United States Patent

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[73] Assignee **The United States of America as represented by the Secretary of the Army**

[54] **FILM-PROCESSING TANK**
2 Claims, 5 Drawing Figs.

[52] U.S. Cl. ..... **95/94 R,** 95/89 R, 68/175, 118/423
[51] Int. Cl. **G03d 3/00**
[50] Field of Search ..... 95/89, 89 A, 94; 226/189; 68/175; 118/423–425

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ABSTRACT: A tank for processing filmlike material that is transported through discrete sections of the tank in looped configuration. Each tank section is provided with a discrete weighted roller, that differs in weight or buoyancy from the other rollers, and each of which ride in guide rails to carry the material into the tank sections. The material is confined by the rollers in its passage through the several sections.

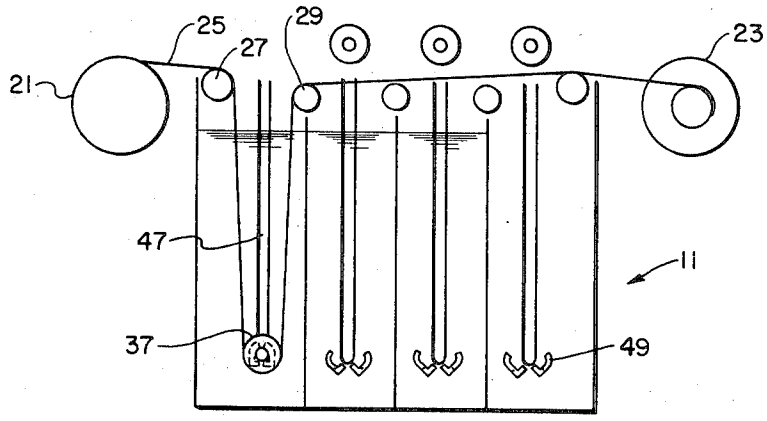


FIG. 1

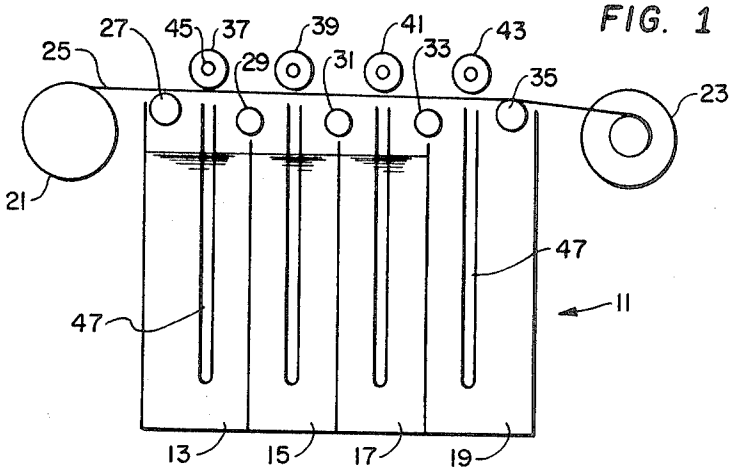


FIG. 2

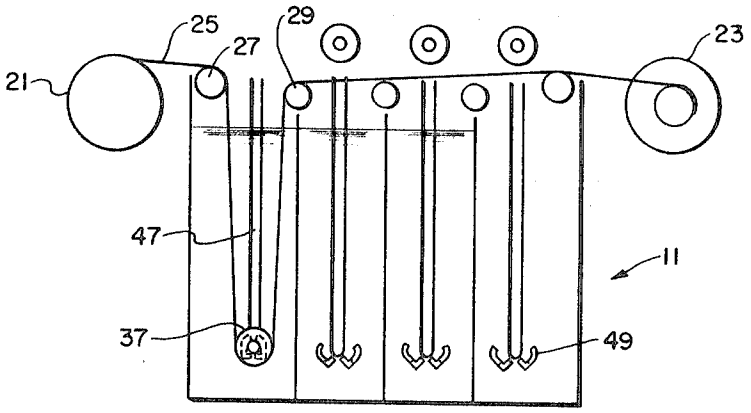
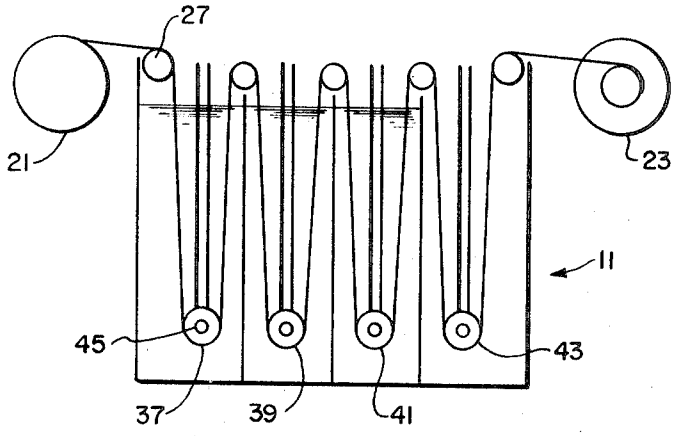


FIG. 3



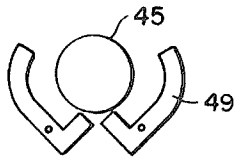


FIG. 4a

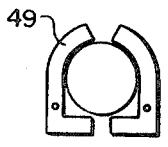


FIG. 4b

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FILM-PROCESSING TANK

The invention described herein may be manufactured, used, and licensed by or for the U.S. Government for governmental purposes without the payment to me of any royalty thereon.

BACKGROUND OF THE INVENTION

The present invention relates generally to a tank for treating and processing web or filmlike sheets of material in looped like configuration and more specifically to a tank of the kind described for processing photographic film. Such processing tanks are conventionally divided to include respective developing, fixing, washing and drying compartments. Such tank system is placed between a feed reel and a takeup reel and the film is transported in a looped pattern through the several compartments.

In such tank systems, standard photographic film processing required the use of substantial amounts of leader to thread up or dress the machine prior to the actual start of film processing. This leader must be attached by splicing or taping to the film, usually in darkness which requires considerable time to accomplish. Furthermore, the leader is expensive if discarded after use, which must be done if it is not carefully washed.

Several design approaches have been proposed in the past to alleviate this problem. "Leaderless" systems have been designed that utilize belts, tapes or a multiplicity of rollers to automatically transport the film through the tank system. Such roller-type systems are complicated, subject to malfunction and are limited to fairly stiff material that will not flex or lose their path of travel in the complex roller system. Some film transport systems include a complex cam-actuated, loop-forming means. Such an automatic system utilizes a preset schedule for forming free-hanging loops in each tank. After a loop is formed in the first tank, a second drive roller meshes into operation which feeds film into a second tank. This continues until all the required loops are formed, dependent upon the number of compartments in the system. Such loop-forming system is complex requiring accurate design and control of components. A serious deficiency exists since the film has no lower roller support permitting the film to twist, tangle and stick together.

SUMMARY OF THE INVENTION

It is the general purpose of this invention to provide a film-processing system for tank processing that includes a method of forming loops by a series of rollers of varying weight which take up the slack formed by the feedout film from the supply reel. Control over the order in which the rollers descend into their respective compartments is determined by the weight of each roller as hereinafter described.

BRIEF DESCRIPTION OF THE DRAWING

The exact nature of this invention will be readily apparent from consideration of the following specification relating to the annexed drawing in which:

FIGS. 1–3 are schematic representations showing operational stages of the film-processing system; and

FIGS. 4*a* and 4*b* are views of the roller-locking means in open and locked positions respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, FIG. 1 shows all the essential components of the film-processing system in accordance with my invention. The system includes a tank 11 that is divided into four compartments 13, 15, 17 and 19. Each of the compartments 13, 15 and 17 have contained therein appropriate liquid solutions for developing, fixing and washing. The fourth compartment 19 may serve as a dryer for the film in its final stage of processing. Adjacent to the left-hand end of the tank is a supply or feed reel 21. A similar takeup reel 23 is located adjacent to the right-hand end of the tank. The film to be processed is shown initially at 25. Positioned slightly above the discrete tank compartments 13–19 are spaced fixed idler rollers shown at 17–35 that serve to position and guide the film in its travel during processing. The means for securing and the mounting of the rollers 27–35 is of no import to the invention and therefor not shown in any detail.

Also positioned above the tank 11 are a series of longitudinally movable rollers shown at 37–43 each including a drive shaft, one of which is shown at 45. Each of the rollers 37–43 is so positioned that any one of the rollers lies between two adjacent idler rollers heretofore described. Thus, for example, movable roller 39 lies between rollers 29 and 31. The positioning of the movable rollers is such that each of said rollers is substantially equidistant from the sides of each tank compartment over which each is positioned. For positioning, guiding and confining the rollers 37–43, each of the tank compartments is provided with opposing guide rails 47 being affixed to opposing sidewalls of the compartment. The guide rails 47 are designed to permit the shafts 45 of the movable rollers to ride therein. For confining the rollers 37–43 in the lower part of each compartment as is shown in FIG. 3, there are provided locking means shown at 49 in FIG. 4. The locking means include a pair of pivotable arms positioned adjacent the bottom end of the guide rails 47. The locking means are so designed as to engage and confine the shafts of the rollers but not so rigidly as to retard the free rotation of the rollers.

It has been determined that operation of the processing device herein described could only be achieved if the movable rollers 37–43 are of varying weights in specific order. Accordingly, the roller 37 closest to the supply reel 21 is the heaviest of the rollers and the rollers 39, 41 and 43 decrease in weight in that order. In one specific design of a film-processing system of the kind described herein the rollers had the following weights:

roller	37	935 g.
roller	39	823 g.
roller	41	707 g.
roller	43	632 g.

The operation of the film-processing system herein described is substantially as follows:

Reference is made to FIG. 1 where it may be seen that the film 25, with a short portion leader attached thereto is positioned in a straight path between the idler rollers 27–35 and the movable rollers 37–43, with the supply reel and takeup reel locked. At this time the movable rollers are released from their temporary fixed position to rest upon the leader portion of the film. Rotation of the feed roll 21 is initiated by a drive motor (not shown) at a predetermined governed speed. As the film 25 is unwound from the feed reel and slack is formed, the roller 37 will begin to descend into the compartment 13 carrying the slack film, as shown in FIG. 2. When the roller 37 reaches the bottom of the guide rails 47, the locking arms 49 will loosely engirdle the shaft portion of the roller 37 and maintain it in such position close to the bottom of the compartment and still allow rotation of the roller. The film 25 is still continuously fed from reel 21 at the same governed rate of speed at which time the movable roller 39 will begin its descent into compartment 15 and film will be drawn over the idler roller 29. In the same sequence the rollers 41 and 43 will fall into their respective compartments 17 and 19. At such time all the movable rollers 37–43 are locked in their respective positions as shown in FIG. 3. At such time the takeup reel 23 is initially activated either manually or preferably motor driven to draw the film through all its processing stages in the several compartments. The supply reel drive at this time may be disengaged. After such processing and all the film is on the takeup reel 23, the rollers 37–43 are retrieved from the lower portions of the tank compartments. Such retrieval may be accomplished by the use of strings or tapes that are secured to each end of the shaft of each roller. Such lifting action will upset the pivotable locking arms 49 to allow lifting of the rollers. Obviously such lifting force must be greater than that exerted when the film is normally drawn through the processing

tank. In the specific description of the embodiment herein, the rollers **37–43** are of successive lighter weight. While such arrangement is preferable, it is obvious that other roller arrangements can be utilized to accomplish the same ends. In one such arrangement the roller **37** would be hollow and open ended or provided with peripheral openings to allow liquid to enter therein. Located medially within the roller is an evacuated chamber of a fixed length formed by sidewalls. The next roller **39** will also be provided with an evacuated chamber that is slightly larger than the one in roller **37**. In similar manner the rollers **41** and **43** will include successively larger evacuated compartments. By such arrangement each of the rollers will be slightly more buoyant than the roller to its left as seen in FIG. **1**. This arrangement will permit the rollers to descend in the same order as the weighted rollers heretofore described.

The processing system herein described lends itself to other applications where a continuous film or web of material must be transported through several liquid-filled treating tanks. Such applications may be in the arts of cloth treating and dyeing, paper manufacturing and the like.

We wish it to be understood that we do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

What is claimed is:

1. A system for processing a continuous strip material including a tank having a plurality of discrete compartments, each having an appropriate treating agent therein,

feed and takeup means for said material positioned respectively at opposite ends of said tank,

a plurality of fixed rollers adjacent to the upper edge of said tank for guiding said material in its travel,

a plurality of movable rollers positioned above said tank adapted to descend freely, individually and successively into each of said compartments as each of said rollers engage slack film released from said feed means to form a U-shaped loop of said film within the several compartments,

means for retaining said movable rollers adjacent to the bottom of each compartment, said retaining means for each of said movable rollers comprising a pair of opposing pivotable locking arms adapted to substantially engirdle the respective roller, and each of said movable rollers being of successive decreasing weight in the order from the feed means to the takeup means.

2. A tank assembly for processing continuous strip film comprising;

an open-top tank having several parallel vertical partitions that divide the tank into hydraulically separate compartments,

independently lockable and independently drivable film feed and takeup means positioned outside of and at opposite ends of said tank such that the compartments are in succession between the feed and takeup means,

a fixed guide roller positioned in the tank at each end thereof and projecting above the respective end walls of the tank to guide film from the feed means into the tank and from the tank to the takeup means,

a fixed guide roller positioned in the tank above each partition,

opposing guide rails in each compartment along the sides of the tank,

a movable guide roller for each compartment, each including an axially extending shaft for registration with the opposing guide rails, the guide rollers for the successive compartments from the feed means end of the tank to the takeup means end of the tank being of progressively less weight,

releasable guide-roller-retaining means adjacent the bottom end of at least one of the opposing guide rails in each compartment for engaging the respective guide roller shaft,

whereby when the movable guide rollers are temporarily fixed in positions higher than the fixed guide rollers, film may be stretched from the feed means to the takeup means between the movable guide rollers and the fixed guide rollers, the feed and takeup means fixed, the movable rollers released to rest upon the film and then the feed means released and driven until the movable guide rollers move downward to their respective retaining means in succession, at which time driving of the feed means may be terminated and driving of the takeup means begun.