

[54] PHOTOGRAPHIC FILM PROCESSOR

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[58] **Field of Search**..... 95/89 R, 89 A, 90.5,
95/93, 94 R

[56] **References Cited**

UNITED STATES PATENTS

2,691,332	10/1954	Happel.....	95/90.5
3,139,904	7/1964	Wengel	95/89 R X
3,662,660	5/1972	Layne	95/89 R

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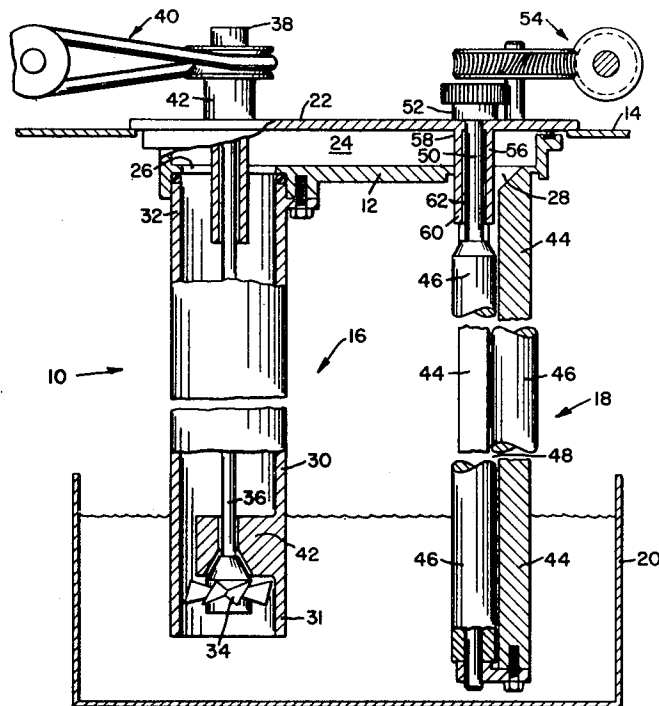
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[57] **ABSTRACT**

A film processor where processing liquid pumped under pressure into a plenum drains through a discharge outlet into and through a processing chamber below the plenum. Drive rollers for transporting film through the chamber have axle portions extending upwardly through the plenum. Fixed sleeve members surrounding the axle portions extend down into the region of lowered pressure produced by the falling liquid. This prevents upward leakage of pressurized fluid from the plenum around the axle portions without the need for dynamic seal members.

2 Claims, 2 Drawing Figures



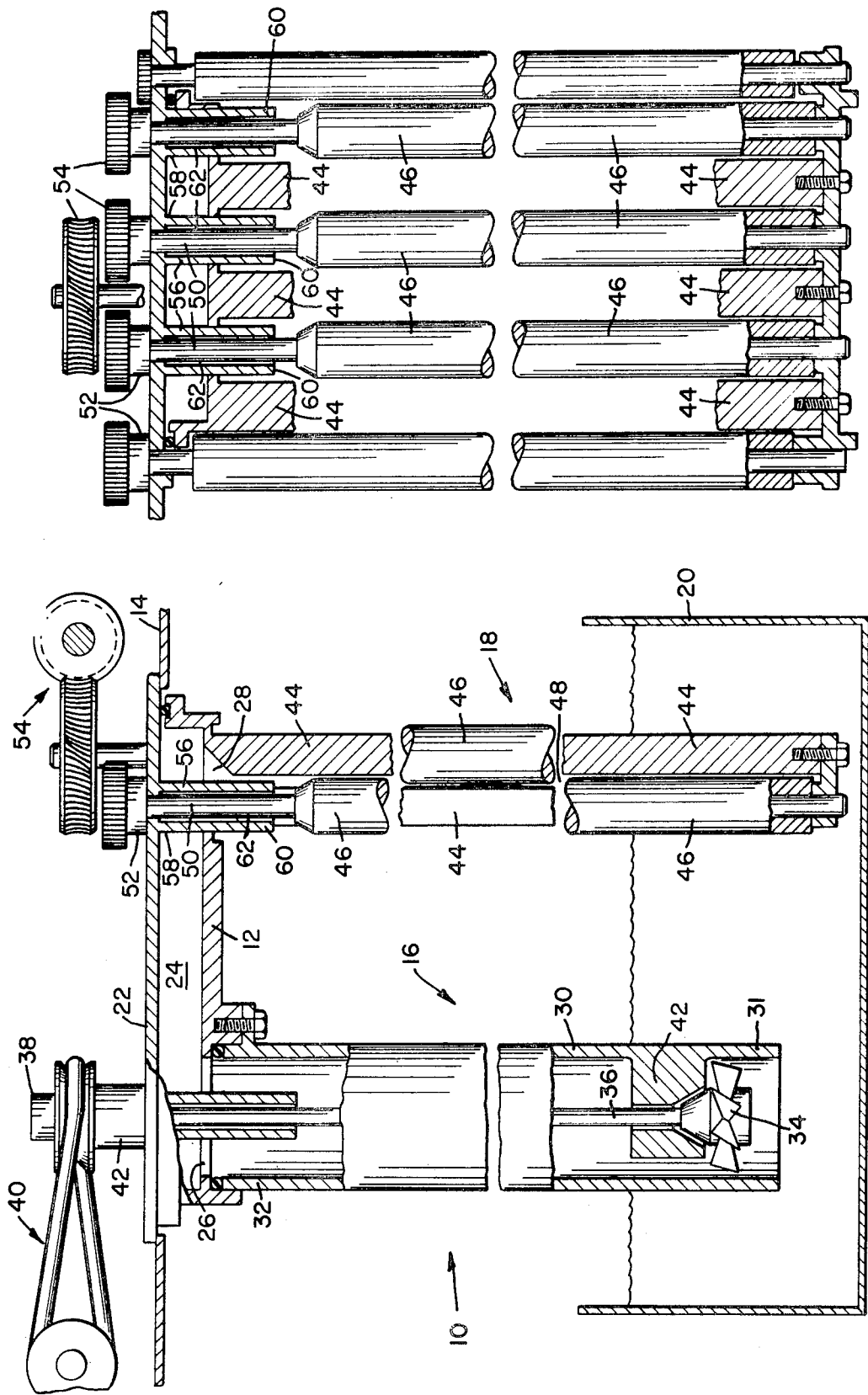


FIG. 2

FIG. 1

PHOTOGRAPHIC FILM PROCESSOR

BACKGROUND OF THE INVENTION

The present invention relates to a processing apparatus for film, particularly X-ray film and like synthesized material, wherein the material is transported through a falling stream of processing liquid. More particularly, the present invention pertains to means preventing from leakage of processing liquid about the axles of the film transport mechanism.

My U.S. Pat. No. 3,662,660 describes apparatus in which film is processed by transporting the film through a falling stream of processing fluid. Two parallel rows of upright members and drive rollers form a processing chamber through which pass both the film and the falling stream. A pump is used to pump process fluid under pressure to a plenum enclosed in a top member above the processing chamber. A plenum outlet permits fluid to drain down into and through the chamber. The transport means, usually drive rollers, assist in defining the processing chamber, so that the rollers must be located adjacent the plenum outlet. The axles for the rollers extend up through the plenum and engage drive means located above the top member. Since the plenum is under positive pressure, there is the problem of sealing to prevent leakage of processing liquid through the top of the plenum from around the axles. Rotating pressure seals contacting the axles are not entirely satisfactory because of the wear problem and the need to replace such seals periodically.

One characteristic of a falling stream is the tendency to draw together as it accelerates. This places the stream under a slight negative pressure. In the present invention use is made of this characteristic to prevent leakage of liquid under pressure through the top of the plenum from around the drive roller axles. According to the teachings of the present invention, as set out hereinbelow, such leakage is prevented without the use of rotating pressure seal means contacting about the axles of the drive rollers.

SUMMARY OF THE PRESENT INVENTION

The processor of the present invention may be characterized in one aspect thereof by the provision of a housing enclosing a plenum, the housing having a top; means for pumping a processing liquid into the plenum under pressure the liquid falling through a plenum outlet by gravity; drive members depending from the housing adjacent the outlet, the drive members having axles extending up through the plenum and the top of the housing; and a sleeve surrounding and spaced from each of the axles, each sleeve having its upper end fixed to the housing top in a fluid tight relationship, with the lower end of the sleeve extending into the falling liquid at a point below the fluid outlet, the pressure at this point being lower than the plenum pressure and insufficient to force liquid up between the sleeve and axle through the housing top.

OBJECTS OF THE INVENTION

One object of the present invention is to provide film processing apparatus of the type described, having non-wearing means to prevent liquid from leaking about drive roller axles extending through a pressurized plenum.

Another object of the present invention is to provide a film processing apparatus wherein film drive rollers

each have an axle extending upwardly through a plenum filled with processing liquid under pressure, there being means to maintain at least a portion of the axle at a pressure below the plenum pressure to prevent leakage from about the axles.

Another object of the present invention is to provide a film processor of the type described having the axle of a drive roller extending through a plenum filled with process liquid under pressure, there being a sleeve about the axle communicating with a region of lower pressure below the plenum to prevent pressurized process liquid leaking from about the axle.

These and other objects, advantages and characterizing features of the present invention will become more apparent upon consideration of the following detailed description thereof, when taken in connection with the accompanying drawings depicting the same.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of one film processor module, partly broken away and in section; and

FIG. 2 is a view of a film processor module in front elevation, partly broken away and in section.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, FIG. 1 shows one module generally indicated at 10 of the film processor. It should be understood that several of the modules may be incorporated into one film processor wherein each module would perform one of the processing steps, such as developing, fixing or washing. Reference is made to my abovementioned patent for a description of such a film processor employing a number of the modules 10 arranged in series.

Each module includes a housing portion 12 which is supported by the frame of the film processor schematically shown at 14. Depending from housing 12 is a pump section 16 and a processing section 18. Both the pump section and processing section extend down into a reservoir 20 which contains the processing liquid.

Housing section 12 has a top 22 and encloses a plenum 24, there being an inlet and an outlet 26, 28 respectively communicating with the plenum through the bottom of the housing.

Pump section 16 is a tube member 30 having its lower end 31 disposed below the level of liquid in the reservoir 20 and its upper end 32 connected to the bottom of the housing in fluid tight relationship about inlet 26. An axial flow pump 34 within tube member 30 has its drive shaft 36 extending up through the housing top member 22. The upper end 38 of the drive shaft is connected to any suitable drive means such as the pulley and drive belt combination 40. Steady bearings 42 are provided adjacent the ends of the drive shaft.

The processor portion 18 of the apparatus is described in detail in my abovementioned patent. For purposes of the present invention it is sufficient merely to say that the processor portion is formed by parallel rows of upright members and rollers 44, 46 respectively. The two rows of rollers and upright members define the walls of a processing chamber 48 through which X-ray film or the like is passed for processing. The rollers and upright members depend from housing 12 so that outlet 28 is directed to discharge the processing liquid into processing chamber 48 for substantially the entire length of the chamber. As shown in FIGS. 1

and 2, the liquid entering the chamber from discharge 28 cascades down between and over the walls of the chamber formed by the two rows of upright members and rollers and then into reservoir 20. The processing chamber 48 is open at its ends so that the film (not shown) is oriented in a vertical plane as it passes through the the processing stage 18 and the stream of processing liquid falling through chamber 48.

Rollers 46 each have an axle 50 which extends up through housing plenum 24 and housing top 22. The upper end 52 of each axle engages any suitable drive means such as the worm and spur gears shown at 54 for driving the rollers.

Thus the processing liquid from reservoir 20 is pumped upwardly in tube 30 by axial flow pump 34. The liquid enters housing plenum 22 under pressure through inlet opening 26. From the housing plenum the processing liquid exits through discharge outlet 28 to cascade down through processing chamber 48 over a film and back into the reservoir.

It should be appreciated that with housing plenum 24 under pressure, there is a potential leakage problem through housing top 22 from around each drive roller axle 50. Leakage at the top of the housing is undesirable in that the processing liquid may accumulate and clog gears 54 or come in contact with the various electrical portions of the processor, such as drive motors and control circuits (not shown) located on top of the housing.

While various types of dynamic seals between each of the rotating axles 50 and the housing top 22 may be used, the present invention solves this leakage problem with a static seal about the axle. This eliminates the need for replacement due to wear. Cost is also reduced, since a static seal can be formed integral with the top 22, which reduces manufacturing time and cost.

The present invention solves the leakage problem by providing a sleeve member 56 in the plenum about each axle 50. The sleeve is fixed at its upper end 58 in a fluid tight static joint to housing top 22. The joint can be made by any suitable means, such as threading the sleeve to the housing top or preferably as shown by having the sleeve formed integral with housing top 22. The lower end 60 of the sleeve extends down through the housing plenum, and into the stream of falling fluid at a point below the level of discharge outlet 28. As shown in the Figures, there is no seal between the lower end 60 of the sleeve and axle 50 so that fluid is free to enter into the space 62 between the sleeve and the axle and travel upwardly in the space to leak through the top of the housing from about the axle portions. However, such leakage is prevented by taking advantage of the negative pressure produced by the falling stream of processing liquid. In this respect, the liquid in plenum 24 is under a positive pressure due to the action of axial flow pump 34. However, as the liquid passes through discharge outlet 28 and begins to fall by gravity through chamber 48, this positive pressure in the plenum becomes a negative pressure at some point in chamber 48 below outlet 28.

Between the discharge outlet and the point of negative pressure is a regional lowered pressure, i.e., a pressure between atmospheric and the plenum pressure. Sleeve end 60 extends down into this lowered pressure region. It should be understood that in order to prevent liquid from rising in space 62 and leaking through housing top 22, the pressure in terms of inches of processing

liquid at sleeve end 60 must not be greater than the entire length in inches of the unsealed space 62 measured from sleeve end 60 through the housing top. Accordingly, sleeve 56 together with the thickness of housing top 22 must provide a length greater than the pressure in inches of the falling liquid measured at sleeve end 60. If the housing top is relatively thin, then substantially all of the required length can be provided by sleeve 56.

While sleeve end 60 can extend down to the point of negative pressure, this is not advisable in all cases. In this respect, communicating space 62 to a region of negative pressure could cause air to draw through the space and into the falling processing liquid. The mixing of air with the processing liquid could in some cases speed the degradation of chemicals in the liquid.

Thus, it should be appreciated that the present invention accomplishes its intended objects in providing means for sealing about each axle 50 without requiring a dynamic or rotating seal contacting the axle. Simply providing a sleeve member 56 which has its upper end 58 fixed in a static liquid tight engagement to the housing top 22 and its lower end 60 extending down below the level of discharge 28 and into the region of lowered pressure is sufficient to prevent any leakage from about axle 50.

Having thus described the invention in detail, what is claimed as new is:

1. A processor for film and like materials including a housing having a top and enclosing a plenum, means for pumping processing liquid into the plenum under pressure, the liquid thereafter falling by gravity from a plenum outlet, drive members depending from the housing adjacent the outlet for moving film through the falling stream of processing liquid, each drive member having an axle extending up through the plenum and housing top, wherein the improvement comprises means for preventing leakage of plenum processing liquid through the housing top from around the axles, said leakage preventing means comprising:
 - a. a sleeve member in said plenum surrounding and spaced from each axle;
 - b. said sleeve having one end fixed to said housing top; and
 - c. said sleeve having its other end extending down along said axle and opening into the falling stream of processing liquid, wherein the length of said sleeve in inches is greater than the pressure in inches of processing liquid at said other end.
2. A film processor comprising:
 - a. a housing including a top, said housing enclosing a plenum having an inlet adapted to receive processing liquid under pressure and having an outlet from which said processing liquid falls by gravity;
 - b. upright members forming a processing chamber below said outlet, said liquid falling from said outlet passing through said chamber to processing a film therein;
 - c. at least one of said members being a film driving member depending from said housing and having an axle extending up through said plenum and housing top to engage drive means above said housing top;
 - d. a sleeve in said plenum about said axle, said sleeve and axle defining an annular space therebetween;
 - e. said sleeve having one end fixed to said housing top in liquid tight engagement; and

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f. said sleeve having its other end open and extending into the stream of falling processing liquid below said outlet, the length of said sleeve in inches being greater than the pressure in inches of said falling

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stream of processing liquid at said other end so that processing liquid entering said open end fills only a portion of said space.

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