This invention relates to the production of 
complementary cinematographic film strips re-
spectively bearing series of images representing 
different color aspects of an object field.

Among the objects of the invention are 
the production of such films rapidly and eco-
nomically, the exposure of the respective 
films concomitantly, the printing of positive 
film strips moving in parallel paths from a 
single negative strip traveling in a path hav-
ing portions parallel to the parallel paths of 
said separate positive films, the provision of 
 improved feeding mechanism, the marking 
of the positive film strips automatically in a 
manner to facilitate matching them for im-
bibition printing or cementing together, and 
the control through common switch boxes 
of the marking mentioned and of the changes 
in printing light. Further objects of the in-
vention are to provide means for advancing 
the positive films in synchronism, to provide 
means for advancing the negative film at a 
 plurality of spaced points at twice the rate 
of the positive films and in the direction of 
advance of the positive film at one of said 
points and in an opposite direction at the 
other of said points. Still further objects of 
the invention are to provide an improved 
mounting for a portion of the feeding and 
registering mechanism enabling ready 
threading of the film strips and access to the 
parts, and to provide a very compact arrange-
ment for separately feeding film strips in 
which feeding means cooperate with the 
strips at points in their paths of travel at 
which the strips are relatively close together 
and make relatively small angles with each 
other.

The invention is well adapted for the print-
ing of complementary positive film strips from 
a negative film strip of the character dis-
closed in the patent to Comstock, 1,437,500, 
June 5, 1923. Such a strip bears two series of 
images, the images of the respective series 
being complementary to each other and ar-
ranged in alternation longitudinally of the 
film, and the images of one series being re-
versed with respect to the images of the other 
series.

In one aspect the invention comprises feed-
ing a plurality of positive films along parallel 
laterally offset paths and printing simulta-
eously respectively thereon images from the 
complementary series of a negative film of the 
type mentioned. In a preferred form of the 
invention the positive films are fed in the 
same directions and the negative film is 
caused to traverse a path so related to the 
paths of the positive films that the images 
printed on the latter have their tops extend-
ing in the same direction. Preferably, also, 
the printing may be done in a zone of a 
single image width extending transversely of 
the parallel path of positive film travel. The 
positive and negative film strip feeding 
mechanisms are preferably arranged at op-
opposite sides of the plane of film strip travel 
during printing, and one of the feeding 
mechanisms is preferably mounted for bodily 
movement relatively to the other, as is also 
a portion of the film gate and of the regist-
tering means, to facilitate threading the film 
strips and access to the parts.

In another aspect the invention comprises 
marking a pair of complementary positive 
film strips, preferably by means forming 
therein, outside the image bearing areas there-
of, notches or like indicia which may serve 
as guides and checks in the process of match-
ing the positive strips together or to an in-
hibition blank, whereby proper superposi-
tion of the positive images may be assured. 
In a preferred form these indicia are pro-
vided both at the beginning and at the end of 
the positive strips and are different at the op-
posite ends, as, for example, a single edge 
notch being made in the strips at their be-
ginnings and pairs of notches being made 
at their ends. The making of these notches 
is preferably controlled automatically by 
means moving with the negative strip and 
with the negative strip traversing a path 
of the character mentioned the notching of 

UNITED STATES PATENT OFFICE

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PHOTOGRAPHIC-FILM PRINTER

Application filed May 29, 1925. Serial No. 33,673.
the positive films takes place at different instants.

In a preferred form the control of the notching mechanism is by circuit controlling means governed by notches formed on the negative film strip, and this same circuit controlling means may also be used to control printing light varying mechanism by employing separate notches bearing different relations to the images on the negative strip and supplemental circuit controlling means to determine which of said mechanism shall be operated.

In order to illustrate the nature of the invention one concrete embodiment has been shown in the accompanying drawings in which:

Fig. 1 is a front elevation of the principal parts of a printer embodying the invention with certain parts broken away and omitted;
Fig. 2 is a side elevation of the printer;
Fig. 3 is a view of the rear with a cover plate and certain other parts removed to show the driving mechanism;
Fig. 4 is a sectional view taken generally on the line 4—4 of Fig. 3;
Fig. 5 is a sectional view on an enlarged scale on the line 5—5 of Fig. 3;
Fig. 6 is an elevational view with the cover plate removed of a portion of one of the positive feeding and registering mechanisms;
Fig. 7 is a sectional view on the line 7—7 of Fig. 6;
Fig. 8 is an elevation of the casing housing the positive feeding and registering mechanisms;
Fig. 9 is a fragmentary section on the line 9—9 of Fig. 8;
Fig. 10 is a section on an enlarged scale taken on the line 10—10 of Fig. 6;
Fig. 10a is a detail section on the line 10—10a of Fig. 10;
Fig. 11 is a section on the line 11—11 of Fig. 6;
Fig. 12 is a front view on an enlarged scale of the film marking or notching mechanism;
Figs. 13, 13a and 13b are sections on the line 13—13 of Fig. 12 showing the parts in different positions;
Fig. 14 is a section on the line 14—14 of Fig. 13;
Fig. 15 is a fragmentary front view of a portion of the front of the machine with parts omitted showing the negative guiding means and a light window;
Fig. 16 is a side elevation of a portion of the disclosure of Fig. 15;
Figs. 17 to 20 are views showing details of construction of a film controlled switch mechanism, Fig. 17 being a view partly in plan and partly in section of such a mechanism, Fig. 18 being a rear view with parts broken away of portions of the same mechanism, Fig. 19 is a section on the line 19—19 of Fig. 18, and Fig. 20 a section on the line 20—20 of Fig. 17;
Fig. 21 is a diagrammatic view of certain control and power circuits;
Fig. 22 is a diagrammatic view of portions of the paths of film strip travel;
Fig. 23 is a fragmentary view of a portion of the film similar to that on the left of Fig. 22 on an enlarged scale;
Fig. 24 is a view showing a modified arrangement which may be substituted at the right side of Fig. 23;
Fig. 25 is a front elevation of a film guiding and tensioning means;
Fig. 26 is an end view thereof;
Figs. 27, 28 and 29 are respectively sectional views on the section lines 27—27, 28—28, and 29—29 of Fig. 25; and
Fig. 30 is a view of the negative film strip.

The particular embodiment of the invention chosen for the purpose of illustration is adapted to print from one negative simultaneously upon separate positives p1 and p2, the negative bearing two series of complementary images, one series being printed on positive film p1, and the other series being printed on positive film p2. The negative film n is fed from a suitable feed reel (not shown) downwardly through suitable constant speed feeding mechanism 2, (Fig. 1), through suitable film guiding and film controlled switch means, a fragment of which is shown at 219 in Fig. 1, past a light window 3 (Fig. 3), thence downwardly under the intermittent action of feeding mechanism 4 (Fig. 3) for advancing the same step by step, thence downwardly, transversely, and then upwardly in a loop though a film guide and switch means 220 corresponding to the similar means previously mentioned, (Figs. 4, 13, etc.) and past a light window 7, being intermittently fed by a positive step by step feeding mechanism 8 (Fig. 4), thence upward over a continuously rotating feed sprocket 9 (Fig. 1), beneath a guide roll 10 and on to a reel 11.

The positive films are fed from parallel reels 11 and 11' by means of substantially identical feeding mechanisms including guide rolls 12 and positively driven feed sprockets 13, through film marking or notching and tensioning mechanism 15 over rolls 16 and 17, between which they pass the light windows 3 and 7 and are registered and otherwise controlled as hereinafter described, and are then engaged by positive step by step feeding mechanism 18 and led off at 19 to be wound up upon suitable receiving reels 19.

Referring to Fig. 3, 20 indicates a motor driven power shaft connected through a toothed clutch 21, controlled by mechanism 22, with a vertical shaft 23. The latter drives, through helical gearing 24, a horizontal shaft 25 which is connected by bevel gearing 26 with a vertical shaft 27 which in turn drives...
through bevel gearing 28, a horizontal shaft 29 carrying a negative feed drive sprocket 30, operatively connected with the continuous negative feed mechanism 2, and a gear 31, driving a smaller gear 32 upon a parallel shaft 33. Upon the shaft 33 a driving sprocket 34 is arranged for effecting drive of the second negative continuous feeding mechanism 9, the size of this sprocket being so proportioned to the size of the sprocket 30 that the negative feeds are affected at equal rates though in opposite directions due to the opposite rotations of the shafts 29 and 33.

A sprocket 35 upon the shaft 29 serves as a drive for both positive film feeding mechanisms, whose sprockets 13 are mounted on a common shaft. Helical gearing 36 connects the shaft 33 with a vertical shaft 37, which, through bevel gearing 38, drives the pulley 39 which by a belt 40 is connected to and drives the negative receiving reel 1. The shaft 23 also drives through suitable bevel gearing 41 and 42, horizontal shafts 43 and 44 which drive the step by step negative feeding devices 4 and 8. A shutter 45 carried coaxially with a gear 47 is driven by a bevel pinion 48 upon the shaft 29 between the gearing 41 and 42. The shaft 45 also drives the intermittent positive feed in a manner hereinafter described.

Fig. 5 illustrates the means for effecting the intermittent upward feed of the returning portion of the negative film, which mechanism is, except for its inverted position, substantially the same as the mechanism for effecting the downward feed of the other portion of the negative film. This mechanism comprises a shaft 50 driven through suitable gearing from the shaft 44 and carrying thereon a cam 51 which also constitutes a crank disk and carries a crank pin 52 connected by the connecting rod 53 to a wrist pin 54 upon a vertically reciprocable cross head 55 slidable upon guides 56 supported at their opposite ends in a vertically adjustable frame 57. At the other side of the guides 56, the cross head 55 carries a pin 58 to which is pivotally connected an arm 59 which at its lower end carries a plate 60 having projecting fingers 61 adapted to enter the sprocket holes in the negative film. A spring 62 mounted upon a portion 63 of the wall of the printer casing constantly tends to force the arm 59 into a position in which the pins 61 will be withdrawn from engagement with the negative film. The cam 51 has surfaces 63 and 64, the former spaced a substantially less distance radially from the periphery of the shaft 50 than the latter, and these surfaces cooperate with the arm 59 to permit retraction of the pins 61 from engagement with the film during their downward movement, to cause them to enter the film sprocket holes when in bottom position and to retain such engagement until top position is reached, and then to permit re-lease of the pins from the sprocket holes. The travel of the pins 61 is such that the negative film a is moved two image spaces for each complete reciprocation of the pins. It is to be observed that the pins 61 when at the lower ends of their travel are very near the light window 7 and at the upper limit of their path are only spaced a few picture spaces from the window. As a result possible shrinkage of the negative a can not interfere with the feed or registration of the strip, because the distance between the window 7, closely adjacent to which is the registering means shortly to be described and either end of the path of the pins 61 is so short that abnormal shrinkage would be essential before trouble would result. By raising or lowering the frame 57 the path of the pins may be adjusted as desired, suitable screw and nut adjusting means 63 (in Fig. 4) controlled by a shaft 62 being provided for this purpose. Corresponding adjusting mechanism is provided for the mechanism 4.

For the purpose of feeding the positive films intermittently and registering the positive and negative strips the following mechanism is provided.

Pivotally supported upon the front of the printer casing is a housing 101, said housing being provided with trunnions 102 whereby it is journaled in brackets 103 upon the front of the casing. Manually releasable latch means 101' normally holds the housing 101 in the position shown in Figs. 2, 4 and 5, but is releasable to permit the housing to tilt outwardly to facilitate threading the film strips. Through the trunnions and transversely of the housing extends a shaft 104, which is manually operable by a hand wheel 105, but which is normally driven by gearing including the bevel gearing 106' actuated by the shaft 43. The positive films are advanced simultaneously by identical mechanisms, arranged adjacent the opposite sides of the casing 101, and advancing the films a single image space at a time. Mechanism for registering the films when advanced, mechanism for pressing the films into engagement with the negative film strip, and mechanism for actuating the several mechanisms mentioned are all carried by the housing 101. Referring more particularly to Figs. 6 and 7, it will be observed that the shaft 104 carries thereon a series of cams 106, 107 and 108, and also an eccentric 109 which is connected by a strap 110 and adjustable connecting rod 111 with a pin 112 upon a cross head 113 slidable upon guides 114. The cross head 115 carries a pin 115 which is connected to a T-shaped member 116 whose head 117 carries plates 118 having fingers 119 adapted to extend through slots 120 in a wall of the housing 101 and to engage in the sprocket holes of the positive films to advance the latter. A spring 121 acts to impart a pressure upon the arm 116 to force
the pins backwards out of the sprocket holes when the position of the cam 106 permits. The cam 106 cooperates with the member 116 in the same manner as the cam 51 with the arm 59.

5 For the purpose of pressing the positive films into contact with the negative at the moment of printing, as later more fully described, slides 125 (see particularly Figs. 7 to 11 inclusive) respectively cooperating with the positive films are adapted to be actuated by the arms of a Y-shaped lever 126 pivotally connected thereto at 127, and pivoting about a pin 128 stationary as regards the housing 101, the lower end 129 of the lever 126 being engageable with the cam 107 to effect a positive retraction of the member 128, while a spring 130 constantly acts to force the same forward as soon as such movement is permitted by the change in the position of the cam 107.

Suitable film registering means actuated by the cam 108 upon the shaft 104 is also provided. The cam 108 engages an arm 132 which terminates in a sleeve 133 journaled for rocking motion upon a pin 134 supported in projecting arms 135 carried by the casing 101 and also supporting the pin 128. Sleeve 133 carries spaced diverging arms 137 and 138 which at their outer ends are pivotally connected to pins 139 mounted in members 140 which form portions of supporting means for series of registering pins and for automatically operative stop pin mechanism.

One set of these, namely those cooperating with the right hand positive film strip p in Fig. 22 will be described and then the differences between the two sets may be noted. Supported in a member 141 secured to the member 140 is a set of pins 142, 143, 144 and 145. The pins 142 and 143 are arranged at one side of the path of travel of the positive film strip and opposite the sprocket holes therein. The pins 144 and 145 are arranged at the opposite side of the path of travel of the same film, strip and opposite the other series of sprocket holes therein. The four pins are for a distance from their ends tapered symmetrically with respect to their axes so that their extremities may enter perfectly positioned sprocket holes in a new film at equal distances from the top and bottom edges of the sprocket holes, and at equal distances from the lateral edges of the sprocket holes.

The pin 146 at the large end of its tapered portion is of the full size of a standard sprocket hole and fits such a sprocket hole exactly in each direction. The pin 144 fits a standard sprocket hole accurately transversely, but at a certain distance from its end at the side of the pin remote from the pin 146 the taper merges into a cut away portion so that it is of less thickness than the length of a standard sprocket hole, whereby longitudinal shrinkage of a film strip may be accommodated. The pin 143 is cut away at two sides so that lateral shrinkage may be accommodated, but the pin is of the full thickness in its other dimension so that it fills a standard sprocket hole in the longitudinal direction of the film. The pin 142 is cut away along three sides so that it provides not only for lateral shrinkage, as was the case with pin 143, but also for longitudinal shrinkage, as in the case of pin 144. These four pins are simultaneously advanced by the lever mechanism including the arm 138 previously described. The pins slide in bores 150 in a block 151 and are adapted to be projected through a series of openings 152 in a plate 154 carried upon the slide 125. Mounted upon the face of this plate are guide plates 155 which are perforated as indicated at 156 to permit the pins 142, 143, 144, and 145 to pass through them, these plates 155 having their outer surfaces flush with the outer surface of the plate 154, (see Fig. 9) and serving to retain the positive film in position against the plate 154 and to separate the lateral edges of the positive film from the negative film during the process of registration, whereby the positive film, in the case of films intended to be connected back to back is quite thin, cannot be forced through the openings in the negative film and caused to interengage therewith with resultant tearing and other difficulties.

Also carried by the members 140 and 141 is part of an automatic stop mechanism which comprises a pin 160 having an extremity 161 slightly smaller in each direction than a standard sprocket hole and adapted in case the films are so far out of registration as to preclude their proper registration without tearing, to engage the films and thereby through mechanism to be hereafter described, to effect an interruption in the operation of the entire machine. The pin 160 is provided with a rectangular portion 162 slidable in a correspondingly shaped recess in a tubular member 164 which is held against rotation by a pin 165 in the member 140. To the rear of its rectangular portion the pin 160 is circular and is surrounded by a spring 166 which operates against a shoulder 167 normally to maintain the pin 161 protruded to an extent such that its extremity lies in the same plane as the extremities of the pins 142 to 146. When the pin 160 occupies this position a disk of conducting material 168 connected by rivets 169 to a sleeve of insulating material 170 contacts with a pair of contact elements 171 and 172, projecting into a recess 175 in a member 174 formed of insulating material and secured to the member 140. To preclude the movement of the pin 160 in a direction opposite the movement of the pins 142 to 145 as the latter are advanced without breaking a circuit including the elements 171 and 172, the pin 160 is provided at its rear
end with a nut 175 received in a recess 176 in
the insulating element 170 and held in posi-
tion therein by a member 177 of sheet metal
having an edge 178 adapted to underlie a
shoulder 179 upon the sleeve 170 and to be
held in position in a notch 180. There is suf-
cient play around the rear end of the pin 160
and nut 175 to permit the necessary tilting of
the contact annulus 168 to insure the making
of a circuit when the pin 161 is in forward
position, but this free play is insufficient to
permit such lost motion as would enable the
circuit to remain closed upon any substantial
obstruction to the forward movement of the
pin 160. The registering and stop pin mecha-
nism may obviously assume different forms,
as for example, that described in Troland
Patent No. 1,508,756, granted September 7,
1926, and the particular form disclosed is
described and claimed in the Troland appli-
cation Serial No. 68,883, filed November 13,
1925. It will be observed that in the mecha-
nism cooperating in the registering of the other
positive strip with the negative the
position of the pins corresponds to that pro-
duced by the inversion of the pin mountings
and such an arrangement may in fact be used.
The full size pin 145, with such an arrange-
ment, enters the same holes in the negative
film with which the full size pin of the camera
coupling aust be. As shown in Fig. 24, however,
if desired the full size pin could be arranged
to enter holes bearing the same relation to the
axis of symmetry of the images on the nega-
tive film strip, so that the relations of the
light windows and the images printed thereat
to the full size registering pin will be the
same.

Separate printing lights 199, of which but
one is shown, are arranged in a light house
200, these lights being adjustable towards or
away from the light windows by suitable
screw mechanisms 201 and also being verti-
cally adjustable to take care of the effect of
shrinkage in the negative film strip. The
light from these lamps passes through glassed
windows 202 arranged in slides 202' adjusta-
ble in the rear of boxes 203 and is controlled
by the rotating shutter 45. The boxes 203
are constructed to permit a minimum of air
leakage and are supplied with air under low
pressure for the purpose of causing good con-
tact between the negative and positive films at
the moment of printing. The negative film
passes in a suitably guided path (see Figs.
4, 15 and 16) along the front of the main
printer casing and across the light windows
through which the air pressure passes to bow
the central portion of the negative film strip
outwardly. Suitable guides 205, 206, 207,
208 and 209 guide the edge of the negative
strip and preclude lateral movement thereof
during the feeding and printing operations,
and these guiding means also serve with
guides 155 on the pressure plates to maintain
the film strips out of contact during the inter-
mittent advancement thereof, at which time
the pressure plates are retracted. When the
apparatus is in operation air under pressure
is supplied to the chambers or boxes 203
through suitable connection 212. This pres-
sure is just sufficient to bulge the center of
the negative film slightly outwardly and hold its
lateral edges against the guides 208. When
the pressure plates 154 move forwardly to
press the positive films into contact with the
negative film, contact first occurs at the bulg-
ing center of the negative film and the posi-
tives then flatten the negative out and contact
with the rest of the surface thereof opposite
the light windows. The plates 154 comprise
small panes 154' of "safety glass" opposite the
light windows which act to apply the pres-
sure to the films and prevent damage by the
printing light.

It will be observed that the registering
pins 142, 143, 144, and 145 and the positive
film strip guiding plates 155, and also the
automatic stop pins 161 are carried by the
housing 101 in positions above the horizontal
plane including the axis of the trunnions 102,
and that the positive feed fingers 119 also
reciprocate in said housing in paths above
the same plane. As a result, when the latch
mechanism 101' is released and the housing
101 tilted outwardly on the trunnions 102, the
positive film strips may be very readily
threaded in position and brought into proper
relation to the registering pins, etc., and
access to the negative film strip guides, etc.,
is also facilitated.

In order to enable the easy determination
of the proper spacial relation necessary be-
tween the positive film strips when they are
about to be cemented together, and to provide
means for properly effecting registration in
case the strips are cemented before develop-
ment, suitable means for marking them, as by
forming guide notches in their edges, is pro-
vided. Mounted upon the front of the cas-
ing and below the continuous feeding mecha-
ism for the positive and negative films but
above the light windows there is disposed a
notching mechanism whose function it is to
notch the positive films at corresponding
points at the beginning of the printing run
and to notch them also at corresponding
points at the end of the printing run in order
to provide means whereby an additional
check upon the proper registration of the
films may be obtained when the films are
cemented together. This mechanism 15
comprises a casing 270 secured to the front of
the main printer housing and provided at its op-
posite sides with film guiding and supporting
mechanism generally designated 272 (see
Figs. 12 to 14). The latter, which are later
more fully described, briefly consist of stat-
tionarily and movably supported guide
rollers 273 and 274, together with mechanism
for maintaining the film under tension, not only during the operation of the nicking mechanism, but also to provide for its better cooperation with the positive feeding mechanism. The notching mechanism is made in duplicate in order that the two positive films may be notched, and these are notched at substantially different times, one when one of a pair of complementary images on the negative film reaches a position spaced by a predetermined distance from the light window, and the other when the complementary image of the same pair reaches a corresponding distance from the opposite light window. Each of the notching mechanisms is electrically controlled by circuits and switches which will later be described. Referring, in view of the general identity of detail, to the right hand notching mechanism comprises a solenoid 275 wound upon a hollow sleeve 276 within which a core 277 is reciprocable, the core being normally projected to a maximum distance from the recess within the sleeve by a spring 278, but adapted to be drawn into the sleeve until its inner end 279 engages the bottom of the recess. For the purpose of limiting the outward movement of the core, a cover 280 is secured to the outer end of the casing 270 and this provides passages 281 through which guide pins 282 carried at the extremity of the cores may reciprocate. Surrounding a reduced portion 283 adjacent the outer end of the core 277 is one extremity of an arm 284 which has secured thereto a part of the actuating means for the notching mechanism, including a projecting element 285 having pivotally mounted at the outer end thereof a member 286 provided with a portion 287 adapted to engage a shoulder 288 upon the element 285 to limit rotary movement of said element 286 in a counter-clockwise direction in the view shown in Fig. 13, and, in terms of force acting upon said member, to prevent its yielding under the force exerted upon it in its movement to cause the notching operation. Owing to a cutaway portion 290 the member 286 may swing backward after the manner of a clapper box when its end is subjected to a force tending to swing it in an opposite direction. A spring 290 normally holds the member 286 in the position shown in Fig. 13. The member 286 has a projecting nose 291 adapted to contact with and apply pressure to a shoulder 292 formed upon a swinging arm 293 which carries adjustably mounted thereon a notching cutter 294. A spring 295 normally moves the notching cutter and its supporting member to the position shown in Fig. 13 where engagement takes place between a surface of the member 293 and a stop pin 296. A cooperating stationary cutter 297 is supported upon a stationary part in suitable position for cooperation with the cutter 294. It will be observed that the shoulder 292 is provided with a slight undercut 298. The mode of operation of this portion of the mechanism will be obvious. On energization of the solenoid 275 the core 277 will be drawn to the right in Fig. 13. As indicated in Fig. 13 the engagement of the nose 292 with the shoulder 291 will cause the movable cutter 294 to cooperate with the stationary cutter 297 in cutting a notch, which may be of any desired shape, but which is herein triangular, from the lateral edge of the film. As the solenoid will not be immediately deenergized it will be evident that the movable cutter be withdrawn from the notch before the positive film is next moved, as otherwise tearing would occur. This is automatically accomplished by reason of the fact that due to the separation of their paths the nose 291 slides by the extremity of shoulder 292 at about the instant when cutting is completed and as a result the spring 295 operates to swing the notching cutter back to a position above the line of travel of the film, notwithstanding the fact that the arm 285 has not yet been withdrawn. Accordingly the film is free to be advanced by the feeding mechanism without tearing and on deenergization of the solenoid the spring 278 will act to move the arm 284 in a direction to withdraw the member 286, and the nose will be free to pass the shoulder by reason of the clapper box type mounting which permits the nose to swing backward as it passes over the shoulder. The positive films are guided and supported as they pass the notching devices by mechanism 272 already briefly described and including the rolls 273 and 274. The rolls 274 are mounted on swinging gate members 300 (see Figs. 25 to 29) which are pivoted on bosses 301. Each of the gate members is provided with H shaped grooves comprising a transverse slot 302 and a pair of slots 303, 304 perpendicular to the transverse slot and adjacent the edges of the gate. Mounted in the last slots are channel elements 305 and 306 which have journaled therein near their opposite ends film engaging rolls 307 and the channel elements are pivoted between their ends on reduced portions 308 of a bar 309 which lies in the transverse slot 302. A strip 310 serves to retain the bar 309 and its connected channel elements in the gate. A bowed spring 311, disposed in the slot 302 between the bottom thereof and the bar 309, resiliently forces the bar and with it its attached elements towards a surface 312. This surface is slightly lower than a pair of guide surfaces 313 which are opposite the sprocket hole carrying portions of the film strips and the image bearing portion of the film accordingly does not have a chance to scratch. The gate and the channel element 305 are notched as at 314, to permit the notching cutter to engage the edge of the film strip and the
gate may be held closed by a latch mechanism 315. The mechanism specifically disclosed may obviously assume other forms. It will be observed that this mechanism not only holds the positive during notching but provides a tension against which the intermittent feed pulls.

In printing, the films are preferably arranged with the light passing through the back of the negative and with the back of the positive towards the negative, i.e. so that printing will occur through the back. The negative n accordingly is turned as it passes from the downwardly extending portion of its path to the upwardly extending portion thereof.

As is customary with printers which operate to print complementary images on separate positive film strips at the same time, the printing lights are variated during the printing operation in accordance with the density of the negative. Arrangements for this purpose include separate variable resistances of usual construction 215 and 216 respectively arranged in series with the lamps 199 and 197. These resistances are conventionally shown in Fig. 21, and are provided with separate gravity operated solenoid controlled operating devices of usual construction. The controlling solenoids for the resistances are respectively shown at 217 and 218 and energization of these solenoids effects a well-known manner a change in the resistance in the light circuits.

For the purpose of controlling these solenoids and the solenoids of the film marking or notching mechanism, common negative film controlled pilot switches are used, suitable manual switches later described being operable to determine whether the notching mechanism or the light control mechanism shall be operated. Separate pilot switch mechanisms 219 and 220 are arranged in the paths of the descending and upwardly moving portions of the negative film at suitable distances ahead of the light windows. As these mechanisms are substantially identical but one needs be described. The position of the mechanism 220, cooperating with the upwardly moving portion of the film strip n is indicated in Fig. 4. The other of these mechanisms is not clearly visible in the drawings but an edge thereof shows in Fig. 1. These mechanisms include gates 221 pivoted as at 222 and having latch mechanisms 223 for holding them closed. The gates are substantially H-shaped in elevation and are provided with guide springs 224 which support the edges of the negative film strip during its cooperation with the control mechanism. Pivoted mounted upon a stud 224' carried by a box member 225 to which the gate 221 is pivotally connected is a rocking lever mechanism comprising a relatively long arm 226 having at its free end, but insulated therefrom, a bridge member 227 of conducting material adapted to complete a circuit between a pair of stationary contact members 228 and 229 mounted in a wall 230 of insulating material. The rocking lever mechanism also includes a second arm 231 connected in fixed angular relation to the lever 226 and carrying at one end thereof a roller 232 adapted to contact with the edge of the negative film strip and also having connected between it and a pin 233 a very light spring 234 which draws the roller 232 against the edge of the negative film strip.

The negative film strip is provided with a plurality of lateral notches 235° and 235°. These notches have relatively steep leading edges, whereby the rollers 232 drop sharply into them to effect quick circuit closures. They have bottoms which are initially substantially parallel to the edge of the film strip, whereby the circuit may remain closed for a substantial time, and they have relatively gently sloping portions leading back to the full width portions of the strip. The notches 235° cooperate with the rollers to effect notching and the notches 235° to effect light changes. The former are so related to the strip that the positive films come to rest by the instant at which the notching mechanism operates. The latter bear such relation that the circuit is closed to effect a shift in the resistance while the films are feeding and while the shutter interrupts the passing of light between the lamps and the light windows.

A suitable manual switching arrangement hereinafter described may be placed in different positions to limit the operation caused by the operation of the switch mechanisms 227, 228 and 229, either to the notching or to the light change devices. The distance of the notches 235° and 235° from the axes of symmetry has been pointed out, and although in no ordinary case would the notches be as close as suggested in Fig. 30, the notch 235° is dotted in to bring out this feature more clearly. In this figure the direction of film travel is indicated by the arrow.

The various circuits of the printer are shown in Fig. 21. Direct current is supplied from a suitable source 240 to a line 241 and through an automatic voltage regulator 242 to a line 243. The line 241 branches and one branch 244 leads to connections to one side of the printing lights. The other branch 245 leads to a switch operating magnet 246 which controls simultaneously the three poles 247, 248 and 249 of a three pole switch. The wire 243 branches and one branch 250 is controlled by the switch 249 and is connected through the resistances 215 and 216 to the opposite sides of the printing lights. The other branch 251 is controlled by the automatic switches operated when the films are too far out of registration, by a normally closed control switch 252 operable to break the circuit.
when occasion arises, and by a switch 254 which may be closed to energize the magnet 246. On closure of the switch 248 the switch 254 is shunted. Switch 247 closes a circuit from an A. C. source of current 255 through a motor M which drives the printer mechanism. Leads 257 and 258 from the source of current 255 supply current to the light changing solenoids 217 and 218 and to the notching solenoids 275. A double-pole double-throw manually operated switch 260 determines whether the light change or notching solenoids shall be energized. The film controlled switches 219 and 220 respectively control the solenoids individual to their respective films.

When the machine is started up, the switch 254 is closed, which results in starting the driving motor and lighting the printing lights. The clutch 21 is then out, so that the films are not advanced. A switch 261 is connected to the clutch control 22 so that as the clutch is engaged the switch is closed. The switch 260 is thrown to bring the light changing solenoids into circuit and after notching is thrown to bring the light changing solenoids into circuit, the negative film strip in each case causing the pilot switches 219 and 220 to effect the requisite control of their solenoids.

In the event of the films getting too far out of registration the automatic stop switches may open the circuit through the magnet 246 and the entire printer will be shut down until it is again purposely set in operation after the lack of registration is cured. Should the operator desire to stop the machine at any instant he can do so by operating the switch 255. It will thus be seen that the operation of the machine is entirely automatically controlled after it is once started and that it may at any instant be stopped immediately if necessary.

While one specific embodiment of the invention is disclosed and described herein for purposes of illustration, it will be evident that numerous variations in construction, materials and arrangement of parts may be made within the scope of the invention as set forth in the following claims.

Owing to the fact that the housing 101, containing the positive film feeding mechanism, is pivoted to swing into and out of threading position about the axis of the drive shaft 104, the positive film feeding mechanism in the main casing and the positive film feeding mechanism are maintained in predetermined timed relationship during the swinging movement of the housing 101 to threading position and back again to normal position.

The negative film feeding means is described in the claims as “multiple-speed” in contradistinction to the single step feed of the positives.

I claim:

1. The method of making complementary cinematographic films which comprises feeding a plurality of positive films along laterally offset paths in which surfaces of said films are parallel to a common plane, feeding a single negative film in a path in which it moves parallel to said first mentioned paths but in different directions in the respective paths, and concomitantly forming complementary series of images on the positive films in said first paths.

2. The method of printing from a multiplex cinematographic negative film bearing plural series of complementary images upon different positive films, which comprises intermittently feeding the positive films parallel with each other at a predetermined rate, intermittently feeding the multiplex negative film at a multiple of said rate successively in parallelism with the parallel portions of said positive films in the same direction as one positive film and in the opposite direction to the other, and concomitantly printing the complementary series on the different films respectively.

3. The method of printing from a multiplex film having multiplex images in reversed relation to each other which comprises feeding parallel positive films in the same direction, successively feeding the multiplex negative film in printing relation to said positive films with the printing images oriented in the same direction, and concomitantly printing the multiplex images on said positive films respectively.

4. The method of making complementary cinematographic films which comprises the step of concomitantly printing complementary series of images on separate films respectively from one film having a plurality of complementary series and moving at the printing spaces in the same direction as one of said first mentioned films and in the opposite direction to the other, said first mentioned films traveling in the same directions at said printing spaces.

5. The method of making complementary cinematographic films which comprises the step of concomitantly printing complementary series of images on separate positive films moving in parallel laterally offset paths respectively from a single negative film bearing a plurality of complementary series and having portions parallel to said paths, the relative directions of motion of the positive and negative films in said parallel paths being respectively opposite in the different paths.

6. In a cinematographic apparatus, a plurality of light windows arranged side by side, means for feeding separate positive film strips past said light windows in parallel laterally offset paths including positive film feeding means at the same side of a line passing through both light windows, and separate negative film feeding means arranged at opposite sides of said line.

7. In a cinematographic apparatus a plurality of light windows arranged side by side,
means for feeding separate positive film strips past said light windows in parallel laterally offset paths including step-by-step positive film feeding means at the same side of a line passing through both light windows and separate step-by-step negative film feeding means arranged at opposite sides of said line, at twice the speeds of said positive film strips.

8. In a cinematographic apparatus a plurality of light windows arranged side by side, means for feeding separate positive film strips past said light windows in parallel laterally offset paths including positive film feeding means at the same side of a line passing through both light windows and separate negative film feeding means arranged at opposite sides of said line, the rate of feed of said negative film feeding means being a multiple of that of the positive film feeding means.

9. In a cinematographic apparatus a plurality of light windows arranged side by side, means for feeding separate positive film strips past said light windows in parallel laterally offset paths including step-by-step positive film feeding means at the same side of a line passing through both light windows and separate step-by-step negative film feeding means arranged at opposite sides of said line, the rate of feed of said negative film feeding means being twice that of the positive film feeding means.

10. In a cinematographic apparatus, a plurality of light windows arranged side by side, means for feeding separate positive film strips past said light windows in parallel laterally offset paths including positive film feeding means for each window at the same side of a line passing through both light windows and at equal distances from their windows respectively, and separate negative film feeding means arranged at opposite sides of said line and at equal distances from their light windows respectively.

11. In a cinematographic apparatus, a plurality of light windows arranged side by side, means for feeding separate positive film strips past said light windows in parallel laterally offset paths including step-by-step positive film feeding means at the same side of a line passing through both light windows and at equal distances from their light windows respectively, and separate step-by-step negative film feeding means arranged at opposite sides of said line and at equal distances from their light windows respectively.

12. In a cinematographic apparatus, a plurality of light windows arranged side by side, means for feeding separate positive film strips in the same direction past said windows and means for feeding negative film past said windows in opposite directions.

13. In a cinematographic apparatus, a plurality of light windows arranged side by side, means for feeding separate positive film strips in the same direction past said windows, and means for feeding negative film past said windows in opposite directions, and means for feeding separate positive film past said windows in opposite directions, and means for feeding negative film past said windows in opposite directions, and means for feeding separate positive film past said windows in opposite directions.
dows, said last-named means including simultaneously actuated film strip engaging means cooperating with said positive film strip, whereby one positive film is movable past one window in the same direction as the negative and a second positive film is movable past another window in the opposite direction from the negative.

19. In a cinematographic apparatus, a plurality of light windows, means for feeding a single negative film strip in relatively opposite directions past said windows, and means for feeding separate positive film strips in the same direction past said windows, said negative film strip feeding means being operative to produce feed at twice the rate of said positive film feeding means, whereby one positive film is movable past one window in the same direction as the negative and a second positive film is movable past another window in the opposite direction from the negative.

20. In a cinematographic apparatus, a plurality of light windows, means for feeding a single negative film strip in relatively opposite directions past said windows, including separate negative film feeding means arranged at opposite sides of a straight line passing through both of said windows, and means for feeding separate positive film strips in the same direction past said windows, said negative film strip feeding means being operative to produce feed at twice the rate of said positive film feeding means, whereby one positive film is movable past one window in the same direction as the negative and a second positive film is movable past another window in the opposite direction from the negative.

21. In a cinematographic apparatus, a plurality of light windows, means for feeding a single negative film strip in relatively opposite directions past said windows, and means for feeding separate positive film strips in the same direction past said windows, said last-named means including simultaneously actuated film strip engaging means cooperating with said positive film strips, said negative film strip feeding means being operative to produce feed at twice the rate of said positive film feeding means, whereby one positive film is movable past one window in the same direction as the negative and a second positive film is movable past another window in the opposite direction from the negative.

22. In a cinematographic apparatus, a plurality of light windows, means for feeding a single negative film strip in relatively opposite directions past said windows, including separate negative film feeding means arranged at opposite sides of a straight line passing through both of said windows, and means for feeding separate positive film strips in the same direction past said windows, said last-named means including simultaneously actuated film strip engaging means cooperating with said positive film strips, said negative film strip feeding means being operative to produce feed at twice the rate of said positive film feeding means, whereby one positive film is movable past one window in the same direction as the negative and a second positive film is movable past another window in the opposite direction from the negative.
portion of said feeding means permitting their bodily movement away from said light window.

23. In a cinematographic apparatus, a casing provided with a light window, and means for feeding positive and negative film strips past said light window and registering them opposite the same including supporting means for the registering means and for a portion of said feeding means permitting their simultaneous bodily movement away from said light window.

30. Cinematographic apparatus comprising a film gate arranged to pass two films in contact, film feeding mechanism individual to each film, common means for driving said mechanism, and means for moving one mechanism from the other mechanism without disconnecting the driving means, whereby the two mechanisms may be maintained in predetermined timed relationship during said movement.

31. In a cinematographic apparatus, a light window, means for feeding a negative film strip past said window, and means for feeding a positive strip past said window, both of said means being arranged to be positively driven by power from a common source, whereby the rates of feed may be timed one with the other, the positive film feeding means being pivotally mounted upon a shaft through which power is transmitted thereto, whereby it may be moved toward and away from said window about its pivot without interfering with the timing of the film feeding means.

32. In a cinematographic apparatus, a casing provided with a light window, a film gate pivotally attached to said casing adjacent to said window, means within the casing for feeding the negative film past said window, and means in said film gate timed with the negative film feeding means for feeding a positive film past said window.

33. In a cinematographic apparatus, a casing provided with a light window, a film gate pivotally attached to said casing adjacent to said window, step by step feeding means within the casing for moving the negative film past said window, and step by step means in said film gate timed with the negative film feeding means for moving a positive film past said light window.

34. In a cinematographic apparatus, a casing provided with a plurality of light windows, means in the casing for feeding a negative film successively past said light windows, a film gate cooperating with all said windows, and separate means in said film gate adjacent to each of said windows for simultaneously feeding a separate positive film past each window.

35. In a cinematographic apparatus, a casing provided with a plurality of light windows, means in the casing for feeding a negative film successively past said light windows, a film gate cooperating with all said windows, and separate means in said film gate adjacent to each of said windows for simultaneously feeding a separate positive film past each window.
image of another pair in coincidence with the
other window, means for feeding a separate
positive film strip past each of said windows,
and means responsive to the negative film for
cutting a notch in each of the positive films
in a corresponding position, whereby the
positive films may be combined in correct
registered relationship.

Signed by me at Brooklyn, New York, this
21st day of May, 1925.

HERBERT O. CARLETON.