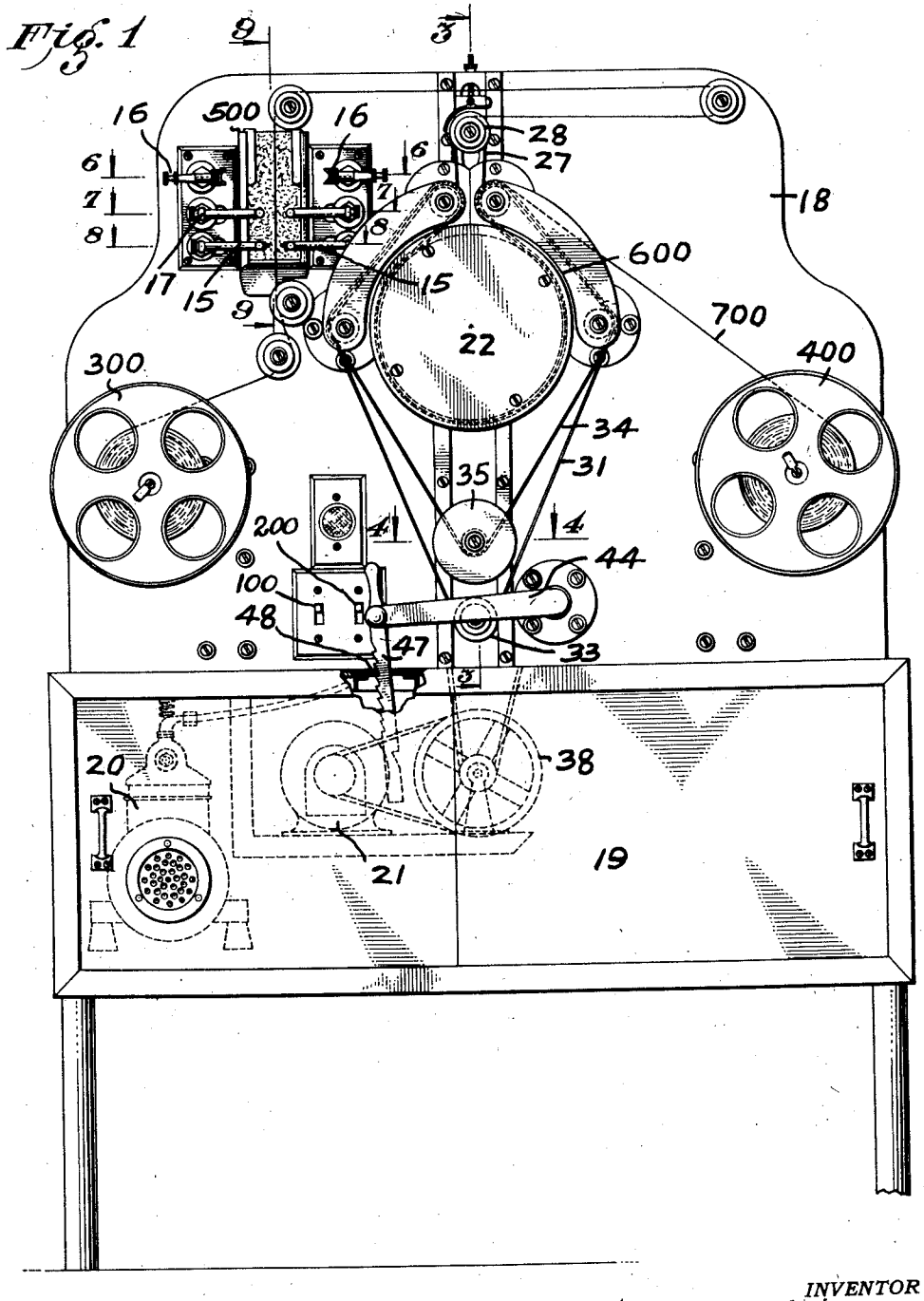
March 3, 1942. G. J. GAGE 2,275,139

METHOD OF TREATING MOTION PICTURE FILMS

Filed April 9, 1938 5 Sheets-Sheet 1

Fig. 1




INVENTOR
George J. Gage.
BY
James A. J. Koche
ATTORNEY

March 3, 1942. G. J. GAGE 2,275,139

METHOD OF TREATING MOTION PICTURE FILMS

Filed April 9, 1938 5 Sheets-Sheet 2

Fig. 2

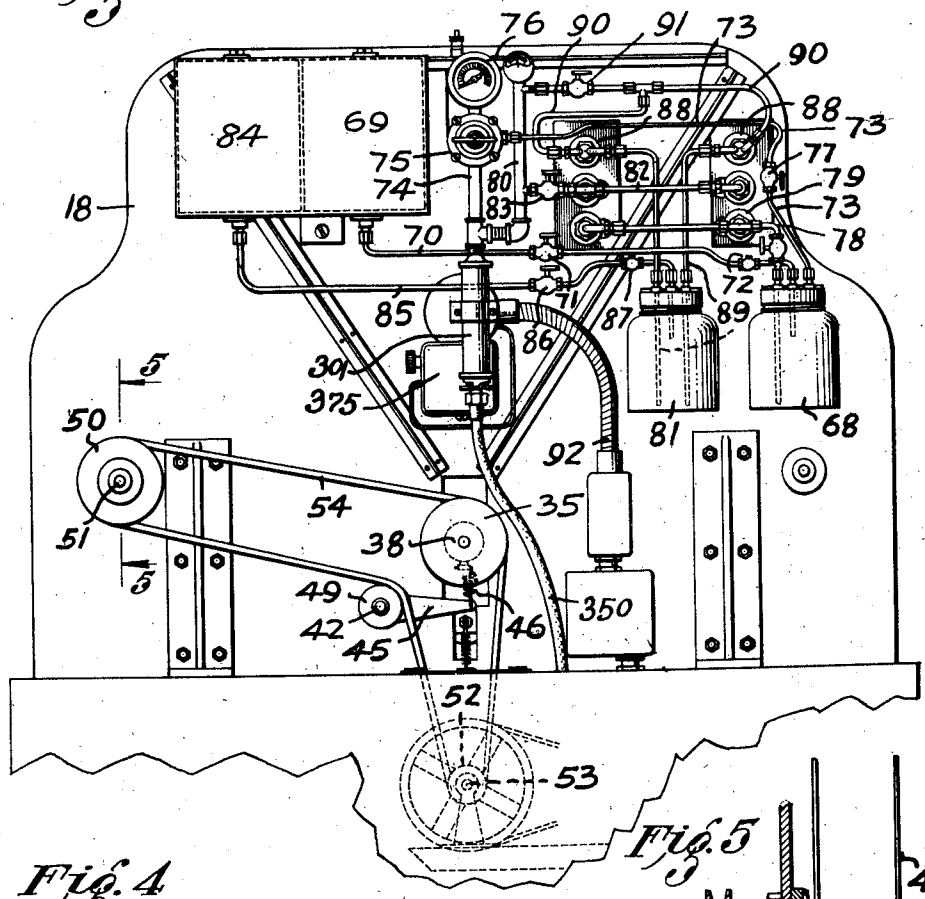



Fig. 4

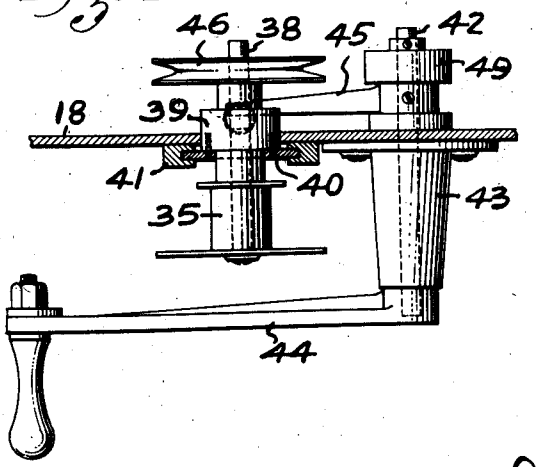
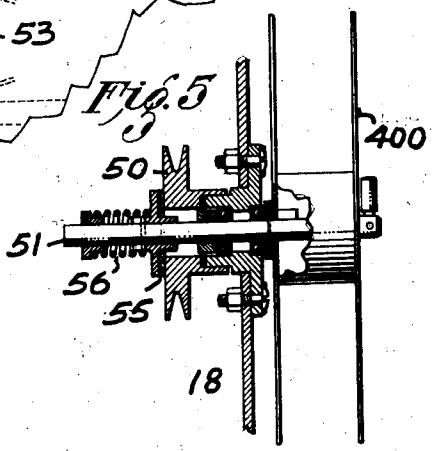



Fig. 5



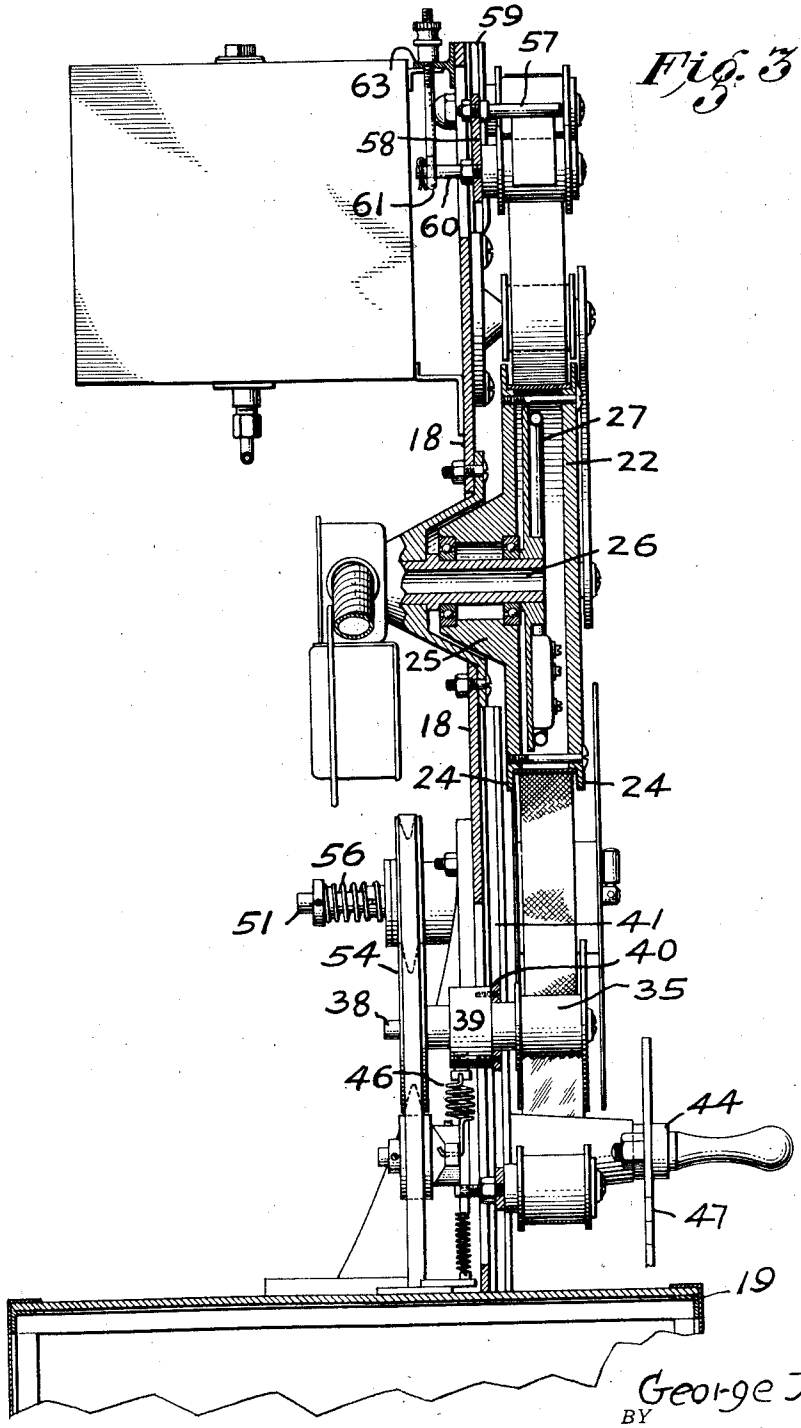

INVENTOR
George J. Gage.
BY
James A. G. Koche
ATTORNEY

March 3, 1942. G. J. GAGE 2,275,139

METHOD OF TREATING MOTION PICTURE FILMS

Filed April 9, 1938 5 Sheets-Sheet 3

Fig. 3




INVENTOR
George J. Gage
BY
James A. J. Kochel
ATTORNEY

March 3, 1942. G. J. GAGE 2,275,139

METHOD OF TREATING MOTION PICTURE FILMS

Filed April 9, 1938 5 Sheets-Sheet 4

Fig. 6

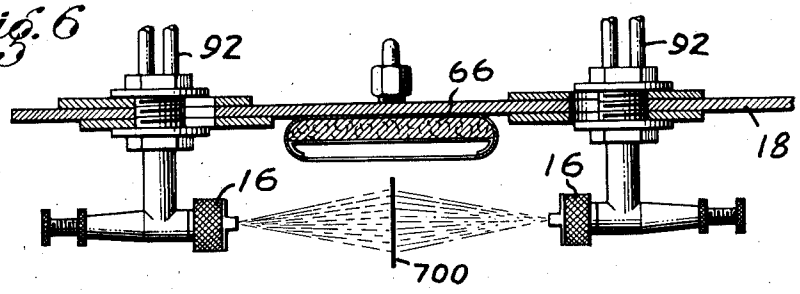



Fig. 7

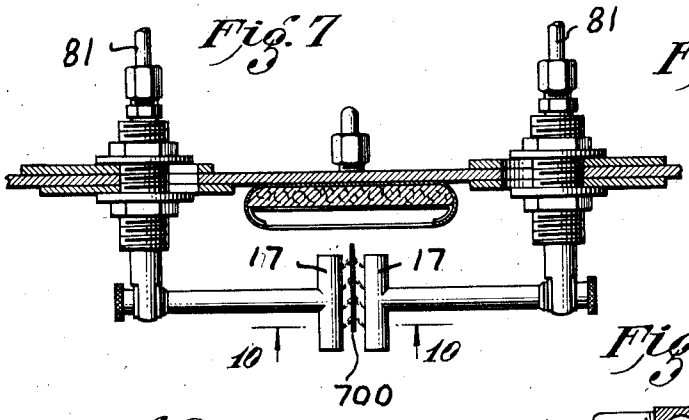



Fig. 10

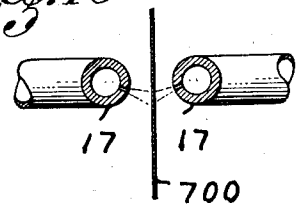



Fig. 11

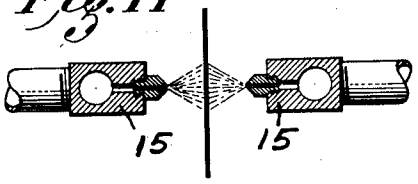



Fig. 9

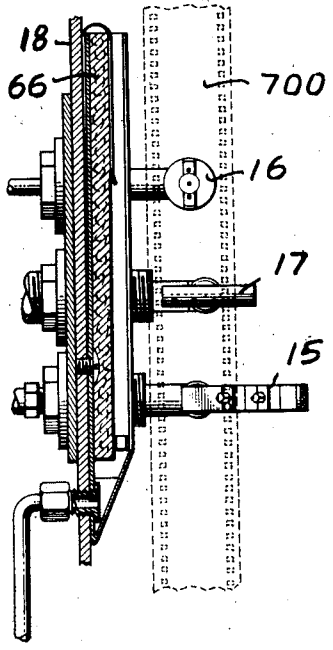
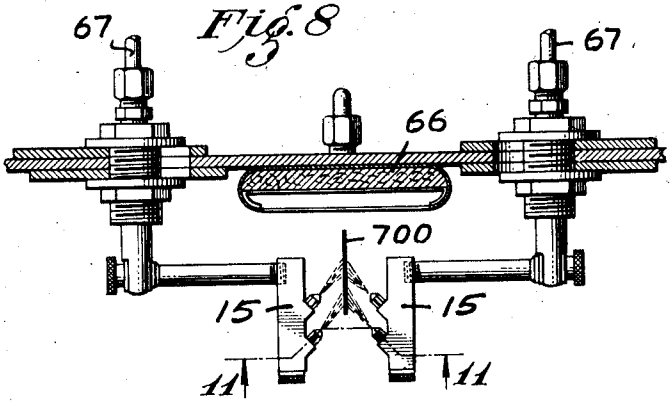



Fig. 8



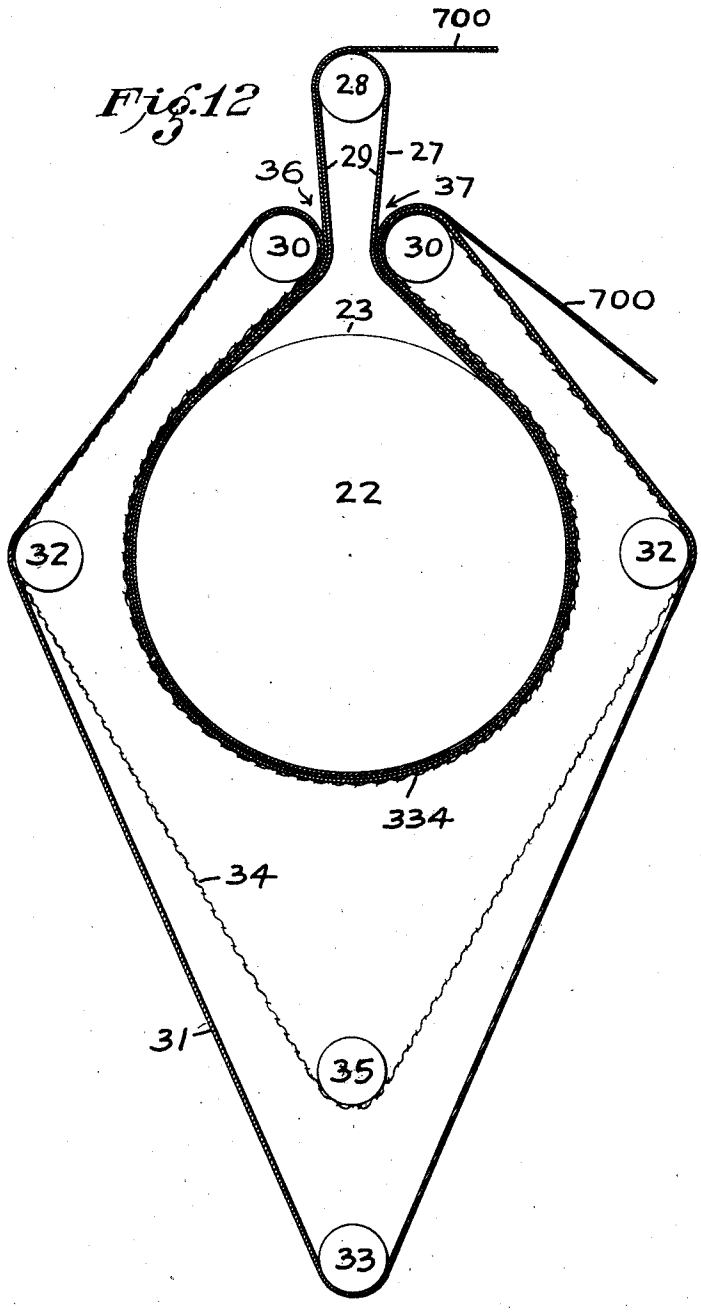

INVENTOR
George J. Gage
BY
James A. G. Koehler
ATTORNEY

March 3, 1942. G. J. GAGE 2,275,139

METHOD OF TREATING MOTION PICTURE FILMS

Filed April 9, 1938 5 Sheets-Sheet 5

Fig. 12




INVENTOR
George J. Gage
BY
James A. G. Koehl.
ATTORNEY

Patented Mar. 3, 1942 2,275,139

# UNITED STATES PATENT OFFICE

2,275,139

## METHOD OF TREATING MOTION PICTURE FILMS

George J. Gage, Los Angeles, Calif.

Application April 9, 1938, Serial No. 201,042

1 Claim. (Cl. 18—56)

This invention relates to the method of treating motion picture film and is an improvement upon the invention disclosed and broadly claimed in United States Letters Patent No. 2,011,576, issued to me August 20, 1935.

My invention is primarily directed to an improved method enabling all and singular the various steps in the method set forth in my aforementioned letters patent to be practiced with greater precision and speed and accompanying attainment of certain new and highly advantageous results.

My prior patent teaches that by simultaneously applying heat and surface pressure to the film to slightly soften the emulsion the silver deposit on the emulsion is effectively flattened and the infinitesimal voids in the surface of the emulsion closed so as to prevent carbonized matter from settling therein and also, greatly to minimize friction on the film when pulling the film through a projector.

It is my opinion that motion picture film is affected by certain climatic (particularly arid), conditions, and also by radiant heat from the arc in the optical system of a motion picture projector to the extent that deterioration of the film results which is proportional to the rate of loss (by evaporation) of the moisture content from the molecular structure of the film. In consequence thereof, the film loses its vitality, softness, pliability and other characteristic qualities so necessary for continued practical use of the film. I find this true of both old and new film and also of film that has merely remained in storage and has never been exhibited.

I have discovered that by occasionally replenishing the molecular structure of the film with moisture, all of the characteristics favorable to practical usage of the film are retained and the structure placed in a soft, pliable condition.

It is a matter of common knowledge that, in general, bodies increase in size as the temperature increases. I further have discovered that when a motion picture film is run through a picture projector, heat from the projector's arc strikes or attacks the longitudinal center of the film with greater severity at the center than at the longitudinal edges of the film and that there is elongation linearly and medially of the film which is not proportional to that occurring at said longitudinal edges. This causes buckling of the film and tends to destroy necessary horizontal alignment of the sprocket openings, such that when the film is again run through the projector, said openings do not correctly intermesh with the teeth of the driven sprockets. This, sooner or later strains the walls of the openings and tears and breaks down the edges of said film. In addition to this impairment, the frames of the film no longer register exactly as intended with the frame aperture of the projector, and in addition thereto, the intended order of the sound recordings relative to the pick-up mechanism of the sound reproducing apparatus is materially interfered with, making impossible faithful reproduction of sound.

I find that if the film while in continuous translation is subjected to the effect of a humidifying medium at film contracting temperature and substantially concurrently therewith is subjected to the effect of correct surface pressure and heat, the temperature of which is high relative to that of the humidifying medium, normal shrinkage is secured and that if the surface pressure is applied by surface pressure media which seals the film therebetween, essential portions of moisture are transmitted to the molecular structure of the film. If old film is treated in the manner aforestated and is also correctly subjected to the effect of dirt, grease and discoloration eliminating and also to stain neutralizing agents, it can be restored to a condition which is comparable to fresh soft film that has never been run through a projector.

It is of course understood that a film once treated as aforestated, should, for continued preservation thereof be similarly treated from time to time.

The present invention changes somewhat the modus operandi of my prior patented method, and has for some of its more important features, those, as follows, to wit:

(1) The feature enabling film to be conditioned at low cost and in a manner to insure beneficial results.

(2) The feature enabling the film to be treated more thoroughly while in continuous translation.

(3) The feature which insures a highly effective scrubbing of the film with a cleaning agent and effective removal from the film of all dirty fluid and loose particles of foreign matter before the film is subjected to final treatment.

(4) The feature which insures translation of the film through the heat zone at a speed which exactly corresponds with the angular velocity of the surface pressure media.

(5) The feature which substantially seals the film between the surface pressure media to thereby insure transmission of moisture to the molecu-

lar structure of the film during the step of raising the temperature of the film.

(6) The feature enabling the amount of pressure of the surface pressure media accurately to be controlled.

(7) The feature which insures rapid translation of the film in operative synchronism with all other operations.

(8) The feature making possible controlled transmission of the film at desired speed.

(9) The feature enabling a discoloration correcting and stain neutralizing agent pneumatically to be applied at any pressure deemed by the operator to be best suited to conditions and to place the film at a temperature to insure beneficial treatment thereof when subjected to the surface pressure media and heat.

(10) The step in the method which insures giving to the film the property more readily to transmit light with resulting increased clarity of the projected images.

(11) The feature enabling satisfactory correction of the aforestated inequalities and heretofore existing imperfections and in addition thereto insures better definition of the sound track.

(12) The feature which insures absolute cleanliness of the film before receiving a light rectifying treatment.

(13) The feature enabling controlled portions of the rectifying solution to be applied to the film and uniformly distributed throughout all surfaces thereof.

Wherever herein the invention is said to reside in a theory, it shall be clearly understood that I am not to be bound to the correctness thereof. Actual practice, however, and careful comparison of relative results, seem clearly to show that the theory as stated is correct.

Other objects and advantages will appear in the following specification, and the novel features of the invention particularly pointed out in the appended claim.

My invention is illustrated in the accompanying drawings forming a part of this application, in which

Figure 1 is a front elevation of the mechanism with parts broken away and parts in section;

Figure 2 is a view in rear elevation of the mechanism;

Figure 3 is a vertical section on an enlarged scale taken substantially on the line 3—3 of Figure 1;

Figure 4 is a horizontal section taken substantially on the line 4—4 of Figure 1;

Figure 5 is a vertical section taken on line 5—5 of Figure 2;

Figures 6, 7, 8 and 9 are respectively detail sections taken on the lines 6—6, 7—7, 8—8 and 9—9 of Figure 1;

Figure 10 is a section taken on line 10—10 of Figure 7;

Figure 11 is a section taken on line 11—11 of Figure 8; and

Figure 12 is a schematic illustration partly in elevation and partly in section of the heating and pressing means.

In carrying the invention into practice use is made of mechanism providing zones 500 and 600. Continuous reeling and unreeling of the film while undergoing treatment in these zones is accomplished by means of a pay-off reel 300 and a take-up or winding reel 400.

The zone 500 includes a lower pair of horizontally aligned nozzles 15—15; an upper pair of horizontally disposed nozzles 16—16 and an intermediate pair of horizontally aligned nozzles 17—17. All of these nozzles are suitably supported by a vertical panel 18 which rises from an under structure 19, the latter accommodating air compressor 20 and a motor 21.

The nozzles of each of the aforestated pairs are situated with respect to each other to provide a space between the discharge orifices thereof through which the film can pass without any possibility of its contacting said nozzles. The arrangement also is such that a blast of fluid under pressure will be effectively discharged against an adjacent side of the film from the orifices of each said nozzle.

It is intended that from the intermediate nozzles 17 clean air shall discharge against opposite sides of the film at approximately thirty-five pounds pressure.

From the upper nozzles 16 it is intended that a mixture comprising carbon tetrachloride and chloroform or their equivalents, also Victoria blue or its equivalent shall discharge against opposite sides of the film at a pressure of approximately thirty-five pounds.

From the lower nozzles 15 it is proposed to discharge cleaning fluid against opposite sides of the film at a pressure of from 1 to 5 pounds. This fluid may comprise carbon tetrachloride with a suitable portion of chloroform, the latter being a solvent, serving to slightly soften the Celluloid side of the film so that when surface pressure and heat are applied to the film, all surface scratches in said Celluloid side of the film will be effectively closed.

The speed of the film during reeling and unreeling thereof should be constant and equal in every respect to the angular velocities of the surface pressure media at the zone 600. A satisfactory practical speed is estimated between the range of from 90 to 130 feet per minute.

In the zone 600 is a rotary drum-like heater 22 of substantial diameter, provided with a perfectly smooth periphery 23, the face width of which is approximately the same as the width of the film. Said drum is provided with parallel spaced apart side flanges 24 for confining the film against lateral displacement during continuous translation of the film. The hub 25 of the drum is freely supported upon a spindle 26 which projects horizontally from the front of the panel 18. As this drum is very similar structurally and functionally to the drum 1 in my aforestated prior patent, it will suffice to say that it is hollow and contains a resistance coil adapted when in closed circuit with a source of electrical potential to heat the drum to desired temperature. A practical temperature for my purpose is approximately 190° F.

The drum 22 in addition to being employed as a heat conductor also is an element in a combination of various means providing surface pressure media for gripping and evenly pressing the film 700 almost concurrently with departure thereof from zone 500.

In the general scheme of things, an endless pressure belt 27 is trained over a pulley 28 and has leads 29—29, constricted relatively in a downward direction by their passage between horizontally aligned pulleys 30—30, the belt then passing snugly around drum 22. A similar but somewhat longer belt 31 comes snugly next to the belt 27 and is trained over the pulleys 30—30, across pulleys 32—32, thence under pulley 33. The belts 27 and 31 are preferably constructed of the same material as the film 700. That is to

say, they can be formed of raw film stock. A third belt **34** is employed and is preferably made of one piece woven fabric, stitched, as is customary to render it as nearly unstretchable as possible. It is trained over the pulleys **30—30** and comes under belt **31** circumferentially of the drum **22** and passes over pulleys **32, 32**, thence under pulley **35**. The training of this belt is such that its wrap **334** is outermost of similar wraps of belts **27** and **31**.

The pulley **35** can move vertically in order that by the means presently to be described it can be raised and lowered to enable the tension on the belt **34** to be controlled, whereby the amount of surface pressure imposed upon both sides of the film **700** can be regulated to a nicety.

By reason of the arrangement of said belts **27, 31** and **34**, film can be threaded into the space between belts **27** and **31** from point **36** at the left of Fig. 12, and after being acted upon by the combined belts and the drum **22** can leave from the exit **37** to be wound upon reel **400**. The film **700** is thus always disposed flatwise between the Celluloid belts **27** and **31** and is positively made to travel in absolute synchronism therewith and with the drum **22**.

Pulley **35** has its shaft **38** journaled in a bearing **39**, the latter forming a fixed part of a plate **40**, movable vertically in guide rails **41** on the panel **18**. A rocker shaft **42** is journaled in a bearing **43** on said panel and forwardly of the latter, said shaft has a crank arm **44** adapted to be actuated manually and thereby impart vertical motion to said plate **40** through crank arm **45** on said shaft **42** and a coil spring **46**, the latter connecting said arm **45** with the aforestated bearing **39**. The crank arm **44** has a toothed latching bar **47** which extends through an opening **48** in the top wall of said understructure **19** and is adapted to engage an edge wall of said opening to thereby latch the arm **44** in any position of vertical adjustment.

On the shaft **42** is an idler **49** and trained thereover and around the pulley **50** on shaft **51** of reel **400**, thence around driven pulley **52** on shaft **53** is a driven belt **54**. The shaft **53** is belted to the motor **21** as shown in Fig. 1. It therefore follows that when the motor **21** is operating, power is transferred to the belt **54** thereby driving the reel **400** and simultaneously therewith, power is transferred to belt **34**. By reason of intimacy of relationship of the wraps of belts **27, 31** and **34** to each other and to the drum **23**, all of said belts and the drum will be driven at the same angular velocities. It manifestly follows also that the linear velocity of the film will be the same as said angular velocities of said belts as it must be if these several instrumentalities are to function in the manner intended.

In order that the belt **27** can also be tensioned, the shaft **57** of pulley **28** is carried by a vertically movable plate **58** mounted in guide rails **59** on the panel **18**. A stud **60** extends laterally from said plate and same passes through the eye **61** of an adjusting screw **62**. The screw passes through a bracket **63** in back of said panel and is provided with a nut **64** by which the screw can be adjusted and the traveling plate **58** made to tension said belt **27** by a change in the elevation of said pulley **28**.

The pulley **33** under which the belt **31** passes is yieldingly urged downward by a spring **65** and by this simple means, said belt is under constant resilient tension.

The shaft **51** of reel **400** has a friction element **55** which is yieldingly advanced against a flat face of pulley **50** by a coil spring **56**, thereby exerting sufficient drag on the rotation of said reel to prevent it overrunning at the usual operating speeds of the machine.

The nozzles **15—15** are each provided with orifices **65**, the axes of which are parallel to each other and disposed at such angle to the plane of movement of the film **700** as to insure discharge of liquid jets across the surfaces of the film towards a waste collector **66** in front of panel **18**. Liquid under pressure is conducted to said nozzles through tubing **67** from a liquid container **68**. The container is supplied with liquid from a reservoir **69** through a conduit **70** having a regulating valve **71** and a check valve **72**. Air under pressure is supplied the container through tubing **73** from a pressure line **74**, the latter provided with a regulator **75** and a pressure gauge **76**. In the tubing **73** is a valve **77** for controlling admission of air under pressure to said container **68**. Liquid from the container is delivered to the tubing **67** through a valved discharge tube **78** which makes connection with said tubing at the unions **79**, the latter having connection with the tubing **67**.

The nozzles **17** have their orifices disposed at an angle to insure delivery of fine jets of air against and across the film toward the collector **66**. The cleaning liquid used at the nozzles **15** is volatile and when impinged against the surfaces of the film as heretofore described, all dirt, grease and other particles of foreign matter will be rapidly expelled and conducted to said collector. It is intended that all surplus liquid shall be eliminated from the film before the latter passes the nozzles **17**. Air discharging from the nozzles **17** insures quick evaporation of the lighter portions of said surplus liquid and in spite of the speed at which the film travels, all heavy surplus liquid and loose particles of foreign matter are completely eliminated from the film and the latter placed in a dry clean condition, ready for the next step in the method of treating same.

Air from the branch pressure line **80** is conducted to the tubing **81** through a conduit **82**, the latter having a regulating valve **83**.

The container **81** receives its supply of rectifying and lubricating liquid from a reservoir **84** through a conduit **85**, the latter having a regulating valve **86** and a check valve **87**. Liquid from this container is conducted to the unions **88** through tubes **89** and to said unions run tubes **90** from the branch pressure line through a valved connection **91**. From the unions **88**, liquid under pressure is conducted to the nozzles **16** through tubes **92**. The orifices of the nozzles **16** deliver a wide fan-shaped spray of liquid across the entire surfaces of the film such as insures covering all parts thereof.

Compressed air is supplied the main line **74** through a conduit **92**.

The chloroform used at the nozzles **16** functions to hold the light rectifying agent in solution whereby to insure even distribution of said agent throughout all parts of the print. The Victoria blue used herein as a rectifying agent has desirable lubricating qualities and when the carbon tetrachloride and the chloroform evaporate from the print, the lubricant content of said agent remains and insures smooth running of the film through the projector without objectionable use of wax at the sprockets.

As the volume of the chemicals discharging from the fluid nozzles in zone **500** can be reg-

ulated as desired, it manifestly follows that the temperature of the film can readily be controlled to effect normal shrinkage of the film. As the zones **500** and **600** are very closely related to each other normal shrinkage temperature of the film is effectively maintained until the film is securely caught between the surface pressure media in zone **600** where it concurrently is acted upon by the radiant heat of the drum **22** and normal shrinkage of the film very definitely secured, during which time, the film is securely held at all places against movement relative to the surface pressure media.

To the best of my knowledge, the feature which consists in first lowering the temperature to effect normal shrinkage of the film, then setting the film or securing permanent normal shrinkage, is broadly new, and I shall hope to take full benefit of any functional equivalents of the means disclosed herein for accomplishing this result.

Wherever in the foregoing description I state that the film is translated through space, this shall mean that during the steps which include cleaning, drying and rectifying and lubricating the film, the film has contact with no surfaces that may possibly mar any part of the film or redeposit any foreign matter thereon. The fact that pressures are balanced at opposite sides of the film at each pair of nozzles in zone **500** insures definitely isolating the film from said nozzles.

I find also that because of the angle at which fluid under pressure discharges from the nozzles in zone **500** there is effective turbulence of the fluid which greatly accelerates the effect of the fluid on the film.

The term "rectifying agent" employed herein shall include any chemical or any combination of chemicals capable of neutralizing the effect of the yellowish light obscuring tarnish which the film takes on with age or which comes in consequence of the generation of sulphur fumes either at the arc of the projector during passage of the film across the light or during the process of developing the film.

The temperatures at the nozzles **15—15** and **16—16** are maintained between 28 and 30 degrees F. Due to the close proximity of the zone **500** to the heat and pressure zone **600** the film enters the said heat and pressure zone at from 28 to 30 degrees F. It is important to bear in mind that as a result of the temperature of the film relative to the temperature at said heat and pressure zone, humidity is generated between belts **27** and **31** and is effectively driven into the emulsion and into the Celluloid of the film, thereby supplying the same with moisture necessary for practical preservation of the film during ordinary usage thereof. This treatment is found also to give to the film a highly desirable degree of toughness such as insures against premature damage thereof at the sprocket openings.

At the front of panel **18** switch **100** is employed by means of which the circuit in which motor **21** is connected can be controlled. A similar switch **200** enables the resistance coil in drum **22** to be placed in either closed or open circuit as required. At **301** is disclosed a moisture condenser which is connected between the air hose **350** and line **74**. A thermostat **375** is operatively connected in the circuit of the resistance coil of said drum **22**, whereby the temperature of the drum can be regulated to from 120 to 190 degrees F.

What I claim as my invention is:

The herein described method of cleaning and revitalizing motion picture film which comprises continuously moving the film at a predetermined constant linear velocity; pneumatically impinging an atomized liquid solvent against the opposite sides of the film at an angle to direct the liquid across the film and at a controlled velocity to cause dislodgement of foreign matter from said sides to effect discharge of said matter and surplus liquid from said film at one edge of the latter; similarly impinging clean air against said opposite sides of the film to discharge any loose foreign matter remaining thereon and to dry said opposite sides of the film; uniformly wetting said dry sides of the film with a light rectifying and film softening liquid and applying controlled surface pressure and heat to said wet sides of said film.

GEORGE J. GAGE.