

Dec. 27, 1949

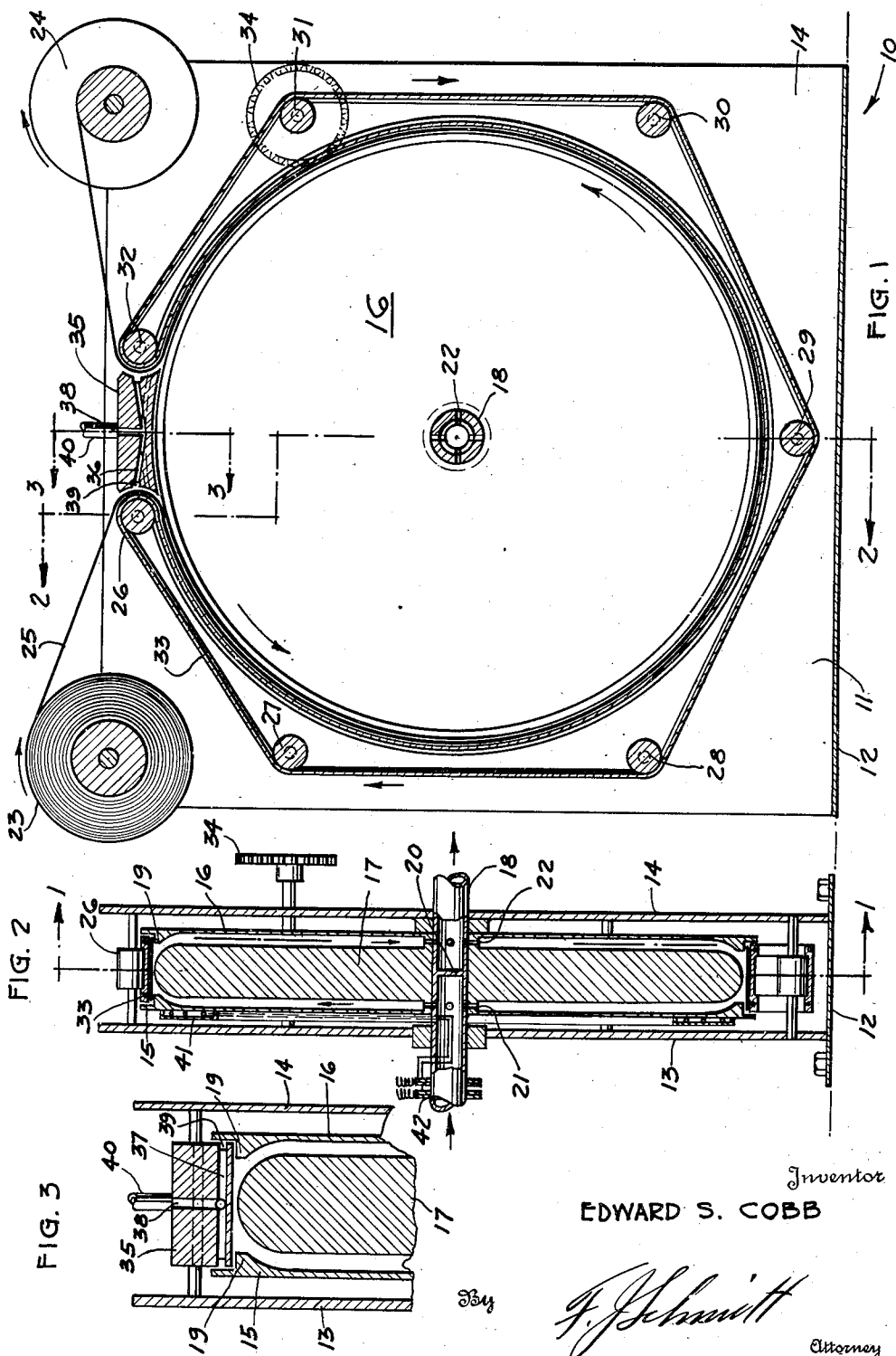
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2,492,133

FLUID TREATMENT APPARATUS FOR CONTINUOUS FILMS

Filed April 17, 1946

3 Sheets-Sheet 1



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FLUID TREATMENT APPARATUS FOR CONTINUOUS FILMS

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3 Sheets-Sheet 2

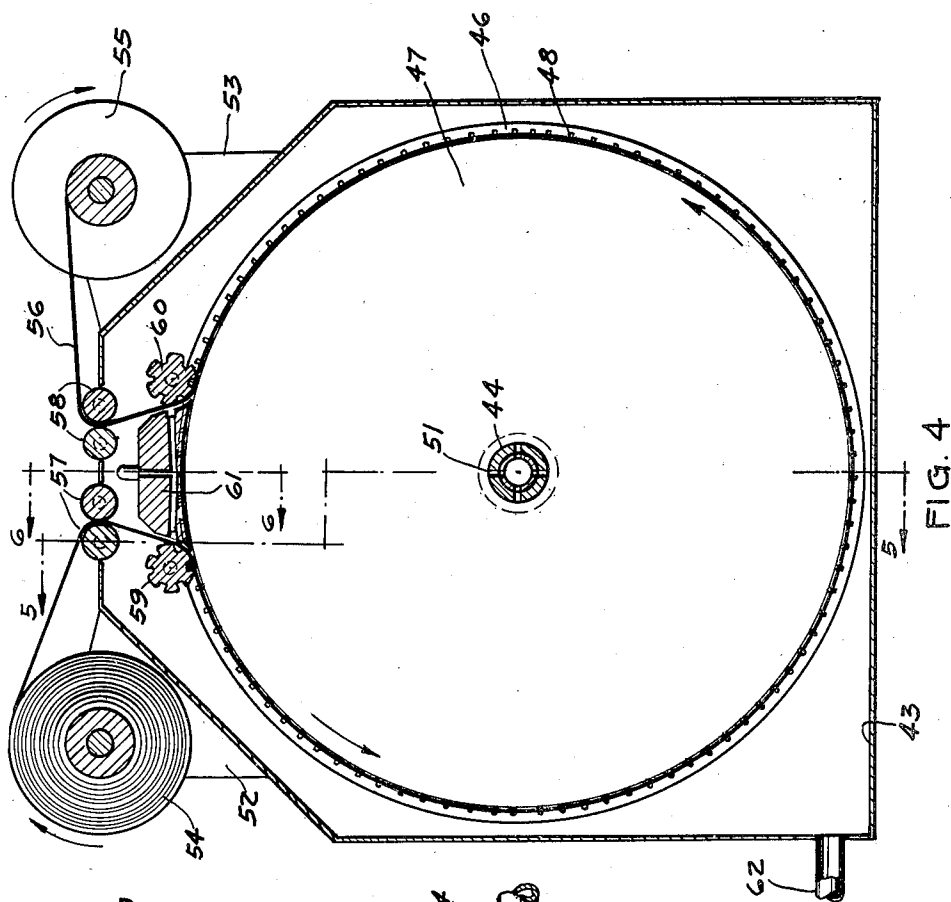


FIG. 4

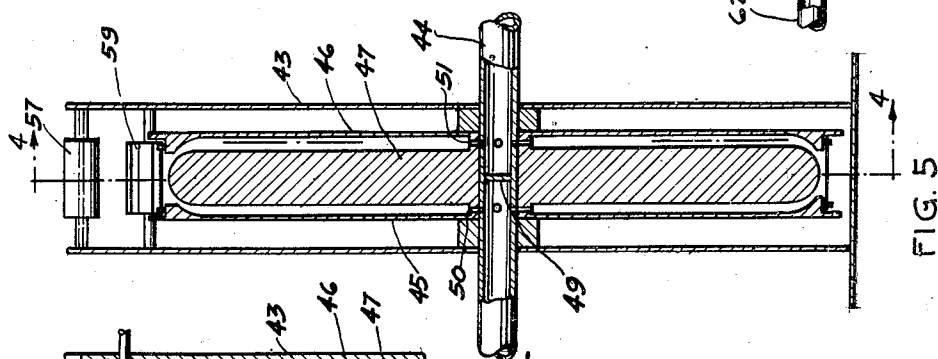


FIG. 5

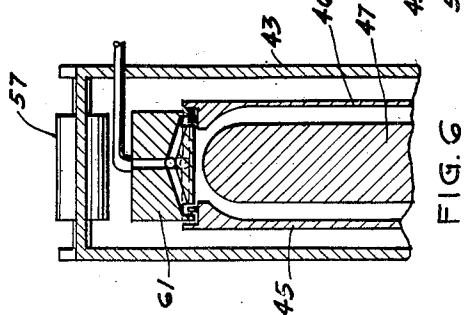


FIG. 6

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3 Sheets-Sheet 3

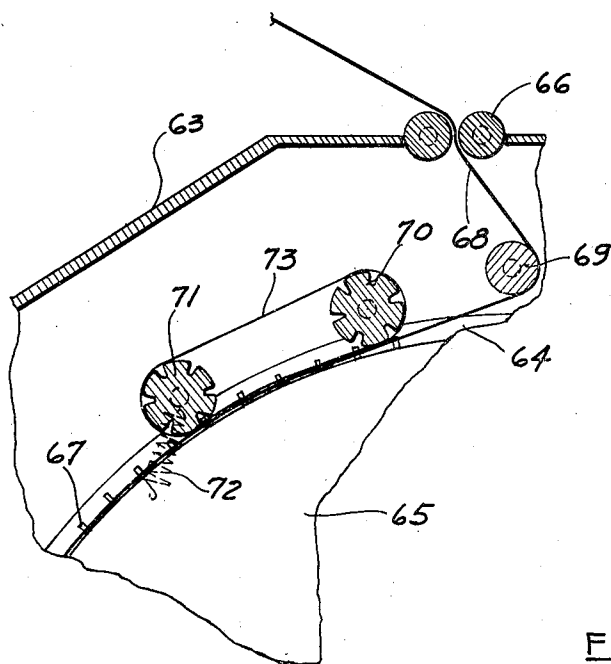


FIG. 7

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FLUID TREATMENT APPARATUS FOR
CONTINUOUS FILMS

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Application April 17, 1946, Serial No. 662,765

14 Claims. (Cl. 95—94)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

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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.

Objects of the present invention are to provide improved apparatus of the character referred to in which film or the like may be processed expeditiously and with decreased 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 renewed, thereby enabling the fluid in contact with the strip to be maintained at predetermined strength; to provide improved apparatus of the character referred to in which fluid may circulate in a closed system and provision is made for heating or cooling the fluid immediately prior to contact with the strip and cooling it immediately thereafter; and to provide improved apparatus of the character referred to in which provision is made for vigorous and regulated agitation of the fluid.

Additional objects of the invention are to provide improved apparatus for fluid treatment of strip material in which means are employed for moving a strip longitudinally while simultaneously passing a stream of fluid over the strip transversely thereof; 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, preferred forms of which are shown in the accompanying drawings, wherein:

Fig. 1 is a vertical sectional view of a fluid treatment apparatus embodying the features of the present invention, taken substantially on the line 1—1 of Fig. 2.

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

Fig. 3 is a sectional view taken substantially on the line 3—3 of Fig. 1;

Fig. 4 is a vertical sectional view of a modified form of apparatus embodying the features of the present invention taken substantially on the line 4—4 of Fig. 5;

Fig. 5 is a sectional view of the modified apparatus taken substantially on the line 5—5 of Fig. 4;

Fig. 6 is a sectional view of the modified appa-

ratus taken substantially on the line 6—6 of Fig. 4; and

Fig. 7 is a vertical sectional view of a portion of a further modified form of apparatus embodying the features of the present invention.

Referring more in detail to the drawings:

In Figs. 1-3 there is shown at 10 an apparatus embodying the features of the present invention. The apparatus 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. The drum may be of either solid or hollow construction and is of slightly smaller diameter than the discs. The drum is mounted between said discs in spaced relation therefrom. Preferably the discs have inwardly projecting peripheral flanges 19 extending therearound.

The bore within the tubular shaft 18 is divided by a transverse partition 20. The shaft functions as an ingress and egress for fluid, and has radial ingress bores 21 to the left of the partition 20, as viewed in Fig. 2, extending into the space between the front disc 15 and the drum 17, and radial egress bores 22 to the right of said partition extending into the space between the rear disc 16 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, motion picture 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, 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 and are preferably arranged around the discs 15 and 16 in the manner illustrated in Fig. 1. A flexible, relatively nonstretchable, endless 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.

Preferably, driving means are connected to one of the pulleys 26—32, and in Figs. 1 and 2 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 driv-

ing means may be connected with any of the other pulleys or with the shaft 18 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 19 at the periphery of 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.

Fluid, such as photographic developing solution, enters the space between the front disc and the drum through the ingress bores 21 and passes substantially radially over the face of the drum which thereby directs it to the periphery. Such fluid then passes over the strip in a substantially transverse direction as the latter travels longitudinally, and chemical reaction between the fluid and the surface of the strip, or other treatment, may take place. The fluid returns to the source through the space between the drum and the rear disc and thence through the egress bores 22 and shaft 18. The apparatus is normally installed in a closed system that includes a storage tank and pump, not shown, to make continuous operation possible.

It is thus seen that a relatively large volume of solution may be passed over a surface of the strip and that any particular portion of the fluid remains in contact with the strip for only a relatively short time, and also that the fluid is subject to a high degree of agitation. The width of the space between the surface of the drum 17 and the front and rear discs 15 and 16 is preferably greater than the width of the space between the drum and the strip being treated, thereby creating a nozzle effect and increasing turbulence of the fluid in the region of the strip. In photographic development work, it is desirable for the solution in contact with the film to be constantly renewed and subjected to the maximum degree of agitation in order that development reactions may be carried out with the solution at predetermined strength and in the briefest period of time.

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 35 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 faces 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. As shown in Fig. 3, the shoe extends into the space between the discs, and its sides are spaced from the discs only by a sufficient distance to permit free rotation of the discs therepast.

The shoe 35 has a central longitudinal bore 36 (Fig. 1), a central transverse bore 37 (Fig. 3), and a vertical bore 38, which intersect at a common point. The shoe also has a peripheral groove 39 adjacent the surface of the strip 25 and the interior surfaces of the discs and which communicates with the bores 36 and 37. A fitting 40 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 would tend to escape around the sides and ends of said shoe.

A heating device 41 (Fig. 2) may optionally be

included in the apparatus in order to heat the fluid immediately prior to contact with the strip to increase the speed of chemical reaction therewith. The heating device may conveniently comprise one or more annular electric heating elements secured to the exterior of the front disc 15 and incased by an annular shield. The heating elements may be energized by connection with slip rings 42 secured to the exterior of the shaft 20 and engaged by suitable brushes. It is desirable that heating of the fluid take place immediately prior to contact with the strip in order that the fluid is maintained at elevated temperature for the shortest possible period of time. Many fluids, as, for example, photographic developing solutions, deteriorate rapidly when maintained at elevated temperatures. Normally the fluid is rapidly cooled to room temperature by contact with the rear disc 16, but, if desired, additional cooling means, as, for example, water circulation coils (not shown) may be annularly arranged on the outside of disc 16 in a manner similar to the arrangement of the heating elements on disc 15 to expedite cooling. It will be observed, however, that the extended surface of the disc 16 exposed to the atmospheric or other air in the support housing, would ordinarily provide ample cooling to the ambient temperature.

In the modified form of apparatus illustrated in Figs. 4-6, the support is in the form of a substantially closed box or housing, and the fluid is retained within the apparatus by air pressure that balances the fluid pressure.

The modified form of apparatus comprises a box-like support or housing 43 in which is rotatably mounted a tubular shaft 44. Said shaft has a front disc 45, a rear disc 46, and a drum 47 mounted thereon. The discs and drum are constructed and arranged similarly to the corresponding elements of the device shown in Figs. 1-3, except that the flanges have radially protruding pins having smooth, rounded points adapted to engage perforations in the strip, such as are commonly provided in motion picture film. As in the device shown in Figs. 1-3, the shaft has a transverse partition 49, radial ingress bores 50, and radial egress bores 51.

Brackets 52 and 53 are secured to the exterior of the housing and are adapted to rotatably mount reels 54 and 55 on which is wound a strip 56 to be processed by the apparatus. The unprocessed strip is fed from the reel 54 through the apparatus and the processed strip is wound on the reel 55.

The upper wall of the housing 43 is apertured to admit the strip to the interior thereof. A first pair of smooth guide rollers 57 are provided to guide the strip into the housing, and a second pair of smooth guide rollers 58 are provided to guide the strip from the housing and onto the reel 55.

Notched rollers 59 and 60 are rotatably mounted in the housing in such manner that the notches therein are engageable with the pins 48 on the discs 45 and 46. The roller 59 is located adjacent the first guide rollers 57 and directs the strip into engagement with the periphery of the discs with the pins penetrating the perforations in the strip. The roller 60 is located adjacent the second guide rollers 58 and directs the strip off the discs.

To restrain leakage of fluid from the space between the discs in the portion of the periphery not covered by the strip 56, a shoe 61 is secured to the housing between the notched rollers 59 and 60. The shoe 61 is similar in design and func-

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tion to the shoe 35 in the embodiment of the invention shown in Figs. 1-3 and hereinbefore described, hence the shoe is not again described in detail. The only difference in shoe 61 is that it is grooved along its edges to accommodate the pins 48 on the periphery of discs 45 and 46.

To balance the pressure of the fluid between the discs, the space within the housing outside of the discs is subjected to air under pressure, and an inlet 62 is provided for this purpose. The full pressure of the fluid bears on the strip, and it is balanced by the air pressure on the opposite side, thus relieving the strip of any stress, such as would cause damage or tend to force it off the pins.

The embodiment of the invention shown in Figs. 4-6 may be equipped with heating or cooling means similar to those shown and described in connection with the embodiment of Figs. 1-3, and may be driven by any suitable means connected to the shaft 44.

The embodiment of the invention shown in Fig. 7 is similar to the embodiment of Figs. 4-6 except that the notched roller that guides the strip onto the periphery of the discs is supplemented by a perforated flexible belt, preferably of steel or other metal.

As shown in Fig. 7, the embodiment comprises a housing 63, a rear disc 64, a drum 65, and guide rollers 66, all similar to the corresponding elements of the embodiment of Figs. 4-6 and hence not again described in detail. The disc 64 has strip engaging pins 67 around its periphery, shown as engaging a strip 68, in the same manner as the pins in the embodiment already described.

An auxiliary guide roller 69 is rotatably mounted in the housing, and the strip 68 passes thereover from the rollers 66. A notched wheel 70 is rotatably mounted in the housing, and a second notched wheel 71 is rotatably mounted on a suitable fitting, to which is secured a tension spring 72, also secured to the housing. A belt 73 of metal or other suitable material passes over the notched wheels and has perforations corresponding to the perforations in the strip 68 and the pins 67.

As the strip 68 is fed from the auxiliary roller 69, the belt 73 in the region of the notched wheel 70 starts the perforations in the strip into engagement with the pins 67. The spring 72 draws the wheel 71 downwardly and to the left as viewed in Fig. 7, and thus a portion of the belt 73 behind the wheel 70 engages over the pins and conforms in configuration to that of the periphery of the discs. Said portion of the belt forces the strip into close engagement with the disc and thereby guides the strip into a position where the pins pass through the perforations.

While I have shown but certain embodiments of the present invention, it is obvious that the device is subject to further 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 having inwardly projecting peripheral flanges, a drum of smaller diameter than said discs forming a narrow peripheral space around said drum

inwardly of said peripheral flanges, means rotatably mounting said discs and said drum on said support with said drum interposed between said discs and in spaced relation therefrom, said mounting means being adapted for connection to a source of said fluid under pressure and providing ingress for fluid in the space formed on one side of said drum and egress therefor on the other side of said drum, whereby to induce a flow of said fluid substantially transversely of said peripheral space from one side of said drum to the other, means for rotatably mounting reels on said support, means for guiding a strip from a reel around the flanges on said discs and onto another reel, and means fitting around the peripheral space not covered by said strip for preventing leakage of fluid from said spaces.

2. An apparatus for fluid treatment of strip material comprising a support, a pair of discs, means rotatably mounting said discs on said support in spaced relation to each other a distance substantially equal to said strip material, a drum of smaller diameter than said discs closely spaced between them, said discs being provided with internal peripheral shoulders, said mounting means being adapted for connection to a source of supply of said fluid under pressure and providing ingress and egress for the flow of said fluid in the spaces between said discs and said drum from the center of one disc around the periphery of said drum to the center of the other disc, heating means for said fluid on said one disc adjacent the periphery thereof for heating said fluid just prior to its reaching the periphery, means for rotatably mounting reels on said support, and means for guiding a strip from a reel around the peripheral shoulders of said discs and onto another reel.

3. An apparatus for fluid treatment of strip material comprising a support, a pair of discs, means rotatably mounting said discs on said support in spaced relation to each other a distance substantially equal to said strip material, a drum of smaller diameter than said discs closely spaced between them, said discs having internal peripheral flanges, said mounting means being adapted for connection to a source of said fluid under pressure and providing ingress and egress for fluid in the space between said discs and said drum, the ingress being on one side of said drum and the egress on the other, near the center of the discs, means for guiding and retaining strips around the peripheral flanges of said discs, the space between the drum and the discs and strip forming a passage for said fluid from the ingress to the periphery of said discs, over a surface of the strip in a transverse direction, and thence to the egress.

4. An apparatus for fluid treatment of photographic film comprising a support, a pair of axially aligned spaced discs rotatably mounted on said support, means for guiding film around the periphery of said discs, means adapted for connection to a supply of said fluid under pressure and providing ingress to the space between the discs, means providing egress from said space, and a drum spacedly mounted between the discs and closely spaced from the periphery thereof for directing flow of fluid from the ingress to the periphery of the discs, across the film at a controlled rate, and thence to the egress.

5. An apparatus for fluid treatment of strip material comprising a support, a pair of discs, means rotatably mounting said discs on said support in spaced relation to each other a distance

substantially equal to said strip material, a drum of smaller diameter than said discs closely spaced between them, said discs having internal peripheral flanges, said mounting means being adapted for connection to a source of fluid supply under pressure and providing ingress and egress for fluid in the space between said discs and said drum, the ingress being on one side of said drum and the egress on the other, near the center of the discs, means for rotatably mounting reels on said support, means for guiding movement of a strip from a reel to the peripheral flanges of said discs, around a portion of the periphery of the discs, and onto another reel, said drum being supported between said discs and cooperating therewith to form a passage for directing flow of fluid from the ingress, to the periphery of the discs, over the inner surface of the strip at a controlled rate as determined by the dimensions of the spacing between said strip and the drum, and thence to the egress, and means mounted on said support for preventing leakage of fluid from between the discs in the region of the periphery not covered by the strip.

6. An apparatus for fluid treatment of strip material comprising a support, a pair of discs, means rotatably mounting said discs on said support in spaced relation to each other a distance substantially equal to said strip material, a drum of smaller diameter than said discs closely spaced between them, said discs having internal peripheral flanges, said mounting means being adapted for connection to a source of fluid supply under pressure and providing ingress and egress for fluid in the space between said discs and said drum, the ingress being on one side of said drum and the egress on the other, near the center of the discs, means for rotatably mounting reels on said support, an endless belt, rotatable means mounted on said support retaining said belt with a portion thereof in engagement with a portion of the periphery of said discs, said belt being adapted to guide a strip from a reel, around the portion of the periphery of said discs engaged by said belt, and onto another reel, said drum being supported between said discs and cooperating therewith to form a passage for directing flow of fluid from the ingress, to the periphery of the discs, in a thin layer transversely over the inner surface of the strip at a controlled rate, as determined by the dimensions of the spacing between said strip and the drum, and thence to the egress, 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.

7. An apparatus for fluid treatment of strip material comprising a support, a pair of discs, a drum of smaller diameter than said discs, means rotatably mounting said discs and said drum on said support with said drum interposed between said discs and in spaced relation therefrom, said mounting means being adapted for connection to a source of fluid under pressure and providing ingress into the space on one side of said drum and egress from the other side thereof for fluid flow therebetween, across the periphery of said drum, means for rotatably mounting reels on said support, an endless belt, rotatable means mounted on said support retaining said belt with a portion thereof in engagement with a portion of the periphery of said discs, said belt being adapted to guide a strip from a reel, around the portion of the periphery of said discs engaged by said belt, and onto another reel, said drum and discs being cooperable to direct flow of fluid from the ingress,

over the inner surface of the strip between said discs, and thence to the egress, and means mounted on said support for preventing leakage of fluid from between the discs in the region of the periphery not covered by said belt.

8. An apparatus for fluid treatment of strip material comprising a substantially closed support housing, a pair of discs, a drum of smaller diameter between said discs, means rotatably mounting said discs in said housing in closely spaced relation to said drum, said mounting means being adapted for connection to a source of fluid supply under pressure and providing ingress and egress for fluid in the space between said discs, said housing having apertures for passage of strips, said discs having peripheral means for engaging perforations along the sides of the strips, means rotatably mounted in said housing for guiding a strip into and out of engagement with said peripheral means, the spacing between said drum and said discs and strip forming a passage for directing the flow of fluid from the ingress, to the periphery of the discs, over the inner surface of the strip between said discs, and thence to the egress.

9. An apparatus for fluid treatment of strip material comprising a substantially closed support housing, a pair of discs, a drum of smaller diameter between said discs, means rotatably mounting said discs in said housing in closely spaced relation to said drum, said mounting means being adapted for connection to a source of fluid supply under pressure and providing ingress and egress for fluid, said housing having apertures for passage of strips, a plurality of radially extending pins secured around the peripheries of said discs for engaging perforations in the strips, a notched roller rotatably mounted in said housing for guiding a strip over and into engagement with said pins, a second notched roller rotatably mounted in said housing for guiding the strip off the pins, the spacing between said drum and said discs and strip forming a passage for directing the flow of fluid from the ingress to the periphery of the discs, over the inner surface of the strip between said discs, and thence to the egress.

10. An apparatus for fluid treatment of strip material comprising a substantially closed support housing, a pair of discs, a drum of smaller diameter between said discs, means rotatably mounting said discs in closely spaced relation to said drum, said mounting means being adapted for connection to a source of fluid supply under pressure and providing ingress and egress for fluid, said housing having apertures for passage of strips, a plurality of radially extending pins secured around the peripheries of said discs for engaging perforations in the strips, a pair of notched wheels rotatably mounted in said housing, a perforated flexible belt around said wheels for guiding a strip over and into engagement with said pins, means for guiding the strip off the pins, the spacing between said drum and said discs and strips forming a passage for directing the flow of fluid from the ingress, to the periphery of the discs, over the inner surface of the strip between said discs and thence to the egress.

11. An apparatus as defined in claim 8, wherein said housing is supplied with compressed gas for maintaining said strips in fluid tight relation on the peripheries of said discs, and means mounted in said housing for preventing leakage of fluid from between said discs in the region of their peripheries not covered by said strip.

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12. An apparatus as defined in claim 8, having means in said housing for assuring proper engagement of said strip with said peripheral means by providing positive initial contact therebetween followed by a resilient and even pressure over said strip around its perforations to complete the engagement.

13. An apparatus as defined in claim 12, wherein said means for assuring proper engagement comprises a notched wheel mounted in said housing adjacent said means for guiding said strip into engagement with said peripheral means, a second notched wheel freely mounted in said housing, resilient means for biasing said second wheel against the peripheries of said discs and away from said first wheel, and a perforated flexible belt around said wheels.

14. In an apparatus such as defined in claim 12, a perforated strip, means for feeding said strip onto a rotatable element provided with corresponding pins for said perforations, and means for assuring proper engagement of said strip on said element as it is rotated, comprising a first notched wheel having a fixed bearing, a second notched wheel having a free bearing, a flexible belt around said wheels correspondingly perforated, and means for biasing said free bearing away from said fixed bearing and against said

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rotatable element, said fixed bearing being spaced from said element so as to just start the strip perforations over the ends of said pins, whereby the flexible belt will provide a distributed steady pressure over the preceding portion of said strip to draw it evenly down said pins and seat it firmly over said element without distortion or injury to said perforations.

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