

horse power will be about 4d. per hour. M. Lenoir's engine is very similar to the ordinary steam engine, having a cylinder, piston, crank shaft, and fly wheel. The following proportions of gas are admitted in the cylinder: One volume of coal gas mixed with twelve volumes of atmospheric air. This mixture is ignited by the electrical spark from a battery connected by wires at each end of the cylinder. The connexion being made and broken by the rotatory action of the crank shank, the expansive force necessary to move the piston of the engine is produced by the ignition of the gas, which not only produces steam and carbonic acid by their combustion, but by the heat generated increases their volume to a sufficient extent to force the piston to travel backwards and forwards, thus producing motion. The engine once fixed, the battery charged, and the gas turned on, it is ready for action, and as soon as the work required is completed, the gas is shut off, the engine stops, and the expense ceases.

The facility for employing Lenoir's engine in countries where coal is not easily attainable has been increased by substituting for coal gas a mixture of oxide of carbon and hydrogen, which can easily be procured on a commercial scale at a small cost by passing steam over heated charcoal, the water being decomposed, its hydrogen being liberated, and its oxygen combining with the carbon itself produces oxide of carbon, and the mixture of these gases is a cheap and good substitute for coal gas. Consequently, M. Lenoir's engines can be employed with great advantage in our British colonies and in South America.

(To be continued.)

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*Fire in a Cotton Mill from Electricity.* By JAMES B. FRANCIS, C.E.

On the 21st of March last, at about 8:30 A. M., the overseer of the spinning room in the Appleton Mills in this city noticed a smell of fire, and, in the course of five or eight minutes, discovered it on the upper side of a timber, in a belt box in the story below that of which he has charge. It had made but little progress and was immediately extinguished. My attention was called to it about half an hour after the fire was extinguished.

The belt box is an inclosure at the end of the No. 2 Mill, in which run the main belts, carrying power from the main shaft in the basement to the stories above. Three sides of it consist of a light wooden frame covered with boards, the fourth side is formed by the end wall of the mill. It is of different dimensions in the different stories; in the story in which the fire occurred, called the weaving room, it occupies about 7 feet lengthwise of the mill, and about  $19\frac{1}{2}$  feet crosswise. Two small water pipes, carrying off condensed water from steam pipes, pass through the belt box, maintaining it usually at a temperature between  $80^{\circ}$  and  $90^{\circ}$  Fahr. In the room outside of the belt box, the temperature at this season is usually between  $70^{\circ}$  and  $80^{\circ}$ .

I found the timber which had been on fire to be of white pine, about  $7\frac{1}{2}$  inches square, having one end built into the brick wall, and the other end framed into one of the main floor beams; it lays horizontally and parallel to the face of a leather belt,  $19\frac{1}{2}$  inches wide. This belt is driven by a drum 11 feet in diameter, having iron arms and wooden lagging, and making 92 revolutions per minute; consequently, the belt moves at the rate of 3179 feet per minute. The amount of power transmitted by this belt is estimated at 175 horse power, corresponding to a tension of the tight side of the belt of not less than  $\frac{175 \times 33,000}{3179} = 1817$  pounds. The pulley driven by the belt is 6

feet in diameter and is entirely of iron; the peripheries of both drum and pulley are covered with leather. The belt is made of two thicknesses of leather cemented together, and is about three-eighths of an inch thick; it was slightly greased on the inside, seven or eight weeks before the fire, with a mixture of tallow and neats-foot oil.

The part of the belt near the timber was the slack side, running upwards, nearly vertically, and at the nearest point was about 8 inches from the timber, and when I first saw it, a constant stream of sparks was passing between the belt and the corner of the timber which had been on fire. The charred wood indicated that about 6 inches of the corner had been on fire, and that it had extended about an inch in width on the top of the timber, and about half an inch in width on the side nearest the belt; neither the top nor side of the timber have been painted.

Opposite the middle of the charred surface, and nearly opposite the middle of the belt, and about  $2\frac{1}{2}$  inches from the charred corner, an iron bolt, three-quarters of an inch in diameter, passes vertically through the timber, having a nut on the top, and the lower end connected with a chain, supporting the iron frame of a binder pulley to another belt, driven by the same drum. Whenever I have tried it, a small spark could be drawn by the finger from any part of this iron work.

As stated above, at my first examination, sparks were observed passing between the belt and the corner of the timber; the next day I observed that they were passing between the belt and the top of the bolt and nut, and not, so far as could be seen, to the corner of the timber. At my first examination the timber had just been wetted for the purpose of extinguishing the fire; the next day, on wetting it again, the sparks were observed to pass between the belt and corner of the timber, as at my first examination. I have frequently examined it since, and, when the belt was moving, have always found sparks passing between the belt and the top of the bolt and nut.

The electrical excitement in the Appleton Mills at the time of the fire was unusually great, as was shown by the brilliance and length of the sparks, and the force of the shocks to the body on coming near some of the belts. I have not observed sparks passing between the belt and timber when the latter was dry, as it undoubtedly was, when the fire originated. So far as I have observed, however, the electrical

excitement has not since been so great as it was on the day of the fire, and I can find no other probable cause for the fire, and the conclusion is irresistible that it was caused by electricity.

It is not unfrequent to find in the belt boxes of a mill an accumulation of dust and flyings of cotton or wool, covering everything not in rapid motion to a sensible depth. In this case the belt box was very clean, to which fact, perhaps, may be attributed the slow progress of the fire and the detection of its cause.

Electrical excitement, manifested by sparks, shocks, and the symmetrical arrangement of the fibres of cotton and wool, is so common in our cotton and woollen mills as to excite no remark; it is, however, very different at different times. It is frequently used to light gas; a person standing on the wooden floor, and presenting one finger to a belt from which he can draw sparks, and another finger to the gas as it issues from a metal burner, the gas is instantly lighted. When the electrical excitement is strong, the same thing can be done at a considerable distance by several persons holding each others' hands. It has never been observed here before, that any other substance than gas could be thus ignited. Since this fire, however, the agent of the Appleton Company has succeeded in igniting tinder, by the sparks passing between the belt and the top of the bolt, and I have since done the same thing.

Many fires have occurred in our cotton mills which could not be accounted for at the time; ample means are provided for extinguishing fire, if promptly applied, which they are likely to be when the machinery is in operation, when, of course, the work-people are at hand. So far as I have observed, electrical phenomena are exhibited in the mills only when the machinery or shafting is in motion. By the light of the late fire at the Appleton Mills, it appears probable that many other fires, which were totally inexplicable at the time of their occurrence, may be attributed to this cause.

The exhibition of electricity in our mills is usually greatest in very cold weather, when the atmosphere contains the least moisture. At the time of the fire above described, the weather was quite different, being mild and cloudy, with a slight drizzle of rain falling. About 3 inches of snow fell during the preceding night. At 6.30 A. M., when the mill started, the temperature out of doors was 30°, at 2 P. M., 40°.

Lowell, Mass., April 3, 1866.

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### *Photographing on Copper.*

A M. Mialaret-Becknell writes from Saint-Jean Baptiste, Louisiana, to the *Cosmos* of Paris describing a method of photographing on copper and etching the photograph produced. The method is, in brief, the following, and it may be worth while for amateurs to experiment with;

Take a perfectly smooth and thoroughly clean plate of copper, dry it perfectly and immerse it in a bath of—