June 7, 1927.

C. DE MOOS

1,631,476

PHOTOGRAPHIC FILM DEVELOPING MACHINE

Filed June 9, 1922

4 Sheets-Sheet 1

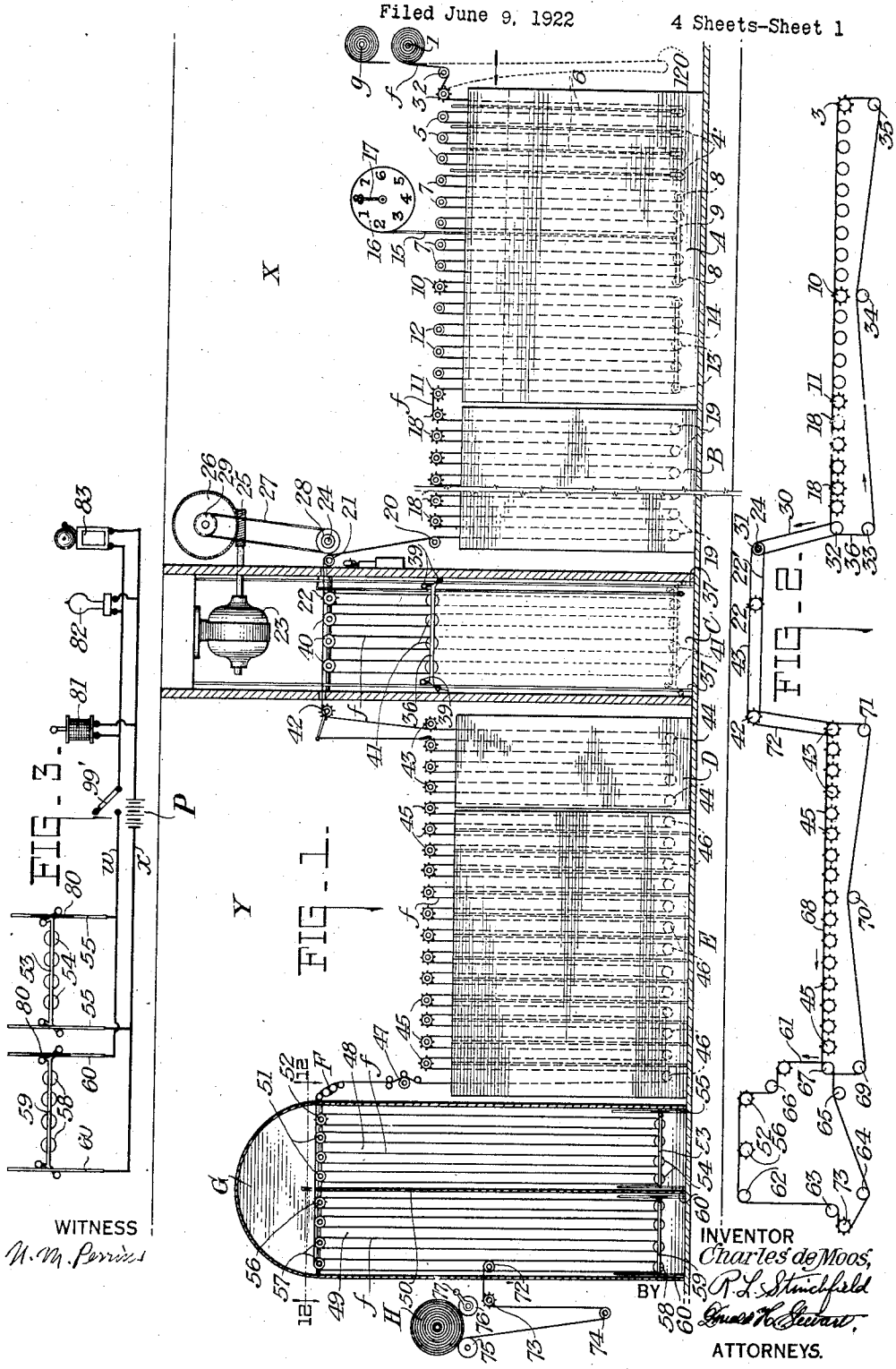

FIG. 1.

FIG. 2.

FIG. 3.

WITNESS

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4 Sheets-Sheet 2

FIG. 4.

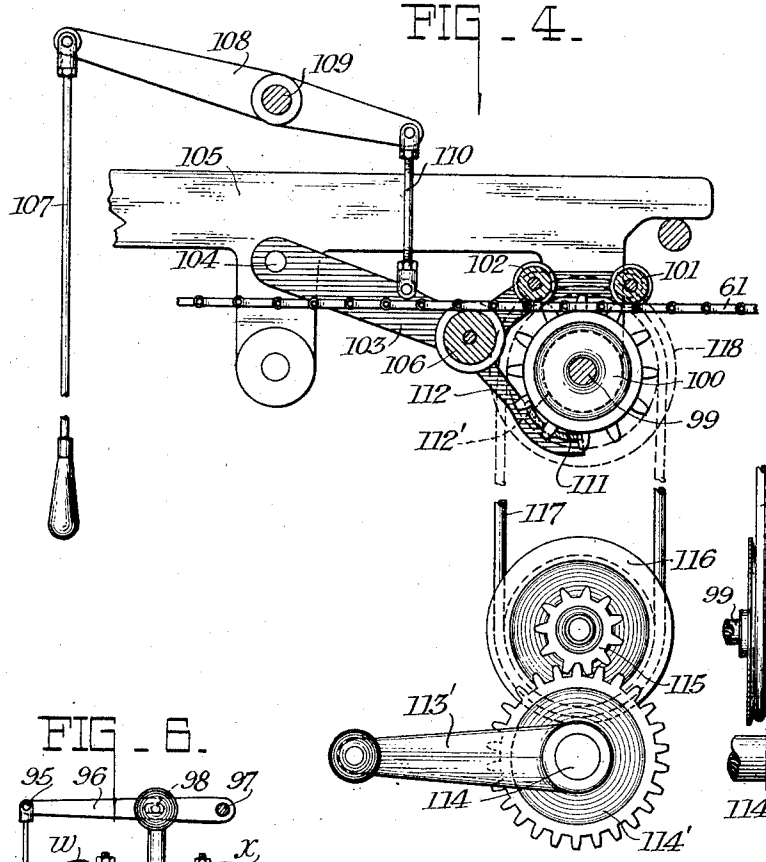


FIG. 5.

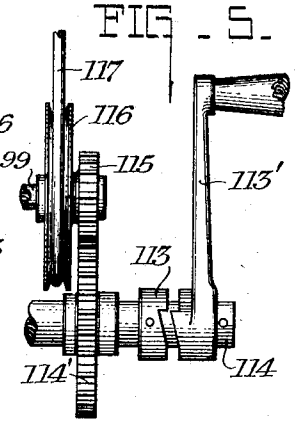


FIG. 6.

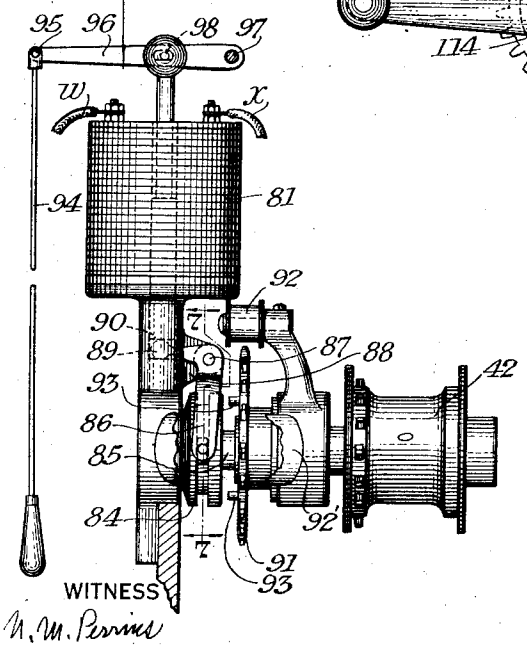
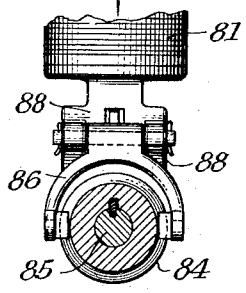


FIG. 7.



WITNESS

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PHOTOGRAPHIC FILM DEVELOPING MACHINE

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FIG. 8.

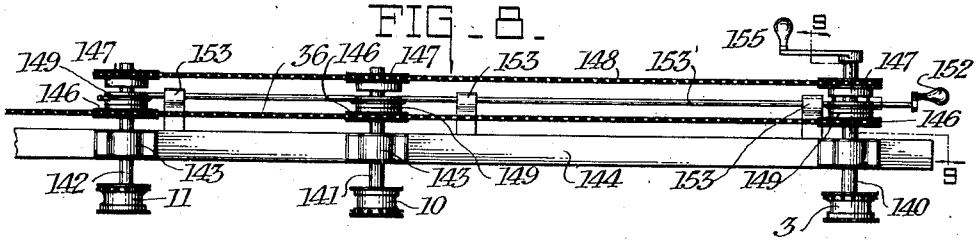


FIG. 9.

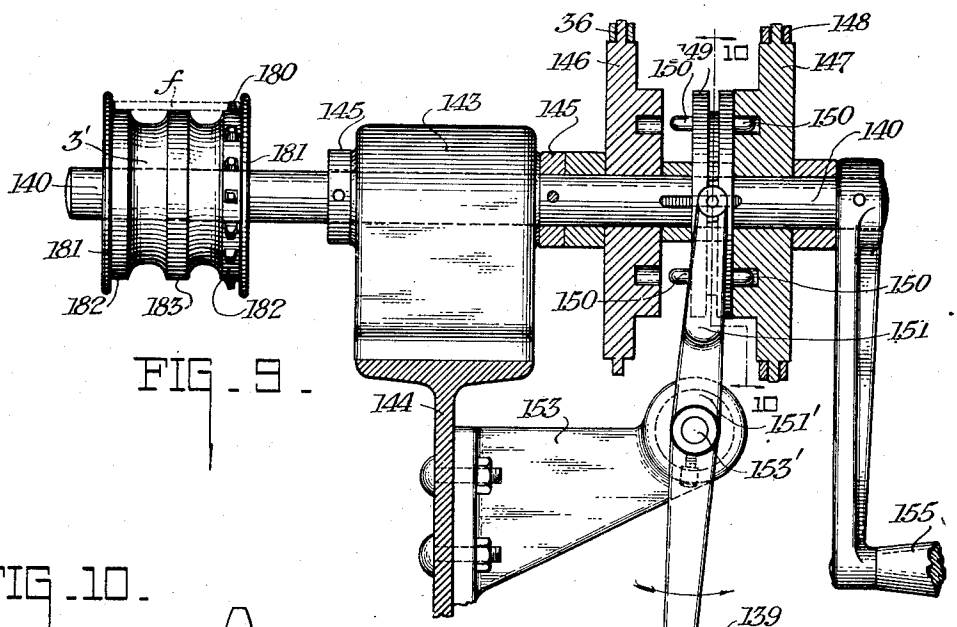


FIG. 10.

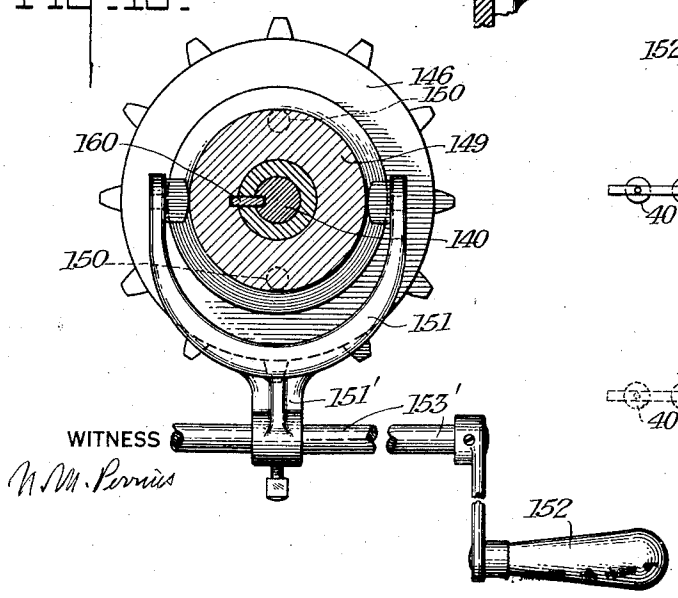
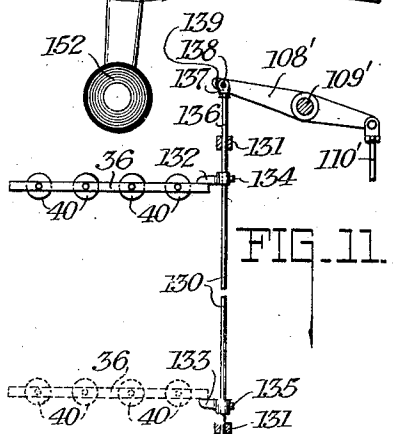


FIG. 11.



WITNESS

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June 7, 1927. 1,631,476

C. DE MOOS

PHOTOGRAPHIC FILM DEVELOPING MACHINE

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FIG. 12.

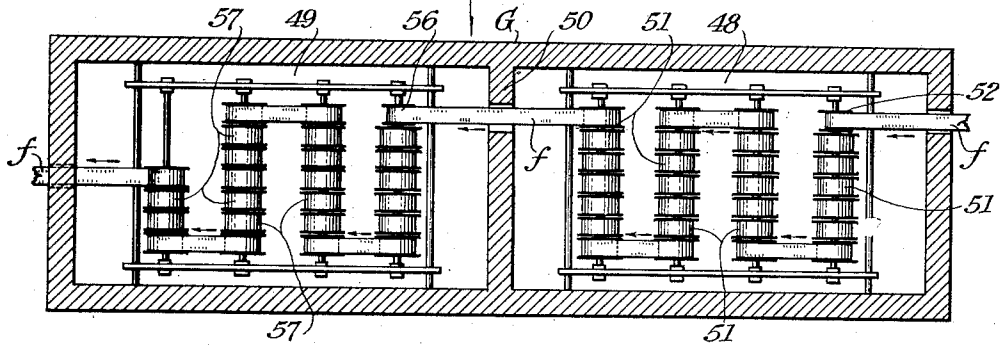
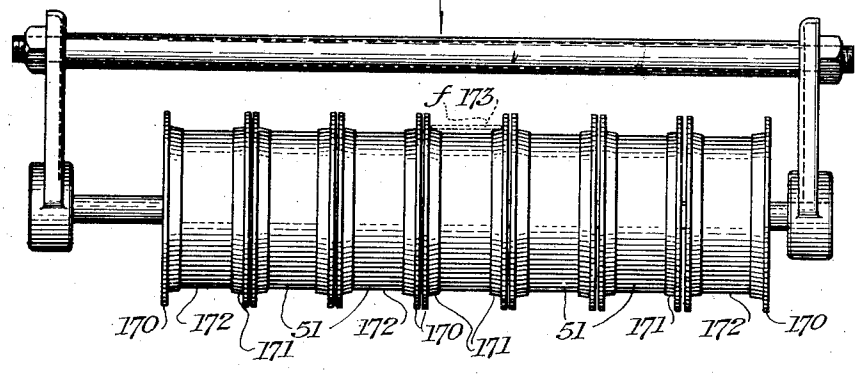


FIG. 13.



WITNESS

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Patented June 7, 1927. 1,631,476

UNITED STATES PATENT OFFICE.

CHARLES DE MOOS, OF FORT LEE, NEW JERSEY, ASSIGNOR TO EASTMAN KODAK COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

PHOTOGRAPHIC FILM-DEVELOPING MACHINE.

Application filed June 9, 1922. Serial No. 567,146.

This invention relates to photography and more particularly to photographic film-developing machines of the type used in completing the various treatments necessary to produce the motion picture film negative and positive films. One object of my invention is to provide a machine in which the film in the developing bath will not be spoiled by an accident to the film in other parts of the machine; another object is to provide a compensating take-up chamber which will receive an extra quantity of film when an emergency arises; another object is to provide an automatic feed for the take-up chamber; another object is to provide a movable film rack which forms a part of the take-up mechanism, together with an automatic clutch for the take-up chamber; another object is to provide a driving mechanism for the film strip; another object is to provide a drying chamber and means for allowing for the film shrinkage therein; still another object is to provide an automatic device which will cooperate with the take-up chamber automatic clutch to control the film band; and a further object is to provide means for adjusting the loops in both the take-up and the drying chambers. With these and other objects in view, the invention consists in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings in which like reference characters denote like parts throughout:

Fig. 1 is a view of a complete machine constructed in accordance with and illustrating one form of my invention, parts being shown in section and parts in elevation, unessential details being omitted;

Fig. 2 is a diagrammatic view of the drive;

Fig. 3 is a diagrammatic view of an electric circuit used with the machine shown in Fig. 1;

Fig. 4 is a section through a portion of the drying chamber driving mechanism;

Fig. 5 is an elevation of a portion of the drive shown in Fig. 4;

Fig. 6 is a side elevation, partly broken away, of a magnetic clutch;

Fig. 7 is a section on line 7—7 of Fig. 6;

Fig. 8 is a top plan of the hand or power drive for the developing bath mechanism;

Fig. 9 is an enlarged detail, partly in section taken on line 9—9 of Fig. 8;

Fig. 10 is a section taken on line 10—10 of Fig. 9;

Fig. 11 is a detail of a mechanical clutch operating mechanism used in the take-up chamber;

Fig. 12 is a section on line 12—12 of Fig. 1; and

Fig. 13 is an elevation of a pulley rack.

A strip of film is drawn successively through the developing and fixing baths, A and B, and then into a take-up chamber C, from which the strip material is drawn through a spraying bath D into special treatment bath E, then through wipers F, into a drying chamber G. From this chamber the film is drawn by suitable mechanism and is finally wound into a completed roll at H. In chamber C, I have provided an automatic looping mechanism which will be of sufficient capacity to hold at least the quantity of film which can be treated in bath A at one time. For convenience the right-hand side of the machine in which tanks A and B are located is called the dark side as these operations are conducted in a darkened room X, and the left-hand side the light side, where tanks D and E are located in a bright room Y, with the take-up chamber C in between.

Referring more particularly to Fig. 1, the film *f* is drawn from a core 1, over idler 2 by means of a sprocket 3 after which it passes over suitable lower rollers 4 and upper rollers 5 which run free upon their respective shafts. Rollers 4 are supported upon rods 6 which project above the top of tanks A, these rods normally remaining in the position shown. From one roller 4 the film passes over an upper idler roller 7 of which there are a series, below which there are a series of rollers 8 carried by a floating rack 9. A sprocket 10 draws the film over rollers 7 and 8; and in the machine here shown a second sprocket 11 draws the film over second sets of idlers 12 and 13, the latter being carried by a floating rack 14. In this way the film is led through the developing bath. One of the floating racks 9, carries a chain 15 which is affixed at the upper end

to a dial 16 which indicates the time, by means of a hand 17, indicating the time it takes for the developing operation. This device has been patented, see Patent No. 1,467,106, photographic film treating apparatus, issued to Chas. de Moos Sept. 4, 1923.

From bath A the film passes into the fixing bath B, propelled by a series of sprockets 18 below which there are idlers 19, from the last of which the film passes out of the tank over idlers 20 and 21 and thence into the take-up chamber C, a sprocket 22 in this chamber feeding the film.

The power for turning the sprockets so far described is derived from the motor 23 which drives the main shaft 24 through the worm 25, gear 26, and the chain 27 and sprockets 28 and 29. A chain 30 connects sprockets 31 and 32, the former being connected to the film-driving sprocket 22 by a chain 22′ and the latter driving chain 36 which passes over idlers 33, 34 and 35 and then over a series of sprockets driving the film sprockets 3, 10, 11 and 18. In Fig. 2 only the film-driving sprockets are shown as having teeth, the chain sprockets both idlers and drivers being shown plain.

Sprocket 22, the intake sprocket, is driven from shaft 24 by a sprocket affixed to shaft 24, it being the function of member 22 to feed the strip material into the take-up chamber. Here as shown in full lines, the lower, or movable rack 36 moves on guides 37 embraced by rollers 39, and its normal position is raised as shown. The film is looped about rollers 40 on the top fixed rack and over idlers 41 on the lower rack. Film is drawn from this chamber by a sprocket 42, known as the exit sprocket, which is separately connected by a chain 43 to drive shaft 24. There are a series of rollers on each shaft in the take-up chamber, just as there are in the drying chamber racks shown in Fig. 12. The number is determined by the film which can be in the developing bath A at one time, here, about 400 feet. This take-up chamber is designed so that at least 425 feet of film will pass into the loops as the lower rack 36 moves from position shown in full lines to that shown in dashed lines, Fig. 1. This, naturally, can only occur when pulley 42 is stationary and pulley 22 is moving. Thus film is temporarily stored in this chamber.

From sprocket 42 the film passes through the series of tanks of the baths D and E where the film is sprayed, tinted or toned or where any desired treatment can be given. The sprockets 43 carry the strip over rollers 44 through bath D; while sprockets 45 carry the film over rollers 46 in baths D. From tank D the film passes through a vacuum suction device 47 and a film wiping pad F into the drying chamber G.

This chamber comprises two sections, 48 and 49, separated by a partition 50. Air is circulated through one, over the partition into the other chamber. As best shown in Figs. 12 and 13 the film is looped about idler rollers 51 after passing over the intake sprocket 52. A lower floating rack 53 carries a similar series of rollers 54. This rack is movable upon rails 55 for a limited distance. In section 49 the film is routed in the same way, over an intake sprocket 56, upper idlers 57 and lower idlers 58 carried by rack 59 movable upon rails 60. As the film shrinks in drying the racks, 53 and 59 will move the necessary distance as sprockets 52 and 56 are driven together by a belt 61 which passes over a series of idlers 62, 63, 64, 65 and 66 being driven by 67. A second belt 68 passing over idlers 69, 70 and 71 drives the sprockets 43 and 45. A belt 72 transmits power from drive roller 42 to sprocket 43. Thus when drive roller 42 stops, all of side Y of the machine stops moving.

From the last roller 58 of rack 59 the film passes over idler 72′ being drawn by sprocket 73, after which the completed film passes over a suitable guide roller 74 to the wind-up mechanism 75 and 76. The completed film may be wound into a roll H by power through 75 or by hand if desired by handle 77, the latter being only used in emergencies.

The usual variations in the length of the film bands are cared for by the floating racks in the drying chamber, but it is desirable to stop the light side (Y) of the machine if the film should break in the drying chamber. This is accomplished by an automatic clutch operated in the following manner: When rack 53 or 59 moves beyond a limited distance (Fig. 3) in either direction, by rolling off of the insulated portion 80 of rails 55 and 60, a circuit is made energizing solenoid 81, lighting a lamp 82, and ringing a bell 83, all simultaneously, as these are all connected to wires w and x. P conventionally indicates a source of power.

First, the solenoid 81 (Fig. 6) when energized throws out clutch block 84 slidable on, but keyed to turn with, drive shaft 85. Film sprocket 42 is affixed to this shaft and, therefore, stops when the solenoid operates. The clutch block is embraced by a yoke 86 which comprises one side of a bell crank lever pivoted at 87 to the frame 88, and having one end 89 engaging the core 90 of the solenoid. Sprocket 91 runs freely upon shaft 85 being driven by a chain (not shown) held on the sprocket by idler 92 supported by the casting 92′ which is partly broken away. Pins 93 engage in suitable apertures in the clutch block when thrown in. This may be accomplished by a pull chain 94 attached at 95 to a lever 96 pivoted at 97 to the frame, and pivoted at 98 to the solenoid core. By pulling the chain after

the circuit is broken, sprocket 42 is started.

After the circuit is once made as above described it is necessary to return the racks 53 and 59 to their initial position to the break the circuit, although switch 99′ can be used if desired. To return the racks to their original position the following mechanism may be used: Referring to Fig. 4, a shaft 99 is driven by a sprocket 100 under the power furnished by a chain 61 normally pressed to the sprocket by rollers 101 and 102 carried by the lever 103 pivoted at 104 to frame 105. A roller 106, also carried by the lever is below the chain and will raise it from the sprocket when the lever is moved by pulling chain 107 attached to lever 108 pivoted at 109 to a frame and connected by a link 110 to lever 103. The chain 107 can be pulled to cause the chain 61 to leave the sprocket wheel after which a further movement causes the friction pad 111 carried by arm 112 of lever 103 to contact with the face of a drum 112′ affixed to shaft 99 stopping the rotation of the shaft or exerting a braking action according to the pressure applied upon chain 107.

To rotate shaft 99 at a different speed from that obtained from the chain 61 the chain 61 is raised from the sprocket just enough to release the driving connection but not to apply the brake. A handle 113′ can then be thrust into operative engagement with clutch block 113 and the shaft 114 can be rotated through gears 114′, 115, pulley 116, belt 117 and pulley 118 affixed to the shaft. This shaft carries the film sprocket 52 and a similar mechanism can be used for sprocket 56 if desired.

With the above described mechanism the film racks 53 and 59 can be raised or lowered as the case may require either by actually rotating the film-driving spools by hand, or by momentarily releasing them from their mechanical drive.

When the light side Y of the machine has stopped it is obvious that the film being developed would be ruined unless removed from the developer by drawing through the tank A in the usual manner. If the light side of the machine is stopped through accident or otherwise, first the solenoid above described is energized; second the lamp 82 is lit; and third the bell 83 is actuated; these last two being signals to notify the machine operator of the condition of the film in the machine. The operator then makes a loop of film as is shown at 120, Fig. 1, so that he can then have time to sever the film F and attach the leader strip or dummy band *g*. The loop is made by manually pulling the film from the idler 2. Sprockets 3, 10, 11, 18 and 22 are still moving and draw the film from bath A into bath B, the leader G being drawn into the first bath. During this time the rack 36 is moving down as sprocket 42 is not moving. When it reaches its lowermost position, (dashed lines, Fig. 1) it automatically stops the dark side X of the machine, as will be hereinafter described. As can readily be seen this operation of the take-up chamber mechanism saves practically all of the film being developed. A slightly prolonged time in the fixing solution is not injurious to the film. As the sprockets continue to move at a constant speed all of the film receives the same development, which is, of course, necessary.

In order to stop the sprockets on side X and sprocket 22 of the take-up chamber, a mechanical trip is used. As shown in Fig. 11 this consists of a rod 130 movable vertically in bearings 131 and having two stops 132, 133 adjustable on the rod by set screws 134, 135, and placed in the path of the movable rack 36 so that in its upper position (full lines) the rod is raised, in which position it remains until the rack moves to its lower position (dashed lines) where it strikes stop 133 when the rack will move the rod down. The upper end of the rod 136 carries a yoke 137 and pin 138 the latter passing through a slot 139 in lever 108′. This lever is similar to lever 108 in Fig. 4, and is pivoted at 109′ to a frame and having a link 110′ engaging a lever operating a clutch in all respects like that shown in Fig. 4, so that it will not be again described. Therefore, when rod 130 moves up, pulley 22 is power driven, and, when moved down, is unclutched and stopped by the brake. Pulleys 3, 10, 11 and 18 are likewise actuated or stopped by this mechanism as they are connected to it by the belts 22′, 30 and 36, so all these sprockets normally move as a unit.

It is desirable, however, that sprockets 3, 10, and 11 be, at times, moved separately from the others, since it is necessary to use these to vary the depths of the idlers 4, 8 and 13 in the bath A to control the time of the development. For this purpose I have provided a clutch as is shown in Figs. 8 to 10. Here film sprockets 3, 10 and 11 are shown as mounted on shafts 140, 141 and 142, each being supported by a similar bearing 143 on the I beam 144. Collars 145 definitely locate each of the shafts, 140, 141 and 142, and a clutch is carried on each shaft of the following type: Sprocket 146 is the power sprocket driven by chain 36 and runs free on the shaft. Sprocket 147 also runs free on the shaft and is driven by a short chain 148. Between these sprockets there is a clutch block 149 with pins 150 to engage one or the other of the sprockets, being actuated by a yoke 151, attached to a rod 151′ which can be moved by handle 152. The clutch block 149 is keyed at 160 to the shaft but is slidable thereon. A series

of brackets 153 are affixed to the I beam 144 forming the supports for the clutch block operating rod 153'. One of the shafts, here shown as 140, carries an operating handle 155 by which sprockets 3, 10, and 11 can be manually operated after moving the clutch to the proper position. With this adjustment the idlers 4, 8 and 13 can be quickly regulated, their depth in tank A indicating on dial 17 the time of development.

In Fig. 12 the section through the drying chamber shows that the driving sprockets 52 and 56 are of much smaller diameter than the idlers 51 and 57. The large size of the idlers is an advantage as friction is materially reduced and the strain on the film is considerably lessened. As shown in Fig. 13 the idlers are preferably of a type having flanges 170, raised, slightly angularly shaped film contacting seats 171 and a reduced central hub 172. Thus only the edges of the film touch the rollers as is shown in dashed lines at 173.

It will also be noted from Fig. 9, that sprocket 3' is constructed with the teeth 180 only on one side, there being flanges 181 for guiding the film F. The edges 182 of the sprocket are raised to contact with the film band, and there is in addition a central rib 183 which contacts with the film back. This rib is useful in connection with the one side driving sprocket as it assists in properly guiding the film. But if desired the usual form of spool contacting at the edges only may be used, as shown in Fig. 8.

In this specification where film is referred to, it is intended to cover not only the negative and positive films generally used in the motion picture business, but also any photographically sensitive coating applied to any desired flexible base.

It is obvious that when the film is not to be tinted, toned or otherwise treated, the baths, E, may be omitted and the film will then pass from the drive sprocket 43 over the drive rollers 45 and through the suction 47 and thence into the drying cabinet without looping about rollers 46 in the bottom of the tank.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a film-treating machine, the combination with means for moving a film band through a series of treatment baths, of means for automatically stopping the movement of a portion of the film band in advance of stopping the movement of the entire film band.

2. In a film-treating machine, the combination with means for continuously moving a film band through a series of treatment baths, of means for stopping a portion of the film band in advance of stopping the movement of the entire film band, and means for automatically storing temporarily a portion of the film.

3. In a film-treating machine, the combination with means for drawing a film continuously through a plurality of treatment baths, of means between two of the treatment baths for temporarily storing film.

4. In a film-treating machine, the combination with means for passing film through a series of treatment baths, of sprockets operating at a uniform speed for feeding the film into each of the baths, means for stopping the film-feeding sprockets for some of the baths and automatic means for stopping the remaining sprockets after a predetermined interval of time.

5. A film-treating machine adapted to continuously move a film band through a series of baths, and through a drying chamber, means for stopping the movement of said film, and means for first stopping the film from entering the drying cabinet, second, means for continuing the movement of the film band through some of the baths and, third, stopping the movement of the film band throughout the machine.

6. In a film-treating machine, a plurality of baths, a take-up chamber, an incoming and an exit film-driving sprocket for this chamber, means for controlling the operation of the exit sprocket, a variable film-receiving mechanism comprising means for increasing and decreasing the quantity of film in the take-up chamber, and means for controlling the incoming sprocket automatically through the movement of the variable film-receiving mechanism.

7. In a film-treating machine, a plurality of baths, a take-up chamber, an incoming and an exit film-driving sprocket for this chamber, means for controlling the operation of the exit sprocket, a variable film-receiving mechanism comprising means for increasing and decreasing the quantity of film in the take-up chamber, automatic means for starting the incoming sprocket after the film-receiving mechanism has a predetermined quantity of film thereon, and automatic means for stopping this sprocket after the film-receiving mechanism has a different predetermined quantity of film thereon.

8. In a film-treating machine, a plurality of baths, a take-up chamber, an incoming and an exit film-driving sprocket for this chamber, means for controlling the operation of the exit sprocket, a variable film-receiving mechanism comprising means for increasing and decreasing the quantity of film in the take-up chamber, and means for automatically stopping the incoming sprocket when the take-up chamber has received a predetermined quantity of film.

9. A film machine comprising a plurality of treatment baths, a drying chamber, a

take-up chamber, a source of power, means for driving the film from the source of power including an intake sprocket and an exit film-driving sprocket carried by the take-up chamber, floating film racks in the drying chamber and in the take-up chamber, and automatic means for controlling the exit sprocket through the movement of the drying chamber floating rack.

10. A film machine comprising a plurality of treatment baths, a drying chamber, a take-up chamber, a source of power, means for driving the film from the source of power including an intake sprocket and an exit film-driving sprocket carried by the take-up chamber, floating film racks in the drying chamber and in the take-up chamber, and automatic means for controlling the intake sprocket through the movement of the take-up chamber floating rack.

11. A film machine comprising a plurality of treatment baths, a drying chamber, a take-up chamber, a source of power, means for driving the film from the source of power including an intake sprocket and an exit film-driving sprocket carried by the take-up chamber, floating film racks in the drying chamber and in the take-up chamber, and automatic means controlled by these racks for controlling the exit and the intake sprockets.

12. A film machine comprising a plurality of treatment baths, a drying chamber, a take-up chamber, a source of power, means for driving the film from the source of power including an intake sprocket and an exit film-driving sprocket carried by the take-up chamber, floating film racks in the drying chamber and in the take-up chamber, separate automatic means for controlling the movement of these sprockets, the exit sprocket being controlled by the drying chamber floating rack and the intake sprocket being controlled by the take-up chamber sprocket.

13. In a film-treating machine, the combination with mechanism for moving a film through a series of treatment baths, two clutches included in the film-moving mechanism, a take-up chamber, and means for operating one clutch to stop a portion of the film band, and means for automatically actuating the second clutch to stop the remainder of the film band, the take-up chamber receiving a length of film band moved after the first clutch is thrown out.

14. In a film-treating machine, the combination with a driving mechanism for moving a film band through a plurality of baths, of a take-up chamber, a movable film rack in the take-up chamber, an exit film-driving sprocket and an intake sprocket, clutches between these sprockets and the film-driving mechanism, the intake sprocket clutch being operated by the movable film rack in the take-up chamber.

15. In a film-treating machine, the combination with a driving mechanism for moving a film band through a plurality of baths, of a take-up chamber, an exit film-driving sprocket and an intake film-driving sprocket for the take-up chamber, a movable film rack in the chamber, clutches between the sprockets and the driving mechanism, and means operated by the movable rack for starting the intake sprocket by actuating the clutch when the rack is in one position, and stopping the sprocket by actuating the clutch when the rack is in another position.

16. In a film-treating machine, the combination with a driving mechanism for moving a film band through a plurality of baths, of a take-up chamber between several of the baths, a movable rack in the take-up chamber, a film-driving sprocket at the exit and a film-driving sprocket at the entrance to the take-up chamber, clutches between these sprockets and the film-driving mechanism, and automatic means for throwing in the entrance sprocket after the exit is thrown in, and automatic means for throwing off the entrance sprocket after the exit sprocket is thrown off, said automatic means in each case being controlled by the movable rack in the take-up chamber.

17. In a film-treating machine, the combination with a driving mechanism for moving a film band through a plurality of baths, of a take-up chamber, film-looping mechanism in this chamber for carrying a large or a small quantity of film, film-feeding sprockets at the exit and entrance to this chamber, clutches between the sprockets and the power drive, and automatic means including the looping mechanism for controlling the time in which one clutch will operate relative to the other.

18. In a film-treating machine, the combination with a driving mechanism for moving a film band through a plurality of baths, of a take-up chamber, film-looping mechanism in this chamber for carrying a large or a small quantity of film, film-feeding sprockets at the exit and entrance to this chamber, clutches between the sprockets and the power drive, the intake sprocket clutch being thrown out by the looping mechanism after the exit sprocket clutch has stopped through the film-looping mechanism carrying a large quantity of film.

19. In a film-treating machine, the combination with a driving mechanism for moving a film band through a plurality of baths, of a take-up chamber, film-looping mechanism in this chamber for carrying a large or a small quantity of film, film-feeding sprockets at the exit and entrance to this chamber, clutches between the sprockets and

the power drive, the intake sprocket clutch being thrown in after the exit clutch has been thrown in and the size of the loop in the take-up chamber is reduced to a small quantity of film, there being operative connections between the looping mechanism and the intake sprocket clutch.

20. A machine for the continuous treatment of film having a plurality of stations for supplying film for treatment, rewinding film after treatment and for operating on said film, and a chamber between two of said stations for storage of a reserve supply of film, a film feeding means for driving film as it enters said chamber, an independently controllable film feeding for means driving said film as it leaves said chamber, rollers fixed at the top of said chamber and a weighted frame carrying rollers in said chamber, whereby film may be passed from one feeding means in loops over said rollers to the other feeding means and whereby such loops constitute a reserve supply when the speeds of the feeding means are not the same.

21. A machine for the continuous treatment of film having a plurality of stations for supplying film for treatment, rewinding film after treatment and for treating said film, means for moving film from station to station successively through the machine, and a chamber between two of said stations for storage of a reserve supply of film, a driven sprocket for engaging and driving film as it enters said chamber from one of said stations, an independently controllable driven sprocket for engaging and driving film as it leaves said chamber, and for feeding it to another station, rollers fixed at the top of said chamber and a weighted frame carrying rollers in said chamber, whereby film may be passed from one sprocket in loops over said rollers to the other sprocket and whereby such loops constitute a reserve supply when the speeds of the driven sprockets are not the same.

Signed at Fort Lee, New Jersey, this 24 day of May 1922.

CHARLES DE MOOS.