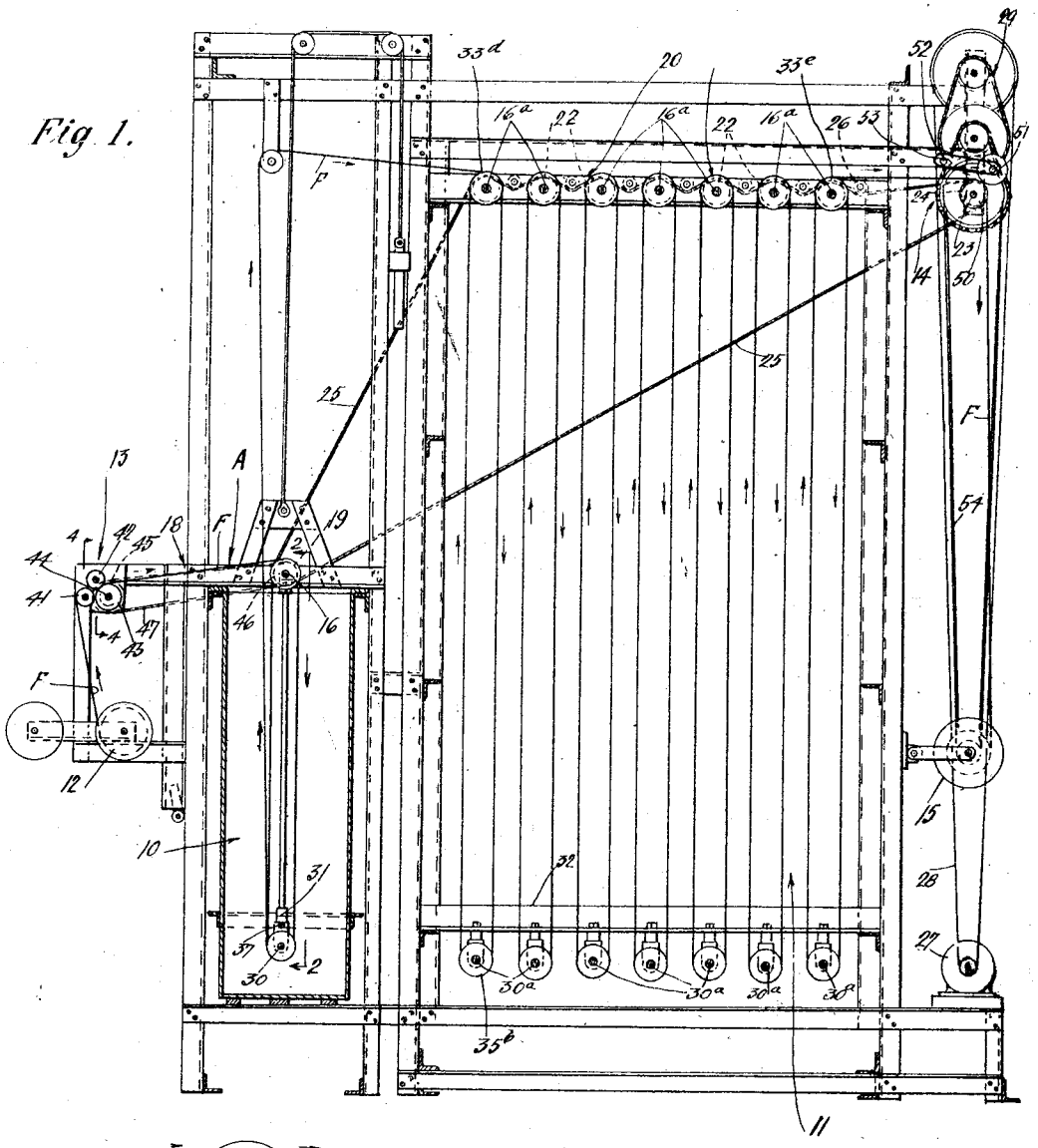
July 7, 1925. 1,544,931

L. J. PATTERSON

FILM TREATING APPARATUS

Filed July 11, 1923 2 Sheets-Sheet 1

Fig. 1.



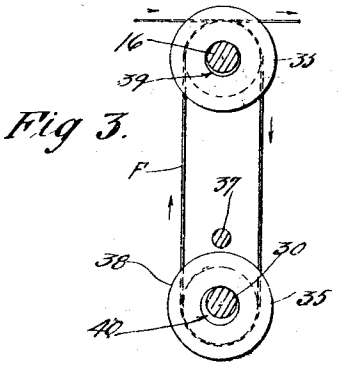
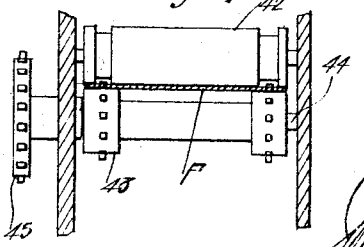


Fig. 3.

Fig. 4.



Inventor.
Leo. J. Patterson.
by
his Attorney.

July 7, 1925.

1,544,931

L. J. PATTERSON

FILM TREATING APPARATUS

Filed July 11, 1923

2 Sheets-Sheet 2

Fig. 2.

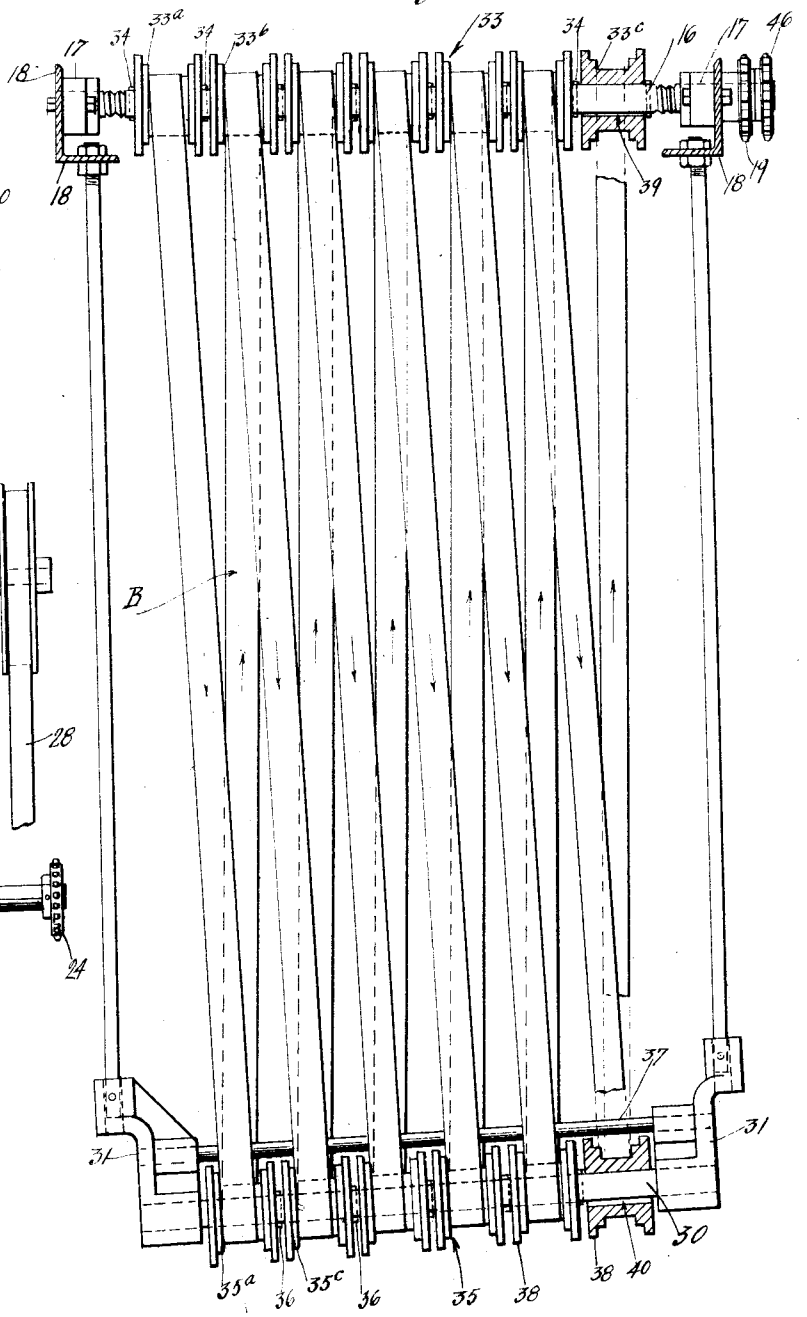


Fig. 6.

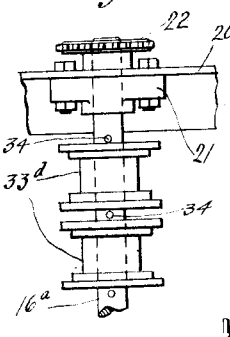
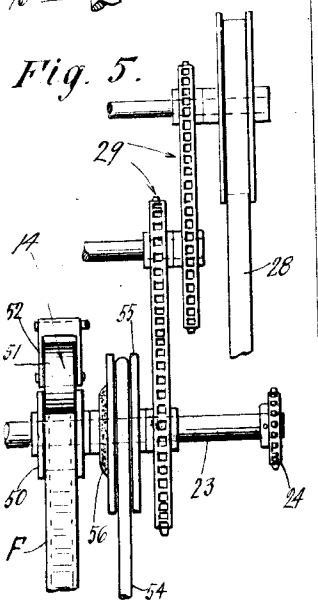


Fig. 5.



Inventor.
Leo. J. Patterson.
by
his Attorney.

Patented July 7, 1925. 1,544,931

UNITED STATES PATENT OFFICE.

LEO J. PATTERSON, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO CINEMA MACHINE CORPORATION, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

FILM-TREATING APPARATUS.

Application filed July 11, 1923. Serial No. 650,761.

To all whom it may concern:

Be it known that I, LEO J. PATTERSON, a citizen of the United States, residing in Los Angeles, county of Los Angeles, State of California, have invented new and useful Improvements in Film-Treating Apparatus, of which the following is a specification.

This invention relates to film handling apparatus and more particularly to apparatus for feeding or propelling continuous strips of motion picture film through the various baths, dryers and machines used in connection with its treatment. The general purpose of the invention is to provide a method and means for moving and controlling the movement of the film through its course in such a manner that film breakage is prevented and whereby increased output is obtained. In general, this is accomplished by a novel means for maintaining the film under allowable and substantially uniform tension throughout its length, irrespective of its extent and irrespective of physical changes in the film body.

My invention meets and overcomes the various peculiar and vexing problems inherent in the mechanical handling of long strips of film as it is passed through the various steps of its treatment, and in order to more fully set forth the application, function and novelty of the invention, it is well to first discuss certain of these problems.

Film treating machines are required for sensitizing, resensitizing or color sensitizing, developing, washing, drying, bleaching, dyeing or toning film; and in many processes it is desirable to employ several of these diverse treatments in succession, the effort being to start the film, whether a negative or positive, at one end of the treating apparatus and deliver the finished product at the other end. This finished product may be ordinary or previously sensitized stock, re-sensitized or color sensitized, black and white negative or positive, toned black and white positive or finished natural color positive ready for projection. Thus, in treating a single length of film, certain portions may be in wet baths, while other portions may be passing through drying chambers. The difficulty heretofore encountered in continuously passing film through the various steps of its treatment has been due to the characteristics which the film has of expanding when wet and contracting when dry, this difference being on the average of from 2/32″ per foot to 3/32″ per foot and the length of film treated ranging as high as 1000′ or more.

Any tendency of the film to contract while being propelled, naturally subjects the film to considerable parting strain. Film yields all the more readily to such strain due to the fact that it is considerably weakened by exposure to moisture or immersion in fluids. It is evident that avoidance of driving sprockets is desirable because of the alternate expansion and contraction of the film and yet that continuous propulsion of the film is required because of its continuity and the desirability of exposing every portion of the film to the various treatments for substantially uniform time periods. While various attempts have been made to solve this problem, satisfactory results have not been heretofore obtained, so far as I am aware.

According to this invention, the foregoing difficulties are overcome and a film of unlimited length rendered capable of being successively passed through any number of wet and dry processes without danger of breaking, scratching, or tearing.

By the very nature of my device variations in the length of the film are automatically compensated, slack arising through excessive expansion being taken up by an immediate automatic acceleration of the film in advance of the expanding portion; while the back pull exerted by a contracting portion of film is compensated by an automatic checking of the advance of the film ahead of the contracting portion without interrupting the film advance behind the portion.

The precise method by which I accomplish the above is set forth in the following de-

tailed description of a preferred embodiment of my invention, from which description other features of novelty and objects of the invention will be apparent. Reference will be made to the accompanying drawings—

Fig. 1 is a diagrammatic view of an apparatus embodying my invention;

Fig. 2 is an enlarged vertical section on line 2—2 of Fig. 1.

Fig. 3 is a diagrammatic view showing the mounting of the drive and idler spools and their relative positions with respect to a brake rod.

Fig. 4 is an enlarged section on line 4—4 of Fig. 1;

Fig. 5 is a view of the speed reduction train and drive mechanism as viewed from the right in Fig. 1; and

Fig. 6 is a fragmentary plan view showing one of the drive shafts in the drying chamber.

Although my invention is applicable to many different forms of apparatus for handling and treating lengths of motion picture film and the like, I will describe but one embodiment in detail. Such a description will enable those skilled in the art to understand the fundamental principles of the invention and how such principles are embodied in one type of machine, whereupon many other applications of the invention to the different machines now known in the art will be apparent. I therefore wish to state at the outset, that the fact I have described but one embodiment of the invention is not to be construed as indicating that my invention is restricted to such limited use, or that my rights are to be limited to this particular embodiment.

For illustrative purposes I have shown the invention embodied in an apparatus where film passes successively through a liquid bath in treating tank 10 and thence through a drying chamber 11, such an apparatus being especially well adapted for the purpose since it involves a typical example of exposing film to conditions which cause its alternate expansion and contraction.

The general course of the film F from the supply spool 12, "hold-back" or film retarder 13, tank 10, chamber 11, delivery means 14 to the take-up reel 15 is indicated by the arrows in Fig. 1. A drive shaft 16 is journalled at 17 on the tank frame 18 and carries sprocket 19, while a plurality of substantially parallel drive shafts 16^a are journalled on the chamber frame 20 at 21 and carry sprockets 22. Power shaft 23 is journalled on frame 20 and carries sprocket 24. Sprockets 19, 22 and 24 have equal diameters and are connected by drive chain 25, which is also trained beneath idlers 26 on frame 20. Shafts 16 and 16^a are thus adapted to be rotated in the same direction upon rotation of shaft 23. In the specific embodiment illustrated, this direction of rotation is clockwise, as viewed in Fig. 1, the chain being driven by motor 27, through belt 28, and the sprocket and chain speed reduction 29. The drive of shafts 16 and 16^a is constant and positive. An idler shaft 30 is carried by hangers 31 which depend from frame 18, and idler shafts 30^a are supported by the cross-bar 32 in drying chamber 11, there being a companion idler shaft for each drive shaft. In the drawings each drive shaft is shown in vertical alignment with its companion idler shaft, but this showing is not a limitation on the invention, as the shafts may be in any relative arrangement which is operative.

Since the construction, mounting and functions, of the spools on shafts 16 and 30 are the same as of the spools on shafts 16^a and 30^a, respectively, it will be necessary to describe but one set of spools in detail.

A series of drive spools 33 is carried on shaft 16, the spools normally being frictionally driven by the shaft. Pins 34 serve to position the spools laterally on the shaft and separate the spools so that one spool cannot be driven by frictional contact with another, thus insuring that each spool is driven independently from shaft 16, only. Shaft 30 carries a series of idler spools 35 which are in staggered relation to spools 33, in the manner illustrated in Fig. 2. Pins 36 on shaft 30 serve to maintain this relation by limiting the side play of spools 35 and also prevent frictional contact between the spools. A brake rod or bar 37 is supported by hangers 31 above and parallel to shaft 30.

In order to more definitely describe the mounting and compensating action of the spools, I will assign to them certain characteristics and dimensions which I have found by actual practice to be suitable, although I do not wish to imply that successful operation is dependent on the parts having these particular characteristics and proportions. The several shafts, spools and rods are constructed of such material that the co-efficient of friction between each spool 33 and shaft 16 is substantially the same as that between the bar 37 and the rim flanges 38 of each idler spool 35 when, under certain circumstances, the idler spool is raised into contact with said bar. The bores 39 of spools 33 are about 1.02 inches inside diameter so that, while shaft 16, which is one inch in diameter, for instance will ordinarily frictionally drive these spools the rotation of the latter may be checked without checking the shaft rotation. The bores 40 of spools 35 are about 1.02 inches inside diameter so the spools 35 are capable of considerable play or movement bodily about

shaft 30 which is 0.875 inches diameter. As a matter of fact, spools 35 normally "float" about shaft 30, the shaft primarily functioning with pins 36 as a means for laterally positioning the idler spools. Brake bar 37 is about .0625 inches above flanges 38 of spools 35 when such spools are in their lowermost position with relation to shaft 30, but it is apparent that when about half of the clearance between the idler spools and shaft 30 has been taken up by raising the spools, flanges 38 will contact with brake bar 37.

Film from supply spool 12 is threaded through retarder 13 which may consist of rollers 41, 42 and film sprocket 43 (Fig. 4), the teeth of the latter engaging the usual film perforations. Sprocket 43 is mounted on shaft 44 which is journalled on frame 18 and carries sprocket 45. The latter sprocket is driven from shaft 16 through sprocket 46 and chain 47. The drive connection is such that the peripheral speed of film sprocket 43 is less than the maximum face peripheral speed of drive spools 33 as frictionally driven by rotation of shaft 16 when said shaft is rotating at a given speed, this ratio of peripheral speeds being accomplished, for instance, by making sprocket 43 and spools 33 of equal diameter, and making sprocket 45 of greater diameter than sprocket 46 so that shaft 44 which carries sprocket 43 revolves at a slower speed than shaft 16 which carries spools 33. Since sprocket 43 and the first drive spool 33^a are connected by a course of film, the peripheral speed of the spool cannot be greater than that of the sprocket (assuming that the course of film between them is not expanding), and therefore since sprocket 43 and its shaft 44 revolve as one, the angular velocity of spool 33^a will be less than that of its shaft 16, and a slippage will occur between the spool and its shaft. It is obvious, however, that spool 33^a continuously functions as a film advancing means as long as the course of film between it and sprockets 43 does not contract, since shaft 16 is normally tending to rotate the spool at a higher peripheral speed than that at which sprocket 43 is traveling, and it is also evident that in the event the said course of film expands or stretches, spool 33^a will pick up in speed, pass more film and thus compensate for the expansion. On the other hand, should contraction occur in this course of film, the film advance is retarded and the peripheral speed of spool 33^a is reduced to compensate the contraction, an increased slippage between the spool and its shaft then occurring. The extent of film retardation offered by sprocket 43 is also dependent on certain other conditions, but these conditions may be discussed to better advantage later in the description. At this point, however, I wish to point out that while I have illustrated the film retarding means 13 as including a positively driven sprocket 43, I may utilize other means to perform the same function. For instance, a pulley, positively driven to effect the described condition of film retardation, may be substituted for film sprocket 43, in which case, roller 42 may be arranged to hold the film in such contact with the positively driven pulley to prevent slippage between the film and pulley.

Film F passes from drive spool 33^a down around the first idler spool 35^a, thence upwardly around the second drive spool 33^b and so on over the entire series of spools on shafts 16 and 30, finally being taken off from the last drive spool 33^c, whence it passes to similarly arranged drive spools 33^d and idler spools 35^b on shafts 16^a and 30^a, respectively. From the last drive spool 33^e in chamber 11 the film is carried over drive pulley 50 which, for illustrative purposes, may be considered as of the same diameter as spools 33 and which pulley is loose on power shaft 23, and thence the film passes to take-up reel 15. Pressure idler 51 is journalled in the swinging arm 52 which is pivotally mounted on frame 20 at 53 and idler 51 rides on the face of pulley 50, or rather, on the film which is trained over this pulley. The weight of idler 51 as imposed upon the pulley 50 causes the pulley to be frictionally driven by shaft 23, but allows slippage between pulley and shaft, so that the speed of rotation of the pulley may be less than that of the shaft. Of course, idler 51 presses the film upon pulley 50 with sufficient force to insure film traction on said pulley. The peripheral speed of pulley 50 is normally the same as that of spools 33, the pulley being held down to this speed by reason of its film connection with the spool 33^e, and since shafts 16 and 23 revolve at the same speed, shaft 23 will rotate faster than pulley 50. The amount of pull on the film exerted by the delivery means 14 (consisting of shaft 23, pulley 50 and idler 52) will be discussed later. Take-up reel 15 is driven by belt 54 trained over a pulley 55, which pulley is loose on the power shaft 23 and is driven therefrom by a usual friction clutch 56.

It will be seen that between each two adjacent drive spools, say 33^a and 33^b, on shaft 16, a loop of film is formed with an idler spool, in this case 35^a, included within and at the bottom of the loop. Taken as a whole, therefore, the film within tank 10 is arranged in the form of a spiral or a series of connected loops, while within chamber 11 the film is arranged in a series of spirals, each spiral being made up of a series of loops in the same manner as that described in connection with the tank contained film.

Film expansion or contraction may take place within each loop, between spirals, between series of spirals, and between the tank in the chamber, and I have provided for compensating such length variation, irrespective of point of occurrence, by the particular method of mounting the drive and idler spools on their respective shafts and the provision of brake bars 37.

To better describe the operation of the device, it is well to first assume that no fluid is present in tank 10 and that the film is in such a condition that it is neither capable of expanding nor contracting. Such a film condition probably never exists, but the assumption will aid in describing certain operative principles of the machine. We will also suppose that the film is carried directly from the last tank drive spool 33^e to pulley 50, which is a proper assumption since the apparatus in chamber 11 is a mere duplication of that in tank 10. Now suppose (for purposes of description) that the drive chain 47 were removed to disconnect the retarder 13, and the film tightly grasped at a point A between reel 12 and the first drive spool 33^a, and the film pulled back with a force greater than the film advancing force, which is then put into effect by starting motor 27. Shaft 16 is revolved in a clockwise direction, as viewed in Fig. 3, tending to drive spools 33 in the same direction. However, since the film is pulled back at point A, the first drive spool 33^a is held from rotating, while, for the instant, all the remaining drive spools 33 continue in their rotation. The superior manual pull on the film, however, shortens the first film loop 33^a, 35^a, 33^b, raising the idler spool 35^a into contact with bar 37 which thereupon exerts a braking action on, and stops the rotation of this idler spool. The stopping of spool 35^a, in turn, halts the rotation of spool 33^b, since the two spools are connected by a course of film and since the co-efficient of friction between shaft 16 and spool 33^b is substantially the same as between spool 35^a and bar 37, while the braking force applied against spool 35^a by rod 37 has an advantage of increased leverage over the driving force applied to spool 33^b by shaft 16, or, in other words, the braking torque is greater than the driving torque. Now the apparatus is so designed that this braking action of spools 35^a and 33^b takes place before the predetermined allowable tensile strain on the film course B, extending therebetween, has been exceeded. It is evident that one-half the weight of idler 35^a is supported by film course B and that the tension imposed on the film by this amount of weight lies well within the allowable limit of film tension.

The stopping of drive spool 33^b results in a shortening of the next succeeding film loop, whereupon the second idler spool 35^c is raised and braked, bringing the third drive spool to rest. Thus a progressive halting of the idler and drive spools takes place throughout the film spiral. Delivery pulley 50 has such frictional contact with its shaft 23 that it exerts sufficient pull on the film to insure the support of the last idler spool and to maintain the predetermined film advance from the last idler spool during normal operation, but is stopped in its rotation by the complete braking of the said last idler spool in a manner similar to that in which the driving spools 33 are stopped by a preceding companion idler spool. By reason of the delivery means, take-up 15 is not depended upon for advancing the film, (though, of course, the individual delivery pulley may be eliminated and take-up reel 15 arranged to take the film directly from the last drive spool 33^e and function in a manner similar to that described in connection with shaft 23, pulley 50 and idler 51), and the film may be disconnected from the take-up reel for the purpose of threading it onto another reel without effecting the continuous film feed through the apparatus. The pull of pulley 50, however, is insufficient to impose more than the allowable tensile strain on the course of film between it and the last idler spool after said last spool has been braked. As soon as the film has thus been brought entirely to rest, friction 56 slips and take-up reel 15 ceases to rotate.

The entire film has thus been brought to rest even though shafts 16 and 23 are still in motion, but the stopping of the film has been progressive and each loop has only been subjected to such a tension as is sufficient to completely brake its particular idler spool. In other words each loop may be considered as having been halted within itself so there has been no accumulation or building up of tension at any point in the spiral.

Now assume the actual operating conditions; the film is released at point A and drive chain 47 reconnected so as to cause rotation of film sprocket 43. As previously stated sprocket 43 retards the speed of the film to cut down the rotative speed of drive spool 33^a (and hence the remaining drive spools) to less than that of shaft 16, or, in other words, drive spools 33 are capable of advancing the film at a greater lineal speed than it is fed into the machine by the retarder. It has been pointed out that delivery pulley 50 operates similarly to drive spools 33; it therefore follows that said pulley is capable of delivering film from the machine (or from the last drive spool) at greater lineal speed than it is fed in by the retarder. Drive spool 33^a feeds the film forwardly from sprocket 43 and lowers spool 35^a out of full braking contact with brake

bar 37 whereupon the force of driving friction between shaft 16 and driving spool 33b becomes greater than the force of braking friction between the idler spool 35a and bar 37. Spool 33b thereupon starts to rotate, functioning to advance the film to the second idler spool 35c. The second film 100b is thus lengthened, relieving the second idler spool from complete braking contact with bar 37 and thus allows the third drive spool 33c to be driven by shaft 16. This relief of companion idler and drive spools progresses through the entire spool series and through delivery means 14 until the entire film is advancing, being continually taken up by reel 15. During this movement of the film, idler spools 35 scrape lightly against brake bar 37 but with insufficient braking effect to stop the rotation of the drive spools 33. A frictional equilibrium is thus established, wherein the driving frictional force exceeds the braking frictional force, and the film is advanced under the uniform predetermined tension throughout, each single course of film being subjected only to a tension sufficient to support one-half the weight of an idler spool plus the amount of force necessary to move it through a single loop.

In the above we assumed that no variation in film length takes place. Now let us consider the effect of film contraction and expansion. Film contraction has the effect of increasing the tension of the film; while film expansion has the effect of decreasing the tension of the film. Generally speaking, this variation in tension disturbs the equilibrium above described, but by reason of the arrangement of the spools, the film expansion or contraction is automatically compensated to automatically restore the equilibrium and thus maintain the film under the uniform predetermined tension.

Suppose for instance the film making up the loop 33a, 35a and 33b were to expand, or in other words, the first loop were to lengthen. Idler spool 35a is then lowered away and relieved from braking engagement with bar 37, the degree of relief depending upon the amount of expansion, allowing drive spool 33b to be revolved at a higher speed by shaft 16 to take up the increased loop length and thus prevent the accumulation of slack in the film. The next following idler spool then drops, due to the increased film feed of spool 33b and the third drive spool is thereby allowed to gain in speed and functions to pick up and pass the increased length of film along to the succeeding loop, where the compensating action is repeated in a similar manner. In this way, the advance of the film ahead of the expanding portion is accelerated and such acceleration continues entirely through the machine unless the expansion is compensated by intervening film contraction. As soon as drive spool 33b has completely advanced the expanded portion of the film, it draws idlers 35a back into normal engagement with bars 37 and the equilibrium is progressively restored throughout the machine.

In explaining the compensating action due to film contraction, I will again refer to the film loop between spools 33a, 35a, and 33b, assuming in this case that the loop is exposed in a drying chamber rather than immersed in a liquid bath. As the loop shortens through contraction, spool 35b is carried upwardly until its flanges 38 engage bar 37 with increased pressure, which results in spool 35a being checked or stopped in its rotation, depending on the degree of film contraction. This braking of spool 35a, in turn, checks the rotation of spool 33b, since the two spools are connected by film course B and since there is now a preponderance of braking friction over driving friction, (this preponderance being gained by reason of the leverage advantage which the braking elements have over the driving elements.) Thus, depending on the degree of film contraction, the spool 33b is checked in its rotation or brought to rest, which checks or entirely stops the advance of the film in the next loop ahead, while the rotation of the first drive spool 33a is uneffected and continues to feed the film therefrom into the loop at uniform, constant speed until the loop is lengthened sufficiently to lower idler pulley 35a out of its abnormal braking engagement with bar 37. Upon such lowering of idler spool 35a the drive spool 33b is again free to be revolved at normal film advancing speed to feed the film forwardly through the first loop. Thus the equilibrium which was disturbed by reason of the contraction of the film, is restored and during the restoration the film in the loop has not been subjected to excessive tensile strain.

In connection with the foregoing, spools 33a, 35a and 33b may be considered as a complete compensating unit and it will be understood that each succeeding set of spools similarly related further compensate for film contraction within their associated film loop. However, since each loop is a part of a single length or spiral of film, the variation in length of one loop effects certain of the loops ahead of it. For instance, take the case just described, where spool 33b is checked by reason of film contraction between it and spools 33a. When spool 33b and the advance of the film in the first loop is initially checked, all the drive spools to the right thereof (Fig. 2) are still rotating at normal speed, and the second loop is therefore taken up or shortened. This results in the second idler spool 35c being raised with increased pressure against bar 37 and this action checks or stops the third drive spool 33c. Thus a progressive check-

ing of the spools and loops takes place until the entire length of film ahead of roller 33^b is checked in its advance (unless an intervening expansion of the film compensates the contraction) until roller 33^a has fed in enough extra film to compensate for the contraction, whereupon all the spools are progressively released from the left until all of the driving spools are again functioning to advance the complete length of film.

It will be noted that the contraction is compensated within each loop as the contraction occurs and that even though all the loops were contracting at the same time, this contraction is compensated as it occurs with no accumulative tendency. Except for the provisions I have made, slight contractions in each loop, which contractions in themselves might not be sufficient to break the film, would, if transmitted from loop to loop, build up or accumulate to such an extent that the film would finally give way and tear.

Film expansions and contractions are not ordinarily sudden, while the compensation afforded by my device is immediate. Therefore in ordinary practice the frictional equilibrium is practically constant and the tension on the film is maintained substantially uniform even during the most extreme cases of expansion and contraction, and this tension never exceeds the permissible limit.

It is to be noted that it is not necessary to the successful operation of the device that all the drive or idler spools need be of exactly the same diameter, as the peripheral speed of each is maintained at the proper rate irrespective of variations in diameter. Shafts 16 and 30 may be slightly inclined towards each other in order that the major axis of each film course may be perpendicular to the faces of the driving spools as the film passes onto them from the idler spools and perpendicular to the idler spool faces as the film passes onto them from the driving spools. Such an inclination is desirable because, otherwise, due to the staggered relation of the driving and idler spools the film would tend to exert a side thrust on film and spools and cause undesirable friction.

It will be noted that I have avoided the provision of driving mechanism at the bottom of solution or wash tanks. Thus, in my device there is no necessity for immersed gearing, packed shafts, and the like, which are troublesome and inaccessible.

It will be understood that many structural variations may be made without departing from the spirit and scope of my invention. For instance, I may dispense with the idler spools in certain of the loops, I may dispose the drive and idler shafts in other than vertical alignment, I may vary the relative sizes of shafts, sprockets and spools, or I may vary the general construction to adapt the invention to machines other than those mentioned. Therefore I do not wish to be limited to the particular embodiment of my invention shown and described, except for such limitations as a fair interpretation of the claims may import.

I claim:

1. In film propelling apparatus, spools over which the film is trained, frictional driving means for certain of said spools, the other spools being bodily movable, and means to brake the last named spools during their bodily movement.

2. In film propelling apparatus, drive spools and bodily movable idler spools over which the film is alternately trained, frictional driving means for the drive spools, and means to brake the idler spools during their bodily movement.

3. In film propelling apparatus, means for applying film advancing force at a plurality of points on the film, and means co-acting with the film for independently c ntrolling each film advancing means, whereby the film is maintained under substantially uniform tension throughout, said means including bodily movable idler spools coacting with the film intermediate said points of force application, and means adapted to brake the idler spools during their bodily movement in one direction.

4. In film propelling apparatus, drive spools and idler spools over which the film is alternately trained, said idler spools being bodily movable, means for advancing the film over the spools under substantially uniform tension throughout, irrespective of film contraction or expansion, said means comprising means for frictionally driving the drive spools, and means for braking the idler spools during their bodily movement.

5. In film propelling apparatus, drive spools and idler spools over which the film is alternately trained, said idler spools being bodily movable, means for advancing the film over the spools under substantially uniform tension throughout, irrespective of film contraction or expansion, said means comprising means for frictionally driving the drive spools, and means for braking the idler spools during their bodily movement, the frictional driving force exceeding the braking force when the film is under normal or less than normal tension, and the braking force exceeding the driving force when the film is under greater than normal tension.

6. In film propelling apparatus, a frictional driving means for a loop of film, means adapted to feed film into the loop at less linear speed than the frictional driving means is capable of advancing the film through the loop, frictionally driven delivery means capable of pulling film from the loop at a greater lineal speed than it is fed thereinto by said feeding means; and means

adapted to retard movement of the film through the loop and actuated by virtue of shortening of the loop.

7. In film propelling apparatus, a frictional driving means for a loop of film, means adapted to feed film into the loop at a fixed linear speed that is less than the linear speed at which the frictional driving means is capable of advancing the film through the loop, frictionally driven delivery means capable of pulling film from the loop at a greater lineal speed than it is fed thereinto by said feeding means; and means adapted to retard movement of the film through the loop and actuated by virtue of shortening of the loop.

8. In film propelling apparatus, a frictionally driven spool, a cooperating rotatable and bodily movable idler spool to receive a film loop from the driven spool, and means for braking said idler spool upon predetermined bodily movement thereof.

9. In film propelling apparatus, a driving shaft, a spool frictionally driven thereby with normal limited slip between the shaft and spool, and a cooperating idler spool to receive a loop of film from said first spool.

10. In film propelling apparatus, a driving shaft, a spool frictionally driven thereby with normal limited slip between the shaft and spool, a cooperating bodily movable idler spool to receive a loop of film from said first spool, and means limiting movement of said idler spool toward said first spool due to contraction of the film to reduce the feed of film by said first spool.

11. In film propelling apparatus, a series of propelling spools independently frictionally driven with normal limited slip between each spool and its shaft, and a bodily movable and rotatable idler spool between two of said driven spools.

12. In film propelling apparatus, a series of propelling spools independently frictionally driven with normal limited slip between each spool and its shaft, a bodily movable and rotatable idler spool between two of said driven spools, and means limiting the bodily movement of said idler spool and braking the idler spool and hence the succeeding driving spool to retard the feed of film by the succeeding driving spool.

13. In a film propelling mechanism, a drive shaft, two spaced sets of supporting spools, one set of spools being loosely mounted on and being adapted to be frictionally driven by said shaft, the other set of spools being movable towards and away from said one set and being adapted to compensate for expansion and contraction of film trained alternately over the two sets by virute of such movement.

14. In film propelling apparatus, a series of propelling spools independently frictionally driven with normal limited slip between each spool and its shaft, a bodily movable and rotatable idler spool between two of said driven spools and adapted to form a loop in the film between said two drive spools, means adapted to feed film to one of the drive spools at less than the full peripheral speed of the drive spools, and frictionally driven take-up means capable of pulling film from the loop at greater speed than it is fed thereinto by said feeding means.

15. In film propelling apparatus, frictional driving means for a loop of film, means to retard the film and retard the frictional driving means, means to retard movement of the film through the loop and actuated by virtue of shortening of the loop, and frictionally driven means capable of pulling film from the loop at a greater lineal speed than the retarding means allows the film to pass through the loop.

16. In a film propelling apparatus, a frictionally driven spool, an idler spool below the first spool and adapted to be supported in a film loop from the first spool, a brake limiting upward movement and rotation of the idler spool, and means limiting downward movement of the idler spool.

17. In film propelling apparatus, a receptacle for film loops, a driven shaft across the receptacle carrying loose film driving spools, and a second shaft across the receptacle carrying a free idler spool for a film loop between two of said driving spools.

18. In film propelling apparatus, a frictional driving means for a loop of film, a bodily movable idler spool in the film loop, and means to brake the idler when it is moved by reason of the film loop shortening.

19. In film propelling apparatus, a plurality of independent frictional driving means for loops of film, independent bodily movable idler spools in the several film loops, and means to brake each idler spool when it is moved by reason of its film loop shortening.

20. In film propelling apparatus, a frictional driving means for a loop of film, and means to retard movement of the film through the loop actuated by virtue of shortening of the loop.

21. In film propelling apparatus, a plurality of independent frictional driving means for loops of film, and independent means to retard movement of the film through the several loops actuated by virtue of shortening such a loop.

22. In film propelling apparatus, a frictional driving means for a loop of film, a bodily movable idler spool in the film loop, and means to brake the idler when it is moved by reason of the film loop shortening; the braking force being greater than the frictional driving force.

23. In film propelling apparatus, a plu-

rality of independent frictional driving means for loops of film, independent bodily movable idler spools in the several film loops, and means to brake each idler spool when it is moved by reason of its film loop shortening; the braking force being greater than the frictional driving force.

24. In film propelling apparatus, a frictional driving means for a loop of film, and means to retard movement of the film through the loop actuated by virtue of shortening of the loop: the braking force being greater than the frictional driving force.

25. In film propelling apparatus, a plurality of independent frictional driving means for loops of film, and independent means to retard movement of the film through the several loops actuated by virtue of shortening such a loop; the braking force being greater than the frictional driving force.

26. In film propelling apparatus, a driving shaft with a driving spool loosely mounted thereon to be frictionally driven from the shaft, an idler shaft substantially parallel to the driving shaft, an idler spool loosely mounted on the shaft so as to be rotatable thereon and bodily movable transversely thereof a limited distance, the driving and idler spools being adapted to take a loop of film, and a brake rod arranged near the periphery of the idler spool on that side of the idler shaft toward driving shaft, and into contact with which brake rod the idler spool is adapted to be moved by virtue of shortening of the film loop.

27. In film propelling apparatus, a driving shaft, a plurality of driving spools arranged in longitudinally spaced relation on the driving shaft, each spool being loose on the shaft so as to be frictionally driven from the shaft independently of all other driving spools; an idler shaft substantially parallel to the driving shaft, a plurality of idler spools loosely carried by the idler shaft, each spool being freely rotatable on the idler shaft and bodily movable thereon in a direction transverse of the shaft; said driving and idler spools being adapted to take a plurality of film loops; and a brake rod near and parallel to the idler shaft and on that side of the idler shaft toward the driving shaft, each idler spool being adapted to peripherally contact with said brake rod when moved by virtue of shortening of its film loop and before it has reached its limit of transverse movement with reference to the idler shaft, and means to retard the movement of the film and thereby to retard the rotation of the driving spools relative to their driving shaft.

28. In film propelling apparatus, a frictional driving means for a loop of film, means to retard the film and retard the frictional driving means, a bodily movable idler spool in the film loop, and means to brake the idler when it is moved by reason of the film loop shortening.

29. In film propelling apparatus, a frictional driving means for a loop of film, means to retard the film and retard the frictional driving means, and means to retard movement of the film through the loop actuated by virtue of shortening of the loop.

30. In film propelling apparatus, a plurality of independent frictional driving means for loops of film, means to retard the film and retard the frictional driving means, independent bodily movable idler spools in the several film loops, and means to brake each idler spool when it is moved by reason of its film loop shortening; the braking force being greater than the frictional driving force.

31. In film propelling apparatus, a driving shaft with a driving spool loosely mounted thereon to be frictionally driven from the shaft, an idler shaft substantially parallel to the driving shaft, an idler spool loosely mounted on the shaft so as to be rotatable thereon and bodily movable transversely thereof a limited distance, the driving and idler spools being adapted to take a loop of film, and a brake rod arranged near the periphery of the idler spool on that side of the idler shaft toward the driving shaft, and into contact with which brake rod the idler spool is adapted to be moved by virtue of shortening of the film loop, and means to retard the movement of the film and thereby to retard the rotation of the driving spool relative to its driving shaft.

32. In film propelling apparatus, a plurality of independent frictional driving means for loops of film, independent bodily movable idler spools in the several film loops, means to feed film to the driving means at less linear speed than said driving means is capable of advancing the film, means to brake each idler spool when it is moved by virtue of its film loop shortening; and frictionally driven take-up means adapted to pull the film from the driving means at greater lineal speed than said feeding means feeds the film to the driving means.

33. In film propelling apparatus, a driving shaft, a plurality of driving spools arranged in longitudinally spaced relation on the driving shaft, each spool being loose on the shaft so as to be frictionally driven from the shaft independently of all other driving spools; an idler shaft substantially parallel to the driving shaft, a plurality of idler spools loosely carried by the idler shaft, each spool being freely rotatable on the idler shaft and bodily movable thereon in a direction transverse of the shaft; said driving and idler spools being adapted to take a

plurality of film loops; a brake rod near and parallel to the idler shaft and on that side of the idler shaft toward the driving shaft, each idler spool being adapted to peripherally contact with said brake rod when moved by virtue of shortening of its film loop and before it has reached its limit of transverse movement with reference to the idler shaft, means to retard the movement of the film and thereby to retard the rotation of the driving spools relative to their driving shaft; and frictionally driven take-up means capable of withdrawing the film from the driving spools at a greater lineal speed than it moves through said retarding means.

In witness that I claim the foregoing I have hereunto subscribed my name this 27th day of June 1923.

LEO J. PATTERSON.