AN ETHER-VAPOR GENERATOR.

The idea of using a volatile body in boilers is not a new one. As long ago as the year 1852 a small flotilla of ships was equipped with what were called "combined vapor" or "binary" motors that had been devised by M. du Tremblay with the object in view of diminishing the consumption of the fuel of the engines, and consequently the capacity of the coal bunkers. The volatile liquid employed was sulphuric ether, which was vaporized by the exhaust of the steam engine, and which afterward acted in a special cylinder. The saving hoped for was realized, but an accident abruptly put an end to this process, which was seemingly so full of promise. A cylinder containing the ether necessary for the supply of the apparatus got broken in the hold of one of the vessels and the vapor disengaged at the surrounding temperature having become ignited through the flame of a lamp, during night-work, the ship was destroyed by fire. Although this accident was really not attributable to the operation of the ether motor, it nevertheless gave Du Tremblay's invention a fatal blow.

Struck by the theoretical advantages of ether over steam, M. de Susini, in 1892, resumed the study of the application of this liquid for the production of motive power, and constructed the apparatus shown in Fig. 3. Like his predecessor, M. de Susini for the heating of the ether employed the exhaust of an ordinary steam engine. The ether, after acting in a cylinder upon the surface of a piston, was sent through the pipes, *D, B, C*, into a surface condenser, wherein it became liquefied and whence it was withdrawn by a pump, which sent it to the boiler through the pipe, *A*. But it was again necessary to employ a steam engine, since M. de Susini did not dare to heat the ether directly by an open fire. The result was a great complication of parts, and the apparatus, despite the indisputable saving effected, was unable to supplant the good old-fashioned steam boiler of Papin and Watt.

But the problem seems now to be solved, for an inventor has succeeded in overcoming the difficulties that confronted his predecessors. A really practical ether generator has at length been produced, and, after its efficiency shall have been demonstrated to engineers, it will doubtless come into universal favor.

The great disproportion that exists between the theoretical work furnished in the form of heat by a steam boiler and the effective work produced by the engine has long been recognized. In other words, the real efficiency, measured with respect to the quantity of fuel consumed, is but a small fraction of the unit that would stand for the total efficiency, and the conversion of the calorific energy into mechanical is effected with a loss of nine-tenths, or, in other words, in quite fantastic proportions. This trouble is inherent in the very principle of construction of steam engines. The effective power, in fact, is obtained from the great expansion of the water in passing from a liquid to a vaporous state, followed by a contraction of the steam returning to a liquid state. Now, such differences in volume can be obtained only by furnishing the water, in the first place, with the great quantity of heat necessary for its vaporization, and afterward getting back this heat. It will be seen, then, that when the steam leaves the cylinder to flow either to the condenser or into the atmosphere, it has really restored, in the form of work, the quantity of heat which, by raising its temperature, served to carry its pressure from that of boiling water to that employed in the engine; but it has lost, without utility, the 971 British heat units furnished to every pound of water (540 calories per kilogramme) in order to cause it to pass from a liquid to a vaporous state. This loss, this absorption without profit, of valuable energy may be notably diminished by using, instead of water, a volatile liquid that does not possess such great latent heat of vaporization, such as ether or chloroform.

Thus, while water requires 2,126 British heat units (536 calories) in order to reach a temperature of 212 deg. F. (100 deg. C.), and 2,523 (636 calories) for its conversion into steam at a pressure of one atmosphere, sulphuric ether requires but 361 heat units (91 calories) for its ebullition, and, at a temperature of 96.8 F. (36 deg. C.) has a pressure of one atmosphere for a total absorption of 432.5 heat units (109 calories). The use of it, substituted for that of water in engines, would, therefore, theoretically, permit of a saving of four-fifths of the fuel required for the performing of an identical amount of work.

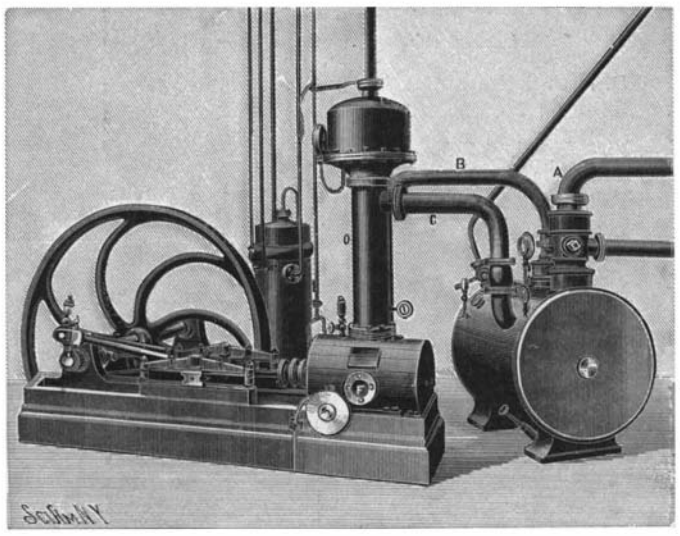


Fig. 3.—GENERAL VIEW OF THE DE SUSINI ETHER MOTOR.

But ether is a volatile liquid, against which too many precautions cannot be taken if it be exposed directly to the flames of a furnace. The pressure increases with great rapidity, and reaches one atmosphere in forty seconds. Such rapidity may prove an advantage provided unforeseen variations are automatically corrected as soon as they occur; and it is to the solution of this delicate problem that M. Desvignes de Malapert has directed himself, in order to render his generator practically inexplosive and to cause it to operate with perfect regularity.

Fig. 1 shows in section the elements composing the Desvignes ether generator. It will be seen that it possesses the general arrangement of a Belleville tubular boiler, since it consists of a series of juxtaposed tubes, *A*, held between two junction plates and inclined obliquely. The outer of these steel plates is 0.984 inch in thickness, and the inner one slightly thinner, while the two plates are set up about ¼ inch apart. The tubes of the generator are of red copper 0.078 inch thick. The holes in the plate that hold the tubes are very finely threaded and the tubes, perfectly smooth on their outer surface, are pressed tightly into the holes and then expanded with a conical tube expander, so that they fit tightly in the threads of the plate. The parts of the tubes next to the plates are also expanded on the latter, thus making a very tight joint. The heater, *E*, which is placed beneath, consists of a perforated tube supplied with illuminating gas or carbureted air, according to circumstances. This burner is fed through a valve, *F*, suitably connected with an automatic regulator operated by the pressure in the boiler.

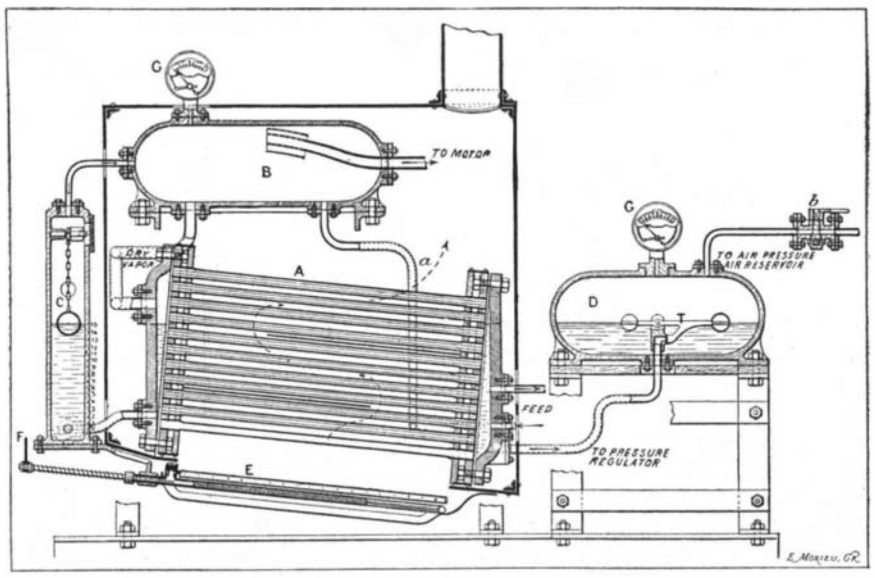


Fig. 1.—SECTION OF THE DESVIGNES DE MALAPERT ETHER GENERATOR.

A, boiler tubes; *B*, vapor reservoir; *C*, level-apparatus; *D*, pressure regulator; *E*, gasoline burner; *F*, valve for regulating the flow of the gasoline; *G, G*, pressure gages; *T*, float with counterweight.

The essential part, characteristic of the invention, is the feed expansion-regulator, the object of which is to limit the pressure in the generator at a point fixed in advance and thus prevent any excessive pressures. This apparatus is quite necessary as a safeguard, for the pressure increases very rapidly, and it might happen, if there were a sudden increase of heat from the fire, that the tubes would become so hot that even after the fire was turned off by the automatic regulator, the boiler would still continue to generate ether vapor under an increased pressure. The regulator consists of a closed reservoir, *D*, connected with the generator by a pipe and containing a certain quantity of ether whose level is the same as that in the generator. Before the apparatus is set in operation, air is compressed in this reservoir by means of a hand pump to the pressure which it is wished not to exceed in the generator. The pipe connecting with the generator is closed by a valve which is held upon its seat by the pressure in *D*, which exceeds that in *A*. A weight fixed upon the left hand end of lever, *T*, counterbalances a float at its other extremity. The operation of this arrangement is as follows: When the pressure in the generator exceeds the normal degree, that is to say, that of the regulator, the valve opens, and the ether is forced into the reservoir—an event that cannot occur as long as the pressure in the boiler remains below the determinate maximum. As soon as the pressure in the boiler resumes its normal point, the ether reenters the tubes till the normal level is reached. At this point the float which has been holding the valve open during the return of the liquid, allows it to close; and, as the level in the reservoir is always above the valve, no air can escape into the tubes. This arrangement affords entire security, and no explosion is possible, since the generator would instantaneously discharge its contents in case there were a superproduction of heat.

The generator is completed by an electromagnetic level apparatus consisting of a float, *C*, on the chain of which is fastened a strong magnet that moves a magnetized needle on the outside of the float chamber; and a spiral tubular condenser in which the ether returns to a liquid state after acting in the cylinders of the motor. A feed pump then sends the liquid to the generator, and the cycle of operations begins anew. The condenser, which is of small size (11.8 x 23.6 x 19.6 inches for a 10 horse power motor), is cooled either by a current of cold water or by air. In the latter case it has been found that 1 square foot of heating surface in the boiler necessitates about 1.05 square feet in the condenser with a current of air of 6½ feet per second. As ether vapor condenses very easily, it is necessary to avoid this condensation in its passage from the boiler to the motor. The copper pipe that carries the gas is therefore surrounded with a heat-retaining packing of wool covered with sheet iron, so that it is always warm and does not allow the vapor that passes through it to condense.

After trying this apparatus as a stationary engine, the inventor installed it upon an automobile frame, and found that it operated in this case just as satisfactorily as in the other.

The generator of this carriage (Fig. 2) is arranged in the rear, between the two driving wheels. Although its weight does not exceed 265 pounds, it is capable of supplying a 10 horse power motor. The tubular boiler is heated by a burner that burns air carbureted by gasoline. It is surmounted by a steam dome or reservoir. The expansion regulator is placed to the right, and the level is in front, so that the driver has the speed indica-

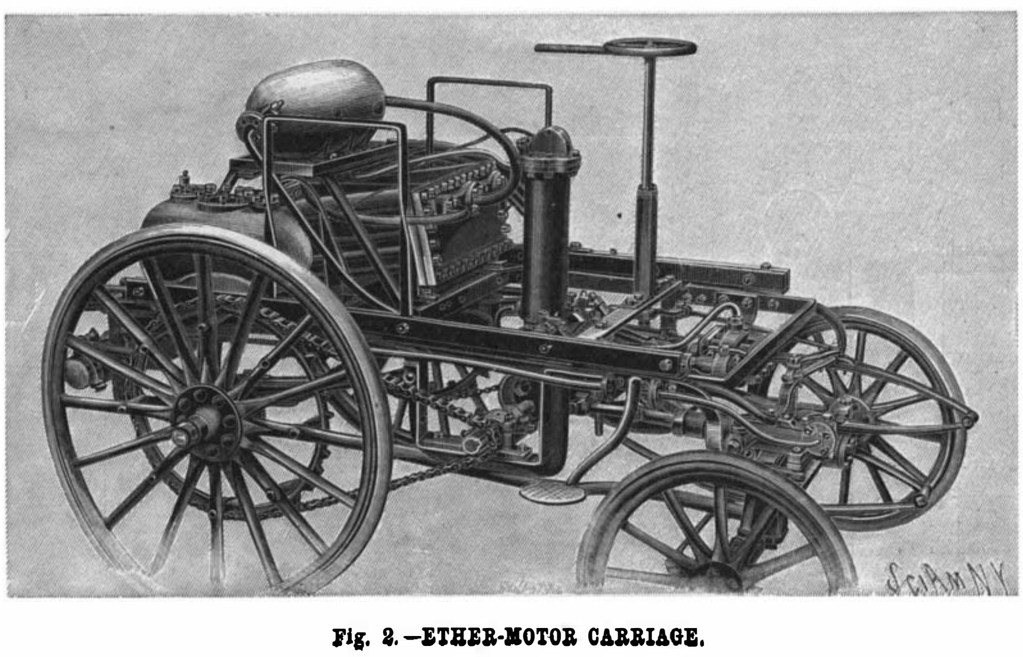


Fig. 2.—ETHER-MOTOR CARRIAGE.

tors and safety apparatus constantly under his eyes. The arrangement of this experimental vehicle is still defective, since it is far from being comfortable, and the mechanical parts are juxtaposed without any regard to appearances. But the principal point is that, although a little primitive, it has been found to operate satisfactorily. Thorough demonstration has been given of its practicability, and it can now be said that the ether motor has become practical and constitutes a new resource for the industry, the existence of which has been threatened by the constantly increasing cost of fuel. A motor of an organic efficiency greatly superior to that furnished by steam or explosive gases, and permitting of a great saving in fuel, cannot fail to be well received, especially if its mechanical arrangements are rational. Such is the case with the ether generator applied at first to navigation in 1852 by Du Tremblay, and improved and rendered practical by Desvignes de Malapert, who has succeeded in surmounting all the difficulties of the problem. Perhaps we are on the eve of a genuine industrial revolution, and shall, in a near future, witness the complete revolution of the process now in use for cheaply producing motive power.—La Nature and La Locomotion.

A NEW SYSTEM OF WIRELESS TELEGRAPHY.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An interesting new system of telegraphing without wires has been invented by Mr. Axel Orling, a young Swedish electrician, and Mr. J. Tarbotton Armstrong, a well-known engineer of London, which is dissimilar from either the Marconi, Tesla, or other systems now in use. The invention was patented long before that of Marconi, but the inventors refrained from bringing it before the public until it had been developed and brought to a satisfactory state of perfection to render it available for commercial exigencies.

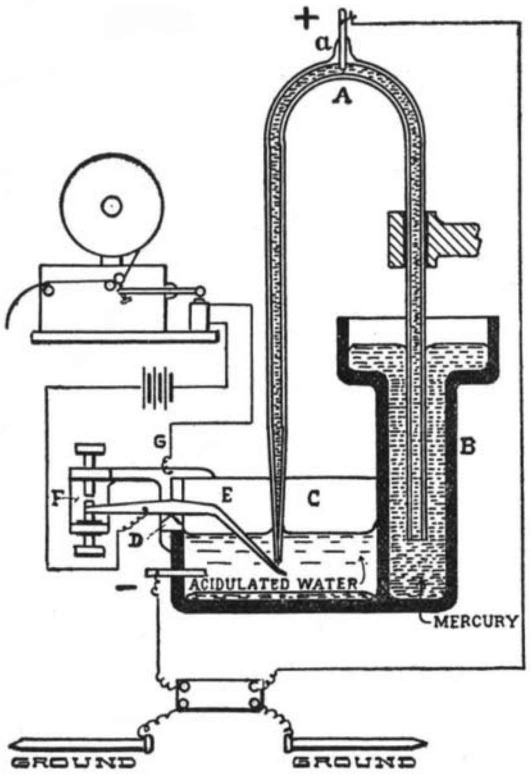
The advantages claimed for the Armorl instrument are its simplicity, portability, the low cost of installation, and facility of manipulation. The Marconi and other systems at present practised, broadly speaking, consist of discharging induced high potential currents from a transmitter into the atmosphere, finally arresting them at their destination by means of a sensitive receiver. In the Armorl system the earth is utilized as the conductor, and the currents discharged are of very low potential. The efficiency of the conductivity of the earth may be adequately realized from the fact that in order to transmit a message twenty miles, a current with a pressure of only eight volts is utilized, while even a pressure of four volts has been found sufficient to travel the same distance with complete satisfaction.

In the Armorl invention induction coils, coherers, high masts and various other impediments incidental to the prevalent systems of telegraphing without wires are entirely dispensed with. The Armorl apparatus is so small and compact that it can be compressed within the compass of a small box measuring seven inches in length by four inches in width, and eight inches in depth, and weighs from five to six pounds.

These interesting results have been achieved by the invention of a new receiver and transmitter, the former of which supplants the coherer. Hitherto the telephone receiver has been considered the most susceptible to electric currents, but this receiver has proven far more highly sensitive. It is described as the electro-capillary relay, and is an entirely new method of receiving electric currents. Through the courtesy of the inventor we are enabled to publish a sectional diagram of the device, and to describe its fundamental principles of working.

It is based upon the capillary attraction of mercury due to the electric currents. *A* is a small glass tube with one leg terminating in a finely-drawn point, while each is open at the end. At the top of the head of the tube is a small neck, *a*, fitted with a stopper, and to which the positive wire is attached. This instrument, which is only about four inches in total height, works on the principle of a siphon. One leg is inserted in the cell, *B*, which is filled with mercury, while the other point terminates in another cell, *C*, filled with a solution of acid and water. Upon the outer edge of this cell, *C*, is fixed an agate pivot, *D*, and upon this is delicately poised a sensitive balance, *E*, one end of which descends into the cell, *C*, immediately below, and almost touching the end of the capillary tube, while the other end extends outward to a small contact point, *F*, almost touching it, and to which is attached the wire connecting to the Morse tape machine or whatever other instrument it is desired to operate. The consequence is that whenever the end of the balance in the cell is depressed, even if it be ever so slightly, it causes the outer extremity to fly upward, and to come into contact with the point, *F*, just above it. The capillary tube, *A*, is filled with mercury. The positive current wire is connected to the stopper, *a*, while the negative current wire runs to a pole in the acidulated water solution. As the current enters the capillary tube, through the point, *a*, it sets up capillary attraction of the mercury within the tube, with the result that a certain quantity of the mercury, varying according to the intensity of the current, exudes from the tube in cell, *C*, and drops on to the end of the balance. This immediately depresses this end of the beam and causes the opposite end to rise until it touches the contact point, *F*, and the current is conducted along the wire, *G*, to its requisite destination. As the balance, *E*, falls by the weight of the mercury, the latter is deposited upon the floor of the cell.

The balance of the beam, *E*, upon the agate pivot, *D*, is so delicate that the smallest quantity of mercury falling from the tube sets it in motion; and as the capillary attraction of the mercury within the tube is set up by even the faintest current of electricity, an adequate idea of the sensitiveness and delicacy of the device may be gathered. Electric currents which the most sensitive galvanometers fail to record, or



THE ARMORL SYSTEM OF WIRELESS TELEGRAPHY.

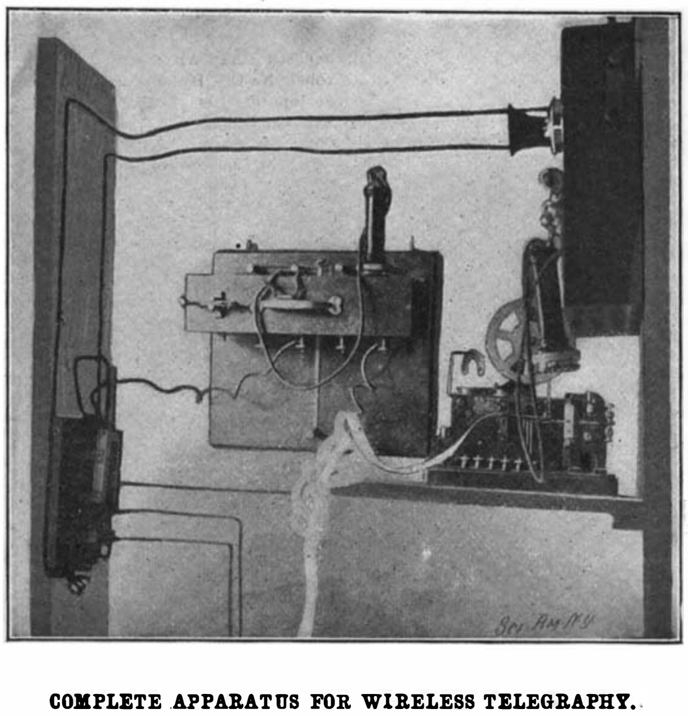
which will not affect the receiver of the telephone, will actuate this receiver, so that there is no possibility of a current entering the apparatus without moving the balance, *E*. For instance, if a cent piece is wetted, a dime placed upon it, and a wire from the coins is conveyed to the point, *a*, the faint and almost imperceptible current that is thus generated will be recorded. Another prominent feature of the apparatus also is that no self-induction is set up, which is the case with the existing type of relay. It may be contended that the embodiment of such a delicate mechanism within a portable box, which might be subjected to rough handling, would render it liable to be deranged, especially in field work, but the device is carefully and securely packed to obviate any such mishap.

The complete apparatus comprises this receiver and a small battery of eight volts packed in a case, which is provided upon the outside with two contact screws. Two pointed iron stakes are driven into the ground to a depth of approximately eighteen inches, and about twelve feet apart. To each of these a wire is attached connecting the negative and positive poles respectively of the instrument. A small key similar to that usually employed for dispatching Morse code signals is attached, together with a telephone receiver. The current thus set up flows through these wires and stakes into the ground. The operator holds a telephone receiver to his ear with one hand while he transmits the message with the other in the ordinary manner. At the opposite station, where similar iron stakes are placed to receive the impulses, if necessary, the receiver can be connected to a Morse tape printing machine, and the messages printed as they are received.

The inventors have rendered the employment of wireless telegraphic communication somewhat nugatory, however, by the discovery of a similar method of telephoning through the ground. The adaptation of this system, however, is quite recent and the results of their experiments have not yet enabled them to supply a sufficiently practicable system for commercial purposes. Although the sounds transmitted are received with perfect clearness at present they are somewhat faint, and the inventors are completing a small device for intensifying the sounds when received by the receiver.

The greatest distance over which these inventors have endeavored to transmit these electric impulses has been 20 miles with an 8-volt battery. The success of the experiments up to this distance, however, has convinced them that this is by no means the maximum distance, but at present they intend to establish this as their limit. For long distance telegraphing they have conceived an ingenious idea. At intervals of 20 miles they sink into the ground out of sight a small device enclosed in an iron box, consisting mainly of the capillary relay. The message when dispatched from the first station is arrested in its passage at the termination of the first 20 miles by this small apparatus, and then instantly, as received, dispatched on a new lease of life over the intervening 20 miles to the second relay. Thus, for instance, if it is desired to send a message 100 miles, in addition to the terminal stations at either end, there would be four intermediate relays. As each of these relays costs only approximately three dollars, the economy of the system is a strong recommendation.

If one is traveling in a conveyance, however, such as a carriage with metal flanges round the wheels, the person riding can establish and maintain telegraphic or telephonic communication, without descending from or stopping the vehicle. In this instance, the wheels take the place of the iron stakes to conduct the electric impulses from the instrument to the earth. A metal roller suspended from a metal bracket rests upon the wheel of the carriage, and to this bracket is connected the apparatus by means of a thin wire. The weight of the carriage upon the wheels ensures constant contact of the latter with the earth.



COMPLETE APPARATUS FOR WIRELESS TELEGRAPHY.

Automatic Train Signaling.

It is reported that the Pennsylvania Railroad Company is considering the adoption of an automatic electric-signal system on its locomotives, says the Western Electrician. The system was recently tested by the Chicago and Eastern Illinois Railroad, between Dolton and Momence, Ill., a distance of 63 miles. The result of the experiment was very satisfactory and seemed to show that the electric signals were far better than the ordinary block system.

In the experiments conducted by the Chicago and Eastern Illinois, the line was divided into block sections of suitable length, and adjacent block sections were separated by an insulated track section one rail in length. The track batteries were placed at these points, the positive wire leading to the insulated rail and the negative wire to the block section in the rear. The rails in each block were bonded in the usual way. In the engine cab were located two incandescent signal lamps, one white and the other red. One or the other of these is always burning. Current was supplied by battery on the engine or tender, and was switched from one lamp to the other by an instrument operated by the track circuit. Each locomotive axle had electrical connection with a conductor leading to the instrument on the engine. When the wheels entered the insulated section (if the stop signal was to be given) the current passed from the rail through the wheel conductor and cab instrument, switching the lighting circuit to the red lamp.

In this system the signal is always given two blocks back from the obstructed block, or the train-order signal, so that when the red lamp burns the engineer knows that he has one clear block in which to stop his train. The red lamp burns when a switch is open, a block section occupied or a train-order signal displayed.

The projected European plant of the J. G. Brill Car Building Company will be at Preston, one of the most flourishing cities of Lancashire, England. The new works will be equipped almost entirely with machinery from the United States and will have a capacity of 1,000 cars and 4,000 car trucks per year. About 500 men will be given employment.