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## THE JULIEN SYSTEM OF LIGHTING RAILROAD CARS.

In the illustrations accompanying this article we show the application of the electric light to the illumination of cars. The apparatus consists of incandescent lamps, supplied by storage batteries of the Julien type. A number of cars, sleeping, parlor, and ordinary ones, and even a baggage car, are now thus lighted, and it is fair to assume an extensive introduction of the system. The public attention has been so forcibly drawn to the dangers of kerosene lamps on railroads, that special interest attaches to the subject of the electric lighting of vehicles of travel.

The installation on different cars varies in the number, character, and distribution of the lamps. The plant in all the cases we allude to comprises a storage battery. The battery is of the type manufactured and supplied by the Julien Electric Co., of this city. This is carried in a receptacle beneath the longitudinal center of the body of the car and to one side of it. From it one or more circuits are carried through the interior of the car. On them the lamps are arranged in parallel or, as it is frequently called, in multiple arc. Edison or Weston lamps are used, and suitable switches provided for turning all or part of the lamps on and off.

The illustrations represent the system as applied to a parlor car upon the New York Central Railroad. Thirty cells of the Julien storage battery supply the electricity.

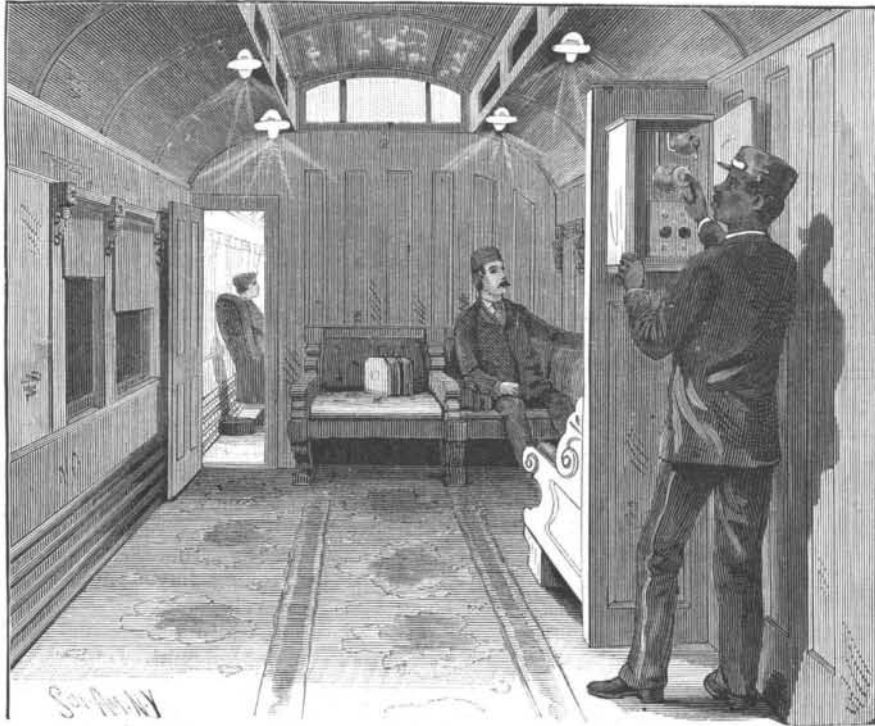
They are charged from an Edison dynamo, driven by a horizontal engine. Two independent circuits are supplied by it. One is used directly for lighting purposes in the depot. The other, an independent con-

The storage battery wires run to the main floor of the building and terminate at a charging bench, their terminals being springs fastened down upon the surface or "seat," one at each extremity. If a cell were placed upon the bench and its proper terminals connected respectively to the right and left hand springs, it would be in a position to be charged by the dynamo.

Intermediate springs, connected in pairs, are also attached to the bench. The batteries are contained in boxes, six cells to a box. Upon the bench there is room for six of these cases. The terminals from the cells in each box, which cells are arranged in series, are carried down to two opposite corners at the front. When the six boxes are in place on the bench, their terminals press upon the springs, completing the circuit by means of the series of batteries, throwing thirty-six cells in series into the portion of the circuit included between the terminal springs at the extreme ends of the bench. If less than the six boxes are to be charged, a piece of wire is used to bridge over the vacant place and connect the adjacent springs. In the particular car we are describing only five boxes are used, and the above connection is applied to the charging bench.

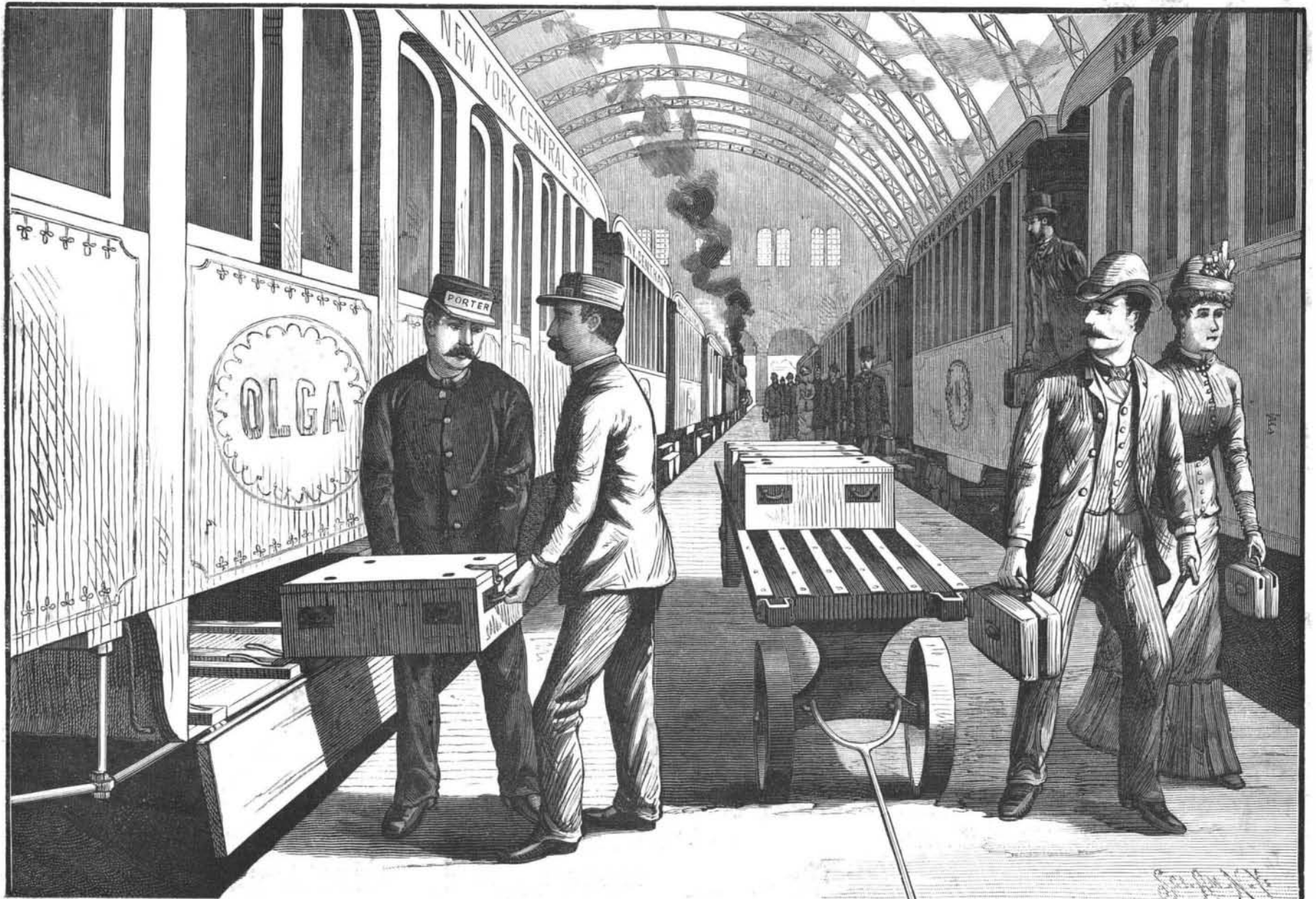
To charge the cells they are ranged in order on this bench and the current from the dynamo is turned on. It is maintained at a potential difference of seventy-five volts and at an

(Continued on page 294.)



SWITCH BOARD IN CAR.

nection, is for charging the storage battery. On each circuit is placed an ampere meter, so that the proper current for one or the other purpose can be supplied.

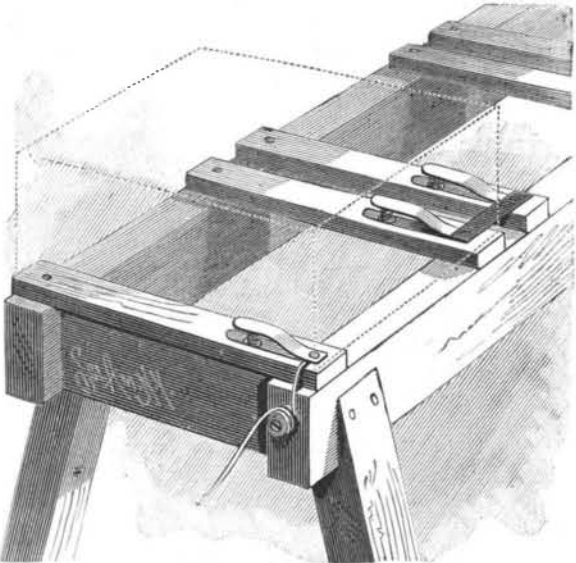


THE JULIEN SYSTEM OF LIGHTING CARS.—PUTTING IN BATTERIES.

### THE JULIEN SYSTEM OF LIGHTING RAILROAD CARS.

(Continued from first page.)

intensity of eighteen amperes per the ammeter, which is constantly under the engineer's eye. Care must be taken to start with sufficient voltage, as otherwise the battery may discharge through the dynamo. The current is maintained for seven hours, when the circuit is thrown open and the batteries are ready for work.



SPRING CONNECTIONS ON CHARGING BENCH.

A relay or double set of batteries are provided for the car. When it reaches the depot, a truck is loaded with the five charged cells. It is run alongside of the battery compartment, and the freshly charged boxes are substituted for the exhausted ones. A corresponding arrangement of springs on the floor of the case automatically connects the boxes in series. The spent relay battery is carried on the truck to the charging bench and placed on it ready for the current. All the work is done by the ordinary depot employes, no skill or special knowledge being required. The connections take care of themselves.

Within the car the lamps are arranged in two rows down each side of the car; a total of twenty-four are employed within. Two lamps are also provided for each platform. Upon a partition at the saloon end of the car is the switch box. In it are contained spring switches, by which either the body of the car, or the toilet rooms alone, or the platform lights can be thrown into action, or, if desired, all can be supplied simultaneously.

The general construction of the Julien battery is also shown. The nineteen plates—nine positive and ten negative—are arranged alternately. Each plate is about one-sixth inch thick. The metal of which they are composed is an alloy of lead, antimony, and mercury. They are perforated, so as to represent gratings, and the openings are filled with a mixture of red lead, litharge, and mercury. The use of supporting plates of this composition insures stiffness and prevents buckling, and avoids corrosion in the charging process. The mercury insures a sort of continuity between the supporting plate and the active composition. The internal resistance is about 0.005 ohm.

The normal intensity of current is 35 amperes. The lower the rate of discharge is kept, the higher efficiency is attained. On an emergency, it can, without injury, be raised for a short time to 60 amperes. At starting, each cell gives a difference of potential of 2.2 volts, which may fall to 1.7 volts in the discharge. The plates in a single cell weigh 27 pounds. For railroad use they are placed in India rubber cells. Thus established, and filled with acid, the complete cell weighs 34 pounds. The five boxes represent a total of about 1,000 pounds.

To charge these 30 cells, a current of 18 amperes and 75 volts is required, representing about 1½ electrical horse power. Of this current, 82 per cent is claimed to be utilized. In the charging process, it should be noted that the intensity toward the end is dropped to 12 amperes, indicating a lower horse power. Seven hours is required to charge the cells, after which they are run for four and a half hours, at an intensity of about 16 amperes.

In some cases, the batteries are charged without being removed from the cars. The wires from the dynamo are connected on the

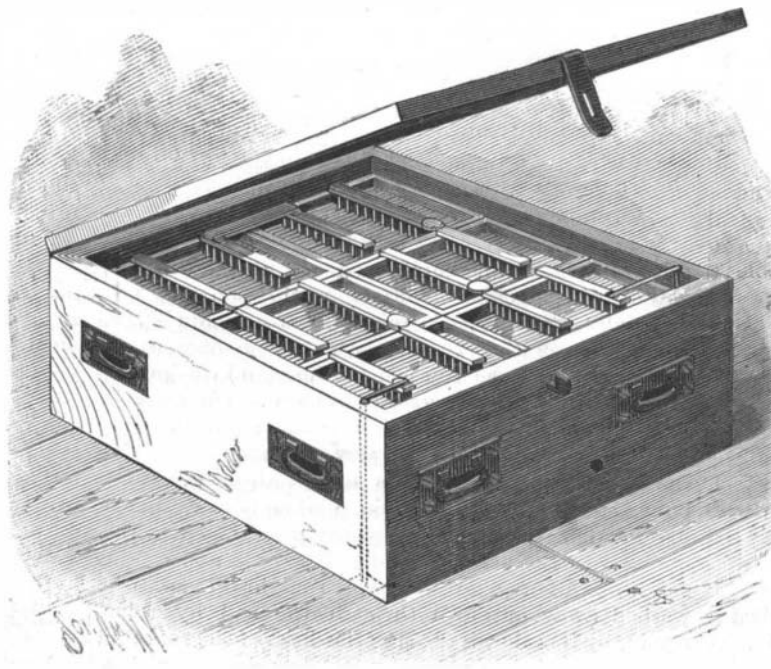
switch board to the battery wires, and the operation goes on with all *in situ*. In such installations only one set of cells is required.

The storage battery gives a current free from fluctuations, which is claimed to conduce greatly to the duration of the lamps. In estimates of expense of maintenance, a duration of two months with ten hours' daily use is allowed for the lamps. This is found to be on the safe side. Thus, on the Boston and Albany road, in sixty days' running, out of twenty-four lamps, only three gave out. The other lamps showed no signs of deterioration. The current from a dynamo is subject to many changes, and it seems natural that a lamp should run longer on a storage battery circuit.

The cost is calculated to amount to about 0.6 cent per lamp per hour. This compares favorably with central station lighting. The effect of the system as established on the cars is very fine. When it is remembered that for a few kerosene lamps situated near the central line of the car roof two lateral rows of twelve 16 C. P. lamps each are substituted, the effect can be realized. The car is literally almost as bright as day. On one train, all the cars are thus lighted, from the baggage to the smoking car. Each one has its own battery and switch board. Great credit is due to the Julien Electric Company for their method of attacking this difficult problem, the safe and economical lighting of moving trains.

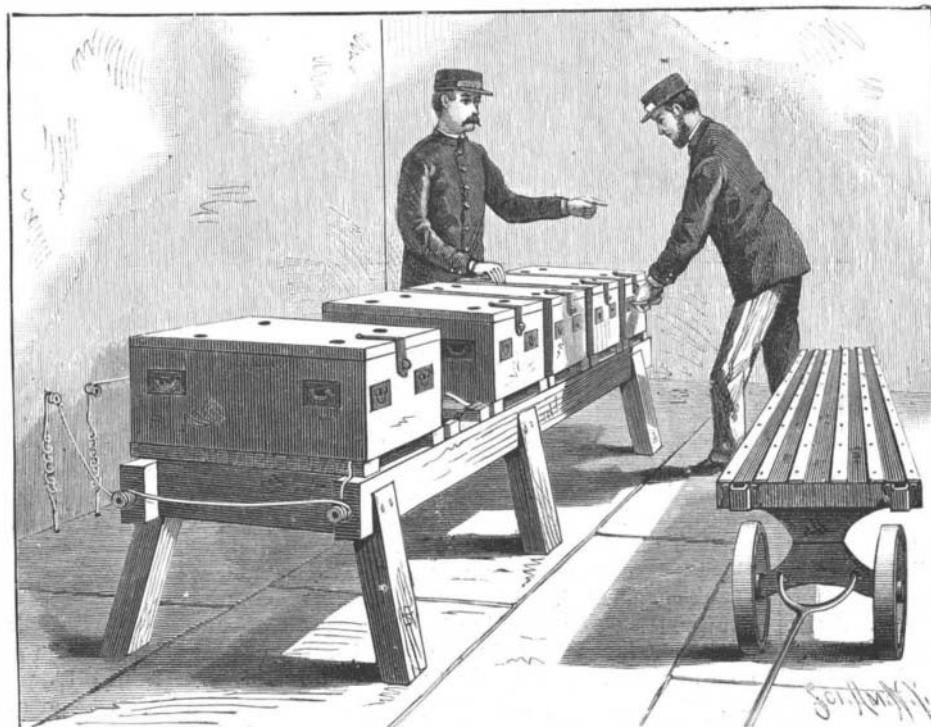
#### The Price of Copper.

The announcement has recently been made that a contract for the delivery of 8,000,000 lb. of copper at ten cents a pound, between the months of June and September, has been entered into by the Calumet & Hecla Company, of Michigan. This remarkably low price will have important effects on the electrical industries, in the prosecution of which increasing quantities of copper are annually employed. Only one



ARRANGEMENT OF BATTERIES IN BOX.

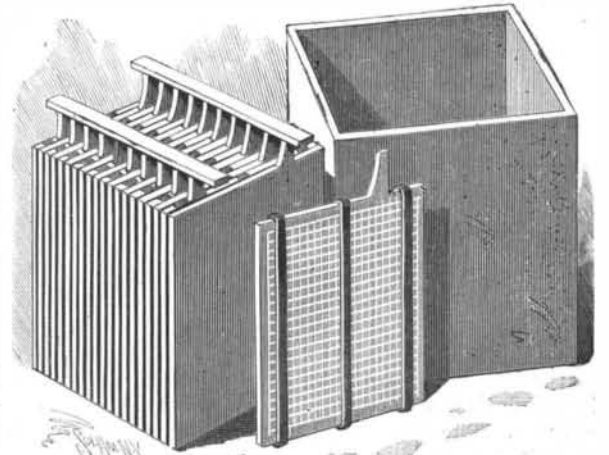
company, the Quincy, it is said, can compete with these prices. The old handicap upon the transmission of power by electricity, due to the price of the conducting wire, is fast disappearing, or at least diminishing, in importance. Dynamo construction, also, will be cheapened by every reduction in the cost of copper.



CHARGING BENCH.

#### The Rabbit Pest in Australia.

Mr. H. Taylor, of the rabbit branch of the Mines Department, in his report to the Minister, for December last, said that the total number of men employed in the work of destruction was 2,285, and the rabbits killed 852,739. In the course of the report Mr. Taylor said: "I have, on several occasions, pointed out that the majority of the men engaged as rabbiters were making a very high rate of wages, and it is now reported that a number of skilled tradesmen have been



THE JULIEN BATTERY.

known to abandon their ordinary pursuits, and take to rabbiting as a more lucrative occupation. However, in the thickly infested districts," he adds, "where labor is not scarce, the run owners have recently reduced the rate of bonus," and he thinks that "this will result in better work being done, as the men will require to work more vigorously to obtain good wages, and, consequently, a greater number of rabbits will be destroyed. Notwithstanding the immense number of rabbits which is at present being killed, it is a matter for great regret that the prospects of eradicating the pest seem as remote as ever—the reports to hand showing that rabbits are slowly, but surely, making their way into the northern portion of the colony; and the run owners in that locality must shortly expect to learn something of the worry and expense attached to the work of rabbit destruction."

#### The American Association for the Advancement of Science.

The thirty-sixth annual meeting of the American Association is to be held in this city, during the week beginning August 10. The Academy of Sciences has among the local societies taken the lead in the matter of arranging for the reception of the national body, by appointing a committee of conference to secure concerted action among the different institutions of the city. Committees on ways and means, and other permanent organization, it is hoped may be early brought about, as the time is none too long at the best. The meeting last year, at Buffalo, was not a very large one, and offered a contrast to the great Philadelphia meeting of 1885. It is to be hoped that the metropolis will serve as an attraction, and secure the presence, not only of representative American scientists, but of European ones as well.

#### What is Wealth?

The inventors and scientists are the greatest destroyers of hardly won wealth, the tendency of science and invention being to substitute less costly and more effective capital for that which has been previously in use.—Edward Atkinson.

It is a mistake to say that inventors and scientists are destroyers of wealth—they are rather savers of wealth and economizers of labor and material. It is very rare that an invention destroys any wealth in existence, but inventions are daily and hourly producing results which will make the future wealth less expensive. The wealth of a person or a country does not consist in the amount of cost tied up in property, but in the amount of valuable results that can be obtained from the property. Much property, like unproductive mines, represents great cost, but no wealth.—Wood and Iron.