Oct. 10, 1967 A. OKSAKOVSKY ETAL 3,345,929

PHOTO DEVELOPING APPARATUS

Filed Jan. 11, 1965 3 Sheets-Sheet 1

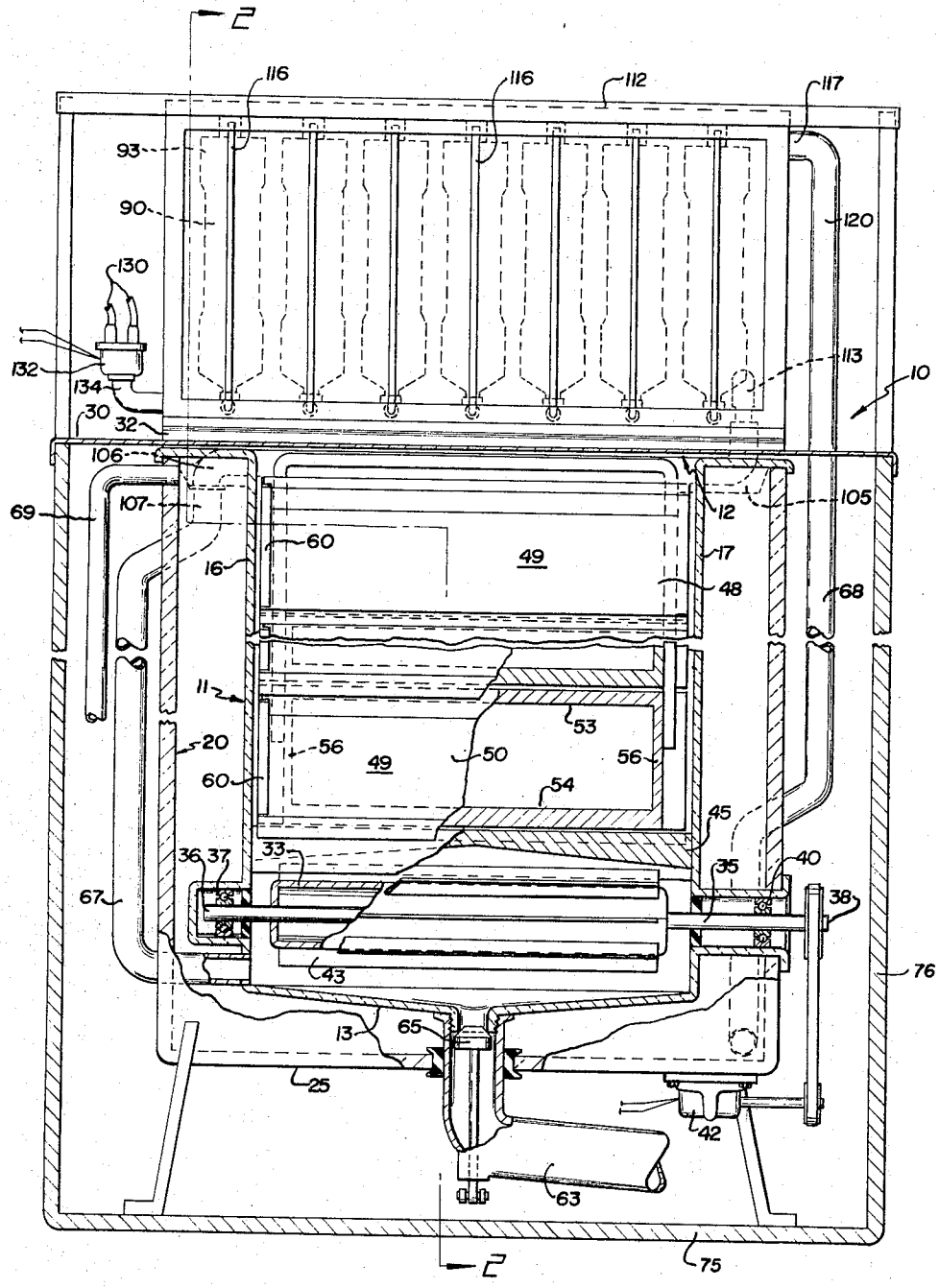


FIG. 1.

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PHOTO DEVELOPING APPARATUS

Filed Jan. 11, 1965 3 Sheets-Sheet 2

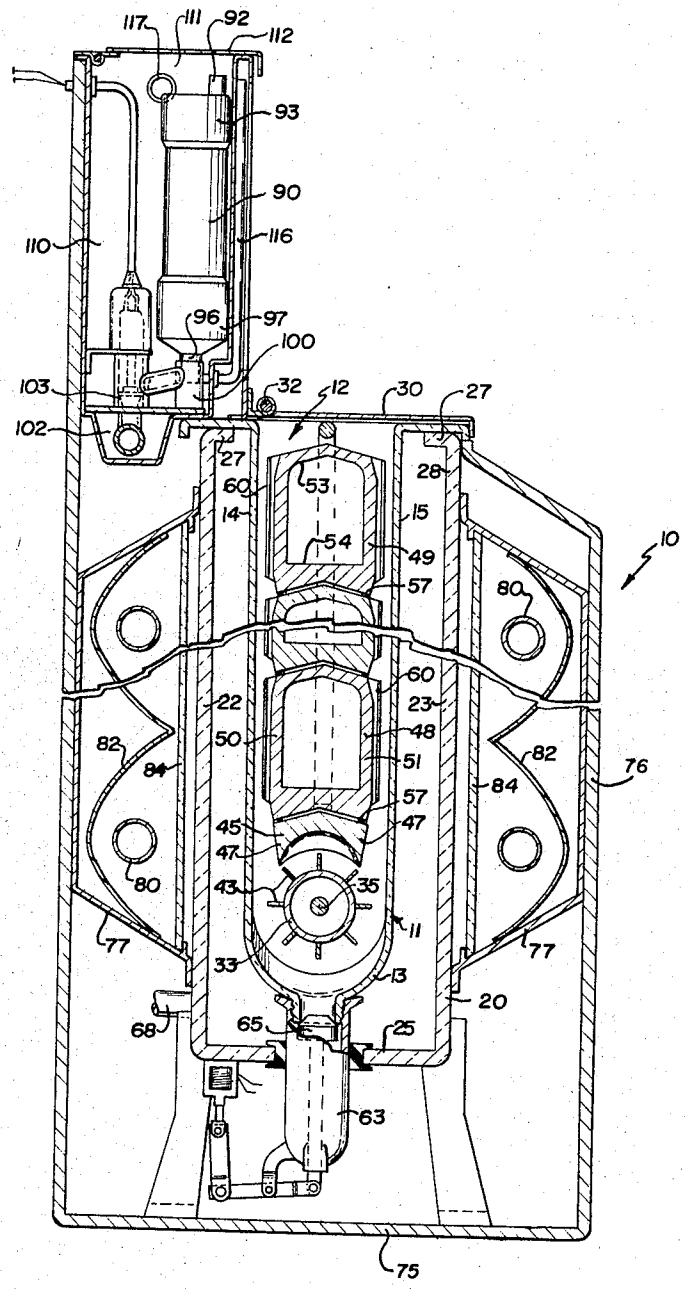


FIG. 2.

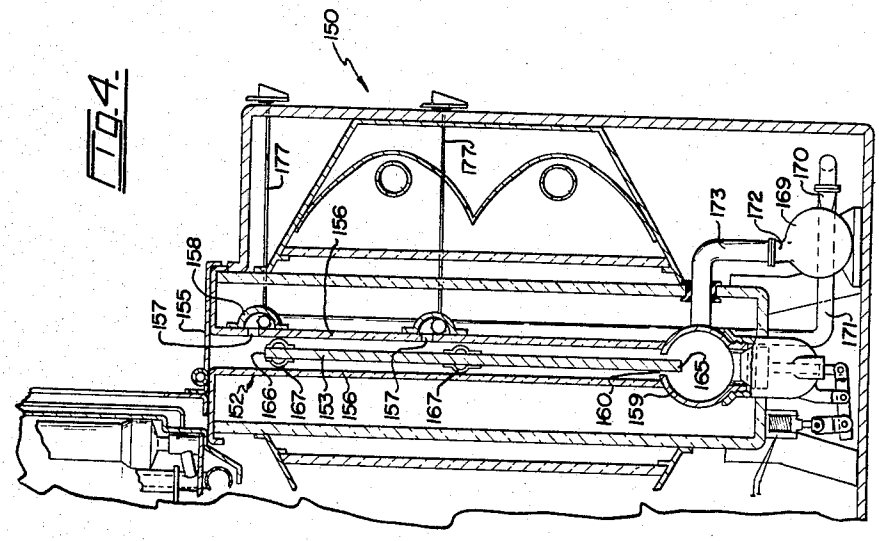
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Filed Jan. 11, 1965 3 Sheets-Sheet 3

FIG. 4.



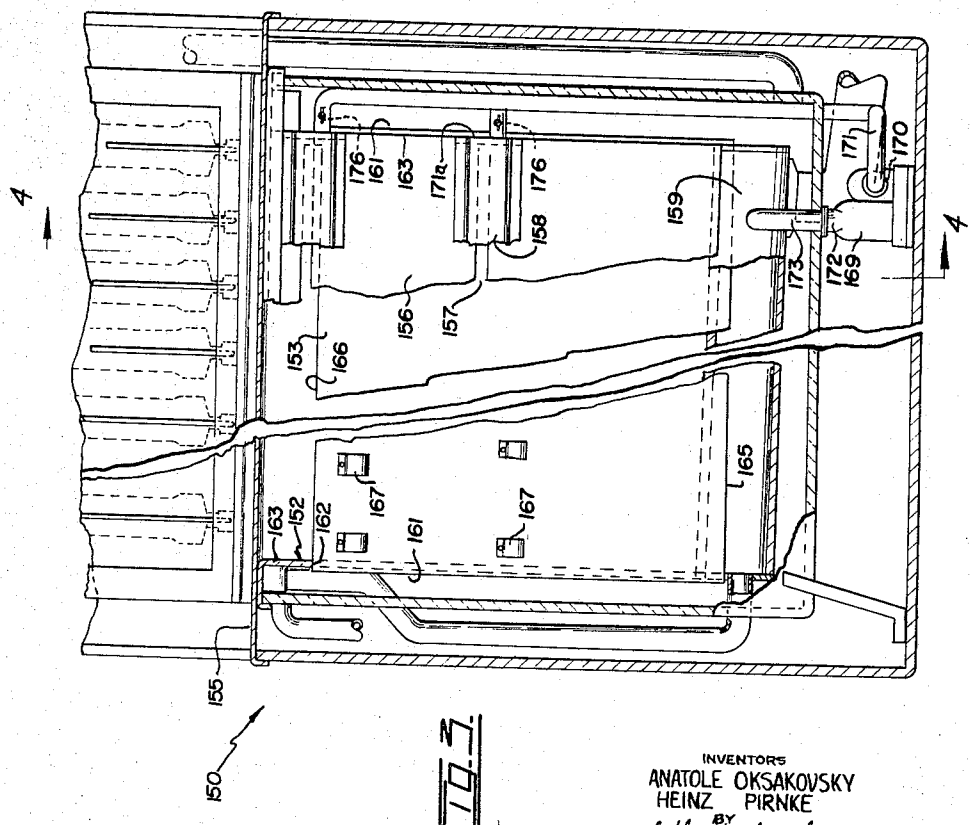


FIG. 3.

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3,345,929

PHOTO DEVELOPING APPARATUS

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5 Claims. (Cl. 95—96)

ABSTRACT OF THE DISCLOSURE

Photographic developing apparatus having a narrow developing tank divided by a hanger, on which the film to be developed is secured, into two narrow passages through which developing fluid is continuously circulated by a fluid moving device arranged along the bottom of the tank.

This invention relates to photo developing apparatus.

In the processing and developing of photographic elements, the latter carrying photo-sensitive emulsions which have been previously exposed to light rays and which necessitate the developing, rinsing, fixing, washing thereof in different varied solutions, it has been customary practice where color photography is concerned to use separate processing tanks for each of the processing fluids used. The photographic elements then have either by hand or by some mechanical means been transferred from one tank to the other to be immersed in the processing fluids in properly timed sequence. The production of properly developed photographic elements has therefore necessitated a high degree of skill on the part of the operator. In both manual and automatic processes, in which the photographic elements to be developed are passed successively from tank to tank, there is a successive deterioration in the quality of the developed elements due to contamination of the fluid and the affect of dust particles, and in the case of manual processes, the lack of proper time control. Processing fluids ordinarily used in the developing of photographic elements for color photography are relatively costly and operators are therefore loathe to discharge the contents of the tanks after one use. As the development of photographic elements and the chemical actions involved are of a very sensitive nature, the progressive deterioration of the fluids and their contamination as photographic elements are successively passed therethrough, will naturally result in gradual deterioration of the quality of the developed photographic elements due to the inability of the operator to accurately determine the condition of the replenished fluid.

The use of separate processing tanks also results in rather elaborate and extensively bulky developing equipment. This type of equipment is therefore not easily portable and requires excessive floor space.

This type of equipment is also not eminently suitable for use by smaller developing establishments and photo studios and individual photographers where, due to vagaries of business and consequent intermittent use of the developing apparatus, the cost of installation of elaborate processing controls would be prohibitive.

It is appreciated that semi-automatic and single processing tank equipment in which the photographic elements are successively treated, have heretofore been devised. However, such equipment has not been eminently successful for use by smaller establishments due primarily to the fact that it has not been easily adjustable to the needs of said smaller establishments where the numbers and sizes of photographic elements to be developed vary from hour to hour and day to day.

It is an object of this invention to provide a fully automated processing apparatus which may be used for developing either color or black and white films and prints.

Still another object of this invention is to provide the apparatus foregoing which is compact, easily transportable and which, besides being relatively inexpensive as to initial cost, provides relatively inexpensive operation by relating the amount of fluid used to the total area of the photographic elements to be processed at any time.

A still further object of this invention is to provide such an apparatus in which the quantities of processing fluids used may be correlated with a number of photographic elements to be developed so that uniform developing of each of the photographic elements may be achieved.

A yet further object of this invention is to provide a photo developing apparatus which is so automated that it may be operated by one having very little skill.

A still further object of this invention is to provide a photo developing apparatus wherein the processing fluids are arranged to flow over the photographic elements in a non-turbulent state, whereby uniform development is achieved.

The present apparatus comprises a photo processing tank for holding photo processing fluid and having a pair of opposed vertically extending parallel side walls, a hanger member slidably insertable into the tank in a vertically extending position centrally between and spaced parallel to said side walls, said hanger extending as a continuous wall parallel to said side walls, thereby forming a pair of vertically extending passages and being located so that its lower edge is spaced above the bottom of the tank and its upper edge below the level of the fluid in the tank, gripping means on the hanger for holding photographic elements submerged in said fluid in said passages in planar parallelism with the side walls, fluid circulatory means in the tank below the lower edge of the hanger for circulating the fluid through the passages and hence over the photographic elements, and means to discharge the fluid from said tank.

In the drawings which illustrate the embodiments of the invention,

FIGURE 1 is a front elevation of one embodiment of the invention, showing partially in section certain features thereof,

FIGURE 2 is a side view of the embodiment of FIG-1 taken along line 2—2 thereof,

FIGURE 3 is a front elevation of a portion of another embodiment of the invention, showing the processing tank and the circulatory means therefor, and

FIGURE 4 is a side view of the embodiment of FIGURE 3 taken along line 4—4 thereof.

Generally speaking, the present apparatus in all its forms and embodiments consists of a single processing tank arranged to hold uprocessed photographic elements and into which the processing fluids necessary to develop, fix and wash the photographic elements may be discharged and subsequently evacuated therefrom. The apparatus provides a means by way of a plurality of graduated reservoirs whereby the necessary processing fluids in predetermined quantities may be maintained at constant temperatures and discharged into the single processing tank at predetermined intervals. The apparatus in all its forms and embodiments also includes means to circulate the processing fluid in the processing tank, and the tank itself is so constructed that the photographic elements contained therein may be re-exposed when desired to a light source without removing the photographic elements therefrom.

Referring now to the drawings and particularly FIGURES 1 and 2 thereof which illustrate one embodiment

10 of the apparatus, the processing tank 11 thereof is generally of rectangular construction and is vertically elongated, being open at its upper end 12, and has its bottom end generally rounded. The side walls 14 and 15 of the tank are composed of a transparent material, such as glass or a clear plastic, and are connected to the end walls 16 and 17 thereof in a suitable manner, such as by fusing, to form a watertight tank.

This processing tank 11 is enclosed within a climatizing tank 20 of similar construction to said processing tank, said climatizing tank having side walls 22 and 23 adjacent side walls 14 and 15 also composed of a transparent material, such as glass or plastic. The side walls 22 and 23 and the bottom 25 of the climatizing tank are spaced from the side walls 14 and 15 and the bottom 13 of the processing tank, the latter tank being suspended at its upper end 12 from an inwardly extending flange 27 formed at the upper end 28 of the side walls 22 and 23 of the climatizing tank 20. A cover plate 30 is hingedly mounted as at 32 to said flange and extends across the open end 12 of the processing tank 11 so as to close the latter. Located at the bottom of the processing tank is an impeller 33, said impeller having a longitudinally extending horizontal drive shaft 35 journalled at one end 36 in suitable bearings 37 secured to one end wall 16 of the tank and extending at its other end 38 outwardly through the walls of both processing tank and climatizing tank through suitable sealed bearings 40, said other end 38 is connected to an electric motor 42 by means of which it is to be rotated. To the drive shaft 35 are secured a plurality of longitudinally extending vanes 43 which follow a circular path adjacent the bottom end 13 of said processing tank, and arranged in the tank and extending the full width thereof above the impeller 33 is a flow divider 45 having side walls 47 which are spaced from the side walls 14 and 15.

This flow divider is arranged to serve as a supporting base for the hanger member 48 by means of which photographic elements are to be suspended inside the processing tank. The hanger member of this particular form 10 of the apparatus is comprised of a plurality of vertically separable and stackable hanger elements 49. Each of the hanger elements is of hollow box-like construction having parallel side walls 50 and 51 and upper and lower walls 53 and 54 respectively. The ends of the hanger elements are closed by end walls 56, said end walls extending as flanges beyond the surface of said side walls 50 and 51 and being of the same width as the inside thickness of the processing tank. The lower walls 54 of each of the hanger elements are provided with a peripheral rubber seal 57 which is arranged to seat firmly on the upper wall 53 of the hanger element therebelow so that when the hanger elements are stacked one upon the other, said peripheral seal would deny the passage of any fluid therebetween. The peripheral seal 57 of the lowermost of the hanger elements is also arranged to sealably contact the flow divider so as to prevent passage of fluid between the divider and the adjacent hanger elements. The ends 56 of each of the hanger elements are arranged to slidably fit between the side walls 14 and 15 of the processing tank so as to centrally locate each of the hanger elements therein.

The hanger elements 49 are of sufficient width so that only thin passageways are formed between the side walls 50 and 51 and the side walls 14 and 15 of the processing tank. The hanger elements are provided with clips 60 whereby photographic elements may be supported within the thin passageways in planar parallelism and spaced from said side walls 14 and 15. It is to be understood that the photographic elements are to be arranged so that their surfaces carrying the photographic emulsion confronts said side walls 14 and 15.

Both tanks 11 and 20 are provided with means for filling and draining, the processing tank 11 being provided with a drain 63 located centrally at the bottom thereof and extending through the bottom of the climatizing tank. This drain is controlled by a solenoid operated valve 65. Emission of fluid to the processing tank 11 is provided by way of a pipe 67 which extends through the climatizing tank 20 and is ported through wall 16 near the bottom thereof. The climatizing tank is to be filled by way of a pipe 68 ported through an end wall thereof near the bottom of the tank, and provided with an overflow pipe 69 ported through the opposite end wall near the top of said tank.

The processing and climatizing tanks 11 and 20, respectively, are suitably supported on a base 75 of a cabinet 76, the latter having inner framing members 77, said framing members also serving as supports for a plurality of electric lights 80, of the fluorescent or incandescent type, which are located within the cabinet adjacent the transparent side walls 22 and 23 of the climatizing tank 20. These lights are provided with reflectors 82 and, there is also provided between the lights and the latter mentioned side wall, panes of frosted glass 84 which serve to diffuse the light rays emanating from the lights so that a uniform re-exposure of the photographic elements, where required, is achieved.

Also located within the cabinet and above the tanks 11 and 20 are a plurality of reservoirs 90 for holding and discharging the required processing fluids. The reservoirs which are arranged to separately hold fluids for developing, hardening, fixing, washing, bleaching, etc., are formed of a material, such as glass, which is not susceptible to the action of the fluids. These reservoirs are bottle shaped having filling spouts 92 at their upper ends 93, and having an open neck 96 at their lower ends 97. The bottles are arranged in a row extending the width of the apparatus, their open necks 96 being connected by individual fittings 100 to an elongated transversely extending manifold 102. The reservoirs may be filled through the filling spout 92 with appropriate processing fluids, their flow outwardly through the fittings 100 and into the manifold 102 being controlled by solenoid operated valves 103 located within the fittings. These valves are of known manufacture and need not be described here.

The manifold 102 is discharged of its contents at its other end 106 through a screen covered discharge pipe 107, the latter being connected to the processing tank filler pipe 67.

The reservoir 90 and the manifold 102 are encompassed by a second climatizing tank 110 which is open at its top 111 and provided with a hinged lid 112. The manifold 102 is open at its end 105 to the water in the climatizing tank 110, the passage of water thereinto being controlled by a solenoid operated valve 113.

Extending through this tank near its bottom thereof and, connected to each of the fittings 100, are vertical glass gauges 116 which indicate the level of the fluid inside the reservoirs. These gauges, of course, extend vertically and are located adjacent the cabinet wall, the latter being provided with slots adjacent the gauges whereby the gauges may be viewed. The climatizing tank 110 is provided adjacent its upper end but below the filling spouts 92 of the reservoirs with an overflow discharge port 117 which is connected by a conduit 120 to the filling pipe 68.

It is intended that both climatizing tanks 20 and 110, which are connected as hereinbefore described, shall be continually provided with a flow of water at a predetermined temperature whereby the fluid in the reservoirs 90 and the fluid, when discharged into the processing tank 11, may be maintained at a constant temperature. It is to be appreciated that temperature variations materially affect both the time required for immersion of the photographic elements in the processing fluid and the resultant color. It is apparent, therefore, that for complete automation of the processing of the photographic elements, where controls are to be used which are divorced from

manual operation, the time interval that each of the processing fluids shall be in contact with the photographic elements, and the temperature of the fluid must be constant.

As the processing fluids must be maintained at a predetermined temperature, the climatizing tanks therefore are arranged to be constantly supplied with water at a fixed and predetermined temperature. The apparatus **10**, therefore, is connected by water supply lines **130** to both a hot water supply and cold water supply, said supply lines **130** being connected to a mixing device **132** which by means of thermostatic controls of known manufacture co-mingles the hot and cold water in such proportions as to provide the temperature desired. The properly co-mingled water is then discharged through line **134** which is connected to the climatizing tank **110** near the bottom thereof. The continuous supply of water fills climatizing tank **110** and thence passes through the overflow **117** into climatizing tank **20** and thence outwardly from the latter through the overflow **69** to waste.

In the operation of apparatus **10**, the photographic elements are secured to the hanger elements **48** and said elements inserted in the manner hereinbefore described into the processing tank **11** to rest upon the flow divider **45**. The total area of the photographic elements to be developed, of course, determines the number of hanger members **48** which is necessary to use, that is, if only smaller sized photographic elements are to be developed, only one hanger member need to be installed within the processing tank **11**. The reservoirs **90** are then filled to the level as indicated by the gauge so that when the contents of an individual reservoir are discharged into the processing tank, the fluid level will be just above the top of the uppermost of the hanger elements **49**. It will be seen that as the passages between the hanger elements **48** and the side walls **14** and **15** of the processing tank are very narrow and, as the impeller **33** generally fills the bottom of the latter tank, very little processing fluid will be required and, furthermore, as the total area of the photographic elements to be developed determines the number of hanger members to be used, the quantity of fluid to be used will likewise be determined.

When the processing tank has been filled to the desired level, the impeller **33** is activated, causing the processing fluid to pass upwardly through one of the passages adjacent the photographic elements therein across the top of the uppermost of the hanger elements, and downwardly through the other of the passages back to the impeller. It is contemplated that the speed of the impeller shall be such that the passage of the processing fluid over the photographic elements is non-turbulent so that the emulsions thereon are contacted in a uniform manner by said fluids. After each of the successive processing fluids is used it may be discharged from the processing tank **11** by opening the solenoid valve **65** and draining the processing fluid then in the tank into waste. It will be realized that as only sufficient fluid has been used to develop the number of pictures then in the processing tank, the wastage of this processing fluid is not excessive and, furthermore, ensures the use of fresh photographic processing fluid for each group of pictures or photographic elements to be developed. It is to be further noted that during the washing process which accompanies the successive stages of processing negatives and the like that the valve **113** being located at one end of the manifold will permit the washwater to purge the latter of any traces of processing fluid which is passed therethrough prior to the washing.

The solenoid operated valves governing the flow of the processing fluid from the reservoirs **90** and the solenoid operated valve governing the discharge from the processing tank **11**, may be manually operated through switches of known manufacture connected to each of the valves. However, it is intended that apparatus **10** shall be fully automatic and therefore it is contemplated that said apparatus be provided with a sequential program timer electrically connected to the solenoid operated valves, whereby the latter may be made to function in predetermined sequentially timed operation. These valves, of course, are connected through electrical conduits, not shown, to a source of power so as to affect their operation. The use of such sequential program timers is common in industry and details of its construction need not be described in this application. The timer may also be used to affect the operation of the lights **80** where re-exposure for color photography is required. The timer, of course, only operates the lights at desired intervals relative to the processing sequence determined by the type of photographic elements to be developed.

It is, of course, intended that the apparatus **10** shall be complete in one cabinet to include all of its constituent elements herebefore described.

FIGURES 3 and 4 illustrate another embodiment **150** of the apparatus, said last-mentioned apparatus differing only from apparatus **10** in the construction of its processing tank herein accorded the numeral **152**, the hanger member accorded the numeral **153**, and the means whereby processing fluid in the tank is to be circulated.

In apparatus **150** the tank **152** is again of vertically elongated rectangular construction having an open top and is provided with a lid **155** in the same manner as apparatus **10**. The tank **152** also has transparent side walls **156**, but is much thinner than processing tank **11**.

One of the side walls **156** of tank **152** is provided with a plurality of longitudinally extending horizontal slots or recesses **157** extending the full width of said side wall, and said slot is covered by an elongated trough **158**. Arranged at the bottom of the tank **152** is a horizontal longitudinally extending discharge pipe **159** having an elongated longitudinally extending slot **160** formed in its upper surface. The hanger member **153** of apparatus **150** is formed from a single sheet of thin material, such as glass or stiff plastic, and is located so as to extend the full width of the tank **152** centrally between its side walls **156**, said hanger member being slidably locked at its side edges **161** in grooves **162** formed in the end walls **163** of the tank **152**. The hanger member thereby divides the tank into two thin vertically extending passages and extends at its lower edge **165** into the discharge pipe **159** through the slot **160**, and is located so that its upper edge **166** lies below the slot **157** formed in the side walls **156**. The hanger member **153** is also provided with clips **167** whereby photographic elements may be secured thereto in planar parallelism with the said side walls **156**.

Circulation of processing fluid to be contained by the tank is affected by means of a pump **169**, preferably of the centrifugal type, which is connected at its intake port **170** by means of a conduit **171**, the latter having a connection to one end **171***a* of each of the troughs **158**, and being connected at its discharge port **172** by means of a conduit **173** to discharge pipe **159**. It is intended that the processing tank **152** shall be filled with processing fluid to a level above the upper edge **166** of the hanger **153** so that the fluid therein normally overflows through the slot **157** into the trough **158**. The operation of the pump therefore circulates the fluid back to the discharge pipe and upwardly on both sides of the hanger member through the slot **160**. Processing tank **152** is also provided with a solenoid controlled discharge which is located at one end, and operated in the same manner as solenoid valve **65** operates to drain tank **11**. The overflow of the processing fluid through slots **157** is also controlled by manually operated valves **176** located at the connection of the ends **171***a* of said trough with the conduit **171**, so that a selected one of the slots **157** may be placed in communication with the pump **169**, dependent upon the number of photographic elements to be used and, consequently, the amount of processing fluid to be used. These valves may be constructed as simple stop

cocks, each being operable by means of operating rods 177 extending outwardly of the face of the cabinet. It is to be understood that with apparatus 150 a number of hanger members 153 shall be available for use, each one being of a size, depending on the total area of the photographic elements to be developed, so that its upper edge 166 lies just below the level of the fluid in the tank and the selected slot 157 which is, as hereinbefore stated, to be connected to the pump. It is also to be understood that each of the troughs 158 is provided with a control valve similar to valve 176, each being capable of individual operation.

The flow of the processing fluid through tank 152 is slightly different to the flow of fluid through processing tank 11, the flow in the former tank being upwardly through each of the passages on either side of the hanger member 153 and thence outwardly through the slots 157. However, it is to be noted here that the operational speed of the pump shall be such that said flow of processing fluid shall be of a non-turbulent character in the manner of flow of fluid through processing tank 11. It is also to be understood that apparatus 150 shall be provided with reservoirs of the same nature as the reservoirs of apparatus 10 having the same connection to tank 152 as tank 11, and that the process shall be as fully automatic as apparatus 10 and in the same manner thereof.

What we claim as our invention is:

1. Photo developing apparatus comprising a photo processing tank for holding photo processing fluid and having a pair of opposed vertically extending substantially parallel side walls, a hanger member slidably insertable into the tank in a vertically disposed position located centrally between and spacedly parallel to said side wall, said hanger member being formed of a plurality of vertically stacked and separable components, each component having sealing means engageable with the component adjacent so that said hanger members extend as a continuous wall parallel to said side walls thereby forming a pair of vertically extending passages and being located so that its lower edge is spaced above the bottom of the tank and its upper edge below the level of the fluid in the tank, gripping means on the hanger member for holding photographic elements in said passages and in planar parallellism with the side walls, fluid circulatory means in the tank below the lower edge of the hanger for circulating the fluid through the passages and hence over the photographic elements, and means to discharge the fluid from said tank.

2. Photo developing apparatus comprising a photo processing tank for holding photo processing fluid and having a pair of opposed vertically extending parallel side walls, said side walls being formed of a light transmitting material, a hanger member slidably insertable into the tank in a vertically extending position centrally between said side walls, said hanger member extending as a continuous wall parallel to and closely proximate to said side walls, thereby forming a pair of thin vertically extending passages and being located so that its lower edge is spaced above the bottom of the tank and its upper edge below the level of the fluid in the tank, gripping means in the hanger for holding photographic elements submerged in said fluid in said passages in planar parallelism to the side walls, fluid circulatory means in the tank below the lower edge of the hanger for circulating the fluid through the passages and hence over the photographic elements, said circulating means extending substantially the full width of the hanger member and being arranged to provide continuous non-turbulent flow of said processing fluid over the photographic elements, valve controlled means operable to discharge the fluid from the tank, graduated processing fluid reservoir means connected to the tank operable for dispensing measured quantities of processing fluid thereto, valves at the reservoir means for controlling the discharge of processing fluid therefrom, a pair of climatizing tanks, one encompassing the reservoir means and the other encompassing the processing tank and connected to each other for holding a liquid in indirect heat exchange relation with the fluid in said reservoir means and processing tank, means for continually supplying liquid to said climatizing tank at substantially constant temperature, said climatizing tank encompassing the processing tank having side walls adjacent the light transmitting side walls of the said processing tank also formed of a light transmitting material, a switch controlled light source adjacent both said light transmitting walls of said last-mentioned climatizing tank, and sequential time control mechanism operably connected to the valves at the reservoir means and processing tank discharge means and the switch controlling light source for automatically controlling the sequence of operation of the same.

3. Photo developing apparatus as claimed in claim 2 in which the circulating means comprises an elongated impeller mounted for rotation in the tank and having horizontally elongated blades extending substantially the full width of the processing tank, and including means to drive the impeller.

4. Photo developing apparatus comprising a photo processing tank for holding photo processing fluid and having a pair of opposed vertically extending parallel side walls, one of said walls having at least one horizontally extending elongated opening formed therethrough, said opening serving as an overflow vent to regulate the level of the fluid in the tank, an elongated trough extending across the opening from end to end thereof, a hanger member slidably insertable into the tank in a vertically extending position centrally between and spacedly parallel to said side walls, said hanger extending as a continuous wall parallel to said side walls thereby forming a pair of vertically extending passages and being located so that its lower edge is spaced above the bottom of the tank and its upper edge below the level of the fluid in the tank, gripping means in the hanger for holding photographic elements submerged in said fluid in said passages in planar parallelism with the side walls, an elongated fluid discharge pipe extending along the bottom of the tank substantially the full width thereof, said pipe having an elongated longitudinally extending upwardly opening slot formed therein, said slot being located above the lower edge of the hanger member, a conduit connection between the pipe and trough, and a pump in the conduit connection arranged to pump the fluid flowing into the trough to the pipe so as to cause circulation of the fluid through the passages and hence over the photographic elements, said pump being operated to produce continuous non-turbulent flow of the fluid through said passages.

5. Photo developing apparatus as claimed in claim 4 including processing fluid reservoir means connected to the processing tank for dispensing measured quantities of said fluid thereinto, said means being graduated so as to measure a quantity of fluid sufficient only to fill the tank to the level of a selected slot in said side wall.

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