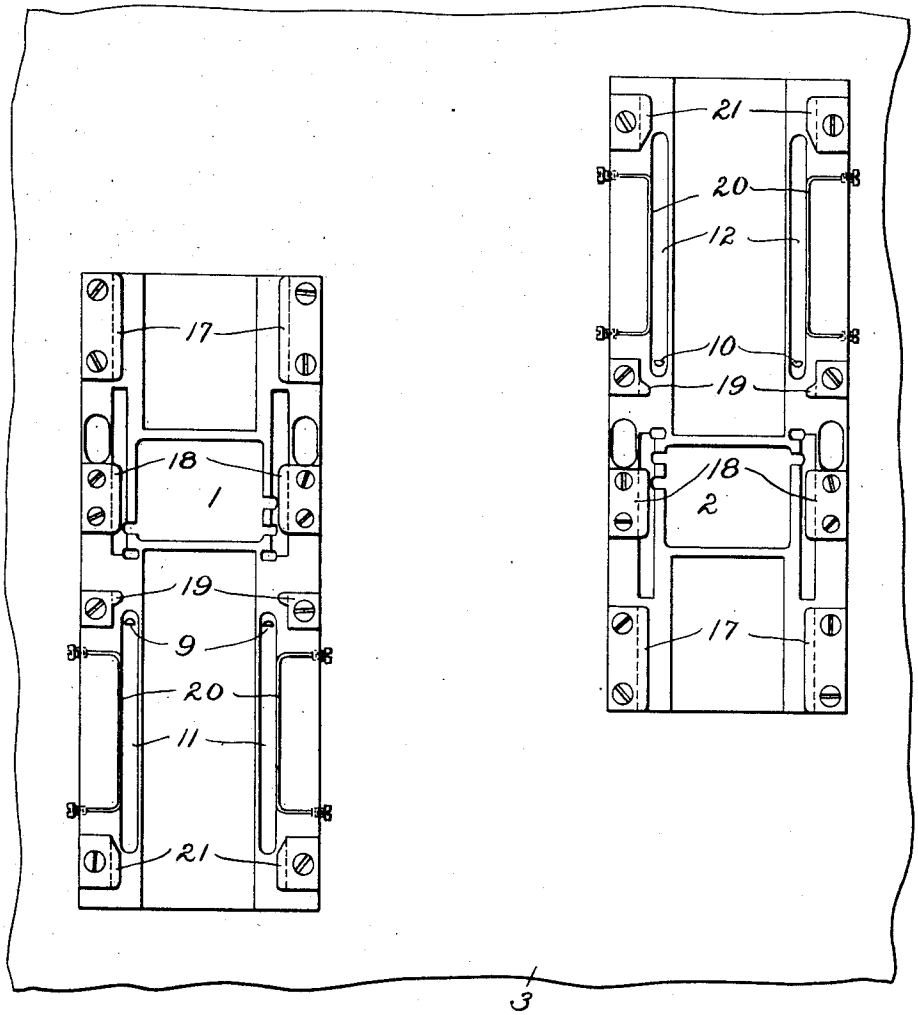
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REGISTRATION MEANS FOR FILM PRINTING MACHINES

Filed Nov. 13, 1925 4 Sheets-Sheet 1

Fig. 1



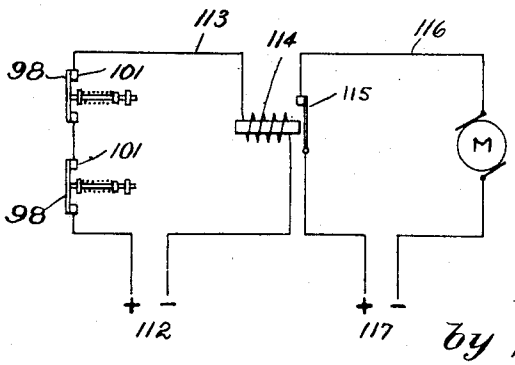


Fig. 13

Inventor
Leonard T. Troland
by Roberts, Roberts & Cushman
Atty's

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REGISTRATION MEANS FOR FILM PRINTING MACHINES

Filed Nov. 13, 1925 4 Sheets-Sheet 2

Fig. 11

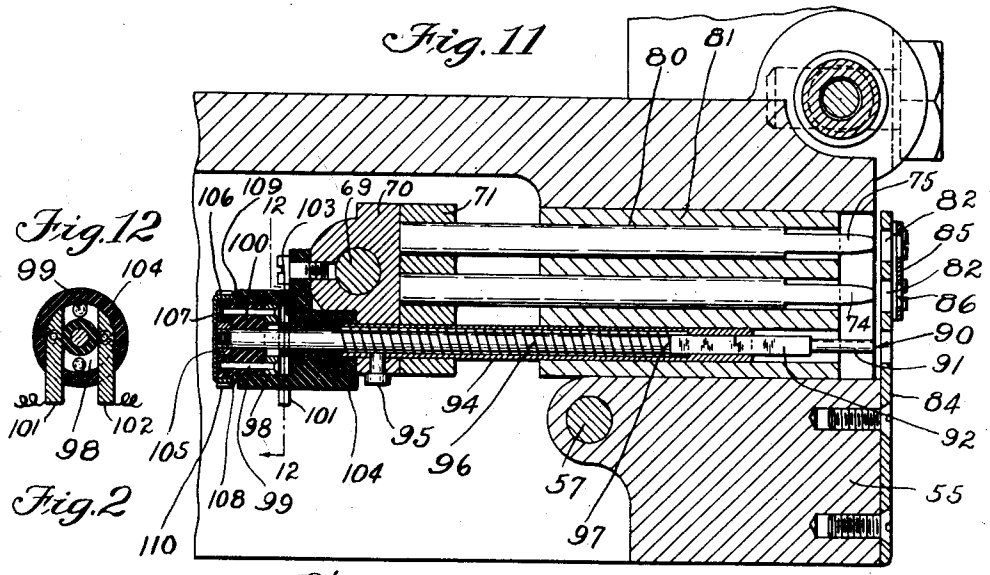


Fig. 12

Fig. 2

Fig. 4

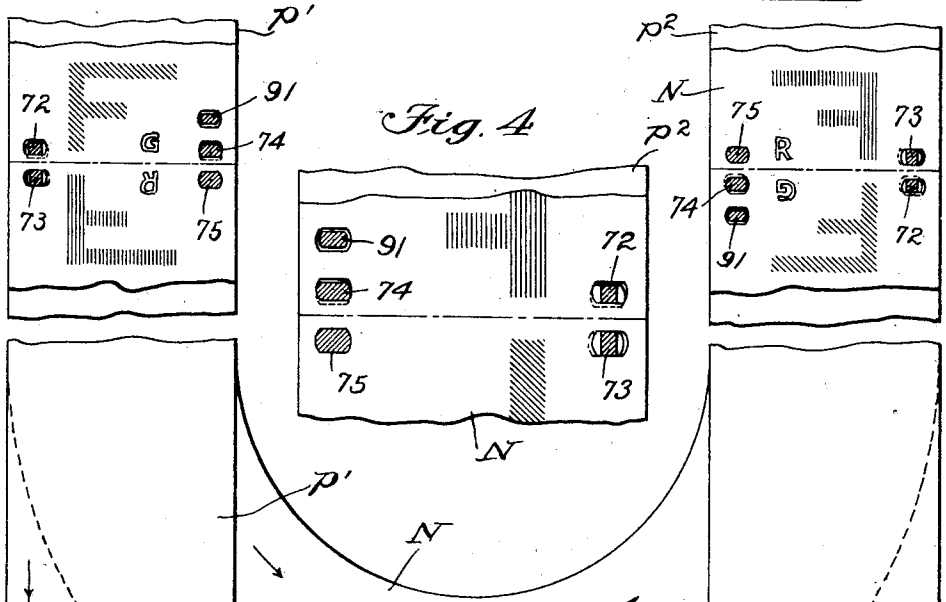
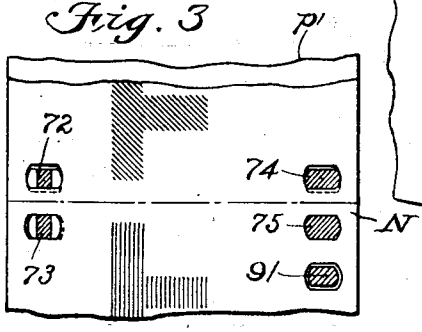


Fig. 3



Inventor
Leonard T. Troland
by Roberts Roberts & Cushman
Att'ys

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REGISTRATION MEANS FOR FILM PRINTING MACHINES

Filed Nov. 13, 1925 4 Sheets-Sheet 3

Fig. 10

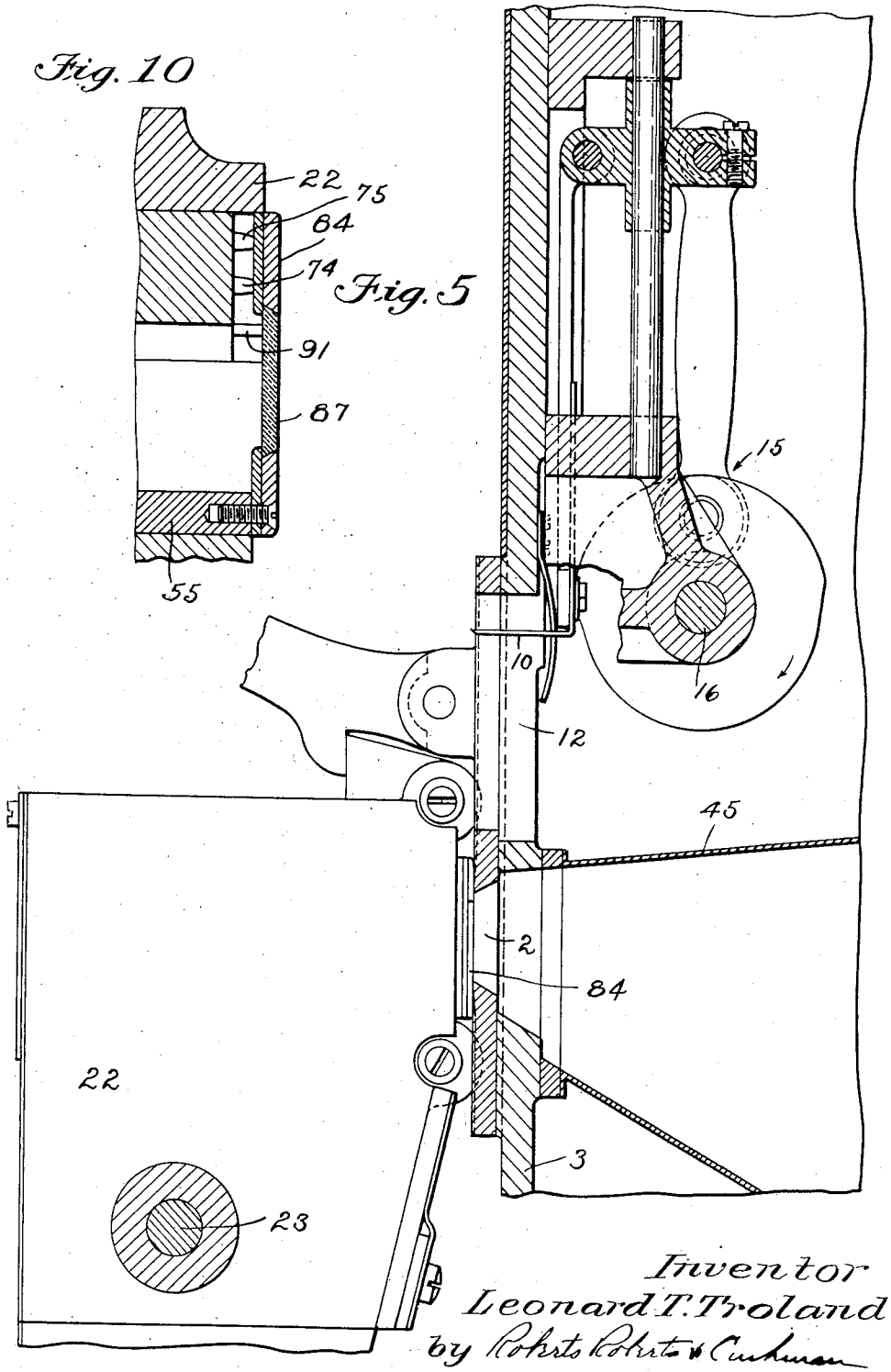


Fig. 5

Inventor
Leonard T. Troland
by Roberts Roberts & Cushman
Att'ys

June 11, 1929. L. T. TROLAND 1,716,989

REGISTRATION MEANS FOR FILM PRINTING MACHINES

Filed Nov. 13, 1925 4 Sheets-Sheet 4

Fig. 6

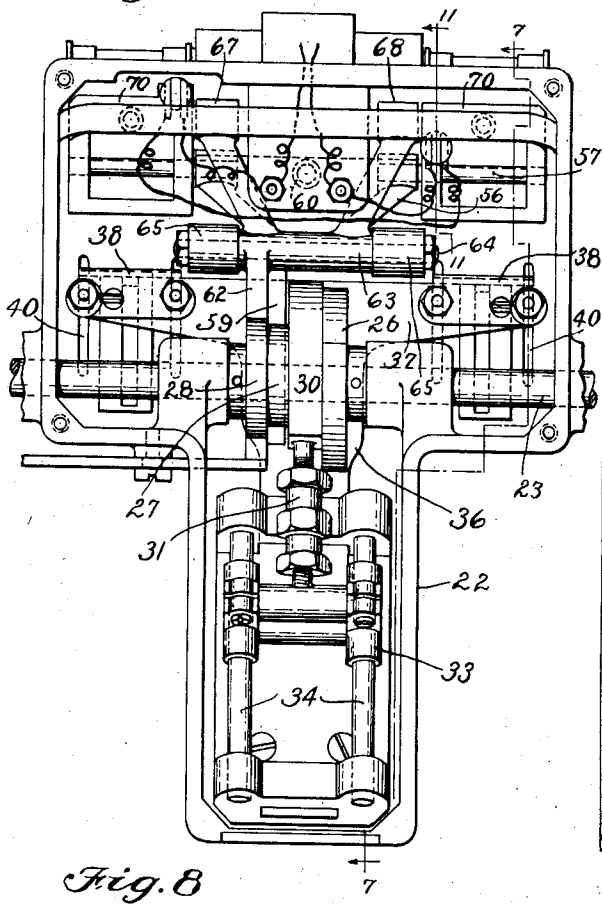


Fig. 7

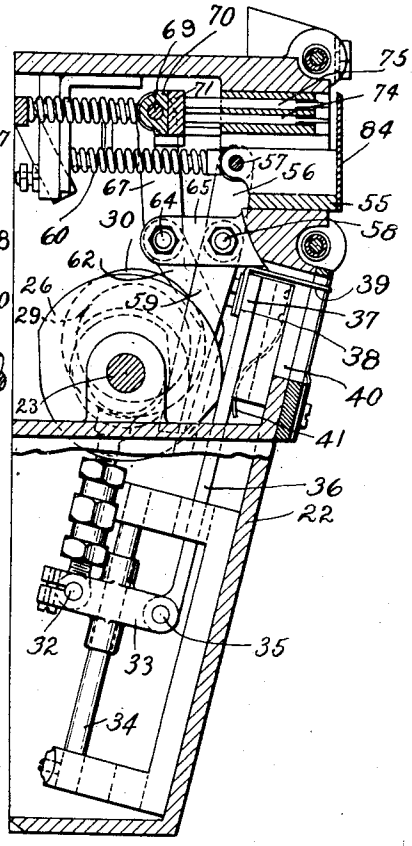


Fig. 8

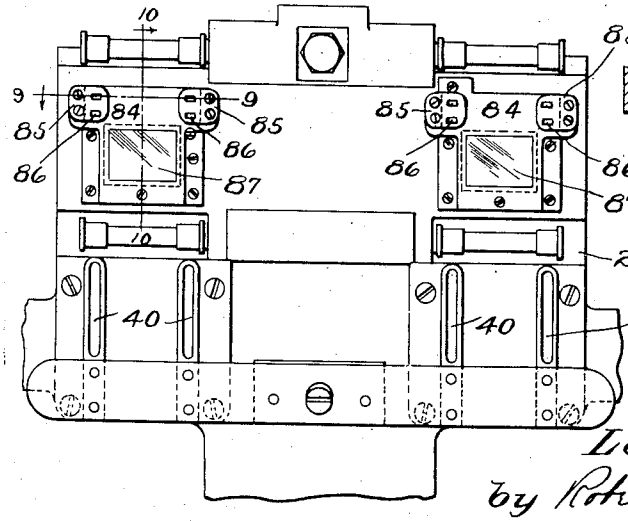
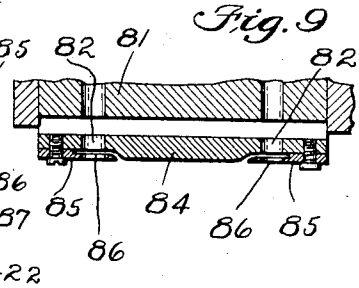


Fig. 9



Inventor
Leonard T. Troland
by Roberts Roberts & Cushman
Att'ys

Patented June 11, 1929. 1,716,989

UNITED STATES PATENT OFFICE.

LEONARD T. TROLAND, OF MALDEN, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO TECHNICOLOR MOTION PICTURE CORPORATION, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MAINE.

REGISTRATION MEANS FOR FILM-PRINTING MACHINES.

Application filed November 13, 1925. Serial No. 68,833.

This invention relates to the production of cinematographic film strips and more particularly to the production of complemental cinematographic film strips respectively bearing series of images representing different color aspects of an object field and especially to the production of complemental positive films which when suitably colored and placed in superposed registry will reproduce the object field with substantial accuracy in natural colors.

In the production of films bearing complemental pictures a high degree of accuracy in registration is essential for the reason that the high magnification to which such pictures are subjected when projected on the screen shows very pronouncedly any lack of proper registration. During the process of development and during storage between periods of use the negative films frequently undergo substantial shrinkage both longitudinally and laterally, and this shrinkage may not be uniform from point to point in a relatively long strip. As a result difficulty in registering the negative film with the positive films which are printed from it may be quite substantial and means must be provided for effecting uniformity of registration between the positive and negative films before printing takes place. At times, also, the shrinkage of the negative film may be such that perfect registration will be impossible without tearing one or the other of the films, and accordingly, in order that the films may not be ruined it is essential to provide means to stop the film feed automatically should such a condition be encountered.

Among the objects of the invention are the provision of improved registering means adapted to insure the perfect registry of one or more film strips with respect to an aperture or to each other, and the provision of improved means for automatically and instantaneously interrupting the feeding of such film or films in case, for any reason such as shrinkage, sticking, or imperfect punching of the sprocket engaging openings, tearing would occur before registration could be effected. A more specific object of the invention is the provision of improved means for effecting registration of positives with negative films bearing complemental series of images in printing or other mechanisms in which exact registration of a plurality of film strips is essential, so that as when complemental positive films are cemented in superposed relation after coloring and projected, or projected simultaneously with suitable equipment, the pictures produced may be free from blurring and color fringes.

In one aspect the invention comprises registering one or more film strips by means engaging a plurality of sprocket holes at the same side thereof whereby the tension on the film is divided between a plurality of points so that tearing or stretching of the sprocket holes is avoided. Preferably the registering means also engages sprocket holes at opposite sides of the film strips whereby tension may be applied at spaced points in the same transverse zone and registration more effectively accomplished. Preferably the registering means takes the form of a plurality of simultaneously reciprocable pins each of which is tapered at its extremity symmetrically both as to an axial plane parallel to the direction of film travel and as to an axial plane transverse to the path of film travel, so that all the pins may initially be capable, if necessary of exercising some effect in registration, the shapes of certain of the pins at points spaced from their ends being varied to provide for both longitudinal and transverse variations in film strip dimension. Guiding means for one of the film strips is preferably provided to enable spacing of positive and negative strips during feeding, such guiding means being associated with the registering means and having openings through which the registering pins travel and also cooperating only with the edges of the film strips so that scratching of the picture spaces is avoided.

In another aspect the invention comprises improved means for interrupting film strip feed when the lack of initial registration is such as to render tearing or undue stretching of the sprocket holes inevitable if efforts to effect registration are continued, the invention in this aspect comprising improved means for controlling current supply to a motor operating the feeding mechanism for the film.

To illustrate the nature of the invention

one illustrative form thereof is shown in the accompanying drawings, in which:

Fig. 1 is a fragmentary front elevation, with parts omitted, of a printing mechanism;

Fig. 2 is a corresponding view of certain portions of the paths of film travel;

Figs. 3 and 4 are views on an enlarged scale showing different arrangements of registering and stop pins;

Fig. 5 is a view partially in side elevation and partially in vertical section showing a portion of the feeding mechanism;

Fig. 6 is an elevational view with the cover plate removed of the positive feeding and of the registering mechanism;

Fig. 7 is a sectional view on the line 7—7 of Fig. 6;

Fig. 8 is an elevation of the casing containing 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 on the line 10—10 of Fig. 8;

Fig. 11 is a section on an enlarged scale on the line 11—11 of Fig. 6;

Fig. 12 is a detail section on the line 12—12 of of Fig. 11; and

Fig. 13 is a diagrammatic view of a control circuit.

In its illustrative embodiment the invention is shown as incorporated in a printer of the type known as the Carlton printer. In such printers a pair of light windows 1, 2 are arranged adjacent each other in a casing 3 and at these windows images from complemental series are printed on separate positive film strips. Separate positive film strips P^1 and P^2 are intermittently fed downwards one film space at a time past the light windows 1 and 2 and a negative film strip N, having thereon complemental series of images arranged in alternation and with the images of one series reversed with respect to the images of the other, is fed in the same direction as the portion P^1 opposite the window 1 and in the opposite direction to the strip P^2 opposite the window 2, being advanced a plurality of film spaces at each intermittent advance thereof. The positive film strips move in front of the negative film strip as illustrated in Fig. 2, and the positive and negative films are fed simultaneously and are stationary simultaneously so that registration and printing may occur while all the film strips are stationary, for the film strips may assume various forms. The negative feeding mechanisms, as illustrated, include pairs of claws 9 and 10 which are respectively simultaneously actuated in opposite directions and arranged, the first pair below the light window 1 and the second pair above the light window 2. These claws are adapted to be projected through slots 11 and 12 respectively in the front of the casing 3 during feeding of the negative strips and are retracted during their movements in the opposite directions, at which time registration and printing takes place. To actuate the pins 9 and 10 any suitable mechanism may be employed and in Fig. 5 a four-motion operating mechanism 15 for the pins 10 is shown as actuated by a shaft 16 to which power may be supplied from a suitable motor M (see Fig. 13). Similar mechanism is provided in reversed position for the pins 9. Suitable guides 17, 18 and 19 are arranged in advance of, between the ends of, and beyond the light windows, and further guides 20 and 21 are arranged adjacent the slots 11 and 12.

The positive feeding mechanism will be described in somewhat greater detail, since it is arranged within common housing and actuated through common power mechanism with the registering mechanism. Pivotally supported on the front of the printer casing 1 is a housing 22 suitably journaled to permit its pivotal movement about the axis of a shaft 23 driven through suitable connections by the motor M. The shaft 23 extends transversely of the housing and may be manually actuated as well as driven by the motor M. The positive films are simultaneously advanced by identical mechanisms arranged adjacent to the opposite sides of the casing 22 and advancing the films a single image space at a time. The mechanism for registering the positive and negative film strips at the end of feeding, the mechanism for pressing the positive films into engagement with the negative during printing, and the mechanism for actuating the several mechanisms mentioned are all carried in the housing 22.

Referring more particularly to Figs. 6 and 7 it will be noted that the shaft 23 is provided with a series of cams 26, 27 and 28 and also an eccentric 29. The last is connected by a strap 30 and adjustable connecting rod 31 with a pin 32 and cross head 33 slidable upon guides 34. The cross head 33 carries a pin 35 to which a T-shaped member 36 having a head 37 is connected. The head 37 carries plates 38 and pins 39 adapted to extend through slots 40 in a wall of the housing 22 and to engage in the sprocket holes of the positive films to advance the latter. A spring 41 exerts a pressure upon the arm 36, normally holding the pins out of the sprocket holes when the position of the cam 26 permits. The cam 26 cooperates with the member 36 to advance the pins through the slots when they are at the upper end of their travel, to maintain them advanced throughout downward movement, and to permit retraction at the end of downward movement and throughout upward movement.

The light is transmitted to the printing windows 1 and 2 through boxes 45 to whose interior air under pressure is supplied in any suitable manner. This pressure acts on the negative film through the light windows and is just sufficient to bulge the center of the negative film slightly outwardly and to hold its lateral edges against the guides 18.

For the purpose of pressing the positive films into contact with the negative during printing, slides 55 are adapted to be actuated by the arms of a Y-shaped lever 56 pivotally connected thereto at 57 and pivoting about a pin 58 which is stationary as regards the housing 22. The lower end 59 of the lever 56 is engaged by the cam 27 to effect positive retraction of the member 55 and a spring 60 acts constantly to force the member 55 forwardly as quickly as such movement is permitted by the change in the position of the cam 27.

To register the positive and negative films opposite the light windows, means actuated by the cam 28 upon the shaft 23 are provided. Cam 28 engages an arm 62 which terminates in a sleeve 63 journaled for rocking movement upon a pin 64 supported in projecting arms 65 upon the casing 22, which arms also support the pin 58. The sleeve 63 is provided with spaced diverging arms 67 and 68 and the latter at their outer ends are pivotally connected to pins 69 mounted in members 70 which form portions of supporting means for series of registering pins and for automatic stop pin mechanism which also constitutes a part of this invention. One set of pins, namely those cooperating with the right-hand positive film strip P^2 in Fig. 2 will be described and then the differences between the two sets may be noted. A member 71 secured to the member 70 supports a set of pins 72, 73, 74, and 75 arranged approximately at the corners of a rectangle whose width is determined by the width of the film strip between the sprocket holes and whose length is equal to the distance between adjacent sprocket holes. The pins 72 and 73 lie at one side of the path of travel of the positive film strip and opposite the sprocket holes therein. The pins 74 and 75 are disposed at the opposite side of the path of travel of the same film strip and opposite the second series of sprocket holes therein. The four pins are for a distance from their ends tapered symmetrically both as to planes perpendicular to the path of film strip travel and transverse thereto, and also planes perpendicular to the path of film strip travel and extending longitudinally thereof. As a result the extremities of each of the pins will enter perfectly positioned sprocket holes of a new film at equal distances from the top and bottom edges of the sprocket holes and also at equal distances from the lateral edges of the sprocket holes. The pin 75 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 74 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 75 the taper merges into a cutaway portion so that the thickness of the pin is less than the dimension longitudinally of the film strip of a standard sprocket hole, whereby longitudinal shrinkage of the film strip may be accommodated. The pin 73 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 72 is cut away at three sides so that it provides not only for lateral shrinkage as in the case of the pin 73 but also for longitudinal shrinkage as in the case of the pin 74. These four pins are simultaneously advanced and retracted by the lever mechanism including the arm 68 previously described and slide in bores 80 in a block 81 and are adapted to be projected through a series of openings 82 in a plate 84 carried by the slide 55. Mounted upon the face of this plate are guide plates 85 perforated as at 86 to permit the pins 72, 73, 74 and 75 to pass through them. These plates have their outer surfaces flush with the outer surface of the plate 84 (see Fig. 9) and serve to retain the positive film in position against the plate 84 and to separate the lateral edges of the positive film from the negative film during registration. This prevents the positive film, which is quite thin, being forced through the openings in the negative film and caused to interengage therewith with resultant tearing and other difficulties.

Instead of locating the stop-pin 91 remote from the full-size pin 75 as shown in Figs. 2, 4, etc., it may be located adjacent the full size pin as shown in Fig. 3; indeed somewhat greater accuracy is obtained by the latter arrangement.

The plates 84 comprise small panes 87 of "safety glass" opposite the light windows which act to apply the pressure to the films during printing and also serve to permit observation of the film without damage from external light. When the pressure plates 84 move forwardly to press the positive films into contact with the negative film, contact occurs at the bulging center of the negative film and the positives then flatten the negative out and contact with the rest of the surface thereof opposite the light windows.

It will be observed that in the mechanism cooperating in the registration of the positive film P^1 with the negative film at the left-hand side of the printer, the position of the pins corresponds to that produced by

the inversion of the pin mounting at the right and such an arrangement may in fact be used. The full size pin 75 with such an arrangement enters the same holes in the negative with which the full size pin of the camera feeding mechanism cooperates, as shown in Fig. 4. However, if desired the full size pin could be arranged to enter holes bearing such relation to the axis of symmetry of the images on the negative film strip that the relations of the light windows and the images printed thereon to the full size registering pin would be the same, as for example by arranging the pins at the right-hand side of Fig. 2 in the manner shown in Fig. 4 while leaving the pins at the left-hand side of Fig. 2 as shown. Either arrangement possesses certain advantages.

Also carried by the plates 70 and 71 is part of an automatic stop mechanism which comprises a pin 90 having an extremity 91 slightly smaller in each dimension (about 0.01 inch clearance on all sides) than a standard sprocket hole and adapted in case the films are so far out of registration as to preclude 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 machine. Pin 90 is provided with a rectangular portion 92 slidable in a correspondingly shaped passage in a tubular member 94 which is held against rotation by a pin 95 in the member 70. To the rear of its rectangular portion the pin 90 is circular and is surrounded by a spring 96 which acts against a shoulder 97 to maintain the pin 91 normally protruded to an extent such that its extremity lies in the same plane as the extremities of the pins 72—75. When the pin 90 occupies this position a ring of conducting material 98 connected by rivets 99 to a sleeve of insulating material 100 contacts with a pair of contact elements 101 and 102 projecting into a recess 103 in a member 104 of insulating material secured to the member 69. To preclude the movement of the pin 90 in a direction opposite the movement of the pins 72—75 as the latter advance without breaking a circuit including the elements 101 and 102, the pin 90 has at its rear end a nut 105 received in a recess 106 in the insulating element 100 and held in position therein by a member 107 of sheet metal having an edge 108 adapted to underlie a shoulder 109 upon the sleeve 100 and to be held in position in a notch 110. Sufficient play is provided around the rear end of the pin 90 and nut 105 to permit the necessary tilting of the contact annulus 98 to insure the making of a circuit when the pin 90 is in forward position, but this play does not suffice to permit sufficient lost motion to enable the circuit to remain closed upon any substantial obstruction to the forward movement of the pin 90. Thus it is unnecessary to attach the relatively stiff lead wires to the movable part. The stop mechanism is duplicated adjacent each light window and in the arrangement shown in Figs. 1 and 2 the stop pins travel in paths spaced but a short distance from the central transverse line of the windows 1 and 2.

Noting Fig. 13 it will be observed that the two switches including the sets of contacts 98, 101 and 102 are included in series in a circuit 113 including a source of current 112, connecting the source with a solenoid 114 which when energized maintains a switch 115 in a closed position. The switch 115 controls a circuit 116 connecting a source of current 117 with the motor M which operates the feeding mechanism, etc. of the printer. As a result, if the positive and negative films opposite either light window 1 or 2 are out of registration by more than a predetermined amount when the registering pins start their forward movement the automatic stop mechanism will engage the film strip which is too far out of the necessary position and causes breaking of the circuit and so immediate stopping of the feeding of the strips before the strips can be torn. Suitable shutter means, not shown, permits access of the printing light windows 1 and 2 only after registration is complete.

The operation of the mechanism described has been adequately explained as the structure was pointed out, but it may be summarized as follows: after the positive film strips have been advanced downwardly a single space by the positive feeding mechanism and after the portions of the negative film strips have been respectively moved two image spaces at each light window there will be a positive image space awaiting printing and a negative image to be printed thereon opposite each light window, the negative images at opposite windows not being complemental to each other, but belonging to complemental series. The mechanism described will then cause forward movement of the plates 69 and 70 carrying the registering and automatic stop pins and if the film strips are not too far out of registration the registering pins will serve very effectively to bring the strips into registration, the four spaced contacts with the films at each window assuring perfect registration and diminishing the possibility of tearing with the arrangement in the species of the invention shown both in Fig. 2 and in Figs. 3 and 4. The registering pins will lie one-half at one side and one-half at the other side of the axis of symmetry nearest the negative images being printed. In case the film strips are too far out of registration to permit an effort to bring them into registration to be safely made the stop pins 90 will engage one

of the film strips and cause breaking of the circuit 113 with resultant stoppage of the mechanism.

From the foregoing it will be evident that this invention is particularly applicable for use with a positive film of standard pitch (unshrunken) but difficult to position without injury because thin and a negative film which while thicker is shrunken somewhat off standard pitch.

While I have herein described one embodiment which the invention may assume in practice it will be understood that it may assume other forms or be substantially modified without departing from the spirit thereof or the scope of the appended claims.

I claim:

1. Cinematographic apparatus comprising, in combination, a light window, means for registering positive and negative film strips at said window including registering pins arranged in pairs at opposite sides of said light window, and means for controlling feed of said film strips including a pin arranged nearer the center of said light window than said registering pins.

2. Apparatus for effecting registration between cinematographic film strips comprising a registering pin adapted to fill completely a standard sprocket hole and to protrude through both strips, and a plurality of registering pins cooperating with other sprocket holes in both strips, each of said last mentioned pins being smaller in at least one dimension than a standard sprocket hole.

3. Cinematographic apparatus comprising means for advancing two films in spaced parallel relationship, a pin arranged to enter aligned sprocket openings in both said films to register the same, and means to restrain the first film from being moved into contact with the second at the edges by said pin including film guiding means engageable with the films only at their edges.

4. Cinematographic apparatus comprising means for advancing two films in spaced parallel relationship, a pin arranged to enter aligned sprocket openings in both said films to register the same, and means to restrain the first film from being moved into contact with the second by said pin including film guiding means traversed by said pin.

5. Cinematographic apparatus comprising means for advancing two films in spaced parallel relationship, a pin arranged to enter aligned sprocket openings in both said films to register the same, and means to restrain the first film from being moved into contact with the second by said pin including film guiding means traversed by said pin and engageable with the films only at their edges.

6. Cinematographic apparatus comprising means for advancing two films in spaced juxtaposition, pins arranged to enter aligned sprocket openings in both said films to register the same, means to restrain the first film from being moved into contact with the second by said pins, and means for moving one film transversely into contact with the other film after the films are registered, said restraining means being mounted on said last means and engaging only the edges of said films.

7. Cinematographic apparatus comprising means for advancing two films in spaced parallel relation, members transversely advanced to enter aligned sprocket openings in both said films to register the same, means to restrain the first film from being moved into contact with the second by said members, and a member for moving the first film transversely into contact with the second after the films are registered, said restraining means being mounted on said last moving member and engaging only the edges of the films.

8. Cinematographic apparatus comprising means for advancing two films in spaced parallel relation, members transversely advanced to enter aligned sprocket openings in both said films to register the same, means to restrain the first film from being moved into contact with the second by said members, and a member for moving the first film transversely into contact with the second after the films are registered, said restraining means being mounted on said last moving member and having therein openings through which said registering members pass.

9. Cinematographic apparatus comprising means for advancing two films in spaced parallel relationship, registering means for said films, a member for moving one of said films transversely of its path of travel after registry into contact with the other, and means for drawing said first mentioned film out of contact with the other during feeding engaging only the edges thereof.

10. Cinematographic apparatus comprising means for advancing two films in spaced parallel relationship, registering means for said films, a member for moving one of said films transversely of its path of travel after registry into contact with the other, and means for drawing said first mentioned film out of contact with the other during feeding engaging only the edges thereof and said last named means being carried by said member.

11. Cinematographic apparatus comprising means for intermittently advancing two films in spaced parallel relationship, pilot pins recurrently advanced through aligned openings in both films to register the same, and means adjacent opposite edges of said films for restraining the first film from being moved towards the second by said pilot pins.

12. Apparatus for effecting registration

between a positive film strip and a negative film strip bearing complemental images arranged in pairs thereon with the images of each pair reversely disposed with respect to an axis of symmetry, comprising registering pins adapted to enter sprocket holes in the negative strip disposed next adjacent to and at opposite sides of such axes of symmetry and protrude through the sprocket holes of the positive strip.

13. Apparatus for effecting registration between a positive film strip and a negative film strip having complemental images arranged in pairs thereon with the images of each pair reversely disposed with respect to an axis of symmetry, comprising registering pins adapted to enter at both sides of said negative strip sprocket holes disposed next adjacent to and at opposite sides of such axes of symmetry and to protrude through holes of the positive strip.

14. Apparatus for effecting registration between a positive film strip and a negative film strip bearing complemental images arranged in pairs thereon with the images of each pair reversely disposed with respect to an axis of symmetry, comprising registering pins adapted to enter sprocket holes in the negative strip disposed next adjacent to and at opposite sides of such axes of symmetry, each of said registering pins being tapered symmetrically with its axis at its extremity and one of said pins of the full size of a standard sprocket hole at the end of said tapered portion and the other filling a standard sprocket hole in one direction only.

15. Apparatus for effecting registration between a positive film strip and a negative film strip having complemental images arranged in pairs thereon with the images of each pair reversely disposed with respect to an axis of symmetry, comprising registering pins adapted to enter at both sides of said negative strip sprocket holes disposed next adjacent to and at opposite sides of such axes of symmetry, each of said registering pins being tapered at its extremity symmetrically with respect to its axis and one of the pins being of the full size of a standard sprocket hole at the end of its tapered portion and each of the others being of less cross-sectional area than a standard sprocket hole at the ends of their tapered portions.

16. Apparatus for effecting registration between a positive film strip and a negative film strip bearing complemental images arranged in pairs thereon with the images of each pair reversely disposed with respect to an axis of symmetry, comprising registering pins adapted to enter sprocket holes in the negative strip disposed next adjacent to and at opposite sides of such axes of symmetry, each of said registering pins being tapered at its extremity symmetrically with respect to its axis and one of the pins being of the full size of a standard sprocket hole at the end of said tapered portion and the other filling a standard sprocket hole only in a direction transverse to the film strip.

17. Apparatus for effecting registration between a positive film strip and a negative film strip having complemental images arranged in pairs thereon with the images of each pair reversely disposed with respect to an axis of symmetry, comprising registering pins adapted to enter at both sides of said negative strip sprocket holes disposed next adjacent to and at opposite sides of such axes of symmetry, each of said registering pins being tapered symmetrically with its axis at its extremity and one of said pins being at the end of its tapered portion of the full size of a standard sprocket hole, one of them full size longitudinally but not laterally of a hole, one laterally but not longitudinally, and one neither longitudinally nor laterally.

18. In a film printing machine, a driving motor, means associated therewith for intermittently moving both the negative and positive films, a printing window, means for registering the films with respect to each other and to the window, a pin adapted to be moved in a direction perpendicular to the direction of film travel to penetrate one of the sprocket openings of each film if the films are correctly registered, a motor circuit, a pair of fixed contacts spaced apart and constituting the terminals of a switch in said circuit, and conducting means on said pin normally adapted to bridge said contacts but movable with said pin to break the circuit when the pin meets with substantial resistance due to incorrect registration of the films.

Signed by me at Boston, Massachusetts, this 22nd day of October, 1925.

LEONARD T. TROLAND.