sured fact in this city. Trains that ordinarily came into the city in perhaps two sections came in divisions with several sections in each division. Saturday 100,000 extra visitors must have come to the city, and on Sunday at least as many more arrived. Meantime the citizens had prepared a welcome by decorating the leading buildings in the business center. On Sunday there was the largest attendance within the grounds of any Sunday by nearly double, the number of paid admissions being 88,000, but there were no indications in the grounds of the great day to come. The only thing unusual about the park was the crowds. Crowds were everywhere, and many people were not fortunate enough to even secure a cot or a table to sleep on. In places down town many people are reported to have paid a dollar for the privilege of having a chair to sit in all night.

Monday the gates at the Exposition grounds were thrown open at six o'clock, although heretofore eight o'clock has been the hour of opening. Even this hour was not too early for many of the new comers who were seeing the Exposition for the first time. An important feature of the attendance was the number of Chicago citizens who purchased tickets, went to the grounds and entered the gates so their presence should be recorded, then immediately turned about and returned home. Chicago pride was the main incentive for this, so that the day should be the high tide mark in attendance, but another consideration was that this day, the twenty-second anniversary of the great fire which laid almost the entire city in ashes, should be a memorable one, so far as its observance was concerned.

Then, again, a large attendance guaranteed a sufficient sum in the treasury to pay off all obligations and leave the Exposition free from debt.

The formal exercises of the day began at ten o'clock, and some of the important features of the programme were: a fanfare of universal peace by eight buglers from the regular army, who were stationed at different points about the basin, and sounded the notes of peace; a chorus of eight hundred voices, that sang the national hymns of the countries of Europe and the most popular of standard American tunes; the ringing of the Liberty bell; and representation of the different States of the nation by school children. The great event was the parade of floats, which took place at sundown. This was followed by a grand display of fireworks, the leading figure being a representation of the burning of Chicago, covering 14,000 feet of space, and representing four scenes, the O'Leary cow, the cow kicking over the lamp, the fire starting and sweeping everything before it, and the city in ruins.

The Liberty bell was rung by a rope composed of contributions of fiber of all kinds from all corners of the earth, and comprising all kinds of vegetable and animal fibers, from hemp and manila to silk and scalp locks and braids of hair from Indians. Two old fire engines, survivors of the great conflagration, were conspicuous reminders of the event the celebration commomorated. Pokagon, a son of the Indian who sold the site of Chicago to the whites for three cents an acre, was conspicuous among the special guests of the day and made an address, and John Young, a son of the Pottawatomie Indian from whom Chicago was named, was also present. The original treaty granting the land to the whites, which has been carefully preserved to this day, was one of the precious relics of the day that was exhibited.

On the following morning the official announcement of the previous day's attendance was 713,646 in paid admissions, 682,587 full admissions and 31,059 children, while the 37,380 passes swelled the total attendance to 751,026. The crowds were handled with remarkable success, but the numbers were too great, and premiums were paid even for a foothold on street cars, and many men clambered to the roofs of the cars, a sight that has not been seen in Chicago for many years.

The number of paid admissions from May 1 to October 12 amounted to 16,803,955. The attendance on Chicago day (October 10) being 703,021. The attendance at the greatest day in Paris, 1889, was only 397,150.

The New York Pasteur Institute.

The new building of the New York Pasteur Institute, West Central Park and Ninety-seventh Street, was formally opened October 9, the inaugural address being delivered by Dr. Paul Gibier, the director of the institute, who is one of the most distinguished pupils of Pasteur. For several years the Pasteur Institute was maintained at almost the sole charge of Dr. Gibier, who has an extensive practice among the Franco-American population of New York. At length a subscription was raised and the present fine building erected. The institute is five stories high and is built of brick and stone. The building is constructed on scientific principles and all the latest improvements introduced in the laboratories of Pasteur, Charcot and Brown-Sequard have been adopted here. Bedrooms for patients who pay and for those who are treated gratuitously are provided in sufficient number to accommodate the maximum number of patients who have already been treated at one time. On the roof are rooms built of asphalt, to contain the rabbits and other animals used in experiments. Various medicinal baths are also provided. Dr. Gibier came to the United States in 1888 to study yellow fever. In New York the following year it was proposed to him to establish an anti-rabie and bacteriologic institute, and the present fine building is a just recognition of the value of his labors.

A NEW STEAM TURBINE.

Steam has been found to be the medium best adapted for converting heat into mechanical work; its low price, simple means of production, good chemical qualities, the ease with which it is reduced to a liquid state and the comparatively small dimensions of the appliances needed, have caused its decided preference to other gases. During several generations work has been progressing in all civilized countries for the development of the steam engine; and yet invention in this field is far from having reached perfection. Each year the consumption of steam per horse power is reduced by a fraction; each new number of the technical journals brings information of new and improved constructions of steam engines. Every constructor of engines knows that here is a vast field for the persevering work of man. To this the results of the last decade bear testimony.

Concerning the theoretical conditions for a favorable conversion of heat into mechanical work, viz., high initial temperature and high pressure, the possibilities of their being accomplished in the steam engine are very limited. The strength of the boilers is even now put to severe tests by the high pressure, and the sensitive parts of the engine cannot endure the high temperatures which might be desirable. The sides of the cylinder, being alternately heated and cooled, communicate to the steam an average temperature which is lower than that of the live steam, and the consequence is a rapid condensation and consequent loss of energy during the period of admission of steam. Efforts have been made to overcome this difficulty by surrounding the cylinder with a steam jacket, or by dividing the expansion into several cylinders, in order to reduce the variations of temperature and the consequent total condensation to a minimum. Thus compound triple and quadruple expansions have been evolved, necessitating more movable parts of machinery and increasing the passive resistance. It has long been the aim of inventors to effect the expansion of steam necessary for economy of fuel by means of less complicated machinery and to avoid the oscillating movement. For the results attained through the investigations of one of them we will give an account below.

De Laval's steam turbine, which forms the subject of our first page illustration, is in principle exactly similar to the well-known axial jet turbine for water, being so arranged that the steam has acquired the same pressure as the surrounding atmosphere before reaching the turbine wheel, thus converting its entire capacity for work into momentum.

The steam passes between the blades of the turbine at a constant relative velocity and in a clear jet, without any disposition to further change its pressure or specific gravity. The consequence is that the movement of the steam in the turbine is according to the same laws as for water, and the blades of the turbine can, therefore, be constructed in the same manner as if designed for water.

Some idea of the size of the steam turbine may be obtained by reference to the lower figure of our first page engraving, which represents, actual size, the wheel of a twenty horse power steam engine now running at the World's Columbian Exposition, at Chicago, driving a duplex dynamo. This wheel is journaled in a steam-tight casing, in which are located the nozzles supplying steam to the turbine. The blades against which the steam strikes are made thin at the edge to reduce the resistance to the flow of steam. In this turbine steam is expanded to the pressure of the surrounding medium before arriving at the blades. This expansion takes place in the nozzle, and is caused by making the sides of the nozzle divergent. As the steam passes through the nozzle its volume is increased in greater proportion than the cross section of the jet, thus causing an increase in velocity. With an initial pressure of seventy-five pounds, and an expansion to the pressure of one atmosphere, the final velocity of the steam is about two thousand six hundred and twenty-five feet per second. If the expansion is continued to the pressure of one-tenth of an atmosphere, the resulting velocity will be about four thousand six hundred feet per second. It will thus be seen that expansion is carried much farther in this steam turbine than in ordinary steam engines.

The wheel is made of steel, the blades being cut out of the solid material by means of a milling machine. A steel ring is shrunk on the periphery of the wheel to prevent the steam from passing over the ends of the blades. It also serves to oppose the tendency of the turbine to act as a fan.

With the greatest possible care, it has been found difficult to perfectly balance the wheel. To meet this difficulty the inventor has placed the wheel upon a flexible shaft, so that the turbine when running at a high rate of speed adjusts itself and revolves on its true center of gravity, the center line of the shaft meanwhile describing a surface of revolution. If the shaft were rigid, the vibrations of the turbine wheel would be communicated to its bearings, which would heat and be liable to cutting.

The turbine wheel shaft extends into the gearing box and carries a pinion, 3, as shown in the detached view of the wheel and shaft. This pinion, which is double, engages a double cog wheel in the box, the pinion on the turbine shaft being one-tenth the diameter of the driven wheel, so that the speed of the latter is one-tenth of that of the turbine wheel, or two thousand revolutions per minute.

In the gearing box of a larger turbine the speed is reduced from 30,000 revolutions to 3,000 by means of a driver on the turbine shafts which set in motion a cog wheel of ten times its own diameter. These gearings are provided with spiral cogs carefully cut and placed at an angle of about 45°. On account of the high velocity, all tensions caused by the transmission of power are very slight; consequently, the cogs can be quite small, which is one of the conditions for even running of the gearing. The shaft of the larger cog wheel, running at a speed of 3,000 revolutions, is provided at its outer end with a pulley for the further transmission of power.

The turbine box of the large machine contains eight nozzles, of which four can be opened or closed by means of independent valves, according to the power required. The more exact regulation is effected by the governor. The turbine, therefore, can be made to work at the same pressure and degree of expansion even if the effect is varied as 2 : 1. The nozzles are easily accessible for removal and exchange, if required. The journals and gearing are lubricated from the oil cups on top of the gearing box. This machine is intended to work with condensation. A vacuum is obtained by means of any ordinary condenser. The nozzles are strongly divergent toward the opening, and the entire turbine box made perfectly tight.

The speed of the turbine is controlled by a very sensitive governor on the shaft of the larger gear wheels. The segment weights or wings are movable on knife edges with the least possible friction. When the governor revolves, the weights diverge their inner ends, push a pin forward, this pin in turn causing the cut-off of the steam through the movement of a balanced valve in the steam supply pipe at the top of the turbine. A spiral spring inclosed in the governor keeps the weight in a state of equilibrium at a speed of 3,000 revolutions. It consequently corresponds to the weight of the collar on pendulum governors. The exhaust steam is taken from the center of the turbine box.

This turbine is applied to all uses to which ordinary reciprocating engines are applied, but in the running of dynamos, and in other uses requiring uniform speed, it has proved itself superior to reciprocating engines.

This engine is on exhibition at the Swedish Section, K 22, Machinery Hall, World's Columbian Exposition, Chicago, where the inventor, Dr. Gustaf de Laval, is represented by Mr. Reinh. Hornell.

Working Harveyized Armor Plate.

The naval authorities are experiencing difficulty in preparing the Harveyized armor plates for use. Although the Harvey plate has beaten all others, as is generally conceded, it is a question whether the plates can be successfully fastened to the vessels without impairing their high efficiency. The Harveyized plates are so much superior in hardness to plain and nickel steel plates that the tools used heretofore are useless. The armor for the Maine has recently been supplied by the Bethlehem Company, but the constructors have not as yet discovered any feasible method of fastening on the armor without cutting out spaces and drilling to fasten the plates to the side. With the Harveyized plate the tools will do the cutting after the steel has been softened. It is believed that this local softening of the steel will weaken the steel so that its qualities will be reduced to those of nickel plate. Another point is also brought forward: the late Mr. Harvey received $96,000 for the right to use his process, and the department is also paying a royalty of one cent a pound for all Harveyized plate, so that the new armor plate is already very expensive and will be doubly so if certain parts require to be re-treated. The matter is being investigated, and it is hoped that some method will be devised for putting on the armor plate without the necessity of an expensive operation which doubtless injures the value of the plate.

A WATERPROOF preparation for coating walls, paper, and other fabrics, and water supply pipes. The composition is manufactured by dissolving shellac or resin in methylated spirit with application of heat. To the partially cooled solution lead carbonate and carbolic acid are added.

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