Aug. 16, 1949. E. S. COBB 2,478,896

FLUID TREATMENT APPARATUS WITH ROTARY FILM GUIDE

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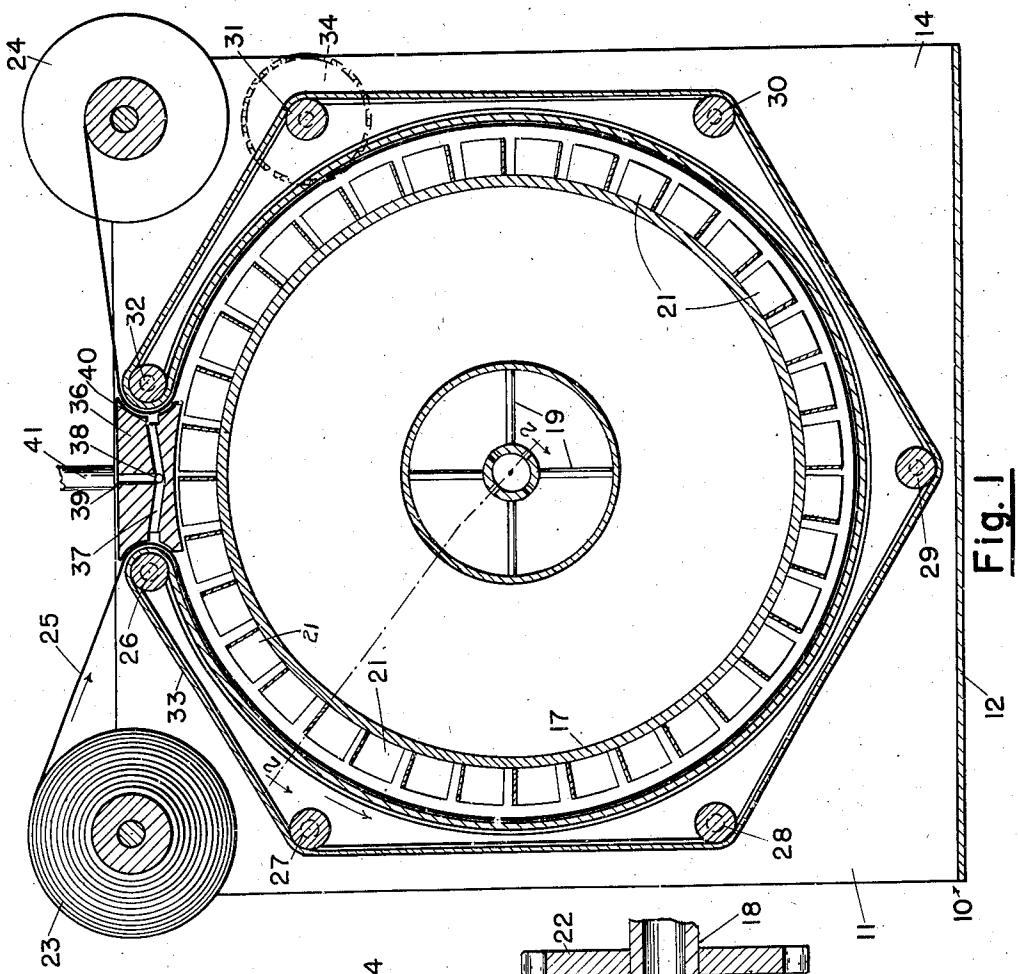


Fig. 1

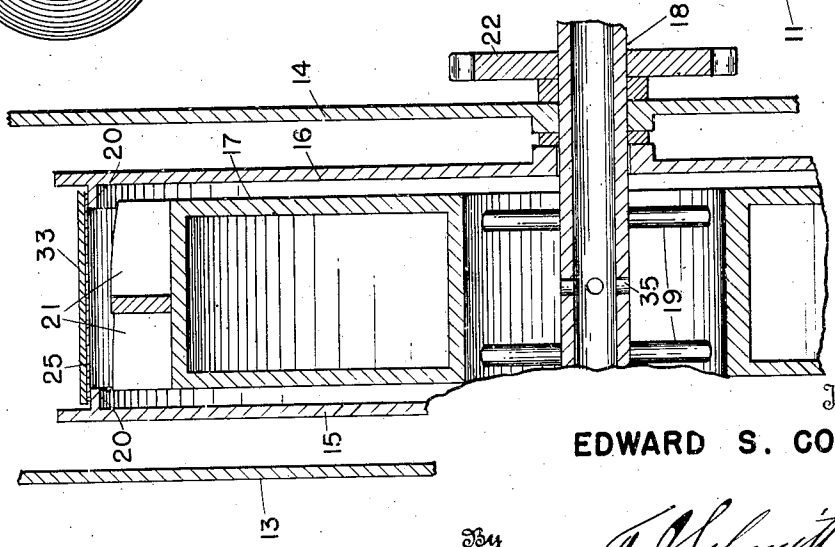


Fig. 2

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FLUID TREATMENT APPARATUS WITH ROTARY FILM GUIDE

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6 Claims. (Cl. 95—94)

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This invention relates to apparatus for fluid treatment of strip material, as, for example, developing, drying or otherwise processing motion picture film or the like.

In my co-pending application, Serial No. 662,765, filed April 17, 1946, entitled "Fluid treatment apparatus" there is described and claimed apparatus in which strip material, for example, photographic film, may be moved longitudinally around the periphery of a pair of discs and treated by fluid that flows across the surface in a transverse direction. The apparatus may be installed in a closed system that includes a fluid storage tank and a circulation pump, which continuously circulates fluid through the apparatus.

It is an object of the present invention to provide improved fluid treatment apparatus of the character referred to in which fluid may be constantly recirculated within the apparatus, thereby eliminating the need for external circulation means.

Other objects of the invention are to provide improved fluid treatment apparatus in which film or the like may be processed expeditiously and with but little risk of damage; to provide improved apparatus for continuous fluid processing of relatively long strips in which the fluid in contact with the strip is continuously agitated and renewed, thereby maintaining the fluid in contact with the strip at predetermined concentration and controlling the rate of reaction between fluid and strip; to provide improved apparatus of the character set forth in which means are provided for preventing spillage of fluid and protection thereof against chemical reaction with the atmosphere; and to provide improved fluid treatment apparatus of rugged construction and easy operation.

In accomplishing these and other objects of the present invention, I have provided improved details of structure, a preferred form of which is shown in the accompanying drawing, wherein:

Fig. 1 is a vertical sectional view through a fluid treatment apparatus embodying the features of the present invention; and

Fig. 2 is a sectional view through the apparatus taken substantially on the line 2—2 of Fig. 1.

Referring more in detail to the drawing:

The apparatus of the present invention is designated generally as 10, and includes a rigid support 11, preferably formed of a base plate 12 and a pair of spaced parallel upright plates 13 and 14 fixed to said base plate. A front disc 15, a rear disc 16 and a drum 17 are mounted between the upright plates on a rotatable tubular shaft 18 that passes through suitable bearings in said plates.

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The discs 15 and 16 are mounted on the shaft 18 for free rotation with respect thereto. The drum 17 is fixed to said shaft to rotate therewith, a preferred connecting means being a plurality of spokes, as indicated at 19 in Fig. 1. The drum is mounted between the discs in spaced relation therefrom and the latter have inwardly projecting peripheral flanges 20 (Fig. 2). A plurality of transverse angularly disposed fins or blades 21 are fixed to the outer peripheral surface of the drum and extend therearound. The drum at the outer tips of the fins is of slightly smaller diameter than the discs at the flanges 20. A gear 22, or other appropriate driving means, is connected to the shaft 18 to furnish means for rotating said shaft and the drum 17.

The upright plates 13 and 14 are equipped with transverse removable spindles or other appropriate means for rotatably supporting reels 23 and 24 on which are wound strip material 25, as, for example, photographic film, to be processed by the apparatus. The reel 23 contains the unprocessed material which is fed therefrom, around the major portion of the periphery of the discs 15 and 16, where it is contacted by the fluid in a manner hereinafter described, and onto the reel 24, being guided and driven by means hereinafter described.

A plurality of pulleys 26—32 are rotatably mounted between the upright plates 13 and 14, preferably being arranged around the discs 15 and 16 in the manner illustrated in Fig. 1. A flexible, substantially non-stretchable belt 33 passes around the pulleys and around the major portion of the periphery of the discs 15 and 16, also as illustrated in Fig. 1.

Driving means are connected to one of the pulleys 26—32, and in Fig. 1 such means are illustrated as including a gear 34 connected to the shaft on which pulley 31 is mounted and adapted to be driven by any suitable means, not shown. It is obvious, however, that the driving means may be connected with any of the other pulleys without departing from the invention.

Strip material 25 is fed from the reel 23 around the first pulley 26, outside of the belt 33, which guides it around the flanges 20 at the periphery at the discs. The strip emerges from around the last pulley 32 from which it is wound onto the reel 24. It is seen that the belt holds the strip in close contact with the flanges through the major portion of the periphery of the discs.

The tubular shaft 18 contains radial ingress

bores **35** (Fig. 2). Fluid, such as photographic developing solution, is introduced into the space between the discs through the shaft **18** and the ingress bores **35**. Such fluid fills the space within the discs **15** and **16** and the belt **33**.

In order to prevent leakage or escape of fluid through the space between the pulleys **26** and **32** in the region of the periphery of the discs not covered by the belt **33**, a shoe **36** is secured to the upright plates **13** and **14** between the pulleys **26** and **32**. The configuration of the ends of said shoe is preferably substantially complementary to the circumferential surface of the pulleys **26** and **32**. The ends of the shoe are positioned close to the adjacent pulleys, but sufficient clearance is provided to permit free movement of the belt **33** and strip **25** therepast. The shoe extends into the space between the discs and the sides are spaced from the discs only by a sufficient distance to permit free rotation of the discs therepast.

The shoe **36** has a central longitudinal bore **37**, a central transverse bore **38**, and a vertical bore **39**, which intersect at a common point. The shoe also has a peripheral groove **40** adjacent the surface of the strip **25** and the interior surface of the discs, and which communicates with the bores **37** and **38**. A fitting **41** is secured to the shoe and communicates with the vertical bore **38**. A source of reduced pressure or vacuum, not shown, is connected to said fitting to draw off any fluid that tends to escape around the sides and ends of said shoe.

The operation of a fluid treatment apparatus constructed as described is as follows:

Strip material **25**, as for example, photographic film, is fed from the reel **23** around the major portion of the periphery of the discs **15** and **16**, where it rests on the flanges **20**, and onto the reel **24**. The material is retained on said flanges and continuously fed by the belt **33**. The belt **33**, the strip and the discs are driven by a source of power applied to the gear **34**, the motion being in the direction indicated in Fig. 1.

Fluid within the apparatus, as, for example, photographic developing solution, is agitated and forced to flow across the strip in a transverse direction by the fins **21** on rotation of the drum **17**, which is rotated by a source of power not shown, connected to the gear **22**. The drum rotates at a relatively high speed either in the same direction as the direction of travel of the strip **25**, or in the opposite direction, but rotation in the opposite direction is preferred in order to produce a more rapid flow of the fluid relative to the strip.

Fluid that is lost from the apparatus, either by clinging to the strip **25** or through the fitting **41**, is replaced through the shaft **18**.

It is thus seen that the continuous recirculation of fluid takes place within the apparatus, and it is only necessary to add fluid to replace that lost through normal operation of the apparatus. Fluid within the apparatus is retained therein against spillage and atmospheric contact.

While I have shown one embodiment of the present invention, it is obvious that the device is subject to modification without departing from the spirit of the invention. Therefore, I do not wish to be limited by the disclosure set forth, but only by the scope of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. An apparatus for fluid treatment of strip material comprising a support, a pair of discs, a drum of smaller diameter than said discs and having angularly disposed fins around the periphery thereof, means relatively rotatably mounting said discs and said drum concentrically on said support with said drum being axially spaced between said discs, said mounting means providing ingress for fluid into the space between said discs, an endless belt, rotatable means mounted on said support retaining said belt with a portion thereof in fluid tight engagement with a portion of the periphery of said discs, said belt being adapted to guide and feed a strip around the periphery of said discs engaged by said belt, rotation of said drum producing a positive flow of fluid having a transverse component with respect to the strip, and means mounted on said support for preventing leakage of fluid from between the discs in the region of the periphery not engaged by said belt, said region being near the top of said apparatus.

2. An apparatus for fluid treatment of strip material comprising a support, a pair of discs having inwardly projecting peripheral flanges, a drum of smaller diameter than said discs and having angularly disposed fins around the periphery thereof, means relatively rotatably mounting said discs and drum concentrically on said support with said drum being axially spaced between said discs, said mounting means provided with an axial passage with radical discharge passaged for the ingress of fluid into the space between said discs, means for guiding and feeding a strip around the flanges of said discs, rotation of said drum producing a flow of fluid having a component transverse with respect to the strip and means for preventing leakage of fluid from the apparatus.

3. An apparatus for fluid treatment of strip material comprising a support, a pair of discs, a drum having angularly disposed fins around the periphery thereof, means relatively rotatably mounting said discs and said drum concentrically on said support with said drum being axially spaced between said discs, said mounting means provided with an axial passageway having radial discharge openings between said discs for the ingress of fluid into the space between said discs and means for guiding and feeding a strip of material around the periphery of said discs in fluid tight relationship therewith, rotation of said drum producing a positive flow of fluid having a component of flow transverse to the strip.

4. An apparatus for fluid treatment of strip material comprising a support, a pair of axially spaced circular discs rotatably mounted in said support and having inwardly extending shoulders at their peripheries for receiving and guiding said strip around the space between said discs so as to confine said fluid therein, and a torus-shaped rotor mounted between and spaced from said discs and having paddles on its periphery adjacent said strip for circulating said fluid in said space across the inner face of said strip in a direction having a component transverse with respect to the strip, then radially inwardly around one side of said rotor into and then through its center and radially outwardly around the other side of said rotor back to the strip.

5. An apparatus for fluid treatment of strip material comprising a support, a pair of axially spaced circular discs rotatably mounted in said support and having inwardly extending shoulders at their peripheries for receiving and guiding said

strip material around the space between said discs so as to confine said fluid therein, and a torus-shaped rotor mounted between and spaced from said discs and having impeller means extending across said space for circulating said fluid therein in a direction substantially transversely across the inner face of said strip material then radially inwardly around one side of said rotor into and through its center and radially outwardly around the other side of said rotor back to said strip material.

6. Apparatus for the automatic development and fixing of strip film and photographic paper comprising two external base plates spaced from each other, a tubular shaft mounted in bearings centrally positioned in said plates and extending therethrough, discharge ports positioned in the median plane between and parallel to the plates and communicating with the interior of the tubular shaft, two discs rotatably mounted on said tubular shaft between the plates, annular flanges positioned near the periphery of and on the adverse faces of the discs, an annular drum securely mounted on the tubular shaft between and spaced laterally from the discs, angularly positioned fins on the periphery of the drum, guiding spools mounted between said plates around the periphery of said discs, an endless belt having one leg extending exteriorly of the guiding spools and the other leg extending partially around the discs in contact with the said flanges thereon and

adapted to hold strip film in fluid tight contact with said flanges, and a block provided with suitable passages connected to a source of vacuum, said block being positioned between the discs above the flanges thereon at the part not contacted by the endless belt to prevent the escape of fluid which may be supplied between the discs and to remove the excess fluid from the strip film where it is fed into and out of the apparatus by the endless belt past said passages.

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