

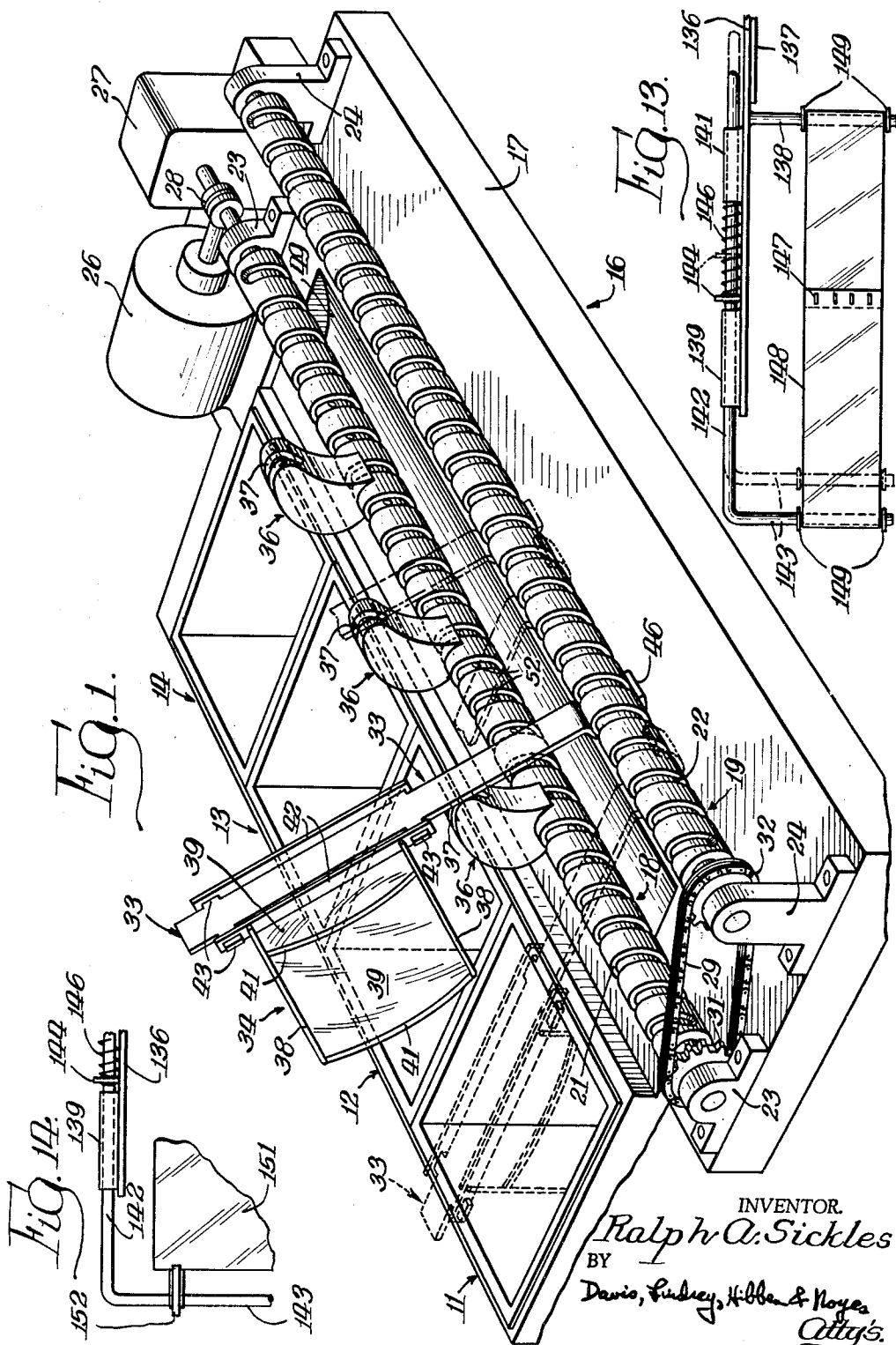
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APPARATUS FOR INTERMITTENT IMMERSION
OF ARTICLES IN LIQUID BATHS

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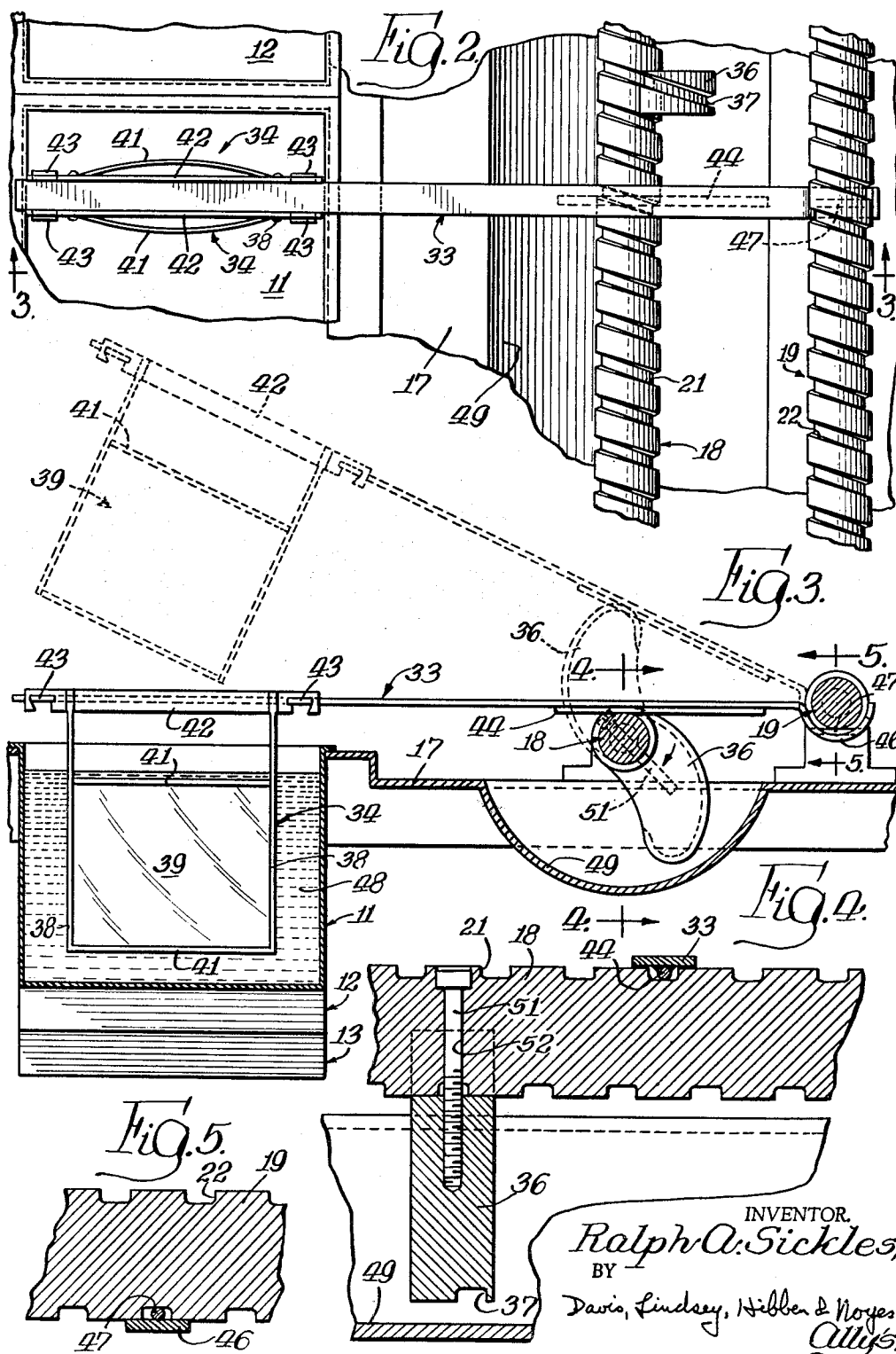
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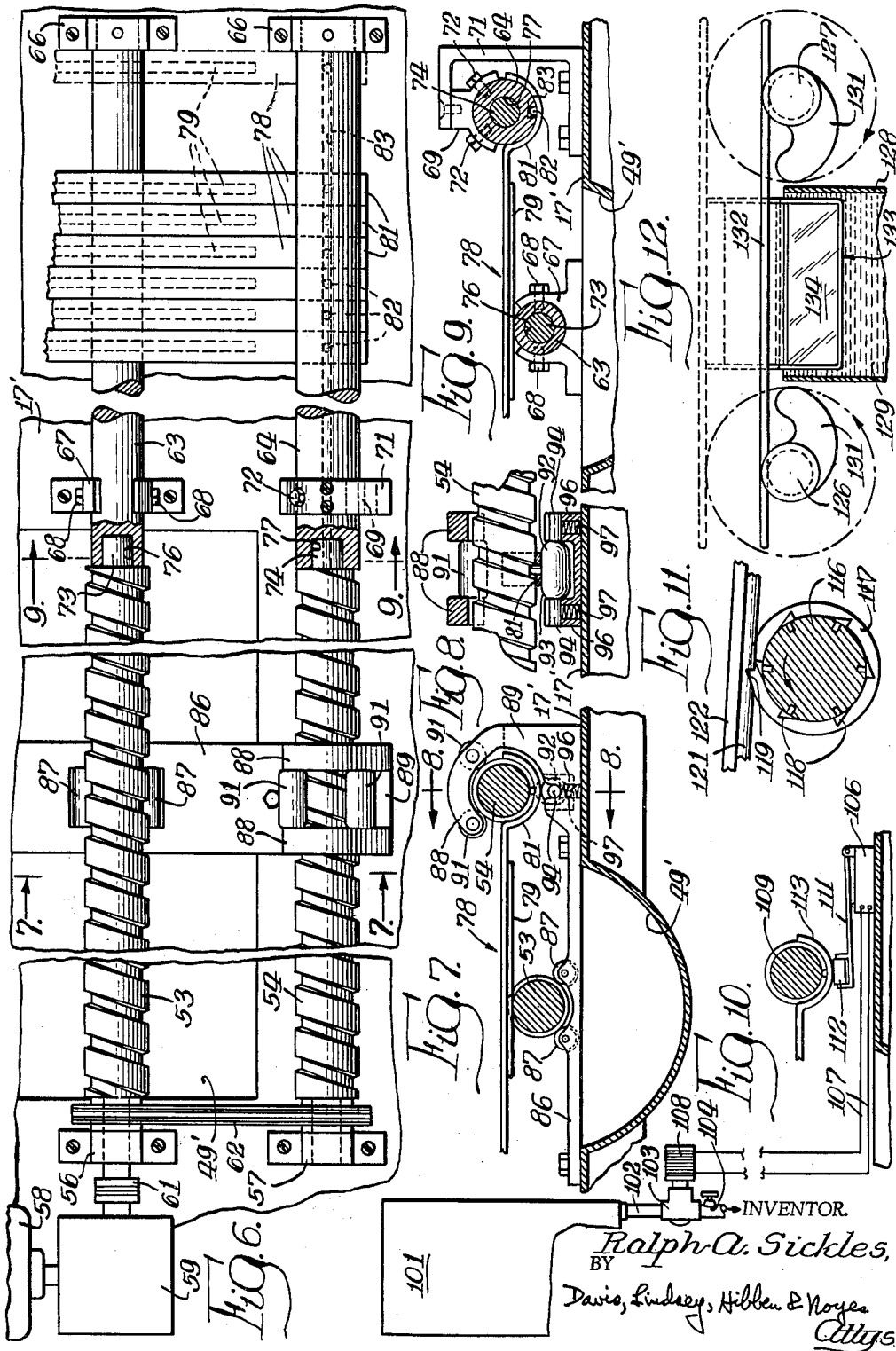
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APPARATUS FOR INTERMITTENT IMMERSION OF ARTICLES IN LIQUID BATHS

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This invention relates to improvements in apparatus for conveying articles and intermittently immersing the same in a plurality of successively arranged liquid baths.

In photographic development work and the like it is necessary to transfer photographic film or plates between successive developing, fixing, and washing baths or other processing liquids. To carry out such operations entirely by hand is tedious, time consuming and inefficient. Various mechanized or partially mechanized schemes have been proposed heretofore for minimizing such hand operations, but for the most part such devices have been relatively expensive and complicated so that they are not widely used.

Accordingly, a primary object of the present invention is to provide a novel and improved apparatus for effecting intermittent immersion of articles in a plurality of successively arranged liquid baths.

A further object of the invention is to provide a novel and improved apparatus of the above-described character which is relatively inexpensive and which has a relatively simple mechanical structure.

Another object of the invention is to provide a novel and improved apparatus of the above-described character which is readily adjustable to accommodate varying numbers of baths and required immersion times.

An additional object of the invention is to provide a novel and improved conveying apparatus for transferring photographic film or plates between successive processing baths.

Other objects and advantages of the invention will become apparent from the subsequent detailed description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of an apparatus comprising one specific embodiment of the present invention;

FIG. 2 is a fragmentary top plan view of the apparatus shown in FIG. 1;

FIG. 3 is a transverse sectional view taken along the line 3-3 of FIG. 2;

FIG. 4 is a fragmentary sectional view on an enlarged scale as seen along the line 4-4 of FIG. 3;

FIG. 5 is a fragmentary sectional view on an enlarged scale as seen along the line 5-5 of FIG. 3;

FIG. 6 is a fragmentary top plan view of a modified form of the apparatus;

FIG. 7 is a transverse sectional view as seen along the line 7-7 of FIG. 6;

FIG. 8 is a fragmentary sectional view taken along the line 8-8 of FIG. 7;

FIG. 9 is a transverse sectional view as seen along the line 9-9 of FIG. 6;

FIG. 10 is a fragmentary partially schematic view showing an additional feature of the invention;

FIG. 11 is a fragmentary view showing a further modification of a portion of the apparatus;

FIG. 12 is a small scale view illustrating another modified form of the apparatus; and

FIGS. 13 and 14 are fragmentary elevational views showing a modification of another portion of the apparatus.

Referring first to FIG. 1, the invention is herein illustrated in connection with an apparatus such as might be used in the development or other processing of photographic cut film or plates. Thus, a plurality of tanks 11,

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12, 13 and 14 are arranged in side-by-side relation to contain the various developing, washing, and fixing liquids as may be required in any given process. The conveying apparatus comprising the present invention is designated generally at 16 and is disposed alongside the tanks 11-14.

The apparatus 16 comprises an elongated base 17 having supported thereon a pair of elongated horizontal shafts or rotary conveyor members 18 and 19. The peripheral surface of each conveyor member 18 and 19 is provided with an identical helical groove or screw thread, as at 21 and 22, respectively. Although the members 18 and 19 as herein illustrated are provided with a recessed helical groove, it will be understood that a raised screw thread will also provide an equivalent structure since in each instance the shaft is provided with interspaced lands and grooves, and the term "helical groove" or "helical groove means" as used herein is intended to cover both such arrangements. The helically grooved conveyor members 18 and 19 or rotatably supported in parallel spaced relation by means of pairs of bearing blocks 23 and 24 secured to the base 17, the conveyor member 18 which is closest to the tanks 11-14 being supported at a lower elevation than the conveyor member 19. The conveyor members 18 and 19 are provided with any suitable drive means for effecting rotation of the conveyor members in unison. In the illustrated embodiment, the drive means comprises a motor 25 connected through a speed reduction device 27 and a coupling 28 to an end extension on the conveyor member 18. The opposite end of the conveyor member 18 is drivingly connected to the conveyor member 19 by means of a chain drive 29 and a pair of gears 31 and 32.

A plurality of detachable carrier arms 33 are provided for supporting the photographic film or plates and for conveying the same from one tank to the next. As hereinafter explained in greater detail, each arm 33 is disposed transversely with respect to the horizontal axes of the conveyor members 18 and 19 and extends outwardly therefrom toward the tanks 11-14. The outer end portion of each arm 33 is provided with one or more racks 34 or other devices for supporting a piece of cut film or plate. The inner end portion of the arm 33 extends in between the rotatable conveyor members 18 and 19 so as to cooperate with the groove 21 at the upper side of the conveyor member 18 and with the groove 22 at the lower side of the conveyor member 19. Upon simultaneous rotation of the conveyor members 18 and 19, the carrier arms 33 are caused to travel lengthwise from one end of the conveyor to the other.

At predetermined axially spaced locations corresponding to the junctures between adjacent tanks, at least one of the conveyor members (in this instance, the conveyor member 18) is provided with a plurality of displacement elements, such as the radially extending cam elements 36, in order to effect intermittent raising and lowering of the outer ends of the carrier arms 33 during travel of the carrier arms along the conveyor and thereby effecting transfer of the film from one tank to the next. As also explained in more detail below, each cam element 36 has a groove portion 37 which is aligned and coordinated with the shaft groove 21 so as to effect smooth and continuous travel of the carrier arm along the conveyor.

As shown in FIGS. 2 and 4, the carrier arm 33 is preferably an elongated flat strip having a width substantially greater than the width of the helical grooves 21 and 22 so that the strip engages the outer peripheries of the grooved shafts 18 and 19 in bridging relation over the helical grooves. The arm 33 extends outwardly from the conveyor members 18 and 19 and is supported in cantilever fashion so that the outermost end of the arm 33 overlies the tanks 11-14. Any suitable means may be

provided at the outermost end of the arm 33 for detachably supporting cut film or other articles for immersion in the liquid baths. In this instance, a pair of film holders or racks 34 are provided at the opposite longitudinal edges of the arm 33. Each rack 34 has a generally rectangular configuration with oppositely disposed sides 33 and a pair of outwardly bowed cross members 41 having opposed grooves (not shown) for receiving the edges of a piece of cut film 39. The upper edge of each rack 34 has a transverse mounting strip 42 with notches at its ends for detachably suspending the rack from a pair of lugs 43 projecting from the carrier arm 33.

The intermediate portion of the carrier arm 33 rests on top of the conveyor member 18 and is of sufficient width to bridge the helical groove 21, as previously described. To effect an operative connection between the carrier arm 33 and the grooved conveyor member 18, the underside of the arm 33 is provided with a suitable groove-tracking means which in this instance comprises a section of circular rod 44 rigidly affixed to the underside of the arm 33 and having a diameter small enough to extend into the helical groove 21 in the manner shown in FIGS. 2 and 4. It will be understood that inasmuch as the groove-tracking element 44 extends at right angles to the axis of the rotating conveyor member 18, the engagement of the element 44 with opposite sides of the helical groove 21 will cause the arm 33 to travel along the conveyor member 18 during rotation thereof.

A similar tracking arrangement is provided at the innermost end portion of the carrier arm 33 which, as best seen in FIG. 3, has a substantially semi-circular shape, as at 46, so as to fit around and conform closely to the curvature of the lower circumferential half of the grooved conveyor member 19. As previously explained, the width of the arm 33 including the curved or arcuate end portion 46 is greater than the width of the groove 22, and in order to provide a driving connection the curved section 46 has rigidly fitted in chordal relation therein a groove-tracking element 47, similar to the rod 44, which extends into the helical groove 22 in driving relation therewith at the lowermost side of the conveyor member 19. It will be understood that the grooved conveyor members 18 and 19 are constructed identically and are so aligned that the perpendicularly extending carrier arm 33 will be driven substantially uniformly, along the length of the conveyor by reason of the coaction between the helical grooves 21 and 22 and the respective groove-tracking elements 44 and 47 as the conveyor members 18 and 19 are driven at identical speeds.

As will readily be understood, when the carrier arm 33 is in its lowermost or substantially horizontal position as shown in full lines in FIG. 3, the film 39 will be immersed in the liquid bath, as shown at 48 for tank 11 in FIG. 3. As the film moves through the bath during operation of the conveyor and approaches the end of the tank 11, the carrier arm 33 must be elevated a sufficient length of time to allow the racks 34 to clear the adjacent wall portions of tanks 11 and 12. The necessary intermittent raising and lowering action at the junctures between adjacent tanks is accomplished by means of the radially extending cam elements 36. Although the cam elements 36 may have any desired shape dependent upon the action desired, the generally kidney-shaped or lobe-shaped configuration herein illustrated is particularly effective since it provides, at a constant rotary speed of the conveyor member 18, a relatively slow lifting or withdrawing action of the article from the bath followed by a relatively rapid lowering or immersion of the article in the next bath. Thus, during withdrawal of the article, ample time is allowed for drainage of the adherent liquid and thereby minimizing carry-over of liquid from one bath to the next.

As best seen in FIG. 2, the groove portion 37 in the edge of the cam element 36 is aligned with the helical groove 21 in the conveyor member 18 so as to form a

smooth continuation thereof. If desired, the pitch of the groove portion 37 in the cam 36 may be accentuated slightly at the outermost end of the cam element so that when the carrier arm 33 is completely elevated, as shown in broken lines in FIG. 3, the lateral movement of the arm along the conveyor is accelerated for a brief instant so as to effect rapid movement of the racks 34 across the tank walls and thereby permitting rapid lowering of the racks into the next tank. With such an arrangement, the outermost end of the carrier arm 33 may travel ahead of the innermost end of the arm for a short time but as soon as the arm clears the cam element 36 the normal perpendicular relationship of the arm 33 to the axes of the conveyor members 18 and 19 will be restored automatically.

As best seen in FIGS. 3 and 4, the base 17 may be provided with an elongated semi-circular trough or depressed portion 49 to allow clearance for the rotating cam elements 36. The cam elements 36 are preferably adjustable along the length of the conveyor member 18 by means of screws 51 extending through selected apertures 52 in the shaft 18 and threaded into the cam elements 36. Thus, the cam elements 36 can be located at any desired points along the length of the conveyor member 18 in order to accommodate varying sizes and locations of the liquid-containing tanks. Preferably, the trough 49 extends substantially the full length of the conveyor member 18 so as to facilitate adjustment of the cam elements 36.

For the sake of convenience in preparing the chemical or processing baths for use in a photographic development process, it will frequently be convenient to have the tanks 11-14 of different dimensions (such as illustrated by the varying depths of tanks 11, 12 and 13 shown in FIG. 3) thereby allowing the operator to use standard and readily available batches of chemicals without departing from the indicated procedures for preparation of the solutions. It will also be understood that the lengths of the respective tanks are selected to provide the required processing time in each tank.

As the arm 33 is moved along the length of the conveyor in response to rotation of the conveyor members 18 and 19, the weight of the racks 34 and the film contained therein is sufficient to hold the arm 33 in operating engagement with the conveyor members 18 and 19. As heretofore explained, the wide flat configuration of the strip comprising the carrier arm 33 insures smooth sliding travel of the carrier arm with good lateral stability. Furthermore, the spaced point coaction between the groove-tracking elements 44 and 47 and the grooves 21 and 22, respectively, further retains the arm 33 in laterally stable and normally perpendicular relation to the axes of the conveyor members. During most of the conveying period, the arm 33 is disposed horizontally so that there is no particular tendency toward longitudinal or axial shifting of the arm. However, when the arm 33 is elevated, as shown in dotted lines in FIG. 3, the arcuate or semi-circular end section 46 serves to restrain the arm against axial shifting movement in either direction.

The use of a pair of conveyor screws with lifting cam means on at least one of the screws, as above-described, provides a conveying system having exceptional flexibility and capable of excellent control. The rotating cam arrangement is smooth in operation and readily permits the close control required to raise, drain, shift, and lower the film rack during transfer from one tank to the next. Moreover, the present system can easily be adapted for use with relatively large and heavy articles.

In FIGS. 6 to 9, a modified form of the conveying apparatus is shown having a base 17' with a trough 49' similar to the trough 49 previously described. A pair of helically grooved shafts 53 and 54 are supported on the base 17' with the left-hand ends of the shafts journaled in bearing blocks 56 and 57, as viewed in FIG. 6. The

left-hand end of the shaft 53 has a driving connection with a motor 58 through a gear reduction device 59 and a coupling 61. In this instance, a chain drive 62 interconnects the shafts 53 and 54 at the same end as the motor drive. At the right-hand ends of the shafts 53 and 54 a pair of smooth non-rotating rods 63 and 64 are supported on the base 17' in axial alignment with the shafts 53 and 54, respectively. The outermost ends of the rods 63, 64 are rigidly supported in a pair of brackets 66. The innermost end of the rod 63 is rigidly supported from below by means of a half pillow block 67 secured to the base 17' and having screws 68 extending into the rod 63. By employing a half-pillow block, the upper surface of the rod 63 is left free and unobstructed, as seen in FIG. 9, for the purpose hereinafter described. The innermost end of the other rod 64 is supported from above by means of a half-pillow block 69 suspended from an upright bracket 71 and rigidly secured to the rod 64 by screws 72. Thus, the lower surface of the rod 64 remains free and unobstructed. As viewed in FIG. 6, the right-hand ends of the rotating shafts 53 and 54 are provided with reduced diameter bearing portions 73 and 74, respectively, which are journaled in a pair of axial recesses 76 and 77 provided in the adjacent left-hand ends of the rods 63 and 64, respectively.

During operation of the conveyor, the carrier arms (which are designated generally at 78 and are similar to the arms 33 heretofore described) move from left to right as viewed in FIG. 6, and at the exit ends of the grooved shafts 53 and 54 the carrier arms 78 are automatically displaced onto the smooth non-rotating rods 63 and 64 which constitute extensions of the rotating shafts 53 and 54. As successive carrier arms 78 are discharged onto the receiving rods 63 and 64, the carrier arms slide along the rods and are stored in side-by-side relation for removal at any convenient time. It will be appreciated that the rods 63 and 64 may be of any convenient length to provide receiving and storage facilities for any desired number of carrier arms 78.

As shown in FIG. 9, during discharge of the carrier arms 78 onto the smooth non-rotating rods 63 and 64, the arms 78 having tracking elements 79 secured to their undersides ride smoothly along the free and unobstructed upper surface of the rod 63. At the same time, the curved inner end portions, designated at 81, of the carrier arms 78 slide smoothly along the free and unobstructed lower surfaces of the rod 64. For guiding the movement of the curved portion 81 of the carrier arm along the under surface of the rod 64, an elongated axially extending slot 83 is provided in the rod 64 and receives a pin 82 extending upwardly from the curved portion 81, the pin 82 also functioning as the tracking element for cooperation with the helical groove in the shaft 54 during movement of the carrier arm 78 therealong.

Dependent upon the length of the shafts 53 and 54, it may be desirable to provide one or more intermediate supports along the lengths of these shafts. A suitable intermediate supporting arrangement is shown in FIGS. 6 to 8 wherein a transverse base plate 86 is mounted on the base 17' in bridging relation over the trough 49'. A pair of rollers 87, which are preferably made of Teflon or similar plastic material, are supported in freely rotatable relation on the base plate 86 for engaging and supporting the shaft 53 at the lower portion thereof. Since the shaft 54 tends to be deflected upwardly by the weight of the carrier arms 78 and the articles supported thereon, an intermediate support engaging the upper portion of the shaft 54 is also provided. This support comprises a pair of curved arms 88 overlying the shaft 54 and projecting rigidly from an upright end bracket portion 89 on the base plate 86. A pair of freely rotatable rollers 91, of Teflon or the like, are journaled between the arms 88 for engaging the upper portion of the shaft 54.

A bottom support for the shaft 54 is also provided by means of a roller 92, of Teflon or the like, having

beveled or rounded end corners 93 and reduced diameter end shaft portions 94, as shown in FIG. 8. The shaft portions 94 are rotatably receiving in a pair of slotted bracket portions 95 extending upwardly at the opposite sides of the base plate 86. A pair of helical compression springs 97 are mounted beneath the shaft portions 94 for normally urging the roller 92 into engagement with the bottom side of the shaft 54. However, the springs 97 provide a yieldable mounting for the roller 92 so as to permit passage of the curved portion 81 of a carrier arm 78 between the roller 92 and the shaft 54, as shown in FIGS. 7 and 8. As the carrier arm approaches the roller 92, the side edge of the curved carrier arm portion 81 engages the rounded end corner portion 93 of the roller 92 and cams the latter downwardly against the action of the springs 97 so as to permit passage of the carrier arm, and after the carrier arm has passed beyond the roller 92 the springs 97 return the roller 92 to its normal position of rolling engagement with the shaft 54.

FIGURE 10 illustrates an auxiliary feature of the invention which provides for automatic replenishment of the solution in one or more of the tanks 11-14. Thus, a bulk supply of solution or other liquid is maintained in a supply tank 101 having an outlet conduit 102 with a solenoid actuated valve 103 and a metering orifice 104. It will be understood that the conduit 102 communicates with an appropriate tank (not shown) comprising part of the processing system. A microswitch 106 having leads 107 to a solenoid 108 is mounted adjacent one of the rotating grooved shafts 109, which in this instance corresponds to the shaft 19 of FIG. 1 or the shaft 54 of FIG. 6. An actuating arm 111 is pivotally mounted on the switch 106 and is normally urged toward the shaft 109 by spring means (not shown) so that the solenoid circuit is normally open. The arm 111 carries a roller 112 for engaging the underside of the shaft 109. When a carrier arm moving along the shaft 109 approaches the switch arm 111, the curved portion of the carrier arm, indicated at 113, engages the roller 112 and forces the arm 111 downwardly during passage of the carrier arm portion 113 between the roller 112 and the shaft 109, thereby closing the switch 106 and energizing the solenoid 108 so as to open the valve 103. Thereupon, the required amount of solution, as determined by the metering orifice 104, is automatically fed from the supply tank 101 through the conduit 102 to the processing tank (not shown). It will be understood that instead of using a solenoid valve, the contact roller 112 and its supporting arm 111 could be arranged to effect direct mechanical opening of the suitable valve means. Moreover, suitable arrangements utilizing microswitches or the like can also be provided so as to be responsive to passage of a carrier arm along the conveyor system for other purposes, e.g. operation of indicator lights or alarms, turning on liquid washes or sprays, or introducing a gas into one or more of the processing baths for purposes of agitation.

FIG. 11 illustrates still another auxiliary feature of the invention. In processing film it frequently happens that when the film is first immersed in a liquid bath air bubbles tend to collect on and adhere to the film preventing proper contact of the processing liquid with the film. The arrangement shown in FIG. 11 provides a means for displacing such air bubbles. A shaft 115 is shown having a helical grooved portion 117, the shaft 116 corresponding in this instance to the shaft 18 of FIG. 1 or the shaft 53 of FIG. 6. In the portion of the groove 117 at the entry or the inlet end of the shaft 116, a plurality of stepped portions or ratchet elements 118 are secured in the groove in circumferentially spaced relation, and a cooperating notch 119 is formed in the tracking element or rod 121 secured to the underside of each carrier arm, indicated at 122. As the shaft 115 rotates in a counterclockwise direction, as viewed in FIG. 11, the moving ratchet elements 118 engaging the rod 121 cause the outer

end of the carrier arm 122 and the film mounted thereon to be lifted slightly and as each ratchet element 118 enters the notch 119 the carrier arm 122 drops abruptly so as to effect repeated jarring of the carrier arm which will shake loose the air bubbles adhering the film. It will be understood that this action occurs only during a short initial portion of the travel of the carrier arm after the film has first been immersed in the initial bath and thereafter when the arm has passed beyond the portion of the groove 117 having the ratchet elements 118, the conveying action proceeds in the manner previously described.

FIG. 12 illustrates a modification of the invention which is particularly useful where only relatively shallow immersion of the film or other article in the processing bath is required. In this arrangement, a pair of helically grooved conveyor shafts 126 and 127 are mounted in parallel relation at opposite sides of a tank 128 containing a processing liquid bath 129. Each of the shafts 126 and 127 is provided with a lifting cam 131 similar to the cam 36 heretofore described. The cams 131 are arranged and coordinated to cooperate with an elongated carrier arm 132 which extends across the tank 128 with its opposite ends supported on the spaced rotating shafts 126 and 127. The carrier arm 132 is provided with tracking elements (not shown) cooperable with the grooves in the shafts 126 and 127 so as to effect movement of the carrier arm along the shafts. A rack or film support 133 is suspended centrally from the carrier arm 132 for mounting a piece of cut film or plate 134. During travel through the tank 128, the carrier arm 132 is in its lowermost position as illustrated in full lines in FIG. 12 with the film 134 immersed beneath the surface of the liquid bath 129. When the carrier arm 132 approaches the end of the tank 128, the lifting cams 131 engage the carrier arm 132 simultaneously so as to lift the carrier arm upwardly to its dotted line position as shown in FIG. 12, thereby withdrawing the film 134 from the tank and elevating it sufficiently to clear the tank walls during transfer to the next successive bath after which the carrier arm 132 is lowered by the cams 131 so as to immerse the film in the next bath.

In FIGS. 13 and 14 an alternative form of rack or film hanger is shown which may be used in place of the rack 34 shown in FIG. 1 or the rack 133 shown in FIG. 12. In FIG. 13 the hanger is shown as used in processing roll film. The outer end of the carrier arm is designated as 136 and has the usual tracking element 137 at its underside. A depending bar or rod 138 is rigidly secured to the underside of the carrier arm 136, and a pair of spaced tubular guides 139 and 141 are secured to the upper side of the carrier arm 136. An elongated rod 142 extends through the tubular guides 139 and 141 in freely slidable relation therein and has its outermost end turned downwardly to provide a depending bar portion 143 which is spaced from and parallel to the bar 138. An upright abutment or retainer 144 is rigidly secured to rod 142 intermediate the tubular guide portions 139 and 141, and a spring 146 surrounds the rod 142 with its opposite ends engaging the guide portion 141 and the retainer 144. Preferably, the abutment 144 comprises a washer welded to the rod 142 and having a straight bottom edge engaging the upper flat surface of the carrier arm 136 for preventing rotation of the rod 142. Thus, the spring loaded bar 143 is normally urged outwardly by the spring 146 so that the abutment 144 normally engages the end of the tubular guide portion 139.

In using the hanger, the ends of a roll of film are stapled together, as at 147, to form a continuous loop 148 which is then mounted between the depending bars 138 and 143, the bar 143 being pressed inwardly against the action of the spring 146, as indicated in broken lines in FIG. 13, to facilitate the mounting operation. Upon being released, the bar 143 is resiliently urged outwardly away from the bar 138 so as to hold the loop 148 in taut rela-

tion therebetween, as illustrated in full lines in FIG. 13. It will be noted that in the latter position the abutment 144 is spaced slightly from the tubular guide portion 139 so that the full spring action is realized and the loop 148 is held in tension. A pair of spacer flanges 149 are mounted on each of the rods 138 and 143 to hold the loop 148 in proper position.

FIG. 14 illustrates the manner in which the film hanger of FIG. 13 may be adapted for use with cut or sheet film. In this case, a sheet of film 151 is tensioned between the spring loaded bars 143 and 138 by means of a plurality of clips 152 mounted on the rods 138 and 143 and attachable to the opposite edge portions of the sheet 151.

Although the invention has been described with particular reference to use of the conveyor apparatus in a photographic development system, it will be apparent that the invention may be used under widely different circumstances requiring intermittent immersion of an article in a series of liquid baths. For example, the apparatus can be used effectively in the preparation and staining of microscope slides. Other analogous uses will be readily apparent.

It is to be understood that various modifications and equivalent structures may be resorted to without departing from the scope of the invention as defined in the appended claims.

I claim:

1. Apparatus for intermittently immersing articles in a plurality of successive liquid baths, comprising a pair of parallel, spaced, elongated, rotatable conveyor members each having helical groove means extending therealong, at least one carrier arm disposed transversely with respect to the axes of said conveyor members, means on a portion of said arm adapted to support an article to be immersed, said arm having means extending into operative engagement with the groove means of each of said members, means for rotating said conveyor members continuously and in unison whereby to effect movement of said arm along said conveyor members, and means carried in axially spaced relation at predetermined locations along at least one of said conveyor members for raising and lowering said portion of said arm at predetermined intervals during movement of the arm along said conveyor members.

2. The apparatus of claim 1 further characterized in that said last-named means comprises a plurality of radial cam elements mounted in axially spaced relation along the conveyor member.

3. The apparatus of claim 1 further characterized by the provision of valve means adapted to control the feeding of a fluid to at least one of the tanks, actuating means disposed adjacent one of said conveyor members and adapted to be engaged by a carrier arm passing along the conveyor member, and means interconnecting said actuating means and said valve means for opening the latter in response to engagement of the carrier arm with said actuating means.

4. The apparatus of claim 1 further characterized in that the helical groove adjacent one end of one of said conveyor members is provided with ratchet means and said carrier arm is provided with cooperating recess means whereby said arm is repeatedly raised and dropped so as to displace air bubbles from the article being immersed.

5. The apparatus of claim 1 further characterized by the provision of a pair of elongated non-rotating storage members disposed in axial alignment with said conveyor members for receiving carrier arms discharged from said conveyor members, and means supporting said storage members to permit free and unobstructed sliding passage therealong of said carrier arms.

6. Apparatus for intermittently immersing articles in a plurality of successively arranged liquid-containing tanks, comprising a pair of horizontal, elongated rotatable conveyor members having helical grooves therealong, means supporting said conveyor members in parallel

spaced relation with one conveyor member at a lower elevation than the other conveyor member, said conveyor members being adapted to be located along one side of the tanks with said one conveyor member closer to the tanks than said other conveyor member, at least one elongated carrier arm disposed transversely of said conveyor members and adapted to extend outwardly from said conveyor members overlying the tanks, one end portion of said arm being in operative engagement with the lowermost side of said other conveyor member, an intermediate portion of said arm being supported on and in operative engagement with the uppermost side of said one conveyor member, and the opposite end portion of said arm being adapted to support an article to be immersed in the tanks, said arm being movable along said conveyor members in response to rotation of the latter, and a plurality of radially projecting cam elements affixed to said one conveyor member in axially spaced relation therealong, said cam elements having grooved portions aligned with the helical groove of said one conveyor member and operatively engageable with said intermediate portion of said arm whereby the intermediate portion of said arm is intermittently raised and lowered for withdrawing and immersing the article at said opposite end portion of said arm during travel of the arm along said conveyor members.

7. The apparatus of claim 6 further characterized in that said cam elements are adjustably securable at predetermined locations along said one conveyor member for accommodating different tank locations and sizes.

8. The apparatus of claim 6 further characterized in that said arm comprises a flat strip having a width greater than the width of the helical grooves in said conveyor members and groove-engaging means projecting from said strip into the grooves whereby said strip has a laterally stable sliding engagement with the outer peripheries of said conveyor members during movement of the arm by coaction between said groove-engaging means and the grooved conveyor members.

9. The apparatus of claim 6 further characterized by the provision of retaining means at said one end portion of said arm cooperable with said other conveyor member for substantially restraining the arm against axial shifting during raising and lowering thereof.

10. The apparatus of claim 9 further characterized in that said retaining means comprises a substantially semi-circular section at said one end portion of said arm, said section fitting around and engaging substantially the lower circumferential half of said other conveyor member whereby to resist axial shifting of said arm in either direction.

11. The apparatus of claim 6 further characterized in that said arm comprises a flat strip having a width greater than the width of the helical grooves in said conveyor members so that the strip has a laterally stable sliding engagement with the outer peripheries of said conveyor members, groove-tracking means projecting downwardly from said strip and extending into the groove of said one conveyor member, at the uppermost side thereof, and groove-tracking means projecting upwardly from said strip and extending into the groove of said other conveyor member at the lowermost side thereof.

12. The apparatus of claim 6 further characterized by the provision of a pair of first and second elongated non-rotating storage members disposed in axial alignment with said one and said other conveyor members, respectively, at the exit ends of the latter for receiving carrier arms discharged from said conveyor members, means supporting from below said first storage member, and means supporting from above said second storage member, whereby the uppermost side of said first storage member and the lowermost side of said second storage member are free and unobstructed to permit sliding passage therealong of said intermediate portion and said one end portion of said carrier arm.

13. The apparatus of claim 6 further characterized by the provision of roller means engaging the lowermost sides of both of said conveyor members, roller means engaging the uppermost side of said other conveyor member, and resiliently yieldable mounting means for the roller means engaging the lowermost side of said other conveyor member for allowing passage of said one end portion of said carrier arm therebetween.

14. Apparatus for intermittently immersing articles in a plurality of successive liquid baths, comprising a pair of parallel, spaced, elongated, rotatable conveyor members each having helical groove means extending therealong, at least one carrier arm disposed transversely between and supported on said conveyor members, said arm having means extending into operative engagement with the groove means of each of said members, means for rotating said conveyor members continuously and in unison whereby to effect movement of said arm along said conveyor members, means on said arm intermediate said conveyor members for supporting an article to be immersed, and means carried in axially spaced relation at predetermined locations along each of said conveyor members for raising and lowering said arm at predetermined intervals during movement of the arm along said conveyor members.

15. The apparatus of claim 14 further characterized in that said last-named means comprises a plurality of radial cam elements mounted in axially spaced relation along the conveyor members.

16. Apparatus for intermittently immersing articles in a plurality of successively arranged liquid-containing tanks, comprising a pair of horizontal, elongated, rotatable conveyor members having helical grooves therealong, means for supporting said conveyor members in parallel spaced relation alongside the tanks at opposite sides thereof, at least one elongated carrier arm supported transversely between said conveyor members for bridging the tanks, the opposite ends of said arm being in operative engagement with the uppermost sides of said conveyor members whereby said arm is movable along said conveyor members in response to rotation of the latter, means intermediate the ends of said arms for supporting an article to be immersed in the tanks, and a plurality of radially projecting cam elements affixed to each of said conveyor members in axially spaced relation therealong, said cam elements having grooved portions aligned with the helical grooves of said conveyor members and operatively engageable with said arm whereby said arm is intermittently raised and lowered for withdrawing and immersing the article at the intermediate portion of said arm during travel of the arm along said conveyor members.

17. Apparatus for intermittently immersing articles in a plurality of successive liquid baths, comprising a pair of parallel, spaced, elongated, rotatable conveyor members having helical groove means extending therealong, an article support disposed transversely with respect to the axes of said conveyor members and extending outwardly therefrom, means at the outermost end of said support for mounting an article to be immersed, said support having spaced portions operatively engaging the groove means of each of said conveyor members, means for rotating said conveyor members continuously and in unison whereby to effect movement of said support along said conveyor members, and cam means mounted at predetermined axially spaced locations along one of said conveyor members for rotation therewith, one of said support portions engaging the other of said conveyor members to provide a fulcrum for pivotal movement of the support and the other of said support portions being engageable by said cam means for pivoting said support about said fulcrum and thereby raising and lowering said outermost end of said support at predetermined intervals during movement of the support along said conveyor members.

18. The apparatus of claim 17 further characterized in that said one support portion comprises a substantially semi-circular section fitting around and engaging the other of said conveyor members whereby to restrain said support against axial shifting during pivotal movement thereof.

19. The apparatus of claim 17 further characterized by the provision of roller means engaging the lowermost sides of both of said conveyor members, rollers means engaging the uppermost side of said other conveyor member, and resiliently yieldable mounting means for the roller means engaging the lowermost side of said other conveyor member for allowing passage of said one support portion therebetween.

20. Apparatus for intermittently immersing articles in a plurality of successive liquid baths comprising a pair of parallel spaced elongated rotatable conveyor members each having helical groove means extending therealong, at least one carrier arm disposed transversely with respect to the axes of said conveyor members, means on a portion of said arm adapted to support an article to be immersed, said arm comprising a substantially flat strip having a width greater than the width of the helical grooves

in said conveyor members and groove engaging means projecting from said strip into the grooves whereby to effect movement of said arm along said conveyor members during rotation of the latter and whereby said strip has laterally stable sliding engagement with the outer peripheries of said conveyor members during movement of the arm therealong, and means carried on at least one of said conveyor members for raising and lowering said portion of said arm at predetermined intervals during movement of the arm along said conveyor members.

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