

Dec. 1, 1931.

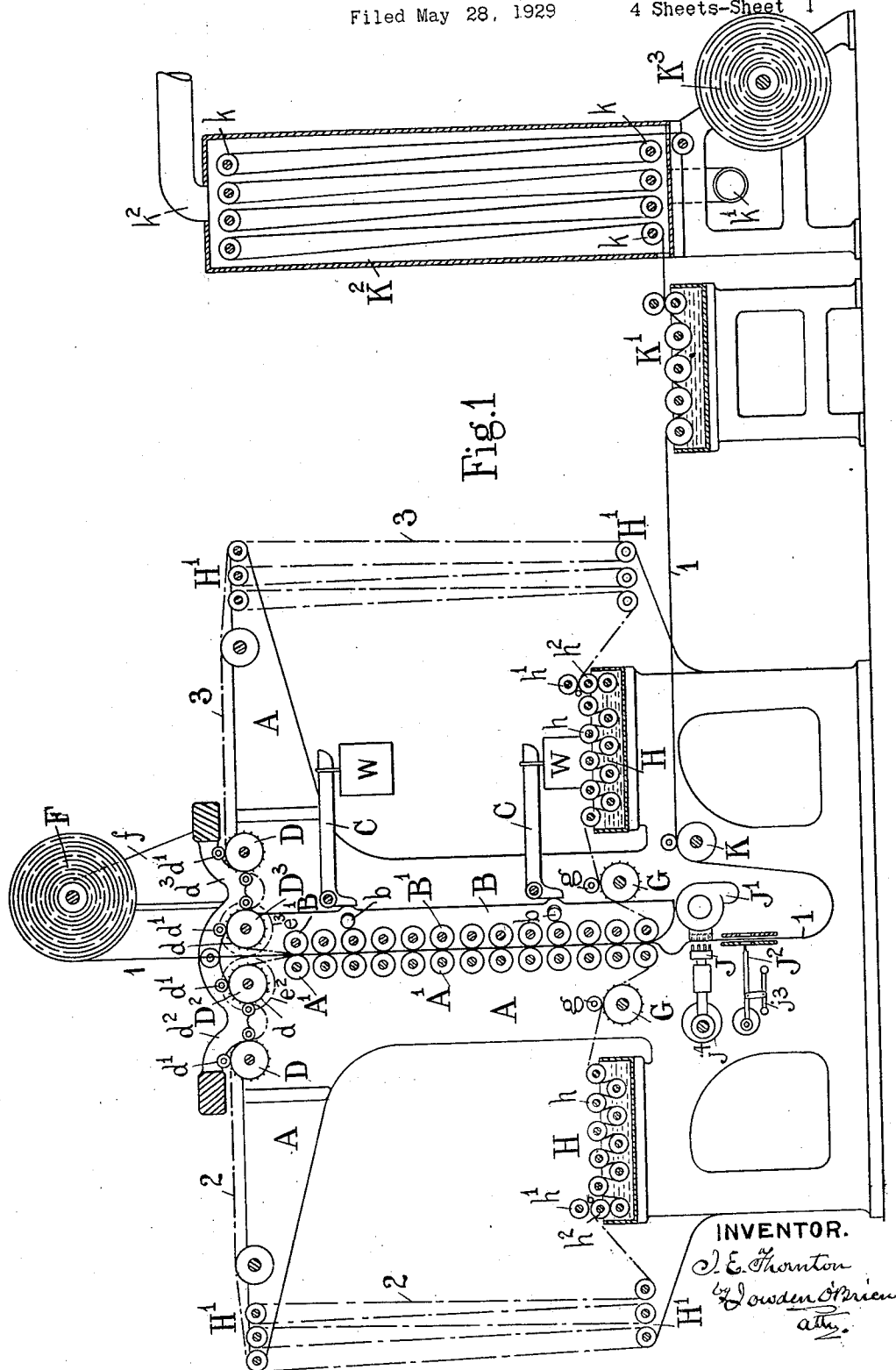
J. E. THORNTON

1,834,355

MACHINE FOR THE PRODUCTION OF CINEMATOGRAPH AND OTHER FILMS

Filed May 28, 1929

4 Sheets-Sheet 1



Dec. 1, 1931.

J. E. THORNTON

1,834,355

MACHINE FOR THE PRODUCTION OF CINEMATOGRAF AND OTHER FILMS

Filed May 28, 1929

4 Sheets-Sheet 2

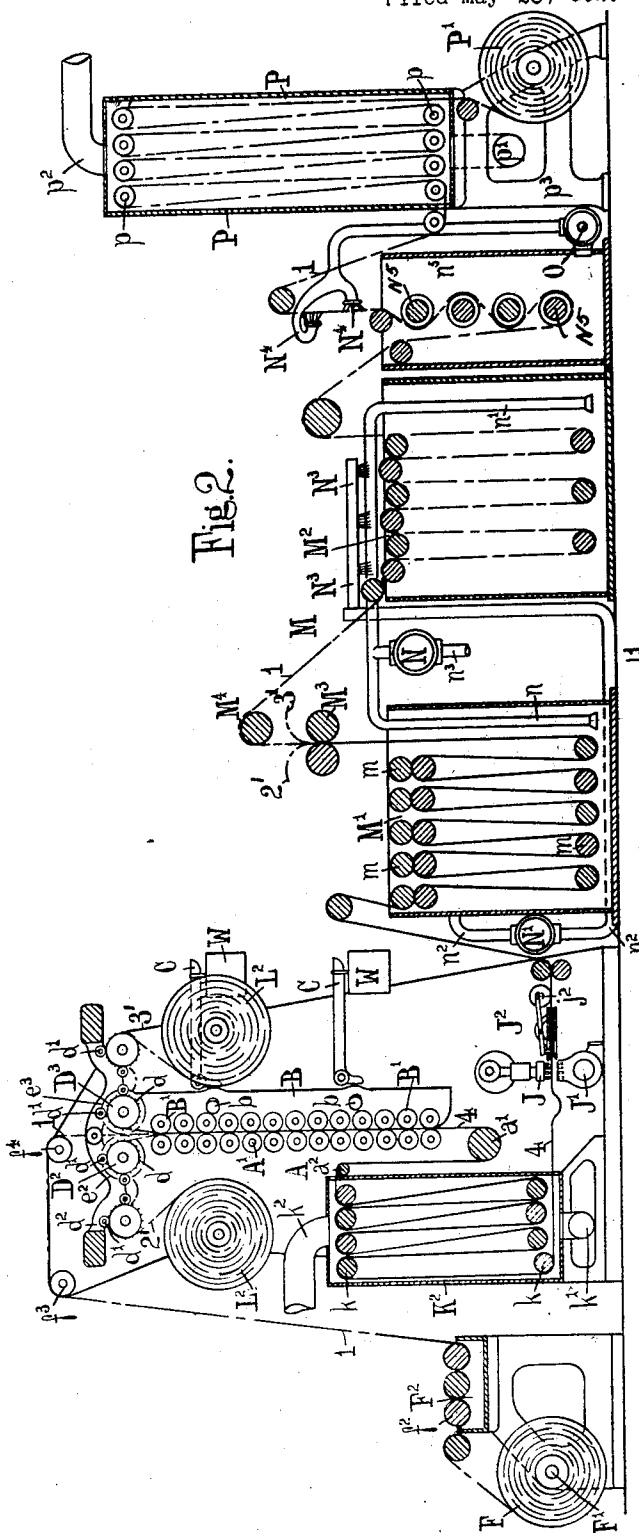


Fig. 2.

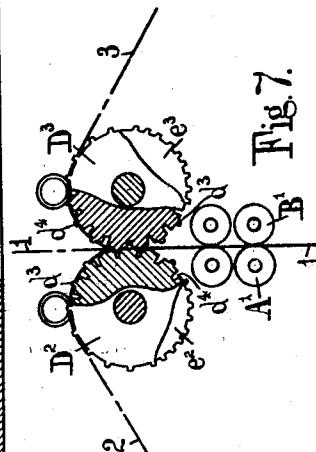


Fig. 7.

INVENTOR.

J. E. Thornton
by *W. C. O'Brien*
att.

Dec. 1, 1931.

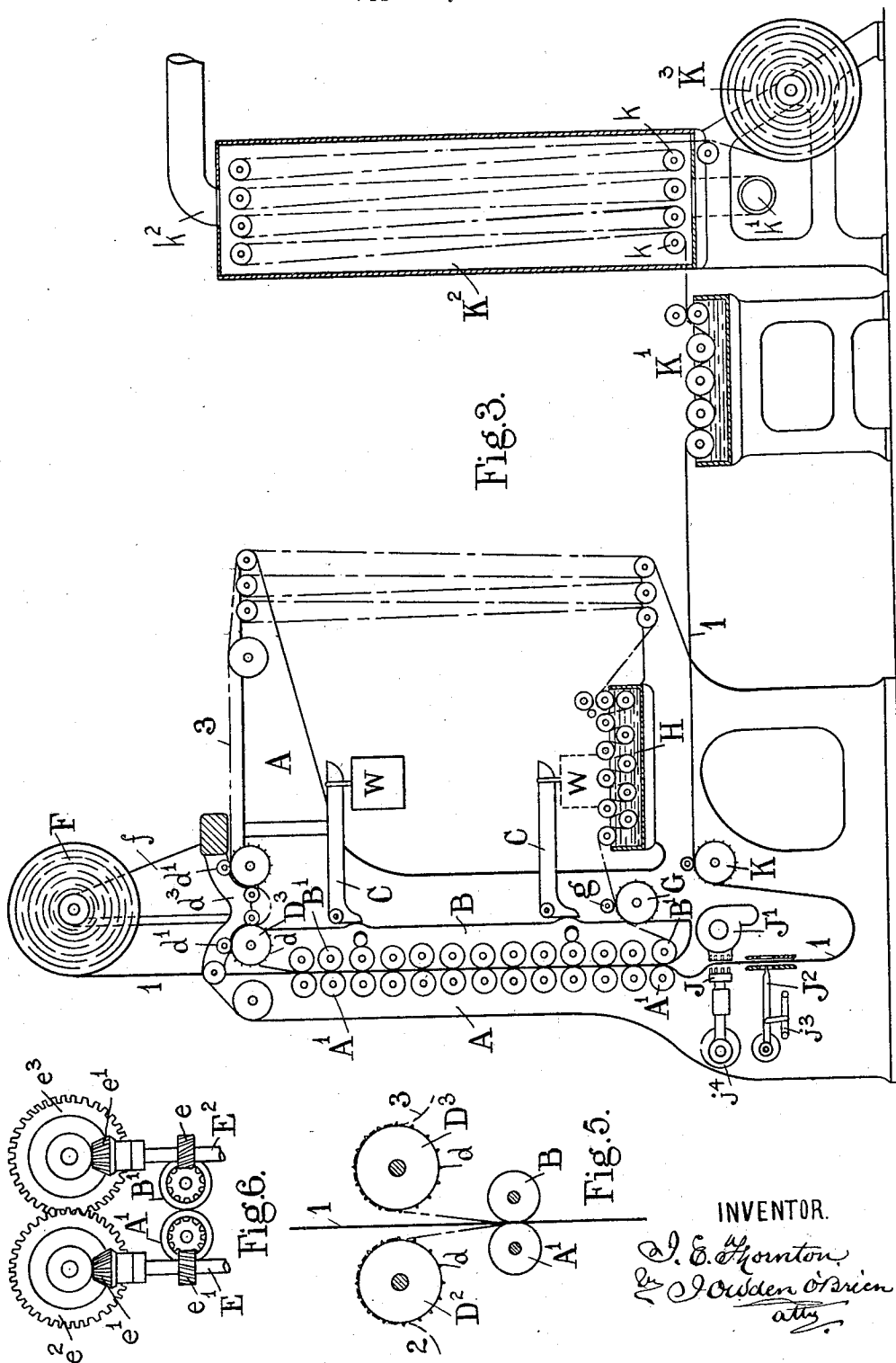
J. E. THORNTON

1,834,355

MACHINE FOR THE PRODUCTION OF CINEMATOGRAPH AND OTHER FILMS

Filed May 28, 1929

4 Sheets-Sheet 3



INVENTOR.

J. E. Thornton
By J. C. O'Brien
att'y.

Dec. 1, 1931.

J. E. THORNTON

1,834,355

MACHINE FOR THE PRODUCTION OF CINEMATOGRAPH AND OTHER FILMS

Filed May 28, 1929

4 Sheets-Sheet 4

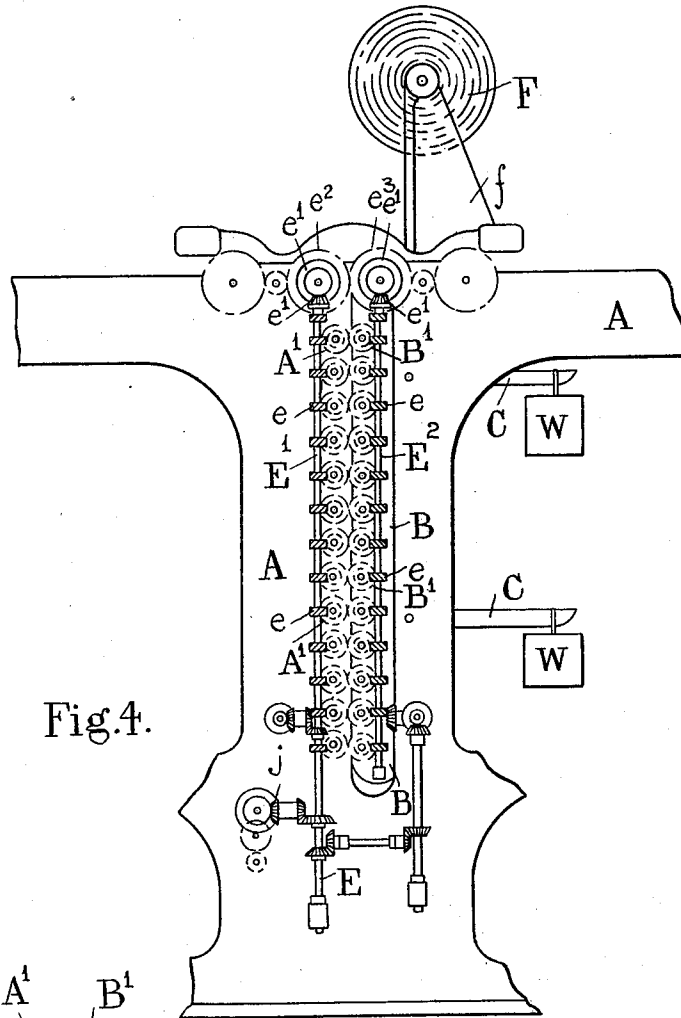
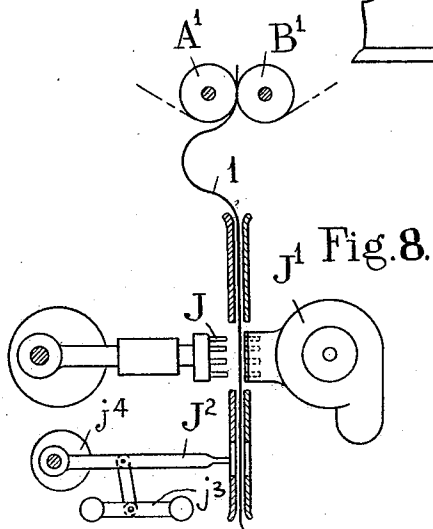


Fig. 4.



J¹ Fig. 8.

INVENTOR.

J. E. Thornton
by *Walden Orsien*
att'y

UNITED STATES PATENT OFFICE

JOHN EDWARD THORNTON, OF ST. BRELADE, JERSEY, CHANNEL ISLANDS

MACHINE FOR THE PRODUCTION OF CINEMATOGRAPH AND OTHER FILMS

Application filed May 28, 1929, Serial No. 366,743, and in Great Britain June 21, 1928.

This invention relates to an improved form of apparatus for impressing and transferring multi-color component images on to cinematographic or other continuous film-strips; for automatically placing such images in accurate register one with the other upon the strip; and for adding a series of traction perforations in the film-strip after the images have been impressed or transferred to and accurately registered upon the film-strip.

It is applicable in the manufacture of film-positives which are produced by photo-mechanical printing from printing belts on to transparent film, such as described in specification Serial No. 354,714.

It is also applicable in the manufacture of film positives which are produced by transferring gelatine relief images from temporary supports of paper on to a permanent support of transparent film, such as described in specification Serial No. 354,715.

In films produced according to the above mentioned specification Serial No. 354,714 by photo-mechanical or imbibition printing processes, the pictures are printed by contact, the prints in both methods of printing being formed on a blank unperforated film strip, and the prints in 354,715 which are formed in sensitized and developed gelatine as reliefs, a number of pictures at a time as a strip, so that a number are in contact and being printed or transferred simultaneously. This renders it impossible when printing to register each picture separately by coincident perforations in both films, as is done when printing sensitized films step by step one picture at a time in the usual way.

The machine according to the present invention for carrying out the printing process necessary for producing the films in the above mentioned specifications comprises the following features in combination:—

(1) A series of pressure rolls carried by a fixed frame and simultaneously driven in unison at the same surface speed by suitable gearing.

(2) A second series of pressure rolls carried by a movable or floating frame in such a manner that each floating roll is opposite

a fixed roll all the floating rolls being driven in unison at the same surface speed by suitable gearing; and also at the same surface speed as the non-floating rolls.

(3) Weighted levers or equivalent devices to press the series of floating rolls against the series of fixed rolls so that uniform pressure contact is maintained against moving films and printing belts passing between the rolls and which may be of variable thickness.

(4) Suitable gearing to connect the driving shaft of the fixed rolls with the driving shaft of the floating rolls to interlock with both and ensure that both sets of rolls rotate in unison without backlash.

When the machine is constructed for producing two-images on opposite sides of a single-width or a double-width film by photo-mechanical or imbibition processes it is also constructed with:—

(5) A pair of registering sprockets placed opposite each other at the entrance to the pressure rollers, these sprockets being inter-gearred or interlocked to rotate in unison without backlash and having their teeth engaging with the registering perforations of the printing belts so that two cliché-images are simultaneously registered exactly opposite each other on opposite sides of the film before passing between the pressure rolls.

In a machine for transferring two colloid images on to opposite sides of a single width unperforated blank film strip from two image carrying bands such as paper or other temporary supports or belts the machine is also provided with:—

(6) Means for supporting, carrying and driving the two rolls of transfer paper;

(7) Means for applying a moistening fluid to both sides of the non-perforated blank film before it enters the pressure rolls.

(8) Means for feeding and passing the multiple cemented strip after leaving the pressing rolls through a drying chamber and/or through developing apparatus.

In all the different forms of the apparatus perforating apparatus may be arranged to perforate the film after leaving the pressure rolls. Where the machine is constructed for transferring two colloid images on to oppo-

site sides of a single width unperforated blank film strip from two temporary paper supports the perforations are made through three thicknesses—one film and two paper—
 5 if perforated immediately after leaving the pressure rolls. This can be avoided if desired by omitting the perforating at this stage and applying visual perforations after development of the film.

10 The invention will be described with reference to the accompanying drawings:—

Fig. 1 is a side elevation of machine for printing simultaneously by photo-mechanical or imbibition process upon opposite sides
 15 of a transparent film a pair of component images of two different colors without sensitizing and without light to produce the film forming the subject of specification Serial No. 354,714.

20 Fig. 2 is a side elevation of machine for the production of a continuous film-positive of two colors by means of a central support of film material on to opposite sides of which component images of different colors are
 25 transferred and cemented from two temporary supports of porous paper or other material to produce the film forming the subject of specification Serial No. 354,715.

30 Fig. 3 is a side elevation of machine for the production of a continuous film positive by photo-mechanical or imbibition printing process on one side of a single-width film or
 printing two component images side by side on one side of a double width film.

35 Fig. 4 is a sectional view of the gearing for the sprocket wheels and pressure rolls applicable to any of the machines shown in Fig. 1, Fig. 2 or Fig. 3.

40 Fig. 5 is a detail view of registering sprocket.

Fig. 6 is a detail view of drive for same.

Fig. 7 is a detail view of a modified form of registering sprockets applicable to either of the machines shown in Fig. 1 or Fig. 2.

45 Fig. 8 is a detail view of perforating mechanism.

The machine shown in Fig. 1 which previously stated is particularly applicable for production of the continuous film strips forming the subject of specification Serial No.
 50 354,714 comprises a fixed frame A carrying a number of rollers A^1 arranged vertically one above the other and a movable or floating frame B carrying a corresponding number of rollers B^1 .

55 The floating frame B is mounted on bearing rods or supports b so that it can move laterally and is controlled by the two pivoted bell crank levers C which carry adjustable weights W to maintain uniform pressure between the rollers A^1 and B^1 even though the film strip
 60 1 and the printing belts 2 and 3 passing between the rollers should vary in thickness which variation might be from $\frac{1}{1000}$ to $\frac{3}{1000}$
 65 of an inch.

Above the top rollers of the series A^1 and B^1 are arranged two sprocket wheels D^2 , D^3 arranged a little distance apart and having their teeth d spaced to correspond exactly with the spacing of the registration perforations in the printing belts 2 and 3. The
 70 printing belts 2 and 3 are held down on to the teeth d of the sprocket wheels D^2 and D^3 by the weighted pivoted levers d^2 and d^3 which carry flanged rollers d^1 the flanges of which
 75 press on to the margin surfaces of the belts between the sprockets thereby holding the belts down to the root of the teeth and keeping them quite taut.

The two sprocket wheels D^2 , D^3 are driven 80 from a common shaft and are geared together by the gear wheels e^2 , e^3 so that the wheels D^2 , D^3 will rotate in unison without there being any backlash between them, thereby procuring the exact register of the two belts 2 and
 85 3 which is necessary for the printing of the two component images on opposite sides of the film 1 so that the two images may exactly coincide on the finished film.

Each of the rollers A^1 and B^1 is also positively driven (see Fig. 4) by skew gearing e
 90 from the vertical shafts E^1 and E^2 . The shaft E^1 is driven through bevel or other suitable gear e^1 from the shaft carrying the sprocket wheel D^2 and the shaft E^2 is driven
 95 by similar gear e^1 from the shaft carrying the sprocket wheel D^3 .

Thus the sprocket wheels D^2 and D^3 and the rollers A^1 and B^1 are all geared together
 100 and are driven at the same surface speed, so that after the belts 1 and 2 have been accurately registered by the sprockets they will remain in such accurate register until they and the film emerge from the last pair of
 105 rollers at the end of the printing operation.

The roll of non-perforated film 1 is carried in an idle spool F mounted on a stand f above the sprockets D^2 and D^3 and is led down
 11 between the sprockets so that the two printing belts 2 and 3 are pressed into contact therewith as the three bands enter the nip of the first pair of rollers A^1 , B^1 .

After emerging from the series of pressure rollers A^1 , B^1 the printing belts 2 and 3 pass over tractor sprocket wheels G being
 115 kept in contact therewith by weighted rollers g and then pass over and under the rollers h of the dyeing apparatus H any or all of which rollers are positively driven. The belt leaves the dyeing apparatus between the rollers h^1 and h^2 which serve to remove the surplus dye from the belt. The belts 2 and
 120 3 then pass up and down over the rollers H^1 before passing back to the sprocket D arranged immediately in front of the corresponding registration sprocket D^2 or D^3 .

The sprocket wheels G, the rollers h of the dyeing apparatus H and the sprockets D are all preferably driven through gearing from the main driving shaft so that they all rotate

in unison with and at the same surface speed as the registration sprockets D^2 and D^3 and the pressing rollers A^1 and B^1 .

The printed film 1 after leaving the last pair of pressing rollers A^1 and B^1 passes through the perforating apparatus J, a loop being formed in the film between the rollers and the perforation to permit of compensations in the positions of the perforations. The perforator J is preferably of the eccentric plunger type driven through gearing j from the shaft E^1 which drives the rollers A^1 . An exhaust fan J^1 may be arranged to remove the perforated pieces and dust from the film.

The positioning of the perforations is governed by the pilot feed claw J^2 which draws the film 1 through the perforator. The feed claw J^2 is reciprocated by the eccentric j^4 driven by gearing from the shaft E^1 and is moved up and down to draw forward the film through the link and lever mechanism j^3 .

After being perforated the film 1 passes over the sprocket K to the finishing bath k^1 where it is treated with hardening, flexing or varnishing agents. The film then passes through the drying chamber k^2 being led up and down therein over the rollers k arranged at the top and bottom. The drying chamber is supplied with hot air which enters at the bottom through the pipe k^1 and after absorbing moisture from the film leaves the chamber through the outlet pipe k^2 at the top of the chamber; or it may enter at the top and exhaust from the bottom.

The finished film after passing through the drying chamber K^2 is finally wound on to the reel or spool K^3 .

A modification of the sprocket registering device for the belts 2 and 3 is shown in Fig. 7 which arrangement is however only applicable where the belts are of greater width than the film 1 and have their perforations in the margins outside the film. In this arrangement the teeth d^3 of one sprocket D^2 fit into holes d^4 in the other sprocket D^3 and the teeth d^3 of the sprocket D^3 fit into holes d^4 in the sprocket D^2 . Therefore each alternate tooth passes through the perforations of both belts, the nonperforated blank film laying between and missed by the teeth. This arrangement ensures accurate register of the two belts, but in many cases is not as convenient an arrangement for obtaining accurate register as the arrangement described above with reference to Fig. 1.

The machine shown in Fig. 3, which is applicable for printing on one side of a single width film or a double width film, is of similar construction to that shown in Fig. 1 with the exception that as there is only one printing belt it is only necessary to provide one dyeing apparatus and one path for the passage of the film back to the feed sprocket D^3 .

When the film is single width only one

dyeing apparatus is used. But where the film is of double width with two rows of images of different color a double-width or duplex dyeing apparatus is used with two sets of rolls for applying dyes of two different colors side by side.

The machine shown in Fig. 2 is constructed for the transfer of two gelatine images from their two perforated supports 2^1 and 3^1 (preferably of porous paper) on to the continuous non-perforated film strip 1. The machine comprises a fixed frame A carrying a number of rollers A^1 arranged vertically one above the other and a movable or floating frame B carrying a corresponding number of rollers B^1 . The floating frame B is mounted on bearing rods or supports b so that it can move laterally and is controlled by the two pivoted bell crank levers C which carry adjustable weights W to maintain pressure between the rollers A^1 and B^1 , even though the film strip 1 and the temporary supports 2^1 and 3^1 passing between the rollers should vary in thickness, which variation might be from $\frac{1}{1000}$ to $\frac{3}{1000}$ of an inch.

Above the top rollers of the series A^1 and B^1 are arranged two sprocket wheels D^2 , D^3 arranged a little distance apart and having their teeth d spaced to correspond exactly with the spacing of the registration perforations in the temporary supports 2^1 and 3^1 . The temporary supports 2 and 3 are held down on to the teeth d of the sprocket wheels D^2 and D^3 by the weighted pivoted levers d^2 and d^3 which carry flanged rollers d^1 the flanges of which press on to the margin surfaces of the supports between the sprockets thereby holding the supports down to the root of the teeth and keeping them quite taut.

The two sprocket wheels D^2 , D^3 are driven from a common shaft and are geared together by the gear wheels e^2 , e^3 so that the wheels D^2 , D^3 will rotate in unison without there being any backlash between them, thereby procuring the exact register of the two supports 2^1 and 3^1 which is necessary for the transfer of the two component images on to the opposite sides of the film 1 so that the two images may exactly coincide on the finished film.

Each of the rollers A^1 and B^1 is also positively driven (see Fig. 4) by skew gearing e from the vertical shafts E^1 and E^2 . The shaft E^1 is driven through bevel, helical or other suitable gear e^1 from the shaft carrying the sprocket wheel D^2 and the shaft E^2 is driven by similar gear e^1 from the shaft carrying the sprocket wheel D^3 . Thus the sprocket wheels D^2 and D^3 and the rollers A^1 and B^1 are all geared together and are driven at the same surface speed so that after the supports 2^1 and 3^1 have been accurately registered by the sprockets they will remain in such accurate register until they and the film

1 emerge from the last pair of rollers at the end of the printing operation.

The non-perforated transparent film 1 which has a dry substratum on each face is drawn off from the roll F carried on the stand F¹ at one side of the machine. The stand F¹ carries a damping trough F² provided with rollers f² around which the film 1 passes to damp the two substratum coatings and render them adhesive. The film 1 passes from the trough F² over guide rollers f³, f⁴ so that it passes down to the nip of the first pair of pressure rollers A¹ and B¹ between the temporary supports 2¹ and 3¹ as the latter leave the registering sprockets D² and D³.

The temporary supports 2¹ and 3¹ are drawn forward off the rolls L² and L³ by the sprockets D² and D³ and as described above are accurately registered upon these sprockets.

The film 1 and the supports 2¹ and 3¹ are squeezed together as they pass down between the pressure rollers A¹ and B¹ so that the dry gelatine images on the supports become firmly cemented to the damp gelatine substratums on the film.

The triple band 4 formed by the two supports 2¹ and 3¹ with the film 1 cemented between them after emerging from the pressing rollers is guided by the guide rollers a¹, a² to the drying chamber K² being led up and down therein over the rollers k arranged at the top and bottom. The drying chamber is supplied with hot air which enters at the bottom through the pipe k¹ and after absorbing moisture from the film leaves the chamber through the outlet pipe k² at the top of the chamber or vice versa.

A perforating apparatus J, preferably of the eccentric plunger type is arranged to perforate the triple band 4 after leaving the drying chamber K². The perforator J preferably works in conjunction with an exhaust fan J¹ which removes the perforated pieces and dust from the film.

The positioning of the perforations is governed by the pilot feed claw J² which draws the band 4 through the perforator. The feed claw J² is reciprocated by the eccentric j² to draw forward the band 4.

If desired the perforating apparatus J may be omitted, in which case however a visual personal control method of perforating must be applied to the finished film after developing and drying.

A developing bath M is arranged to receive the triple band 4 after leaving the perforator J (or after leaving the drying chamber K² if the perforator J is omitted). The developing bath M is of similar construction to the apparatus described in my specification Serial No. 263,853, filed March 22, 1928. It comprises two tanks M¹, M² supplied with hot water from a pump N through pipes n, n¹ the water being exhausted by a

pump N¹ through pipes n², n³. The band 4 passes over a guide roller to the tank M¹ wherein it passes between driven upper rollers m and round idle lower rollers m¹. Most of the soluble colloid is removed from the film in this bath, from which the band passes between rollers M³ and over guide roller M⁴ to the tank M² through which it is similarly driven, and wherein it is treated with hot water by sprays N³ fed from the pump N¹. After leaving the tank M², the band is first passed over rollers N⁵ which guide it between sprays N⁴ by a pump O with hardening and flexing liquids. The temporary supports 2¹ and 3¹ are loosened by the action of the bath M¹ and are stripped off by the guide rollers M³ so that the film 1 alone passes to the second bath M² so that the developing process started in the first bath is completed in the second bath by final removal of all remaining surplus colloid.

A final drying chamber P is arranged to dry the film 1 after it has been developed and treated with hardening, flexing, or varnishing material. The drying chamber P is of similar construction to the chamber K² previously described, being provided with rollers p at the top and bottom over which the film passes and with an inlet p¹ at the bottom for the heated drying air and an outlet p² at the top for the air after it has removed the moisture from the film or vice versa.

The reel P¹ on to which the finished film 1 is wound after leaving the drying chamber P is carried in the same frame P² which supports the chamber P.

Any number of rollers can be employed and if desired these can be carried in a number of separate shorter frames instead of in one long frame as shown, and the machine can therefore be built much higher than shown in the drawings in order to increase the length of travel of the bands under contact.

Although in the preceding description the different forms of the machine are all described with the pressure rollers A¹ and B¹ arranged vertically one above the other, they may if desired be arranged horizontally so that the film and belts or supports travel between them in a horizontal direction the loop carriers being arranged either horizontally or vertically, but preferably vertically as in the drawings.

By duplicating the apparatus by provision of two additional printing belts and an additional set of registering drums, pressure drums, and sprocket drums, all geared up to the first set, so that really two machines are combined into one, it becomes possible to print and accurately register a second pair of images of different colors over and superimposed upon the first pair of images. In this way a picture of four colors can be produced, two component images upon one side,

making four component images in all, and each of a different color.

The first print is made upon a surface of a transparent film which has first been prepared by a suitable coating which when dry will readily absorb or cause to be easily transferred by precipitation or by mechanical transfer alone the inks or dyes from the printing belt on to the film. This may be a dilute solution of cellulose such as cellulose acetate or cellulose nitrate; or it may be mixture of cellulose and colloid, such as cellulose acetate and gelatine in a common solvent; or it may be a simple colloid solution such as gelatine, glue, albumen, or the like, or a mixture thereof; and with either of these solutions is incorporated any suitable agent that will assist the transfer of the colored inks or dyes from printing belt to film, for example in some cases a mordant is used, in others a hardening agent and in others a hygroscopic agent.

In multi-color printing, after the first print has been applied to the film and before the second print is superimposed thereon, a similar coating of the varnish preparation is applied to the film over the first print, thus providing the printed film with a suitable receptive surface to take the second print.

This varnishing layer is applied to the printed film after it leaves the first section of the machine and before it enters the second section, and it may be applied by any suitable known form of coating device, such as a spray, a ductor roller fed from a trough, or an inclined weir supplied by a ductor roller revolving in a trough, or by a slotted tube, or by a slotted trough and a regulating scraper knife, according to the nature and consistency of the varnishing mixture. After receiving this coating the film passes through suitable drying apparatus, such as a blast of heated air or over electrically heated or gas heated or steam heated rolls or flat tables, or through a drying room.

What I claim as my invention and desire to protect by Letters Patent is:—

1. A machine for producing a series of positive images upon a continuous strip of cinematograph or other film by photo-mechanical or imbibition printing, or by transfer of colloid images thereto, from photo-mechanical printing belts or temporary paper supports, comprising in its construction a series of pressure rolls, a stationary frame upon which the pressure rolls are mounted and a shaft and gearing by which the rolls are driven in unison at the same surface speed, a second series of pressure rolls, a movable frame upon which the rolls are mounted arranged with each roll of said second series opposite a roll in the first series and a shaft and gearing for driving the second series of rolls in unison at the same surface speed, weighted levers to press the second series of rolls,

against the first series to give a uniform pressure contact and gearing connecting the driving shaft of the fixed rolls with the driving shaft of the floating rolls, to interlock with both and ensure that both sets of rolls rotate in unison without backlash.

2. A machine for producing a series of positive images upon a continuous strip of cinematograph or other film by photo-mechanical or imbibition printing, or by transfer of colloid images thereto, from photo-mechanical printing belts or temporary paper supports, comprising in its construction a series of pressure rolls, a stationary frame upon which the pressure rolls are mounted and a shaft and gearing by which the rolls are driven in unison at the same surface speed, a second series of pressure rolls, a movable frame upon which the rolls are mounted arranged with each roll of said second series opposite a roll in the first series and a shaft and gearing for driving the second series of rolls in unison at the same surface speed, weighted levers to press the second series of rolls, against the first series to give a uniform pressure contact, gearing connecting the driving shaft of the fixed rolls with the driving shaft of the floating rolls, to interlock with both and ensure that both sets of rolls rotate in unison without backlash, a pair of image carrying bands passing between the two series of rollers a pair of registering sprockets placed opposite each other at the entrance to the pressure rolls, teeth on the sprockets, the teeth engaging with the registering perforations of the pair of the image carrying bands in such a manner that two cliché images are simultaneously registered exactly opposite each other and then squeezed by the rolls against opposite sides of the film.

3. A machine for producing a series of positive images upon a continuous strip of cinematograph or other film by photo-mechanical or imbibition printing, from photo-mechanical printing belts or temporary paper supports, comprising in its construction: a series of pressure rolls, a stationary frame upon which the pressure rolls are mounted and a shaft and gearing by which the rolls are driven in unison at the same surface speed, a second series of pressure rolls, a movable frame upon which the rolls are mounted arranged with each roll of said second series opposite a roll in the first series and a shaft and gearing for driving the second series of rolls in unison at the same surface speed, weighted levers to press the second series of rolls against the first series to give a uniform pressure contact, gearing connecting the driving shaft of the fixed rolls with the driving shaft of the floating rolls to interlock with both and ensure that both sets of rolls rotate in unison without backlash, a pair of perforated image carrying bands passing between the two series of

rollers, a pair of registering sprockets placed opposite each other at the entrance to the pressure rolls and teeth on the sprockets, the teeth engaging with the registering perforations of the pair of the image carrying bands in such manner that two cliché images are simultaneously registered exactly opposite each other and then squeezed by the rolls against opposite sides of the film, a pair of delivery sprockets at the exit from the pressure rolls, gearing for driving the registering and delivery sprockets, a weighted cradle pressing upon each registering sprocket to retain the perforated belts in accurate engagement with the teeth thereof, means for supporting, carrying, and moving the two image carrying bands, means for applying transfer fluid to each image carrying band after it emerges from and before it re-enters the pressure rolls and means for supporting and feeding forward the blank strip.

4. A machine for producing a series of positive images as in claim 3 and means for perforating the film with a series of traction perforations.

5. A machine for producing a series of positive images as in claim 3 with means for perforating the film with a series of traction perforations, a drying chamber through which the film is passed, an air inlet and outlet to the chamber, means for feeding and passing the printed film through the chamber and means for reeling the strip on emerging therefrom.

6. A machine for producing a series of positive images as in claim 3 with means for perforating the film with a series of traction perforations, a drying chamber through which the film is passed, an air inlet and outlet to the chamber, means for feeding and passing the printed film through the chamber, means for reeling the strip on emerging therefrom, and means for coating, varnishing and otherwise treating the strip during its passage from the machine to the drying chamber.

7. A machine for producing a series of positive images upon a continuous strip of cinematograph or other film by photo-mechanical or imbibition printing, or by transfer of colloid images thereto, from photo-mechanical printing belts or temporary paper supports, comprising in its construction a series of pressure rolls, a stationary frame upon which the pressure rolls are mounted and a shaft and gearing by which the rolls are driven in unison at the same surface speed, a second series of pressure rolls, a movable frame upon which the rolls are mounted arranged with each roll of said second series opposite, a roll in the first series and a shaft and gearing for driving the second series of rolls in unison at the same surface speed, weighted levers to press the second series of rolls, against the first series to give a uniform pressure

contact, gearing connecting the driving shaft of the fixed rolls with the driving shaft of the floating rolls, and a pair of perforated image carrying bands of greater width than the film strip passing between the two series of rollers.

In testimony whereof I have hereunto set my hand.

JOHN EDWARD THORNTON.

75

80

85

90

95

100

105

110

115

120

125

130