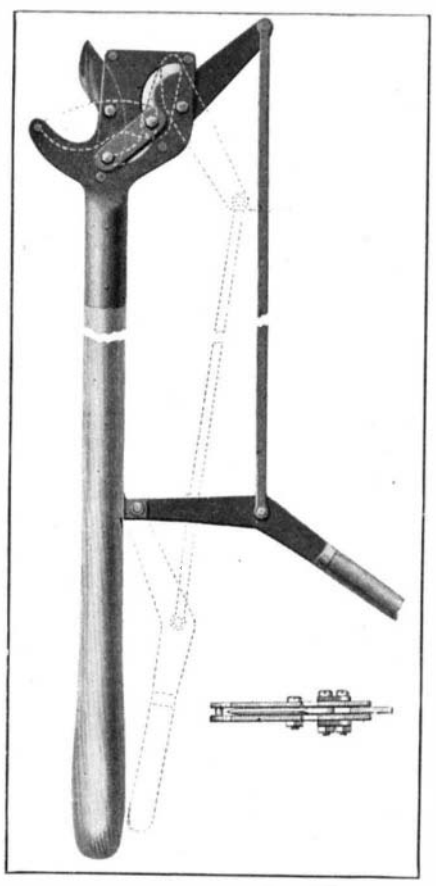
pounds, which are the best known of the English compound engines.

The "La France," as she is called, was built by the Societe Alsacienne de Constructions Mecaniques of Belfort, France. The firm is building a large number of the same type for the Chemin de Fer du Nord, on whose line between Calais and Paris some of the finest records of these engines have been made. The distance between these two cities, 184¾ miles, is covered in three hours and fifteen minutes, in which is included time for one stop for a change of engines.



NEW PRUNING SHEARS.

The Great Western compound was built and erected at Belfort, then dismantled and shipped to the Great Western Railway Company's shops at Swinden, where it was re-erected and put in service. The likeness between the English engine and those of the Chemin de Fer du Nord will be apparent at a glance to readers of the SCIENTIFIC AMERICAN, who are already familiar with the French engines from the illustrations which have appeared in this journal. In order to divide the total stresses, and keep down the size and weight and reciprocating parts, steam is expanded in four cylinders, two on the outside and two on the inside of the frames, the outer high-pressure cylinders, which are 13⅜ inches in diameter, being connected to the rear pair of driving wheels; and the two low-pressure cylinders, which are a fraction over 22 inches in diameter, being placed between the frames below the smokebox, and connecting to a pair of cranks formed in the axle of the forward driving wheels. Provision is made by means of a valve controlled from the cab, by which the engineer can at will admit high-pressure steam direct to the low-pressure cylinders, a three-way valve in the cab serving to operate auxiliary valves on the high-pressure cylinders, by which the exhaust steam from these cylinders may be turned directly into the blast pipe. When the engine is running compound, this exhaust passes through the auxiliary valves into the low-pressure cylinders. The valve gear is of the Walschaert type, and provision is made for independently controlling the distribution of steam to the high-pressure and low-pressure cylinders by the manipulation of the reversing gear, thus rendering possible a wide range of expansion to suit the conditions of service.

The boiler is of the Belpaire type, and is fitted with the Serve tubes, the total heating surface being about 2,500 square feet. Under a pressure of 227 pounds per square inch, the theoretical tractive effort of the engine is 28,814 pounds. The tender is of the regular English six-wheeled type, with a capacity of 3,000 gallons of water. It must be admitted that this engine is of very handsome contour and general appearance, the only exception being the external pipe that straddles the barrel of the boiler just forward of the steam dome. The performance of this locomotive will be studied with great interest by the locomotive engineers of Great Britain. It is true that they are already familiar with the splendid results obtained on French railroads; but at the same time it is realized that a true comparison with their own engines will only be possible when both the English and French type are running, as they will be on the Great Western Railroad, under exactly similar conditions of service.

NEW PRUNING SHEARS.

We show in the accompanying engraving an improved form of pruning shears which has recently been invented by Mr. Alfred S. Boyd, of Rockville, Ind. This shears belongs to the class adapted for trimming the surplus growth of shrubs and trees, and the improvement consists in a new construction which affords a very strong, light, compact, and easily operated shears that can be very cheaply manufactured. As illustrated, the shears consists of a cutter head secured to the end of a long handle or pole, and is operated by a lever conveniently secured near the opposite end of the pole. The cutter-head consists of two similar steel plates, which are shaped at one side to form a cutter jaw. A shear blade is mounted between these plates with its outer end projecting above the cutter jaw. At its inner end this blade is provided with a pin whose ends project through S-shaped slots formed in the plates. The pin is connected by two links to a pin similarly projecting through these slots and secured to a rock arm pivoted between the plates at the opposite ends of the cutter-head. This construction is shown in section in our detail view of the cutter-head. A rod connects the outer end of this arm with the operating lever at the lower end of the handle. By moving the operating lever outward the shears will be opened as shown by full lines in our illustration. The shearing blade may be made to close down between the edges of the stationary jaw, by swinging the operating handle inward to the position shown in dotted lines. It will be observed that this construction affords a compound leverage for actuation of the shear blades, which is very powerful, so that the shears may be worked with ease, and small limbs of trees or shrubbery be cut without excessive labor.

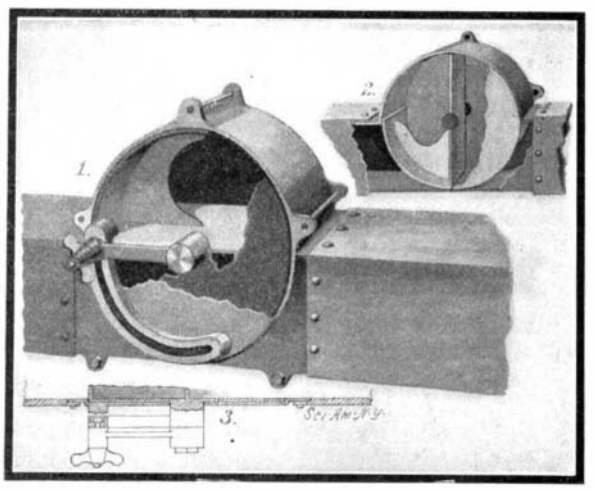
Death of the Oldest American Clockmaker.

On March 5, there passed away, at his home, in Dorchester, Mass., Edward Howard, the veteran clockmaker of America. Mr. Howard was born at Hingham, Mass., in 1813. In partnership with David Porter Davis, he established the first clock factory in this country, and later built the American Waltham Watch Works, at Waltham. Besides clocks, Messrs. Howard & Davis manufactured scales, and some of the first of these that they made were sold to the government and to various banks in 1849, for weighing California gold. Steam fire engines were a third object of this firm's activity. Mr. Howard was an inventor of note, and his is one of the few instances of an inventor living to the age of ninety years, and reaping the full fruit of his labors. At the time of his death he had not engaged in active business for the past twelve years, or since the incorporation of the great clock company bearing his name.

The figure of a huge elk constructed out of beans is one of the peculiar exhibits at the World's Fair. The bean elk comes from Ventura County, California.

AN IMPROVED GRAIN VALVE.

In designing a good grain valve, one is limited by certain requirements not met with in valves which are adapted to control the flow of fluids. The construction must be such that when the valve is being closed, it will not produce any shearing or crushing action on the grain, which would tend to break or smash the grains, and also the arrangement should be such that the grain can find no lodgment in any of the parts, and thereby choke the valve and prevent it from operating. These requirements are fulfilled in the valve which is illustrated herewith, and which is the invention of Mr. George J. Noth, of 913 West Fifth Street, Davenport, Iowa. The valve casing consists of a box, which fits at each end into the grain pipes or conduits, and whose upper wall is formed of a plate bent to the shape of a semi-cylinder. The side walls of the valve casing are outwardly offset, to receive two disks which form the side walls of the

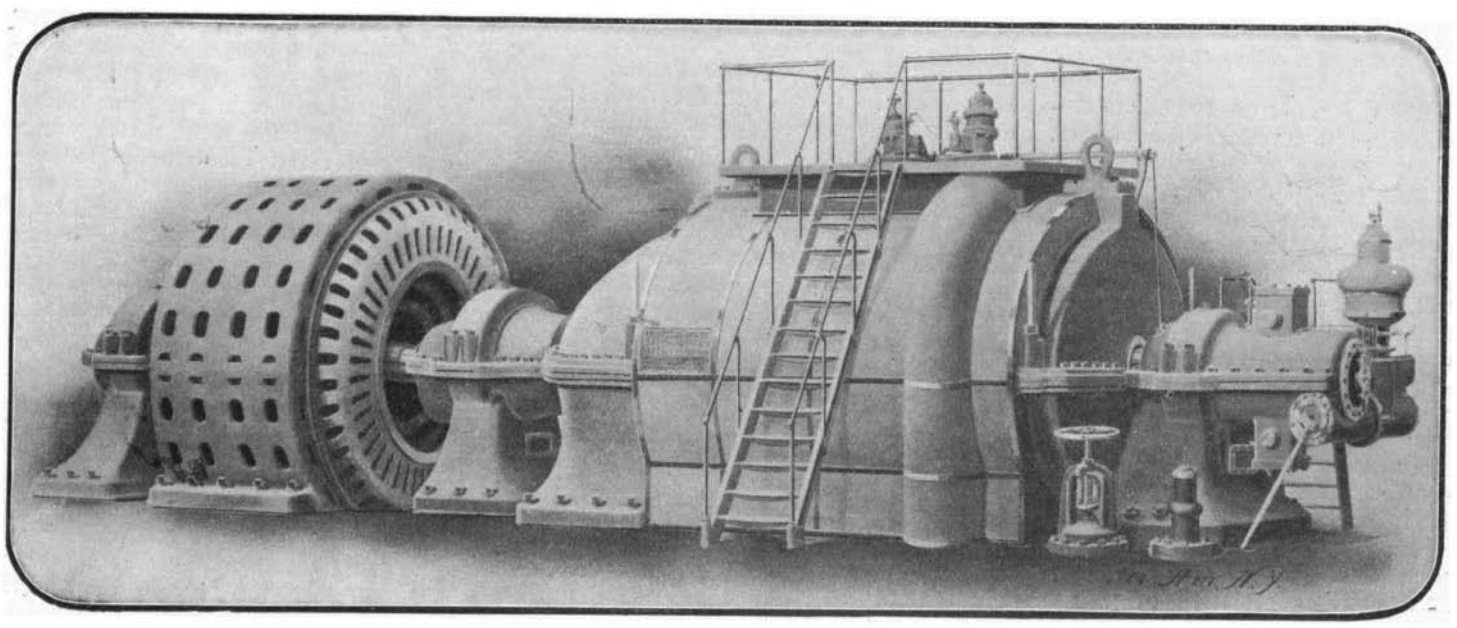


GRAIN VALVE.

valve proper. The purpose of this offset is to bring the surfaces of the disks flush with the walls of the casing, as shown in Fig. 3, and thus to prevent any lodgment of the grain at these points. The disks are connected by a diametrically-disposed plate, and also by a curved or quadrant plate, which extends from one end of the diametrical plate along the peripheries of the disks, through a little over a quarter of their circumference. The disks are formed with hubs, which find bearings in the side walls of the valve casing. Secured to the projecting end of one of these hubs is a lever which, at its outer end, carries a clamping bolt. The latter operates in a curved slot formed on the outer face of the valve casing, and provides a means for locking the valve in any desired position. In Fig. 1 the valve is shown in open position, with the diametrical plate lying horizontal, and offering no obstruction to the passage through the grain pipes or conduits. In bringing the valve to closed position, as shown in Fig. 2, it will be observed that the quadrant plate does not cross the path of the grain at a right angle during its entire movement; but it moves in an arc of 90 deg., approaching nearer to parallelism with the movement of the grain as the path is cut off.

STEAM TURBINE OF 11,000 HORSE-POWER.

When once the Parsons steam turbine had been introduced into this country, its development in size and power was very rapid. It will be remembered that the rights for the manufacture of this type in the United States were secured by the Westinghouse Company, and the sizes which they first constructed, some four or five years ago, were of 600-horse-power nominal capacity, direct-connected to 400-kilowatt, polyphase generators. The advantages of the steam turbine in economy and convenience, as shown by the subsequent operation of these first machines, were so substantial and unvarying that the company has not hesitated to sign contracts for the construction of turbines of 7,500-horse-power nominal capacity. These great machines, of which several are under construction for different concerns, will have a continuous overload



11,000-HORSE-POWER TURBO-GENERATOR FOR THE PENNSYLVANIA RAILROAD TERMINAL TUNNEL.

capacity of 11,000 horse-power in one self-contained unit, and they will therefore be comparable in power with the largest prime movers of the reciprocating type.

An idea of the compactness of the new turbo-generating unit, and of the simplicity and pleasing contour of the design, is obtained from the accompanying illustration, which represents one of several which are under construction for the great central power station of the new Pennsylvania Railroad tunnel from Jersey City to Long Island. These machines will furnish power for operating with electric locomotives the heavy Pullman trains which will enter the terminal station from the west, and also for running the elaborate system of suburban trains that will operate from the same station. Three complete 500-kilowatt units are also being built for the equipment of the power station of the Philadelphia Rapid Transit Subway system, which is now under construction. Eight units, with a combined turbine horse-power of 88,000, will furnish power for operating the London Underground system, while three 5,000-horse-power turbines are being built for the street railway system of the same city. All of these turbines will use steam at a working pressure of 174 pounds per square inch, with from 100 to 175 degrees of superheat, and they will be operated with the high vacuum which is a characteristic of the Parsons-Westinghouse turbine.

The advantages of economy of floor space characteristic of the steam turbine are strikingly illustrated in this large unit, for in spite of its maximum capacity of 11,000 horse-power, the space occupied by the turbine measures only 13 feet 3 inches by 27 feet 8 inches, which works out at 30 horse-power per square foot of floor area, based on the maximum overload capacity of 11,000 horse-power. It is not too much to say that the economy in space of the turbo-generator ranks second only to its economies of operation, as it requires only one-fourth of the space necessary for the most modern, vertical type of direct-connected, reciprocating units of equal electrical output. In units of say 1,000 electrical horse-power, the ratio of space occupied is as 1 to 10. The machine operates at the low speed for a turbine of 750 revolutions per minute.

The machine rests upon a single bedplate cast in two sections, which are held together by links shrunk on. Upon this bed-plate are bolted the pedestals, the generator casing, and the turbine body; but it may be mentioned, as a curious outcome of the fact that there are no reciprocating parts to disturb the equilibrium of the machine, that the bed-plate itself is not fastened to the foundations by foundation bolts, but depends for immobility upon its own weight. The barrel or cylinder is cast like the bed-plate in two sections, secured by shrunk-on links, and it is heavily lagged with non-conducting material.

The rotating parts consist of a central steel shaft, with a diameter at the journals, which are of the solid, self-aligning type, of 15 inches—a remarkable drop in dimensions from the 34-inch shafts of a cross-compound reciprocating engine of the same capacity. Upon this shaft is carried the mass of radial blades that form the rotating portion of this type of turbine.

Steam is led to the turbine successively through an automatic quick-closing throttle, a hand-throttle, a strainer, and the main admission valve. Provision is made for admitting high-pressure steam to the second stage of the turbine, when it is desired to increase its capacity by fifty per cent on overloads. The main admission valve is a double-beat poppet valve, controlled by a small pilot valve, that is actuated by the governor. The steam is admitted to the turbine in puffs, the duration of which is proportionate to the load. At the outer end of the turbine shaft is mounted a worm which drives a short, horizontal cross shaft that operates at one end an oil pump, and at the other end the governor. This pump supplies oil to all the journals.

At the time, two years ago, when the SCIENTIFIC AMERICAN illustrated the large 12,000-horse-power cross-compound reciprocating engines of the Manhattan Elevated central power station, in this city, we stated that probably these were the last engines of their size and kind that would be built for electric generation. If the great turbo-generators herewith illustrated show, as they undoubtedly will, the same and even higher economies than have been realized in the smaller units, they will undoubtedly become the future drive for electric power stations the world over.

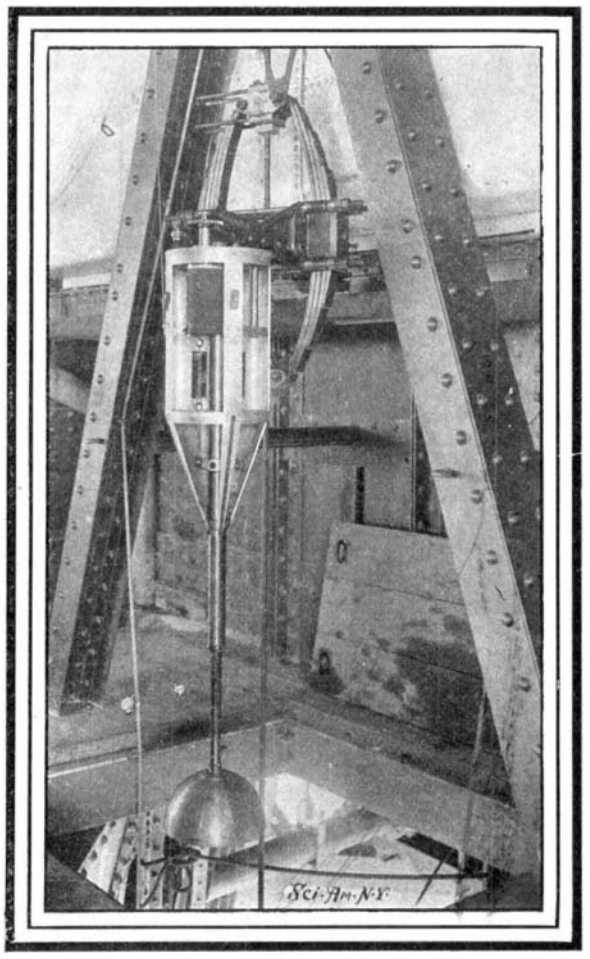
The Current Supplement.

A more interesting issue of the SUPPLEMENT than the current number, 1472, has rarely been published. Mr. John N. Cobb, one of the agents of the United States Fish Commission, discusses at length the sponge fishery of Florida and illustrates his text with many interesting photographs. Articles which will surely be read by the antiquarian are those on purses and on watch-dials. Dr. H. Schweitzer's paper on some new photographic chemicals is published. An excellent review of Blondlot's N-ray experiments is given. A consideration of calcium steel, the new rival of ceramic products, gives many a curious bit of information. Prof. D. I. Mendelejeff, whose name will be forever linked with the periodic law that he discovered, recently read a paper which he called "An Attempt at a Chemical Conception of Universal Ether." An abstract of this paper is published in the current SUPPLEMENT. Thomas W. Pritchard reviews the methods of distilling pine products now in use in our Southern States. "How to Build an Electric Oven" is the title of a practical article which will be found of value to amateur experimenters. The usual Engineering, Electrical, and Consular Notes will be found in their accustomed places.

EXPERIMENTS UPON THE PRESSURE OF WIND AT THE EIFFEL TOWER.

BY EMILE GUARINI.

Some very interesting experiments upon the resistance of the air have been recently made by M. G. Eiffel, at the tower which bears his name, by means of an apparatus of his invention which may be daily seen in operation when the air is calm. At a given signal, a cylinder carried by a double spring falls with great velocity from the second floor of the tower (that is to say, from a height of about 375 feet), along a vertical cable, and then progressively slows up, and stops without any shock at 3.28 feet from the ground, remaining attached to the cable. This cylinder, a part of which is conical, carries in front a plate which is thrust backward by the pressure of the wind during the fall. Such displacement compresses an accurately tared spring which measures the pressure and inscribes it upon a registering drum, the revolution of which is regulated by the fall itself. The ordinary inscribing style is replaced by a tuning-fork that makes 100 vibrations a second. When the apparatus is opened, there is therefore found inscribed upon the drum an undulating curve that gives for every point the height of the fall, the pressure acting at this moment, and the velocity, within an approximation of a hundredth of a second. This is the first time that one and the same apparatus has continuously indicated these various results from the zero velocity to that of 130 feet a second, which is that of the most violent winds.



APPARATUS FOR MEASURING THE PRESSURE OF WIND.

As the pressure device may be of any form and size whatever (a normal or oblique plane, a cone, sphere or cylinder), the apparatus is capable of giving more accurate and certain results than have hitherto been obtained in experiments on the resistance that the air offers to a moving body, and which is nothing else than the pressure of the wind upon a stationary body.

Such determination presents great practical interest, either as regards the utilization of the pressure of the wind as a motor, or the resisting of it, as becomes necessary in the practice of the profession of the engineer and in experiments with dirigible balloons.

In order to complete the description of the apparatus, the principle of which has just been indicated, it suffices to add that in order to diminish the effect of the velocity of this mass of 265 pounds moving at the rate of 130 feet a second, say nearly 90 miles an hour, the frame of the apparatus is carried by a very powerful double spring which slides freely along the cable as far as to within 65 feet of the ground, at which point the diameter of the cable progressively widens and the double spring also is forced to widen, and then exerts a pressure upon the cable and, through its friction, gradually diminishes the velocity.

The experiments have shown that the pressure of the wind is notably less than that admitted up to the present. After they have been finished, this question, which has hitherto been very uncertain, will have made an important progress and have demonstrated once again the services that the Eiffel tower is capable of rendering to science.

Engineering Notes.

The North-Eastern Railroad of Great Britain has been experimenting with a new system of illumination for its railroad cars. The advantage of this system is that no wick is required, and there is a complete absence of smoke and smell. In this method gasoline is poured into a receiver which contains a specially prepared and patented absorbent block; this block absorbs the spirit, which in passing through it is vaporized. When the lamp is turned on, this vapor comes into contact with an ordinary incandescent mantle, and a brilliant flame of 50 candle power is obtained. One charge of the lamp furnishes enough gasoline vapor to last for eleven hours continuous light.

It is shown by the experiments of Dr. M. Ennslin (see Dingler's Polytechnisches Journal, Vol. 318, Nos. 50 and 51, 1903), that there exists a proportionality between the load and the elastic deflection up to a limit beyond which the latter will go on more slowly than the load. The total deflection, on the contrary, will increase more rapidly than the loads from a given value of the latter. It is shown that the coefficient of elasticity of the disks investigated is partly greater and partly smaller than the one of bars from the same material, this being most likely due to the following reasons: (1) The inaccurate knowledge of the longitudinal tension, as well as of the constants of elasticity, of the material in three perpendicular directions. (2) A singular state of internal stress, as due to the rolling process which is altered by annealing. (3) The influence of transverse strains on the deflection of the disk. Neglecting the latter would result in the coefficient of elasticity of the disk being found smaller than that of tension bars. Revising the theory of circular disks, he concludes that any objections which might be raised are incapable of exerting any material influence on the figures found by experiment. In order to establish a still more satisfactory accord between experiment and theory, the isotropy of the material should be more fully accounted for. The accuracy of the theoretical results within the limits of proportionality may anyhow be said to be sufficient from a practical point of view, but the author is not able to draw any conclusions with regard to the behavior of circular plates beyond these limits.

An interesting railroad relic, reminiscent of the first days of the steam locomotive, has been discovered in the north of England. The Liverpool & Manchester Railroad Company, the first public road constructed, it will be remembered, inaugurated a competition in the latter part of the twenties of the past century for a locomotive, in which Stephenson and other inventors participated. Three engines—the "Rocket," by Stephenson; the "Sans Pareil," by Hackworth, and the "Novelty," by Braithwaite and Ericsson respectively—participated in the trials that were carried out in 1830. As is well known, Stephenson's "Rocket" secured the award of $2,500 which was offered, as being the most suitable engine attaining a speed of 29 miles per hour. The "Sans Pareil" was second with a speed of 23 miles per hour, while the "Novelty" withdrew from the trials owing to the joints of the boiler giving way when the locomotive had traveled only three miles. Both the "Rocket" and the "Sans Pareil" are now preserved in the South Kensington Museum, but the "Novelty" mysteriously disappeared and was never found again until quite recently. It appears that Ericsson was so mortified by the failure of his conception, that he left it with his friend, Mr. Melling, who possessed engineering works located upon a space adjoining the Rainhill Station. These works were subsequently dismantled and the premises were occupied by the Rainhill Gas and Water Company. The "Novelty" was thus lost sight of, but it has now been recognized working as a stationary engine, the wheels having been removed for this purpose, and its identity thus somewhat disguised. Attempts are to be made to secure this third premier locomotive, and to place it alongside of its two contemporaries in the South Kensington Museum.