Aug. 27, 1957

E. C. WAGNER

ULTRA HIGH SPEED PHOTOGRAPHIC PROJECTION PRINTING MACHINE

2,803,991

Filed March 16, 1955

6 Sheets-Sheet 1

Fig. 1.

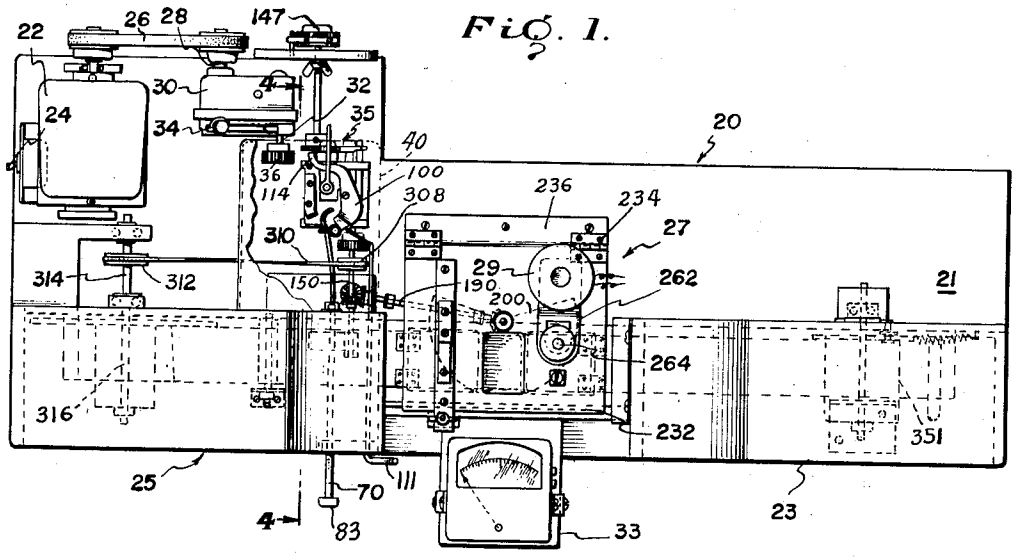
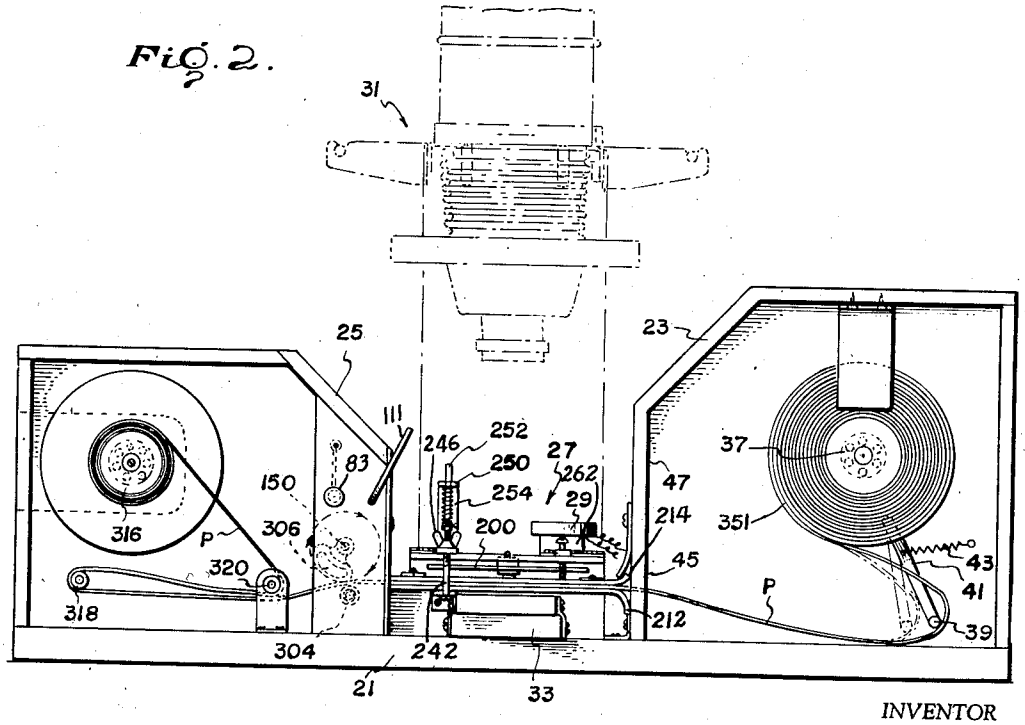


Fig. 2.



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6 Sheets-Sheet 2

Fig. 3.

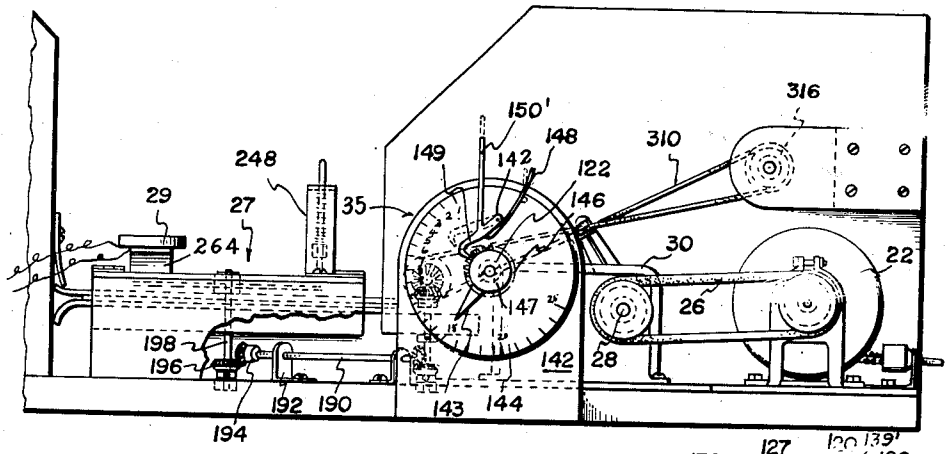


Fig. 4a.

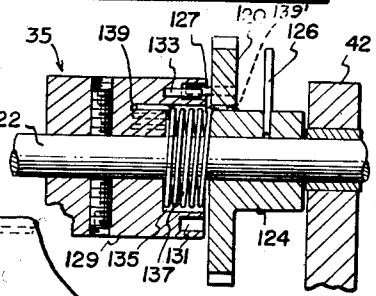
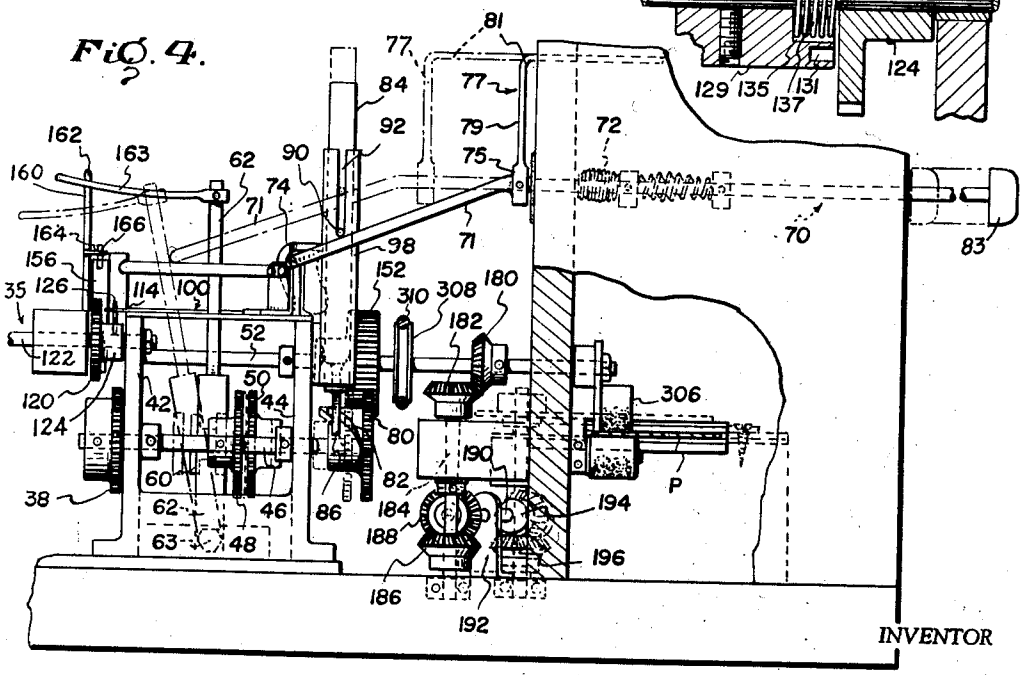


Fig. 4.



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2,803,991

Filed March 16, 1955

6 Sheets-Sheet 3

Fig. 5.

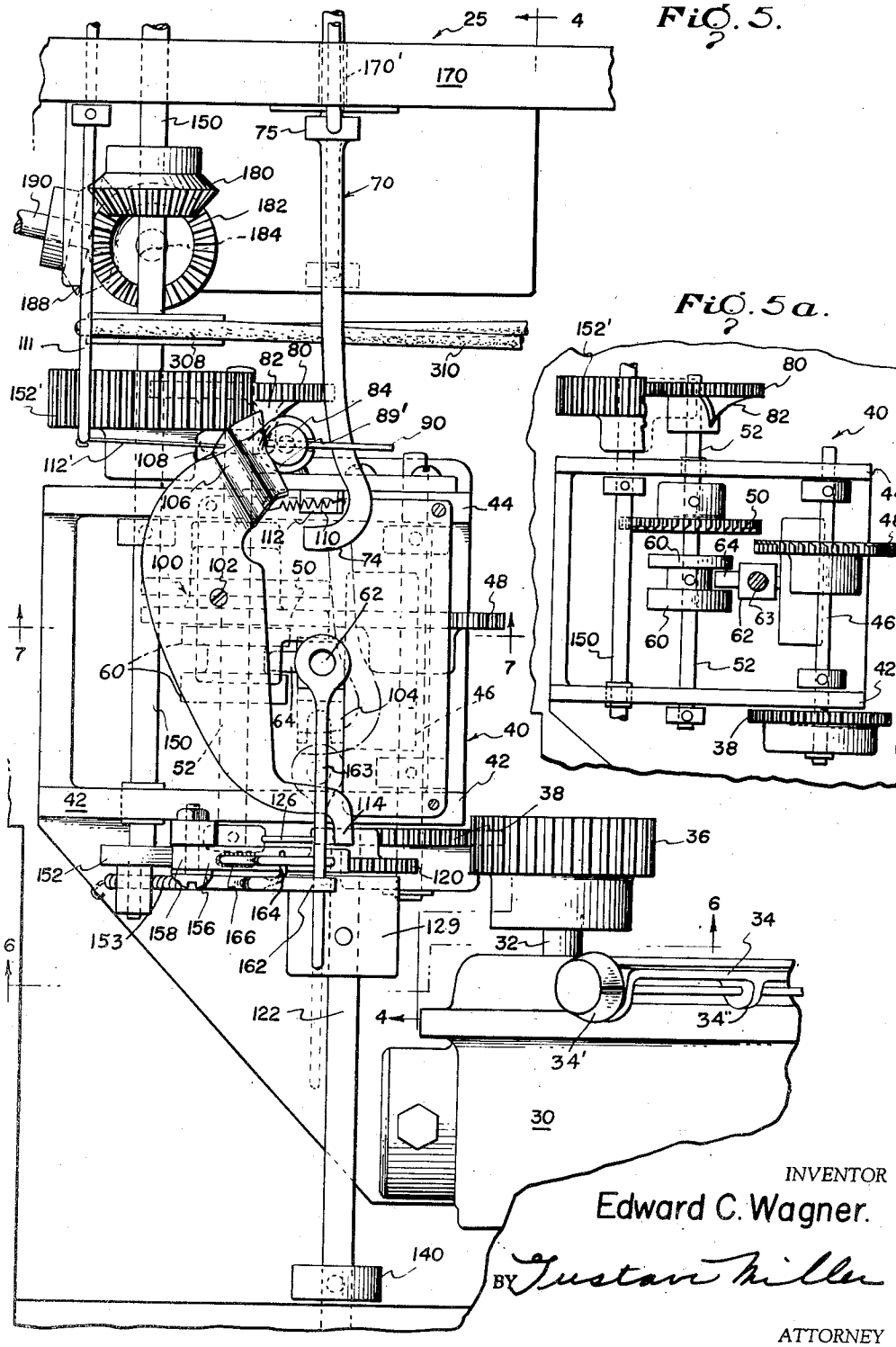


Fig. 5a.

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2,803,991

Filed March 16, 1955

6 Sheets-Sheet 4

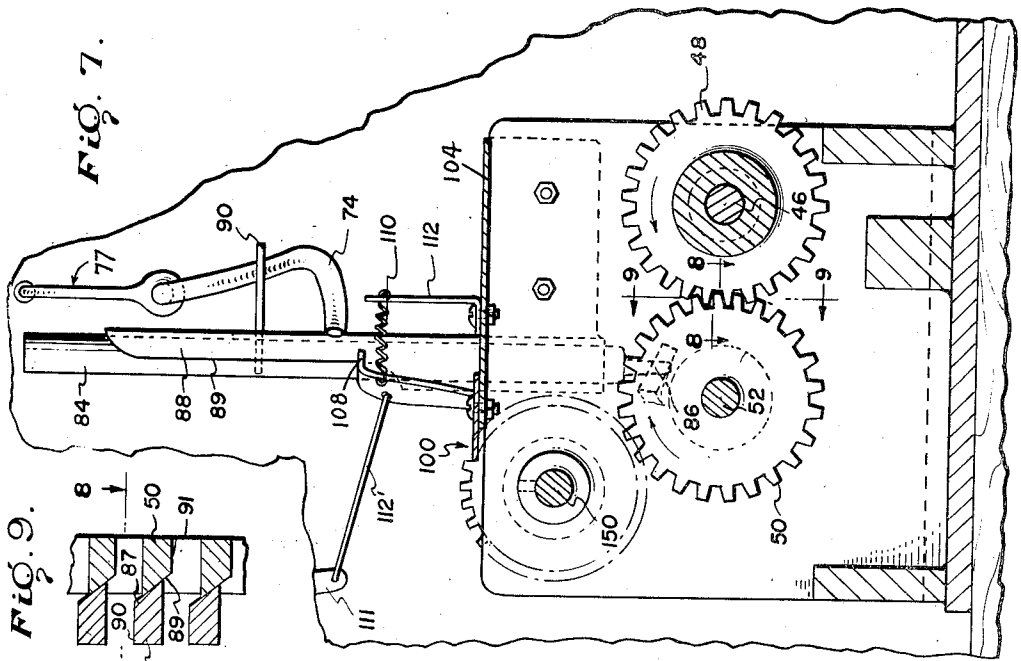


FIG. 7.

FIG. 9.

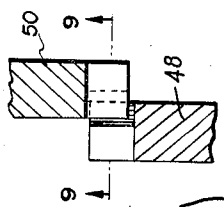


FIG. 8.

FIG. 6.

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Aug. 27, 1957 E. C. WAGNER 2,803,991

ULTRA HIGH SPEED PHOTOGRAPHIC PROJECTION PRINTING MACHINE

Filed March 16, 1955 6 Sheets-Sheet 5

FIG. 10.

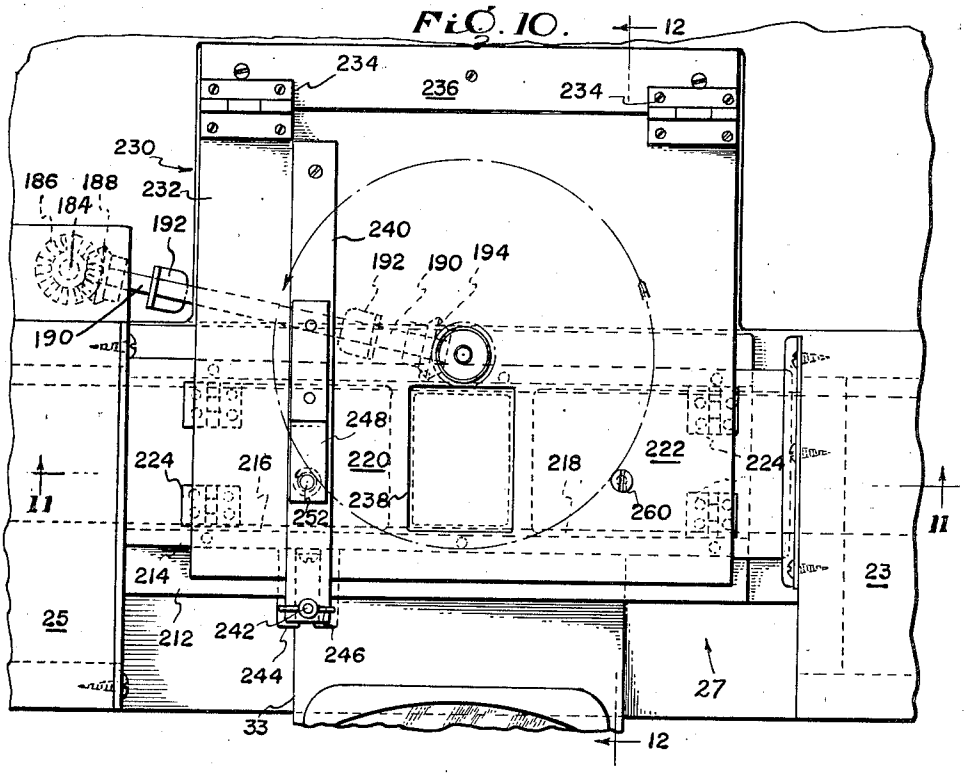
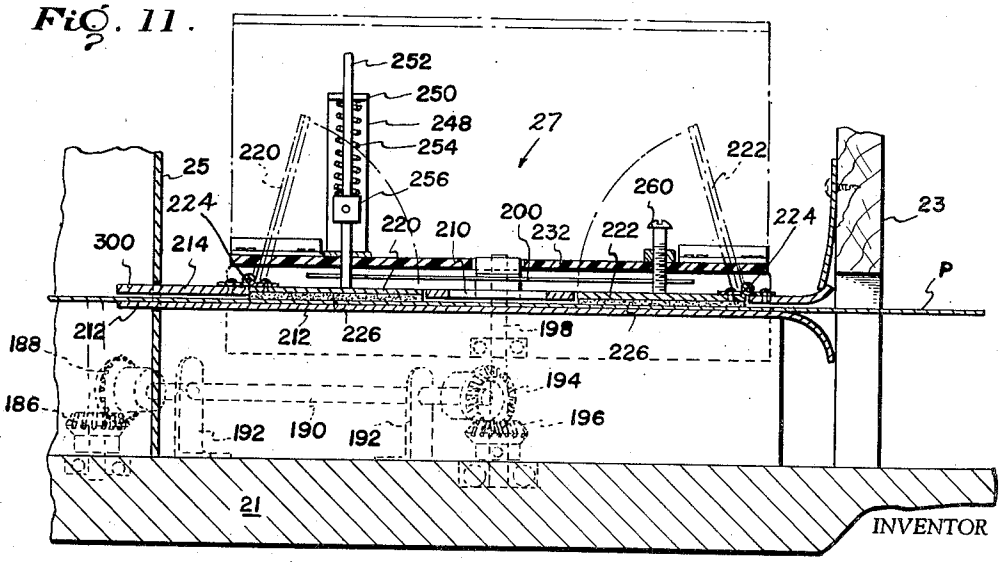


FIG. 11.



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2,803,991

Filed March 16, 1955

6 Sheets-Sheet 6

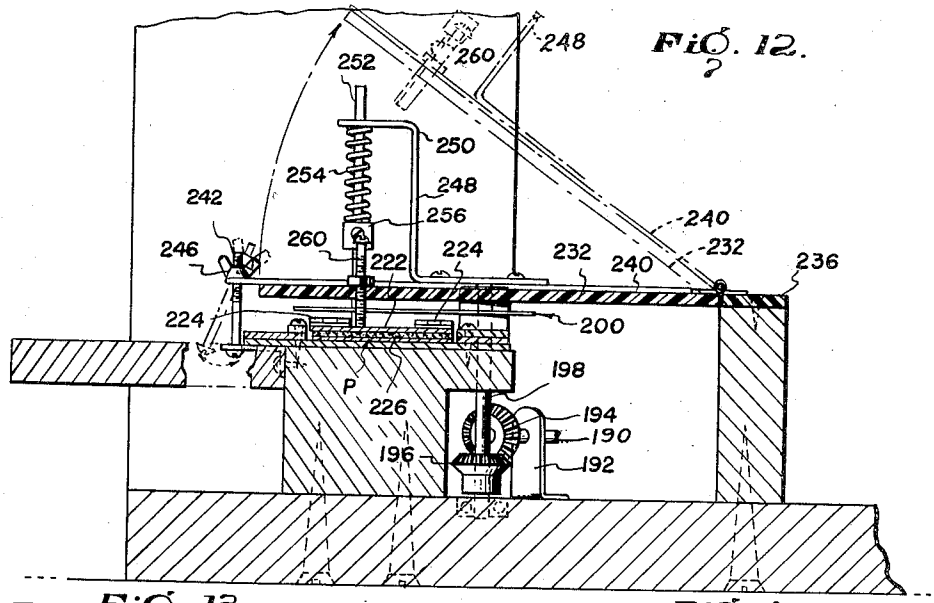


FIG. 12.

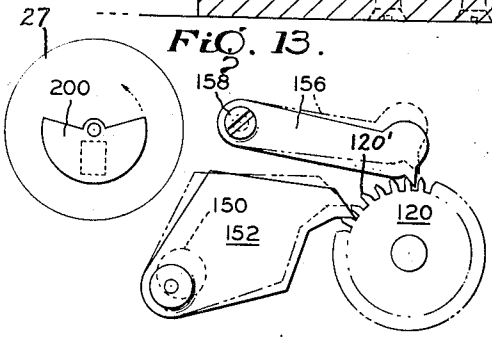


FIG. 13.

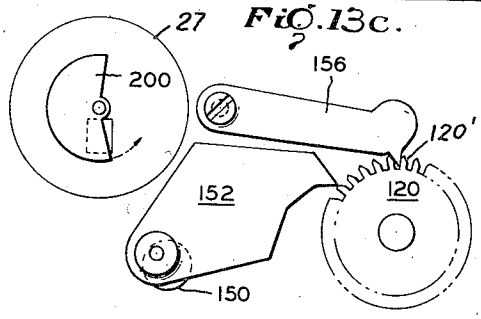


FIG. 13c.

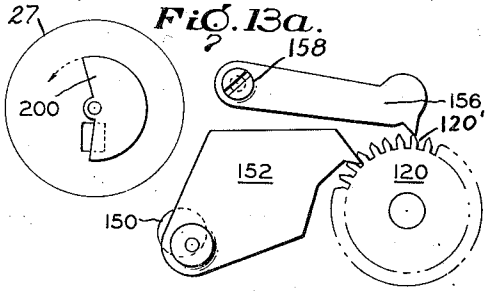


FIG. 13a.

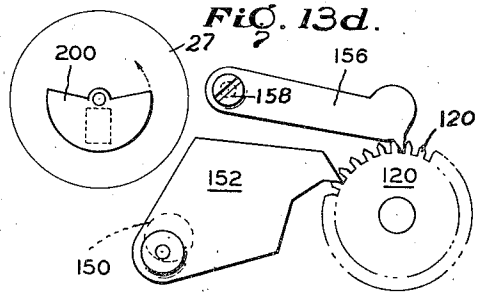


FIG. 13d.

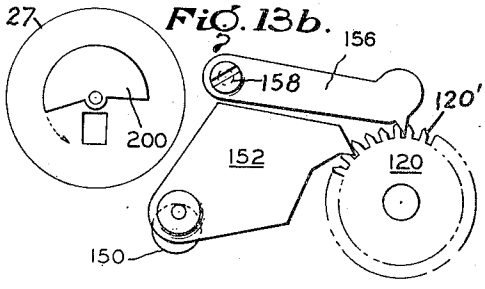


FIG. 13b.

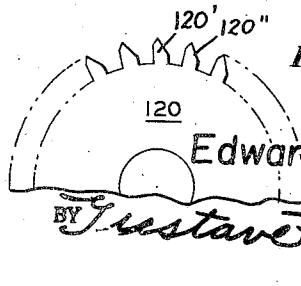


FIG. 14.

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2,803,991

ULTRA HIGH SPEED PHOTOGRAPHIC PROJECTION PRINTING MACHINE

Edward C. Wagner, Pensacola, Fla.

Application March 16, 1955, Serial No. 494,914

10 Claims. (Cl. 88—24)

This invention relates to photography and more particularly to ultra high speed photographic projection printing machines.

It is often desirable to be able to print a predetermined number of prints in side-by-side relation on a single strip of sensitized paper from a single photographic negative. Multiple identical prints from a single photographic negative are often required, for example, in connection with the photographing of students, where each student may have ordered a plurality of identical prints. It is also desirable that the photographic printing apparatus used for such purposes be simple in operation and capable of being operated by relatively unskilled personnel.

Accordingly, it is an object of this invention to provide a projection printing machine which automatically prints any desired predetermined number of prints on a single strip of sensitized paper from a single photographic negative.

It is another object of this invention to provide an automatic projection printing machine which is simple and rapid in operation and which may be operated by relatively unskilled personnel.

It is another object of this invention to provide a projection printing machine having a simple, efficient, and easily operable clutching mechanism for connecting the printing mechanism to a constantly operating drive means.

It is still another object of this invention to provide a projection printing machine which may be easily adjusted to print any predetermined number of prints from a given negative, with counting means for automatically declutching the printing mechanism from the power drive source when the predetermined number of prints have been made.

In achievement of these objectives, this invention provides an automatic projection printing machine having a power driven means for intermittently moving a strip of sensitized paper through an exposure frame where it is exposed to light from a photographic negative which is being printed. A constantly driven motor is connected through a manually operated clutch and suitable power takeoffs to a means for intermittently advancing the photographic paper through the exposure frame and for constantly driving a shutter which controls the admission of light from the negative to the sensitized paper. The declutching of the motor with respect to the several power takeoffs is controlled by an automatic counting device which may be set to permit any predetermined number of exposures to be made from a given negative. After the number of exposures for which the counting device has been set have been made, the power takeoffs for the device which feeds the sensitized paper and for the rotating shutter are automatically disengaged.

Further objects and advantages of this invention will be best understood from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a top plan view of an apparatus in accordance with the invention;

Fig. 2 is a front elevation view of the apparatus of the invention;

Fig. 3 is a back elevation view of the apparatus of Figs. 1 and 2;

Fig. 4 is a side elevation view, partially in section, as seen on lines 4—4 of Figs. 1 and 5;

Fig. 4*a* is a vertical section through the spring loaded counting gear and hub;

Fig. 5 is an enlarged top plan view, partially cut away, showing details of the gearing and declutching arrangement;

Fig. 5*a* is a reduced top plan view of the gear box of Fig. 5 with the top cover and pivoted brake arm removed to more clearly show the gear relationships;

Fig. 6 is an enlarged elevation view of the gear box as seen substantially on line 6—6 of Fig. 5;

Fig. 7 is an enlarged view in vertical cross-section as seen substantially on line 7—7 of Fig. 5;

Fig. 8 is a view in horizontal cross-section along section line 8—8 of Figs. 7 and 9, showing the meshing engagement of the clutch and drive gears;

Fig. 9 is a view in vertical section along line 9—9 of Figs. 7 and 8;

Fig. 10 is an enlarged detailed top plan view of the shutter area of the apparatus;

Fig. 11 is a view in longitudinal cross-section as seen substantially on line 11—11 of Fig. 10;

Fig. 12 is a view in vertical cross-section as seen substantially on line 12—12 of Fig. 10.

Figs. 13 and 13*a*–13*d* are views showing the cycle of the shutter rotation and the related position of the dog members of the counting gear mechanism;

Fig. 14 is an enlarged fragmentary detail of the counting gear teeth.

General organization

Before beginning a detailed description of the apparatus of the invention, the following short summary is given in order to give an understanding of the general organization of the apparatus.

Suitably mounted upon a base 21 in spaced relation to each other are sensitized paper pay-out and take-up housings 23 and 25, respectively. Disposed intermediate housing 23 and 25 and in the path of the sensitized paper is the shutter housing generally indicated at 27 which supports an exposure meter 33. A photographic projector 31 is positioned above the shutter housing in properly focused relation to the exposure aperture. A photoelectric element 29 connected to meter 33 is provided to permit proper adjustment of the light from projector 31 in accordance with the particular negative which is being printed, the projector light being adjusted to give a predetermined reading on the meter.

A constantly operating motor 22 provides the motive power for intermittently advancing the sensitized paper through the shutter housing and also for driving a rotating shutter 200 disposed within the shutter housing. Motor 22 is connected through a variable speed transmission 30 to power input shaft 46 of a gear box generally indicated at 40. Motor 22 may be clutched in driving engagement to the power take-offs for the intermittent sensitized paper feed and for the rotating shutter by means of a manually operated clutch operating member 70 which engages clutch gears 48 and 50 disposed within gear box 40 to thereby transmit power to the paper feed device and to the rotating shutter.

A counting device generally indicated at 35 is set by the operator to cause clutch gears 48 and 50 to be automatically declutched at the end of a predetermined number of exposures. The counting device automatically re-sets itself to repeat the same number of exposures upon the next actuation of manually operated clutch operating member 70.

Detailed description

Referring now to the drawings, the apparatus of the invention is generally indicated at 20 and includes a driving motor 22 connected to a suitable source of electric power through a control switch 24 and connected by means of a belt drive 26 to the power input shaft 28 of a variable speed transmission generally indicated at 30. Variable speed transmission 30 is of conventional construction and permits a constant speed input at shaft 28 to be controlled within predetermined limits to provide a variable speed output of predetermined magnitude at output shaft 32. A control lever 34 having an operating knob 34' and mounted in brackets 34'' is provided for controlling the output speed of shaft 32.

As will best be seen in Fig. 5, output shaft 32 has rigidly mounted thereon a spur gear 36 which is in constant meshing engagement with a gear 38 carried by shaft 46 of the gear box generally indicated at 40. Gear box 40 includes a pair of spaced parallel bearing bracket members 42 and 44. Bracket 44 is spaced forwardly of bracket 42, with respect to the front-rear dimension of the apparatus. Gear 38 is disposed rearwardly of the surface of rear bearing bracket 42 and is supported on shaft 46, the opposite ends of shaft 46 being supported in suitable bearings in bearing brackets 42 and 44. A clutch gear 48 is fixed to shaft 46 substantially midway of the length thereof. A mating clutch gear 50 is rigidly attached to a shaft 52 which extends parallel to shaft 46 but in spaced relation thereto. Both gears 48 and 50 are substantially of the spur gear type. Shaft 52 is supported in suitable bearings by the opposite bearing brackets 42 and 44, but is slidably mounted with respect to its bearings to permit clutch gear 50 to be slid into and out of meshing engagement with clutch gear 48.

To insure prompt and positive meshing of the gear teeth of clutch gears 48 and 50, the abutting surfaces 87 and 89 of the teeth of the respective gears are beveled in such a direction that the respective beveled surfaces 87 and 89 lie in parallel planes at the plane of meshing, as best seen in Fig. 9. During the movement of the two gears 48 and 50 into meshing engagement, the respective surfaces 87 and 89 slide over each other as the slidable clutch gear 50 moves into engagement with fixed gear 48, until the driving surfaces 90 and 91 of the respective gear teeth are finally in driving engagement.

In order to engage clutch gears 48 and 50 with each other, means are provided for slidably moving shaft 52 with respect to its supporting bearings to thereby move clutch gear 50 into engagement with clutch gear 48. In order to accomplish this purpose, a pair of spaced collar members 60 are rigidly fixed in spaced relation to each other on shaft 52. Cooperating with the spaced collars 60 to effect a sliding movement of shaft 52 and thus of clutch gear 50 is a pivotally mounted rocker arm 62 (Figs. 4 and 5*a*) which is pivotally movable about a horizontal pivotal axis 63. Rocker arm 62 carries an abutment 64 which fits between collars 60. Hence, any rocking movement imparted to rocker arm 62 causes a sliding movement of shaft 52 due to the engagement of abutment 64 with collars 60.

In order to effect a rocking movement of arm 62 and thus to cause the clutching engagement of gears 48 and 50, there is provided a slidably movable clutch operating arm 70 supported in suitable bearings in paper take-up housing 25. Clutch operating arm 70 is biased forwardly by a spring member 72 (Fig. 4) to the full line position shown in Fig. 5 in which stop collar 75 on clutch operating arm 70 engages the rear surface of casing 25. A guide member 77 is attached to collar 75 and includes a vertical leg 79 to which is connected a horizontal leg 81 (Fig. 4). Leg 81 is slidably movable in an aperture in the rear wall of casing 25 and guides clutch operating arm 70 in its movement. An operating knob 83 is provided at the forward end of operating arm 70. Knob 83 is normally

disposed forwardly of the front surface of casing 25 as shown in full line in Fig. 4.

The clutch operating arm 70 is provided with a downwardly inclined portion 71 having a laterally bent end portion 74 which is engageable with the upper end of rock arm 62 to cause a rocking movement of arm 62 about its pivotal axis 63.

Pivotal movement of rock arm 62 about its axis causes abutment 64 on arm 62 to engage collars 60 on shaft 52 thereby sliding shaft 52 rearwardly, and causes slidable clutch gear 50 to engage fixed clutch gear 48.

This permits power to be transmitted to the rotary shutter and to the paper feed mechanism through power take-offs which will be described hereinafter.

Unclutching arrangement

The unclutching of gears 48 and 50 is accomplished automatically at the end of a predetermined number of exposures by means of the apparatus which will now be described. Rigidly fixed to the front end of shaft 52 and outwardly of the front bearing bracket 44, as will best be seen in Figs. 4 and 5*a*, is a gear 80 having attached to the inner surface thereof and on one side only of the axis of shaft 52, a declutching cam 82. Cooperating with cam 82 is a vertically slidable rod 84 having at its lower end a pin 86 which is vertically movable into the path of cam 82. When pin 86 is in its down position as shown in full line in Fig. 4, it engages cam 82 to move shaft 52 forwardly to declutch gears 48 and 50. Rod 84 is supported by a vertically extending hollow bearing sleeve 88 which in turn is attached to the outer or forward bearing bracket 44. Rigidly connected to rod 84 substantially midway of the length thereof and extending perpendicularly outwardly in a horizontal plane therefrom is an elongated pin member 90 which is adapted to move vertically in a slot 92 of a bearing sleeve 98. As will best be seen in Fig. 4, the downwardly inclined portion 71 of clutch operating member 70 underlies pin 90. When clutch operating member 70 is pushed inwardly or rearwardly, to cause clutch gears 48, 50 to engage, as shown in dotted outline in Fig. 4, downwardly inclined portion 71 of the clutch operating arm 70 cams pin 90 in an upward direction, thereby raising rod 84 upwardly in its bearing sleeve 88 to the dotted outline position shown in Fig. 4. This raises pin 86 at the lower end of rod 84 upwardly out of the path of cam 82 on shaft 52. Thus, the operation of clutch operating arm 70 not only rocks rocker arm 62 about its pivotal axis to shift shaft 52 to effect a clutching engagement of clutch gears 48 and 50, but also effects the upward movement of rod 84 to move declutching pin 86 out of the path of declutching cam 82. After clutching engagement of gears 48 and 50 has been effected by the movement of operating arm 70, pressure is released on knob 83 and spring 72 returns clutch operating arm 70 to the full line position shown in Fig. 5.

Rod 84 is maintained in the elevated position to which it is cammed by clutch operating arm portion 71 despite the return movement of clutch arm 70 to its unactuated position. This is accomplished by the provision of a brake or holding member generally indicated at 100 (see Figs. 5 and 7) which acts upon rod 84. As best seen in Fig. 5, brake member 100 comprises a substantially flat tongue-like member pivotally connected at 102 to a horizontal support plate 104 which is attached to the upper opposite edges of bearing brackets 42 and 44. Brake 100 includes at its forward end an upstanding bent portion 106 (see Fig. 7) having at its upper end a horizontally bent portion or brake lip 108 which frictionally engages the outer surface of rod 84. The outer surface of vertical bearing sleeve 88 for rod 84 is cut away as indicated at 89' (Fig. 5) in order to permit the edge of brake lip 108 to frictionally engage the outer surface of rod 84. A spring member 110 is connected to bent portion 106 of brake 100 and is rigidly anchored at its opposite end to a vertical angle member 112 supported by horizontal plate 104. Spring 110 strongly

biases brake 100 in a clockwise direction as shown in Fig. 5 to cause brake lip 108 to firmly frictionally engage the surface of rod 84 to prevent rod 84 from dropping downwardly into declutching position until a predetermined time in the operating cycle is reached.

At its opposite end, brake 100 is provided with a horizontally extending tongue 114 which is engaged by a counting device to be hereinafter described to effect disengagement of brake lip 108 with respect to rod 84, thereby permitting rod 84 to drop into its declutching position, as shown in full line in Fig. 4.

A manually operated unclutching means is also provided, and comprises a manual operating member 111 which extends through the take-up housing 25 and is connected by a link 112' to bent portion 106 of brake 100. By pushing inwardly on operating member 111, rod 84 may be manually released to cause unclutching of gears 48 and 50.

Counting mechanism

In order to permit printing of a predetermined number of prints from a single negative, means are provided for automatically declutching gears 48 and 50 after a predetermined number of exposures have been made. The counting mechanism is generally indicated at 35 and includes a counting gear 120 (Figs. 4–*a*, 13 to 13–*d* inclusive) which is loosely mounted on a shaft 122 adjacent but spaced from the rear surface of rear bearing bracket 42, gear 120 being provided with bevelled teeth 120' inclined on the side adjacent to the direction of rotation as at 120''. Rigidly affixed to counting gear 120 is a hollow hub 124 which is disposed between the forward surface of gear 120 and the rear surface of bearing bracket 42. Hub 124 lies in the same vertical plane as the tongue portion 114 of brake 100. A pin 126 projects radially outwardly from hub 124 for engagement with tongue 114 of brake 100. A pin 127 projects laterally from the rear surface of gear 120, pin 127 being disposed adjacent the outer periphery of gear 120.

A hub member 129 is rigidly fixed to shaft 122 adjacent the rear surface of gear 120 on which pin 127 is positioned. Hub 129 is provided with an annular recess 131 in which is positioned a stop pin 133. Hub 129 is also provided with a countersunk annular recess 135 for receiving a spiral spring 137 which surrounds shaft 122. One end of spring 137 is anchored in a hole 139 of annular recess 135. The opposite end of spring 137 is anchored in a hole 139' in the rear surface of counting gear 120. Spring 137 normally biases pin 127 of gear 120 into engagement with stop pin 133 of hub 129. When shaft 122 is manually rotated by the operator to set the number of exposures to be printed, counting gear 120 follows shaft 122, although loosely mounted on the shaft, due to the effect of biasing spring 137, pin 127 remaining in engagement with stop pin 133 during the setting operation.

As best seen in Fig. 3, the rear end of shaft 122 projects through bearing bracket 142 and carries a pointer member 143 which may be set to any predetermined position with respect to an indicating dial 144 which is rigidly mounted on the outer rear surface of bearing bracket 142. Dial 144 is calibrated to indicate the number of exposures to be made, the number of divisions on dial 144 corresponding to the number of teeth 120' on counting gear 120. A ratchet 146 is rigidly mounted on the outer end of shaft 122 adjacent the outer surface of dial 144, and an operating knob 147 is carried by shaft 122 rearwardly of ratchet 146. A pawl 149 is pivotally supported adjacent ratchet 146 by bearing bracket 142 and is biased by spring 148 into engagement with the ratchet. An operating handle 150' is connected to pawl 149 to permit the pawl to be retracted from engagement with the ratchet when it is desired to change the setting of the pointer 143.

To adjust the counting gear 120 to a predetermined desired setting, pawl 149 is retracted from engagement with ratchet 146 by manually actuating handle member 150' against the bias of spring 148. This permits shaft 122 and pointer 143 to be rotated by means of operating knob 147 to rotate pointer 143 to the desired setting on the scale 144. This causes shaft 122 to rotate and causes the stop pin 133 carried by hub 129 to angularly move in accordance with the movement of shaft 122 and pointer 143. Counting gear 122, including its rigidly attached hub 124 and pin 126 carried by hub 124 follow the angular movement imparted to shaft 122 due to the biasing effect of spring 137. During the setting movement imparted to pointer 143, pin 127 of counting gear 120 remains constantly in engagement with stop pin 133 of hub 129. Thus, by turning pointer 143 to a predetermined setting on dial 144, pin 126 carried by the hub of the counting gear 120 is displaced to a corresponding position requiring a predetermined angular displacement of counting gear 120 before the declutching brake 100 is actuated by pin 126 to disengage clutch gears 48 and 50.

Means are provided for positively driving the counting gear to cause pin 126 to advance toward projection 114 of brake 100 to thereby declutch gears 48 and 50. This driving means will now be described. As will best be seen in Figs. 5, 6 and 7, a shaft 150 is suitably supported by bearings in the oppositely disposed bearing brackets 42 and 44. At its forward end and forwardly of front bearing bracket 44, shaft 150 has rigidly mounted thereon a large spur gear 152' best shown in Fig. 5 of the drawings. Shaft 150 is spaced above and in parallel relation to slidable shaft 52 on which clutch gear 50 is mounted and also to the shaft 46 on which drive gear 48 is mounted. Gear 152' is substantially longer in an axial direction than gear 80 to insure that these two gears are always in mesh despite any sliding movement of shaft 52 on which gear 80 is mounted.

A driving dog 152 is pivotally mounted about an eccentric axis at the end of shaft 150 adjacent the rear surface of bearing bracket 42. A spring 153 (see Fig. 6) biases driving dog 152 downwardly. Rotation of shaft 150 imparts an oscillatory movement to drive dog 152. Drive dog 152 engages counting gear 120 during 180 degrees of its oscillatory movement and advances gear 120 by an angular advance corresponding to one tooth for each cycle of oscillation of dog 152. A ratchet dog 156 is disposed above drive dog 152 and is pivotally movable about a fixed pivotal axis 158 carried by a vertical support arm 158' rigidly mounted at the upper end of the rear edge of bearing bracket 42.

Ratchet dog 156 normally drops by the action of gravity into engagement with the teeth 120' of counting gear 120 as drive dog 152 oscillates about its pivotal axis to thereby retain counting gear 120 in the position to which it has been advanced by drive dog 152. Counting gear 120 is rotated in a step-by-step movement in a clockwise direction with respect to the views shown in Figs. 13*a*–13*d*, inclusive, by the oscillatory driving movement of drive dog 152. During this step-by-step movement of the counting gear 120, pin 127 carried by gear 120 moves against the biasing force of spring 137, and pin 126 carried by the hub 124 of the counting gear advances toward the tongue 114 of clutch brake 100. As counting gear 120 advances in a step-by-step movement under the driving action of drive dog 152, ratchet dog 156 moves into and out of engagement with the teeth 120' of the gear 120, permitting a clockwise movement of the counting gear under the driving action of dog 152, but preventing a reverse or counterclockwise movement of gear 120 which would otherwise be caused during certain phases of the oscillatory movement of drive dog 152 by the biasing force of spring 137.

The engagement of drive dog 152 and of ratchet dog 156 with respect to the teeth of counting gear 120 is

synchronized with the position of the rocker arm 62 of the clutch mechanism in the following manner: At the upper end of the rocker arm 62 is positioned a horizontally extending arm 163, as best seen in Figs. 4 and 6. Arm 163 underlies a substantially horizontal lateral bent portion 162 of an otherwise vertical arm 160 which is rigidly connected to the drive dog 152 as at 152'. Arm 163 is slightly upwardly inclined in the direction of the forwardly bent portion 162 of arm 160. When rocker arm 62 is moved forwardly about its pivotal axis to the full line position shown in Fig. 4 (corresponding to a declutched condition of clutch gears 48 and 50), arm 163 swings upwardly in such manner as to engage the underneath surface of forwardly bent portion 162 of vertical arm 160 to raise drive dog 152 upwardly to a position in which it is locked out of engagement with the teeth of counting gear 120. When this upward movement of vertical arm 160 occurs, a horizontal projection 164 on vertical arm 160, which underlies a projection 166 on the upper edge of ratchet dog 156 engages the underneath surface of projection 166 (see Fig. 4) and raises ratchet dog 156 up out of engagement with the teeth of counting gear 120. Thus, the movement of rocker arm 62 to the position corresponding to an unclutched condition of gears 48 and 50 causes drive dog 152 and ratchet dog 156 to be positively removed from engagement with counting gear 120. The movement of ratchet dog 156 out of engagement with the teeth of counting gear 120 permits spring 137 to revolve gear 120 in a counterclockise direction back to the position at which pin 127 carried by counting gear 120 engages stop pin 133 carried by hub 129 on shaft 122. Thus, pin 126 carried by counting gear 120 is automatically reset at a position corresponding to the setting of pointer 143 on dial 144 to cause the mechanism to print the number of prints called for by the setting of the pointer as soon as the clutch operating arm 170 is again actuated to cause gears 48 and 50 to engage.

Rotating shutter and shutter housing

The rotating shutter 200 housed in the shutter housing 27 is driven by a power take-off from shaft 150 which will now be described. As will best be seen in Fig. 5, the forward end of shaft 150 is supported by a bearing 170' in the rear wall 170 of sensitized paper take-up housing 25. Rearwardly of wall 170, shaft 150 has rigidly secured thereto a bevel gear 180 which mates with a corresponding bevel gear 182 mounted at the upper end of a vertical shaft 184 (see Fig. 4). A bevel gear 186 (see Fig. 10) is secured to the lower end of shaft 184 and rotates in a horizontal plane. Mating with gear 186 and rotating in a vertical plane is a bevel gear 188 which is attached to the end of a horizontally extending shaft 190. Shaft 190 is supported at its opposite ends by vertical bearing brackets 192 mounted on base 21. A bevel gear 194 rotating in a vertical plane is attached to the end of shaft 190 opposite gear 188. Gear 194 meshes with a bevel gear 196 which rotates in a horizontal plane and which is attached to the lower end of shaft 198. Rotary shutter 200 is attached to the upper end of a shaft 198.

As will best be seen in Figs. 10, 11, and 12, the sensitized paper P is adapted to move over a flat horizontal base member 212 when advancing through the shutter housing 27. Base member 212 extends between pay-out housing 23 and take-up housing 25 and is provided with a smooth surface. Disposed in slightly spaced relation above base member 212 a sufficient distance to provide a passage for the sensitized paper is an elongated plate member 214 which also extends between housings 23 and 25. Plate 214 is spaced above base member 212 by suitable spacing shims extending beneath the opposite outer longitudinal edges of plate member 214.

Located midway of the length of plate 214 is a generally rectangular-shaped opening which defines an exposure window 210 equal in area to the print which is being made. Disposed on either side of the exposure window 210 in equally longitudinally spaced relation thereto are openings 216 and 218 which are closed by hinged flaps 220 and 222, respectively. Flaps 220 and 222 are connected to plate 214 by hinges 224. The function of flaps 220 and 222 is to permit the application of pressure to the sensitized paper to prevent any movement of the sensitized paper except when the paper is being positively advanced by the paper feeding mechanism.

A layer 226 of felt or other similar material is attached to the underneath surface of each of the flap members 220 and 222, the felt layers contacting the surface of the sensitized paper.

A cover member 232 is positioned above the plate 214, the rear edge of cover 232 being attached by hinges 234 to the upper edge of a bracket or support member 236. Cover 232 is provided with a rectangular opening 238 which registers with the exposure window 210 of plate 214 so that light from the projector passes through windows 238 and 210 to reach the sensitized paper.

Shutter 200 is mounted adjacent the upper end of vertical shaft 198 and in the space between cover 232 and plate 214. Shutter 200 is a circular disk member having a segment of its circular area cut away. Light from the projector is admitted to the sensitized paper when the cut-away portion of the shutter disk passes over the exposure window 210. The time of exposure of the sensitized paper is a function of the speed of rotation of the shutter, and also of the percentage of the circular area of the shutter which is cut away.

A bar 240 extends transversely across the upper surface of cover 232 and extends beyond the outer edge of the cover. The cover is secured in closed position by means of a bolt 242 which passes through the extending end of bar 240 and also through a cooperating member 244 connected to the lower part of the shutter housing. Wing nut 246 secures bolt 242 in position.

Cover 232 also supports the pressure-applying means which determines the degree of hold-down pressure exerted by hold-down flaps 220 and 222 on the sensitized paper. For this purpose, a vertical bracket member 248 is attached to bar 240 intermediate of its length. Bracket 248 is provided at its upper end with a horizontally extending bent portion 250 which is apertured to receive the upper end of a rod 252. The lower end of rod 252 extends through an aperture in cover 232 and into contact with the upper surface of the hinged flap member 220. A spring member 254 is interposed between the underneath surface of the horizontal portion 250 of bracket 248 and the upper surface of a bearing nut 256 which is rigidly attached to rod 252 intermediate the height thereof. Rod 252 exerts a pressure on the hinged flap member 220 in accordance with the biasing pressure of spring 248.

On the opposite side of cover 232, an adjustable screw member 260 passes downwardly through an aperture in cover 232 to permit the application of a predetermined desired pressure to the upper surface of flap member 222 and thus to the portion of sensitized paper in advance of the exposure window 210.

As will best be seen in Figs. 13 and 13*a*–13*d*, inclusive, the operation of the counting gear mechanism, including counting gear 120 and drive dog 152, is synchronized with the operation of the shutter 200 so that the shutter is always in closed position when the counting gear completes a tooth movement. This insures that the shutter is in closed position when declutching occurs.

As shown in Fig. 13, shutter 200 is in fully open position just as the drive dog 152 reaches bottom dead center position and is about to start its forward driving movement. Figs. 13*a* and 13*b* show the driving movement of drive dog 152, this driving movement occurring in the 180 degrees of clockwise movement of shaft 150 beyond the position shown in Fig. 13. The entire movement of counting gear 120 occurs during the 180 degrees of the cycle shown in Figs. 13*a* and 13*b*. Consequently, the

movement of pin 126, carried by gear 120, which causes the release of clutch brake 100, occurs during the portion of the cycle of dog 152 shown in Figs. 13*a* and 13*b*. During this same portion of the drive cycle of the counting gear, shutter 200 moves from fully open to fully closed position. Pin 126 is so positioned relative to the teeth of the counting gear as to engage brake arm 100 at the completion of driving stroke of drive dog 152 shown in Fig. 13*b*. Hence, when pin 126 moves into engagement with clutch brake 100 to cause declutching of the power drive to shutter 200, shutter 200 moves into fully closed position. This insures that the shutter is in fully closed position when it is not moving, thereby preventing exposing the sensitized paper present in the exposure window when the shutter is stationary.

Exposure meter

As will best be seen in Fig. 1, a light sensitive element such as a photo-voltaic cell 29 is supported on the upper horizontal surface of a horizontal bracket member 262 which is pivoted at point 264 on cover 232. When a set of prints is to be made from a negative in projector 31, photo-sensitive element 29 is swung into position over the region of the superimposed exposure windows 238 and 210 by swinging bracket 262 about its pivotal axis 264. Axis 264 is so located that the photo-sensitive element 29 may be swung into a position directly over the portion of window 210 in which the head of the person shown in the print will be positioned, thereby giving a reading of the light intensity for a given negative in the region of the head of the subject in the photograph. The operator or person setting up the machine adjusts the light intensity of the projector to give a predetermined reading on the meter 33 which is disposed in front of the shutter area.

Sensitized paper advancing means

As will best be seen in Fig. 2, the sensitized paper P is dispensed from a roll 351 wound upon a drum or spool 37 which is supported for rotation within payout housing 23. Paper P passes around a positioning roller 39 supported at the lower end of a pivotally mounted arm 41. Arm 41 is biased by means of a spring 43 to the right or away from the shutter area, as shown in Fig. 2. Paper P passes through an opening in the vertical wall 47 of housing 23 and on to the upper surface of film support plate 214, the film passing beneath the hold-down flaps 220 and 222, as previously described and beneath the exposure aperture 210. After passing by the shutter housing 27, the exposed sensitized paper passes into the take-up housing 25, where it passes over a short extension of film support plate 212 which extends into housing 25 and then over a roller 304. The paper is intermittently advanced into take-up housing 25 by means of a rotating member 306 attached to an end of shaft 150 which projects into housing 25. Member 306 extends for only a segment of a circle and hence contacts the surface of the paper for only a portion of each revolution of shaft 150. The angular position of member 306 is coordinated with the position of shutter 200 so that member 306 advances the sensitized paper P while the shutter 200 is closed. Thus, the paper P is intermittently advanced between successive exposures. The paper is advanced when it is contacted by member 306.

The take-up spool or drum 316 is continuously driven through a belt 310 driven from shaft 150. Belt 310 passes around pulley 308 fixed to shaft 150 and around pulley 312 fixed to shaft 314 (see Fig. 1). The take-up drum 316 is attached to and rotates with shaft 314.

Summary of operation

Before beginning operation, the operator should ascertain that a supply of the sensitized paper P is available on pay-out drum 37 of the pay-out housing 23, and that the paper has been threaded through the shutter housing 27 and onto the take-up drum 316 of take-up housing 25. The operator should also move photoelectric element 29 into position over the area of exposure window 210, and adjust the light from projector 31 to obtain a predetermined reading on meter 33 in accordance with the requirements of the particular negative which is being printed.

The operator should also set pointer 143 on dial 144 to a position corresponding to the number of exposures which are to be printed from the given negative. Rotation of pointer 143 rotates shaft 122 and thus causes pin 133 carried by hub 129 to be moved to a predetermined angular setting relative to clutch brake 100. A counting gear 120 loosely mounted on shaft 122 carries a pin 127 which is constantly urged by biasing spring 137 into engagement with pin 133 carried by hub 129. A pin 126 engageable with brake 100 is carried by counting gear 120 and is thus angularly displaced from brake 100 in accordance with the movement imparted to pointer 143.

Drive motor 22 is energized by closing switch 24, and transmits power through drive belt 26 to variable speed transmission 30. The output speed of transmission 30 may be varied by operating handle 34 to give a desired shutter speed. Transmission 30 transmits power through gear 36 to gear 38 on shaft 46 and thus to driving clutch gear 48.

By pushing clutch operating handle 83 inwardly against the force of biasing spring 72, lateral portion 74 of the clutch operating arm engages rocker arm 62, causing abutment 64 on the rocker arm to engage collars 60 on driven shaft 52 and thus axially shift shaft 52 which is slidably mounted in its bearings. Driven clutch gear 50 which is mounted on slidable shaft 52 is thereby caused to move into meshing engagement with drive clutch gear 48.

The inward movement of clutch operating member 70 causes the inclined portion 71 of member 70 to engage pin 90 on vertically mounted rod 84, thereby lifting pin 86 at the lower end of rod 84 out of the path of a declutching cam carried by gear 80 at the end of driven shaft 52. Rod 84 is maintained in its elevated position by spring biased brake arm 100 which engages the surface of rod 84.

With clutch gears 48 and 50 engaged, power is transmitted through gear 80 at the end of driven shaft 52 to gear 152 mounted on shaft 150. The end of shaft 150 projects into the paper take-up housing 25 and carries a constantly driven segmental rotating member 306 which intermittently draws the sensitized paper through the shutter housing. Shaft 150 is also connected by belt 310 to the paper take-up drum 316 in take-up housing 25. Shaft 150 also imparts rotation to the constantly rotating shutter 200 through a train of bevel gears.

Shaft 150 also imparts an oscillatory movement to drive dog 152 which advances counting gear 120. Pin 126 carried by the counting gear advances toward projection 114 at the end of brake 100 and ultimately abuts against projection 114 to move the brake arm out of frictional engagement with vertically slidable rod 84. This permits the declutching pin 88 at the lower end of rod 84 to engage declutching cam 82 and impart a sliding movement to driven shaft 52 to cause declutching of clutch gears 48 and 50. This removes power from the paper advancing mechanism and from the rotating shutter.

Movement of shaft 52 to a position corresponding to an unclutched condition of clutch gears 48 and 50 rocks rock arm 62 forwardly and causes an arm 63 carried by rock arm 62 to lift drive dog 152 and ratchet dog 156 out of engagement with counting gear 120. This permits the biasing spring 137 of the counting gear to return the counting gear to a position in which pin 127 of the counting gear engages pin 133 carried by hub 129 fixed to shaft 122 on which setting pointer 143 is fixed. Thus, the counting gear is automatically returned to a setting corresponding to the setting of pointer 143, so that upon the next actuation of clutch operating member 70 the machine

will automatically print the number of exposures to which pointer 143 is set.

It can be seen from the foregoing that there is provided in accordance with this invention an automatic projection printing machine which is reliable in operation and which may be operated by relatively unskilled personnel. The machine may be set to make any predetermined number of exposures from a given negative and automatically resets itself to repeat the same number of exposures unless purposely set to make a different number of exposures. The apparatus includes a simple and easily operated clutching mechanism which permits the shutter mechanism and paper feed mechanism to be connected to the source of motive power and also includes a counting device which automatically declutches the shutter drive means and the paper drive means from the source of motive power at the completion of the desired number of exposures.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein and it is aimed, therefore, to cover all such changes and modifications as fall within the true spirit and scope of the invention.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. A photographic printing machine for printing a selected number of prints from a given photographic negative comprising a base, a pay-out housing and a take-up housing mounted on said base in spaced apart relation, a shutter housing between said pay-out and take-up housings, a rotatable shutter in said housing, a pay-out reel for supporting a roll of sensitized paper in said pay-out housing, a take-up reel in said take-up housing, a pair of spaced horizontal plates in said shutter housing, the path of the paper extending between said spaced horizontal plates, an aperture in the upper of said spaced plates, said shutter being positioned below said aperture in said aperture in said upper plate, said plate aperture being adapted to have a projector located thereabove, power means for intermittently feeding the sensitized paper at a predetermined speed beneath said plate aperture, means synchronized with said power means for rotating said shutter alternatingly to close and open said plate aperture to expose to the projector, means to preclude opening of said plate aperture when the paper is in motion, a counter mechanism associated with said means for moving the paper, mechanical means for counting the number of paper exposures made, adjustable means for selecting the number of exposures for each negative, clutch means for operatingly associating said source of power with said take-up reel, manual means for engaging said clutch to activate said take-up reel, and automatic mechanical means for selectively disengaging said clutch means upon completion of the desired number of paper exposures, a felt layer underlying said upper plate and engageable with the sensitized paper, a pair of pivotally mounted pressure flaps, one disposed on either side of said aperture in said upper plate, spring means biasing said pressure flaps into engagement with said sensitized paper, and means for varying the pressure exerted on said sensitized paper by said pressure flaps.

2. The machine of claim 1 wherein said automatic mechanical means includes a rotatable shaft, a cam thereon and a mechanical trip member associated with said counter for actuating said cam to disengage said clutch means after a predetermined number of exposures.

3. The machine of claim 1 wherein said clutch means includes a driving gear operable upon engagement of said clutch means and a driven gear operatively connected with said take-up mechanism, said gears being engageable upon engagement of said clutch means.

4. The machine of claim 3 wherein said last-mentioned gears have oppositely inclined parallel faces to facilitate engagement of said gears.

5. The machine of claim 1 wherein said upper plate is pivotally mounted for upward swinging movement to expose a selected portion of said film when desired for adjustment or the like.

6. The machine of claim 5, and latch means normally securing said upper plate in film engaging position.

7. The machine of claim 1 wherein the means for varying the pressure on said flaps comprises a vertical bracket member extending upwardly from said upper plate, a flange extending horizontally from a vertical position of said bracket member, a rod extending from said flange into engagement with one of said flaps and a spring normally biasing said rod downwardly into engagement with said flap.

8. In a construction of the class described, the subcombination of a rotatable circular shutter having less than 180° of its circumference cut away, a pivoted drive dog, means for intermittently actuating said drive dog, an intermittently actuated gear wheel having teeth inclined in a direction opposite to the direction of rotation, a shaft carrying said gear, means for pivoting said dog once during each rotation of said gear, a ratchet dog means for raising the ratchet dog out of engagement with said gear and means synchronizing said gear, drive dog and ratchet dog, so said ratchet dog and said drive dog are released from engagement with said gear when said shutter is in open position.

9. The machine of claim 8, and spring means operable upon release of said ratchet dog for returning said gear to initial operative position.

10. The machine of claim 9, said initial operating position being correlated with the position of a calibrating dial at zero to permit resetting at a predetermined number of exposures.

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