Nov. 15, 1949 V. E. PRATT ET AL 2,488,141

FILM PROCESSOR HAVING MEANS FOR RETAINING A FILM LOOP AT CONSTANT LENGTH IN A U-SHAPED CONDUIT

Filed March 7, 1945 4 Sheets-Sheet 1

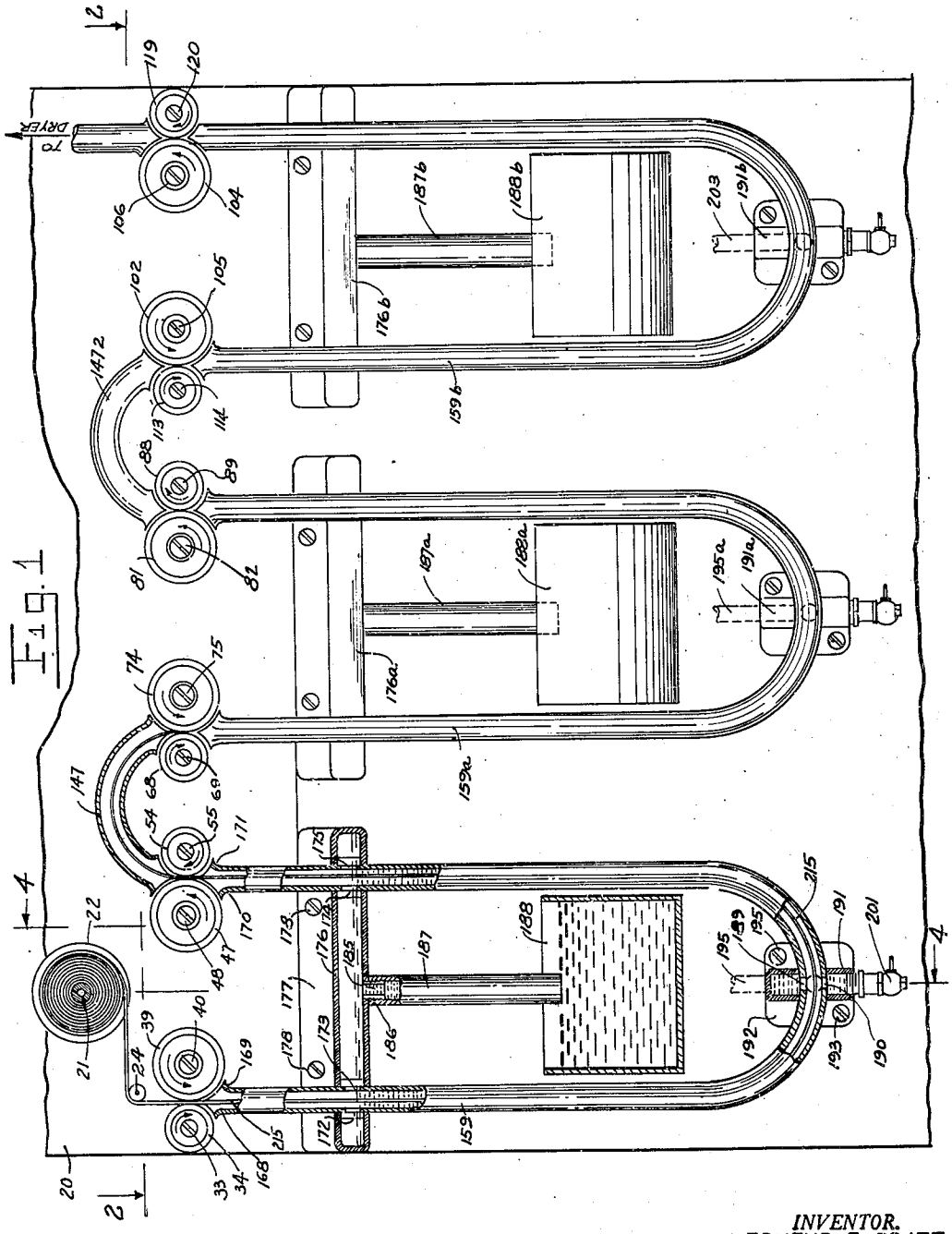


Fig. 1

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Filed March 7, 1945 4 Sheets-Sheet 2

Fig. 2

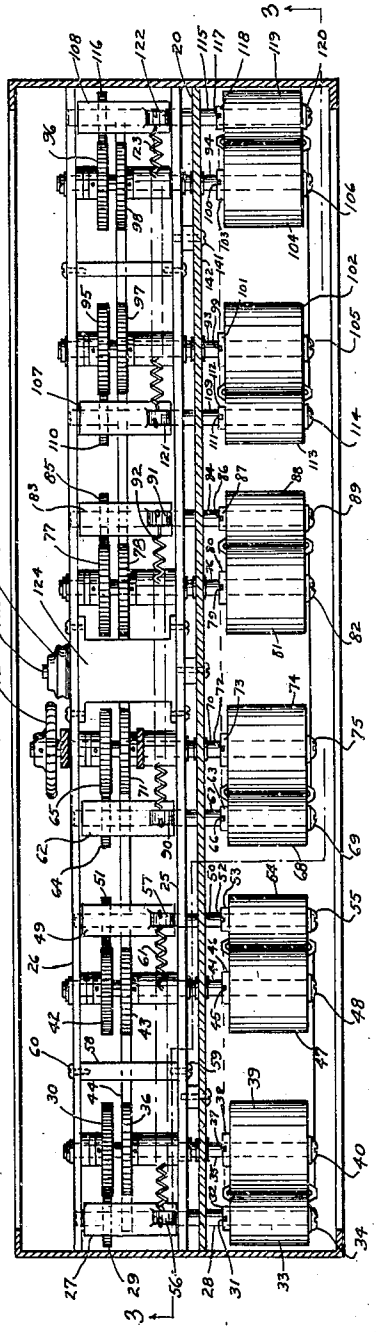
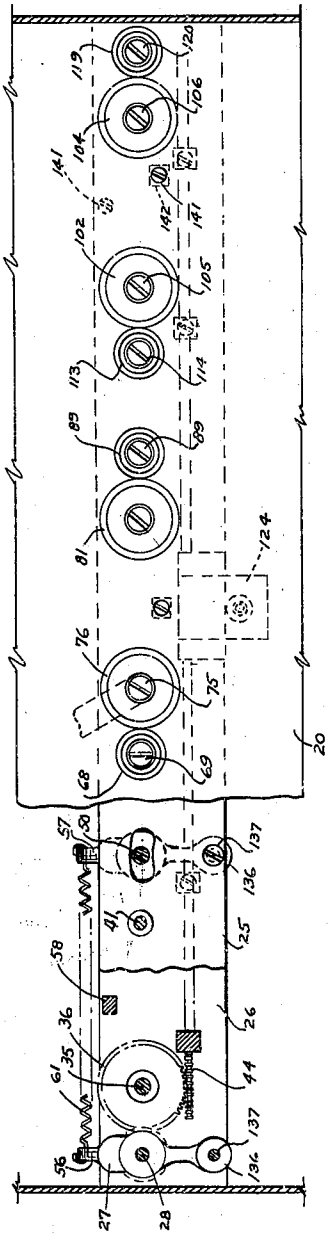


Fig. 3



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Fig. 4

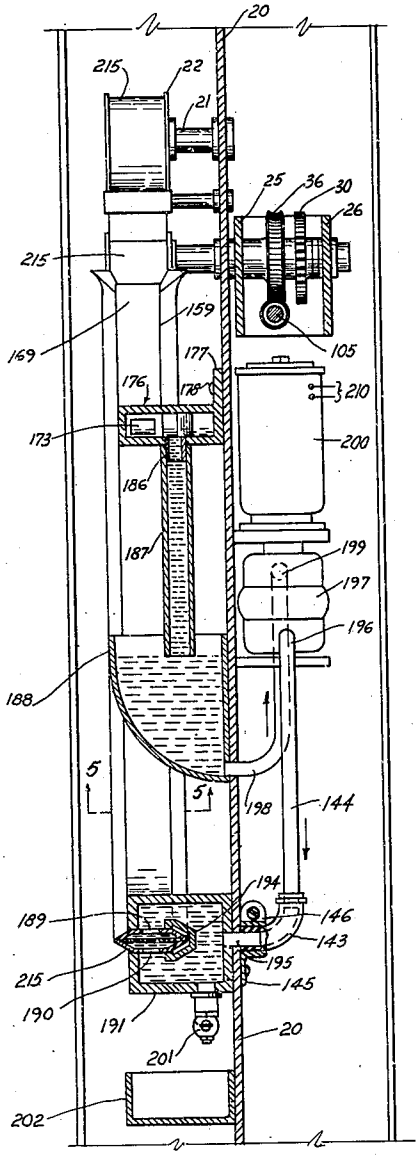


Fig. 5

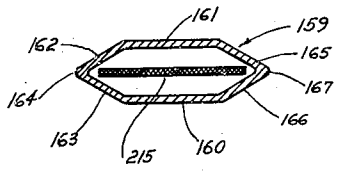
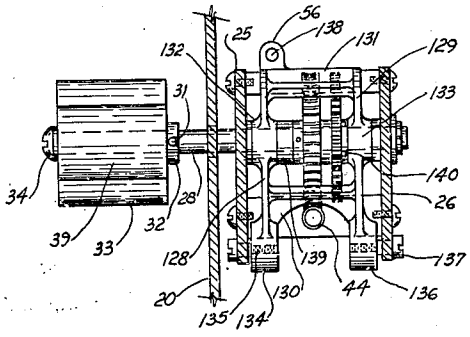


Fig. 6



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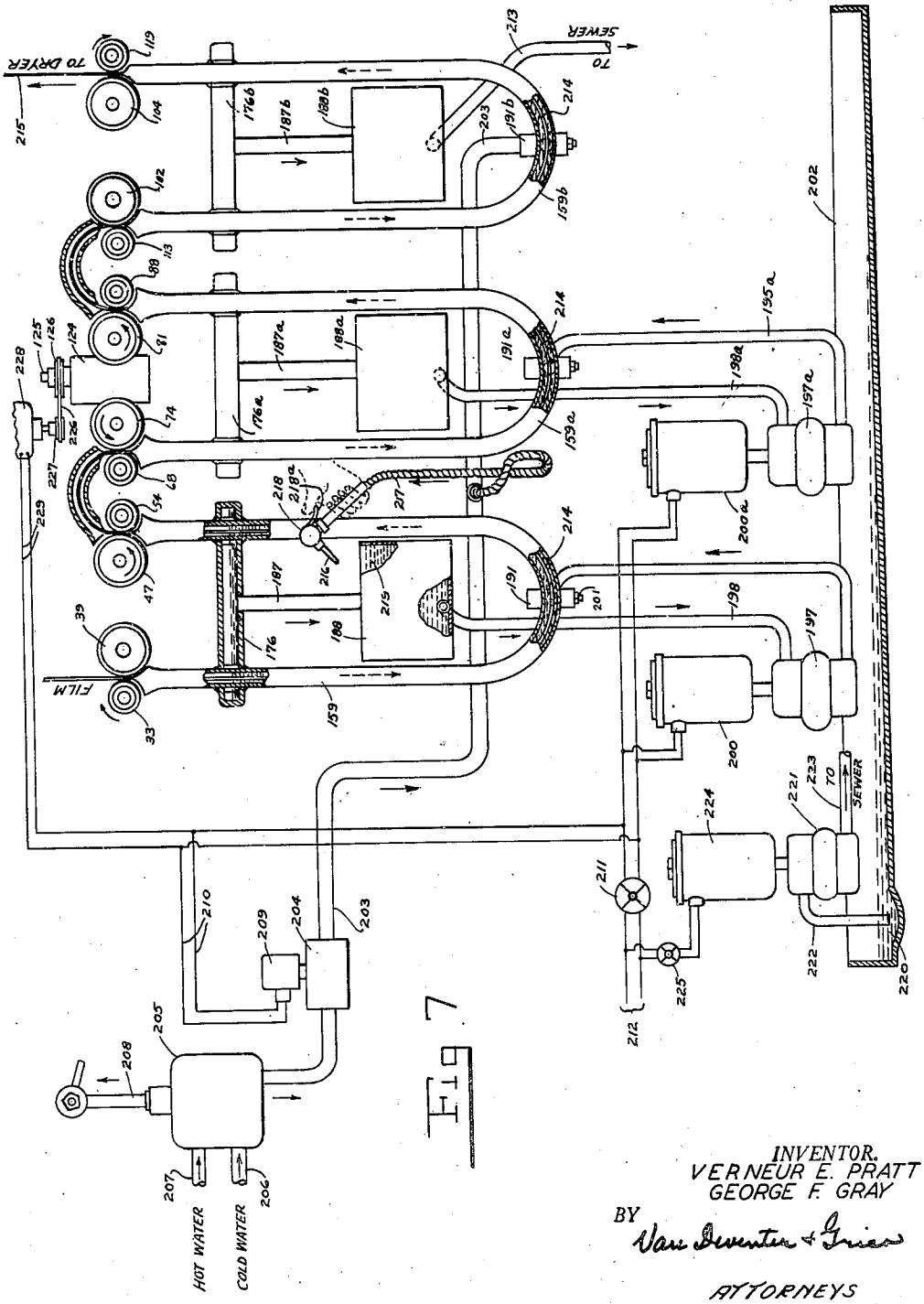


Fig. 7

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UNITED STATES PATENT OFFICE

2,488,141

FILM PROCESSOR HAVING MEANS FOR RETAINING A FILM LOOP AT CONSTANT LENGTH IN A U-SHAPED CONDUIT

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Norwalk, Conn.

Application March 7, 1945, Serial No. 581,355

5 Claims. (Cl. 95—94)

1

This invention relates to improvements in film processors wherein the film to be processed is moved through a series of U-shaped conduits, each of which may contain a fluid employed in processing the film, the film being fed into one leg of each U by a cooperative driving and driven roller, and being removed from the other leg of the U by a second cooperative driving and driven roller; and is directed more particularly to maintaining a uniform loop of film within the U-shaped conduit and between the two pairs of cooperative rollers which deliver it to and remove it from the conduit.

This invention is a continuation in part of co-pending application Serial Number 573,438, filed January 18, 1945, now Patent No. 2,424,052, dated July 15, 1947.

In said co-pending application the cooperating driving and driven rollers are comprised of a driving roller, the diameter of which is substantially equal to the distance between two planes extending from the axes of the two legs of the U-shaped conduit, and the driven rollers are adjusted with respect to said driving roller a distance greater than the thickness of the film and less than the thickness of a thick leader which is attached to the film for propelling it through the array of rollers and U-shaped conduits, thereby pulling the film through without permitting its emulsion surface to become scratched.

According to the present invention, in line with a plane extending from each leg of the U-shaped conduits is a cooperative pair constituting a drive and a driven roller. Thus, each U-shaped conduit employs a pair of driving and driven rollers in line with each of its straight legs. The driving rollers are of exactly the same diameter and are driven by a common driving means. The cooperative driven rollers are carried on individual pivoted supports and these supports are joined together by spring means urging them into contact with their cooperative driving rollers. By employing a unit spring means having one end attached to one pivoted support and its other end attached to its other pivoted support, the force urging the driven rollers into contact with the driving rollers and/or the film therebetween is absolutely equal. This results in removing film from each conduit at exactly the same rate it is delivered thereto.

Referring to the drawings, which are given by way of example to illustrate one way of practicing the invention:

Figure 1 is a front elevation showing a series of three U-shaped conduits, each of which has in

2

alignment with each leg a pair of cooperative driving and driven rollers;

Figure 2 is a plan view showing the mechanism for driving the driving rollers and the relation of the driven rollers thereto;

Figure 3 is an elevation partly in section taken along the line 3—3 of Figure 2;

Figure 4 is a sectional elevation as seen along line 4—4 of Figure 1;

Figure 5 is a sectional view of the U-shaped conduit as seen along the line 5—5 of Figure 4;

Figure 6 is a perspective view of one of the free roller pivotal supports; and

Figure 7 is a diagrammatic sketch showing a complete processing system employing driving means according to the present invention.

Referring first to Figure 1, a supporting wall 20 carries a reel shaft 21 adapted to support a reel 22 containing exposed film. The film, designated by the numeral 215, passes over a free roller 24 and is fed between rollers to be presently described.

Behind the wall 20, as may be seen in Figure 2, is a pair of spaced parallel supporting members 25 and 26. A cradle 27, the details of construction of which will be described in connection with Figure 6, is pivotally carried between the supports 25 and 26. Journalled in the cradle 27 is a shaft 28 which has keyed thereto a gear 29 which meshes with a gear 30, which will be presently described. A cross pin 31 in the shaft 28 is engaged by a slot formed in the hub 32 of a roller 33. The roller 33 is secured to the shaft 28 by means of an end screw 34. A shaft 35 is journalled in suitable bearings in the supports 25 and 26, and has keyed thereto the gear 30 which was described above as meshing with the gear 29. The shaft 35 also has keyed thereto a worm gear 36. This shaft also carries suitable collars to eliminate any end play. A cross pin 37 in the shaft 35 is engaged by a slot formed in the hub 38 of a roller 39. The roller 39 is secured to the shaft by an end screw 40.

Spaced apart from the shaft 35 is a like shaft 41 which is also journalled in suitable bearings in the supports 25 and 26. The shaft 41 has keyed thereto a spur gear 42 identical with the spur gear 30. A worm gear 43 is also keyed to the shaft 41 and is in alignment with the worm gear 36, and common to those two worm gears is a worm shaft 44 which is driven by a suitable gear reduction. A cross pin 45 in the shaft 41 is engaged by a slot in the hub 46 of a roller 47, and this roller is held onto the shaft by means of an end screw 48.

A cradle 49 is pivotally mounted between the supports 25 and 26 and a shaft 50 journalled in

the cradle carries a gear 51 which meshes with the gear 42. A cross pin 52 in the shaft 50 is engaged by a slot in the hub 53 of a roller 54 secured on the shaft by means of an end screw 55. The cradle has an upwardly projecting lug 56. Likewise the cradle 49 has an upwardly projecting lug 57. Between the shafts 35 and 41 is mounted a distance rod 58 which is secured to the support plate 25 by means of a screw 59 and secured to the support plate 26 by means of a screw 60. A helical spring 61 has one end connected to the lug 56 and its other end connected to the lug 57. Since the spring 61 freely spans the space between the lugs 56 and 57, its urge upon the cradles is exactly the same, with the result that the cradle 27 is urged to the right, as seen in Figure 2, and the cradle 49 is urged to the left with equal force, and the tensional engagement of the roller 33 with the drive roller 39 is exactly the same as the tensional engagement of the roller 54 with the drive roller 47. It will be remembered that the shafts 35 and 41 are driven, respectively, through the worm gears 36 and 43 actuated by the worm shaft 44, so that the direction of rotation of the driving rollers, as may be seen in Figure 1 indicated by the arrows, is counter-clockwise.

Since the spur gears 29, 30 and 51, 42 are in definite ratio to the diameters of the rollers 33, 39 and 54, 47, respectively, the regulation effected by the spring 61 falls within the backlash of the meshed gears. A cradle 62, identical with the cradle 27, is pivotally carried between the supports 25 and 26, and journalled in the cradle 62 is a shaft 63 which has keyed thereto a gear 64 which meshes with a gear 65. A cross pin 66 in the shaft 63 is engaged by a slot formed in the hub 67 of a roller 68 which is in turn secured to the shaft by an end screw 69. A shaft 70 is journalled in suitable bearings in the supports 25 and 26, and has keyed thereto the gear 65 which meshes with the gear 64. A worm gear 71 is keyed to the shaft 70 and meshes with the worm 44. The shaft 70 also carries suitable collars to eliminate end play, and a cross pin 72 therein is engaged by a slot formed in the hub 73 of a roller 74. A screw 75 in the end of the shaft 70 retains the roller 74 on the shaft.

Spaced apart from the shaft 70 is a like shaft 76 journalled in suitable bearings in the supports 25 and 26. This shaft has keyed thereto a spur gear 77 identical with the gear 65, and a worm gear 78 identical with the worm gear 71 and also meshing with the worm 44. The shaft 76 also carries suitable collars to eliminate end play and is provided with a cross pin 79 which engages a slot formed in the hub 80 of a roller 81 secured to the shaft by means of an end screw 82.

A cradle 83 like the cradle 49 is pivotally mounted between the supports 25 and 26, and a shaft 84 journalled in the cradle has keyed thereto a gear 85 which meshes with the gear 77. The shaft 84 has a cross pin 86 mounted therein and engaged by a slot formed in the hub 87 of a roller 88 which is retained on the shaft by means of an end screw 89. The cradle 62 has an upstanding lug 90 formed thereon and the cradle 83 has an upstanding lug 91 formed thereon. A helical spring 92 is secured to the lugs 90 and 91 and freely spans the space therebetween.

Spaced shafts 93 and 94 are journalled in the supports 25, 26, and have keyed thereto, respectively, spur gears 95, 96 and worm gears 97, 98. These shafts also have cross pins 99, 100, respectively, engaged by slots formed in the hubs 101, of a roller 102; and 103 of a roller 104, said roller being retained on said shafts by means of end screws 105, 106. Both of these shafts are provided with collars to eliminate end play, and both the worm gears 97, 98 mesh with the worm 44.

A cradle 107 is pivotally carried in the supports 25 and 26 between the shaft 93 and the cradle 83, and a second cradle 108 is pivotally mounted in the supports to the right of the shaft 94. The cradle 107 carries a shaft 109 to which a gear 110 is keyed. The shaft 109 also carries a cross pin 111 which is engaged by a slot formed in the hub 112 of a roller 113 retained on the shaft by means of an end screw 114. The gear 110 meshes with the gear 95.

The cradle 108 carries a shaft 115 to which a gear 116, meshing with the gear 96, is keyed. A cross pin 117 in the shaft 115 engages a slot formed in the hub 118 of a roller 119 retained on the shaft by means of an end screw 120. The cradle 107 has an upstanding lug 121 formed thereon and the cradle 108 has a like lug 122. A spring 123 has its ends secured to the lugs 121 and 122 and freely spans the space therebetween.

Several distance rods, like the distance rod 58 above described, are employed for properly spacing the supports 25 and 26.

The worm 44 projects from each side of a gear reduction unit 124, and a shaft 125 extending therefrom at a right angle to the worm 44 carries a shive 126 which may be belted to a pulley on a prime mover for furnishing power thereto.

The shaft 70 may extend rearwardly from the support 26 and may have keyed thereto a sprocket 127 which may be connected to a take-up reel in a dryer for the processed film but, since the dryer forms no part of the present invention, it need not be described herein.

Referring now to Figure 6, the cradle, generally designated by the numeral 27, includes a side portion 128, and spaced apart therefrom, a second side portion 129 joined together by a lower web 130 and an upper web 131. The side portion 128 carries a bearing boss 132 and the portion 129 carries a like bearing boss 133 in alignment therewith and in which the shaft 28 is journalled. The shaft 28 has keyed thereto the gear 29 and also carries a collar or spacer sleeve 139 and a washer 140 to eliminate end play. The portion 128 carries a boss 134 on the lower end thereof, and this boss is tapped to accommodate the threads of a shouldered screw 135, means (not shown) being provided for locking the screw in the boss 134 after assembly. The portion 129, on its lower end, also carries a boss 136 which is tapped to accommodate the threads of a shouldered screw 137. When assembled, the straight shanks of the shouldered screws 135 and 137 are journalled in the supports 25 and 26. The lug 56 extends upwardly from the web 131 and is provided with a hole 138 to be engaged by the end of the spring 61.

Since the cradles 49, 62, 83, 107, 108 are identical with the cradle 27, they need not be described in detail.

The supports 25 and 26 are secured to the supporting wall 20 in any suitable manner, for example, by means of screws 141 extending through the wall 20 and threadedly engaging the supporting member 25 with a spacer washer 142 therebetween.

Returning to Figure 1, a U-shaped conduit 159, the cross section of which may be seen in Figure 5, consists of parallel sides 160 and 161 joined

by angular portions 162 and 163 on one side forming an apex 164. Similar sides 165 and 166 join the sides 160 and 161 and meet at an apex 167. The film 215 normally clears the conduit 159 and the like points of contact with the conduit are on the extreme edges.

One leg of the conduit 159 has flares 168 and 169 formed thereon. These flares are oppositely disposed, 168 being adjacent to the roller 33 and 169 being adjacent to the roller 39. The other leg of the conduit is similarly flared at 170 and 171.

One leg of the conduit has aligned holes 172 and 173 formed therein and in alignment with these holes in the other leg are formed aligned holes 174 and 175. A hollow casing 176 extends laterally from the wall 20 and has an upstanding flange 177 which is secured to said wall by means of screws 178. The hollow casing 176 has clearance passages formed therein to accommodate the legs of the conduit 159, and these legs and the casing are soldered or brazed together to form a fluid tight joint.

The purpose of the casing 176 is to receive the processing fluid (which is forced through the conduit by means of a pump to be presently described) as the fluid is ejected through the openings 172, 173, 174 and 175 into the exterior of casing 176.

The casing 176 has a hole 185 formed in the bottom wall thereof and this hole is fitted with a bushing 186 to which is attached a short pipe 187, which extends into the open end of a tank 188 secured to the wall 20. Thus, fluid passing from the openings 172 to 175, inclusive, and into the casing 176 flows out through the hole 185 and via the pipe 187, and is delivered to the tank 188. At the bottom the U-shaped conduit 159 has aligned holes 189 and 190 formed therein. A hollow casing 191 has a flange 192 which is secured to the wall 20 by means of screws 193. The conduit is positioned in the hollow casing 191 as shown and is soldered or brazed thereto to form a fluid tight joint.

A nipple 195 has one end in communication with the casing 191 and extends through the wall 20 and is in fluid tight engagement with a fitting 143 formed of rubber or the like. A pipe 144 has one end connected to the fitting 143 and the other end is connected to the outlet 196 of a pump 197. The fitting 143 may be supported on the rear of the wall 20 by means of a bracket 145 secured thereto and carrying clamping means 146 embracing the fitting 143. The pipe 198 has its lower end in communication with the interior of the tank 188 and its upper end is connected to the inlet 199 of the pump 197. The pump is directly connected to an electric motor 200. When the motor is turned on, fluid is drawn from the tank 188 via the pipe 198 to the inlet of the pump and thence, via the outlet 196, via the pipe 144, the fitting 143 and the nipple 195, fluid is delivered to the hollow casing 191. The fluid then passes via the aligned holes 189 and 190 into the U-shaped conduit 159 where it divides, and part of it passes up the left leg, as seen in Figure 1, then outwardly from the conduit via the holes 172 and 173 into the hollow casing 176. Part of the fluid also passes up the right leg and out via the holes 174 and 175 into the hollow casing 176. The fluid flows from the casing via the pipe 187 and returns to the tank 188.

The fluid entering the conduits via the holes 189 and 190 has substantial velocity, and therefore, it washes off any deposits on the surface of the film due to the processing fluid. This is particularly important in cases where fixer-developers are used in our apparatus. The action of the fixer-developer results in a deposit on the surface of the emulsion, which deposit shields the emulsion from free action by the solution. However, the velocity of the fluid up both legs of the conduit washes off the coating or deposit, thereby leaving the surface of the emulsion open to the continued action of the fixer-developer.

The hollow casing 191 is provided with a suitable drain cock 201 by means of which the entire system may be drained into a container or trough 202 in the bottom of the machine.

A second U-shaped conduit 159^a is identical with the conduit 159 and has associated therewith a hollow casing 176^a and a discharge pipe 187^a discharging into a tank 188^a.

At the bottom of the U is a hollow casing 191^a like the hollow casing 191. A pump 197^a similar to the pump 197 is provided for drawing liquid from the tank 188^a and delivering it to the hollow casing 191^a.

A third U-shaped conduit 159^b is identical with the conduit 159 and has associated therewith a hollow casing 176^b and a discharge pipe 187^b discharging into a tank 188^b.

At the bottom of the U is a hollow casing 191^b like the hollowing casing 191. A pipe 203 has one end connected to the hollow casing 191^b (see also Figure 7) and the other end of this pipe is connected to a solenoid valve 204 which is in turn connected through a mixing valve 205 for mixing hot and cold water together to deliver water at a predetermined temperature. A pipe 206 leads from the mixing valve to a source of cold water under pressure and a pipe 207 is connected to the mixing valve 205 and leads to a source of hot water under pressure.

The mixing valve 205 is provided with a thermostatic control 208 which automatically controls the temperature of the water delivered by the pipe 203.

The valve 204 includes a solenoid 209 which is connected via a pair of wires 210 and a switch 211 to a source of current 212.

The switch 211, when turned on, supplies energy to both the motor 200 and the motor 200^a and to the solenoid 209 on the valve 204. Thus, when the machine is turned on, the pump 197 driven by the motor 200 circulates fluid in the U-shaped conduit 159, the pump 197^a, driven by the motor 200^a, circulates fluid in the U-shaped conduit 159^a and the solenoid valve 204 is opened and delivers warm water to the U-shaped conduit 159^b.

It has been described above that the processing fluid circulated through the U-shaped conduits 159 and 159^a returns to the pumps and is recirculated. However, the washing water which is delivered via the pipe 203 to the U-shaped conduit 159^b overflows into the hollow casing 176^b, passes down the pipe 187^b into the tank 188^b and thence passes to the sewer or drain via a pipe 213, the upper end of which is connected to the bottom of the tank 188^b.

From the above description it will be clearly understood that the reel 22 of exposed film 215 may be positioned on the stud 21, and the end of the film may be passed over the roller 24 and inserted between the drive roller 39 and its companion roller 33. Since the roller 33 is urged toward the roller 39 by means of the spring 61, the film starts feeding down the left leg of the conduit 159 and as the rollers continue to feed

the film, it passes around the curved lower end of the conduit 159 and upwardly in the right leg of the conduit. As the film is leaving the upper end of the right leg, it enters between rollers 47 and 54 which also tensionally engage the film under the urge of the spring 61. Since the spring 61 has a free span, the urge of the roller 54 against the film is exactly equal to the urge of the roller 33 against the film. Therefore, the pair of rollers 47, 54 will remove film from the U-shaped conduit 159 at exactly the same rate the film is delivered thereto by the pair of rollers 33, 39.

An arcuate channel 147 spans the space between the line of contact of the rollers 47, 54 and the line of contact between rollers 68, 74. As the end of the film 215 is moved upwardly by the rollers 47, 54, the arcuate channel 147 guides the end of the film and ensures its delivery between the rollers 68, 74. The latter rollers feed the film downwardly into the conduit 159a and then the film passes around the bottom and up the right leg to be engaged by the rollers 104, 119, and from these rollers the film may pass to a dryer which forms no part of the present invention.

Referring again to Figure 7, applicants provide a drain pan or trough 202 in the bottom of the machine. This drain pan or trough is provided for catching any fluids which spill or which are dumped from the system. Applicants also provide a dirigible nozzle 216 which is connected by means of a flexible hose 217 to the pipe 203. The nozzle may have a plunger valve 218 with a handle 218a so that the operator may turn the spray nozzle off or on at will for washing down the interior of the machine or flushing out and draining the several tanks and conduits in the machine.

Another important use of the nozzle 216 is in connection with mixing the processing solutions. For example, the powdered, pulverized and/or liquid chemicals may be placed in the bottom of the proper tank 188, then the operator may, by means of the nozzle 216, fill the tank until the liquid level reaches the line indicated by the numeral 219, and thereby add the proper amount of water for the charge of chemicals. The charge of chemicals may be proportioned so that one charge will completely process a roll of film, following which the operator may, by means of the drain cock 201, empty the tank of solution. This is preferably done with the pumps operating so that when the system is drained additional water may be added to the tanks, and this will be pumped through the pump and out by the drain cocks and thereby flush each section of the machine.

The drain pan has a sump 220 formed therein preferably adjacent to one end thereof. A pump 221 has its inlet connected to one end of a pipe 222, the other end of which extends into the sump. The outlet of the pump is connected to a pipe 223 which leads to the sewer. The pump 221 is directly connected to a motor 224, and this motor is connected via switch 225 to the source 212, so that any time it is desired to remove fluid from the drain pan 202, it is only necessary to turn the switch 225 and set the pump 221 into operation.

The pulley 126 on the gear reduction 124 is connected via a belt 226 to a pulley 227 which is secured to the shaft of a driving motor 228. The driving motor 228 is connected via a pair of wires 229 to the wires 210 so that the switch 211 may, in addition to controlling the solenoid 209 and the motors driving the pumps 197, 197a, also effect the driving of the series of driving rollers driven by the worm shaft 44.

All of the rollers, both the drive rollers and the free rollers (as was the case in the above mentioned application of which the present application is a continuation in part) have rims formed of rubber or the like. Therefore, the film passing between cooperating drive and free rollers is positively driven, due to the frictional engagement by said rubber-like rims, and the chance of the film becoming scratched is minimized.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention, as defined by the following claims.

What is claimed is:

1. In a device for processing film, a U-shaped conduit for containing processing fluid, said conduit having vertical legs with open ends, means supporting said conduit, a frame, a pair of cradles pivotally supported on said frame in spaced relation to each other and in definite relation to said open ends, a shaft journalled in each of said cradles and a free roller mounted on each of said shafts, a pair of drive rollers journalled in said frame between said cradles, both said free and said drive rollers having rubber-like rims, said drive rollers being adapted to be engaged by said free rollers on lines of contact above and in line with said open ends, a spring secured to and forming a free span between said cradles, said spring being adapted to exert equal urges of said free rollers against the cooperating drive rollers; a free loop of film extending between one pair of cooperating rollers, through said conduit and between the other pair of cooperating rollers; and means for driving said drive rollers at an identical rate of speed, whereby the length of said loop remains substantially constant.

2. In a device for processing film, a support, a plurality of U-shaped conduits carried on said support for containing fluids, said conduits having open ended vertical legs, a set of rollers for each conduit comprised of a pair of adjacent rollers of equal diameters driven at the same rate of speed, said rollers being positioned between a second pair of free rollers which are movable toward the driven rollers and adapted to urge the film into contact with said drive rollers along lines lying on planes extending through said legs, pivoted cradles supporting shafts carrying said free rollers, at least the cooperative faces of all said rollers being formed of rubber-like material, and a spring secured to and forming a free span between said cradles for causing said free rollers to urge the film as aforesaid, whereby film passing between one of said rollers and its cooperating free roller is fed into said conduit at exactly the same rate as film passing between the other of said drive rollers and its cooperating free roller is removed from said conduit, said film forming a free loop between said rollers and lying within said conduit.

3. In a device for processing film, a support, a U-shaped conduit on said support for containing processing fluid, said conduit having vertical legs with open ends, an array of rollers above said conduit comprised of a pair of adjacent rollers of equal diameters, said rollers being carried on shafts positioned between a second pair of mov-

ably supported rollers which contact said first rollers along lines substantially in line with the open tops of said conduit, at least the peripheral faces of all said rollers being of rubber-like material, means for driving said first rollers at the same speed, spaced pivoted cradles supporting shafts carrying said second rollers, and a single spring secured to and freely spanning the space between said cradles, whereby a film inserted between one of said first rollers and its cooperating free roller is fed into one leg of said conduit at exactly the same rate said film, after passing down said leg and up the other leg, is removed from said conduit by the other of said first rollers and its cooperating free roller, said film forming a free loop between said rollers and lying within said conduit.

4. In a device for processing film, a support, a plurality of U-shaped conduits carried on said support for containing fluids, an array of rollers above the open ends of the legs of said conduits and comprised of a free roller and a drive roller for each leg of each conduit, two drive and two free rollers forming a set, said drive rollers of each set being positioned between said free rollers of each set and each of the latter being movably positioned with respect to and adapted to cooperate with its corresponding drive roller, and spring means common to and urging both the free rollers of each set into contact with the drive rollers of the same set, whereby film passing through said array and looped through each of said conduits in the form of a free loop is delivered to one leg of each U and removed from the other leg thereof at the same rate.

5. In film processing apparatus, a frame forming a support, a cradle having a shaft journalled therein, means pivotally carrying said cradle on said support, a second cradle having a shaft journalled therein, means pivotally carrying said second cradle on said support in spaced relation to said first cradle, rollers secured to said shafts and termed free rollers, a pair of driven shafts journalled on said frame between said cradles in spaced relation to each other, said last shafts being driven in unison, other rollers secured to said driven shafts and termed driven rollers, the peripheral faces of all said rollers being smooth and toothless and formed of rubber-like material, and a spring having one end secured to one of said cradles and having its other end secured to the other of said cradles for urging said free rollers toward said driven rollers, whereby a free loop of film formed between the two pairs of cooperating free and driven rollers is maintained constant by the delivery of film thereto solely by one of said pairs and by the equal removal of film therefrom solely by the other of said pairs.

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