Feb. 7, 1939. W. V. BRENBARGER ET AL 2,146,170

FILM SUPPORTING AND DRIVING MEANS

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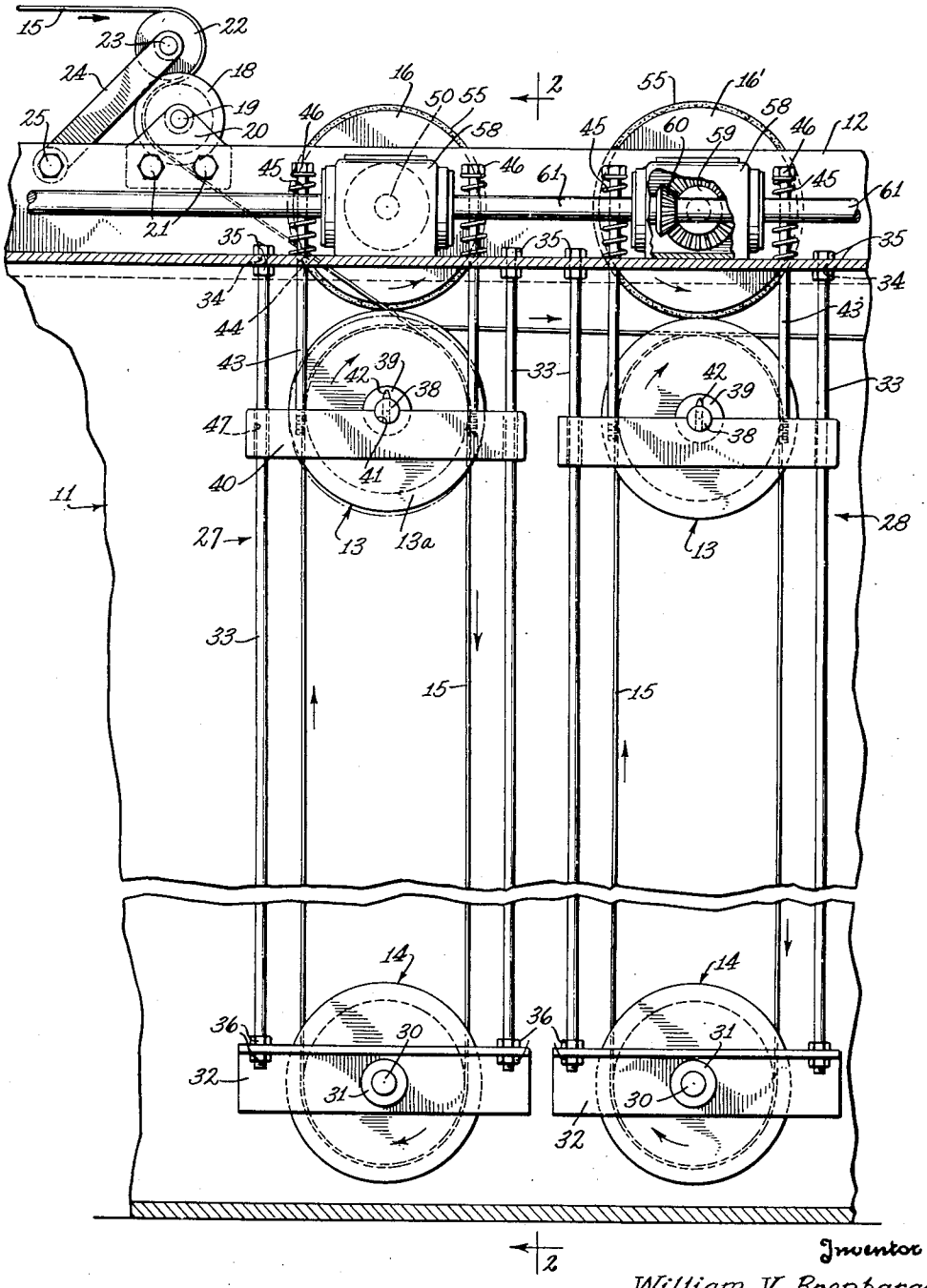

Fig. 1.

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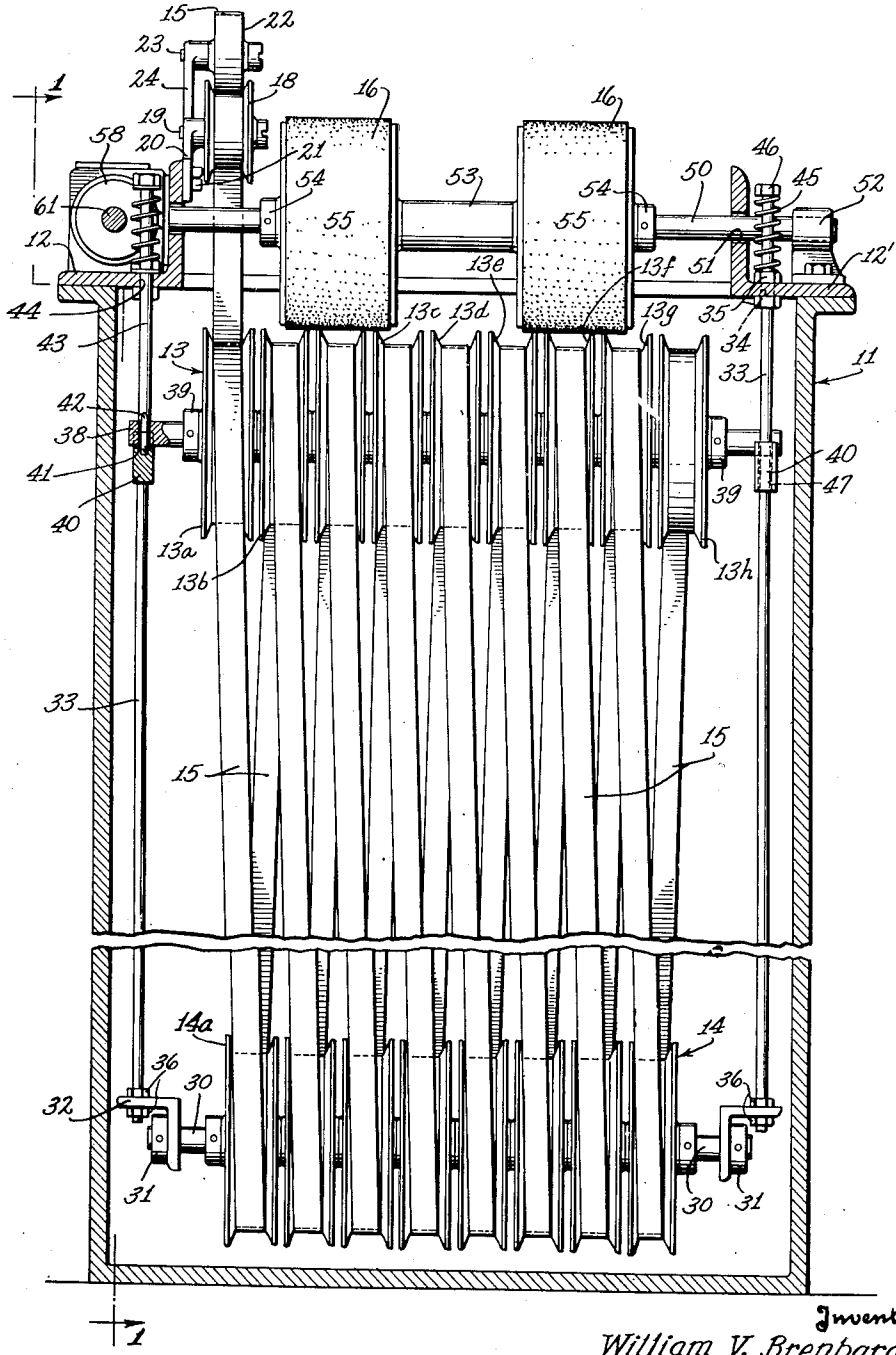

Fig. 2.

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FILM SUPPORTING AND DRIVING MEANS

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10 Claims. (Cl. 271—2.3)

This invention relates generally to apparatus for developing motion picture film and particularly to means for supporting and moving the film through the developing, fixing and washing tanks and through the drying cabinets.

In film developing it is the usual practice to run the film in a continuous length through a series of tanks containing developing solutions, rinse solutions, fixing solutions, and wash solutions, and to run it through one or more drying cabinets. A series of film carrying rollers is provided at the top and at the bottom of the tanks and in the drying cabinet so that the film forms a multiplicty of loops in passing through each tank and through the drying cabinet. The film is driven either by sprocket wheels located at suitably spaced distances or by the frictional engagement of the film with certain of the rolls which are driven, or by a combination of both of these means.

This invention employs the frictional driving rollers alone and is not concerned with the sprocket system of driving the film.

As is well known in the art, the film, as it becomes wet in developing, swells and stretches and subsequently as it is dried shrinks again to approximately its original size. In developing machines utilizing the frictional driving of the film, various means are employed to keep the film under the proper tension, so that it will frictionally engage the driving rollers sufficiently to be driven thereby through the tanks. Such tensioning means must provide for the stretching and shrinking of the film. In order to accomplish this there is usually provided means for enlarging and reducing the size of the film loops or some of the loops which the film forms as it is wound about the various rollers.

One common method of accomplishing this is to have certain of the lower rollers weighted and mounted for vertical movement. The disadvantage of this construction lies in the fact that the film must support the weight of the lower rollers and their mounting means, thereby tending to mechanically stretch the film and distort the images and sound track thereon. It therefore is an object of this invention to provide means for supporting and moving the film adapted to accommodate for the natural stretching and shrinking of the film without causing the film to support or bear the weight of any portion of the apparatus, so that there will be no possibility of subjecting the film to a greater tension than it can readily bear without stretching.

Certain developing machines provide driven lower rollers so that if the film stretches the slack developed thereby leaves or drops below the driving rollers with the consequent result that the film is not driven by such rollers and the slack tends to work back to the starting point of the driving mechanism. Very often in such machines the film accumulates upon the bottom of the tank in a series of convolutions and may easily be scratched and may even fail to be properly drawn back upon the proper rollers when the slack is subsequently taken up. The disadvantages of this system are obvious, and it therefore is an object of this invention to provide a means for supporting and driving the film so that the film cannot become slack at any point throughout the mechanism.

Certain other developing machines place the film under considerable tension at the point where it leaves the apparatus and rely upon this tension to raise free running lower rollers into engagement with driving means so that the lower rollers are driven. This system has the obvious disadvantage of placing considerable strain upon the film, since the film itself must overcome the means which yieldably holds the lower rollers out of driving position. Great danger of mechanically stretching the film is always present in such apparatus. Therefore, it is a further object of this invention to provide supporting and driving means for the film which only places a minimum tension upon the film sufficient for it to be frictionally driven by the driving rollers.

Furthermore, many of the devices in use at the present time draw the film from the developing machine at a constant speed and hence, due to shrinkage and stretching of the film during the developing process, must necessarily run the film into the developing solution intermittently. The disadvantage of this condition is the fact that the film may be improperly developed, especially the sound track, due to its intermittent entrance into the developing solution. Intermittent feeding of the film into the developing solution is one of the greatest faults of present day equipment.

In view of the disadvantages of the ordinary film supporting and driving apparatus it is a particular object of this invention to provide apparatus that will feed the film into the developing solution at a constant rate and from which the film may come out at varying speeds depending upon the stretch and shrinkage of the particular film stock during development.

Generally it is an object of this invention to

provide film supporting and driving means which will steadily feed the film into the developing solution and which will automatically compensate for the natural elongation of the film when wet and which will also compensate for the shrinkage of the film as it dries and which, when so compensating for the changing in size of the film, will not place an abnormal or undesirable amount of strain upon the film, nor allow the film to accumulate in slack loops.

This is accomplished by providing film supporting and driving means, the initial driving rollers of which rotate at a slightly slower peripheral speed than the other driving rollers and by providing means for disengaging any or all of the driving rollers if the tension on the film approaches a given amount.

These and other objects will be apparent from the drawings and the following description thereof.

Referring to the drawings—

Fig. 1 is a fragmentary sectional elevation of a developing tank showing film supporting and driving means of this invention in position therein. The plane of the section is indicated by line 1—1 of Fig. 2;

Fig. 2 is a sectional elevation on line 2—2 of Fig. 1.

Particularly describing the invention, reference numeral 11 generally indicates a developing tank which may be of any ordinary construction. It is the ordinary practice to removably mount the film supporting and driving mechanism on top of the tank and accordingly reference numerals 12 and 12' indicate channel members for supporting the film supporting and driving mechanism. These channels may be suitably connected by means of cross members (not shown), such construction being within the scope of the ordinary mechanic.

The film supporting and driving mechanism generally comprises a plurality of sections of upper and lower film carrying rollers. The upper film carrying rollers are designated generally by reference numeral 13 and the lower film carrying rollers by reference numeral 14. The film 15 is looped about these rollers successively as indicated. Certain of the upper rollers are driven by peripheral contact with driving rolls 16 and 16' which are driven by a suitable mechanism, subsequently to be described.

For the purpose of guiding the film to the first section of upper and lower rollers, there is provided tensioning roller 18 which is rotatably mounted on a stud shaft 19 on the bracket 20 which is secured to the channel member 12 by bolts 21. Above this roller there is provided the roller 22 mounted on the pin 23 which is in turn mounted on an arm 24. This arm is pivotally mounted at 25 on the channel 12. The film passes over and around the right side of the roller 22 and then around the left side and bottom of roller 18 to roller 13a from which it passes in loops successively about the various rollers 13 and 14 of the first section of upper and lower rollers 27.

The film passes from the last of the upper rollers in the first section 27 to the second section of upper and lower rollers, generally indicated by reference numeral 28 and successively passes over the various rollers in this section and then passes to the next section in the same tank and other tanks. It is to be understood of course, that as many of these sections of upper and lower rollers may be provided as is necessary to conduct the film through the various solutions needed in the development of the film and through the drying cabinets.

This pair of rollers 18 and 22 provide a necessary drag or tension on the film to insure its being drawn into the machine by the first section of the upper rollers at a steady, constant rate.

This invention contemplates driving the film through frictional contact with certain of the upper rollers which are driven by frictional contact with driving rolls 16 and 16'. It further contemplates having the first section of rollers driven at a slower speed than the succeeding sections, in order to compensate for the natural stretching of the film when wet. The invention also contemplates means for permitting the upper rollers 13 to move away from and out of driving engagement with the driving roll when a given amount of tension is placed on the film.

Referring to the details in construction, the lower rollers 14 of each of the sections of upper and lower rollers are rotatably mounted upon a shaft 30. Both the upper and lower rollers are of the ordinary double-flanged type commonly used in film developing apparatus, however, it has been found desirable to employ large sized rollers so that they may be more easily rotated by the film. A collar 31 is provided at each end of the bank of rollers to keep them in proper position upon the shaft. The shaft 30 is supported at each end upon cross members 32. The cross members are hung in the developing tank by means of rods 33 which extend upwardly through suitable holes 34 in the members 12 and 12' and are provided with the nuts 35 threadably engaging the upper end and nuts 36 at the lower end.

As distinguished from the comparatively rigid mounting of the lower rollers, the upper rollers 13 are mounted for yieldable vertical movement. Referring to the details of the mounting of the upper rollers, these rollers are rotatably mounted on a shaft 38 and are held in position thereon by collars 39. This upper shaft is carried by saddle members 40 which are provided with the grooves 41 into which the shaft 38 fits and is secured by means of pins 42. These saddle members 40 are dependently mounted in the tank upon supporting rods 43 which extend upwardly and slidably through suitable holes 44 in the members 12 and 12'. These rods are provided with the compression springs 45 and nuts 46. The saddle members 40 are provided with the holes 47 which are of greater diameter than the rods 33 and through which said rods extend. This construction provides for yieldable downwardly vertical movement of the upper rollers 13, the saddle members being slidable on the rods 33.

For the purpose of driving certain of the upper rollers 13 in each of the sections of upper and lower rollers, the driving rolls 16 and 16' are provided. Reference number 16 indicates the first set of driving rolls located over the first section of upper and lower film carrying rollers, said section being at the beginning of or entrance to the developing apparatus. It is to be understood of course that as many of the sets of driving rolls 16' are to be provided as there are sections of upper and lower film carrying rollers 28 throughout the developing apparatus. Each of the driving rolls 16 is designed to have a peripheral speed slower than the succeeding sets of driving rolls 16' throughout the machine.

For the details in the construction of these rolls, the rolls 16 are rigidly mounted on a drive shaft 50 in any suitable manner. This shaft

passes through holes 51 in the channels 12 and 12' respectively, and is supported at one end by a bearing 52. The driving rolls are separated by a sleeve 53 and held in place by the collars 54. Each of the driving rolls is provided with a resilient band or tire 55 of any suitable material.

The shaft 50 extends into a gear box, generally indicated by reference numeral 58 and is provided with a suitable mitre gear 59 which engages with a similar gear 60 on main drive shaft 61 which passes through the various gear boxes and which may be driven at the desired speed by any ordinary motive power.

To accomplish the driving of the initial driving rolls 16 so that they will have a less peripheral speed than any of the succeeding driving rolls 16', this may be done either by making the rolls 16 slightly smaller than the succeeding rolls 16' or by changing the gear ratio in the gear box. As the simplest means of accomplishing this, the driving rolls 16 are made slightly smaller than the succeeding rolls 16'. In the drawings the decreased size of the initial drive rolls has been exaggerated for the purpose of illustration.

In the operation of the device the film is threaded through the various tanks and cabinets, the film passing in loops about the various sections of upper and lower rollers to a take-up reel. At the end of the developing apparatus, where the film emerges completely developed and dried, sufficient tension is placed upon it to draw it away from the last section of upper and lower rollers.

The film enters the developing apparatus by passing around rollers 18 and 22 which serve to put a drag upon the film which the apparatus must overcome. This insures constant feeding of the film into the machine. From these rollers the film passes to roller 13*a* and then around lower roller 14*a* and back up to pass around roller 13*b* and in like manner passes around the remainder of the upper and lower rollers of the first section of rollers, leaving the last upper roller, 13*h*, to pass to the first upper roller of the next section 28. The film passes around the rollers of this second section and is then conducted about as many succeeding sections of upper and lower rollers as is necessary to carry the required capacity of film through the various tanks and the drying means.

Frictional contact of the film with the rollers 13*b*, 13*c*, 13*d*, 13*f*, 13*g* and 13*h* causes it to be propelled over the first section of upper and lower rollers. It has been found unnecessary to provide driving means for all of the upper rollers 13 and any desirable number of these might be driven. Film passing around the rollers of the second section and each succeeding section of upper and lower rollers is also driven by certain of the upper rollers which are normally peripherally engaged by driving rolls 16'. As the film swells and stretches as it becomes wet by the developing solutions, that is compensated for by the fact that the drive rolls 16' drive the upper rollers 13 which they engage at a peripheral speed slightly greater than the speed of the rollers in the first section 27.

The compression springs 45 are set to yieldably hold the upper rollers 13 in engagement with the driving rolls. The springs, with the exception of the first section 27, should preferably exert just sufficient force to support the upper rollers and the normal film load. With this construction, whenever any excess or abnormal tension occurs the springs 45 yield and allow the upper rollers 13 to drop out of engagement relation with the drive rolls until such time as the normal tension returns. The springs of the first section preferably exert a greater force than the springs of the succeeding sections so as to insure the film being drawn into the developing tank at a constant speed.

With this construction it should be apparent that there can be no danger of mechanically stretching the film. By reason of the fact that the initial driving means operates at a slower speed than the succeeding means no slack can develop through elongation of the film during development. Furthermore, the film is fed steadily into the developer solution at a constant controlled speed.

We claim as our invention:

1. In film supporting and driving means, the combination of: a frame; a first section of upper and lower film carrying rollers dependently mounted on said frame; a plurality of succeeding sections of upper and lower film carrying rollers dependently mounted on said frame; means for driving certain of the rollers of said first section at a given rate of speed; means for driving certain of the rollers of the succeeding sections at a speed in excess of the speed of the rollers of said first section; and means whereby the rollers of said sections may be disengaged from their respective driving means when the tension of the film exceeds a given amount.

2. In film supporting a driving means, the combination of: a frame; a first section of upper and lower film carrying rollers dependently mounted on said frame; a plurality of succeeding sections of upper and lower film carrying rollers dependently mounted on said frame; a driving roll rotatably mounted in said frame for engagement with certain of the upper rollers of said first section; succeeding driving rolls rotatably mounted for engagement with certain of the upper rollers of respective succeeding sections, said last mentioned driving rolls being of greater diameter than the first mentioned driving roll; and means for rotating said driving rolls.

3. In film supporting and driving means, the combination of: a frame; a first section of upper and lower film carrying rollers dependently mounted on said frame; a plurality of succeeding sections of upper and lower film carrying rollers dependently mounted on said frame; a driving roll rotatably mounted in said frame for engagement with certain of the upper rollers of said first section; succeeding driving rolls rotatably mounted for engagement with certain of the upper rollers of respective succeeding sections, said last mentioned driving rolls being of greater diameter than the first mentioned driving roll; means for rotating said driving rolls; and means whereby the engaged upper rollers may be disengaged from said driving rolls when the tension of said film exceeds a given amount.

4. In film supporting and driving means, the combination of: a frame; a first section of upper and lower film carrying rollers dependently mounted on said frame; a plurality of succeeding sections of upper and lower film carrying rollers dependently mounted on said frame; a driving roll rotatably mounted in said frame and adapted to peripherally engage certain of the upper rollers of said first section; succeeding driving rolls rotatably mounted in said frame and adapted to peripherally engage certain of the upper rollers of the succeeding sections; means for driving said driving rolls, said first mentioned driving roll

having a peripheral speed less than the speed of the last mentioned driving rolls.

5. In film supporting and driving means for use in a developing tank or the like, the combination of: a frame; a lower shaft dependently mounted on said frame adjacent the bottom of said tank; a plurality of film carrying rollers rotatably mounted on said shaft; an upper shaft dependently mounted on said frame; a plurality of film carrying rollers rotatably mounted on said shaft; a drive shaft rotatably mounted above said upper shaft in said frame; a driving roll rigidly mounted on said drive shaft and adapted to peripherally engage certain of the film carrying rollers on said upper shaft; means for rotating said drive shaft; and means for permitting said upper shaft to move downwardly to disengage the film carrying rollers thereon from the driving roll when the tension of the film exceeds a given amount.

6. In film supporting and driving means for use in a developing tank or the like, the combinatin of: a frame; a plurality of lower film carrying rollers rotatably mounted on said frame; a drive shaft rotatably mounted on said frame; a driving roll mounted on said drive shaft; means for rotating said shaft; vertically movable supporting members mounted on said frame; a shaft mounted on said supporting members below said drive shaft; upper film carrying rollers rotatably mounted on said shaft; and means for yieldably holding said supporting members with some of said upper film carrying rollers in peripheral engagement with said driving roll.

7. In film supporting and driving means for use in a developing tank or the like, the combination of: a frame; a plurality of lower film carrying rollers rotatably mounted in said frame adjacent the bottom of the tank; a drive shaft rotatably mounted on said frame; means for rotating said drive shaft; a driving roll mounted on said drive shaft; two pairs of downwardly extending rods vertically slidably mounted on said frame; a cross member connecting each pair of rods at their lower ends; a shaft mounted at each end on the respective cross members; upper film carrying rollers rotatably mounted on said shaft; and spring means associated with said rods whereby some of said upper film carrying rollers are yieldably held in engagement with said driving rolls.

8. In film supporting and driving means for use in a developing tank or the like, the combination of: a frame; a first bank of lower film carrying rollers rotatably mounted on said frame; a second bank of lower film carrying rollers rotatably mounted on said frame; a first drive shaft rotatably mounted in said frame; a second drive shaft rotatably mounted in said frame; means for rotating said shafts; a first driving roll mounted on said first drive shaft; a second driving roll mounted on said second drive shaft, said second driving roll being larger than said first driving roll; a first set of vertically movable supporting members mounted on said frame; a second set of vertically movable supporting members mounted on said frame; a first shaft mounted on said first set of supporting members; a second shaft mounted on said second set of supporting members, said first and second shafts being below said first and second drive shafts respectively; a first bank of upper film carrying rollers rotatably mounted on said first shaft; a second bank of upper film carrying rollers mounted on said second shaft; spring means associated with said first set of supporting members whereby some of the upper film carrying rollers of said first bank are yieldably held in engagement with said first driving roll; and spring means associated with said second set of supporting members whereby some of the upper film carrying rollers of said second bank are yieldably held in engagement with said second driving roll.

9. In film supporting and driving means, the combination of: a frame; a plurality of lower film carrying rollers rotatably mounted on said frame; a plurality of upper film carrying rollers rotatably mounted on said frame; a drive roll mounted for peripheral engagement with some of the upper rollers; means for rotating said drive roll; and means for permitting said upper rollers to move away from said drive roll to disengage said upper rollers from said drive roll when the tension of the film exceeds a given amount.

10. In film supporting and driving means, the combination of: a frame; a plurality of lower film carrying rollers rotatably mounted on said frame; a plurality of upper film carrying rollers rotatably mounted on said frame; a drive roll mounted for peripheral engagement with some of said upper rollers; means for rotating said drive roll; and means for yieldably holding said upper rollers in peripheral engagement with said drive roll whereby said upper rollers may be disengaged from said drive roll when the tension of the film exceeds a given amount.

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