

July 30, 1957

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2,800,845

PHOTOGRAPHIC FILM DEVELOPER

Filed March 15, 1955

4 Sheets-Sheet 1

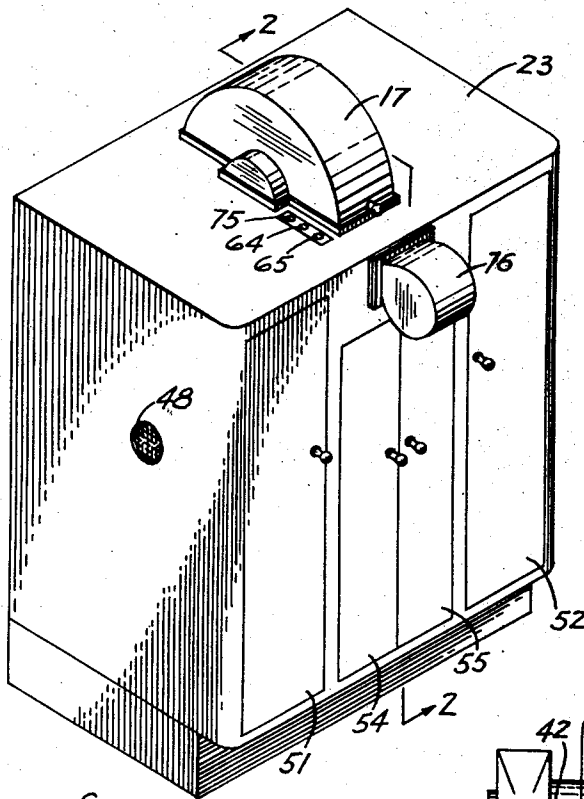


FIG. 1

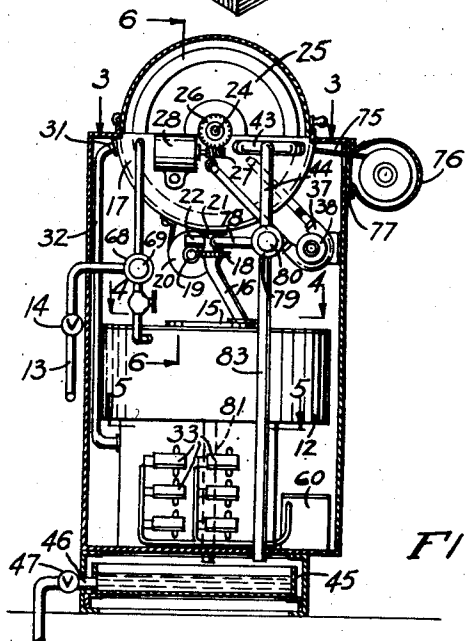


FIG. 2

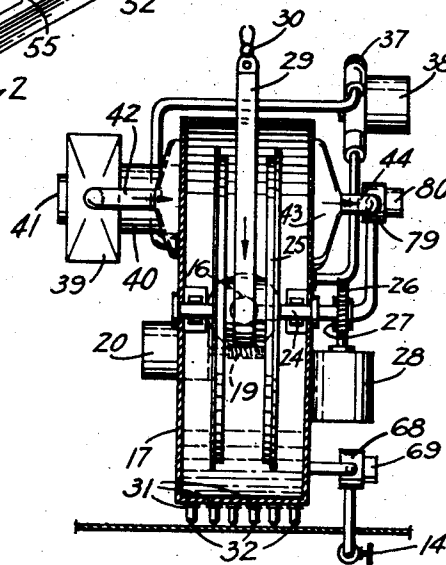


FIG. 3

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4 Sheets-Sheet 2

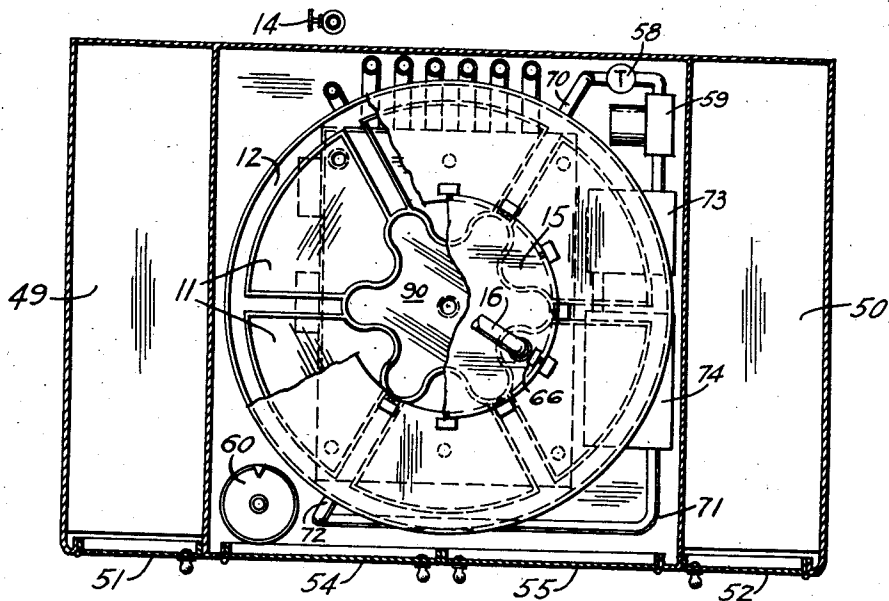


FIG. 4

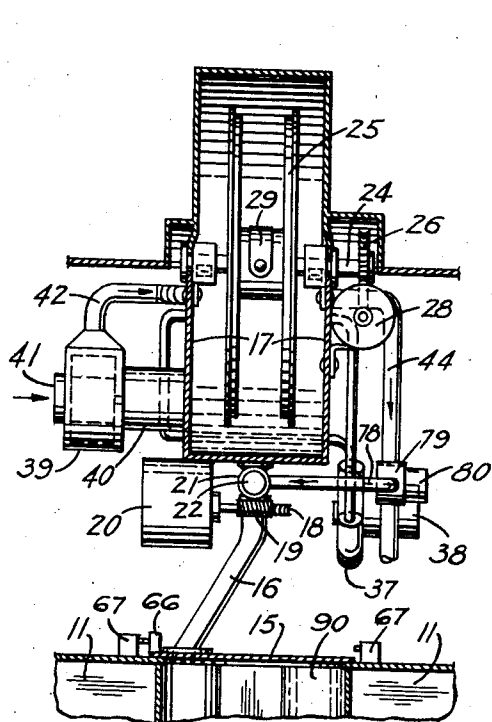


FIG. 6

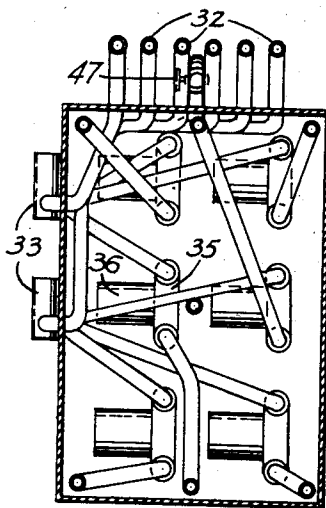


FIG. 5

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FIG. 7

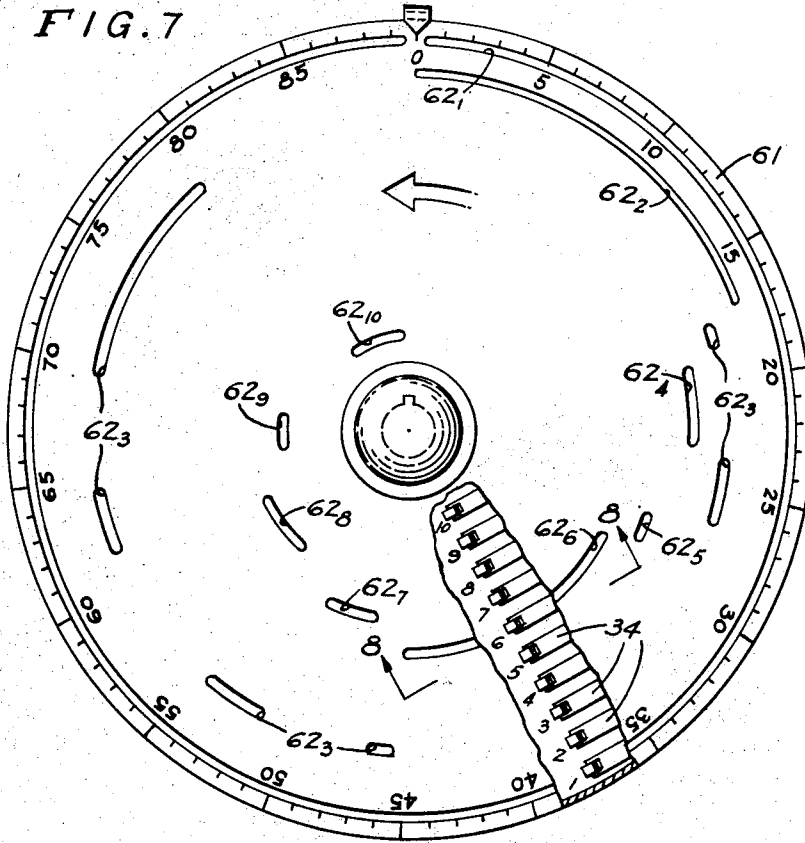
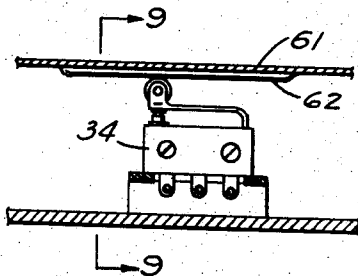


FIG. 8

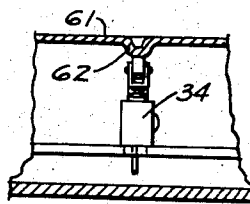


FIG. 9

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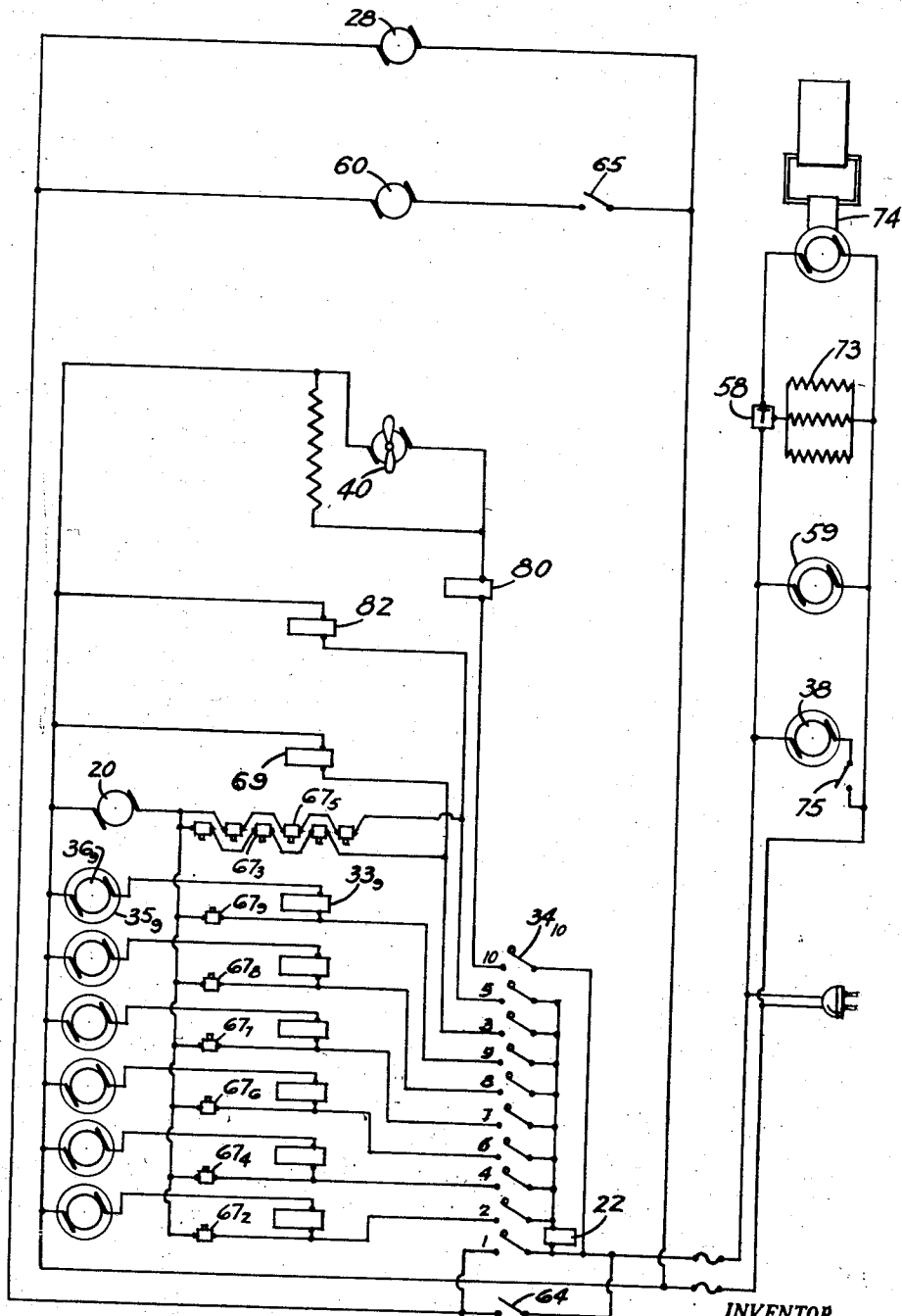


FIG. 10

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PHOTOGRAPHIC FILM DEVELOPER

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10 Claims. (Cl. 95—90.5)

This invention relates to automatic film developers and process control means therefor. Film developers now in use generally require a photo dark room and the expert services of a photographic laboratory technician in order to obtain reasonably good results. There are some daylight developing boxes and some portable dark rooms fitted with developing equipment, but they still require the services of a technician or amateur who is thoroughly familiar with the processes in order to be able to operate them properly. The present developer is completely automatic and is self contained in a compact cabinet requiring no technician or familiarity with photographic processes, merely the insertion of a proper program timing disc in the timer unit of the developer corresponding to the type of film which is to be developed.

The main object of this invention is to provide a compact cabinet arrangement wherein all the necessary equipment for processing any size and type of film in any lengths is arranged in a most economical manner, the process being completely automatically controlled, and performed without the aid of a photo dark room.

Another object is to provide interchangeable adaptor mounting plates for the magazine for selective use on the processor, depending upon the type of film magazine in which the exposed film is received for processing.

A further object of this invention is to provide a compact cabinet arrangement containing a water jacketed vertical cylindrical tank sectorially subdivided into a plurality of compartments for the various processing solutions that are to be used in the developing of different types of films in a processing tank located centrally above this cylindrical tank and having an offset drain pipe rotatable to any compartment position for draining into said compartment, separate liquid pumps, one for each compartment, a recirculating pump for the processing tank, a drier blower for said processing tank, a heat exchange unit for maintaining a proper operating temperature in the water jacket of the liquid tank, and a program timing unit, all enclosed and compactly arranged within a suitably sized cabinet, with doors providing access to all operating parts for servicing or replacement.

A further object is to provide an exchangeable timing disc for the program timing unit whereby the program timing may be properly controlled for any particular process, so that any one or more of the plurality of developing fluids may be used in a prescribed timing sequence in the single processing tank in accordance with the requirements of said particular process.

Further and more specific objects will appear in the following description of the details of a specific form of this invention, having reference to the accompanying drawings, wherein

Fig. 1 is a perspective outer view of the cabinet,

Fig. 2 is a section thereof taken on the line 2—2 of Fig. 1,

Figs. 3, 4, 5 and 6 are enlarged sectional views taken

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on the correspondingly numbered sectional lines indicated in Fig. 2, respectively,

Fig. 7 is a detailed view of a particular program timing disc showing its relation to the microswitches,

Figs. 8 and 9 are detailed sectional views taken on lines 8—8 of Fig. 7 and 9—9 of Fig. 8, respectively, and

Fig. 10 is a schematic diagram showing the electrical control circuits and the electrical apparatus used in the present developer.

In present day practice, in order to get good results in any processing of films, it has been customary to employ the services of a photographic laboratory technician. Even then it was not always possible to get best results due to the factor of human error. The present developer was found to eliminate possible errors in developing any particular type of film, because this developer is fully automatic, and is adaptable to any type of process that might be required for developing any type of film; and the provision of the single processing tank has eliminated the necessity of having expensive and elaborate series of developing tanks for different solutions for treating the film as it is fed over a series of pulleys or rolls thru one tank and then the other until finally it emerges and is dried. The present spiral reel which moves the film thru the solution in the single processing tank requires a comparatively small space and a small amount of solution and can be timed more accurately to give better results by changing the solutions in an accurately timed sequence in accordance with the process being used. The solutions are supplied by individual pumps and simultaneously controlled valves to a predetermined level in the processing tank, and then continue supplying the solution as the overflow is directed back into the corresponding compartment in the cylindrical tank, thus providing a continuous recirculation in the processing tank for a predetermined period followed by a quick draining period because of the small capacity processing tank, before the film is subjected to the next step in the process.

Any layman can operate this processor and get the optimum results. All he has to do is to select the proper program timing disc and mount it in the timing unit before he starts the process, and then fix the film magazine with the exposed film in it on the cabinet using the proper adaptor mounting plate, attach the clip on the reel to the end of the exposed film, and close the cover over the processing tank, run the film onto the reel by turning on the reel motor, and then turn on the starting switch. The developer takes care of the entire processing operation until the film is dried and ready to be removed.

The present developer will first be described in all its parts and their relation to each other and then the operation will be described in detail. While the various parts are shown more or less diagrammatically, many refinements may be made in accordance with requirements and available material. Only the essential equipment and one preferred arrangement is shown in the illustrations in the drawings.

Fig. 1 shows the overall outer appearance of the particular arrangement illustrated here. The cabinet has a central main compartment in which may be located a vertical cylindrical tank which is water jacketed for the purpose of maintaining proper temperatures in the several solutions by regulating the temperature of the water in the jacket. This cylindrical tank is subdivided sectorially into a plurality of individual solution compartments 11. Jacket 12 may be supplied with water thru the inlet 13 and valve 14. This tank is covered except for a central opening which is covered by rotatable circular cover 15.

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Cover 15 is supported by the lower end of drain pipe 16, the upper end of which is swivelled to the drain valve fitting at the bottom of the processing tank 17. The upper end of drain pipe 16 is provided with a gear 18 which is operated by worm 19 driven by motor 20. The drain valve 21 is a 3-way valve operated to a closed position for the processing tank but opened to conduit 44 by solenoid 22, but is normally held open to the processing tank and closed to conduit 44 by a spring (not shown). The upper half of processing tank 17 comprises a hinged cover and is fitted to the lower half so that it forms a light tight as well as liquid seal. The parting joint between this cover and the lower portion of the processing tank may be made substantially flush with the top of the cabinet 23. Split bearings are provided across the center of the processing tank, the lower portion being provided with half the bearings and the cover with the other half, for the shaft 24 on which the spiral reel 25 is mounted. Shaft 24 has a gear 26 fixed thereto at one end which gear is driven by worm 27 on the shaft of motor 28. Thus when the cover is opened the shaft with the reel may be readily removed by lifting it off the worm 27 and out of the lower halves of the bearings in which the shaft 24 normally rotates. Shaft 24 is adapted to receive any size of spiral reel 25 to accommodate different width films up to 70 millimeters or more if desired. These reels may be adapted to receive as much as 100 feet of film, however short lengths of film may also be quickly processed in this developer in the same way as longer films. The hub of the reel is provided with a strap 29 having a clip 30 on its end for clipping to the end of the exposed film in the magazine. The lower portion of the processing tank 17 is further provided with inlets 31 for the several different solutions used in the processes. Inlets 31 are connected by conduits 32 to their respective supply valves 33. Individual supply valves 33 are each connected to their respective pumps which draw the several fluids from their respective compartments 11 and are selectively operated by means of the controlled microswitches 34 in accordance with a prescribed program timing disc 61 with ridges 62 annularly arranged thereon to operate the switches in proper timed sequence as the disc turns. The processing tank 17 may be further provided with a recirculation pump 37 driven by motor 38 for drawing liquid from one side of the tank and returning it to the other side to provide agitation of the liquid across the several turns of the film as it is rotated thru the liquid. This pump is optional and may be manually controlled if additional recirculation should be desired.

The processing tank 17 is further provided with a heater-drier, operated by a blower 39 driven by motor 40 and having an inlet 41, for blowing hot air thru the conduit 42 into a fanned-out nozzle positioned substantially radially with respect to the reel to blow the hot air thru all the turns of the film on the reel and out thru a similarly shaped but unrestricted outlet funnel on the opposite side of the tank and down thru the conduit 44 into the compartment underneath the cabinet, over the drain pan 45, so that any condensation will drain into the pan and the saturated air will be discharged outside the cabinet. The drain pan may be provided with an outlet 46 and drain valve 47. The cabinet may be provided with ventilation openings like that shown on the side of the cabinet in Fig. 1 as at 48.

The cabinet may be provided with compartments 49 and 50 on its sides with doors 51 and 52 on the front of the cabinet. The main compartment 53 may be provided with a pair of doors 54 and 55.

The program timing unit 60 is comprised mainly of two parts. The first is a bank of microswitches 34 arranged radially at different distances with respect to the center of the disc 61. The second is the disc 61 and timer motor 63 that turns it at a uniform speed through one revolution, in 90 minutes in the present illustration. As the disc

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turns, its embossed portions 62 operate the microswitches in accordance with a definite time pattern as may be required by the process for which this particular disc is designed, each microswitch being connected to control a particular circuit for operating a function in the process.

For example, the disc shown in Fig. 7, when turned in the direction of the arrow, and starting with a position where the point indicated at the top in the figure is set radially in line with the microswitches, would first operate switches 34₁ and 34₂.

The disc shown in Fig. 7 is designed for only one of many different processes that may be carried out in this developer. The disc 61 here illustrated is for a color film developing process.

Assuming that the developer has been properly serviced by placing the proper ingredients in the several compartments 11 in the cabinet, any one or more of which may be required in a number of different processes when an exposed film 75 is brought in a magazine 76 to be developed, the proper disc 61 (in this case for a type of color film) is selected and mounted in the timer unit 60. A proper adaptor mounting plate 77 is mounted over the opening at the front of the cabinet corresponding with the type of magazine in which the film is brought. The end of the film 75 is passed thru this opening as the magazine is fixed to the adaptor plate. The cover of the processing tank is raised, the shaft 24 is removed, a reel 25 with opening spiral grooves and of the proper width for the film 76 is mounted in place on the shaft, and the shaft with the reel is replaced in its bearings, making sure that the gear 26 properly meshes with worm 27. Belt 29 is pulled out and the clip 30 is fixed to the end of the film 75. The cover of the tank is closed and latched and the push button of switch 64 is depressed to operate the motor 28 which turns the reel as long as the button is held down. The film 75 is thus wound on the reel which is of the open type that is formed with spiral grooves in its sides to hold the film in spaced spiral turns about .1 inch apart so that any medium thru which the reel is turned will have ample access to all portions of the film. When the film has been wound on the reel, the process switch 65 is closed and the push button of switch 64 is kept depressed for a seconds to permit the first microswitch 34₁ to be actuated to close the timer motor circuit. This also operates the reel drive motor 28, and both motors operate throughout the process and stop when the process is finished and the microswitch 34₁ opens as the embossed ridge 62₁ on the plate 61 on which the microswitch 34₁ was riding, ends.

During the process the several other microswitches 34₂ to 34₁₀ are operated in timed sequence in accordance with the extent of their corresponding ridges 62₂ to 62₁₀ on the plate 61. For the first 17 minutes, microswitch 34₂ is closed. As soon as this switch is closed, the pump and supply valve associated with solution compartment 11₂ are operated and the drain valve solenoid 22 is energized turning this three-way valve 21 from its normal position in which it is open to the processing tank 17 to an open position with respect to the overflow conduit 44 thru by-pass 78 and three-way valve 79 which is normally open to this by-pass and the overflow conduit 44. At the same time motor 20 is started and turns the drain pipe until it overlies compartment 11₂ when lug 66 fixed to the periphery of cover plate 15 strikes breaker 67₂ mounted on the stationary portion of the cover over the compartment 11₂, which breaks the circuit thru motor 20, stopping the rotation of the drain pipe at this compartment. Thus, as soon as the processing tank is filled to the proper level, pump 35₂ becomes a recirculating pump because the first developer solution in this circuit continues to flow into the processing tank and overflows into funnel 43 and pipe 44, then into drain pipe 16 and back into compartment 11₂.

When the microswitch 34₂ is opened at the end of 17 minutes, solenoid 22 is deenergized and drain valve 21

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returns to its normal position open to processing tank 17. The tank is drained quickly thru the large drain valve. In about 30 seconds switch 34₃ is closed. This operates the three-way valve 68 for the rinse water by means of energizing solenoid 69. The drain valve 21 is again operated by solenoid 22 to open the drain pipe 16 to the overflow line 44. In the meantime the drain pipe rotor 20 is actuated to turn the drain pipe until it comes opposite one of the rinse breakers 67₃ to stop the drain pipe clear of any of the compartments and permit it to drain into the drain pan 45 by way of the central drain space 90 and its drain outlet 81 at the bottom.

After a one minute rinsing period switch 34₃ is opened and drain valve 21 returns to its normal drain position and the processing tank is again quickly drained.

In a similar manner switches 34₄, 34₅, 34₆, 34₇, 34₈, and 34₉, with switch 34₃ operating after each of 34₄, 34₅, 34₇, 34₈ and 34₉ provide, in accordance with their actuating ridges on plate 61, a series of timed steps in the process successively as follows: soaking in hardener from compartment 11₄ for four minutes, a rinse for three minutes, a second exposure for one and a half minutes, controlled by valve solenoid 82 (shown schematically in Fig. 10), soaking in Color Developer from compartment 11₆ for 16 minutes, a rinse for 1 minute, a soaking in a hardener from compartment 11₇ for 4 minutes, a rinse for 3 minutes, soaking in a bleach from compartment 11₈ for 6 minutes, a wash for 3 minutes, soaking in a fix solution from compartment 11₉ for 4 minutes and a final wash for 10 minutes. After each of these steps a 30 second interval occurs during which the processing tank is drained completely as described above.

The last microswitch 34₁₀ energizes the hot-air blower motor 40 and overflow drain solenoid 80 which turns three-way valve 79 into a position providing straight passage thru conduit 44 and drain pipe 83 cutting off the by-pass conduit 78 leading to the tank drain valve 21. The hot-air blower 39 is operated for 10 minutes to provide a drying period. At the end of this period both switches 34₁₀ and 34₁ are opened and the processing cycle is completed, the dryer and reel motors as well as the timer motor, all being stopped and solenoid valve 79 returned to its normal position connecting the overflow conduit 44 with drain valve 21.

A heat exchange unit may be mounted in the cabinet on the right side as shown in Fig. 4 and comprises a recirculation conduit 71 connected to the water jacket 12 at opposite sides of the cylindrical tank at 70 and 72. A thermoswitch 58 is mounted in this conduit. Pump 59 continually recirculates the jacket water thru the jacket 12 and passes it thru the heat exchange unit which comprises a heater 73 and a refrigerator 74. The thermoswitch is a three position switch, responsive to temperature variations of the water in conduit 71. The switch is normally open and may be set to turn on either the heater or the refrigerator momentarily at temperatures varying more than 2 degrees below or 2 degrees above a normal operating temperature of 68 degrees respectively, as the case may be. Thus the best operating temperature is maintained in the developing solutions regardless of any heating or cooling operating conditions that may occur in the cabinet during operation of the process as well as while the developer is idle to hold it in readiness for operation.

The subscripts to the numerals used in the above description obviously refer to the circuits or duplicate elements in the several circuits controlled by the correspondingly numbered microswitches 34 in the order of their appearance in Fig. 7 beginning with 34₁ at the periphery of the disc 61 and ending with 34₁₀ at the inner end nearest the center of the disc, which control the correspondingly numbered circuits in Fig. 10, as indicated by the small numerals adjacent the microswitches. The order of the microswitches indicated in Fig. 10 is altered for the sake of clarity in tracing the several circuits.

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The program timing discs for different processes may be readily made by embossing arcuate ridges at radii corresponding to the circuits desired to be operated in angular lengths and sequence around the disc corresponding to the duration periods and sequence of operation of those circuits.

Although the disc shown has the ridges made by embossing, such ridges could be formed in various other ways. Instead of the ridges being formed by embossing the disc, they could be strips of sheet material pasted on the disc.

The microswitches could be of a simpler type with sliding shoes on the operating arms instead of rollers.

In actual practice, it is intended to supply a series of exchangeable discs for several different processes with each developer, as well as a set of adaptor mounting plates to accommodate all known magazine types and a set of different standard widths of reels to accommodate the different standards.

Also a simple kit for making additional discs for new processes could be conveniently prepared for those who wish to make up their own processes. This is mentioned only to emphasize the versatility of the machine and the simplicity of its controls.

Many other obvious modifications in details and arrangement of parts of this developer could be made without departing from the spirit and scope of this invention, as defined in the appended claims.

What is claimed is:

1. An automatic film developer comprising a cabinet having a ventilation opening in its wall, and a drain below its floor, a processing tank mounted in said cabinet with a closure on the outside of the cabinet and having a shaft adaptable to receive a film reel of any width, an open grooved-type of film reel adaptable for mounting on said shaft, means for turning said shaft, a plurality of solution storing compartments under said processing tank each having one of a plurality of solutions which may be required in a film developing process, means for mounting a film magazine with an exposed film on said cabinet, means for attaching the end of said exposed film to the hub of said reel, said processing tank closure being adapted to seal it against light after attaching the film, means for then operating said shaft to pull the film into the spiral reel, and means for automatically developing and drying said film, including a timing unit having an exchangeable program timing disc adapted for controlling the recirculation of a plurality of the solutions in a predetermined timed sequence followed by the drying step in accordance with one of a plurality of processes using any number or all of the solutions in the storage compartments, a recirculating system associated with each solution compartment comprising a pump and delivery valve connected in series between said compartment and said processing tank for delivering said solution, an overflow line from said processing tank, a drain valve and a drain pipe for said processing tank, said drain pipe being adjustable to drain into said compartment, and said overflow line being connected to said drain pipe thru a passage in said drain valve while it is closed to the processing tank to complete said recirculating system.

2. An automatic film developer as defined in claim 1, wherein said means for drying includes a hot-air blower having a fan-shaped nozzle in one side of the processing tank opposite an unrestricted converging outlet which also forms the overflow on the other side of said tank, both extending substantially radially of said reel to provide a hot air current across said tank thru all the turns of the film coiled thereon, said overflow line having a three-way valve turned normally to direct the air current to the outside of said cabinet while closing off the connection to said drain valve and drain pipe.

3. An automatic film developer as defined in claim 2, said solution compartments being water-jacketed, and thermostatically controlled means in said cabinet for main-

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taining said jacket water at a predetermined operating temperature.

4. An automatic film developer as defined in claim 3, a water supply line extending thru the rear wall of said cabinet for connection into the public water supply system, connected by a T-connection in said cabinet to said water jacket thru a shut-off valve and to said processing tank for supplying rinse and wash water thereto, said supply to said processing tank being controlled by a three-way valve in said T-connection, said three-way valve having a normal position closing off the passage to said processing tank and opening the passage to said water jacket, and means for simultaneously moving said valve to open said passage to said processing tank, said overflow valve to connect said overflow pipe to said drain pipe, and said drain pipe to a drain position during a rinse or wash period in said process, and funnel means under said drain position directing said drainage in said drain below the floor of said cabinet.

5. An automatic film developer as defined in claim 4, said water jacket having an overflow directed into said drain.

6. An automatic film developer as defined in claim 5, said solution compartments being positioned annularly below said drain pipe, said drain pipe being swivelled at its upper end to the bottom of said drain valve and having means for turning it on said swivel, the lower end of said drain pipe passing thru a cover over the inwardly projecting ends of said compartments, and a fixed cover over the balance of said compartments to reduce contamination of the solutions by fumes tending to flow from one tank over into another.

7. An automatic film developer as defined in claim 6, said drain pipe supported cover having a lug fixed to its periphery adjacent the drain pipe, and control means on said fixed cover adjacent said periphery operable by said

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lug as the drain pipe is turned, to stop its turning means when the drain pipe reaches stations for proper draining of the overflow from said processing tank either into a specific compartment the solution of which is being used at the time, or at any one of the intermediate stations for draining wash water therefrom into said funnel means during a rinse or wash period.

8. An automatic film developer as defined in claim 7, said timing device including a timing motor drive for said timing disc, said disc having arcuate embossed portions at spaced radial distances from its center, a plurality of microswitches adjacent said disc at correspondingly spaced distances from the center, each switch operated by its corresponding embossed disc portion to control a function of said process for a period depending on the length of the arc of said portion in a sequence depending on the relative angular position of said arc with respect to the other embossed portions and switches.

9. An automatic film developer as defined in claim 8, wherein said microswitches are mounted on a radially extending bar.

10. An automatic film developer as defined in claim 9, wherein substantially half of the microswitches are mounted diametrically on one side of said disc and the other half on the other side to reduce the overall diameter required for said disc.

References Cited in the file of this patent

UNITED STATES PATENTS

1,561,699	Ybarrondo	Nov. 17, 1925
2,230,584	Busse	Feb. 4, 1941
2,534,603	Katzen et al.	Dec. 19, 1950
2,542,830	Newton et al.	Feb. 20, 1951
2,621,571	Katzen et al.	Dec. 16, 1952