

July 14, 1936.

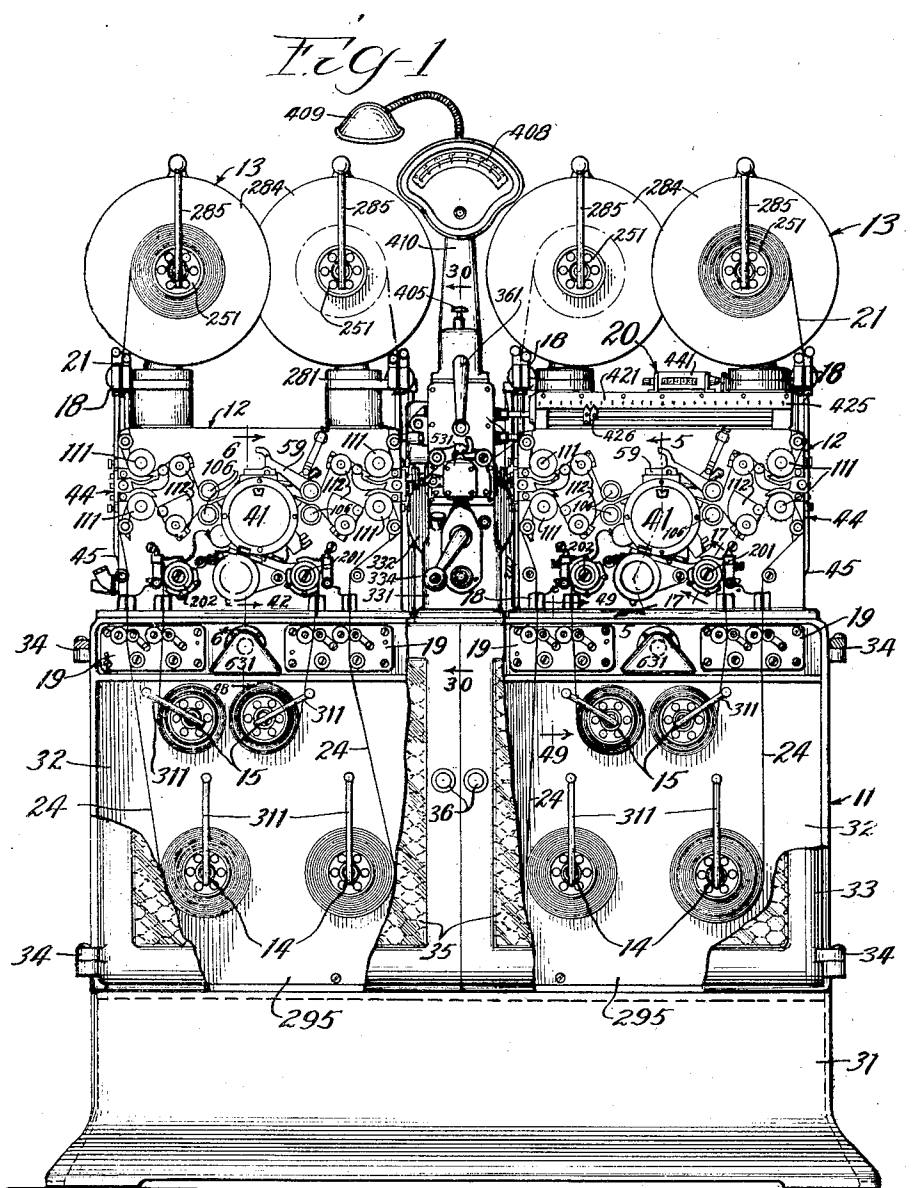
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 1



Inventor:
Albert S. Howell,
By: *Middle & Middle,*
Attys.

July 14, 1936.

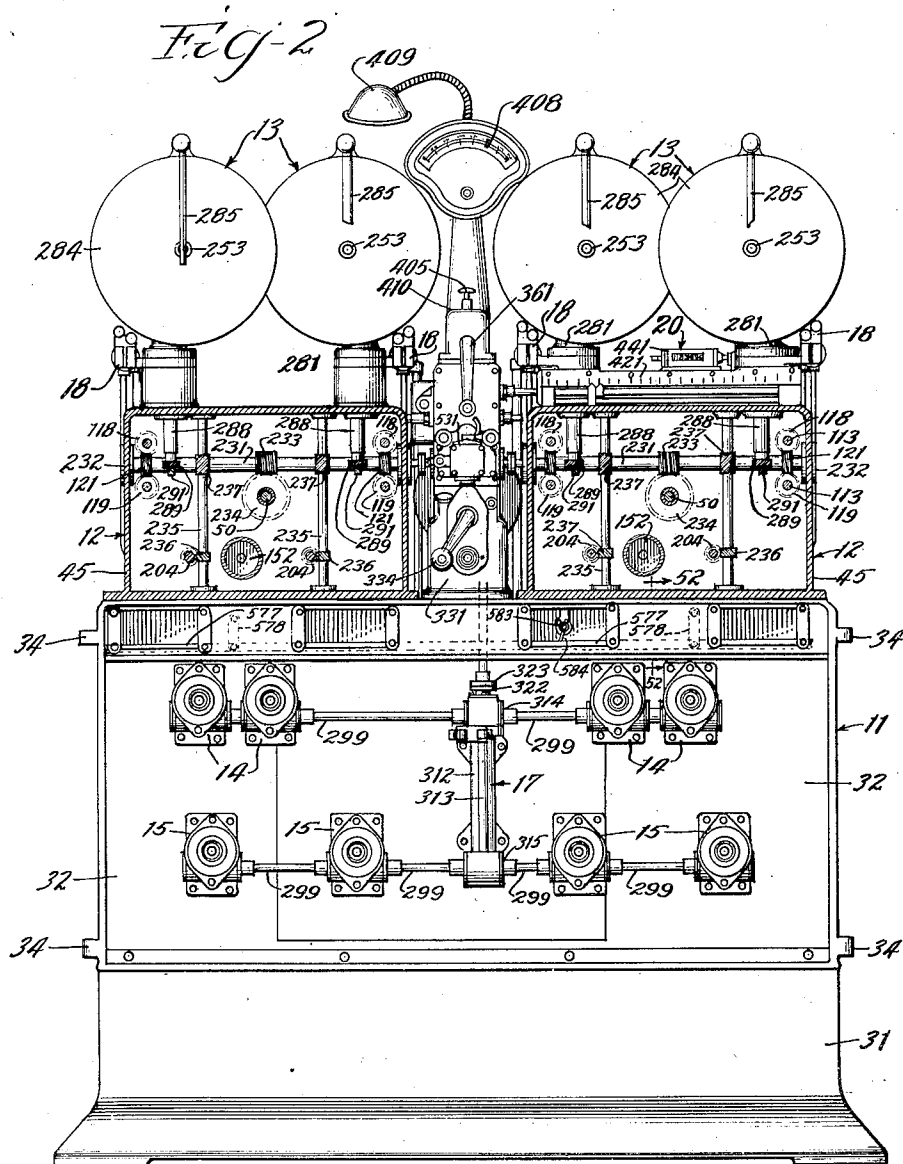
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 2



Inventor:
Albert S. Howell,
By: *Widley Miller*
Attys.

July 14, 1936.

A. S. HOWELL

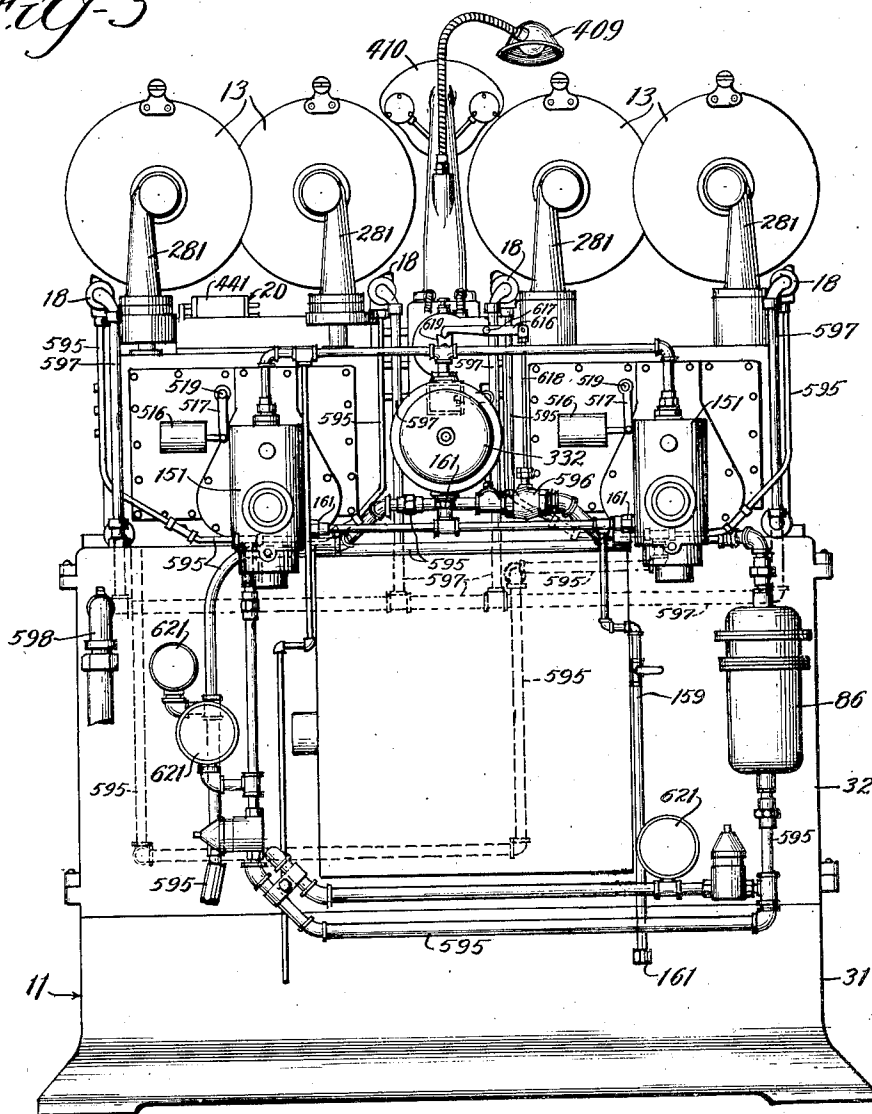
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PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 3

Fig-3



Inventor:
Albert S. Howell.
By: *Mickley Mickle*
Att'y's

July 14, 1936.

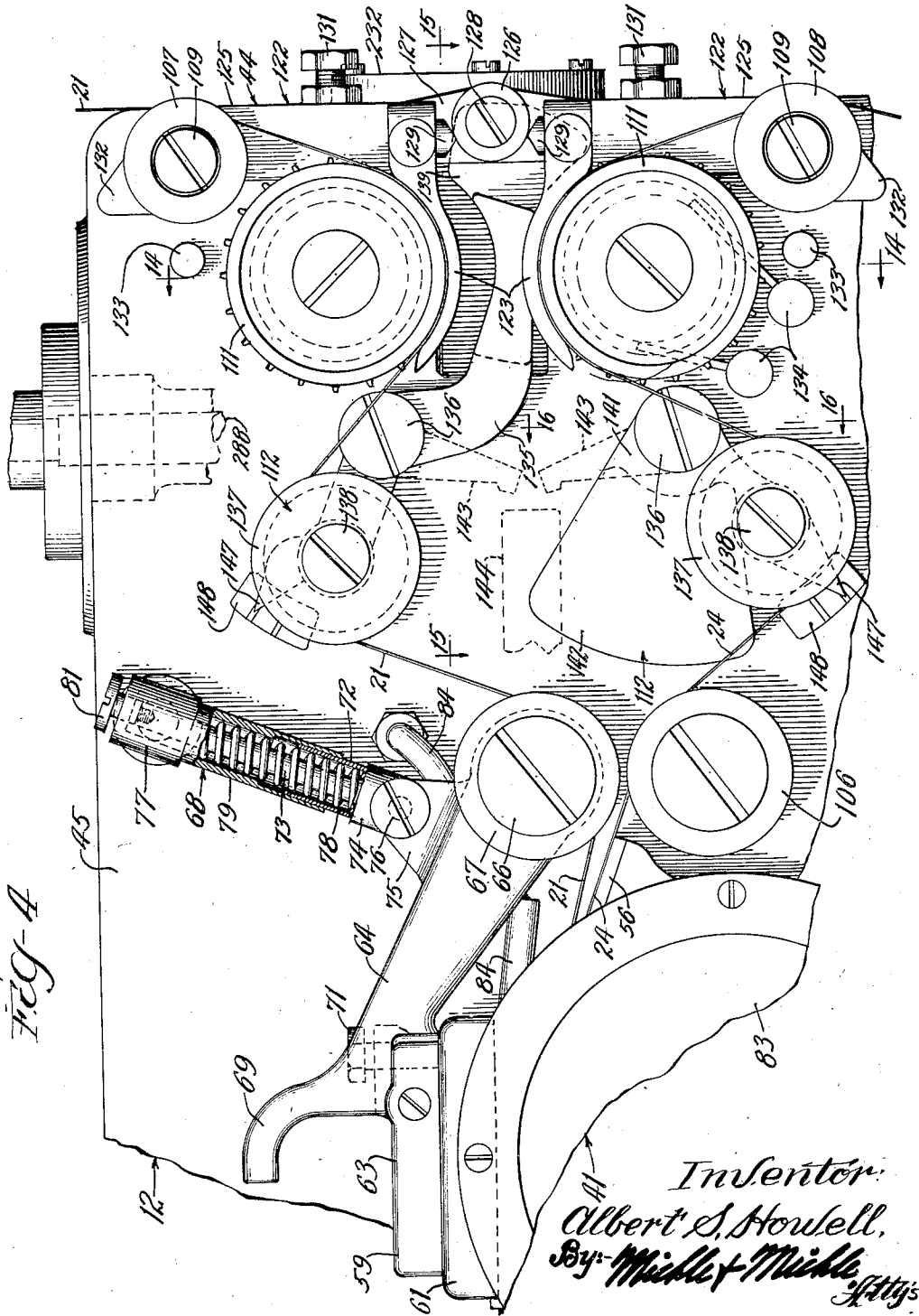
A. S. HOWELL

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PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 4



July 14, 1936.

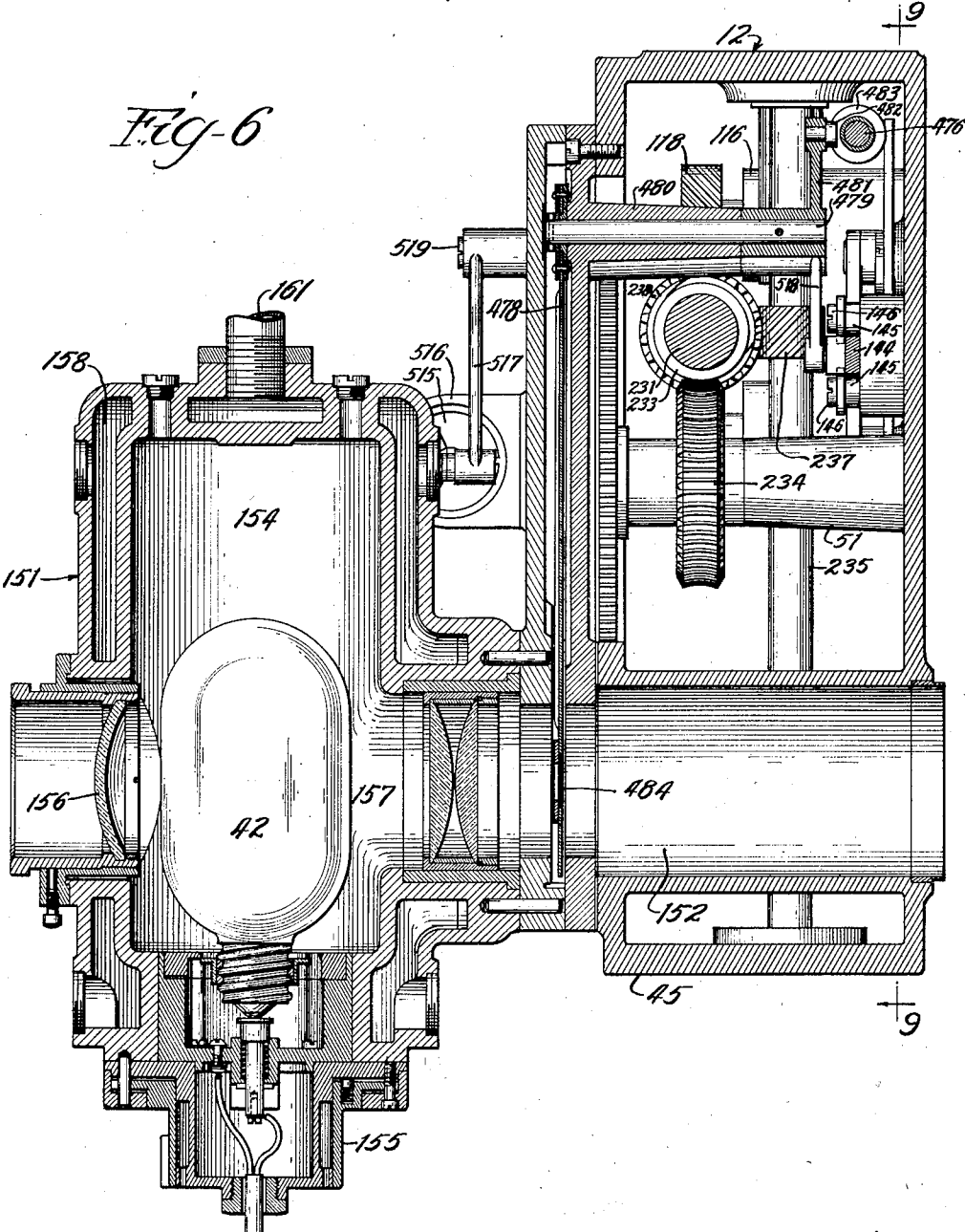
A. S. HOWELL

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PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 6



Inventor:
Albert S. Howell,
By: *Middle & Middle*
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July 14, 1936.

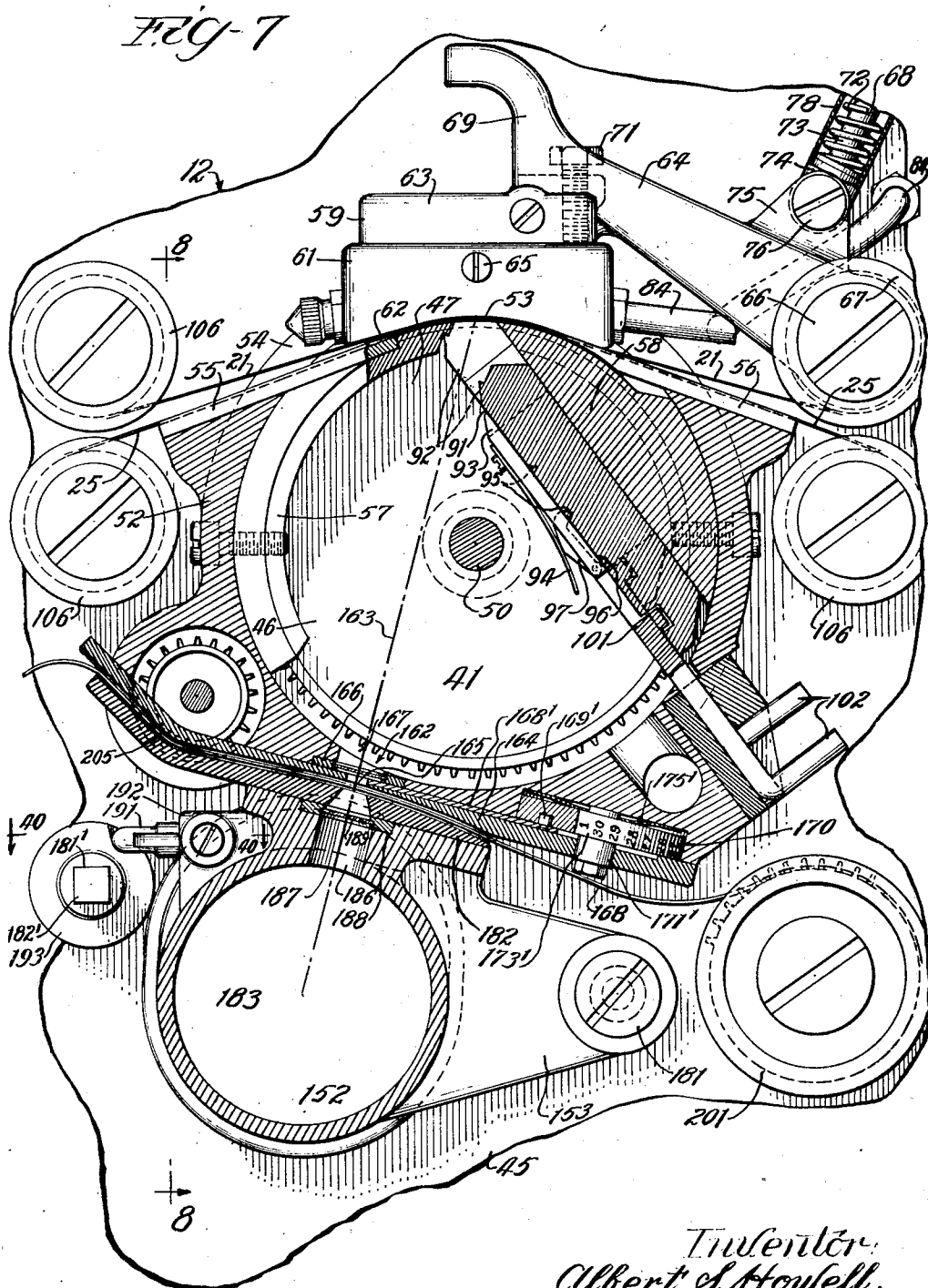
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 7



Inventor:
Albert S. Howell,
By: *Michey & Michle*
Sellers

July 14, 1936.

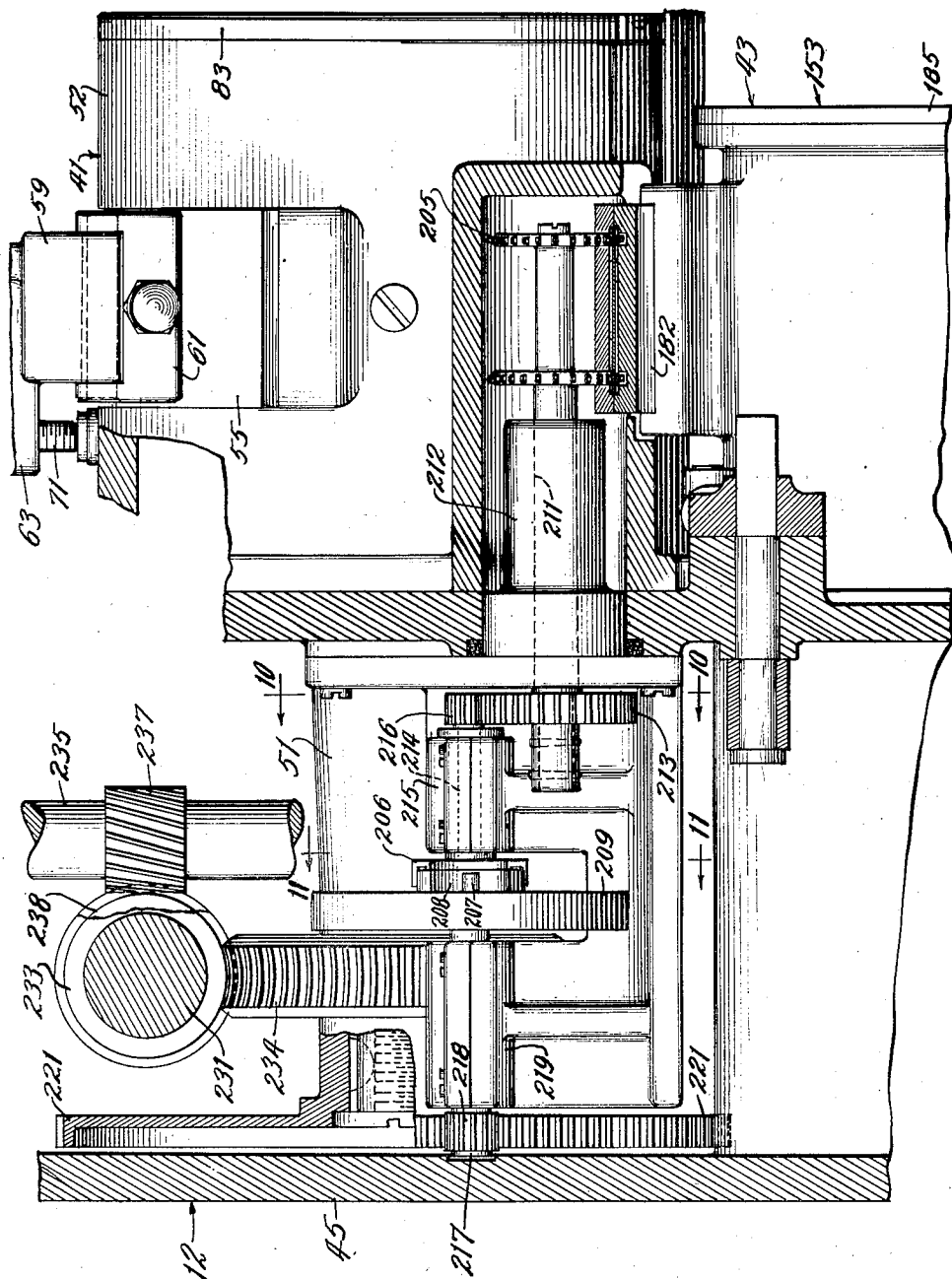
A. S. HOWELL

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PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 8



Inventor:
Albert S. Howell,
By: *Middle & Middle*
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A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

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26 Sheets-Sheet 9

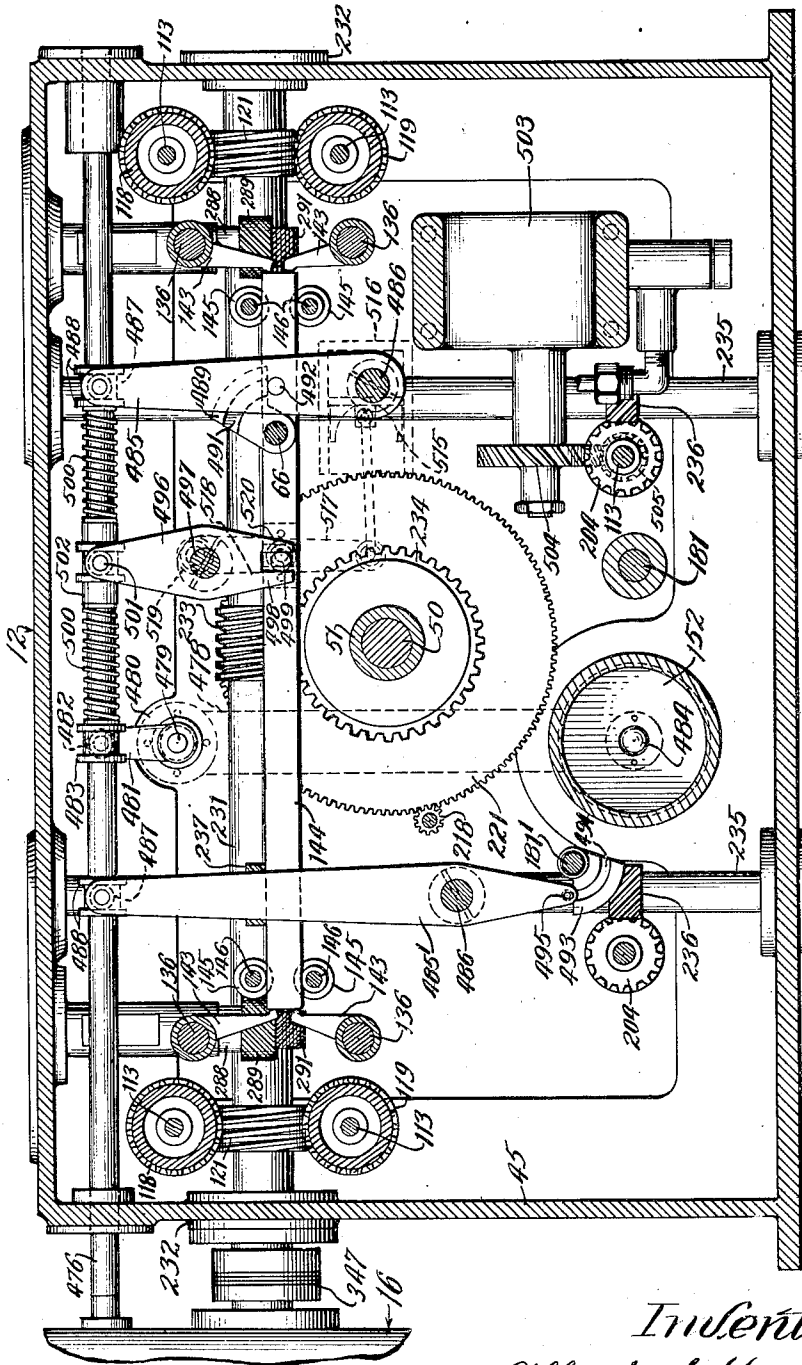


Fig. 9

Inventor:
Albert S. Howell,
By *Wick & Wick*
Attorneys

July 14, 1936.

A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 10

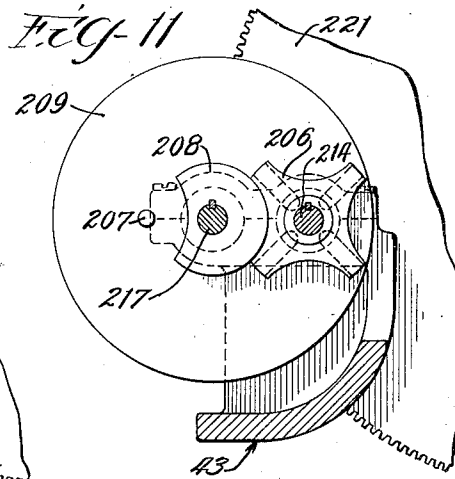
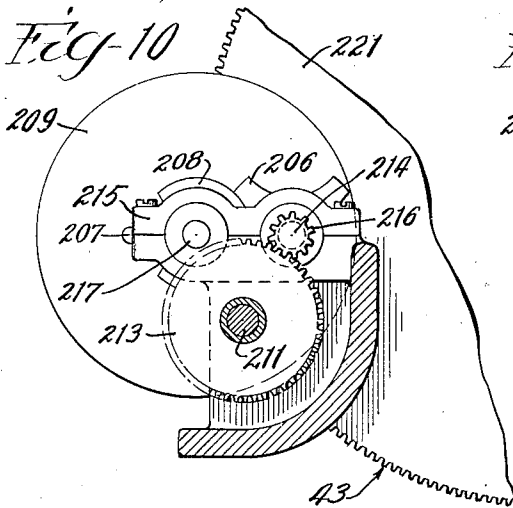


Fig-12

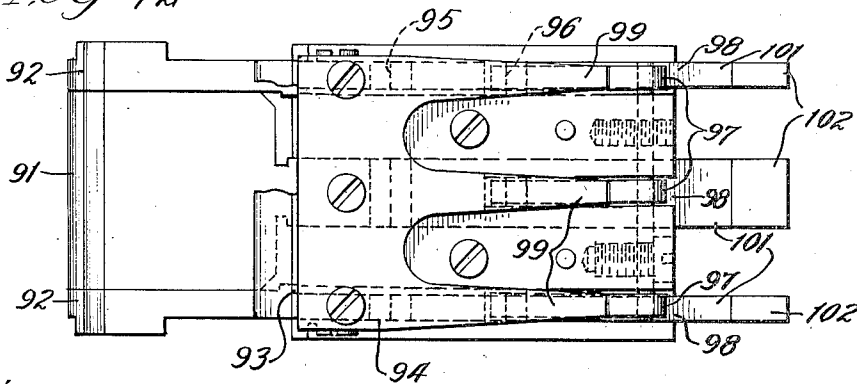
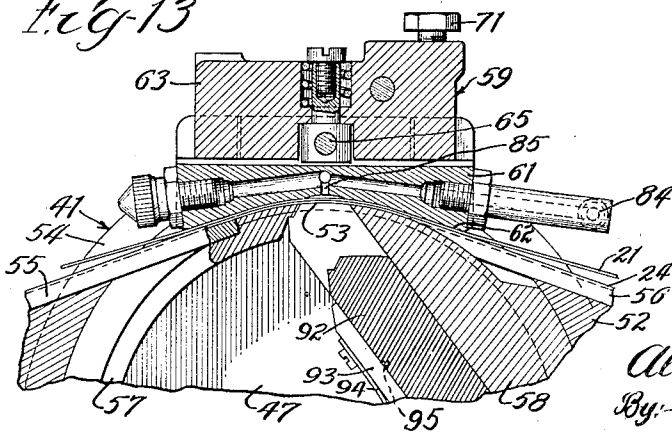


Fig-13



Inventor:
Albert S. Howell,
By: *Middle & Middle*
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July 14, 1936.

A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 11

Fig-14

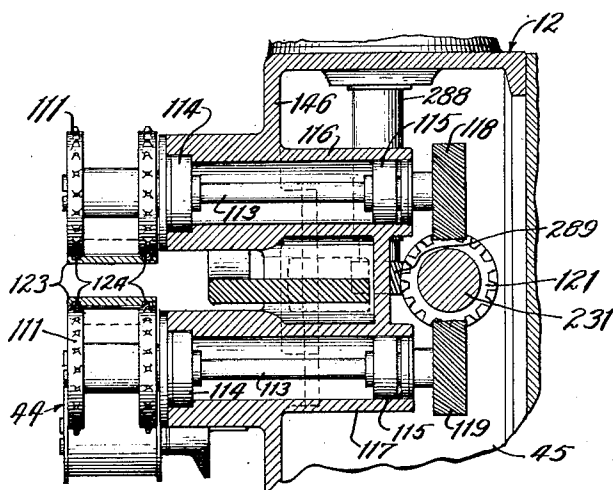


Fig-16

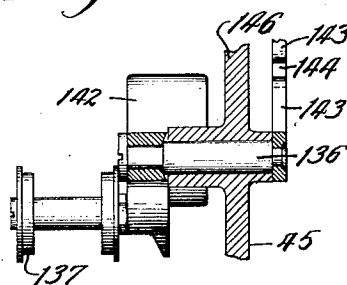
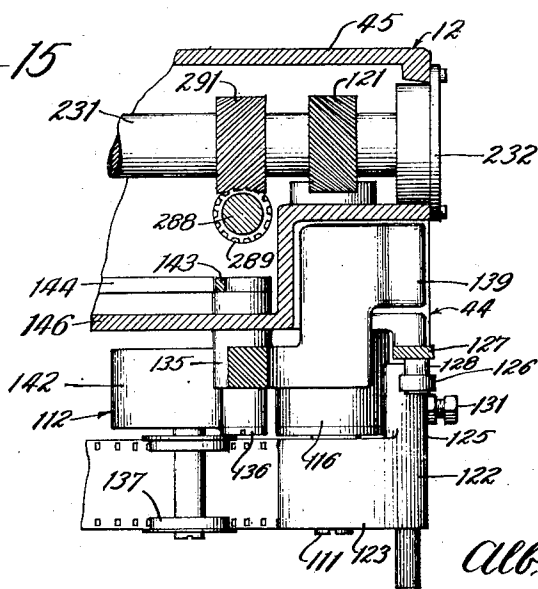


Fig-15



Inventor:
Albert S. Howell,
By: *Miller & Miller*
Attys

July 14, 1936.

A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 12

Fig-17

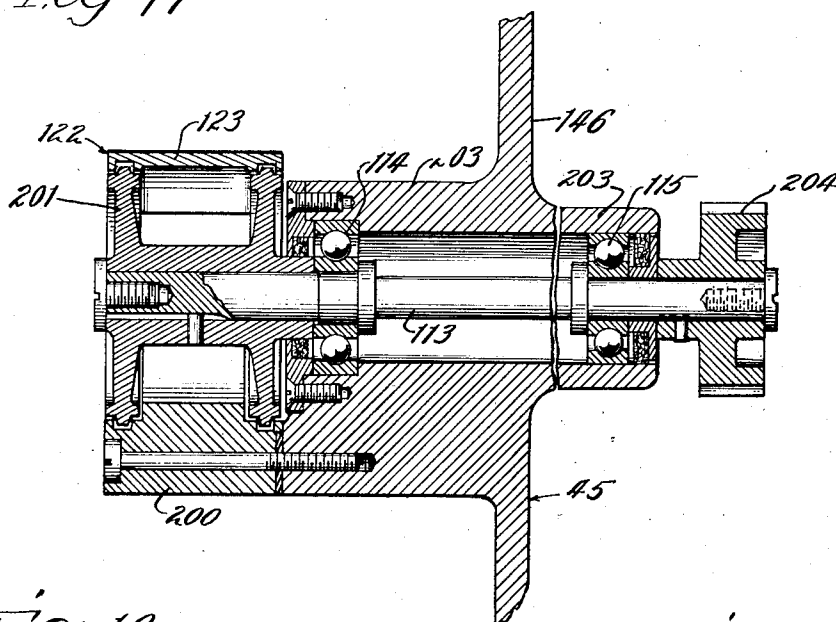


Fig-18

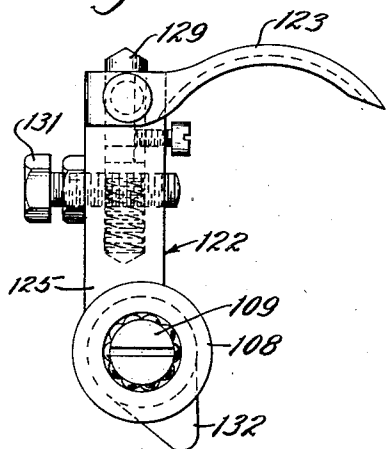
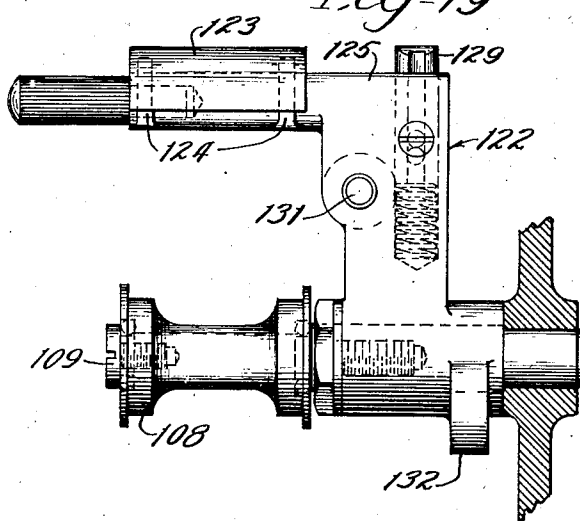


Fig-19



Inventor:
Albert S. Howell,
By: *Mickel & Mickel*
Attys

July 14, 1936.

A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 13

Fig-20

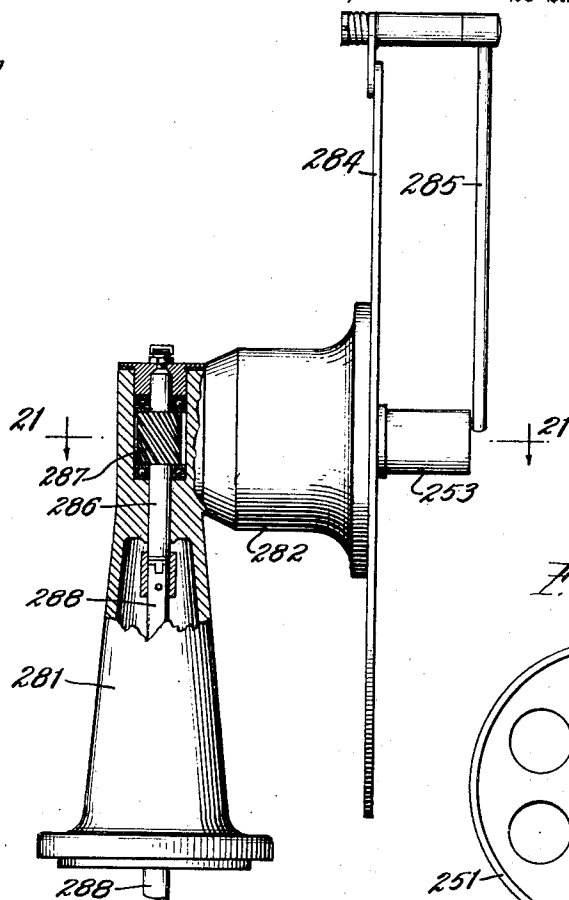


Fig-22

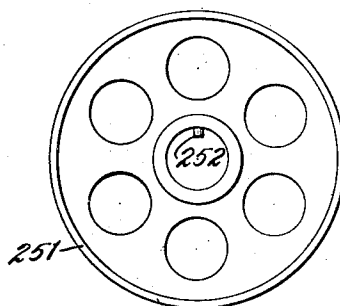
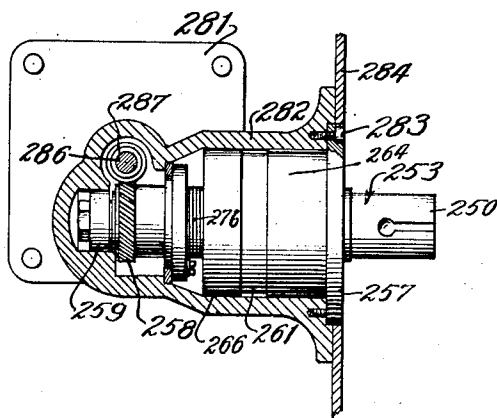


Fig-21



Inventor,
Albert S. Howell,
By: *Wichel & Wichel*
Attys

July 14, 1936.

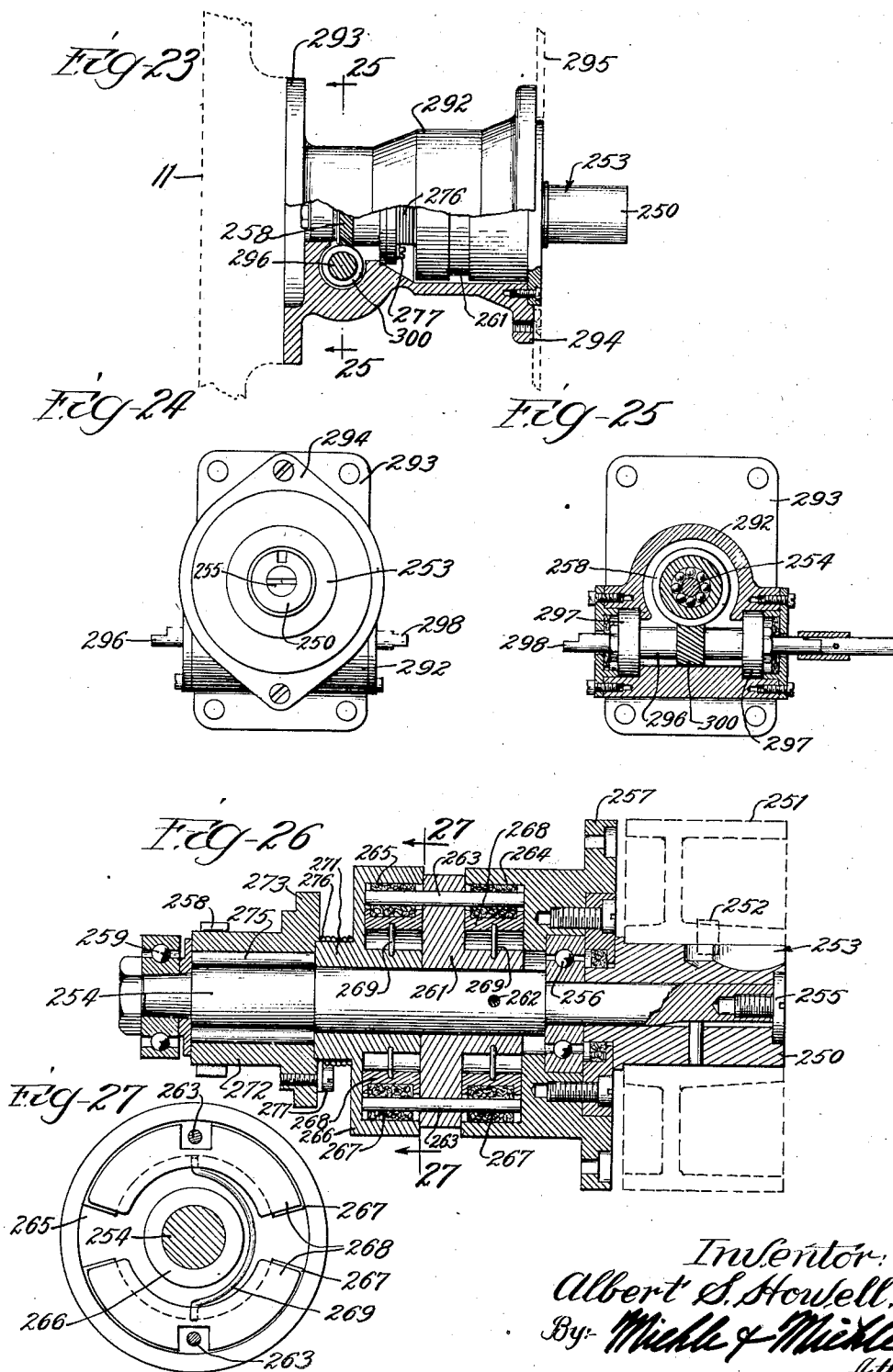
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 14



Inventor:
Albert S. Howell.
By: Miehle & Miehle
Attys

July 14, 1936.

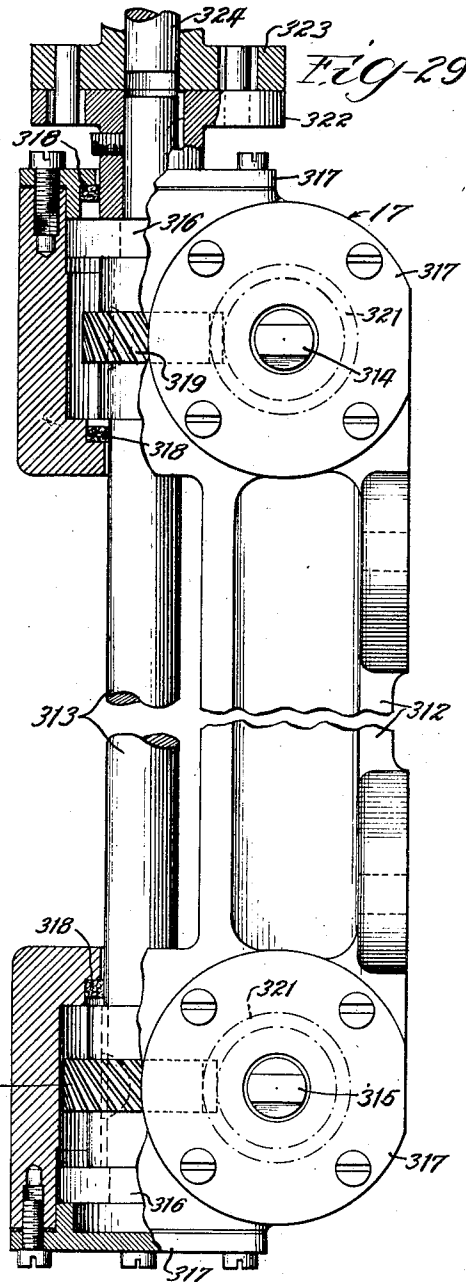
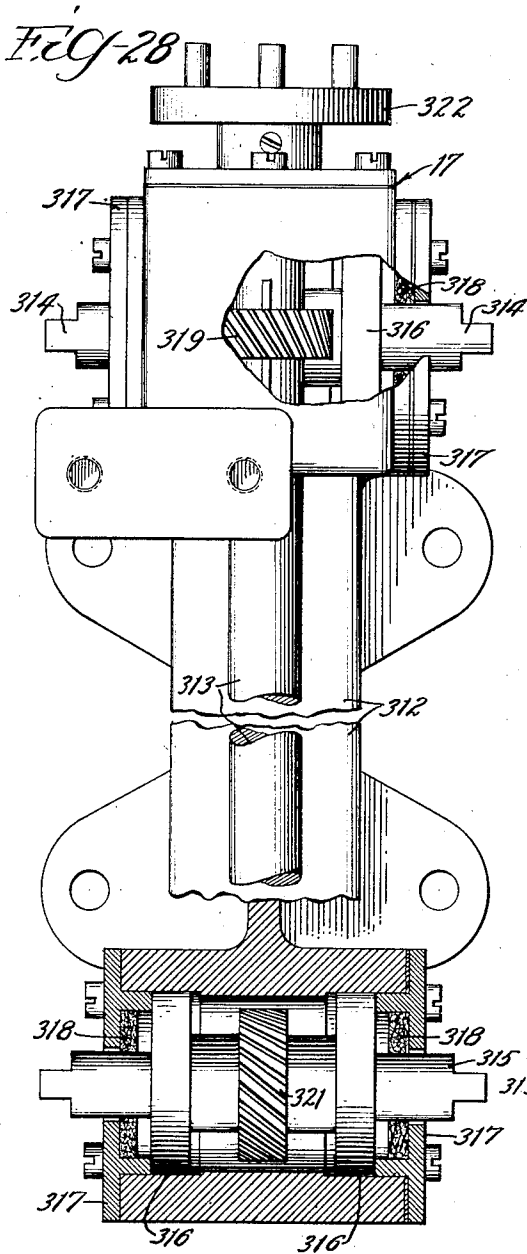
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 15.



Inventor:
Albert S. Howell,
By: *Miller & Miller*
Attys

July 14, 1936.

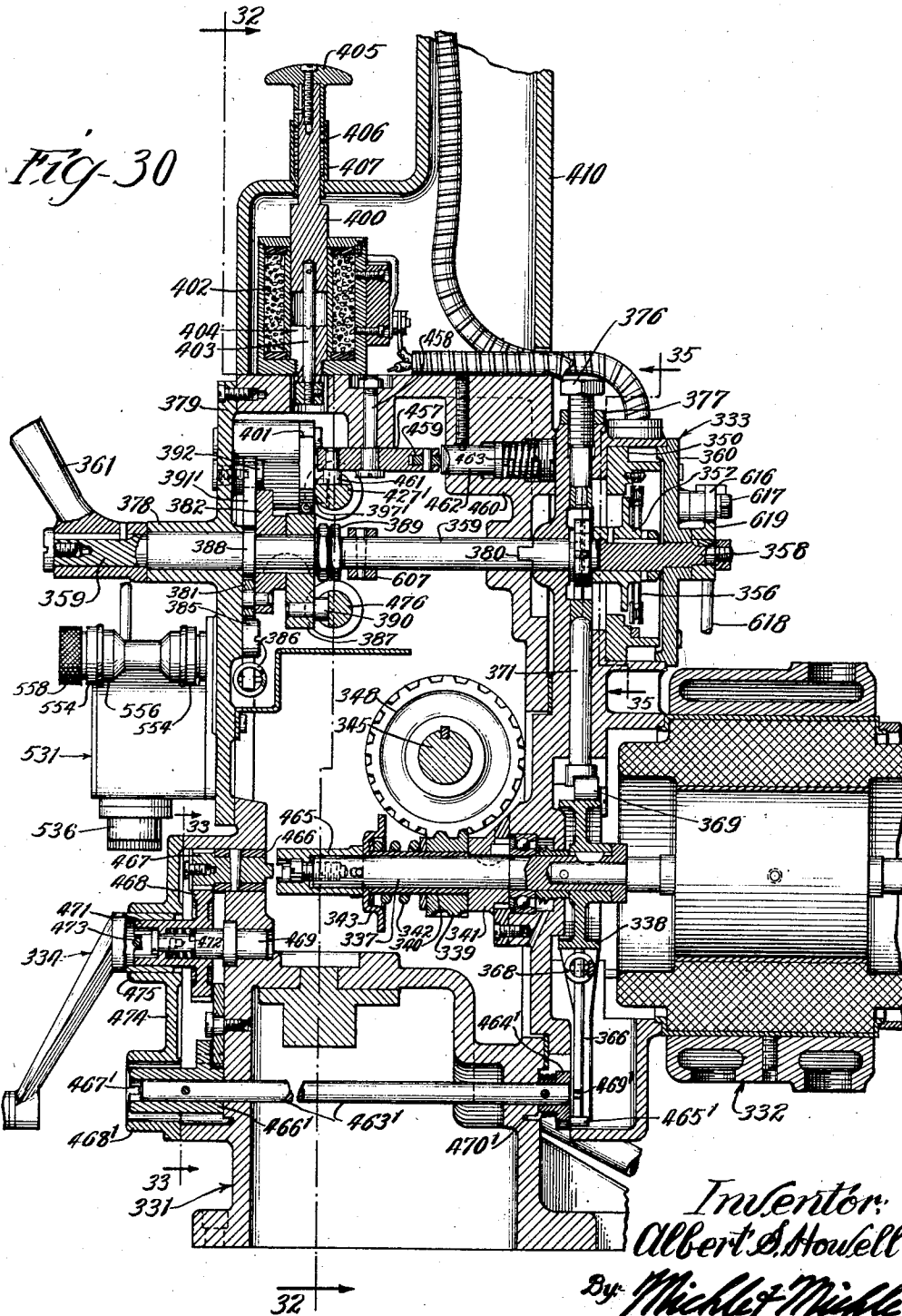
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PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 16



July 14, 1936.

A. S. HOWELL

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PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 17

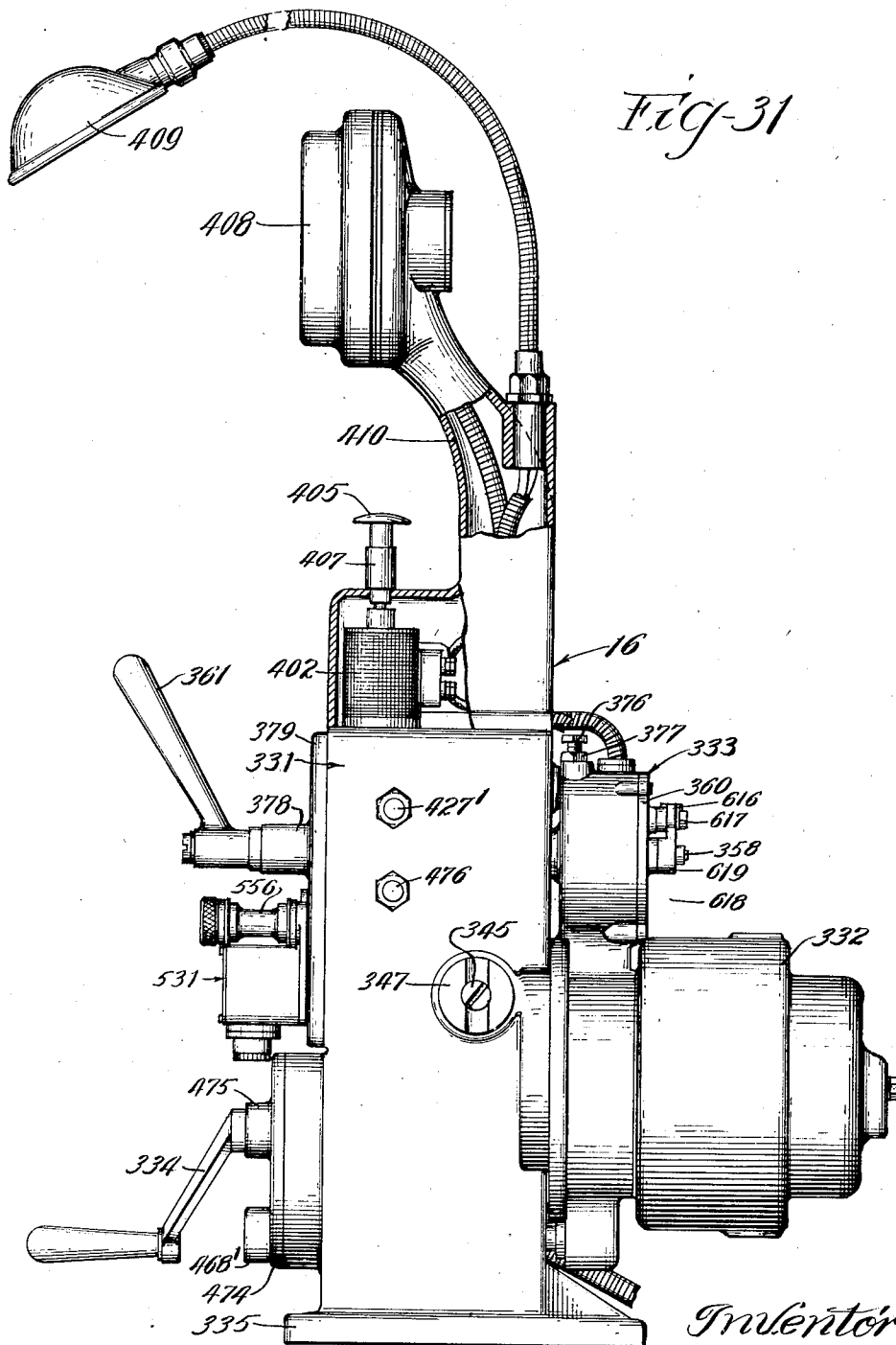


Fig-31

Inventor:
Albert S. Howell,
By: *Mitchell & Mitchell* Attys.

July 14, 1936.

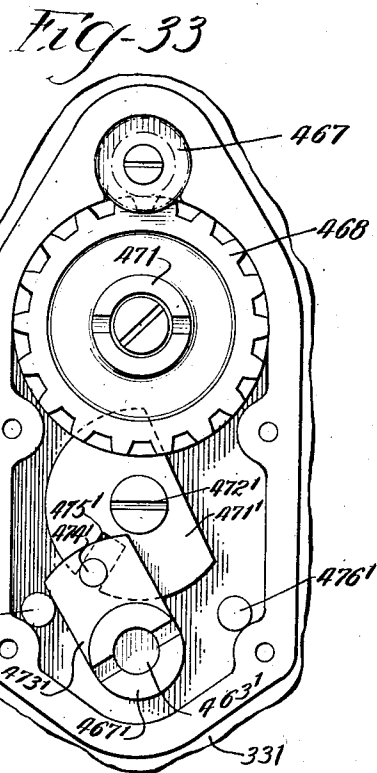
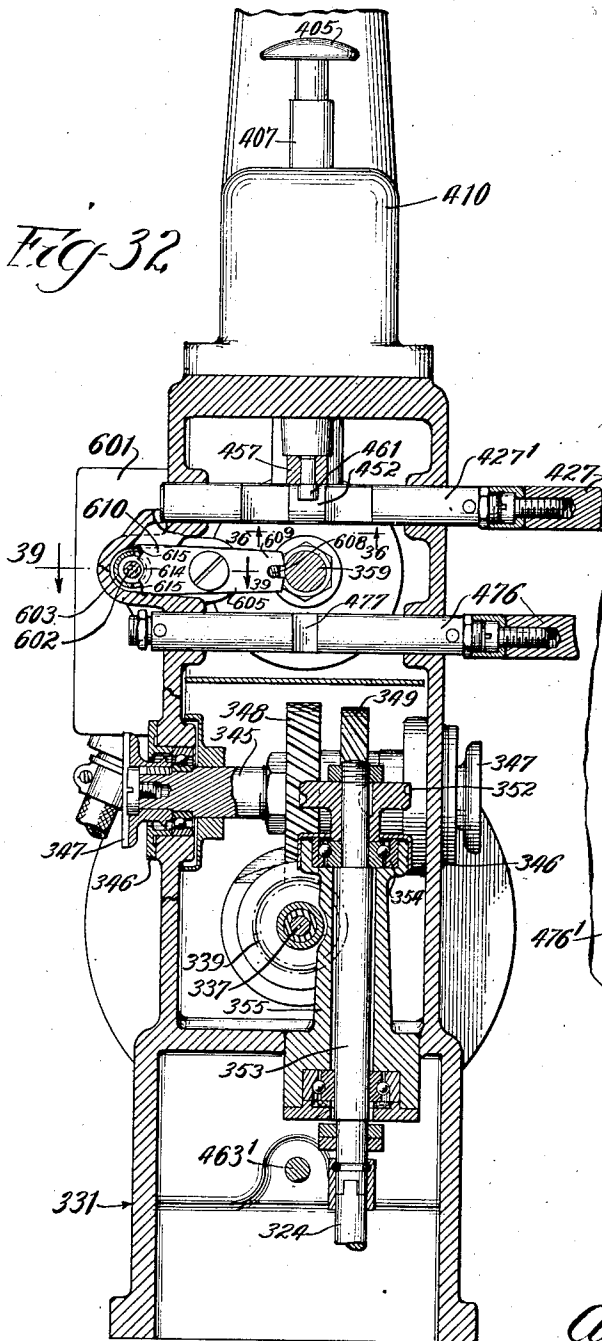
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 18



Inventor:
Albert S. Howell
By: *Mickler-Miller & Co.*

July 14, 1936.

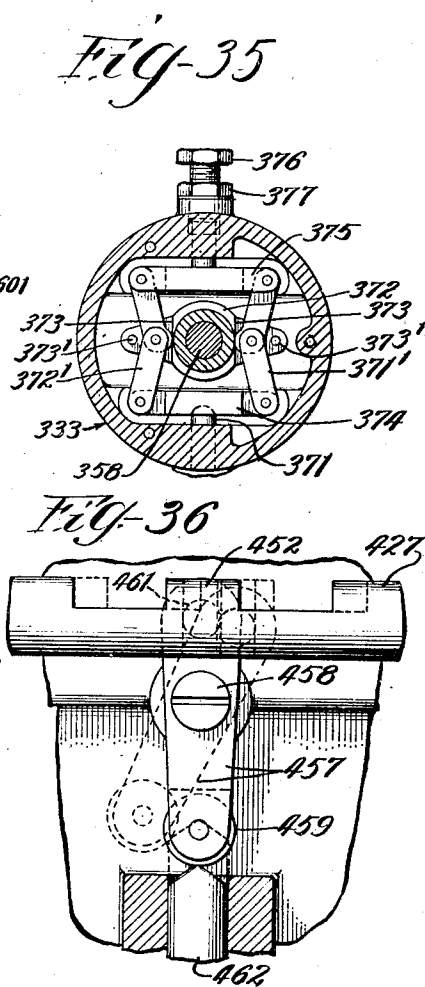
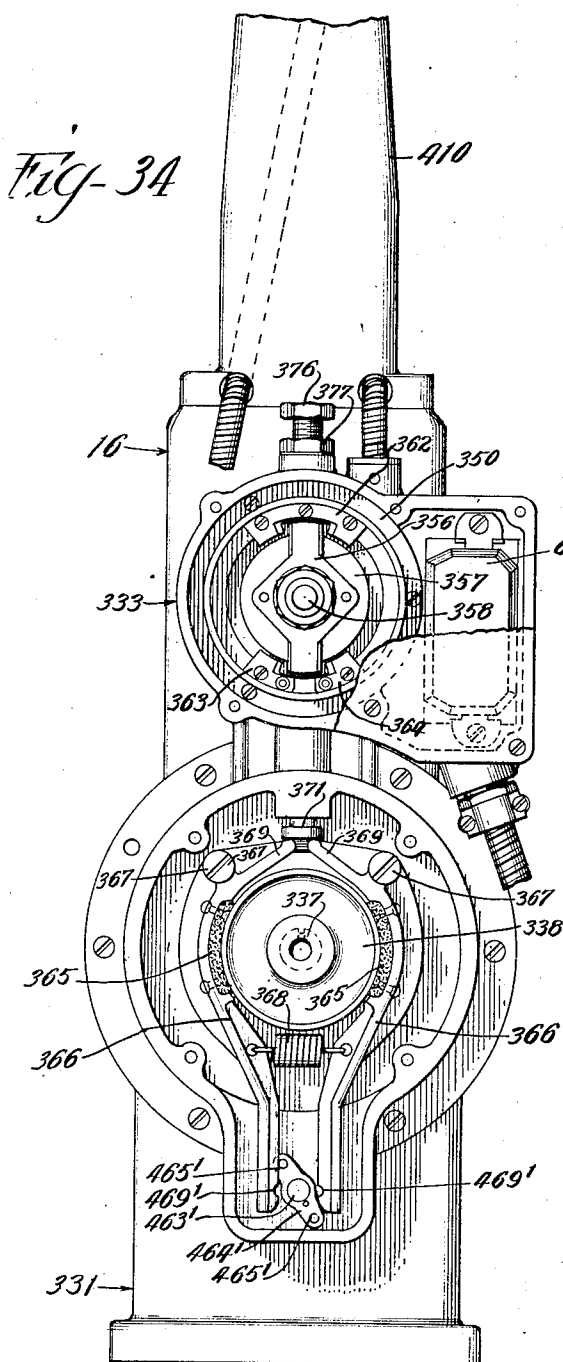
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 19



Inventor,
Albert S. Howell,
By *Winkler & Winkler*
Attys.

July 14, 1936.

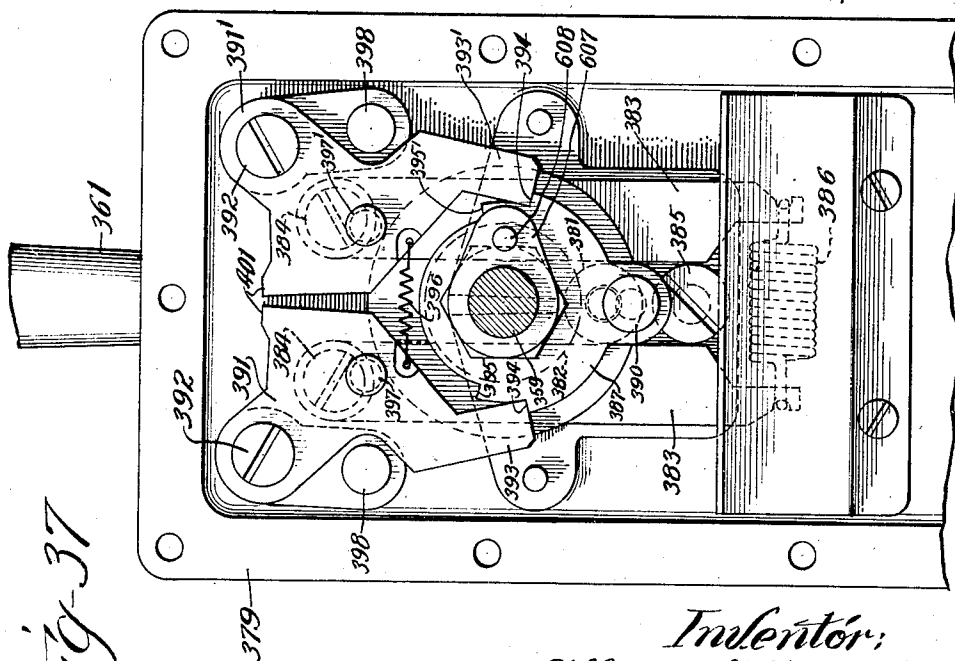
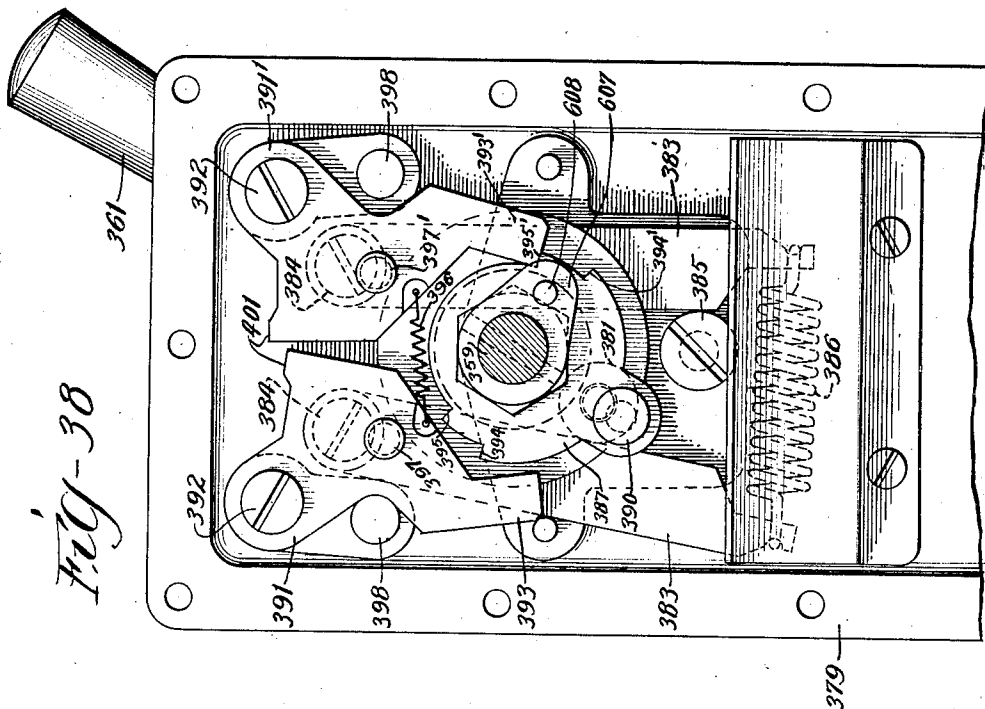
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 20



Inventor;
Albert S. Howell
By: Mickle & Mickle
Attys.

July 14, 1936.

A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 21

Fig-40

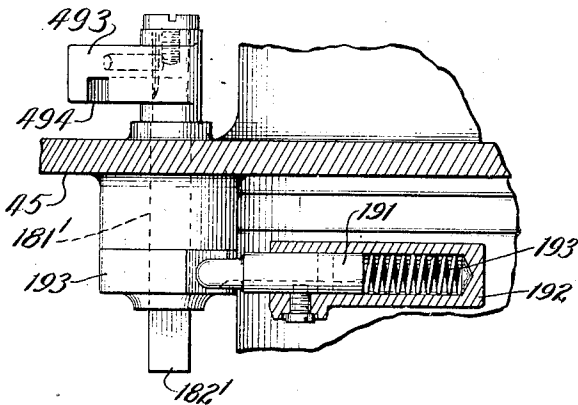


Fig-39

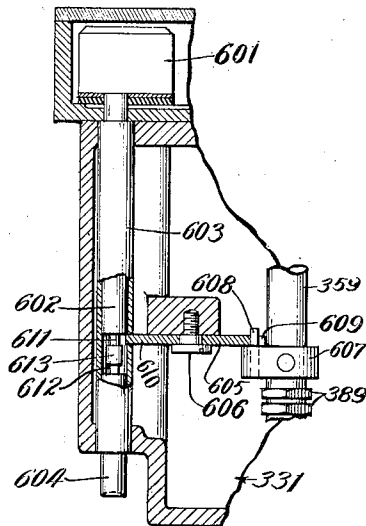


Fig-42

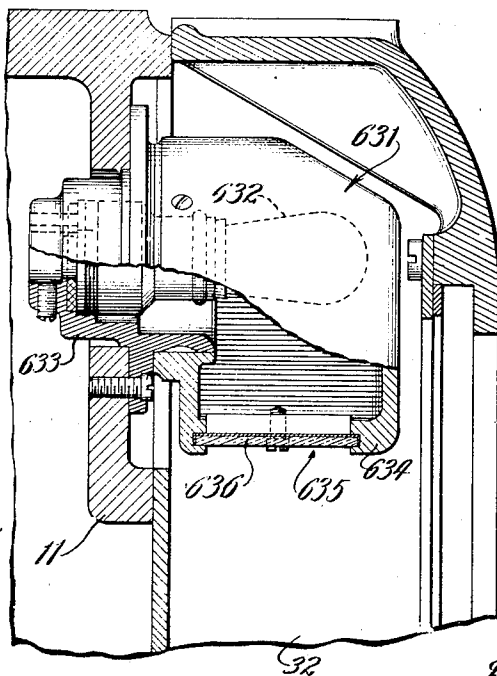
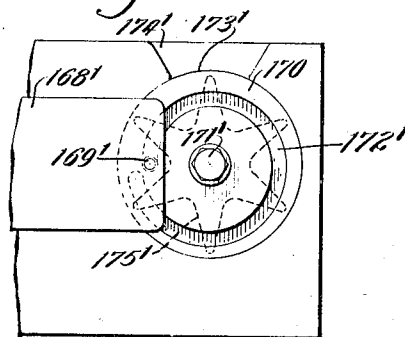


Fig-41



Inventor.
Albert S. Howell,
By *Wick & Wick, Attys.*

July 14, 1936.

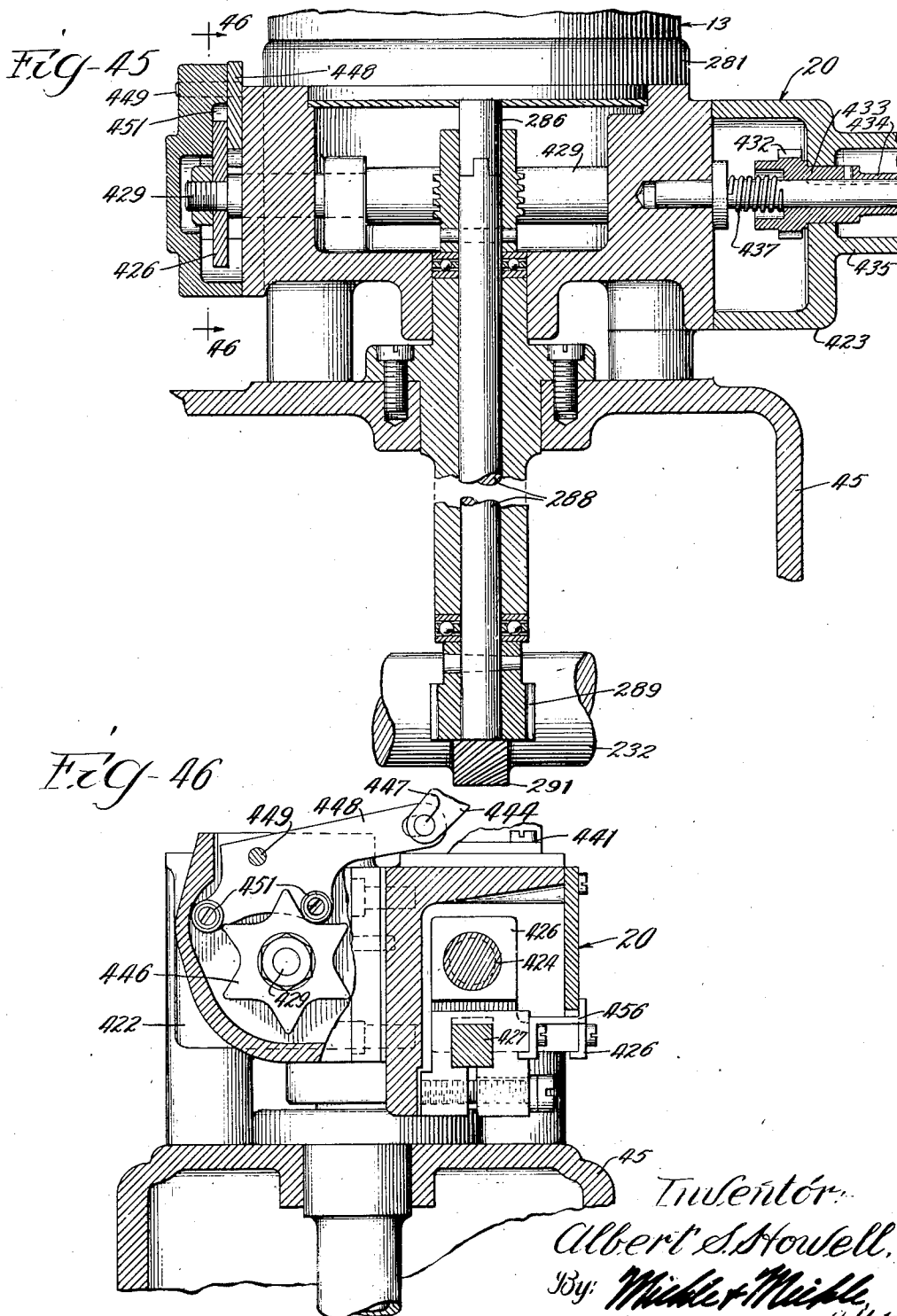
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PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 23



July 14, 1936.

A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 24

Fig-48

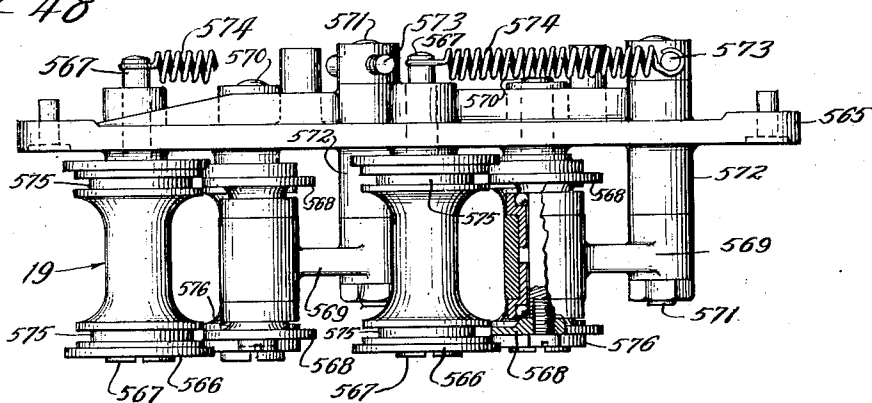


Fig-47

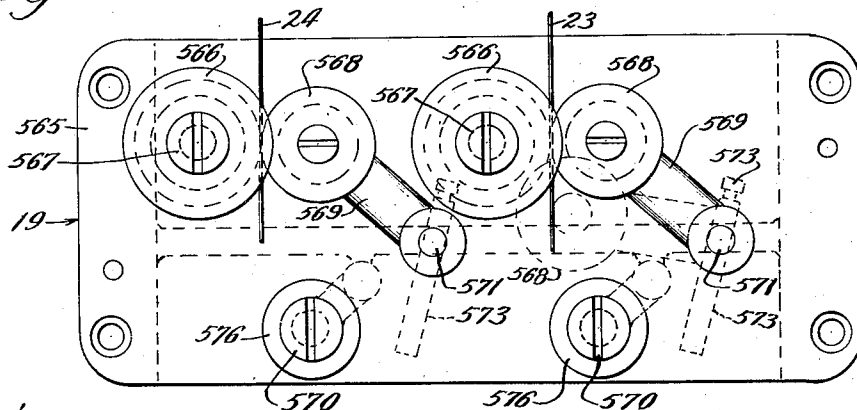
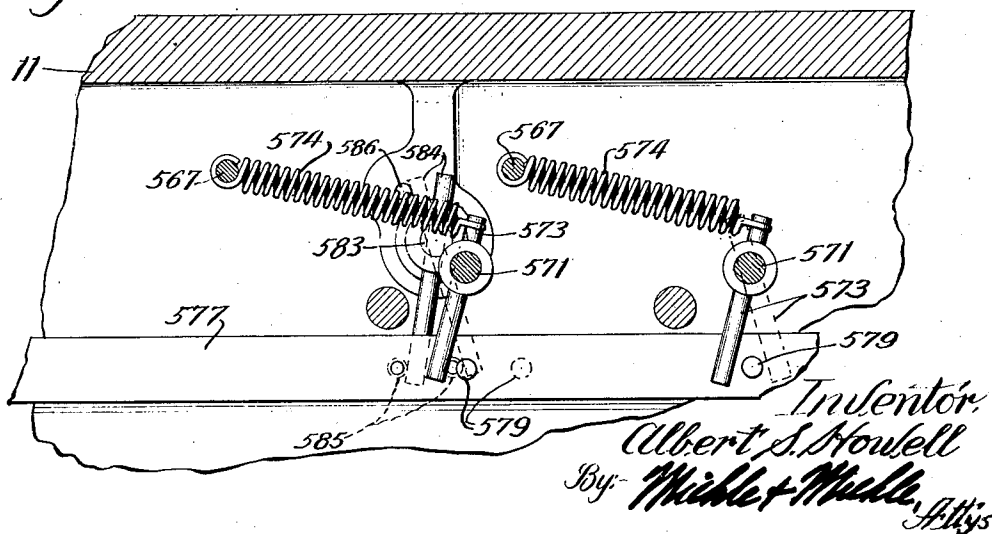


Fig-50



July 14, 1936.

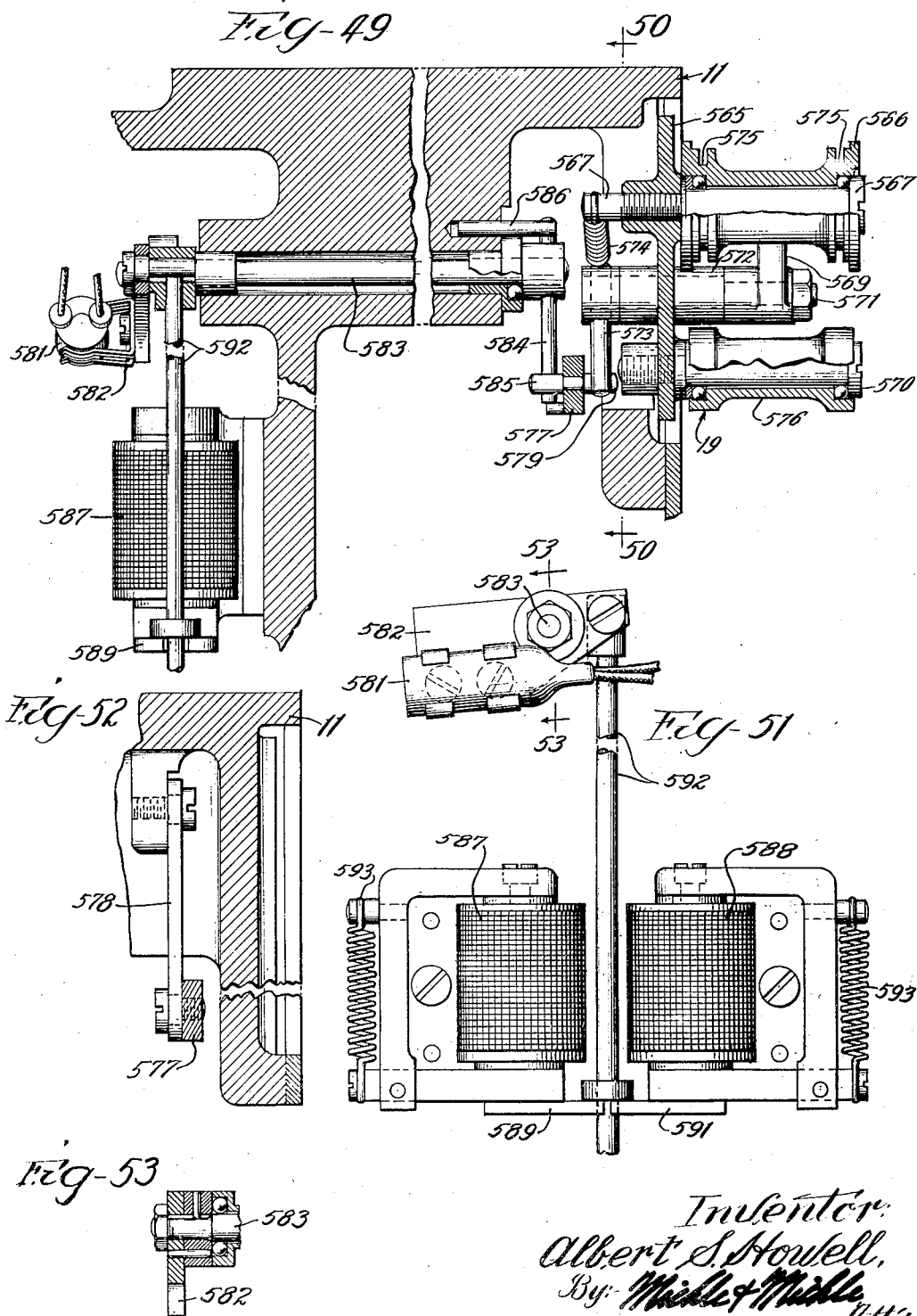
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 25



July 14, 1936.

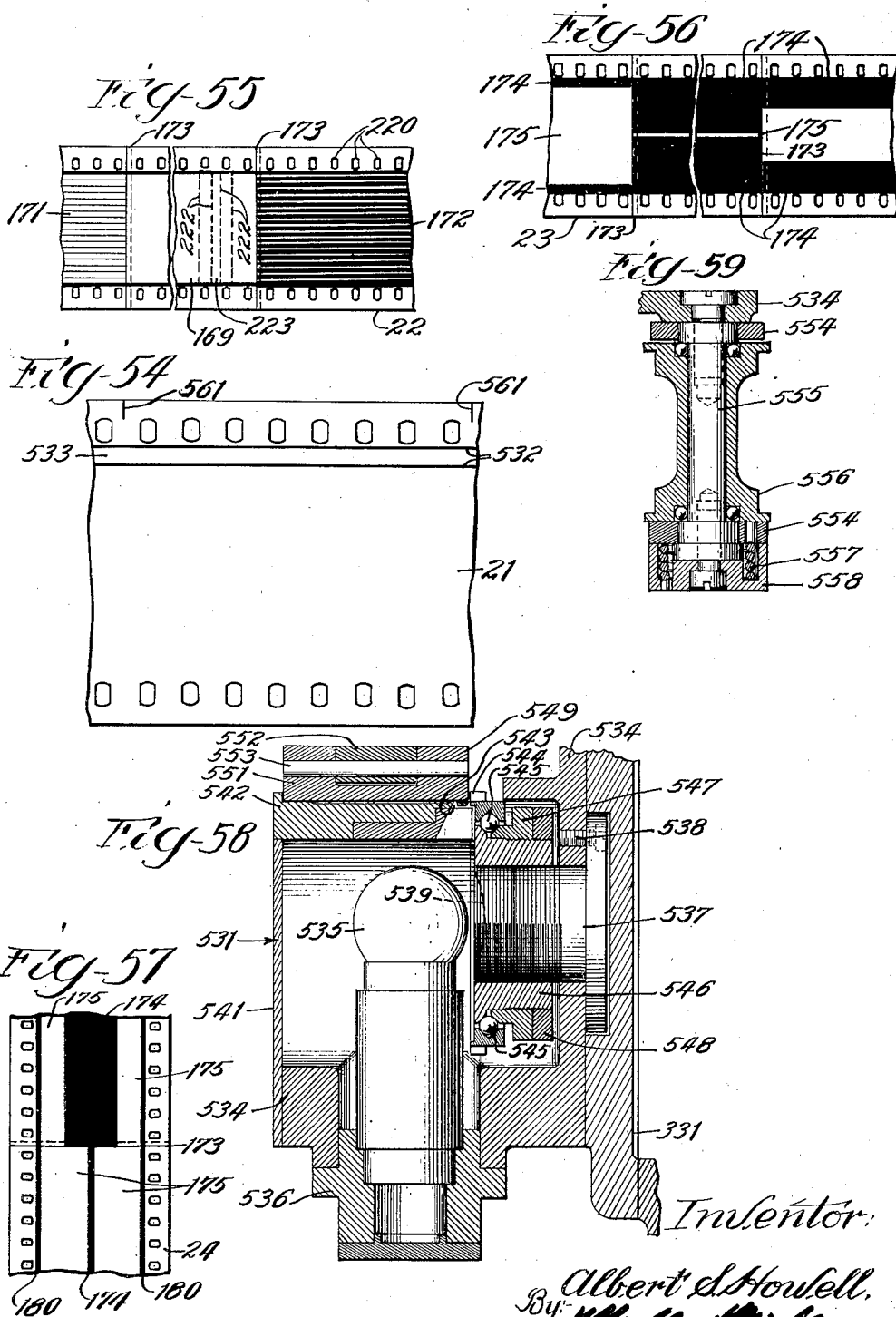
A. S. HOWELL

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Filed Dec. 21, 1931

26 Sheets-Sheet 26



Inventor:

By *Albert S. Howell*
Miller & Miller, Attorneys

UNITED STATES PATENT OFFICE

2,047,474

PHOTOGRAPHIC PRINTING MACHINE

Albert S. Howell, Chicago, Ill., assignor to The
Bell & Howell Company, Chicago, Ill., a cor-
poration of Illinois

Application December 21, 1931, Serial No. 582,284

20 Claims. (Cl. 95—75)

My invention relates particularly to a motion picture film printing machine of the type and character described and claimed in my copending application, Serial Number 461,331 filed June 16, 1930.

The general object of my invention resides in the provision of an efficient and improved photographic printing machine of the progressive printing type, such as is used in the printing of motion picture films, and preferably providing for the printing of picture and sound records upon a film from separate picture and sound record bearing films, all with a view toward convenience, automatic operation and reduction of supervision during printing, and high production.

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 elevational view of a motion picture film printing machine embodying my invention, partly broken away to show certain details of construction;

Figure 2 is a similar view of the same with other parts removed, broken away and shown in section;

Figure 3 is a similar elevational view, viewing the back of the machine;

Figure 4 is an enlarged view of some of the parts of one of the printing head units;

Figure 5 is a partial section taken substantially on line 5—5 in Figure 1;

Figure 6 is a similar sectional view taken substantially on line 6—6 in Figure 1;

Figure 7 is a sectional view of the printing head taken substantially on line 7—7 in Figure 5;

Figure 8 is a sectional view taken substantially on line 8—8 in Figure 7 and showing the intermittent motion mechanism;

Figure 9 is a section taken substantially on line 9—9 in Figure 6 and showing the operating mechanism of a printing head unit;

Figures 10 and 11 are sectional views taken on lines 10—10 and 11—11 respectively in Figure 8;

Figure 12 is a detail view of the printing head aperture adjusting slides;

Figures 13 is a section taken substantially on line 13—13 in Figure 5;

Figures 14, 15 and 16 are sectional views taken

substantially on lines 14—14, 15—15 and 16—16 respectively in Figure 4;

Figure 17 is an enlarged sectional view taken substantially on line 17—17 in Figure 1;

Figures 18 and 19 are detail views of a film guard;

Figure 20 is an enlarged view of a reel spindle partly broken away to show details of construction;

Figure 21 is a sectional view taken substantially on line 21—21 in Figure 20;

Figure 22 is a detail view of a typical film spool;

Figures 23 and 24 are enlarged detail views of another reel spindle, Figure 23 showing the spindle partly broken away to show details of construction;

Figure 25 is a section taken substantially on line 25—25 in Figure 23;

Figure 26 is an enlarged longitudinal sectional view of a reel spindle core showing details of construction and illustrating a spool mounted thereon in dotted lines;

Figure 27 is a section taken substantially on line 27—27 in Figure 26;

Figures 28 and 29 are enlarged detail views showing a transfer or distributing part of the transmission mechanism, partly broken away to show details of construction;

Figure 30 is an enlarged transverse vertical section taken substantially on line 30—30 in Figure 1 showing the control unit construction and broken away in parts;

Figure 31 is a side elevational view showing the complete control unit with parts broken away to illustrate certain connections;

Figure 32 is a sectional view taken substantially on line 32—32 in Figure 30 illustrating details of construction of the control unit;

Figure 33 is a similar sectional view taken substantially on line 33—33 in Figure 30;

Figure 34 is an elevational view viewing the control unit from the rear with the motor removed and parts broken away;

Figure 35 is a sectional view taken substantially on line 35—35 in Figure 30;

Figure 36 is an enlarged detail sectional view taken substantially on line 36—36 in Figure 32;

Figure 37 is an enlarged view of a removable cover of the control unit viewing the cover from the inner side and showing mechanism associated therewith;

Figure 38 is a similar view showing certain parts in changed positions;

Figure 39 is a horizontal sectional view taken

substantially on line 39—39 in Figure 32 illustrating a switch lockout mechanism;

Figure 40 is an enlarged detail view taken substantially on line 40—40 in Figure 7 illustrating details of the control film gate lock mechanism.

Figure 41 is an enlarged detail view of the manually adjustable light control devices, viewing the printing head from the bottom and above the control film gate, Figure 7;

Figure 42 is an enlarged sectional view taken substantially on line 42—42, Figure 1 illustrating details of construction of a threading lamp;

Figure 43 is an enlarged elevational view of the footage indicator and counting device shown in Figures 1 and 2 with parts broken away and omitted to show details of construction;

Figure 44 is a plan view of the apparatus shown in Figure 43 and similarly broken away to show details of construction;

Figure 45 is a section taken substantially on line 45—45 in Figure 44;

Figure 46 is a section taken substantially on line 46—46 in Figure 45;

Figure 47 is an enlarged detail view of one of the detector units as shown in Figure 1 and disassembled from the machine;

Figure 48 is a top plan view of the unit shown in Figure 47;

Figure 49 is a broken away sectional view taken substantially on line 49—49 in Figure 1 showing a detector unit and its associated devices assembled to the printing machine;

Figure 50 is a section taken substantially on line 50—50 in Figure 49;

Figure 51 is a detail view, viewing Figure 49 from the left and showing the associated electrical apparatus;

Figure 52 is a sectional view taken substantially on line 52—52 in Figure 2 and illustrating the suspension of the detecting unit connecting bar;

Figure 53 is a section taken substantially on line 53—53 in Figure 51;

Figure 54 is a detail view of a section of film illustrating characteristic exposures;

Figures 55, 56 and 57 are detail sections of control film;

Figure 58 is a greatly enlarged sectional view of the control unit printing device shown assembled in Figures 1 and 30; and,

Figure 59 is a section of the gate bearing for the control unit printing device shown in Figures 1, 30 and 58.

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

To illustrate the invention I have shown a frame or base 11, two horizontally spaced printing head units 12, the head units 12 being mounted on the base 11, film reel spindles 13 for sensitized film arranged above the base 11, similar film reel spindles 14 for photographic printing or negative film arranged in the base 11, similar film reel spindles 15 for printing control film also arranged in the base 11, a control unit 16 for actuating and controlling the operating mechanism and arranged between the printing head units, transmission mechanism 17 for connecting the control unit 16 with the various operable parts, a recording device or gage 20 whereby the operations of the machine may be determined, detecting devices 19 arranged to indicate film breaks, film cleaners 18 arranged to clean the film during or as an incident to printing operations, together with an illustration of a printed sensitized film 21, suitable sections of control film 22, 23

and 24 (Figures 54 to 57 inclusive), and suitable subordinate apparatus for cooperating therewith as will be later described.

To provide a suitable frame I have shown (Figures 1, 2 and 3) the base 11 formed to provide a substantially vertical case or housing having a support portion 31 and a compartment portion 32, in which certain operating parts may be suitably mounted as will be later described. A pair of doors 33 are hinged to the frame 11 as indicated at 34 and arranged to close the compartment portion 32 thereof as shown (Figure 1). The doors 33 are provided with transparent panels 35, preferably of wired or reinforced glass, and suitable fittings such as knobs 36.

To provide suitable printing head units 12 or units of mechanism with which photographic printing or the printing of sensitized film from a photographic printing element, such as a negative film, may be effected, I have shown (Figures 1 to 13 inclusive) such a unit which is capable of effecting printing and embodies desirable features of adjustment and control incidental to printing operations. In accordance with my invention and to facilitate successive printing from separate printing elements, or multiple printing, a plurality of such units are provided, each one of which is a substantial duplicate of the other.

The printing head units 12 preferably include a printing head 41 through which films are advanced for printing, means providing printing illumination including a lamp 42, exposure control mechanism 43, and film actuating and controlling mechanism including suitable film feed sprockets, guards, and tension devices generally indicated at 44 (Figures 1 and 4), all suitably mounted in juxtaposition and operative relationship on a housing or mechanism case 45 which is arranged for support on and attachment to the frame 11 as indicated.

The printing head 41 includes a sprocket 46 for advancing film and is formed of spaced disc-like parts 47 and 48 having sprocket teeth 49 thereon and suitably secured for unitary action as in my above mentioned copending application. The sprocket 46 is removably attached to a shaft 50 which is journaled in a suitable bearing member 51 as indicated (Figure 5).

The bearing member 51 is suitably secured to the mechanism case 45, and a substantially cylindrical body 52 forms a housing or enclosure for the printing head mechanism.

An exposure aperture 53 is formed in the body part 52 substantially at the center of a transverse slot 54 and suitable guide plates 55 and 56 are arranged in the slot 54 and extend from internally mounted slot forming members 57 and 58 for guiding film to and away from the exposure aperture 53. The relation of the sprocket 46 to the guide plates 55 and 56 and the slot forming members 57 and 58 is such that the teeth 49 of the sprocket 46 project above these parts at and adjacent the aperture 53 for engaging and advancing film across said aperture during printing operations and a film gate 59 is provided to cooperate with the guides 55 and 56 in guiding film across the aperture 53.

The film gate 59 consists of a guide block 61 having a guide surface 62 formed in accordance with the pitch of the guides 55 and 56 and the periphery of the sprocket 46. The block 61 is pivotally connected to a head portion 63 of a pivoted gate arm 64 by means of a pin 65 as shown (Figures 4, 5, 7, 8 and 13).

The gate arm 64 is secured to a shaft 66 rotat-

ably mounted in the case 45 and providing a bearing for a film spool 67 and is yieldingly pressed toward the guides 55 and 56 by means of a pressure device 68. A hook 69 formed on the arm 64 facilitates manual engagement for opening and closing the gate, and a threaded stop screw 71 facilitates adjustment. The pressure device 68 in the present embodiment consists of a compression spring 72 mounted on an aligning pin 73 having a head 74 connected to a lug 75 on the arm 64, by means of a shoulder screw 76, and arranged for reciprocating movement in a rotatable bearing post 77 mounted on the case 45 adjacent the stud 66. A telescoping housing 78 and 79 adapted to telescope and suitably attached to the head 74 and the post 77. A shoulder screw 81 limits the action of the spring 72 and the position of the post 77 is such that after the gate 59 is opened to a predetermined extent the compression spring 72 acts to hold the gate 59 open for lacing or adjustments.

Means is provided for pressing or holding the sensitized film 21 in intimate surface contact with negative film 25 to insure correct printing and without material friction. This is accomplished by subjecting the contacting films to fluid pressure applied on the exterior surfaces of the contacting films at the exposure aperture 53.

Compressed air is directed into the body part 52 of the printing head 41 through a tube 82 and against the film through the exposure aperture 53, a cap 83 being provided to close or seal the end of the body part 52, and similarly, compressed air is directed against the film from an opposite direction through the guide block 61 of the film gate 59, a flexible tube 84 connecting the case part 45 and the block 61 and communicating with suitable channels formed in the block as shown (Figure 13). A transverse concave slot 85 is formed in the block 61 opposite the aperture 53 to facilitate distribution of the compressed air.

Air under pressure is or may be supplied from any suitable source and through a suitable cleaner or filter 86 (Figure 3) and suitable pipe or tube connections.

For printing full frame size pictures the full aperture 53 is used and for printing sound and picture films such as picture films having sound recordings along one or the other side of the picture bearing portions thereof from separate sound and picture record bearing negative films, the proportions of the aperture 53 are adjusted accordingly and to restrict the printing illumination to the desired portion of the film. To accomplish this a set of slides of proportions corresponding to the standard picture and sound recording portions of a film are provided. In the present embodiment these slides include a central slide 91 embraced by two relatively narrow slides 92 corresponding in dimensions and location to the standard width of sound tract (Figures 5, 7, 12 and 13).

The slides 91 and 92 are slidably mounted on the member 58 and are secured in operative positions by means of a cover plate 93 and a spring plate 94 (Figure 12). The slides 91 and 92 are notched as at 95 and 96 and pawls 97 mounted in slots 98 in the plate 93 and actuated by finger portions 99 of the spring plate 94 engage in the notches 95 and 96 to secure the slides 91 and 92 in adjusted positions. For convenience in manipulation, operating slides 101 are provided, and these are interlocked with the slides

91 and 92 upon assembly as indicated and have exposed handle portions 102 which are engaged for manually manipulating the slides 91 and 92.

The slot blocking ends of the slides 91 and 92 are formed to overlap or interlock with the member 57 as shown (Figures 7 and 13) to positively prevent the passage of light when these slides are in closed position.

Sensitized photographic film 21 and photographic printing or negative film 25 are directed to and away from the printing heads 41 by means of suitable feed sprockets and through suitable film tension devices, and to provide means for accomplishing this I have shown (Figures 4, 7 and 14 to 19 inclusive) three film spools 106 15 similar to the spool 67 and one of which is arranged adjacent thereto and the other two of which are disposed on the opposite side of the printing head 41 therefrom whereby the films 21 and 25 are directed to and away from the guide plates 55 and 56, and similar film spools 107 and 108 carried on studs 109 mounted on the case 45 for directing the said films to and away from their respective feed and storage reels, as will be later described, and, intermediate the spools 67 and 107 and the spools 106 and 108, a film actuating or feed sprocket 111 and tension device 112 for each one of the films 21 and 25. The feed sprockets 111 are alike in every respect and are each suitably secured to a drive shaft 113 30 (Figure 14) carried in suitable anti-friction bearing members 114 and 115 mounted in spaced bearing hubs 116 and 117 formed on the case 45. Suitable spiral gears 118 and 119 are suitably secured to the shafts 113 in position to engage 35 a companion gear 121 for driving the sprockets 111 as will be later described.

A guard device 122 (Figures 4, 18 and 19) is provided for each one of the sprockets 111 to insure positive engagement between the films 21 and 25 and their respective sprockets 111, and to provide these I have shown a guard plate 123 40 formed in accordance with the periphery of the sprocket 111 and embracing a segment thereof. Slots 124 are formed in these guard plates to permit the teeth of the sprockets 111 to pass without interference while a light pressure is applied to the passing film by the guard plate 123.

The guard plates 123 are suitably formed on carrier brackets 125 pivoted on the studs 109, 50 which studs are positioned to effect a slight lifting movement of the guard plates 123 with respect to the sprockets 111 when the brackets 125 are moved about the studs. A stop roller 126 mounted on a bar 127, by means of a shoulder screw 128, is arranged between two brackets 125, 55 and spring pressed snap plungers 129 are mounted in the brackets 125 as indicated to engage the stop rollers 126 and secure the guard devices 122 in operative position. A lock screw 131 provides adjustment of the plate 123 with respect to the sprocket 111 and a lug 132, engaging a pin 133 mounted on the case 45, limits the retracting or opening movement of the plate.

Suitable film strippers 134 are arranged adjacent the sprockets 111 to insure the separation 65 of the film from said sprockets.

The tension devices 112 are preferably arranged to act in opposed directions and to urge the films 21 and 25 out of or away from a direct 70 path between the sprockets 111 and the rollers 67 and 106 and independently tension the films 21 and 25 between the sprocket 46 and the sprockets 111.

To provide these I have shown a lever 135, for 75

the tension devices 112 operating on the film 21, secured to a rock shaft 136 mounted in the case 45 and carrying a film spool 137 rotatably mounted on a stud 138 and an integral counter-weight 139. Tension is applied to the film 21 by gravitational force acting on the counter-weight 139 through the lever 135 and spool 137.

Similarly and for the tension devices 112 operating on the film 25, a lever 141 similar to the lever 135 is secured to another rock shaft 136 and a spool 137 also rotatably mounted on a stud 138 is carried by the lever 141 in position to engage the film 25, and a weight portion 142 of the lever 141 functions through gravitational force to tension the film 25.

A lever arm 143 is rigidly secured to each rock shaft 136 as indicated (Figures 4, 9 and 14 to 16 inclusive) and arranged to engage a bar 144 which is mounted to reciprocate between guide rollers 145 (Figure 9) suitably mounted on an inner face 146 of the case 45 by means of shoulder screws 146. The mechanism for adjusting the tension devices 112 will be later described.

Suitable pointers 147 are formed on the brackets 135 and 141 and companion pads 148 may be formed on the case 45 and suitably marked in accordance with normal and abnormal operating conditions whereby conditions of operation may be determined.

To provide printing illumination I have shown the lamps 42 and to isolate the heating effect of the lamps from the printing heads 41, the lamps 42 are segregated or remotely located preferably in separate lamp housings 151 substantially as shown and suitably attached to the case 45 as indicated (Figures 3 and 6). Printing illumination is directed to the exposure aperture 53 through a duct 152 formed in the case 45 and a film gate 153 which will be later described.

The lamp housing 151 includes a lamp compartment 154 in which the lamp 42, mounted in a suitable carrier device 155, is secured as shown (Figure 6). A suitable reflecting device 156, is arranged adjacent the lamp 42 and to direct illumination through the duct 152 and a suitable light condenser 157 is arranged between the lamp 42 and the duct 152.

The lamp housing 151 is a double walled structure having an intermediate compartment 158 through which a cooling liquid such as water may be directed from a suitable source of supply and subject to manipulations of a control valve 159 (Figure 3) through suitable pipes or conduits 161.

Printing illumination is admitted to the printing heads 41 through transverse slots 162 formed in the body part 52 at a position remote from or substantially opposite the exposure aperture 53 and is directed to the aperture 53 between the parts 47 and 48 of the sprocket 46 as indicated by broken lines 163 (Figures 5 and 7).

A film guide plate 164 is suitably secured to the part 52 and has an aperture 165 therein similar to the slot 162 and registering therewith, and an air cut-off slide 166 is arranged in suitable guideways formed in the part 52 and between said part and the guide plate 164 and has a transparent part 167 arranged to cover the aperture 165 to prevent the passage of air without interfering with the transmission of light to the exposure aperture 53.

To provide manually operable means for varying the printing illumination in accordance with printing requirements I have shown means for

varying the effective area of the slot 165. (Figures 7 and 41).

A slide device 168 is mounted in a suitable guideway in the guide plate 164 and a control pin 169 is rigidly mounted on the slide as shown. The slide 168 is adjusted by means of a cam 170 mounted on a bearing stud 171 extending for rotation through a bore in the guide plate 164 and mounted on the printing head 41. The pin 169 engages in a cam slot 172 which forms a uniformly accelerating cam approximately 360 degrees in extent, formed in the cam 170 as shown (Figure 41). The throw of the cam slot 172 is equal to a predetermined range of light variations so that the slot 165 may be varied from a complete shut off to a maximum opening and suitable characters are formed on a peripheral surface 173 of the cam 170 for indicating positions of the slide 168.

The periphery of the cam 170 is exposed to view through a slot 174 formed in the printing head 41 through which the cam may be manipulated by a finger. A star shaped spring 175 is positioned between the printing head 41 and the cam 170 to provide a friction drag and the assembly is secured in operative position by the guide plate 164.

To provide automatic means for varying the printing illumination in accordance with requirements or as determined by the relative densities of successive portions of the negative film or photographic printing element, I have shown means for varying the effective width or area of the slot 165 in accordance with successive requirements including a control element or film 168 and means for positioning this film with respect to the aperture 165 or advancing it across said aperture or across the path of the printing illumination.

The control element or film 168 is or may be a photographically produced film having successive portions of varied or different densities or translucency. The successive portions may be separately produced in a variety of possible degrees of translucency and spliced together, end to end, in an assembly corresponding in length and translucency to the requirements of a particular negative film.

Various degrees of translucency are or may be produced by printing or rendering portions of the area of the film opaque such as by printing opaque parallel lines on the film as shown (Figures 55, 56 and 57), the film sections 22, 23 and 24 of these figures showing different arrangements of the opaque lines of the control film 168.

The sections or strips of control film 22, 23 and 24 illustrated (Figures 55, 56 and 57 respectively) are characterized by alternating translucent or transparent and opaque sections, the relative width of these sections being varied to effect varying degrees of translucency or transparency.

The section or strip 22 (Figure 55) is made up of three sections, a section 169 being entirely transparent to transmit the maximum light, a section 171, having relatively narrow opaque lines adapted to slightly diminish printing light, and a section 172 having relatively wide opaque lines whereby printing is diminished to a minimum. Similar results may be accomplished with sections having other arrangements of the transparent and opaque portions such as by varying the number and location of these portions, as illustrated (Figures 56 and 57). The section 23 is characterized by or utilizes two opaque portions 75.

174 and but one transparent portion 175, and similarly the section 24 is characterized by two transparent portions 175 and but one opaque portion 174. It is desirable to print border lines 180 on the sections 24.

The sections 22, 23 and 24, may be produced in suitable quantity or lengths and in a variety covering a predetermined range of possible variations in light requirements for a supply from which suitable lengths are cut and spliced together as required and in desired succession, as indicated at 173.

The control film gate 153 is secured on a shaft 181 journaled in a bore through the case 45 for pivotal opening and closing movement of this gate (Figure 7), and carries a guide plate 182 formed in accordance with the guide plate 164 and to cooperate therewith in guiding the control film 168 with respect to the aperture 165.

A light chamber 183 is formed in the gate 153 of a form similar to the light duct 152 in the case 45 and for registration therewith when the gate 153 is in closed position as shown (Figures 5 and 7). Light entering the chamber 183 from the duct 152 is reflected toward the aperture 53 by a reflecting plate 184 mounted on a carrier 185, which is detachably secured to the gate 153, and through a suitable opening 186 through the gate 153 and a transverse slot 187 through the guide plate 182 similar to the slot 165 and registering therewith. A filter slide 188 is positioned in suitable guideways adjacent the guide plate 182, which slide upon occasion carries a ray filtering plate 189 of suitable characteristics whereby the quality of the printing illumination may be independently varied.

A latch pin 191 is mounted for longitudinal movement in a bearing lug 192 of the gate 153 (Figures 7 and 40) and to engage a lock collar 193, a suitable compression spring 194 is provided to urge the pin 191 against the collar 193.

The lock collar 193 may be any suitable device in which the pin 191 may engage for latching the gate 153 in closed position and to provide means for positively locking the gate in closed position upon occasion. The collar 193 is secured to a shaft 181' having a suitable bearing in the case 45 and a formed end 182' which may be engaged by a socket wrench or the like, as will be later described.

For feeding the control film 168 to and from the ends of the guide formed by the guide plates 164 and 182 (Figures 1, 7 and 17), I provide constant feed sprockets 201 and 202 similar in every respect to the feed sprockets 111 and similarly mounted in bearing hubs 203 formed on the wall 146 of the case 45. The sprockets 201 and 202 are driven through spiral gears 204 associated with each sprocket as will be later described.

Fixed film strippers 200 and suitable guards such as the guard devices 122 may be arranged about the sprockets 201 and 202 as shown.

The sprockets 201 and 202 are positioned beyond the ends of the guide formed by the guide plates 164 and 182 for the formation of compensating film loops between the sprockets and the guide, and means is provided to impart continuous intermittent feed to the control film 168 in the guide and across the aperture thereof.

To accomplish this intermittent feed, a film sprocket 205 is mounted in the part 52 to engage the film 168 during its passage through the guide formed by the guide plates 164 and 182 as shown

(Figure 7), and means is provided for intermittently actuating said sprocket to advance the film.

The intermittent movement is effected by means of a Geneva movement device including a slotted star wheel 206, a crank pin 207, and lock plate 208 (Figures 8, 10 and 11). The crank pin 207 and lock plate 208 are mounted on a suitable flywheel 209 which is provided for an obvious purpose.

The film sprocket 205 is suitably secured to a drive shaft 211 rotatably mounted in a bearing member 212 and a gear 213 is secured to the shaft 211 as indicated (Figure 8). A counter-shaft 214 is arranged in a suitable bearing 215 adjacent the shaft 211 and carries the star wheel 206 of the Geneva movement device and a pinion gear 216 secured to its respective ends. The pinion gear 216 meshes with the gear 213 and is actuated to drive said gear by the Geneva movement device, so that the sprocket 205 is actuated intermittently to effect a corresponding feed of the film 168.

The flywheel 209, carrying the Geneva movement parts 207 and 208, is splined and feathered on a shaft 217 carrying a pinion 218 and suitably mounted in a bearing 219. The pinion 218 is arranged to mesh with a drive gear 221 carried by and keyed to the sprocket shaft 50 of the printing head 41 for rotation therewith.

To converse and materially reduce the amount of control film required for controlling printing, the relative proportions of the gears 221 and 213 and their respective pinions 218 and 216 are such as to effect a reduction in the extent of the movement of the control film, the control film being fed at a fixed ratio to the sensitized and photographic printing films.

In order that the splices or connections between the sections of the control film do not come to rest at the aperture of the slot 165 in the intermittent feed of the control film, the following arrangement is provided. The extent of the periodic feeding movements of the control film are of sufficient extent that they are slightly greater than the width of the aperture slot 165 plus the width of a splice 173 of the control film. The extent of the movement is indicated by the dotted lines 222 while the width of the slot 165 is indicated by light lines in Figure 41. Also the positioning of the splices 173 is such with reference to the usual perforations 220 of the control film that the film comes to rest with the splices 173 thereof to one side of the aperture slot 165.

As shown, the periodic feed movements of the control film are equal to the spacing of the perforations 220 thereof, so that no attention is required in the lacing of the control film in order that the splices 173 do not position at the aperture slot 165 during rest periods of the control film.

The periodic movements of the control film are relatively fast, so that the degree of light resulting from the change from one section of the control film to another is changed sharply and without appreciable blending effect on the sensitized film being printed.

To provide actuating means for the various devices of the printing head units 12 I have shown a drive shaft 231 arranged in suitable bearings 232 in the mechanism case 45 (Figures 2 and 9) and extending from said case for attachment to a power source as will be later described.

The drive shaft is positioned to extend between the drive shafts 113 of the sprockets 111 positioned

near the end walls of the case 45 and over the drive shaft 50 of the printing head sprocket 46.

Transmission worms or gears 121 are arranged along the shaft 231 and to mesh with the gears 118 and 119 and a similar worm 233 is arranged to engage a worm drive gear 234 suitably secured to the printing head drive shaft 50.

Jack shafts 235 are arranged in suitable bearings in the case 45 to transmit motion from the shaft 231 to the control film drive sprockets 201 and 202, the drive connections each consisting of a spiral gear 236 mounted on each jack shaft meshing with a gear 204 and a similar gear 237 mounted on each jack shaft 235 and meshing with a companion worm 238 on the drive shaft 231 (Figures 2 and 8). The relative ratio of the gears 236 and 237 to their companion gears is such as to effect a reduction in speed proportionate to the ratio of the control film speed to the sensitized and printing film speeds.

Sensitized and negative photographic films are stored and transported on spools 251 (Figures 22 and 26) having a drive pin 252 which may be engaged to rotate the spool, and standard left and right spindle mechanism units 253 are provided for controlling the spools 251. One of the mechanism units 253 is included in each one of the spindles 13, 14 and 15.

The mechanism units 253 include a bushing 250 arranged to engage in the hub of the spool 251 and slotted to receive the pin 252 thereof. The bushing 253 is secured to a shaft 254 as indicated at 255, and the shaft 254 is mounted by means of an antifriction bearing 256 in a carrier 257 and provides a spindle upon which a drive gear 258 and suitable clutch mechanism may be arranged, another antifriction bearing 259 cooperating with the bearing 256 in rotatably supporting the shaft.

To provide a clutch mechanism I have shown a driving spider 261 secured to the shaft 254 by means of a pin 262 and carrying diametrically disposed and transversely arranged laterally extending pins 263. An internal friction drum 264 is formed in the carrier 257, and a similar friction drum 265 is formed in a drive part 266 and is positioned adjacent the spider 261 and opposite the carrier 257. Friction pads 267 suitably reinforced by holders 268 are arranged in the friction drums 264 and 265 and are radially pressed against the friction surfaces thereof by means of springs 269. The pins 263 extend through the pads 267 and drive or carry the pads 267 and their respective holders 268 as indicated (Figures 26 and 27).

The drive part 266 is rotatably mounted on the shaft 254 and is provided with an extending hub portion 271. A drive member 272 having a suitable flange 273 and the gear 258 formed thereon is arranged adjacent the part 266 on suitable antifriction rollers 275, and a unidirectional drive connection between the drive member 272 and the drive part 266 is effected by means of a flexible coil 276 arranged on the hub portion 271 and secured to the flange 273 of the drive member 272 by means of a screw 277.

The coil 276 is wrapped about the hub 271 and functions by frictional engagement therewith to draw the friction drum 265 with the drive member 272 as a unit only when the direction of rotation of the member 272 is such as to tend to wind the coil 276 tightly about the hub 271. Obviously relative rotation tending to unwind the coil 276 effects disengagement between the parts and the

direction of the winding of the coil 276 determines the direction of action of the respective mechanism units.

The friction connection between the stationary drum 264 and the spider 261 provides a lag to prevent spinning or overrunning, and the friction connection between the drum 265 and the spider 261 drives the spindle mechanism to wind film on the spool 251 while permitting the usual slip-page compensating for variations in diameter of the film roll on the spool 251.

To provide the reel spindles 13 for sensitized film, a mechanism unit 253 is arranged in a suitable support including a base 281 having a head portion 282 in which the mechanism unit 253 is arranged and secured by means of screws 283 (Figures 20 and 21), and a reel flange plate 284 which is secured to the head 282 and carries a suitable guard device 285. These supports are arranged in pairs on the printing head units 12 as shown (Figures 1, 2 and 3), and include a drive shaft 286 carrying a suitable gear 287 in position to mesh with the gear 258, formed on the part 272, an extension shaft 288 arranged to extend into the printing head unit adjacent the drive shaft 231 and having a gear connection therewith through a gear 289 carried by the shaft 288, and a companion gear 291 carried by the shaft 231 provide a driving connection for each spindle unit 13.

The reel spindles 14 and 15 for negative or photographic printing film and for control film are similarly provided, and mounting bodies (Figures 2 and 23 to 25 inclusive) are provided to receive the mechanism units 253 of the spindles 14 and 15, these mounting bodies being provided with base flanges 293 and outer flanges 294. The body 292 is suitably secured on pads formed in the compartment portion 32 of the base 11, by means of screws, and a cover plate 295 is attached to the flanges 294 as indicated (Figure 23) and to the base 11 and encloses the body parts 292 and provides a flange for these film reels.

Drive spindles 296 are arranged in suitable antifriction bearings 297 and in position to effect driving engagement between gears 300 formed thereon and the gears 258 of the units 253 of the spindles 14 and 15. Extended clutch portions 298 of the spindles 296 provide driving connections which are coupled with drive shafts 299 (Figure 2).

Suitable film guards 311 are provided for the reel spindles 14 and 15 as shown (Figure 1).

The transmission 17 serves to drive the reel spindles 14 and 15 from the control unit 16. In the present embodiment I have shown a body 312 (Figures 2, 28 and 29) formed to provide suitable bearings for a main shaft 313 and transversely arranged distributing shafts 314 and 315. The shafts 313, 314 and 315 are supported in antifriction devices 316 secured in position by means of caps 317, and gaskets 318 are provided to retain lubricant. Spiral gears 319 arranged on the shaft 313 and companion gears 321 on the shafts 314 and 315 of suitable proportions effect the transmission connection.

The shafts 314 and 315 extend from the body 312 and are formed to interlockingly engage or key into the coupling shafts 299 for transmitting power to the spindle units 14 and 15, and a coupling part 322 is secured to the shaft 313 to cooperate with a companion coupling part 323 secured to an extension shaft 324 actuated by the power and control unit 16.

The control unit 16 illustrated includes a hous-

ing 331, a power unit 332, means for controlling the power unit including a switch 333, a crank 334 facilitating manual operation, and devices for controlling the switch 333 which will now be described, (Figures 1 to 3 and 30 to 39 inclusive).

The housing 331 encloses the various operating mechanism associated therewith, and a base flange 335 is formed on the housing to facilitate attachment thereof to the frame 11.

The power unit consists of an electric motor enclosed in a housing 336 and having its armature shaft suitably engaged with an extension drive shaft 337 mounted in and extending into the housing 331. A brake element or drum 338 is mounted on the drive shaft 337 and is secured to rotate therewith. A drive gear 339 is rotatably mounted on a bushing 340 adjacent a friction element 341 keyed to the shaft 337 for rotation therewith, and a spring 342 seated against an oil throw-off disc 343, carried by the shaft 337, frictionally engages the gear 339 against the friction element 341 to provide a friction drive or slip connection for relieving the motor of starting strains or the like.

The housing of the power unit 332 is water jacketed and connected into the water circulation system for cooling as shown (Figures 3 and 30).

A transverse drive shaft 345 is arranged in suitable bearings 346 in the housing 331 and is connected by means of coupling units 347, to the drive shafts 231 of the printing head units 12 as shown (Figures 1, 2 and 32). Gears 348 and 349 are keyed on the shaft 345 and are secured in position as indicated, so that the gear 348 meshes with the motor shaft gear 339. The gear 349 meshes with a gear 352 carried by a perpendicular shaft 353, mounted in antifriction bearings 354 in a bracket 355 suitably secured in the housing 331, and this shaft is connected with the extension shaft 324 for driving the reel spindles 14 and 15 as above described.

The switch 333 (Figures 30 and 34) is a device for establishing electrical connections or closing motor circuits for effecting forward and reverse action of the power unit and consequently left and right or forward and reverse action of the printing machine.

Switch plates 356 are secured to a carrier 357 of insulating material which is suitably secured to an operating shaft 358 for rotation therewith. The operating shaft 358 is mounted in suitable bearings in the housing 331 and arranged for engagement by a detachable extension 359 thereof to which an operating handle 361 is suitably secured which will be later described. The stationary contacts 362, 363 and 364 are arranged, adjacent the blades 356, (Figure 34) on a base member 350 of insulating material, so that movement of the handle 361 toward the left of a substantially central or neutral position (viewing Figure 1) closes a circuit through the contacts 362 and 363 to effect right to left film movement and similarly movement of the handle 361 toward the right effects left to right film movement by closing a circuit through the contacts 362 and 364.

A suitable cap 360 is provided for covering the switch 333.

To provide means for braking the power unit 332, (Figures 30 and 34) brake shoes 365 are mounted on levers 366 which are pivoted on studs 367 secured to the motor housing 336 and adjacent the drum 338. A spring 368 connecting the levers 366 is arranged to clamp the shoes 365 against the drum 338 for braking action and

means is provided for manipulating the brake shoes through inwardly extending arms 369 of the levers 366 as an incident to operations of the handle 361 for starting or stopping the printing machine. To accomplish this a pin 371, having a slotted head and mounted for axial movement in the housing 336, is positioned on the arms 369 of the levers 366 and extends for engagement by an actuating mechanism associated with the operating shaft 358. This actuating mechanism includes a wedge element 372 suitably secured to the shaft 358 for movement therewith and having oppositely disposed wedge surfaces 373. A pressure bar 374 is mounted on the pin 371 and a similar bar 375 is suitably secured to an adjusting screw 376 having threaded engagement with the housing 336 and secured by means of a lock nut 377. The bars 374 and 375 are arranged on opposite sides of the wedge element 372 and connected through toggle joints 371' and 372' oppositely engaging the wedge surfaces 373 of the wedge element 372.

Rotation of the shaft 358 in either direction from its aforesaid central or neutral position is accompanied by movement of the wedge element 372, proportionate expansion of the toggle joint connections between the bars 374 and 375 and longitudinal movement of the pin 371 for releasing the brake. The point at which the brake releases may be adjusted, or wear of the brake shoes 365 may be compensated by means of the adjusting screw 376. Pins 373' carried by the wedge element 372 prevent maximum extension and consequent locking of the toggle joints 371' and 372'.

To facilitate assembly the operating shaft extension 359 is mounted in a bearing 378 formed in a detachable mounting plate 379, which is suitably secured to the housing 331 with the shaft extension 359 in alignment with the shaft 358. A tongue and groove connection 380 facilitates assembly and disconnection.

A centering device is provided for returning the operating handle 361 to its central or neutral position when released during operation and to effect opening of the motor switch as an incident to the return movement of the operating handle.

The centering device and mechanism for controlling operation of the operating handle are assembled on the plate 379 and removable therewith as illustrated (Figures 37 and 38).

The centering device includes a crank pin 381 mounted in an annular member 382 keyed to the shaft 359 as shown (Figure 30), oppositely disposed pivoted locating plates 383 mounted on the plate 379 by means of shoulder screws 384 and embracing the crank pin 381 and a fixed stop 385 mounted in the plate 379, and a tension spring 386 connecting the plates 383. One of the plates 383 is shifted by the crank pin 381 when the operating handle 361 and shaft 359 are moved in either direction from a central or neutral position (Figure 37) as shown (Figure 38) against the action of the spring 386. The opposite plate 383 is anchored against the fixed stop 385 and when the handle 361 and the shaft 359 are released or unobstructed the spring 386 centers the shaft and its associated parts.

To provide mechanism for controlling operation of the operating handle 361 whereby operation thereof is permitted under predetermined conditions only as will be later described and to retain the switch 333 in either left or right running positions during normal operation of the

machine, a latch plate 387 is keyed to the shaft 359 and together with the annular member 382 is clamped securely against a collar 388 formed on the shaft 359 by means of suitable nuts 389.

5 A pin 390 is rigidly mounted in the latch plate 387 for engagement by mechanism to be later described whereby movement of the latch plate is limited or controlled.

Latch levers 391 and 391' are pivoted on shoulder screws 392 mounted in the plate 379. Latch portions 393 and 393' of the latch levers are arranged to engage neutral stops 394 and 394' or running stops 395 and 395' formed on the latch plate 387 as conditions require. A spring 396 10 connecting the latch levers 391 and 391' urges these levers toward the latch plate 387 subject to a mechanical control operating through control pins 397 and 397' rigidly mounted in the latch plates 391 and 391' respectively for engagement by mechanism to be later described.

Stop pins 398 may be mounted in the plate 379 for limiting movement of the latch plates 391 and 391' and similar stop pins 399 may be provided for limiting movement of the plates 383.

25 Means is provided to expand or release the latch levers 391 and 391' from the latch plate 387 upon occasion, either manually or electrically and to accomplish this a plunger 400 is arranged above and to engage adjacent shoulders 30 401 formed on the latch levers 391 and 391', when assembled, to effect the release of one or the other or both of the plates when actuated.

The plunger 400 is mounted in and is the armature of a solenoid 402 which is secured to the housing 331 (Figure 30) and includes a trip pin 35 403 extending through a rigid bushing 404 to engage the latch levers and a suitable exterior knob 405 for manual engagement. A spring 406 mounted on the plunger between the knob 405 and a seat formed in a bushing 407 retracts the plunger 400 after an operation and normally holds the plunger in retracted position. Electrical devices are provided for energizing the solenoid 402 to effect the release of either one or 40 both of the latch levers as will be later described.

A meter 408 and a dark room lamp 409 may be mounted in a suitable fixture 410 secured to the control unit housing 331, and electrically connected with the machine.

50 To provide means for indicating, determining, and recording the extent of operations of the printing machine I have shown (Figures 1 to 3 and 43 to 46) an indicating mechanism 421 and a recording mechanism 441.

55 The indicating mechanism 421 includes a frame 422 providing end bearings 423 for a screw shaft 424, a scale 425 indicating film footage, an indicator 426 screwthreaded on and positioned by the lead screw 424, a gauge bar 427 arranged for axial movement in the frame 422 and parallel to the shaft 424, and suitable mechanism for driving the shaft 424 including a gear 428 carried by the lead screw, a jack shaft 429 having a geared connection 430 with the drive shaft 288 of one of 60 the film spindles 13 (Figures 44 and 45) and carrying a gear 431, and an idler gear 432 formed on an axially movable sleeve 433 having a squared end portion 434 extending from the frame 422 in a guard socket 435 to receive a crank 436 indicated by dotted lines (Figure 44) and slidably mounted on a pin 438 having a bearing in the frame 422 and sleeve 433 as indicated (Figures 44 and 45). The indicator 426 may be manually adjusted or set by means of the crank 436 and by 70 shifting the idler gear 432 out of engagement with

the gear 431 and against a compression spring 437. The gear 432 is returned after adjustments by the spring 437.

The recording mechanism 441 may be any suitable recording device such as a mechanical 5 counter 442 having a stem 443 and crank 444 which may be oscillated for recording film footage and a manually actuated resetting member 445.

To effect continuous recording of the film 10 footage during operations of the printing machine in either direction of operation thereof I provide means for oscillating the shaft 443 in accordance with rotations of the jack shaft 429 including a star or cam wheel 445 (Figures 45 15 and 46) suitably secured to the jack shaft 429, a lever 448 pivoted at 449 and operatively connected with the crank 444, as indicated at 447, and two spaced cam rollers 451 mounted on the lever 448 engaged with the cam wheel 446 for 20 oscillation of the lever 448 and the crank 444 to actuate the recording mechanism 441 with rotation of the jack shaft 429 for recording the footage of the film advanced through the machine.

The gauge bar 427 is arranged to extend to 25 adjacent the housing 331 of the control unit and is suitably coupled to an extension bar 427' which is mounted for axial movement in the housing 331 adjacent the levers 391 and 391' (Figures 30, 32 and 36 to 38 inclusive) and is 30 transversely slotted to provide an abutment 452, which lies between the pins 397 and 397' mounted in the levers 391 and 391' respectively, for engagement with said pins to actuate these levers as above described, so that movement of the bar 35 427 to the left (Figure 32) effects movement of the lever 391' out of engagement with the latch plate 387 and movement of the bar 427 to the right effects movement of the lever 391 out of engagement with the latch plate 387.

A manually adjustable stop 455 and a fixed stop 456 are arranged on the bar 427 to effect shifting of the bar by means of an indicator 426. Thus, as the indicator moves to the left into engagement with the stop 455, the bar 427 is moved 45 to the left and disengages the lever 391' from the latch plate 387, and as the indicator moves to the right into engagement with the stop 456, the bar 427 is moved to the right and disengages the lever 391 from the latch plate 387.

50 The arrangement is such that, when the machine is operated in the direction in which the shaft 358 and its extension 359 are retained in operative position by the lever 391', the indicator 426 moves to the left into engagement with the stop 455, and, when the machine is operated in the direction in which the shaft 358 is retained in operative position by the lever 391 the indicator moves to the right into engagement with the stop 456, thus automatically stopping the machine, in either direction of operation thereof, at the ends of predetermined runs, the stop 455 being adjustable in accordance with a required run of the machine or to correspond with the length of a film used in the machine.

65 A snap action is imparted to the bar 427 in the following manner. An arm 457 is pivoted on a shoulder screw 458 mounted in the housing 331, and carries a roller 459 and a pin 461 engaged in a suitable slot formed in the bar 427 as indicated (Figures 30, 32 and 36). A wedge pin 462 is arranged adjacent the shaft 359 and in the path of the roller 459, preferably in lug 460 formed in the housing 331 and a compression spring 463 acting on the pin 462 restrains move- 75

ment of the roller 459 toward a central position but forces the roller in either direction after the central position is passed.

The pin 461 carries the bar 427 with the link 457 to release the levers 391 and 391' as above described.

To provide means for manually actuating or setting the printing machine independent of the power means I provide means for effecting a temporary drive connection between the crank 334 and the apparatus through the motor shaft 337, including a toothed clutch element 465 suitably secured to the motor shaft 337, a companion clutch element 466 arranged coaxially with the clutch element 465 and for axial movement in the housing 331 and carrying a shrouded gear 467, and a spur gear 468 arranged to engage the shrouded gear 467 and for axial movement on a bearing stud 469 mounted in the housing 331 (as indicated, Figures 30 and 33).

A hub portion 471 of the gear 468 encloses a compression spring 472 for retracting the clutch element 466 and is slotted to receive a drive pin 473 carried by the crank 334. A suitable cap plate 474 encloses the gears 467 and 468 and forms a guard 475 for the slotted end of the hub portion 471 of the gear 468.

To facilitate manual operation of the machine by means of the crank 334 and to insure against engagement of the clutch elements 465 and 466 during power operation of the machine, such as may injure an operator, means is provided for releasing the motor brake and for locking the gear 468 to prevent engagement of the clutch elements 465 and 466, subject to operating conditions.

To accomplish this a shaft 463' is rotatably mounted in the housing 331 adjacent the stud 469 and the brake levers 366 (Figures 30, 33 and 34). A double crank fixture 464' in which pins 465' are secured and arranged to engage the levers 366 upon rotation of the shaft 463', is suitably secured to one end of the shaft as indicated, and a sleeve 466' having a slotted end 467' similar to the slotted end 471 of the hub of the gear 468 is secured to the opposite end of the shaft 463'.

A guard 468' is formed on the cover plate 474 similar in proportion to the guard 475 so that the operating handle 334 may be inserted to engage the sleeve 466' for rotating the shaft 463'.

Rotation of the shaft 463' in a clock-wise direction, viewing (Figure 33) effects expansion of the brake levers 366 through the pins 465'. Notches 469' in the levers 366 retain the pins 465' to prevent self return movement of the shaft 463' which is urged in a clock-wise direction (Figure 34) by a coil spring 470' mounted on the fixture 464' and engaging the housing 331.

A lock plate 471' is rotatably mounted on a shoulder screw 472' secured to the housing 331 between the shaft 463' and the stud 469. The thickness of the lock plate 471' is such that it will fit freely between the gear 468 and the housing 331 when the gear 468 is in retracted position as shown (Figure 30) and the plate 471' is formed so that in the position shown (Figure 33) a portion of the plate will block axial movement of the gear 468 and in another position in which it clears the gear 468 for inward movement of the gear to engage the clutch elements 465 and 466.

In the present embodiment the plate 471' is substantially a disc partly cut away, and to provide means for adjusting the plate 471' as an incident to movements of the shaft 463', an arm 473' is formed on the sleeve 466' and carries a pin

474' engaging in a slot 475' formed in the plate 471'. Limit pins 476' may be mounted in the housing 331 for limiting rotary movement of the shaft 463'.

Only one operating handle 334 is provided and obviously when this is in use for shifting the lock plate 471' it cannot be used to shift the gear 468 and the clutch element 466 during power operation of the machine.

When the power is cut off the handle 334 may be connected to the sleeve 466', the shaft 463' is rotated in a clock-wise direction to expand the brake levers 366 until the pins 465' engage in the notches 469' to retain the shaft 463' in that position. Simultaneously the latch plate 471' is rotated in a counter clock-wise direction approximately 60 degrees or to a nonobstructing position, when the handle 334 may be connected to the hub portion 471 of the gear 468 for shifting the clutch element 466 into engagement with the clutch element 465 to permit manual operation of the machine.

The brake levers 366 are not fully expanded by the pins 465' and when power is again applied by means of the operating handle 361 the brake levers are fully expanded by the pin 371 as above described, thus releasing the pins 465' and permitting the spring 470' to return the shaft 463' to normal position as shown.

The control unit 16 is connected to control the printing illumination, the operation of the film gates 59 and 153 and the tension devices 112 by means of a sectional rod or shaft 476 extending through the control unit 16 and into the printing head units 12 and mounted in suitable bearings for axial movement. The shaft 476 is coupled to the latch plate 387 by means of the pin 390 carried in the plate as above described and engaging in a slot 477 formed in the shaft 476 as indicated (Figures 9, 30 and 32), and is shifted thereby as an incident to movement of the operating handle 361 and the shafts 358 and 359.

The printing illumination is controlled by a shutter 478 (Figures 6 and 9) arranged between the lamp housing 151 and the light duct 152 of the printing head unit 12 and carried by a shaft 479 rotatably mounted in a bearing 480 arranged in the printing head unit. A crank 481 is secured to an end of the shaft 479 and supports a pin 482 in position to engage in an annular collar 483 on the shaft 476 (Figures 6 and 9).

A ruby glass 484 is mounted on the shutter 478 as shown to provide non-actinic light at the exposure aperture when the shutter 478 is closed.

Operation of the film gates 59 and 153 is controlled by levers 485 and 485' pivoted on studs 486 suitably mounted in the mechanism case 45 and positioned by the shaft 476 through pins 487 carried by the levers 485 and 485' and spaced annular collars 488 suitably secured to the shaft 476 (Figure 9) and embracing the pins 487.

A plate 489 is suitably secured to the shaft 66 of the film gate 59 within the housing 45 (Figure 9) and has a circular slot 491 therein, and a pin 492 is suitably secured to the lever 485 at a distance from the shaft 66 equal to the radius of curvature of the slot 491.

Similarly a plate 493 having a circular slot 494 therein and similar to the plate 489 is suitably secured to the shaft 181 of the gate 153 and a pin 495 is mounted on the lever 485' at a distance from the shaft 181 equal to the radius of curvature of the slot 494 and so as to pass freely through the slot upon movement of the plate 493.

When the printing machine is not in operation 75

and the operating shaft 358 and handle 361 are in neutral position as shown, the gates 59 and 153 may be opened at will and likewise movement of the operating shaft 358 is permitted when said gates are both closed, but when the gate 59 is open, movement of the lever 485 is obstructed by the pin 492 engaging in the slot 491, and when the gate 153 is open the lever 485' is similarly obstructed by the pin 495 engaging in the slot 494. However, when the operating shaft 358 is moved to either one of the running positions the levers 485 and 485' are shifted about the studs 486 and the pins 492 and 495 are out of register with their respective slots 491 and 494 and prevent opening of the gates 59 and 153.

Control of the film tension devices 112 is effected through lever arms 143 secured to rock shafts 136 and engaging a bar 144 as above described (Figure 9), and a lever 486, pivoted on a stud 497 suitably mounted on the housing 45, and having a bifurcated end 490 engaging a pin 499 on the bar 144 and carrying a pin 501 adjacent the shaft 476 for engaging between spaced annular collars formed on a sleeve 502 which is slidably mounted on the shaft 476 and mounted between compression springs 500 as shown, provides a means for actuating the bar 144 from the shaft 476 and consequently the tension devices 112 in accordance with adjustments of the operating handle 361.

The arrangement is such that, when the operating handle 361 is in its central or neutral position as shown, the tension devices are positioned for lacing the printing and sensitized films. When the handle 361 is operated in either direction for operation of the machine, the tension devices on the side of the printing heads from which the film is fed thereto are permitted to tension the film while the tension devices on the side of the printing heads from which the film passes therefrom are positioned in non-tensioning position, thus providing adjustment of the tensioning devices automatically with manipulation of the handle 361 for operation of the machine in either direction and for lacing of the film.

The arrangement of the springs 500 provides a yielding connection, to permit of modifying the effect of rapid changes with respect to the tension mechanism by means of a dash pot mechanism which is provided for the regulation of changes.

To provide a dash pot mechanism I have shown (Figures 6 and 9) a piston 515 arranged in a cylinder 516 mounted on the housing 45 and connected through suitable levers 517 and 518 and a shaft 519 for actuation by a pin 520 secured to the lever 518 and connected with the bar 144. The piston is fitted freely into the cylinder and arranged for pneumatic action.

An oil pump 593 may be suitably mounted in one or both of the mechanism cases 45 and connected to provide forced lubrication. A suitable drive connection being effected through a spiral gear 504 connected for driving the pump 593 and a companion gear 505 suitably mounted on one of the shafts 113 or the like.

To provide means for effecting characteristic printing such as defining or outlining stripes and periodic markings I have shown a separate printing unit 531 (Figures 1, 30, 58 and 59) associated with the control unit 16 and constructed and arranged to print or expose two parallel lines 532 (Figure 54) defining or outlining a sound track 533 or a space occupied by sound recordings on the printed sensitized film 21.

The printing unit 531 includes a body 534 ar-

anged to form a housing for a lamp 535 suitably mounted in a carrier 536 and provided with a bearing stud 537. The body 534 is or may be suitably secured to the control unit 16. A reflector 539 and a polished cover plate 541 for the body 534 cooperate with the lamp 535. A guide plate 542 is arranged on the body 534 in which a light slot 543 is formed in accordance with the characteristic printing and a sprocket wheel 544 is arranged to control the position of the sensitized film 21 with respect to the slot 543.

The sprocket wheel 544 is or may be in the form of a toothed annulus internally grooved to provide a ball race and supported on bearing balls 545. An internal race for the balls 545 is provided by a collar 546 having threaded engagement with the stud 537 and secured in operative position by the reflector 539 as shown (Figure 58) and an adjusting nut 547 having threaded engagement with the collar 546. A lock nut 548 is or may be provided for securing the nut 547 in adjusted relationship. The sprocket 544 is freely rotatable and rotated by the sensitized film as an incident to movement thereof through the unit.

A film gate 549 is provided to cooperate with the plate 542 and the sprocket 544 in guiding and locating the film. The gate 549 includes a guide block 551 secured to a carrier 552 by means of a pin 553 and is mounted by means of spaced arms 554 formed on the carrier 552 and pivoted on a stud 555 suitably mounted on the body 534 as indicated (Figure 59). A suitable film spool 556 is mounted on antifriction bearings between the arms 554 and a spring 557 engaging one of the arms 554 and mounted in a housing 558 secured to the stud 555 provides pressure for the film gate 551.

For printing footage or like periodic and characteristic marks 561 (Figure 54) I have shown a separate lamp 562 mounted within the printing head 41 (Figure 5) adjacent the exposure aperture 53 and outside of the sprocket parts 47 and 48 and adapted to expose film periodically along an edge thereof and through at least one slot 563 formed in the sprocket part 47.

To provide means for detecting film breaks during printing operations and cutting off the power supply when a film is broken or when a printing lamp is not functioning I have shown (Figures 1, 2 and 47 to 53 inclusive) the detecting devices 19 comprising a bearing plate 565 carrying film spools 566 rotatably mounted on stationary studs 567 and disc rollers 568 mounted in pivoted arms 569 as indicated (Figures 47, 48 and 49).

The arms 569 are secured to shafts 571 having bearings 572 in the plate 565. Cross pins 573 are mounted in the shafts 571 adjacent the back surface of the plate 565, and tension springs 574 attached to ends of the cross pins 573 and to extensions of the studs 567 tend to move the disc rollers to the position shown in dotted lines (Figure 47).

When film is laced between the spools 566 and the rollers 568, the rollers 568 act to hold the film against the spools 566 in accordance with the pressure applied by the springs 574 and when a break occurs and the film passes out from between the corresponding spool 566 and roller 568, and the discs of the rollers 568 pass freely through suitable annular grooves 575 formed in the spools 566 and in alignment with the discs of the rollers 568, permitting the

rollers 568 to move to the dotted line position (Figure 47) and coincidentally moving the cross pins 573 to the dotted line positions (Figure 50).

Stationary rollers 576 are or may be mounted on the plate 565 adjacent the spools 566 and on suitable studs 570 to assist in guiding film.

The plates 565 are suitably secured to the frame 11 in alignment and a swinging bar 577 is arranged in the frame 11 and suspended on spaced links 578 (Figures 2 and 52). Pins 579 are mounted in the bar 577 in the path of movement of the cross pins 573 and so that movement of any cross pin will shift the bar 577 as indicated by the dotted line positions of the pins 579 (Figure 50).

A mercury switch 581 mounted on a suitable carrier plate 582 and electrically connected to control the motor or power means is secured to a rock shaft 583 supported in the frame 11 (Figures 49 and 51) and a pin 584 mounted in the rock shaft 583 extends into the path of a pin 585 carried by the bar 577, in the direction effected by one of the rollers 568 assuming the position thereof indicated in dotted lines (Figure 47), so that movement of the bar 577 tilts the mercury switch 581 to break an electrical circuit and thereby stops the printing machine when either the negative film or control film passes out from between a corresponding spool 566 and roller 568.

A stop pin 586 is or may be arranged in the frame 11 and in the path of the pin 584 to limit movement of the rock shaft 583 (Figure 50).

Similarly the mercury switch 581 is actuated to stop the printing machine when either one of the printing lamps 42 fail to function. This is accomplished by means of solenoid coils 587 and 588 each individualized to and in series with one of the printing lamps.

During normal operation of the printing lamps the coils 587 and 588 are energized and by means of their respective armatures 589 and 591 lift and sustain the weight of a bar 592 connected to the bracket 582 and when either the coil 587 or the coil 588 is deenergized by failure of the associated printing lamp, the weight of the bar 592 assisted by armature springs 593 overcomes the strength of the other coil and tilts the mercury switch 581 as above described.

Means is provided for permitting operation of the machine for adjustments and the like independent of the mercury switch 581 which means is arranged so that operation thereof is prevented except under predetermined conditions.

To accomplish this a secondary switch 601 (Figures 32, 34 and 39) is suitably mounted on the control unit 16 adjacent the switch 333 and electrically connected across the mercury switch 581 so as to bypass current or to cut out the mercury switch when closed.

A switch operating shaft 602 is mounted for longitudinal movement in a bearing sleeve 603 suitably secured in the housing 331 of the control unit and extends therefrom to provide a push button 604. Depression of the button 604 closes the switch 601 which is of the spring type so that the shaft 602 will be returned when released.

To permit closing of the switch 601 only when the operating handle 361 is in neutral position and retain the closed condition until said operating handle is returned to neutral position permitting an adjusting operation a latch mechanism is provided which includes a latch plate 605 pivoted on a shoulder screw 606 mounted in the housing 331, a collar 607 carrying a pin 608 suit-

ably secured to the extension shaft 359, the pin 608 being engaged in a bifurcated end 609 of the lever 605, and a lock formed between an end 610 of the lever 605 and the sleeve 603.

The sleeve 603 is slotted to permit free rotary movement only of the end 610 of the lever 605, relatively deep annular grooves 611 and 612 are formed in the shaft 602 in accordance with the open and closed positions of the switch 601 and the shaft 602 is slightly reduced in diameter between the grooves 611 and 612 and provides a hub 613 between the grooves 611 and 612.

The grooves 611 and 612 are proportioned, located and spaced so that the end 610 of the lever 605 may enter the groove 611 when the switch 601 is open and so that it may enter the groove 612 when the switch is closed. A circular notch 614 of greater radius than the hub 613 and of less radius than the shaft 602 is formed in the end 610 of the lever 605 which is arranged to permit longitudinal shifting of the shaft 602 between but not beyond the grooves 611 and 612. Radial sockets 615 are formed adjacent the notch 614 to permit the end 610 of the lever 605 to enter either the groove 611 or 612 and embrace the shaft 602 at the bottom of the groove, thus preventing longitudinal movement of the shaft 602.

Obviously the shaft 602 does not interfere with normal operation of the machine and the operating handle may be moved in either direction when the button 604 is depressed to close the switch 601, but if the switch 601 is closed and the operating handle 361 is moved into either running position, electrical contact will be sustained until the operating handle is returned to neutral position when the shaft 602 will be released permitting the switch to open.

To provide means for cleaning the sensitized, negative and control films as an incident to the movement thereof during printing operations I have shown the film cleaners 18 of a suitable type unnecessary to be described and suitably mounted on and secured to the printing machine as shown (Figures 1, 2 and 3).

Compressed air is supplied to the cleaners 18 through pipe fittings 595 connecting the cleaners with a control valve 596 and similarly a vacuum connection for the cleaners is effected through pipe fittings 597 and an inlet connection 598.

It is desirable to shut off the compressed air when the machine is not in operation and to accomplish this automatically, a lever 616 is suitably pivoted on the control unit 16 as at 617 (Figures 3, 30 and 31) adjacent the operating shaft 358, a valve control rod 618 is suitably connected to the valve 596 and to one end of the lever 616, and a double faced wedge cam fitting 619 is engaged by the lever 616 and fixed to the shaft 358 for movement therewith.

Movement of the operating handle 361 in either direction for starting the machine moves the lever 616 in a clock-wise direction and to depress the control rod 618, opening the valve 596. Return movement of the handle 361 permits the valve 596 to close.

Suitable pressure gages 621 may be connected in the various pipe lines or fittings for indicating conditions in operation and suitable filters such as the filter 86 may be provided upon occasion. Dark room lamps 631 are mounted in the case 11 (Figures 1 and 42) to facilitate threading and observation. These lamps include an incandescent bulb 632 suitably mounted in a base 633

secured to the frame 11, and a hood 634 attached to the base 633 and inclosing the bulb 632 having an opening 635 therein in which a transparent window 636 of ruby color or no actinic value is mounted. The bulb 632 may be electrically connected for continuous operation or a suitable switch may be provided to permit control thereof.

It will be noted that the sensitized film 21 may be arranged on and between the remote reel spindles 13 of the printing machine and through the printing units 12 successively as shown (Figure 1) or separate sensitized films may be arranged on and between the pair of spindles 13 associated with each printing unit 12. That separate or unassociated photographic printing elements or negative films 24 may be arranged on the pairs of reel spindles 14 associated with each printing unit 12 or that such elements having separate sound and picture printing records or characteristics may be arranged on the spindles 14 in any order for successive printing on sensitized film properly laced in the machine, and that by changing the sensitized film at the end of each run the printing machine may be kept in substantially continuous operation since the machine is reversible and no rewinding of either the sensitized, the negative, or the control film is required.

The negative and control films are protected by their arrangement in the housing 32 and the arrangement of the sensitized film facilitates adjustments and changes during operation.

The printing machine produces printed film of high quality because of the substantially vibrationless transmission of power to the various operating parts and positive coordination of said parts through the spiral and worm gears above mentioned and the substantially perfect contact between the sensitized and negative films at the exposure apertures 53 effected by the application of compressed air to said films as above described.

Waste of film is eliminated by the automatic control devices above described and time is saved, permitting maximum economical production of printed films. One operator may manage several of the printing machines simultaneously.

While I have described and shown the preferred embodiment of my invention I do not wish to be limited to the precise details of construction 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.

I claim:

1. In a photographic printing machine the combination with an exposure device for printing progressively upon a sensitized photographic element from a photographic printing element, of an exposure control element formed of connected parts of unlike translucency and being progressively operative and synchronized for controlling the exposure of said sensitized element, and means for actuating said exposure control element whereby portions of the connected parts adjacent the connections are moved at an accelerated speed across an effective position in the exposure device.

2. In a photographic printing machine the combination with an exposure device for printing progressively upon a sensitized photographic element from a photographic printing element, of an exposure control element formed of connected parts of varied exposure characteristics and being arranged for synchronized progressive movement past a light control station, and means

for actuating said exposure control element whereby the junctions of the connected parts are avoided.

3. In a photographic printing machine the combination with an exposure device for printing progressively upon a sensitized photographic element from a photographic printing element, of exposure control means, comprising a ribbon having successive portions of unequal control value and extent, and means for actuating said ribbon in synchronized progressive relationship whereby the exposure of said sensitized photographic element is controlled and the junctions between the successive portions of said ribbon are avoided.

4. In a photographic printing machine the combination with an exposure device for printing progressively upon a sensitized photographic element from a photographic printing element, of exposure control means, comprising a film made up of successive portions of unequal translucency spliced together, a series of perforations extending along said film by means of which the film is advanced across a printing light for varying the light, and means for advancing the film periodically whereby the spliced connections between the successive portion of the film remain stationary only at one side or the other of the printing light.

5. In a photographic printing machine the combination with an exposure device for printing progressively upon a sensitized photographic element from a photographic printing element, of exposure control means, comprising a film made up of successive perforated portions of unequal translucency, the perforations being arranged in series and extending along the film and the successive portions of said film being spliced together between perforations, and means for advancing the film across an exposure control slot whereby perforations adjacent a splice connecting film portion are registered with respect to the exposure control slot and the splice is moved rapidly across said slot.

6. In a photographic printing machine the combination with an exposure device for printing progressively upon a sensitized photographic element from a photographic printing element, of exposure control means, comprising a ribbon having successive portions of unequal extent, and means for actuating said ribbon in synchronized progressive relationship and to avoid the junctions between the portions thereof having unequal exposure characteristics whereby the exposure of said sensitized photographic element is uniformly controlled.

7. In a photographic printing machine the combination with an exposure device adapted for printing progressively upon a sensitized photographic strip from a photographic printing strip having a progression of scenes or sections of different densities and extents and adapted for the control of the printing light by a separate exposure control strip progressively operative upon the printing light, each of said strips being provided with uniformly spaced feed perforations and said control strip being provided with a progression of control sections varying in density and extent to correspond with the corresponding sections of the printing strip, and toothed means engaging said perforations and adapted for the feeding of said strips in synchronism, including a constantly operating intermittent feed mechanism for feeding said control strip and adapted to prevent the positioning of the junctions be-

tween the control sections of the control strip at the light control station thereof during the rest periods in the intermittent feeding movement of the control strip.

5 8. In a photographic printing machine the combination with an exposure device adapted for printing progressively upon a sensitized photographic strip from a photographic printing strip having a progression of scenes or sections of different densities and extents and provided with a printing light aperture adapted for the passage thereacross of a separate exposure control strip progressively operative across said pas- 10 sage to control the printing light, each of said strips being provided with uniformly spaced feed perforations and said control strip being provided with a progression of control sections varying in density and extent to correspond with the corresponding sections of the printing strip, and toothed means engaging said perforations and adapted for the feeding of said strips in synchronism including a constantly operating intermittent feed mechanism for feeding said control strip step by step in a magnitude equal 15 to the spacing of the perforations of said control strip and arranged to prevent the positioning of the junctions between the control sections of the control strip at said printing light aperture during the rest periods in the intermittent feeding movement of the control strip.

9. In a photographic printing machine the combination with film printing mechanism, associated film sprockets, and transmission mechanism operatively connecting said printing mechanism and said film sprockets, of a control unit therefor including a motor having a driving connection with said transmission mechanism, a switch device arranged to control said motor, means normally disengaged for permit- 20 ting periodic manual operation of said transmission mechanism, and means controlled by said switch device whereby said last mentioned means is rendered inoperative.

10. In a photographic printing machine the combination with film printing mechanism, associated film sprockets, and transmission mechanism operatively connecting said printing mechanism and said film sprockets, of a control unit therefor including a motor having a driving connection with said transmission mechanism, a switch device arranged to control said motor, means normally disengaged for permitting periodic manual operation of said transmission mechanism, and lock means arranged to prevent operation of said last mentioned means while said motor is in operation.

11. In a photographic film printing machine the combination with film printing mechanism and power means for normally actuating said printing mechanism, of manually operable means for actuating the printing mechanism, said manually operable means including a clutch device, transmission devices for rotating the clutch device, and lock means associated there- 60 with whereby engagement of said clutch device is prevented, said lock means being releasable by means of said crank when the crank is disengaged from the transmission devices.

12. A control unit for film printing machines and the like comprising a housing, a drive motor mounted on said housing and having a brake element associated therewith, a cooperating brake element mounted adjacent said motor, a 75 crank arranged to control said motor, and means

actuated by said crank for determining the relative positions of said brake elements.

13. A control unit for film printing machines and the like comprising a housing, a drive motor mounted on said housing and having a brake element associated therewith, a cooperating brake element mounted adjacent said motor, a crank arranged to control said motor, means actuated by said crank for determining the relative positions of said brake elements, and a 5 separate crank mechanism whereby said brake elements may be adjusted to facilitate manual adjustments.

14. In a motion picture printing machine the combination with a printing head, a sprocket 15 associated therewith, and spaced sprockets remotely located and coordinated with said first mentioned sprocket, of tension devices individualized to the separate films and operable by urging the films away from a predetermined path, 20 and visible indicators associated with said tension devices and arranged to indicate their normal operating positions.

15. In a photographic film printing machine the combination with printing apparatus including a printing head having an exposure aperture across which sensitized and negative films are moved as an incident to printing, another aperture through which printing light is directed, and a control film having successive portions of predetermined extent and translucency, of means including a coordinated intermittent movement device arranged to effect synchronized intermittent movement of the controlled film, each movement of the control film being of greater extent 25 than the width of the aperture through which the printing light is directed.

16. In a photographic film printing machine the combination with printing apparatus including a printing head having an exposure aperture across which sensitized and negative films are moved as an incident to printing, another aperture through which printing light is directed, and a control film formed of spliced parts of lengths and translucency proportionate to variations in printing light requirements, of means including a Geneva movement device associated with the printing head and arranged to effect synchronized intermittent movement of the control film, each movement of the control film 30 being of greater extent than the width of the aperture through which the printing light is directed, the excess movement being greater than the width of one splice connecting the control film parts.

17. In a photographic film printing machine the combination with printing mechanism comprising a printing head having a plurality of film gates, of locking means whereby said gates are secured in predetermined positions during operation of the printing machine including pivoted members arranged for movement with said gates, and means operable as an incident to the starting and stopping of the printing machine for preventing predetermined movement of said pivoted members.

18. A photographic printing machine comprising a frame, film printing mechanism associated therewith including spaced printing head units having film gates and tension devices, an immediately disposed power and control unit having a drive shaft for actuating said printing head units, and an associated control device arranged to adjust all of said tension devices. 75

19. A photographic printing machine comprising a frame, film printing mechanism associated therewith including spaced printing head units having film gates and tension devices, an inter-
5 mediately disposed power and control unit having a drive shaft for actuating said printing head units, a control device for determining the operation of said drive shaft, and means associated therewith whereby said tension devices
10 are adjusted in accordance with adjustments of said control device.

20. In a printing machine the combination with printing mechanism, a control device for determining operations of the printing mechanism, and electrically operable devices for preventing operation of the printing mechanism
5 under predetermined conditions, of separate means for permitting operations of the printing mechanism to facilitate adjustment, said means being associated with the control device and retained in operation thereby during adjustments.
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