Steel Axles.

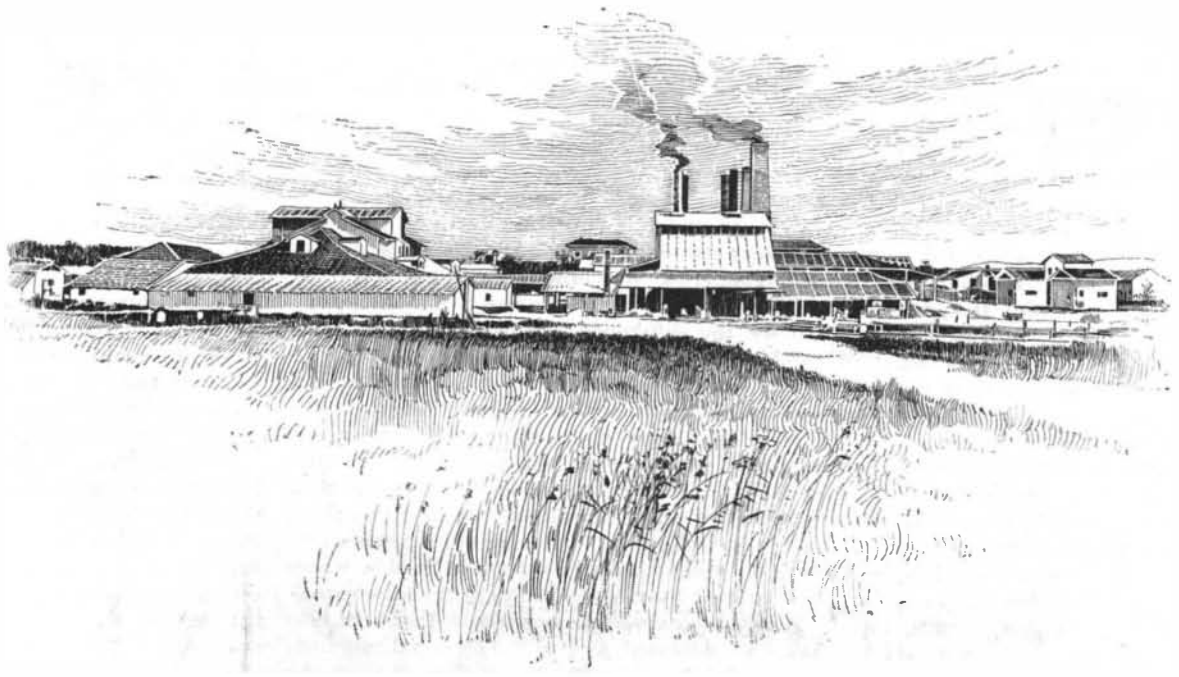
One of the most specious arguments used against steel, the *Railroad Gazette* says, is deduced from the mileage of broken axles, which often show that the average mileage of the broken steel axles is less than that of the iron. This is by no means a conclusive argument; for if the statistics of the axles still running be examined, it will almost invariably be found that steel has proved more durable than iron. The explanation of this seeming anomaly is simple. A new steel axle which has a flaw or is "nicked" in any way is doomed from the start. The crack will gradually but surely spread in the homogeneous material, and the axle will fail or be condemned for a growing flaw after a comparatively short life. The remaining axles, being sound, will continue to run and give a long mileage, and when finally removed will still be sound, though worn below the minimum size. The iron axles, on the other hand, begin the progress of disintegration at once. The more or less imperfectly welded fibers begin to separate, and after a certain time the great majority have been condemned, while the greater number of the steel axles are still running, though possibly none of the iron axles failed as soon as the faulty steel ones.

Steel, however good and suitable in quality, cannot stand unless it is also of suitable form. Some have very incorrectly stated that the section of steel exposed to heavy service should be alike throughout. A car axle, according to this dictum, should be of the same diameter throughout its length. This form, however, was abandoned in the very early days of railroads, owing to the persistency with which fractures occurred just inside the wheel hubs. The true law is manifestly that the section should vary according to the strain, and that the strains should be as nearly uniform as possible throughout the axle, subject to the proviso that there should be no sudden change of form. It will be found that steel fails where this rule is disregarded and stands where it is observed.

One instructive instance is found in the well known case of the bolts by which armor plates are attached to a ship's side. The hard wood backing used between the armor plate and the skin of the hull compresses when the armor is struck by a shot, and its rebound fractured all the bolts tried until Palliser brought out a bolt in which the shank was reduced until its cross section was somewhat smaller than that at the bottom of the threads. When the rebound took place, this bolt stretched a percentage of the whole length of the shank, while with an ordinary bolt the stretch could only take place at the bottom of the threads, and this distance was too short in which to cushion the blow. A large number of failures of steel would never occur if attention were paid to the principle here involved and concentration of the maximum strain carefully avoided.

An Earthquake in Greece.

Early in the morning of January 31, the island of Zante, on the west coast of Greece, was severely shaken by an earthquake, during which many business houses were wrecked and the roof of a prison fell in, wounding many prisoners. Two hours later the city of Zante was shaken by repeated shocks, houses fell in all quarters, and the prison became so unsafe that many prisoners were removed. The people, in a panic, fled from the houses and crowded the streets and market place. Scores of families left the town to camp in the fields on the outskirts, and many dead bodies were taken from the ruins, the government sending out troops with tents and provisions for the homeless. On February 2 and 3 other severe shocks occurred, which are said to have wrecked more than a hundred houses in the city of Zante, and proved very disastrous to several villages on the island. Thousands are said to have left the city to sleep in the fields.



A SUGAR HOUSE IN CUBA—LA SOLEDAD.

The island of Zante is 25 miles long and about 12 miles wide, having an area of 277 square miles and a population of about 48,000. The eastern part of the island is a fruitful plain skirted on the west by a range of limestone hills 1,000 to 1,200 feet high. The town of Zante, and its capital, has a population of 16,000.

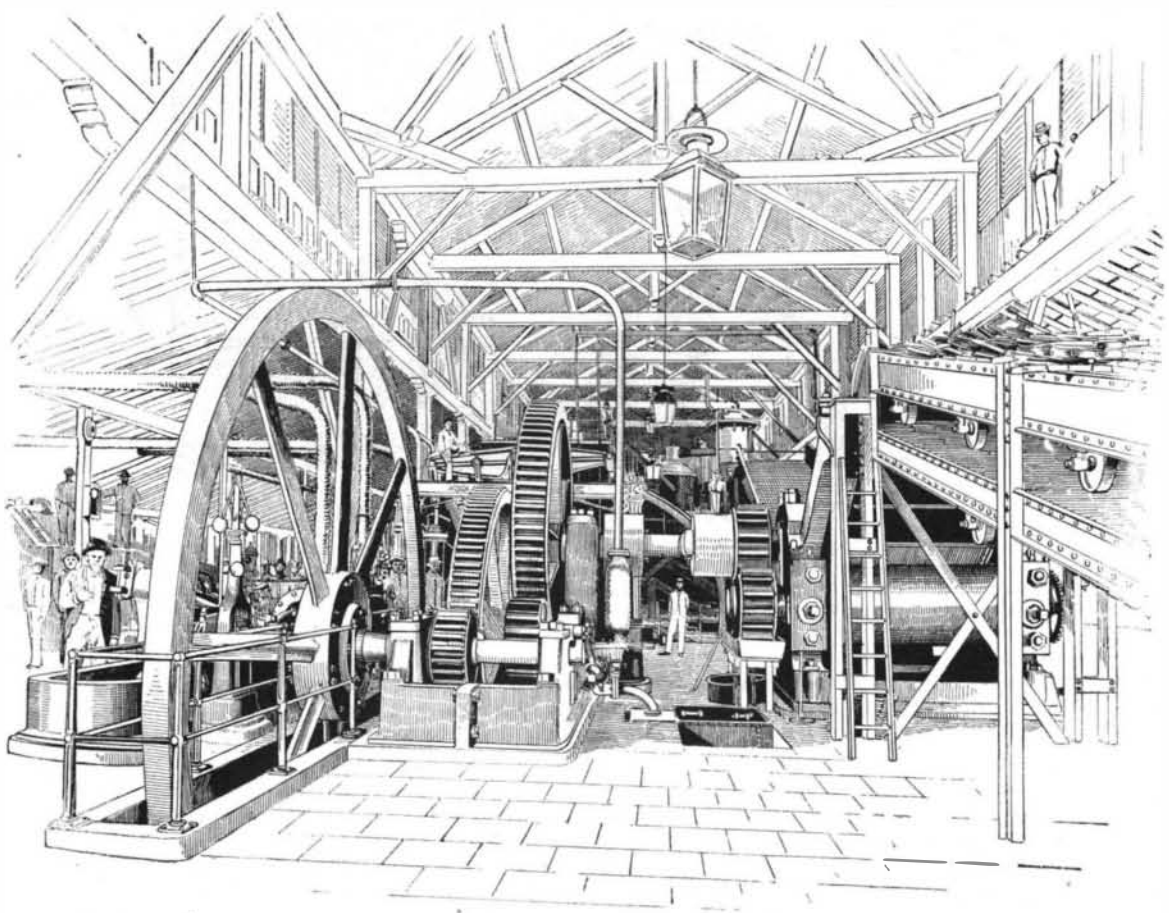
Labor Troubles in England.

It is astounding nowadays what a small matter will result in a big strike. The men engaged in taking the slag from the furnaces at Barrow by means of two locomotives demanded a third, and on Sunday morning four men thus employed struck work because the duet had not been made into a trio. They were followed by the furnace men, and those employed at the steel works had to follow suit. Thus three thousand men have been thrown out of employment all on account of a donkey engine. The difficulty was all pieced up with the exception of the locomotive men, who, having left their work without notice, were not again taken on. The men demanded this, and the general manager promised to deal leniently with them, but refused to take them back into the employ forthwith. Hence the continuance of the strike on so frivolous a pretext. And this at a time when trade is exceptionally bad, when orders are scarce and profits practically *nil*, and when trade prospects are as gloomy as they well can be!—*Ironmonger.*

NOTES ON THE SUGAR INDUSTRY IN CUBA.

BY HUMPHREY J. KIELY.

It is interesting and gratifying to note the rapidly increasing volume of business between the United States and Cuba. The wonderful natural resources of this fertile island, appropriately called "The Pearl of the Antilles," offer many opportunities for the profitable investment of capital and for the consequent introduction of machinery and various mechanical appliances useful and in many cases necessary in the preparation of the products of its fruitful soil. The island is about 600 miles long, 21 miles wide in the narrowest part and 111 in the widest, and is distant 130 miles from Florida. It abounds in forest woods and produces all the fruits of the tropics in great abundance. It is only within recent years that our trade has increased with this country, and the late reciprocal arrangement has done much to extend that trade, especially when it is remembered that the agricultural commodities produced there are as essential to us as our manufactured products are to Cuba. The mineral wealth of the country, consisting of gold, copper, iron, manganese, asphalt and marble, is immense, but the staple product of the island is sugar, and more capital is invested in the cultivation and manufacture of this one article than in all the others combined. The production this year is estimated at 1,000,000 tons, as against 800,000 tons last year, and the limit of producing capacity has not yet been reached, as large tracts of land are still available for cultivation, and the world's demand is constantly increasing. It is the largest sugar-producing country in the world, the climate and soil possessing just the qualities required for the cultivation of sugar cane, and it is not unusual for a visitor to have pointed out a field from which yearly crops have been taken for a score of years without the aid of fertilizer of any kind. Before the emancipation of the slaves, about twenty years ago, when the plantations were numerous and the price of sugar high, the margin of profit was so great that little attention was paid to economy in production or the use of labor-saving machinery. Many of the small plantations with their primitive methods have been abandoned, and it is not an unusual sight travel ng through the country to come upon the ruins of a once prosperous estate looking desolate and gloomy with its crumbling walls and tottering chimney, and to see flowers and shrubbery flourishing amid the wreckage of its dismantled machinery. This has been due in a great measure to the competition of beet sugar, and now large central factories, fewer in number but far greater in capacity, have taken the place of the numerous small estates.



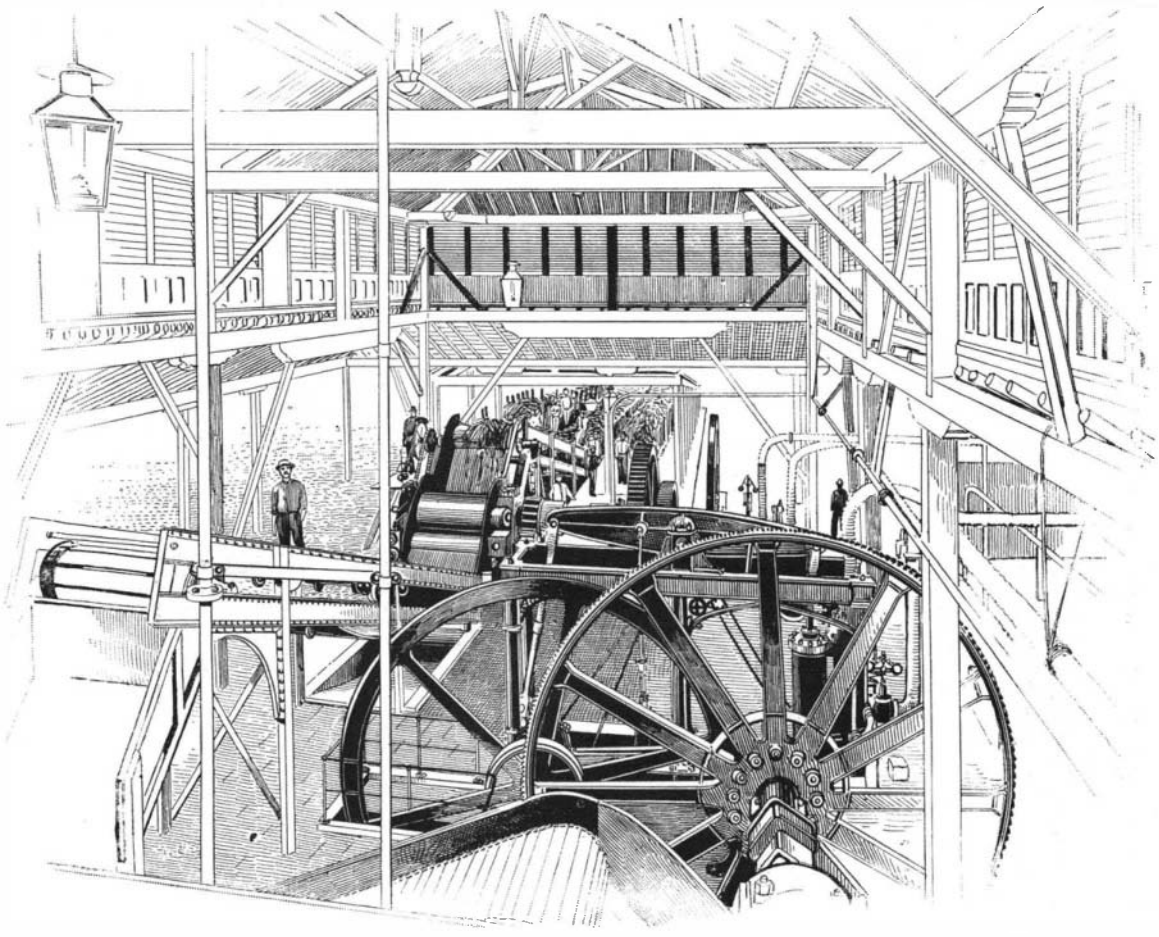
This engraving shows the hagasse carrier arranged on top of the furnaces, through openings in which the hagasse is delivered, and passes to the fires.

A SUGAR MILL, CUBA—THE BAGASSE CARRIER.

It is difficult to conceive, without a personal inspection, the immense size and magnificence of the equipment of these central factories, but some idea may be gained from the fact that they each represent an investment ranging from $200,000 to $1,800,000, and comprise in some cases 10,000 acres each. Central Caracas, probably the finest estate on the island, is valued at $1,800,000.

The central factories are usually an assemblage of very large roomy frame structures, in which work goes on night and day without intermission during the entire grinding season, which commences late in December and ends in May. In some factories work is suspended a few hours Sunday morning for the purpose of oiling and cleaning the apparatus, but this practice is not general. The cane is plentiful and each vies with the other in striv-

ing to produce the greatest number of tons, a ready market being found for their entire production. Every hour's delay, therefore, means its equivalent financial loss to the planter, and a serious accident to the machinery, entailing suspension of work, brings with it disastrous results. To guard against this every precaution is taken, and duplicate parts are kept constantly on hand, and the resources for making quick repairs include on the principal estates a fairly well equipped machine and blacksmith shop, and in one case at least—"Central Constancia"—a foundry also. The large estates are also traversed by their own railroads, and locomotives and cars for transporting the cane form part of their equipment. These factories are filled with the most costly machinery of the best workmanship and material, and the whole process of manufacture is, by means of mechanical appliances, almost automatic in its character, as evidenced by the comparatively few laborers found employed. The field hands are, however, numerous, and include males and females of all ages. They are employed cutting cane in the fields, which is transported on railroad cars and heavy carts drawn by powerful oxen to the factory, and there deposited on the slowly moving cane conductor. This is the initial step in the manufacture, and the manual labor practically ends here, as from this time until the sugar is bagged the process is almost entirely mechanical. The cane conductor is one of the most important parts of the equipment, as the stoppage of this cuts off the supply of cane and necessitates the shutting down of the entire plant. The conductor is, therefore, of the best construction, and is usually 125 feet long by 6 feet wide, and extends outside of the main building to allow the cars and carts to run alongside and discharge their contents upon its surface. The cane is piled on haphazard and usually lies in a mass about 2 feet deep on the carrier, as it approaches the crushing rolls at a speed of 15 feet per minute.



The endless belt cane carriers are seen in the distance. The cane is brought from the fields in carts alongside the carrier belts and thrown upon them, and by the carrier belts the cane is delivered to the crushing rolls.

A SUGAR MILL, CUBA—EL SAN FRANCISCO.

The mills through which the cane passes are composed of three heavy chilled steel rolls 38 inches diameter by 7 feet 6 inches long, each weighing 12 tons, and connected by massive gearing. The power required for their operation averages 180 horse power. Notwithstanding their immense size, these rolls spring when grinding, as the great mass of cane is forced through a very small space, the receiving inlet being 1½ inches and the outlet ¼ inch. Their average cost, including the engine, is $30,000.

The cane emerges from the rolls crushed and shredded, the extracted juice running by its own gravity in canals to the defecators, from which it passes through the various stages of manufacture until finally discharged from the centrifugals in dark brown crystals ready for bagging.

In nearly all centrals two mills and in some cases three are used, in order to get the greatest possible extraction of juice from the cane.

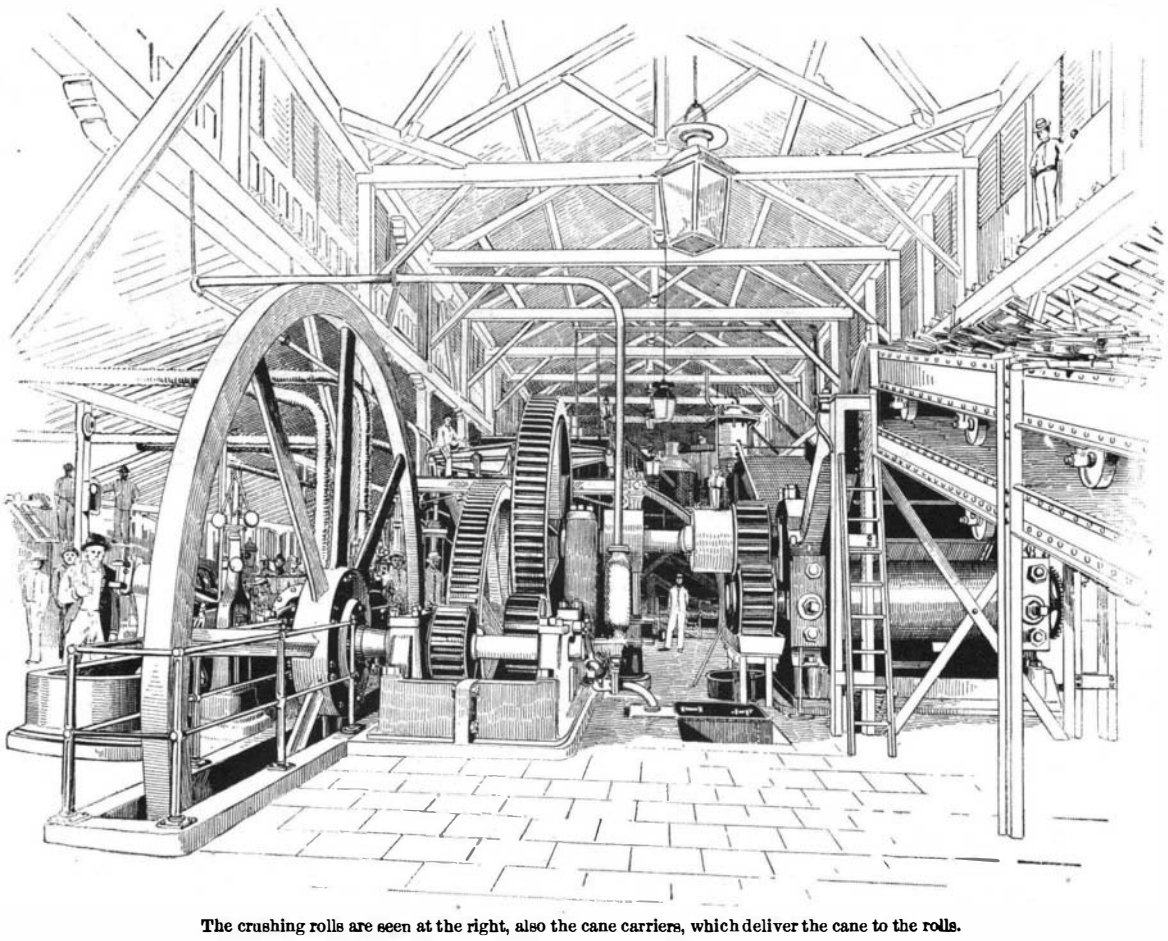
The crushed cane, after passing through the last mill, is called bagasse, and was formerly taken by hand and spread to dry in the sun, and when thoroughly dried carried back and used as fuel. The system now employed, however, is more in keeping with the general marked improvement made in recent years in sugar machinery.

By the present method the green bagasse is discharged direct from the mill on to a bagasse carrier, which consists of two endless link belts running parallel in a wooden trough, with hard maple flights attached at suitable intervals. In this conveyer the bagasse is transported usually a distance of two or three hundred feet to the bagasse burners, and is there automatically discharged into the furnaces especially constructed with forced draught for burning this material.

From this brief description it will be seen that the cane, just as it is cut from the fields, contains within itself not only the raw product, but also the fuel from which the motive power to convert it into the finished article is derived. This is a most important consideration when it is remembered that the cost of coal averages $14 per ton delivered. The owner of one estate paid $12,000 for coal in 1889, and in the following year saved that amount by the introduction of bagasse burners and carriers. This system is now in use in nearly all of the estates.

It will readily be seen what an important market is here afforded for improved machinery and labor-saving appliances, and also how valuable and essential they are to the planter, as without their aid it is practically impossible to produce the product with sufficient economy to compete with others possessing these advantages. The United States is certainly in a most favorable position to develop and by energetic canvass greatly increase this trade, as the present reciprocity treaty admits machinery of American manufacture free of duty, and imposes a heavy tax on the same machinery of foreign manufacture. Coupled with this great advantage is the fact that frequent steamers from New York arrive there within four days, while the comparatively few freight steamers from Europe are usually 16 days in transit.

The average selling price of a bag of sugar is $10, and the estimated cost of manufacturing same $6. It has been stated by those in a position to know that the average net profit to the manufacturer is $1.50 per bag, and as few of the estates turn out less than 50,000 bags per season, it will be seen that the necessary large investment is warranted by the handsome returns.



The crushing rolls are seen at the right, also the cane carriers, which deliver the cane to the rolls.

A SUGAR MILL, CUBA—EL SAN FRANCISCO.

Illuminating Parades from Trolley Wires.

In Wilmington, N. C., the Street Railway Company, of which John H. Barnard is general manager, exhibited during a recent trades parade an extremely simple solution of the problem of satisfactorily illuminating floats for night parades. For the interesting occasion, the Willmington Street Railway Company offered to take contracts for lighting the floats with incandescent lamps. By several this offer was accepted, and so gratifying were the results that it is most probable that hereafter this method will be exclusively employed. To obtain contact with the trolley wire a very simple trolley was devised. A piece of stiff spring brass wire was coiled in two planes, the lowest coil being fastened to the float. The horizontal coils afforded ample side motion, while the vertical ones gave good upward pressure against the trolley wire. From this various circuits were led about the float, the lamps being connected up five in series. The ground connection was very easily obtained by a little car with iron wheels six inches in diameter, built to fit the gauge of the track, which was towed under the wagon on which the float was built.

Thirty 16 c. p. lamps were found to give a splendid illumination to a very large float, and this, with the simplicity and small cost of the arrangement, makes it quite certain that practically all floats shall be so lighted in the annual parade next year. As their own exhibit the Wilmington Street Railway Company arranged a float on which was seated Benjamin Franklin drawing electricity from the clouds. His kite string consisted of a light bamboo pole, on the end of which was a broad sheet copper contact shoe. This shoe was entirely hidden by the kite, while the bamboo pole was concealed by a dark colored covering, from which fourteen incandescent lamps protruded. The fifteenth was dropped and illuminated the Leyden jar. This float being built on a flat car, the ground contact was obtained through its wheels.—*Street Railway Review.*

How to Keep the Make Shop Free from Steam.

Quentin McGall, of the firm of McGall Brothers, of Orange Valley, has just devised one of the most useful inventions for the hatting trade that can be imagined, and he not only has devised it but he has demonstrated that it will work by practical tests. Every hatter is aware of the difficulty experienced in keeping the sizing department free from fog or condensed steam in the winter months, and many have been the plans devised for obviating the trouble. Hoods with exhaust fans have been placed over the kettles and fans have been placed in ceilings and on the sides to suck out the moisture, but none have been satisfactory, although the hoods over the kettles have worked the best. Since the trouble was caused by the cold air from the outside finding its way into the shop and there being condensed by striking warm moisture-laden air inside, Mr. McGall decided that if the air which came in could be heated it would help the matter. Consequently he had a large steam coil made, four feet square, and placed at one end of the new sizing shop recently put up by the firm. This he incased in a pine box, open at both ends. On the outer end he placed a large steam fan, speeded up to a high point.

When the apparatus was ready for the test the day was one of the coldest of the present season, and a good one to test the plan. The room was full of fog at the time. The effect when the fan was started was almost magical. The steam began to disappear at once, and in a few moments the room was as clear as the outside air and remained so as long as the fan was kept going. When the fan was stopped the steam at once began to accumulate, and in a few minutes the room was as bad as ever. The firm is now arranging to place the device in all their make shops, and other manufacturers have arranged to do the same. The advantages of being able to keep the making departments free from steam are many. The conditions are much healthier, and a better grade of work can be turned out.—*American Hatter.*

THE FONTAINEBLEAU PROVING GROUNDS.

The time when proving grounds were of limited size, and their organization included only a butt and a few epaulements, is already very remote. New conditions have been imposed by the fact of progresses of all kinds realized by artillery. The proving grounds of the present day must necessarily be of great extent and be equipped in such a way that it shall be easily possible to solve most of the problems that are submitted to the art of war. In order to set forth more clearly the economy of such theaters of instruction, it is well to take one example, and we shall, to this effect, select the Fontainebleau proving grounds.

These grounds, directed east and west, occupy in the forest (very near the city) a strip of cleared land, 5·6 kilometers in length by 200 meters in width. Aside from a few hillocks, exercising upon their environs a command of 5 or 6 meters, this strip is quite level. It rises solely by 50 meters at each of its extremities, which are, on the one hand, an eminence called Mail Henri IV., and on the other, a rocky plateau. In artillery practice, the firing is done in the east-west direction, in other words, the pieces are put in battery on the Mail side, and fire their projectiles toward the plateau.

As for the objectives, the arrangement of these is such that they present to the *personnel* charged with the execution of the firing the aspect of a striking reality. They are representations, as faithful as possible, of defensive means or various obstacles—of troops in the act of marching or that have come to a halt; guns in battery or drawn by horses; men on foot or on horseback, and in dispersed order or in mass, etc.

A few details here will not be out of place.

In the way of obstacles, we remark in the proving grounds under consideration various epaulements of earth and a redan with escarpment wall, magazine shelter and guns in place. The redan is represented at B, in Fig. 2, which shows also a village with its church, A, a hermitage at H, and a certain number of pieces of walls. The village is made of boards. As for the walls figured, they consist of scantlings nailed to laths and painted white. The upper part, painted red, represents the coping, and a rectangle painted yellow, a door, etc. To an observer placed at a distance, the illusion is complete.

The study of the processes of representing troops is just as interesting. A board painted black and cut in such a way as to represent the head and shoulders of a man is held vertically by means of a picket driven into the earth. Here we have a sharpshooter crouching. An alignment of similar silhouettes offers the aspect of a line of infantry upon the knees. Nailed to the coping of a wall, it will give the idea of a series of defenders of the obstacle.

TELEPHONING FROM BOSTON TO CHICAGO.

Opening of the American Telephone and Telegraph Company's Telephone Line from Boston to Chicago, by the Governor of Massachusetts, February 7, 1893. The picture shows a group of telephone officials assembled at the Telephone Building, 125 Milk Street, Boston. His Excellency Governor Russell speaking to Chicago; next behind the governor stands Lieut.-Gov. Roger Wolcott; at the right Adj.-Gen. Samuel Dalton.

Three scantlings, 1·33 meters in height, are painted black, and assembled jointedly in such a way that the one in the center exceeds the two others by 30 centimeters. Here we have a man upright upon his legs. Let a certain number of these very simple apparatus be juxtaposed, and we shall have a line of infantry standing (Fig. 2, D). If, in distributing sharpshooters over the ground, it is desired to come still nearer the truth, it is necessary, instead of painting the scantlings black, to invest them with old wearing apparel.

Manikins of analogous structure and organization may serve to represent combatants grouped in a special manner, or staff officers, etc. As for the campaign guns, caissons and teams, they are, as well known, figured in conformity with the prescriptions of the committee of artillery of April 22, 1884. Silhouettes of sharpshooters are employed to represent the gunners.

In order to satisfy, in the rules, the exigences of the service of instruction, it is necessary to be able, at an opportune moment, to effect rapid changes of objectives. Now, such changes are obtained by a play of silhouettes arranged in such a way as to appear or disappear as many times as necessary, and that, too, at the will of the instructor. We give here, by way of example, a description of a line of disappearing infantry, represented in the foreground at C, Fig. 2.

The apparatus consists essentially of a large wooden axle supported by wooden bearings and established, perpendicularly to the line of fire, at the bottom of a trench in the form of a flattened V. The object of this arrangement is to protect both the axle and the silhouettes that it controls from the effect of bursting projectiles. The silhouettes consist of a wire frame simulating the human form and over which is stretched a black fabric. Levers are arranged to permit of revolving the axle, and consequently of raising or lowering the silhouettes at will. The maneuver of them is intrusted to men who actuate them by means of an iron wire cable, C (Fig. 2). The Fontainebleau proving grounds are equipped with eight lines of disappearing infantry, each 20 meters in length. Placed one behind another, they occupy an interval of 1,800 meters, whence it follows that their system, methodically utilized, permits of figuring the marching of a body of infantry gaining ground by successive bounds, and consequently constituting a movable objective. We also find in the proving grounds under consideration special apparatus designed to represent troops on a march and advancing and falling back in a continuous manner. A movable object of this kind (Fig. 2, F) consists of a system of two wheels or drums connected by an axle carrying uprights, to which are nailed horizontally arranged laths. Upon these latter are fixed silhouettes of infantry or cavalry soldiers. The traction, which may be effected in one direction or the other, is done by means of a cable drawn by a team of horses. The travel is about 700 meters. We must express our regret that, for want of space, we cannot here go into the very interesting details of this method of traction.

The installation, maintenance and maneuvering of these different objectives imply the organization of a force of operators. Now, as the maneuvering has to be executed in the course of the execution of the firing, this special force must necessarily be able to have at its disposal a certain number of shelters. Fig. 2 represents, to the left, the shelter formed for the men whose business it is to maneuver the line of disappearing infantry, C. Fig. 1 shows on a larger scale a few details of construction of this structure of security.

Essentially dismountable and of easy installation, a new model of low shelter comprises a full center arch of corrugated iron 1·5 mm. in thickness, composed of three parts riveted together and connected by angle irons; a plate closing the front provided with a sight hole 10 millimeters in height; a plate in the rear barring entrance to the shelter; a plate assuring the protection of the latter; and, finally, a *mask* protecting the front. The weight of the iron plates does not, as a whole, exceed 950 kilogrammes.

In order to effect the mounting of the shelter, it is well to proceed as follows: Upon the bottom of an excavation 1·2 meters in depth are established the arch and the front and rear closing plates and the mask. These four elements once in place, a ditch is excavated around the whole, and the earth therefrom serves to cover the arch to a depth of 1·5 meters. On the side of the batteries the shelter must be protected by a mass of earth 3·5 meters in thickness, in which are methodically buried two walls of dry stones. The organization of the Fontainebleau proving grounds includes a dozen shelters of this kind, each of sufficient size to accommodate eight persons.

The schools of instruction in firing would not be a true means of teaching if the troops called upon to take part in them were not, at every instant, informed