THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

For the Promotion of the Mechanic Arts.

Committee on Science and Arts Case No. 2526.

Motion Picture Apparatus.

Hall of the Institute,

Philadelphia, June 4, 1913.

The Franklin Institute of the State of Pennsylvania, acting through its Committee on Science and the Arts, investigating C. Francis Jenkins' Motion Picture Apparatus, reports as follows:

With the phenomenal development of the motion picture art, which has led to the present perfection of the commercial motion picture machine, there has been created a demand for what might be termed a "home-machine", which, while possessing all the advantages of projection of the larger apparatus, would include features of portability, absolute safety in operation and constructional simplicity.

It is well known that owing to the inflammable nature of the celluloid film ordinarily used for motion picture projection, special precautions have to be taken in using commercial machines to prevent the film becoming ignited, and it has become necessary to provide that the housing of the machine conform with underwriters' requirements.

In the operating of the projector the film can never be left stationary and exposed to the source of illumination for more than a fraction of a second without catching fire. This feature has hitherto excluded all possibility of stopping the film to allow of examining separate pictures for the purpose of analysing the motion.

Attempts have been made to meet the special requirements of a "home" motion-picture projector, and the solution of the problem has, up to the present time, been effected by providing a machine so constructed that it admits only of the use of a special non-inflammable film and, when used for slide projection, of special slides. This increases the expenses of operating the machine, and, considering the facilities for obtaining standard film, limits the range of subjects.

The applicant's invention consists of a portable machine for projecting motion pictures and lantern slides, and is intended for home use, class-rooms, neighborhood centres, etc. It is designed primarily for operation by anyone not particularly skilled in the electrical art and also with the object of using a standard celluloid film without any possibility of the latter catching fire when left stationary and exposed to the light. In providing a motion picture machine for the above uses, these two features are of first importance.

Photographs of the machine are shown in Plates 1 and 2.

The applicant uses as a source of light an arc lamp with small soft-cored carbons which lie in a horizontal plane and are arranged to slide in a pair of brass tubes inclined at 90 degrees with each other. (Plate 3, Fig. 2).

Inside the lamp-box and in series with the carbons is a wire resistance, consisting of coils bent around an asbestos-covered former-- (Plate 3 Fig. 2). This resistance is maintained permanently in the circuit.

To connect the projector it is only necessary to make a plug connection to an ordinary lighting circuit either direct or alternating. The arc is struck by hand.

When the arc is struck the current is about five amperes; with this low striking current there is small danger of blowing the fuses in ordinary house-lighting circuits. Working normally, the lamp takes from three to four amperes.

A pin hole in the top of the lamp-box provides a means of examining the carbons, as an image of the latter is projected through this hole on the ceiling of the room.

The lamp-box is made somewhat over 4½ inches square and is fitted with standard 4½-inch condensers, (Plate 3, Fig. 3).

The lamp-box is arranged to swing horizontally for projecting lantern slides, leaving the motion picture machine ready for instant re-operation. For this purpose the former is fitted with a standard slide holder and supplementary lens on adjustable stand. (Plate 4, Fig. 1).

In the applicant's machine the rotating

shutter employed to cut off the light while the film is being moved, is arranged between the condenser and the film. (Plate 6, Fig. 1). In almost all other projection machines in present use the shutter is arranged in front of the film and does not, therefore, assist in reducing the amount of heat which falls on the film.

A two-wing shutter is employed-- one wing only is necessary to cover the film while the latter is being moved and the other is for the purpose of supporting the peripheral ring of the shutter. (Plate 6, Fig. 2).

Two cams are provided on the shutter for actuating the hook mechanism which moves the film.

Normally, the pictures are run through the machine at a speed of sixteen per second and the film is then moved in one-ninth of one-sixteenth or one one-hundred and forty-fourth part of a second.

With this small period of motion of the film for each picture, and with the consequent maximum period of illumination (about 90%) the effect on the eye is so imperceptible as not to necessitate any additional wings on the shutter to lessen the contrast between the

light and dark periods.

Other machines usually employ a three-wing shutter. The film is moved while one wing is cutting off the light. The other wings serve no further purpose than to split up the period of illumination and lessen the tiring effects on the eye.

With the three-wing shutter, the film period of rest is about one-fourth of the period of revolution of the shutter, and on account of the presence of the two other wings, the period of illumination is reduced to about 50%.

By shortening the period of movement of the film and by using two narrow blades in his shutter, thus increasing the percentage illumination, the applicant is able to employ a less amount of light.

The film is moved by means of reciprocating and oscillating hooks actuated by the cams on the shutter disc. (Plate 6, Figs. 2, 3, and 4, and Plate 5, Fig. 6).

To provide the vertical reciprocating motion for the hooks, their shank carries a roller, (Plate 5, Fig. 6), which travels in a E-shaped cam groove on the face of the shutter disc. A second cam groove on the

shutter spindle is also used to effect the horizontal oscillation of the hooks, by means of which oscillation they alternately engage with and are freed from the perforations in the film.

The hooks and shank are formed in one piece of ingenious construction which combines mechanical strength with lightness and consequent minimum inertia. (Plate 5, Fig. 5).

The points of the hooks are made wedge-shaped to minimise the play when they are in engagement with the film. Their motion is also arrested just before the end of the stroke of the cam by the bases of two parallel slots in which they engage. These insure certainty of register of the picture and, by virtue of the springiness of the hooks and shank, make the travel of the film constant against any irregularities in the cam motion, wear, etc.

The film is fed from an upper film box over a small arc of the top surface of a sprocket wheel and through the film guide (in front of the aperture) back to the same sprocket wheel and into a lower box. (Plate 5, Fig. 1). This is the same general mechanism as is used in

the applicant's motion picture camera shown in Plate 7.

By employing one sprocket and holding the two parts of the film in engagement with the teeth on it by pressure rollers, a constant slack is provided in the loop of film that passes in front of the aperture. Consequently there is no resistance experienced by the hooks to the motion of the film.

The above arrangement however necessitates the use of a prism for projection (Plate 4, Fig. 1), but this creates the advantages that the operator standing behind the machine looks directly at the picture while adjusting the arc with one hand and turning the crank with the other, also that for showing lantern slides the lamp-box may be freely swung at right angles to the position it occupies for motion picture projection.

The use of one pair of gears greatly simplifies the mechanical construction of the machine and the cost of manufacture is therefore reduced.

The spool in the lower film box upon which the film is wound is connected with the gearing of the machine by an elastic belt made of a fairly soft wire spring. This belt maintains a constant tension.

The picture is "framed" on the screen by means of a small slide arranged in front of the film aperture and moved by a light lever.

The advantages of the applicant's machine are its portability (it weighs but eighteen pounds complete), its simplified construction, and also its safety.

On account of the extremely small amount of heat falling on the film, the latter may be stopped at any desired point and any separate picture on it may be projected on the screen for some minutes without any danger of the celluloid catching fire. This has hitherto not been possible with any motion picture projection apparatus employing celluloid film.

The ability to analyse motion is an important consideration and has many unique applications, as studying the circulation of the blood, etc.

Eighteen years ago the applicant exhibited a commercial motion picture projecting machine which he termed the "Phantascope". This was recognized by the Institute and subsequently proved to be the first successful form of projecting machine for the production

of life-size motion pictures from a narrow strip of film containing the successive phases of motion. Since that time he has been actively engaged in the development of principles in the motion picture art, and as the outcome of three years' work has evolved the machine under consideration.

He has been granted two U. S. Patents for features of this new machine and has four other patents pending.

In recognition of the value of this invention, the Institute recommends to the Philadelphia Board of Directors of City Trusts the award of the John Scott Legacy Medal and Premium to C. Francis Jenkins, of Washington, D. C., for his Motion Picture Apparatus.

Walton Clark President

R. B. Owens Secretary

J. A. Crowfield Chairman of the Committee on Science and the Arts.

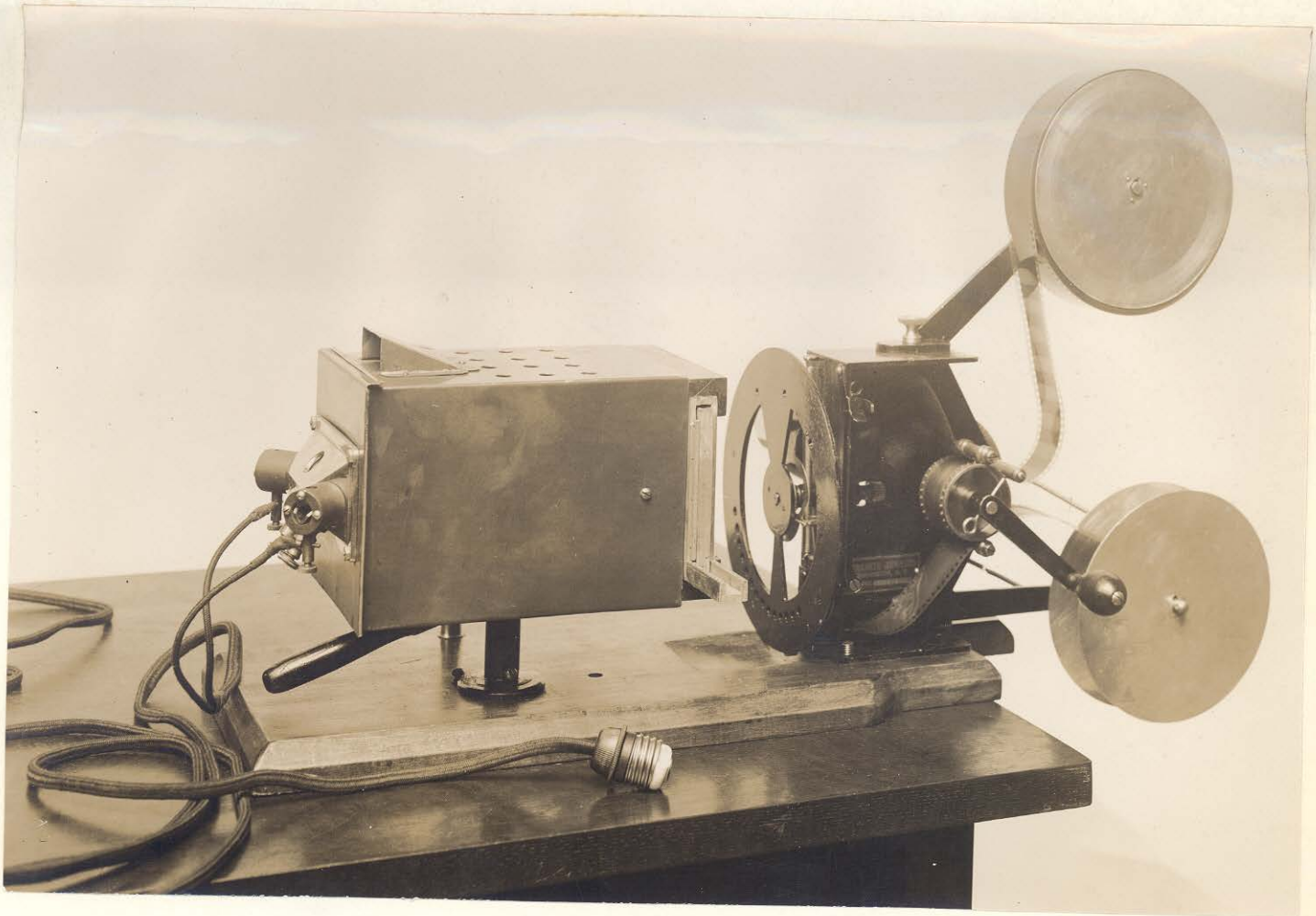

Plate 1.

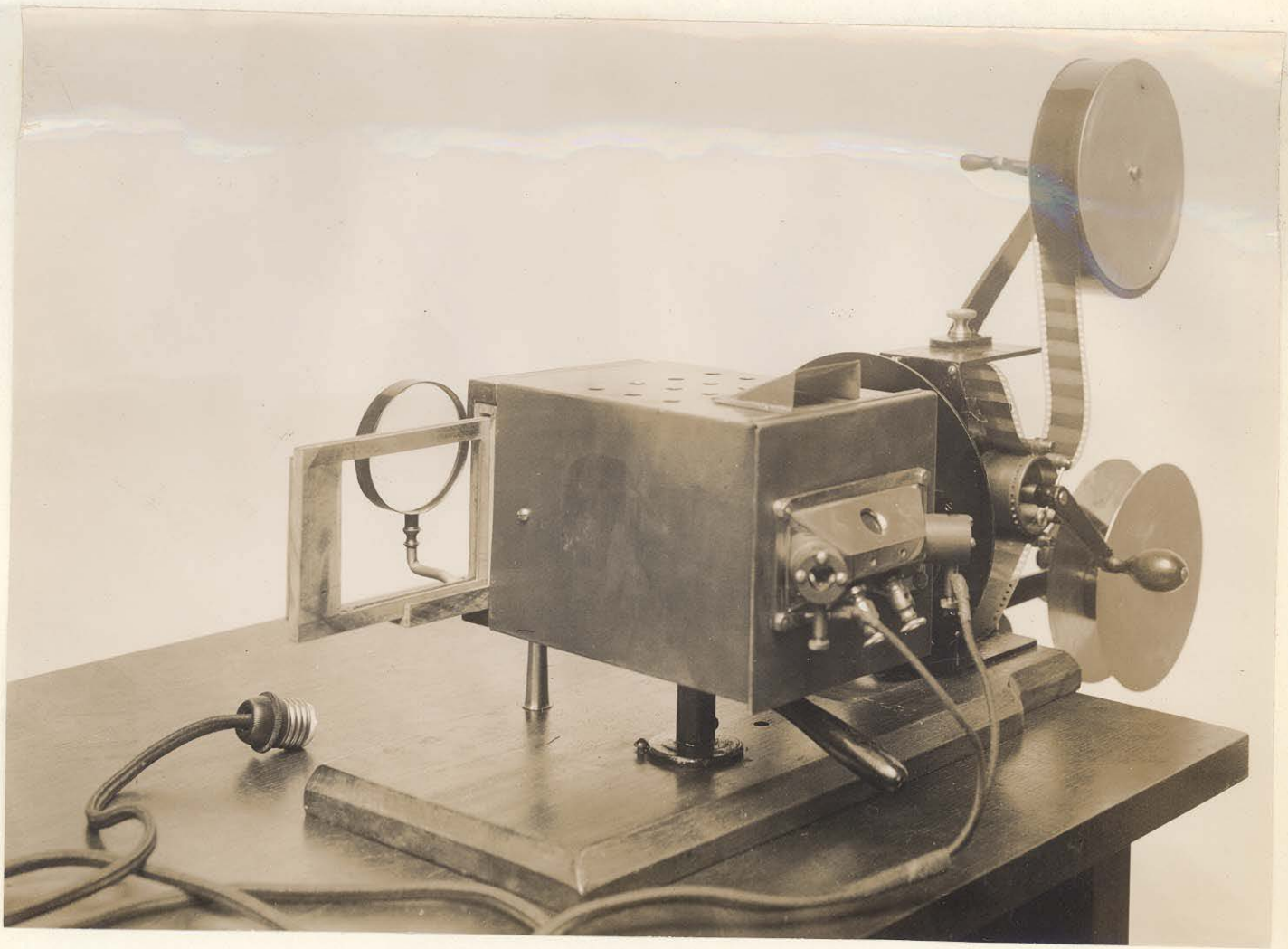

Plate 2.

Fig. 1.

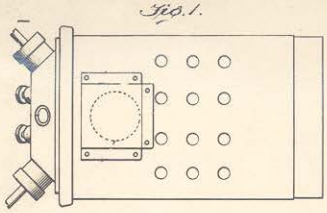

Fig. 2.

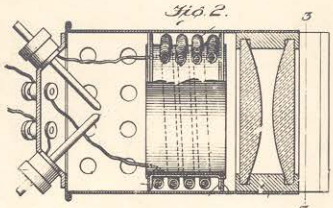

Fig. 3.

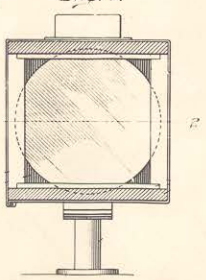

Plate 3.

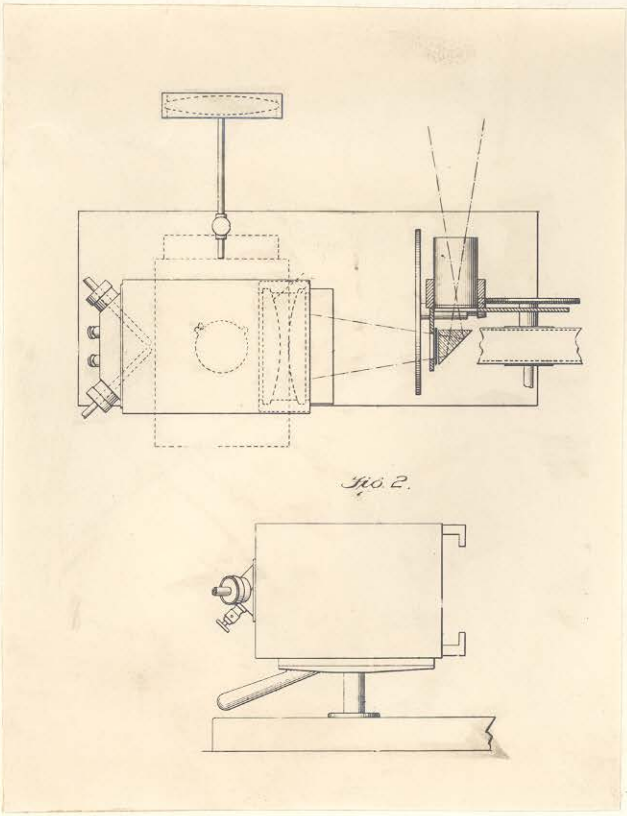

Fig. 2.

Plate 4.

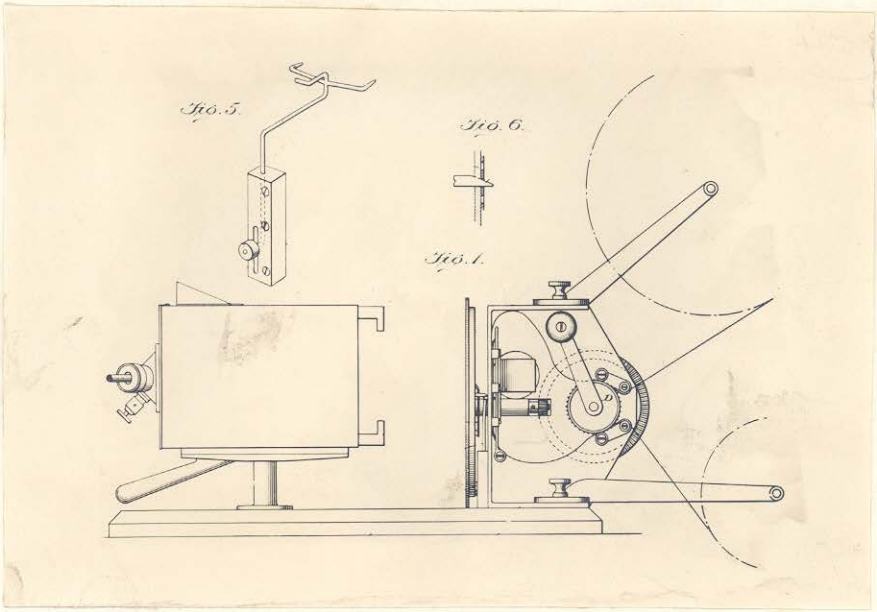

Plate 5.

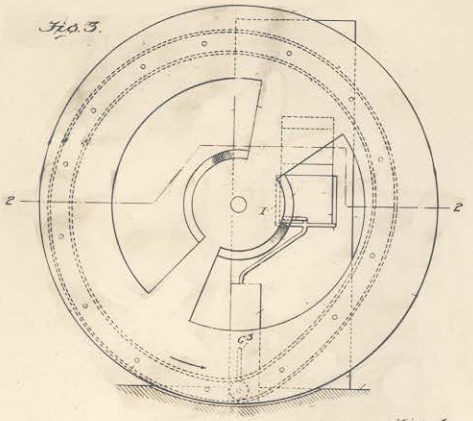

Plate 6.

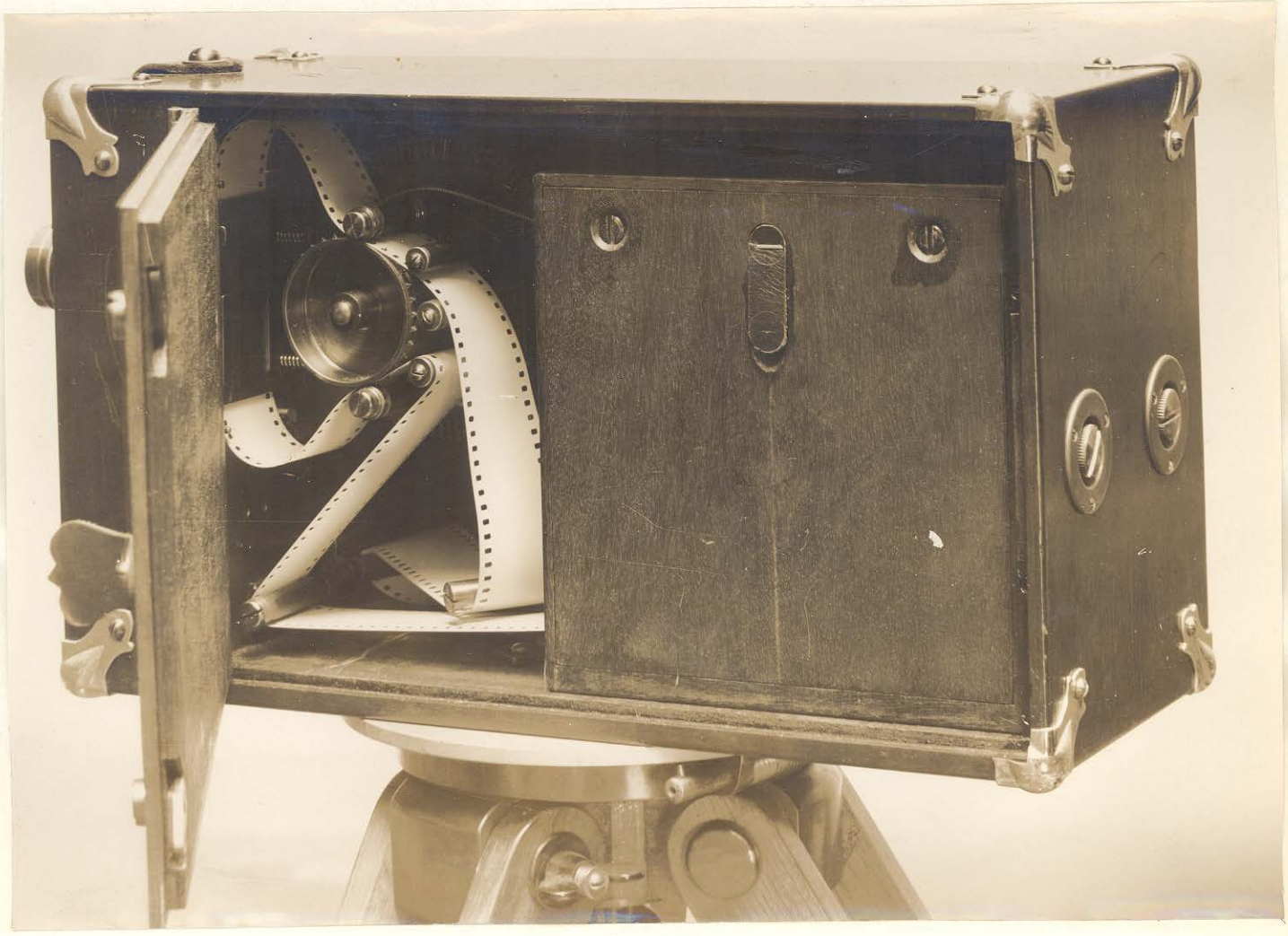

Plate 7.