June 21, 1932. A. S. HOWELL 1,863,657

PHOTOGRAPHIC PRINTING MACHINE

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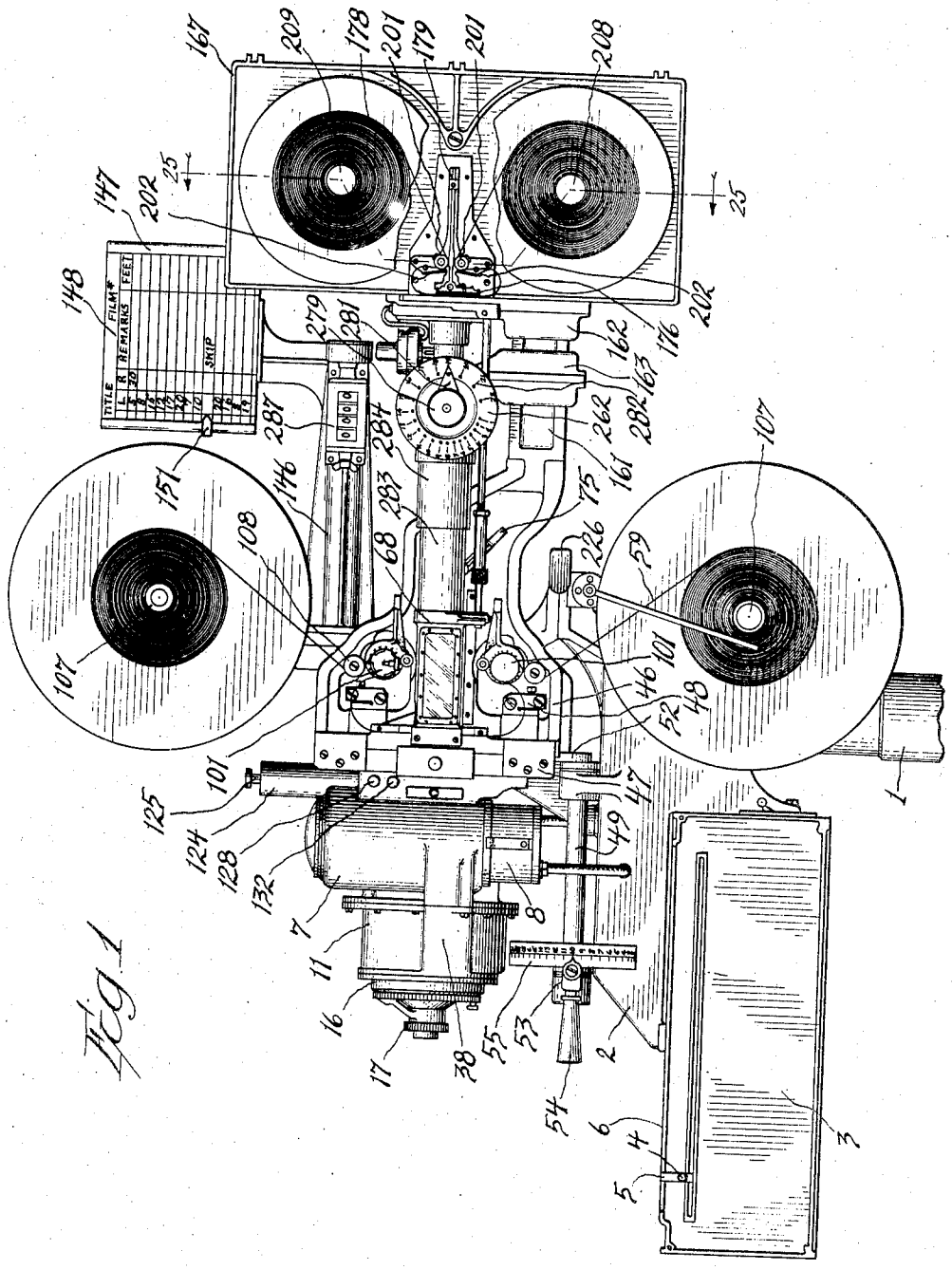


Fig. 1

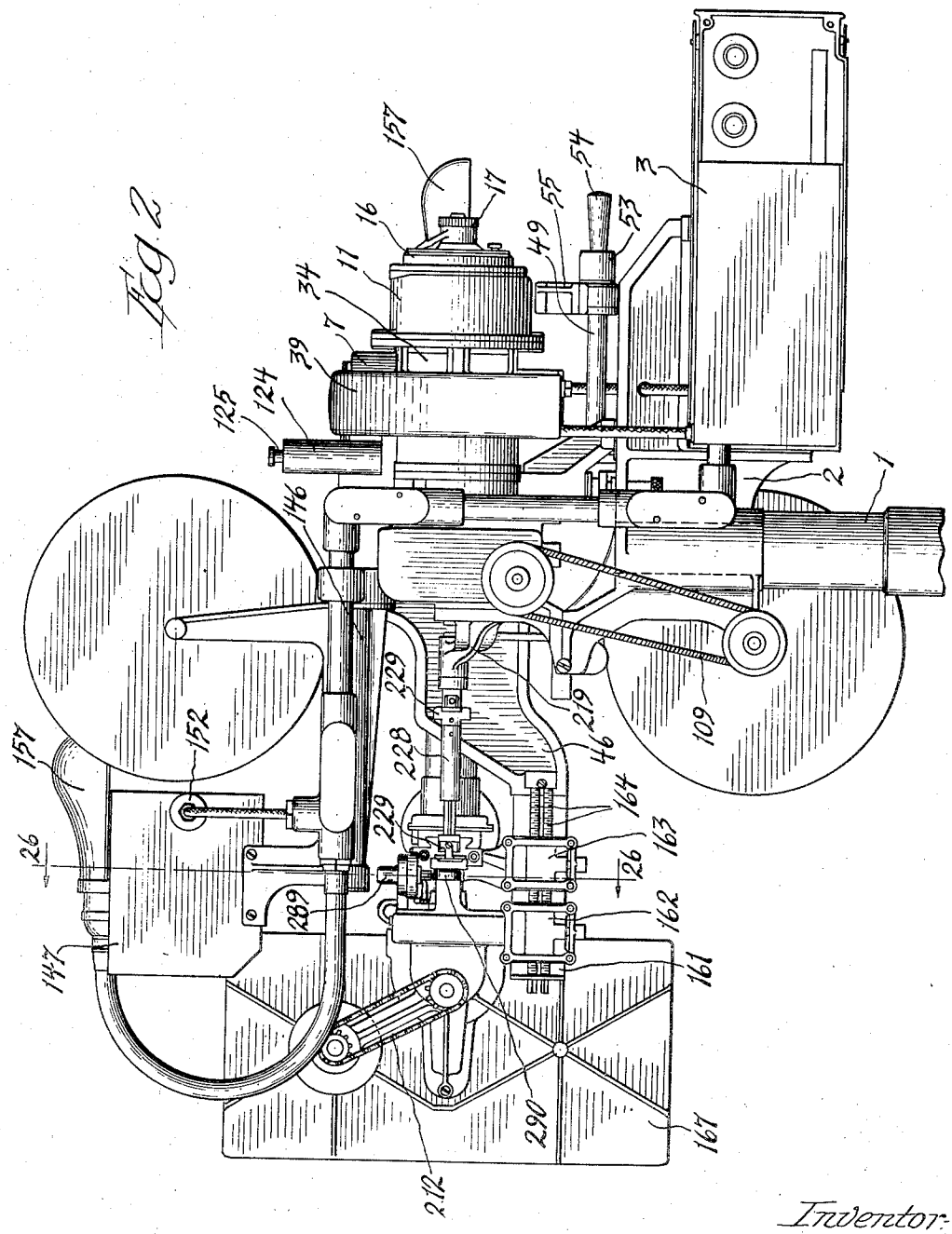
Inventor:
Albert S. Howell
By Michle + Michle,
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Fig. 2

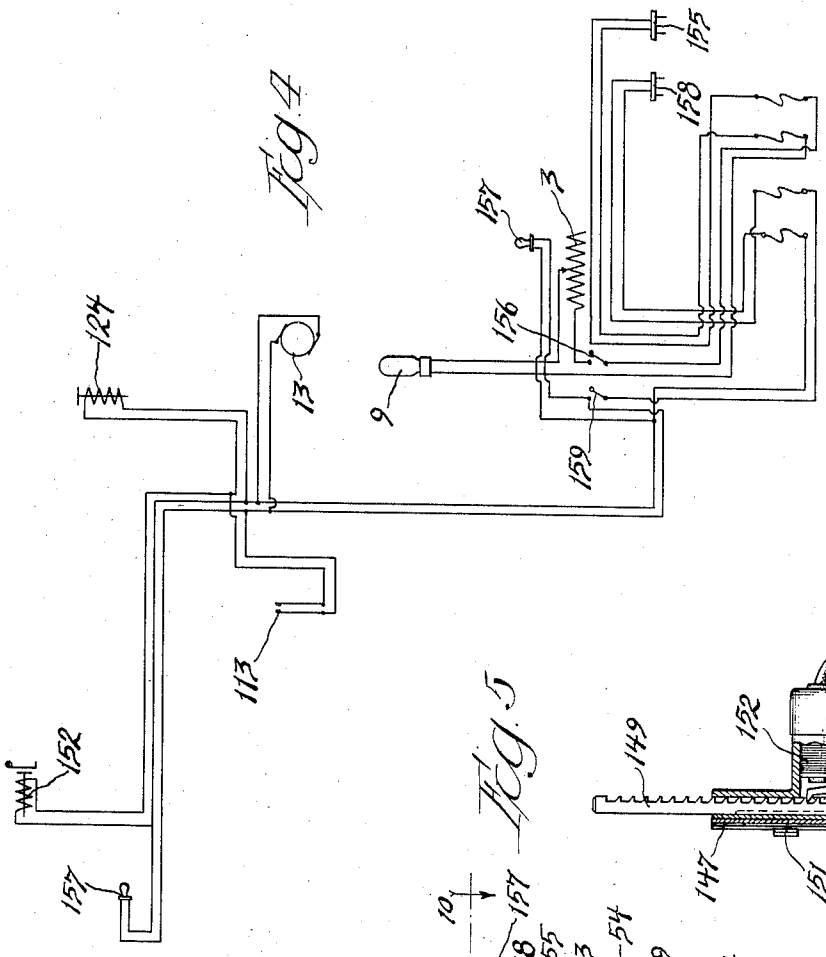


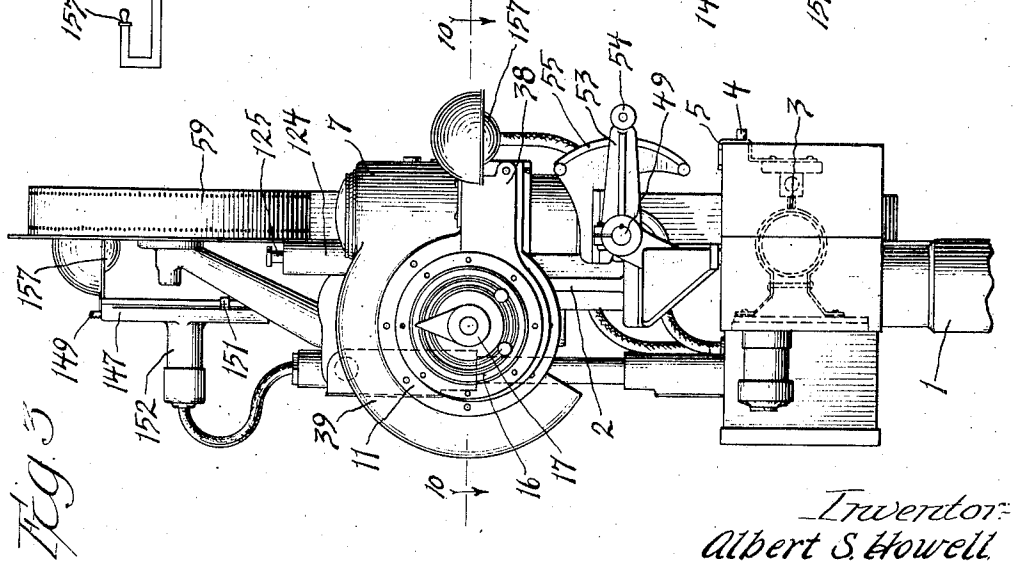
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June 21, 1932. A. S. HOWELL 1,863,657

PHOTOGRAPHIC PRINTING MACHINE

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June 21, 1932. A. S. HOWELL 1,863,657

PHOTOGRAPHIC PRINTING MACHINE

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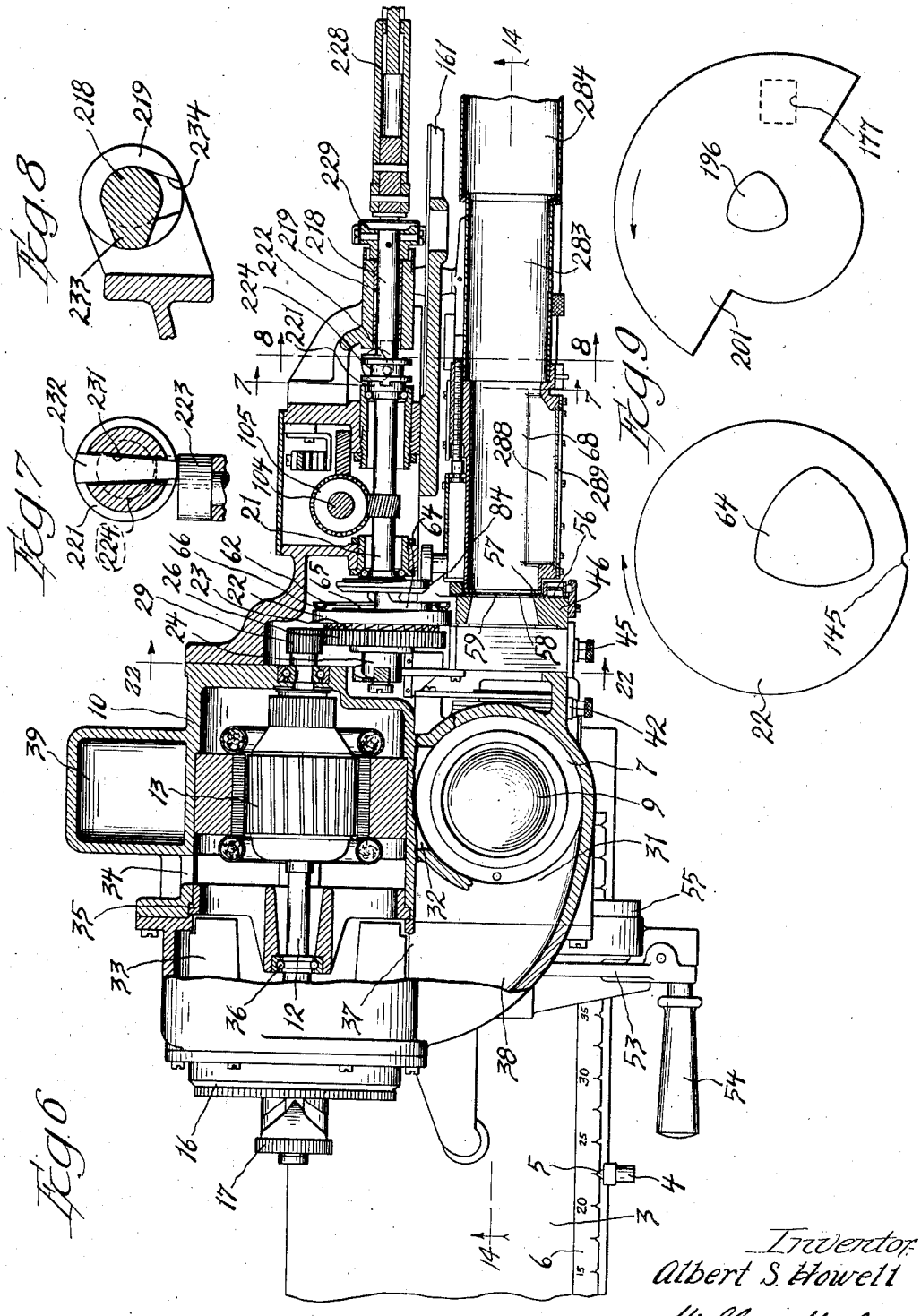


Fig. 6

Fig. 8

Fig. 9

Fig. 7

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June 21, 1932. A. S. HOWELL 1,863,657

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Fig. 10

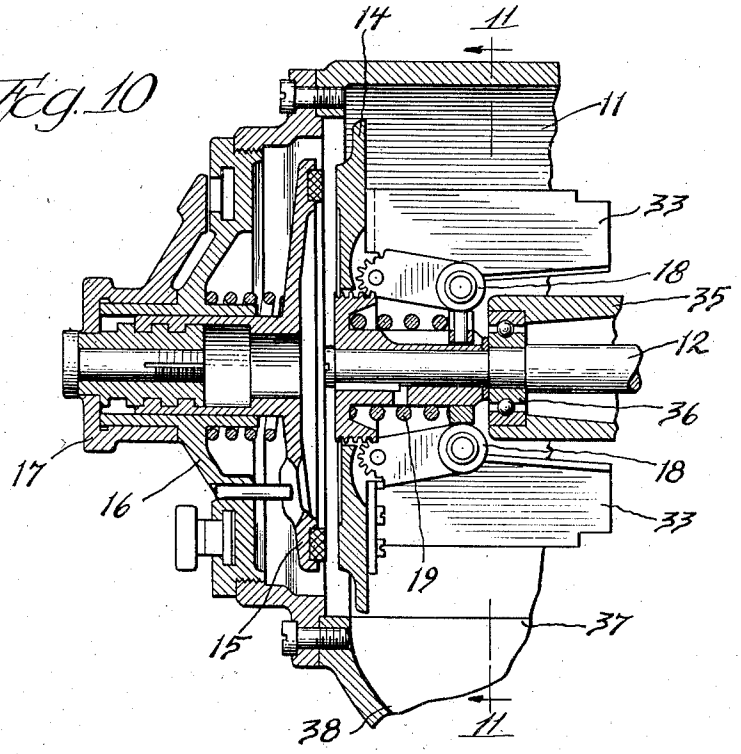
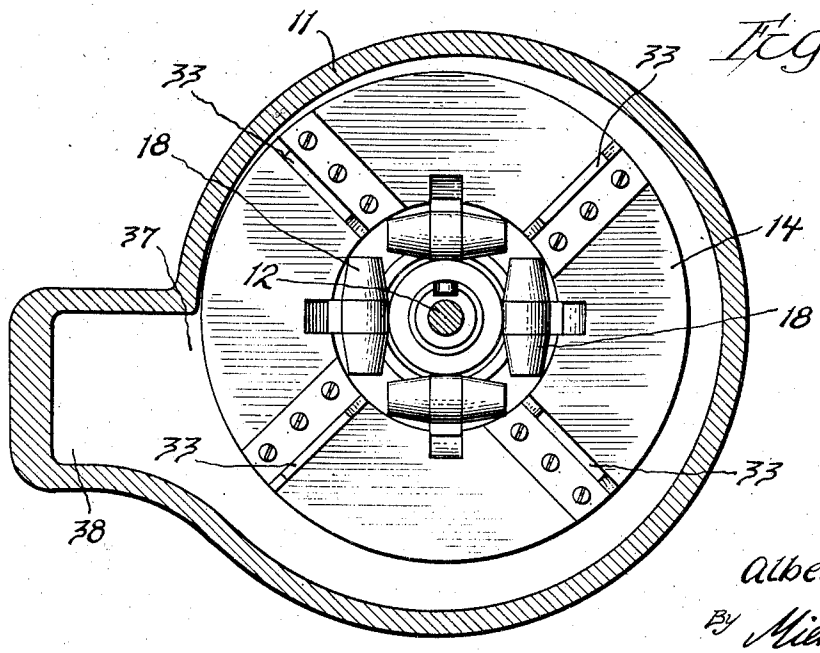


Fig 11



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PHOTOGRAPHIC PRINTING MACHINE

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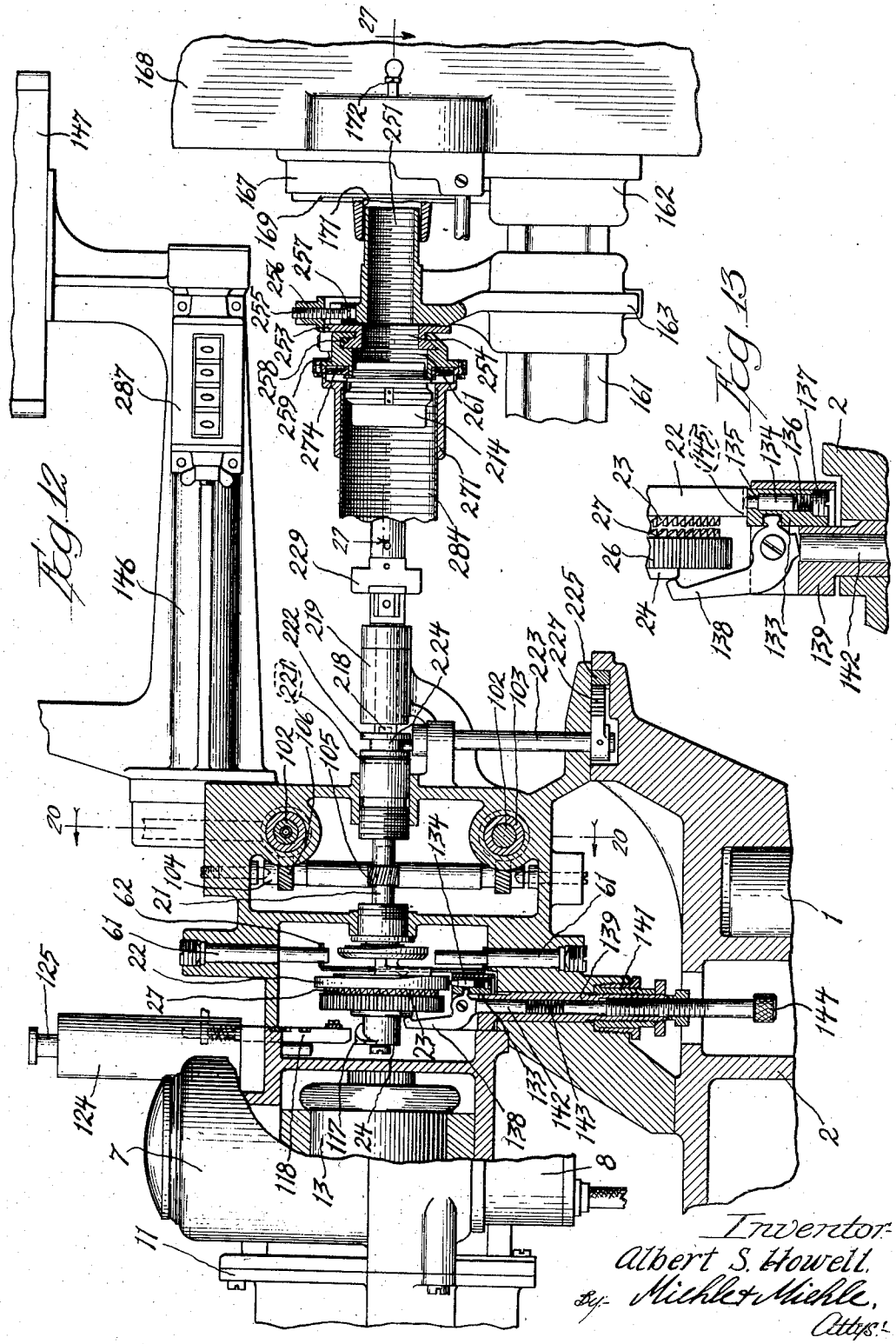


Fig. 12

Fig. 13

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June 21, 1932. A. S. HOWELL 1,863,657

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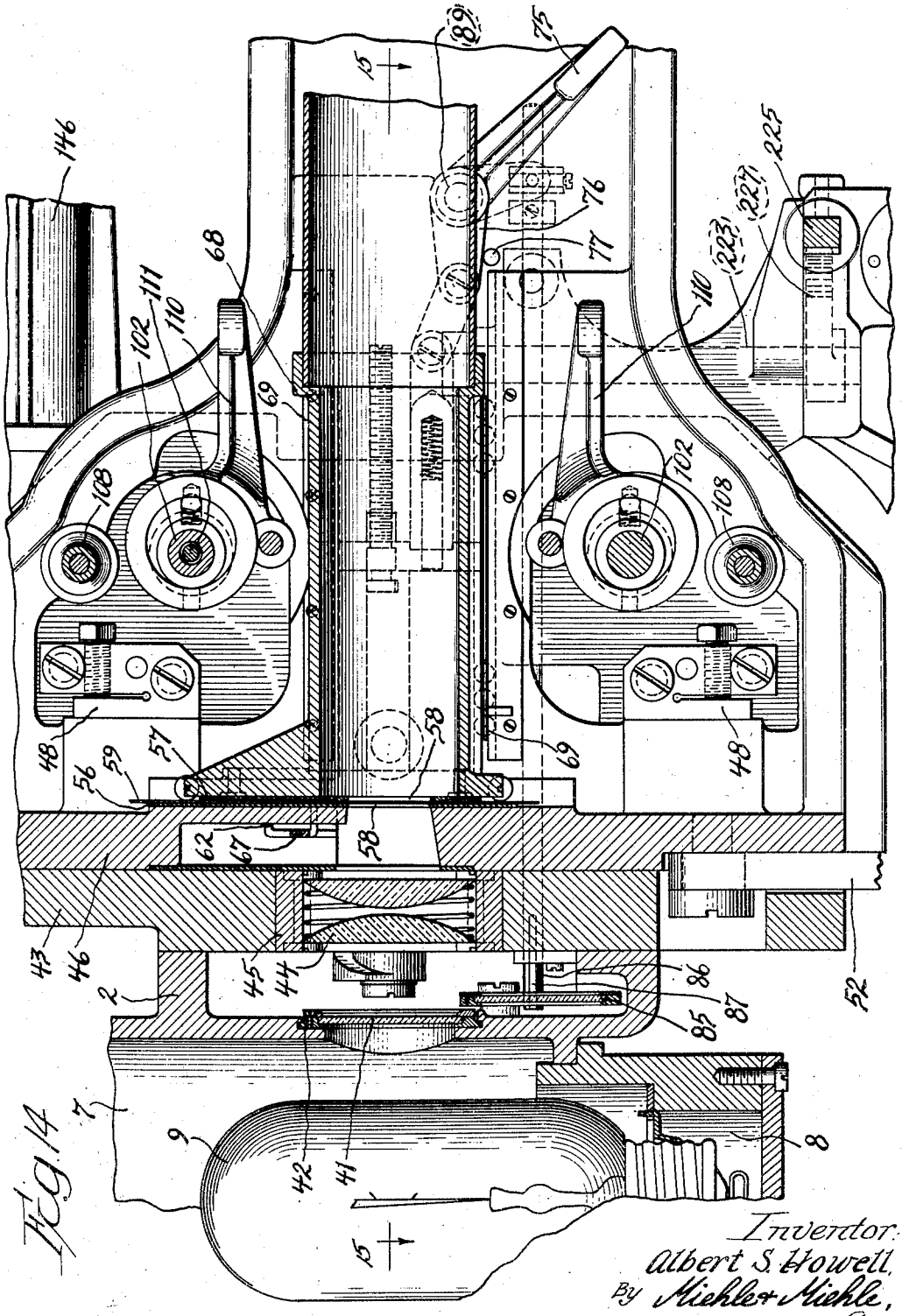


FIG. 14

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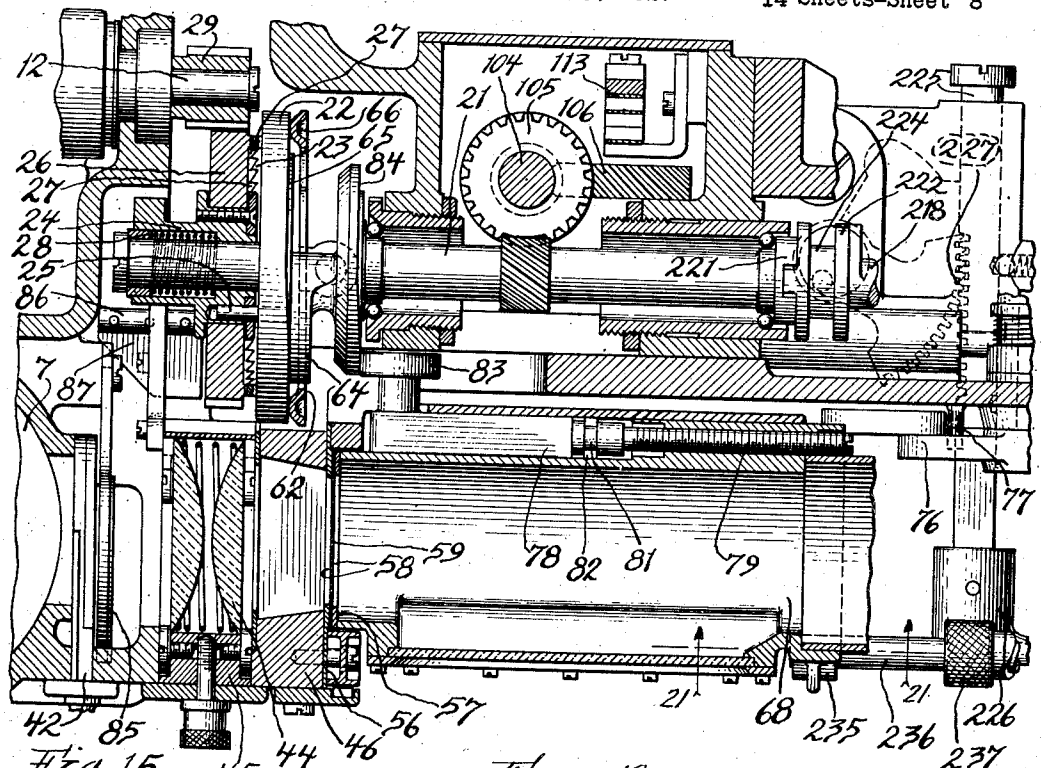


Fig. 15

Fig. 16

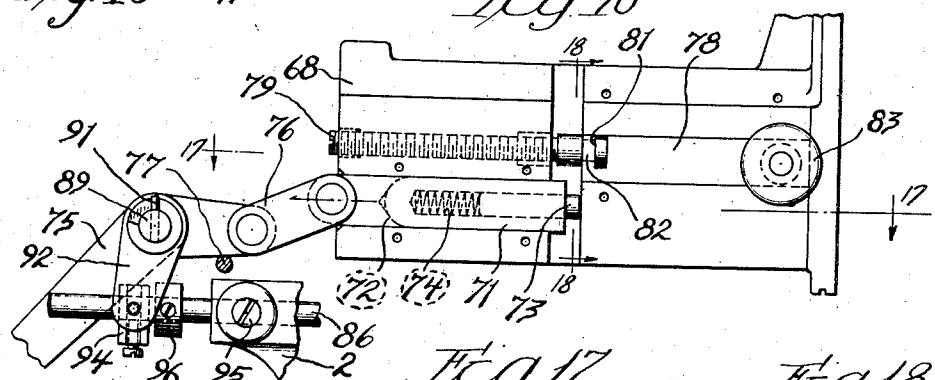


Fig. 17

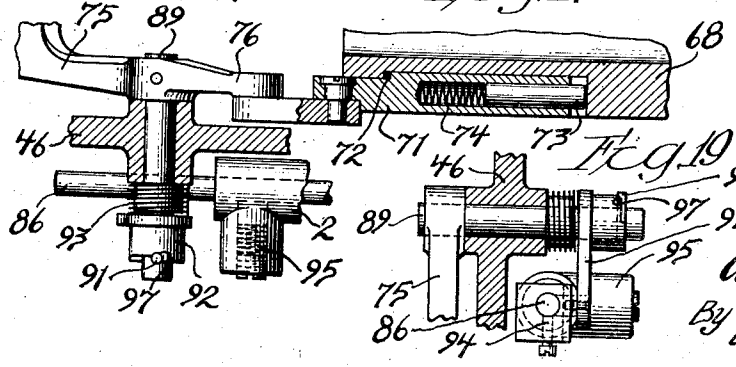


Fig. 18

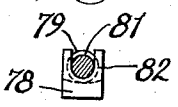


Fig. 19

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Fig. 20

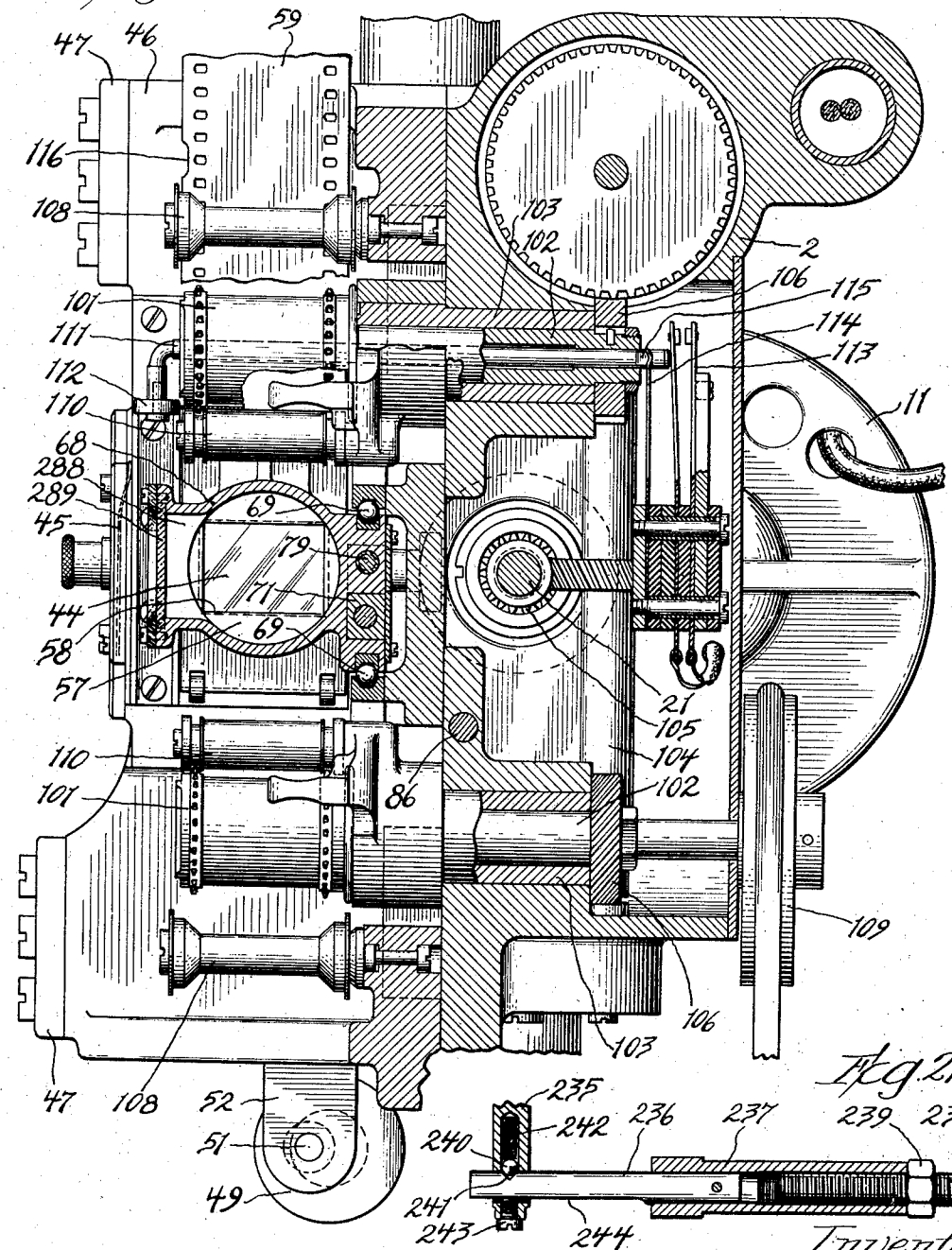


Fig. 21

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Fig. 22

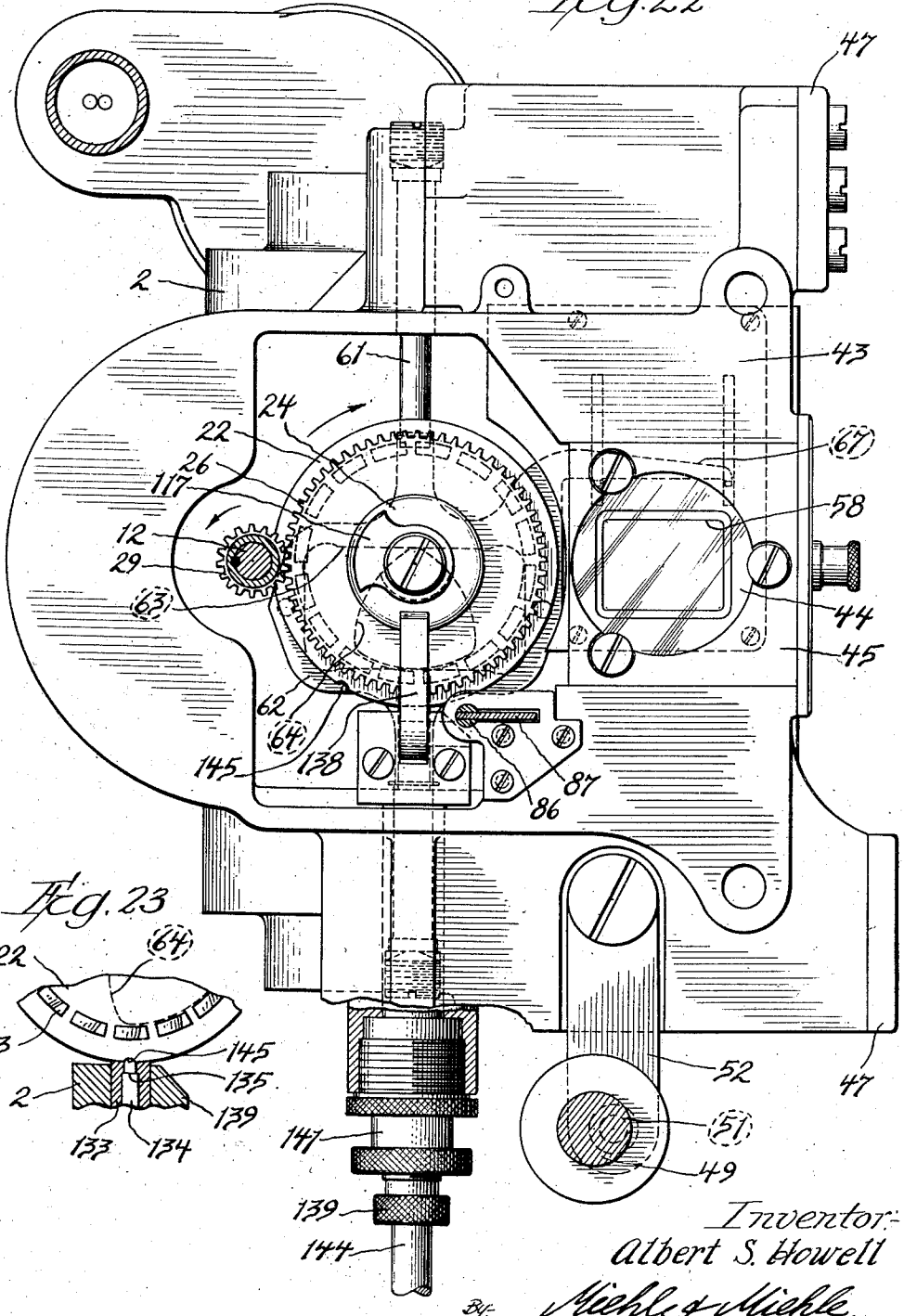


Fig. 23

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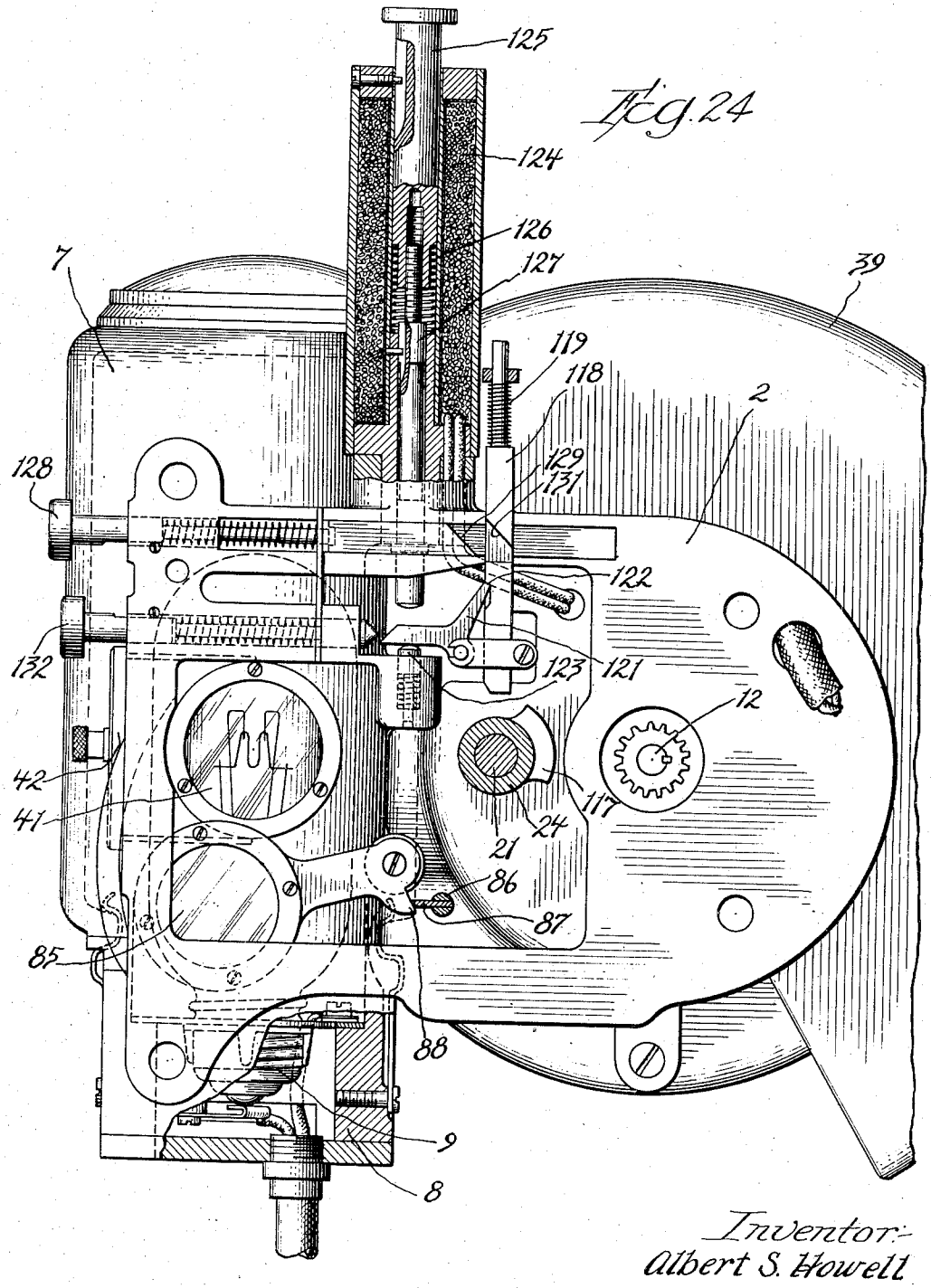


Fig. 24

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Fig. 25

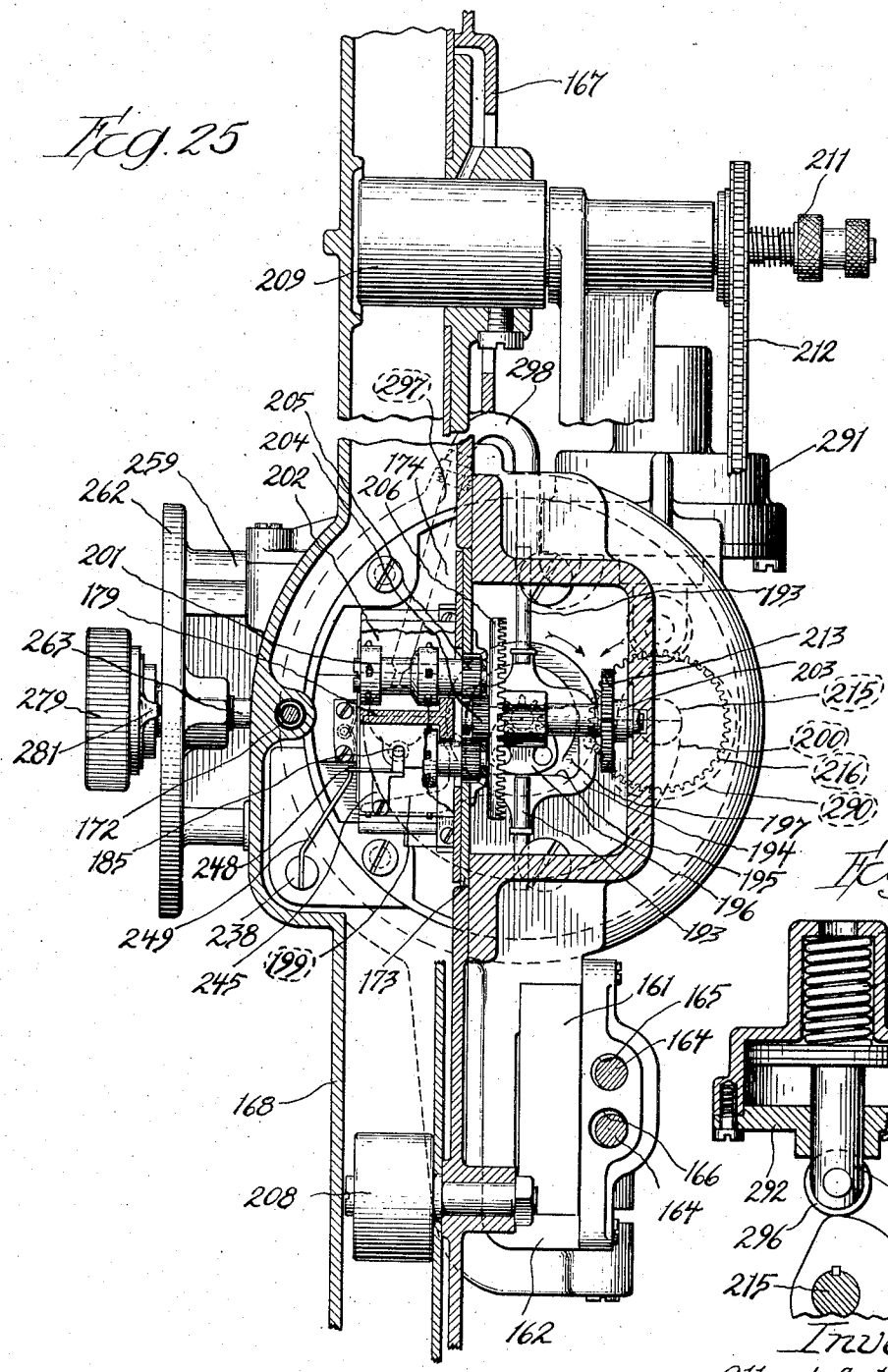


Fig. 26

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PHOTOGRAPHIC PRINTING MACHINE

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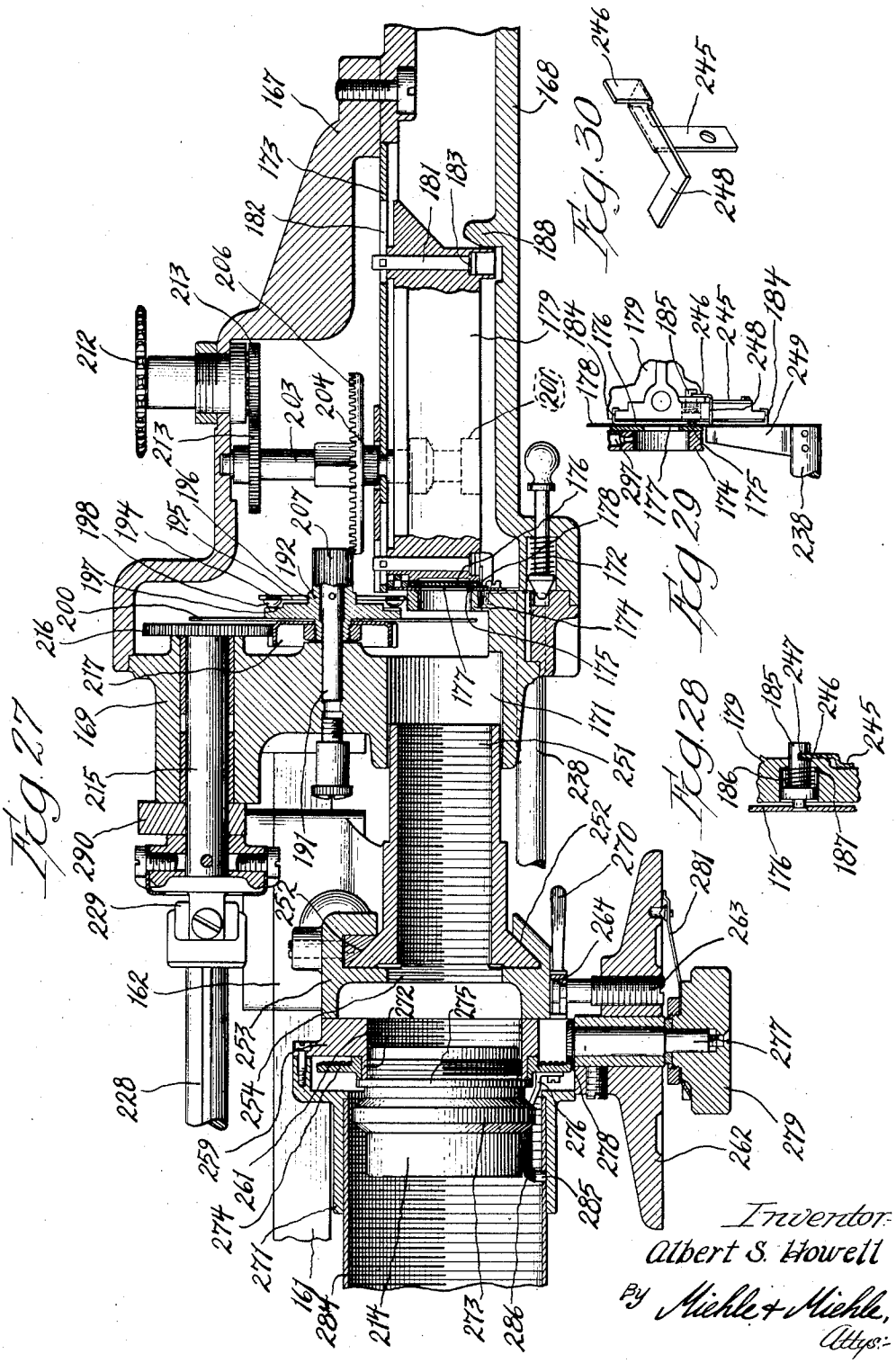


Fig. 27

Fig. 30

Fig. 29

Fig. 28

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Attys.

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Fig. 31

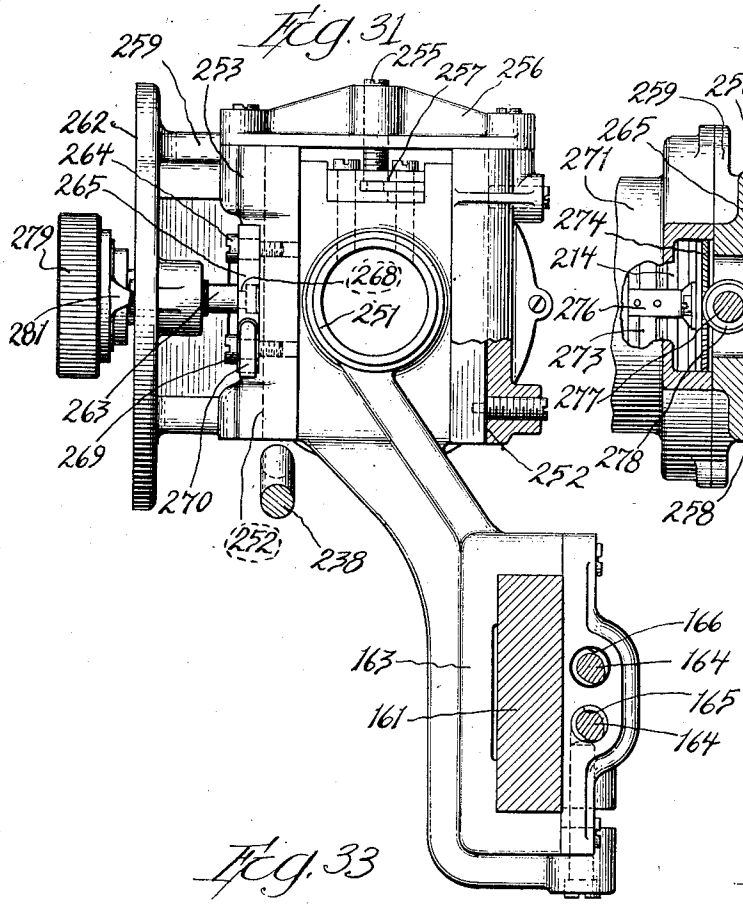


Fig. 32

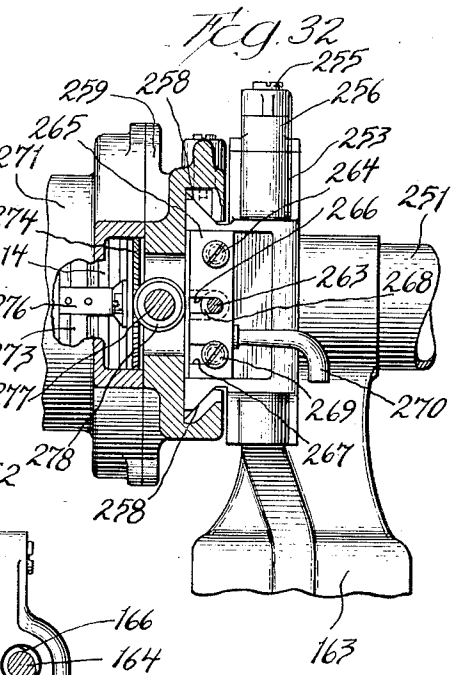


Fig. 33

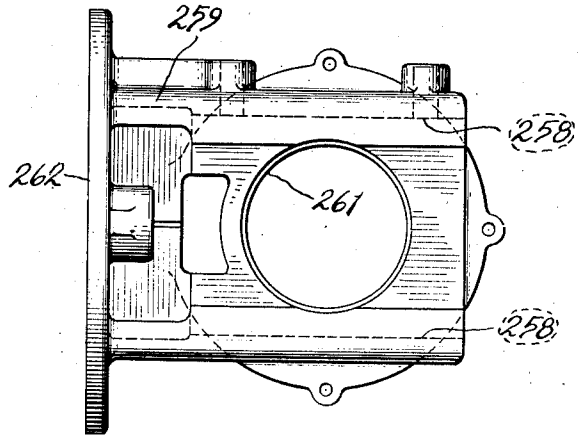
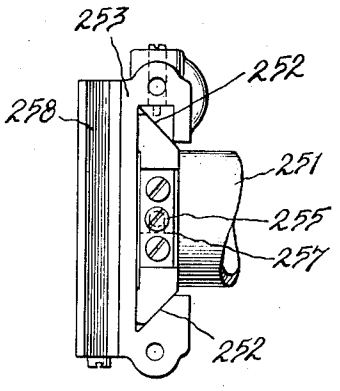


Fig. 34



Inventor:
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Patented June 21, 1932 1,863,657

UNITED STATES PATENT OFFICE

ALBERT S. HOWELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE BELL & HOWELL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

PHOTOGRAPHIC PRINTING MACHINE

Application filed June 20, 1927. Serial No. 200,163.

My invention relates particularly to motion picture film printing machines of the optical type involving the spacing of the negative and positive films and the interposition of a photographic lens therebetween, although certain features thereof are not limited to this type alone.

The invention has for its general object the provision of an efficient and conveniently controlled photographic printing machine with a view toward the production of prints of excellent quality and particularly with a view toward the printing from the conventional 35 mm. film upon the conventional 16 mm. film.

With this object in view my invention consists in certain features of novelty in the construction, combination, and arrangement of parts by which the said object and certain other objects, hereinafter appearing, are effected, all as fully described with reference to the accompanying drawings and more particularly pointed out in the appended claims.

In the said drawings—

Figure 1 is a front elevation of an optical reduction printer embodying my invention and having parts removed and broken away;

Figure 2 is a rear elevation of the same;

Figure 3 is an end elevation of the same;

Figure 4 is a diagram of the electrical circuits embodied in the machine;

Figure 5 is an end elevation of the control indicating device, hereinafter described, with parts broken away;

Figure 6 is a partial enlarged top plan view of the machine with parts removed, broken away and in section;

Figure 7 is an enlarged partial section on the line 7—7 of Figure 6;

Figure 8 is an enlarged partial section on the line 8—8 of Figure 6;

Figure 9 is a diagrammatic view showing the timed relation of various instrumentalities of the machine;

Figure 10 is an enlarged partial section on the line 10—10 of Figure 3;

Figure 11 is a partial section on the line 11—11 of Figure 10;

Figure 12 is a partial front elevation of the machine with parts broken away, removed and in section;

Figure 13 is a similar view of a portion of the machine showing the parts in positions different from those in which they are shown in Figure 12;

Figure 14 is an enlarged partial sectional view on the line 14—14 of Figure 6;

Figure 15 is an enlarged partial sectional view on the line 15—15 of Figure 14;

Figure 16 is a fragmentary rear view of a portion of the mechanism;

Figure 17 is a sectional view on the line 17—17 of Figure 16;

Figure 18 is a partial section on the line 18—18 of Figure 16;

Figure 19 is a partial view of the mechanism shown in Figure 17 and looking to the right therein and with a part broken away;

Figure 20 is a sectional view substantially on the line 20—20 of Figure 12;

Figure 21 is a partial enlarged sectional view on the line 21—21 of Figure 15;

Figure 22 is an enlarged intermediate view substantially on the line 22—22 of Figure 6;

Figure 23 is a partial view similar to Figure 22 showing a part broken away and showing the parts in different positions from those in which they are shown in Figure 22;

Figure 24 is an enlarged intermediate view substantially on the line 22—22 of Figure 6 but looking in a direction opposite that indicated by the arrows of this line;

Figure 25 is a partial condensed sectional view substantially on the line 25—25 of Figure 1;

Figure 26 is an enlarged partial section on the line 26—26 of Figure 2;

Figure 27 is an enlarged partial sectional view on the line 27—27 of Figure 12;

Figure 28 is an enlarged fragmentary front elevation of a portion of the positive film guide of the machine and related parts, hereinafter described, with a part broken away;

Figure 29 is an enlarged fragmentary front elevation of the positive film guide of the machine and related parts, hereinafter described, with parts broken away;

Figure 30 is an enlarged isometric projec-

tion of one of the parts shown in Figure 28, hereinafter described;

Figure 31 is an end elevation of the photographic lens supporting structure of the machine, hereinafter described;

Figure 32 is a front elevation of the structure shown in Figure 30 with parts broken away, removed and in section;

Figure 33 is an end elevation of a part of the lens carrying structure, hereinafter described;

Figure 34 is a top plan view of a portion of the lens carrying structure, hereinafter described, with a part removed.

Like characters of reference indicate like parts in the various views.

Referring to the drawings, 1 designates supporting pedestal on the upper end of which a composite or assembled frame 2 is pivotally mounted for angular movement in a horizontal plane. See Figures 1, 2, 3, and 12. This frame is extended endwise of the machine in one direction at the lower portion thereof and mounted on this extended portion is an enclosed rheostat 3 of usual design which is manually adjustable by means of an exterior knob 4 provided with a pointer 5 cooperating with a stationary scale 6 for indicating the adjustment of the rheostat. See Figure 6.

An upper portion of the frame 2 forms a light tight vertical lamp chamber 7 within which is mounted, by means of a suitable socket 8 forming the lower end of the lamp chamber and removably secured thereto, an incandescent electric lamp 9 of suitable design which provides the printing light. See Figures 1, 2, and 6.

Another upper portion of the frame forms a cylindrical motor casing 11 which is disposed in parallelism with the focal axis of the machine alongside the lamp chamber and at the rear thereof, and mounted within this motor casing, with its shaft 12 disposed in parallelism with the focal axis of the machine, is an electric motor 13 for driving the machine. See Figures 3 and 6. The outer end of the motor casing is extended, and disposed within this end portion is a centrifugal speed governor consisting as follows. See Figures 10 and 11. A disklike friction member 14 is carried with and is rotatably fixed with the outwardly extending end of the motor shaft 12 and is axially movable with respect thereto. This friction member is engageable with a non-rotatable friction member 15 which is carried for adjustment axially of the motor shaft on a removable cap 16 forming the outer end of the motor casing 11 and connected for manual adjustment with a manually operable member 17 on the exterior of the cap in a manner unnecessary to be described. Axial positioning of the friction member 14 is controlled by weighted levers 18, rotatably fixed with the motor shaft and pivotally mounted for movement radially thereof and connected with the friction member 14 to operate the same against the friction member 15, and a spring 19 yieldably urging the friction member 14 away from the friction member 15. The centrifugal force exerted upon the weighted levers 18 engages the friction member 14 against the friction member 15 with varying pressure whereby the speed of the motor shaft is uniformly controlled, adjustment of the speed of the motor being afforded by axial adjustment of the friction member 15.

The part of the upper portion of the frame 2 adjacent the inner end of the motor forms an enclosure within which is rotatably mounted a cam shaft 21 which is disposed in parallelism with the focal axis of the machine. See Figures 6, 15, and 20. The shaft 21 is provided adjacent the inner end thereof with a cam disk 22 on the face of which, corresponding with the adjacent end of this shaft, are positive clutch teeth 23. A hub 24 is mounted on the adjacent end of the shaft 21 for axial movement with respect thereto and is rotatably fixed with the shaft by means of an axially extending pin 25 secured on the cam disk 22 and slidably engaged in a corresponding bore in the hub. See Figure 15. A spur gear 26 is mounted on the hub 24 for rotation with respect thereto and is axially fixed therewith, and is provided with clutch teeth 27 engageable with the clutch teeth 23, thus providing a positive driving clutch for driving the machine. A spring 28 operates between the hub 24 and the shaft 21 to yieldably urge the gear 26 in the direction to engage the clutch, and the hub 24 is axially movable to move the gear 26 for engagement and disengagement of the clutch. A spur gear pinion 29 is secured on the inner end of the motor shaft 12 and meshes with the gear 26 for driving the machine through the aforementioned clutch, the gear 26 being slidable along the pinion 29 for clutch engaging and disengaging movement. The motor drive above referred to is fully described and claimed in my U. S. Patent No. 1,509,555, granted September 23, 1924, for improvement in electric motor drive and control means for motion picture machines and the like, and requires no further description for present purposes.

The lamp chamber 7 is light confining and is provided at its lower portion with an air inlet opening 31 and at its upper end with an air outlet opening 32, and a forced air draft is maintained through the lamp chamber during operation of the machine in the following manner. See Figure 6. Air impelling vanes 33 within the motor casing 11 are spaced about the axis of the motor 13 and are disposed intermediate the friction member 14 and the motor 13 and are secured to the

friction member 14 for rotation with the motor shaft. See Figures 10 and 11. The intermediate portion of the motor casing 11 between the vanes 33 and the motor 13 is provided with openings 34, see Figures 2 and 6, which communicate with the portion of the motor casing occupied by the vanes through openings in a spider 35 carrying a bearing 36 of the motor shaft 12. The motor casing 11 is provided with an outlet opening 37 overlying the vanes 33, and this outlet opening communicates with the inlet opening 31 of the lamp chamber through an angular enclosed light trapping air passage 38. See Figures 6, 10, and 11. A second angular enclosed light trapping air passage 39 communicates at one end with the outlet opening 32 of the lamp chamber and extends about the cylindrical motor casing 11 and communicates at its other end with the atmosphere. See Figures 2, 3, and 6. When the motor 13 is operating the air impelling vanes 33 draw air through the openings 34 of the motor casing and force it into the lamp chamber through the opening 37 of the motor casing, through the passage 38 and into the lamp chamber 7 through the inlet opening 31 thereof. The air thus entering the lamp chamber is forced upwardly therein and is then exhausted into the atmosphere through the outlet opening 32 of the lamp chamber and the passage 39, the passages 38 and 39 trapping light from the lamp chamber. Thus the lamp chamber 7 and the lamp 9 therein are prevented from becoming overheated, the arrangement affording a compact design well adapted to the general structure shown.

The filament of the lamp 9 is centered with the focal axis of the machine, and the lamp chamber 7 is provided with a light opening, also alined with the focal axis of the machine, across which is disposed a light diffusing element in the form of a ground glass 41 which is carried in a mounting 42 mounted in a transverse slide on the frame 2 for removal of the ground glass for accessibility. See Figures 6, 14, and 15. The frame 2 has a vertical transverse wall 43, in front of the light opening of the lamp chamber, which is apertured at the focal axis of the machine, and an optical condenser 44 is disposed in this opening in alinement with said focal axis for cooperation with the lamp and ground glass 41 to effect a printing light, the condenser 44 being carried in a mounting 45 mounted in a transverse slide on the frame 2 for accessibility.

A second frame 46 is mounted on the frame 2 for vertical adjustment with respect to the frame 2 in the following manner. The wall 43 and the mechanism enclosing portion of the frame 2 form an angle and the frame 46 is angled correspondingly and engages the angle of the frame 2 for vertical sliding movement with respect thereto, retaining plates 47 and adjustable bearing blocks 48 secured on the frame 2 and slidably engaged by the frame 46 retaining this frame in said angle of the frame 2. Pivotally mounted on the frame 2 is a horizontally disposed shaft 49 which is operatively connected with the frame 46 by an eccentric 51 on the shaft engaging a connecting link 52 which is pivotally connected with the frame 46, whereby angular adjustment of the shaft effects vertical adjustment of the frame 46 with respect to the frame 2. See Figures 1, 14, 20, and 22. A lever 53 is secured on the shaft 49 and is provided with a handle 54 for manual operation. An indexed segment 55 is mounted on the frame 2 and cooperates with the lever 53 to indicate adjustment of the frame 46 with respect to the frame 2, there being provided means, unnecessary to be described, operating between the segment 55 and the lever 53 for releasably securing the shaft 49 in any adjusted position for correspondingly positioning the frame 46 with respect to the frame 2.

The transverse wall of the frame 46 is apertured corresponding with the focal axis of the machine, and carried with the frame 46 is a vertically extending intermittent negative film feed guide including film face guide members 56 and 57 provided with light apertures 58 corresponding with the focal axis of the machine, the face guide member 56 being secured against the outer face of the transverse wall of the frame 46 and the face guide member 57 being mounted for movement to and away from the guide member 56 in a manner hereinafter described. See Figures 14 and 15.

Intermittent film feeding mechanism is provided for intermittently feeding a negative film 59 in the aforementioned guide and this mechanism consists as follows. See Figures 12, 15, and 22. Secured on the frame 2 is a pair of alined vertically spaced studs 61 disposed in diametrically opposite relation with the cam shaft 21, and mounted on the studs 61 for pivotal movement and movement longitudinally thereof is a shuttle 62 provided with a transverse opening 63 through which the cam shaft 21 extends. A radial cam 64 fast on the shaft 21 engages opposite horizontal edges of the opening 63 of the shuttle to effect vertical reciprocating or film feed and return movement of the shuttle with rotation of the shaft 21, and a face cam 65 on the cam disk 22 engages projections 66, spaced in diametrically opposite relation with respect to the studs 61, on the shuttle to effect film engaging and disengaging movement of the shuttle. The shuttle 62 is provided with a toothed extension 67 engageable with usual perforations of the film 59 in the negative film guide for intermittently feeding the film therein in a usual manner, the cams 64 and 65 being properly timed for this purpose.

It will be observed that the intermittent film feeding mechanism just described is carried by the frame 2 and that the cooperating negative film guide is carried by the frame 46, so that adjustment of the frame 46 with respect to the frame 2 longitudinally of the film guide, as hereinbefore described, varies the relation of the aperture of the film guide longitudinally of the guide with respect to the intermittent feeding mechanism, thus providing for "framing" in a simple and effective manner.

Disposed in the angle of the frame 46 is a tubular light enclosing member 68 disposed substantially coaxial with the focal axis of the machine, and this member is mounted on the frame 46 for movement with respect thereto longitudinally of the focal axis of the machine by means of suitable anti-friction bearings 69. See Figures 14, 15, and 20. The end of member 68 adjacent the lamp chamber 7 is extended vertically, and the face guide member 57 is secured on this end of the member 68 for movement therewith to and away from the face guide member 56 secured on the frame 46 to open and close the guide, and movement of the member 68 with respect to the frame 46 is controlled as follows. See Figures 14 to 19 inclusive. A slide block 71 is mounted on the member 68 for movement with respect thereto parallel with the movement of the member 68 with respect to the frame 46, engageable shoulders 72 on the member 68 and block 71 providing stop means limiting the movement of the block with respect to the member 68 in the direction of guide opening movement of the member 68. See Figure 17. The block 71 is bored longitudinally of the movement thereof and inwardly from the end thereof nearest the negative film guide, and mounted for sliding movement in this bore is a plunger 73. A spring 74 in the bore of the block 71 yieldably urges the plunger 73 in the direction of guide closing movement of the member 68 and the plunger engages the member 68 to yieldably urge the same with respect to the block 71 in this direction. A manually operated lever 75 is pivotally mounted on the frame 46 on an axis transverse to the focal axis of the machine and is connected with the block 71 by means of a toggle link device 76, whereby guide opening and closing movement of the block 71 and the member 68 is effected by opposite pivotal movements of the lever 75, guide closing movement of the member 68 being effected through the resilient means including the spring 74 and guide opening movement of the member 68 being effected through engagement of the shoulders 72 of the block 71 and member 68. The member 68 is locked in closed guide position by operating the toggle link device over center against a stop formation 77 on the frame 46. See Figures 14 and 16.

In order that the film in the negative film guide may be released during intermittent movement thereof the following mechanism is provided. A second block 78 is mounted on the member 68 for adjustment with respect thereto parallel to the movement of the member 68, and an adjustment screw 79 extending longitudinally of the movement of the member 68 is screwthreaded on the member 68 and is provided with a groove 81 engaged in a yoke formation 82 of the block 78 for adjustably positioning this block with respect to the member 68. A roller 83 is rotatably mounted on the block 78, and an axial cam 84 fast on the cam shaft 21 is engaged by the roller 83 when the member 68 is in closed guide position to operate the member 68 against the spring 74 to release the film 59 in the negative film guide during intermittent movement thereof, the cam 84 being suitably timed with the cams 64 and 65 for this purpose. The simplicity and effectiveness of this arrangement is apparent, and it will be observed that the mechanism for intermittently releasing the film in the guide does not interfere with or require additional manual manipulation for opening and closing the guide.

A ruby glass light shutter 85 is pivotally mounted within the frame 2 for movement into and out of position between the ground glass 41 and the condenser 44 to interrupt the printing light to the aperture of the negative film guide. See Figures 14 to 17, 19 and 24. This shutter is controlled in the following manner to interrupt the printing light when the negative film guide is open for preventing the egress of printing light from the opened guide with a view toward dark room operation of the machine. A rod 86 is carried for longitudinal movement on the frame 2, and this rod is provided with a cam 87 cooperating with a cam engaging formation 88 on the shutter 85 to operate the shutter into position to interrupt the printing light to the aforementioned film guide when the rod 86 is moved in the direction of guide closing movement of the member 68, the shutter moving out of printing light interrupting position under the influence of gravity when the rod 86 and cam 87 are moved in the opposite direction. The lever 75 is pivotally mounted on the frame 2 by means of a shaft 89 on one end of which the lever is secured and which extends through and is journaled in a bore of the frame. See Figures 16, 17, and 19. A radially extending pin 91 is secured on the opposite end of the shaft 89 and a lever 92 is journaled on this shaft between the frame 2 and the pin 91, a coiled compression spring 93 encircling the shaft between the lever 92 and the frame 2 and yieldably urging the lever 92 against the pin 91. The outer end of the lever 92 is connected with the rod 86

for operating the same by means of a grooved collar and pin connection 94 so that pivotal movement of this lever effects operation of the shutter 85. A spring pressed friction device 95 on the frame 2 engages the rod 86 to retard operation of the rod, and a stop collar 96 is secured on the rod 86 for engagement with the frame 2 to limit movement of the rod in the direction by which it operates the shutter 85 into printing light interrupting position. The end of the hub of the lever 92 engaging the pin 91 is provided with a notch 97 releasably engageable with the pin for operating the lever 92 to actuate the shutter 85 and the arrangement to actuate the shutter is as follows. As shown the mechanism is shown in closed film guide position with the toggle link device 76 in locked position against the stop 77. In this position of the manipulating lever 75 and the shaft 89 the pin 91 is operatively engaged in the notch 97 of the lever 92 by reason of the spring 93, the shutter 85 being out of its printing light interrupting position. Initial film guide opening movement of the lever 75 moves the toggle link device over center to unlock, and the pin 91 engaged in the notch 97 operates the lever 92 to actuate the rod 86 and cam 87 thereof to move the shutter 85 into printing light interrupting position, this action taking place before actual opening of the negative film guide. At the time when the shutter 85 is in printing light interrupting position the collar 96 engages the frame 2 to prevent further movement of the rod 86 in the same direction. Further guide opening movement of the lever 75 effects opening of the guide, and further movement of the lever 92 being prevented, the pin 91 disengages from the notch 97 by movement of the lever 92 along the shaft 89 against the spring 93 to permit the further guide opening movement of the lever 75, the pin moving with respect to the lever 92 during this movement of the lever 75. Upon movement of the lever 75 from opened guide position to close the guide, the lever 92 is not actuated by reason of the brake device 95 until the pin 91 re-engages the notch 97 after which the lever 92 is actuated to operate the rod 86 to move the shutter 85 out of printing light interrupting position, the shutter being so moved after the guide is closed and during final guide closing or locking movement of the lever 75. Thus it will be observed that the shutter 85 and the guide are controlled by one manually controlled member and that the shutter is moved to printing light interrupting position before the guide is opened and out of this position after the guide is closed.

Constant feed film sprockets 101 are spaced above and below the tubular member 68 in film feeding alignment with the negative film guide, and these sprockets are mounted on the outer ends of spindles 102 which are journaled in bushings 103 secured in bores of the frame 2. See Figures 1, 14, and 20. A vertical shaft 104 is rotatably mounted within the frame 2 and is driven from the cam shaft 21 by spiral gearing 105. See Figures 12, 15, and 20. The shaft 104 is connected for driving the sprocket spindles 102 by means of spiral gearing 106, the arrangement being such that the sprockets are driven in correspondence with the intermittent feeding of the film in the negative guide for feeding the film to and from the guide. In the operation of the machine the negative film 59 is fed from an upwardly disposed film spool 107 over an upper guide roller 108 to the upper film sprocket 101. See Figure 1. From the upper film sprocket the film leads to the upper end of the negative film guide in the form of a compensating loop. From the lower end of this guide the film leads to the lower film sprocket 101 in the form of a compensating loop, and from this sprocket it leads over a lower guide roller 108 on to a downwardly disposed film spool 107 which is driven from the lower sprocket spindle by a belt and pulley driving device 109 to rewind the film, this device being adapted to slip to compensate for different diameters of the roll of film on this spool. See Figure 2. The film is retained on the film sprockets by means of releasable film retaining roller devices 110. See Figures 1, 14, and 20.

The upper sprocket spindle 102 is axially bored, and extending through the bore of this spindle is a longitudinally movable rod 111. See Figures 14 and 20. The outer end of this rod is turned at right angles to the main portion thereof and has a roller 112 mounted thereon which is engageable with the outer edge of the negative film 59 on the sprocket. A normally open electric switch 113 of the spring blade breaker type is mounted within the frame 2 adjacent the inner end of the rod 111 and is associated with the inner end of this rod to be closed with inward movement of the rod. A flat spring 114 has one end secured stationarily with the switch 113 and engages a transverse groove 115 on the rod 111 inwardly beyond the inner end of the associated spindle 102 to urge the rod inwardly to close the switch 113 and to prevent rotation of the rod. The spring 114 yieldably urges the rod 111 in the direction to engage the roller 112 with the outer edge of the film 59 on the upper sprocket 101, and this engagement normally maintains the rod in an outer position with the switch 113 opened. The outer edge of the film 59 is provided with notches 116 spaced therealong in correspondence with adjustments, such as printing light variations, to be made during the printing operation, and upon the roller 112 encountering each notch, the spring 114 operates the rod 111 inwardly to close the switch 113, the

switch being again opened as the roller disengages from the engaged notch and again engages the normal edge of the film.

The switch 113 as controlled by the notched negative film 59 is utilized for stopping operation of the printing operation for adjustment of the printing light and for indicating the adjustment of the printing light in the following manner. As hereinbefore described the positive driving clutch consisting of the clutch teeth 23 and 27 is engageable and disengageable by axial movement of the hub 24, the spring 28 yieldably urging the clutch into engagement and normally maintaining it so engaged. See Figures 12 and 15. Formed on the outer end of the hub member 24, which is rotatably fixed with the driven element of the clutch, i. e. the clutch teeth 23 on the cam disk 22, is an axial segment cam 117. Mounted for longitudinal movement radially of the hub member 24 is a vertically disposed bar 118 movable into and out of the path of the cam 117. See Figures 12, 13, and 24. A spring 119 yieldably urges the bar 118 downwardly into the path of the cam 117 and when in this position, see Figure 13, the cam 117 engages the same and reacting thereagainst disengages the clutch with angular movement of the driven clutch member by axially moving the hub member 24 and with it the gear 26 and the clutch teeth 27, forming the driving member of the clutch, to disengage the clutch against the influence of the spring 28. When the bar 118 is moved upwardly out of engagement with the cam 117 the spring 28 engages the clutch. A trigger member 121 pivotally mounted on the frame 2 normally maintains the bar 118 in an upper position out of the path of the cam 117 and against the influence of the spring 119 by releasable engagement with a notch 122 in the bar, a spring plunger device 123 yieldably urging the trigger member against the bar. See Figure 24. Mounted on the frame 2 above the trigger member 121 is an electromagnetic solenoid 124 within which is slidably mounted an armature 125 yieldably urged upwardly by a spring 126. A rod 127 is secured with the armature and extends downwardly therefrom in overlying relation with the trigger member 121, so that when the solenoid is energized the armature 125 is drawn downwardly against the influence of the spring 126 which causes the rod 127 to strike the trigger member 121 and move the same against the influence of the spring device 123 out of engagement with the notch 122 of the bar 118 whereupon the spring 119 moves the bar downwardly into the path of the cam 117 to disengage the driving clutch. After disengagement of the driving clutch the clutch is re-engaged by manually operating a spring push button device 128 provided with a cam formation 129 engageable with a similar cam formation 131 on the bar 118 to raise this bar to re-engage the trigger member with the notch 122 of the bar. A second manually operated push button device 132 is operable on the trigger member 121 to disengage the same from the notch 122 of the bar 118 for disengaging the driving clutch at will.

Means for quickly stopping the film operating mechanism, and preferably for stopping it at a predetermined position in its cycle, upon disengagement of the driving clutch is provided and will now be described. Mounted for vertical movement below the cam disk 22 is a block 133 movable into and out of frictional engagement with the peripheral surface of this cam disk. See Figures 12, 13, 22, and 23. Mounted in a vertical bore of the block 133 for vertical movement with respect thereto is a plunger 134. The upper end of this plunger is reduced and the upper end of the bore of the block is correspondingly reduced to provide opposing shoulders 135 limiting upward movement of the plunger with respect to the block. A spring 136 is disposed in the bore of the block 133 below the plunger 134 and is arranged between the plunger and a screw 137 screwthreaded into the bottom of the bore of the block to yieldably urge the plunger upwardly with respect to the block which movement is limited by the shoulders 135. See Figure 13. Normally the block 133 is so positioned that neither the block nor the upper end of the plunger 134, which normally projects above the block, are engaged with the peripheral surface of the cam disk 22. See Figure 12. A lever 138 is pivotally mounted on an axis transverse to and immediately below the gear 26 and is connected with the block 133 for operating the block 133 and plunger 134 vertically into and out of engagement with the peripheral surface of the cam disk 22. The lever 138 is pivotally carried and the block 133 is carried for relative vertical movement on a mounting member 139 which is mounted on the frame 2 for vertical adjustment by means of a suitable adjusting device 141. A plunger 142 is mounted for longitudinal movement in a vertical bore of the mounting member for longitudinal movement in a vertical of the mounting member 139 and is yieldably urged upwardly by a spring 143 in this bore and interposed between the lower end of the plunger and an adjusting screw 144 screwthreaded into the lower end of the bore of the member 139. The plunger 142 is directly below the axis of the lever 138 and under the influence of the spring 143 the upper end of the plunger engages a chordal surface on the lever 138 to yieldably urged the lever into a position in which the block 133 and the plunger 134 are out of engagement with the periphery of the cam disk 22, as shown in Figure 12. The main portion of the lever 138 extends upwardly from the axis thereof for engagement

with the hub member 24 for operation of this lever with axial clutch disengaging movement of the hub member to move the block 133 and the plunger 134 upwardly into engagement with the peripheral surface of the cam disk 22, which constitutes a friction surface, for stopping the driven member of the driving clutch and consequently the film operating mechanism of the machine. The periphery of the cam disk 22 is provided with a notch 145 which is engaged by the plunger 134 to stop the film operating mechanism at a predetermined position in its cycle, as hereinafter described, the spring 136 permitting retraction of the plunger into the bore of the block 133 to permit the block to engage frictionally the peripheral surface of the cam disk 22 when the notch 145 is not registered with the plunger 134. Thus is provided friction brake means and positive stop means for stopping rotation of the driven member of the driving clutch and the film operating mechanism with obvious advantage. When the hub member 24 is moved axially to engage the driving clutch the spring 143 operating through the plunger 142 operates the lever 138 to move the block 133 and plunger 134 out of engagement with the cam disk 22 for the driving thereof by engagement of the driving clutch.

It will be observed that by disengaging the driving clutch when the film operating mechanism is stopped the driving tendency of the motor is terminated so that only the momentum of the film operating mechanism need be overcome in stopping the same, thus reducing the strain on the stop mechanism. The cooperation of the friction brake and the positive stop means provides for quick stoppage without recoil and reduces the strain of stoppage on the positive stop means.

The solenoid 124 is connected in circuit with the breaker switch 113 so that while the roller 112 is engaged with a normal or unnotched portion of the negative film 59 the solenoid is not energized whereby operation of the film operating mechanism is permitted. When, however, the roller 112 engages in a notch 116 of the negative film the switch 113 is closed, as hereinbefore described, which results in energizing the solenoid 124 with consequent disengagement of the driving clutch and functioning of the stop mechanism as hereinbefore described. When the film operating mechanism is so stopped any desired adjustment, such as adjustment of the printing light, is made, and operation of the film operating mechanism is then resumed by pushing the spring push button device 128 which effects release of the stop means, engagement of the driving clutch, and resetting the bar 118 under control of the trigger 121 preparatory to stoppage of the film operating mechanism when the roller 112 encounters another notch 116 in the negative film 59.

In order that the adjustments, to be made at the stops so effected, may be conveniently before the operator the following mechanism is provided. See Figures 1, 3, and 5. An upwardly disposed bracket 146 is secured to and extends from the frame 2 longitudinally of the focal axis of the machine, and mounted on the outer end of this bracket is a card holder 147 adapted for the interchangeable mounting thereon of a suitable index card 118. The index card bears sequentially arranged indicia thereon corresponding with the notched negative film 59 with which it is used and indicating the adjustments, such as the adjustments of the printing light, to be made at the stops effected by the notched negative film during printing therefrom. A vertically disposed longitudinally movable ratchet bar 149 is carried with the card holder and is provided with an indicator 151 which in the movement of the ratchet bar separately indicates the indicia on the index card on the card holder. An electro-magnet 152 is mounted on the rear of the card holder and operates upon a pivotal escapement toothed armature 153, engaged with the teeth of the ratchet bar 149, to operate the armature in one direction, a spring 154 being provided to operate the armature in the opposite direction. Thus when the electro-magnet 152 is energized and de-energized the armature permits the ratchet bar to drop one tooth whereby the indicator 151 is moved from one indicium on the card to the next. The electro-magnet 152 is connected in circuit with the switch 113 so that when the roller 112 encounters a notch 116 in the negative film the armature 153 is actuated to drop the ratchet bar one tooth to bring the indicator 151 in registry with the indicium on the card 148 denoting the adjustment to be made at the corresponding stop of the film operating mechanism.

The electric circuit arrangement of the machine is indicated in Figure 4. The lamp 9 is connected in series with the rheostat 3 and is supplied from a source of direct current 155 controlled by a switch 156. The solenoid 124 and electro-magnet 152, which are in circuit with the switch 113, the motor, and illuminating lamps 157 on the machine are supplied from a source of alternating current 158 controlled by a switch 159.

The projection device above described cooperates with a photographic device spaced therefrom along the focal axis of the machine for printing upon a positive film from the negative film 59, and the photographic device and the related parts will now be described.

The frame 46 is provided with a support rail 161 which is disposed parallel with the focal axis of the machine, and mounted on this rail for independent adjustment there-

along are two supports 162 and 163. See Figures 2 and 25. Rotatably mounted on the frame 46 and extending in parallelism with the support rail at the rear thereof is a pair of screws 164, each of which is screwthreaded through a screwthreaded bore 165 of a respective support 162 or 163 and passes through an unthreaded bore 166 of the other support, whereby are provided adjustment screw devices for independently adjusting the supports 162 and 163 along the support rail 161 and consequently along the focal axis of the machine. Mounted on the outer support 162 is a light excluding enclosing casing 167 which is inclusive of a door 168 forming the front of the casing for access thereinto and a circular member 169 closing a corresponding intermediately disposed opening on the inner side of the casing and provided with an extended bore 171 therethrough which is disposed adjacent the front of the casing and is alined with the focal axis of the machine. See Figures 1, 2, 12 and 27. The door 168 is suitably hinged to the casing 167 at its outer side, and a spring latch device 172 at the inner side of the door serves to releasably secure the door in closed position on the casing. The circular member 169 is secured with the casing 167 in a usual manner unnecessary to be described.

The enclosure of the intermediate portion of the casing 167 is divided by a vertical partition plate 173 disposed parallel to the front opening of the casing and completing a film chamber adjacent the door 168. See Figures 25 and 27. The circular member 169 is provided with a vertical transverse portion 174 spaced inwardly from the main portion thereof and apertured coaxially with the bore 171 and extending across the aforementioned film chamber. See Figures 25, 27, and 29. A vertically disposed intermittent positive film feed guide is associated with the portion 174 and includes a film face guide member 175 secured on the outer face of the portion 174 and a second film face guide member 176, the guide member 175 being provided with a light aperture 177 alined with the focal axis of the machine, the bore of the portion 174, and the bore 171 of the member 169 for exposing an unexposed film 178 in this guide. A carrier member 179 extends longitudinally of the focal axis of the machine intermediate the ends of the positive film guide. This carrier member is disposed on the outer side of the partition plate 173 and is mounted thereon for movement longitudinally of the focal axis of the machine by means of shouldered studs 181 engaging slots 182 in the partition plate and frictionally engaged therewith to frictionally position the carrier member by means of spring washers 183 on the studs between the heads thereof and the carrier member. See Figure 27. The end of the member 179 adjacent the member 169 is vertically extended and carries the film guide member 176 on this extended portion for movement therewith into and out of film retaining relation with the film guide member 175. The ends of the guide member 176 are turned over the corresponding ends of the vertically extended portion of the member 179, as designated at 184, and permit limited movement of this guide member with respect to the member 179 along the focal axis of the machine. A stud 185 is secured on the intermediate portion of the guide member 176 and extends longitudinally of the focal axis of the machine through a bore in the member 179. See Figures 28 and 29. A compression spring 186 encircles the stud 185 between a shoulder 187 in the said bore of the member 179 and the head of this stud and yieldably urges the guide member 176 with respect to the member 179 in the direction of the guide member 175, this movement being limited by the turned over ends 184 of the guide member 176. When the member 179 is positioned in guide closed position the spring 186 exerts a slight pressure on the film 178 in the guide, and the door 168 is provided with an extension 188 which engages back of the carrier member 179 to prevent the door being closed with the positive film guide open and to prevent accidental movement of the member 179 out of closed guide position while the door is closed. See Figure 27.

Intermittent film feeding mechanism is provided within the casing 167 for intermittently feeding the unexposed or positive film 178 in the positive film guide and this mechanism consists as follows. See Figures 25 and 27. Mounted on the member 169 and extending inwardly therefrom is a stud 191 disposed in parallelism with the focal axis of the machine, and rotatably mounted on this stud is a bored cam shaft member 192. Secured on the member 169 is a pair of alined vertically spaced studs 193 disposed in diametrically opposite relation with respect to the cam member 192, and mounted on the studs 193 for pivotal movement and movement longitudinally thereof is a shuttle 194 provided with a transverse opening 195 through which the cam member 192 extends. A radial cam 196 fast on the cam member 192 engages opposite horizontal edges of the opening 195 of the shuttle 194 to effect vertical reciprocating or film feed and return movements of this shuttle with rotation of the cam member 192, and a face cam 197 fast on the cam member 192 engages projections 198, spaced in diametrically opposite relation with respect to the studs 193, on the shuttle to effect film engaging and disengaging movement of the shuttle. This shuttle 194 is provided with a toothed extension 199 engageable with usual perforations of the film 178 in the positive film guide for intermittently feeding the film therein in a usual manner, the cams 196 and

197 being properly timed for this purpose. See Figure 25. A revolving segmental light shutter 201 is secured on the cam member 192 in timed relation with the cams 196 and 197 and sweeps over the aperture 177 of the guide member 175 in a plane between the main portion of the member 169 and the portion 174 thereof to intermittently interrupt exposure of the film 178 during intermittent movement thereof effected by rotation of the cam member 192.

A pair of rotatable constant feed film sprockets 201 are spaced vertically above and below the carrier member 179 within the casing 167 and in back of the positive film guide, and are disposed in film feeding alinement with this guide and are movably mounted and connected for movement with the carrier member 179 into film retaining relation with stationary film retaining members 202 with film guide closing movement of the member 179 and out of film retaining relation with these film retaining members with film guide opening movement of said carrier member, for purposes of lacing and unlacing the film 178 on these sprockets, in a manner unnecessary to be described, this structure being fully described and claimed in my co-pending application for Letters Patent, Serial No. 70,449, filed November 21, 1925, for improvement in motion picture mechanism.

The sprockets 201 are driven from and in timed relation with the cam member 192 in the following manner. See Figures 25 and 27. Journaled on and extending between the plate 173 and the rear wall of the casing 167 is a transverse shaft 203 on the end of which adjacent the plate 173 is secured a gear pinion 204 which meshes with gear pinions 205 fast on the inner ends of the sprockets 201. A crown gear 206 is secured on the shaft 203 and meshes with a gear pinion 207 fast on the cam member 192 whereby the sprockets 201 are driven in timed relation with the associated intermittent film feeding mechanism.

In the operation of the machine the film 178 is fed from a lower film spool 208 within the aforementioned casing 167 around the lower film sprocket 201, thence in the form of a compensating loop to the lower end of the positive film guide, from the upper end of this guide in the form of another compensating loop to the upper sprocket 201 and around it, and from there is wound upon an upper film spool 209. See Figure 1. The upper film spool 209 is driven to rewind the film 178 by means of a slip driving device 211, unnecessary to be described, and a sprocket and chain driving device 212 which is driven from the shaft 203 through a pair of meshing spur gears 213 one of which is secured on the shaft 203. See Figures 2, 25, and 27. It will be observed that the enclosure by the light excluding casing 167 of the positive film 178 adapts the machine for daylight operation, and daylight loading and unloading with the use of usual daylight loading film cartridges.

Images on the negative film at the aperture of the negative film guide are projected upon the unexposed film 178 at the aperture of the positive film guide through a usual photographic lens 214 disposed between the projection and exposure devices above described, the film operating mechanism of the projection and exposure devices being operated in synchronism in a manner now to be described. The films 59 and 178 are operated in opposite directions because of the image reversal caused by the lens 214.

A shaft 215 is journaled in a bore of the member 169 and is disposed in parallelism with the focal axis of the machine and the cam member 192, and has a spur gear 216 mounted on its inner end which meshes with a spur gear 217 of like size secured on the cam member 192 for driving the cam member, the shaft 215, by reason of the gears 216 and 217 being of equal size, making one revolution to each revolution of the cam member 192. See Figures 25 and 27. The shaft 215 is substantially alined with the aforementioned cam shaft 21. Disposed outwardly beyond and adjacent the outer end of the shaft 21 and in alinement therewith is a short shaft 218 which is journaled in an extension bracket 219 secured on the frame 2. See Figures 2 and 6. A positive clutch member 221 is fast on the end of the shaft 21 adjacent the shaft 219 and a complementary positive clutch member 222 is formed on the adjacent end of the shaft 218 for driving the same, and the shaft 218 is axially movable to engage and disengage the clutch member 222 with the clutch member 221 for driving the shaft 218 from the shaft 21 and for disengaging the same therefrom. Axial movement of the clutch member 222 is controlled by a vertical eccentric shaft 223 pivotally mounted on the frame 2 and engaging a circumferential groove 224 on this clutch member, angular movement of the shaft 223 being manually controlled by a transverse rack bar 225 slidably mounted on the frame 2 and provided with a handle 226 at its front end for convenient manipulation and meshing with a gear segment 227 secured on the shaft 223. See Figures 1, 12, 14, and 15.

Disposed between the shafts 215 and 218 and connecting the same for driving the shaft 215 from the shaft 218 is a shaft driving device consisting of an axial slip shaft driving device 228 of usual construction and a pair of universal joint driving devices 229 of usual construction connecting the slip driving device with the shafts 215 and 218, thus permitting vertical adjustment of the frame 46 with respect to the frame 2 and permitting

adjustment of the exposure device longitudinally of the focal axis of the machine by adjusting the support 162 along the support rail 161 as hereinbefore described. See Figures 2, 12, and 27.

The machine shown is what is termed a reduction printer, it being proportioned to print from a larger negative film 59, say of a width of 35 mm. on to a smaller positive film 178, say of a width of 16 mm. Obviously the dimension of the individual picture spaces extending longitudinally of these films are in a like proportion. Consequently the intermittent film feeding mechanism for operating the positive film 178 is of correspondingly smaller proportions than that of the intermittent film feeding mechanism for operating the negative film 59 with the natural result that the axis of the cam member 192 is closer to the focal axis of the machine than is the axis of the cam shaft 21. It will be observed that the shaft driving device consisting of the slip driving device 228 and the universal joint driving devices 229 is directly connected with the cam shaft 21 and that it is indirectly connected with the cam member 192 through the gears 216 and 217 whereby the aforementioned shaft driving device extends in substantial parallelism with the focal axis of the machine and is spaced sufficiently therefrom so as not to interfere with other instrumentalities of the machine.

The positive clutch comprising the clutch members 221 and 222 makes one revolution to each revolution of the cam shaft 21 and the cam member 192 which it is obvious make one revolution to each cycle of their respective mechanisms, and this clutch is a single position clutch by reason of the fact that the clutch member 221 is provided with a wedge shaped diametrical clutch groove 231 which is engaged by a correspondingly wedge shaped diametrical clutch projection 232 on the clutch member 222, so that engagement of this clutch automatically times the projection and exposure mechanisms. See Figures 6 and 7.

The projection and exposure mechanisms of the machine are so timed that both of the films 59 and 178 are intermittently moved in their respective guides while the light shutter 200 is in closed position, that is when the shutter is disposed in front of the aperture 177 of the positive film guide member 175 to interrupt the printing light on the positive film 178 at this aperture, and it is in this position that the aforementioned stop mechanism under the control of the notched negative film 59 stops the film operating mechanisms when the plunger 134 engages in the notch 145 on the cam disk 22, as shown in Figures 13 and 23 and heretofore described. The timing of the cams 64 and 196 and the light shutter 200 is shown in Figure 9, the positions of these cams and the light shutter being shown when the mechanism is stopped by the aforementioned stop mechanism.

In order that the exposure mechanism may be accurately stopped in shutter closed position, as indicated in Figure 9, when the clutch, comprising the clutch members 221 and 222, is disengaged, the clutch member 222 is provided with a second clutch projection 233 extending radially thereof which is engageable in a slot 234 on the bracket 219 when the clutch member 222 is disengaged from the clutch member 221. See Figures 6 and 8.

Thus the machine is stopped in shutter closed position by the stop mechanism under the control of the notched negative film 59 so that no positive film 178 is spoiled during such stoppage, and positive stoppage of the exposure mechanism in shutter closed position is assured to prevent spoilage of any portion of the positive film upon disengagement of the driving clutch thereof comprising the clutch members 221 and 222, disengagement of this clutch permitting the operation of the projection mechanism independently of the exposure mechanism, as where it is desired to omit printing of a portion of the negative film 59 upon the positive film 178.

As hereinbefore described the film 59 in the negative film guide is released during intermittent movement thereof in this guide by reason of the cam 84 cooperating with the roller 83 to intermittently operate the tubular member 68 and with it the guide member 57 against the influence of the spring 74 away from the guide member 56.

In order that the positive film 178 in the positive film guide is released during intermittent movement thereof in this guide by the same mechanism by which the negative film 59 is so released in the negative film guide the following mechanism is provided. The outer portion of the tubular member 68 is provided at its outer end with a downward extension 235. See Figures 1, 15, and 21. The lower portion of this extension is bored in parallelism with the focal axis of the machine and with the movement of the member 68, and slidably engaged in this bore is a sport rod 236, the end of which, outwardly beyond the outer end of the member 68, is secured in one end of the bore of a sleeve 237. A rod 238 is adjustably screw-threaded into the other end of this sleeve and is secured in adjusted position thereon by a lock nut 239. The rod 238 extends longitudinally of the focal axis of the machine toward the exposure mechanism, and enters the enclosure of the casing 167 through a bore in which it is slidably engaged. See Figures 1, 25, and 27. Referring to Figure 21, the extension 235 is bored upwardly from its lower end on an axis intersecting that of the rod 236, and a ball 240 is disposed in this vertical bore above this rod and is yieldably urged downwardly

into a notch 241 on this rod by means of a compression spring 242 interposed between said ball and the upper end of said vertical bore whereby the rod 236, the sleeve 237 and the rod 238 are moved longitudinally with movement of the tubular member 68 longitudinally of the focal axis of the machine. A screw 243 screwthreaded into the lower end of the vertical bore of the extension 235 engages a flat surface 244 of the rod 236 to prevent angular movement of this rod, the sleeve 237 and the rod 238. A member 245, formed of flat spring metal, has its lower end secured to the rear face of the lower portion of the vertically extended portion of the carrier member 179 and has an upper portion 246 thereof rearwardly offset and engaged in a lateral slot 247 formed in the rear end of the hereinbefore described stud 185. See Figures 25, 28, 29, and 30. Thus movement of the upper portion of the member 245 away from the guide member 175 effects similar movement of the guide member 176 against the influence of the aforementioned spring 186 to release the film 178 in the positive film guide, release of the member 245 permitting the guide member 176 to move in the opposite direction under the influence of the spring 186 to exert a slight pressure on the film 178 in the positive film guide. The member 245 is provided with a right angled lateral extension 248 adjacent its upper end which extends outwardly beyond the positive film guide and then in the direction of the projection device. Secured on the end of the rod 238 within the casing 167 is a laterally extending finger 249 which lies in abutting relation with the end of the extension 248 of the member 245, whereby when the rod 238 is moved in the corresponding direction the guide member 176 is moved against the influence of the spring 186 to release the film 178 in the positive film guide. The movement of the tubular member 68 to release the negative film 59 in the negative film guide, effected by the cam 84 operating on the roller 83 against the influence of the spring 74 as hereinbefore described, is transmitted to the rod 238, the sleeve 237 and the rod 236 by means of the ball 240 spring pressed into engagement with the notch 241 of the rod 236, and this movement effects release of the positive film 178 in the positive film guide as well, whereby the cam 84 operating upon the roller 83 constitutes a common means for intermittently releasing both guides to release the films therein during intermittent movement thereof with obvious advantage.

The positive film guide is opened and closed by operating the carrier member 179 in a direction away from the guide member 175, the member 245 merely moving away and toward the finger 249 with this movement of the carrier member. When the negative film guide is opened by manipulation of the aforementioned lever 75, the ball 240 disengages from the notch 241 of the rod 236 against the influence of the spring 243 and permits the extension 235 to slide along this rod until the negative film guide is closed when the ball re-engages the notch for release of the positive film guide as before described. Thus, the negative and positive film guides may be opened independently of each other.

The hereinbefore mentioned support member 163, which is adjustable along the support rail 161 of the frame 46 and longitudinally of the focal axis of the machine, is provided at its upper end with a tubular formation 251 which surrounds the focal axis of the machine and extends from the member 163 in the direction of the member 169 and telescopically extends into the bore 171 of the member 169 with its extended end for longitudinal movement with respect thereto. Mounted on the support member 163, at the other end of the tubular formation 251, for vertical movement with respect thereto normal to the focal axis of the machine, by means of spaced opposing adjustable slide bearings 252 disposed on opposite sides of this tubular formation, is a support or bearing member 253 provided with a bore 254 therethrough surrounding the focal axis of the machine. See Figures 27, 31 and 34. The support member 253 is adjusted with respect to the support member 163 along the slide bearings 252 by means of a screw 255 disposed in parallelism with said slide bearings and screwthreaded through the intermediate portion of a cross piece 256, secured on the upper end of the support member 253, and axially fixed with the support member 163 by means of a suitable bearing 257 permitting rotation of the screw with respect to the support member 163.

Mounted on the support member 253, on the side thereof facing the projection device, for horizontal movement with respect thereto normal to the focal axis of the machine and normal to the adjusting movement of this support member, by means of spaced opposing adjustable slide bearings 258 disposed on opposite sides of the focal axis of the machine, is a support member 259 provided with a bore 261 therethrough surrounding the focal axis of the machine. See Figures 12, 32, and 33. The support member 259 is provided with an indicating dial 262 disposed normal to the focal axis of the machine and facing forwardly. See Figures 1, 27, 31, and 33. The support member 259 is adjusted with respect to the support member 253 along the slide bearings 258 in the following manner. A screw 263 is screwthreaded through the dial 262 on an axis parallel to and lying between the slide bearings 258, and pivotally mounted at one end on the support member 253 by means of a headed screw 264 is a yoke plate 265 provided with an intermediate slot

266 and a similarly facing slot 267 disposed at the other end of the plate. When the plate 265 is in the pivotal position shown in Figure 32 the slot 266 is engaged in a circumferential groove 268 of the screw 263 to axially fix the screw with the support member 253 for adjustment of the support member 259 along the slide bearings 258 with rotation of the screw, the slot 267 being engaged under the head of a screw 269, screwthreaded on the support member 253, to firmly fix the plate with the support member 253. The plate 265 by reason of the slots 266 and 267 may be moved, pivotally on the screw 264, out of engagement with the groove 268 of the screw 263 so that the support member 259 may be removed from the support member 253 by disengagement of the slide bearings 258 and replaced thereon without disturbing adjustment of the screw 263 for purposes hereinafter described. A small handle 270 is affixed on the plate 265 for the convenient manipulation thereof.

Secured on the side of the support member 259 facing the projection device is a tubular member 271 forming a portion of the support member and disposed coaxially with the bore 261 thereof. See Figures 12 and 27. The end of the bore 261 of the support member 259 is continued a short distance into the enclosure of the tubular member 271 by means of a hub 272, and the hereinbefore mentioned lens 214 is screwthreaded into this extended end of the bore 261 and lies within the enclosure of the tubular member 271.

The lens 214 is a usual photographic lens provided with an adjustable iris mechanism which is inclusive of an external ring 273 angularly movable with respect to the body of the lens for adjusting the iris mechanism. The tubular member 271 is enlarged adjacent the support member 259 and disposed in this enlargement is a correspondingly large annular bevel gear 274 which is rotatably mounted in coaxial relation with the lens upon the hub 272 between the main portion of the support member 259 and a usual mounting shoulder flange 275 on the body of the lens 214. Secured on the bevel gear 274 is a finger 276 which engages a slot on the exterior of the ring 263, thereby rotatably fixing the gear 274 with the ring 273 for adjustment of the iris mechanism of the lens 214 with angular movement of the gear. See Figures 27 and 32.

Rotatably mounted on the support member 259 in coaxial relation with the dial 262 and accordingly disposed radially with respect to the tubular member 271 and extending from the exterior of this tubular member into the interior thereof through a bore through the dial, is a shaft 277 upon the inner end of which and within this tubular member is formed a bevel gear pinion 278 meshing with the gear for adjustment of the iris mechanism from the exterior of the tubular structure. Secured on the outer end of the shaft 277 is a manipulating knob 279, and also secured with the shaft 277 on the exterior of the dial is an index arm 281 cooperating with an index 282 on the face of the dial for indicating adjustment of the iris mechanism of the lens 214 and yieldably engaged with the dial to prevent accidental movement of the shaft 277. See Figures 1, 27, and 31.

A light enclosing tube 283 disposed in coaxial relation with the tubular member 68 has one end thereof secured in telescopic engagement with the outer end of the member 68 and continues the enclosure thereof in the direction of the tubular member 271. See Figures 1 and 6. Another light enclosing tube 284 is telescopically engaged with the tube 283 for relative sliding movement with respect thereto and extends therefrom to the tubular member 271 within which it is telescopically engaged for disengagement therefrom. See Figures 1, 6, and 27. A radially disposed inwardly projecting pin 285 is mounted on the tubular member 271 and is engaged in a bayonet slot 286 in the adjacent end of the tube 284 for releasably securing the tube 284 with the tubular member 271. See Figure 27. Thus is provided a light enclosing tubular structure between the projection and exposure film guides surrounding the focal axis of the machine and enclosing the projection light path between the projection and exposure guides. The telescopic engagements of the tubes 283 and 284 and the tubular formation 251 within the bore 171 of the member 169 for relative movement permits adjustment of the photographic device, and the tubular member, comprising the members 259 and 271 carrying the lens 214, longitudinally of the focal axis of the machine and permits film guide opening movement of the tubular member 68. The tubular member, comprising the members 259 and 271, carrying the lens 214 is removable by moving the tube 284 on the tube 283 out of engagement with the tubular member 271 after releasing the bayonet slot 286 from locking engagement with the pin 285 in a usual manner and disengaging the plate 265 from the screw 264 and then laterally removing the tubular member, comprising the members 259 and 271, along the slide bearings 258. The lens 214 is thus easily accessible, and it will be noted that the means for adjusting the lens from the exterior of the tubular structure and the means for indicating adjustment of the lens exteriorly of the tubular structure is carried with the laterally removable tubular structure with obvious advantage.

Adjustments of the printing light are effected by either adjusting the rheostat 3 or the iris mechanism of the lens 214 as before described, such adjustments being indicated

on the index card 148 in the proper sequence. For the convenience of the operator a footage recording device 287 is mounted on the bracket 146 and is driven from the film operating mechanism in a manner unnecessary to be described.

The tubular member 68 is provided at the front thereof with a side opening 288 which is adjacent the negative or projection guide, and a ruby glass 289 is mounted on the member 68 and covers said opening to prevent the passage of printing light through said opening. This opening 288 permits viewing of the exposure aperture of the negative or projection guide while the ruby glass 289 prevents the passage of printing light through the opening with obvious advantage. See Figures 1, 6, and 20.

Secured on the shaft 215 adjacent the outer end thereof is a cam 290. See Figures 2, 26, and 27.

Secured on the member 169 and disposed above the cam 290 is a vertical cylinder 291, the lower end of which is closed by a cap 292 secured thereto. Mounted for sliding movement in the enlarged lower end of the cylinder is a piston 293 which is provided with a piston rod 294 extending through and engaged for sliding movement in a bore of the cap 292. See Figure 26. A spring 295 is disposed within the reduced upper end of the cylinder and above the piston and yieldably urges the piston downwardly. The lower end of the piston rod is provided with a roller 296 which engages downwardly on the cam 290 whereby this cam and the spring 295 cooperate to effect reciprocation of the piston 293 with rotation of the shaft 215. The lower end of the cylinder 291 is communicated with the exposure aperture 177 of the positive film guide through a closed passage comprising a hole 297 in the portion 174 of the member 169 communicating with the bore of the portion 174 corresponding with the exposure aperture 177 and extending upwardly therefrom and through the portion of the casing 167 surrounding the member 169 and a pipe 290 extending between and communicating with said hole and the lower end of the cylinder 291. See Figures 25, 26, and 29.

Rotation of the cam 290 is effected with the operation of the positive film operating mechanism as is obvious, and pulsations of air are effected at the exposure aperture 177 of the positive film guide for dislodging dust or other foreign matter that is liable to lodge at the exposure aperture and mar the pictures printed on the positive film. The cam 290 makes one revolution to each revolution of the positive film feeding mechanism by reason of it being secured to the one revolution shaft 215, and this cam is so timed that a pulsation of air is effected at the exposure aperture 177 during each release of the film in the guide and movement thereof as hereinbefore described.

Certain features and structure of the machine herein shown and described are described and claimed in U. S. Letters Patent issued to me and identified as follows: Reissue No. 14,799, February 3, 1920, No. 1,225,335, May 8, 1917, and No. 1,577,030, March 16, 1926.

While I have herein shown and particularly described the preferred embodiment of my invention I do not wish to be limited to the precise details of construction shown as changes may readily be made without departing from the spirit of my invention, but having thus described my invention, I claim as new and desire to secure by Letters Patent the following:

1. In a motion picture film printing machine the combination with a projection device including a light apertured film feed guide and an intermittent feed mechanism for operating a film therein, a frame carrying said feed mechanism, a second frame carrying said guide, means whereby one of said frames is adjustable longitudinally of said guide with respect to the other frame, and a motion picture film photographic device cooperating with said projection device and carried by said second frame.

2. In a motion picture film printing machine the combination with a projection device including a light apertured film guide and an intermittent feed mechanism for operating a film therein, of a frame carrying said feed mechanism, a second frame carrying said guide and mounted on said first mentioned frame for adjustment with respect thereto longitudinally of said guide, a motion picture film photographic device cooperating with said projection device and carried by said second frame, and manually controlled means for adjustably positioning said second frame with respect to said first mentioned frame.

3. In a motion picture film printing machine the combination with a projection device including a light apertured film feed guide and an intermittent feed mechanism for operating a film therein, of a frame carrying said feed mechanism, a second frame carrying said guide, means whereby one of said frames is adjustable longitudinally of said guide with respect to the other frame, a motion picture film photographic device cooperating with said projection device and carried by said second frame, and a driving connection between said first mentioned frame and said photographic device for effecting operation of said feed mechanism and said photographic device in synchronism and adapted to permit said adjustment of said frames.

4. In a motion picture film printing machine the combination with a projection de-

vice including a light apertured film feed guide and an intermittent feed mechanism for operating a film therein, of a frame carrying said feed mechanism, a second frame carrying said guide and mounted for adjustment with respect to said first mentioned frame longitudinally of said guide, a motion picture film photographic device cooperating with said projection device, means whereby said photographic device is carried by said second frame for adjustment with respect thereto longitudinally of the focal axis of the machine, and a shaft driving device extending longitudinally of the focal axis of the machine between said first mentioned frame and said photographic device and including spaced universal driving joints and an axial slip driving device.

5. In a motion picture film printing machine the combination with a projection device including a light apertured film feed guide and an intermittent feed mechanism for operating a film therein, of a frame carrying said feed mechanism, a second frame carrying said guide, means whereby one of said frames is adjustable longitudinally of said guide with respect to the other frame, a motion picture film exposure device, a photographic lens interposed between said projection and exposure devices, and means whereby said exposure device and said lens are carried by said second frame for independent adjustment with respect thereto longitudinally of the focal axis of the machine.

6. In a motion picture film printing machine the combination with a projection device including a light apertured film feed guide and an intermittent feed mechanism for operating a film therein, of a frame carrying said feed mechanism, a second frame carrying said guide, means whereby one of said frames is adjustable longitudinally of said guide with respect to the other frame, a motion picture film exposure device, a photographic lens interposed between said projection and exposure devices, means whereby said exposure device and said lens are carried by said second frame for independent adjustment with respect thereto longitudinally of the focal axis of the machine, and means whereby said photographic lens is adjustable transversely of said focal axis.

7. In a motion picture film reduction printing machine the combination with spaced projection and exposure devices disposed in focal alinement and each including a revoluble cam member disposed in axial parallelism with the focal axis of the machine, the cam member of said exposure device being disposed closer to said focal axis than the other cam member, of means for driving said cam members in unison including a shaft device directly connected with the cam member of said projection device and extending in substantial parallelism with said focal axis and a one to one gear connection between said shaft device and the cam member of said exposure device.

8. In a motion picture film printing machine the combination with a lamp chamber, of an electric driving motor disposed alongside thereof in parallelism with the focal axis of the machine, a projection device associated with said lamp chamber including a revoluble cam shaft disposed on an axis parallel with the focal axis of the machine and lying between the same and the axis of the motor, a gear on the cam shaft for driving the same, a gear pinion on the motor and meshing with said first mentioned gear for driving the same from the motor, an exposure device disposed in focal alinement with said projection device and including a second cam shaft disposed in parallelism with the focal axis of the machine, and a shaft device extending longitudinally of the focal axis of the machine for driving said second cam shaft from said first mentioned cam shaft.

9. In a motion picture film printing machine the combination with a projection device including a light apertured film guide and an intermittent film feed cam shaft disposed at one side thereof and in parallelism with the focal axis of the machine, of a frame carrying said cam shaft, a lamp chamber carried by said frame and associated with said guide, an electric motor carried by said frame and disposed alongside said lamp chamber in parallelism with said cam shaft, a driving connection between said motor and cam shaft, a second frame carrying said guide and mounted on said first mentioned frame for adjustment with respect thereto longitudinally of said guide, a motion picture photographic device cooperating with said projection device and carried by said second frame for adjustment with respect thereto longitudinally of the focal axis of the machine and including a second intermittent film feed cam shaft disposed in parallelism with the focal axis of the machine, and a shaft device for driving said second cam shaft in synchronism with said first mentioned cam shaft and including two spaced universal driving joints and an axial slip driving device.

10. In a motion picture film printing machine the combination of a projection mechanism and a photographic mechanism including an intermittently exposing light shutter, means for driving said mechanisms in synchronism including a releasable positive clutch for driving said photographic mechanism to permit operation of said projection mechanism independently of said photographic mechanism and adapted to automatically synchronize said mechanisms with engagement thereof, and stop means connected for control with said clutch and adapted to stop operation of said photographic device

with said shutter in closed position with disengagement of said clutch and to release with engagement of said clutch.

11. In a motion picture film printing machine the combination of a projection mechanism and a photographic mechanism including an intermittently exposing light shutter, means for driving said mechanisms in synchronism including a one revolution releasable single position positive clutch for driving said photographic mechanism to permit operation of said projection mechanism independently of said photographic mechanism, said clutch including a manually controlled clutch member rotatably fixed with said photographic mechanism and axially movable to engage and disengage said clutch, a stationary stop, and a second stop on said clutch member adapted to be engaged with said stationary stop when said clutch member is in clutch disengaged position to stop said photographic mechanism in shutter closed position and to be disengaged therefrom when said clutch member is in clutch engaged position.

12. In a motion picture film printing machine the combination with a light apertured intermittent feed film guide one of the film face guide members of which is movable to and away from the other, of a pivoted manually operated member, an intermediate member mounted for movement in the direction of movement of said movable guide member, a spring interposed between said intermediate member and said movable guide member and operative in a direction to close the guide, means limiting movement of said intermediate member with respect to said movable guide member in the direction of guide opening movement of the intermediate member, a toggle link operating connection between said pivoted member and said intermediate member, a stop limiting movement of said toggle link connection for locking the same in guide closed position, and means for intermittently operating said movable guide member against the influence of said spring to release a film during intermittent movement thereof in the guide.

13. In a motion picture film printing machine the combination with a light apertured intermittent feed film guide, of a projection tube structure alined with the light aperture thereof and movable normal to the plane thereof and carrying one of the film face guide members thereof, a slide member slidably mounted on said tube structure for movement with respect thereto in a direction corresponding with the movement of the tube structure, a spring interposed between said tube structure and said slide member and operating on said tube structure in a direction to close said guide, abutment portions on said slide member and said tube structure limiting movement of said slide member with respect to said tube structure in the direction of guide opening movement of said slide member, manually operated means connected with said slide member for effecting guide opening and closing movement thereof including means for locking said slide member in closed guide position, a second slide member slidably mounted on said tube structure for movement with respect thereto in a direction corresponding with said movement of the tube structure, screw adjusting means operating between said second slide member and said tube structure, a revoluble cam, and part on said second slide member and engageable with said cam for operating said tube structure for intermittently releasing a film during intermittent movement thereof in the guide.

14. In a motion picture film printing machine the combination with spaced light apertured projection and exposure film feed guides one of the film face guide members of each of which is movable to and away from the other to open and close the guides, of manually controlled means for independently operating said movable guide members to open and close said guides, means for intermittently feeding films in said guides in synchronism, and a common means for intermittently operating said movable guide members to release said films during intermittent movement thereof and adapted to permit independent opening of either of said guides.

15. In a motion picture film printing machine the combination with spaced light apertured projection exposure film feed guides one of the film face guide members of each of which is movable to and away from the other to open and close the guides, of manually controlled members for independently operating said movable guide members to open and close said guides, resilient means interposed between said movable guide members and said manually controlled members permitting film releasing movement of said movable guide members and yieldably urging said movable guide members in the direction of guide closing movement thereof, means for intermittently feeding films in said guides in synchronism, means for intermittently operating the movable guide member of one of said guides to release a film therein during intermittent movement thereof, and a connection between said last mentioned movable guide member and the other movable guide member whereby said other movable guide member is operated to intermittently release the corresponding film during intermittent movement thereof, said connection including notched and notch engaging members yieldably engaged for release to permit independent opening and closing movement of either of said movable guide members.

16. In a photographic printing machine the combination with spaced projection and

exposure devices, of a tubular projection light enclosing structure extending therebetween and including a laterally removable photographic lens carrying structure, a slide mounting carrying said lens carrying structure for lateral adjustment, and screw adjustment means extending longitudinally of said slide mounting and operating between said slide mounting and said lens carrying structure and including a screw provided with a circumferential groove and a yoke member engageable in said groove and pivotally mounted for disengagement with said groove to permit removal of said lens carrying structure from said slide bearing without disturbing the adjustment of said screw.

17. In a photographic printing machine the combination with a tubular projection light enclosing structure, of a photographic lens mounted therein in coaxial relation therewith and provided with an adjustable iris mechanism, an annular bevel gear member mounted within said tubular structure for angular movement in coaxial relation with the lens for operating said iris mechanism, a revoluble spindle manually operated from the exterior of said tubular structure and extending from the exterior of said tubular structure in radial relation therewith into the interior thereof, a bevel gear pinion fast on said spindle within said tubular structure and meshing with said annular member for angularly adjusting the same, and means on the exterior of said tubular structure and associated with said spindle for indicating the adjustment of said iris mechanism.

18. In a photographic printing machine the combination with spaced projection and exposure devices, of a tubular projection light enclosing structure therebetween including a laterally removable structure, a photographic lens mounted within said removable structure and provided with an adjustable iris mechanism, means for adjusting said iris mechanism from the exterior of said tubular structure and carried by said removable structure, and means for indicating adjustment of said iris mechanism on the exterior of said tubular structure and carried by said removable structure.

19. In a photographic printing machine the combination of a light apertured film guide adapted to be opened, a ruby glass shutter movable to and from a position to interrupt printing light to the light aperture of said guide, manually operated means for opening and closing said guide, and means under the control of said manually operated means and adapted to position said shutter in said position thereof when said guide is open and out of said position when said guide is closed.

20. In a photographic printing machine the combination of a light apertured film guide adapted to be opened, a light shutter movable to and from a position to interrupt printing light to the light aperture of said guide, manually controlled means for opening and closing said guide and including means adapted to lock the guide in closed position with final guide closing movement and to unlock the guide with initial guide opening movement of said manually controlled means whereby said shutter is moved into said position thereof with said initial guide opening movement and out of this position with said final guide closing movement of said manually controlled means.

21. In a photographic printing machine the combination of a light apertured film guide adapted to be opened, a light shutter movable to and from a position to interrupt printing light to the light aperture of said guide, a manually controlled operating member, means whereby said operating member opens and closes said guide including means for locking the guide in closed position and adapted to unlock with initial guide opening movement of and to lock with final guide closing movement of said operating member, and means for operating said shutter from said operating member including yieldably engaged notched and notch engaging members adapted to move said shutter into said position thereof with initial guide opening movement of said operating member and to move said shutter out of said position with final guide closing movement of said operating member and adapted to release to permit independent movement of said operating member during the remainder of the guide opening and closing movements of said operating member.

22. In a photographic printing machine the combination of a light apertured film guide adapted to be opened, a ruby glass light shutter movable to and from a position to interrupt printing light to the light aperture of said guide, a pivoted manually actuated operating member, means whereby said operating member opens and closes said guide including means for locking the guide in closed position and adapted to unlock with initial guide opening movement of and to lock with final guide closing movement of said operating member, a reciprocable cam for actuating said shutter, friction means retarding movement of said cam, stop means limiting movement of said cam in the direction to move said shutter into said position, a second pivoted member for operating said cam and disposed coaxially with said operating member and provided with an axially facing notch, a notch engaging member rotatably fixed with said operating member and engageable in said notch and releasable therefrom with relative angular movement between said notched and notch engaging members, and spring means yieldably urging

said notched and notch engaging members axially into notch engaging relation.

23. In a photographic printing machine the combination with a lamp chamber provided with air inlet and outlet openings, of an electric motor for driving the machine, a centrifugal speed governor including an axially movable friction member rotatably fixed with the motor shaft and centrifugal means fixed with the motor shaft for variably positioning said friction member axially, air impelling vanes on said friction member, and a casing enclosing said governor and impelling vanes and provided with an air inlet and an air outlet communicating with the air inlet opening of said lamp chamber.

24. In a photographic printing machine the combination with a lamp chamber provided with air inlet and outlet openings, of an electric motor for driving the machine, a centrifugal speed governor including a disklike friction member carried with the motor shaft and rotatably fixed therewith and movable axially with respect thereto and centrifugal means carried with and rotatably fixed with the motor shaft for variably positioning said friction member axially, air impelling vanes carried by said friction member, and a casing enclosing said governor and impelling vanes and provided with an air inlet and an air outlet communicating with the air inlet opening of said lamp chamber.

25. In a photographic printing machine the combination with a vertically arranged light confining lamp chamber, of a horizontally arranged electric motor for driving the machine and arranged alongside said lamp chamber, a centrifugal speed governor at one end of the motor shaft and including a disklike friction member rotatably fixed with the motor shaft and axially movable with respect thereto and centrifugal means rotatably fixed with the motor shaft for variably positioning said friction member axially, radially disposed air impelling vanes mounted on said friction member and disposed intermediate said friction member and the motor, a cylindrical casing disposed similarly with respect to the motor and enclosing the same and said governor and vanes and provided with an air inlet opening therethrough intermediate the motor and said vanes, and an air outlet opening overlying said vanes, an angular enclosed light trapping air passage communicating said outlet with the lower portion of said lamp chamber, and a second angular enclosed light trapping air passage communicating with the upper portion of said lamp chamber and extending about said cylindrical casing and communicating with the atmosphere.

26. In a motion picture machine the combination with a light apertured film guide adapted for release of a film therein for movement, of an intermittent feeding mechanism for feeding a film therein, means for intermittently releasing said guide to release the film therein during intermittent movement thereof, and means for effecting pulsations of air at the aperture of said guide during release and movement of the film therein.

27. In a motion picture film printing machine the combination with an exposure apertured film guide adapted for release of a film therein for movement, of an intermittent feeding mechanism for feeding a film therein including a revoluble member, means for intermittently releasing said guide to release the film therein during intermittent movement thereof, a compression cylinder, a piston operative therein, a spring for operating said piston in one direction, a cam rotatably fixed with said revoluble member for operating said piston in the other direction, and a closed passage connection between said cylinder and the aperture of said guide whereby air pulsations are effected at said aperture, said cam being timed with said feeding mechanism to effect said air impulses during release and movement of said film.

In witness whereof I hereunto affix my signature this 14th day of June, 1927.

ALBERT S. HOWELL.