copies it is only necessary to remove the negative spool from the winding up end to the supply spool standard of the apparatus and begin over again. The perforations in the edges of the film are of specially square shape and give the square sprocket teeth of the propelling pulley a better pull on the film. The teeth pass through the perforations of both films, causing both to move exactly the same and at all times to keep in perfect register. The speed of the film passing under the exposing chamber must be uniform, and this is obtained by propelling the sprocket wheel by an electric motor or by a spring motor. The electric motor is seen behind the light chamber in the larger of the two engravings. The axle of the motor has worm gear operating a cog wheel on the main shaft. The V shaped elastic band holds the frame (in which is a ground glass) in contact with the films, producing a sort of tension on the film. To the left of the light chamber is a supplementary tension, adjusted by screw nuts, as shown.

Referring to the diagram illustration will be seen two slotted diaphragm cards. These are placed over the ground glass just mentioned, at the bottom of the light chamber, and are for the purpose of regulating the amount of light that acts on the negative. If the negative film, as a whole, should be thin, then the card with the narrow slot is used, which allows a shorter exposure to be made, as the negative and film are passed under it. If the negative is full of density, then the narrow card is removed and the wider slotted card substituted, which allows a larger volume of light to act upon the negative film. The exposed film is wound around large open reels from its spool, and developed by passing through troughs of developer solutions.

The necessity of providing apparatus to quickly reproduce positive impressions from the negative ribbon films is one of the reasons why this simple device was invented, and its novelty consists in the fact that the film moves continuously under a uniform source of light without any intermittent motion or the use of shutters. The operation of exposing the film is carried on in a room illuminated by the usual ruby red light.

National Academy of Sciences.

WASHINGTON MEETING.

BY WILLIAM H. HALE.

The meeting of the National Academy of Sciences, held at the Smithsonian Institution, April 20–22, was attended by over thirty members, or about one-third of the entire membership; the president, Prof. Wolcott Gibbs, in the chair.

The business transacted included the election of Asaph Hall as vice-president, in place of F. A. Walker, deceased; of Ira Remsen as home secretary, in place of Prof. Hall, promoted; and of Alexander Graham Bell as treasurer, in place of Dr. Billings, resigned. Additional members of the council elected were: H. P. Bowditch, G. J. Brush, J. S. Billings, O. C. Marsh, Simon Newcomb and Arnold Hague.

New members elected are: William H. Dall, of Washington; Frank A. Gooch, of New Haven; Charles S. Minot, of Boston; and EdwardW. Morley, of Cleveland.

Only fourteen papers were read, and five of that number were obituaries, viz., of G. Brown Goode, by S. P. Langley; of Thomas L. Casey, by H. P. Abbot; of Charles E. Brown-Sequard, by H. P. Bowditch (read by title); of Hubert A. Newton, by J. W. Gibbs, read in his absence by A. W. Wright; and of George H. Cook, by G. K. Gilbert.

The scientific papers were "The Influence of Environment upon the Biological Processes of the Various Members of the Colon Group of Bacilli," an experimental study by AdelaideWard Peckham, M.D. (presented by J. S. Billings);"On the Energy Involved in Recent Earthquakes," by T. C. Mendenhall; "On a Ring Pendulum for Absolute Determinations of Gravity," by T. C. Mendenhall and A. S. Kimball; "On the Variation of Latitude," by S. C. Chandler; "Variation of Latitude and Constant of Aberration from Observations at Columbia University," by J. K. Rees, H. Jacoby and H. S. Davis (presented by S. C. Chandler); "The Position of the Tarsiids and Relationship to the Phylogeny of Man," by Theodore Gill; "A New Harmonic Analyzer," by A. A. Michelson and S. W. Stratton; "On Recent Borings in Coral Reefs," by Alexander Agassiz; "Notes of Experiments upon the Roentgen Rays," by A. W. Wright.

In the last named paper, Prof. Wright gave results of his experiments which seem to confirm the theory that these rays are not refrangible. By using flat plates of glass instead of prisms, he obviated the effect of the thicker part of the prism on the rays, which, by absorbing them, gives the appearance of a negative index of refraction. Beside the plate of glass he placed a crystal of Iceland spar, without obtaining evidence either of refraction or of polarization. In another series of experiments he employed means to obtain a thin ray and to pass it between the poles of a powerful magnet, and afterward reversed the poles, but without inducing any perceptible change in the direction of the ray. The most interesting point in his experiments has been made within a few days and is not yet fully verified; but in using a screen of platinum wires he observed that the screen caused a faint dark line to appear, which may correspond to the interference lines in the spectrum. If so, this would indicate that these rays can be diffracted, even if they are not capable of refraction.

The next meeting of the Academy will be held at Boston, on November 16 next.

SLOW SPEED CABLE CAR GRIP FOR USE ON CURVES.

The cable car system of traction is at a great disadvantage wherever it is necessary to put in any sharp curves on the line of the road. The construction of the ordinary form of cable car grip is such that, if a stop is made in the middle of a curve, and the cable is released, it will leave the grip and spring toward the center of the curve. Hence, in order to traverse a curve, the gripman takes a firm hold on the cable and swings around on to the next tangent at full speed. That there is danger in such a practice goes without saying, and on such a line as the Broadway cable road, New York, the risk becomes unbearable. The most troublesome curve on this road is one which leads at Fourteenth Street from Broadway into Union Square. Fourteenth Street is one of the busiest thoroughfares in the city, and its proximity to the shopping district causes a large part of the pedestrian traffic to consist of women and children, who are continuously passing across the double tracks of the Broadway cable line at a point near the center of the curve. When it is borne in mind that the cars run under ten seconds' headway in the busiest hours of the day, the danger to pedestrians at this point can be realized.

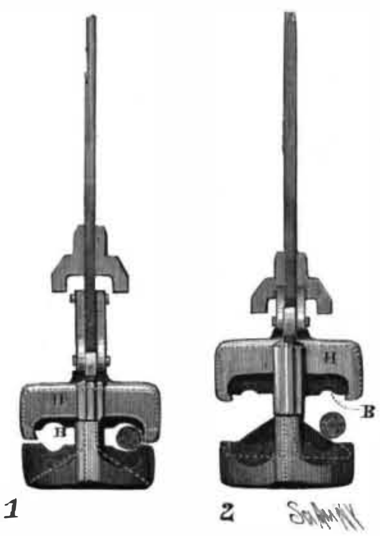

FIG. 1.--Cable released but held in place by hooks. FIG. 2.—"Tripping" the cable.

Various plans have been proposed by which to meet the difficulty, all of which were more or less objectionable, for the reason that they involved either the appropriation or disfigurement of a part of Union Square grounds. It was proposed to carry the tracks directly across the square at street level or beneath it by means of a tunnel. Another suggestion involved cutting off the corner of the block at Fourteenth Street and Broadway, or carrying the tracks through the block by means of an arcade cut bodily out of the buildings. It will be seen that all of these plans aimed at one thing—the elimination of the sharp curve at Fourteenth Street—and that they all took it for granted that the mechanical difficulties connected with the grip and cable were unsurmountable.

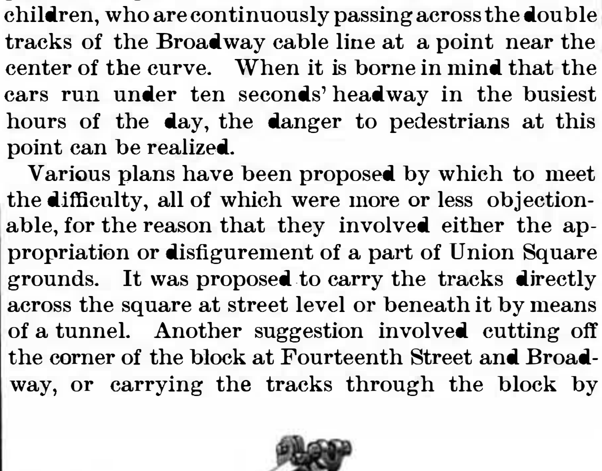

Fig. 3.–PERSPECTIVE VIEW OF GRIP WITH RETAINING HOOKS ATTACHED.

The solution of the difficulty, however, has come in the shape of a very simple mechanical contrivance, which is so easily applied and operated as to cause surprise that it was never thought of when the cable grip was first designed. By reference to the engravings it will be seen to consist of nothing more than a couple of loose hooks, H H, which keep the cable in the grip when the upper jaw, B, is raised to release the cable.

The grip consists of a lower fixed jaw, C, and an upper movable jaw, B. The lower jaw is rigidly attached to a crosshead on the track frame by means of two vertical shanks of plate steel, M M, and is always carried at a fixed level. The upper jaw, B, is carried by a shank, L, which is raised or depressed by the action of levers attached to the crosshead and operated by the gripman. The jaws are each provided with two longitudinal grooves, so that the cable may be taken up on either side of the grip. When the car is stationary the cable runs in the groove in the lower jaw, and the car is started by depressing the upper jaw and gripping the cable, the speed of the car being regulated by the pressure of the grip. At full speed the cable is held perfectly stationary in the grip, and at slower speeds it is allowed to slip somewhat, the car being carried along by the friction between the jaws and the cable.

The cable is thrown out of the grip altogether, or "tripped," by raising a couple of wedges (shown in Fig. 2), which are carried by links, R, bracket, P, and the two plates, E E, and are operated by a separate lever on the car. The plates, E E, are provided with stops which, as the plates are lifted, engage the shank, L, and raise the top jaw, B, to the position shown in Fig. 2.

The trouble with the old form of grip was that when B was raised on a curve the cable would spring out to the inside of the curve and be "lost." To remedy this the hooks, H H, whose cross section conforms to that of the jaw, B, are hung by links, G, to the jaw near its ends, and have a slightly larger vertical movement than the jaw. When the latter is raised sufficiently to release the cable, the hooks, H, remain down in place and keep the cable from springing sideways out of the grooves. This position is shown in Fig. 1. If B be raised still further, as in "tripping" the cable, a swelling upon the jaw just below the link, G, serves to raise the link and carry the hook clear of the cable.

It will thus be seen that this very simple device enables the speed and stopping and starting of the car to be controlled with as much certainty on a sharp curve as on a tangent, and we are informed by Chief Engineer Pearson that the thirty cars which have already been equipped with it are giving the greatest satisfaction.

Artificial Fuel.

Eggette or ovoid fuel, in distinction from briquettes, says the English journal Machinery, may be considered somewhat of a luxury for domestic use, similar to that which anthracite coal bears to bituminous. In Europe, the convenience of the fuel for the furnace was not so much considered as the ability to produce a fuel which was cheapest and best suited for handling, storage, and transportation. Much greater stress than in America was laid on the thorough preparation of the coal, on the quality of the pitch or binding material used, and on the size of the blocks giving the greatest economy in manufacture and handling.

The systems of preparing the coal for coking and briquetting, by washing and jigging, originated in Europe and have there been long practiced to such an extent that almost throughout the whole of the Continent coke can be guaranteed to contain only a certain per cent of ash. This difference in the art of washing fine coals may to some extent account for the slow progress made in the manufacture of briquettes in America.

Statistics show that the production of briquettes in 1893 was as follows:

France	1,750.000	tons.
Belgium	1,200,000	"
England	850,000	"
Austria	250,000	"
Germany	1,230,000	"
Italy	560,000	"
Spain	100,000	"
Russia and Sweden	100,000	"
United States	100,000	"
China, India, and Canada	150,000	"

The proper mechanical preparation of the coal goes far toward making the briquetting of an otherwise waste of coal successful and profitable. That the thorough washing or freeing from all slate and other impurities is one of the chief factors in determining the value of the product is obvious, since the value of the fuel depends mainly on its freedom from ash, or the amount of available combustible matter it contains. This is especially important where the fuel is to be transported and an extra cost is added for handling and transportation.

The Pneumatic Mortar Carriage.

Recent tests of the pneumatic mortar carriage, of which we gave an illustrated description in our issue of January 2, have demonstrated its ability to be fired through an abnormally large arc of elevation. Owing to the fact that the recoil cylinders are at all times in line with the bore of the gun, it can be fired from 2° depression to 75° elevation—a distinct advantage over the common form of hydraulic carriage, which is provided with a fixed recoil cylinder placed at a certain angle, and has a limited range between 48° and 65° of elevation. The construction of the pneumatic carriage allows the gun to be mounted nearer to the surface of the ground than is usual, and its manipulation is rendered proportionately easy.