(No Model.)

4 Sheets—Sheet 1.

# T. ARMAT.

## VITASCOPE.

No. 578,185.

Patented Mar. 2, 1897.

Fig. 1.

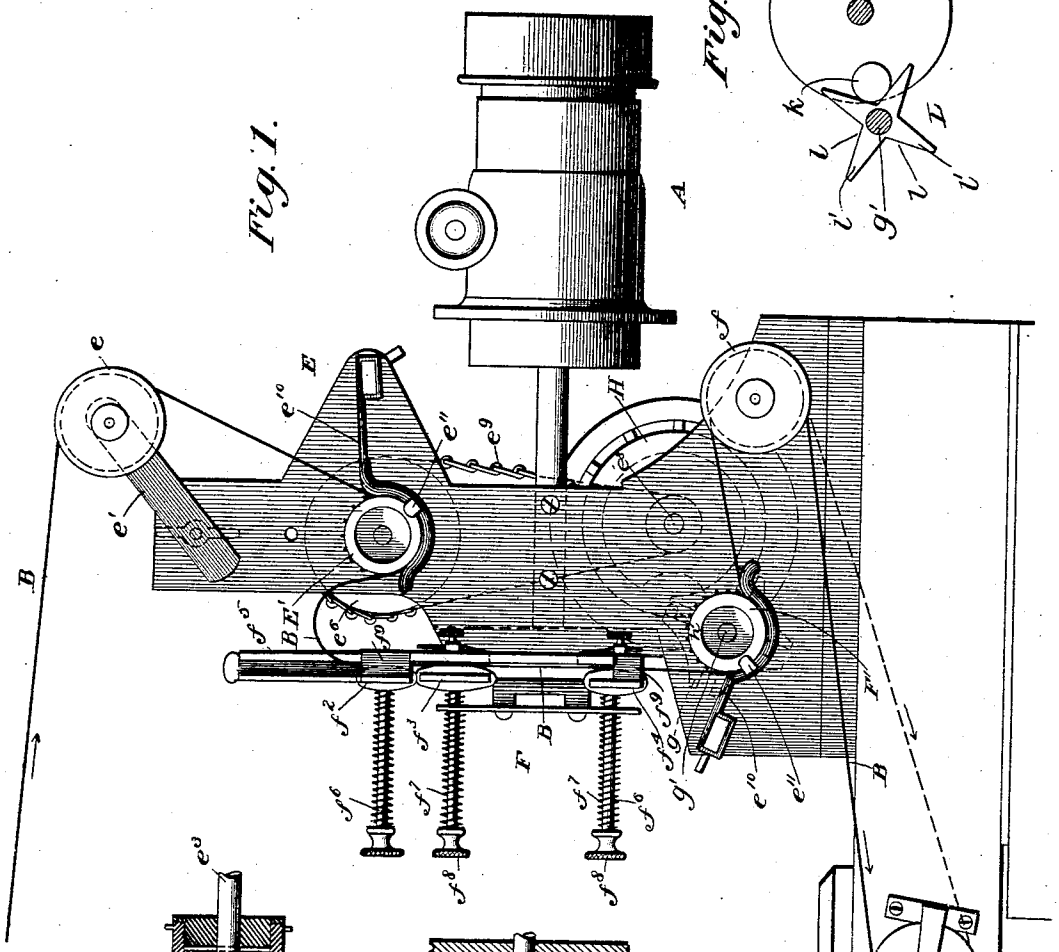


Fig. 13.

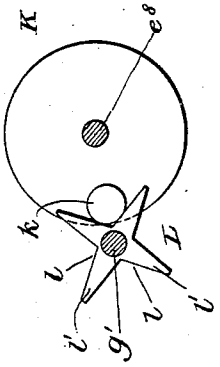


Fig. 3.

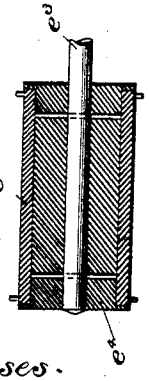
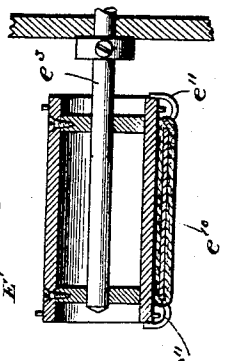


Fig. 2.



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## VITASCOPE.

No. 578,185. Patented Mar. 2, 1897.

*Fig. 4.*

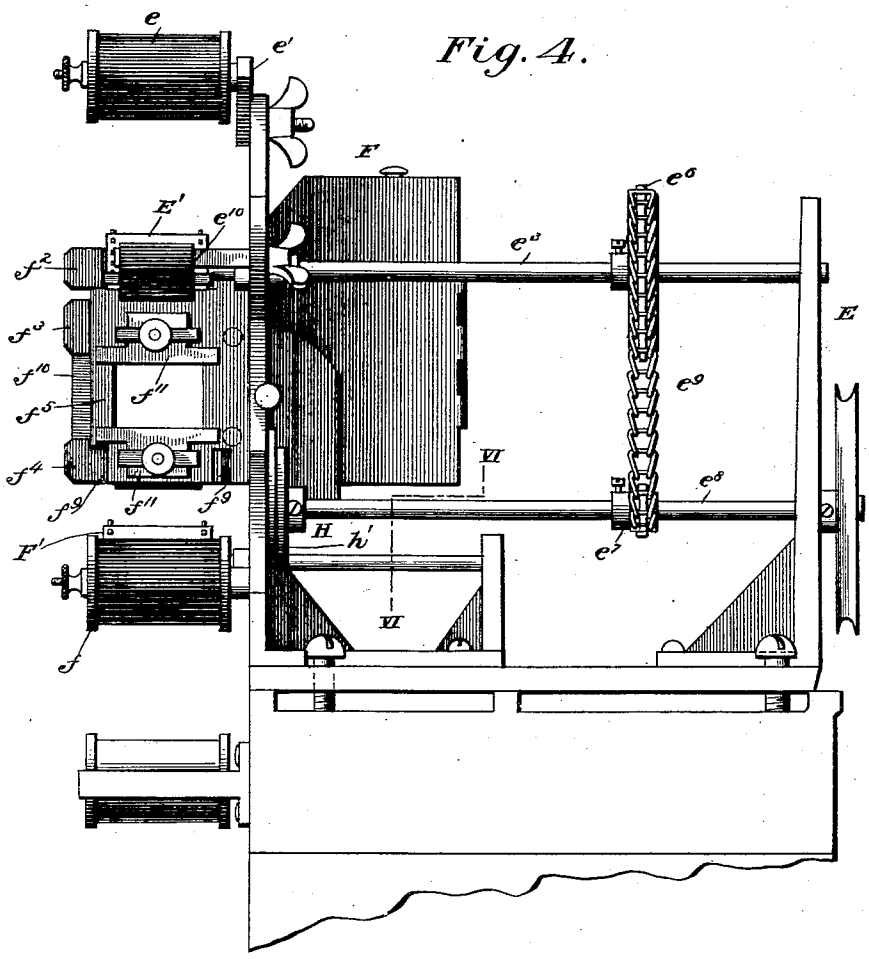



*Fig. 5.*

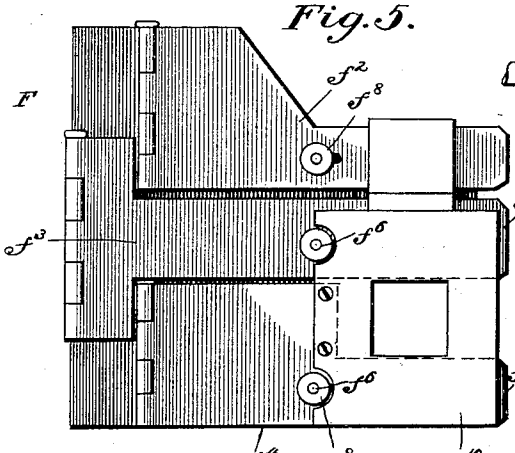



*Fig. 6.*

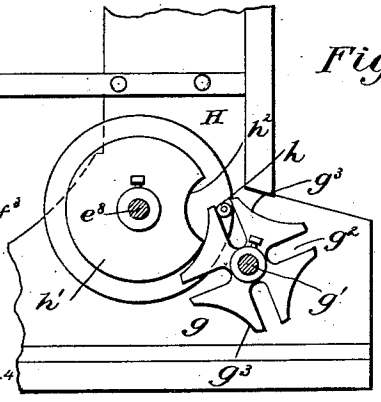
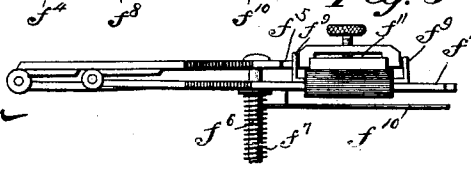



*Fig. 5a*

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No. 578,185. Patented Mar. 2, 1897.

Fig. 7.

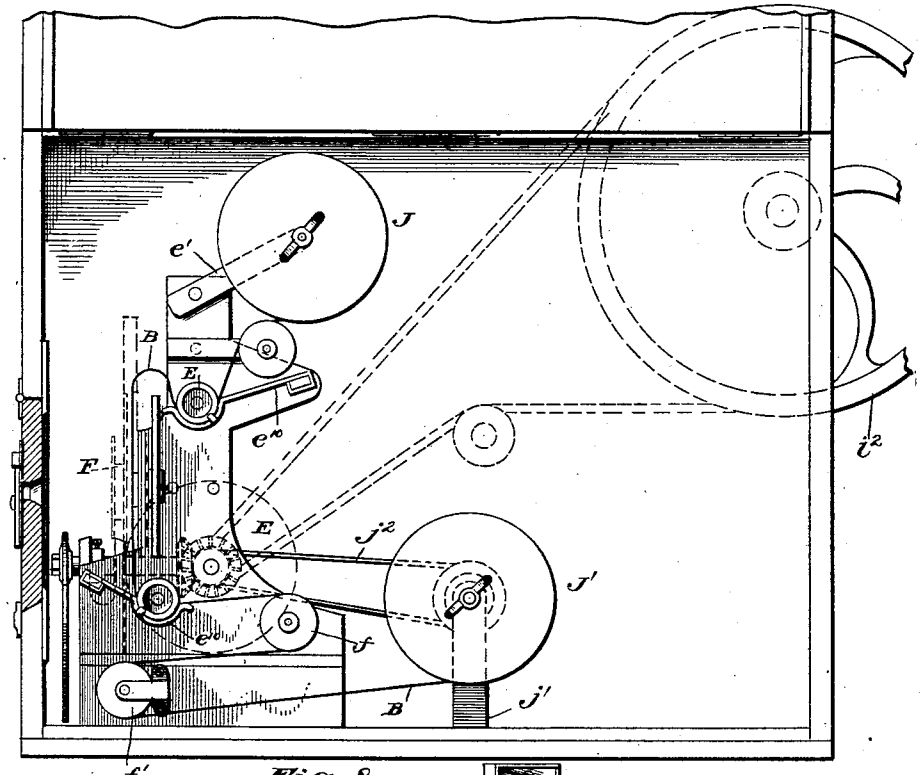



Fig. 8.

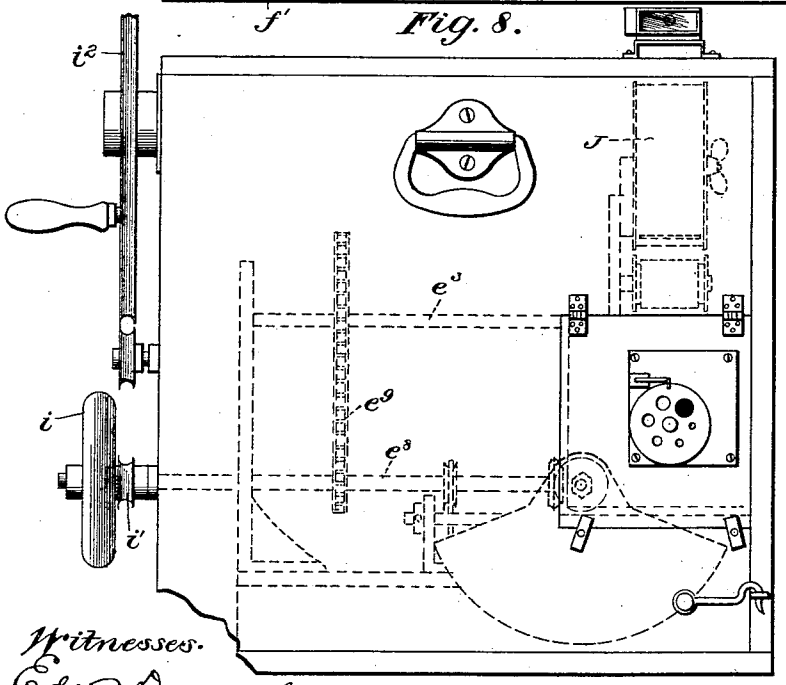
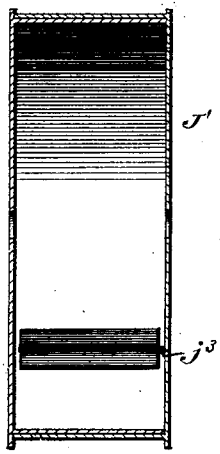



Fig. 9.

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(No Model.) 4 Sheets—Sheet 4.

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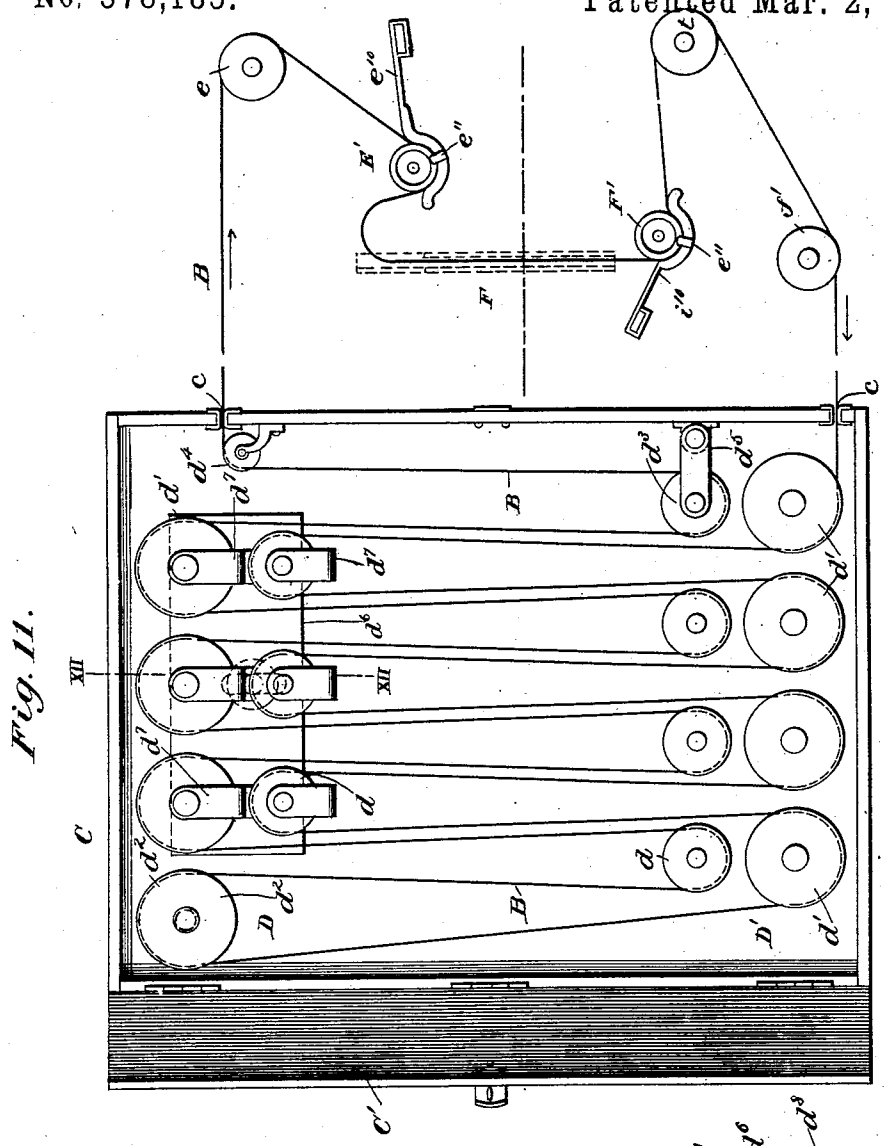


Fig. 11.

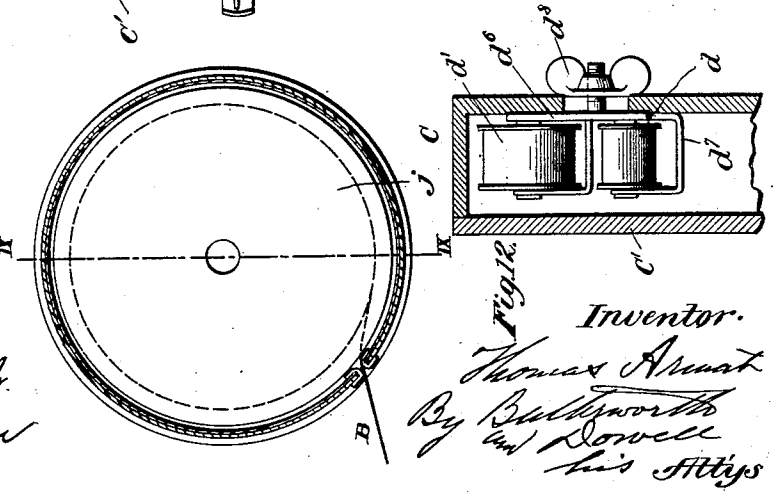


Fig. 10.

Fig. 12.

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# UNITED STATES PATENT OFFICE.

THOMAS ARMAT, OF WASHINGTON, DISTRICT OF COLUMBIA.

## VITASCOPE.

SPECIFICATION forming part of Letters Patent No. 578,185, dated March 2, 1897.

Application filed September 26, 1896. Serial No. 607,058. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS ARMAT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Vitascopes; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to apparatus for exhibiting pictures, but more particularly to that class of picture-exhibiting apparatus disclosed in my pending application, Serial No. 579,901, filed February 19, 1896, in which the impression is given to the eye of objects in motion.

The primary object of the invention is to provide improved and efficient means whereby a series of photographic or other pictures showing successively the different positions or attitudes assumed by a person or object in motion may be displayed in such a manner as to reproduce to the eye the appearance of the moving object through all the phases of such movement with a life-like and unblurred effect.

Another object is to provide simple and efficient mechanism for intermittently moving the film or band forming the picture-carrying surface, so as to successively place the objects thereon in position for reproduction, without liability of slipping and not moving the film the proper distance on account of the variations in its thickness or otherwise and without liability to injury from the knocking and jarring of the mechanism which is incident to the means usually employed or injury to the film by unnecessary strain and wear thereon.

Further objects are to provide simple and efficient mechanism capable of being also used in a photographic camera, to provide a tension and guiding device which will avoid the necessity of exerting a great pressure upon the film and which will instantaneously engage the film and hold the same in its proper position without flexing or puckering at the point of exposure, and to provide simple and efficient means for holding the film while being operated.

With these and other objects in view the invention consists in the construction and combination of the several parts, substantially as hereinafter described, and then pointed out in the claims at the end of the description.

Referring to the accompanying drawings, forming a part of this specification, Figure 1 is a side elevation of a portion of an apparatus for reproducing pictures from a picture-carrying surface, illustrating my improved mechanism for operating and controlling the movements of the picture-carrying surface. Fig. 2 is a longitudinal section of one of the film-operating drums and the yielding pressure and guiding arm, and Fig. 3 is a detail longitudinal section of a modified form of drum. Fig. 4 is a rear elevation, on a smaller scale, of the film-operating mechanism and tensioning device with the projecting lens removed. Figs. 5 and $5^a$ are a detail front elevation and plan, respectively, of the tension and guiding device. Fig. 6 is a fragmentary vertical sectional view, taken on the line VI VI of Fig. 4, illustrating in elevation the mechanism for operating one of the drums so as to intermittently move the film. Fig. 7 represents the interior of a camera casing or box with the mechanism in position for operating a photographic film. Fig. 8 is a front elevation of the camera-box, illustrating in elevation one means for imparting movement to the film-operating mechanism. Fig. 9 is a transverse vertical section of a casing or inclosure for containing the film-reel, the reel and film being removed. Fig. 10 is a longitudinal sectional view of the film-containing casing with the reel therein in position for use. Fig. 11 represents in side elevation, partly diagrammatic, a preferred arrangement of the film and support and casing or inclosure therefor. Fig. 12 is a vertical sectional view taken on the line XII XII of Fig. 11, and Fig. 13 is a vertical sectional view of a modified form of mechanism for intermittently operating the drum.

In this apparatus, like that shown in my pending application above referred to, the picture is exposed for projection a much longer time than is required to displace it and substitute another in its stead, thus prolonging the period of illumination very greatly as compared with the period of interruption or change, and there is no necessity for obstruc-

tion of the light by the interposition of a shutter or opaque substance across its path, so that the impression of the picture on the eye is so much longer and more permanent than the distortion or shadow effect incident to its movement, and the interval of change or interruption is so infinitesimal that the image of the picture is readily retained until displacement and substitution takes effect, and owing to the inability of the eye to receive an impression from every phase of motion the interruption or change is wholly imperceptible, and the result is a most vivid appearance of an object in motion, otherwise unchanging, clearly exhibiting all the phases of such motion with life-like effect. This I accomplish by improved mechanism for moving the film or other picture-carrying surface intermittently in such a manner that the interval of exposure and illumination of the picture shall so far exceed the interval of time required to effect a change as to enable the eye to receive a perfect impression or image at each exposure and to retain it through the interval of motion or change and until another picture has been superimposed, as it were, upon the one displaced, thus taking advantage both of the inability of the eye to receive an impression of movement exceeding a certain rapidity and upon that faculty of the eye which enables it to retain an impression after each phase or view of the object has vanished—the persistence of vision—which enables me to change the pictures one for another imperceptibly, so as to give to the eye the impression of objects in motion.

In practice I employ, as usual, an illuminator and a condensing-lens (not shown) adapted to concentrate the rays of light upon a picture located in the focus of an objective lens A, the latter, as well as the illuminator and condensing-lens, being of the usual or of any preferred construction and being arranged in any suitable manner. The strip or film B may be composed of any suitable transparent or translucent flexible substance adapted to provide a surface for carrying pictures produced thereon by photographic or other means, the several pictures in the series representing, successively, different positions of a moving object, so that the rapid exhibition of the entire series of pictures in the order in which they were made or taken may result in the reproduction of the appearance of the moving object in every phase of its motion. This film may be either an endless or a continuous band and supported upon rollers or in any other suitable manner, but I prefer to make the film endless and arrange the same as shown in Fig. 11. In this case a box or inclosure C is provided with a lid or cover C′, preferably partly or wholly of glass, so as to permit the interior of the box or casing to be readily seen, and slots or guiding portions *c* through which the film may pass, said guiding portions being provided with a soft covering of suitable material to prevent injury to the film during its rapid movement into and out of the casing.

Within the casing are arranged an upper and a lower bank of rollers or spools D D′, respectively, each comprising two series or rows of rollers of any desired number and of different diameters, the smaller rollers *d* being interposed between the outer or larger rollers *d′*. The smaller rollers of each bank are preferably arranged in the same vertical plane as the larger rollers, so as to provide a number of pairs according to the length of the film it is desired to inclose within the casing, and the rollers of one bank are directly opposed to the spaces between the rollers of the other bank, so that the film may be made to pass successively around or partially around the larger rollers of one of the banks and the smaller rollers of the other bank, as D′ and D, respectively, and then to the initial roller $d^2$ of the bank D to the initial smaller roller of the bank D′, and so on successively through the series of rollers to the last roller $d^3$ of the bank D′ and then over a guide-roller $d^4$, arranged adjacent to the upper guiding portion or slot *c* of the casing or box C, though it is to be understood that the reverse of this winding may take place, as from the smaller rollers to the larger, or there may be provided more than two banks of rollers if desired.

One of the rollers of the bank D′, preferably roller $d^3$, may be journaled upon an arm, as $d^5$, which has one end pivoted to the casing, so as to permit free upward and downward movement of the roller, said roller being of sufficient weight, or independently weighted, to provide sufficient tension on the film to take up any slack therein, while either or both of the banks or a number of the rollers thereof may be made adjustable, as, for instance, the three pairs of rollers of the bank D. These adjustable rollers or spools may be journaled upon spindles extending outwardly from a base-plate $d^6$, the outer ends of these spindles being supported in preferably L-shaped brackets $d^7$, extending outwardly from the base-plate on the side opposite to where the film passes around the rollers. The other rollers of each bank, except the tension-roller $d^3$, are also preferably journaled in similar brackets, which may be secured to the casing or secured to or formed integrally with a plate held or arranged in the casing in any suitable manner.

The base-plate of the adjustable rollers is provided with an outwardly-extending stem or bolt which passes through a slot arranged in the casing and has a nut $d^8$ arranged on its outer end adapted to rigidly bind the base-plate to the casing in various adjustments. By this means a very long film may be protected and arranged in a very compact space, so as to be readily fed into and out of the inclosure or casing and provision made so as to compensate for varying lengths of film.

The film B may pass from the casing C to a roller or idler *e*, Fig. 1, journaled in

a bracket or arm $e'$, suitably held upon the frame E, and then around the lower surface of a feed-drum E'. This drum may be of any suitable construction, but preferably consists of a light hollow casing, as aluminium, provided with teeth or projections for engaging perforations or apertures in the film, and fitted over or upon and rigidly secured to one or more collars arranged upon a shaft $e^3$, as shown in Fig. 2, or said drum may consist of a hard-rubber spool or other body portion $e^4$, secured to the shaft $e^3$, over which is forced a soft-rubber band or ring $e^5$, so as to be rigidly held between the outer flanges of the spool, as shown in Fig. 3, the band $e^5$ being provided with teeth or projections for engaging the apertures in the film. The shaft $e^3$ may be journaled in any suitable manner in the frame E, and may be provided with a sprocket-wheel $e^6$, which is connected to a sprocket-wheel $e^7$ on the driving-shaft $e^8$ by a chain $e^9$, or operated from said driving-shaft in any other preferred manner, so as to constantly rotate the feed-drum E' and feed the film. To one side of this feed-drum may also be placed an arm $e^{10}$, adjustably held to the frame, if desired, and provided with a curved spring or yielding portion adapted to bear underneath the film and press it gently against the periphery of the drum, so that the teeth will engage the perforations and prevent its slipping, the arm being preferably covered with plush or other soft material to prevent wearing or injuring the surface of the film, and with fingers or projections $e^{11}$, adapted to engage the edges of the film and aline the same, and to prevent enlarging or otherwise injuring the perforations or apertures in said film.

Owing to the rigidity or stiffness of the film it will be caused to move or be carried upwardly and outwardly a short distance away from the drum E' and its point of contact with the yielding portion of the arm $e^{10}$, so as to provide constant slack in the film at this point, and then with a return-bend it may pass in a substantially straight line through the tension and guiding device F, and thence around the drum F', (which may be similarly constructed to the feed-drum E' and provided with a similar pressure and guide arm,) from which the film may pass around an idler $f$, and thence around another idler or roller $f'$, as shown in full lines in Fig. 1, or in the manner indicated in dotted lines in said figure or in Fig. 11, when the casing therein shown is employed; both the rollers $f$ and $e$, as well as the others, if desired, being provided with a layer of plush or soft material to prevent injury to said film.

As a means for tensioning and frictionally holding the film so as to permit the series of pictures thereon to be brought successively into the illuminated field and retained therein for exposure for a predetermined time I preferably provide the tension device with three yielding members $f^2$, $f^3$, and $f^4$, though, of course, a greater number may be employed. These yielding members are each independently hinged or pivoted to a stationary member $f^5$, which is adapted to be rigidly secured to the frame E, and have their outer portions provided with a covering of soft material, as plush, overlying a yielding body, as rubber, if desired, so as to frictionally hold the film against the stationary member and prevent wear of the film, a layer of leather or other material being arranged upon the stationary member, so as to form an opposed bearing-surface for the film. A series of stems or bolts $f^6$ project outwardly from the stationary member $f^5$, each of which pass through an aperture in one of the yielding or hinged members and have a spiral spring $f^7$ interposed between the outer surface of each member and a nut $f^8$ arranged upon the outer end of said stem or bolt, so as to vary the pressure of each spring in order to exert the desired pressure upon the film. The members $f^2$ and $f^4$ have guides $f^9$, Figs. 1 and $5^a$, passing through recessed portions of the stationary member, so as to engage the edges of the film and aline the same as it passes through the tension device, while upon the lower member $f^4$ a plate $f^{10}$ may be provided to protect the film from the heat of the illuminator and provide a space for the circulation of air between said plate and the film, so as to keep the latter cool. This plate is provided with an opening adapted to register with an opening in the stationary member or plate $f^5$, so as to permit exposure of the pictures carried by the film, the stationary member being preferably provided with one or more adjustable plates $f^{11}$, Fig. 4, for varying the size of the opening therein according to the position of the pictures or objects to be exposed relative to the perforations in the film, as the pictures on different films do not always occupy the same position with reference to the apertures or perforations.

The upper member $f^2$ preferably exerts less pressure than the other members and serves the double purpose of a brush to keep the film free from dust and to assist in holding the film so as to provide slack above the tension device and prevent flexing or puckering of said film at the point of exposure.

By providing three or more yielding members the tension of each member on the film may be greatly diminished, and at the same time the prompt action of one or more of the members is secured the instant the film has moved the desired distance.

For the purpose of intermittently moving or feeding the film or picture-carrying surface in such manner as to cause the series of pictures thereon to be brought into and permitted to remain in the illuminated field for an interval of time exceeding the time required to effect the displacement of any one picture and the substitution of another therefor, I prefer to employ a wheel or disk $g$, Figs. 1 and 6, which is secured to the shaft $g'$ of

the drum F′, preferably immediately inside of the upright or standard of the frame. This wheel or disk is provided with radial slots or recesses $g^2$, preferably four in number, extending to the periphery of said wheel, and may have depressed or concaved portions $g^3$ between the slots, so as to provide a wheel or disk substantially of the form of a Maltese cross.

Adjacent to the wheel $g$ and preferably secured to the driving-shaft $e^8$ is a rotating element H, provided with a lateral projection $h$, on which may be arranged a roller adapted to successively enter the slots or recesses $g^2$ and engage portions of the wheel, so as to intermittently move the latter when the element H is rotated. The element H may also be provided with a disk or circular plate $h'$, having a portion thereof recessed, as at $h^2$, to permit the wheel $g$ to rotate while engaged by the projection $h$, but which will engage the depressions in said wheel by its periphery as soon as the projection leaves any one of the slots, so as to cause the slots or recesses in the disk to always register with said projection and to hold the wheel and drum F′ stationary for an interval of time in excess of the interval of time of each movement of said drum, the shafts $e^3$ and $e^8$ being so timed relatively to each other that the feed-drum E′ and the drum F′ will move the film the same distance in the same interval of time. It is to be understood, however, that a separate disk or wheel provided with concave depressions may be secured to the shaft $g'$ or arranged to rotate therewith and properly positioned with respect to a slotted disk and that a separate circular plate or disk may be provided for engaging these depressions, the latter being also rotated and positioned with respect to the projection $h$ of the rotating element. The rotating element is preferably of greater diameter than the wheel $g$ in order that said wheel may be rotated the required distance and be held stationary as long as possible relatively to the time occupied by each movement. This arrangement permits very small and light film-moving drums to be employed, and, as will be seen, the projection $h$ will gradually enter and leave the slots or recesses in the disk $g$, so as to gradually start and stop said drums, thus greatly removing the strain from the film incident to the necessarily instantaneous motion thereof, and furthermore provides an intermittently-operated drum which constantly engages the film, so as to prevent the possibility of the film slipping by reason of variations in its thickness.

The operation of the invention will be readily understood from the foregoing description when taken in connection with the accompanying drawings.

The parts being in the position shown in Figs. 1 and 11 and the driving-shaft $e^3$ operated by an electric motor or in any other suitable manner, so as to rotate the shaft $e^3$ and the feed-drum E′ at the proper speed, the film B will be moved in the direction indicated by the arrows, but the pressure exerted by the tension device F will hold the film stationary with the exposed picture in the field of illumination for a predetermined time, so as to provide sufficient slack in the film at the bend thereof above said tension device to permit a rapid movement of a given length sufficient to displace any one of the pictures in the series and permit another to be brought into position for exposure or reproduction. When the object has been held in the field of illumination the proper interval of time, the projection $h$ enters one of the slots in the disk $g$ and rotates said disk and the drum F′ and moves the film so as to displace the exposed picture and bring another into the field of illumination, the yielding members of the tension device permitting the film to be forced or drawn downward, but the instant the drum F′ ceases to rotate one or more of said members will engage the film and prevent further movement thereof until the drum is again rotated. The projection $h$ is so arranged that it carries the wheel or disk $g$ a part of a revolution equal to the distance between any two slots or recesses, in this case one-fourth of a revolution, and simultaneously with the exit of said projection from any one slot the periphery of the circular plate or disk $h'$ engages the depressions or concave portions $g^3$ of said disk, so that the drum F′ will be held perfectly stationary in order to permit each phase or position of the object to be held in the field of illumination the proper interval of time and the next slot placed in position for the projection $h$ at the next rotation of the element H. During this interval of time the slack in the film between the drum F′ and the idler $f$ will be gradually drawn into the box or inclosure C by the feed-drum E′, but not at such a speed as to exert a tension or pulling strain upon the drum F′, and in the same instant of time, while the picture is being exhibited, the slack in the film between the tension device and the drum E′, which has been partially or wholly taken up by advancing the film, will be compensated by an additional amount of slack paid out by said latter drum, thus providing sufficient slack ahead of the tension device to permit the next succeeding picture to be brought quickly into the field of illumination. This operation will be repeated in regular sequence, the greater portion of the film being caused to move continuously, while that portion thereof which lies between the two drums is intermittently moved forward just far enough to expose a picture at each move, the interval of illumination of the picture being made to exceed the interval of movement or change preferably very greatly. In this manner the pictures on the picture-carrying surface or film may be successively displaced and substituted one for another with great rapidity, so that in exhibiting a series of similar pictures representing the same moving

object in different phases of its motion the impression may be given to the eye of persons or objects in motion and with a vivid and life-like appearance. I thus provide simple and efficient means for positively engaging and operating the film, so that it may be moved the proper distance for exposing the successive pictures without liability to slipping due to the varying thickness of the film and without the knocking and jolting of the machinery incident to the necessarily rapid movement of the parts or unnecessary strain and wear upon the film. Also simple means are provided for tensioning and guiding the film and for placing and adjustably holding the film in a comparatively small space.

The film-operating mechanism may be used to advantage in a photographic camera, as shown in Figs. 7 and 8. The camera may be of the usual or of any preferred form, and the driving-shaft $e^8$ may be provided with a fly-wheel $i$ and a sprocket or pulley wheel $i'$, adapted to have motion imparted thereto by a belt or chain connecting said pulley or sprocket wheel to a much larger hand-wheel $i^2$, so as to permit very rapid movement of the film, though any other suitable means may be employed for rotating the driving-shaft. In this case, and in some instances with a reproducing apparatus, the film is wound upon a suitable reel and held in a casing or closure J, supported upon the arm $e'$, instead of the idler $e$, and after passing around the idler or roller $f'$ the film is passed backward and wound upon a reel $j$, Fig. 10, journaled within a casing J'. This latter casing is mounted and rigidly held upon a support, as at $j'$, and the reel on which the strip is to be wound is rotated by a slip-belt $j^2$ or by any other suitable frictional gearing. Each of these casings or closures, Figs. 9 and 10, preferably comprise two telescopic members adapted to be removably held together by friction or otherwise, and has a pin or shaft on which the reel $j$ is loosely journaled or to which the reel is secured, so as to rotate therewith. The members of each casing are provided with slits $j^3$, adapted to register with each other and permit the film to be wound upon or from the reel contained therein, the slits being provided with a suitable covering to prevent abrading the surface of the film. Such casings protect the film from light or exposure in a photographic apparatus and protect it from dust and the like when used in a reproducing apparatus.

Instead of the mechanism shown in Figs. 1 to 8, inclusive, for intermittently operating the drum and film I may provide a disk or wheel, as shown in Fig. 13. In this case the rotating element K has a lateral projection $k$, adapted to enter the slots or recesses $l$ and engage portions or arms $l'$ of the wheel L at each revolution thereof, so as to rotate said wheel and the drum F' the proper distance. The disk or circular plate $h'$ and the engaging portions therefor for positively holding the drum stationary and alining the slots or recesses for the projection $k$ both in this and in the preferred form may be dispensed with and the tension device utilized for stopping the film the instant the projection $k$ ceases to rotate the wheel and film-engaging drum.

In some instances I may provide an inclosure or casing for the mechanism and arrange a mirror at an angle and at a convenient distance from the projecting lens, so as to reflect the rays upward and backward upon a screen located above the mechanism in order to secure as large a picture as possible within a compact space when it is desired to place the apparatus in public places for exhibition by using coin-actuated mechanism or otherwise.

While, as described, the pictures are brought successively into an illuminated field and each picture illuminated without interruption from the instant it enters such field until displaced by the next picture in the series, I do not desire to be confined to the use of the invention without a shutter, inasmuch as such a device might be used under some circumstances, as, for instance, when constructed so as to interrupt the illumination only at that instant of time when the film is moving and without rendering the interruption perceptible to the eye.

It is obvious that the film may be fed to the tension device by other means than the use of a feed-drum and taken up by other means than that shown, that certain parts of the apparatus may be dispensed with or others substituted therefor, and that some parts of the operating mechanism and other parts of the apparatus may be employed with either a photographic or reproducing apparatus without departing from the spirit of my invention.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination with a film or strip, of a tension device for yieldingly holding said film, a drum engaging the film, a wheel or disk provided with projections or portions forming a series of peripheral recesses, and a rotating element provided with a projection adapted to successively enter the recesses and engage a portion of the wheel at each revolution so as to intermittently rotate the drum and move the film with a gradual start-and-stop motion, whereby a very small and light drum may be employed and a positive intermittent motion imparted to the film so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

2. The combination with a film or strip, of a tension device for yieldingly holding said film, a drum engaging the film, a wheel or disk provided with peripheral slots or recesses, and a rotating element provided with a lateral projection adapted to successively enter the slots or recesses and engage a portion of the wheel at each revolution so as to

intermittently rotate the drum and move the film through the tension device, whereby a very small and light drum may be employed and a positive intermittent motion imparted to the film so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

3. The combination with a film or strip, of a tension device for yieldingly holding said film, a drum engaging the film, a wheel rotating with said drum and provided with peripheral slots or recesses, a rotating element provided with a lateral projection adapted to successively enter the slots and engage portions of the wheel during a small portion of each revolution so as to intermittently rotate the drum and move the film through the tension device, and means for holding the drum and slotted wheel stationary during the greater portion of each revolution of the rotating element and for alining said wheel so as to permit the projection to readily enter the slots, whereby a very small and light drum may be employed and a gradual start-and-stop intermittent motion imparted to said drum so as to avoid racking and jolting of the machinery and unnecessary wear and strain upon the film, substantially as described.

4. The combination with a film or strip, of a tension device, a drum engaging the film so as to draw or force the same past said tension device, a peripherally-slotted wheel rotating with the drum and provided with concave depressions between said slots, a rotating element provided with a lateral projection adapted to enter the slots and engage portions of the wheel so as to intermittently rotate the same, and a disk or circular plate having a recessed portion adapted to engage the depression in the slotted wheel, whereby a very light and small drum may be employed and a gradual start-and-stop intermittent motion imparted to said drum so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

5. The combination with a film or strip, of a tension device, a drum engaging the film so as to draw or force the same through said tension device, a peripherally and radially slotted or recessed disk or wheel rotating with said drum and provided with concave depressions between said slots, a rotating element provided with a projection adapted to successively enter the slots and engage portions of the wheel so as to intermittently rotate the same, and a disk or circular plate having a peripheral recessed portion positioned with respect to the projection so as to permit rotary motion of the slotted wheel and having its periphery adapted to engage the depressions in said slotted wheel so as to hold the drum stationary for an interval of time in excess of the interval of rotation, whereby a very light and small drum may be employed and a gradual start-and-stop intermittent motion imparted to said drum so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

6. The combination with a film or strip, of a feed-drum engaging the film so as to impart movement thereto when rotated, mechanism for rotating said drum, a tension device through which the film passes, a second drum engaging the film so as to move the film forward through said tension device, a peripherally-slotted wheel rotating with said latter drum and provided with concave depressions between said slots, a rotating element of greater diameter than the slotted wheel provided with a lateral projection adapted to enter the slots and engage portions of the wheel so as to intermittently rotate the same, and a recessed disk or circular plate having its periphery adapted to engage the depressions in the slotted wheel so as to intermittently hold said wheel stationary, whereby a very light and small drum may be employed and a gradual start-and-stop intermittent motion imparted to said drum so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

7. The combination with a film or strip, of a feed-drum engaging the film so as to impart movement thereto when rotated, a tension device through which the film passes, mechanism for constantly rotating the drum so as to provide slack on one side of the tension device, a second drum engaging the film so as to move said film forward through said tension device, a peripherally-slotted wheel rotating with said latter drum and provided with concave depressions between said slots, a rotating element comprising two disk-like portions, one of which has a lateral projection adapted to enter the slots and engage portions of the wheel so as to intermittently rotate the same, and the other with a peripherally-recessed portion located adjacent to the projection so as to permit rotary motion of the slotted wheel and having its periphery adapted to engage the depressions in said slotted wheel so as to intermittently hold said wheel stationary, whereby a very light and small drum may be employed and a gradual start-and-stop intermittent motion imparted to said drum so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

8. The combination with a film or strip, of a tension device, a drum engaging the film so as to draw or force the same past the tension device, a peripherally-slotted wheel rotating with said drum and provided with concave depressions between said slots forming a substantially Maltese-cross-shaped wheel, a rotating element provided with a lateral projection adapted to enter the slots and engage portions of the wheel so as to intermittently

rotate the same, and a recessed disk or circular plate adapted to engage the depressions in the slotted wheel so as to intermittently hold the drum stationary, whereby a very light and small drum may be employed and a gradual start-and-stop intermittent motion imparted to said drum so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

9. The combination with a film or strip, of a feed-drum engaging the film so as to impart movement thereto when rotated, a shaft to which said drum is secured, a tension device for holding the film, a second drum engaging the film so as to draw or force said film past the tension device, a peripherally-slotted wheel rotating with said drum, a rotating element provided with a lateral projection adapted to enter the slots and engage portions of the wheel so as to intermittently rotate the same, means for intermittently holding the slotted disk and drum stationary for intervals of time in excess of the intervals of rotation, a shaft to which the rotating element is secured, together with a sprocket-wheel and chain connection between this latter shaft and the feed-drum shaft so as to be simultaneously operated, whereby simple operating mechanism and a very light and small drum may be employed and a gradual start-and-stop intermittent motion imparted to said drum so as to avoid racking and jolting of the mechanism and unnecessary wear and strain upon the film, substantially as described.

10. The combination with a film or strip and means for intermittently moving the same so as to successively expose the pictures thereon, of a tension device provided with three or more yielding parts or members for holding the film so as to insure prompt action of one or more of said members the instant the film has moved the desired distance, substantially as described.

11. The combination with a film or strip and means for imparting movement to the same, of a tension device provided with three or more independent spring-pressed members or parts for yieldingly holding the film so as to insure prompt action of one or more of said members the instant the film has moved the desired distance; the upper member exerting less pressure than the others and serving to act as a brush to clear the film of dust as well as to exert tension on said film, substantially as described.

12. The combination with a film or strip, of a tension device comprising a stationary member, three spring-pressed members arranged one above the other and adapted to yieldingly press the film against said stationary member, and guides arranged upon the upper and lower members for alining the film; said upper member exerting less pressure upon the film than the other members and serving also as a brush to free the film from dust, substantially as described.

13. The combination with a film or strip, of a tension device, means for intermittently moving said film so as to impart a step-by-step movement thereto, and mechanism for feeding the film so as to provide slack therein between the same and said tension device; said tension device being provided with three yielding parts or members for holding the film so as to insure prompt action of one or more of said members the instant the film has moved the desired distance, substantially as described.

14. The combination with a film and means for operating the same so as to successively expose a portion thereof, of two or more banks of spools or rollers around which the film passes, each comprising two series or rows of rollers of varying diameters forming a series of pairs, the banks being opposed to each other, and the rollers of one bank opposed to the spaces between the rollers of the opposite bank, so that the film may pass around the larger rollers of one bank to the smaller rollers of the other bank successively, and then around the larger rollers of the latter bank to the smaller rollers of the first-mentioned bank in a similar manner, whereby a great length of film may be arranged in a very compact space, substantially as described.

15. The combination with an endless film and means for operating the same so as to successively expose a portion thereof, of a casing or closure provided with a cover or lid and guiding-slots through which the film may pass, and two banks of spools or rollers around which the film passes, each comprising two series or rows of rollers of varying diameters forming a series of pairs, the banks being opposed to each other and the rollers of one bank opposed to the spaces between the rollers of the opposite bank, so that the film may pass around the larger rollers of one bank to the smaller rollers of the other bank successively, and then around the larger rollers of the latter bank to the smaller rollers of the first-mentioned bank in a similar manner, whereby a great length of film may be arranged and protected in a very small space, substantially as described.

16. The combination with an endless film, and means for operating the same so as to successively expose a portion thereof, of a casing or closure provided with a cover or lid, guiding-slots through which the film passes, a guide-roller for the film arranged adjacent to one of the guiding-slots, and two banks of spools or rollers around which the film passes, each comprising two series or rows of rollers of varying diameters forming a series of pairs, the banks being opposed to each other and the rollers of one bank opposed to the spaces between the rollers of the opposite bank, so that the film may pass around the larger rollers of one bank to the smaller roll-

ers of the other bank successively, and then around the larger rollers of the latter bank to the smaller rollers of the first-mentioned bank in a similar manner; said banks having two or more of their rollers adjustable and one of the rollers journaled in an arm pivoted to the casing, whereby long and varying lengths of film may be arranged and protected in a very compact space, substantially as described.

17. In a device of the character described, a drum comprising a body portion and a covering of soft rubber provided with projections adapted to engage apertures or perforations in a film and serve as an abutting or engaging surface therefor, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS ARMAT.

Witnesses:

CHARLES E. RIORDON,

J. A. E. CRISWELL.