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3,380,368

FILM PROCESSOR TRANSPORT MECHANISM

Original Filed July 23, 1963

3 Sheets-Sheet 1

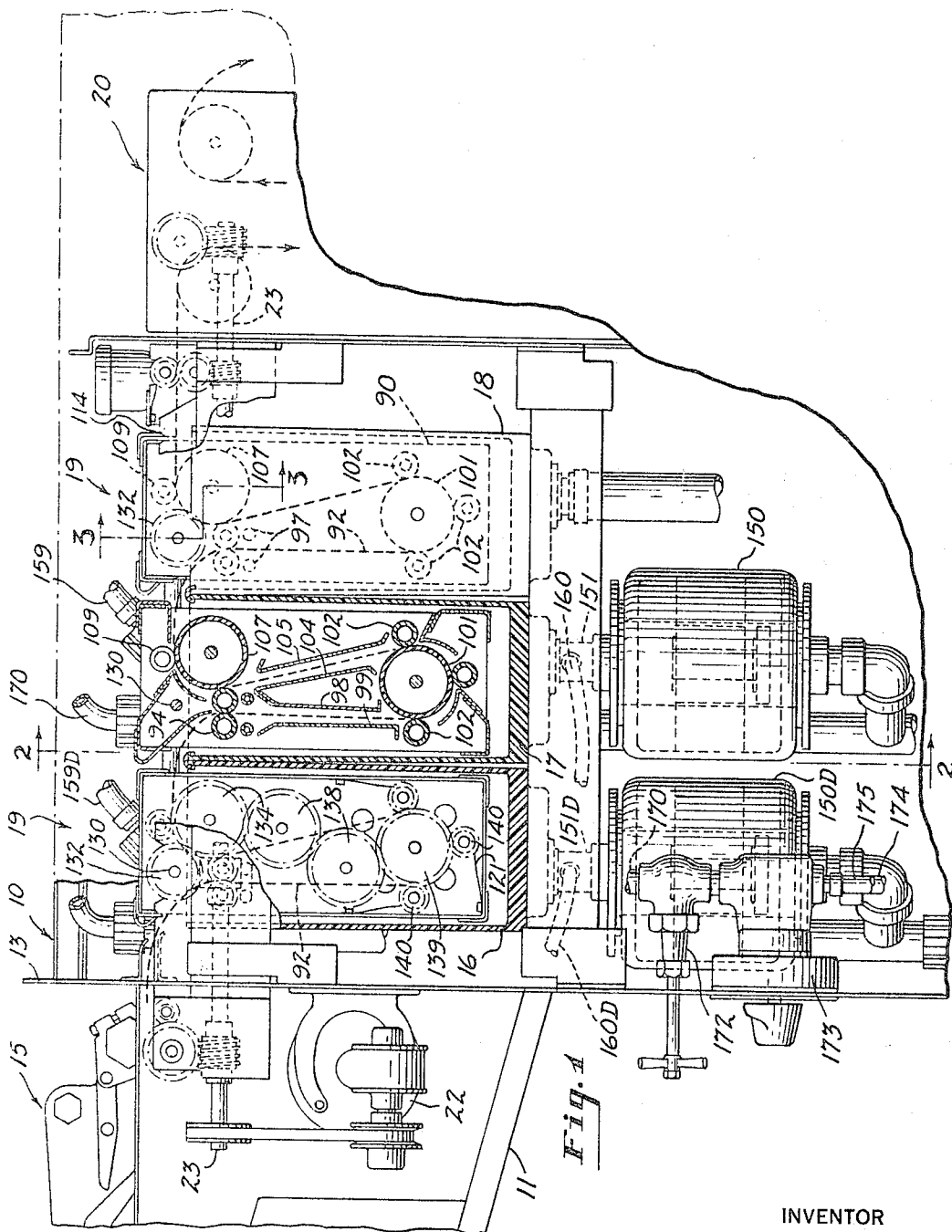


Fig. 1

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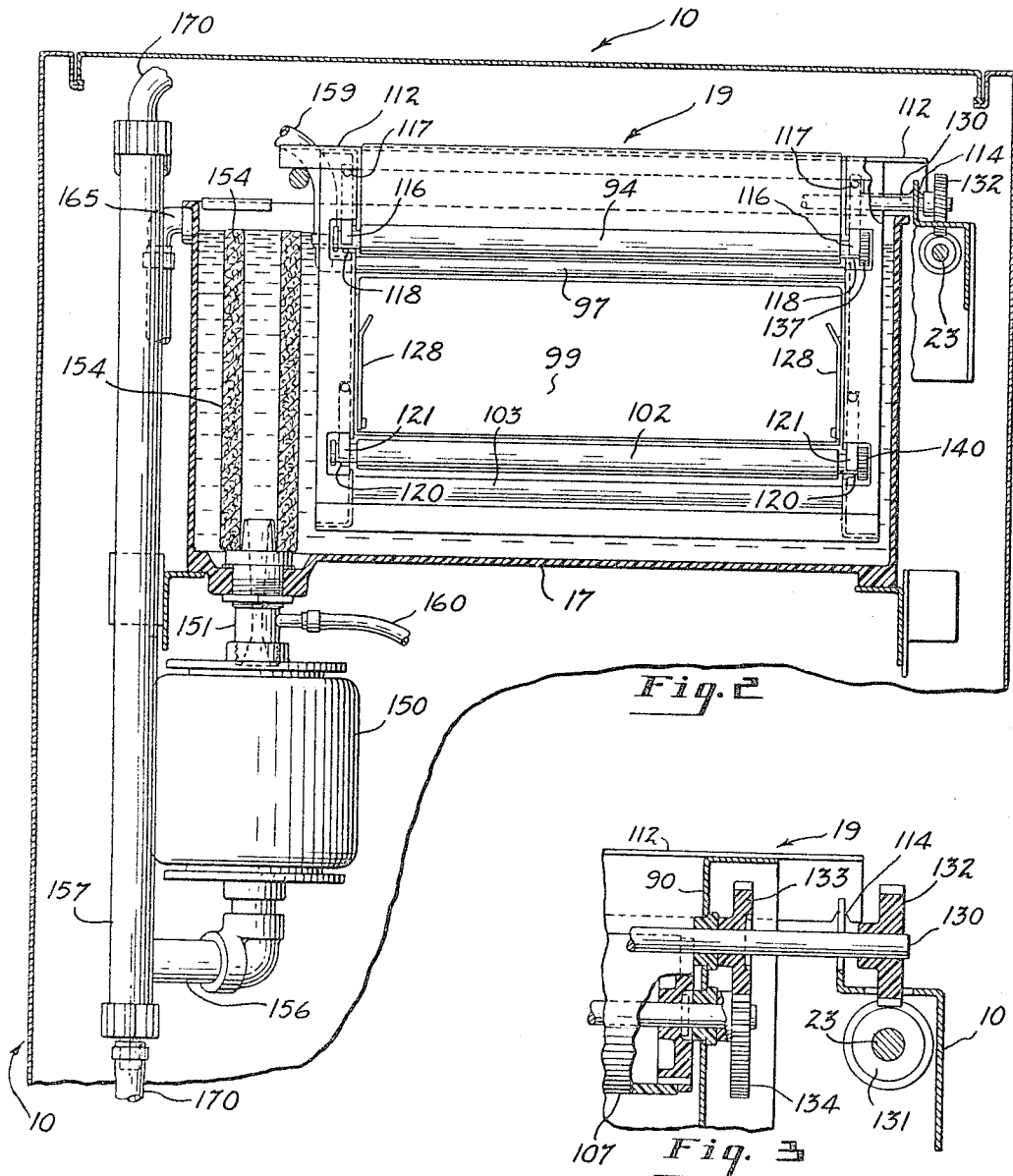
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FILM PROCESSOR TRANSPORT MECHANISM

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FILM PROCESSOR TRANSPORT MECHANISM

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3 Sheets-Sheet 3

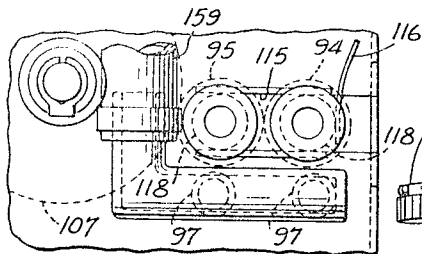


Fig. 6

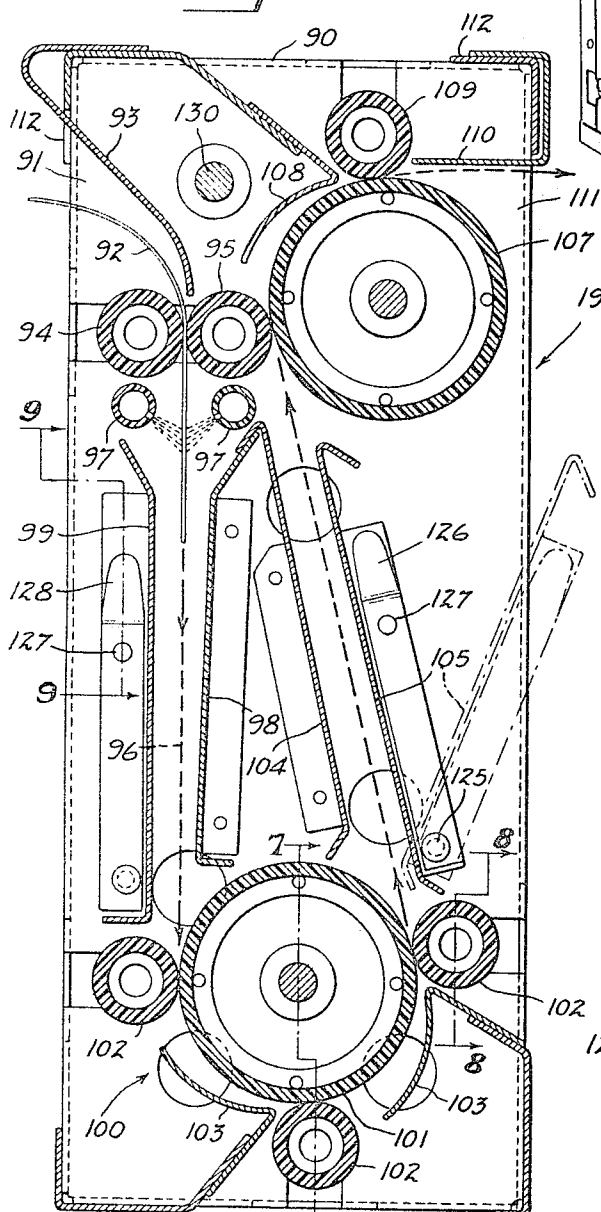


Fig. 5

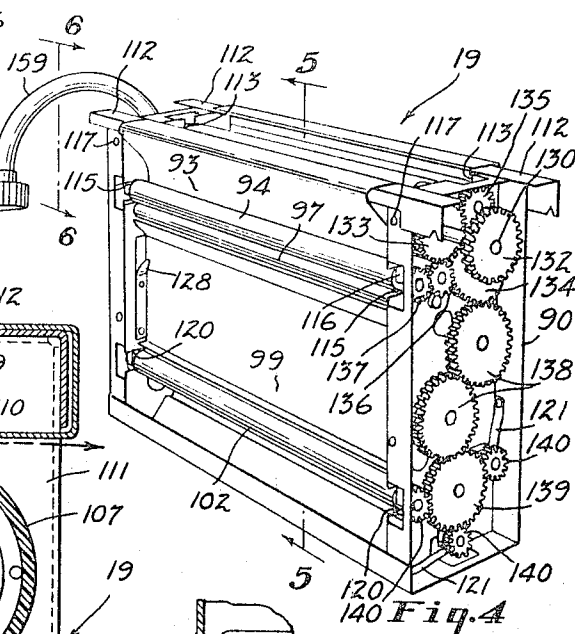


Fig. 4

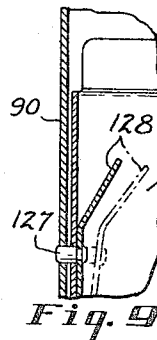


Fig. 9

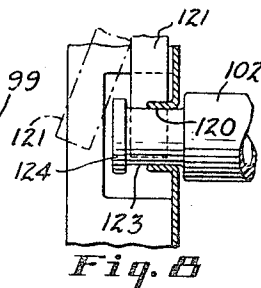


Fig. 8

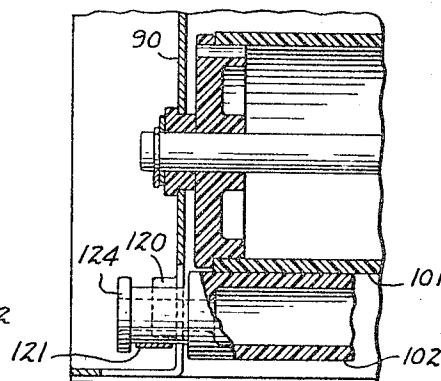


Fig. 7

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FILM PROCESSOR TRANSPORT MECHANISM

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Original application July 23, 1963, Ser. No. 296,999,
Divided and this application Feb. 10, 1967, Ser. No. 615,175

6 Claims. (Cl. 95—94)

ABSTRACT OF THE DISCLOSURE

Film transport mechanism for automatic film processor especially suited for processing cut sheets of film such as X-ray film. The disclosed transport mechanism has spaced plates defining portions of a film feed path and a space into which replenishment fluid is fed in the manner which causes agitation and assures good processing fluid-to-film contact. The plates are pivotal outwardly for facile cleaning. The disclosed transport mechanism also has a novel roll construction in which a large feed roll and a pair of smaller feed rolls are biased together and into contact with the larger roll such that the inlet film path is between the smaller rolls and the outlet path is between the intermediate one of the three rolls and the large roll.

Cross references

This application is a division of Ser. No. 296,999, filed July 23, 1963, now abandoned, in favor of a continuation application, Ser. No. 615,260 filed Feb. 10, 1967, both entitled, "Film Processor."

Background of the invention

(I) Field of the invention.

This invention pertains to film processors and more particularly to a novel and improved film processor transport mechanism especially adapted for the development of exposed sheets of film as X-ray film.

(II) Description of the prior art.

The processing of X-ray film presents problems which are peculiar to such film. Principal among these are:

(1) Both surfaces of a substrate are coated with emulsion while ordinary photographic film has one coating; and,

(2) In the case of cut film, the processor must cope with an admixture of sizes.

While the typical X-ray film processor can process all types of film, these listed and other peculiarities render the usual general purpose processor unsuitable for X-ray film.

With prior film processors it has been customary to provide developing tanks of a size larger than the fix and wash tank. This has been the custom because it has been necessary to have the film being processed remain in the developing solution longer than it need remain in the fix solution or wash water. In prior processors, serpentine-like paths for film transport have been provided by pluralities of rollers. Alternately, a series of rollers are positioned in pairs to define film paths which, but for turnaround mechanisms, are straight. In either even, the processors have been unduly complicated and expensive and difficult to clean and repair.

Summary of the invention

With the present mechanism a novel and improved feed system for processing fluid has been provided which permits the tanks and the transfer mechanisms for developing, fixing, and wash to be identical in size and

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construction. This permits simplified, lower-cost manufacture. It also provides other features of the invention.

With all three transfer mechanisms and tanks of identical size and construction the transfer mechanisms in each of the three tanks are identical and interchangeable. The transfer mechanisms are of the lift-out type. A discovery which has been made is where the chemistry of the components of the transport mechanism and the processing fluids are compatible and permit it, the frequency with which the transfer mechanisms must be cleaned is greatly reduced by sequential, periodic interchange. Thus, one transfer mechanism will be moved sequentially from the developing solution to the fixing solution and thence to the wash solution. From the wash solution, the transfer mechanism is subsequently moved to the developing solution.

By periodically rotating the transfer mechanisms in the described manner, a self-cleaning system is provided so that the transfer mechanisms need be cleaned only at very infrequent intervals as compared with prior processors and collection of undesirable deposits in difficult locations is minimized if not completely eliminated.

It is not uncommon for the owner of a film processor to utilize spare transfer mechanisms to prevent shutdown of the processor, either because of the failure of the transfer mechanism or for cleaning. With the present construction only one spare transfer mechanism is required because the three are, unlike prior mechanisms, identical in size.

An important feature of the invention resides in the construction of the transfer mechanism which has limited numbers of rollers and easy access for cleaning. A sheet of film is directed downwardly by a pair of feed rollers into and through a chute, thence to a turnaround roll mechanism. From the turn-around the sheet passes upwardly through a second chute. The chutes are each defined by a pair of flat plates, the outer one of which pivots outwardly to allow ready access for cleaning. Cleaning of the transfer mechanism is further facilitated by the provision of a simplified roll construction which permits the rolls to be readily moved from the assembly and thoroughly and simply cleaned.

The improved and speeded film processing is obtained through a novel system for supplying processing fluid to the film. Horizontally disposed spray bars are employed which direct processing liquid against both faces of a sheet of film as it commences its travel through a film transfer mechanism. These spray bars are fed directly by a pump. Replenishment fluid is fed by a venturi into the system whenever a film is passing through the feed rolls. Thus, as a film passes through the feed rolls, fresh replenishment fluid is automatically fed into both the developing and fixing solutions as it is needed and this fresh solution is transported directly to the spray bars where it is applied to the surface of the film. Moreover, the bars are positioned below the fluid level with orifices that issue jets of processing fluid. These jets are arranged to enhance the processing both by obliquely striking the surfaces of a sheet being processed and by agitating the processing fluid.

Accordingly, the object of this invention is to provide a novel and improved film processor transport mechanism and a method of processing film and operating a processor.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawings, in which:

Brief drawing description

FIGURE 1 is an enlarged fragmentary side elevational

view of the processor with parts broken away and removed;

FIGURE 2 is a fragmentary sectional view of the device as seen from the plane indicated by the line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary sectional view of portions of the drive system as seen from the planes indicated by the line 3—3 of FIGURE 1;

FIGURE 4 is a perspective view of a film transfer mechanism;

FIGURE 5 is an enlarged sectional view of the film transfer mechanism as seen from the plane indicated by the line 5—5 of FIGURE 4;

FIGURE 6 is a fragmentary end elevational view as seen from the plane indicated by the line 6—6 of FIGURE 4;

FIGURE 7 is a fragmentary sectional view as seen from the plane indicated by the lines 7—7 of FIGURE 5;

FIGURE 8 is an enlarged fragmentary view showing a feed roll retaining mechanism as seen from the planes indicated by the lines 8—8 of FIGURE 5; and,

FIGURE 9 is a fragmentary sectional view of the removable lock mechanism for a side of the film chute as seen from the planes indicated by the lines 9—9 of FIGURE 5.

Description of the preferred embodiments

Referring now to the drawings, and FIGURE 1 in particular, a film processor housing is shown generally at 10. The housing 10 includes a laterally projecting feed assembly support section 11 which extends laterally to the left as viewed in FIGURE 1. In the preferred installation, the processor will be positioned with the main portion of the housing 10 outside of a dark room and a feed section 11 positioned within the dark room. A laterally projecting flange 13 will circumscribe the edges of an aperture in a dark room wall forming a light-tight seal.

A film feed assembly 15 is removably supported on the feed extension 11 of the housing 10. The feed assembly supplies sheets of film one at a time to developing, fixing, and wash tanks 16, 17, 18 which are positioned side by side within the main portion of the housing 10 and to the right of the feed assembly 15 as viewed in FIGURE 1. Identical and removable film transfer mechanisms 19 are positioned in the tanks 16, 17, 18 for transporting the sheets of film supplied by the feeder sequentially through the tanks 16, 17, 18. An automatic dryer 20 is within the main portion of the housing 10 and positioned adjacent an outlet opening 21. The dryer receives sheets from the wash tanks 18, dries them, and discharges them into a collecting bin 24 adjacent the outlet opening 21.

A drive motor 22 is positioned within the feed extension 11 of the housing. The drive motor 22 is connected to a drive shaft 23 which extends longitudinally through the housing 10. The shaft 23 is in driving connection with the feed assembly 15, the film transfer mechanism 19, and the dryer 20. The single drive motor 22 is used to operate all film transporting mechanism and the dryer.

As is most plainly seen in FIGURE 1, the three film transport mechanisms 19, positioned in the developing, fixing, and wash tanks 16, 17, 18 are identical and interchangeable. Accordingly, a single one of these transport mechanisms will be described in detail with the principal description being directed to FIGURES 4 through 9.

The transport mechanism 19 includes a frame 90 which defines an inlet opening 91 for receiving a sheet of film indicated at 92. The sheet of film 92 is fed to the transport mechanism either from the feed assembly 15 or the preceding transport mechanism 19. The film is directed inwardly through the opening 91 until it strikes a deflector plate 93 which forms a part of the frame 90. The deflector 93 bends the film 92 downwardly through a space between a downwardly directing feed roll 94 and

an intermediate feed roll 95. The mounting and drive of these rolls 94, 95, together with the mounting and drive of other of the rolls will be described presently.

The feed rolls 94 direct a sheet of film 92 downwardly along a feed path indicated by a line 96. This feed path 96 carries the film 92 between a spaced pair of transversely disposed spray bars 97 which direct processing fluid against the film. As an examination of FIGURE 5 will show, the feed rolls 94, 95 are parallel and positioned with their axes in a common horizontal plane immediately below the preferred fluid level. The spray bars 97 parallel these feed rolls and also have their axes in a common plane.

As the film 92 descends along the path 96 past the spray bars, it enters a chute defined by a fixed plate 98 and a pivotal plate 99. The film continues its downward descent until it enters a turnaround mechanism shown generally at 100. The turnaround mechanism includes a relatively large diameter main roll 101 journaled in the frame 90. The main turnaround roll 101 is surrounded by three spaced resiliently biased turnaround rolls 102 and a pair of curved deflector plates 103. The turnaround rolls 102 and the deflector plates 103 coact to cause the film 92 to adhere to the contour of the central turnaround roll 101 until the film is directed upwardly through a chute defined by another fixed plate 104 and another pivotally mounted plate 105.

The film 92 next passes between the intermediate feed roll 95 and a large diameter outlet feed roll 107 which is journaled in the frame 90. Film is then deflected outwardly, to the right as seen in FIGURE 5, by an outlet deflector plate 108 until it passes between the large diameter main outlet feed roll 107 and a small diameter outlet feed roll 109 positioned above the main roll. The film finally strikes a horizontally positioned exit deflector plate 110 and passes through an outlet opening 111 in the frame 90. The film passing through the outlet opening 111 will pass directly into the inlet opening 91 of the succeeding transfer mechanism or, in the case of the wash tank 18, directly into the dryer assembly 20. Thus, one feature of the mechanism is that film is transferred directly from one processing tank transfer mechanism 19 to the next eliminating the need for film transport mechanisms positioned between the removable processing transport mechanism.

The upstanding length of the two chutes, that is the distance between the upper feed rolls, at both inlet and outlet, and the turnaround mechanism is slightly less than the shortest film to be processed. Thus, in the case of X-ray film, this space will be $6\frac{1}{2}$ " with a minimum film dimension of 7". This spacing, together with the use of deflector plates wherever possible, minimizes the number the times the film must pass between the rolls, thereby providing maximum exposure to the processing fluids.

The frame 90 of the transfer mechanism 19 includes laterally projecting support members 112 at the top of the mechanism. As is seen in FIGURE 2, these support members 112 rest on the frame of the processor housing 10 to support a transport mechanism 19 in the appropriate one of the processing tanks. As seen in FIGURES 1 and 3, the members 112 and the frame have interlocking notches at 114 which locate the tanks.

As indicated in the introductory portion of this application, one of the outstanding features of the invention resides in the spray bars 97 which apply processing fluid directly to the surface of the film. This is accomplished in a manner which will be described in greater detail in the liquid distribution system portion of the specification. Other of the outstanding features of the invention reside in the construction which greatly expedites and facilitates cleaning and repair of the transport mechanism.

All rolls are constantly driven in a manner described below. Though they are constantly driven, all rolls other than the main turnaround roll 101 and the main outlet feed roll 107 float in the defined paths and are yieldably

biased toward the main rolls. Moreover, all rolls other than the main rolls are designed to be quickly removed from the transport mechanism 19 without the use of any tools of any type. The top outlet roll 109 is gravity biased into position and may be lifted out of its locating guide slots 113, FIGURE 4, whenever desired. The remaining small diameter rolls 94, 95 and 102 are all positioned in suitable guide slots and biased into position by pivotally supported spring retainers.

The support of the rolls 94, 95 is best seen in FIGURES 2 and 6. An examination of these will show that two rolls are slidably positioned in spaced guide slots 115. The guideslots 115 are open at their outer ends so that the rolls 94, 95 can be slid in and out of the slots 115. The rolls are identical and there is no particular order of insertion. Once the rolls are inserted they are maintained in place by a pair of pivoted spring retainers 116, one of which is carried at each end of the frame 90. The spring retainers 116 are mounted on suitable pivots 117, FIGURES 2 and 4. Normally the spring retainers are disposed in grooves 118 near the ends of the downward feed roll 94. Inward flexure of the spring retainers 116 permits them to pivot outwardly allowing the rolls to be removed. When positioned for roll retaining as shown in the FIGURES 2 and 6, the spring retainers 116 are maintained against pivoting by the side walls of the grooves 118 and at the same time they yieldably bias the roll 94 against the roll 95 and the roll 95 in turn against the main outlet roll 107.

The rolls 102 are each individually positioned in guide-slots 120, see FIGURES 4, 7, and 8. In FIGURE 8 the positioning of a spring retainer 121 corresponding to one of the spring retainers 116 is shown in solid lines. The phantom line position of the retainer 121 shows it disconnected to permit removal of the roll 102. As an examination of FIGURES 7 and 8 will show, there is a groove 123 near the end of the roll 102 with a spring retaining flange 124 provided at the end of the roll to keep the spring retainer 121 in its roll retaining position when the device is assembled. Thus, by simply flexing and pivoting the spring retainers 116, 121, it is possible, without any tools whatsoever, to permit removal of all of the small diameter rolls 94, 95 and 102.

Cleaning of the chutes is also accommodated by a novel construction. The pivotal plates 99 and 105 each pivot outwardly to permit the chute areas to be cleaned. In FIGURE 5, the plate 105 is shown in solid lines in its film processing position. The pivotal plate 105 is hingedly mounted at 125 so that it may be moved from its solid line position to the phantom position to facilitate cleaning.

The pivotal plates 105, 99 are located and maintained in their processing position by pairs of leaf spring latches 126, 128 respectively. The operation of one of the leaf spring latches 128 is shown best in FIGURE 9 where the solid line position shows a latching pin 127 carried by the latch 128 and locking the pivotal plate 99 in its film processing position. Movement of the leaf spring latch 128 from its solid line position to its phantom line position disengages the pin 127 from the frame 90 allowing the pivotal plate 99 to be moved outwardly to its cleaning position. The similar leaf spring latches 128 of the pivotally mounted plate 105 operate in a manner identical to the leaf spring latches 128.

As is seen in FIGURES 2 and 3, the transport mechanism 19 has an idler shaft 130 which is driven by the main drive shaft 23. The drive of the idler shaft 130 by the main shaft 23 is through a worm 131 fixed to the main shaft and a worm gear 132 secured to the outer or right hand end, as viewed in FIGURES 2 and 3, of the idler shaft 130. The idler shaft worm gear 132 is lifted out of engagement with the worm 131 whenever the transport mechanism 19 is lifted out of the processing tank. Thus, connection of the roller drive system, driven by the idler

gear 130 in a manner which will be described in greater detail below, is through a removable connection of the worm 131 and the worm gear 132.

Rotation of the various feed rolls in the transport mechanism 19 is obtained through constantly meshing gearing. A feed roll drive gear 133 is secured to the idler shaft 130 and in constantly meshing engagement with an outlet main feed roll gear 134. Other of the gearing is best seen in FIGURE 4. An examination of that drawing will show that a pinion 135 is fixed to the end of the top of the roll 109 and in engagement with the main feed roll gear 134. Similarly, a pinion 136 on the intermediate feed roll 95 engages the gear 134 and drives a pinion 137 on the downward feed roll 94. Idler gears 138 transmit rotational force from the outlet main roll gear 134 to a turnaround main roll gear 139 secured to the main turnaround roll 101. Turnaround pinions 140 secured to the turnaround rolls 102 are driven by the main turnaround roll 139.

The fluid distribution systems for the developing and fixing tanks are substantially identical. Accordingly, the distribution system of the fixing tank will be described. Comparable parts in the developing fluid distribution system will be designated by corresponding numbers with the letter D added to identify the developer system.

During normal operation the fixing tank 17 would preferably be filled manually to the desired level. During operation pumps 150 and 150D are turned on. A venturi 151 is positioned between the base of the processing tank 17 and the pump 150 connecting them together.

Replenishment fluid is drawn into the system by the venturi 151 through a replenishment supply line 160.

As is shown in FIGURE 2, the processing tanks 16 and 17 are equipped with overflow lines 165 which conduct excess processing fluid to a drain. The operation of the pumps and venturis is described in greater detail in the above-referenced patent application.

As has been suggested previously, one of the outstanding features of the invention resides in the spray bars 97, which are positioned immediately below the levels of the over-flows 165, and, therefore, below the fluid level in the tanks. The outlet orifices of the spray bars are oriented to emit jets of fluid which impinge obliquely and downwardly directly on surfaces of the film being transported. Since the spray bar outlets are below the level of fluid in the tank 17, the emitted jets of fluid agitate the fluid in the tank around the film. Moreover, since the jets of fluid contain the fresh replenishment fluid, maximum benefit of the fresh fluid is obtained. This combined impingement and agitation action with fresh fluid so decreases the time which sheets of film must be maintained in the processing tanks that developing, fixing and wash times may, for the first time, be identical. Further, since the spray bars are positioned immediately below the liquid level, the fast processing action commences as soon as the sheet of film enters the body of processing fluid.

Rinse water is fed directly to the rinse tank 18 by a rinse water supply conduit 170. Water from the rinse tank is removed through an overflow type drain 171 which has an inlet only at its top at a level of rinse water desired in the tank 18. The rinse water conduit 170 is controlled by a manually actuatable valve 172 and is supplied by a mixing valve 173. The mixing valve 173 has cold and hot water supply lines 174, 175 which feed water to it.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A film transport mechanism for positioning in a processing tank comprising:

- (a) a frame defining an inlet spaced from an outlet each near the top thereof;
 - (b) first roller and guide means supported by the frame near the inlet for receiving a sheet of film through said inlet and directing it downwardly;
 - (c) a turnaround mechanism near the bottom of the frame for receiving a sheet of film from the first means, turning it and directly it upwardly toward the outlet;
 - (d) a second roller and guide means supported by the frame near the outlet for receiving a sheet of film from the turnaround mechanism and directing it outwardly through said outlet opening; and,
 - (e) spaced plates defining a first film-guide slot extending substantially from the first means to the turnaround mechanism and a second guide slot extending from the turnaround mechanism to the second means; and,
 - (f) means for directing processing fluid tangentially toward a transported film and toward said first film-guide slot whereby fluid in said first slot is agitated.
2. The device of claim 1 wherein certain of said plates are movably mounted for facile movement from an operating position to a transport mechanism cleaning position and releasable lock means to maintain each such movable plate in its operating position.
3. A film transport mechanism for positioning in a processing tank comprising:
- (a) a frame defining an inlet spaced from an outlet each near the top thereof;
 - (b) first roller and guide means supported by the frame near the inlet for receiving a sheet of film through said inlet and directing it downwardly;
 - (c) a turnaround mechanism near the bottom of the frame for receiving a sheet of film from the first means, turning it and directing it upwardly toward the outlet;
 - (d) a second roller and guide means supported by the frame near the outlet for receiving a sheet of film from the turnaround mechanism and directing it outwardly through said outlet opening;
 - (e) plate-like members defining a first film-guide slot extending substantially from the first means to the turnaround mechanism and a second guide slot extending from the turnaround mechanism to the second means;
 - (f) certain of said plate-like members being pivotally mounted near one edge thereof for swinging movement from an operating position to a cleaning position; and,
 - (g) such plate-like members each being equipped with spring clip means spaced from the pivots for removably retaining the movable plates in their operating positions.
4. In a film transfer mechanism for a photographic film processor the improvement which comprises:
- (a) a frame including spaced and parallel guideslots formed therein;
 - (b) a main roll journaled in the frame;
 - (c) a plurality of feed rolls mounted in the guideslots and movable in the slots toward and away from the main roll; and,
 - (d) yieldable retainer means carried by the frame and acting against the feed roll outermost with respect

- to the main roll and yieldably biasing the feed rolls against one another and the innermost roll against the main roll, said retainer means maintaining the feed rolls in the guideslot and being manually movable to permit facile removal of the feed rolls from the slot.
5. The removable film transport mechanism for transporting sheets of film through a bath of film processing fluid comprising:
- (a) a frame having a top and bottom;
 - (b) a deflector plate mounted near the top of the frame for deflecting a sheet of film fed to the transport mechanism downwardly;
 - (c) first roller transport means carried by the frame below said deflector plate for transporting the film downwardly;
 - (d) a first film guide means carried by the frame below said first roller transport mechanism for guiding the downwardly directed film in its downward path through said bath;
 - (e) a turnaround mechanism carried by said frame near the base thereof and in said bath for receiving film from said first guide means and turning it upwardly;
 - (f) a second guide means carried by the frame for guiding the film in an upward path of travel through said bath;
 - (g) a second roller transport means carried by the frame for receiving said film from the second guide means and diverting it outwardly through an outlet opening near the top of said frame;
 - (h) said second roller transport means including a relatively large roller, rollers coacting with the large roller and a deflector plate between two of the rollers; and,
 - (i) the first and second roller transport means comprising said large roller, an intermediate roller normally abutting said large roller and positioned toward the inlet of said mechanism, an inlet roller normally abutting said intermediate roller, and positioned on the inlet side of said intermediate roller and an outlet roller above said large roller and normally gravity-biased into engagement with said large roller, whereby said intermediate roller forms a part of both said first and said second roller transport means with the film passing on one side of said intermediate roller on entrance to the transport mechanism and on the other prior to its exit from the transport mechanism.
6. The device of claim 5 wherein said inlet roller is biased against said intermediate roller, biasing the intermediate roller against said larger roller.

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