July 4, 1939. F. W. JACKMAN 2,164,653

APPARATUS FOR TREATING CINEMATOGRAPHIC FILM

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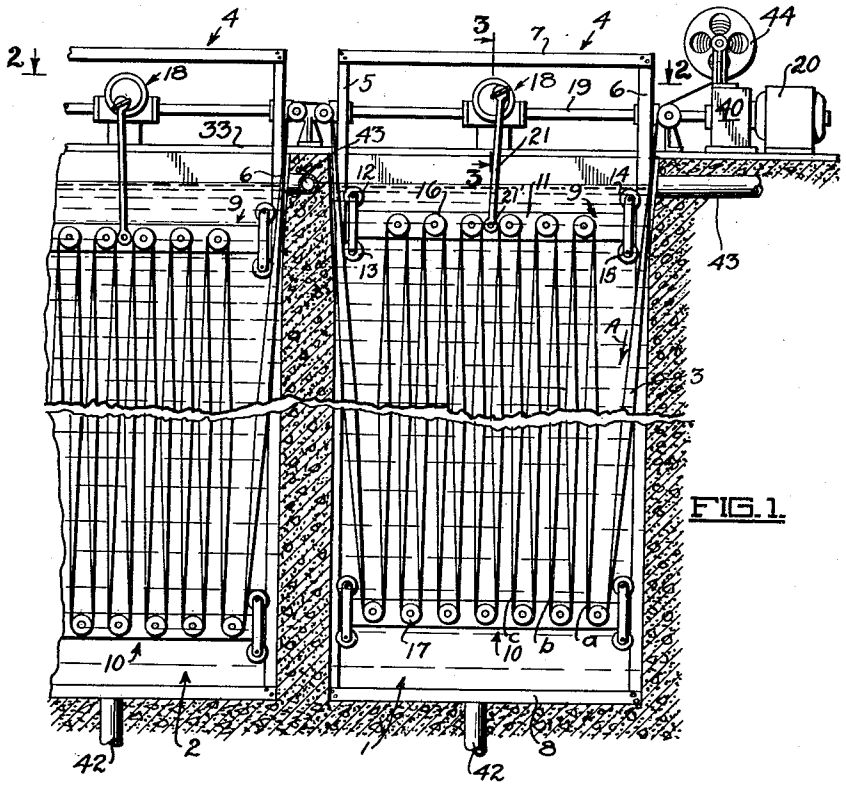


FIG. 1.

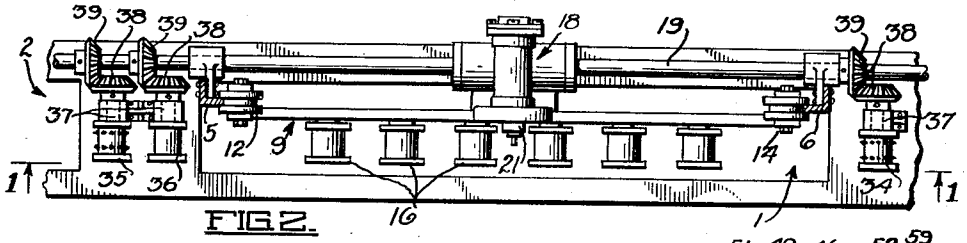


FIG. 2.

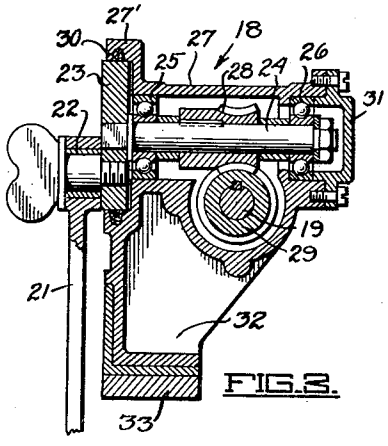


FIG. 3.

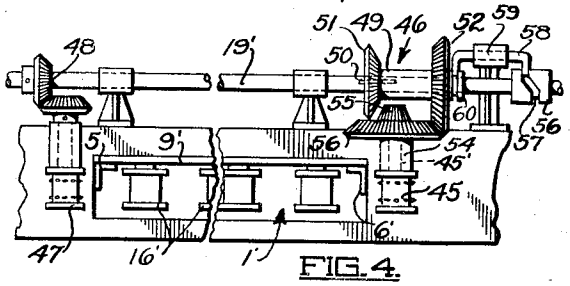


FIG. 4.

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APPARATUS FOR TREATING CINEMATOGRAPHIC FILM

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9 Claims. (Cl. 95—94)

This invention relates in general to the processing of photographic film and more particularly to apparatus for ensuring uniform action of the treating solution upon the film and minimizing the effects such as chemical drag and adherence of spent portions of the treating solution to the film.

In developing motion picture film by causing it to pass continuously through various film treating solutions, particularly the developing and fixing solutions, it has been found that streaks frequently appear upon the surface of the film. Also some portions of the film, especially those portions adjacent to where considerable reaction has occurred between the developer chemicals and the film emulsion, are some times found to be developed to a different degree than other portions. As the film moves through the solution the probable reaction between the chemicals of the emulsion affected by light during the photographic or printing exposure and the treating solution causes a reaction compound to form on the surface of the film. As the film moves through the processing or treating solution, these compounds tend to drag along the face of the film thus preventing uniform surface development. This drag of the reaction compounds is of especial importance along the sound track of the film where the streakage produced by this chemical drag from a transparent portion to an opaque portion tends to distort the sound record.

Uneven development of the film is also caused by the saturation of the solution adjacent the film surface with the chemical compounds resulting from the reaction of the chemicals of the developing solution with the emulsion of the film. Thus, it has been found that in a film, where one portion receives considerable chemical action through the developer solution, the development of an adjacent portion will be influenced thereby due to the impregnation of the chemical reaction compounds at this point. The film while traveling through the solution tends to cause a flow of adjacent portions of the developer solution in the same direction due to friction and adhesion (commonly called surface tension) of the chemical solution with the surface of the film. This movement of the developer solution along with the surface of the film prevents fresh developer chemicals from reaching the film emulsion thus delaying development and also causing the film to be unevenly developed.

One object of the present invention is to prevent uneven treatment of a cinematographic film strip while progressing through film processing solution.

This is accomplished by feeding the film strip through the processing solution and at the same time continually changing the speed of the film while passing through the solution sufficiently to break the frictional or parasitic flow of the adjacent portions of the processing solution so as to allow fresh portions of the solution to come in contact with the film. Hence, the reaction products or compounds will be more quickly dissipated in the developer solution thus minimizing the drag of these compounds along the surface of the film.

Another object of the invention is to move a film strip at a continually changing speed through a film processing solution while supplying the strip to the solution at a uniform speed.

This is accomplished by providing guiding means for guiding the film through the treating solution and causing a continual movement of the guiding means while the film is being supplied at a uniform speed.

More particularly describing the invention, Fig. 1 is a sectional elevation view of a part of a film developing machine embodying a preferred form of my invention and is taken along the line 1—1 of Fig. 2.

Fig. 2 is a plan view of the film developing machine and is taken along the line 2—2 of Fig. 1.

Fig. 3 is a sectional view through the spool head reciprocating mechanism and is taken along the line 3—3 of Fig. 1.

Fig. 4 is a plan view of a modified form of film treating mechanism.

In Fig. 1 I have shown my invention as being embodied within tanks 1 and 2 which may constitute a portion of a complete continuous film treating machine. For example, tank 1 may contain a developing solution through which the motion picture film 3 is first passed; tank 2 a fixing solution; the next tank a rinsing solution, etc. Each of the tanks 1 and 2 has a rectangular frame 4 suitably secured therein. Frame 4 comprises a pair of vertical guide rails 5 and 6 connected at their upper and lower ends to cross bars 7 and 8. A pair of film spool heads 9 and 10 are provided for movement along the guide rails 5 and 6. Each of these spool heads is adapted to be immersed in the solution and comprises a cross head 11 having at its ends grooved wheels 12, 13, 14, and 15 adapted to ride along the rails 5 and 6. Sets of film supporting spools 16 and 17 are spaced along each spool head 9

and 10 to guide the film 3 in a sinuous path through the treating solution. The upper spool cross-head 9 is adapted to be continuously reciprocated by a crank mechanism generally indicated at 18 which is driven through a drive shaft 19 by a motor 20. A connecting rod 21 is pivotally mounted at its lower end 21' to the central portion of the upper spool cross-head 9 and its upper end is rotatably journaled upon a crank pin member 22 (Fig. 3) threadably mounted upon a crank disk 23. Disk 23 is securely mounted upon the end of a cross shaft 24 which is rotatably mounted within ball bearings 25 and 26. Bearings 25 and 26 are provided within a housing 27 which also provides bearings for the drive shaft 19. A worm gear 28 suitably keyed to the cross shaft 24 meshes with a worm 29 suitably keyed to the drive shaft 19. A flange 27' formed on the housing 27 extends over the periphery of the disk 23 and has a lubricant seal 30 therearound which contacts the rim of disk 23 to retain lubricant within the housing 27. A bearing cap 31 is provided at the end of housing 27 adjacent the ball bearing 26 to hold the cross shaft assembly in place. A bracket 32 extending downwardly from the housing 27 is secured upon a cross piece 33 resting on the upper rear portion of the tanks 1 and 2.

Referring to Fig. 2, the drive shaft 19 also drives a pair of driving sprockets 34 and 35 and a drive roller 36 at a constant speed. Each of the sprockets and roller has its shaft journaled within a bearing 37 and is provided with a bevel gear 38 meshing with a similar gear 39 securely mounted upon the driving shaft 19. The shaft 19 is driven at a relatively slow speed by means of a speed reduction mechanism generally indicated at 40 (Fig. 1) which is placed between the shaft 19 and the film driving motor 20.

Inlet and outlet pipes 42 and 43 respectively are provided within each of the tanks 1 and 2 to maintain a current of fresh film treating solution at all times through the tank and also to keep the solution at a constant level, preferably above the upper spool cross-head 9.

In the operation of the film treating machine, the film 3 is fed from a supply reel 44 into the tank 1 at a uniform speed by the drive sprocket 34. Similarly the film emerges from the tank at a uniform speed due to the constant speed of the roller 36 and sprocket 35. However, while the film is progressing through the film treating solution, in a sinuous path (in the direction of arrow A) around the spool cross-heads 9 and 10 the cross-head 9 is being continually reciprocated thus agitating the solution. Thus, as the spool cross-head 9 moves downward the lower spool cross-head 10 is also allowed to move downward due to the weight thereof. This movement of the cross-heads is in direct opposition to the movement of the various alternate strands *a, b, c,* etc., moving in an average upward direction. Therefore, these two movements equalize each other causing the particular strands *a, b, c,* etc., to slow down, stop, or even travel backwards depending on the ratio between the average speed of the film and the speed of the reciprocating mechanism 18. However, the vertical movement of the spool cross heads 9 and 10 is preferably sufficiently slow to prevent agitation thereby of the processing solution to such an extent that the solution is aerated thus causing oxidation and breaking down of the element of the solution. As the cross-head 9 moves upward, however, this movement is in the same direction as the average movement of the alternate film strands *a, b, c,* etc. Thus, during the upward stroke of cross head 9 these strands of film will be speeded up faster than the average speed of the film. It will be seen that any eddy currents set up in the solution which tend to cause adjacent portions of the film to travel along with the surface of the film will be neutralized. Also, the drag of the reaction compounds along the surface of the film will be minimized due to the varying speed of the film and also because of the fact that these compounds will be more readily dissipated within the solution by reason of fresh chemicals coming in contact with the surface of the film.

The modification shown in Fig. 4 comprises a tank 1' containing a film treating solution. The drive shaft 19' is driven in a manner similar to that of 19 in Fig. 1. The film is driven in a sinuous path over upper and lower film spool heads as in the form shown in Fig. 1; however, the upper spool head 9' is held stationary by securing it to the vertically extending guide rails 5' and 6'. The lower spool head (not shown) is allowed to be carried by the lower loops of the film. In this case the film, as it enters the tank, is fed at a uniform speed thereto by a sprocket 47 which is driven by a bevel gear arrangement 48 from the drive shaft 19'. The film is withdrawn from the tank by a sprocket 45 driven by an automatically reversing gear mechanism generally indicated at 46 which intermittently changes the direction of film travel. The reversing mechanism 46 comprises a sleeve 49 slidably keyed at 50 to the drive shaft 19'. Bevel gears 51 and 52 are secured adjacent each end of the sleeve 49. The shaft 45' of sprocket 45 is journaled in a bearing 54 and has bevel gears 55 and 56 secured to the end thereof. Movement of the sleeve 49 along the shaft 19' in one direction causes the gears 52 and 56 to mesh thus causing the sprocket 45 to rotate in a direction opposite to that of sprocket 47 while movement of sleeve 49 in the opposite direction causes the gears 51 and 55 to mesh thus driving the sprocket 45 in the same direction as sprocket 47. A cylindrical cam 56 secured to shaft 19' has a cam groove 57 thereon which is engaged by a follower 58 slideable within a bearing 59. The other end of follower 58 engages a circular groove 60 formed at the end of sleeve 49. Thus one complete rotation of shaft 19' will cause two shifting motions of the sleeve 49. The gears 51 and 55 have a speed ratio of 2 to 1 while the gears 52 and 56 as well as the bevel gear arrangement 48 have equal speed ratios. Therefore, in one complete revolution of the drive shaft 19', the sprocket 45 will rotate one revolution forward and one-half revolution backward while the sprocket 47 will rotate one-half revolution forward. Thus the average speed of the film on entering the tank will be the same as when leaving but at the same time the film will be given an irregular motion which is sufficient to break the surface adhesion of the adjacent portions of the developer chemicals and at the same time minimize the drag of the reaction compounds across the surface of the emulsion.

Having thus described the invention, what is claimed as new and desired to secure by Letters Patent, is:

1. In a film treating device having a container for a film treating solution, the combination of means for progressing a film through said solution, film supports for guiding the film in a plurality of loops through the solution and means for

cyclically reciprocating one of said film supports to reciprocate the other of said film supports and the film while said film is progressing through said solution.

2. A film treating device of the character described having a container for a film treating solution comprising a pair of spool heads immersed in said solution for supporting a film in a series of loops in said solution, means for progressing said film through said solution, a crank for reciprocating one of said spool heads, and means for operating said crank whereby said film is progressed through said solution at varying speeds and said solution agitated.

3. A film treating device of the character described having a container for a film treating solution comprising upper and lower film guiding supports immersed in said solution for guiding a film therearound in a sinuous path through said solution, means for progressing said film through said solution, and means for constantly vertically reciprocating said upper film guiding support within said solution whereby the speed of said film is changed sufficiently to break the adhesion between said film and adjacent portions of said solution.

4. A film treating device comprising a drive shaft, means connected with said drive shaft for progressing a film through a film treating solution, a reversing mechanism connected with said drive shaft, and means for intermittently operating said reversing mechanism whereby said film is progressed through said solution at a speed varying sufficiently to break the adhesion between said film and the adjacent portions of said solution.

5. A film treating device having a container for a film treating solution comprising a film spool head movably mounted within said container, a second film spool head reciprocally mounted above said first spool head, said spool heads being adapted to carry a film in a series of loops therearound, a drive shaft, means connected with said drive shaft for progressing the film through said container, and a second means connected with said drive shaft for reciprocating said second spool head, said first spool head being simultaneously reciprocated by an amount dependent upon the amount said second spool head is reciprocated and by the number of loops of film between said spool heads.

6. In a film treating device having a container for a film treating solution, the combination of a film spool head mounted within said container and immersed in said solution, a second film spool head reciprocally mounted above said first spool head and immersed in said solution, said spool heads being adapted to carry a film therearound, a drive shaft, means connected with said drive shaft for progressing said film through said container, a crank operated by said drive shaft, and a connection between said crank and said second spool head for imparting a reciprocatory motion to said second spool head whereby the speed of said film is continuously varied and said first spool head is reciprocated.

7. In a film treating device having a film treating tank for containing a film treating solution, the combination of means for progressing said film into and out of said solution at a substantially constant speed, an upper spool head and a lower spool head for supporting said film within said solution in a series of similar vertical loops, and a driving mechanism for reciprocating said upper spool head and all of said loops simultaneously to vary the rate of travel of said film through said solution.

8. In a film treating device having a film treating tank for containing a film treating solution, the combination of means for progressing said film into and out of said solution at a substantially constant speed, an upper spool head and a lower spool head for supporting said film within said solution in a series of similar vertical loops, and a driving mechanism for cyclically reciprocating both of said spool heads and the film loops supported thereby during the travel of the film through said solution.

9. In a film treating device having a film treating tank for containing a film treating solution, the combination of means for progressing said film into and out of said solution at a substantially constant speed, an upper spool head and a lower spool head for supporting said film within said solution in a series of similar vertical loops, and a driving mechanism for cyclically reciprocating one of said spool heads to thereby reciprocate the other of said spool heads and all of said loops simultaneously to vary the rate of travel of said film through said solution.

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