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ANTIDRAG DEVELOPING MACHINE AND METHOD OF DEVELOPING FILM

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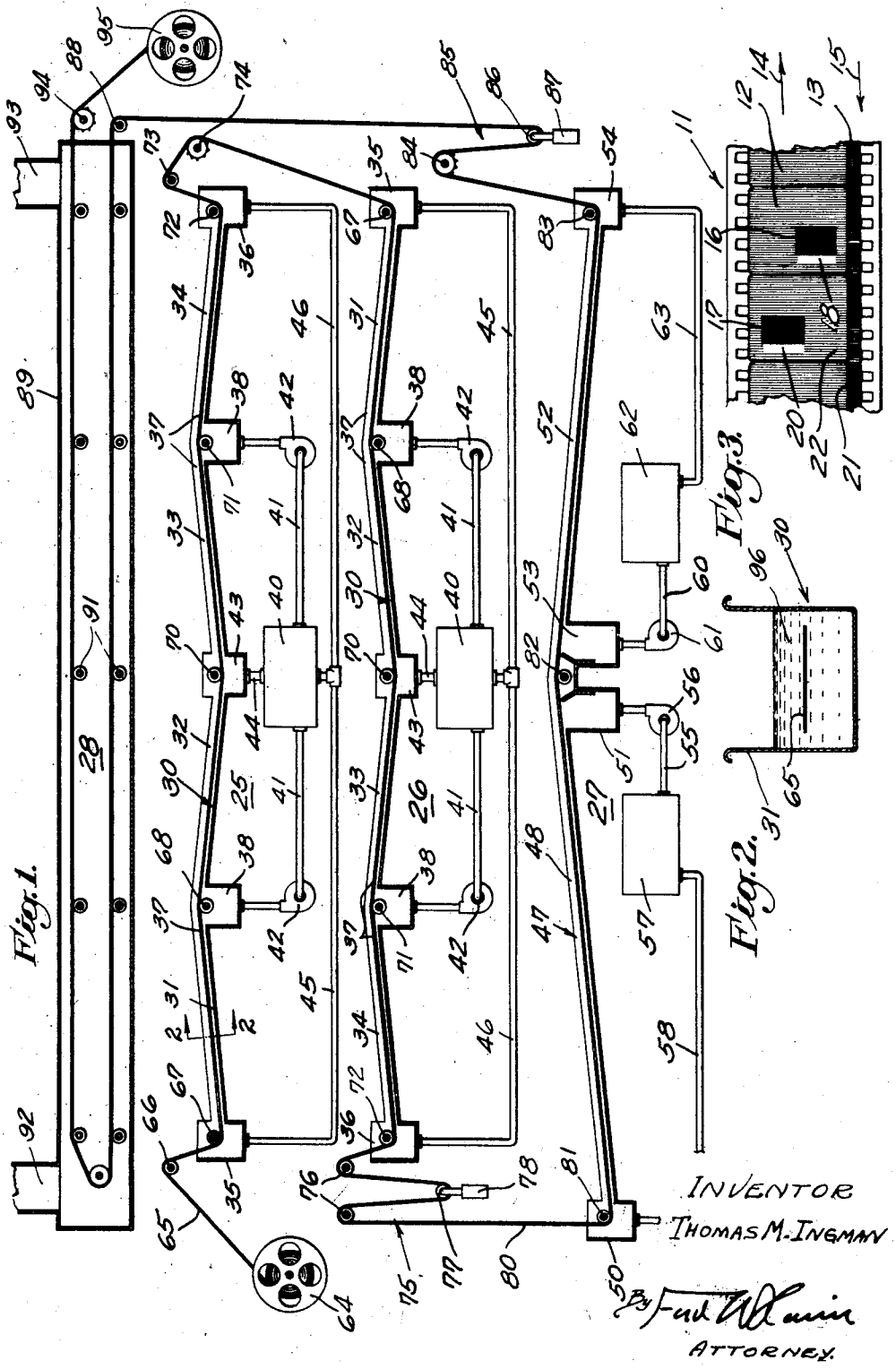


Fig. 1.

Fig. 3.

Fig. 2.

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ANTIDRAG DEVELOPING MACHINE AND METHOD OF DEVELOPING FILM

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28 Claims. (Cl. 95—94)

My invention relates to the treatment of film strips and relates particularly to a method and apparatus for the treatment of a film strip whereby a constant degree of treatment may be substantially maintained throughout the entire length of the film strip, whereby the effect of drag of chemical compounds and other substances across the face of the film strip will be minimized or eliminated.

As an example of the utility of my present invention, I may cite the conditions encountered in the developing of a motion picture film in the average continuous or automatic developing machine in which the strip of film is moved at a substantially constant rate of speed through consecutive baths or fluids. As the film strip is moved through a treating solution, the chemicals in the treating solution react with the elements of the images of the film, and reaction compounds are formed which make their way to the surface of the film. If the film strip is moving relative to a body of treating solution, such as a developing solution, or if the solution is moving along the surface of the film strip, this relative movement of the solution longitudinally over the face of the film strip drags these reaction compounds along the face of the film strip, with the result that the image is distorted. For example, films now developed in continuous developing machines are found to have halos or light areas at one side of the representations of objects in the images, which seriously detract from definition or clearness of the photographic image. Also this chemical drag distorts the sound records of motion picture films and is destructive to the quality of sound reproduction. As a further example, a commonly employed sound record on talking motion picture films consists of striations of variable density arranged in a sound track at one side of the film. The drag of chemical compounds from the dark portions to the light portions or from the light portions to the dark portions of a sound track distorts the photographic sound image to the extent that the relative opacity of the different striations does not accurately follow or represent the fluctuations of the sound controlled light wave employed to produce the initial negative sound image or sound track.

My invention comprehends a method and apparatus for substantially eliminating chemical drag in the treatment of motion picture film, or at least minimizing such drag to the extent that the effects thereof are imperceptible, and my invention further comprehends means for maintaining a substantially constant action of the treating solutions on the film throughout the entire length of a film and in the consecutive portions thereof.

I have found also in the development of films in continuous developing machines that the sound track development is influenced by the character of the adjacent picture image, due to unequal action of the treating solutions in the different portions of the sound track, such difference in the action of the solutions resulting from the weakening of adjacent portions of the solutions or impregnation of adjacent portions of the solutions by chemical compounds resulting from reaction of the chemicals or elements of the solutions with the constituents of the picture images.

It is an object of the invention to provide a simple method and apparatus in which a film strip to be developed is conducted through a path of movement, and during its movement through such path is subject to streams of fluid or solutions flowing first in one direction and then the other, so that where a slight chemical drag is caused by one stream flowing across the film in one direction, such drag is immediately neutralized by the succeeding stream flowing in an opposite direction.

It is a further object of the invention to provide a method and apparatus for treating a film strip, in which the film strip is conducted through a sinuous or undulating conduit member or trough consisting of adjacent, consecutive, upwardly and downwardly sloping sections, and while being moved through the undulating path provided by the conduit member or trough is treated by streams of treating fluid or solution of desired characteristics which are introduced into the upper portions of the sections and caused to flow downwardly therein, thereby subjecting the film strip to relatively opposite flows of treating fluid to minimize or substantially eliminate chemical drag, the velocity of the fluid streams being such that constant activity of the treating fluid is maintained in all parts of the film strip.

A further object of the invention is to provide a simple and economical, yet efficient, film treating device in which the principles of the invention may be practiced.

Further objects and advantages of the invention will be made evident throughout the following part of the specification.

Referring to the drawing, which is for illustrative purposes only,

Fig. 1 is a partly sectioned elevational view of diagrammatic character, showing a simple form of apparatus embodying my invention.

Fig. 2 is an enlarged cross section on a plane represented by the line 2—2 of Fig. 1.

Fig. 3 is a view of a fragment of a motion picture film having a sound track.

In Fig. 3 I diagrammatically show a portion of a film 11 having frames 12 and a sound track 13, the frames 12 constituting photographic picture images and the sound track 13 constituting a photographic sound image. I have found that the constancy, evenness, and definition of the images of a motion picture film developed in a continuous developing machine are affected by several factors: first, by the chemical drag from parts of the images to adjacent parts thereof; and second, by the difference in strength of the layer of solution, such as the developer, engaging or covering the surface of the film. As an example of the first factor or condition, if the film 11 is developed by moving it for a considerable distance through a developer in the direction of the arrow 14, the developer will drag chemical compounds, such as bromide, across the face of the film in a direction opposite to the direction of movement of the film or in the direction of the arrow 15; therefore, reaction compounds formed in the areas 16 and 17 of the frames 12 will be dragged leftwardly and will adhere to the surface of the film in the areas 18 and 20 lying to the left of and adjacent the areas 16 and 17 and slow down the action of the development in such areas. Also, a similar drag will occur in the sound track, and the densities of the striations 21 of the sound track 13 will be changed from true values relative to the intensity of the sound vibrations from which they were originally produced. As an example of the second factor or condition, it is found that where the frames of a film vary in density, the varying absorption of chemical constituents from the developer by the portions of the frames 12 lying adjacent the sound track will vary the strength of the developer engaging the sound track 13, and the rate of degree of development of the sound image will be varied in accordance with the strength of the developer to which it is subjected.

In my invention I provide, as shown in Fig. 1, a film treating or developing device having a developing division 25, a fixing division 26, a washing division 27, and a drying division 28. The divisions 25 and 26 are substantially identical, each consisting of a conduit member in the form of a trough 30 which extends essentially horizontally but undulates from one end to the other thereof so as to form consecutive, adjacent, upwardly and downwardly sloping sections 31, 32, 33, and 34, there being fluid outlet chambers 35 and 36 at and communicating with the front and rear ends of the trough 30. Between the raised end portions 37 of the sections 31 and 32 and of the sections 33 and 34, fluid inlet chambers 38 are placed, the upper ends of which are in direct communication with the upper portions of the sections. From fluid containers 40 fluid delivery pipes 41 having pumps 42 therein extend to the inlet chambers 38, to deliver fluids thereto from the containers 40, which fluids flow from the upper portions of the chambers 38 into the upper ends or portions of the sections 31 to 34 and flow downwardly in the sections 31 and 34 to the respective outlet chambers 35 and 36 at the lower ends thereof, and downwardly in the sections 32 and 33 to central outlet chambers 43 disposed between the lower ends of the sections 32 and 33 and connected to the containers 40 through return pipes 44. From the outlet members or chambers 35 and 36 pipes 45 and 46 return fluids to the containers 40.

In the disclosed preferred embodiment of the treating device, a number of important features have been taken into consideration. The fluid containers 30 have been made in slender trough-like form so that the quantity of fluid required in the operation of the device may be maintained at a minimum; the containers have been disposed essentially horizontally so that the head against which the pumps 42 must operate is kept at a minimum; and the portions or sections of the containers 30 between, or defined by, the fluid delivery and take-off members 35, 36, 38, and 43 have been sloped so as to provide a gravity flow in the fluids which will offset the slowing of the flow of fluids by friction due to contact thereof with the film and with the walls of the troughs 30, the result being that the depth of the troughs may be maintained at a minimum. Accordingly, in the device the sections referred to are defined by the streams of treating fluid which are caused to flow in essentially opposite directions along the path of the film defined by the trough members 30, and the use of the term "section" herein refers to the zones or divisions of the fluid containers 30 identified or defined by the fluid streams, since it is in the characteristic action of these streams that an important feature of the invention resides.

The washing division 27 comprises a conduit member or trough 47 consisting of a forward, upwardly sloping section 48 which extends from an outlet chamber 50 to an inlet chamber 51, and a rear section 52 which extends from an inlet chamber 53 placed adjacent the chamber 51 to an outlet chamber 54. Through fluid delivery piping 55 having a pump 56 therein, wash water is carried from a water reservoir 57 to the inlet member 51, this water overflowing into the upper end of the section 48 and flowing downwardly therein to the outlet chamber 50, to be returned through piping 58 to the water reservoir 57. Through fluid delivery piping 60 having a pump 61 therein, water is carried from a second reservoir 62 to the inlet member or chamber 53, this water overflowing into the upper portion of the section 52 and flowing downwardly therein to the outlet chamber 54, to be returned through piping 63 to the reservoir 62.

With reference to the apparatus shown in Fig. 1, the invention is practiced essentially in the following manner. From a film spool 64 a film 65 to be developed is carried over a guide spool 66 and is passed under a guide spool 67 mounted in the inlet chamber 35 of the developing division 25, from which it is passed over and under respective guide spools 68, 70, 71, and 72 to a spool 73 placed adjacent a pulling sprocket 74. From the sprocket 74 the film is carried under and over respective spools 67, 68, 70, 71, and 72 of the fixing division 26 so as to be thereby guided through the conduit member 30 of such fixing division 26. From the final spool 72 of the fixing division 26 the film is carried to a take-up means 75 consisting of a pair of spools 76 mounted on stationary axes and a traveling spool 77 associated with a weight 78 for producing a continuous and predetermined tension in the film. As indicated at 80, the film is carried to a spool 81 situated in the outlet member 50 and is passed therefrom upwardly in the section 48 of the conduit means 47 forming part of the washing division 27. The film is passed over a spool 82 situated at the peak or high point of the con-

duit member 47 between the sections 48 and 52 and is carried downwardly through the section 52 to pass under a spool 83 mounted in the outlet member 54 at the lower end of the section 52. From the spool 83 the film is carried to a pulling sprocket 84 and then to a film take-up means 85 consisting of a traveling spool 86 having a weight 87 hung thereon. From the take-up means 85 the film is led over a spool 88 into a chamber 89 which forms the drying division 28 and has suitable guide spools 91 therein which support the film in the path of flow of conditioned air which may enter and leave the chamber 89 through members 92 and 93. The film is drawn from the chamber 89 by a pulling sprocket 94, from whence it extends to a take-up reel 95 adapted to be frictionally driven in accordance with standard practice in film handling apparatus. The pulling sprockets 74, 84, and 94 are driven at the same speed, and each accordingly motivates the film at the same speed of movement, the variations in the length of the film strip resulting from its treatment between the pulling sprockets 74 and 84 and between the sprockets 84 and 94 being compensated for by the take-up or compensating means 75 and 85.

Since the invention is described as relating to the development of a motion picture film, the fluid placed in the container 40 is a developer solution, and accordingly during the passage of the film 65 through the conduit member or trough 30 of the developing division 25, it is subjected to streams of developer flowing downwardly in the respective sections 31, 32, 33, and 34 of the division 25. As shown in Fig. 2, the quantity of fluid delivered to each of the sections 31 to 34 is sufficient relative to the inclination of such sections that each stream of fluid 96 will be of ample depth to entirely surround the film 65 and to float the film so that it will not touch the bottom of any section of the conduit member or trough 30. In the section 31 of the division 25 the rightwardly traveling film is subjected to a stream or flow of developer in leftward direction. This produces an initial leftward drag of materials or chemical compounds across the face of the film; but in the succeeding section 32 the flow of developer is rightward relative to the film strip since the stream of fluid in such section 32 is traveling at a greater rate of speed than the film strip. This results in the dragging of materials or chemical compounds rightwardly to counteract the leftward drag, and where the leftward drag has caused a leftward offsetting of the photographic images, the rightward drag will move the leftwardly offset compounds adhering to the film in rightward direction. In the sections 33 and 34 the film strip is subjected to leftward and rightward dragging effects, one of which offsets the other. The streams of developer fluid are directed in opposite directions at such velocity that they are effective in removing from the surface of the film the reaction compounds resulting from the action of the developer on the photographic images of the film strip. In the operation of the device the developer is kept in constant and rapid movement relative to the surface of the film strip so that no body of developer remains in contact with a single surface area for any great length of time, and therefore there are no differences in the degree of development of different parts of the film due to depletion of the strength of portions of the developer.

In the development of motion picture films it is often the practice to carry the film from the developer to a washing step before conducting it into the fixing or hypo solution, but in the drawing I have not shown such intermediate washing step since the use thereof in no way changes the principles of my invention. In the fixing division 26, in which the container or reservoir 40 is filled with a fixing solution, the film is subjected to reversely flowing streams of fixing solution, and accordingly the treatment compensates for any tendency for the flow of fluids relative to the surface of the film strip to produce image drag. The same principle is employed in the final washing division 27 in which the first wash water flows leftwardly through the section 48 thereof and rightwardly through the section 52 thereof.

It will be understood that in my device and process image drag in both the fixed image and the sound image is eliminated or minimized. Furthermore, a constant development of the sound track is maintained by reason of the treating solutions being moved at relatively high velocity relative to the film, and due to turbulence in the fluid streams the treating fluids are maintained well mixed, it being contemplated that in the use of the invention the strength of the treating fluids will be maintained in accordance with standard practice by the addition of chemicals to replace the quantities thereof lost in reaction with the chemical elements of the film strip. In the practice of the invention the film may be moved through the respective divisions at a relatively slow speed, since the treating solutions are maintained in rapid circulation. This is preferable to moving a film rapidly through a stationary or slowly moving developer, since liability of injury to the film is reduced to a minimum. In addition to this, it permits the making of the developing machine of comparatively small size.

Although I have herein shown and described my invention in simple and practical form, it is recognized that certain parts or elements thereof are representative of other parts, elements, or mechanisms which may be used in substantially the same manner to accomplish substantially the same results; therefore, it is to be understood that the invention is not to be limited to the details disclosed herein but is to be accorded the full scope of the following claims.

I claim as my invention:

1. An anti-drag film treating device of the character described, including: means defining a path of movement for a film, said path being divided into consecutive sections; means for moving a film through said path; and means for moving treating fluid through said path in engagement with said film, the direction of flow of such fluid being opposite in adjacent sections of said path and at such velocity as to remove reaction compounds from the surface of said film.

2. An anti-drag film treating device of the character described, including: means defining a path of movement for a film, said path being divided into consecutive connected sections; means for moving treating fluid through said path, the direction of flow of such fluid being opposite in adjacent sections of said path; and means for moving a film continuously through said path in engagement with the treating fluid flowing therein.

3. An anti-drag film treating device of the character described, including: means defining a path of movement for a film, said path being divided into consecutive connected sections;

means for moving treating fluid through said path, the direction of flow of such fluid being opposite in adjacent sections of said path; and means for moving a film through said path in a position submerged in the fluid flowing in such path.

4. An anti-drag film treating device of the character described, including: means defining a path of movement for a film, said path being divided into consecutive connected sections alternately sloped upwardly and downwardly so that said path will be substantially sinuous in a vertical plane; means for moving a film through said path; and means for moving treating fluid through said path in engagement with said film, the direction of flow of such fluid being opposite in adjacent sections of said path, said fluid flowing from the high points of said path to the low points thereof.

5. An anti-drag film treating device of the character described, including: means defining a path of movement for a film, said path being divided into consecutive connected sections alternately sloped upwardly and downwardly so that said path will be substantially sinuous in a vertical plane; means for moving a film through said path; a container for a treating fluid; means for delivering treating fluid from said container to the high points of said path; and return conduits connecting the low points of said path with said container.

6. An anti-drag film treating device of the character described, including: means defining a path of movement for a film, said path being divided into consecutive connected sections alternately sloped upwardly and downwardly so that said path will be substantially sinuous in a vertical plane; means for moving a film through said path; a container for a treating fluid; means for delivering treating fluid from said container to the high points of said path; and treating fluid drain members leading from the low points of said path.

7. An anti-drag film treating device of the character described, including: an essentially horizontally disposed conduit member defining a path of movement for a film, said member being divided into consecutive connected sections; means for moving a film through said member; and means for moving treating fluid through said member in engagement with said film, the direction of flow of such fluid being opposite in adjacent sections of said member.

8. An anti-drag film treating device of the character described, including: an essentially horizontally disposed conduit member defining a path of movement for a film, said member being divided into consecutive connected sections; means for moving treating fluid through said member, the direction of flow of such fluid being opposite in adjacent sections of said member; and means for moving a film through said member in a position submerged in the fluid flowing in such member.

9. An anti-drag film treating device of the character described, including: an essentially horizontally disposed conduit member defining a path of movement for a film, said member being divided into consecutive connected sections alternately sloped upwardly and downwardly so that said member will be substantially sinuous in a vertical plane; means for moving a film through said member; and means for moving treating fluid through said member in engagement with said film, the direction of flow of such fluid being opposite in adjacent sections of said member, said fluid flowing from the high points of said member to the low points thereof.

10. An anti-drag film treating device of the character described, including: an essentially horizontally disposed conduit member defining a path of movement for a film, said member being divided into consecutive connected sections alternately sloped upwardly and downwardly so that said member will be substantially sinuous in a vertical plane; means for moving a film through said member; a container for a treating fluid; means for delivering treating fluid from said container to the high points of said member; and return conduits connecting the low points of said member with said container.

11. An anti-drag film treating device of the character described, including: a developing division; a fixing division; a washing division, each of said divisions comprising an essentially horizontally disposed conduit member divided into adjacent sections; means for pulling a film strip continuously through said conduit members; and means for delivering fluids to said conduit members so that flows of fluid in adjacent sections of said conduit members will be in opposite directions and in contact with said film strip.

12. An anti-drag film treating device of the character described, including: a developing division; a fixing division; a washing division, each of said divisions comprising an essentially horizontally disposed conduit member divided into adjacent sections sloping consecutively upwardly and downwardly so as to make said conduit members substantially sinuous in a vertical plane; means for pulling a film strip continuously through said conduit members; fluid containers; means for delivering fluid from said containers to the upper portions of said sections to flow downwardly in said sections in contact with said film strip; and fluid drain means connected with the lower portions of said sections.

13. An anti-drag film treating device of the character described, including: a developing division; a fixing division; a washing division, each of said divisions comprising an essentially horizontally disposed conduit member divided into adjacent sections sloping consecutively upwardly and downwardly so as to make said conduit members substantially sinuous in a vertical plane; means for pulling a film strip continuously through said conduit members; fluid containers; fluid delivery pipes leading from said containers to the upper portions of said sections, there being means for causing delivery of fluid from said containers through said fluid delivery pipes to the upper portions of said sections to flow downwardly in said sections in contact with said film strip; and fluid return pipes connecting the lower portions of said sections with said containers.

14. A method of the character described for preventing image drag and preserving maximum constancy in the treatment of a film strip, comprising: moving a film strip at a substantially constant speed through a prescribed path; defining adjacent sections in said path; and causing treating fluid streams to flow in said sections of said path and in contact with said film strip, the fluid streams in adjacent sections flowing in opposite directions relative to the length of said film strip.

15. A method of the character described for preventing image drag and preserving maximum constancy in the treatment of a film strip, com-

prising: establishing a path of movement for a film strip, said path of movement being essentially horizontally directed and undulating vertically so as to consist of consecutive upwardly and downwardly sloped sections; moving a film strip at a substantially constant speed through said path; and introducing treating fluid streams at the upper ends of said sections of said path, said streams flowing downwardly in said sections toward the lower ends thereof and making contact with said film strip.

16. A method of developing motion picture film, comprising: moving a film continuously through a developer; and causing the consecutive portions of the developer through which the film is moved to travel in different directions relative to the surface of the film in a manner to compensate for image drag.

17. A method of developing motion picture film, comprising: moving a film continuously through a treating fluid; and causing said treating fluid to flow relatively back and forth across the surface of the film to offset the drag of chemicals on the image of said film.

18. An anti-drag film treating device of the character described, including: walls forming a container for a treating fluid; propelling members for moving a film to be treated through said container; and means for moving a treating fluid within said container and in engagement with the surface of said film, said means being formed to cause said treating fluid to flow relatively back and forth across said surface of said film to offset the drag of chemicals on the image of said film.

19. An anti-drag film treating device of the character described, including: walls forming a container for a treating fluid; members for positioning a film to be treated in said container; and means for moving a treating fluid within said container and in engagement with the surface of said film, said means being formed to cause said treating fluid to flow relatively back and forth across said surface of said film to offset the drag of chemicals on the image of said film.

20. A method of the character described for treating motion picture film, comprising: moving a film continuously through a treating fluid at relatively slow speed; and causing the consecutive portions of the treating fluid through which the film is moved to travel at relatively high speed in different directions relative to the surface of the film to remove therefrom the adhering surface layer of fluid.

21. An anti-drag film treating device of the character described, including: walls forming a container for a treating fluid; propelling members for moving a film to be treated through said container; and means for moving a treating fluid within said container and in engagement with the surface of said film, said means being formed to cause said treating fluid to flow relatively in different directions across the surface of said film to offset the drag of chemicals on the image of said film and at a velocity to remove reaction compounds from the surface of the film.

22. An anti-drag film treating device of the character described, including: walls forming a container for a treating fluid; members for positioning a film to be treated in said container; and means for moving a treating fluid within said container and in engagement with the surface of said film, said means being formed to cause said treating fluid to flow relatively in different directions across said surface of said film to offset the drag of chemicals on the image of said film.

23. A method of the character described for treating a film strip, comprising: moving a film strip at a substantially constant speed through a prescribed path; defining adjacent sections in said path; and causing treating fluid streams to flow in said sections of said path and in contact with said film strip, the fluid stream in one section always flowing in one direction and the fluid stream in the section adjacent thereto always flowing in a different direction.

24. A method of the character described for treating a film strip, comprising: moving a film strip at a substantially constant speed through a prescribed path; defining adjacent sections in said path; and causing treating fluid streams to flow in said sections of said path and in contact with said film strip, the fluid streams in adjacent sections flowing in opposite directions relative to the length of said film strip and at such velocity as to remove reaction compounds from the surface of said film strip.

25. A method of the character described for treating a film strip, comprising: moving a film strip at a substantially constant speed through a prescribed path; defining adjacent sections in said path; and causing treating fluid streams to flow in said sections of said path and in contact with said film strip, the fluid stream in one section always flowing in one direction and the fluid stream in the section adjacent thereto always flowing in a different direction and at such velocity as to remove reaction compounds from the surface of said film strip.

26. A film treating device of the character described, including: means defining a path of movement for a film, said path being divided into consecutive sections; means for moving treating fluid in opposite directions in adjacent sections of said path of movement, the flow of fluid in each of said sections always being in the same direction.

27. The method of preventing harmful image drag and distortion in the developing of a motion picture film by conducting said film through a path of movement and flowing a developer at turbulence-producing velocity back and forth across the face of said film in said path of movement.

28. The method of preventing harmful image drag and distortion in the developing of a motion picture film by conducting said film through a path of movement and flowing a developer at turbulence-producing velocity across said film in one direction in one portion of said path of movement and across said film in another direction in an adjacent portion of said path of movement.

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