

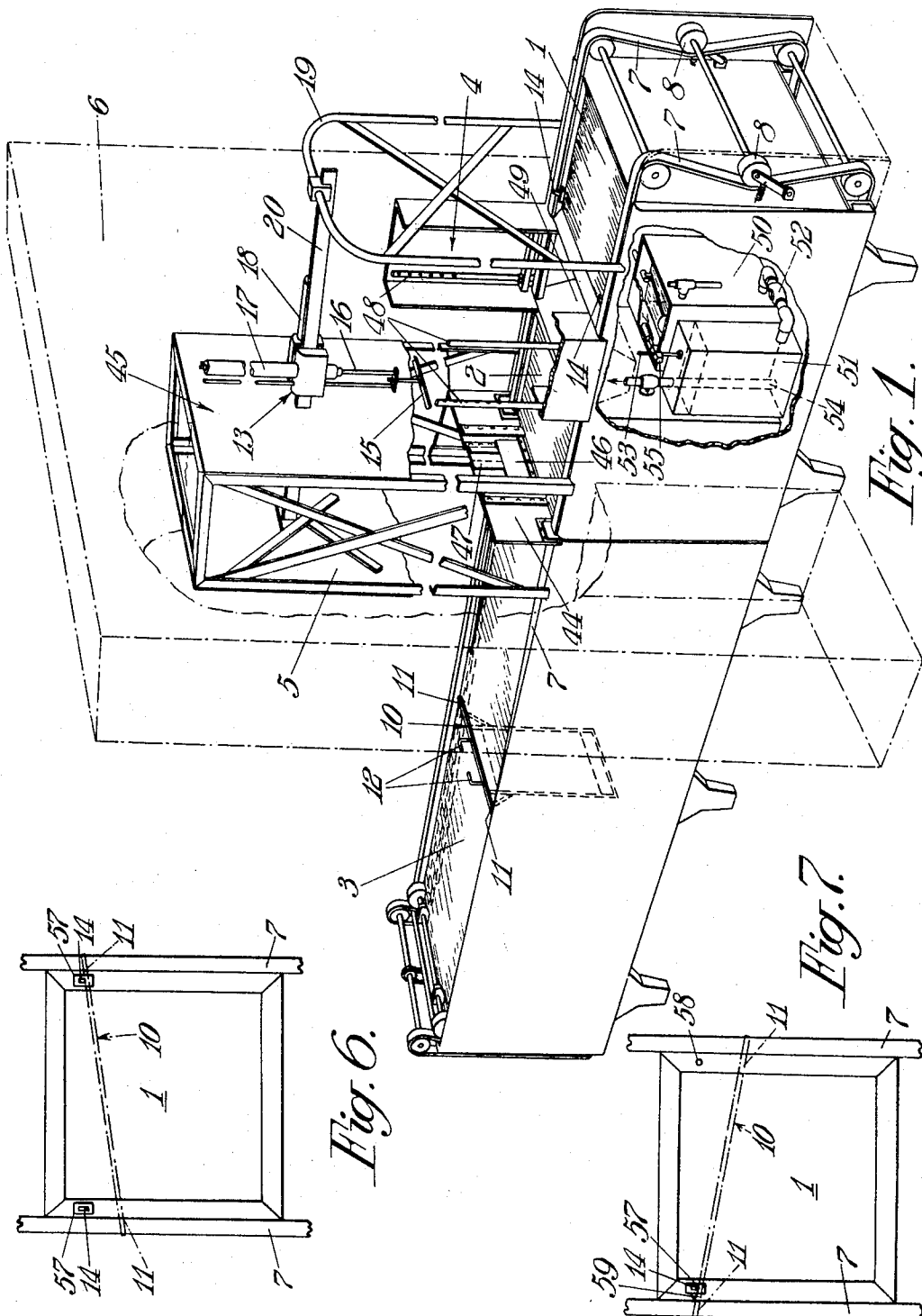
Feb. 14, 1956

T. H. HILLS
DEVELOPING APPARATUS FOR PHOTOGRAPHIC
FILMS, PLATES AND PAPERS

2,734,436

Filed April 14, 1952

5 Sheets-Sheet 1



Thomas H. Hills, Inventor,
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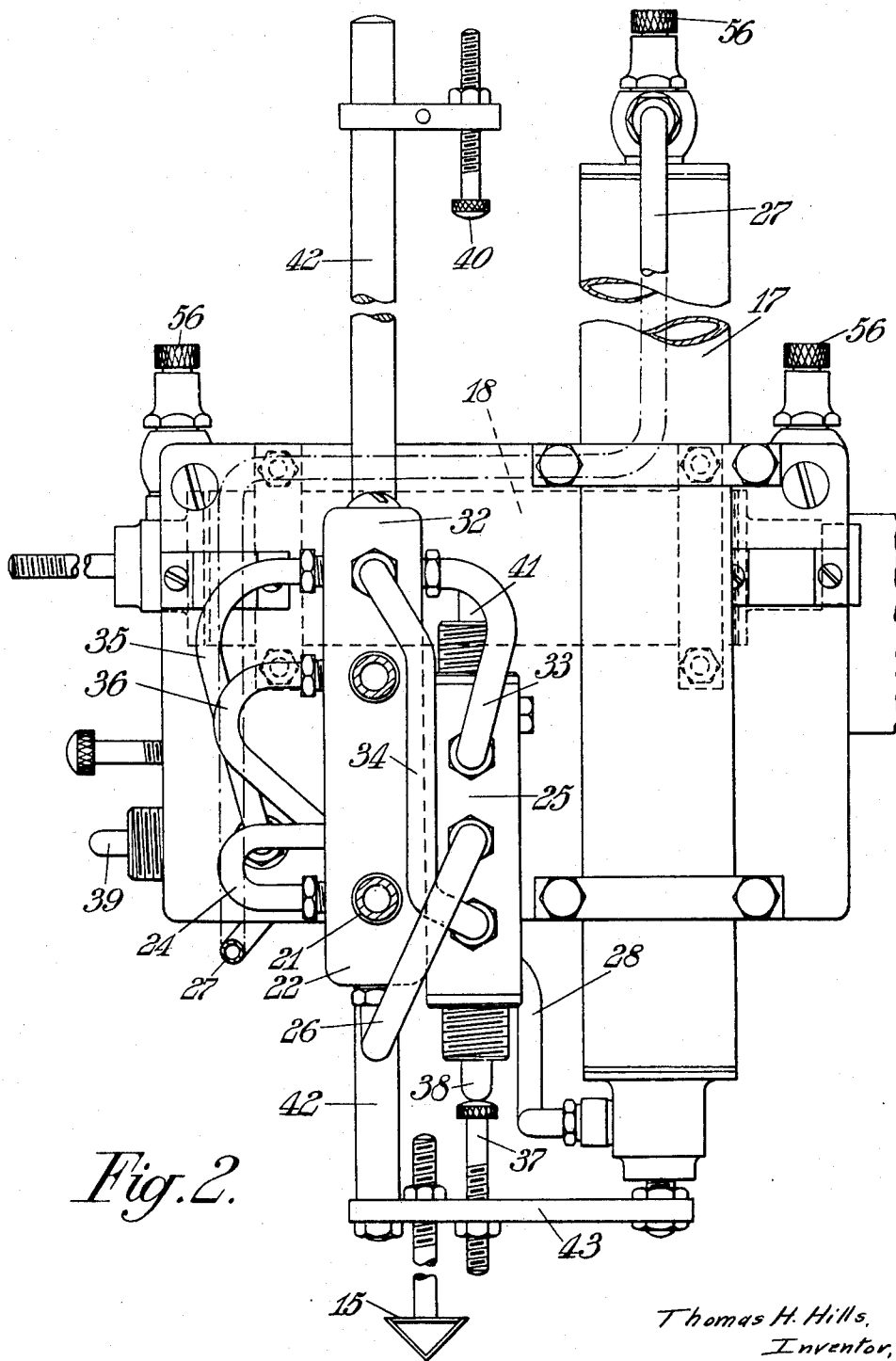
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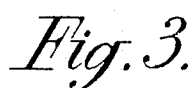
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DEVELOPING APPARATUS FOR PHOTOGRAPHIC FILMS, PLATES AND PAPERS

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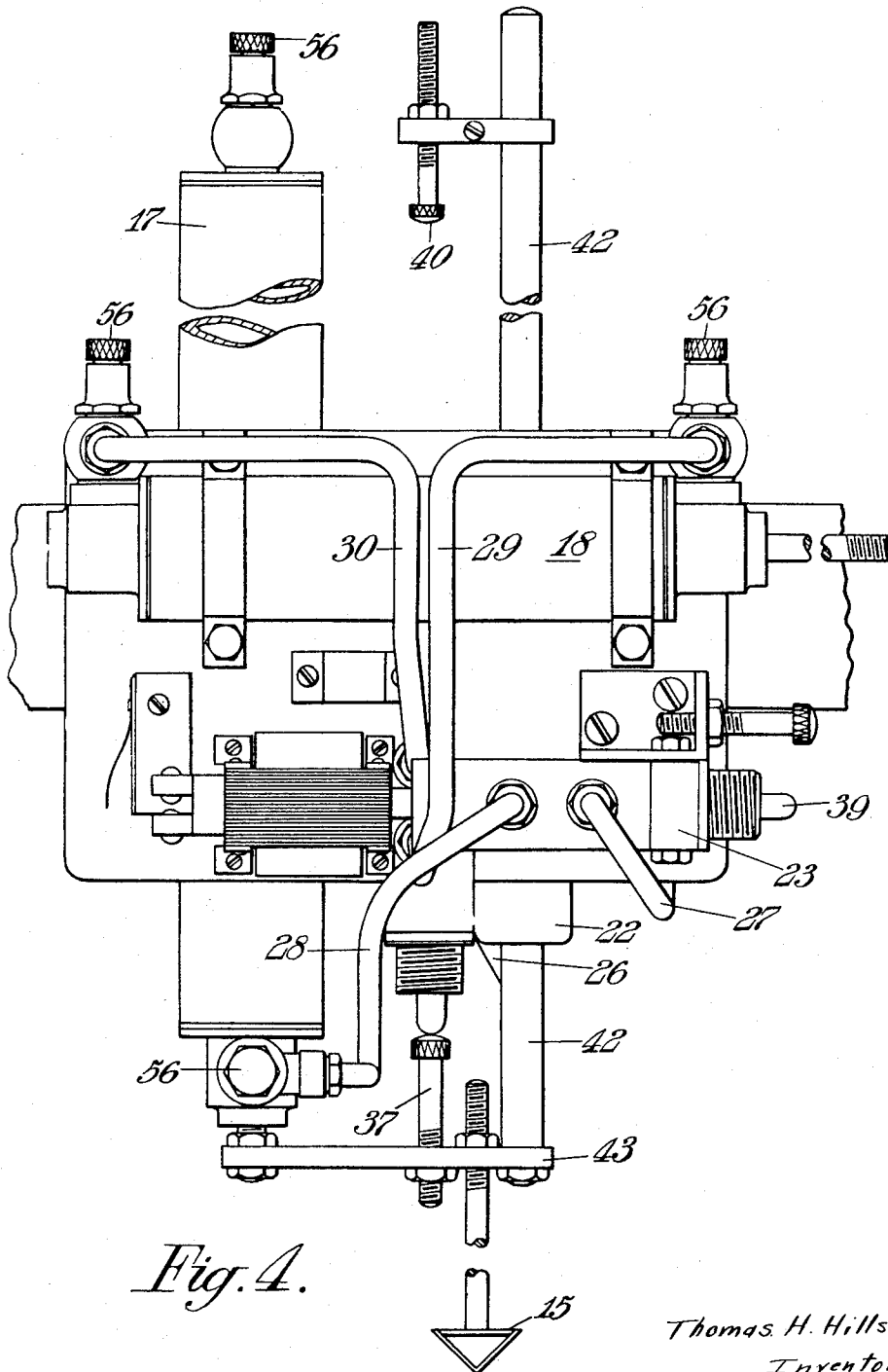


Fig. 4.

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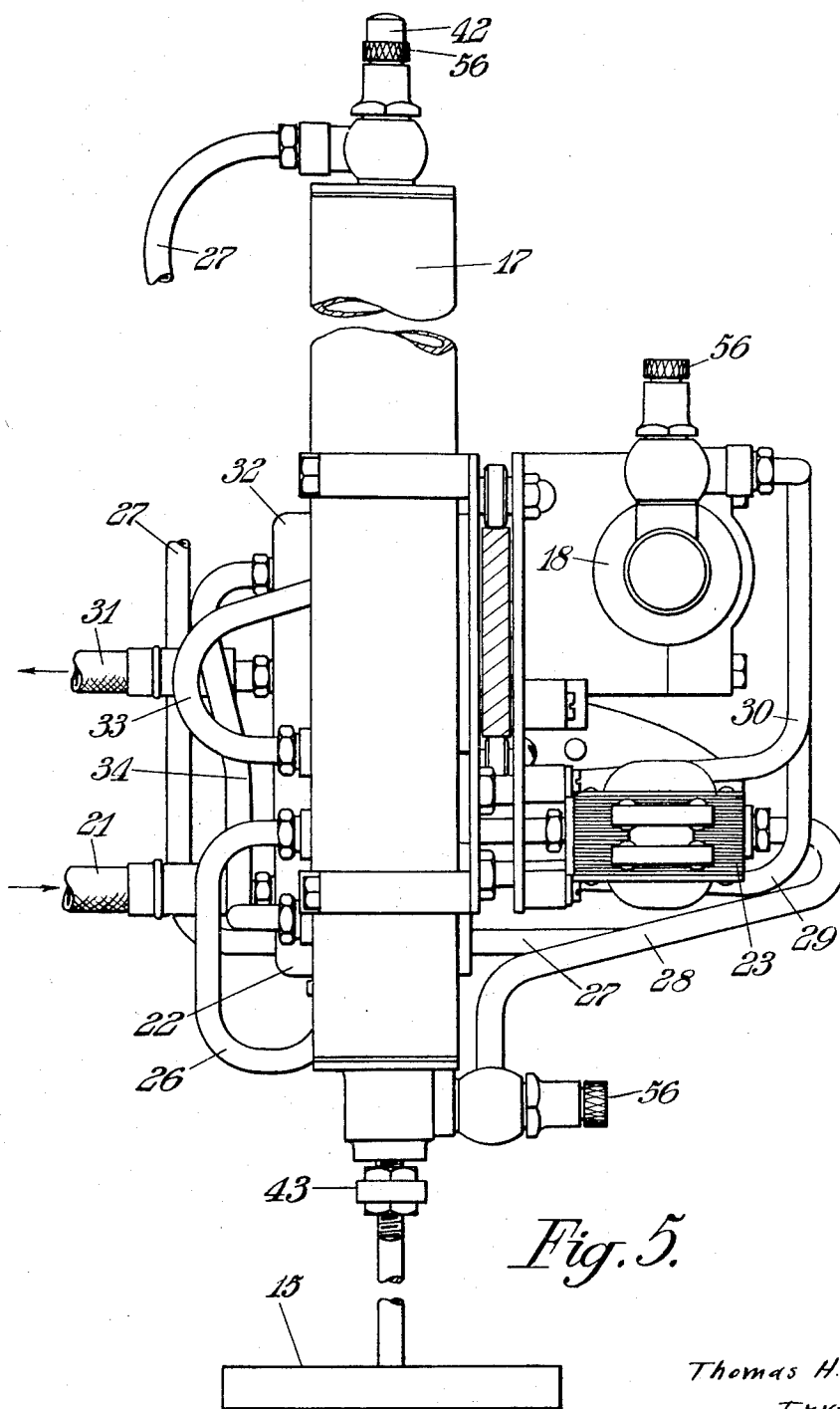


Fig. 5.

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DEVELOPING APPARATUS FOR PHOTOGRAPHIC FILMS, PLATES, AND PAPERS

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Application April 14, 1952, Serial No. 282,187

4 Claims. (Cl. 95—89)

This invention relates to developing apparatus for photographic films, plates and papers, in particular to X-ray films.

The object of the invention is to provide apparatus for use in developing X-ray films which will completely develop, fix and wash the film automatically and quickly without attention save for the loading of the exposed films into the device.

The invention consists in apparatus for developing photographic films, plates and papers and the like comprising a series of open topped tanks for holding the developing, fixing and washing liquids, placed in line, frame means each for carrying one piece of photographic material, a continuously movable conveyor belt means for supporting and moving the frame means through the liquids in the tanks, and lifting, traversing and lowering means between adjacent tanks for engaging and transferring the frames one at a time from one tank to the next, operation of the lifting, traversing and lowering means being initiated in each instance by the arrival of a frame means at the point of engagement with the said lifting, traversing and lowering means.

The invention further consists in that the lifting, traversing and lowering means are each provided with pressure air operated piston means.

A further feature of the invention is that the lifting, traversing and lowering means may be arranged to convey the films through a spray bath to wash the former or to treat them with chemical solutions on their passage from one tank to another.

A still further feature is that a lifting, traversing and lowering means may be incorporated in a light trap in the wall of a dark room so that the washing process may be continued in the light outside the room.

The accompanying drawings show, by way of example only, one embodiment of the invention in which:

Figure 1 is a perspective view of the apparatus,

Figure 2 is a front elevation of the lifting, traversing and lowering device,

Figure 3 is an elevation of one end of the lifting, traversing and lowering device,

Figure 4 is a back elevation,

Figure 5 is an elevation of the other end of the lifting, traversing and lowering device, and

Figures 6 and 7 are alternative arrangements of the cycle initiating means.

The apparatus as shown in Figure 1 comprises a series of tanks of which 1 contains the developing solution, 2 the fixing solution, while 3 is the washing tank. The unit 4 is a spray washing device to remove the surplus developer from the films before they are placed in the fixing tank 2. The mechanical system controls both the movement of the films through the length of the tanks as well as through their transference from one tank to the next at the correct time intervals. The apparatus is constructed so that in use the developing and fixing tanks are in a dark room, the two communicating with the washing tank through the artificial space 5 cut in the common

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wall 6. The tanks are arranged in a continuous line so that the films in processing start at one end of the developing tank 1 and move continuously along the length of the tanks passing through the wall 6 at the end of the fixing period to reach the washing tank 3.

Along both sides of the tank system there is a guide rail which is located along the top of the tanks and extends to the full length of the unit. In the washing tank 3 these guide rails incline downwards so that at the final end of the washing tank they are some two inches below the level of the water. These guide rails serve both to locate and support two flat inextensible rubber impregnated canvas belts 7 which are one inch wide and one-quarter inch thick. The two belts 7 operating together act as a conveyor for the X-ray films and pass at the end of the tank over two driving pulleys not shown which are locked on the same shaft, the latter being driven through a reduction gear by a synchronous electric motor. The belts are kept in constant motion during the operation of the unit, their speed being of the order of two inches per minute. These belts are endless and they return along the outside of the tank system, below the working level, located and tensioned by a series of jockey pulleys 8.

Before processing the X-ray films are attached to a non-corrosive flat metal frame 9, which has a top cross member 10 sufficiently long to allow its ends 11 to rest on the two canvas belts when placed across the tanks. Attached to the top of the frame are two inverted L-shaped hooks 12, which are parallel to the frame in alignment and have their points about one inch apart. Their purpose is to engage with the frame lifting, traversing and lowering device 13 to be described later. The frame is placed manually across the developing tank 1. The length of the developing tank is such that the frame will travel its entire working length in about five minutes. At the end of this period the ends of the frame which rest on the belts are arrested by two small triggers, one on either side of the unit, a small movement of each of these triggers serving to close a microswitch both of which switches are in series. There is sufficient friction between the canvas belt and the frame for it to move at the same speed as the belts but not so great that it will not slide on the belt when in contact with the triggers. Should the manual loading of the frame leave it out of correct alignment across the tank this will be corrected by the triggers, the end of the frame first to contact a trigger ceasing to move while the opposite end still moves forward to operate the opposite trigger. It is the operation of these two triggers and their microswitches which sets into motion the frame lifting device 13. It should be noted, therefore, that it is the frame itself which initiates the process which ultimately places it in the next tank. Alternative means for initiating the process are referred to later on in the specification.

Attached to the bottom of the lifting device is an inverted T-shaped hook 15. At rest its lever is such that the corresponding L-shaped hooks on the frame come to rest just clear of the upper surface of the two arms of the T. These arms are grooved so that the corresponding L hooks on the frame are engaged by an upward movement of the T. The movement of the T hook consists of four independent strokes which complete a rectangle, the long vertical sides of which are twenty inches and the shorter top and base six inches. To achieve this movement the T hook is fixed to the lower end of a piston rod 16 which is connected to the piston of a vertical cylinder 17 of twenty inches full stroke. This cylinder is double acting and is located by its attachment at right angles to a second double acting cylinder 18 of six inch stroke, the long axis of the shorter cylinder being along the mid-line of the tanks. Where the length of the hori-

zontal movement carried out by the horizontal cylinder is sufficient to carry the film through a spray washing device this horizontal cylinder may have to be increased in length up to twelve or more inches. A fixed frame 19 is located across the tanks at the level of the shorter cylinder, and this supports a polished metal guide rail 20. The two cylinders are mounted on a carriage which is free to slide along the line of this rail, the latter being parallel to the shorter cylinder, the piston rod of the short cylinder being fixed to a suitable point on the frame. 10 The upward movement of the T hook is therefore achieved by the up-stroke, while the travel along the length of the tank is achieved by the movement of the two cylinders as one unit. At the end of the cross travel the downward movement is achieved by the return stroke of 15 the vertical cylinder 17, the T hook descending to such a level that the frame is restored to the belts and the T itself is clear to return by the fourth movement, which restores it to its original position.

All the movements of the above are effected by a single supply of compressed air by way of the flexible supply line 21 which is connected to the pressure chest 22. Pressure lines are taken from this chest to the solenoid operated vertical movement control valve 23 by way of the pipe 24, and to the vertical movement control valve 25 by the pipe 26. Connections are taken from the valve 23 to the two ends of the vertical cylinder by way of the pipes 27, 28, while connections are taken from the valve 25 to the two ends of the horizontal cylinder by way of the pipes 29, 30.

The flexible line 31 is the exhaust for the exhaust chest 32, and is connected by way of the pipes 33, 34 with the valve 25 and pipes 35, 36 with the valve 23.

The operation of the lifting, traversing and lowering of the film carrier commences with the T 15 in the lowered position. The initiation of the cycle by the closing of both microswitches associated with the triggers closes the circuit of the solenoid which moves the valve 23 into the position to supply air to the bottom of the vertical cylinder 17, resulting in the lifting of the film on its frame until the adjustable abutment screw 37 engages the lower end 38 of the movable part of the valve 25, thus directing the air by way of the pipe 29 to the forward end of the horizontal cylinder 18. As this cylinder is fixed to the device, the latter moves as a whole in the forward direction until the end 39 of the movable part of the valve 23 engages an abutment on the supporting frame thereby returning the valve to its original position and directing the air to the upper end of the cylinder 17. As a result of this the T 15 is lowered and the film frame deposited on the conveyor belts in the next tank. At the same time the abutment screw 40 engages the end 41 of the movable member of the valve 25 thereby directing the air to the backward end of the horizontal cylinder 18 which causes the unit as a whole to complete the cycle by returning to the commencing position, in which position it is ready to receive the next film frame.

In the case of both valves, the ends of the cylinders being exhausted are connected by the respective valves to the exhaust chest 32 and the flexible tubing 31.

Each connection with the end of a cylinder is provided with an adjustable needle valve 56 by means of which the rate of entry of the air into the cylinder or exhaust therefrom can be regulated to determine the speed at which the lifting, traversing and lowering of the film frames takes place.

Mounted alongside the vertical cylinder, and parallel to it, is a hollow tube and in this there is a sliding rod 42. The lower end of this rod 42 is connected by a link 43 to the lower end of the main piston rod above the T hook. This serves both to prevent rotation of the piston rod and to stabilise the latter.

The air controlled cylinder unit described above is in practice installed at each point where frames have to be transferred from one tank to the next in series.

At the point where the system of tanks passes through the wall 6 there is a special device to prevent any harmful quantity of light from entering the dark room while allowing the free passage of the frames. The end of the fixing solution tank, which is situated in the line of the wall, is extended upwards for a distance of six inches to form a baffle 44. Two false partitions are arranged at about six inches on either side of this, so that they fill up the opening in the wall forming, in effect, with the wall an inverted box open at its bottom. The box 45 is so located that the lower edges are two inches above the top line of the tanks. This, with the extension of the end wall of the fixing tank, makes it impossible for any unreflected ray of light to pass through the wall. One of the lifting units already described is positioned in this box and on its fourth or return stroke the T hook has to pass through the line of the baffle. For this reason a T-shaped slot is cut through the baffle, and this is faced with flexible rubber flaps 46, 47 which, while not impeding the passage of the hook, prevent the passage of any harmful amount of light.

While a frame is moving horizontally during the cross stroke between tanks 1 and 2 it passes between a series of water tubes 48 which are perforated to form a spray. The jets of water washing the surface of the film as it moves between them. The excess water from this spray unit, and from the surface of the films is collected in a V-shaped trough 49 which separates the tank 1 from which the film has been lifted and the tank 2 into which it will be lowered when washed. Liquid is caused to flow through the above system only when a film is actually passing before it, this is achieved by a branch of the compressed air supply line, controlled by a solenoid reversing valve and an additional microswitch, the latter being positioned on the lifting unit in such a position that it operates only during the appropriate part of the cycle.

The supply water is fed into the open tank 50 via a standard ball valve, so that a constant level is maintained. This is in turn connected with the base of a closed tank 51 via a one-way valve 52. The latter tank has two pipe connections at its top. One 53 is connected to the air supply via the solenoid operated valve 55 direct, while the other 54 is sealed through the top of the tank to extend to within an inch of the base. In the "OFF" position the solenoid operated valve 55 connects the tank 51 to atmosphere, the relative levels of the two tanks being so adjusted that the sealed tank fills from the open until the water is just below the level of the air supply pipe. In operation the controlled air pressure is applied to the sealed tank via the air line. Water cannot flow back into the open tank because of the one-way valve, and so there is a rise of pressure which forces the water up the second pipe, which in turn feeds the spray pipes mentioned above. The desired rate and force of flow of this system is controlled by the pre-setting of a standard restrictor valve in the air line.

A similar device, but in this case constructed of glass or other non-corrosive material, may be used for the controlled replenishment of any of the chemical solutions employed. It will be appreciated that each film in its passage removes a certain volume of the solutions through which it passes, and the tanks can be maintained at a steady and constant level by the adjustment of this device.

Figures 6 and 7 show alternative arrangements of the lifting, traversing and lowering cycle initiating means. In Figure 6 the microswitches 57 have upstanding triggers 14 which are in the path of the ends 11 of the top cross members 10 of the frames 9, but should the frames be placed in the first tank at an angle other than a right angle to the line of movement of the belts, one of the switches is closed first, but being in series with the other switch the circuit is not closed until the frame swings round and operates the second trigger as well, by this means it is ensured that the frames are at right angles to the tanks before lifting commences. Another way of

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achieving the above, and which obviates the necessity of providing two microswitches, is to provide a fixed upstanding post to one side of the tank while a switch and trigger are provided at the other side so guarded by an abutment or abutments that the trigger cannot be operated until the film frame is at right angles to the tanks. This arrangement is shown in Figure 7 in which the vertical post 58 is provided one side while an abutment 59 is provided to one side of and just behind the front of the trigger 14, from which it can be seen that when one side of the frame is in advance of the other it will contact the post 58 first and will then swing round until the other side of the frame engages the trigger 14, while if the latter side of the frame approaches first it will be prevented from operating the trigger 14 by the abutment 59 until the other side of the frame is adjacent the post 58. Other means for ensuring that the frames are at right angles to the line of motion of the belts before lifting commences may be provided as convenient.

An important feature of the general design of unit is the fact that all additional operations, such as the transfer of films from one tank to the next, their washing, the replacement of chemicals and the like are put into motion by the frames themselves. No energy or material is consumed at times when the unit is not in full operation, the only portions of the unit in continuous operation being the endless belts. This unit is intended for the complete processing of X-ray films or ordinary photographic material both paper and film and other applications when photographic material has to be handled in bulk.

The number and lengths of the tanks can be chosen to suit particular requirements and other details for carrying the invention into effect may be varied without departing from the scope of the invention.

I claim:

1. Apparatus for developing photographic films, plates, papers and the like comprising a line of open topped tanks for holding liquids, a pair of parallel continuously movable endless conveyor belts one along the top edge of each side of the line of tanks, frame means each adapted for carrying photographic material and to be supported on opposite sides upon the conveyor belts with the photographic material submerged in the liquid in a tank, pneumatically operated lifting, traversing and lowering means positioned above and adjacent the ends of adjacent tanks comprising a pair of cylinders, the one mounted vertically and the other horizontally for carrying out a cycle of operations whereby in transferring a frame means from one tank to the next, a frame means engaging hook associated with the vertically mounted cylinder describes an uninterrupted cycle of movements along a closed path including at least three different sides of a rectangle, and in which cycle the frame means is engaged at an initial position at the end of one tank, is lifted from the conveyor belts and clear of the tank, is carried forward to a position over the next tank and is lowered on to the conveyor belts, and in

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which the hook returns to the initial position to complete the cycle preparatory to the engagement of the following frame, the commencement of the cycle of operations is initiated by the engagement of a frame with the trigger of an electric switch mounted one side of the tanks adjacent a conveyor belt, said switch being one of a pair of like switches positioned on a line at right angles to the belts and connected in series.

2. Apparatus for developing photographic films, plates, papers and the like comprising a line of open topped tanks for holding liquids, a pair of parallel continuously movable endless conveyor belts one along the top edge of each side of the line of tanks, frame means each adapted for carrying photographic material and to be supported on opposite sides upon the conveyor belts with the photographic material submerged in the liquid in a tank, pneumatically operated lifting, traversing and lowering means positioned above and adjacent the ends of adjacent tanks including a pair of cylinders, the one mounted vertically and the other horizontally for carrying out a cycle of operations whereby in transferring a frame means from one tank to the next a frame means engaging hook associated with the vertically mounted cylinder describes an uninterrupted cycle of movements along a closed path including at least three different sides of a rectangle, and in which cycle the frame means is engaged at an initial position at the forward end of one tank, is lifted from the conveyor belts and clear of the tank, is carried forward to a position over the next tank and is lowered on to the conveyor belts, and in which the hook returns to the initial position to complete the cycle preparatory to the engagement of the following frame and washing apparatus between two of the tanks comprising perforated tube means through which water is sprayed upon the photographic material as it passes between the one tank and the next, said water being provided under pressure to the tube means by the displacement of the water from a closed vessel by means of compressed air, and a receiver below the tube means to collect the liquid.

3. Apparatus for developing photographic films, plates, papers and the like as claimed in claim 2 in which the water in the closed vessel is supplied from an open topped tank by way of a non-return valve.

4. Apparatus as claimed in claim 3 in which the instant at which washing or dosing takes place is controlled by a solenoid operated in a pressure air supply line, the solenoid being controlled by a switch operated by the movement of the lifting, traversing and lowering means.

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