L. L. THURSTONE.

MACHINE FOR PRODUCING FLICKERLESS MOVING PICTURES.

APPLICATION FILED MAY 20, 1909.

982,904. Patented Jan. 31, 1911.

4 SHEETS—SHEET 1.

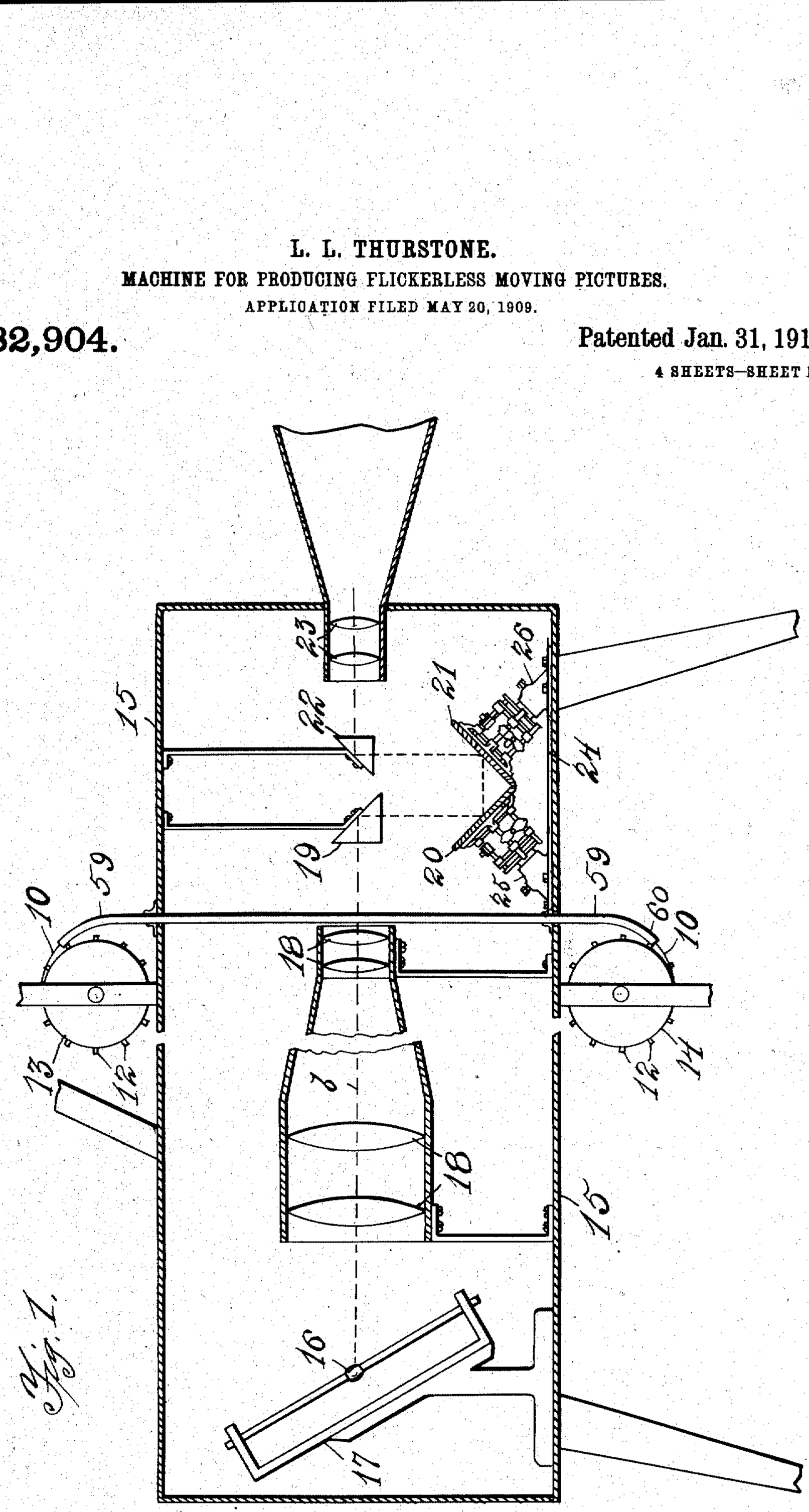

Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 2.

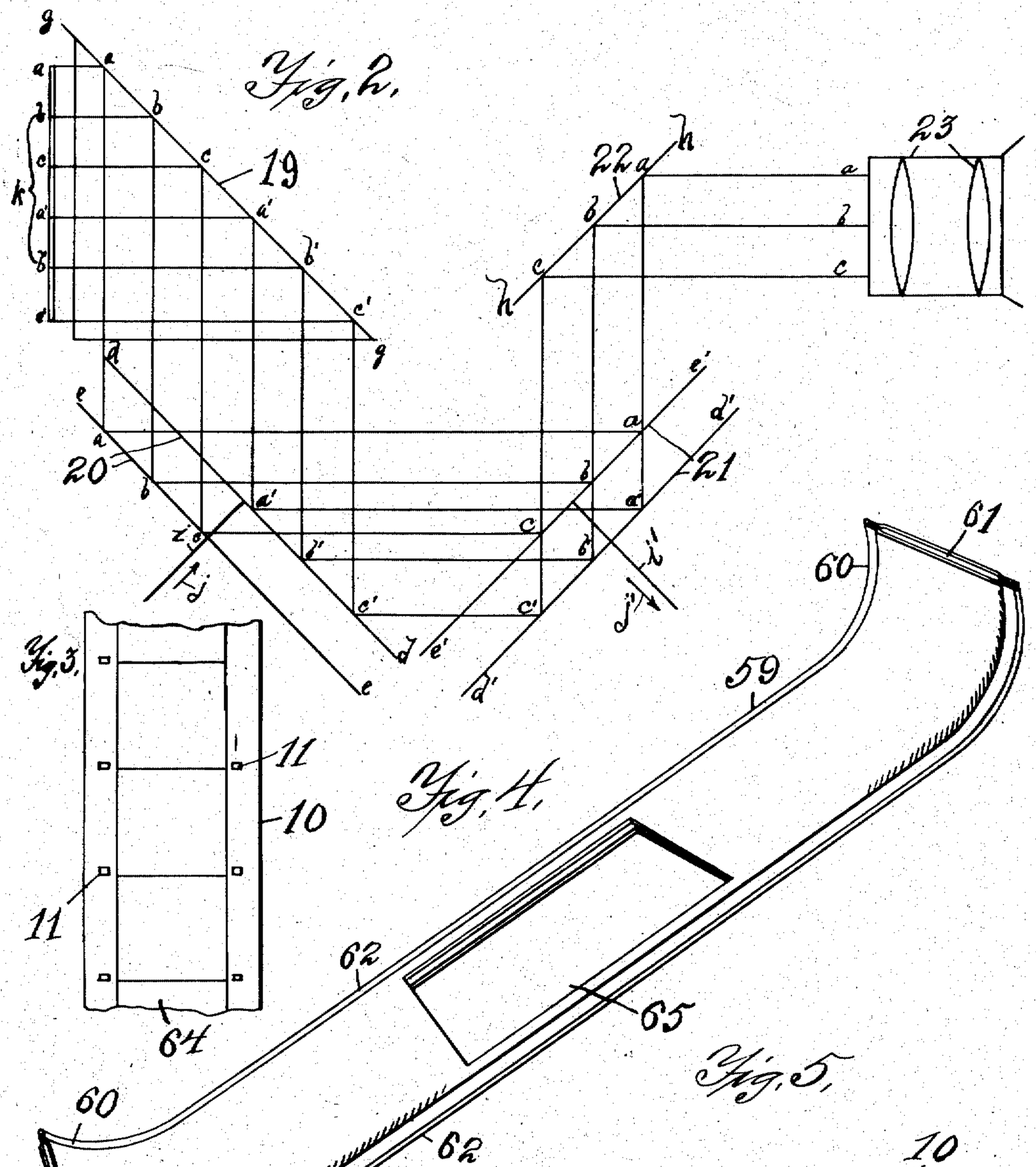
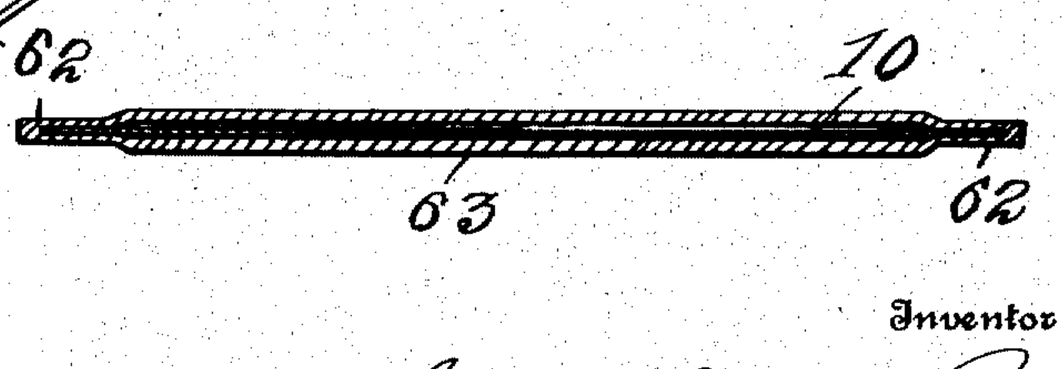


Fig. 3.

Fig. 4.

Fig. 5.



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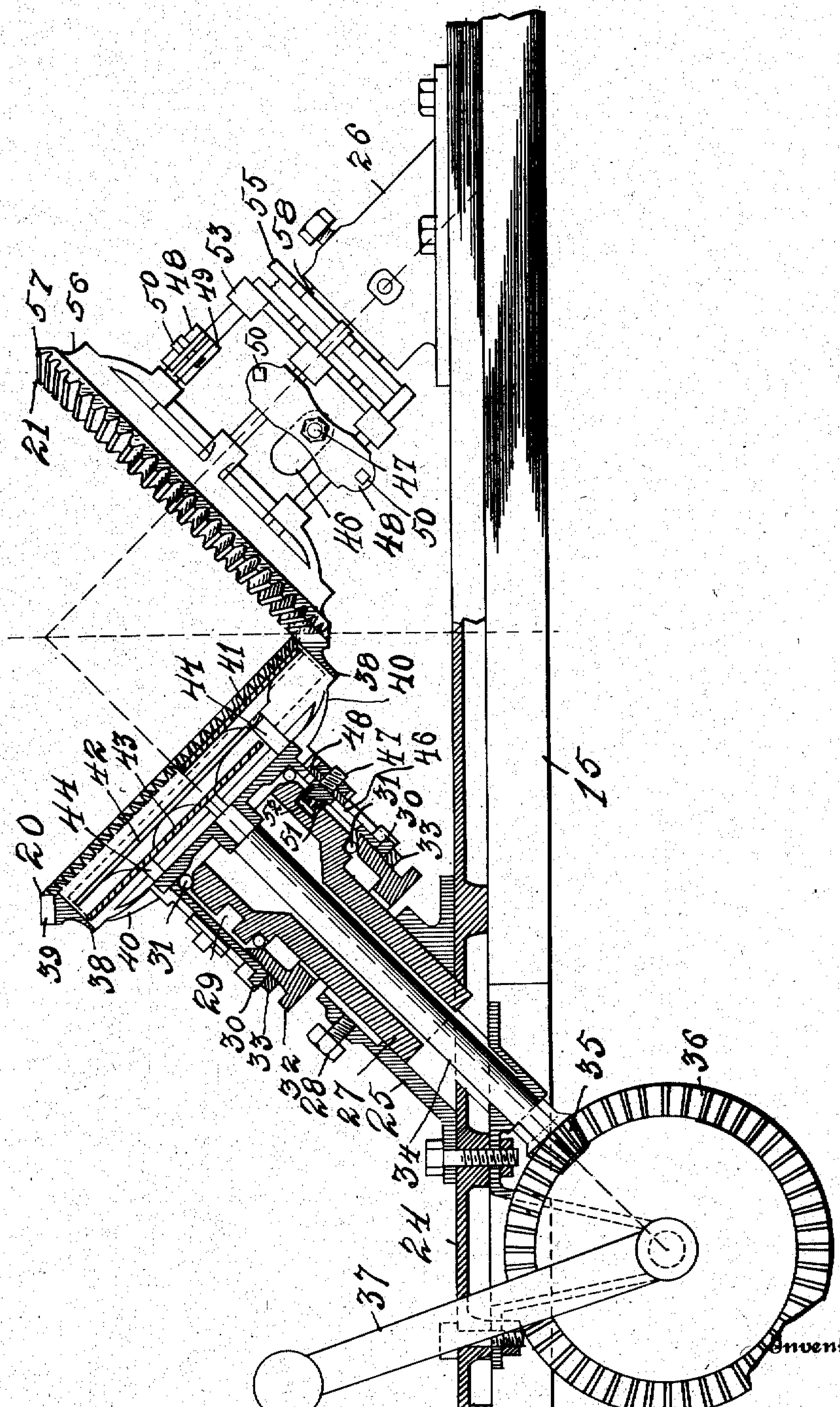
4 SHEETS—SHEET 3.

Fig. 6.



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4 SHEETS—SHEET 4.

Fig 7

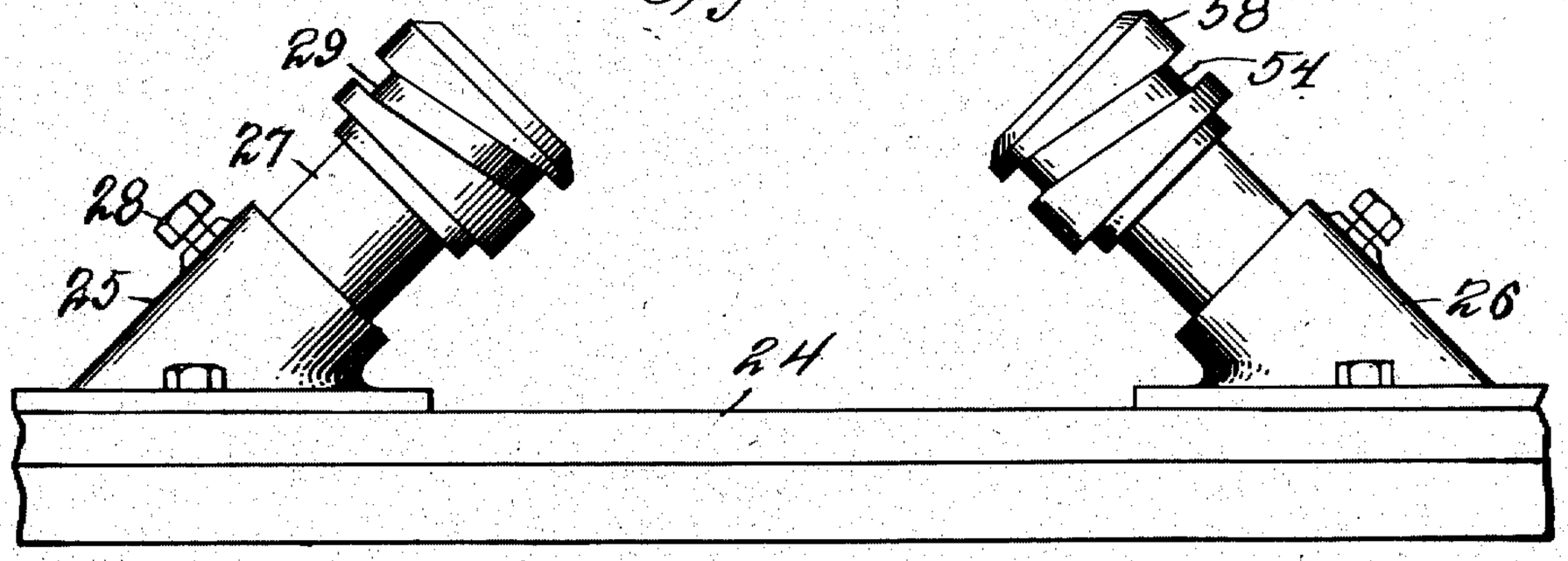


Fig. 8.

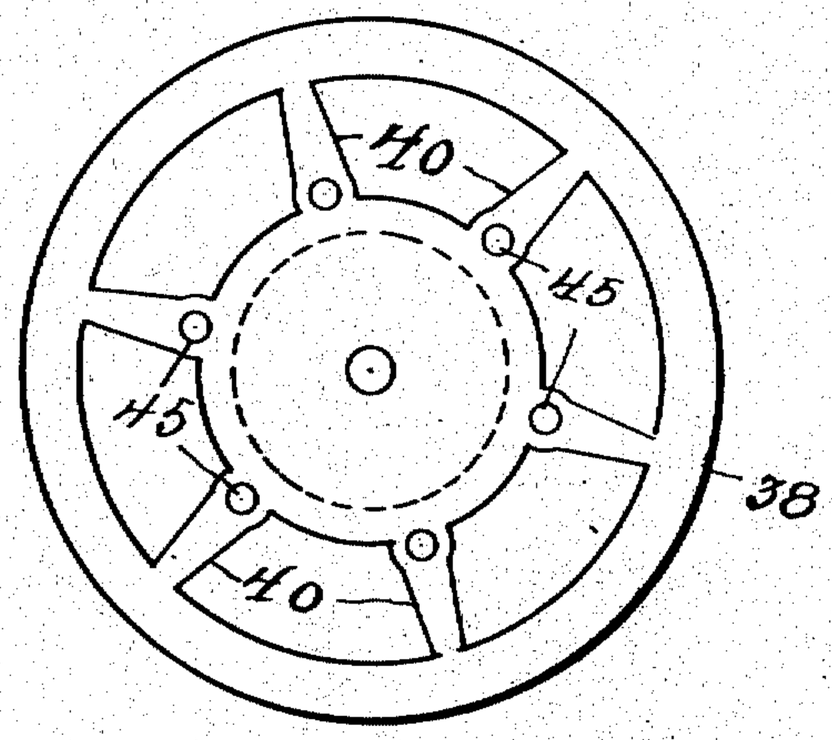
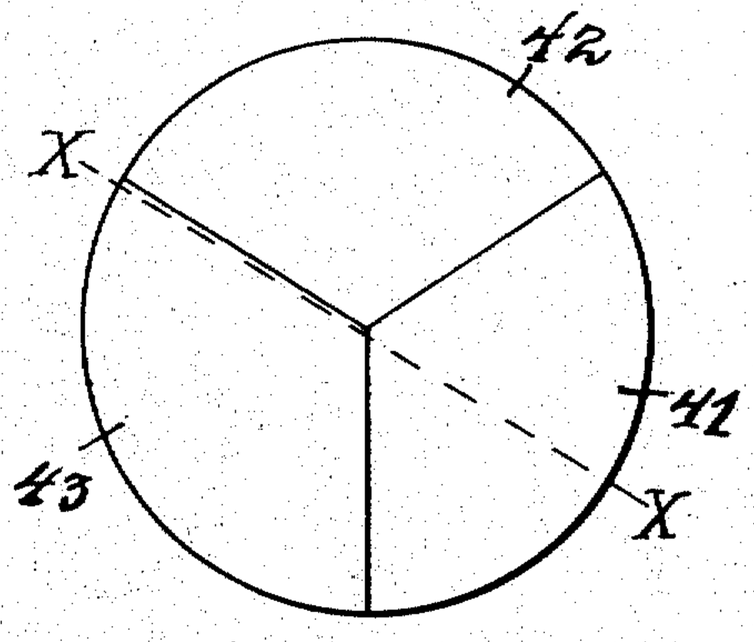


Fig. 9.



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UNITED STATES PATENT OFFICE.

LOUIS L. THURSTONE, OF JAMESTOWN, NEW YORK.

MACHINE FOR PRODUCING FLICKERLESS MOVING PICTURES.

982,904. Specification of Letters Patent. Patented Jan. 31, 1911.

Application filed May 20, 1909. Serial No. 497,147.

To all whom it may concern:

Be it known that I, LOUIS LEON THURSTONE, a citizen of the United States, residing at Jamestown, county of Chautauqua, and State of New York, have invented a new and useful Machine for Producing Flickerless Moving Pictures, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

The invention relates to machines for projecting moving pictures and is an improvement upon my former moving picture mechanism, as shown in my application, Serial Number 466,988; and the object of the present improvement is to provide, first, a shutterless moving picture mechanism which more perfectly projects the moving pictures upon the screen; second, to provide mechanism to reduce the vibration in the moving pictures by providing a rotary instead of an intermittent reflecting mechanism, which rotary mechanism allows an absolutely uniform movement of the film instead of the usual intermittent movement, thereby greatly reducing the wear upon the film perforations and providing an absolutely flickerless living picture on the screen by making the picture continuous instead of intermittent, every point of the picture on the screen being continuously illuminated by its particular detail of the picture.

In the drawings Figure 1 is a sectional view of the lamp house showing the arrangement of the projecting mechanism. Fig. 2 is a diagram showing the manner in which the projection of the continuously moving film is accomplished. Fig. 3 is a plan view of a portion of an ordinary picture film record. Fig. 4 is a perspective view of the film guide showing the arrangement and construction of the same with the central opening through which the pictures are projected; and Fig. 5 is a crosswise sectional view of the film guide with the film therein. Fig. 6 is a side elevation partly in section, the mirrors at line X X in Fig. 9 showing the arrangement of the revolving mirrors and the mechanism for revolving the same. Fig. 7 is a side elevation showing the supports for the revolving mirrors as they incline toward one another and showing the slot cams encircling each of said supports which cams give the axial movement to the revolving mirrors. Fig. 8 is a plan view of the cylindrical cap and bevel gear showing the support for the mirrors. Fig. 9 is a plan view of the three sector shaped mirrors which are revolved upon different planes by the same mechanism.

Similar numerals refer to corresponding parts in the several views.

The numeral 10 indicates the continuous picture film which has the spaced perforations 11 along the edge for the purpose of engaging the film cogs 12 on the rolls 13 and 14 for uniformly moving said film from one roll to the other. A thin flat tubular guide 59 is made, as shown in Fig. 4 for film 10 to pass through. The ends 60 curve toward the rolls 13 and 14, the length of the guide 59 being sufficient to place the open ends 61 opposite the rolls 13 and 14. The edges 62 of tube 59 are contracted so as to fit fairly closely upon the edges of the film 10 yet allowing said film edges to slide through, while the sides of the central portion 63 of the tube are sufficiently far apart to preclude the possibility of the central picture portion 64 of the film 10 ever coming in contact with the inner sides of the guide 59. It is apparent that should the picture portion 64 ever rub against the side of the guide it would scratch the pictures and ruin the film. Accordingly the contracted edges 62 are arranged centrally lengthwise and fit so closely on to the edges of the film 10 that the central portion 64 will never be in danger of marring. An opening 65 is provided in the center of guide 59 through which the pictures are projected, and preferably extending over more than two pictures.

The numeral 15 indicates a box or lamp house which has suitable supports. A light, preferably an arc light 16 is adjustably mounted on a support 17. Lenses 18 for condensing and for rendering the rays from light 16 parallel are supported in suitable supports within box 15 so that the light from the arc light 16 passes through said lenses. Film 10 passes through box 15 before said lenses in guide 59 so that said light passes through said film to a stationary mirror or forty-five degree prism 19. The light is then reflected from mirror 19 into the revolubly mounted mirrors 20 and by mirrors 20 into the opposite angled revolubly mounted mirrors 21 and from said mirrors into the stationary mirror or prism 22 and thence out through objectives 23 to the screen.

It is apparent that in order to allow a

uniform movement of the film 10 and project an absolutely flickerless single ray from light 16 through a series of pictures, it is essential that the deflecting mirrors shall be placed upon different planes and move from one plane to another in order to accomplish this projection—the rotatable mirrors 20 and 21 are provided for this purpose, and the rotating mirror mechanism is arranged in the following manner: A firm base 24 is attached to the bottom of box 15 upon which a tubular pair of brackets 25 and 26 are attached by means of suitable screw bolts, which brackets incline toward one another at an angle of ninety degrees. A tubular cam head 27 is securely fastened by a suitable key 28 within bracket 25, which tubular head has the cam slot 29 extending around the same. A cylindrical cap or outer casing 30 is revolubly mounted on the outer end of cam head 27, preferably by means of suitable ball-bearings 31. A ring 32 has a retaining nut 33 and a raceway on its upper end, being screwed into the lower end of cap 30 which arrangement provides for the adjustment of both of the ball-bearings. Cap 30 is revolved by means of a shaft 34, which extends up through plate 24 and tubular cam head 27 to cap 30. The lower end of shaft 34 has a bevel gear 35, which meshes in bevel gear 36, which bevel gear 36 is revolved by means of crank 37, and suitable means for applying power thereto. The outer end of cap 30 supports a ring 38 which has thereon a bevel gear 39. Ring 38 is mounted upon the outer end of cap 30 by means of arms 40 at suitable distances. Within ring 38 the sector shaped mirrors 41, 42, and 43 are mounted upon suitable threaded rods 44 which rods are adjustable by screw threads in the upper end of cap 30 in holes 45, as shown in Fig. 8, there being six of the rods 44, thus allowing two rods for the support of each of the three sector shaped mirrors. This arrangement of rods 44 allows of an exact adjustment of both of the supporting rods 44 for each mirror so that its exact angle may be adjusted. It is apparent that the three mirrors will be fixed in their positions within ring 38 upon cap 30 and will turn with the said cap and that the light will be reflected consecutively from one to another in the manner hereinafter set forth.

Cylindrical caps 30 and 53, each have a lengthwise slot 46 in one side to receive therein a slot pin 47 which is constructed as follows: A plate 48 is provided which extends from one bolt 44 to the adjacent bolt on opposite sides of slot 46 and is clamped thereto by means of a suitable clamping piece 49 and screw bolts 50. The posts 44 of each individual mirror are slidingly held in a cap 30 and connected together by the bar or plate 48. Plate 48 has a hole through its center to receive the threaded end of slot pin 47 and is secured thereto by suitable nut. The inner end of pin 47 is provided with a revolubly mounted roller 51, which is adjusted by means of an end screw 52 upon pin 47, so as to take up the wear in slot 29.

A similar triple set of sector shaped mirrors 41, 42, and 43 are provided in the opposite revoluble reflector 21. Reflector 21 is constructed exactly similar to reflector 20 with cap 53 and ring 56, having a bevel gear 57 which meshes in bevel gear 39, and having ball-bearings which are adjusted upon the slot cam head 58 the same as ball-bearings 31 upon slot cam head 27, also having an adjusting ring 55 for the ball-bearings. A cam slot 54 is provided in head 58. The only difference in the construction between the two revoluble mirrors is that slot cam head 58 is not necessarily tubular as head 27, since mirror 56 is turned by the bevel gears 39 and 57 so that shaft 34 turns both mirrors.

The operation of the projecting mechanism is as follows: The light is projected as hereinbefore described and the action of the reflecting mirrors is shown in the diagram in Fig. 2. Their operation consists in the revolution of the shaft 34 by means of gear 36 and crank 37 which shaft turns cylindrical cap 30 around the slot cam head 27; the slot cam head 27 being stationary, the mirrors will be given a slight axial movement as they are rotated around the cam, the latter being computed from the size of the pictures used, the radius of the mirror employed and the number of mirrors on each shaft. The revolution of cap 30 turns gear 39 which revolves gear 57 on the similar cap 53 on the slot cam head 58. The preferable size of each picture on the film 10 is about three-fourths inch high and one inch wide, the central ray from the picture is represented by the line *b*. This ray is reflected in the large mirror or forty-five degree prism 19 in the plane *g*. Mirror 19 extends vertically over about two and one-half pictures. After being reflected in the mirror 19 in the plane *g*, the ray *b* continues in a downward vertical path to a segment of the revoluble mirror 20 in the plane *e* where it is again reflected to a horizontal path meeting the opposite segment of the revoluble mirror 21 in the plane *e'* which again reflects it to a vertical path and finally it is reflected in the mirror or prism 22 in the plane *h* to a horizontal path to the objective 23 and then to the screen. The film 10 moves vertically downward at a uniform speed and the mirror in the plane *e* moves in the slot cam in the direction of the arrow *j* along the axis *i* of shaft 34; the mirror *e'* moves in the direction of the arrow *j'* along the axis *i'*. The magnitude of the move-

ment of the two mirrors *e* and *e'* is the same in equal intervals of time, and is such that when the film moves uniformly downward a distance *k*, the planes of the mirrors *e* and *e'* are shifted a distance

$$\frac{k}{2\sqrt{2}}$$

in the direction shown by the arrows. The result of this is that when the film has moved downward a distance *k* as shown in the drawing the central ray *b'* is reflected in the mirrors in planes *g* and *e* and *e'*, the latter two having moved to the planes *d* and *d'* respectively in such a manner as to be reflected continually in the same point in the mirror *h* and to constantly occupy the same final direction and position when reaching the objective. The same is true of the rays from the edges of the picture which are represented by letters *a*, *a'*, *c*, *c'* respectively. It is evident that owing to this movement of the mirrors in planes *e* and *e'* the finally projected picture will appear absolutely stationary in spite of the fact that the film is continually in uniform movement.

It is natural that when one set of mirrors in planes *e* and *e'* have moved axially a suitable distance reflecting one picture, it is necessary to have a second set of mirrors to reflect a new picture to the screen. This second set of mirrors must enter the beam of light at an elevation identical with the starting point of the first set of mirrors. This is accomplished by withdrawing the mirrors in planes *d* and *d'* laterally, and simultaneously introducing, in a direction perpendicular to the plane of the paper, a second set of mirrors which enter the beam of light in the planes *e* and *e'* and are moved through the same planes and in a manner corresponding to the preceding set of mirrors. When each pair of mirrors has reflected its picture from the film it has moved to the planes *d* and *d'* in which planes the last edges of the mirrors leave the beam. It is evident that the lateral (perpendicular to the paper) movement, and the axial (arrows *j* and *j'*) movement take place simultaneously and not successively, which might be supposed. The method of accomplishing this movement of the mirrors is to mount three mirrors on each of two cam heads 27 and 58, to revolve the mirrors about their respective axes *i* and *i'* and thus accomplish the lateral movement, the axial movement being accomplished by means of two cams.

It should always be understood that the three mirrors 41, 42 and 43 which make up each of the revolving mirror heads 20 and 21 are constantly passing into and out of the beam or beams of light and that only one of said segments or mirrors 41, 42 or 43 is in the path of light at the same instant except when the beam of light is exactly on the dividing line between the two mirrors. This it will be recognized is only for an instant as the beam passes from one to the other. It is therefore apparent that the segments of the mirrors, as, for example 41 of each of the mirror heads 20 and 21, are simultaneously in the beam of light and that two pairs of mirrors in said mirror heads 20 and 21 are always out of the path of the beam of light, except, as above stated, when one pair is entering and another emerging from said beam.

I claim as new:

1. In a device of the character described, a reflecting mechanism consisting of a plurality of plane reflectors, means for revolving said reflectors, and means for moving each reflector in parallel planes.

2. In a device of the character described, means for producing a beam of light, reflectors angularly placed with relation to each other and each having several reflecting surfaces of mutually different elevations, and rotatable means for moving said mirrors into and out of the path of said beam of light.

3. In a device of the character described, means for producing a beam of light, a reflector in the path of said beam of light comprising plane mirrors having different elevations with respect to each other, and rotatable means for moving said mirrors into and out of said beam of light.

4. In a device of the character described, a slotted cam head, a reflector rotatably mounted on said slotted cam head, and means for turning said reflector.

5. In a device of the character described, slotted cam heads angularly placed with respect to each other, reflectors rotatably mounted on each of said slotted cam heads, and means for rotatably moving said reflectors on said cam heads.

6. In a device of the character described, slotted cam heads inclined toward one another, compound reflectors rotatably mounted on each of said slotted cam heads, intermeshing gear teeth on said reflectors, and means for turning said reflectors.

7. In a device of the character described, a tubular bracket, a slotted cam head adjustably mounted in said tubular bracket, a cap rotatably mounted on said slotted cam head, a roll on said cap engaging said slotted cam, sector shaped mirrors on said cap, and means for rotatably moving said cap on said cam head.

8. In a device of the character described, a tubular bracket, a slotted cam head adjustably mounted in said tubular bracket, a cap rotatably mounted on said slotted cam head, a roll on said cap engaging said slotted cam, screw rods on said cap, sector shaped mirrors adjustably mounted on said screw rods, and means for turning said cap on said cam head,

substantially as and for the purpose specified.

9. In a device of the character described, a tubular bracket, a tubular slotted cam head adjustably mounted in said tubular bracket, a cap rotatably mounted on said slotted cam head, a roll on said cap engaging said slotted cam, screw rods on said cap, sector shaped mirrors adjustably mounted on said screw rods, a shaft extending up through said base and tubular slotted cam head to turn said cap, and gearing and a crank for turning said shaft, substantially as and for the purpose specified.

10. In a device of the character described, a base, a tubular pair of brackets inclined toward one another and attached to said base, a slotted cam head adjustably mounted in each of said tubular brackets, caps rotatably mounted on said slotted cam heads with ball-bearings, rollers on said caps engaging said slotted cam, threaded rods mounted in said caps, mirrors mounted on said threaded rods on said caps, intermeshing beveled gears on said caps, and suitable means for turning one of said caps, substantially as and for the purpose specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

L. L. THURSTONE.

Witnesses:
JARED T. NEWMAN,
FLORA M. HARNEY.