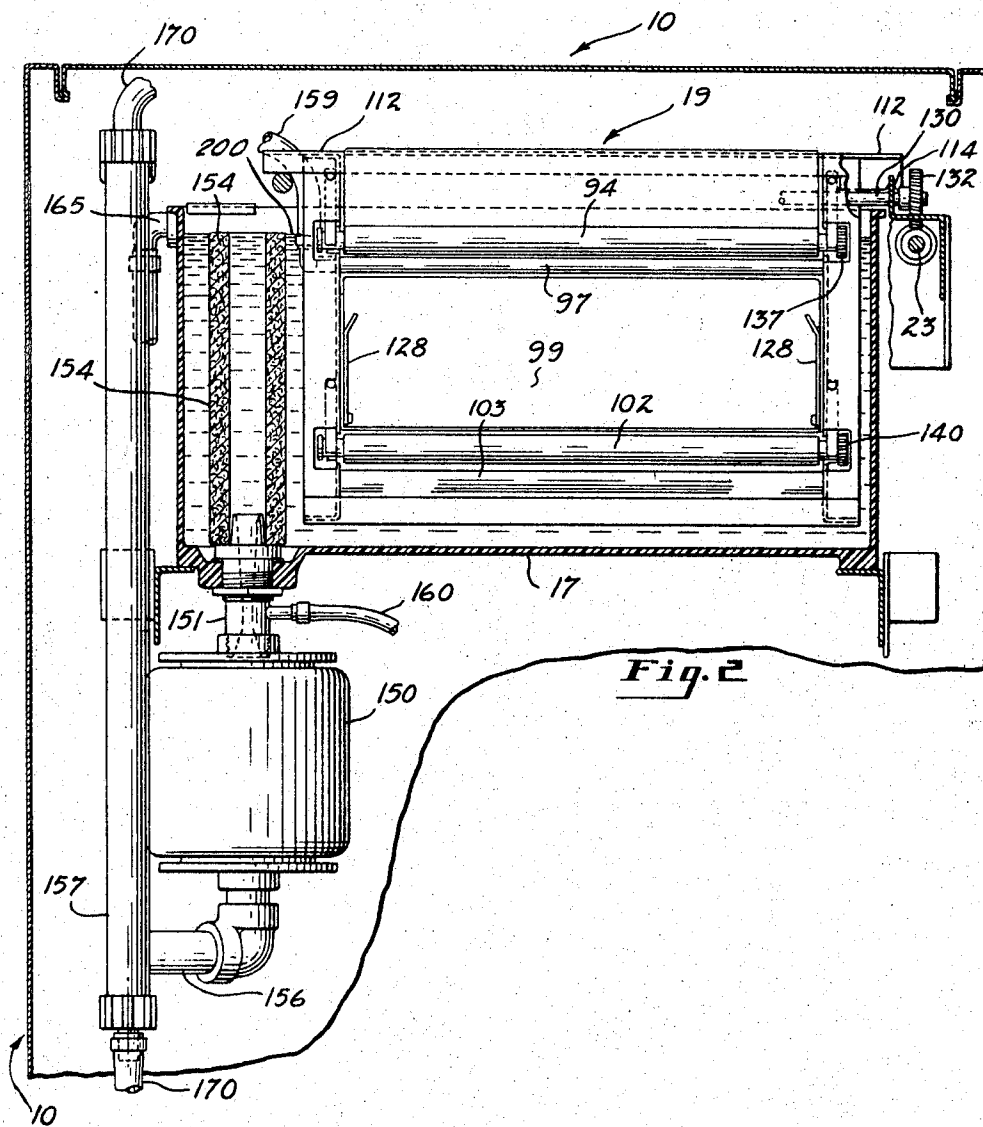


3,477,357

3 Sheets-Sheet 2



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Nov. 11, 1969

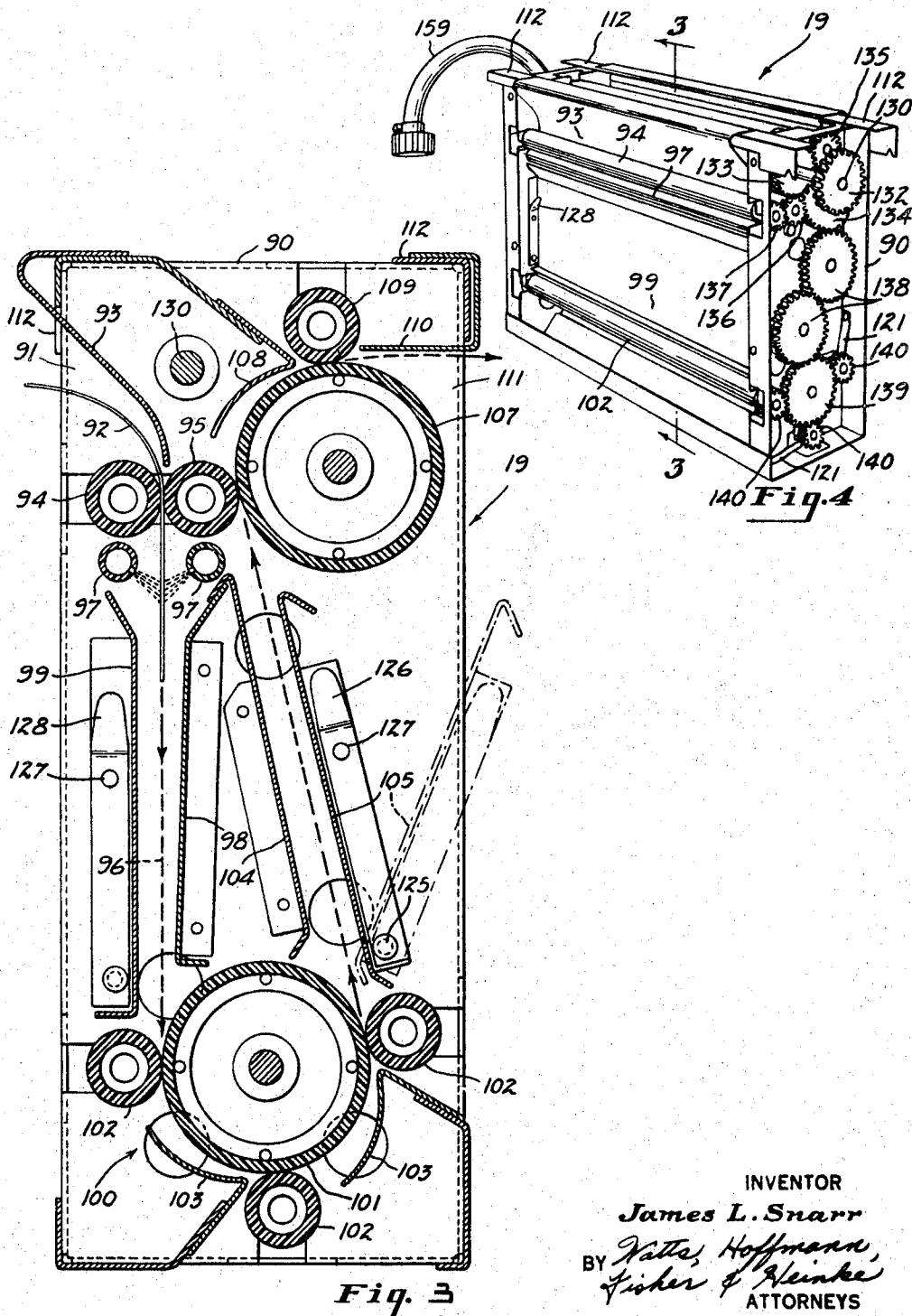
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3,477,357

PROCESSOR

Original Filed July 23, 1963

3 Sheets-Sheet 3



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3,477,357
PROCESSOR

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Application Feb. 10, 1967, Ser. No. 615,260, now Patent
No. 3,418,913, dated Dec. 31, 1968, which is a continu-
ation of application Ser. No. 296,999, July 23, 1963.
Divided and this application Sept. 19, 1968, Ser. No.
760,868

Int. Cl. G03d 3/12

U.S. Cl. 95—94

5 Claims

ABSTRACT OF THE DISCLOSURE

An X-ray film processor which includes a plurality of
film transport mechanisms, each positioned in a differ-
ent processing tank. The transport mechanisms are con-
structed such that film may be directly transferred from
one transport mechanism to another, or to a drier as the
case may be, without any intermediate transfer mecha-
nisms. The fluid level in the tanks is maintained such that
all rolls are at least partially submerged in the fluid or
normally biased into engagement with a roll so partially
submerged, whereby all rolls are constantly wetted to
prevent the development of encrusted and dried deposits
of processing fluids on all rolls of the processor.

CROSS-REFERENCES TO RELATED APPLICATIONS AND PATENTS

This application is a division of copending application
for United States Letters Patent Ser. No. 615,260, filed
Feb. 10, 1967, under the title "Film Processor," invented
by James L. Snarr.

Application Ser. No. 615,260 is a continuation of ap-
plication for United States Letters Patent Ser. No. 296,-
999 invented by James L. Snarr, filed July 23, 1963, and
abandoned in favor of the said continuation application
Ser. No. 615,260.

The application Ser. No. 615,260, identified above, is
now United States Letters Patent No. 3,418,913, issued to
James L. Snarr on Dec. 31, 1968.

United States Letters Patent 3,380,368 issued Apr. 30,
1968 to James L. Snarr, under the title "Film Processor
Transport Mechanism," which resulted from application
Ser. No. 615,175, filed Feb. 10, 1967, as a division of said
application Ser. No. 296,999.

BACKGROUND OF THE INVENTION

Field of the invention

This invention pertains to film processors and more
particularly to a novel and improved film processor for
the development of exposed sheets of film such as X-
ray film. More specifically, the present invention is di-
rected to method and apparatus for transferring X-ray
film from one processing tank to another and from the
final processing tank, known as a "wash" tank, to a drier.

Description of the prior art

The processing of X-ray film presents problems which
are peculiar to such film. Among these the principal ones
which have an effect on the present invention are:

(1) Both surfaces of a substrate are coated with pho-
to sensitive emulsion while with ordinary, photographic
film, only one surface is coated with emulsion; and,

(2) The usual X-ray film processor is used at intermit-
tent times to develop film, while processors of other types
such as, for example, an automatic film processor for
commercially-processing ordinary photographic film typi-
cally will be used substantially continuously.

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While the typical X-ray film processor can process
many types of film, these listed and other peculiarities
render the typical photographic film processor unsuitable
for X-ray film.

In the typical X-ray film processor, developing, fix, and
wash tanks are provided. Each tank is equipped with a
removable film transport mechanism which receives a
sheet of cut film fed to it, transports it through the solu-
tion in which the transport mechanism is at least in part
immersed, and then—in the case of the prior art mecha-
nisms—feeds the film to a transfer mechanism.

Prior to the development of the processor of this
invention, these transfer mechanisms have been above
and overlying adjacent tanks. That is, for example, a
transfer mechanism comprised of a cluster or rollers
would be positioned above the developing tank for receiv-
ing a film which has been transported through the de-
veloping tank. It removes the film from the developing
tank, brings it around a turnaround roller, and directs it
downwardly into the fix tank—feeding it into the transfer
mechanism in the fix tank.

As the film passes through the transfer mechanism,
quantities of processing fluid adhering to the film become
deposited on the rolls of the transfer mechanism. Since
these transfer mechanisms are often designed to "squee-
gee" excess processing fluid from a strip of film, con-
siderable quantities of the processing fluid can become
adhered to the rolls of the transfer mechanism. These de-
posited quantities of processing fluid become dried on the
rolls and as use continues, substantial quantities of these
dried processing fluids can collect on the rolls of the
transfer mechanism.

Since an X-ray film processor in its typical applica-
tion may be subjected to intermittent periods when the
processor is operating but no film is fed through it, the
rolls of the transfer mechanism are not subjected to
continual re-wetting by new pieces of cut film being trans-
ferred by them. Rather, as suggested previously, the trans-
fer rolls often operate for substantial periods of time
without transferring any film. During these periods of
time, the fluids deposited on the transfer rolls can be-
come thoroughly dry, forming a substantial crust on each
of these rolls.

Film processors having the described transfer mecha-
nisms require daily cleaning. Even with daily cleaning,
the deposits may collect in any given day to the point
where thorough and proper processing of film is adversely
affected.

SUMMARY OF THE INVENTION

With the processor of the present invention, separate
film transfer mechanisms are eliminated. The removable
film transport mechanisms are constructed such that film
is transferred directly from one transport mechanism to
another or to a drier.

Only one roll of the entire transport mechanism of this
invention is above the level of the processing fluid. That
one roll is gravity biased against an outlet feed roll which
extends into the processing fluid. Thus, the one roll above
the level of processing fluid is constantly in contact either
with this outlet feed roll or film being fed. This constant
contact keeps the film wet at all times in which the proces-
sor is in use. Since all other rolls are at least partially im-
mersed, no materials can dry on any of the rolls.

This constant wetting of the rolls completely obviates
the need for daily cleaning. More consistent results are
obtained because the rate of gradual deterioration in
quality of the development after each cleaning is greatly
diminished as compared with other driers because the
rolls do not become encrusted with dried deposits.

It can be seen that the heart of the difference of the
present apparatus over the prior art is that film is trans-

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ferred directly from one removable transport mechanism to another. All rollers of the transport mechanism are either at least partially immersed in, or in contact either with a roller which is partially immersed in the processing fluid or wet film, so that all rollers are maintained wetted at all times.

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

Further 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.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a 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 and on an enlarged scale;

FIGURE 3 is an enlarged sectional view of a film transport mechanism as seen from the plane indicated by the line 3—3 of FIGURE 4; and,

FIGURE 4 is a perspective view of a film transport mechanism on a scale reduced with respect to FIGURE 2.

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 darkroom and a feed section 11 positioned within the darkroom. A laterally-projecting flange 13 will circumscribe the edges of an aperture in a darkroom 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 drier 20 is within the main portion of the housing 10 and positioned adjacent an outlet opening 21. The drier receives sheets from the wash tank 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 drier 20. The single drive motor 22 is used to operate all film transporting mechanisms and the drier.

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. A more detailed description of the transport mechanisms will be found in the referenced patents.

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

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feed roll 95. The mounting and drive of these rolls 94, 95, together with the mounting and drive of other of the rolls are described in greater detail in the referenced patents.

The feed rolls 94, 95 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 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 3, 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 drier 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 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 FIGURE 1, the members 112 and the frame have interlocking notches at 114 which locate the tanks.

The pivotal plates 105, 99 are located and maintained in their processing position by pairs of leaf spring latches 126, 128 respectively. Movement of the leaf spring latch 128 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 work 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.

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. An examination of FIGURE 3 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

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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.

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 overflow lines maintain the fluid at the desired level which is high enough that the main outlet feed roll 107 is partially immersed in the fluid.

Rinse water is fed directly to the rinse tank 18 by a rinse water supply conduit 170, FIGURE 1. Water from the rinse tank is removed through an overflow type drain 171 which has an inlet only at its top (not shown) at a level of rinse water desired in the tank 18, and essentially the same level as the overflow 165. 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.

As an examination of FIGURE 2 will show, the fluid level indicated at 200 is, as a minimum, at the bottom level of the overflow 165. This level is maintained since, as indicated above and in the referenced patents, fluid is constantly recirculated and replenishment fluid is introduced each time film is fed through the processor. This level 200 of the fluid is slightly above the axis of the rolls 94, 95 so that the rolls 94, 95 and 107 are each partially immersed in the fluid. The turnaround roll 101 and the rolls 102 which abut it, are all totally immersed in the fluid. Only the outlet roll 109 is above the fluid level. Since the outlet roll is gravity-biased either against the roll 107 or against a sheet of film as it passes between the rolls 107, 109, it is continuously being wetted whenever the processor is operating.

In the typical hospital, the processor will be turned on in the morning and allowed to operate continuously all day. This is done to be sure that the various solutions are up to temperature and the like, and that the processor is immediately ready to develop film whenever there is a need for it. Obviously then, the roll 109 will be continuously wetted throughout the day, preventing processing fluids from becoming dry and encrusted on it. Should a slight residual film of fluid remain on the roll when it is shut off for the night, any dried material on the roll 109 in the morning will be a relatively thin film and is quickly dissolved away when the processor is turned on for the day's operations.

For these reasons, troublesome deposits of dried processing fluids never develop on any of the rolls of the transfer mechanisms.

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

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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. In an X-ray film processor having a capability of developing sheets of cut X-ray film at intermittent periods of time and having a plurality of fluid tanks and film transport mechanisms positioned each in an associated tank, the improvement which comprises:

(a) each of said transport mechanisms including:

(i) film receiving means including rollers for receiving a sheet of film fed to it;

(ii) film transporting means including the mentioned and other rollers for transporting the film through a processing fluid in the associated tank;

(iii) film transfer means for directing film directly from the transport mechanism in one tank to a film receiving means in another tank or a drier, said film transfer means including certain of said rollers; and,

(b) said apparatus including structure maintaining the level of the fluid in each such tank high enough such that each of the rolls is at least partially submerged in the processing fluid or normally biased into engagement with one such roll such that all rolls are constantly wetted whenever the device is in operation, whether or not the film is being fed through the processor.

2. The processor of claim 1 wherein each of said transfer means is positioned such that when the film is transported from one transport mechanism to the other it passes over the tops of adjacent tanks.

3. The device of claim 1 wherein all of the rolls save one are at least partially immersed in said fluid and said one roll is gravity biased against another.

4. The device of claim 3 wherein said one roll and said other roll are both outlet feed rolls forming part of the said film transfer mechanism.

5. In the operation of a film processor having film transport mechanisms disposed in tanks containing processing fluid, the improved steps which comprise:

(a) maintaining the fluid level in each of such tanks at a level such that all rolls are at least partially submerged in said fluid or in contact with a roll at least so partially submerged; and,

(b) operating the processor to maintain all rolls constantly wetted during use of the processor whereby to prevent the development of crusted and dried processing fluids on the transport rolls.

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