

Oct. 31, 1967

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PHOTOGRAPHIC TREATING APPARATUS

3,349,686

Filed Feb. 4, 1964

2 Sheets-Sheet 1

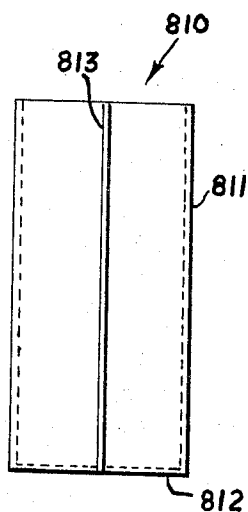


FIG. 2

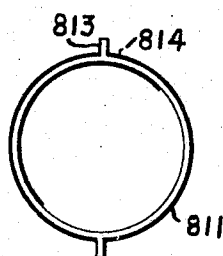


FIG. 1

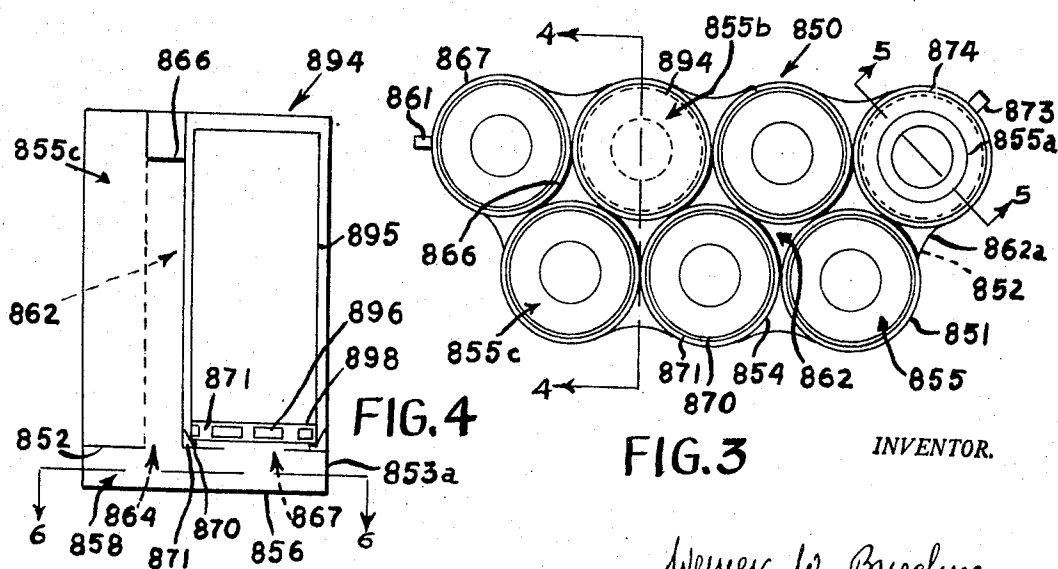


FIG. 4

FIG. 3

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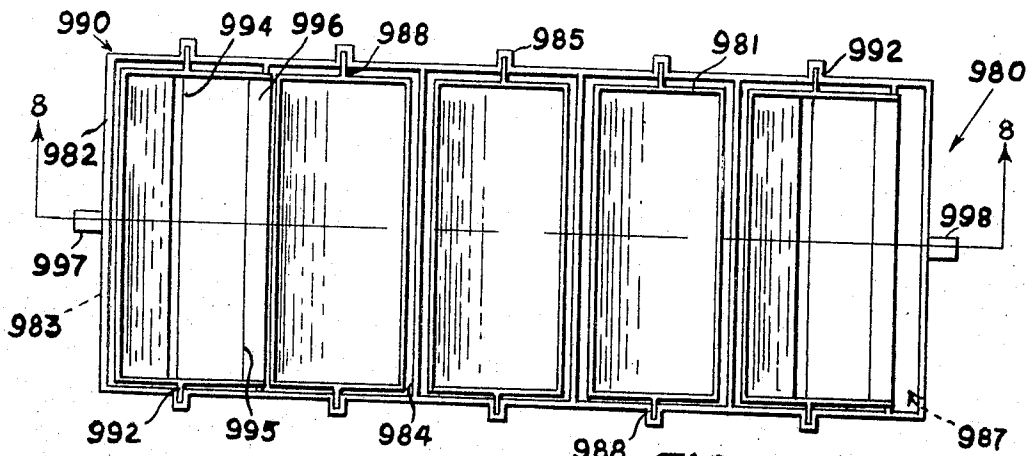
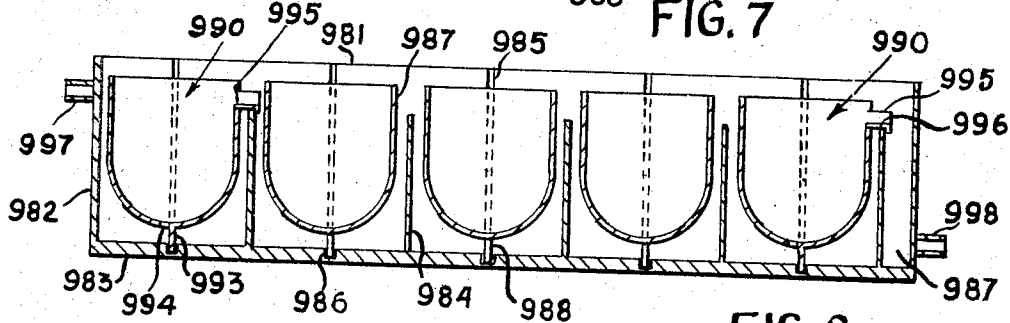
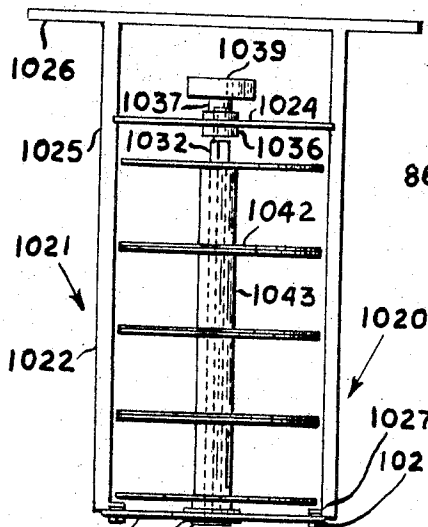
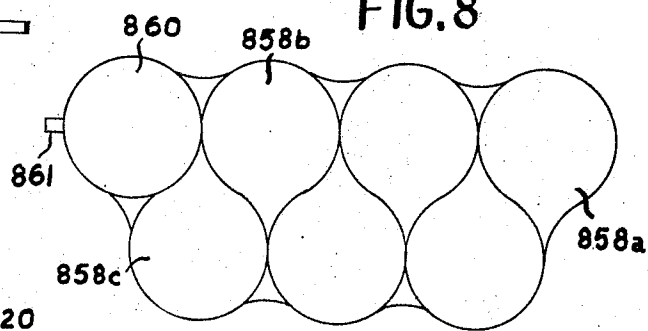
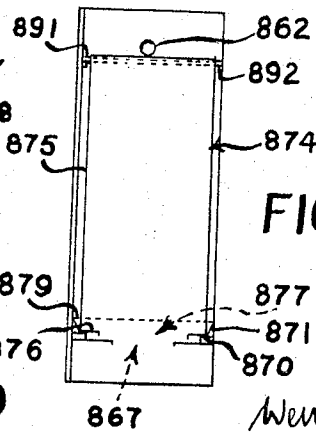
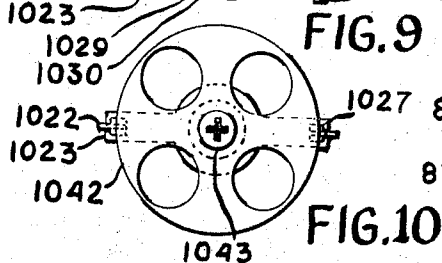
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PHOTOGRAPHIC TREATING APPARATUS

Filed Feb. 4, 1964

2 Sheets-Sheet 2



INVENTOR.

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This application is a continuation-in-part of my copending applications Ser. No. 23,313, filed Apr. 19, 1960, entitled, Photographic Process and Apparatus, now Patent No. 3,124,051 and Ser. No. 52,524, filed Aug. 29, 1960, entitled, Photographic Process and Apparatus, now Patent No. 3,236,649.

This invention relates to apparatus for the treatment and processing of photographic materials. Particularly, the invention is concerned with an improved apparatus for the processing of multilayer color materials, permitting the obtention of consistent reproducible results in inexpensive simple equipment.

Patent 3,236,649 discloses and claims process and apparatus for the batch-wise photographic multistep treatment of plane photographic materials, which employ a unique vertical up and down flow pattern of a temperature conditioning medium, which may also be used as a washing medium in intermediary and/or final washing steps as they occur particularly in present day color developing processes.

Not all photographic materials are conveniently treated or developed while in a plane configuration. This applies particularly to lengths of roll films and the like and movie films, which are conveniently convoluted into various spiral forms in order to avoid excessive dimensioning of the equipment used in the development. It is often preferred to develop the strips of film in form of concentric spiral reels or in form of a cylindrical spirally wound layer on a suitable supporting surface. There is therefore a need for an apparatus which permits the chemical treatment of not only cylindrical sheets but also of reels of film or of movie film which is wound in a cylindrical or concentrically spiral configuration, which apparatus provides still the benefits of the temperature control and the provision of a stream of flowing washing water in each washing step.

It is therefore an object of the present invention to provide an apparatus which is particularly adapted for the treatment of concentrically or cylindrically spirally wound lengths of films and especially of color films. Other objects will become apparent as the description of the invention proceeds.

The objects of the invention are achieved by the provision of an apparatus which comprises a bath and contained in said bath at least one cylindrical photographic treating vessel and at least one cylindrical wash vessel, which wash vessel is inserted in the bath in sealing relationship such that a unidirectional stream of a washing medium, fed to the bath, passes in generally vertical flow direction through said wash vessel. Another, more preferred embodiment of the apparatus of the invention comprises principally a compartmented bath and contained in compartments of said bath a multiplicity of cylindrical photographic treating vessels such that a unidirectional stream of a liquid medium, passing through the compartments of said bath containing the said vessels, flows by the said treating vessels following an essentially vertical flow pattern.

In other words, the apparatus of the present invention comprises cylindrical treating vessels and wash vessels, which are arranged in a compartmented bath in such manner, that a temperature conditioning medium, such as water, passes by the treating vessels and through the wash vessels in an essentially vertical flow direction.

The preferred apparatus of the invention comprises

principally a compartment bath, removably contained in compartments of said bath a multiplicity of photographic cylindrical treating vessels and washing vessels, said washing vessels having openings therein and said treating vessels having no openings, said compartments having means forming openings therein, so that a unidirectional stream of a liquid medium passing through the compartments of the bath will follow an essentially vertical flow pattern, passing around the treating and through the wash vessels, each of said cylindrical treating vessels and of said wash vessels having sealing means cooperative with counter sealing means contained in the compartments of the bath so as to establish essentially liquid tight seals between the vessels and the compartments to help define liquid medium passageways.

For the treatment of cylindrical sheet and film materials it is preferred that the said bath, treating vessels, wash vessels and, if applicable said compartments, making up the apparatus of the invention have a generally rectangular or circular horizontal cross section or configuration, respectively, and that the dimensions of said components and parts of the apparatus are such that the said cylindrical photographic materials may be inserted in the apparatus in a generally vertical orientation, with all parts of the photographic material submerged in the treating media while they are treated therein. In the process and apparatus for the treatment of the cylindrical sheet materials the layer of treating medium is preferably in the form of a narrow annulus, and most advantageously of a full annulus, standing on one of its circular ends with the length axis in vertical orientation.

The bath of the apparatus is advantageously provided with means adapted to flow a unidirectional stream of a liquid medium, preferably of water, from one end to the other end of the said bath. Suitably, an inlet is provided at one end and an outlet at the other end. Said inlet and outlet may also be provided in other suitable locations at or in the bath. The rectangular or circular compartments are beneficially arranged in the bath in at least one row. If they are in more than one row the rows of compartments are with advantage off-set from each other, preferably by one-half the width or diameter of the compartment so as to form a zig-zag pattern in which the photographic material may be forwarded from step to step by alternating it between the rows. The components separating and forming the compartments may be removably or, more preferably, fixedly contained in the bath.

Suitable means, delivering the temperature conditioning medium are disclosed in my Patent 3,124,051 and disclosed and claimed in my copending patent application Ser. No. 342,197, filed Feb. 3, 1964.

The treating vessels may be full cylinders, lying half cylinders with or without a vertical extension of the cylindrical half walls, or they may be upright annular vessels having an annular configuration with the length axis in vertical orientation.

The establishment of an essentially vertical flow pattern in the compartments of the bath is assisted and furthered by the provision or use of means which are adapted to provide essentially liquid tight seal between the treating vessels and the juxtaposed parts of the compartment wherein they are contained. In the case of the treating vessels this is conveniently achieved by the provision of vertical sealing means at the vessels or of counter sealing means at the side walls of said compartments, and, if desired cooperating vertical sealing means are provided both at the vessels and at the side walls of the compartments of said bath.

In the most preferred embodiments of the apparatus of the invention, the sealing means are provided in the lower portion of the treating vessels, most advantageous-

ly at the bottom or at the cylindrical side wall or at an extension thereof close to the bottom end of the vessel, in such manner that they engage with the bottom of the compartment or suitable counter sealing means provided in or at the bottom of the compartment so as to establish the desired essentially liquid tight seal when the vessel is inserted in the compartment. Alternatively, suitable counter sealing means are provided solely in or at the bottom in such fashion that they engage in sealing relationship with the bottom and/or the lower side wall or its extension of the vessel when it is inserted therein. The bottom type sealing and counter sealing means are also called herein horizontal sealing means and horizontal counter sealing means, respectively. The vessels employing the horizontal type of seal are most advantageously used in a compartment in which at least one passageway for the streaming liquid medium is provided in the bottom of the compartment, preferably in such position that it is located underneath the bottom of the vessel or its extensions when the vessel is inserted in the compartment. In this embodiment of the apparatus the treating vessel is provided, if necessary, with at least one lower passageway which permits a stream of liquid medium to pass by the inserted treating vessel and through said lower passageway in the bottom of the compartment, such that the liquid medium attains an essentially vertical flow pattern in the compartment.

In the case of the wash vessels, horizontal sealing means are preferably provided in addition to the vertical sealing means at the wash vessels or in the compartments and most advantageously cooperating horizontal sealing means are provided both at the wash vessel and in the compartment of the bath in addition to the said vertical sealing means. The sealing and the counter sealing means may have any other desired form and location, as may be desirable and necessary to establish in a compartment or bath and with the vessels of a given construction the essentially liquid tight seal.

The wash vessels are provided with at least one lower passageway such that a streaming washing medium may pass into the vessel and through the vessel in an essentially vertical flow pattern. The said passageway is advantageously provided in the bottom portion or, if desired in the lower portion of the cylindrical side wall in a full or partial circular arrangement.

For most efficient operation and highest convenience it is preferred to employ the apparatus of the invention in which the photographic vessels are upright cylindrical treating and/or wash vessels. For the treatment of only one sheet of the cylindrical photographic material at a time the apparatus comprising the upright cylindrical vessels forming with the carrier means a narrow annulus and which preferably have a trough-like reservoir at their top ends provides the highest economy in the operation of the process.

Additional benefits are achieved in the operation and use of the apparatus of the invention, if disposable treating vessels are used, if desired, in combination with supporting vessels adapted to accommodate and hold the disposable vessels in the compartments of said bath. The supporting vessels and/or the disposable vessels comprise preferably means adapted to provide essentially liquid tight seal, as described hereinbefore. The embodiment of the apparatus of the invention comprising thin layers of treating media having a thickness of less than one inch and preferably less than one-half of an inch, in vessels which are advantageously provided with a superimposed trough-like reservoir, are generally preferred for use by the amateur photographer.

The photographic material to be processed in the apparatus of the invention is generally vertically orientated. As an assist in the insertion, agitation and removal of the plane photographic material the apparatus comprises advantageously at least one cylindrical carrier which is adapted to support the cylindrical photographic material

and to maintain the cylindrical configuration during the treatment. The carrier used in combination in the apparatus of the invention may be adapted to hold at least one band or strip of photographic film in at least one cylindrical plane.

The preferred carrier of the apparatus of the invention comprises in addition guide means adapted to prevent contact of the photographic material with the other components of the apparatus during insertion, treatment and removal and to facilitate mechanical agitation of the photographic material in the treating medium during the treatment. The semi-automatic or fully automatic embodiment of the apparatus of the invention comprises with advantage in combination at least one carrier comprising an agitating and/or forwarding support. The apparatus of the invention comprising the trapezoidal type of compartmented bath in combination with the trapezoidal type of wash and/or treating vessels is generally preferred.

In the most preferred embodiment of the process the development and other chemical treatment of the concentrically spirally wound film material is carried out in a full cylindrical layer of treating liquid which is usually and beneficially employed in the vertical orientation.

The vessels containing the treating and/or washing media may be arranged in one straight row, as is preferred in the horizontal embodiment of the process or they may be arranged in two parallel rows, with the layers of treating media and/or washing media off-set so as to form a zig-zag pattern in which the photographic material may be forwarded. The layers of treating media and/or washing media may also be arranged in a circular pattern. An arrangement in which a central layer of vertically flowing washing medium is surrounded by the layers of treating media was found to be particularly advantageous. The double row and particularly the zig-zag arrangement as well as the circular arrangement of the treating and/or washing media is preferably employed with the vertically oriented layers and may be used for the treatment of sheet or spirally wound film material with equal benefit.

The apparatus of the invention comprises advantageously also means for automatic agitation of the photographic material relative to the treating media and/or washing media as the treatment proceeds. The agitation may be brought about by moving the treating or washing media relative to the stationary photographic materials relative to the stationary treating media or flowing washing medium respectively or by moving both the treating media and the photographic material relative to each other.

Generally preferred is a mechanical actuation of the photographic material relative to the layers of treating and washing media. Rotation of the cylindrical photographic material, unidirectionally or more and continuously or intermittently advantageously intermittently and reciprocatingly may be used, depending on the circumstances both in the process for the treatment of sheet material and bands of film material. The photographic material may, however, also be vertically reciprocated. It was found that the vertical reciprocation of the spirally wound film materials permits the obtention of excellent results, particularly also if the vertical reciprocation is combined with an intermittent rotational motion.

Further embodiments and modifications of the apparatus of the invention will become apparent in the following detailed description and drawings. The accompanying drawings show various modifications of the apparatus of the invention and extensions thereof without being restricted thereto.

FIG. 1 is a top plan view and FIG. 2 a side elevational view of another embodiment of the upright cylindrical treating vessel comprising vertical sealing means.

FIG. 3 is a schematic representation of a top plan view, FIG. 4 of a vertical section along line 57—57 of FIG. 3, and FIG. 5 of a vertical section along line

58—58 of FIG. 3 of a composite apparatus comprising a compartmented bath and one cylindrical treating vessel and one cylindrical wash vessel inserted therein. FIG. 6 is a horizontal section taken along line 59—59 of FIG. 4.

FIG. 7 is a top plan view and FIG. 8 is a vertical section, taken along line 64—64 of FIG. 7, of another embodiment of the compartmented bath with horizontal cylindrical treating vessels and wash vessels inserted therein.

FIG. 9 represents a side elevation of an embodiment of a cylindrical film reel carrier.

FIG. 10 is a horizontal section taken along line 66—66 of FIG. 9.

The terminology and definitions of terms used herein correspond to those used and defined in my Patents 3,124,051 and 3,236,649 and in my copending patent application Ser. No. 350,612, filed Mar. 9, 1964, to which patents and application special reference is made herewith.

An embodiment of the apparatus of the present invention is shown in FIGS. 30 and 31 of Patent 3,124,051 and described in detail in said patent. As to this embodiment of the apparatus of the present invention special reference is made to said patent herewith. Said patent discloses and illustrates also many embodiments of treating and wash vessels and of associate equipment which may be beneficially used with or in the apparatus of the present invention.

In an embodiment of the treating vessel which may with advantage be used in the apparatus of the invention, vertical seal strips are provided at opposite sides of the vessel as shown in FIGS. 1 and 2 of the accompanying drawings. Vessel 810 comprising vertical cylindrical wall 811 and bottom 812 has provided diametrically opposite vertical seal strips 813. Seal strip 813 is mounted flush with the top edge of the vessel and terminating flush with the bottom end of the vessel. When the vessel is inserted into a rectangular or circular compartment comprising suitable counter sealing means in positions of the compartment or bath so that they cooperate with the sealing means of the vessel 810 essentially liquid tight seal is established. When the vessel is inserted therein such that an underflow passage is left underneath the bottom of the vessel a stream of liquid medium overflowing the wall of the compartment on one side flows downwardly on this side of the compartment and flows upwardly on the opposite side of the compartment overflowing at the wall on this side of the compartment. If desired the said passageway may be provided by terminating seal strip 813 in the vessel at a level above bottom 812 such that the stream of liquid medium underflows the seal strip 813 on both sides of the vessel.

The bath of the present invention may be further modified by the provision of closed cells under the components such that each of the closed cells is communicatively connected by suitable conduit and/or other suitable means with the next upstream or downstream compartment. A bath having this principle incorporated in its design and having seven circular compartments instead of the hereinbefore described rectangular compartments, is depicted in FIGS. 3, 4, 5 and 6 of the accompanying drawings. Bath 850 comprises irregular, curved vertical wall 851, bottom 852, curved vertical separatory walls 854, forming essentially cylindrical compartments 855 and 855a, 855b and 855c, and a lower section formed by cell bottom 856, extensions 853a of wall 851 and bottom 852 of the said compartments. Said lower section of the bath is subdivided into cells 858 and 858a, 858b and 858c, which cells are formed by vertical downward extensions of wall 851 and of parts of separatory walls 854, so as to give these cells 858 a peculiar pear shaped horizontal cross section as shown in FIG. 6. An exception is cell 860 i.e., the number one cell carrying inlet 861, which is essentially circular in the horizontal cross sec-

tion. Inlet 861 is joined communicatively to cell 860 and outlet 862 is provided in the upper portion of cell 855a. The triangular vertical conduits 862, formed by curved sections of separatory walls 854, and in the case of conduit 862a, by curved sections of separatory walls 854 and by a curved section of wall 856, are communicatively connected to the next downstream cell 858, following a zig-zag pattern starting at cell 860 at the left (FIG. 6) by the provision of passages 864 at or above the pointed cross sectional areas of cells 858. The cylindrical walls of compartments 855 are of equal height, with the exception of overflow passages 866 which are provided at the wall sections of the compartments adjoining conduits 862 at a substantially lower level.

In the bottom of each compartment is provided a circular opening 867 serving as a passage for the flowing liquid medium between the compartment and the underlying cell. Around the circumference of the bottom of each compartment is joined ring-like support 870 for the cylindrical vessels and circular counter sealing means 871 in such manner that the bottom of the vessels rests on support 870 when they are inserted and that counter sealing means 871 engage in sealing relationship with the sealing means 879 provided at the lower circumference of the wash vessels. In compartment 855a is shown inserted a cylindrical wash vessel 874, comprising cylindrical wall 875 and bottom 876, having a central lower passageway 877. Around the lower edge of cylindrical wall 875 is joined circular sealing means 879 adapted to establish essentially liquid tight seal with counter sealing means 871, when the wash vessel 874 is inserted in the compartment. Around the top edge of cylindrical wall 875 is joined ring-like upper sealing means 891, adapted to establish essentially liquid tight seal between wall 875 of the wash vessel and circular upper counter sealing means 892 provided around the inside of the cylindrical compartment wall.

It is to be noted that the height of the wash vessel is approximately such that its upper overflow passage, in vessel 874 the circular upper edge of the vessel, is at or close to the level of overflows 866 in the compartments, when the vessel is inserted.

In compartment 855b is shown inserted treating vessel 894, comprising vertical cylindrical wall 895, bottom 896 and ring-like wall extension 897 below the bottom 896 of the vessel. Wall extension 897 is provided all around with perforations 898, serving as a passage for the flowing liquid medium. It is to be noted that the cylindrical wall 895 of the treating vessel extends to a level approximately higher than the level of overflow passage 866, when the vessel is inserted in operating position in the compartment.

For the operation of the composite apparatus comprising the compartmented bath and inserted therein the treating and wash vessels, the inlet 861 is connected to a source of flowing liquid medium, preferably of a medium which serves both as a temperature conditioning medium and as the washing medium, which is most advantageously temperature conditioned water.

The stream of water enters cell 860, flows upwardly therein through opening 867 into compartment 855, overflowing at overflow passage 866 into conduit 862, where it flows downwardly into cell 858c, passing from there upwardly through opening 867 into the compartment 855c directly above cell 858c, overflowing into the neighboring conduit 862 into cell 858b, from where it flows upwardly through opening 867 into the open space formed underneath the bottom 896 of treating vessel 894, from where it passes through perforations 898 to flow upwardly all around treating vessel in a thin, essentially vertical annular layer, overflowing at overflow 866 into the vicinary conduit 862 and so forth, until it enters cell 858a where it flows upwardly through opening 867 in the bottom of the compartment and through aperture 877 in the bottom of wash vessel 874 and up in the wash vessel, overflowing

at the upper circular edge of wash vessel 874, leaving the apparatus through outlet 862. As can be readily seen, the combination of upper sealing means and counter sealing means prevents the wash water from flowing downwardly into the annular space, thus avoiding the formation of standing water pockets around the wash vessels.

The apparatus incorporating the just described principles provides in excellent manner an essentially vertical flow pattern for the flowing liquid medium. The particular cylindrical design of the compartments reduces the amount of liquid medium contained in the bath at any one time, thus reducing the weight of the filled apparatus and making the temperature conditioning and washing more effective by providing a faster turnover of the flowing liquid medium.

If desired, the principles of design and arrangement of the components may also be applied, with suitable modification to the rectangular modification of the compartments. The passage for the flowing liquid medium in the bottom of the compartments may have any other desired shape. It may be rectangular or irregular or comprised of a multiplicity of perforations or the bottom may be left out completely. Instead of providing overflows 866 in the compartment as shown, a horizontal slot in the compartment walls or a row of perforations may serve as the overflow. The apparatus may also be modified for the use of rectangular upright vessels by shaping and dimensioning the compartments and the bath accordingly. Many modifications of the apparatus may be made, which are within the skill of the artisan without bringing the apparatus from under the scope of the invention.

The principles of providing a cell under each of the compartments, with overflows and vertical conduits provided in the bath, so as to establish an essentially vertical flow pattern of the flowing liquid medium with or without treating and/or washing vessels inserted, may be applied with particular advantage in the construction of a circular bath of the general type described hereinafter. The circular bath employing the expedient of the underlying cells and of the central washing area in combination with the cylindrical type compartment is particularly suited for use in the development and/or other treatment of film in form of spirals, contained on suitable carriers as will be described hereinafter, because of its high efficiency, accuracy, lightness and compactness.

Another version of the composite multistep apparatus of the present invention utilizes the horizontal trough described hereinbefore. The troughs may likewise be arranged in a common water bath the width of which is slightly exceeding the length of the individual troughs. The troughs are preferably inserted in one row in such manner that their longitudinal axis runs parallel to the narrower side walls of the bath. The individual troughs are advantageously spaced apart from each other, usually by an inch or more to avoid contamination of the baths by splashing of the chemical solutions. As in the "upright vessel" arrangement the temperature of the solutions in the horizontal troughs may be controlled by a stream of temperature controlled water surrounding and passing by the troughs. To better control the flow of the surrounding temperature controlled water, baffles are advantageously provided between each trough such that individual compartments are formed along the length of the bath. In order to avoid the formation of water pockets and to assure best possible temperature control, the water should flow along a zig-zag pattern by alternating underflows and overflows along the path of the water from compartment to compartment. Each cell contains one of the horizontal troughs. So for instance, if the water enters the first compartment at the bottom part, the separating wall between the first and second cell is made lower than the water level, so that the stream of water flows over the upper edge of the separatory wall, preferably over its entire or nearly its entire width. The separating wall between the

second and the third compartment in turn extends to the height of the upper edge of the water bath but leaves a gap at the bottom in form of a slot extending over the entire or nearly the entire width of the bath. The next separatory wall is closed at the bottom and extends just below the desired water level in the bath permitting the water to flow over its upper edge and so forth.

The separatory walls may be fixedly joined to the bath, or, they may be removably inserted in vertical slots provided in or at the longer sidewalls of the bath at the desired spacing. The indentations may extend also along the bottom of the bath to provide a relatively close seal around the walls and the bottom of the bath, so that the desired flow pattern is not lost.

If desired, some of the horizontal modified washing troughs may be used for the intermediary and final washing steps as has been described hereinbefore. In the alternative, the washing steps may be carried out directly in the cells, containing no trough. The cells may for this purpose be modified by the provision of bearings on each of the narrow sides, corresponding in their arrangement and dimensions exactly to those provided in the troughs, so that they are capable of receiving and rotatably supporting the axle or axle stumps of the cylindrical support containing the cylindrical sheet. In order to make the washing more effective, baffles may be provided at each side or on one side of the axle, parallel thereto and in horizontal or in slanted position so that the cell is divided into the center compartment containing the circular sheet and in one or more outer compartments. The upper opening left between the two baffles should be somewhat wider than the diameter of the cylindrical sheet. The upper edges of the baffles should preferably be positioned exactly opposite the widest part of the cylindrical sheet when the latter is inserted in operating position. If the baffles are shorter so that the upper edges lie in a position below the widest diameter of the inserted cylindrical sheet, the edges may extend further inward. In either case, if possible, only a narrow slot should be left on either side between the upper edge of the baffle or baffles and the surface of the inserted cylindrical sheet. The inner compartment must have an opening at its lower portion, preferably close to the bottom of the compartment, connecting it with the stream of water flowing through the bath. The water stream will flow upwards or downwards, as the case may be, through the slot, passing at a relatively high flow rate by and over the surface of the circular sheet to be washed. Rotation or rotatable reciprocation of the sheet around its axis assists in the washing action, rendering it more effective.

The effectiveness of the washing step will be further increased if the baffles are provided with curved sections following the contours of the cylindrical sheet, leaving only a small gap or space between the inner baffle walls and the surface of the cylindrical sheet. The opening at the bottom of the compartment has advantageously the shape of a narrow slot extending over the whole width of the cell. The slot should preferably be at least double as wide as the cross section of the space provided between the surface of the cylindrical sheet and the inner surface of the curved baffle. The operation of this modification of the apparatus is similar to that described hereinbefore.

An example of a composite apparatus comprising a compartmented bath and inserted therein a multiplicity of horizontal treating and wash vessels, such that a stream of liquid medium passing through the bath takes on an essentially vertical flow pattern, is illustrated in FIGS. 7 and 8 of the accompanying drawings. Bath 980 comprises side walls 981, end walls 982, bottom 983 and separatory walls 984, dividing the bath into five working compartments and one terminal adjuvant compartment 987. In the side walls of each compartment are vertical grooves 985 and in the bottom horizontal grooves 986, which serve as the female counter sealing means. In the second, third and fourth compartment

(counted from the left) are inserted horizontal treating vessels, which comprise at their vertical end walls vertical sealing strips 988. The treating vessels are supported in the compartments by engaging the sealing strips 988 in grooves 985, such that an essentially liquid tight seal is established between the side walls of the compartment and the end walls of the vessels, with a passageway left open underneath the vessel.

In working compartments numbers two and five are shown inserted wash vessels 990. The horizontal cylindrical wash vessel 990 of the present invention, used in the composite apparatus comprises at its end walls vertical seal strips 992 of a shape and dimensions, identical to those provided on the treating vessels. In the wash vessels, however, are also provided horizontal seal strips 993, which are joined to the bottom and to vertical seal strips 992, so as to form a unitary seal strip extending around the end walls and bottom of the wash vessel. To the left of bottom seal strip 993 is provided horizontal slot 994, which serves as the lower passageway for the washing medium.

In the wall at the right is provided horizontal overflow passage 995 with horizontal lip 996, extending essentially horizontally to the right. Passage 995 and lip 996 are located at a level and are of a width such that it extends over separatory wall 984 of the compartment when the wash vessel is inserted therein. When the wash vessel is inserted in the bath, vertical seal strips 992 engage in grooves 985 of the side walls of the compartment and horizontal seal strip 993 engages in the horizontal groove 986 such that essentially liquid tight seal is established between the side walls and bottom of the compartment and the end walls and bottom, respectively, of the wash vessel.

At the end wall 982 at the left of the bath is provided inlet 997 and at the right end wall outlet 998. When a stream of liquid medium is passed through inlet 997, the liquid medium flows downwardly in the first compartment, passing thereafter through passageway 994 in the first wash vessel 990, flowing upwardly in the wash vessel and overflowing at passage 995 and over lip 996 into the second compartment, where it passes under the treating vessel 987, and flows upwardly on the opposite side, overflowing separatory wall 984, and flowing downwardly in the next compartment, where it underflows the next treating vessel and overflowing into the next compartment and so forth, until it overflows into the adjuvant compartment 987, to leave the bath through outlet 998. As can be readily seen, the particular design of the apparatus assures that a temperature conditioning and washing medium, like water flows in an essentially vertical pattern, when it passes through the apparatus, serving alternately as temperature conditioning and washing medium. The treating and wash vessels may be readily exchanged in the compartments, such that any desired treating pattern may be readily established in the composite apparatus.

Many modifications may be made in the design and construction of the apparatus without departing from the spirit of the invention and any of the features and principles laid down hereinbefore may also be applied, if necessary, with suitable modifications and adaptations, to the composite apparatus containing the horizontal vessels.

The apparatus of the present invention may be used with advantage for the development of roll-film and similar materials.

One or several films may be treated in one and the same vessel with the same semiautomatic, reliable operational characteristics as have been described in the foregoing, giving inherently the same advantages for continuous, photographic material and particularly for the multilayer negative and reversal color materials such as Ektachrome and Ektacolor film materials. Consistent results can readily be obtained in a semiautomatic operation also by the less

experienced operator thanks to the exacting control of the processing conditions possible in the apparatus of the present invention.

An embodiment of a film carrier which may be used with particular advantage in the development and/or other treatment of concentrically spirally wound bands or strips of film in accordance with the present invention is illustrated in FIGS. 9 and 10 of the accompanying drawings. Carrier 1020 comprises rectangular frame 1021, made up of vertical frame members 1022 and horizontal frame members 1023 and 1024. To the top ends of extensions 1025 provided at the upper ends of vertical frame members 1022 is joined horizontal agitating support 1026, adapted to vertically reciprocate the carrier, if it is used in an apparatus comprising suitable automatic, mechanical agitating means, e.g. of the kind described hereinbefore. The lower horizontal frame member 1023 is removable and is secured to the vertical frame members by latching means 1027 and pins 1028 or other suitable fastening means, so as to permit ready and convenient removal or insertion of the lower frame member 1023, yet holding it securely in place when the carrier is in use. In the center of frame member 1023 is provided bore 1029, in which is rotatably set disc 1029 with a star-shaped perforation of a size and shape, so as to enable it to receive the end of shaft 1032, when bar member 1023 is inserted on the carrier 1020. Shaft 1032 has a star-shaped cross section and is rotatably set with its upper rounded section in bearing 1034, contained in the central portion of upper frame member 1024 and held in the bearing in a predetermined position, but rotatably by stops 1036 and 1037.

To the top end of shaft 1032 is joined knob 1039 for rotating shaft 1032 by hand. On shaft 1032 are shown inserted film reels 1042, with round hollow cores 1043, which may be any of the commercially reels available for the winding of a film in spiral fashion in spaced manner, such that the individual windings do not touch. They may be of the apron type, using an apron with raised dot-like impressions at their edges or they may be of the type having at both circular ends spirally winding channels, into which the edges of the film are laid when it is slipped into the reel. The latter type is generally preferred and the reels sold under the trade name "Nicor" were found to be particularly useful in the carrier of the present invention, because of their compact construction in relation to the area of film which they are adapted to hold, permitting the use of more compact treating vessels with a saving in the amount of treating liquid required. However, the carrier may also be readily adapted to hold any other kind or type of film developing reel. The reels have advantageously a coaxial, star shaped bore in cove 1043, adapted to slip over star shaped shaft 1032.

For the use of the carrier, lower frame member 1023 is removed. The reels are then individually loaded with film and the reels inserted onto shaft 1032, stacking the reels as is shown in the drawings. Thereafter, lower frame member 1023 is reinserted such that the bottom end of shaft 1032 is inserted in rotatable disc and pins 1027 are inserted to hold member 1023 securely in place. The carrier is then ready for use and may be inserted in the first treating vessel containing a developer or other treating solutions. It may be vertically reciprocated by hand and the reels may also be rotated by hand relative to frame 1021, thus permitting a composite reciprocating vertical and rotational agitation of the spirally wound film in the treating media.

The vertical frame members 1022 are set with their wider sides parallel to the paper plane. The outer vertical edges are conveniently used as guide means for the carrier. This function is greatly assisted, if the carrier is used in a vertical cylindrical treating of wash vessel in which are provided on opposite sides of the inside of the cylindrical wall vertical grooves or channels or the like, adapted to receive the said vertical outer edges of vertical frame members 1022 in sliding fashion. With the use of this

expedient, the carrier itself can be reciprocated in vertical direction, while the frame of the carrier is unable to make any rotational movement. The combination of the vertical cylindrical vessel having the vertical counter guide means with the carrier of the invention having the vertical guide means, is particularly suited for use in apparatus having automatic mechanical agitating means. When the carrier is used in such apparatus, the reels containing the film, may be rotationally agitated occasionally by hand, i.e. by the help of knob 1039. More advantageously, the shaft is connected to suitable mechanical means known per se, which cause the shaft to turn by a small angle at each vertical stroke of the carrier. This may be achieved by the use of special star wheels or gears, which upon each lowering of the carrier engage with the wall of the vessel or with an extension provided thereon and which are thus caused to turn by a predetermined angle. The rotation of said star wheel or gear is thus by suitable means utilized for the rotation of shaft 1032 by a desired angle.

The rotation of the shaft 1032 caused by each vertical stroke of the carrier may also be made to be reciprocating instead of unidirectional, as may be desired.

The just described reel carrier of the invention may be modified in any desired manner. It may be provided in addition with a forwarding support such that it may be used in fully automatic apparatus, in which the photographic material is automatically agitated and forwarded from step to step as the process sequence to be carried out requires.

If desired, the reel carrier may be also made without the agitating support and/or without special guide means. Guide means of different construction may be used. The insertion of the reels may also be accomplished by loading the shaft from the top, by making the upper frame member 1024 instead of the lower member 1023 removable. The shaft may also be adapted to be swung sideways out of the carrier, providing still another mode of loading the carrier.

The carrier may be made for any desired size of reels and for any desired number of reels. Though it may be dimensioned to take merely a single reel, it is much preferred to design it for the use with a multiplicity of reels, preferably of three or more, because with the use of increasing numbers of reels at one time, the benefits offered by the reel carrier becomes more and more pronounced, as they permit the handling of a number of reels as a unit rather than requiring the separate handling of the reels. With proper dimensioning, a given carrier may be suitable to handle a multiplicity of reels carrying films of various sizes at one time, provided that the coaxial bores of these carriers are adapted to pass the shaft of the carrier when the reel is slipped over the shaft.

The present invention comprehends also the use of film carriers of different design and construction for special purposes in the process of developing and/or treating bands or long strips of film of the invention. Reference is made to the various cylindrical carriers described and illustrated in my Patent No. 3,124,051, including the open drum type carrier of large dimensions for the use with movie film etc. in the annular upright vessels.

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

I claim:

1. An apparatus for the treatment of photographic ma-

terials in a multiplicity of treating media, which apparatus comprises principally a compartmented bath, removably contained in compartments of said bath a multiplicity of photographic cylindrical treating vessels and washing vessels, said washing vessels having openings therein and said treating vessels having no openings, said compartments having means forming openings therein, so that a unidirectional stream of a liquid medium passing through the compartments of the bath will follow an essentially vertical flow pattern, passing around the treating and through the wash vessels, each of said cylindrical treating and wash vessels having sealing means cooperating with counter sealing means contained in the compartments of the bath so as to establish essentially liquid tight seals between the vessel and the compartments to help define liquid medium passageways.

2. The apparatus of claim 1 in which said cylindrical treating and washing vessels are lying half cylindrical vessels.

3. The apparatus of claim 1 in which the treating vessels containing the treating media required for each step of the process and the wash vessels, one for each washing step required by the process, are arranged in two rows.

4. The apparatus of claim 1 in which the treating and wash vessels are upright full cylinders.

5. The apparatus of claim 1 in which the treating and wash vessels are upright annular vessels.

6. The apparatus of claim 1 in which said treating vessels are disposable vessels.

7. The apparatus of claim 1 which additionally comprises automatic mechanical agitating means.

8. The apparatus of claim 1 in combination with means adapted to provide a stream of a liquid temperature conditioning medium having an essentially constant temperature so as to maintain the temperature in the treating and wash vessels at the level required by the process to be carried out, and means adapted to pass said stream of liquid medium through said compartmented bath.

9. The apparatus of claim 1 in which the cylindrical treating vessels are provided with vertical sealing means.

10. The apparatus of claim 1, in which cells for the passage of temperature conditioning medium are provided underneath the compartments of the compartmented bath.

11. The apparatus of claim 1, which additionally comprises in combination at least one film carrier adapted to contain at least one roll of concentrically spirally wound film.

12. The apparatus of claim 1, which additionally comprises in combination at least one film carrier adapted to contain at least one strip of spirally wound film.

13. The apparatus of claim 11, wherein the film carrier is adapted to hold a multiplicity of reels of concentrically and spirally wound film in stacked fashion.

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