April 2, 1929. L. T. TROLAND 1,707,695

SUCTION APPARATUS FOR IMBIBITION PRINTING

Filed May 27, 1927 2 Sheets-Sheet 1

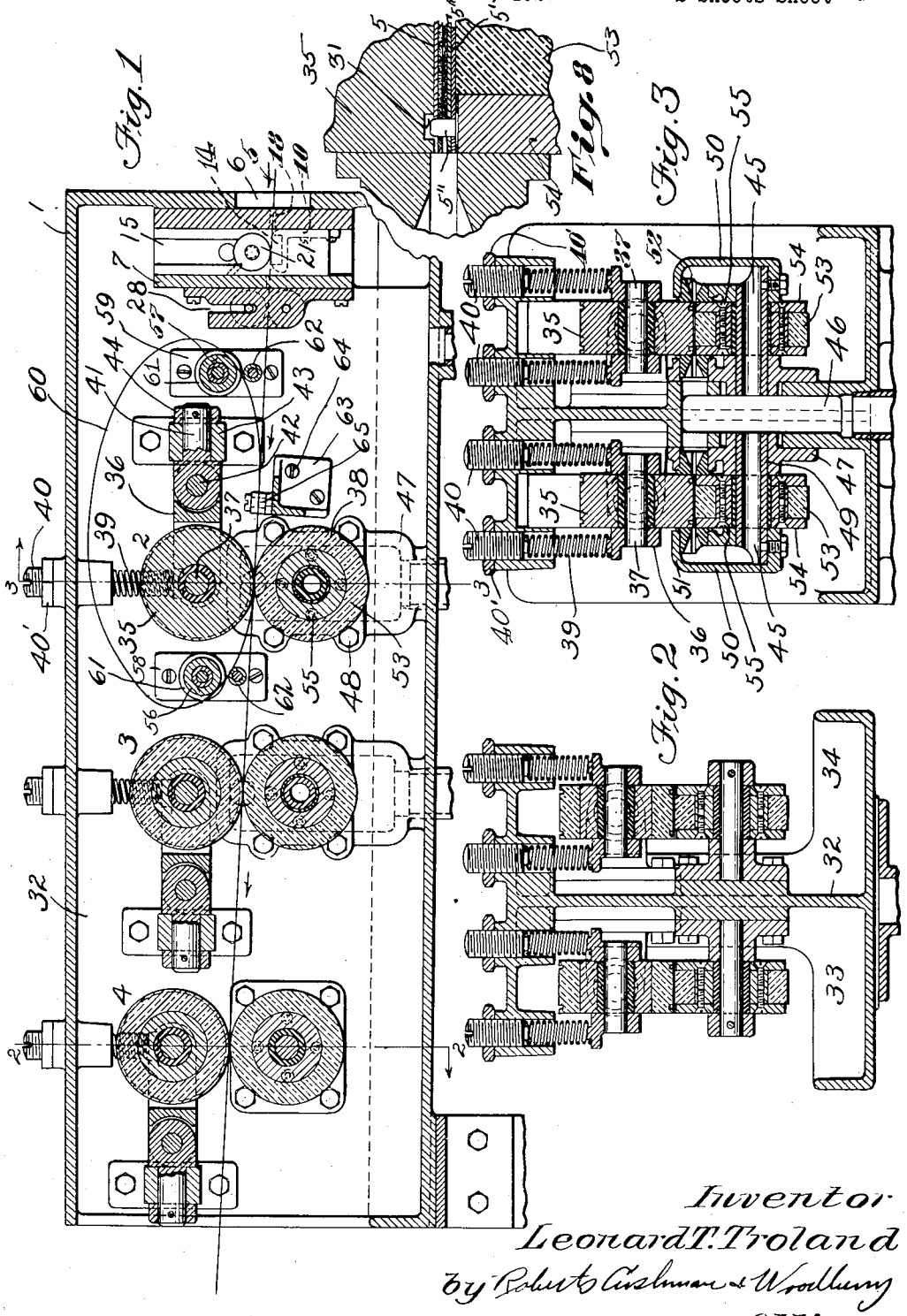

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Fig. 4

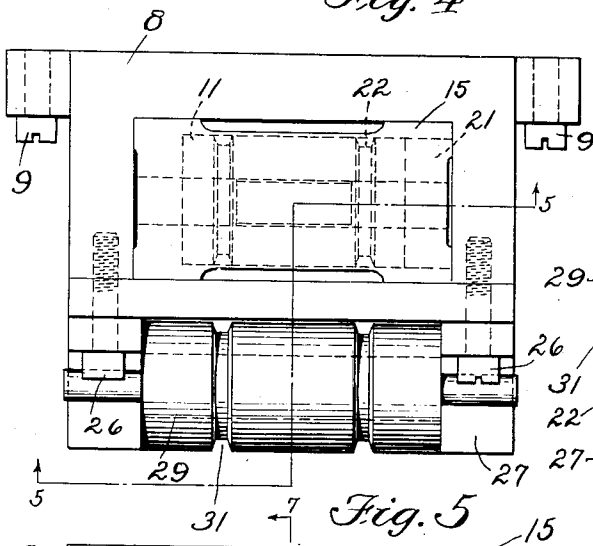


Fig. 6

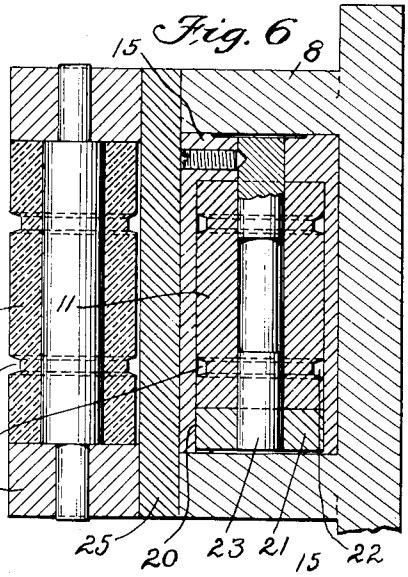


Fig. 5

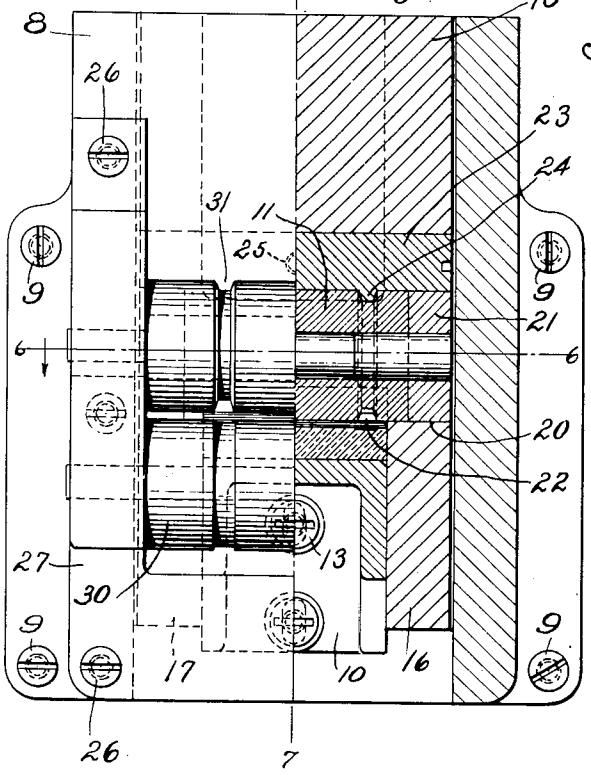
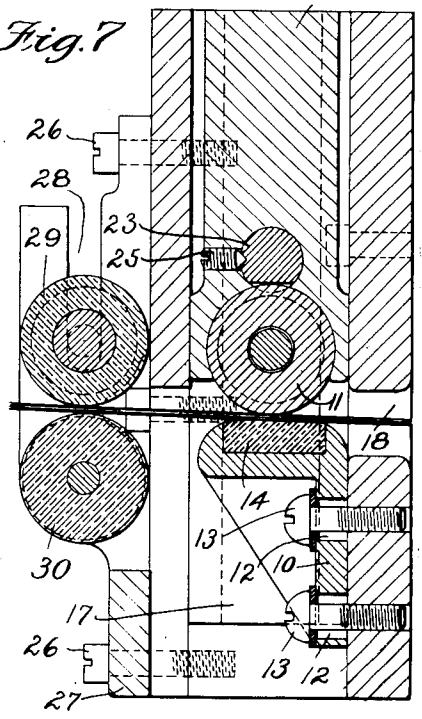


Fig. 7



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Patented Apr. 2, 1929. 1,707,695

UNITED STATES PATENT OFFICE.

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

SUCTION APPARATUS FOR IMBIBITION PRINTING.

Application filed May 27, 1927. Serial No. 194,671.

This invention relates to the production of cinematographic films by imbibition printing and more especially to a method and means for effecting uniform and intimate pressure contact between the printing surfaces.

In the production of films by imbibition, wherein a series of images are continuously transposed from a matrix film to a blank film, both strips (subsequent to the application of dye to the matrix film) may be brought into contact while immersed in a liquid bath and the contact maintained until the blank film absorbs the dye from the matrix in proportion to the amount present on the developed or relief portions of the matrix, thus producing a transferred picture.

One of the principal defects of this method is the difficulty of obtaining a definition in the transfer as good as that which exists in the matrix. Diffusion of dye tends to take place from regions of high density in the transfer to regions of low density and consequently will result in blurred edges on the images unless distribution of this amount of dye over the whole area of the blank is determined by the contour and distribution of dye in the matrix. This tendency of diffusion constantly exists in the transfer as long as the films are wet and is always in the direction of producing a uniform deposit of color all over the transfer. Because portions of the matrix which contain the most dye are thicker than those containing less dye, portions of the blank lying underneath the thick parts of the matrix are subjected to heavier pressure when passing between the pressure rolls, and for this reason are thinned out or not permitted to swell and absorb the dye.

It is therefore an object of this invention to reduce or entirely overcome such tendency toward lateral diffusion of the dye and to provide suitable conditions for the dye upon the matrix to be transfused by imbibition directly across the interface and into the surface of the film blank to be printed. It is also an object to facilitate the complete or substantially complete transfusion of all of the dye in the matrix film in this manner to or into the blank. Other objects will appear from the following disclosure.

In the procedure of the present invention the matrix film is first permitted to absorb the necessary amount of dye (e. g. in accordance with the contour and/or development of the image reliefs thereon). Both the matrix film and blank are then wet with water and preferably brought into registry and surface contact while submerged therein, after which all superfluous water present between the film strips is removed by suction (with or without pressure) so that the films may form an intimate face contact and the blank film is in suitable condition to absorb the proper amount (usually all) of the dye directly from the matrix, without lateral diffusion and blurred definition.

The apparatus of the invention includes, in association with known means for dyeing, wetting, registering and contacting the matrix and blank films (see copending applications of William E. Whitney and Daniel F. Comstock, Serial No. 194,640, filed May 27, 1927, and Serial No. 194,641, filed May 27, 1927), means for compressing the contacting films more firmly together (and to a backing strip if used) through a line of contact or compression transversely of the film, and means for advancing such line of contact or compression continuously longitudinally of the film. Means also are provided adjacent the margins of the films, at the ends of such line of compression and slightly in advance thereof, for withdrawing superfluous water from between the compressing surfaces of the film and away from the lateral margins and sprocket holes, simultaneously with the closest contact or maximum degree of pressure or just before or just after this point is reached. It may be advantageous that such means for the withdrawal of the intervening film of water shall be effective both at and beyond the line of greatest compression to remove any water which may be liberated upon the release of pressure.

One typical embodiment of the invention is illustrated by the accompanying drawings, in which

Fig. 1 is a longitudinal vertical section of a water-removing chamber;

Fig. 2 is a cross section on line 2—2 of Fig. 1;

Fig. 3 is a cross section on line 3—3 of Fig. 1;

Fig. 4 is a plan view of the water gate attached to the chamber;

Fig. 5 is a view in elevation of the water gate, partly in section on line 5—5 of Fig. 4;

Fig. 6 is a view on line 6—6 of Fig. 5;
Fig. 7 is a view on line 7—7 of Fig. 5; and
Fig. 8 is an enlarged detail of the suction part of Fig. 3.

Referring to the drawing, numeral 1 denotes a tank or framework in which there is mounted a series of paired presser rolls 2, 3 and 4, through which the composite strip 5, consisting, for example, of the matrix and the blank film to be printed, carried on a flexible registering belt, as hereinafter to be described and as more fully disclosed in said Comstock application. One end of this chamber may be supported upon a stationary support, preferably a part of the machine frame, and the other end attached to a water chamber wherein the film and matrix may be brought into contact while submerged in an appropriate liquid, such as water. (See co-pending patent of Melvin G. Young, No. 1,675,743 granted July 3, 1928.) The water clinging to or concealed between the film strips is removed as they traverse this unit of the apparatus, and the films acquire a pressure contact relationship. This is maintained by engagement with the registering belt or backing strip with and an effectively adhesive contact between the two films. In order to allow egress of the strips from the water chamber, it is ported at 6 and provided with a water gate 7, whereby the water is prevented from escaping from the chamber with the strips. A very efficient water gate for this purpose comprises a hollow frame 8 (see Figs. 4–7) secured to the chamber by bolts 9 and carrying thereon a bracket arm 10 against the upper surface of which a movable roll 11 is mounted, adjacent to the port 6. The bracket arm is adjustably mounted upon the hollow frame by means of apertures 12 in the arm 10 and frame 8 through which bolts 13 extend, the apertures being enlarged to provide for properly positioning the arm under the path of the strips as they pass through the port 6. At the point where the roll 11 presses against the arm 10, the latter is recessed to seat some resilient material 14, such as rubber. As the composite strip passes between the roller and the upper surface of the rubber, the latter bears against the strip 5 and effectively seals the passage therebeneath. In the upper part of the frame member a sliding block 15 is inserted having downwardly extending side projections 16 and 17 for filling in on each side of the bracket arm 10 (Fig. 5). Opposing apertures 18 are provided in the frame 8, through which the strips travel to and between the bracket arm and roller 11. This roller is inserted within the retaining block between side projections 16 and 17 through an opening 20 in the side projection 16 (Fig. 5) where it is loosely retained in place, the opening being closed by a thrust washer 21. It is necessary to provide annular grooves 22 adjacent to the ends of the roller to accommodate the sprocket teeth on the carrier belt, as later to be described. In order to prevent any water from escaping by way of these grooves a bar 23 is fitted into the retaining block 15 just above the roller, carrying projecting flanges 24 of similar conformation to the grooves 22, in order to extend therein and close them, the bar being retained in place by holding screw 25.

There is fastened exteriorly on the water gate by bolts 26 a support 27 having two spaced projections slotted at 28 for journaling between them a trunnioned roller 29 in superposition to a fixed roller 30, the bight of said rollers being positioned in the path of the strips and arranged to receive the latter therebetween. The webs and peripheries of both of these rolls are preferably constructed of some such material as rubber with the upper gravity roll grooved at 31 similar to roller 11 to avoid interfering with the sprocket teeth on the flexible belt.

It will be understood as has been clearly set forth in the Comstock application above referred to that two machines, for example, one providing the red aspect and the other supplying the green aspect of the picture to be printed, may be arranged in substantially parallel relation. For this purpose they may be arranged in duplicate units 33 and 34 divided by a wall 32, as shown in Figs. 2 and 3. Each unit may be equipped with a series of paired rolls; though one water gate may be constructed to accommodate both compartments; or separate gates of like construction may be mounted in the complemental unit.

The pair of rollers 2 are superposed with the upper roller 35 being mounted on arm 36 by journal 37, and actuated against the fixed roller 38 by springs 39 compressed between the arm and adjusting screws 40 in the top of the chamber, the screws being retained by lock nuts 40′. Arm 36 preferably is loosely pivoted to a link 41, one end of which carries an eye through which the pivotal bolt 42 is inserted and the other end rotatably engages a fixed bracket 43 on the chamber wall and retained therein by collar 44.

The lower roller, as 38, is mounted in fixed position on the wall 32 and may be so constructed and arranged that a suction line 45 can be directed to both edges of the film strip as they pass between the pairs of rolls 2 and 3. At the point where the rolls are mounted in the chamber the wall 32 is widened and hollowed to provide a chamber 46 (Fig. 3) and to the side of this chamber a bracket 47 carrying the fixed pulley is fastened by bolts 48. Journal 49 upon which the fixed pulley rotates is hollow and extends through the pulley and bracket to communicate at one end with the chamber 46 in the dividing wall and at the other to be extended by means of a closure cap 50 which is flanged at 51 to fit

over the end of journal member 49 and outlet nozzles 52 adjacent to the nip of the rollers, to form a continued passage to the roller periphery whereby suction can be directed to the edge of the film strips. Preferably the fixed roller is faced with a rubber ring 53, which may be somewhat raised in the center, secured between the side plates 54. The latter are clamped to the pulley by bolts 55.

Additional idlers 56 and 57 are mounted on the wall by brackets 58 and 59 and carry a belt 60 to cooperate with the presser rolls for squeezing out the water from between the strips. These idlers are grooved at 61 and the belt guided in the grooves by guide rolls 62 which are mounted on the brackets in proximity to the idlers. Another bracket 63 is attached upon the wall by screws 64 and carries rollers 65 provided to engage opposite edges of the strips and retain them in proper position.

The pairs of pressure rolls 3 and 4, which are constructed similar to the pair of rollers 2 already described, are mounted in the trace of the movable rolls 2. They are likewise provided with rubber faces but the additional flexible belt need not be employed, and the suction pipe may or may not be connected therewith. However, the suction and flexible belt, or either, can be added or eliminated from any pair of the rollers as conditions may require.

The composite strip 5 is made up of a backing or conveyor strip 5′, (Fig. 8), preferably made of a flexible, resilient metal of sufficient strength and rigidity to preserve its dimensions, such as thin steel, having engaging means thereon at uniformly spaced intervals, such as the pins 5″ which are adapted to be received in the lateral rows of sprocket holes (as usually provided) in the matrix film 5‴ and blank film 5⁗.

In operation, the matrix film 5‴ and blank film 5⁗ are brought into registry with each other and with the pins 5″,—over which the sprocket holes of the films fit,—and the film surfaces intimately contacted while submerged in a liquid such as water. (See said copending Young patent.) The composite strip then passes through the port 6 and water gate 7.

The teeth 5″ pass through the grooves 31 while the blank film 5⁗ is pressed firmly downward against matrix film 5‴ and both against the backing 5′ which is sustained by the resilient rubber pad 14 (see Figs. 1 and 7). Loss of water through grooves 31 is prevented by the lugs 24 which fit therein at the upper part of their revolution (Fig. 5). The strip is next received between rollers 29 and 30 and passes therebetween in a similar manner but without necessity of restraining liquids as in the water gate. The strip then passes, with backing strip on the bottom, with pins extending upwardly and with the matrix film and blank film superposed thereon, to the rollers 2. Before passing between rollers 35, 38, the band 60 is received between the rows of pins 5″ and advances with the film strip 5, gradually pressing against the film blank 5⁗. The band 60 continues with the film strip and passes between the rolls therewith. The pins 5″ pass through the grooves in roller 35 (similar to grooves 31) while the band 60 is urged downwardly against the central part of the blank film 5⁗ and firmly over the pins 5″, the sides of which are firmly bound by the sprocket holes in the film, as the band 60 is forced downwardly by the rollers, thus pressing it into intimate contact with the matrix film 5‴ and this in turn against the backing strip 5′. This contact or compression between the rolls is transmitted in a line or zone of the film running transversely of the strip, and this pressure zone progresses longitudinally of the films, as the composite strip is drawn through the rollers in the direction of the arrows. Suction is also established through the pipe lines 46, 45 and thence through nozzles 52 to the opposite edges of strip 5, adjacent to the ends of the line of compression (and preferably also before and behind this point) of sufficient force to rapidly and completely remove all extraneous moisture which may tend to accumulate at these points. In this manner, not only is the moisture promptly and completely expelled from between the films and removed, but water retained between the films in the sprocket holes of the films or elsewhere in the adjacent parts of the apparatus is likewise withdrawn. Thus the films are brought into such intimate contact that subsequent slippage or parting of the contacting surfaces is effectively prevented. At the same time, as the line of contact of the films advances along the length of the strip, the water on the films and between them may tend to spread rearwardly and thus to wet the succeeding film surfaces equally, in case any accidental dry spots may have been produced as by an occasional air bubble or the like.

The films, as thus intimately and firmly contacted with each other under uniform pressure, are in an especially suitable relationship for the imbibition transfer of the dye from the matrix film to the blank film. Moreover, they tend to retain such association, due probably to the minute dimension of the thickness of the interface and possibly also to cohesion between the two gelatine surfaces. The preservation of this firm surface contact is still further assured by the close fitting of the pins 5″ in the sprocket holes of the films and their parallel disposition with respect to each other.

The thus contacted films may now pass between the rollers 3 and rollers 4 (either or both of which, if necessary or desired, may

be equipped with like suction, compression, and guiding devices as those above described) and thence to further means of conveyance and treatment of the films.

It will be readily understood that various modifications and substitutions of the invention may be made in its practical application and that it may be employed with equivalent materials other than photographic films. Such modifications and substitutions are to be understood as comprehended by the above disclosure and included within the terms of the following claims.

I claim:

1. A method for effecting the intimate contact of wet films, which comprises compressing the same together, and applying suction to the edges of the films adjacent to the compressed area.

2. A method for effecting the intimate contact of wet films, which comprises compressing the same together along a line of contact transversely of the contacting films, advancing the line of compression contact longitudinally of the film, and applying suction to the margins of the films adjacent to the ends of the line of contact.

3. A method for effecting the intimate contact of wet films, which comprises compressing the same together along a line of contact transversely of the contacting films, advancing the line of compression contact longitudinally of the film, and applying suction to the margins of the films in advance of the line of contact.

4. Apparatus for effecting the intimate pressure contact of wet motion picture films, comprising a backing strip, projecting means thereon for engaging sprocket holes in said films, a roller having a cylindrical surface thereon adapted to engage the surface of the film transversely thereof and intermediate the projecting means of the backing strip, and means for forcing said surface against the films.

5. Apparatus for effecting the intimate pressure contact of wet films and a backing strip having projecting means thereon for engaging sprocket holes in said films, comprising a pair of rollers having cylindrical surfaces thereon adapted to engage the surface of the film transversely thereof and intermediate the projecting means of the backing strip, and means for forcing said surfaces against the films.

6. Apparatus for effecting the intimate contact of wet films, in registered contact with each other, comprising a pair of compression rollers adapted to receive the wet films therebetween and having bearing surfaces, corresponding to and engaging the films in pressure contact therebetween, and suction means at the marginal edges of the films adjacent to the point where pressure is applied.

7. Apparatus for effecting the intimate contact of wet films, in registered contact with each other, comprising a pair of compression rollers adapted to receive the wet films therebetween and having bearing surfaces, corresponding to and engaging the films in pressure contact therebetween, and suction means at the marginal edges of the films in advance of the point where pressure is applied.

8. Apparatus for effecting the intimate contact of wet films, in registered contact with each other, comprising a pair of compression rollers adapted to receive the wet films therebetween and having bearing surfaces, corresponding to and engaging the films in pressure contact therebetween, and suction means at the marginal edges of the films beyond the point where pressure is applied.

9. Apparatus for effecting the intimate contact of wet films, preferably in registered relationship to each other, comprising a compression roller, cylindrical bearing surfaces corresponding to and engaging the contacting wet films, means for adjustably controlling the pressure to be applied to the films thereby, and suction means at the marginal edges of the films adjacent to the application of such pressure.

10. Apparatus for effecting the intimate contact of wet films, preferably in registered relationship to each other and to a backing strip, comprising a compression roller having cylindrical bearing surfaces thereon, corresponding to and engaging the contacting wet films transversely, a second surface opposed to the roller and engaging the under side of the backing strip, and means for drawing the backing strip and films between the roller and surface, and suction means at the edge of the films and backing strip adjacent to the zone of compression between the roller and the opposed surface.

11. Apparatus for effecting the intimate pressure contact of wet cinema films, comprising a backing strip, projecting means thereon for engaging the sprocket holes of said films, a roller having cylindrical surfaces thereon adapted to engage the surface of the film transversely thereof and intermediate the projecting means of the backing strip, and means for forcing said surfaces against the films, and suction means at the edge of the films and backing strip adjacent to the line of compression therebetween.

12. Apparatus for effecting the intimate pressure contact of wet films, comprising a backing strip, projecting means thereon for engaging the sprocket holes of said films, a roller having cylindrical surfaces thereon adapted to engage the surface of the film transversely thereof and intermediate the projecting means of the backing strip, means for forcing said surfaces against the films, and suction means at the edge of the films and

backing strip in advance of the line of compression therebetween.

13. Apparatus for effecting the intimate pressure contact of wet films, comprising a backing strip, projecting means thereon for engaging the sprocket holes of said films, a roller having cylindrical surfaces thereon adapted to engage the surface of the film transversely thereof and intermediate the projecting means of the backing strip, means for forcing said surfaces against the films, and suction means at the edge of the films and backing strip beyond the line of compression therebetween.

14. Apparatus for effecting the intimate pressure contact of wet films, comprising a backing strip, projecting means thereon for engaging the sprocket holes of said films, a pair of rollers having cylindrical surfaces thereon adapted to engage the surface of the film transversely thereof and intermediate the projecting means of the backing strip, and means for forcing said surfaces in opposition against the films, and suction means at the edge of the films and backing strip adjacent to the line of compression between the rollers.

15. Apparatus for effecting the intimate pressure contact of wet films, comprising a backing strip, projecting means thereon for engaging the sprocket holes of said films, a pair of rollers having resilient cylindrical surfaces thereon, raised in the middle and adapted to engage the surfaces of the film transversely thereof intermediate the projecting means of the backing strip, and means for forcing said surfaces against the films, and suction means at the edge of the films and backing strip in advance of the line of compression between the rollers.

Signed by me at Boston, Massachusetts, this 11th day of May, 1927.

LEONARD T. TROLAND.