EDISON BATTERY DESCRIBED

SCIENTIFIC VIEW OF THE INVENTION.

Its Composition and Elements—Thrives on Use and Short Circuits—Very Durable and of Power in Actual Work, the Contention Is Made by an Expert.

The Edison storage battery was thus described by Walter E. Holland in a paper read before the Electric Vehicle Association.

Nature provides us with three primary forms of energy, mechanical energy, chemical energy and heat. Electricity, the most useful form, is not native, but must be produced from one of the natural sources by a more or less indirect process of transmutation. Chemical energy, by far the most prolific source, is commonly transmuted first into heat, then into mechanical energy and finally into electrical energy at an efficiency of less than 10 per cent.

In the ideal electric battery chemical energy is converted directly into electrical energy with 100 per cent. efficiency, and except for a small internal loss due to resistance this will all appear in the external circuit.

All practical forms of electric battery combine conductors of the first and second classes, thus consisting of an electrolyte and two different metallic members called electrodes. There should be no action between the electrolyte and electrodes until current is drawn; then the current carrying elements of the electrolyte should combine with elements of both electrodes to maintain the supply of current, such combinations being preferably of a nature that would reform electrolyte exactly compensating for that decomposed.

Early in battery history it was discovered that acids made the best electrolytes, and Volta's original cell consisted of electrodes of zinc and copper in sulphuric acid electrolyte. Seventy years later, in 1860, Plante brought out the first useful storage battery, and this also employed sulphuric acid electrolyte, but had electrodes of lead and lead peroxide.

Now it is a generality of chemistry, to which there are few exceptions, that a metal cannot long endure in contact with an acid, but the metal will displace hydrogen of the acid and combine to form a new compound. In view of this fact it is strange that the alkalis, which rank close to the acids as electrolytes and in whose presence most metals can exist with perfect compatibility—it is strange, I say, that these were not used in any sort of battery until the year 1880, twenty years after Plante's achievement and ninety years after the inception of the electric battery principle.

During or soon after that year Lalande and Chaperon invented the zinc copper-oxide alkaline battery, which was later improved by Edison and which to this day remains the most efficient and durable battery of the class known as primary.

As soon as this battery appeared the value of a storage battery working on the same principle was appreciated, and many attempts were made to commercialize it as such. The difficulties to be overcome were enormous, but inventors considered that to secure the advantages of an alkaline electrolyte any expense was warrantable and the inherent defects negligible. The nearest approaches to success were made by Dezmazure, who in 1887 operated a French submarine boat with his battery; and by Entz and Phillips, who operated street cars in New York with their Waddell-Entz battery in 1893.

The difficulties encountered due to the solubility of both electrodes proved too great, however, and the impracticability of using the zinc copper-oxide alkaline combination as a storage cell was practically proved.

At the outset of his battery campaign Edison, recognizing the futility of pursuing further a principle which was necessarily faulty and aginst the laws of nature, put Satan behind him, that is, the acid battery, and turned toward the heaven of alkalis.

His first experiments had to do with the Lalande combination; but it did not take long to determine that electrodes of soluble materials could never serve the purpose. Then a radical departure was made when he discovered that finely divided cadmium could be used in place of zinc in the Lalande battery and that this would oxidize and reduce in the alkaline electrolyte without going into solution. This led to the all important discovery in 1901 of electrolytically active insoluble iron which was not only cheaper than cadmium but gave better voltage. The wonderful efficiency of peroxidized nickel hydrate as a depolarizer was discovered at about the same time, and as this too was absolutely insoluble in alkalis the combination was chemically perfect and the principle of the ideal cell had become a fact.

The factors which determined Edison to go out for a storage battery, the processes which led up to the final achievement, are tersely told in his own expressive language:

"Started with the broad idea that displacing of horse drawn vehicles in cities would be an immense advance.

"That the ideal vehicle was electric.

"That the electric never could be made commercial with the lead sulphuric acid battery, which, while it was based on a unique reaction in chemistry and very beautiful in theory, did not and never could fit in to meet the commercial requirements.

"I believed that nature could afford one more reaction, and I started, avoiding every combination requiring acid.

"After an enormous number of experiments I at last found a reaction that although very weak was promising, and I pursued this for three years, finally producing the first type of the nickel-iron alkaline battery."

It is interesting to note that from the very first he has concentrated his attention on a battery for use in the field of vehicle propulsion. His first alkaline battery patent makes mention of the qualities most needed in vehicle service. It says:

"The object of this invention is to provide and produce a reversible battery which is light, portable and durable."

Since vehicle propulsion is the most difficult field of service, obviously a battery meeting its needs would fulfill the requirements of most any other condition.

The first discovery of the elements of the Edison battery was rather easy as compared to the development and practical application of the principle. Three different commercial types of cell were brought out—type C in 1902 and types B and E in 1903—all of which were unsatisfactory for reasons which it is not necessary to go into at this time, and real success was not attained until the year 1908—seven years after the announcement of Edison's discovery—at which time the radically different construction embodied in the present A type cell was perfected. This type of cell will presently be described.

Before looking into the construction, however, the working principle of this battery must be considered. The active materials in a charged Edison cell are metallic iron in the negative electrode and peroxide of nickel, probably hydrated, in the positive. The electrolyte is a 21 per cent. solution of potassium hydrate, containing lithium hydrate in small quantity.

The materials are not put into the plates in the charged form, but the iron as a mixture of oxides and the nickel as the green nickel hydrate. The first charge reduces the oxides of iron and oxidizes the nickel hydrate, and thereafter they probably never return to their initial condition. In each subsequent cycle the negative charges to metallic iron and discharges to iron hydrate, while the positive charges to a peroxidized hydrate of nickel and discharges to a lower hydrate.

Current passing in either direction, charge or discharge, decomposes the potassium hydrate of the electrolyte, and the oxidations and reductions at the electrodes are brought about by the chemical action of its elements. An amount of potassium hydrate equal to that decomposed is always reformed at one of the electrodes by a secondary reaction, and consequently there is none of it lost, and its density remains constant.

The ultimate result of charging is a transference of oxygen from the iron to the nickel electrode and of discharging a transference back again, and this is why the adjective "oxygen lift" is sometimes applied to the Edison cell.

Innumerable repetitions of tests have shown that cells as commercially manufactured by the Edison Storage Battery Company have surprisingly uniform capacity, and that under any similar conditions, no matter how abnormal, different cells will give practically identical results.

The output of the cell is determined by the capacity of the positive or nickel electrode. It has been found best in every way to design the cell with sufficient allowance of iron active material to give considerable excess capacity to the negative.

Test electrodes of either cupric oxide or electrolytic nickel-oxide may be used successfully for analyzing the voltage curves of the Edison battery, and, by the way, the writer has applied the principle of these further and found electrolytic peroxide of lead far superior to the universally used cadmium as a test electrode material for use in the lead-acid battery.

Cells do not have as high capacity when new as after some weeks of use. The betterment comes from an improvement of conditions in the nickel electrode, which is brought about by regular charging and discharging. Overcharging expedites this self-formation and is recommended. Every cell manufactured gets three overcharge runs before leaving the factory, which is always sufficient to bring the output up to the rating, but full capacity is not attained until after at least twenty complete charges and discharges.

The output and efficiency of a cell, working at ordinary temperatures, depend upon three factors, the rate of charge, the amount of charge and the rate of discharge. Best results are obtained charging at normal to two-thirds normal rate, but much higher rates may be employed with little sacrifice of efficiency.

The Edison cell has an air tight cover, a valve being provided for the escape of gas. Practically no water is lost by evaporation, therefore, and a battery can be left idle for months without attention and there will be no danger of the solution becoming low. Water is lost when a battery is working, however, and this results entirely from overcharging; for any current which is not used to effect the chemical changes at the electrodes goes to produce hydrogen and oxygen, the elements of water, which are emitted as gas.

To replace this loss pure water must from time to time be added. The figure of ampere hour efficiency represents the proportion of a charge which goes to produce the desired chemical change at the electrodes, and the difference between this figure and 100 represents the loss of water.

Constant current discharges of the Edison battery, at no matter what rate, are found to give a quite constant output figure if carried to very low voltage and differ only as to average voltage.

Cells have been subjected to various severe and even abusive tests at the Edison laboratory, the results of which are very interesting; but lack of time forbids taking these up in detail and the demonstrated advantages and characteristics peculiar to the Edison cell will merely be mentioned.

The damage done to lead cells by sulphation through standing wholly or partly discharged is well known, and when such battery must remain out of commission for some time it is necessary either to give it freshening charges at frequent intervals or else to give it a complicated shelving treatment involving much labor and trouble. The Edison battery can be set aside and forgotten in any state of charge or discharge for a practically unlimited length of time without fear of injury.

The materials used in the cell being exceedingly durable by nature and the construction being very rugged a cell will stand an almost unlimited amount of vibration and shock without injury. A jolting machine is used which lifts a cell one-half inch and drops it on solid wood about sixty times a minute. In one case a 13½ pound cell was dropped 1,750,000 times in this machine with practically no effect on its electrical characteristics. The perforated container construction prevents loss of material by disintegration, doing away with sediment short circuits and the necessity of cell washing.

The many troubles heretofore caused by corrosive fumes, jar breakage and plate buckling are all eliminated with the Edison battery, and furthermore no harm is done by charging in the reverse direction or even by completely short circuiting a fully charged cell. In fact this remarkable cell thrives on short circuit discharges. Normal tests made before and after nine short circuit discharges showed an actual improvement as a result of the drastic treatment.

Light weight in a battery gives it many evident advantages and makes possible the building of vehicles of exceedingly high mileage capacity. No other battery in the world can honestly claim to compete with the Edison battery in this respect; its normal output per pound of complete battery is 14 to 18 watt hours, depending upon the type of cell and the length of charge.

The crowning feature of the Edison battery, however, is its marvellous durability. This renders it a dependable piece of apparatus instead of a makeshift which has to be humored, coaxed and doctored. This point has been demonstrated in many laboratory life tests, but the most convincing proof comes from actual service, where thousands of batteries are now giving excellent satisfaction.

The oldest batteries went in commission two years ago and are doing the same work now as then, showing practically no deterioration.

Speaking of the Edison battery, an English authority once said: "It is one of the striking features of the cell that it recommends itself by work more than can be done by any verbal account."

THREE KINDS OF GARFORDS.

Trucks Manufactured by the Company at Elyria.

Garford trucks are made in three styles, one, two and three tons. These are all dual friction drive transmissions and the horse-power is 26 for the one ton and 40 for the other two. All the motors are four cylinder, cast in pairs. A Mayer carbureter is used in the small truck with a Garford design in the other two. Splitdorf magneto is used in the one ton and Bosch magneto in the two and three ton wagons. The gasolene capacity is eighteen gallons in the three cars. The frame is of pressed steel in the one ton truck and of channel iron in the other two.

All the cars are chain driven. Wheel bases vary from 95 inches up to 140 inches and tires from 34 by 3 in the front to 34 by 4 and in the larger sizes dual tires in the rear 36 by 3 or 36 by 3½, according to the weight of the truck. The lightest truck weighs 3,600 pounds, the other two 4,650 and 4,950 respectively. The speed is inversely as the weight, starting at eighteen miles for the one ton and finishing at twelve miles for the three ton truck.

It is claimed for the friction drive that it handles dead weight, the main requisite in commercial vehicle construction, in a much more efficient way than can be done with any other drive. An example is given of the starting of a passenger car with people in it weighing 1,000 pounds. At the moment the clutch slips in instinctively all the passengers give way a bit and the spring seats and the muscular elasticity relieve the engine of a part of its load for just an instant, and that helps to get the car going. But in a loaded truck the instant of applying the power has no such assistance.

A flat floor has no elasticity, or at least not like leather lined seats, and packing cases do not give way at all. The same power application that is designed to fly away with five weight finds it difficult to pick up dead weight, and in order to prevent the racking that might result from attempts to do that the Garford company attempted to find a different system of drive. Selective gears are regarded as supreme for live weight driving, but they are not so convenient for commercial hauls.

To get a very easy system of transmission which would not require as much mechanical skill in the handling as the selective gear the Garford people went to work in earnest. By eliminating sliding gears and differentials they discovered they could provide a very simple form of drive, but they used it first as only a single friction drive, and the disk was under a constant side strain, and in addition to that the outfit was difficult to reverse. By applying two friction wheels to two aluminum alloy disks they discovered that they had just about what they wanted.

One disk is for forward speeds and the other is for reverse. The truck can be backed as fast as it will speed forward and there is no jerking on the frames, body, load or engine. The distinctive feature of the Garford motor truck is the drive, but it is contended that all other features are in keeping. Some of the reasons given by the Garford folks in favor of their trucks are these:

"By the use of our dual friction transmission elimination of sliding gears and differential has been made possible, thereby reducing the working parts to a minimum. Our dual friction transmission allows great flexibility of control and does away with all sudden shocks to mechanism in starting load, reversing motion of car and changing speeds. A slight pressure of the foot accomplishes forward or reverse motion.

"No hand levers to confuse the driver. The driving seat and cab being placed directly over motor permits the greatest possible loading area in proportion to a given wheel base, thereby making it possible to manipulate the Garford truck in congested districts much more easily than trucks with a longer wheel base. The body being built entirely of metal, it is practically indestructible and also fireproof."

THE TRUCK MOST MODERN.

New Theory of Service Makes Them Necessary, Says Walter White.

Walter C. White, vice-president and general manager of the White Company, said yesterday he was extremely enthusiastic about the outlook for trucks of all kinds not only in New York but all over the country.

"The truck is a child of the new era of service," said he. "When a few years ago merchants all over the country began to study the problem of service, seeking to obtain business by the superiority of the service rendered each customer, there was born a new era in business. At first there were only a few leaders, then the high class stores all over the country, and these in turn were followed by the department stores everywhere, until to-day a merchant finds himself tabooed whose service is not up to the minute.

"The result of the recognition of this principle in business has brought a keen rivalry among retail concerns, each one trying to give a more superb service than his competitors. Probably every merchant of prominence considers service one of his best business getters, and for this reason the motor delivery must find a place sooner or later with the majority of retail houses.

"In most cases the truck will effect a saving, and this in spite of the fact that the majority of merchants are doubtful. Probably there is not one thing about his establishment concerning which the average merchant is less certain than what it costs him to move a ton of freight. Any house that will take the time to compile reliable statistics of the cost of moving a ton of their freight a mile will simply be astounded at the figures secured. We have yet to find a case in which the actual cost was not from two to four times greater than the merchant supposed and we have yet to find a case in which motor trucks did not immediately greatly reduce the actual cost, usually reducing it to 25 or 30 per cent. of the cost for horse drawn vehicles. In the meantime the service of the establishment has been improved and vastly improved.

"There is another phase of the question also; since service is so desirable in any retail establishment, even if motor cars were slightly more expensive, their cost would be quickly repaid in increased business. For this reason when the public understands that there are three or four makers who are building trucks that are as reliable as the day is long—trucks that will do everything that is promised or could be expected of them—it will be impossible to supply the demand. To give a concrete example of the growth of the demand for trucks let me say that only a year ago scarcely any buyer of trucks would consider more than one or two.

"To-day it is a common occurrence for us to receive requests for quotations upon equipments ranging anywhere from six to fifty trucks, conclusively showing that not only has the customer felt the demand for the trucks but that he has confidence in them and knows that he can safely replace his entire equipment with the most modern means of transporting merchandise, the motor truck."

PACKARDS FOR COMMERCE.

Exhibit of the Business Vehicles Made by This Company.

The Packard Motor Car Company's exhibit of motor trucks in the second week of the New York Automobile Show in Madison Square Garden is a comprehensive display of commercial vehicles of different types. It occupies nearly 5,000 square feet of floor space in the central arena of the Garden.

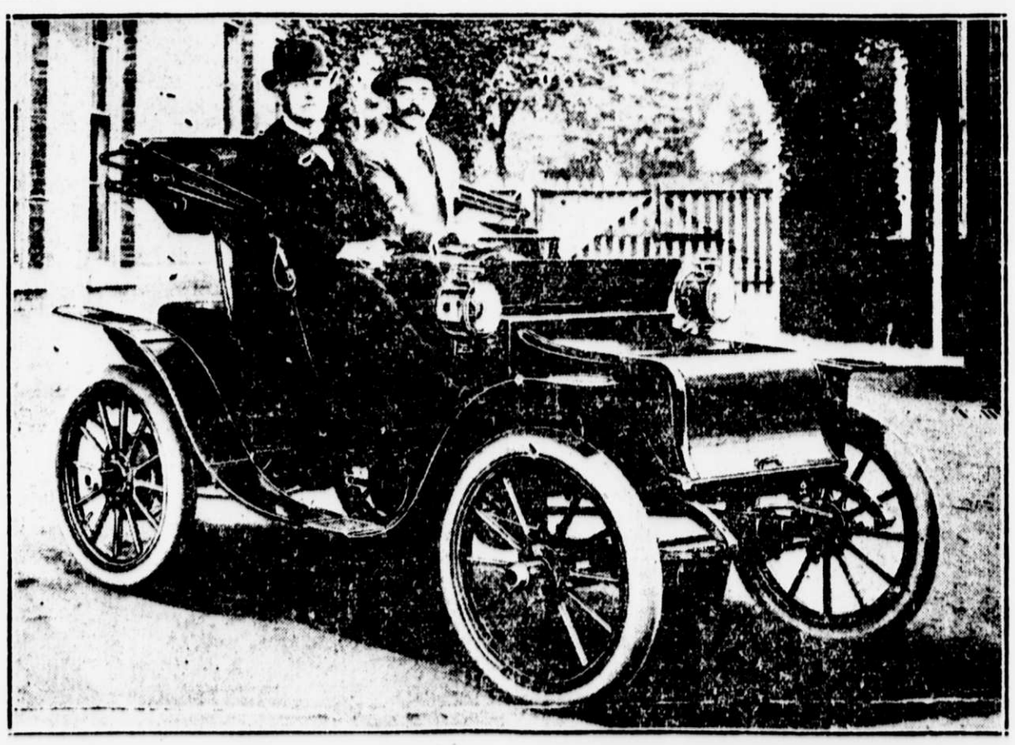
The exhibit consists of five "three tonners" and three "thirties." The latter are shown respectively as a police patrol, a fire squad and chemical wagon and a light delivery. These are comparatively new fields for the Packard "thirty," but in each one their introduction gives promise of great success. The Packard "thirty" is well adapted to patrol, fire, ambulance and other municipal and public service.

One reason that the Packard "thirty" as a delivery wagon is brought to the public attention is because of the opportunity there is to rebuild used Packard cars into delivery wagons and thus obtain high class commercial cars at a moderate cost. Several large users of commercial vehicles have done this, as for instance, Marshall Field & Co., in Chicago. The patrol wagon exhibited is practically the same as the Packard patrols, which have entirely replaced horses in the Detroit patrol service, and the fire wagon is a duplicate of one recently delivered to the fire department of Indianapolis.

The three ton trucks displayed do not begin to cover the wide range of body designs by which this truck is made adaptable to many lines of business and individual needs. All of the trucks shown, however, are interesting types of trucks used in practical every day hauling. First of all there is a standard chassis. Then there is a truck for the Pioneer Warehouse, which shows a large moving van body.

A special builder's truck for Willson & Adams shows how Packard trucks are equipped with rest or loading bodies. The arrangement is similar to the bodies previously built for department stores, but it is novel in one respect, that the loading box is a complete body in itself and is not an inside cage.

The other two trucks are one for Welz & Zerweck, having an open body especially suited to brewers' hauling, and a covered truck for Lemuel Sears & Co., which is typical of enclosed trucks for general merchandise in many lines of business where loads vary in their character.



THOMAS A. EDISON IN HIS BAKER ELECTRIC VICTORIA.

The Wall Street edition of THE EVENING SUN contains all the financial news and the stock and bond quotations to the close of the market. The closing quotations including the "bid and asked" prices, with additional news matter, are contained also in the night edition of THE EVENING SUN.—*Adv.*