Manual

OF

Storage Battery Practice

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Edison Battery

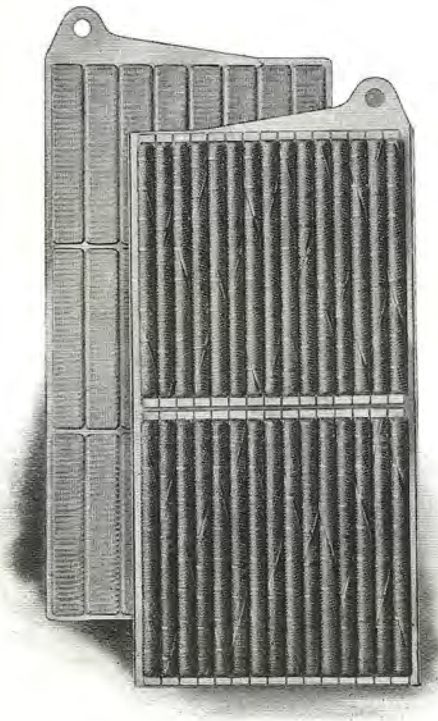

FIG. 25

EDISON NEGATIVE AND POSITIVE PLATES (NEGATIVE ON THE LEFT)

11. Cells—General:

The definition and general description of the cell is substantially the same as given in Sec. 5, Art. 1, differing only in the physical character of the elements and parts. The average voltage of an Edison cell is 1.20 while discharging at normal rate.

12. Plates—General:

The active material of Edison plates is contained in metallic tubes and pockets, each plate being composed of a number of filled tubes or pockets, securely mounted in a supporting and conducting frame or grid, in good contact therewith to provide conductivity for the electric current. The grid is a light skeleton frame, stamped from thin sheet steel, with extra reinforcing width at the top. The grids—as also all metallic parts of the cells—are nickel plated to prevent corrosion.

The elements should not be allowed to dry out while doing this or other similar work, else the negative plates will oxidize and require a very long charge.

After the battery is reassembled a charge must be given to bring all cells to full charge condition—this is very important—and the electrolyte equalized.

7. Electrolyte:

It is important to keep foreign substances, both solid and liquid, out of the battery; a bolt, nail, piece of wire, or salt water might ruin a cell before being discovered. Some impurities give unmistakable evidence of their presence; for instance, chlorine will give off fumes of disagreeable order, iron will show a dirty yellow color of the electrolyte and positive plates. In case of a cell having harmful impurities, it should be taken apart, regardless of its state of charge, the electrolyte and wooden separators discarded, and all parts of the cell plates, jars and rubber separators thoroughly rinsed with running water.

Effect of Impurities

Removal of Impurities

The cell then should be reassembled with new wooden separators, and with new electrolyte of the same specific gravity as before taking apart, and then given several full discharges and recharges. After the last of these discharges and before charging, the cell should be taken apart a second time, discarding the electrolyte, and the wooden separators soaked in several changes of water, and the plates again rinsed as before. The cell then may be reassembled, filling with electrolyte of 1.200 specific gravity, and given a long charge, after which it may be put back into service.

Edison Batteries

In case an Edison cell should become impaired, requiring attention other than merely an overcharge or new electrolyte, the manufacturer should be consulted as to what is needed. The important points to be observed to maintain life and capacity of Edison plates are proper charging and discharging, keeping electrolyte pure, and avoiding extremely high temperature. It is also very important that the exterior of the cells and the crates be kept reasonably free from dampness and dirt, since they cause grounds and consequent electrolysis which, in time, corrodes the jars. It is usually sufficient, in cleaning, to brush or blow out the dirt; for the latter a jet of dry steam is very satisfactory.

Painting of jars and trays should be done as required. The battery manufacturer supplies the most suitable paint for the purpose.

In case any connections heat excessively during the use of the battery, they should be taken off and cleaned to make good contact.

13. Positive Plates:

The active material of the positive plates (Fig. 25) is a form of nickel hydrate. The tube retainers are made of very thin steel ribbon, finely perforated and nickel plated, about 4 in. long and ¼ in. and ⅛ in. in diameter The ribbon is spirally wound, with lapped seams, and the tubes reinforced at about ½ in. intervals with small steel rings. Into these tubes nickel hydrate and pure flake nickel are loaded in very thin, alternate layers (about 350 layers of each to a tube) and tightly packed or rammed The purpose of the flake nickel is to make good contact between the nickel hydrate and the tubes, and thereby provide proper conductivity. The tubes, when filled and closed, are mounted vertically into the grids, the type B having 15 tubes in a single row, and the type A 30 in two rows, one above the other (Fig. 25)

14. Negative Plates:

The active material of the negative plates (Fig. 25) is iron oxide. The retainer pockets are made of very thin, finely perforated nickel-plated steel, of rectangular shape, ½ in. wide, 3 in long and of ⅛ in. maximum thickness. The iron oxide, in finely powdered form, is tightly rammed into these pockets, after which they are mounted into the grids. After mounting they are pressed, forcing them into close contact with the grids, and at the same time making the sides of the pockets of corrugated form to provide a spring contact of the pocket with the active material. The type A plate has 24 pockets in three horizontal rows, and the type B, 16 in two rows.

15. Jars.

The jars or containers (Fig. 27) are of sheet steel, nickel plated, having welded seams, and with corrugated sides for stiffening. The cover of the jar is provided with a capped opening for renewing the electrolyte and adding water; a valved opening called separator, for separating the gas from the spray; and two openings, fitted with stuffing boxes, through which the terminal posts project. The covers are welded to the jars after the elements are assembled therein.

16. Electrolyte:

The electrolyte is a 21 per cent solution of potassium hydrate with a small percentage of lithium hydrate.

17. Separators:

For separating and insulating the plates from each other and from the jars, hard rubber is used as follows: Narrow strips between the plates; grooved frames or crossbars at the vertical edges of plates; thin sheets between the outside negative plate face and the jars; and racks or bridges, resting on the bottom of the jars, for supporting the plates.

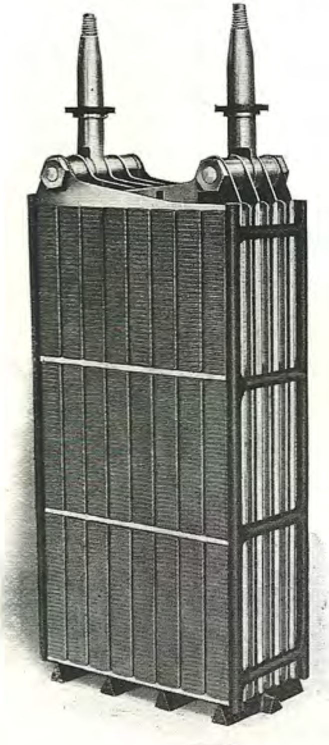

FIG. 26

ASSEMBLED ELEMENTS OF AN EDISON CELL

FIG. 27

EDISON CELLS ASSEMBLED IN TRAY

18. Connectors and Lugs:

The connectors for connecting the cells together to make up a battery are short copper links, on each end of which are swedged the terminal lugs, the whole being nickel plated.

19. Terminal Posts:

The terminal posts are nickel-plated studs, connecting to the plates at one end; the other end, projecting through the jar cover, serves as the cell terminal. The outer end of the post is ground and tapered to fit a terminal lug, and is threaded to accommodate a nut for holding down the lug.

20. Trays:

The trays (Fig. 27) are of light, skeleton construction and have no bottom, the cells resting upon a steel cradle which, in turn, is supported by the lower side slats of the tray. The cells are assembled in the trays, in number according to the size trays desired, and are held down by steel holddowns.

21. Assembly of Battery:

The groups of plates (Fig. 26) of both polarity of the Edison cell are made up as follows: At one upper corner of the plate, where the grid is of extra width, a hole is located for fitting over a steel stud; over this

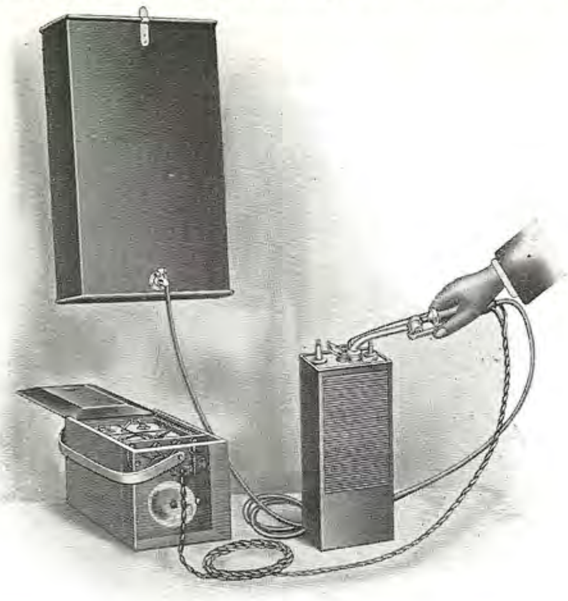

FIG. 28

EDISON ELECTRIC CELL FILLER

stud the number of plates required for the respective groups are slipped, with a steel spacing ring between each. The terminal posts also fit on the studs at the center of the group. Both ends of the studs are threaded and fitted with nuts; by tightening these nuts the plates are securely clamped together and form the group. The two groups (positive and negative) of a cell are fitted together, face to face, and between are inserted the hard rubber separating strips The grooved frame pieces are placed, vertically, against the plates with the plate edges in the grooves; the whole is then placed into the jar, snugly fitting, resting upon the bridge piece at the bottom, with a hard rubber sheet between the outside negative plates and the jar. The cover is next placed in position and welded to the can by a flame. The terminal posts are fitted with soft rubber packing rings to prevent creeping o: the electrolyte, and they also serve as insulation between the terminal posts and the cover. The cells are placed into the crates, in a convenient arrangement to connect the positive pole of one cell to the negative of the next, throughout the whole series. The connecting is done by the connectors, slipping the lugs over the tapered terminal posts and bolting them down. The cells, lastly, are filled with the electrolyte and the forming charge given. (Sec. 6, Art. 5.)

22. Battery Compartment:

Proper construction of an underslung battery compartment in a commercial electric vehicle will facilitate handling and care of the battery to a very great extent. Experience has proven that a wood lined compartment properly ventilated, gives best results with Edison Batteries. A space of one inch should be left between floor boards, these openings should be so located as to come between trays. The advantages claimed for this construction are, proper ventilation in warm weather, easily closed up in winter, exludes to a great extent dirt and water. In this type of compartment a tight permanent roof or covering is usually provided. Trays are removable from the sides. If cells are to be filled through a trap door in the flooring without removing trays, a tight substantial removable cover should be provided to prevent dirt from sifting through from the floor of the vehicle. If battery is located under a front hood or up in the body of the car, proper ventilation and wood lining should be provided for.

In pleasure vehicles it is customary to supply a tight wood lined compartment.

23. Battery Weights:

Edison Batteries in service will develop an average of from 13 to 15 watt hours per pound of cell assembled. The exact cell weights including portion of tray and connections are as follows: B2-5.5 lbs.; B4-8.7 lbs.; B6-12 lbs.; A4-14.5 lbs.; A5-18.5 lbs.; A6-21 lbs.; A8-30 lbs.; A10-37.5 lbs.; A12-45 lbs.

Edison Batteries

5. Charge:

The action which takes place in an Edison cell, both in charging and discharging, is a transfer of oxygen from one electrode to the other, or from one group of plates to the other, hence this type of cell is sometimes called an oxygenlift cell. In a charged cell the active material of the positive plates is superoxidized, and that of the negative plates is in a spongy or deoxidized state.

Initial Charge

Edison batteries usually are sent out in discharged condition, requiring an initial or forming charge. This consists of a twelve-hour charge at the normal rate, and in addition a repetition of this charge is required after every twelve or fifteen complete discharges, or an equivalent thereof, until four such overcharges have been given the battery. This forming process is important to insure proper capacity and long life. After this treatment is completed, the battery should be overcharged once every two months.

Normal Charging Rates

The normal charging rates, in amperes, for the various types of Edison Cells are as follows: B2-8; B4-16; B6-22.5; A4-30; A5-37.5; A6-45; A8-60; A10-75; A12-90. In vehicle service low charging rates, except at the end of a tapering charge, are not advised. Rates below normal will in no way injure the cell, but the voltage on subsequent discharge will be lower than when normal rates are used.

Boosting Charges

If the normal capacity of the cell is insufficient, short intermediate high rate charges can be given provided that the temperature of the electrolyte does not exceed 115° Fahr. These short charges are very efficient and cause no injury. Rates up to three times normal can be employed for periods of 30 minutes.

Amount of Charge

A full charge for any type of Edison cell consists of seven hours at the normal cell rate. In service the amount of charge given, should be governed entirely by the extent of the previous discharge. For example, if a battery is discharged one-half, a 3½ hour charge at normal rate should be given. If an ampere hour meter is used the hand should be set to operate 20% slow on charge. In operation the great tendency is to overcharge Edison Batteries unnecessarily. Overcharging wastes current and causes rapid evaporation of the water in the electrolyte, for these reasons it should be guarded against.

Tapering Charge Rates

If tapering rates of charge are to be employed an average of 1.67 volts should be maintained across the cell terminals throughout the entire charge. The current value at the start of charge will vary according to the amount of resistance in the circuit. If no resistance is used the starting rate will be about twice normal and the finishing rate about 40% of normal.

Toward the latter part of charge Edison cells gas freely. Under normal conditions, battery compartment doors or hoods should be removed or lifted while charging. Inasmuch as storage battery gases are explosive care should be taken to see that no open flame is held near the cells while charging.

As shown on upper curve (Fig. 33) the maximum average charging voltage range of an Edison cell charging at normal rate is from 1.5 volts to 1.85 volts. Under normal conditions a battery can be considered fully charged when voltage has remained constant at 1.85 per cell for thirty minutes. Charge voltage readings are not always a true indication of state of charge as they will vary considerably according to electrolyte temperature and density. Charging Voltage

The efficiency of an Edison battery will vary according to the extent of discharge. Highest efficiencies and greatest advantages are obtained when a battery is required to give an output less than its rating; for instance a discharge taken that calls for four hours charge is more efficient than one that requires seven hours; also less frequent watering of cells is required, and the temperature rises comparatively little. In general this feature in practice is not taken advantage of to the extent that it should be; in many cases, after this has been properly explained to operating men, large savings in current consumption have been effected. Efficiency

By overcharging, an increased capacity as high as 30% above the rating can be secured, but this practice reduces efficiency and is liable to cause high temperatures. Excess Capacity

6. Discharge:

In discharging the positive plates deoxidize and the oxygen, with its natural affinity for iron, goes to the negative plates, oxidizing them. The normal discharge rates in amperes is the same as that given under "Charge" the time, however, being five hours. It is permissible to discharge continuously at any rate up to 25 per cent. above normal, and occasionally for short periods at rates up to six times normal. This limitation is based largely on experience, it having been proven, that when the normal discharge rate of the vehicle on the level exceeds this value, abnormal voltage drop on very steep grades will be encountered.

Low electrolyte temperatures will temporarily reduce capacity of a battery; during severe cold weather openings in the compartment should be closed tightly. This is easily accomplished, as explained under Battery compartment Sec. V, Art. 22. Best results will be obtained when charging is arranged so that the charge will be completed shortly before vehicle goes out, and in some cases it is advisable to give a warming charge when battery has been standing in a cold garage. Temperature Effects

The life of Edison plates is not definitely established, but long life is one of its strong features. Numerous records of batteries having covered forty thousand miles in service are available. Life

7. Electrolyte:

The electrolyte of Edison cells does not enter into chemical combination to perform the functions of the cell, but acts merely as a conveyer; it therefore does not change in specific gravity during charge and discharge other than through evaporation and changes in temperature.

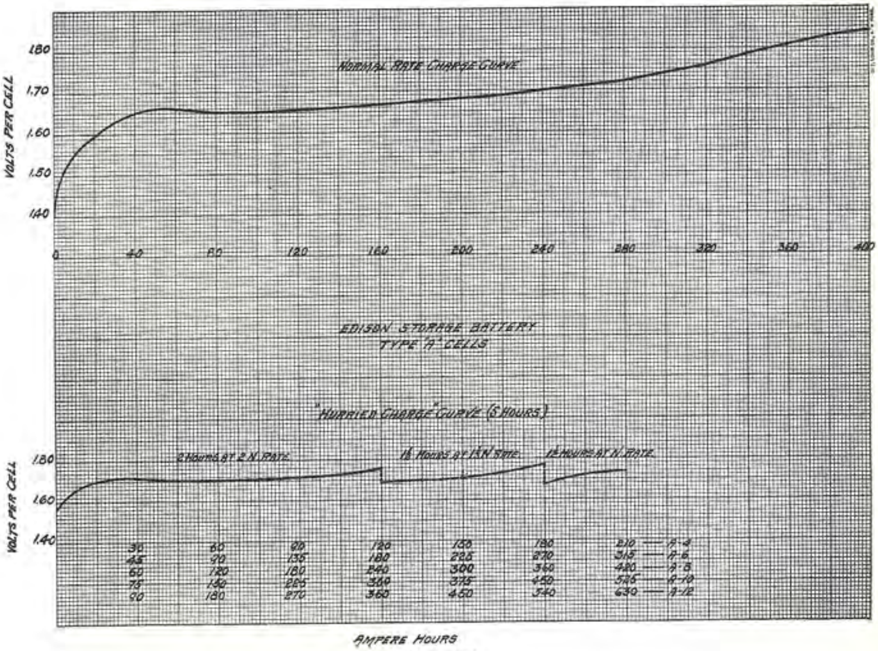
NORMAL RATE CHARGE CURVE
VOLTS PER CELL
1.80
1.70
1.60
1.50
1.40
0
40
80
120
160
200
240
280
320
360
400
EDISON STORAGE BATTERY
TYPE "A" CELLS
"HURRIED CHARGE" CURVE (5 HOURS)
2 HOURS AT 2 N. RATE
1.80
1.60
1.40
30 45 60 75 90
60 90 120 150 180
90 135 180 225 270
120 180 240 300 360
150 225 300 375 450
180 270 360 450 540
210 — A-4
315 — A-6
420 — A-8
525 — A-10
630 — A-12
AMPERE HOURS

FIG. 33

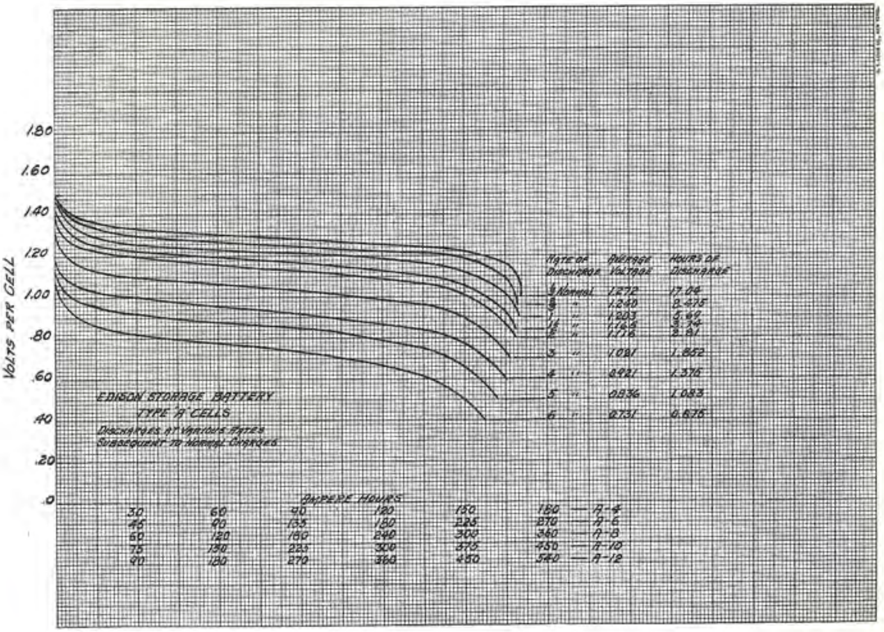
VOLTS PER CELL
1.80
1.60
1.40
1.20
1.00
.80
.60
.40
.20
.0
RATE OF DISCHARGE
AVERAGE VOLTAGE
HOURS OF DISCHARGE
½ Normal 1.272 17.04
1.240 8.475
1.203
1.165
2 " 1.116 2.81
3 " 1.081 1.852
4 " 0.921 1.376
5 " 0.836 1.083
6 " 0.731 0.876
EDISON STORAGE BATTERY
TYPE "A" CELLS
DISCHARGES AT VARIOUS RATES
SUBSEQUENT TO NORMAL CHARGES
AMPERE HOURS
30 45 60 75 90
60 90 120 150 180
90 135 180 225 270
120 180 240 300 360
150 225 300 375 450
180 — A-4
270 — A-6
360 — A-8
450 — A-10
540 — A-12

FIG. 34

Considerable variation in specific gravity is permissible, it having influence only upon battery efficiency. The recommended range of gravity is 1.196 to 1.156 at 80° F. electrolyte temperature, varying inversely .002 specific gravity with each 10° F. change in temperature. Gravity readings should be taken after a full gassing charge.

Purity of Electrolyte

Specific gravity is not necessarily a true indication as to the suitability of the electrolyte, since harmful impurities may get into the electrolyte when watering or otherwise. To guard against this possibility it is recommended to renew the electrolyte after eight or ten months' continual service, or equivalent thereof, with a solution furnished by the manufacturer. The solution is 1.260 specific gravity, or stronger than normal, to compensate for the considerable amount of weaker solution still left in the plates after the cells are emptied. It is advisable to completely discharge the battery before renewing the electrolyte, and to give it a twelve-hour charge, at the normal rate, after renewing.

Renewal of Electrolyte

Watering Cells

Cells must be watered carefully, using distilled water only, without slopping or filling too full. To insure against improper filling, the indicating electric filler (Fig. 28) made by the battery manufacturer should be used.