but is of the Queen make, the adjustable vibrator, the oscillator balls, the adjustable mica condenser, and the interlocking switches are placed on the surface of the table for convenience of manipulating, as is the reversing lever, the case inclosing the wire detectors, and the key.

Another invention of Fessenden's of more than passing interest, is shown in Fig. 4, and has for its object "the maintenance of a certain definite relation between the resistance, inductance, and capacity of the oscillator system, regardless of the potential employed, and securing such a relation between the sparking potential—i. e., the potential required to break down the film of air forming the gap—and the radiation."

To accomplish this result, the spark is made to take place in compressed air, and its functions may be followed by referring to the numerals in the figure; 1 represents an induction coil of the ordinary type, 2 the source of current, 3 the key, 4 one terminal of the spark-gap and the opposite is formed by the plate 5; 4 and 5 are connected to the antenna and earth respectively, as in all fundamental systems; 7 is a cylinder connected to the pump 8 and by which air or gas may be kept at a constant pressure in 7.

Now when the spark is made to traverse the air-gap between the terminals 4, 5, the coefficients of the oscillator circuit, namely, its inductance (L), capacity (C), and resistance (R), must conform to the formula $R^2 > 4\,L/C$. In wireless telegraph practice it is necessary, in employing a spark-gap of free air, to diminish the striking distance between the balls to a centimeter or less, for the reason that unless this is done the conditions of the above formula are not fulfilled, and then R^2 becomes *greater* instead of less than $4L/C$, and the current instead of being oscillatory becomes unidirectional; but when the Fessenden's compressed-air spark-gap is employed, the oscillator balls may be separated considerably beyond that prescribed by theory, and the same effective radiation produced, without resorting to an apparatus of larger dimensions, by merely increasing the density of the dielectric formed by the insulation of air.

A phenomenon is produced by this arrangement that is new in physics and exceedingly interesting, e. g., if a spark four inches in length is caused to pass between the terminals 4 and 5 at a given potential when the pressure of the air in the cylinder is equal to that of the atmosphere, and then if the air is compressed to fifty pounds per square inch above atmospheric pressure, the striking distance of the spark will be diminished to one-fourth of an inch—assuming the potential of the changing current remains the same—and there will be no appreciable increase in the radiation of electric waves, although the shunt resistance of the spark gap is reduced to one-sixteenth of its former value; but when the compression of air in the chamber represents sixty pounds there is at once a marked increase in the effective radiation, and at eighty pounds the energy emitted in the form of waves is nearly three and a half times greater than it was at fifty pounds, and the emission of waves becomes practically proportional to the electromotive force employed to change the oscillator. If the improved potential is doubled, the effective radiation is also doubled, and so on, the described curves showing that when a certain critical pressure of the air is reached, the effective radiation of electric waves is increased proportionally as the potential is increased.

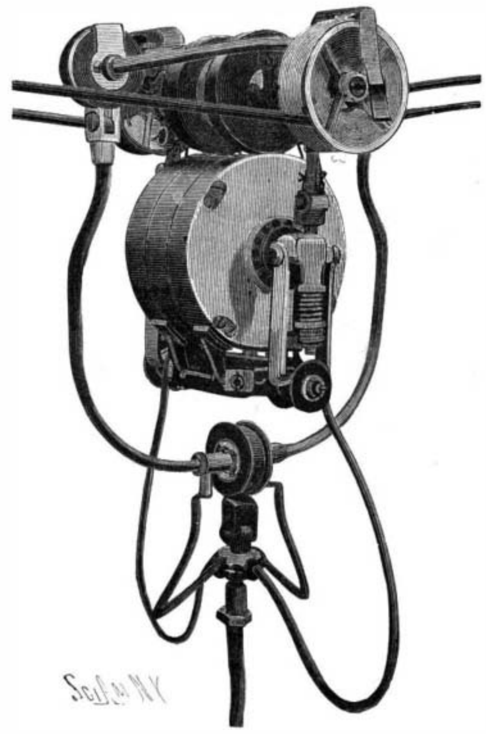
These are but a few of the many facts embodied in the thirteen patents which were recently issued to Fessenden, but serve to illustrate his system and method. The subject in all its phases is so broad and the literature so limited that these patent reports read like a new romance.

Among the most recent tests made by the Fessenden interests were those for the navy. The system is now being placed on the market by Messrs. Queen & Co., the instrument makers of Philadelphia, and bids fair to be one of the foremost systems, both domestic and foreign, for wireless telegraphy. In the early development of the Fessenden electric-wave detector, some difficulty was encountered by the burning out of the loop. This has been entirely overcome by putting a hundred loops or more in parallel. This does not decrease its sensitiveness, as might appear at first sight, because though each loop is only heated up one-hundredth as much as before, and consequently only changes its resistance one one-hundredth as much as before, yet there are one hundred of the loops instead of only one, and each current being changed one one-hundredth as much, there will be one hundred times the amount of current and therefore the total change is exactly the same as it would be with a single loop.

ELECTRIC TROLLEY WAGONS AND OMNIBUSES.

BY FRANK C. PERKINS.

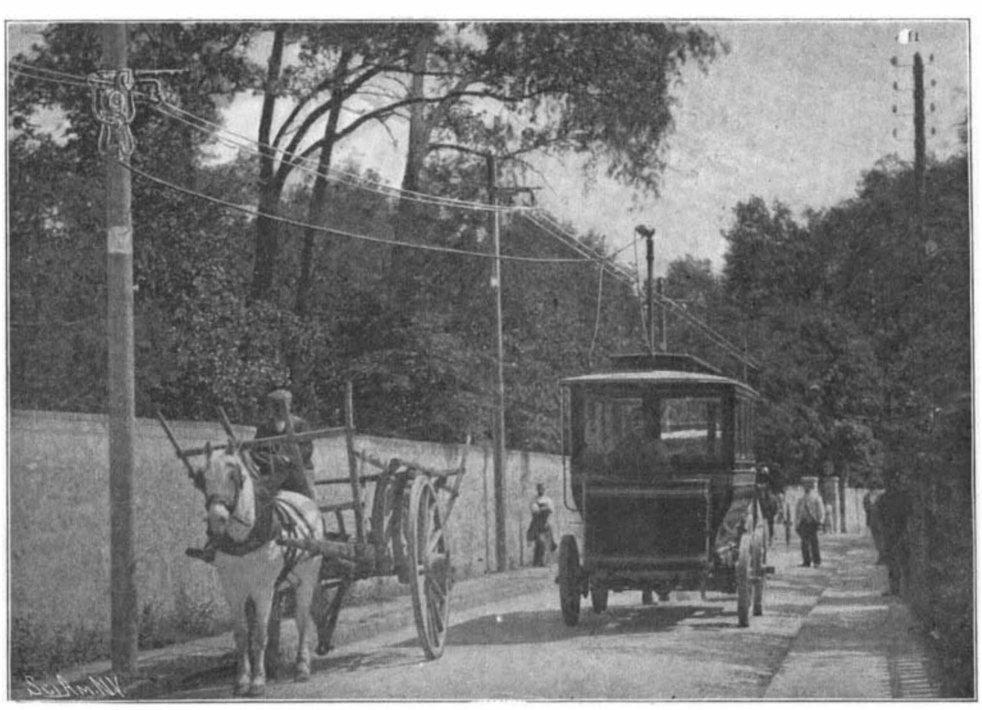
The peculiar character of the streets of many German and French cities renders it often impossible to install electric tramway systems. With the development of the automobile, however, a means has presented itself of placing these thoroughfares in better communication with other portions of the city. The



THE AUTOMOTOR TROLLEY.

systems of transportation to which we refer may be regarded as a combination of the electric car and the omnibus, for the vehicles derive their motive power from an overhead current, but do not run on steel rails.

Two such systems of electric trolley omnibuses have been proposed. One bears the name of its inventor, Mr. Max Schiemann, and is exploited by Siemens & Halske, of Berlin, and the other is known as the Lombard-Gerin system. The Schiemann system has been operated on a line extending from Königstein-Hütten through the romantic valley of the Biela. The length of the line was originally 2.8 kilometers, but it has been extended 9 kilometers, and now operates between Königstein-Hütten and Königsbrunn. The roads are very good, so that a speed of 12 kilometers per hour is easily maintained. Auto-omnibuses, motor-cars, and trailer cars are used, the first being employed for the transportation of light express matter and the latter for the hauling of coal and the like. Steering



THE LOMBARD-GERIN MOTOR TROLLEY LINE BETWEEN FONTAINEBLEAU AND SAMOIS.

is effected by means of the front wheels of the first car of a train, since it has been found that the wheels of the second car will track after those of the first. The trolleys employed have a sliding contact, one trolley being placed at each end of the bus or motor car.

In passing an ordinary conveyance the omnibus is simply steered to the right or to the left a possible distance of about three meters from the trolley line. In passing another omnibus coming in an opposite direction, it is of course necessary, under the circumstances, to remove the trolley poles from one conveyance while the other moves along. The motor-cars used to haul the freight trailers weigh four tons each and have a carrying capacity of one ton. Each trail car weighs 1.5 tons empty and 5 tons loaded, from which it follows that the total weight of the loaded trains is 10 tons. The seating capacity of an omnibus is about 26 persons. The cost of construction is about $800 per kilometer.

With the Lombard-Gerin system, readers of the SCIENTIFIC AMERICAN are not unfamiliar. The system utilizes two overhead wires; one positive and one negative. Instead of driving the vehicles entirely by motors connected up with the axle, an auxiliary device called an "automotor trolley" is used which runs along the overhead wires. In other words, the vehicles are towed along by a self-propelled motor trolley. The towing trolley is driven by a 3-phase induction motor suspended between two conducting trolley-wires. The motor is carried in a frame which also has bearings for the two trolley-wheels. Motion is communicated to the trolley-wheels by the revolving field of the motor.

The current is fed to the trolley-motor from the omnibus motor, which latter may be regarded as a combined rotary transformer and direct current motor. The trolley motor travels with a speed somewhat in excess of that of the car itself. From this peculiar arrangement of causing it to lead the way, as it were, the Frenchmen have termed the auto-trolley "the blind man's dog."

The Lombard-Gerin system has been tried on a line extending from the village of Samois to Fontainebleau, a distance of about five kilometers. On this line the car or omnibus is driven by a double motor operating at a tension of 500 volts direct current. The time taken for the journey is about twenty minutes. The total energy used is 543 kilowatt hours or 64 kilowatt hours per car kilometer.

It is stated that the low expense of equipment for a line of this character renders it of particular value for country districts, where an expensive track construction would be prohibitive on account of the small amount of traffic.

The Compagnie de Traction par Trolley Automoteur gives the ratio of expense to receipts as 58 per cent and quotes the following as the expense of operation for this kind of line:

The electrical energy, at 25 centimes per kilowatt hour, amounts to 1,355 francs on 25 centimes, or 0.161 centime per car kilometer. The repair expenses of the carriages are given as about 776 francs, or 0.092 centime per car kilometer; and the working of the omnibuses with one man per vehicle is given as 456 francs, or 0.054 centime per car kilometer; while the general expenses amount to 307 francs and 55 centimes, or 0.036 centime per car kilometer. This makes a total expense of 2,895 francs or 0.343 centime per car kilometer.

An English Idea of a Safety Lamp.

A prize of £50 or $250 was offered at the Grocers' Exhibition at the Agricultural Hall in London recently for a safe lamp for burning kerosene, that is, for those who use lamps as missiles.

The lamp was not to cost more than 1s. 3d. at wholesale. The kind of lamp which is looked upon in London as a "safety lamp" is interestingly set forth in the following abstract from the Petroleum Industrial and Technical Review:

The desire of directors was to produce a cheap lamp, which could be sold even in the poorest districts, and which could be used with the maximum of safety, and one which required the minimum of technical knowledge in handling. They did not require a lamp which needed the inventor sold with it in order to enable it to act; they wanted to find a lamp that would be safe when a man came home drunk at night. One of the most serious problems of London was as to how they could protect those afflicted with drunkenness against themselves. Therefore, they wanted to find a lamp which, if thrown by a drunken man at his wife or children, would automatically put itself out, so that the man, if he unfortunately inflicted any injury on his wife, should not, at the same time, burn down his house and set fire to his children.

Among the latest aspirants for flying machine honors is Father Felix M. Lepore, of the Mount Carmel Italian Church, near Denver, Col. He has, he says, sufficient money to build a ship after his design which has been supplied by capitalists whom he has interested. His airship is bullet proof, he claims.

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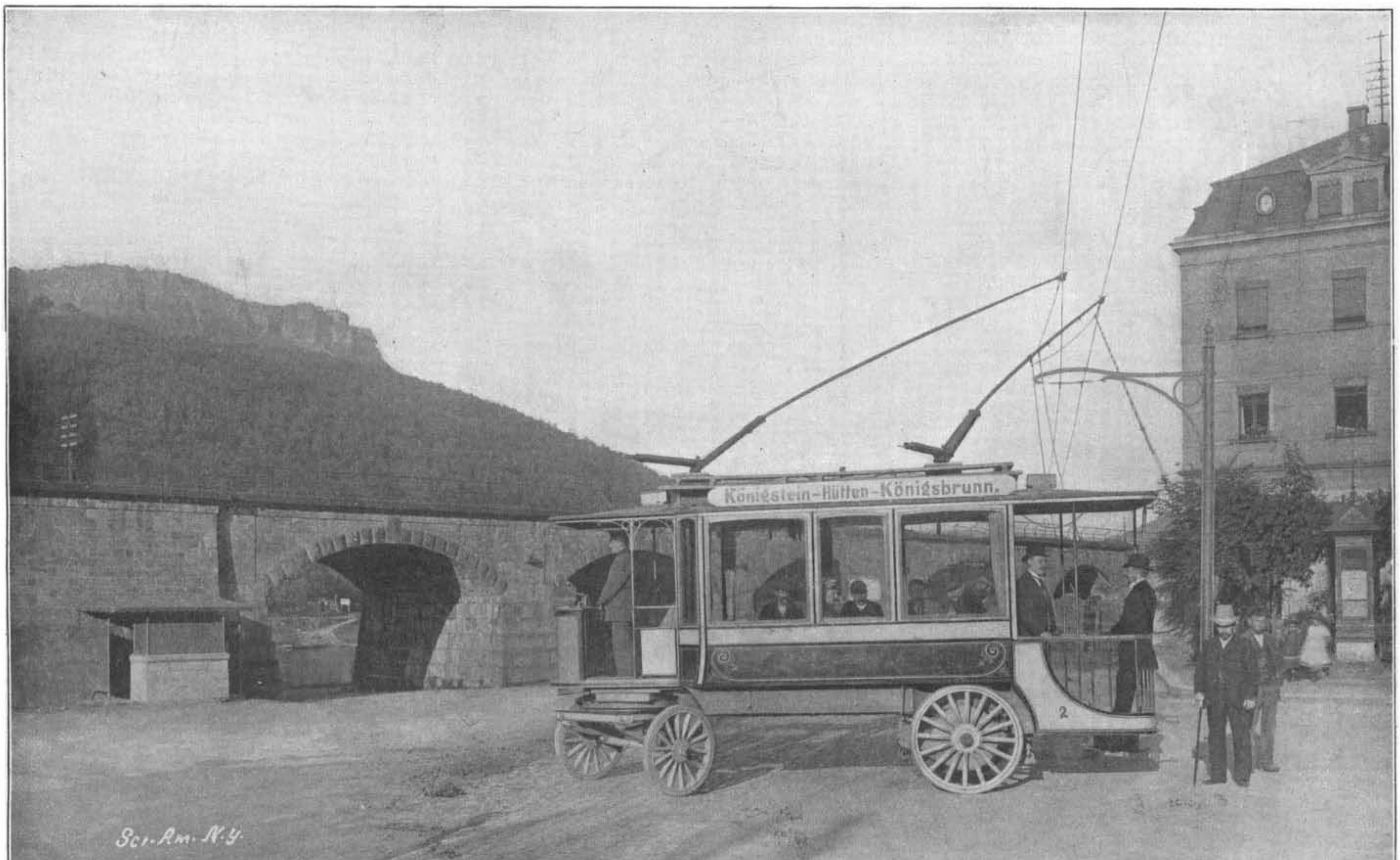
Electrical Trolley Omnibus and Power House.

Electrical Wagon Operated by Auto-Motor Trolley.



Electric Trolley Omnibus Line at Koenigstein.

GERMAN AND FRENCH ELECTRIC TROLLEY WAGONS AND OMNIBUSES.—[See page 6.]