by a spring.