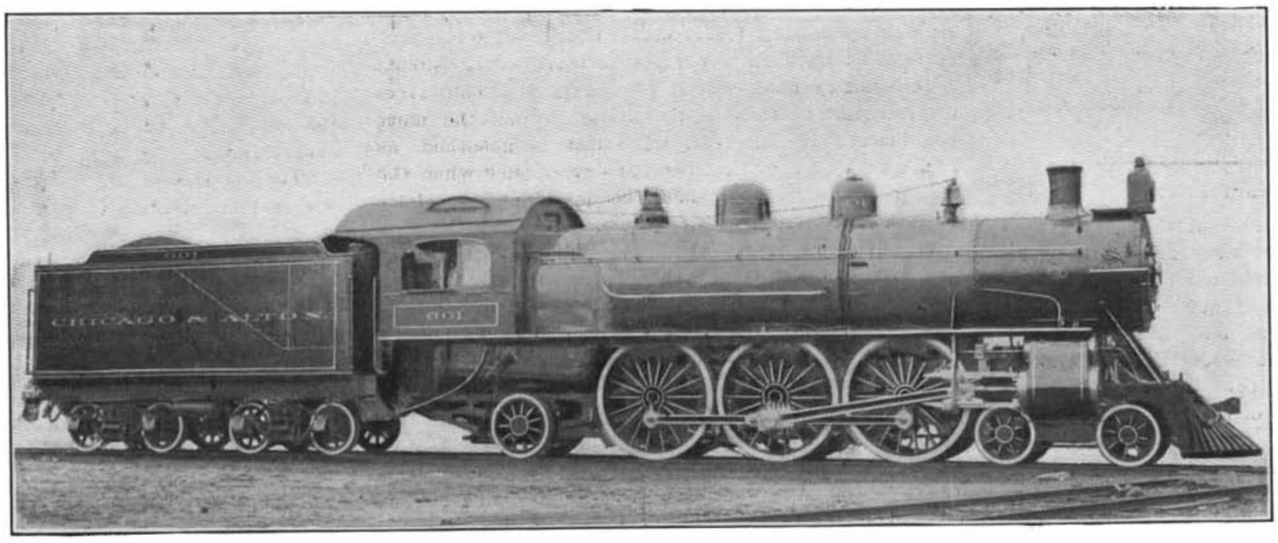
THE MOST POWERFUL EXPRESS PASSENGER LOCOMOTIVE.

The Scientific American has duly illustrated and described, from time to time, the most powerful passenger locomotive as each engine, which was qualified to bear this title, has made its appearance. At present the largest and most powerful express engine in existence is the one shown in the accompanying illustration, which has just been built by the Baldwin Locomotive Works for the Chicago & Alton Railway. This and a sister engine have been built especially for the heavy passenger excursion trains which will be run in connection with the St. Louis Exposition.



THE MOST POWERFUL EXPRESS PASSENGER LOCOMOTIVE.

Cylinders, 22 x 28-inch; driving wheels, 80-inch; heating surface, 4,078 square feet; weight, 219,500 pounds.

With a view to determining the best type of engine for this particular service, the Chicago & Alton Railway borrowed and tested some of the most powerful passenger engines in the United States. They found that, big as some of these were, they were still not equal to the heavy exactions of the proposed service, and accordingly a design of an engine heavier and more powerful than any of its kind in existence was drawn up. Hence, it will be seen that the *raison d'etre* of these enormous engines, so far from being any foolish desire to build the biggest engines in the world, is to be found in the extraordinary exigencies of the traffic which the road will have to handle when the Exposition opens.

The duty of these engines will be to haul trains made up of twelve passenger cars, and weighing about 600 tons exclusive of passengers and baggage. Such a train will accommodate 760 people, whose aggregate weight would not be less than 57 tons, and estimating their baggage at 15 tons, the total weight of the train behind the engine will be 675 tons. Such a train will have to be hauled 110½ miles in two and one-half hours, making two stops and three slowdowns for railway crossings. This will reduce the actual running time to two hours and twenty-four minutes, and necessitate an average running speed of 46 miles per hour.

The most powerful locomotive used in the preliminary test was a Prairie type engine, with six-coupled wheels, 20½ x 28-inch cylinders, 80-inch drivers, 33,043 square feet of heating surface, and 34,990 pounds tractive power. From the results obtained it was decided that to do the work an engine fifteen per cent more powerful than this was needed, and accordingly the present mammoth locomotives were built. The cylinders are 22 inches in diameter by 28 inches stroke; the driving wheels are 80 inches in diameter, and the working steam pressure is 220 pounds to the square inch. The engine is carried on twelve wheels, a forward truck, six connected driving wheels, and a trailer beneath the firebox. The total weight on the driving wheels is 141,700 pounds. On the front truck the weight is 36,300 pounds, and on the trailing wheels 41,500 pounds, the total weight of engine being 219,500 pounds, and the total weight of the engine and tender is about 374,000 pounds. The tender, which has a capacity of 8,400 gallons of water and 9 tons of coal, is the largest yet built by the Baldwin Company. The boiler is of the straight type and 70 inches in diameter, with 328 2¼-inch tubes 20 feet in length. The firebox is 9 feet long by 6 feet wide, 6 feet deep at the front, and 5 feet, 4 inches deep at the back. There are 202 square feet of heating surface in the firebox, 3,848 square feet in the tubes, and 28 square feet in the firebrick tubes, making a total of 4,078 square feet of heating surface, or 500 square feet more than the New York Central express engines possess. The grate area is 54 square feet. A remarkable feature, which in itself is illustrative of the great size of these engines, is the smokebox, which is no less than 8 feet, 5 inches in length. The tractive effort is 31,600 pounds; that is, if the tender drawbar were attached to a dynamometer, it would register over 15 tons.

A NEW ELECTRICAL FIRE ENGINE.

BY A. FREDERICK COLLINS.

In view of the fact that electricity has invaded the domain of every art, science, and industry, it seems not a little strange that the electric fire engine has but recently been invented. At Rouen, France, not long since, some public tests of this type of engine were made, and it proved so eminently satisfactory that this continental municipality at once adopted it.

This new system of fire extinguishers offers among others the following advantages: (*a*) in three or four minutes after reaching a fire it is ready to operate; (*b*) it is extremely light and therefore good time may be made; (*c*) no coal or fire or water is required for raising steam; (*d*) there is an absence of noise, cinders, heat, smoke, etc; (*e*) there is no boiler to clean and no danger from explosion; (*f*) it is less expensive in its initial cost than the steam fire engine and is cheaper to maintain; and (*g*) it requires practically no attention when in operation.

The first electric fire engine constructed at Rouen is shown in the accompanying engraving and consists of an eight horse power electric motor coupled direct to a pump, both of which are on the same plane; the motor makes about 2,000 revolutions per minute and is wound for a 525-volt direct current.

When the electric fire engine is in action, the current is tapped by means of a movable bamboo perch, one end of which is fastened to the truck carrying the equipment and the opposite end is simply poised on one of the overhead trolley wires, or, at night contact may be made with the electric lighting cables.

The feed wire is rolled on a reel above the motor, as shown; the circuit is completed by a similarly arranged wire wound on an adjacent reel; the free end of this wire terminates in a block of cast-iron placed on one of the rails of the street railway tracks.

AN ELECTRIC FIRE ENGINE.

These are the principal parts of the equipment, but there are some other necessary devices including a general interrupter, two circuit breakers, a reversing commutator and other accessories. The apparatus complete is arranged on a two-wheeled, one-horse cart.

The hose is carried on a separate cart coupled to the electric fire engine, and the reel carries 660 feet of hose. The reels upon which the conducting wires are wound carry approximately 660 feet of rubber-insulated wire, so that connection may be effected without difficulty, and it is obvious that water can be projected to a distance of 1,320 feet from the point at which electrical connection is made.

The total weight of the complete apparatus is 2,288 pounds, including that of the two firemen seated on the engine, against 9,760 pounds of a standard La France steam fire engine, such as is called for by the specifications of the Borough of Manhattan (New York city); of course an allowance must be made for the difference in horse power between the Rouen electric fire engine and the Manhattan steam engine, since the former is only eight horse power and the latter is twenty-two horse power, but the ratio of increase in weight per horse power is very small in the electric fire engine.

The dimensions of the one under consideration are as follows: length, 3 feet, 3½ inches; width, 1 foot 8 inches; height, 1 foot, 3 inches. Compared with these figures, the dimensions of a steam fire engine seem abnormally large, viz.: the boiler is 64 inches in height, and 30 inches in diameter.

With water under ordinary pressure from a hydrant, a stream was forced to a height of 145 feet, whereas the normal hydrant pressure would have projected the water to a height of only 49 feet. In the electric fire engine a centrifugal pump is employed; the diameter of the nozzle, which ejected 77 gallons of water per minute, was 7-10 of an inch; the diameter of the hose was 1¾ inches.

To improve the electric fire engine by operating not only the pumps but the traction as well by electric motors would seem but a short step. This would do away, not only with the steam engine, but the horse as well. Capt. John Kenlon, of engine 72, Manhattan, offered a valuable suggestion when he said to the writer, recently, that municipalities in giving franchises to street railway and electric light companies should stipulate in the contract that leads should be run from their circuits to every fire plug on the route. Then electric fire engines could be adopted, the pumps of which could be operated by merely slipping a spring jack into contact with the leads terminating in some portion of the fire plug, while the traction could be obtained by means of a motor and storage battery, just as with automobile trucks.

One of the most troublesome duties attendant upon a steam fire engine is that of supplying it with coal. If the fire is of longer duration than thirty minutes, coal must be had from some supply depot, and this is not only often difficult to obtain but it is very expensive as well. This, with the cost of feeding the three horses required to draw the heavy engine, is excessive, and can be reduced nearly three-fourths when the electric fire engine takes the place of the steam engine.

In this age of electricity there is no doubt but that the new electric method will speedily supplant the old steam engine system; just as the steam fire engine took the place of the older hand pump.

After prolonged negotiations the British Postal Department has sanctioned the connection of Marconi's wireless telegraph station at Poldhu, Cornwall, with the nearest postal telegraph station, so that now continuous communication is possible between the Marconi and State systems. The government had previously offered the Marconi company a private wire from Poldhu to London, but this was insufficient, as with the development of the system it will be necessary to have telegraph wires communicating between the wireless stations and various important provincial centers. This is the first official recognition by the British postoffice of Marconi's invention, and it is anticipated that this concession will in a short time be extended so as to provide the wireless telegraph system with the same advantages already accruing to the cable companies in the transmission of messages from London to Canada and this country.

The Latest About the Edison Battery.

The long delay in the appearance upon the market of the widely heralded Edison storage battery has given many persons an impression that in the development of the invention Mr. Edison ran up against some "snags." What the difficulties met with have been has so far remained dark, but some recent utterances of the inventor and a number of recently issued patents throw some light on this subject.

In the first place, the nominal capacity has been reduced from that given in the first description of the new cell by Dr. Kennelly before the American Institute of Electrical Engineers about two years ago, and with the present rating the Edison battery is hardly equal to the best lead batteries as regards specific capacity. As the amount of energy which a certain quantity of the active material is capable of storing is invariable, it must be inferred that it was found expedient to reduce the proportion of active material to the total weight of the cell. This inference is confirmed by one of the patents referred to, in which it is stated that the oxidizable element of the cell swells considerably during the process of charging, resulting in the bulging out of the walls of the sheet steel pockets which retain the active material. This necessitated a greater space between adjacent plates, which space had to be filled with electrolyte, thus adding to the weight. Possibly the same action necessitated heavier retaining walls. The present invention aims to overcome this difficulty, but it evidently accomplishes the object only in part, for, although it may not be necessary to space the plates as widely with concave pocket walls as with straight walls, the concave walled pockets will hold less active material, which would seem to reduce the capacity.

The subject of the other patent is a new admixture of conducting material for the active material. Originally fine flake graphite was used for this purpose. It is now proposed to mix the finely divided iron with mercury and copper, which is claimed to have the same effect on the conductivity of the active material as the graphite, and in addition keeps up the voltage toward the end of the discharge.—The Horseless Age.

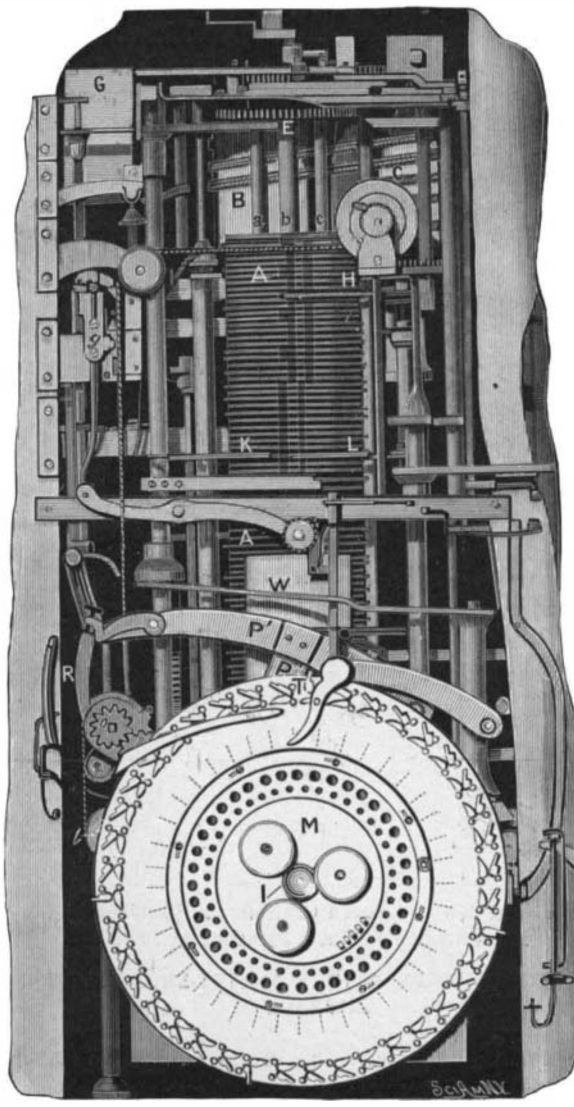
New Statistics of the Weight of the Human Brain.

Prof. Marchand, of Marburg, publishes the statistics of the largest number of brain weights so far collected. His analysis includes 1,169 cases. The average weight of the brain at the birth of a male child, according to Prof. Marchand, is 360 grammes; of that of a female child 353 grammes. He concludes that the lesser weight of a woman's brain is not alone dependent on her smaller stature, for a comparison of both sexes of the same height shows that the male brain is invariably heavier. In a growing child, until it reaches a height of 70 centimeters, the brain weight increases proportionately with the body length, regardless of age or sex. After this the male brain begins to outstrip the female. The maximum weight is attained about the twentieth year, at which age that of the male averages about 1,400 grammes. The female maximum is usually reached about the seventeenth year, when the average is 1,275 grammes.

A new graving dock is to be built at Belfast, Ireland, at a cost of $1,500,000. It will be 750 feet long, 96 feet wide at the entrance, and 100 feet wide at the bottom. The depth will be 32 feet from the blocks to ordinary high-water level, and some 4 feet 6 inches will be allowed for the blocks.

THE JAQUET-DROZ ANDROIDS.

The famous Jaquet-Droz automatons, created in the eighteenth century by a father and son of that name, may have been heard of but probably have never been seen by or described to few, if any, of our readers.



Interior Mechanism of the Writer.

We give, therefore, in this issue, a brief general description of the mechanism of one of the androids, which description we have succeeded in obtaining from their present owner, Mr. Henri Martin, of Dresden, Germany. In the current issue of the SUPPLEMENT will be found a more general description of the androids and of the wonderful feats they performed.

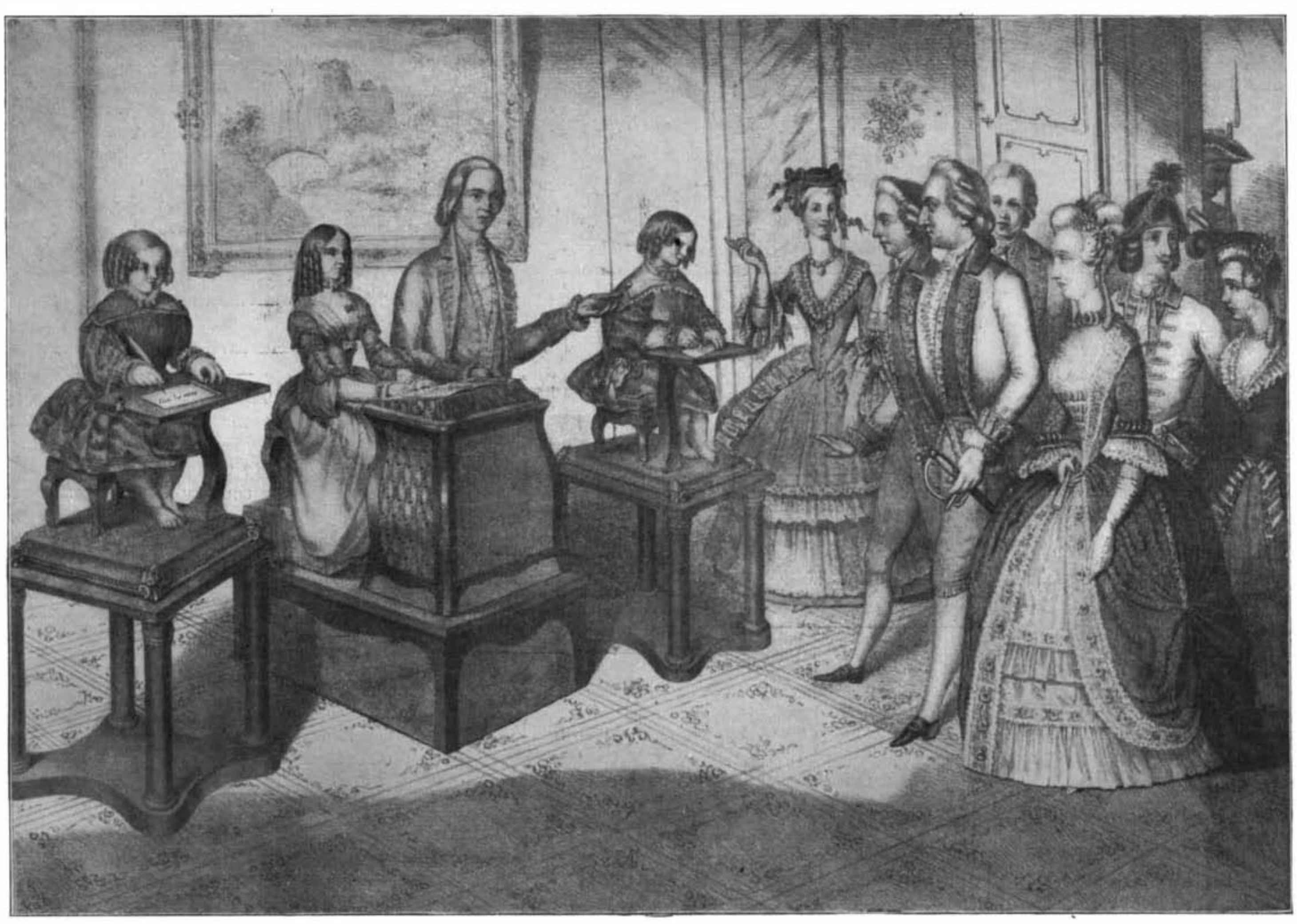
The mechanism, as shown in the cut, is that of the "Writer," built by Jaquet-Droz the elder. The engraving presents a view of the same when the automaton is opened at the back. It is actuated by two movements, an upper one and a lower one. The latter constitutes, as it were, the thinking element, inasmuch as it makes the desired letters and all the necessary preparations, whereupon the upper movement executes the letters proper. Both movements are connected in such a manner that they never operate simultaneously, but that one arrests the other, if it is to act itself.

The barrel, *B*, of the upper movement is connected with the fusee, *C*, by means of a chain, in such a way that, during the winding, the chain unwinds from the former onto the fusee, thus tightening the spring in the drum and causing the movement to start. The motion of the barrel, *B*, is transmitted by means of the gear wheel, *E*, mounted upon the axle, *b*, of the letter cylinder, *A*. At *G*, is the regulator, a fly, which is governed by special stops. From this fly a stop extends downward to the fly of the lower movement in such a manner that when the upper one is free, the lower one is arrested, and *vice versa*.

We will next consider the mechanism of the lower movement. On the arbor, *I*, is mounted the letter disk *M*, consisting of three annular plates connected to each other. Of these plates only the exterior one is visible. The one situated next to this is toothed, while the third one has recesses for the inclined planes. The movement of the disks is simultaneous. The pitch of the inclined planes governs the height to which the driving cam, *P*, is lifted for each letter, and is, therefore, different in each case.

The cam, *P*, is attached to the lever, *P'*. At the end of *P'* is the arm, *R*, to which a double chain is made fast. This chain is led over the pulley, *l*, and around the arbor, *I*, in such a way that it and a similar chain, coming from the other side, cause the loose arbor, *I*, to revolve according as the lever, *P'*, with its cam *P*, is lifted by means of the inclined planes. From this it follows that *I* must make a small or large portion of a whole revolution with each letter. The regulation of these revolutions is accomplished by the teeth, *T*, around the edge of disk, *M*, each pair of which corresponds to a letter or punctuation mark.

Let us now turn to the upper movement. This causes, when the lower one stops, a complete revolution of the wheel, *E*. With this wheel are connected the three rods, *a*, *b*, *c*, so that *b* turns on its axis when *E* revolves. On *b* are mounted 120 eccentric disks, which are maintained in their position by the rods *a* and *c*, in such a manner that the whole eccentric column may be moved up and down on the rods, *a*, *b*, *c*, but at the same time follows the revolution of the rod *b*, on its axis. Each of these disks is specially shaped for a letter corresponding to it. The three levers, *H*, *K*, *L*, bear upon these disks and transmit the motion obtained from them to the right arm and hand. Their motion is a four-fold one: (1) horizontal, moving forward and backward; (2) horizontal, moving right and left; (3) oblique and also arched, resulting from a combination of the first two; and (4) vertical motion. The shapes of the eccentrics have been determined by laborious trials. From the above it will be seen that three disks are necessary to trace one letter. During one revolution the three levers work simultaneously or interruptedly as the eccentrics direct them. The eccentrics are, because of their connection with the crank, through the inclined planes, and because of their perfect adjustment, lifted so accurately in line with the three levers that the latter,



The Writer. The Musician. The Draughtsman.

THE AUTOMATONS OF JAQUET-DROZ EXHIBITED AT THE COURT OF LOUIS XV.—From an old lithograph.