throwing the power in and out of gear. The car is provided with a special gear of four definite speeds, i. e., 1½, 3, 5, 9 miles per hour. With the accelerator, however, the speed of the car can be increased 25 per cent.

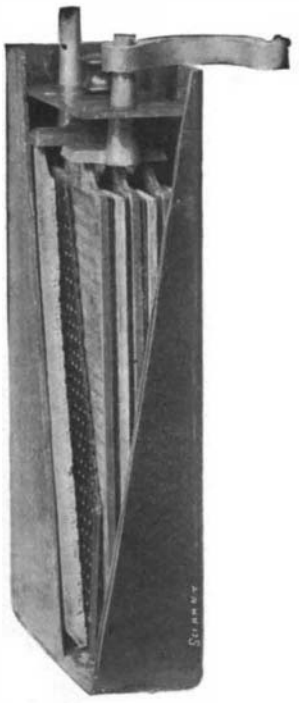
The steering gear is of the Ackermann type, controlled by a hand wheel and worm gear. The car is equipped with ample braking arrangements. The car, in spite of its weight, may be brought to a dead stop when going at full speed within six or eight yards. The road wheels are protected in case of war by chain mail, although this precaution is scarcely necessary, as the main armor belting is only 18 inches off the ground.

The tank contains sufficient fuel for 200 miles.

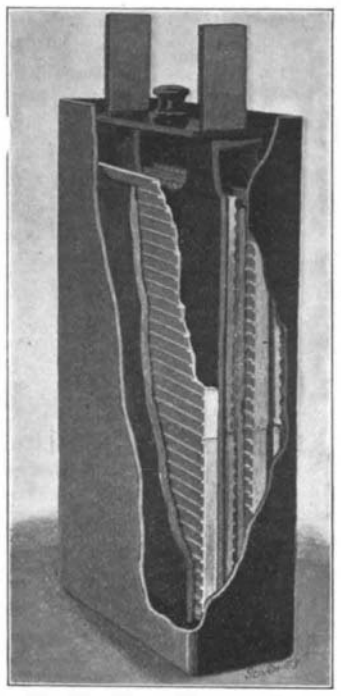
The most important feature of the car is the armor protection. The armor is so designed and constructed as completely to encircle the car frame. The bow and stern of the car are ram shaped, the angle of the nose being about 45 degrees. The extreme length of the armor, which is 18 inches off the ground, from point to point of the ram, is 28 feet. The extreme beam is 8 feet, and the extreme height 10 feet. The armor is of 6-millimeter Vickers steel, and is impervious to small arms. It is attached to the car frame by means of semi-elliptical springs, onto which it is hung by stout brackets. The four semi-elliptical springs are mounted on steel trestles, suitably braced and stayed to the main frame. By this it will be seen that the armor is not rigidly fixed to the frame. On the contrary, it has been the aim of the designer to separate the armor from the car frame itself in order to obviate the detrimental vibration imparted by the road wheels to the frame. The front and the rear of the armor serve as stores for ammunition, being boxed in underneath. Both rams are fitted with couplings, and are connected with tie rods direct to the main axles, so that in case the war-car is used for haulage almost a straight axial pull is obtained. The inside top edge of the armor is provided with half-embedded rollers, so as to prevent boarding, it being impossible owing to these rollers for any hand to obtain a hold on the top of the armor.

The armament of the war-car comprises two pom-poms and two automatic quick-firing Maxim guns fitted on proper gun mountings, either in turrets or without. In the latter case the guns are equipped with shields, and the mountings are so constructed as to lower or raise the gun in or out of action. If necessary 6-pounder guns may be carried. The ammunition stores carry some 10,000 rounds or more. The car is worked by three or four men, the number depending on the number of guns carried. There is sufficient platform room, however, for 20 men.

Only one man is required to drive and steer the car. The hill-climbing capacity of the vehicle is 1 in 7½ with a full load. Sufficient fuel for 500 miles may be carried. The total weight of the car complete, with armor, guns and fuel, is 5 tons 12 hundredweight.



THE PORTER CELL.

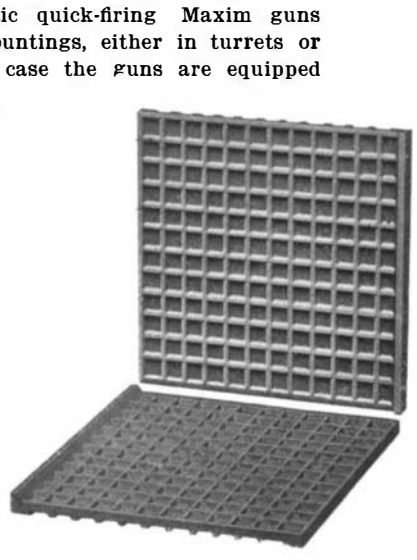


GOULD AUTOMOBILE CELL WITH EARTHENWARE SEPARATOR.

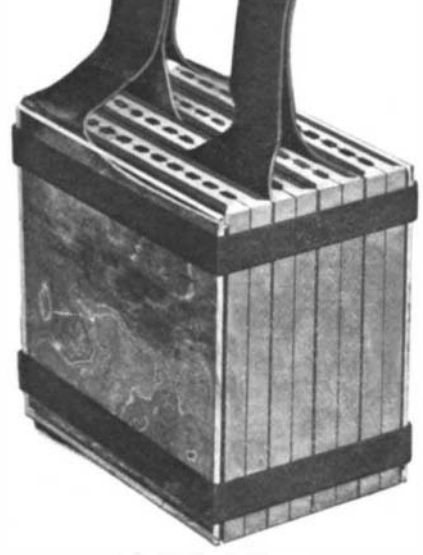
SOME MODERN AUTOMOBILE ACCUMULATORS.

The accompanying illustrations give a good idea of the construction and appearance of some typical storage battery cells used in the present-day electric vehicles.

Heretofore all practical storage cells have been constructed of lead, either from solid lead sheets or by pasting a grid with oxides of lead. These were called the Planté and Faure types of plates after their respective inventors. Another kind of storage cell is now being perfected by Mr. Thomas A. Edison, in which the active material is composed of iron and superoxide of nickel, which are formed into briquettes and pressed into very thin sheet steel frames. The plates are assembled in an electrolyte of caustic potash. The first machine-made cells of this new type have just been completed, and, after they have been thoroughly tested in vehicles, the Edison Storage Battery Company expects to place them on the market. The principal advantage of the nickel-iron cell over the lead one is that in it there is no rotting action due to the successive oxidation of the positive plate, and hence, theoretically at least, there should be no deterioration, while the weight of the cell is nearly half that of the most durable lead cells, the capacity in watt-hours per pound of total weight being about 14. A disadvantage is found in the lower electromotive force, however, which averages 1.25 volts against 2 of the lead cell. This means that nearly double the number of cells will be required to obtain the necessary voltage than are at present needed with the lead battery.



UNPASTED GRID.



THE COMPLETE BATTERY.

PASTED GRID.

THE INTERNATIONAL BATTERY.

A typical example of the lead battery formed from lead sheets will be found in the Gould cell. The plates of this cell are very finely grooved by rotating steel disks, which cut into the lead and crowd it up without removing any of it. An exposed surface 17 times that of the smooth plate is thus obtained, and this is what determines the capacity. The plates are made with fine or coarse grooves, according to their size and the work they are intended for. A cell built on this plan, the largest ever made, was exhibited at Buffalo, N. Y., last year. The dimensions of this cell were 9 feet long, 2 feet wide and 4 feet high. It contained 100 plates 15½ by 31 inches in size, immersed in one ton of sulphuric acid solution, and weighed 8,750 pounds. It gave 16,000 ampere hours at an 8-hour discharge rate or 8,000 ampere hours when discharged in one hour. The cut shows a 7-plate automobile cell, which has a capacity of 90 ampere hours at the 3-hour rate, and weighs complete 28½ pounds. This gives it a total energy value of 6.27 watt-hours per pound. Hard rubber perforated ribbed separators were formerly used in this cell, but at present an improved porous earthenware separator is substituted that is said to possess several advantages.

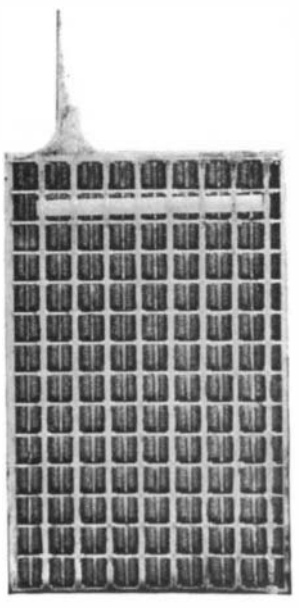
Mr. A. F. Maddern, the inventor of the form of plate used in the above described cell, has recently succeeded in stamping plates from lead sheets in an hydraulic press of novel design. The intricate lead grid and plate seen in the illustrations were produced under a pressure of 250 tons to the square inch. This gives a homogeneous conductor with the largest possible effective surface per unit of weight in contact with the active material. Such contact is always assured in cells of the pasted type, since the small figures or points of the grid can bend slightly to conform with the expansion and contraction of the active material. The grids are so rigid and the active material adheres so well, that the only separator used consists of four hard rubber strips which fit in grooves in the four vertical bars of the frame. These batteries have been manufactured by the Auto-Dynamic Company, and received a thorough testing in pleasure vehicles and delivery wagons during the past year and a half. At a three-hour rate of discharge, a 90 ampere-hour cell gives something over 8 watt-hours per pound. The company are now preparing to manufacture the Planté type of plate shown in one of our illustrations.

A battery that was invented three years ago by Mr. F. W. Barhoff, of Hartford, Conn., and which has been thoroughly tested in a vehicle for 13,000 miles, is constructed from lead rods which are grooved or cut into washers, leaving sufficient lead to form a solid core. These rods are then assembled so as to form plates. This battery has held up remarkably well in the endurance test given it, as it only fell from 8.47 to 5.049 watt-hours per pound during the three years it was in service. The Hartford Auto and Livery Company are preparing to manufacture this battery, which can be produced cheaply and yet is believed to have greater durability than any of the other batteries now on the market.

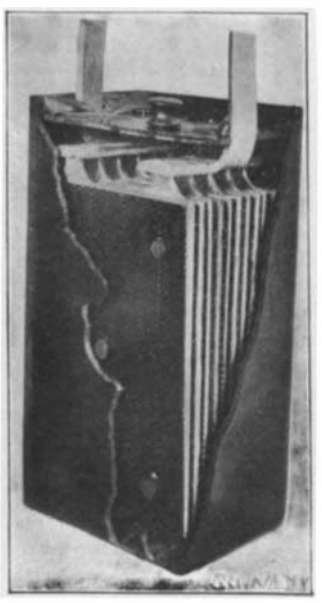
The National Battery Company have just completed a new lightweight cell of the Planté type which is said to have a capacity equivalent to about 14 watt-hours per pound.

The American Battery Company, of Chicago, make a durable cell somewhat sim-

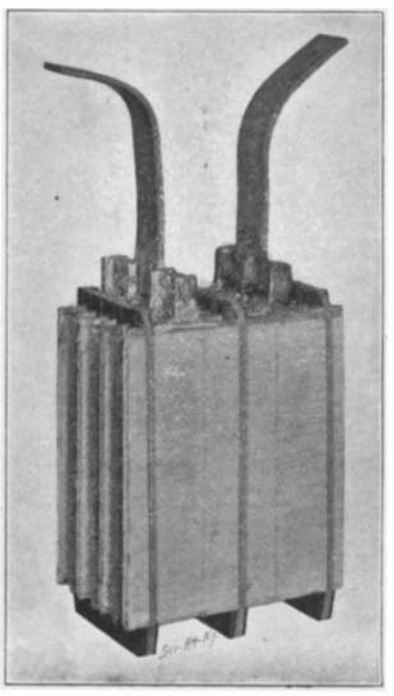
BARHOFF BATTERY PLATE.



REUTERDAHL PLATE.



REUTERDAHL CELL.



AMERICAN BATTERY ELEMENTS.

ilar to the Gould; but in this instance the lead sheets are grooved at an angle by a cutting tool and the lead is cut away. This gives a cross-sectional view of the plate the appearance of a series of superposed V's with a vertical stem passing downward through the apex of each. The automobile cell that gives 27 amperes for three hours weighs 30 pounds, which is equivalent to 5.47 watt-hours per pound.

Of the Faure or pasted type of cell the Porter is one of the lightest at present on the market. The construction of this cell is shown in the illustration. The plates are very light and are made to a standard size of 5 by 7 inches, ⅛ inch thick. A 21-pound cell has a capacity of 96 ampere-hours at the 3-hour rate, which corresponds to between 8 and 9 watt-hours per pound. This company guarantees their batteries for a term of years for 20 per cent of their original cost. The positive plate is good for 360 complete discharges, after which it has to be renewed.

The construction of the International Storage Battery Company's cell can be plainly seen from the illustrations. The two grids of porous earthenware are pasted with the usual lead oxides, after which they are clamped and cemented together with a conducting sheet of lead between them. The grids have parallel ribs on their outer faces, which press against similar ribs on the next plate and hold the plates apart. The earthenware grids, besides being insulators, hold the active material firmly in place, so that it cannot possibly fall out. It certainly would seem impossible for deterioration to occur in this cell from loss of active material.

The Perret battery, the invention of Mr. Frank E. Perret, is one of the lightest and neatest cells that have yet been produced. It is made upon the unit system, similarly to the Barhoff. Each unit consists of a perforated rectangular casing about a quarter of an inch square and 6 or 8 inches in length, filled with special electro-chemically prepared active material. This material is formed from pure lead in a bath of pure dilute sulphuric acid, thus eliminating all deleterious substances that usually creep in through forming solutions. Each Perret unit has a definite capacity, and it is only necessary to assemble the proper number to get any sized cell desired. The 100 ampere-hour cell at the 5-hour rate weighs 15 pounds, which corresponds to about 12½ watt-hours per pound.

The Haschke battery, made by Mr. J. E. Haschke, of Chicago, is a very light automobile cell that has given good results in service. The principal feature of this battery is a chemically prepared cardboard envelope that surrounds and separates the plates, thus making short circuits practically impossible. The cell will stand great abuse in the form of heavy discharges without materially damaging it.

The Reuterdahl battery, the construction of which is shown herewith, is, according to the claims of the makers, the lightest battery that has yet been produced. The grids are made of a special lead alloy which combines lightness with rigidity and ability to withstand electrolytic action. The grids are so shaped as to form a perfect trusswork within the plates, which counteracts any tendency to buckle. In making the negative plates spongy lead is deposited together with a secret chemical substance, thus forming an electrolytic alloy. This is compressed by hydraulic pressure and afterward the foreign substance is dissolved out, leaving only spongy lead in an extremely porous condition and in good electrical contact with the grid. The positive plate is similarly formed, the grid being first electrically coated with a layer of lead peroxide. The separator used in this cell is a perforated sheet of hard rubber having horizontal leaves or shelves on which glass wool (an insulating substance unaffected by electrolytic action) is wound. This allows a free circulation of the electrolyte and at the same time provides a flexible pad which retains the active material in place and prevents it from shedding and short-circuiting the cell.

A 3-hour discharge curve of one of these cells shows a remarkably high voltage, which does not fall to 1.9 volts until the end of 2¾ hours. The capacity in watt-hours per pound of complete cell at this rate is given as 16.74, which is quite a little higher than that of the new Edison cell. We have been unable, however, to substantiate these figures.

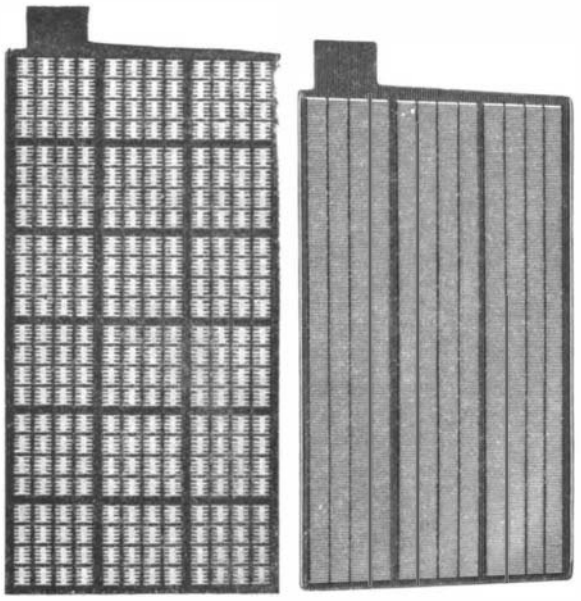
Comparative Braking Tests Between Horse-Drawn Vehicles and Automobiles.

The Automobile Club of America held a braking contest recently in order to demonstrate to the Law Committee of the Board of Aldermen of this city the ease with which an automobile could be stopped as compared with a horse-drawn vehicle.

The results of the test show that at speeds in the neighborhood of 20 miles an hour an automobile can be stopped in about half the distance necessary to bring a horse-drawn carriage to a standstill, while at 7 or 8 miles an hour the automobile requires from two-thirds to one-half the space needed by the latter. At the low speeds of from 7 to 8 miles per hour, which latter is at present the legal limit in New York, the heaviest of the autos could be brought to a stop in from one-half to three-fourths its own length. As an example of this, 1,400 and 2,500 pound machines, traveling at 7.6 and 7.2 miles per hour, were stopped in 4 feet 9½ inches and 6 feet 8 inches, respectively, while an 800-pound machine, going at 8.7 miles an hour, required but 8 feet 9 inches.

The horse-drawn vehicles consisted of a four-horse coach and a two-horse victoria. The former, traveling at 16.3 miles per hour, was stopped in 77½ feet, against 34½ feet required by a French gasoline machine going at 18.9 miles an hour; while the latter, when driven at 13.8 miles an hour, was stopped in 36 feet 10 inches.

The tests prove, distinctly, the superiority of the automobile so far as stopping quickly is concerned, and they should do much toward promoting the framing of a more liberal speed law, in which the motor-driven machine should be allowed more nearly the maximum speed at which it can be brought to a stop within the distance required by a horse-drawn vehicle when driven at 8 miles an hour. The danger to pedestrians is no greater from the pneumatic-tired wheels



THE MADDEN STAMPED LEAD GRID AND PLATE.

of an auto than from the iron-shod hoofs of a fast horse, and the auto should be given equal rights on the road, based on the distance in which it can be stopped.

Automobile News.

The necessary permission having been obtained from the Board of Aldermen, the Automobile Club of America will hold on May 31, on the South Shore Boulevard, Staten Island, a mile record contest, open to motor vehicles of all classes. Gold and silver medals will be awarded respectively to the vehicles making the best and second best time in each class.

The suppression of the Nice-Abbazia race has been severely felt by the organizers of the event and the great number of manufacturers who had gone to a considerable expense in constructing machines especially for the race. The reasons why the Italian government refused at the last moment to grant the authorization are not very clear. It is supposed that the authorization had been granted at first by the Minister of Public Works, and that subsequently the Minister of the Interior placed his veto upon it. The reason for the latter decision is said to lie in the fact that an important market is held at this season at Coni, one of the towns along the route, which attracts the population from all over the north of Italy, hence the roads, which are narrow, would be greatly encumbered with vehicles, and the race would be dangerous under these conditions. This does not, however, explain why the race could not have been postponed to a later date. Another explanation is that a number of chauffeurs started out to explore the route in advance, and did some damage along the way, from which resulted a number of protests, and finally led to the action of the Minister. This decision has been a severe blow to the French automobile industry, and will result in the loss of millions of dollars which have been spent by the leading manufacturers, not only in the designing and construction of the special racing machines, but in the distribution of supplies along the route. M. Serpollet estimated that his company has lost $50,000, two months of work, and $2,000 worth of petroleum which had been distributed through the north of Italy, together with a numerous personnel.

Legal Notes.

The First Wireless Telegraphy Suit.—At last one of the many quarrels between rival inventors of wireless telegraphic apparatus will soon be definitely settled. Siemens & Halske, the makers of Braun's apparatus, have taken the bull by the horns and have begun a suit for infringement in Germany against the Allgemeine Elektricitaets Gesellschaft, who own the Slaby-Arco patents. It is rumored that the Braun system, for which Siemens & Halske stand as sponsors, is nothing but a Germanized Marconi system, and will, therefore, fare rather badly in litigation. At all events, it is certain that the German government distinctly favors the Slaby-Arco system. The Marconi Company, whose stock organization in America was recently announced, will probably soon have to test its rights in the United States courts. But since the Marconi system has already passed through one patent suit unscathed, the chances are that it will come out of others with equal success in America.

Unfair Competition.—Where the attempt is made so closely to imitate a competing article as to confuse and deceive purchasers the courts will not be nice in limiting the scope of the relief granted because some of the imitations if practised singly and without fraudulent intent might not constitute unfair competition; and, when unfair competition has been found, the courts should not give their approval in advance to any suggested or proposed changes, leaving to the defendant the responsibility of deciding for himself what changes are necessary to avoid further infringement. (112 Fed. Rep. 1000.)

Dayton Electrolysis Case.—After a trial lasting some weeks, in which testimony covering several thousand typewritten pages was taken, a decision was rendered in the case of the Dayton City Railway Company, of the same town, in the Court of Pleas. The case is of peculiar legal interest, for the reason that entirely new questions of law were presented for the consideration of the Court. Of the numerous witnesses thoroughly examined and cross-questioned, twenty were experts selected from the leading authorities of the United States in the branches of electric, hydraulic, chemical, mechanical and street railway engineering. All these experts were called upon to discuss the electrolytical effect of a return trolley current. The city claimed that the company had not used proper means for returning the current to the power house, by reason of which neglect water pipes had been badly damaged by electrolysis. The opinion is too lengthy for republication. Its main point can, however, be given in brief form. The court states that the right to use streets for waterworks is granted by the legislature, that the right of an electric railway to use the streets springs from the same source. The electric railway and the waterworks are both beneficial to the public, and their proprietors are entitled to enjoy their respective rights without interfering with each other. No conflict can occur where each confines itself to its own sphere of activity. The city of Dayton made a contract with the company in 1892 for the construction, operation and maintenance of a single-trolley electric railway. The law will not permit the court of Common Pleas under the circumstances to direct the adoption by the company of the double-trolley or conduit system; for the legal doctrine that a man must enjoy his own property in such a manner as not to injure the rights of another, led the court to the conclusion that where contract relations have been authorized by the legislature between the parties, and there has been a proper exercise of such grant, no cause of action will lie against the party exercising such franchise or right under the contract or statute, provided that due care has been used. The facts determined are that the soil underlying Dayton is of such a character as to subject it easily to electrolytic action, but that it is not of a nature to cause corrosion similar to that on pipes; that pipes buried in the soil remain unaffected for thirty years if not subjected to electrolysis; that this electrolytic action upon water-pipes is caused by the operation of a single overhead trolley railway; that the damage suffered by the city could be remedied by the installation of a double-trolley system, which would prevent electrolytic action upon the water-pipes of the city, and that the railway has been operated in a very inefficient and negligent manner, far below the standard of the electrical art. The court, therefore, held that it was its duty to enjoin the defendant "from so operating its railway, and to compel it, within a reasonable time, to introduce such improvements in the system in order that the operation of the single-trolley system authorized by the franchise and contract will be in accordance with the present standard of the art of operating single-trolley roads. The plaintiff shall co-operate to that end."