PNEUMATIC CLOCKS.

Compressed air, which has for some time past formed an important factor in mining, diving, marine engineering, locomotion, and analogous uses, has lately been utilized in a very ingenious manner in operating all the clocks of a city or district simultaneously. Some time since we gave an illustration and description of a pneumatic clock exhibited at the Paris Exhibition and in public use at Vienna. The entire mechanism of a pneumatic clock system, as in use at present at Paris, consists of three distinct parts: the central clock, the receiving clocks, and the tubes for conveying compressed air to the several receiving clocks. At the central station air is compressed to a pressure of about five atmospheres by means of a double piston compressor, and is stored in a large tank of about twenty-five cubic feet capacity. From this main reservoir the compressed air is conducted into a second reservoir, in which its pressure is regulated at seven tenths of an atmosphere by means of a very simple automatic contrivance. Every minute this distributing reservoir is placed in communication with the distributing tubes by means of a distributing clock, shown in Fig. 1.

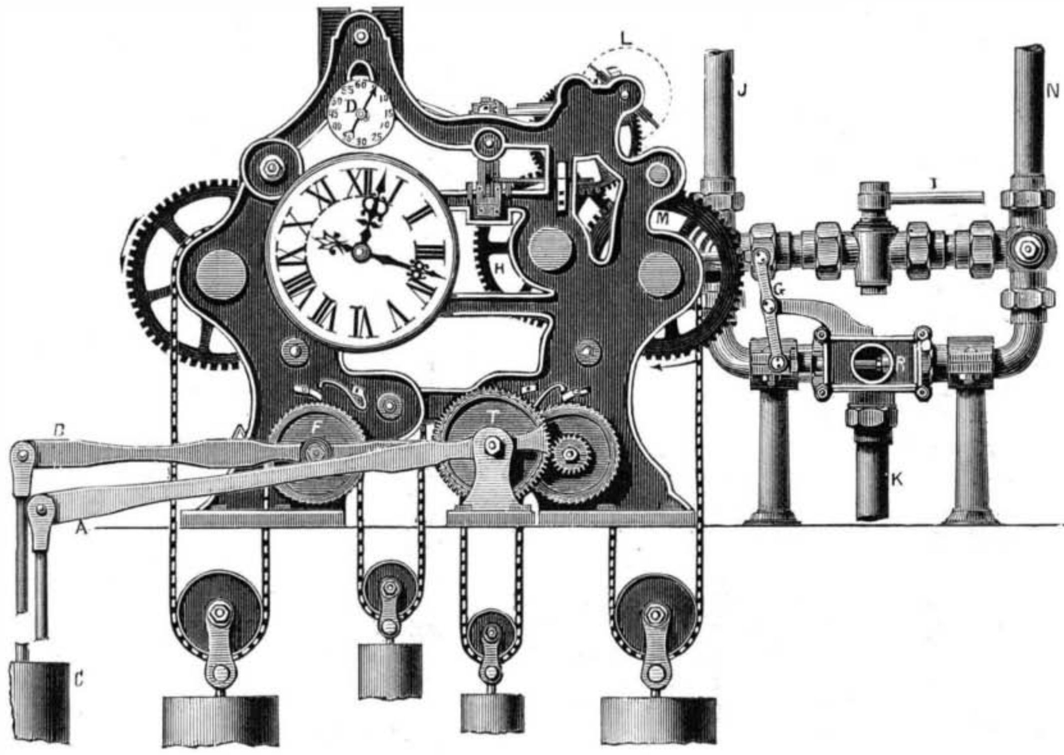

Fig. 1.—DISTRIBUTING CLOCK.

In the annexed engravings, which we take from *La Nature*, the works on the left hand side are those of an ordinary clock, and the mechanism on the right hand side operates the distributing slide valve, R. The second dial of this clockwork is at D. At the beginning of every minute the compressed air from the distributing reservoir is admitted into the distributing box through the tube, J, and is conveyed to the distributing tubes by the tube, N. After about twenty seconds a movement of the lever, G, places the slide valve into its second position, and the tube, N, is in communication with the tube, K, which opens into the air, when the tube, J, is then neither in communication with the tube, R, nor with N. The slide valve, R, rests in this position for forty seconds, that is, until the minute is completed, when another displacement, as described above, establishes a communication between J and N. The compressed air is also used to wind up the weights of the clockwork, by means of the cylinders, C, and levers, A and B, as shown in Fig. 1. The slide valve, R, which may be replaced by a three-way cock, I, is actuated by the clockworks, which are adjusted and regulated every day or hour from the observatory. The central station is provided with duplicate apparatus, so that if one distributing clock is out of order or disturbed in any way the other can be set in operation in a few seconds. The tube, N, is connected with the several mains which convey the compressed air into the various districts or precincts into which the city is divided. The mains are made of wrought iron, are about one and one sixteenth of an inch in diameter, and are connected with lead tubes three fifths of an inch in diameter, for conveying the air into the houses. The tubes leading to the several stories are one quarter inch in diameter, and are connected with lead or rubber tubes one eighth inch in diameter, communicating with the several clocks and preferably colored the same as the wall paper or woodwork of the room, so as not to be easily perceptible. With a pressure of seven tenths of an atmosphere, and permitting the compressed air to pass through the tubes for twenty seconds, any number of clocks can be operated at a distance of one to two miles from the central station.

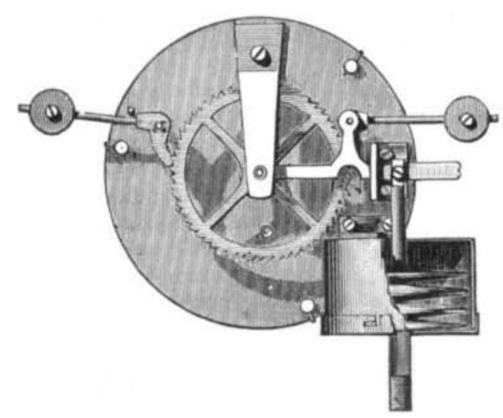

Fig. 2.—RECEIVING CLOCK.

The mechanism of the receiving clocks, shown in Fig. 2, is alike in all cases, and is entirely independent of the size of the dial or the location of the clock. A small bellows, resembling that used in pneumatic call bells, is in communication with the tubes conducting the compressed air from the central office. Every minute the pressure of the air raises the bellows, and a rod attached to the upper bellows-head actuates a lever which engages with a wheel provided with 60 teeth, which is rigidly secured to the minute hand arbor. The wheel rotates the distance of one tooth every minute, and a weighted pawl on the other side of the dial checks this movement. The hour hand is rotated by means of the usual dial wheels. By means of a second bellows the clocks may be arranged to strike. The ordinary spring and weight clocks can be easily transformed into pneumatic receiving clocks.

Many of the principal hotels, railway stations, public offices, courts, etc., of Paris, are provided with the pneumatic clock; and public pillar or street clocks, which are illuminated at night, have been erected in several parts of the city. We are informed that a company has been organized in the city of New York for the purpose of introducing the pneumatic clocks into this and other cities.

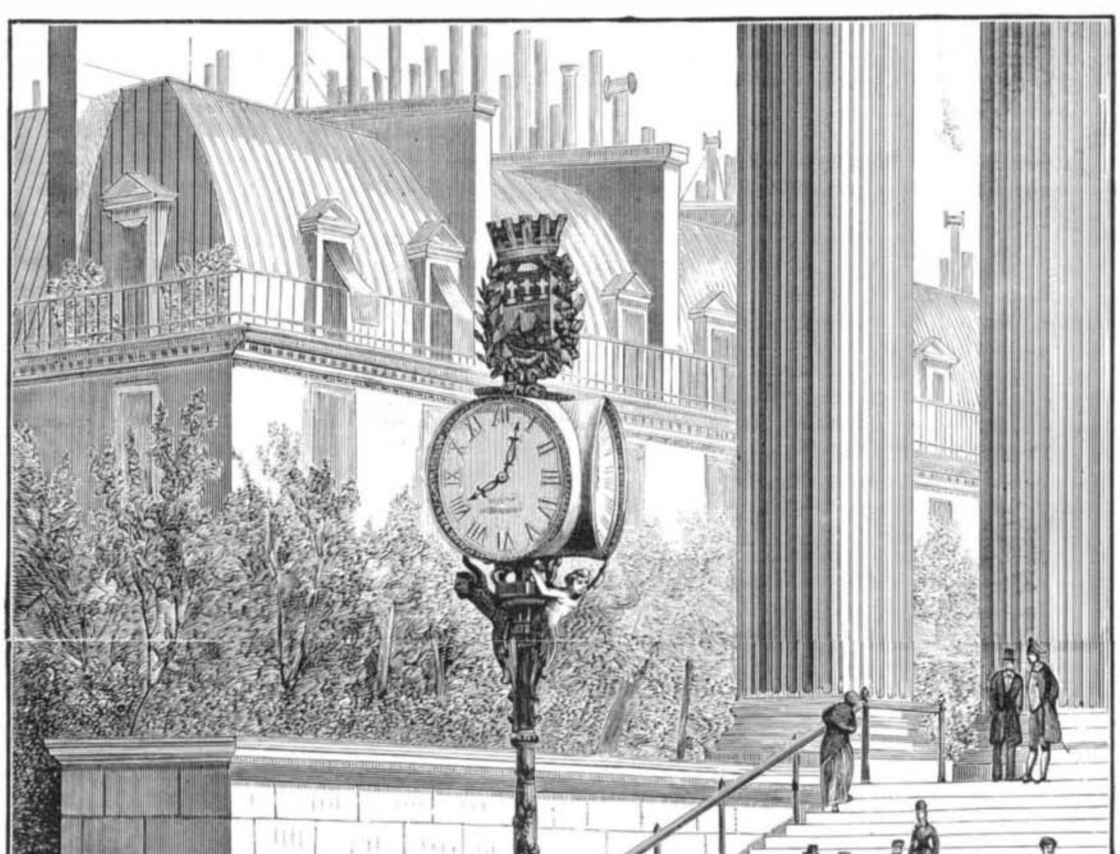

Fig. 3.—STREET CLOCK.

ENGINEERING INVENTIONS.

Messrs. Youngblood & Holmes, of New Orleans, La., have patented a simple device for preventing the collection of scale on the crown sheet of a boiler. It consists of a pan arranged immediately over the grate bars on the bottom of boiler, and partly covered and provided with discharge pipe to prevent the deposit of scales on the boiler sheet and carry them into the mud drum.

Improvements in the construction and arrangement of the devices for opening and closing the lock gates and sluice gates of canal locks, have been patented by Mr. Thomas Milette, of Three Rivers, Quebec, Canada. The object of these improvements is to facilitate the working of the gates and to furnish a water way or sluice under the floor and lock gates for the entrance and emission of the water.

Mr. Charles A. Read, of Bridgeport, Conn., has patented an improved water meter and motor, which is so constructed as to run with little friction, to be sensitive to the least motion of the water, and to have very little leakage.

Mr. Henry Case, of Brooklyn, N. Y., has invented an improved apparatus for sinking and removing piles. It consists of one or more tubes with suitable couplings, by means of which forced currents of water may be made to create auxiliary currents to act directly upon the submarine bottom beneath and about piles or other objects, so that the sand, mud, gravel, etc., are washed away, allowing the pile or obstruction to sink or admitting of its being more readily raised.

Mr. Samuel L. Marsden, of New Haven, Conn., has patented an adjustable device for correcting and compensating the wear on the pitman bearings, toggle bearings, toggles, and movable jaw or jaws of stone breakers and crushers like that of Blake and others. The invention consists of an adjustable toggle block provided with a rounded convex or concave back, and of a toggle block wedge provided with a concave or convex face, in which concavity or convexity the back of the toggle block fits, the said toggle block being vertically adjustable by means of a screw or screws, and being capable of a laterally rocking motion because of its articulation with the toggle block wedge. This invention is designed to compensate both for the direct and angular wear.

Mr. Henry Case, of Brooklyn, N. Y., has patented a breakwater that combines lightness, durability, cheapness, and effectiveness. The invention consists of a latticed or perforated sloping roof supported on piles that project above the water line, and of gratings fixed between the piles and extending above and below the water line on the sea front of the breakwater, the said structure being protected from injury from floating ice and other objects by spring piles, and further protected and secured by chains that, on the sea-front, are loosely stretched from the structure itself down to supplementary piles that are sunk entirely below the water line, the said spring piles and supplementary piles and chains forming part of the device.

AMERICAN INDUSTRIES—No. 48.

THE MANUFACTURE OF VULCANIZED RUBBER FABRICS.

Volumes have been written about the early history of the rubber manufacture, and the experiences of the great inventor who made its success his life's work. But those already familiar with this remarkable record will always have an appreciative ear for a brief reference thereto, while the generation which has arisen since the final triumph of Charles Goodyear was in everybody's mouth may be impelled thereby to study more closely a narrative of such surpassing interest to all mechanics. Among inventors and patentees especially, the thrilling story will ever awaken profound attention: how this yellowish white sap of a tropical tree, turned to gum by evaporation—originally called India rubber because it came from India and was used to *rub* out pencil marks—had baffled the efforts of the leading scientists of the world by its singular chemical properties, only to be at last worked up by an American mechanic into a substance adapted to a greater variety of uses than almost any other product of man's skill; with what untiring zeal and through what manifold difficulties he labored many years for what practical men deemed a chimera; the expensive litigation to which he was put to defend his patents when success had been fairly won, so that even the award of the gold medal at Paris, in 1855, accompanied by the Grand Cross of the Legion of Honor, found him in a debtor's prison—down to his final triumph in "the great India rubber case," when the legal declaration of his rights was finally reached through the last efforts in public life of Daniel Webster, but a few weeks before the death of the latter at Marshfield—all of these details, trite as may be the facts to many men now in middle life, can never fail to come home with touching eloquence to every American citizen, and to her mechanics and artisans especially.

The industry of which the manufacturing details are represented in our first page illustrations this week, from sketches taken at the works of the New York Belting and Packing Company, at Newtown, Conn., is one of the monuments of Charles Goodyear's success. This is the largest manufactory of the kind in the world, and the making of vulcanized rubber fabrics adapted to mechanical purposes is here carried on in a way which indicates the full fruition of his anticipations, whether we consider the quantity and variety of goods made, or the highly important relations which these productions hold to all industrial pursuits, for in many cases they meet wants never before satisfied, and fit needs for which no equally good substitute could be devised. The articles regularly manufactured at this factory include bands or belting for running machinery, from the largest belts ever made down to the smallest sizes in use; packing, to make tight joints in pumps, engines, etc., where the work is either in water, steam, or compressed air, together with a variety of valves, gaskets, and rings for similar use; hose for fire engines and watering gardens, besides heavy steam and brewers' hose; wagon and car springs, gas tubing, solid vulcanite emery wheels, corrugated matting and mats, cushions for billiard tables, etc. A full list of their productions would, indeed, make a formidable catalogue, but the interest therein to the general reader would be enhanced by the reflection that in so few years a comparatively unknown substance had come to play so important a part in our industries.

In giving a description of the process of manufacture, the first consideration is the condition of the crude material as it reaches the factory. Raw rubber comes from South and Central America, Africa, and the East Indies, but the principal supply for the United States, and the highest priced article, is from Para, at the mouth of the Amazon. The trees which furnish it are large, and are tapped much in the same way as we do the sugar maple here. The sap, which has a milky appearance, being collected in large quantities, flat wooden forms of various shapes, but about one foot across, are dipped into it, and then dried in the dense smoke made by a fire from a kind of nut found abundantly there. This operation is repeated until the successive layers make a coating about an inch thick, when they are cut from the wooden forms and the raw rubber is ready for market. Different kinds of cure are adopted in other places, so that the rubber is not so much discolored, but the impurities contained in raw rubber usually amount to about 20 per cent of its weight. The first operation at the factory, therefore, is to cut and tear it up, and, after soaking in warm water, carefully wash and clean it, when it must be thoroughly dried; it next goes to the mixing department, where, by repeatedly working it over, sulphur and the oxides of various metals are incorporated with it; the rubber, now in the form of rough and jagged sheets, passes to powerful calendering machines where it is pressed into smooth and regular strips or sheets as long or short or as thick or thin as may be desired for the various uses to which it is to be put. In this shape it is ready to be worked into belting, hose, packing, and all varieties of articles made, but while it is in this condition the ultimate shape of the fabric to be produced must be given it. The final operation is the vulcanizing, or tempering, in immense heaters, where the degree of heat and time employed must be very carefully regulated. In fact this principle has to be kept well in mind during all the preceding operations, the grinders, rollers, etc., being all hollow cylinders, steam heated according to the requirements of the special work in hand.

In our illustrations the titles of the several views will enable the reader to clearly distinguish the respective operations. The "washer and sheeter," as shown at the top of the page, represents a large vat where the rubber is cut into small pieces by a wheel with numerous sharp knives revolving in the water, which at the same time knead the rubber, something after the manner of preparing pulp in paper making. By this process all dirt and foreign substances are expelled, leaving only the pure rubber, which next goes to the sheeter in small fragments, loosely adhering together. The view shows only one of several powerful machines employed, which consist of large hollow cylinders of cast iron revolving in opposite directions, by which the rubber is pressed and kneaded into thick sheets or mats. Unless the rubber appears to be exceptionally clean, it is, previous to the washing, passed through another machine, not shown in our illustrations, and known as a "cracker." This machine has large, deeply-grooved iron cylinders, which revolve in pairs, slowly and heavily, grinding the tough rubber and driving out bark and dust, while they also stretch it so that other foreign substances drop out.

The rubber having been thus thoroughly cleaned and left in the form of rough sheets, must be hung up for a considerable period to dry, after which it goes to the mixing machines, as shown in the adjoining picture. In this department the character of the product to be produced is principally determined, for the different varieties of rubber for particular uses have each their several mixtures, according to what experience has demonstrated to be the best. The various substances here incorporated with the rubber include sulphur, the oxides of lead, zinc, iron, etc., the proportions differing for each class of goods, and each particular compound calling for a treatment adapted thereto in the after stages of manufacture. The value of long experience in the business, and a thorough acquaintance with all that science can teach in relation thereto, is here most signally appreciated. The workman has his box of mixture furnished him by weight, just so much for a given quantity of rubber, and then, taking the rough sheets as they come from the drying room, he passes them between the heated iron cylinders of the mixing machine, slowly feeding in, also, the mixture which is to be incorporated with the rubber. The same sheet is passed through many times, until the compound has been thoroughly and evenly worked into it, the degree of heat at which the cylinders are kept being all the while closely regulated.

After this process the rubber goes to the calendering department, one of the large machines for which is shown to the left at the bottom of the page. These are heavier than calendering machines generally, and the one represented is the largest ever made for this purpose. The rollers are hollow, and so fitted up for steam heating that the temperature can be kept as desired. The rubber is here rolled a great many times, some of it being passed through in sheets and strips, pure, and some with the rubber pressed upon a web of heavy cotton duck, previously coated with rubber driven through and through its meshes by powerful machinery. The fabric used for this purpose is made expressly for the establishment, so as to give it more than double the strength of the heavy cotton duck used for sails for ships. The cotton fabrics thus combined with the rubber give the belting and hose thus made their great tensile strength, which, in hose, where the tests can be most accurately made by gauging the exact pressure to the square inch, has been proven to be about twice that of leather.

For belt making, the rubber coated and impregnated duck is taken to a large department where this branch of the business is carried on, and unrolled upon tables one hundred feet long, where the workmen cut it accurately to the required width. One strip is cut so that, folded, it will make the width of belt, and another so that the wide strip will just fold over its edges and meet in the middle, which makes a three-ply belt. In this way the strips are passed between a series of powerful rollers, the temperature of which is evenly regulated, as in all the other operations; the folding over at the sides makes an even and perfectly regular edge, and at the middle, where the edges of the outside strip come together, a narrow ribbon of rubber is fed to cover exactly the line of meeting. In this way the entire outside of the belt is pressed by the heated rollers into an even, regular surface.

The thicknesses of the regular sizes of rubber belts for most machine work are three-ply and four-ply, although two-ply belts are also made. The three-ply is generally compared with the heaviest single leather belts, and the four-ply with double leather belts. In making four-ply rubber belts, or in heavier ones when ordered, the width of the outside strip is calculated according to the two or more thicknesses over which it must be folded, and the operation then proceeds as in making the three-ply.

As the rubber surfaces, before being vulcanized, would stick together, they are rolled up with a thickness of duck between, and the rolling machine has an attachment which rolls up this fabric as the machine is fed.

Our engraving gives but an incomplete idea of the room which these operations take up, for the long lengths of belting which have to be prepared previous to going into the machine have then to be carried forward into the vulcanizing heater, and this operation must be continuous from the commencement until the vulcanizing process is complete. The company is now making an elevator belt thirty-six inches wide and half a mile long, which will weigh over eighteen thousand pounds. All of the great grain elevator belts in the country are of rubber, and the company have some of their big belts in Chicago elevators which have been running perfectly for twelve years. The metallic compound with which the rubber for belts is prepared gives its surface a high degree of firmness, while there is yet sufficient elasticity to allow of its hugging the pulley closely, which all machinists understand is necessary to enable a belt to work well; in the compound, also, as well as in the vulcanizing, attention is directed to making a belt which will resist a high degree of heat, so that the surface may not be injured by friction. All mechanics will understand that in putting on belts they should be stretched as tightly as possible, and in large belts, where joints are strengthened by overlapping a thin piece of rubber or leather, the seam side should always be outside; the closer the contact of the belt with the pulley, and the more perfect the exclusion of air from between belt and pulley, the better the service.

For the hose-making department, the general features of which are represented in one of our views, the rubber has its different and particular compounds in the mixing machine, and in the calendering is united with the fabrics suited to the different kinds of goods made here. The lengths and widths required are cut much the same way as in the preparation of belting, and then fitted over cylinders of 25 and 50 feet in length, which are rolled against other cylinders to press together and make solid the laps and joints under a powerful pressure and the requisite degree of heat. These forming cylinders remain in the lengths of hose until the vulcanizing is completed. A great many kinds of hose are made, two-ply being the thinnest, and the sizes from half inch to 10 inches internal diameter; hydrant hose is three-ply, and ordinary engine hose, to stand a pressure of 100 to 150 lb. to a square inch, is four-ply. Their "test" hose, made on carbolized duck for fire-engine service, will stand a pressure of 400 lb. per square inch. The advantage of rubber hose over that made of leather, aside from its much higher tensile strength, lies in the fact that it requires no care, only to be hung up to dry after use, while leather hose must frequently be "stuffed" with oil and tallow, etc., after the manner a currier finishes leather, only the stuffing must be forced inside the hose, making the operation more difficult. For these reasons the use of leather hose is steadily being relegated to the small country towns where only hand engines are used and where the volunteer firemen have ample time to devote to leather dressing.

In addition to the above, the New York Belting and Packing Company manufacture suction hose, and steamer and brewers' hose, on spiral wire, one variety of which has the wire entirely embedded in the rubber, so that the interior is perfectly smooth.

The illustration showing where the square packing is made ready for vulcanizing gives only one of many different operations connected with this branch. The rubber is furnished in sheets and plates of different sizes and shapes for regular articles, either pure or with cloth insertion, but where irregular shapes and forms are wanted, which cannot be cut out of the standard products, they must be made in moulds, not cast, as many suppose, and the rubber, after having been prepared by mixing and otherwise, as in the other operations, must be pressed into the moulds. In this way the corrugated matting, stair pads, car springs, etc., are made. The demand for this packing in steam work, to pack around piston rods, and wherever there is a joint where the metal is subjected to different degrees of temperature, in valves, etc., is enormous, and only an engineer who has had experience with the materials formerly used for this purpose can fully realize its value for such use.

The making of gas tubes, shown in one of the views, presents no substantial difference in principle from hose making. This tubing is made either pure or with cloth insertion.

An important specialty of the business of the company is the making of solid vulcanite emery wheels, in which just enough rubber is used to firmly hold together the particles of emery. It requires powerful machinery to thoroughly work the compound into a homogeneous mass, after which it is rolled into sheets, cut into wheels of the desired size and form, and pressed into iron moulds, when it is ready for vulcanizing. These wheels are of the nature of stone throughout, and nearly as hard as cast iron. They can be used either wet or dry, but by allowing water to drip on them while in use their cutting properties will sometimes be improved, and dust will be avoided.

The concluding operation of all the above processes, however, is the vulcanizing, a representation of two of the heaters for which is given in one of the views. To leave off this portion of the manufacture, and this was the point which gave Charles Goodyear the most of his trouble—all the preceding labor would be thrown away. Each article made must have just so much heat and no more, and be subjected