No. 634,560. Patented Oct. 10, 1899.

A. & L. LUMIERE.

PHOTOGRAPHIC APPARATUS.

(Application filed Aug. 17, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 5.

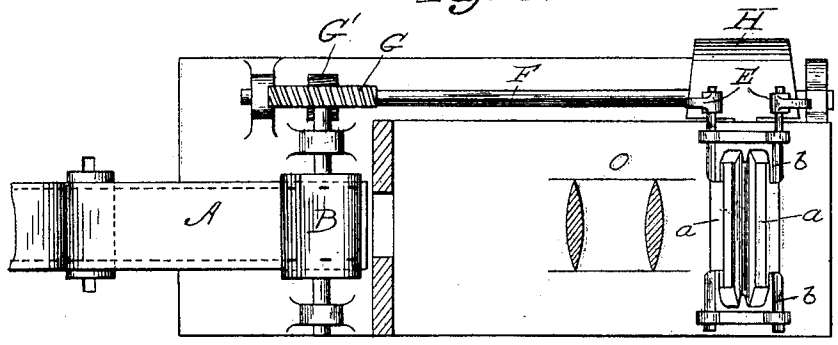
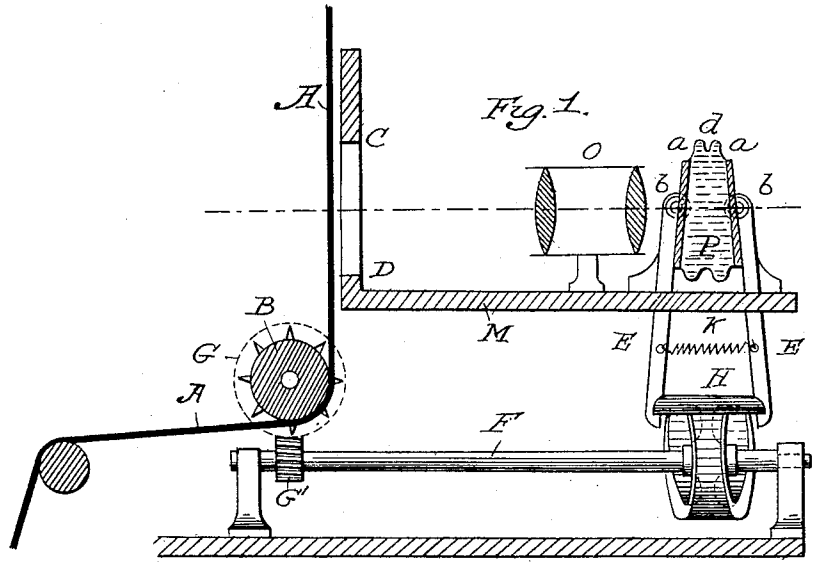


Fig. 1.



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Fig. 2.

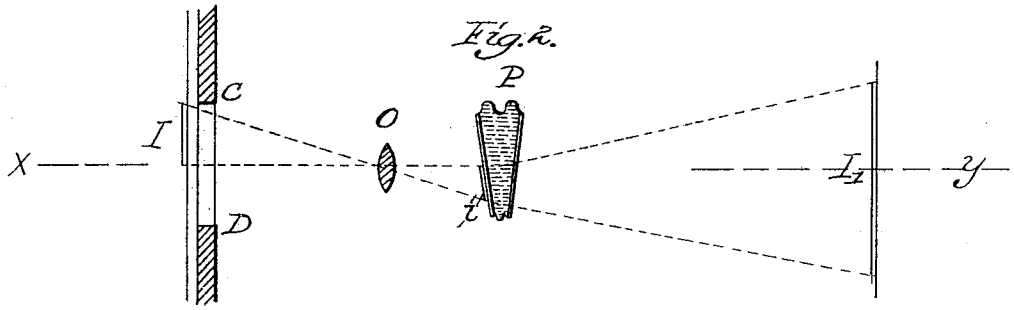


Fig. 3.

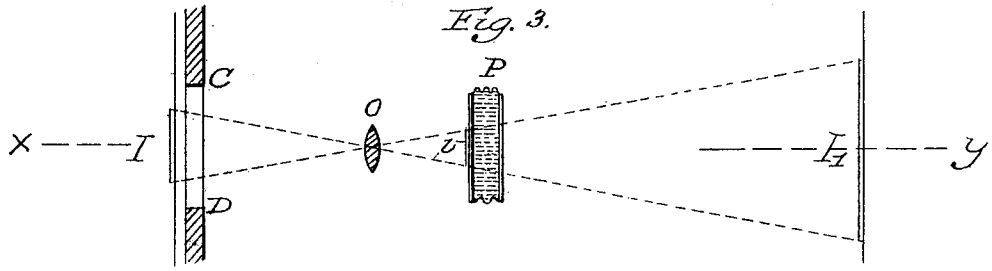
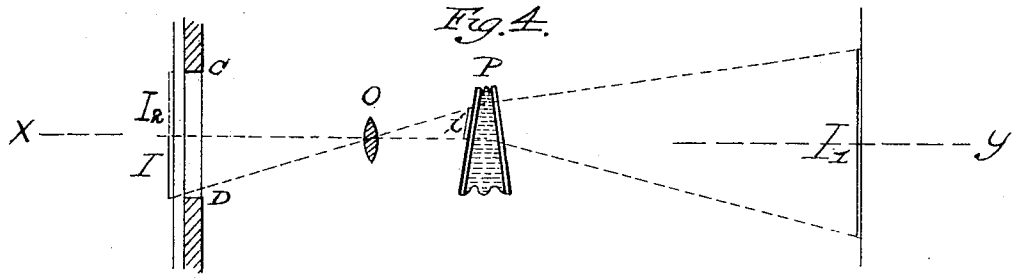


Fig. 4.



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UNITED STATES PATENT OFFICE.

AUGUSTE LUMIÈRE AND LOUIS LUMIÈRE, OF LYONS, FRANCE.

PHOTOGRAPHIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 634,560, dated October 10, 1899.

Application filed August 17, 1898. Serial No. 688,792. (No model.)

To all whom it may concern:

Be it known that we, AUGUSTE LUMIÈRE and LOUIS LUMIÈRE, citizens of the Republic of France, residing at Lyons, France, have invented certain new and useful Improvements in Photographic Apparatus, (for which we have obtained patent in France, deposited May 31, 1898,) of which the following is a full, clear, and exact specification.

The object of our invention is an improvement in an apparatus of the kind called "kinematograph," used to obtain and to project animated scenes, providing for uniform and continuous rotation in the said apparatus of the ribbon destined to receive the successive pictures or to project these pictures on a screen. In order to obtain the stability or fixedness of the projection in spite of the continual change of the picture, it is necessary to deviate the projected rays to a certain extent, which varies at every instant according to the position of the picture at the same instant. We obtain this result by placing in the way of these rays a prism of special construction, the tangent of the angle of which varies in proportion to the movement of the picture by means of a mechanism regulated by this very movement.

The accompanying drawings show the disposition used for this purpose.

Figure 1 is a longitudinal section of the apparatus. Figs. 2, 3, and 4 show the different phases it goes through when at work. Fig. 5 is a plan view of Fig. 1.

The film A, on which there are the successive pictures, descends vertically from top to bottom under the action of a spool B, on which there are pegs which enter into the perforations that are at fixed spaces of the film. It is guided in the known manner and passes behind a window C D, the height of which is that of two consecutive pictures. In front of this window there is a lens O and behind it an ordinary lamp, which is not given in the drawings.

In front of the lens is placed the prism with variable angles P, formed of two parallel glass plates *a a*, disposed so as to be able to oscillate separately on two horizontal axes *b b*. The glass plates are joined together by an india-rubber frame in the shape of bellows, so as to form a water-tight box, the glass plates of which can oscillate freely all the same. This box filled with water or any other convenient colorless liquid forms a prism, the faces of which can receive different inclinations by means of the levers E E, placed on each axis *b*.

The levers E are put in motion by a double cam H, placed on a horizontal shaft F, that is put in motion by drum B by means of helicoidal cog-wheels G G'. Cam H has the shape of a drum, the sides of which are symmetrically cut out like a helix. The inside of both levers E leans against the sides of this drum. The inside of both levers also runs parallel with the glass plates of the prism and passes through the center of oscillation *b*. The contact of the levers on the cam takes place through a spring K. Cam H turns around once while one picture passes. Its breadth and the movement of the helix are such that in the middle of its course the glass plates *a a* of the prism are parallel, (see Fig. 3,) whereas at the extreme points of the course they form the largest angle of deviation at the top or at the bottom, as the case may be. (See Figs. 2 and 4.)

When the picture I, Fig. 2, occupies the upper part of window C D, the angle of prism P is as large as it can be and opens at the top. When the picture is in the middle of window, Fig. 3, the glass plates are parallel and there is no deviation. At last, when the picture is at the bottom of the window, the angle of the prism is as large as it can be, but opens at the bottom, Fig. 4. It is therefore possible by duly choosing the suitable maximum angle of the prism to get the projections of the pictures to coincide on the screen in the extreme positions of Figs. 2 and 4 with its medium projection, Fig. 3. In the intermediate positions the coincidence will necessarily take place, since by this construction the linear change of the pictures is in proportion with the tangent of the angle of the prism and the change of the projection on the screen is in proportion with the angle of the deviation of the rays. Now these two angles (at least within the usual size of the apparatus) vary, so to speak, in the same proportion. At the end of every revolution the

prism returns suddenly from the position in Fig. 4 to that of Fig. 2, so that the new picture I^2, Fig. 4, may be projected in its turn.

The size of the extreme angles is fixed by construction according to the focal distance of the lens; but it is possible to vary it within certain limits by lengthening or shortening the arm of the levers E, so as to be able to regulate the apparatus. This result is obtained by lifting or lowering the whole of the upper part of the apparatus—*i. e.*, the window, the lens, and the prism—placed for that purpose on a movable bearer M. This regulating can be done while making projections in observing the same on the screen.

The apparatus thus disposed can of course be used for obtaining negatives of animated scenes.

The error committed (if we admit that the deviation is in proportion with the angle of the prism) is not worth while speaking of, as the variations of this angle are smaller. There is a means of reducing this error by replacing the sole prism by two or more prisms of the same size, the deviations of which are added together in order to obtain the total deviation. The maximum angle of each of these prisms is thus diminished and the error resulting therefrom likewise. In this case every prism will be moved by a helicoidal cam like cam H, but not running quite so fast. That will attenuate the sudden fall of levers E at the end of every turn.

Referring to Figs. 2, 3, and 4, the optical axis is represented by the line $x\ y$. While the image I descends in a continuous movement behind the opening C D, its projection I′ remains constantly at the same place on the screen, because the angle of the prism varies in proportion to the displacement of the image I. When the prism P, Fig. 4, returns suddenly to the position of Fig. 1, the projection of the image I disappears under the screen and that of the following image I^2 takes its place. This sudden change is necessary for the rapid succession of the images. The purpose is only to preserve at the same point on the screen the projection of the image I while it changes its position from Fig. 2 to that of Fig. 4. Thereby it becomes possible to obtain with a continuous movement of the image I an intermittent movement of the projection.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

An apparatus for projecting chronophotographic pictures comprising a band carrying the pictures, a liquid prism consisting of two movable glass plates joined together by a flexible frame containing the liquid, means for moving the band and means for oscillating the glass plates toward and from each other so that they will lie in planes converging upwardly in one position and then downwardly in another position, substantially as described.

In witness whereof we have hereunto set our hands in presence of two witnesses.

AUGUSTE LUMIÈRE.
LOUIS LUMIÈRE.

Witnesses:
THOS. N. BROWNE,
MARIUS VACHOS.