Aug. 24, 1943. W. B. MOORE 2,327,733

FILM DEVELOPING TANK

Filed Dec. 14, 1939 3 Sheets-Sheet 1

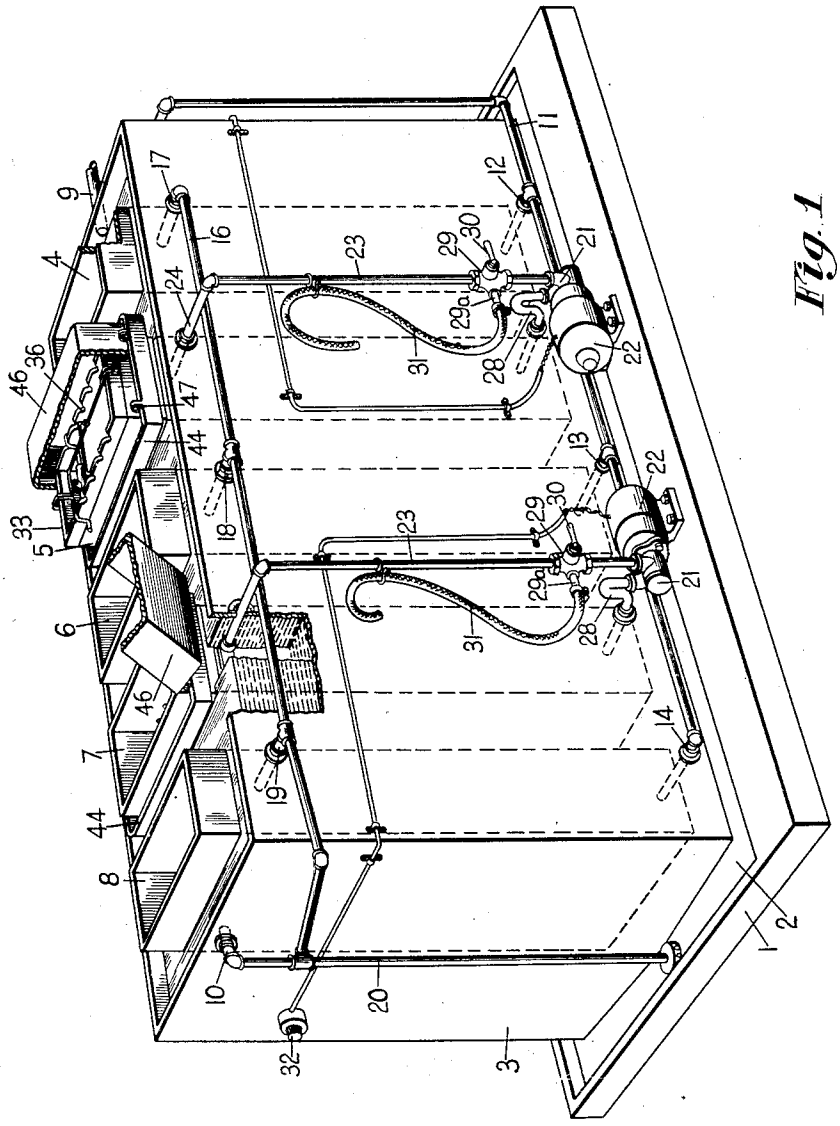


Fig. 1

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Filed Dec. 14, 1939 3 Sheets-Sheet 2

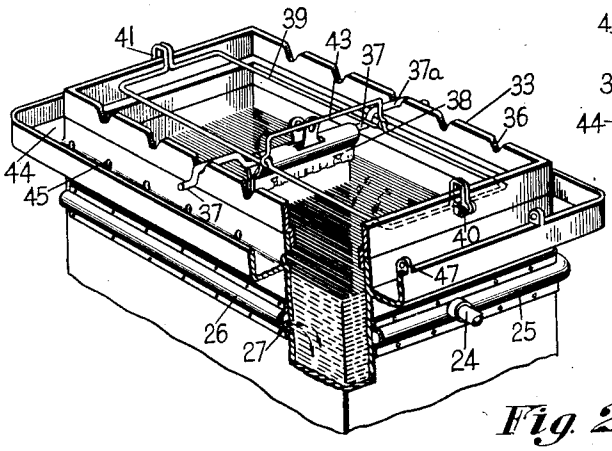


Fig. 2

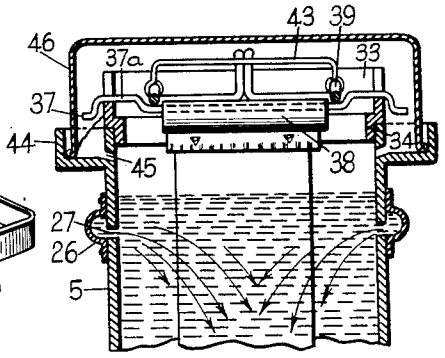


Fig. 3

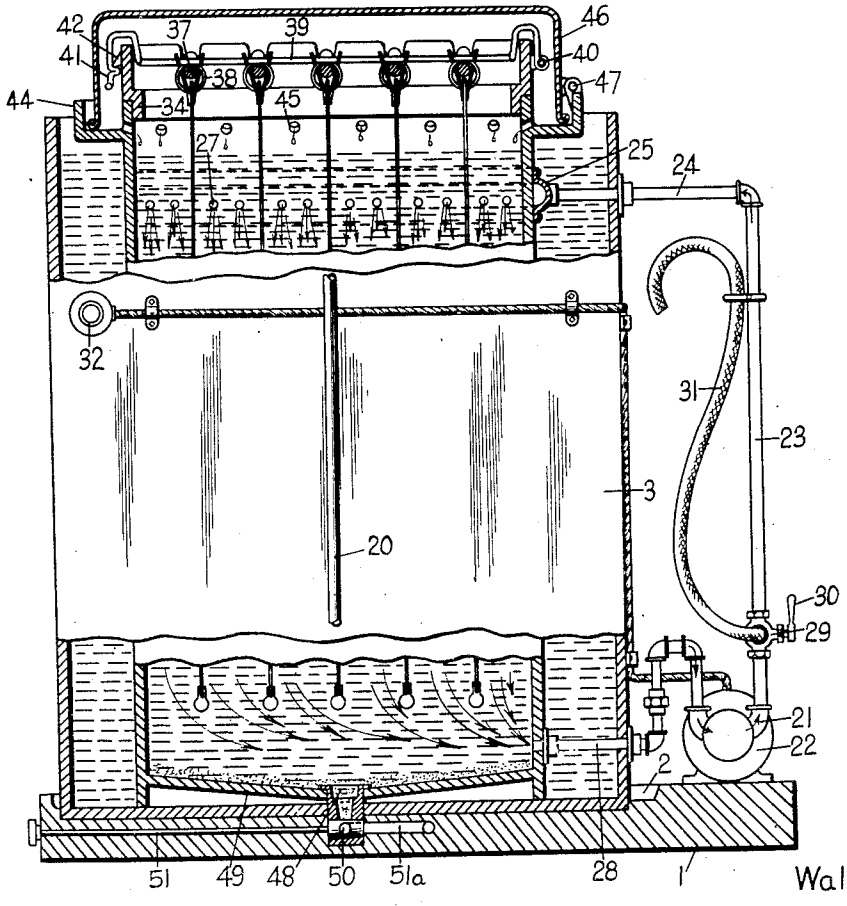


Fig. 4

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FILM DEVELOPING TANK

Filed Dec. 14, 1939 3 Sheets-Sheet 3

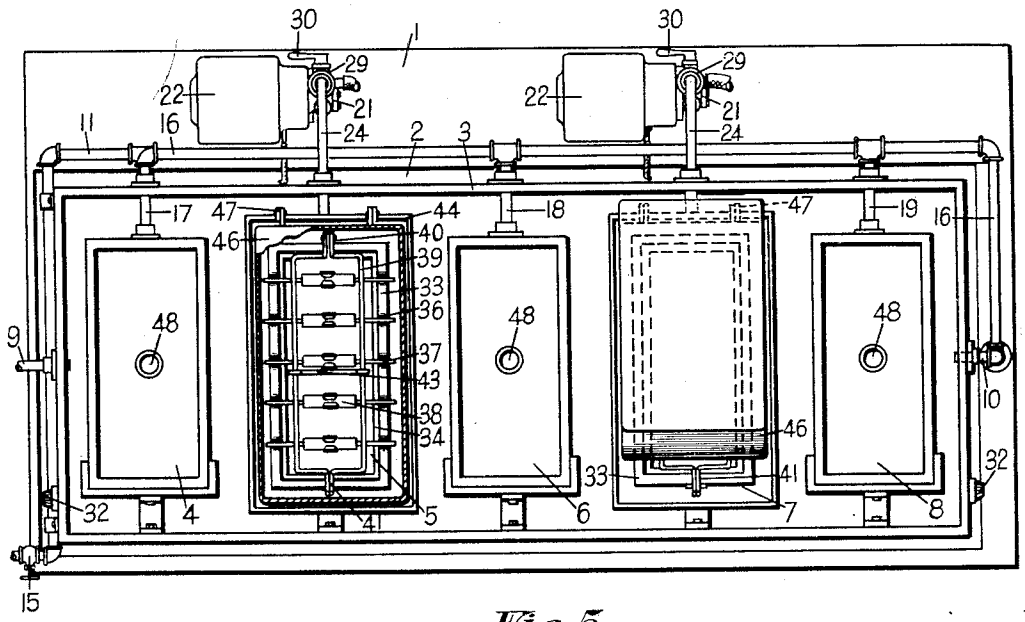


Fig. 5

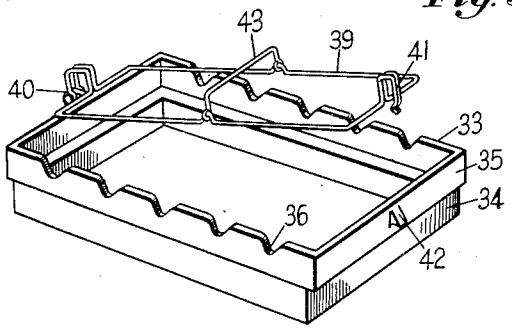


Fig. 6

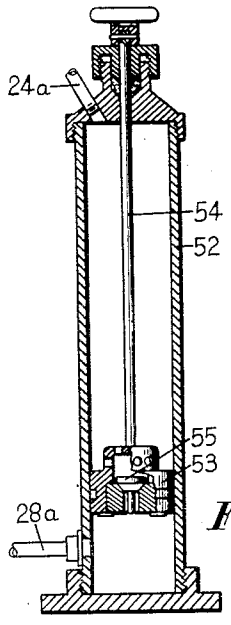


Fig. 7

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# UNITED STATES PATENT OFFICE

2,327,733

## FILM DEVELOPING TANK

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Application December 14, 1939, Serial No. 309,221

2 Claims. (Cl. 95—89)

My invention relates to a film developing tank. It has to do, more particularly, with a tank for developing photographic film and which is particularly useful in developing roll film but which may also be used for developing film pack and cut film.

In the past, no satisfactory tank has been provided for developing film and particularly roll film. In order to properly develop the film it is necessary to have proper circulation of the developing liquid during the developing operation. The developing liquid must be circulated in such a manner as to eliminate all air bubbles from the surface of the film in order to obtain complete and uniform development. Also the circulation must be accomplished in such a manner that the silver released from the film during the developing process will not lie on or adhere to the film during the process of developing but will settle to the bottom of the developing tank. Another disadvantage of prior art developing tanks resides in the fact that they have not been provided with means for maintaining the developing liquids at a constant and proper temperature. In developing film it is important to maintain the liquids used in the developing operation at a normal even temperature. Still another disadvantage of prior art developing tanks resides in the fact that they have not been provided with suitable means for suspending the films in the tanks in such a manner that they may be readily removed from one tank and placed in another tank if desired.

One of the objects of my invention is to provide a developing tank which has means associated therewith for effectively circulating the developing liquid in such a manner that all the films therein will be subjected uniformly to the developing liquid so as to prevent the accumulation of any air bubbles on the films which would interfere with the proper development.

Another object of my invention is to provide a film developing tank of the type indicated which is of such a nature that the circulation will occur in such a manner that the silver released from the film during the developing process will not adhere to the film but will settle to the bottom of the developing tank and will not be subsequently agitated to any extent.

Another object of my invention is to provide a film developing tank which has means associated therewith for maintaining the developing liquid at a constant and proper temperature.

Another object of my invention is to provide a developing tank which has means associated therewith for suspending the films in the tank in an effective manner, said means being of such a nature that the films may be readily positioned in the tank or may be readily removed therefrom.

In its preferred form my invention contemplates the provision of a film developing unit which consists of a series of vertically disposed tanks. These tanks are surrounded by a water jacket which maintains the liquids in the various tanks used in the developing operation at a constant and proper temperature. Certain of these tanks, preferably the tank which contains the developing liquid and the tank which contains the hypo or fixing agent, have means associated therewith for properly circulating the liquid so that all of the films suspended therein will be subjected uniformly to the liquid. The circulation is accomplished in such a manner that all air bubbles will be eliminated from the surfaces of the films and the released silver will deposit on the bottom of the tank. I provide a rack adapted to be associated with the upper end of any of the tanks for suspending the films in the tank in spaced relationship. This rack is of such a nature that the films may be readily removed from one tank and placed in another tank.

This application is a continuation in part of my copending application Serial No. 210,735, filed May 28, 1938, and which issued as U. S. Patent No. 2,226,438 on December 24, 1940.

The preferred embodiment of my invention is illustrated in the accompanying drawings wherein similar characters of reference designate corresponding parts and wherein:

Figure 1 is a perspective view of a film developing unit constructed according to my invention.

Figure 2 is a perspective view, partly broken away, of the upper end of one of the tanks showing the film suspending rack associated therewith and showing a portion of the fluid circulating system.

Figure 3 is a transverse section of the structure illustrated in Figure 2 and showing the inlets for the liquid which is circulated from the top downward through the tank.

Figure 4 is a view partly in end elevation and partly in transverse vertical section of my film developing unit.

Figure 5 is a plan view of the unit shown in Figure 1.

Figure 6 is a perspective view of the film suspending rack.

Figure 7 is a vertical sectional view taken through a hand-operated pump which may be

employed for circulating the liquid in the tank.

With reference to the drawings, in Figure 1 I have illustrated a film developing unit which consists of a series of tanks. However, it is to be understood that my invention is not limited to the number of tanks shown but more may be used. Many of the features of my invention are applicable to a single tank.

The unit comprises a base 1 which has a recessed area 2 in the upper surface thereof. A large tank 3 which is preferably of metal and of rectangular form is disposed in the recess 2 and is suitably secured to the base 1. This tank 3 has its top open. Within the tank 3 a series of smaller tanks are disposed which are indicated by the numerals 4, 5, 6, 7 and 8, respectively. Each of these tanks is of rectangular cross section and is slightly taller than the tank 3. These tanks are spaced from each other and are also spaced from the wall of the tank 3. They are suitably secured in position in the tank 3. The tank 3 serves as a water jacket for the smaller tanks. At one end of the tank 3 an inlet pipe 9 is provided and at the other end of the tank 3 an outlet pipe 10 is provided. The inlet and the outlet are adjacent the upper end of the tank. Water is adapted to enter through the inlet 9 and fill the tank and the overflow will pass out through the outlet 10. When using my film developing unit it is preferred to circulate water through the tank 3 to maintain the liquids in the various smaller tanks at a constant and proper temperature. It is preferred that this temperature be from 65 to 68 degrees F. to obtain proper development. Therefore, the inlet 9 should be connected to a source of water or other liquid which is sufficiently cool to maintain this temperature.

It is preferred that the tank 4 be filled with water, the tank 5 filled with the developing liquid, tank 6 filled with water, tank 7 filled with the hyo or fixing agent and the tank 8 be filled with water. In developing the film, it is first placed in the tank 4 where it is washed to eliminate dust and to reduce to a minimum the possibility of air bubbles forming on the surfaces of the film. Then the film is removed from the tank 4 and is placed in the tank 5 which is filled with the developing liquid. After the film remains in this tank a sufficient length of time to be developed, it is placed in the tank 6 which is filled with water so that the film will be rinsed. Then the film is removed from this tank and is placed in the tank 7 where it is subjected to the hypo for a suitable length of time. It is then removed and placed in the tank 8 where it is subjected to the final washing operation.

A water inlet pipe 11 is provided outside the tank 3 and adjacent the base 1. This pipe 11 has a branch 12 which leads through the wall of the tank 3 and is connected to the bottom of the tank 4. This pipe 11 is also provided with a branch 13 which leads through the wall of the tank 3 and is connected to the bottom of the tank 6. It is also provided with a branch 14 which leads through the wall of the tank 3 and is connected to the bottom of the tank 8. Flow of water into this inlet pipe may be controlled by a valve 15. Thus, means is provided for causing water to flow into the bottom of the tanks 4, 6 and 8. An outlet pipe 16 is associated with the tank 3 adjacent the upper end thereof. This outlet pipe has a branch line 17 which passes through the wall of the tank 3 and which is connected to the tank 4 adjacent the upper end thereof. A branch 18 of the pipe 16 passes through the wall of the tank 3 and is connected to the tank 6 adjacent the upper end thereof. A third branch 19 is connected to the pipe 16 and passes through the wall of the tank 3. Its inner end is connected to the tank 8 adjacent the upper end thereof. The pipe 16 is connected to a vertical pipe 20 which may lead to a sewer. The outlet pipe 10 for the tank 3 may also be connected to the pipe 20. Thus, I have provided means for supplying water to the lower ends of the various wash tanks and means for withdrawing it from the upper ends thereof.

It is important to have the developing liquid in the tank 5 circulate in a proper manner during the developing operation. It is also important to have the hypo in the tank 7 circulate in the proper manner during the fixing operation. Therefore, I provide means associated with each of these tanks for circulating the liquid therein.

For circulating the liquid through the tank 5, I provide a small pump 21 which is driven by an electric motor 22 secured to the base outside the ank 3. A vertically disposed pipe 23 disposed outside the tank 3 is connected to the discharge of the pump 21. This pipe 23 has a branch 24 at its upper end extending inwardly through the wall of the tank 3. The inner end of this branch 24 is connected to a U-shaped pipe 25 (Figure 2) This U-shaped pipe extends along two sides of the tank 5. Each branch 26 extending along the side of the tank communicates with a series of inlet openings 27 (Figures 3 and 4) which are formed in the wall of the tank 5 adjacent the upper end thereof. Thus, a series of inlets is provided adjacent the upper end of the tank at each side thereof. This insures that the incoming liquid will be distributed uniformly throughout the tank and will cause uniform agitation downward throughout the tank. At the lower end of the tank an outlet pipe 28 is connected thereto. This outlet pipe is connected to the inlet of the pump 21. Thus, the pump will serve to circulate the developing liquid through the tank 5, the circulation occuring from the top towards the bottom which is an important feature and will be referred to later. The pipe 23 is provided with a three-way valve 29 interposed therein. This vavle is operated by a handle 30. A flexible conduit 31 is connected to one branch of this valve. In one position of the handle 30 the outlet through the valve to the pipe 31 will be closed and if the pump is operated, the liquid will be forced up through the pipe 23 and into the tank. In the other position of the valve handle, the liquid will be forced into the pipe 29a but will not flow past the valve 29 but instead will flow out through the conduit 31. In this way the tank can be emptied by the pump and the conduit 31 may be disposed in a container for the developing liquid so that the liquid may be removed from the tank and saved. Thus, the pump serves to provide circulation in the tank and also serves as a means for removing the developing liquid from the tank.

The means for circulating the liquid in the tank 7 is exactly the same as that provided for circulating the liquid in the tank 5. Therefore, it need not be described in detail. Each of the motors 22 may be controlled by a rheostat 32. Varying the speed of the motor will vary the amount of circulation.

In order to suspend the films in the tank, I provide a rack of the type illustrated in Figure 6. This rack comprises a rectangular frame 33

which has a lower smaller portion 34 adapted to fit within the upper end of any of the tanks. When positioned in the upper end of a tank the upper larger portion 35 will rest on the upper end of the tank. The upper edge of the frame 33 is provided with a series of pairs of notches 36. Each pair of notches 36 is adapted to receive a transversely extending pin 37 to which the upper end of the film may be attached by means of a clip 38 (Figures 2 and 3). A retaining member 39 is hinged to one end of the frame 33 as at 40. The opposite end of this member 39 is provided with a spring latch 41 which is adapted to cooperate with a keeper 42 formed on frame 33. The member 39 when in its lower position will engage the members 37 and hold them in the notches 36. Each pin is provided with a pair of shoulders 37a which cooperate with member 39 to prevent longitudinal movement of the pin. The member 39 will be retained in such position normally by cooperation of members 41 and 42. The member 39 has a handle portion 43 formed thereon. It will be apparent that with this structure a series of films may be suspended from the rack in spaced relationship. The rack may be moved from one tank to the other with the films suspended therefrom. Thus, the films may be quickly removed from one tank and positioned in another tank.

The tank 5 is provided with a channel 44 which surrounds it adjacent the upper end thereof. This channel is adapted to receive liquid which might drip from the films thereinto while the films are being lifted from the tank by means of the rack. This channel communicates with the interior of the tank by means of a plurality of spaced openings 45 (Figures 2 and 3) formed in the wall of the tank at the bottom of the channel. A lid 46 is hinged to the channel member as at 47 so that the upper end of the tank may be closed. This lid has a depending flange which will surround the upper end of the tank and will be positioned in the channel member when closed. The tank 7 is provided with a similar channel structure and lid structure. Thus, both of these tanks may be covered and protected from the light. Consequently, the room in which the unit is disposed may be illuminated during the developing and fixing operations.

The bottom of each of the tanks 5 and 7 is provided with a cleanout opening 48. The bottom wall of the tank tapers as indicated at 49, towards this opening 48. This opening 48 is under the control of a hollow plug valve 50 which may be rotated by means of a shaft 51. When opened the liquid will flow from the tank through an outlet passageway 51a. The tank may be flushed out by leaving the valve open and operating the pump. This will flush out any settling at the bottom of the tank.

Although I prefer to use a motor drive pump for obtaining the circulation in the tank, it is possible to use a hand-operated pump of the type shown in Figure 7. This pump comprises a cylinder 52 having a piston 53 disposed therein and which may be moved vertically by a rod 54. An inlet 28a is provided at the bottom of cylinder 52 and an outlet 24a is provided at the top thereof. The piston is provided with a one-way valve 55 which permits upward passage of liquid therethrough but prevents downward passage therethrough. When the piston is drawn upwardly by the rod 54, the liquid in cylinder 52 which is above the piston 53 will be forced through the outlet 24a into the tank. Simultaneously, the liquid will be drawn into the lower end of the cylinder through the inlet 28a. When the piston 53 is forced downwardly, the liquid will merely pass from the lower side to the upper side of the piston.

It will be apparent that with this structure, the films will be suspended in the tanks in spaced relationship as illustrated best in Figure 4. Since the tanks 5 and 7 are provided with the circulating means, the liquid in such tanks will be effectively circulated. Since the films will be suspended in spaced relationship therein and since the inlets 27 are spaced along the sides of the tanks, the liquid will be uniformly distributed over all the films and there will be uniform agitation. Consequently, all surfaces of the film will be uniformly subjected to the liquid and all air bubbles will be eliminated from the surface of the film. The silver released from the film during the developing process will not adhere to the film but will be forced downwardly and will deposit on the bottom of the tank. It is important that the circulation be from the top of the tank towards the bottom so that the silver will be forced downwardly away from the film. Furthermore, after the silver once deposits on the bottom of the tank, it will not be again stirred up because the circulation is downward. It is important for the outlet 28 to be spaced above the bottom of the tank sufficiently to prevent clogging.

During the developing process, the liquid in the various tanks will be kept at a uniform and proper temperature by the water jacket. The films suspended from the rack may be easily and quickly moved from one tank to the other during the developing process.

Since the developer is circulated constantly from the top of the tank to the bottom downwardly through the tank, even development and clean films not only result but also the developing time is reduced from 25% to 33⅓%, as I have found in actual practice.

Many other advantages will be apparent from the preceding description, the drawings, and the following claims.

In the following claims where I refer to film, I intend to cover roll film, cut film and film pack carried by racks, or sensitized brass plates, etc.

Having thus described my invention, what I claim is:

1. A developing unit for developing photographic film comprising a series of tanks in which the film is adapted to be successively disposed, a large tank surrounding all of the first-named tanks, all of said tanks being in spaced relationship, the larger tank being adapted to receive water or other liquids to maintain the smaller tank at a predetermined temperature, a pump disposed outside of said large tank and connected to one of said small tanks, the body portion of said one of said small tanks being provided with a series of small spaced inlets on the opposite sides of the tank at the upper end thereof, said film being supported transversely relative to the sides having inlets formed therein, said body portion being provided with an outlet adjacent its lower end but spaced above the lower end, means for driving said pump so that the liquid will be forced through the inlets in the body portion of the tank and will be withdrawn simultaneously from the outlet disposed at the lower end of the tank so as to circulate the liquid downwardly past the film

disposed in the tank, and an overflow channel member disposed in surrounding relationship to the upper outer edge of said body portion of the small tank, said body portion having a plurality of spaced openings formed in the wall thereof at the bottom of the channel member so that the liquid dripping into said channel member will be returned to said body portion of the small tank.

2. A developing unit for developing photographic film comprising a tank in which the film is adapted to be disposed, a pump disposed outside of said tank and connected thereto, the body portion of said tank being provided with a series of small spaced inlets on the opposite sides of the tank at the upper end thereof, said film being supported transversely relative to the sides having inlets formed thereon, said body portion being provided with an outlet adjacent its lower end but spaced above the lower ends, means for driving said pump so that the liquid will be forced through the inlets in the body portion of the tank and will be withdrawn simultaneously from the outlet disposed at the lower end of the body portion of the tank so as to circulate the liquid downwardly past the film disposed in the tank, and an overflow channel member disposed in surrounding relationship to the upper outer edge of said body portion of the tank, said body portion having a plurality of spaced openings formed in the wall thereof at the bottom of the channel member so that the liquid dripping into said channel member will be returned to said body portion of the tank.

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