diminishes the speed. This method, which is simple and ingenious, does away with the usual rheostat regulation of the dynamo, and in fact the little group works with a remarkable regularity and is thus well adapted for arc and incandescent lighting, charging accumulators, and especially the batteries of electric automobiles. It may be used also for operating agricultural machines by means of a pulley fixed on the end of the shaft. In this case the dynamo works without load, but its voltmeter action still continues and it regulates the speed of the motor. The different uses of such a light and convenient plant need not be dwelt upon; its fitness for laboratories, domestic lighting, arc projectors, out-of-door work, farm use, etc., is at once apparent. The consumption for a 4 horse power group of this kind, giving 110 volts and 20 amperes, is reckoned at 0.5 gallon of gasoline per hour; this corresponds to 40 lamps of 16 candle power, or 60 of 10 candles. Counting the gasoline at $0.30 per gallon (in France), the consumption for a lamp of 10 candle power is only $0.002 per hour, and with larger motors it is still smaller.

Another view shows the same type of motor coupled to a centrifugal pump. The pump is placed, with the motor, on a cast-iron base in the interior of which is a space for the induction coil of the igniter. Above is the cylindrical gasoline reservoir, and on the right a second reservoir which supplies the water for cooling the motor. The speed of the motor is in this case about 1,400 revolutions per minute. It is started by the crank and chain-wheel arrangement seen in front. A pump of this kind is well adapted for agricultural use, especially for irrigation, also for drainage and domestic supply. It would render good service on shipboard and in many other applications, and on account of its small space and weight it can be easily mounted on a carriage and made portable. Pumps of this kind are now built from 1 to 8 horse power and will deliver from 2,000 to 30,000 gallons per hour. A number of pumping plants have been designed for furnishing villages with drinking water in different parts of France, and especially in Normandy.

Two other applications of the gasoline motor for agricultural use are shown in the engravings. The first of these is a thresher of the Foulon-Blondeau type, worked by a small motor which is concealed from view in the photograph. The advantage of this plant over most of the motor-driven threshing machines is that the motor, instead of being installed upon a separate carriage, is mounted directly upon the thresher and the plant is thus easier to transport. The dairy outfit was one of the interesting features of this section. The whole is installed upon a table; below is the motor, which is belted to a common shaft from which the different devices are operated. To the right is the cream-separator, then a barrel-churn worked from a second pulley and last a butter-worker with a corrugated cylinder, which moves over the revolving table.

HEADLIGHT WITH A VERTICAL BEAM.

A new type of headlight which has recently been put in service by the Chicago, Milwaukee and St. Paul Railway, promises to have a very extended application among the railroads of this country. It is an electric headlight which, in addition to sending a powerful ray along the tracks in front of the engine, also projects a powerful vertical beam. The vertical beam makes a very decided illumination in the heavens, so much so that it is possible not only to detect the presence of an engine, but also in many cases to follow its path and determine in which way it is heading. An engineer is by this means placed in touch with the movements of other trains in his vicinity, and is enabled to detect their presence where, if they carried ordinary horizontal beam headlights, he would be unaware of their location. Of course, the modern refinements of block systems and automatic signaling are supposed to take care of the proper location of trains with respect to one another, leaving it to the engineer to look out merely for his own particular signals. But there are cases where the most elaborate systems break down, and where the eternal watchfulness and cool nerve of the man at the throttle are all that stand between a trainload of people and disaster. It is mainly with a view to assisting the engineer in exercising a guardianship over his train which shall not be absolutely dependent upon signals, and so averting those disasters which even now occur on the best regulated roads, that the idea of the vertical-beam headlight was devised. Its greatest value will be shown on roads where the curvature is heavy and the line is located in canyons or runs largely in deep cuttings, or through heavily wooded countries, under any conditions, in short, where the horizontal-beam headlight would be visible for only a limited distance ahead. Then again on single-track roads, where trains are running in opposite directions and meeting, or supposed to meet, only at certain specified stations, the new headlight will have its greatest value. Many a head-on collision has occurred because the trains were running on curves or in hilly country, and were unable to detect each other's presence until the distance between them was too short to avoid disaster. With the vertical beam, of course, an approaching locomotive can be located when it is hidden from direct view by a curve or an intervening hill.

The headlight equipment, which is built by the Edwards Railroad Electric Light Company, consists of four parts: first, the motor, a simple-acting steam turbine; secondly, the dynamo, mounted on the same axle with the turbine and designed to yield to the arc light a current of from 30 to 33 amperes and from 30 to 33 volts; thirdly, the lamp, including the arc, the deflectors and the case; and fourthly, the bedplate on which the whole apparatus is mounted.

The steam turbine is provided with a propeller wheel which is wholly constructed of rolled steel. It has a factor of safety of about 7, for while the normal speed of the engine and dynamo is about 2,000 r. p. m., the wheel will withstand successfully a speed of about 14,000 r. p. m. The speed of the engine is held constant, or practically so, regardless of change of load or initial pressure, by a simple and efficient governor, which is so arranged with relation to the other parts of the engine as to be easily and readily accessible, should occasion demand. The wheel shaft is journaled in ball bearings, and the coefficient of friction is so low that the turbine will operate, running to its full speed, under a pressure so slight that a pointer upon a 180-pound steam gage will not leave its stop, the gage being connected between the governor valve and the nozzle. All the moving parts are incased in a cast-iron housing so designed as to thoroughly protect it from the elements, dust, dirt, etc. The lubrication is automatic and is provided by loose rings feeding the oil to the ball bearings from the oil wells.

The dynamo is of peculiar construction, designed for the particular purpose for which it is used. The field is differentially wound, and the electric circuits so arranged that a burned-out armature is impossible. Should a short circuit occur on any point of the circuit, the current is neutralized, and no matter how long the engine may run or the armature rotate, there will be no production of current whatever until the short circuit is removed. As soon as this is done the dynamo performs its proper functions and operates as usual. The current densities throughout the whole machine are very low, so that a minimum heat effect is produced, regardless of extremes of temperature or other conditions which might affect the resistance of the machine. Low-resistance carbon brushes are used, and many months of constant wear show very little deterioration of these brushes. Very large and long journal bearings are provided, and profuse lubrication is secured through the medium of loose rings dipping into the oil wells. An important feature of the equipment is the arc lamp with its parabolic reflector. It is strongly made, and care has been taken to insure a steady and constant light, free from flicker.

A valuable feature of the equipment is the provision of an auxiliary plane deflector, placed outside the goggle at an angle of 45 deg. and in such a position as to intercept about 40 per cent of the whole volume of light issuing from the parabolic reflector and direct it vertically. This vertical beam forms a constant warning signal. Reaching to a great height, and on cloudy nights striking the clouds, it can be seen for many miles. In fact, upon the Big Four road it has been seen for a distance of 21 miles, and on the Chicago, Milwaukee and St. Paul road it has been seen for a distance exceeding 16 miles. The horizontal beam is very powerful, showing up clearly three-quarters of a mile to a mile, on a clear stright track, ahead of the locomotive bearing it.

Perhaps the only valid objection that was raised to the electric headlight is the fact that upon a double-tracked road there might be some tendency to blinding an approaching engineer. To guard against this contingency the apparatus is provided with a translucent shade, within the goggle, which may be drawn at will by the engineer when he is at the proper distance from an approaching engine. This shade destroys the strong glare of the light, giving the effect of frosted glass. As soon as the approaching train is passed the engineer releases the shade and again gets the full value of the light.

The whole apparatus is generally mounted upon one cast-iron bedplate, and it is the work of only six or ten hours to apply the equipment to the locomotive. All that is necessary is to secure the bedplate at the proper place on the smoke arch by means of brackets bolted thereon, the running of a three-quarter-inch live steam pipe from the cab, and the passing of a one and one-quarter-inch exhaust pipe into the smoke arch.

New Deutsch Airship.

M. Henri Deutsch will soon make an ascent from the Aero Club's grounds at Saint Cloud, Paris, with his new airship, "La Ville de Paris." The outcome of the ascent will be awaited with interest.

Correspondence.

The Use of an Artesian Well for Power.

To the Editor of the Scientific American:

In a recent issue of your valuable publication I notice an article under the heading of "Power from an Artesian Well."

I write this to say that there is in this (Hale) county an artesian well 10 inches in diameter that throws out a volume of water sufficient to run a grist mill, cotton ginnery and cotton press and a sawmill. The well is about 600 feet deep, and was bored fifty years ago by Col. Samuel Pickens on the plantation twelve miles southwest of Greensboro, Ala., known as the "Goodrum Place," now owned by Lee M. Otts, Esq. The water comes up with such force from the well that a silver dollar thrown into its mouth will not sink, but will be thrown out. The gusher has diminished very little in the amount of water furnished during the half century it has been running. To give an idea of the amount of water that is thrown from the well, will state that the trough surrounding it is four feet across, and when the water falls back it comes near filling the trough from side to side.

The mill and ginnery run by the water from this well is situated on a hill-side about a hundred yards away, and the water is carried to it by means of a canal cut in the solid lime rock. Just under the mill house is a well 3 feet across and 40 feet deep. In this well, at a depth of 25 feet, is a turbine wheel and the water from the canal is turned on it when it is desired to run the machinery. A tunnel from the bottom of this 40-foot well has been cut a distance of 100 yards—ranging upward—and empties the waste water from the mill into a branch. Wm. E. W. Yerby.

Greensboro, Ala., September 1, 1902.

How Does the Spider Spin Its Web?

To the Editor of the Scientific American:

I was very much interested in an article that appeared in your paper of August 23 about the mystery of spiders stretching their webs across highways and other long distances.

Every observing country boy has noticed these wonderful feats of the spider in suspending his bridge from one point to another, high in air. My father often told us how he and his father, while crossing a bridge over the Merrimack River in Boscawen, N. H., early one morning, saw a spider's web extending clear across the river from one point direct to another, a distance that must have been at least 250 or 300 feet. The sun was just appearing over the treetops and shone upon the web, so that it was distinctly seen the entire length. They speculated how the spider could have spanned the stream with his web. Certainly the web could not have been strung by the help of the wind, which, nine times out of every ten, blows down the river in this locality. The prevailing winds in New Hampshire are from the northwest; and the river at this point flows from the northwest and runs southeast; the bluffs are quite high on each side, from which it follows that the east or west wind could not have blown strong enough at this point to have carried the web across.

Every open-eyed countryman knows that large spiders can walk on the water, or rather run. I have seen them frequently go so fast on the water that one could hardly see them. I have thrown them into the water many times, where the current was swift, to see how soon they would reach the shore. To anyone not familiar with this insect it would be surprising to see how swiftly it can run over the water.

My grandfather thought that the spider ran across the river, although the current was deep and strong at this point. But my father could not agree to this proposition. He said it would be impossible for a spider to regain the other shore so directly across and then carry his web so high above the water and fasten it to the tree branches on the opposite side without getting the web entangled in the branches in climbing the trees. Neither of them could solve the mystery. I have noticed in attics and barns that spiders spin their webs from one rafter to another at an angle of about 30 or 40 degrees. I have also seen them spinning webs from one branch of a tree to another. They seem to jump from one branch and swing on the web so as to reach the lower branch at sometimes an angle of 40 degrees or less. Webs formed on these angles are frequently seen. The upper cable seems to be the one that holds the web; and below this cable the web is spun. But how a web is thrown directly across a road or river is beyond my comprehension, unless the insect after having crossed the river, attaches the web to some bush, then climbs a tree, and spins down to the web, detaching and carrying it to the higher branches. This the spider can do, I am sure, for I used to like to break the webs in order to observe how carefully the insect would pick up the broken strands, mend them, and then carry the broken ends to their proper places.

Lyman Jackman.

Concord, N. H., September 1, 1902.

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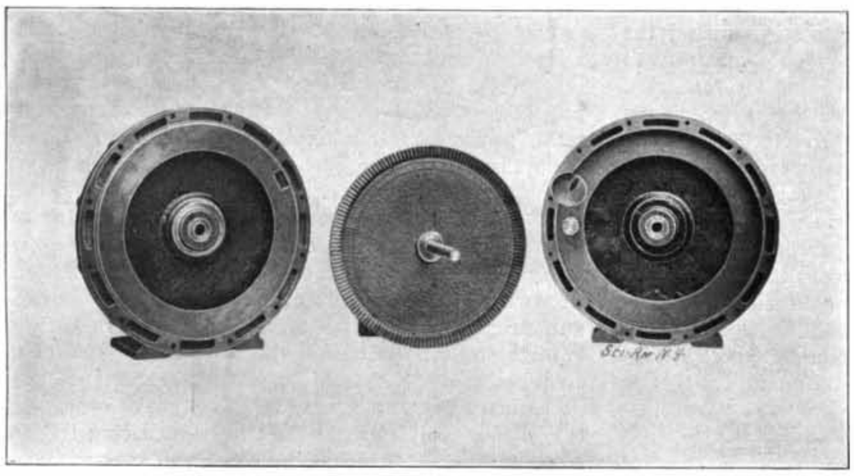
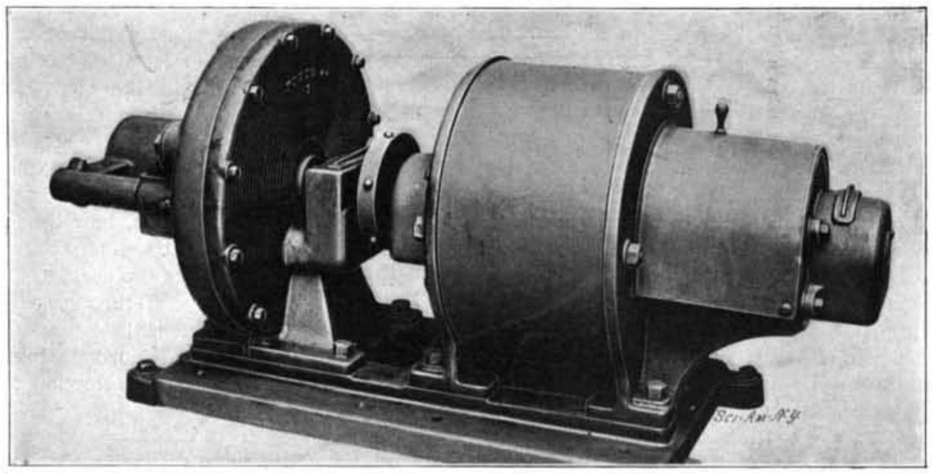
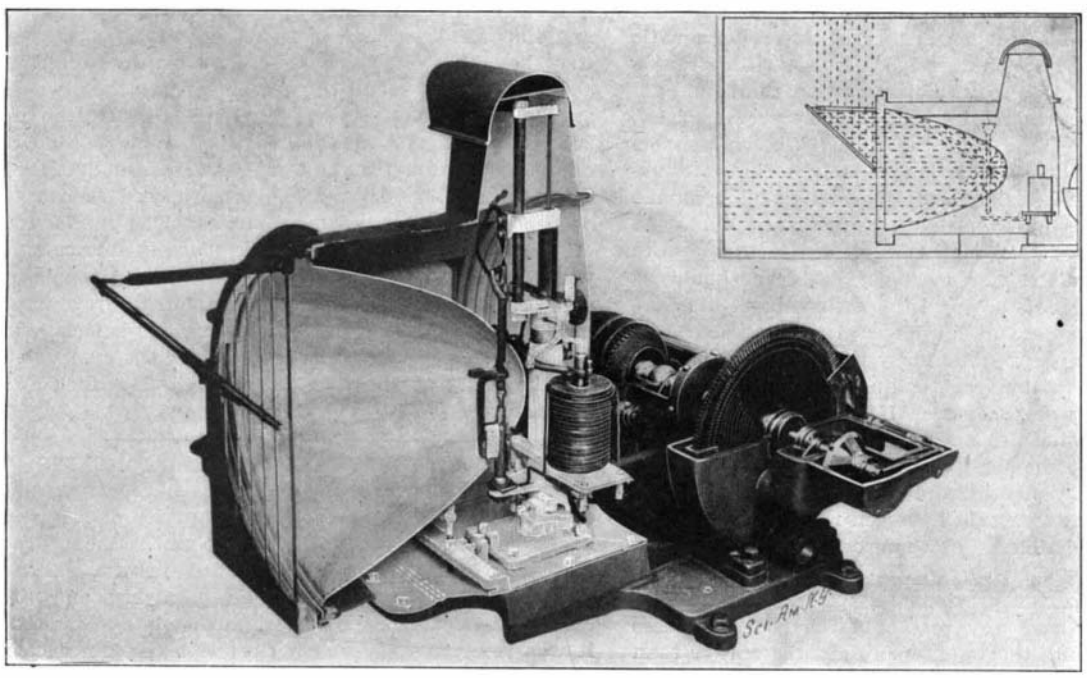


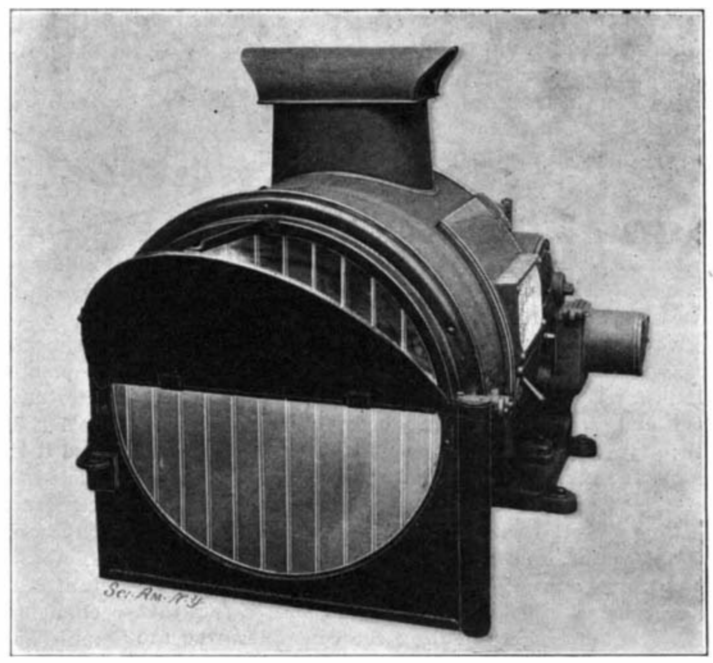
THE TURBINE ENGINE DISASSEMBLED.



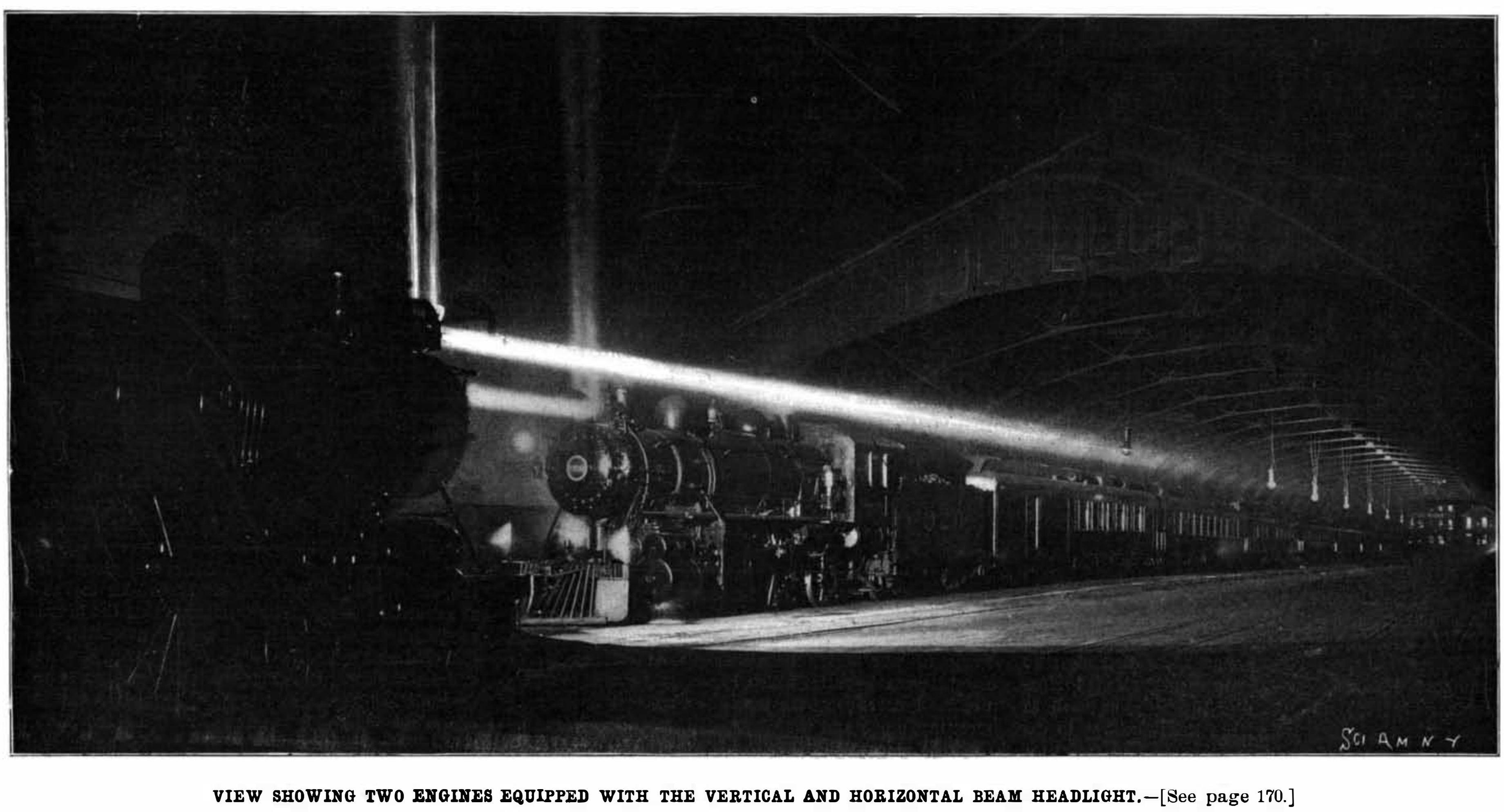
THE MINIATURE TURBINE AND DYNAMO.



A SECTIONAL VIEW OF THE HEADLIGHT.



FRONT VIEW SHOWING SHADE DRAWN.



VIEW SHOWING TWO ENGINES EQUIPPED WITH THE VERTICAL AND HORIZONTAL BEAM HEADLIGHT.—[See page 170.]