July 23, 1935. R. W. FISHBACK ET AL 2,008,904

MULTIPLE PRINTER FOR MOTION PICTURE FILMS

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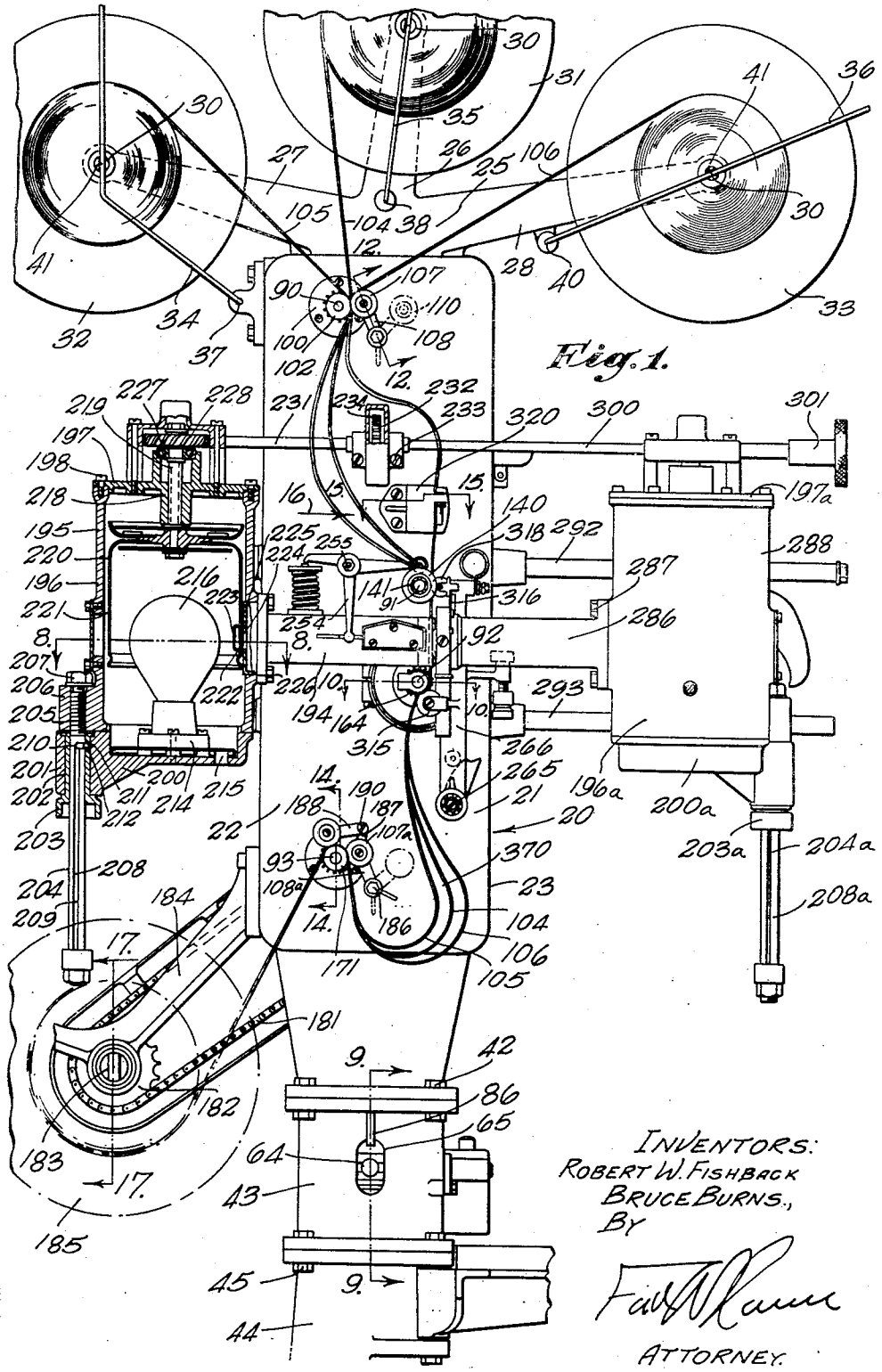


Fig. 1.

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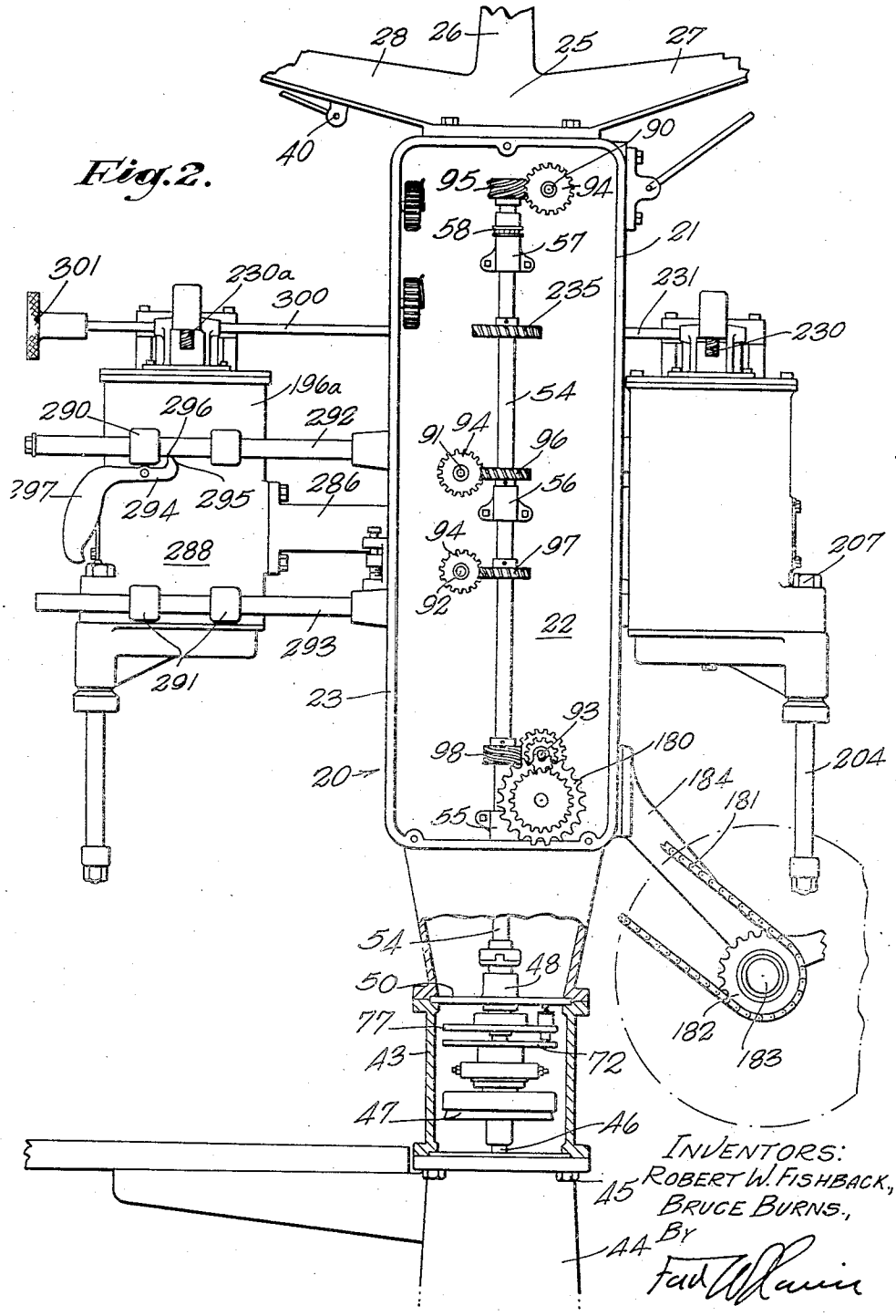
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Fig. 2.



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Fig. 3.

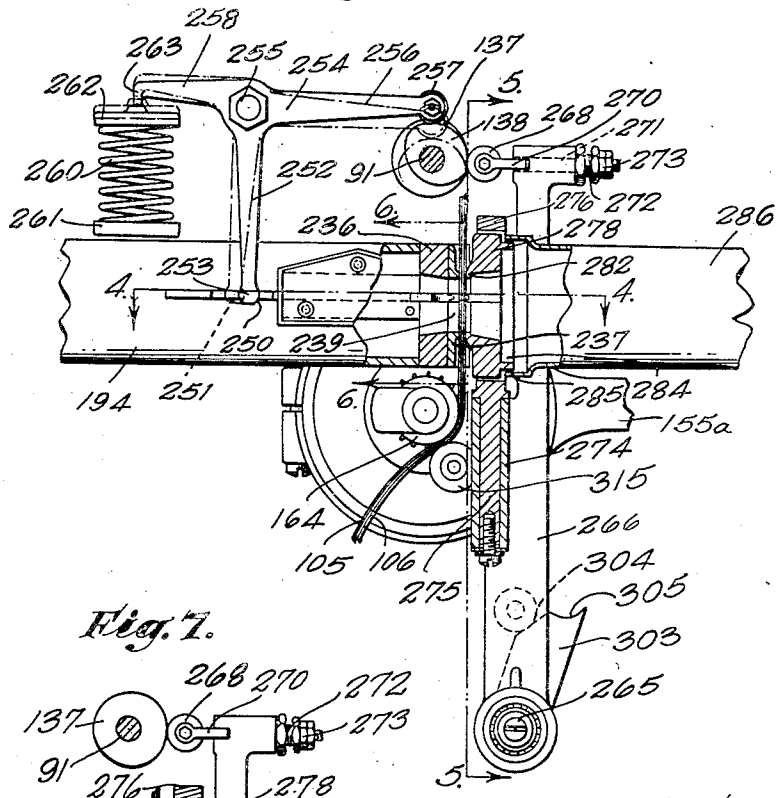


Fig. 7.

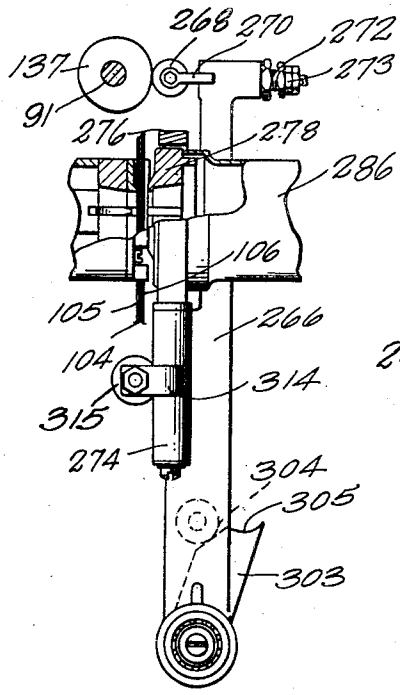
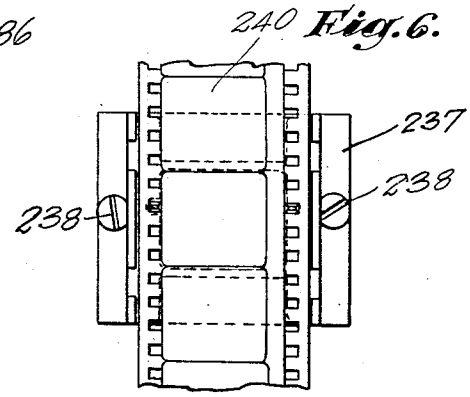


Fig. 6.



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MULTIPLE PRINTER FOR MOTION PICTURE FILMS

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Fig. 5.

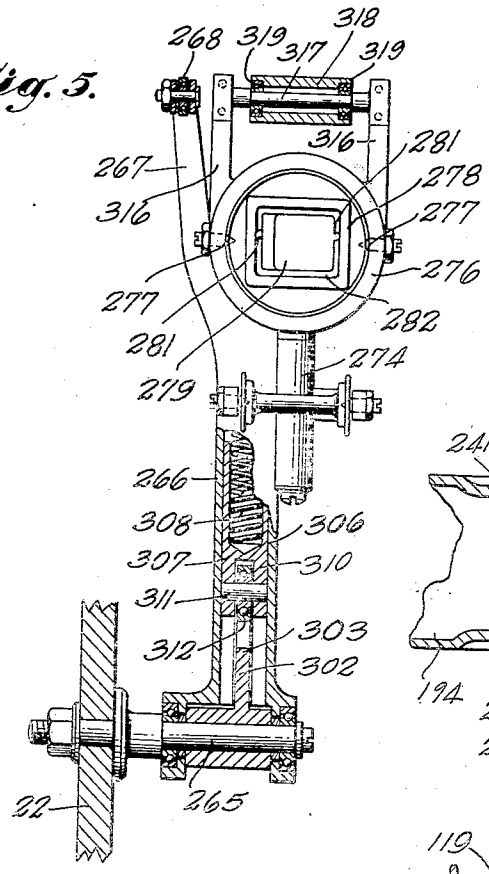


Fig. 4.

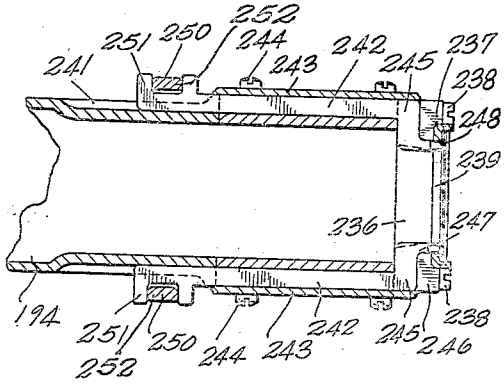
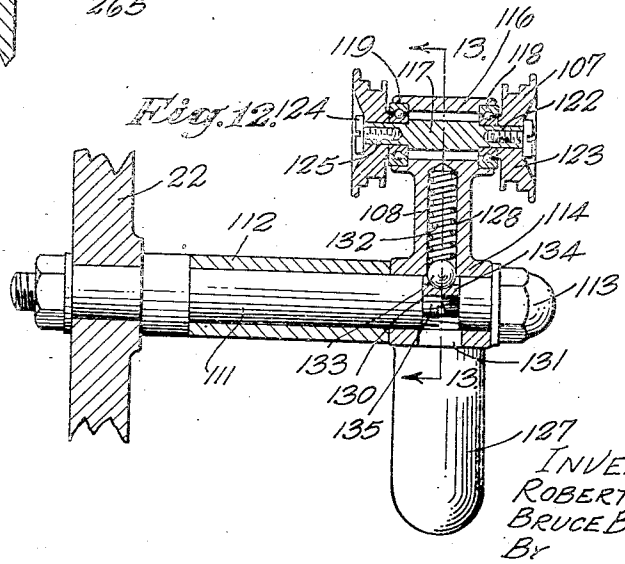


Fig. 12.



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MULTIPLE PRINTER FOR MOTION PICTURE FILMS

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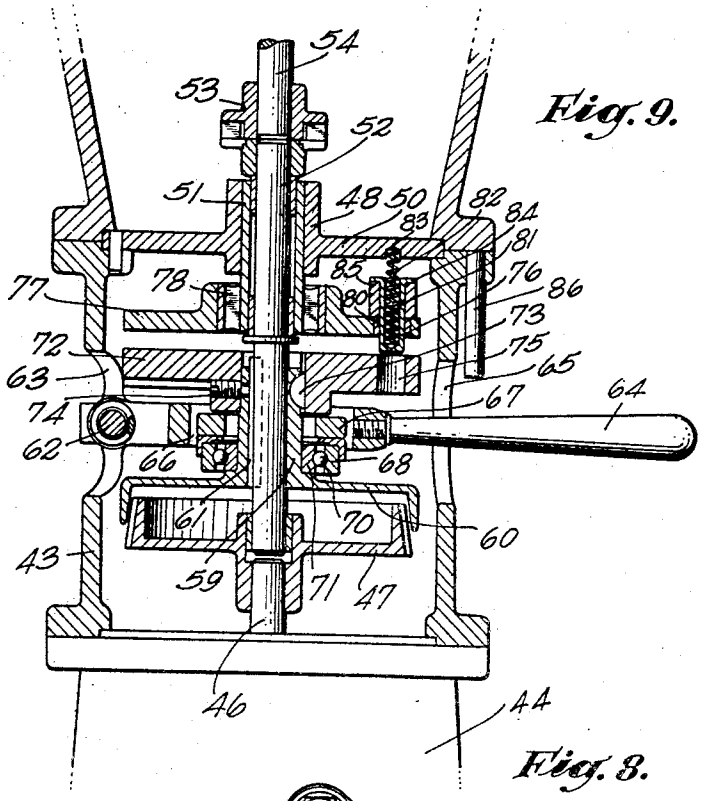


Fig. 9.

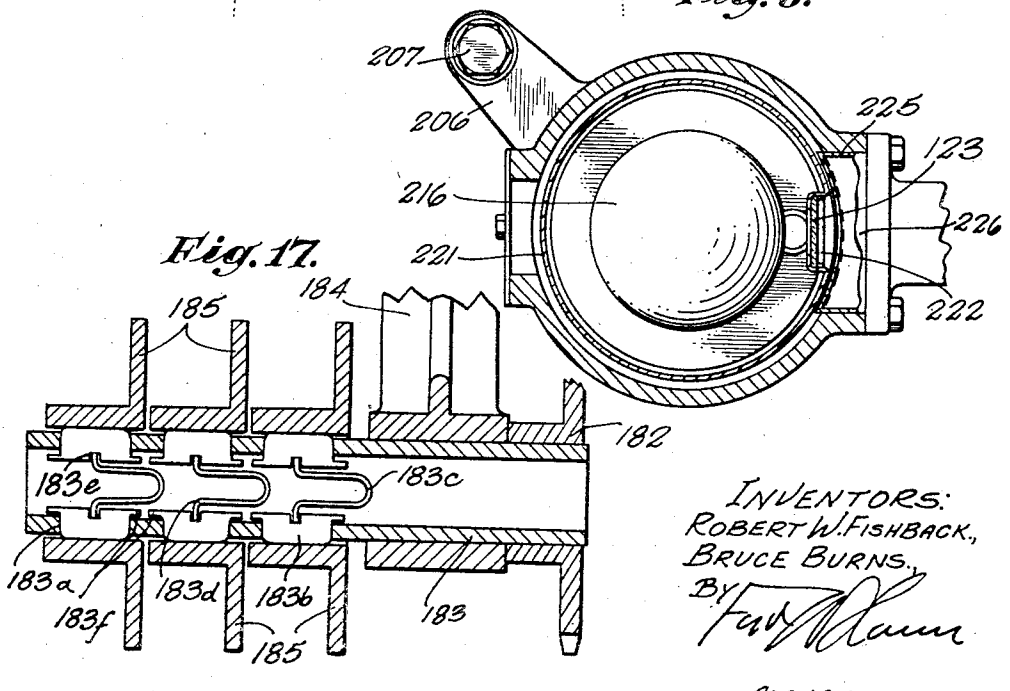


Fig. 8.

Fig. 17.

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MULTIPLE PRINTER FOR MOTION PICTURE FILMS

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Fig. 10.

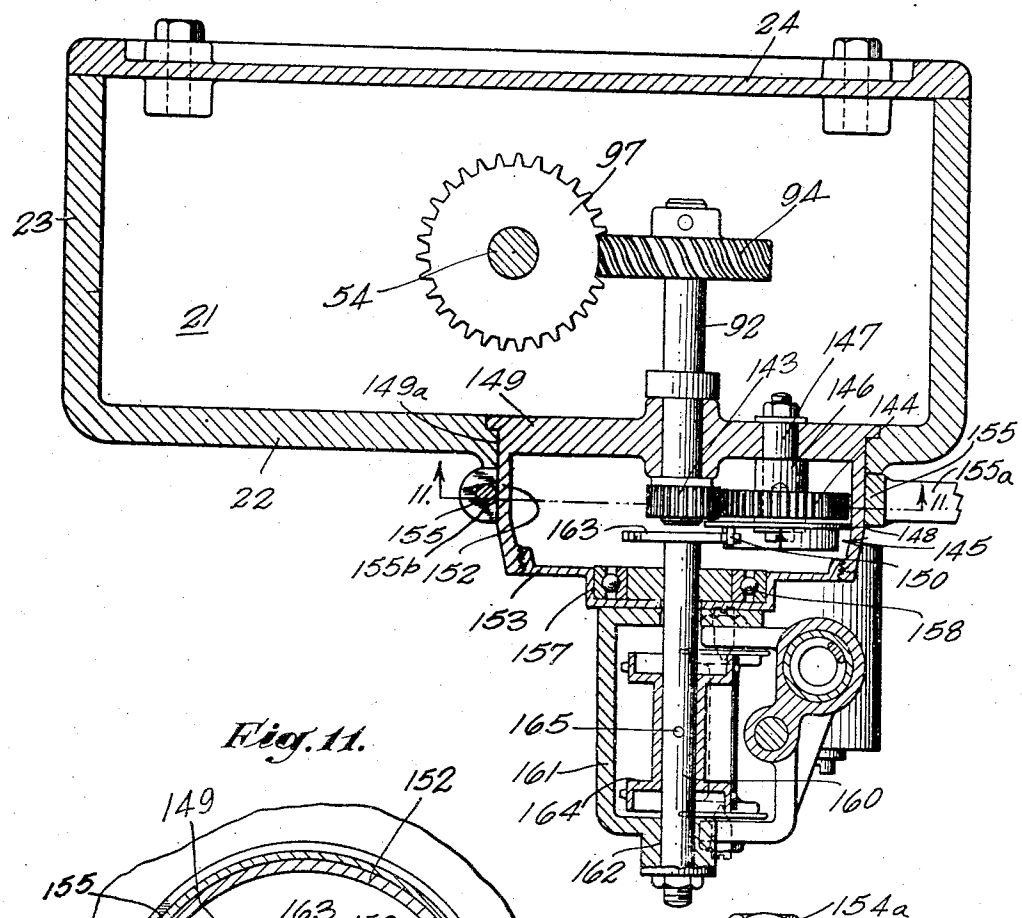
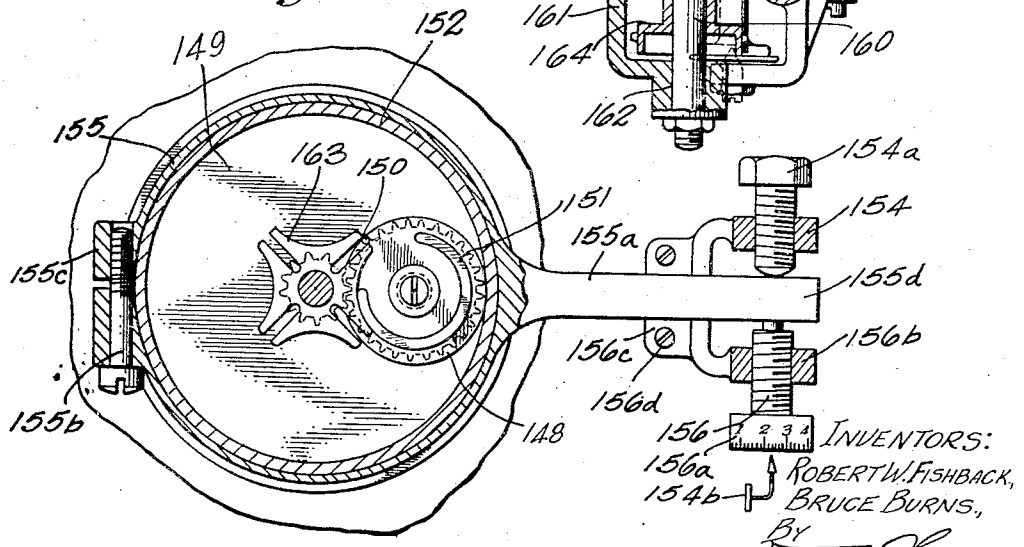


Fig. 11.



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Fig. 15.

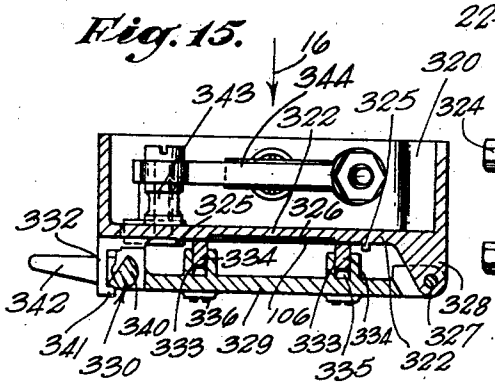


Fig. 16.

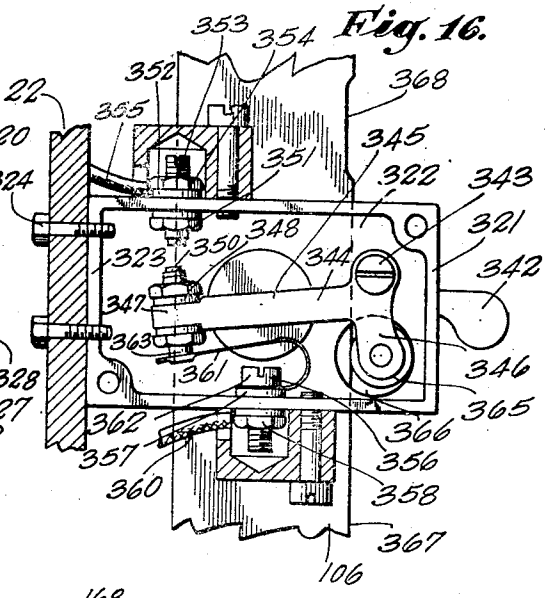


Fig. 14.

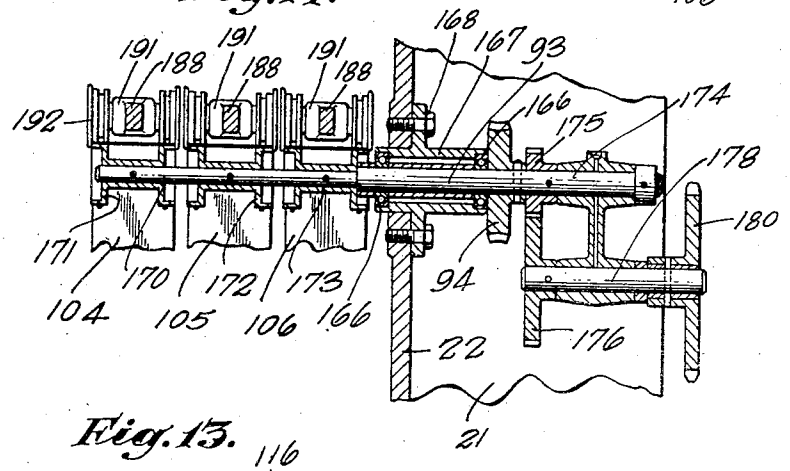
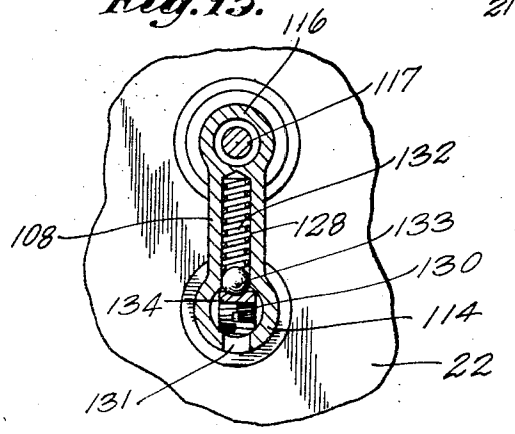


Fig. 13.



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Patented July 23, 1935

2,008,904

UNITED STATES PATENT OFFICE

2,008,904

MULTIPLE PRINTER FOR MOTION PICTURE FILMS

Robert W. Fishback and Bruce Burns, Los Angeles, Calif., assignors, by direct and mesne assignments, to Hughes Industries Co. Ltd., Houston, Tex., a corporation of Delaware

Application November 16, 1931, Serial No. 575,300

14 Claims. (Cl. 95—75)

Our invention relates to film printing machines and relates particularly to a machine for printing a single film simultaneously from a pair of negatives. Although the invention may be used for printing ordinary single-coated positive film from an ordinary black and white negative, or for printing two positives from two separate negatives, it has its principal utility in and is especially designed for printing a colored motion picture positive from a pair of complementary negatives. Positive film for use in colored motion pictures generally has two layers of emulsion for receiving separate complementary color value images. These layers of emulsion may be placed on one side of the transparent celluloid base but in general practice are on opposite sides of the celluloid base.

It is an object of our invention to provide a printer which will simultaneously print complementary color value images in the separate layers of emulsion on a positive film from complementary color value negatives which are placed on opposite sides of the positive.

It is a further object of the invention to provide a simple construction and combination of cooperating elements for moving positive and negative films intermittently in printing relationship and for controlling their exposure to printing lights, which lights are controlled in accordance with a predetermined schedule.

A further object of the invention is to provide a printer which may be easily operated, which does not require frequent adjustment, and which has positive means for stopping the mechanism thereof in such position that the shutters of the light housings are closed, thereby avoiding the possibility of over-exposure of that portion of the film which is stopped in front of the printing apertures.

It is a further object of the invention to provide a simple construction having means for guiding the positive and negative films through a printing position, and having light housings on opposite sides of said films in said printing position, each of said housings having a tubular portion with a light gate adapted for pressural engagement with opposite sides of the assembly of positive and negative films, together with simple means for controlling a simple form of light shutter within said housing.

It is a further object of the invention to provide in a printer construction of the above character a pair of light gates, one of which is stationary and the other of which is movable, and means for moving said light gates relatively apart so that the films may pass freely therethrough during the operation of an advancing mechanism.

It is a further object of the invention to provide a printer of the above character having a movable light gate which is mounted for universal movement so that it may automatically adjust itself into close fitting position against the films and thereby prevent leakage of light and also hold the films tightly together during their printing exposure.

It is a further object of the invention to provide a simple printer construction with a simple cam mechanism for operating registering pins and for moving the light gates relatively apart during the movement of the films.

A further object of the invention is to provide a light housing so constructed that the replacement and inspection of lights therein may be quickly accomplished.

Further objects and advantages of the invention will be made evident throughout the following part of the specification.

Referring to the drawings, which are for illustrative purposes only,

Fig. 1 is a front elevation of a preferred embodiment of our invention.

Fig. 2 is a rear elevation thereof with the back wall of the casing removed.

Fig. 3 is an enlarged, fragmentary, partly sectioned view of the printing gate or aperture and its associated mechanism.

Fig. 4 is a longitudinal section on a plane represented by the line 4—4 of Fig. 3.

Fig. 5 is a partly sectioned view taken as indicated by the line 5—5 of Fig. 3.

Fig. 6 is a view taken as indicated by the line 6—6 of Fig. 3.

Fig. 7 is a fragmentary view similar to Fig. 3, showing the printing aperture members in separated position during the movement of films therethrough.

Fig. 8 is an enlarged section through a light housing taken as indicated by the line 8—8 of Fig. 1.

Fig. 9 is an enlarged fragmentary section on a plane represented by the line 9—9 of Fig. 1, showing the clutch and instantaneous stop mechanism associated therewith.

Fig. 10 is an enlarged cross section on a plane represented by the line 10—10 of Fig. 1, showing the intermittent motivating means for moving the films through the printing aperture members.

Fig. 11 is a cross section on a plane represented by the line 11—11 of Fig. 10.

Fig. 12 is an enlarged fragmentary section on a plane represented by the line 12—12 of Fig. 1.

Fig. 13 is a cross section on a plane represented by the line 13—13 of Fig. 12.

Fig. 14 is an enlarged fragmentary cross sectional view taken as indicated by the line 14—14 of Fig. 1.

Fig. 15 is an enlarged cross section through the light changer switch of the printer mechanism, this section being taken substantially on the line 15—15 of Fig. 1.

Fig. 16 is a rear view of the light changer switch, viewing the same from the directions indicated by the arrows 16 of Figs. 1 and 15.

Fig. 17 is a fragmentary section on a plane represented by the line 17—17 of Fig. 1.

Referring particularly to Figs. 1, 2, and 10, our invention includes a supporting structure 20 consisting of a main casing 21 having a front wall 22, side walls 23, and a removable back 24. Screwed to the top of the main casing 21 is a bracket 25 having an upwardly extending central arm 26 and laterally extending arms 27 and 28, these arms each having a pin or shaft 30, such shafts being adapted to receive film spools 31, 32, and 33. For the purpose of holding the film spools on the shafts 30, we provide spring arms 34, 35, and 36 which are made from steel bars and are respectively pivoted at points 37, 38, and 40. In the forward ends of the pins or shafts 30, notches 41 are cut, in which notches the arms 34, 35, and 36 rest when they are in positions to hold the film spools 31, 32, and 33 in place. Below the main casing 21 and secured thereto by means of bolts 42 is a clutch casing 43 which is bolted onto a standard 44 by use of bolts 45. Projecting centrally upwardly through the standard 44 into the lower part of the clutch casing 43 is a drive shaft 46 which has a clutch cone 47 mounted on the upper end thereof, as shown in Fig. 9, and which forms a part of the power source of the mechanism, in that the shaft 46, during the use of the printer, is driven at a constant rate of speed by a prime mover preferably consisting of an electric motor, not shown. In a hub 48 formed in a plate 50 which is secured between the casings 21 and 43, is a bearing sleeve 51 which supports an intermediate shaft 52 having a flexible coupling 53 at its upper end by which it is joined to a main shaft 54 supported vertically in the main casing 21 by bearings 55, 56, and 57, there being a thrust bearing 58 at the upper end of the bearing 57 for the purpose of supporting the weight of the shaft 54.

Slidable on the lower portion of the intermediate shaft 52 is a clutch member 60 adapted to engage the clutch cone 47, this clutch member 60 having an upwardly extending hub or sleeve 59 which is splined to the intermediate shaft 52, as shown at 61. On a horizontal shaft 62 which extends across an opening 63 in the clutch casing 43 is a clutch-operating lever 64 which extends horizontally across the interior of the clutch casing 43 and projects through an opening 65 in the clutch casing 43 so that it may be manually engaged and operated. The clutch-operating lever 64 has a ring-shaped central portion 66 in which an annular member 67 is pivotally supported, this annular member 67 having secured thereto the outer race 68 of a combined radial-thrust bearing 70, the inner race 71 of the bearing 70 being secured to the upwardly projecting sleeve 59 of the clutch member 60. When the lever 64 is in lowered position, the clutch parts 47 and 60 are in engagement so that rotation is transmitted through the intermediate shaft 52 to the main shaft 54. A plate 72 is secured to the upper portion of the sleeve 59 of the clutch part 60 by means of a key 73 and a locking pin 74. Near the periphery of the plate 72 is an opening 75 adapted to be engaged by a pin 76 which projects downwardly through a relatively stationary plate 77 which is resiliently supported on the lower end of the sleeve 51 by means of a resilient annular wall 78 of rubber material. The pin 76 projects downwardly through an opening 80 in the plate 77 and has an opening 81 therein which receives a spring 82, the upper end of the spring 82 engaging a pocket 83 in the plate 50. The downward movement of the pin 76 is limited by a flange 84 which is adapted to engage a filler piece 85 which surrounds the upper portion of the pin 76, and the pin 76 may be moved upwardly through the opening 80 against the downward pressure of the spring 82. The main drive shaft 54 may be stopped in a definite position by raising the lever 64 so as to disengage the clutch parts 47 and 50 and to bring the plate 72 into engagement with the lower face of the plate 77. When the opening 75 in the plate 72 coincides with the lower end of the pin 76, the pin 76 drops into the opening 75 and abruptly stops the rotation of the plate 72, the shaft 54, and other parts connected therewith. The shock of the abrupt stopping of these parts is cushioned by the resilient member 78 by which the plate 77 is secured to the stationary sleeve 51. A stop pin 86 projecting downwardly from the upper flange of the clutch casing 43 may be employed to limit the upward movement of the clutch-operating lever 64.

As shown in Fig. 2, projecting through the front wall 22 of the main casing 21 are shafts 90, 91, 92, and 93, each of which has a worm gear 94 on its inner end, these worm gears 94 being adapted to be driven by worms 95, 96, 97, and 98 mounted on the main shaft 54. As shown in Fig. 1, the upper shaft 90 may be supported in a bronze bearing having a flange 100 by which it may be secured to the main casing 21.

On the forward end of the shaft 90 an upper film sprocket 102 is secured, thereby forming in conjunction with the shaft 90 an upper sprocket means for continuously pulling films 104, 105, and 106 from the film spools 31, 32, and 33. A hold-down roller 107 is supported on an arm 108 in position to hold the films 104, 105, and 106 against the sprocket 102. This hold-down roller 107 and its supporting arm 108 may be swung into the position indicated by dotted lines 110 during the threading of the printer. The construction of the hold-down roller 107 and its supporting means is shown in Figs. 12 and 13 which show a stub shaft 111 secured to and projecting from the front wall 22 of the main casing 21. On the stub shaft 111 is a spacing sleeve 112 and a cap nut 113, there being a space between the outer end of the sleeve 112 and the cap nut 113 for receiving the hub 114 of the arm 108 which has a cylindrical wall or hub 116 at its outer end through which a freely running shaft 117 supported by ball bearings 118 is extended. The ball bearings 118 fit into counterbores 119 formed in the ends of the cylindrical wall 116 and are received on the reduced ends 122 of the shaft 117, being there held by flange members 123 which are secured on the reduced ends 122 by screws 124 which enter threaded openings 125 in the reduced

ends 122 of the shaft 117. Projecting downwardly from the lower end of the arm 108 is an operating lever or handle 127 which may be manually engaged to swing the arm between the full line and dotted line positions thereof shown in Fig. 1. Extending upwardly within the arm 108 is an opening 128, and in the supporting shaft 111 in alignment with the opening 128 is a hole 130. In the lower wall of the hub 114 is an opening 131 preferably slightly larger than the hole 130. In assembling the hold-down device on the end of the shaft 111, the cap nut 113 is removed, and the hub 114 is slid over the end of the shaft into position against the outer end of the spacer 112. A spring 132 is then inserted through the holes 131 and 130 into the opening 128, this being followed by a ball 133, a small disc 134 having a slight depression in the face thereof, and a slotted adjustment screw 135 which screws into the threaded opening 130 and is employed to move the plate 134 upwardly to a position close to the upper end of the opening 130, as shown in Figs. 12 and 13. The ball, being forced downwardly by the spring 132, serves as a detent mechanism for engaging the depression in the upper face of the plate 134 and for holding the arm 108 in such position that the hold-down roller 107 will press the films 104, 105, and 106 against the sprocket 102. The foregoing construction makes it possible to easily assemble the parts in their operative positions. The shaft 111 may be turned so as to bring the axis of the opening 130 into a desired position and there clamped so as to adjust the cooperative positions of the plate 134 and the ball 133.

The shaft 91, as shown in Figs. 1 and 3, has a cam means mounted thereon, such cam means consisting of rotary cam members 137 and 138. The cam members 137 and 138 are secured to the shaft 91 near the face of the wall 22 of the main casing 21, and the shaft 91 extends forwardly from the cam members 137 and 138 and has a guide spool or roller 140 mounted thereon for free rotation by means of small ball bearings 141, as shown in Fig. 1.

The shaft 92, as shown in Fig. 10, extends through the wall 22 and on the forward end thereof has a gear 143 which engages a gear 144 of an intermittent mechanism, such as a Geneva movement 145. The gear 144 is mounted on a sleeve 146 which turns on a stub shaft 147 secured in a cylindrical body 149 which fits in an opening 149a in the wall 22, and on the forward end of the sleeve 146 is mounted a plate 148 having a Geneva movement pin 150 and ring 151. An annular wall 152 forms part of the body 149, and onto this wall 152 is fitted a cover 153. In a recess 157 of the cover 153 a ball bearing 158 is mounted, and in this ball bearing the inner end of a shaft 160 is supported. Extending outwardly from the casing 153 is a bracket 161 having a bearing 162 which supports the outer end of the shaft 160. The inner end of the shaft has a Geneva movement star 163 thereon in position to be engaged by the pin 150 and ring 151. On the portion of the shaft 160 which extends through the bracket 161 an intermittent sprocket 164 is secured by means of a pin 165. The foregoing Geneva movement mechanism accomplishes an intermittent part rotation of the sprocket in timed relationship to the rotation of the cam members 137 and 138.

The shaft 93, as best shown in Fig. 14, is supported by a pair of ball bearings 166 carried in a bearing sleeve 167 secured by screws 168 to the inner face of the front wall 22 of the main casing 21. On the outer end 170 of the shaft 93, lower sprocket means are formed by three sprockets 171, 172, and 173, and on the inner end 174 of the shaft adjacent the worm wheel 94 is a small pinion 175 adapted to engage a gear 176 mounted on the inner end of a shaft 178 having a sprocket 180 secured to its outer end. From the sprocket 180 a chain 181 is carried to a sprocket 182 which is mounted on a shaft 183 which is held by a bracket 184 in a position parallel to the shaft 93. The shaft 183 is adapted to receive three film receiving spools 185 which are frictionally mounted on the shaft 183 so as to be yieldably rotated and to receive the films 104, 105, and 106 from the sprockets 171, 172, and 173.

As shown in Fig. 17, the shaft 183 is of tubular construction and has pairs of diametrally opposed rectangular openings 183a therein through which friction blocks 183b are caused to outwardly and yieldably project by U-shaped springs 183c having outwardly turned ends 183d which fit into lateral grooves 183e in the inner faces of the blocks 183b. Means for limiting the outward movement of the blocks 183b is provided in the form of flanges 183f which project longitudinally from the inner portions of the blocks 183b. The film spools 185 are slipped into the positions shown in Fig. 17 over the outer end of the shaft 183 and force the friction blocks 183b inwardly, and these friction blocks thereafter frictionally engage the bores of the spools 185, imparting a yielding driving force from the shaft 183 to the spools 185.

Three hold-down rollers 107a are mounted on levers 108a which are pivoted on a shaft 186 extending from the front wall 22 of the main casing 21 parallel to the sprocket shaft 93. These parts 107a and 108a are of a construction identical to the parts 107 and 108 and are held against the sprockets 171, 172, and 173 by means of spring pressed balls 133 such as disclosed in Fig. 12. Extending upwardly from each of the members 108a is a short arm 187, and to the ends of the arms 187 levers 188 are pivoted by use of screws 190. In the swinging ends 191 of the levers 188, as shown in Fig. 14, hold-down rollers 192 are carried in positions to rest against the tops of the sprockets 171, 172, and 173 so as to hold the films 104, 105, and 106 in engagement with the sprockets 171, 172, and 173. The roller 140 and sprocket 164 define a path of movement for the films 104, 105, and 106, and to the left of these films while they are in this path of movement is a light tube 194 which extends from and forms part of a stationary light housing 195 comprising a cylindrical wall 196 secured to the main casing 21, a top wall 197 secured to the cylindrical wall 196 by screws 198, and a removable bottom wall 200 having a projection 201 at one side thereof provided with an opening 202 in which a sleeve 203 is turnable, this sleeve 203 fitting around a round bar 204 which has threads 205 at its upper end screwing into a lug 206 formed on the cylindrical wall 196, there being a lock nut 207 on the upper end of the bar 204, as shown in Figs. 1 and 2. In the bar 204 is a groove 208 consisting of a longitudinal portion 209 and a lateral portion 210 at the upper end of the longitudinal portion. In a depression or pocket 211 in the inner wall of the sleeve is a ball 212, half of which ball extends into the groove 208. By turning the sleeve leftwardly from the position in which it is shown in Fig. 1, the ball 211 may be brought into alignment with the upper end of the longitudinal portion 209 of the groove 208, permitting the bottom 200 of the light housing 195 to be lowered from engage-

ment with the lower end of the wall 196. On the upper face of the bottom 200 a light socket 214 is secured, and an opening 215 is provided in the bottom through which wires may be carried to the light socket 214 for delivering electric current to a light globe 216 mounted in the socket 214. In the top wall 197 is a journal 218 which supports a vertical shutter shaft 219 having a cup-shaped shutter 220 secured to its lower end, this shutter 220 having a downwardly extending cylindrical side wall 221 which encloses the light globe 216. In the wall 221 in the plane of the light tube 194 is an aperture 222 which may have a lense 223 disposed in front of it. As the shutter 220 rotates, the aperture 222 therein moves across an aperture 224 in an aperture plate 225 set into an opening 226 in the wall 196 of the light housing and communicating with the interior of the light tube 194. The upper end of the shutter shaft 219 is supported by a ball bearing 227, and on the upper end of the shaft 219 a worm gear 228 is secured, this worm gear being engaged by a worm 230 secured to a horizontal shaft 231 extending across the face of the wall 22. The shaft 231 extends through a gear casing 232 secured to the front wall 22 by means of screws 233 and has a gear 234 thereon in the gear casing 232 which is engaged by a gear 235 mounted on the main shaft 54, as shown in Fig. 2. The gears 234 and 235 may be a worm gear and worm or may be a pair of matched helical gears. This same statement may apply to the gears 94, 95, 96, 97, and 98 as such gears may be either of worm or helical type, or if desired may be replaced by sets of bevel gears.

As shown in Figs. 3 and 4, the light tube 194 has a body 236 secured to its forward end, and to the outer face of the body 236 a removable and replaceable film guiding plate or light gate 237 is secured by means of screws 238, which has an opening 239 therein the size of a film such as shown at 240 in Fig. 6. In the side walls of the light housing 194 are longitudinal channels or grooves 241 in which film registering bars 242 are slidable, these bars 242 being held in the grooves 241 by plates 243 secured by screws 244. The rightward ends 245 of the bars 242 bend inwardly, as shown in Fig. 4, and are slidable in longitudinal slots 246 in the block 236 situated at the rightward end of the light tube 194. On the ends 245 of the bars 242 are registering pins 247 which project rightwardly through openings 248 in the light gate 237. The leftward ends of the bars 242 each have a notch 250 formed therein between outwardly projecting lugs 251, and engaging the notches 250 are lever arms 252 having circularly enlarged lower ends 253. The arms 252 form part of a lever member 254 which is pivoted on a stub shaft 255 extending from the front wall 22 and has a rightwardly extending lever arm 256 with a follower roller 257 held at the end thereof in position to engage the cam member 138. Extending leftwardly from the lever member 254 is an arm 258 which is forced upwardly by a compression spring 260 held between two dished plates 261 and 262, the upper plate 262 having a depression in its upper face which is engaged by a downwardly extending point 263 formed at the leftward end of the arm 258, the spring 260 tending to rotate the lever member 254 in clockwise direction and to hold the follower 257 in engagement with the cam member 138. The cam member 138 rotates in time relationship to the operation of the Geneva movement 145. The cam is so formed that during the periods of non-movement of the films 104, 105, and 106, the registering pins 247 will be rightwardly projected through sprocket holes in these films and will be withdrawn from such sprocket holes during movement of the films by the sprocket 164.

A feature of the invention is to provide in a film handling machine a means for compensating for change in length of film. It is a well known fact that most motion picture films will shrink, and therefore the gauge between sprocket holes is changed. If the film is not so moved by the intermittent sprocket 164 that holes in the films will align with the registering pins 247, strains will be placed in the films, and the sprocket holes will be stretched or deformed. In the use of our machine the film is checked with reference to a gauge, and the actual shrinkage per frame is determined, after which the machine may be quickly set so that the sprocket will move the films into such a position that sprocket holes in the negative or negatives will accurately align with the registering pins. This is accomplished by use of the following mechanism and in the following manner. Encircling that portion of the cylindrical wall 152 of the body 149 which projects from the front of the wall 22 is a split ring 155 having an arm 155*a* extending rightwardly therefrom and having a screw 155*b* cooperating with the ends 155*c* of the ring 155 to immovably clamp the ring 155 on the cylindrical wall 152. A registering screw 156 having a calibrated head 156*a* is threaded upwardly through a boss 156*b* which extends rightwardly from a bracket 156*c* secured by means of screws 156*d* to the rightward edge of the wall 22, the upper end of the screw 156 being in position to engage an enlargement 155*d* on the rightward end of the arm 155*a*. Through a body 154 which projects from the bracket 156*c* above the enlargement 155*d* is a clamping screw 154*a* adapted to be screwed tightly down against the upper face of the enlargement 155*d*. The screw 156 is first set so that the zero point thereof coincides with a suitably mounted pointer 154*b*. The screw 155*b* is then loosened so that the body 149 may turn within the ring 155. A brass strip punched accurately with sprocket holes to proper gauge is then extended over the sprocket 164, and the upper portion thereof is allowed to extend across the registering pins 247 in projecting position. The entire Geneva movement, the shaft 160, and the sprocket 164 are rotated by turning the body 149 in the ring 155 to such an extent that the proper sprocket holes in the brass master strip will receive the registering pins 247. The ring 155 is then clamped by tightening the screw 155*b*, and the device is set or adjusted to receive film having sprocket holes true to gauge. The negatives which are to be used in the machine, or any other film which is to be used in the machine, are checked with reference to a gauge and the shrinkage determined. The screw 156 is then rotated until the numeral thereon representing the shrinkage per frame of the film coincides with the pointer 154*b*, and the clamping screw 154 is then tightened down against the enlargement 155*d*, moving the arm 155*a* and rotating the Geneva movement and the sprocket 164 to change the positions of the teeth of the sprocket 164 relative to the registering pins to compensate for the change in spacing of the sprocket holes in the films which are to be handled in the machine. The length of the arm 155*a*, the pitch of the screw 156, and the calibrations of the screw 156 are so determined that they directly represent shrink-

age per frame in thousandths of an inch, and the actual number of the teeth of the sprocket 164 relative to the registering pins 247 is a multiple of the values represented by the calibrations of the screw 156 corresponding to the number of film frames between the sprocket 164 and the registering pins 247.

As shown in Figs. 1, 3, 5, and 7, the stub shaft 265 is secured in the front wall 22 in outwardly projecting position below the horizontal plane of the light tube 194, and pivoted thereon is a movable member or arm 266 having an upwardly extending lever 267 which carries a roller or follower 268 in position to engage the cam member 137. This roller 268, as shown in Figs. 3 and 7, is mounted on a clevis or forked plate 270 situated at the leftward end of an adjustment screw 271 which may be secured in a desired position of adjustment by means of a threaded sleeve 272 and lock nuts 273. On the side of the arm 266 is a vertical tube 274 which receives a vertical shaft 275 having a ring 276 formed at its upper end. On the horizontal diameter of the ring 276 pivot screws 277 are mounted, these screws supporting a movable light gate 278 having an aperture 279 therein and openings 281 for receiving the ends of the registering pins 247. As clearly shown in Fig. 3, the light gate 278 has a leftwardly or forwardly extending lip 282 around the aperture 279 for engaging the film 106 and forcing the complemented films leftwardly so that the film 105 will be held tightly against the light gate 237. Extending rearwardly or rightwardly from the light gate 278 is an annular wall 284 which is overlapped by or telescopes into an annular wall 285 formed at the outer or leftward end of a movable light tube 286 which is secured, as shown in Figs. 1 and 2, by means of screws 287 to a movable light housing 288.

The light housing 288 has a cylindrical wall 196a, a top wall 197a, and a bottom 200a which is supported on a vertical bar 204a, these parts being similar to the parts of the stationary light housing 195. Projecting rearwardly from the cylindrical wall 196a are lugs 290 and 291 which are horizontally bored to fit horizontal slide bars 292 and 293, thereby providing a sliding support for the movable housing 288 permitting the housing to be moved rightwardly from the position in which it is shown in Fig. 1 so as to carry the light tube 286 from engagement with the movable light gate 278. On one of the lugs 290 a latch member 294 is pivoted in such position that the point 295 thereof will engage a notch 296 in the bar 292 so as to hold the movable light housing 288 in inward position. The latch member 294 is equipped with a handle 297 which may be pulled outwardly, causing the latch member 294 to disengage the notch 296, and also transmitting to the movable housing 288 a force to move it outwardly on the slide bars 292 and 293. The movable housing 288 is equipped with a shutter and shutter-actuating means of the character disclosed in detail in the stationary housing 195, and slidable on the extending portion 300 of the shaft 231 is a gear 230a which is a duplicate of the gear 230 for driving the gear mechanism which is situated in the movable housing 288. Although not shown, it is understood that the bottom 200a of the movable light housing 288 has a light socket and light globe supported thereon and that counter parts 208a and 203a of the parts 208 and 203 with their associated parts are employed in conjunction with a cover 197a. The shaft 231 may be equipped with a manually operable means of rotating it in the form of a handle 301. As shown in Figs. 1, 3, 5, and 7, a stationary cam 302 is secured to the shaft 265, this cam having a web 303 with a sloping face 304 leading to a concave end face 305. Within a vertical opening 306 in the member 266, as shown in Fig. 5, is a sliding body 307 which is forced downwardly by means of a spring 308 and has forks 310 at its lower end carrying a shaft 311 on which a standard ball bearing 312 is supported so as to form a roller adapted to engage the faces 304 and 305 of the stationary cam 302. The pressure of the roller 312 against the sloping face 304 forces the member 266 toward the light gate 237 in the light tube 194, thereby carrying the light gate 278 into engagement with the film 106. The cam member 137 engages the follower 268 and forces it outwardly in timed relationship to the intermittent partial rotation of the sprocket 164 by the Geneva movement 145 so as to lift the gate member 278 from engagement with the film 106 during the movement of the films 104, 105, and 106. The gate member 278 is rotatable on a horizontal axis defined by the pivot members 277, and the ring 276 is rotatable on the vertical axis of the shaft 275, thereby supporting the light gate 278 for universal movement which permits it to adjust itself tightly against the film 106 when the cam member 137 permits the member 266 to move leftwardly. In Fig. 3 the parts are shown in printing position with the light gate 278 forcing against the film 106. It will be noted that there is a space between the light gate 278 and the leftward edge of the wall 285. The overlapping of the walls 284 and 285 provides a light seal between the light tube 282 and the light gate 278. In Fig. 7, the cam member 137 is shown in position to force the member 266 rightwardly so as to move the light gate 278 from engagement with the film 106. On the middle portion of the member 266 leftwardly extending bracket arms 314 support a hold-down roller 315 which is in a plane below the axis of the sprocket 164 which serves to hold the films 104, 105, and 106 in engagement with the sprocket 164.

Spring arms 316, shown in Figs. 1 and 5, are secured to the upper portion of the ring 276 and support a horizontal shaft 317 on which a hold-down roller 318 is rotatably mounted, as shown in Fig. 5, by means of small ball bearings 319. The hold-down roller 318 cooperates with the guide roller 140 and holds the films 104, 105, and 106 thereagainst. Above the guide roller 140 is a light changer switch 320 which is shown in detail in Figs. 15 and 16. This switch 320 includes a rectangular casing 321 having a front wall 322 and a side wall 323 where the casing 321 is secured to the front wall 22 of the main casing 21 by means such as screws 324 shown in Fig. 16. On the surface of the front wall 322 of the casing 321 are vertical ribs 325 defining a film channel 326 through which the film 106 is extended, and supported by means of a vertical pin 327 extending through lugs 328 on the front of the casing 321 there is a door or gate 329 having a latch 330 at its outer end adapted to engage a latch plate 332 projecting from the casing 321. In vertical grooves 333 on the inner face of the gate 329 are pressure bars 334 adapted to engage the edges of the film 106 and hold it flat in the film channel 326. These pressure bars 334 are resiliently forced inwardly by bow springs 335 and are movably secured in the grooves 333 by screws 336 which extend through the gate 329. The latch 330 includes a rotatable,

partly cylindrical member 340 which rotates so as to drop behind a projection 341 of the latch plate 332 and is provided with a handle 342 whereby it may be rotated so as to disengage from the projection 341 of the latch plate 332. On a pivot member 343 projecting from the back of the wall 322 into the interior of the casing 321 is a switch lever 344 in the form of a bell crank having a long lever arm 345 and a short lever arm 346. In the swinging end 347 of the long lever arm is a body of insulating material 348 which carries a movable contact 350, the upper or front end of which is adapted to engage a stationary contact 351 supported in the upper wall of the casing 321 and insulated therefrom by insulating means 352, the stationary contact 351 having an upwardly extending screw 353 on which a nut 354 is employed to secure a conductor 355. In the bottom wall of the casing 321 is a screw 356 which is insulated by an insulating means 357 and has a nut 358 on its lower end for securing an electrical conductor 360 in contact with the screw 356. A spring 361 is held under the head 362 of the screw 356, this spring being of electro-conductive material and engaging the lower end 363 of the contact member 350, thereby transmitting electric current from the screw 356 to the contact member 350 and also forcing the lever arm 345 upwardly. The short lever arm 346 of the switch lever 344 has a roller 365 pivoted thereon which projects through an opening 366 formed in the front wall 322 of the casing 321 at one edge of the film channel 326. This roller 365 engages an edge 367 of the film 106, and the lever 344 is held in open position, as shown in Fig. 16, by the engagement of the edge 367 of the film 106 with the roller 365. Notches in the edge 367 of the film 106, such as the notch 368 shown in Fig. 16, permit the roller 365 to move in anti-clockwise direction, as viewed in Fig. 16, permitting the spring 361 to rotate the switch lever 344 upwardly and carry the movable contact member 350 into engagement with the stationary contact 351, thereby closing a light changer circuit whenever a notch 368 comes into cooperative position with the roller 365.

The preferred operation of the printer is substantially as follows: The movable light housing 288 is moved outwardly on the slide bars 292 and 293 to open position, and the parts 107, 329, 266, and 107a are swung into open position. When the member 266 is swung into open position, the roller 312 rides up over the sloping face 304 of the stationary cam 302 into the concave end face 305 and thereby holds the movable member 266 in open position. The spool 31, having a double-coated unexposed film, as represented by the film 104, wound thereon is placed on the bracket arm 26, and complementary color value negative films, represented by the films 105 and 106, are placed on spools 32 and 33 and mounted on the bracket arms 27 and 28. The positive and negative films are carried downwardly to the upper sprocket means represented by the sprocket 102 and are held against the sprocket 102 by the hold-down means 107, the double-coated positive film 104 being between the negative films 105 and 106. From the sprocket 102 the films are carried downwardly to the guide roller 140, but in approaching the guide roller 140 one of the negatives, such as the negative 106, is carried through the light changer switch 320 so that notches formed thereon may be employed to operate the light changer switch and thus control a light changer connected with the electric circuits leading to the light globes within the light housings 195 and 288. From the guide roller 140 the films are carried downwardly across the light gate 237 and over the intermittently moving sprocket 164, whereupon the member 266 is swung leftwardly from open position so as to bring the hold-down rollers 318 and 315 into cooperating position with the guide roller 140 and the sprocket 164. Below the sprocket 164 loops 370 are formed in the films 104, 105, and 106, and the films are individually carried over the sprockets 171, 172, and 173 to the separate take-off film spools 185 frictionally mounted on the shaft 183. The movable light housing 288 is then moved leftwardly so as to bring the wall 285 of the light tube 286 into cooperation with the light gate 278, thus placing the printer in condition to start operation by first starting the drive motor, not shown, and then lowering the clutch member 60 into engagement with the clutch cone 47.

Although we have herein shown and described our invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be employed in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

We claim as our invention:

1. A printer of the character described, including: means forming a path for an unexposed film; means for holding a pair of printing films on opposite sides of said unexposed film in said path; a stationary light housing on one side of said path and an outwardly movable light housing on the other side of said path, each of said housings having a light gate for engagement with one of said printing films, one of said light gates being movably mounted to produce automatic adjustment relative to the other of said light gates, said light gates being relatively outwardly movable; means for intermittently advancing said films; resilient means for separating said light gates during the periods of movement of said films and holding said light gates against said printing films during the periods of rest of said films; a light-producing member in each of said housings; and cylindrical shutter means for exposing said films to light from said light-producing members during said periods of rest of said films.

2. A printer of the character described, including: means forming a path for an unexposed film; means for holding a pair of printing films on opposite sides of said unexposed film in said path; a light housing on each side of said path, each of said housings having a light gate for engagement with one of said printing films, said light gates being relatively outwardly movable; means for intermittently advancing said films; resilient means for separating said light gates during the periods of movement of said films and holding said light gates against said printing films during the periods of rest of said films; a light-producing member in each of said housings; a shaft in each of said housings, said shaft extending through a wall thereof; a rotary shutter member on the inner end of each of said shafts for controlling the projection of light through said light gates to said films; a drive shaft extending from one of said housings to the other having driving means at the ends thereof engaging said shafts of said housings; and drive means

for said drive shaft connected to said means for intermittently advancing said films whereby to produce a timed operation of said shutters and said advancing means.

3. A printer of the character described, including: means forming a path for an unexposed film; means for holding a pair of printing films on opposite sides of said unexposed film in said path; a light housing on each side of said path, each of said housings having a light gate for engagement with one of said printing films, said light gates being relatively outwardly movable; means for intermittently advancing said films; means for separating said light gates during the periods of movement of said films and holding said light gates against said printing films during the periods of rest of said films; a slide member projecting from each of said housings; a bottom member for each of said housings, said bottom members being slidable on said slide members between closed and open positions relative to said housings; a light globe mounted on each of said bottom members and projecting upwardly within its respective housing; a cup-shaped shutter in each of said housings in a position to project downwardly over said light globes, said shutters having light apertures therein; shafts extending from said shutters through the walls of said housings; a drive shaft extending from one of said housings to the other having driving means at the ends thereof engaging said shutter shafts; and drive means for said drive shaft connected to said means for intermittently advancing said films whereby to produce a timed operation of said shutters and said advancing means.

4. A printer of the character described, including: a frame structure having supports at the upper end thereof for three film spools; a pulling sprocket means for pulling films from said spools; means forming a path for an unexposed film; means for holding a pair of printing films on opposite sides of said unexposed film in said path; means for advancing said films through said path; light-producing means for projecting printing lights through said printing films to said unexposed film; three continuously driven sprockets for receiving said films from said advancing means, said sprockets being mounted on a single shaft in side-by-side arrangement; a film spool shaft mounted parallel with and adjacent said sprockets for holding three film spools in alignment with said sprockets; and means for rotating said film spool shaft.

5. A printer of the character described, including: means forming a path for an unexposed film; means for holding a pair of printing films on opposite sides of said unexposed film in said path; a stationary light housing on one side of said path; an outwardly movable light housing on the other side of said path; means for moving said movable light housing inwardly and outwardly relative to said path; a light tube extending from each of said housings toward said films in said path; a stationary light gate at the end of one of said tubes; a movable member opposite said stationary light gate; resilient means for holding said movable member toward said stationary light gate; a movable light gate adjustably mounted on said movable member in position to bear against said films on a side opposite to said stationary light gate, said movable light gate being telescoped with the end of the other of said light tubes; means for intermittently advancing said films; means for moving said movable member outwardly so as to separate said light gates during the periods of movement of said films; a light-producing member in each of said housings; and means for exposing said films to light from said light-producing members during said periods of rest of said films.

6. A printer of the character described, including: means forming a path for an unexposed film; means for holding a pair of printing films on opposite sides of said unexposed film in said path; means for advancing said films through said path; light-producing means for projecting printing lights through said printing films to said unexposed film, said light-producing means each including a light source and a movable shutter member; shutter-drive means for moving said shutters in synchronism with said film advancing means; driving mechanism for driving said shutter-drive means and said film advancing means; a power-supplying means; a clutch connecting said power-supplying means with said driving mechanism; and means for stopping said driving mechanism in a prescribed position when said clutch is released.

7. A printer of the character described, including: means forming a path for an unexposed film; means for holding a pair of printing films on opposite sides of said unexposed film in said path; means for advancing said films through said path; light-producing means for projecting printing lights through said printing films to said unexposed film, said light-producing means each including a light source and a movable shutter member; shutter-drive means for moving said shutters in synchronism with said film advancing means; driving mechanism for driving said shutter-drive means and said film advancing means; a power-supplying means; a clutch connecting said power-suppplying means with said driving mechanism; and means for stopping said driving mechanism in a prescribed position when said clutch is released, said stopping means having a resiliently supported part coming into engagement with another part of said stopping means whereby to minimize the shock of suddenly stopping said driving mechanism.

8. A light housing for a printer, comprising: a shell having a top wall, a side wall, and an opening in the bottom thereof, there being a light opening in said side wall; a bottom member for closing said bottom; means for movably supporting said bottom member so that it may be moved between closed and open positions relative to said shell, said bottom member being swingable about said means when in open position; a light globe holder mounted on said bottom member in position to support a light globe within said shell; a cup-shaped shutter projecting downwardly within said shell and over said light globe, there being an aperture in said shutter; a shaft extending upwardly from said shutter through the top wall of said shell; a bearing for said shaft; and gears connected to the upper end of said shaft for rotating said shutter.

9. A light housing for a printer, comprising: a shell having a top wall, a side wall, and an opening in the bottom thereof, there being a light opening in said side wall; a bottom member for closing said bottom; a round rod extending downwardly from one side of said shell, there being a longitudinal groove in the surface of said rod and a short lateral groove at the upper end of said longitudinal groove; a sleeve on said rod having a recess containing a ball which also projects into said groove of said rod; a bracket formed on said bottom member, said bracket having an

opening therein receiving said sleeve; a light globe holder mounted on said bottom member in position to support a light globe within said shell; a cup-shaped shutter projecting downwardly within said shell and over said light globe, there being an aperture in said shutter; a shaft extending upwardly from said shutter through the top wall of said shell; a bearing for said shaft; and gears connected to the upper end of said shaft for rotating said shutter.

10. A printer of the character described, including: a supporting structure; a main shaft extending vertically through said supporting structure; film spool supports in the upper end of said structure; sprocket means at the upper end of said supporting structure for receiving films from said spools, said sprocket means including a shaft supported in said supporting structure and having a geared driving engagement with said main shaft; a cam shaft below said upper sprocket means, said cam shaft being driven from said main shaft; a film advancing mechanism below said cam shaft having a shaft driven from said main shaft; a guide roller above said advancing mechanism; a lower sprocket means on said supporting structure below said film advancing mechanism, said lower sprocket means also including a shaft having driving engagement with said main shaft; a primary light tube above said film advancing mechanism, said light tube consisting of a wall having a stationary light gate formed at the end thereof in position to engage a film extending downwardly from said guide roller to said film advancing mechanism, there being grooves in the side walls of said light tube; film centering bars mounted in said grooves, said bars having centering pins at the outer ends thereof for engaging sprocket holes in films which extend across said stationary light gate; a lever member pivoted above said primary light tube having a cam-engaging arm and arms extending downwardly into engagement with the rear ends of said film centering bars; cam means on said cam shaft engaging said cam-engaging arm of said lever member; a supporting member having its lower end pivoted to said supporting structure and its upper end disposed in proximity to said stationary light gate; a movable light gate mounted near the upper end of said supporting member for universal movement and in a position to cooperate with said stationary light gate, said gate having a peripheral wall extending outwardly therefrom; a follower on the upper end of said supporting member engaging said cam means so that said supporting member and said movable light gate will be moved outwardly during the downward movement of films between said light gates; a secondary light tube adjacent the rearward end of said peripheral wall of said movable light gate and having an end wall adapted to rest in overlapping relationship to said peripheral wall; and means cooperating with said light tubes to project printing lights therethrough in timed relationship to the operation of said film advancing mechanism.

11. A printer of the character described, including: a supporting structure; a main shaft extending vertically through said supporting structure; film spool supports in the upper end of said structure; sprocket means at the upper end of said supporting structure for receiving films from said spools, said sprocket means including a shaft supported in said supporting structure and having a geared driving engagement with said main shaft; a cam shaft below said upper sprocket means, said cam shaft being driven from said main shaft; a film advancing mechanism below said cam shaft having a shaft driven from said main shaft; a guide roller above said advancing mechanism; a lower sprocket means on said supporting structure below said film advancing mechanism, said lower sprocket means also including a shaft having driving engagement with said main shaft; a primary light tube above said film advancing mechanism, said light tube consisting of a wall having a stationary light gate formed at the end thereof in position to engage a film extending downwardly from said guide roller to said film advancing mechanism, there being grooves in the side walls of said light tube; film centering bars mounted in said grooves, said bars having centering pins at the outer ends thereof for engaging sprocket holes in films which extend across said stationary light gate; a lever member pivoted above said primary light tube having a cam-engaging arm and arms extending downwardly into engagement with the rear ends of said film centering bars; cam means on said cam shaft engaging said cam-engaging arm of said lever member; a supporting member having its lower end pivoted to said supporting structure and its upper end disposed in proximity to said stationary light gate; a movable light gate mounted near the upper end of said supporting member for universal movement and in a position to cooperate with said stationary light gate, said gate having a peripheral wall extending outwardly therefrom; a follower on the upper end of said supporting member engaging said cam means so that said supporting member and said movable light gate will be moved outwardly during the downward movement of films between said light gates; a secondary light tube adjacent the rearward end of said peripheral wall of said movable light gate and having an end wall adapted to rest in overlapping relationship to said peripheral wall; a stationary light housing adjacent the outer end of said primary light tube; slide members extending horizontally from said supporting structure; a movable light housing supported on said slide members, said movable light housing being connected to the outer end of said secondary light tube and being movable back and forth so as to carry said secondary light tube to and from overlapping position relative to said peripheral wall; and means in said housing for projecting printing lights through said light tubes in timed relationship to the operation of said film advancing mechanism.

12. A printer of the character described including: a housing portion having a three armed bracket thereupon for supporting rolls of film; two lamp houses supported on said frame and relatively movable from each other; a cylindrical shutter in each lamp house, each synchronized with the other; light tunnels attached to said lamp houses; a fixed film gate between said light tunnels; a resiliently movable gate supported between said tunnels; and means for pulling a plurality of film between said gates.

13. A printer of the character described including: a housing portion having a three armed bracket thereupon for supporting rolls of film; two lamp houses supported on said frame and relatively movable from each other; a cylindrical shutter in each lamp house, each synchronized with the other; light tunnels attached to said lamp houses; a fixed film gate between said light tunnels; a resiliently movable gate supported between said tunnels; said gates being synchro-

nized with said shutters so that said gates are in closed position when said shutters are in open position; and means for pulling a plurality of films between said gates.

14. A printer of the character described including: a housing portion having a three armed bracket thereupon for supporting rolls of film; two lamp houses supported on said frame and relatively movable from each other; a cylindrcal shutter in each lamp house, each synchronized with the other; light means in each lamp house; light tunnels attached to said lamp houses; a fixed film gate between said light tunnels; a resiliently movable gate supported between said tunnels; said gates being synchronized with said shutters so that said gates are in closed position when said shutters are in open position, and means for pulling a plurality of films between said gates.

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