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Pfeifer et al.

[11] **3,913,119**

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[54] **APPARATUS FOR WET TREATMENT OF WEBS OF PHOTOSENSITIVE MATERIAL**

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[51] **Int. Cl.**[2] **G03D 13/00**

[58] **Field of Search** 354/297, 298, 319, 320, 354/321, 322, 324, 339; 226/14, 109, 110, 113, 114, 43

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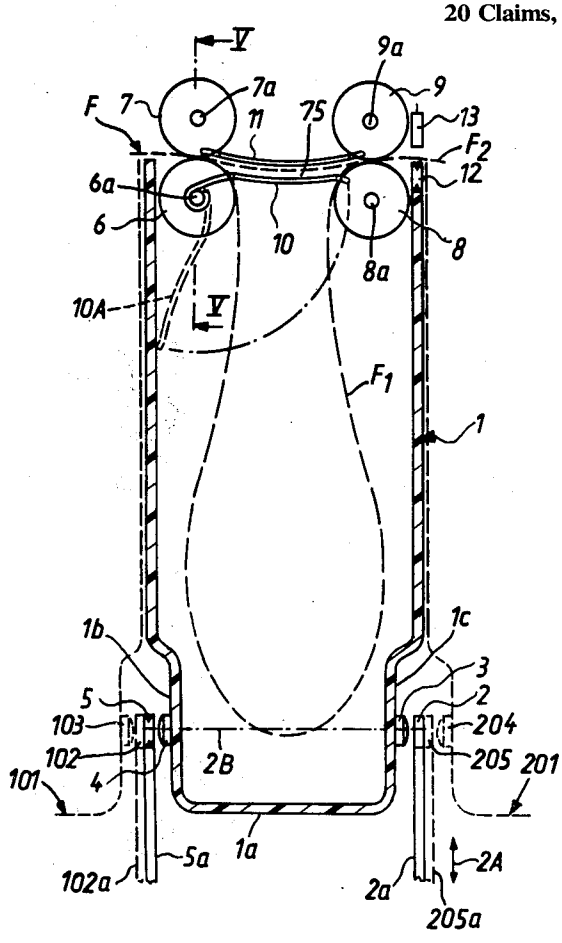
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Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

Apparatus for wet treatment of webs of photosensitive material wherein the top portion of a liquid-containing vessel consisting at least in part of light-transmitting material supports spaced apart first and second pairs of advancing rolls and a web guide which normally extends between the two pairs of rolls. At least the lower section of the web guide is pivotable downwardly so that an intermediate portion of a web whose leader has been introduced into the nip of the first advancing rolls and has advanced through the guide into the nip of the second advancing rolls can be looped in the vessel in response to continuing rotation of the first rolls while the second rolls are idle. The second rolls are arrested by a photoelectric detector when the latter detects the leader of the web downstream of the nip of the second advancing rolls, and this detector also causes an electromagnet to pivot the lower section of the guide downwardly. A second photoelectric detector monitors the length of the loop in the vessel and starts the drive for the second rolls when the length of the loop reaches a preselected maximum value. The second rolls thereupon advance the web at a speed exceeding the speed of the first rolls so that the length of the loop decreases and the second detector again arrests the drive for the second rolls.

20 Claims, 5 Drawing Figures



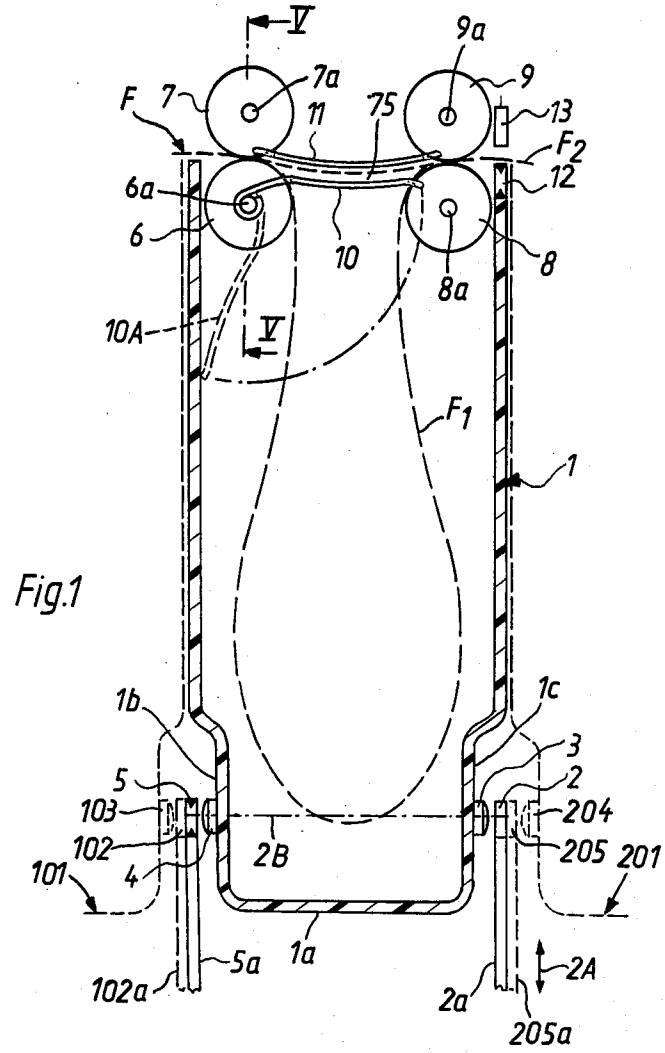

V
9a
7a
F
7
11
75
9
13
F2
12
6a
6
10
8
8a
10A
V
F1
1
1b
1c
3
5
2
103
204
102
205
201
101
4
2B
1a
5a
2A
102a
2a
205a

Fig.1

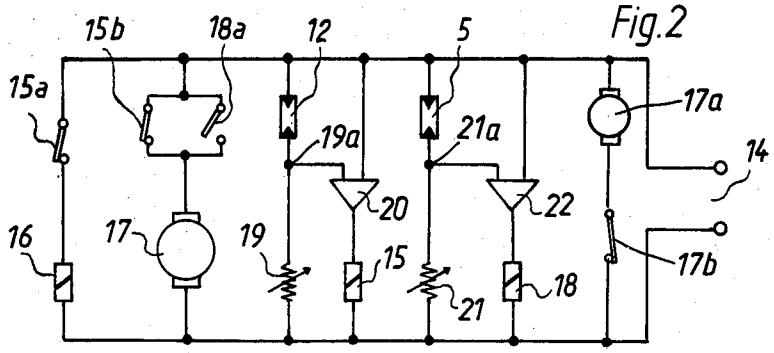

15b
18a
12
5
15a
17a
19a
21a
14
16
17
19
20
22
15
21
18
17b

Fig.2

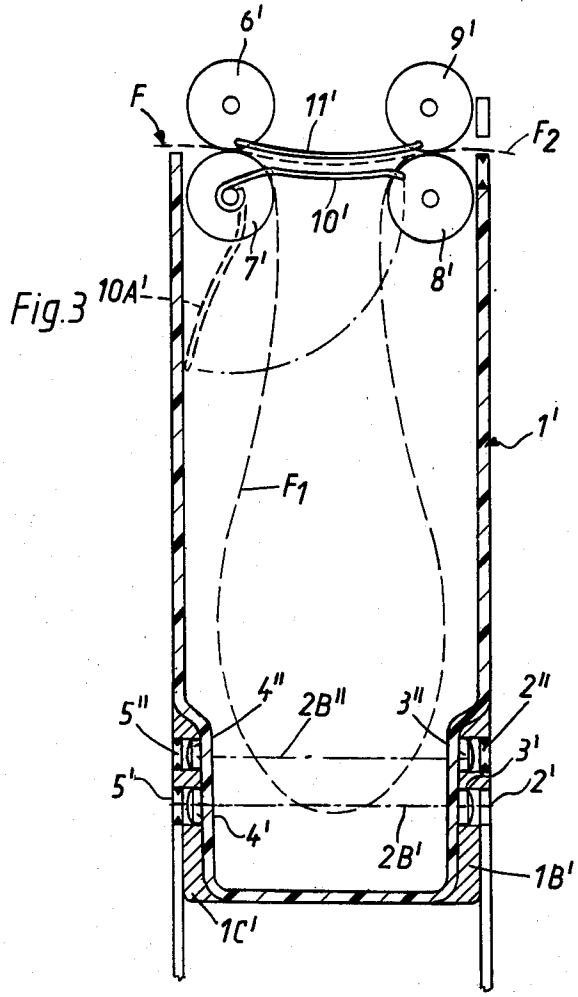


Fig.3

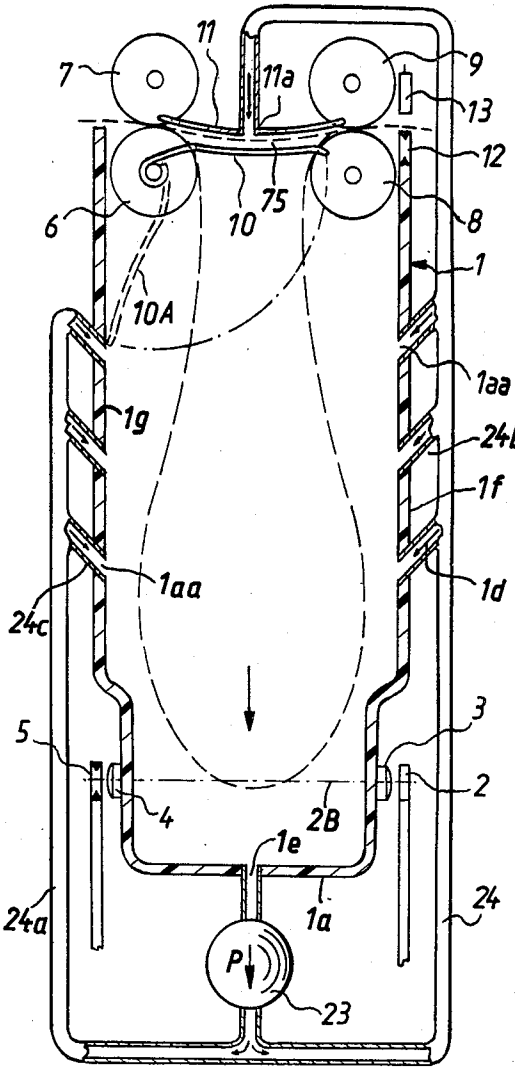
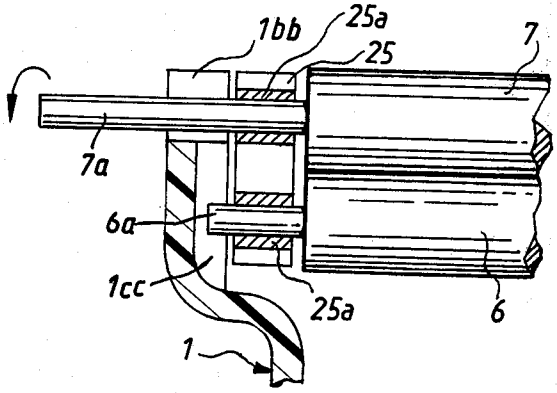

11
7
11a
9
13
12
75
10
6
8
1
10A
1aa
1g
24b
1f
1aa
1d
24c
3
5
2
4
2B
1e
24a
1a
24
P
23

Fig. 4

Fig. 5


1bb
25a
25
7
7a
6a
1cc
25a
6
1

APPARATUS FOR WET TREATMENT OF WEBS OF PHOTOSENSITIVE MATERIAL

BACKGROUND OF THE INVENTION

The present invention relates to improvements in apparatus for wet treatment of flexible elongated webs or strips, especially to improvements in apparatus for web-treatment of web- or strip-shaped carriers for layers of photosensitive material. More particularly, the invention relates to improvements in apparatus of the type wherein a web which is to be treated by one or more liquids is caused to form a loop during travel through a single liquid-containing vessel, or a discrete loop during travel through each of a series of two or more liquid-containing vessels. Still more particularly, the invention relates to improvements in apparatus for wet treatment of webs wherein the leader of a web is first caused to move lengthwise from first to second advancing means in or on the vessel and is thereupon flexed intermediate the two advancing means to form a substantially U-shaped loop which dips into the body of liquid in the vessel and which is being formed while the second advancing means is idle but the first advancing means continues to transport the web lengthwise so as to supply flexible material for the formation of a loop.

It is already known to install, on a series of liquid-containing vessels for wet treatment of exposed photographic films or the like, a first pair of advancing rolls which are adjacent to one side of the first vessel, a second pair of advancing rolls which are adjacent to the other side of the last vessel and are remote from the first pair of advancing rolls, and a carriage which has means for clamping the leader of a web and is movable from a position behind the nip of the first advancing rolls toward the nip ot the second advancing rolls to thereby move the leader into the range of the second rolls. The carriage thereupon remains at a standstill in front of the second advancing rolls while the web is caused to form a series of loops, one in each of the vessels, by resorting to vertically movable push rods the lower end portions of which carry rollers and which are movable from above to engage the web between the carriage and the first pair of rolls so as to push the web downwardly and to simuultaneously form substantially U-shaped loops which are immersed in the bodies of liquid in the respective vessels. In their uppermost positions, the push rods maintain the respective rollers at a level above a straight path extending horizontally from the nip of the first advancing rolls toward the nip of the second advancing rolls. The push rods may descend by gravity, one after the other, whereby their rollers drop onto the web and push it into the respective bodies of liquid.

A drawback of the just described apparatus is that the automation of movements of the carriage, advancing rolls and push rods contributes significantly to initial and maintenance cost, and that the structure which coordinates the movements of such parts is prone to malfunction. Furthermore, the useful life of rollers at the lower ends of the push rods is rather short, especially if the vessels therebelow contain liquids which attack the material of the rollers, e.g., a developing solution for exposed photographic films. Still, further, the web is subjected to substantial tensional stresses, at least during that stage of treatment which takes place while the aforementioned push rods descend by gravity

to loop the web intermediate the carriage and the first advancing rolls. This can cause partial or complete breakage or tearing of the web. Still another drawback of such apparatus is that they can properly transport and treat only such webs which have a predetermined minimum length whereby this minimum length must equal or exceed the combined length of loops in all of the vessels.

SUMMARY OF THE INVENTION

An object of the invention is to provide an apparatus for wet treatment of elongated webs, especially webs which carry layers consisting of photosensitive material, with novel and improved means for looping a web during transport through a single body of liquid or during transport through a series of successive bodies of liquid.

Another object of the invention is to provide the apparatus with loop forming or looping means which can form loops of desired size and/or shape, which can be rapidly adjusted to form shorter or longer loops, and which can be used for looping or relatively short or relatively long webs whereby the minimum length of a web need not exceed and may be substantially less than the combined length of loops in two or more successive liquid-containing vessels

A further object of the invention is to provide the apparatus with novel and improved means for guiding the leader of a fresh web between the first and second advancing means in or on a vessel for a body of developing, fixing, rinsing or other liquid.

An additional object of the invention is to provide an apparatus which embodies the improved loop forming means and is further capable of insuring that each and every increment of a web remains in contact with a liquid for identical intervals of time, especially with a liquid which is confined in the first of a series of two or more vessels.

Still another object of the invention is to provide a simple, compact, inexpensive and reliable device which can loop the web with a high degree of reproducibility and whose operation can be automated to such an extent that it requires no supervision at all or that a single attendant can supervise the operation of a large number of loop formers.

Another object of the invention is to provide an apparatus wherein the looping of webs takes up a very short period of time and wherein a web can be looped while the first advancing means continues to advance the web at a normal speed.

A further object of the invention is to provide an apparatus wherein the looped portion of a web can be automatically maintained out of contact with the walls of the vessel and/or with other component parts, and wherein the web is not tensioned during looping so that the likelihood of breakage is practically nil.

The invention is embodied in an apparatus for web treatment of elongated flexible webs, particulary for web treatment of web-like or strip-like carriers of photosensitive material. The apparatus comprises a liquid-containing vessel (the body of liquid in the vessel may be a developing solution for exposed films, a fixing bath, or a rinsing fluid), guide means which includes an upper section and a lower section and at least the lower section of which is movable (preferably pivotable) between an operative position in which the two sections define an elongated channel extending transversely

across the upper portion of the vessel and an inoperative position in which the lower section permits a web in the channel to move generally downwardly toward and into the lower portion of the vessel, an electromagnet or analogous means for moving the lower section of the guide means between operative and inoperative positions, a first pair of rotary web advancing members adjacent to the inlet of the channel, a second pair of rotary web advancing members adjacent to the outlet of the channel, a motor or analogous first drive means for rotating the first pair of advancing members so that a web whose leader has been introduced into the nip of the first pair of advancing members is caused to advance through the channel of the guide means and into the nip of the second pair of advancing members, a motor, transmission or analogous second drive means for intermittently rotating the second pair of advancing members, first detector means (e.g., a photoelectric detector) for monitoring the web downstream of the nip of the second pair of advancing members, a relay or analogous means for arresting the second drive means and for actuating the moving means so as to effect a movement of the lower section of the guide means to its inoperative position in resonse to detection of the leader of a web by the first detector means whereby, in response to continuing rotation of the first pair of advancing members, the web descends in the vessel and forms a loop having a bight which moves toward and into the lower portion of the vessel, second detector means (e.g., one or more photoelectric detectors) disposed in the region of the lower portion of the vessel for monitoring the bight of the loop, and a relay or analogous means for starting the second drive means in response to detection of the bight by the second detector means.

If the peripheral speed of the second pair of advancing members exceeds the peripheral speed of the first pair of advancing members, the length of the loop begins to decrease as soon as the second drive means is started. The second drive means is thereupon arrested by the second detector means in response to a predetermined reduction of the length of the loop so that the size of the loop begins to increase in response to continuing rotation of the first pair of advancing members until the second detector means again starts the second drive means. The same series of operations is repeated at intervals so that the length of the loop in the body of liquid in the vessel fluctuates within a preselected range, depending on the level of the second detector means and on the delay with which the second drive means is started or arrested in response to lengthening and shortening of the loop.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the folllwing detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical sectional view of an apparatus which embodies one form of the invention;

FIG. 2 is a diagram of the control circuit for the apparatus of FIG. 1;

FIG. 3 is a vertical sectional view of a second apparatus;

FIG. 4 is a vertical sectional view of a third apparatus; and

FIG. 5 is an enlarged fragmentary sectional view, substantially as seen in the direction of arrows from the line V—V of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows an upright vessel or tank **1** which forms part of the improved apparatus and consists, at least in part, of a light-transmitting synthetic plastic material. The material must be selected with a view to withstand the potentially corrosive action of a body of liquid which is confined in the vessel **1**. The lower portion of the vessel **1** mounts certain component parts of a monitoring device here shown as a photoelectric detector including a light source **2**, two collector lenses **3, 4** and a photosensitive transducer **5**. The lenses **3** and **4** are mounted on the vessel **1**, and the light source **2** and transducer **5** are mounted on adjusting members or supports **2***a*, 5*a* which are movable up and down (as indicated by the arrow **2A**). The purpose of the detector **2–5** is to monitor the length of a looped portion of loop F_1 of a web F including a flexible carrier for a layer of photosensitive material which is to be treated by liquid in the vessel **1**. By moving the adjusting members or supports **2***a*, 5*a* up or down, and by simultaneously adjusting the level of the lenses **3, 4** with respect to the bottom wall **1***a* of the vessel **1**, one can select that length of the looped portion F_1 which is necessary to interrupt the light beam **2B** issuing from the source **2** and passing through the lens **3** toward the lens **4**, and thus the timing of the generation of signals by the transducer **5**. The latter is preferably a photosensitive resistor. The light source **2** is preferably selected with a view to produce light in the non-actinic range of the spectrum so that the light cannot adversely influence the photosensitive layer of the web F.

The upper portion of the veessel **1** is open and supports the shafts **6***a*, 7*a* of a first pair of web-advancing rolls **6, 7** and the shafts **8***a*, 9*a* of a second pair of web advancing rolls **8, 9**. If desired, the shafts **6***a*–**9***a* can be mounted in a skeleton frame which can be placed on top of the vessel **1** so that at least the lower portions of the lower advancing rolls **6, 8** dip into the body of liquid which is confined in the vessel. The body of liquid in the vessel **1** may be a developing solution, a fixing bath or a rinsing bath for a web of exposed photographic film. The shafts **6***a*, 7*a* and **8***a*, 9*a* are respectively mounted sufficiently close to each other to insure that the peripheries of the advancing rolls **7, 9** bear against the peripheries of the associated advancing rolls **6, 8** or agains a web F with a force which suffices to prevent slippage of the advancing rolls with respect to the web or vice versa.

The advancing rolls **6, 7** are rotated, preferably at a constant speed, by an electric motor **17***a* (FIG. 2) or an analogous drive means, and the advancing rolls **8, 9** are rotated intermittently, namely, whenever the length of the looped portion F1 is insufficient to interrupt the light beam **2B** between the optical elements **3, 4** of the photosensitive detector **2–5**. In accordance with a first embodiment of the invention, the advancing rolls **8, 9** may be rotated by a drive means including an electromagnetic clutch (not shown) which receives torque

from the motor **17***a* and is energized in response to a signal from the photosensitive detector **2–5** to thereby transmit torque to the shaft **8***a* and/or **9***a*. Alternatively, and as shown in FIG. **2**, the shaft **8***a* and/or **9***a* may be rotated by a drive means including a discrete second electric motor **17** which is started only when the detector **2–5** produces a signal indicating that the length of the looped portion F_1 is at least slightly less than that shown in FIG. **1**.

The vessel **1** (or the aforementioned frame for the shafts **6***a* to **9***a*) further supports an elongated web guide including an upper section **11** and a lower section **10**. The upper section **11** is assumed to be fixedly mounted on the vessel **1** and its underside is formed with a convex surface so that at least the central portion of such surface dips into the body of liquid in the vessel **1**. The lower section **10** of the guide is pivotable with respect to the vessel **1**, for example, about the axis of the shaft **6***a*, so that it can be moved between an operative position which is shown by solid lines and an inoperative position **10A** which is indicated by broken lines. The guide **10, 11** normally defines an elongated channel **75** which extends across the upper portion of the vessel **1**. This channel has an inlet immediately behind the nip of the first pair of advancing rolls **6, 7** and an outlet immediately in front of the nip of the second pair of advancing rolls **8, 9**. The means for effecting movements of the lower section **10** of the guide between the operative and inoperative positions includes an electromagnet **16** which is shown in FIG. **2**. This electromagnet may be a rotary electromagnet whose armature is coupled with and can transmit torque to the eyelet at the left-hand end of the lower section **10**.

A second monitoring means, here shown as a photoelectric detector including a light source **13** and a photosensitive transducer **12**, is mounted immediately downstream of the nip of the advancing rolls **8, 9**. The light source **13** is mounted (e.g., on the vessel **1** or on the aforementioned frame for the shafts **6***a–9a*) at a level above the path for the web F, and the transducer **12** is mounted on the vessel **1** below such path and opposite the light source **13** so that its photosensitive surface is exposed to light issuing from the source **13** when the corresponding portion of the path for the web F is empty.

FIG. **2** shows the aforementioned electric motors **17***a*, 17 for the advancing rolls 6, 7 and 8, 9, the aforementioned electromagnet 16 which can pivot the lower section 10 of the web guide, a source 14 of D.C. current, a first relay 15 having switches 15*a*, and **15***b*, and a second relay **18** having a switch **18***a* connected in parallel with the switch **15***b*. The electromagnet **16** is connected in series with the energy source **14** and with the relay switch **15***a*, and in parallel with the motors **17***a*, 17. The motor 17 is in series with the switches 15*b*, 18*a*. The transducer **12** is preferably a photoelectronic resistor which constitutes one element of a voltage divider further having a variable resistor **19** and a tap **19***a* connected with an amplifier **20** for the relay **15**. The transducer **5** is preferably a resistor similar to **12** and constitutes one element of a second voltage divider further having a variable resistor **21** and a tap **21***a* connected to an amplifier **22** for the relay **18**. The motor **17***a* is in series with a master switch **17***b*.

The relay **15** constitutes a means for arresting the motor **17** for the advancing rolls **8, 9** and a means for causing the electromagnet **16** to effect a movement of the section **10** to the inoperative position **10A** in response to a signal from the transducer **12**, i.e., in response to detection of the leader F_2 of a web F by the detector **12, 13**. The relay **18** is a means for starting the motor **17** for the advancing rolls **8, 9** in response to a signal from the transducer **5**, i.e., in response to an increase of the size of the looped portion F_1 to a predetermined maximum value.

The operatin of the apparatus which includes the structure of FIGS. **1** and **2** is as follows:

When the path for the web F is empty, the relays **15** and **18** are deenergized. Therefore, the switch **18***a* is open and the switches **15***a*, 15*b* are closed. Since the switch **15***a* is closed, the electromagnet **16** is energized and maintains the lower section **10** of the web guide in the solid-line (operative) position of FIG. **1**. The motor **17***a* is on to drive the advancing rolls **6, 7**, and the motor **17** is also on to drive the advancing rolls **8, 9** because the switch **15***b* of the relay **15** is closed. It is preferred, to drive the advancing rolls **8, 9** at a peripheral speed which exceeds that of the advancing rolls **6, 7** (e.g., by approximately 2 percent) so that the rolls **8, 9** (when driven) reduce the length of the looped portion F_1 which is immersed in the body of liquid filling the vessel **1**. This can be achieved by driving the rolls **6–9** at the same angular speed and by employing rolls **8, 9** whose diameters are slightly larger than the diameters of the rolls **6, 7**.

If the leader F_2 of a fresh web F is introduced into the nip of the first advancing rolls **6, 7**, the leader is caused to pass through the channel **75** between the sections **10, 11** (the electromagnet **16** is energized and maintains the section **10** in the operative position shown by solid lines) and thereupon through the nip of the rolls **8, 9**, and the leader finally enters that portion of the path which extends between the elements **12, 13** of the photoelectric detector behind the advancing rolls **8, 9**. The leader F_2 is caused to pass through the upper portion of the body of liquid in the vessel **1**, at least while travelling through the central portion of the channel **75** between the sections **10, 11**, because the convex surface at the underside of the upper section **11** dips into the body of liquid.

When the leader F_2 reaches the position shown in FIG. **1**, the resistance of the transducer **13** changes so that the potential at the tap **19***a* also changes and causes the amplifier **20** to energize the relay **15**. The latter opens its switches **15***a*, 15*b* whereby the electromagnet **16** becomes deenergized and causes or allows the section **10** to move to the inoperative position **10A**. The switch **15***b* opens the circuit of the motor **17** so that the advancing rolls **8, 9** are arrested. The motor **17***a* is on so that it continues to feed the web F into the vessel **1** whereby the web F is looped behind the leader F_2 (because the section **10** dwells in the inoperative position **10A**) and the length of the looped portion F_1 gradually increases as its bight descends toward the light beam **2B**. The leader F_2 is positively held by the rolls **8, 9** against any forward movement as soon as the switch **15***b* opens the circuit of the motor **17**.

When the bight of the looped portion F_1 interrupts the light beam **2B**, the resistance of the transducer **5** changes to change the potential at the tap **21***a* so that the amplifier **22** energizes the relay **18** which closes the switch **18***a* to complete the circuit of the motor **17**. Thus, the advancing rolls **8, 9** begin to transport the web F lengthwise whereby the length of the looped por-

tion F_1 gradually decreases because the peripheral speed of the rolls **8, 9** exceeds the peripheral speed of the rolls **6, 7.** The transducer **5** causes the amplifier **22** to deenergize the relay **18** and to thus open the switch **18***a* when the bight of the looped portion F_1 rises above the light beam **2B** whereby the motor **17** is arrested to stop the rolls **8, 9** and the length of the looped portion F_1 begins to increase because the/motor **17***a* continues to drive the rolls **6** and **7.** The transducer **5** causes the amplifier **22** to reenergize the relay **18** after a certain interval of time, e.g., as soon as the bight of the looped portion F_1 again interrupts the light beam **2B.** The same sequence of operations is repeated again and again whereby the overall length of the looped portion F_1 varies within a rather narrow range, i.e., within a range which is necessary to move the bight of the looped portion below and again above the level of the light beam **2B.**

The apparatus may comprise a simple time-delay device (not shown) which prevents uncontrollable oscillations of the circuit, i.e., such time-delay device prevents a stoppage of the motor **17** in immediate response to an interruption of the light beam **2B** and the starting of motor **17** in immediate response to movement of the bight of the looped portion F_1 above the level of the light beam **2B.** It has been found that the apparatus insures a highly satisfactory transport of webs through the body of liquid in the vessel **1** and a practically uniform dwell of each increment of the web in contact with the liquid.

FIG. **1** shows that the elements **2–5** of the detector which monitors the looped portion F_1 are installed in lateral recesses **1***b*, **1***c* of the vessel **1.** This renders it possible to place the vessel adjacent to one similar vessel or between two similar vessels. FIG. **1** merely shows (by broken lines) a portion of a second vessel **101** which is adjacent to the left-hand side of the vessel **1** and a portion of a third vessel **201** which is adjacent to the right-hand side of the vessel **1.** The reference characters **102, 103** denote two elements of a photoelectric detector for the looped portion of a web in the vessel **101,** and the reference characters **204, 205** denote two elements of a photoelectric detector for the looped portion of a web in the vessel **201.** The elements **102,** 205 are respectively mounted on adjusting members or supports **102***a*, 205*a*.

For example, if the vessel **1** is placed between the vessels **101, 201** in a manner as shown in FIG. **1,** the vessel **101** can contain a developing solution, the vessel **1** can contain a fixing bath, and the vessel **201** can contain a rinsing bath. If the vessel **1** is to be used with one or more similar vessels, its advancing rolls **6, 7** may constitute the second pair of advancing rolls for the web in the vessel **101,** and the advancing rolls **8, 9** may constitute the first pair of advancing rolls for the web in the vessel **201.** This simplifies the construction because the vessel **101** or **201** then merely supports a single pair of advancing rolls and a web guide **10, 11.**

The provision of a detector **2–5** which is movable between a plurality of levels is desirable because the operator can change the length of intervals during which an increment of the web F remains in contact with the body of liquid in the respective vessel by simplying moving the entire detector up or down. The length of intervals decreases if the detector **2–5** is moved to a higher level. Such adjustment of the length of intervals of contact between a body of liquid and successive increments of the web can be effected without necessitating any adjustment in the speed of lengthwise movement of the web, i.e., without changing the speed of the motor **17** and/or **17***a*.

FIG. **3** shows a portion of a modified second apparatus wherein all such parts which are identical with or clearly analogous to the corresponding parts of the first apparatus are denoted by similar reference characters each followed by a prime. The main difference is that the photoelectric detector including the elements **2′**, **3′**, **4′**, **5′** is permanently embedded in inserts **1B′**, **1C′** of the vessel **1′**. Since the detector **2′–5′** is not adjustable, the apparatus may comprise one or more additional photoelectric detectors each of which can be activated or deactivated independently of the other detector or detectors. FIG. **3** merely shows one additional loop detector including the elements **2″**, **3″**, **4″**, **5″** which is embedded in the inserts **1B′**, **1C′** of the vessel **1′** at a level above the detector **2′–5′**. The light beams which are respectively emitted by the light sources **2′**, **2″** are shown at **2B′** and **2B″**. As mentioned above, the detector **2′–5′** is activated when the detector **2″–5″** is deactivated whereby the length of the looped portion F_1 can be increased with a proportional increase in the length of intervals of contact between successive increments of the web F and the body of liquid in the vessel **1′**. The detector **2′–5′** need not be deactivated when the signals from the detector **2″–5″** are used to determine the maximum length of the looped portion F_1.

FIG. **4** shows a third apparatus wherein all such parts which are identical with or clearly analogous to the corresponding parts of the first apparatus are denoted by similar reference characters. The bottom wall **1***a* of the vessel **1** has an outlet opening **1***e* which is connected with the intake of a pump **23** serving to recirculate the liquid in the vessel. The outlet of the pump **23** is connected with the inlet ends of two conduits **24, 24***a*. The discharge end of the right-hand conduit **24** admits a stream of liquid into the channel **75** between the sections **10, 11** of the web guide by way of an opening **11***a* in the central portion of the upper section **11.** The conduit **24** has several portions or branches **24***b* which admit streams of liquid into the vessel **1** via openings **1***aa* in the right-hand side wall **1***f* of the vessel. The conduit **24***a* has portions or branches **24***c* which also admit liquid into the vessel **1** via additional openings **1***aa* provided in the left-hand side wall **1***g* of the vessel. The streams of liquid which issue from the branches **24***b*, 24*c* are directed downwardly (see the arrows **1***d*) so as to promote the formation of looped portion F_1 in the body of liquid in the interior of the vessel **1.** Each stream of liquid has a component of movement toward the bottom wall **1***a*. In the embodiment of FIG. **4,** the direction of each stream makes an acute angle with the plane of the bottom wall **1***a*.

The purpose of the stream of liquid which enters the vessel **1** via opening **11***a* in the upper section **11** of the web guide is to start and thereupon promote the formation of a looped portion F_1 when the section **10** dwells in the inoperative position **10A** and the advancing rolls **8, 9** are arrested. Such stream impinges against the web intermediate the rolls **6, 7** and **8, 9** and pushes the web downwardly into the body of liquid. Therefore, the sections **10, 11** of the web guide need not be curved (even though the sections **10, 11** of FIG. **4** have the same curvature as the similarly numbered sections of FIG. **1**) because the formation of a looped portion F_1 begins auto-

matically as soon as the section **10** is pivoted to the position **10**A even if the upper section **11** does not dip into the body of liquid in the vessel **1.**

The aforediscussed direction of liquid streams which issue from the portions or branches **24***b*, 24*c* of the conduits **24, 24***a* also contributes to more rapid and more predictable formation of a loop whose bight descends toward the light beam **2**B, and such loop forming action of these liquid streams is promoted by the flow of liquid toward and into the outlet opening **1***e* in the bottom wall **1***a* of the vessel **1.** Still further, the streams issuing from the portions or branches **24***b*, 24*c* prevent the looped portions F_1 of the web F from coming into contact with the upright side walls **1***f*, 1*g* of the vessel **1**; eventual contact between the looped portion F_1 and the wall **1***f* and/or **1***g* could cause unpredictable variations in the length of the loop.

FIG. **5** shows the manner of mounting the advancing rolls in or on the vessel, e.g., on the vessel **1** of FIG. **1.** The shaft **7***a* is longer than the shaft **6***a* and each of its end portions (only one end portion shown in FIG. **5**) extends into and outwardly beyond a recess or socket **1***bb* in the upper edge face of the vessel **1.** The shafts **6***a*, 7*a* rotate in bearing sleeves **25***a* which may consist of a suitable synthetic plastic material and are mounted in a clamp **25** serving to maintain the axes of the shafts **6***a*, 7*a* at a predetermined distance from each other. The lower roll **6** dips, at least in part, into the supply of liquid in the vessel **1.** The outer end portion of the shaft **6***a* may extend into a lateral recess **1***cc* of the vessel **1.** If desired, the shafts **6***a*, 7*a* may carry mating gears to insure that the rolls **6, 7** invariably rotate at the same speed but in opposite directions. The output shaft of the motor **17***a* (FIG. **2**) drives the outer end portion of the shaft **7***a* without the vessel **1** through the medium of a belt drive, a chain drive, a gear train or the like, not shown.

That length of a web F which is necessary for automatic threading of the web through a vessel corresponds to the length of the largest looped portion F_1 in a vessel. If the apparatus comprises several vessels, such as the vessels **101, 1, 201** of FIG. **1,** the introduction of the leader F_2 into the nip of advancing rolls **6,** 7 in the foremost vessel **101** is followed by the automatic formation of a first looped portion in the vessel **101,** introduction of the leader into the nip of second advancing rolls on the vessel **1,** the formation of a looped portion in the vessel **1,** the introduction of leader F_2 into the nip of second advancing rolls on the vessel **201,** and the formation of a looped portion in the vessel **201.** Therefore, the overall length of a web F need not equal the combined length of all three looped portions, i.e., the web F may be much shorter than the combined length of looped portions in the vessels **101,** 1 and **201** plus the length of web portions extending between the vessels **101, 1** and **201.**

The speed at which the web moves lengthwise through a single vessel or through a series of two or more vessels depends on the peripheral speed of the first pair of advancing rolls in the first or foremost vessel. The length of intervals of dwell of successive increment of the web in the second and/or third vessel may vary within a certain range due to intermittent rotation of the second pair of advancing rolls in the preceding vessel or vessels. Such fluctuations are of no consequence when the foremost vessel (**101** in FIG. **1**) contains a developing solution since eventual fluctuations of the length of intervals of contact between the increments of a web (e.g., photographic film) and a fixing or rinsing fluid is not harmful to the developed material. The apparatus is capable of insuring uniform development of each and every increment of a web F if the latter is an exposed film and the first vessel **101** contains a developing solution.

If a web is very short, the photoelectric detector for the loop is lifted to the uppermost level to reduce the maximum length of the looped portion F_1 (or the person in charge actuates the uppermost loop detector of FIG. **3**) and the speed of the motor **17***a* for the first pair of advancing rolls **6, 7** is reduced to thus insure that the web remains in sufficiently long-lasting contact with the developing solution even though the size of the looped portion F_1 is much less than is warranted by the depth of the vessel. It is also possible and within the purview of the invention to automatically reduce the speed of the motor **17***a* in response to upward movement of the detector **2–5** of FIG. **1,** or vice versa, so that the person in charge need not adjust the speed of the motor **17***a* but merely the level of the detector **2–5** or that such person merely adjusts the speed of the motor **17***a* whereby the level of the detector **2–5** is changed automatically by a suitable motor or the like.

It is also contemplated to mount the upper section **11** of the web guide **10, 11** for pivotal movement with the lower section **10.** This contributes to greater reliability of the formation of looped portions F_1; however, the web contacts the section **10** and/or **11** when the section **11** dwells in the lower position in which it dips into the body of liquid in the vessel and extends downwardly toward the light beam between the optical elements of the loop detector.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. In an apparatus for wet treatment of elongated flexible webs, particularly for wet treatment of carriers of photosensitive material, a combination comprising a liquid-containing vessel having an upper portion and a lower portion; guide means including an upper section and a lower section, at least said lower section being movable between an operative position in which said sections define an elongated channel extending transversely across said upper portion of said vessel and having an inlet and an outlet, and an inoperative position in which said lower section permits a web in said channel to move generally downwardly toward said lower portion of said vessel; means for moving said lower section between said operative and inoperative positions; a first pair of rotary web advancing members adjacent to said inlet; a second pair of rotary web advancing members adjacent to said outlet; first drive means for rotating said first pair of advancing members so that a web whose leader is introduced between said first pair of advancing members is caused to advance through said channel and into the range of said second pair of advancing members; second drive means for intermit-

tently rotating said second pair of advancing members; first detector means for monitoring the web downstream of said second pair of advancing members; means for arresting said second drive means and for actuating said moving means to effect a movement of said lower section to said inoperative position in response to detection of the leader of a web by said first detector means whereby, in response to continuing rotation of said first pair of advancing members, the web portion behind said leader descends in said vessel and forms a loop having a bight which moves towards the lower portion of said vessel; second detector means in the region of said lower portion of said vessel for monitoring the bight of said loop; and means for starting said second drive means in response to detection of the bight by said second detector means.

2. A combination as defined in claim **1,** wherein said lower section of said guide means is pivotable between said operative and inoperative positions thereof.

3. A combination as defined in claim **1,** wherein at least one of said detector means is a photoelectric detector.

4. A combination as defined in claim **1,** wherein at least said upper section of said guide means has a convex surface at the underside thereof and at least a portion of said convex surface dips into the liquid in said vessel so that successive increments of a web which moves in said channel come into contact with the liquid.

5. A combination as defined in claim **1,** wherein each of said pairs of advancing members comprises an upper and a lower advancing member, at least a portion of each of said lower advancing members extending into the liquid in said vessel.

6. A combination as defined in claim **1,** further comprising means for circulating the liquid in said vessel, said vessel having a bottom wall and said circulating means comprising a pump having an intake connected with a first opening provided in said bottom wall and an outlet and conduit means for supplying liquid from the outlet of said pump into said vessel whereby the evacuation of liquid through the opening of said bottom wall promotes the formation of said loop in the vessel.

7. A combination as defined in claim **6,** wherein said upper section has an opening and said conduit means comprises a portion which discharges a stream of liquid into said opening of said upper section whereby said stream promotes the looping of the web in said vessel in the inoperative position of said lower section.

8. A combination as defined in claim **6,** wherein said vessel further comprises side walls and said conduit means includes portions for discharging streams of liquid into said vessel via openings provided in at least one of said side walls, at least one of said streams having a component of movement in a direction toward said bottom wall to thereby promote the formation of said loop.

9. A combination as defined in claim **8,** wherein said portions of said conduit means discharge said streams toward and in directions making an acute angle with said bottom wall.

10. A combination as defined in claim **1,** wherein at least said lower portion of said vessel consists of light-transmitting material and said second detector means comprises a photosensitive detector having a light source arranged to emit a light beam across the liquid in said lower portion of said vessel.

11. A combination as defined in claim **10,** wherein the light of said beam is in the non-actinic range of the light spectrum.

12. A combination as defined in claim **10,** wherein at least a portion of said photosensitive detector is mounted directly on said vessel.

13. A combination as defined in claim **10,** wherein said photosensitive detector is embedded in said vessel.

14. A combination as defined in claim **1,** wherein said second detector means includes a photoelectric detector and adjusting means for moving said detector between a plurality of levels.

15. A combination as defined in claim **1,** wherein said second detector means comprises a plurality of photoelectric detectors disposed at different distances from said channel.

16. A combination as defined in claim **1,** wherein said second drive means comprises a device for rotating said second pair of advancing members at a peripheral speed exceeding the peripheral speed of said first pair of advancing members so that the bight of said loop rises in response to starting of said second drive means.

17. A combination as defined in claim **16,** wherein the peripheral speed of said second pair of advancing members exceeds the peripheral speed of said first pair of advancing members by approximately 2 percent.

18. A combination as defined in claim **16,** wherein the angular speed of said first pair of advancing members equals the angular speed of said second pair of advancing members and the diameters of said second pair of advancing members exceed the diameters of said first pair of advancing members.

19. A combination as defined in claim **1,** wherein each of said detector means comprises a photoelectric detector.

20. A combination as defined in claim **1,** further comprising a second liquid-containing vessel adjacent to said first mentioned vessel, second guide means for said second vessel, additional first and second detector means for said second vessel, and an additional second pair of advancing members adjacent to the outlet of the channel defined by said second guide means, said first mentioned second pair of advancing members constituting the first pair of advancing members for said second vessel.

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