ABSTRACT: A device for automatic forwarding of photographic material from one treating station to the next. The forwarding device includes a base frame, a forwarding bar member movably supported in the base frame, lifting elements for raising and lowering the base frame, and a first actuating mechanism for horizontally reciprocating the forwarding bar member in the base frame. The forwarding bar member has seating elements thereon for supporting a film carrier when the base frame is in the raised position and for subsequently transferring the carrier to an adjacent processing tank. The device has separate seating elements for supporting the film carrier when the base frame is in its lowered position. In another embodiment, the forwarding device has a second actuating mechanism for reciprocating the forwarding bar member in a direction perpendicular to the direction of movement of the first actuating mechanism.
AUTOMATIC FORWARDING MECHANISM FOR PHOTOGRAPHIC MATERIALS

The present invention relates to automatic forwarding means or mechanism, which is adapted for the forwarding of photographic material, in batchwise operation, through the steps of multistep photographic wet treating processes, and more particularly to automatic forwarding mechanism and to fully automatic apparatus for the development of photographic color materials.

Photographic color materials may be developed by continuous or batchwise procedures. In the batchwise operation, certain well standardized development sequences are followed, which require the transfer of the material from one tank to the next after a predetermined residence time under exactly controlled conditions. Many of the color process schedules are lengthy and time consuming, lasting often longer than one hour and tying up expensive man power. It has therefore been attempted, to provide automatic forwarding equipment, which takes over the functions of forwarding the material from treating station to treating station. The forwarding devices known heretofore are either complex and very expensive to manufacture, or may result in binding of the carrier, with the photographic material contained therein, in the tanks at the slightest irregularity in the placement of the tanks.

It is therefore an object of the present invention to provide a new forwarding device, which can be economically constructed from simple, inexpensive components, so as to be useful also for the photographic amateur.

It is another object of the invention to provide a forwarding mechanism, which does not result in binding or other mechanical difficulties during the transfer operation due to the fact that the carriers for the photographic material are free to laterally and lengthwise move and to be displaced upon insertion and extraction to a certain degree, as may be required as the result of irregular placing of the tanks in the treating stations.

Other objects will become apparent as the description of the invention proceeds and from the attached drawings.

The objects of the invention are achieved by a device, automatic developing apparatus or by bath or water jacket which comprises a base frame, supported by servocylinders or equivalent mechanical lifting means, and at least one horizontal forwarding bar or equivalent means, adapted to forward the photographic material between steps horizontally by a distance corresponding to the spacing of the tanks, or other receptacles containing the treating media or solutions and wherein the treatment is to be carried out. The lifting and forwarding means may be actuated by hand or more conveniently by suitable power sources, the operation of which may be controlled by the operator, or more conveniently by a program timer which is programmed for the specific process sequence to be carried out.

The fully automatic embodiment of the bath comprises advantages also automatic agitating means, if the process to be carried out in the bath requires agitation. Any desired mode of agitation and means therefore, such as gas burst valves, ultrasonic power sources may be combined with the fully automatic embodiment of the bath. The most preferred embodiment of the fully automatic bath, however, comprises in addition to the said forwarding means automatic mechanical agitating means, preferably of the vertically reciprocating type.

If the fully automatic bath is not compartmented or lacks the counter sealing or other supporting means in the sidewalls, it is highly desirable to provide in the bath and in the vessels or other receptacles to be used in the bath means, adapted to localize the vessels relative to the bath and to each other, and to keep them in this fixed position for the duration of the treatment. As is readily apparent, the compartmented bath comprising counter sealing and/or supporting means for the upright vessels is most preferred for use with the automatic forwarding and/or agitating means and offers the greatest advantages in the automatic operation of the bath, especially also in combination with suitable inlet and outlet means for the unidirectional passage of a temperature conditioned medium. If this embodiment of the bath is controlled by a suitable program timer, the operator need pay virtually no attention to the progress of the treatment because of the fully automatic bath comprises advantageously also a light tight hood, enclosing the bath or water jacket and the agitating and forwarding means and preferably also all the other parts of the developing apparatus, so as to permit the use of light in the darkroom while the treatment proceeds undisturbed in the enclosed bath or apparatus. Referring to the attached drawings, FIG. 1 is an isometric view of a water jacket, provided with a fully automatic forwarding device of the invention, exemplified for the operation of the batchwise multistep treatment of sheet materials.

FIG. 2 is an isometric view of another embodiment of a water jacket or bath comprising modified automatic forwarding mechanism, exemplified for the operation of batchwise wet treatments of reels of bands of film or paper. The automatic forwarding device of the invention is described hereinafter in connection with specific embodiments of the water jackets or baths for the reception of the treating tanks. The device may be constructed as a self-contained unit, to be placed onto a water jacket or bath of any desired design or structure; or it may be integrated, by suitable adaptation, with water jackets or parts thereof of any other desired design, especially also with the water jackets illustrated and described in my copending applications Ser. No. 342,029 now U.S. Pat. No. 3,349,688, Ser. No. 342,459, now U.S. Pat. No. 3,349,686, Ser. No. 350,612, now U.S. Pat. No. 3,349,689, Ser. No. 632,842 and Ser. No. 677,132. The forwarding device may particularly also be integrated with parts of the above said light tight hood, so that the hood may take over the function of support for the base frame etc. as may be desired. Referring to FIG. 1 of the accompanying drawings. Water bath 1100 comprises a receptacle comprising principally sidewalls 1101, end walls 1102, bottom 1103 and vertical divider wall 1104. Divider wall 1104 divides the receptacle into a working compartment, adapted to receive upright treating vessels or tanks, and an auxiliary compartment at the far end, which is usually smaller than the working compartment, and which may serve for the storage of the treated photographic material. The sidewalls 1101 of the working compartment are provided along their upper edges with depressions or cutouts 1105 of equal size and shape and spacing. Three upright treating vessels or tanks 1106 are shown inserted in the working compartment side by side. The vessels 1106 carry the upper and upper outside or end walls clasps 1107, which are adapted to slidably fit into said depressions 1105, with their vertical section extending downwardly along the outside of the sidewalls 1101 of the bath, when the vessels are inserted in the working compartment. The just described arrangement of evenly spaced depressions in the top edges of the sidewalls of the working compartment and the cooperating clasps at the treating vessels assures that the vessels are securely held in place and located in a predetermined relative position in the working compartment. This is, as will be explained hereinafter, of paramount importance for the operation of the fully automatic bath of the present invention.

To the end walls 1102 of the bath are vertically joined servocylinders 1110 with retractorable plungers 1111. The servocylinders have a stroke somewhat larger than the depth of insertion of the carrier means for the photographic sheet, measured from the top edge of the vessel to the bottom edge of said carrier, when it is inserted in the vessel in the deepest position. The servocylinders are connected to hydraulic means (not shown) which provide the hydraulic pressures for all four cylinders, so as to simultaneously and evenly operate all four cylinders at the same time.

The free top ends of the plungers 1111 are joined to the corner sections of rectangular base frame 1112, comprising side members 1114 and end members 1115. Each side member 1114 has in its top portion a groovelike depression
1117. extending nearly over the full length of said side members 1114. In depressions 1117 are slideably mounted horizontal forwarding bars 1118, having a length substantially less than said depressions 1117, so that they are held in said depression and are capable of being horizontally reciprocated in the said depressions by a stroke length corresponding at least to the lengthwise spacing, measured from center to center, of the treating vessels, when they are inserted in the bath. or of the depressions 1105 in the top edge of the sidewalls 1101 of the working compartment, respectively. The ends of forwarding bars 1118 at the left, are joined to cross bar 1119, which rigidly connects the two forwarding bars to form a forwarding unit. Cross bar 1119 is joined to stroke rod 1120 of linear actuator 1122, which is mounted at the left and member 1115 of base frame 1112 by frame extensions 1124. The stroke of linear actuator 1122 equals exactly the spacing of the vessels, measured from center to center.

To the top side of forwarding bars 1118 are mounted prismatic forwarding seats 1026, each seat having at its top a triangular or wedge-shaped indenture, running in a direction perpendicularly to the sidewalls of the bath and essentially parallel to the cross bar 1119. Forwarding seats 1026 are arranged in pairs, one each on each forwarding bar, and evenly spaced on their respective forwarding bars by a distance equaling the measured center to center distance of the treating vessels when they are inserted. Forwarding seats 1126 are furthermore mounted such, that when stroke rod 1120 and thus forwarding bars 1118 are in the fully retracted position i.e. in the starting position as shown, each pair of forwarding seats is located above one of the vessels with the apex of the wedge-shaped indenture located exactly over the centerlines of the corresponding vessels. Thus, the first pair of forwarding seats at the far left is in the retracted position of the forwarding unit located exactly above vessel number one i.e. the vessel to be inserted at the left end of the working compartment (not shown). The second pair of seats is located exactly above vessel number two and so forth. The only exception as to location and spacing is found from this rule in the pair of prisms 1130, mounted at the far ends of the forwarding bars 1118 and coordinated to the last vessel at the far right (not shown). Prism 1130 are mounted on the respective forwarding bars somewhat offset to the left, so that the far vertical side of the prism is located somewhat to the left of the extended vertical center plane of the number twelve vessel. Close to the far ends of the side members 1118 of base frame 1112 are mounted prismatic stops 1131.

The automatic bath illustrated in FIG. 1 comprises furthermore a preferred embodiment of the vertically actuated automatic mechanical agitating means. Sleeves 1140 comprising a longitudinal central bore are vertically joined to the outside of the sidewalls 1101, so that they are located opposite the four corners of the working compartment. Horizontal agitator bars 1142, extending over the whole length of the working compartment, are slideably set in sleeves 1140. To the lower ends of rods 1144 are joined wedgeline shoes 1144a, which rest with their slanted bottom side on the slanted top side of sliding wedges 1145. The angles of slant or of the slope of shoe 1144and of wedge 1145 are essentially identically wedges 1145 are slideably set into guide rails 1146, which in turn are joined to the sidewalls of the bath. The wedges 1145 are slideably held on guide rail 1146 by a reversed T-shaped bottom section, which is slideably set in reverse T-groove 1110. The pair of wedges 1145 located at each of the sidewalls 1101 is connected by rods 1149, so as to form a unit. The wedges 1145 at the left end of the bath are movably interconnected over joint 1150, horizontal lever 1152 and horizontal rod 1154. Horizontal rod 1154 joined to the levers 1152 on both sides of the bath are connected to a reciprocating power source (not shown) and coordinated in housing 1156, so that the give levers 1152 and wedges 1145 a reciprocating motion when the power source is actuated. The wedge arrangements on both sides of the bath are enclosed in housings 1158.

Agitator bars 1142 are provided at their top sides with wedgeline, triangular indentures 1160, which are arranged in pairs, one each on each bar 1142 and which correspond in number and spacing exactly to those of the vessels, when they are inserted in the bath, such that the apex of each pair of coordinated triangular indentures 1160 is located exactly in the vertical center plane of each of the vessels, when they are inserted in the bath.

On the number seven pair of forwarding seats 1126 is shown suspended a carrier 1161 with a photographic sheet 1162 contained thereon. The carrier 1161 comprises backrest 1163 and channel members 1164 on both vertical edges and at the bottom edge of backrest 1163, forming grooves in which the corresponding edges of sheet 1162 are supported. The carrier 1161 comprises furthermore triangular barlike agitating support 1166 and forwarding support 1167, which are joined to the backrest over vertical rods 1169. The spacing of the agitating and forwarding supports from each other is such, that the vertical distance between the lower edges of the forwarding and agitating bars is essentially larger than the distance between the apex of the indentures 1160 in the agitator bars 1142, when they are in their lowermost position, and the apex of seats 1126 on forwarding bars 1118, when the base frame 1114 is lowered to its lowest resting position. By this arrangement the forwarding support 1167 is free from forwarding seats 1126 when agitating support 1166 rests on the agitator bar 1142 as the result of the lowering of base frame 1114 to its lowest rest position, permitting the free horizontal movement of the forwarding bar 1118, regardless of the position of the agitator bars 1142.

For the operation of the automatic forwarding means, the electrical control of the central source of hydraulic pressure is conductively connected, advantageously over a relay, to the electric circuit of a program timer, adapted to control the process to be carried out in the bath. A suitable program timer has been described and claimed in my copending application Ser. No. 302,902, filed Aug. 19, 1963, now U.S. Pat. No. 3,349,685. The electrical control of the linear actuator is connected to a delayed time switch (not shown) which is actuated when the base frame arrangement with the carrier suspended thereon has reached its highest position and which energizes the linear actuator after a predetermined time period, the delay being that desired for the drainage of the carried and photographic material. To start the operation the carriers and the sets into the bath the vessels containing the treating liquids required for the process to be carried out, arranged in the order as they are required by the sequence of the multistep process to be carried out. He then sets the forwarding means in the starting position i.e. with base frame 1114 in the fully raised position. The carrier 1161, loaded with the photographic material, is then suspended by forwarding support 1167 on the number one pair of forwarding seats 1126 at the left and directly above the number one vessel (not shown). With the agitator mechanism running the time is thereafter started to initiate the treatment of the first step by lowering of the base frame 1114 to its low position, resting the frame 1114 on the top edges of the serve cylinders 1110. This results in submersion of the photographic material contained on the carrier in the treating medium contained in the number one vessel. As the carrier is lowered, it comes to rest on the vertically reciprocating agitator bars 1142, by agitating support 1166, the apex of which slides into triangular indentures 1160, assuring that the carrier is during reciprocation kept from contacting the walls of the vessel and free structure offcenter, as the treatment and mechanical agitation proceeds.

When the photographic material has been treated in the number one vessel for the predetermined length of time, the program timer actuates the relay, which in turn energizes the source of hydraulic pressure. This results in raising of the base frame 1114 to its elevated position with the carrier and sheet suspended thereon. When the frame 1114 reaches its highest position the coordinated time switch, after the preset time delay (e.g. 20 seconds in some processes for drainage).
energizes the linear actuator which in turn pushes the forwarding bars 1118 toward the right by a stroke length, which equals the distance of the vessels from center to center. This results in the shifting of the carrier to the right, so that it is now suspended over the next vessel. The next pulse in the program timer or, if desired, another time delay switch (not shown) actuates the relay which deenergizes the source of hydraulic pressure, resulting in the lowering of the frame structure, with the photographic material contained on the carrier, being inserted in the treating medium contained in the next vessel for the treatment in the second step. When the carrier has been inserted into the base frame 1112 has been lowered to its fully retracted position, the switch controlling the linear actuator is energized to start the retraction of the stroke rod of the actuator and of forwarding bars 1118 connected thereto into their starting position. When the sheet has been treated in the next vessel for the predetermined time, the program timer starts the next cycle, as described hereinbefore, raising, forwarding and inserting the photographic material in the treating medium contained in the next vessel and so forth, until the sheet has passed through all the steps at exactly the predetermined time schedule, including also the desired or required drainage times.

When the carrier has been immersed and treated in the last (the number 12) vessel, and the base frame has been raised to its elevated position, the stroke of the forwarding bars 1118 pushes the carrier by prism 1130 toward the end of the base frame. The operator may now start the treatment of a new batch of material without removing the carrier from the base frame or he may first remove the carrier. Upon each lowering of the base frame, the carrier contained on the storage portion of the base frame will be lowered into the auxiliary compartment, which may be filled with water or other liquid medium for subsequent washing or other after-treatment of the photographic material, if desired. Also, if liquid is filled into the auxiliary compartment, so as to permit complete drainage and predrying of the treated photographic material, while the treatment of the next batch proceeds.

The above mentioned delay and drainage time may be provided either by a delay in the actuation of the forwarding switch or it may be controlled by a separate pulse given by the program timer. Many modifications may be made in the automatic forwarding means as may be desired. The forwarding bars 1118 may, for instance, be provided with grooves or indentures instead of the forwarding seats 1126, so that the forwarding support 1167 of the carrier is held in the grooves or indentures during the forwarding cycle in a manner as shown in the agitator bars. Mechanical lifting means may be substituted for the hydraulic servomotors and other suitable device may be substituted for the linear actuator to produce the stroke of the forwarding bar arrangement.

If the fully automatic bath is to be used with the raised wall vessels i.e. vessels, in which the downstream major side wall is raised to a level higher than the upstream wall, such as in the upright raised wall vessels described in my application Ser. No. 342,198, now U.S. Pat. No. 3,362,315, a further function of the controls is advantageously introduced. In this modification of the fully automatic treating process and apparatus the stroke of the servocylinders is made large enough to raise the bottom edge of the carrier above the level of the upper raised edge of the downstream major side wall of the vessel. When the base frame has been raised to this high position, the lower edge of the carrier clears the top edge of the downstream major side wall, when it is forwarded downstream toward the next vessel.

At a position of the moving forwarding bars, at which the carrier has passed by the downstream major side wall, but before the forwarding bars have reached their fully advanced position, the servocylinders are lowered to an intermediate position, which is somewhat lower than the fully raised position, but high enough to clear the bottom edge of the carrier over the upper edge of the upstream major sidewall of the vessel. In this manner, when the carrier is forwarded to its fully advanced position over the next vessel, it passes freely over the lower upstream major sidewall, but is prevented from overshooting the raised downstream sidewall of the vessel. This assures that the carrier is safely inserted in the vessel, eliminating the risk of spilling or overshooting. As is readily apparent, this modification of the fully automatic process and apparatus is used with particular benefit, where the very thin upright treating and washing vessels are used, particularly also with the vessels, having a troughlike reservoir superimposed on an extremely narrow upright vessel.

A particular advantage of the agitator means of this embodiment of the bath is to be seen in the fact, that the agitator bars 1142 reciprocate in a true vertical direction. There is thus no horizontal vector in the movement, obviating the use of rollers or other means on the agitating support of the carrier and avoiding friction of the carrier against the walls of the vessel. This makes the vertical agitating means particularly useful also with the semiautomatic mechanical agitation, if no automatic forwarding of the carriers and of the photographic material is desired.

The agitating means may be modified in many ways as will come readily to mind. Instead of using the reciprocating wedge arrangement described hereinabove as the means of the vertical reciprocation of the agitator bars, one may substitute any other desired means capable of producing the vertical reciprocation such as rotating eccentric rollers, vertically reciprocating actuators and so forth. Instead of providing wedge-shaped indentures in the agitator bars as the means for the localization of the carrier, one may employ with equal benefit notched seats, as shown in the forwarding bars in FIG. 1 of the drawings or pairs of vertical pins and the like, arranged in pairs at the top edge of the agitator bars, so as to form a barrier on both sides of that section of the agitating support, which rests on the agitator bars. The carrier may also be suspended on the agitator bars, by the use of hooks on the carrier and/or the agitator bars.

Instead of the two agitator bars, one on each side of the bath, one may employ a single agitator bar, preferably centrally located along the length axis of the bath.

For cylindrically convoluted bands of film or paper, contained e.g. on the conventional film or paper reels, the mechanical agitation may be a vertical reciprocatory agitation or a rotational agitation, e.g. as described in my U.S. Pat. No. 3,124,051, or a combination of both vertical linear and of rotational reciprocatory agitation, unless means are provided for automatic gas burst agitation or any other kind of non-mechanical agitation.

Another embodiment of the vertical mechanical agitation is illustrated in FIG. 2 of the accompanying drawings. Rectangular bath 910 comprises sides walls 911, end walls 912 and bottom 913. The bath is subdivided into square working compartments 915, adapted to receive square or cylindrical upright vessels and rectangular adjutant compartments 916 arranged in two parallel rows, each row having three working compartments and with the working compartments in the two rows offset to each other by one half of the lengths of the sides of the compartments. Under each working compartment is provided a cell 917, which is communicatively connected with one of vertical conduits 919, which are located between the compartments. Each conduit 919 extends over one half of the length of the sides of the compartments and is closed off from the neighboring conduit by vertical conduit separatory wall 910. Each conduit 919 is communicatively connected to one of the compartments by an overflow passage 921. The adjutant compartment 916 in the left front is connected to the number one conduit at the left, which leads to the cell underlying the first working compartment, which in turn connects through overflow slot 921a to the next conduit and into the cell underlying the working compartment and so forth, with the last working compartment 915a at the right rear, connecting through overflow slot 921 to the conduit at the far right which leads to the adjutant compartment 916a at the far right.
Each cell 917 is communicatively connected to the compartment located directly above it by rectangular opening 922, provided in the bottom of the compartment. The upright treating and/or wash vessels, which are advantageously used with this embodiment of the bath may have generally the construction as shown in the vessels in FIGS. 56 to 59, of French Pat. No. 1,402,766 having however, sealing means which are in the form of a rectangle or, square, as so to fit in sealing relationship into rectangular counter sealing means 923 provided all around the vertical walls of the vessels.

Alternatively, the compartments may also be provided with flat ringlike counter sealing means which cooperate with corresponding ringlike sealing means in the vessel or with the bottom sections of the vessel or vice versa.

To the corners of the bath, at side walls 911 are mounted vertical sleeves 924 with vertical shafts 925 slidably inserted through the bores of said sleeves. To the top ends of shafts 924 is mounted agitating frame 926 comprised of three parallel agitator bars 927 and 928, extending parallel to the side walls of the bath. Bars 928 are located on each side of the bath and the central bar 927 is located a short distance above the row of conduits 919. The agitator bars 927 and 928 are connected to each other by end bars 929, to complete the agitator frame 926. The bottom ends of shafts 925 are joined to horizontal rocker bars 930, one each on side each of the bath. The rocker bars 930 are vertically actuated by cranks with rollers at their free ends (not shown). The cranks are set in a crank shaft running at the rear end wall 912, which in turn is reciprocated by a suitable power source (not shown).

Passing of a continuously flowing stream of liquid medium into adjacent cell 916 at the left will produce a stream of the liquid medium in the bath, which has an essentially vertical flow pattern, regardless of whether or not treating or wash vessels are inserted in the individual working compartments 915.

Regarding the order and number of wash and/or treating vessels inserted, the flowing stream of liquid medium will serve alternatingly as the temperature conditioning and/or washing medium as it may be required.

Actuation of said crank shaft by the power source produces a vertical, reciprocating motion of the agitator frame. When a carrier, holding the photographic material, is hung onto the agitator frame by its agitating supports, e.g. of the kind shown and explained hereinbefore, such that it engages in a pair of opposite grooves 938 provided in the agitator bars, the photographic material is agitated in the vessel coordinated to said pair of grooves 938. Each pair of grooves 938 is arranged above the center line of a compartment, so that the carrier with the sheet hangs coaxially in the vessel contained in said compartment. The stroke and timing of the movement may be readily adjusted to that required for the particular photographic material being treated.

The agitator means described hereinbefore may also be employed with any other type of bath, particularly also with the embodiments having the cylindrical compartments and with the circular embodiments of the bath, if the design and dimensions are suitably adapted to the particular requirements.

The automatic forwarding means may also be further modified so as to be suitable for use in the double row compartmented bath and for forwarding the photographic material in this type of bath from vessel to vessel in a zigzag pattern.

An embodiment of the modified forwarding means is depicted in FIG. 2 of the accompanying drawings. The forwarding means comprise rectangular base frame 950, made up of side members 951 and 952 and end members 953, and transversely slidably set thereon rectangular half frame 954, which is made up of longitudinal members 956 and 957 and end members 958. Half frame 954 is slidably set in grooves provided in end members 960 of the base frame 950 with the end members of both frames coinciding in such manner, that half frame 954 may slide to either side of base frame 950. The edges of base frame 950 are mounted on the top ends of piston rods 961, which are part of a hydraulic piston assembly 962, which is in turn actuated by a source of hydraulic pressure (not shown). The automatic forwarding means are preferably mounted to the two-row bath in a manner as shown hereinbefore, such that the side members of frame 950 are essentially parallel to the vertical side walls of the bath.

In each of the longitudinal members 956 of half frame 954 are provided longitudinal grooves 964 in which are slideably supported bars 966. The pair of forwarding bars 966 is joined at the left ends by cross bar 967. At the left end member 958a of frame 954 is mounted linear actuator 968 with its stroke rod joined to the center of cross bar 967. In the top sides of each of forwarding bars 966 are provided notches 969, arranged in pairs, one each on each of the bars. The notches 969 contained on each of the forwarding bars are spaced from each other in such manner, that the distance between the center in each notch to the center of the next notch is exactly one half the distance between the centers of the vessels contained in one and the same row of the bath. The frame and pins are furthermore arranged such that the centers of the first pair of notches at the left fall exactly into the vertical plane which is parallel to the end walls of the bath and which falls on the axis of the first vessel contained in the first working compartment at the left end of frame 954. After insertion, when the frame is in the position as shown in FIG. 2 and when the forwarding bars are fully retracted as shown. The stroke of the linear actuator is exactly one half of the distance between the centers of the vessels, contained in one row and equal to the spacing of the grooves on one and the same forwarding bar, center to center.

To the side member 951 of frame 950 is mounted linear actuator 970 with shaft 971 mounted such, that it may be linearly reciprocated by the actuator by a distance approximating one half of the width of frame 950. This may be achieved by the use of a stroke rod in the linear actuator which penetrates also on the backside of the actuator and which is positively driven in either direction by suitable driving means.

For the operation of the automatic forwarding device the frame 950 is raised to its highest position, frame 954 moved to the position shown in FIG. 2 (provided that the first working compartment of the bath with a vessel inserted therein is located in the left front corner of the bath, as shown) and forwarding bars 961 are retracted all the way to their starting position toward the left end member 958 of frame 954. After inserting the forwarding support of the carrier containing the photographic material to be treated in the pair of number one notches 969 at the far left, the device controlling the operation and timing of the process is started. At the zero time, it deactivates the piston assembly, so that frame 950 with the carrier suspended in the bath is lowered, resulting in the insertion of the carrier in the number one vessel. When the photographic material has been treated therein for the predetermined length of time, the timing device activates the source of hydraulic pressure, resulting in the raising of frame 950 and the lifting of the photographic material from the number one vessel. When the frame 950 has reached its highest position, linear actuator 970 is activated, pulling frame 954 to the left. Linear actuator 968 is thereafter activated, as so to push forwarding bars 966 to their forward position. Thereafter, the source of hydraulic pressure is deactivated, resulting in the lowering of frame 950 and the insertion of the carrier with the photographic material into the vessel number two contained in the working compartment 915. Thereafter, linear actuator 968 is deactivated, resulting in the retraction of forwarding bars 961 to the starting position.

When the material has been treated in the number two vessel for the predetermined length of time, frame 950 is raised to its highest position, thereafter frame 954 is pushed to its right position and forwarding bars 966 are pushed to their forward position. The carrier with the photographic material, which is now suspended by its forwarding supports in the number two grooves, is thus moved to a position exactly above the number three vessel, into which it is inserted, when frame 950 is lowered. After completion of the treatment it is lifted
and forwarded to the next vessel and so forth, until it has been inserted in the last vessel. After it has been lifted from the last vessel, it is removed by the operator for drying or other treatment.

If the said forwarding means are to be used in a circular bath or water jacket, in which the treating and, if desired, the washing vessels are arranged in a circle, such that they follow each other in the order in which they are needed for the carrying out of the process, the forwarding frame and the forwarding bars are designed so as to form two concentric cycles or circles, spaced from each other by a distance sufficient to permit the insertion of the carrier in the forwarding frame. It may also be desirable to provide reciprocating means, which provide for or equalize automatically the difference in the stroke at the larger outer and at the smaller inner frame member, so that the forwarding support of the carrier remains radially disposed towards the center of the bath. The need for equalizing means may be readily overcome by the use of a single circular forwarding bar, running preferably over the centers of the circularly disposed vessels. This embodiment of the forwarding means is best used with a carrier, which has a specially adapted one-point forwarding support, for instance, of a kind as it is described and claimed in my copending application Ser. No. 342,028, now abandoned.

A suitable circular bath is described and illustrated e.g. in FIG. 3 of U.S. Patent No. 3,124,051. The forwarding means for such circular bath may also be modified so as to utilize the central washing station as the only washing station, whereby the material is moved in a zigzag fashion from the outer circle of vessels containing the treating solutions to the central washing station and back to the outer treating vessels and so forth. The thus modified forwarding means may comprise a circular base frame, which is rotated from station to station by an angle, corresponding exactly to the angle between centers of neighboring treating vessels contained in the outer circle. This progressive rotation of the base frame by a predetermined increment, in the raised position, brings about forwarding of the carrier with the photographic material therein from one chemical station to the next, as is required in some color developing processes in some steps. For the forwarding into the central washing station, an auxiliary forwarding bar means, is provided, which transports, upon actuation in the raised position of the base frame, the material radially inwardly, so that it is situated exactly over the central washing station. For transport into the next chemical treating vessel in the outer circle, the auxiliary forwarding bar means is retarded very gradually and the toothed wheel stepping step as before, all motions of course being carried out when the base frame is in its elevated, raised position. In this manner, very compact, fully automatic developing apparatus is provided, which is simple in construction and which is excellently suited for the development of reels of film. Of course, the chemical treating tanks and the washing location have preferably an upper widened, flaring opening for guiding the carrier into the tank or vessel, as is described e.g. in my copending application Ser. No. 342,459 and in my application Ser. No. 677,130.

For the operation of the automatic apparatus of the invention, it is of course desired, that the washing and chemical treating stations are provided in the order as these steps occur in the photographic wet treating process to be practiced (exception is the just described circular automatic developing apparatus). This can be achieved by using stationary washing baths, or, since this is generally not desirable, by the use of my new compartmented water jacket as is taught e.g. in my U.S. Pat. No. 3,236,649 or in my copending application Ser. No. 350,612, now U.S. Pat. No. 3,349,689, Ser. No. 632,842, now U.S. Pat. No. 3,470,810, or Ser. No. 677,132 or Ser. No. 677,131 in which a stream of water flows in an essentially vertical sinusoidal flow path through the water jacket and around the treating vessels and through he washing stations, to serve alternatingly as washing and as temperature conditioning medium, as may be required. The washing stations may also be provided as washing tanks, having separate water inlets, which may be opened and closed, as needed, by electromagnetic valves or the like, provided in the inlet line and controlled by the timing mechanism used for the control of the forwarding mechanism. Suitable timing mechanism is disclosed e.g. in my copending patent applications Ser. No. 302,902, now U.S. Pat. No. 3,349,685, Ser. No. 621,382 and Ser. No. 677,265.

This expedient is of course not needed in the circular bath, having a central washing location, where the water may be flowing continuously during the whole duration of the process schedule.

It has been mentioned hereinafter, that the lifting means for the base frame may be any other mechanical or electromechanical device, known per se. The base frame may be set, for instance, in guide rails and lifted by belts, tapes or cables like the like, driven over suitable pulleys means or the like rotated by a suitable servo motor or the like to produce positive raising and lowering of the base frame. Alternatively, suitably arranged levers, friction gears or geared racks or the like may be substituted as the lifting means. The actuation of these mechanical lifting means may be simply mechanical, e.g. by the use of clutches or the like, which may be activated or brought into driving position e.g. by electromechanical means controlled by electrical impulses provided by the timing mechanism or it may be electrical, e.g. by energizing over a switch the servo motor to run in one or another direction as may be needed for lifting or lowering the base frame.

The forwarding means for the forwarding bars may be activated or driven in similar fashion as described hereinafter, e.g. by mechanical levers, gears, friction wheels and the like, activated mechanically by clutches or the like or electromagnetically or electrically as may be convenient for the particular arrangement.

Preferably, in the case of the mechanical arrangement, a single motor may serve for the energization of the lifting means, forwarding means for the bar members and for the mechanical agitation means, if such are provided. Their activation and the rhythm of their movement may be controlled in known manner by establishing mechanical connections to main driving means using the expeditents described hereinafter. This includes particularly also means, which bring about variable agitation speed at the various stages of the process schedule, to match the requirements of any particular process, using the timing mechanism as the source of the needed impulses. Of course agitation and forwarding means may also be operated by hydraulic means known per se.

If the agitation of the workpiece is performed by gas burst valves, it is possible to simplify the equipment, by building the orifices for the gas outlet into the bottom part of the carrier for the photographic material with a tube connection for the gas at the top. In this manner a single gas burst control means takes care of the agitation in all steps.

As many apparently widely differing embodiments of this invention may be made without departing from the spirit or scope thereof, it is understood, that the invention is not limited to specific embodiments thereof, except as defined in the appended claims.

I claim:

1. Device for the forwarding of photographic material in batchwise operation, while it is supported in suspended carrier means having forwarding support means, from one treating station to the next in photographic wet treating equipment, wherein the centers of the treating stations are essentially uniformly spaced by a distance A measured in the direction of forwarding of the photographic material, which device comprises generally horizontally an operator...
least one row; forwarding seat means provided on said forwarding bar means for temporary support of said forwarding support means of said carrier means and for reception of said forwarding support means from above the said seat means, said forwarding seat means being spaced, in the direction of forwarding of the photographic material, by said distance A; means for supporting the said carrier means, when the said base frame means is in the low position, in a position such that the said forwarding support means are out of contact with said forwarding seat means; and means for essentially horizontal lateral displacement of said forwarding bar means, from a retracted starting position, in the direction of forwarding of the photographic material and by said distance A, when said base frame means is in said high position and for retraction of said forwarding bar means to the said starting position, when said base frame means is in a low position.

2. The device of claim 1, in which the said base frame means is supported on the essentially vertical stroke rods of hydraulic linear actuator means, which serve as the means for raising and lowering the base frame means.

3. The device of claim 1, in which the means for laterally displacing and retracting the said forwarding bar means is a linear actuator.

4. The device of claim 1, in which said forwarding seat means comprises a triangular, wedge shaped indentation, and in which those parts of the forwarding support means of the carrier, contacting said forwarding seat means, have a triangular cross section for insertion in said indentation.

5. The device of claim 1, in combination with a timing mechanism, which controls by electrical impulses the actuation of the lifting means for the base frame and the means for laterally displacing and retracting said forwarding bar means in such manner, that the photographic material is lowered into the treating station, retained therein for the required time for treatment, raised therefrom, held for drainage, moved over to the next treating station, lowered into this treating station, held therein for the required time for treatment and so forth, until the photographic material has passed through all the treating stations.

6. The device of claim 5, in combination with mechanical agitation means.

7. The device of claim 1, in combination with photographic processing apparatus, in which tanks are disposed in compartments of a compartmented water jacket, which water jacket comprises in addition means for the passage of a stream of water in a sinusoidal path successively around said treating tanks, a circular water jacket comprising a central washing station.

8. The device of claim 7, in which washing stations of flowing water are interspersed between treating tanks in compartments of said compartmented water jackets.

9. The device of claim 8, in which the flowing water in said washing stations is provided by said stream of water passing in a direction countercurrently to the direction of forwarding of said photographic material.

10. The device of claim 1, in which the treating stations are arranged in a circular manner, and in which the said base frame means and forwarding bar means have an at least partial circular configuration.

11. The device of claim 1, in combination with separate mechanical agitation means for vertical reciprocation of the suspended carrier means and photographic material relative to the treating media contained in said treating stations.

12. Device for the forwarding of photographic material, in batchwise operation, from one treating station to the next in photographic wet treating equipment, which device comprises generally horizontally extended base frame means; lifting means adapted to raise the base frame means from a low position to a high position and lower it back to the low position; forwarding bar means slideably supported on said base frame means for essentially horizontal reciprocation; means for essentially horizontally reciprocating said forwarding bar means by a predetermined distance, when said base frame means are in a high position; and means for reciprocating said forwarding bar means also in a direction perpendicular to the direction of said first reciprocation.

13. The device of claim 12, which comprises at least two rows of laterally spaced treating stations, in which the said reciprocation of the forwarding bar means in a direction perpendicular to the direction of said first reciprocation is by a stroke, which approximately equals the lateral spacing of the centers of the treating stations.