and at the same time affect the regulation of the general system to as slight a degree as is consistent with good service. To meet the condition of high efficiency, it is evident that the motor should operate continuously at or near its full load capacity and be designed especially for the work it has to perform. For a continuous full load condition, the work must of necessity be constant at all points in the lift, and the nearest possible approach to this was secured by the adoption of the continuous rope or balanced system, where the load is reduced to the weight of the rock alone. Then to secure the necessary variations in speed an induction motor with a non-induction resistance in both primary and secondary was developed. The resistance being varied by the introduction of a modified form of the ordinary street car controller. With an equipment of this kind the cages are started slowly and the dip in line voltage is comparatively slight, being about 7 per cent at starting. By running on the second notch of controller one-third of the maximum speed may be maintained for the full length of the shaft.

The hoist itself, as will be observed in the accompanying photographs, consists essentially of a main driving drum and an idler around which the rope is wrapped four times in order to secure the necessary friction for lifting. From the main driving drum, the rope is carried over the head sheave, down one compartment, under a movable tail sheave, back the second compartment over a second head sheave and on to the driving drum. One cage is inserted between the ends of the cable and the other fastened by means of heavy iron clamps, one above and one below the cage in the adjacent compartment. This simple arrangement allows of varying the relative position of the cages at pleasure and also permits us to use one cage in a single compartment without reference to the other.

The hoist is necessarily a geared machine, the motor speed being reduced by the introduction of cut gearing. To the main drum is attached a brake ring upon which is operated a heavy post brake. This brake is set automatically by means of a heavy weight and is released by hydraulic pressure. In the case of the Yellow Jacket and Belcher, there are two hoists side by side, both being operated by one motor. One of these is intended for the vertical shaft and the other for the incline, which leaves the vertical at the point where the vein intersects it. Double deck cages used in each compartment of the vertical shafts and a two-ton self-dumping giraffe in each compartment of the inclines.

The hoists have been erected in the most substantial manner upon concrete foundations and there is practically no vibration and very little noise.

The Yellow Jacket hoist was a success from the start and was operated for more than a month with a single cage in one compartment. This is the severest test to which the hoist can be subjected, and under these conditions the performance is as near perfection as any hoist I have ever seen. Tests were made during this time and the following are the results:

Weight of cage....	1,200	pounds.
" " car	850	"
" " rock	1,600	"
Total weight lifted.....	3,650	"

Maximum rope speed, 600 feet per minute. Length of vertical lift, 1,175 feet. Time of hoisting, 2 minutes 10 seconds from the moment the load was started until cage was landed on chairs, at the surface. Time to accelerate load, 8 seconds. Power required as per watt meter readings was 88.40 horse power. Theoretical power required, 66.40 horse power. Efficiency of system is therefore about 75 per cent, and this includes motor deficiency and all friction losses from secondary of transformers. Secondary voltage was 525 volts before starting and the running voltage slightly over 500. The maximum current per phase at starting was 180 amperes, and 85 amperes when operating at full load. A reading was also taken while lifting the empty cage at 600 feet per minute and the wattmeter showed 48 horse power. It will therefore be seen that the results obtained are remarkably good, and no trouble should be experienced with a hoist of this character upon any well regulated plant. At a future date I will take pleasure in submitting data when these hoists are operated under balanced conditions. In conclusion, therefore, I will add that the successful operation of this hoist is a decided advance in mine hoisting; not alone in the high efficiency secured, but also in the large capacity as compared with the size of the motor in use. Of course, there are cases to which this system is not adapted, but wherever it is applicable, it is certainly worthy of serious consideration where economical operation is a feature of the development.

All four of the above hoists were built by the Risdon Iron Works, of San Francisco, and that firm publish a pamphlet with controller and torque diagram which will interest anyone interested in mine hoisting. The cut attached is from the experimental model submitted to the writer. All four hoists are built so that the speed can be doubled, using two motors instead of one.

THE MANUFACTURE OF BLOWN GLASS—LAMP CHIMNEYS.

In an article published in the SCIENTIFIC AMERICAN of May 18, 1901, we described the manufacture of plate glass as carried out at the Charleroi Works of the Pittsburg Plate Glass Company. The present article is devoted to the description of another great branch of the glass industry, known generically as blown glass. We saw that in the manufacture of plate glass, the mixture is first melted, then rolled into plate form on a table and finally ground down to the required thickness and polished. In the blown glass industry, the molten mass is formed into the required shape by an entirely different process, known as "blowing," a process which is nothing more or less than that by which a child forms its soap bubbles by blowing through a pipe upon the bowl of which is a film of soapsuds, the blown bubble in the case of the glass being molded, while hot, to the particular shapes required. Although the forms into which blown glass is worked up are endless, the general methods of manufacture are the same, and a description of any first-class works, such as that of the lamp chimney works of Macbeth-Evans Glass Company at Charleroi, which forms the subject of the present article, is illustrative of the blown glass industry in general.

Perhaps the most important feature in the manufacture of lamp chimneys or, indeed, of any form of glassware, is the mixing of the ingredients. As in the case of plate glass, the body of the mixture consists of a sand which is as nearly pure silica as can be obtained. The sand is quarried from silica rock, then thoroughly ground and sifted through a 40-mesh screen, the material being received at the works in the prepared condition. The second most important ingredient is litharge; while potash and soda are used as fluxes. When the above mixture is used for the best quality of lamp chimneys, about 50 per cent of the total is silica. The sand is melted in what is known as the "furnace," a large conical structure which is fired by gas from beneath and contains some 14 to 16 large melting pots, which are molded from a specially prepared and very carefully kneaded pot-clay. The melting pots are generally 44 inches in their largest diameter, and 50 inches in height. They are arranged in a circle within the furnace, each one opposite a door of the kind shown in our illustration. It takes twenty-four hours to melt the contents of a pot of the size just described. Ordinarily the contents are made up of part of the prepared mixture and part "cullett," i. e., glass left over from previous days of operations.

The blowing is done with a long iron tube, known as the blow-pipe, which has a mouth-piece at one end, and is swelled out and thickened into a bell-mouth form at the lower end. In the process of blowing, the operator dips the thickened end into the melting pot and twists it around until it has gathered up a ball of molten glass of the desired size. The blow-pipe is then withdrawn from the furnace and the ball of glass is rolled out to a conical shape on a plate and slightly inflated by blowing through the tube. The blow-pipe is then handed to the second operator, who completes the operation of blowing. The bubble, if we may so call it, of glass, is thicker and heavier at its lower end, and to secure the elongated form necessary in lamp chimneys the operator swings the blow-pipe to and fro, thus causing the bubble to stretch by its own weight. By thus alternately swinging and blowing he brings the bubble to the required length, and approximately to the required diameter, and then places it within a hinged mold, which is opened to receive it, either by himself or one of his assistants. He then twists the pipe and blows at the same time, thus pressing the glass against the inner walls of the mold. The tube with the molded chimney attached is then withdrawn from the mold, and handed to another operator, who, with a pair of spring tongs, forms the flaring top of the lamp chimney and marks a sharp depression just outside its base where it is to be broken away from the blow-pipe. Although a large amount of blowing is done by hand and mouth, increasing use is being made of what is known as the Owens Blowing Machine, which substitutes mechanical for hand power. This consists of a vertical stand, at the base of which is a circular table, carrying half a dozen of the hinged molds already referred to. After the first operator has blown and elongated the ball of glass to the desired shape, the blow-pipes are placed in the mold, with the upper end of the tubes secured in a clamp near the top of the stand. To each of the tubes is connected a rubber hose, which is supplied with air from a small air-pump located on and forming a part of the machine. The table with its blow-pipes is rotated and air pressure is applied through the hose, half a dozen chimneys being thus blown and molded at the same time.

The chimneys are next carried to the annealing furnace. This is constructed with a metallic belt conveyer, that passes through the furnace from end to end. The chimneys are piled up thickly upon this belt and carried through the furnace. The conveyer moves sufficiently slowly to subject each chimney to the heat of the furnace for from 12 to 24 hours. After annealing the chimney is cut down to length. This cutting is done by rotating the chimney horizontally above two fine transverse slits, through which a thin stream of hot air impinges on the glass at the point where it is to be cut through. The strain set up by this local heating is sufficient to enable the girl who attends the machine to break off the ends with a slight bending pressure. The chimney ends, after cutting, are sharp and rough, and it is necessary to give them the proper finish. The mouth of the chimney is smoothed by "glazing," which is done by exposing it to the blast of a small gas-fired furnace until fusion of the edge takes place, the result being the smooth, rounded edge which characterizes the lamp chimney. In the case of chimneys with crimped edges, the crimping is done in a special machine which slightly flares and crimps the edges at one operation. The base is squared and smoothed down by grinding it upon a circular, rotating, cast-iron table, whose surface is covered with sand and water. The lamp chimneys are stood on end in small pockets formed in smaller disks, answering to the "runners" of a plate-glass grinding machine, and are loaded with weights to give the proper pressure. After they have been ground they are taken to a stamping machine, where the maker's name is stamped on with a hydrofluoric acid preparation known as "white acid."

The chimneys are next taken to the labeling and packing room, where they are labeled, wrapped in paper, placed in separate cardboard boxes, and finally delivered to the packers. Such chimneys as are not shipped in boxes are packed loose with straw carefully worked around them. This packing is so successful that shipments of chimneys to such distant points as Africa and Australia reach their destination with practically no breakage.

Electrical Notes.

A line of electrically-operated canal boats running between Toledo and Cincinnati will probably be started in a short time.

A Berlin tramway company offers prizes of $750 and $375 respectively for the best speed indicators suitable for use on their cars. An additional royalty will be paid to the owner of the successful instrument. Those of our readers who desire further particulars are recommended to address Die Direktion der Grossen Berliner Strassenbahn, 218 Friedrichstrasse, Berlin, S. W., Germany.

The Cunard ocean liner "Lucania" has been fitted with the Marconi instruments, and messages have been successfully transmitted from the vessel to Holyhead, and communication was kept up until the vessel was 20 miles from shore. The New York Herald is installing a station at Nantucket lightship. It will then be possible to receive messages from an incoming vessel twelve hours before she is sighted off Sandy Hook.

The London County Council has at last decided upon the scope and approximate cost of its scheme for converting the existing horse tramways of the British metropolis to electric traction. It proposes to construct several new lines, and to carry out great extensions in addition to converting the tramways already in use. The cost of the enterprise is estimated at over $10,000,000. The scheme applies to the tramways throughout the whole county of London, and is to be partly shared by the local authorities of the various suburbs. Several street widenings and other improvements are embraced in this proposal, but the estimate does not include the cost of erecting the generating stations for the supply of the electricity. The conversion will be carried out simultaneously throughout the entire city, immediately Parliamentary sanction is obtained, so that before long London will be in possession of an up-to-date electric tramway system with all the latest improvements.

The conversion of the Underground Railway to electricity is to be proceeded with apace. Mr. Yerkes and his syndicate are to undertake the work. They propose to carry through the scheme without interrupting the traffic. When it is understood that there are twenty trains running in each direction every hour it will be recognized that Mr. Yerkes' task is by no means a light one. The syndicate proposes to erect a generating station to carry out the necessary alterations, and to supply new rolling stock at cost price. The contract is to be fulfilled within two years of Parliamentary sanction. The syndicate will get $2,500,000 worth of ordinary stock at the nominal price of 25 per cent and $830,000 worth of debenture stock, which carries 4 per cent at par, and 5 per cent on the outlay. The contract will not be placed in the hands of one electrical firm, but the various details will be purchased in the cheapest markets. Mr. Yerkes has also announced that everything will be purchased from English firms, and he will not come to this country for any material unless it is not obtainable in the home market.

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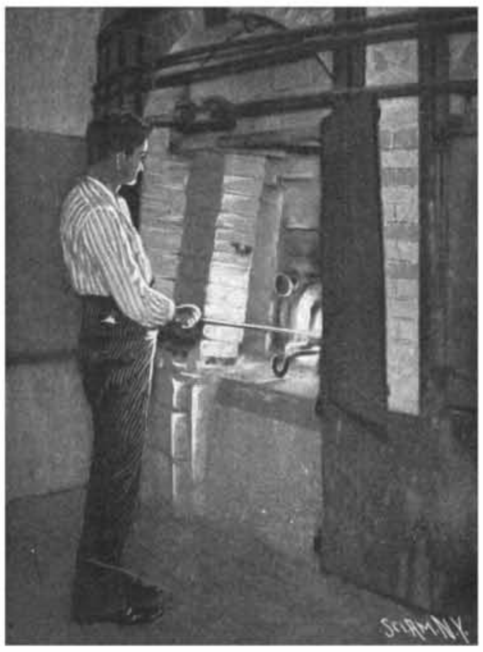
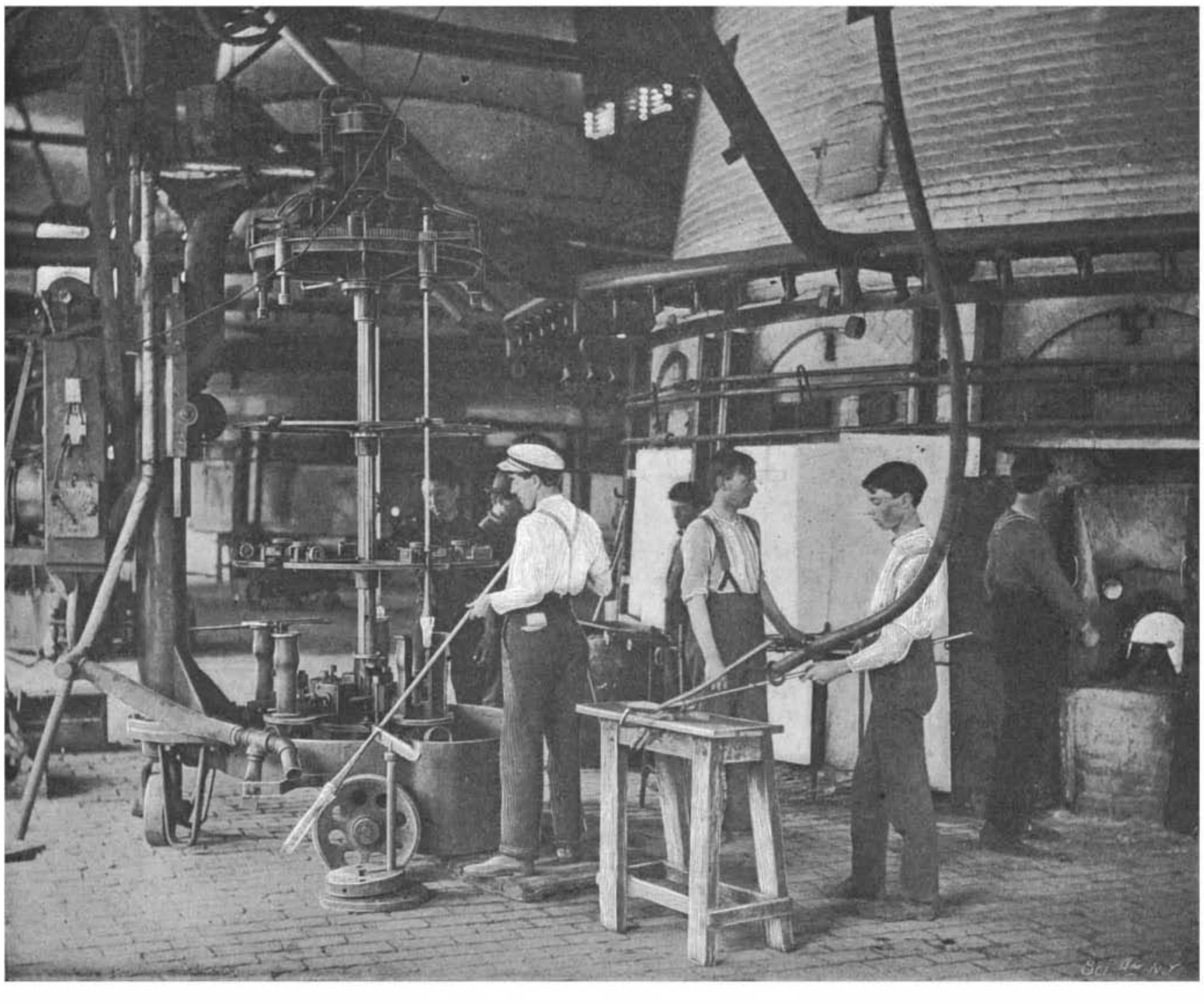
Forming the Chimney in the Mold.

Forming the Ends of the Chimney.

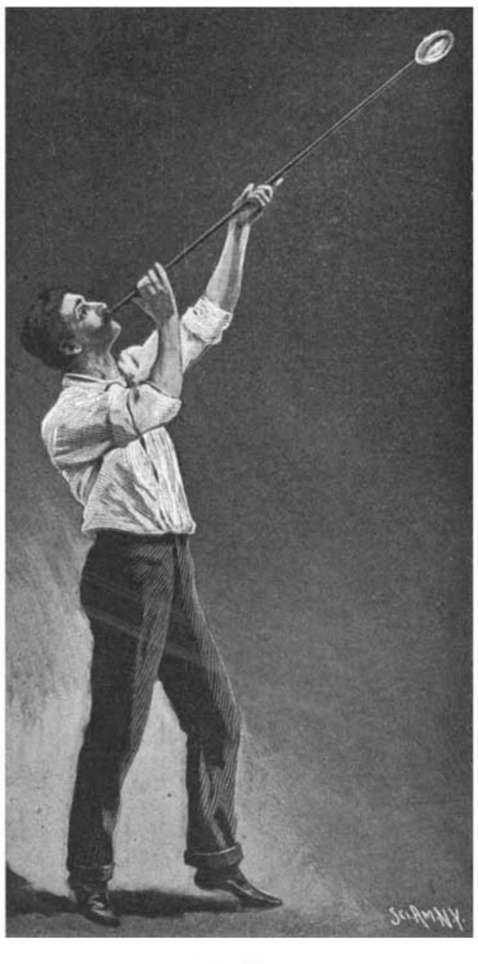


Gathering Molten Glass on the Blowpipe.

Rolling the Glass to Conical Form Before Blowing.



The Melting Furnace and Blowing Machine.



Blowing.

THE MANUFACTURE OF BLOWN GLASS—LAMP CHIMNEYS.—[See page 54.]

A Novel Ore-Carrying Railroad.

BY WALDON FAWCETT.

The Pittsburg, Bessemer & Lake Erie Railroad, between Conneaut, on Lake Erie, and Pittsburg, is essentially a freight-carrying line, having been constructed primarily for the transportation of the iron ore which the immense cargo steamers bring down the Great Lakes from the Lake Superior district, and which is transferred along this road, which is owned by the United States Steel Company, to the steel-manufacturing plants of the company at Pittsburg. The port of Conneaut, Ohio, the terminus of the line, owes much to Andrew Carnegie, who, up to the time of his retirement from the active conduct of affairs in the steel world, took a deep personal interest in the development of this place, with its magnificent harbor, and gave free expression to the opinion that it would one day rank as the greatest ore-unloading port in the world.

The influence of the Pittsburg, Bessemer & Lake Erie road in the world of iron and steel can scarcely be overestimated. By taking the transportation of iron ore out of the hands of the independent carriers, it inaugurated a new era in one branch of operating costs, and of late it has proved an important factor in the growth of the American export trade in iron and steel, as it gives to the Pittsburg ironmakers an outlet to the Great Lakes, whence they may ship their finished products by vessels direct to European ports. Finally, the little road from the Carnegie furnaces to the inland seas constituted the cradle of the pressed-steel car, which is now rapidly coming into universal use in all parts of the world. The first steel cars of the present type were built for use on the Pittsburg, Bessemer & Lake Erie line, and the success of this class of freight-carrying vehicles dates from the day when a train of them was drawn into the furnace yards at Pittsburg loaded with iron ore.

Over this ore carrying railroad are hauled some of the heaviest trains in the world. The system operates, all told, barely 227 miles of track, and yet it transports within a year over 16,000,000 tons of raw material and finished product. This enormous aggregate is as great as the combined tonnage of the Northern Pacific, Union Pacific and Missouri Pacific railways, embracing as they do more than 13,000 miles of track whereon are operated 1,500 locomotives and 50,000 freight cars.

In other respects also this line from Conneaut to Pittsburg is the most remarkable in the United States. According to the statistics furnished to the Interstate Commerce Commission, it is accredited with the lowest rate per ton per mile, the highest average length of revenue haul in proportion to its freight train mileage, the greatest average paying load and the lowest "ton-mile cost" of any railroad on the American continent. Paying loads of about 1,600 net tons are recorded, and the average for an entire year was 777 tons. Officials of the road predict that ere long the average paying load will be in excess of 900 tons, or more than four times as great as the average paying load of all the railroads of the country at large.

The entire line of the road is laid with 100-pound steel rails and 80 per cent of the line is straight track. In the direction of the ore haulage the permanent maximum grade is 31 feet to the mile. There are five of these grades, with an aggregate length equal to thirty per cent of the entire distance. The road is equipped, for the most part, with cars of the steel hopper type, each weighing 17 tons and capable of carrying 50 tons of ore, although there are also in use several hundred steel gondolas with a carrying capacity of 40 tons each.

Undoubtedly the most interesting part of the equipment of the road is found in the immense locomotives which have lately been installed. The problem of getting the ore-laden trains over the heavy grades long proved a perplexing one, and until a few months ago an assistant engine was stationed at each grade. To meet the exigencies of the case orders were placed for the new locomotives, which are among the heaviest and most powerful in the world. Each of the new engines is capable of hauling 1,400 net tons, exclusive of the weight of cars, on a grade of 52 feet per mile.

The total weight of the locomotive in working order is in excess of 125 tons and the weight of the tender is upward of 71 tons, so that the total weight of engine and tender is close to 196 tons. The wheel base of the engine is over 24 feet, and the wheel base of engine and tender together is almost 58 feet. The diameter of the driving wheels outside of the tires is 54 inches. The cab and running board are made of steel, and the tender has a capacity of 14 tons of coal and 7,500 gallons of water.

Iron ore is transferred from the boats to the cars at Conneaut in several different ways. At this port are the only automatic ore unloaders yet installed of the type which has attracted so much attention in the mechanical world, and which by means of a clamshell bucket suspended from a depending mast scoop up ten tons of ore at a time, dumping it directly into the cars. The ordinary type of hoisting and conveying machinery is also employed, and the ore is transferred from stock piles to cars by means of steam shovels, each equipped with a dipper scoop of 4 tons capacity. The ore is unloaded at Pittsburg by means of conveying apparatus of the same general type as that employed to some extent at Conneaut.

So extensive is the trackage at Conneaut that half a thousand cars may readily be handled daily, and 25,000 tons of ore have actually been dispatched from the terminal yards within twenty-four hours. In order that switching engines may be dispensed with to some extent, the Conneaut docks are equipped with a car-haulage system, the primary feature of which is found in endless steel cables, which are kept constantly in motion, and to any point on which a car may be quickly attached by means of clamps.

Automobile News.

A driver of a motor car returning from Biarritz to Paris recently found himself stranded near Etampes through his petrol supply giving out. As petrol was not to be obtained in the district he tried the only spirit that was procurable, and filled up his tank with absinthe. He declares that the motor never ran better than with this improvised fuel.

There is some talk of forming, under the auspices of the Automobile Club of Great Britain and Ireland, a union of chauffeurs, to be known as the "Motor Union," which is to be more easily accessible than the parent club, and, especially, to have lower membership fees, and thus to be within the reach of all. The Union will include the engineers and practical men, and will take charge of the technical department of the club as well as seek to obtain legislation in favor of the automobile interests. The Automobile Club will thus remain a club properly so-called, at the same time maintaining an intimate connection with the Union.

Alexander Winton has attempted to cross the continent with one of his automobile carriages, but after trying to guide it through the sand and snow of Nevada he was finally forced to abandon his trip. He left San Francisco May 20 and encountered his first obstacle in the shape of snow on the top of the mountain range. The automobile slid from side to side down the trail, frequently tumbling into ravines by the way, from which it was extricated with difficulty. It was found that the sand in the Nevada desert was particularly hard to travel on, and the automobilists were finally obliged to abandon their trip by reason of a huge sand drift.

The ascent of Mount Vesuvius in an automobile is a feat which has lately been accomplished for the first time, probably, by Count Carl Schönborn, Secretary of the Austrian Automobile Club. This performance, while not particularly dangerous, requires considerable skill and *sang froid* to carry out. It was upon his wedding trip that Count Schönborn had the idea of making the ascent with his young wife. The couple proceeded first to Rome, where the marriage took place, to Frascati, then to Naples, and a few days later, after having carefully determined their route in advance, they made the ascension to the upper crater, situated at 3,700 feet altitude. In spite of the complete absence of a practicable route, the pieces of stone scattered about, and the lava streams, the Count was able to reach the summit of the cone in only an hour and a half. The descent, which was relatively less difficult, required about two hours.

M. Mougeot, Secretary of the French Postal and Telegraph Department, has been carrying out a series of tests with electric automobiles for collecting the mail at Paris, and expresses himself in favor of the system. It is estimated that from ten to sixteen minutes (according to route) may be gained over the old vehicle, which is built on an ancient plan and has room for only 1,100 pounds of letters; a horse can carry 2,200 pounds, but to do so would require a four-wheeled vehicle, and this would be much slower. An interesting trial has been made by M. Mougeot in person with the new postal wagon equipped with Krieger motors. It weighs 2,200 pounds, including batteries. The tires are pneumatic in front and solid behind. The box has about 35 cubic feet capacity, with seat for two persons at the regulation height, 6 feet 11 inches above the ground. This vehicle made a trial trip in one of the districts of the city, accompanied by M. Mougeot and other officials in automobiles. In spite of the fact that the new mail wagon arrived before the time at the different post-offices, and was thus obliged to wait, it made the tour with a gain of ten minutes over the time allowed for the horse vehicle. The Department is highly pleased with its performance. This machine is one of a number which have been ordered; these include a Jenatzy, Krieger, a Bouquet, Garcin & Schivre and De Dion (new system) for the electric types, a Peugeot machine (petroleum motor), as well as a Serpollet machine (steam motor), which will transport 3,200 pounds of papers.

Engineering Notes.

Charleston, S. C., has a training school for firemen. A 70 foot scaling tower has been provided, as well as all necessary apparatus, and all the firemen in the city are required to take turns in drilling.

The N. Y. C. & H. R. R. R. Company has added to the staff of officials a landscape gardener, whose duty it is to oversee the decoration of station grounds and the improvement of the right-of-way between stations.

The pneumatic tube service for transporting mail in New York and other places was suspended June 30. The contractors will allow their machinery to remain in the hope that the service can be reinstated at the next session of Congress.

A refrigerating plant is to be installed at one of the furnaces of the Carnegie Steel Company, Pittsburg, Pa., in order to free the air from moisture before descending into the furnaces. The moisture will be collected on coils of tube through which brine will pass.

A cooling tower made of brush and twigs is in operation at the power house of the Los Angeles Pacific Railroad at Sherman, Cal. The cooler consists of a timber framework 60 feet long, 12 feet wide, and 13 feet high, filled up with brush and twigs, and it cools the condensing water for a 300 horse power compound Ball engine and a 460 horse power compound engine of the same make, working on a railway load.

Concerning the wear and tear of steam turbines on the steam end, the cost of repair therefor is very slight, indeed, as might be supposed from the fact that the piston, so called, floats, or does not touch the cylinder walls, but it would be thought that more or less loss by erosion of the blades or pins which answer for pistons would ensue, but this is not the case. turbine which has been in use for twelve years w. opened recently, and there was no erosion whatever discovered.

It is customary in sugar refineries to use steam for evaporating the sirup, and, as temperatures above the usual boiling point (212 degrees) are required, it has been the custom with some refiners to carry 100 pounds gage pressure on the coils. It is claimed by an investigator that this is a source of loss over the common pressure of 20 or 25 pounds; he says that there is more than three times the loss at the higher pressure than at the lower, and this exclusive of external leaks by pipe joints, radiation, etc.

A large power station at Rheinfelden, which we have already illustrated, was recently shut down by a curious accident. Owing to sudden storms the water brought to the power station at Rheinfelden large quantities of branches, dead wood and leaves which were caught by the streams at the mouth of the fore-bays leading to the turbines. The branches collected so rapidly that the water rose to a height of over 6 feet. The turbines had to be stopped and the water gates lowered in order to clear the screens.

In the current issue of the SUPPLEMENT there is described an English motor-driven fire engine. The ludicrous adventures of this engine on its way to a fire have been already detailed in this column in the issue of June 22, 1901. Some of the information given in connection with the present article is most interesting. It seems that in the smaller places in England horses have to be borrowed for the fire engines. Often thirty to fifty minutes are wasted in getting horses which, when an alarm of fire was given, were at work at their daily duty. A considerable amount of time is also lost in finding the proper harness for them. The horsing of steam fire engines in country districts is a very difficult problem. There is hardly a town of any size in the United States which does not have one or more fire engines, and they can be got under way with a delay of from thirty seconds to a minute and a half, while in the larger cities even thirty seconds would be considered slow work.

Rapid progress is being made upon the new subway beneath the River Thames, communicating Poplar on the one side with Greenwich upon the other. It is being constructed upon the same principle as the Blackwall Tunnel, the success of which prompted the boring of this subway, and the projection of several other similar tunnels at various points, to facilitate communication between the two banks of the river. Poplar and Greenwich are two busy working centers, and this new tunnel will prove a great boon to the working population. A shaft will lead to the subway at either end, the total length of which from shaft to shaft will be 1,217 feet. The shafts have been sunk to a depth of 63 feet and the subway will slope gradually from either end to a depth of 72 feet below the ground line in the center of the river. At no part will the crown of the tunnel be less than 13 feet below the river bed, so that it will be amply protected from the scouring effect of the water. One thousand six hundred tons of cast-iron tubing will be utilized in the construction of the tunnel, the total cost of which will amount to about $550,000.