

June 27, 1933.

J. E. THORNTON

1,915,560

MACHINE FOR THE PRODUCTION OF CINEMATOGRAF AND OTHER FILMS

Original Filed May 28, 1929

2 Sheets-Sheet 1

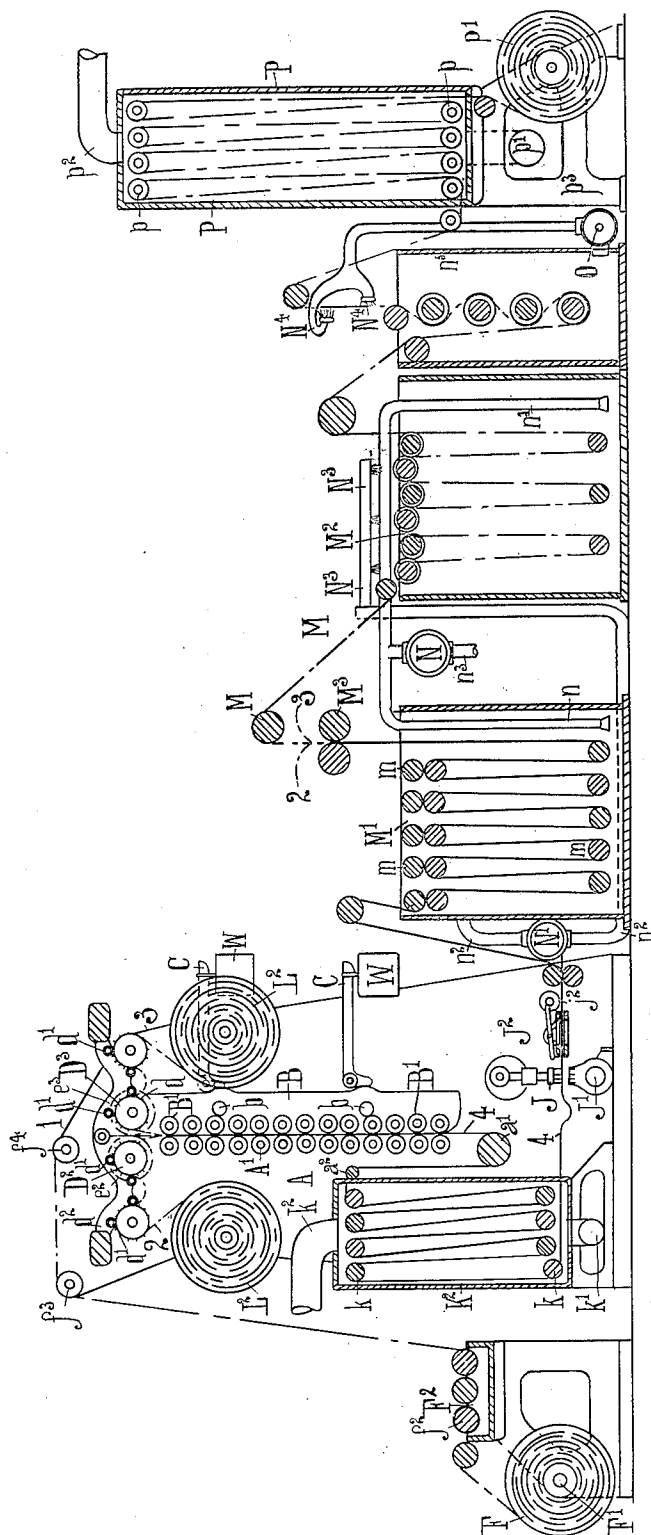


Fig. 1.

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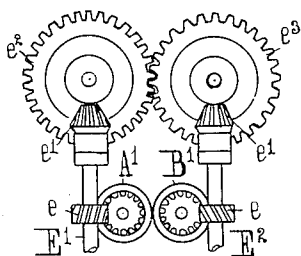


Fig. 2.

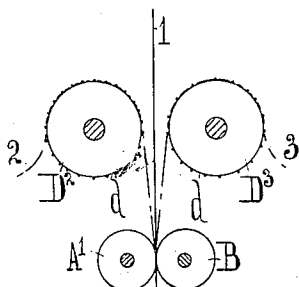


Fig. 3.

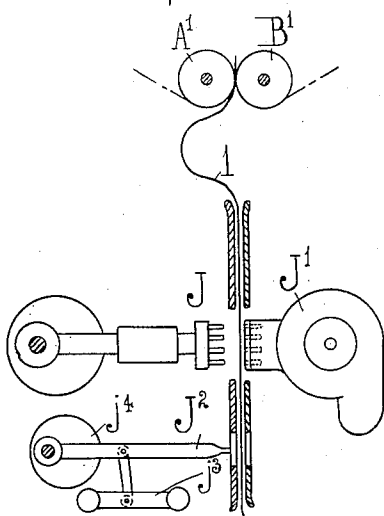


Fig. 6.

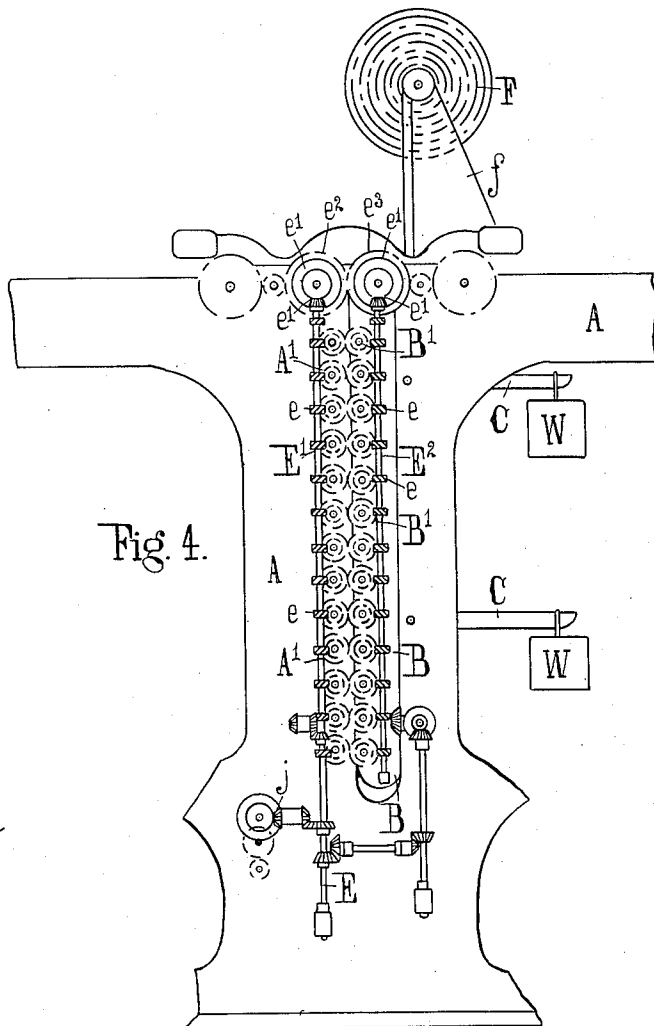


Fig. 4.

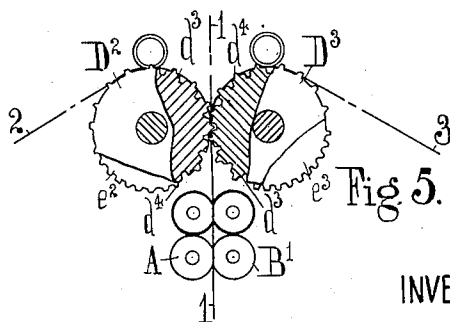


Fig. 5.

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MACHINE FOR THE PRODUCTION OF CINEMATOGRAPH AND OTHER FILMS

Original application filed May 28, 1929, Serial No. 366,743, and in Great Britain June 21, 1928. Divided and this application filed September 22, 1931. Serial No. 564,360.

This invention relates to an improved form of apparatus for transferring printed and insolublized colloid multi-color component images on to cinematographic or other continuous film-strips; for automatically placing and cementing such images on to the film strip in accurate register one with the other; and for adding a series of traction perforations in the film-strip in accurate relation to each image of the series after the images have been transferred to and accurately registered upon the film-strip, and is a division of application Serial No. 366,743 filed May 28, 1929, upon which Patent No. 1,834,355 dated December 1, 1931, has been granted.

It is applicable in the manufacture of film-positives which are produced by transferring photographically printed and insolublized gelatine images from temporary supports of paper on to a permanent support of transparent film and then developing the transferred images into gelatine reliefs on the film, such as described in my Patent No. 1,873,674, dated August 23, 1932 and in my application Serial No. 564,359 filed September 22, 1931.

In films produced according to the above mentioned specifications the prints are made in sensitized gelatine, which is formed upon porous paper supports which are provided with registration perforations, before the images are printed or formed thereon. These paper supports are of a temporary character only. After printing, and before development, the printed images are cemented to a permanent transparent support of film-material, such as celluloid or the like, which has been prepared with an adhesive upon both opposite sides.

Accurate registration of the two printed and insolublized colloid images one with the other, and with their printed sides in contact with opposite sides of the transparent film, and also the cementing of their printed sides to the film, and the final development of the images into gelatine reliefs, and the subsequent treatment and finishing of such relief images, is carried out by the apparatus forming the subject of this invention and hereinafter described.

After the prints have been cemented to the transparent support in accurate registration, each image of a pair exactly opposite the other image of the same pair, the combined strip is dried to complete the adhesion, and is then passed through hot water baths, by which the non-hardened portions of the gelatine are dissolved; this enables the two temporary paper strips to be loosened, detached, and removed, leaving the hardened gelatine images upon the transparent film and firmly attached thereto; continued application of the hot water develops the images (which have been previously converted into hardened gelatine by the printing process) into relief images, and finally removes all surplus soft gelatine not required in the images.

The machine according to the present invention for carrying out the above described processes necessary for producing the films according to 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 the moving film and the two image-carrying paper strips 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.

(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 image-carrying paper strips so that both the images of a component pair are simultaneously re-registered exactly opposite each other on opposite sides of the film before passing between the pressure rolls.

(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.

The perforating apparatus is arranged to automatically perforate the film immediately after leaving the pressure rolls and is geared to exactly synchronize with the feeding and registering devices. Where the machine is constructed for transferring two colloid images on to opposite 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—if perforated immediately after leaving the pressure rolls. But, if desired, automatic perforation at this stage may be omitted, and instead visually controlled perforation after development of the film may be substituted.

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

Fig. 1 is a side elevation of the machine for the production of a continuous film-positive of two colors by means of a central support of adhesive film material on to opposite sides of which component images of different colors are 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.

Fig. 2 is a sectional view of the gearing for the sprocket wheels and pressure rolls.

Fig. 3 is a detail view of registering sprocket.

Fig. 4 is a detail view of drive for same.

Fig. 5 is a detail view of a modified form of registering sprockets.

Fig. 6 is a detail view of perforating mechanism.

The machine shown in Fig. 1 is constructed for the transfer of two printed and insolubilized gelatine images from their two perforated supports 2¹ and 3¹ of porous paper on to the continuous non-perforated film strip 1. The machine comprises a fixed frame A carrying a number of rollers A¹ arranged vertically one above the other and a movable or floating frame B carrying a corresponding number of rollers B¹. The floating frame B is mounted on bearings rods or support b so that it can move laterally and is con-

trolled by the two pivoted bell crank levers C which carry adjustable weights W to maintain pressure between the rollers A¹ and B¹, even though the film strip 1 and the temporary supports 2¹ and 3¹ passing between the rollers should vary in thickness, which variation might be from 1/1000 to 3/1000 of an inch.

Above the top rollers of the series A¹ and B¹ are arranged two sprocket wheels D², D³ 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 2¹ and 3¹. The temporary supports 2 and 3 are held down on to the teeth *d* of the sprocket wheels D² and D³ 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 D², D³ are driven from a common shaft and are geared together by the gear wheels *e*², *e*³ so that the wheel D², D³ will rotate in unison without there being any backlash between them, thereby procuring the exact register of the two supports 2¹ and 3¹ which is necessary for the transfer of the two component images on to opposite sides of the film 1 so that the two images may exactly coincide on the finished film.

Each of the rollers A¹ and B¹ is also positively driven (see Fig. 2) by skew gearing *e* from the vertical shafts E¹ and E². The shaft E¹ is driven through bevel, helical or other suitable gear *e*¹ from the shaft carrying the sprocket wheel D² and the shaft E² is driven by similar gear *e*¹ from the shaft carrying the sprocket wheel D³.

Thus the sprocket wheels D² and D³ and the rollers A¹ and B¹ are all geared together and are driven at the same surface speed so that after the supports 2¹ and 3¹ 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 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 *f*² around which the film 1 passes to damp the two substratum castings and render them adhesive. The film 1 passes from the trough F² over guide rollers *f*³, *f*⁴ so that it passes down to the nip of the first pair of pressure rollers A¹ and B¹ between the temporary supports 2 and 3 as the latter leave the registering sprockets D² and D³.

The temporary supports 2¹ and 3¹ are

drawn forward off the rolls L^2 and L^3 by sprockets D^2 and D^3 and as described above are accurately registered upon these sprockets.

5 The film 1 and the supports 2^1 and 3^1 are squeezed together as they pass down between the pressure rollers A^1 and B^1 so that the dry gelatine images on the supports become firmly cemented to the damp gelatine substratums
10 on the film.

The triple band 4 formed by the two supports 2^1 and 3^1 with the film 1 cemented between them after emerging from the pressing rollers is guided by the guide rollers a^1 ,
15 a^2 to 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
20 moisture from the film leaves the chamber through the outlet pipe k^2 at the top of the chamber or vice versa.

The printed film 1 of insolublized images after leaving the last pair of pressing rollers
25 A^1 and B^1 passes through the perforating apparatus J, a loop being formed in the film between the rollers and the perforator to permit of compensations in the positions of the perforations. The perforator J is preferably of the eccentric plunger type (though it
30 may be of any other type) driven through gearing j from the shaft E^1 which drives the rollers A^1 and in such manner that the perforating apparatus exactly synchronizes
35 with the feeding and registering apparatus. 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
40 the band 4 through the perforator and as already stated works in synchronization with the registering apparatus. The feed claw J^2 is reciprocated by the eccentric j^4 driven by gearing from the shaft E^1 and is moved up
45 and down to draw forward the film through the link and lever mechanism j^3 .

If desired the perforating apparatus J may be omitted, in which case however a visual
50 personal control method of perforating must be applied to the finished film after developing and drying, for example it may be as described and illustrated in my Patent No. 1,169,097 dated January 18, 1916.

A developing bath M is arranged to receive
55 the triple band 4 after leaving the perforator J (or after leaving the drying chamber K^2 if the perforator J is omitted). The developing bath M is of similar construction to the apparatus described in my specification
60 Serial No. 263,853 filed March 22, 1928, upon which Patent No. 1,736,557 dated November 19, 1929, has been granted. It comprises two tanks M^1 , M^2 supplied with hot water from a pump N through pipes n , n^1 the water being
65 exhausted by a pump N^1 through pipes n^2 ,

n^3 . The band 4 passes over a guide roller to the tank M^1 wherein it passes between driven upper rollers m and round idle lower rollers m^1 . Most of the soluble colloid is removed
70 from the film in this bath, from which the band passes between rollers m^3 and over guide roller M^4 to the tank M^2 , through which it is similarly driven and wherein it is treated with hot water by sprays N^3 fed from the pump N^1 . After leaving the tank M^2 , the
75 band is first passed over rollers M^3 which guide it between sprays N^4 for treatment by a pump O with hardening and flexing liquids. The temporary supports 2 and 3 are loosened by the action of the bath M^1 and are stripped
80 off by the guide rollers M^3 , and the film 1 alone passes to the second bath M^2 , so that the developing process started in the first bath is completed in the second bath by final removal of all remaining surplus colloid.
85

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 K^2 previously
90 described, being provided with rollers p at the top and bottom over which the film passes and with an inlet p^1 at the bottom for the heated drying air and an outlet p^2 at the top for the air after it has removed the moisture
95 from the film or vice versa.

The finished film after passing through the drying chamber P is finally wound on to the reel or spool P^1 .

The reel P^1 on to which the finish film 1
100 is wound after leaving the drying chamber P is carried in the same frame P^2 which supports the chamber P.

Any number of pressure rollers can be employed, and if desired, in order to increase
105 the length of travel of the bands under contact, these can be carried in a number of separate shorter frames instead of in one long frame as shown, or the machine can be built much higher than shown in the drawings.
110

Although the pressure rollers A^1 and B^1 are hereinbefore described as being arranged vertically one above the other, they may if
115 desired be arranged horizontally, so that the film and image-carrying paper strips travel between them in a horizontal direction, the loop carriers being arranged either horizontally or vertically but preferably vertically as in the drawings.

Instead of transferring two images on to
120 opposite sides of a single-width film as hereinbefore described, it may be desired, in some modifications of processes, to transfer two images side by side on to a double width film, or one image on to a single-width film. The
125 apparatus in such cases would be the same as described but with only one supply spool for only one strip of image-carrying porous paper.

Similar apparatus is used when it is desired 130

to transfer two images (one on top of the other), by a further operation, upon either a single width or double-width strip of film, for the production of three and four color pictures.

A modification of the sprocket registering device for the belts 2 and 3 is shown in Fig. 5 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 non-perforated blank film lying 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.

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

1. In a machine for simultaneously transferring a pair of photographic colloid images from a pair of porous paper temporary supports on to a cinematograph film by pressure contact, the combination with two series of pressure rolls between which the triple band passes, a stationary frame upon which one series of the pressure rolls are mounted, a movable frame upon which the second series of rolls are mounted and shafts and gearing for driving the two series of rolls in unison, of a developing bath through which the triple band passes on emerging from the rolls and by which the porous paper supports are loosened from the film, stripping rollers to finally remove the paper supports, a further bath to complete the development of the film and a drying chamber to dry the completed film.

2. A machine as in claim 1 having a drying chamber for drying the combined bands immediately after they leave the pressure

rolls to complete the adhesion of the colloid images to the adhesive transparent film strip.

3. A machine as in claim 1 having mechanism for registering, and mechanism for perforating the transparent film strip after the colloid images have been adhered thereto, the perforating mechanism being coupled with the registration mechanism in such manner that these two portions of the mechanism operate in unison, the positions of the perforations in relation to the positions of each picture of the film being always the same.

4. A machine as in claim 1 having a tank and sprays for treating the developed film with hardening and fixing liquid.

5. A machine as in claim 1 having a tank and sprays for treating the developed film with hardening and fixing liquid, and a reel upon which the film is wound.

6. A machine as in claim 1 having means for making prolonged contact between the perforated image-carrying bands and the non-perforated film strip to ensure adhesion of the two series of colloid images on to the two opposite sides of the film strip.

7. A machine as in claim 1 having gearing between the perforating and registering apparatus.

8. A machine as in claim 1 having teeth on the sprockets by which the image-carrying bands are registered to rotate in unison without backlash, the teeth thereof engaging the perforations of the image-carrying bands in such a manner that the two images of each pair are simultaneously registered exactly opposite each other.

9. A machine as in claim 1 in which the non-perforated substratumed bare film is carried on a roller frame from which it is fed between the two series of pressure rollers.

10. A machine as in claim 1 having means for applying moistening fluid to both sides of the non-perforated blank film before entering the pressure rolls.

In testimony whereof I have hereunto set my hand.

JOHN EDWARD THORNTON.