United States Patent

Reichardt

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[45] **Oct. 17, 1972**

[54] **PHOTOGRAPHIC PRINT AND FILM PROCESSING MACHINE**

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[22] Filed: **Feb. 19, 1971**

[21] Appl. No.: **116,870**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 64,285, Aug. 17, 1970, abandoned.

[52] **U.S. Cl.** **95/93**

[51] **Int. Cl.** **G03d 3/08**

[58] **Field of Search** ..... 95/89 R, 93, 96, 97, 98, 90.5

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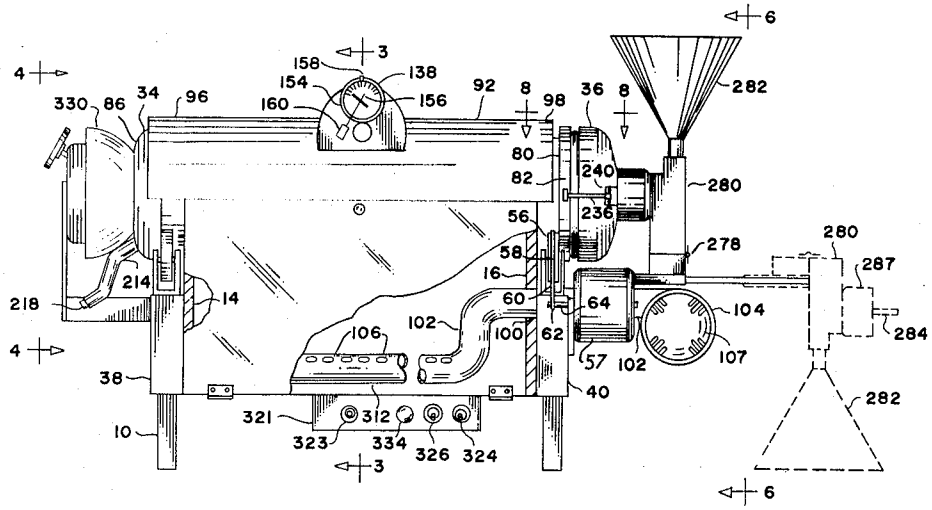
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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Fred L. Braun
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[57] **ABSTRACT**

A photographic print and film processing apparatus having a housing adapted for holding a plurality of chemicals containers; a processing drum rotatable relative to said housing; a convective heating and cooling device for maintaining said containers and said drum substantially at a desirable temperature; and thermostatic elements for controlling said convective device whereby the temperature of chemicals in said containers and said drum are maintained compatible to the successive use of said chemicals in said drum for processing sensitized materials.

17 Claims, 14 Drawing Figures



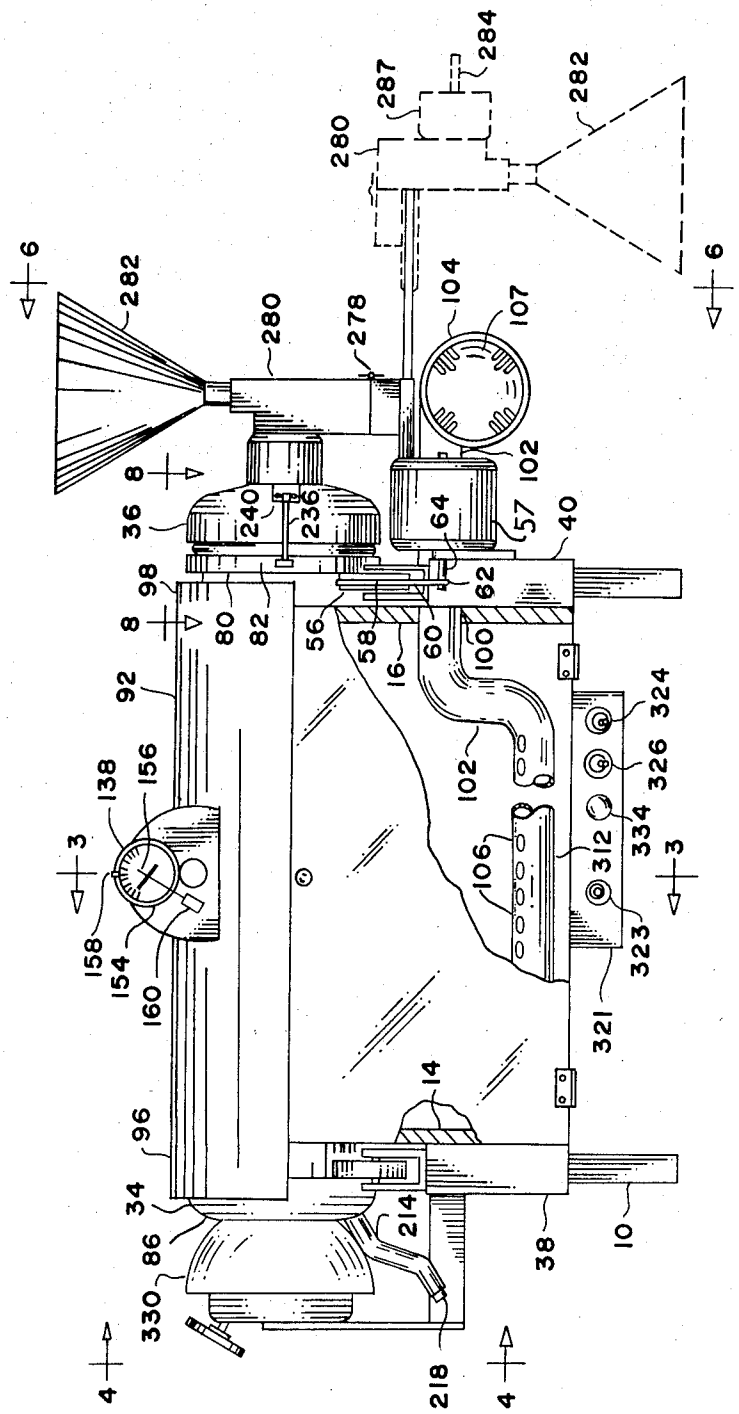


FIG. 1

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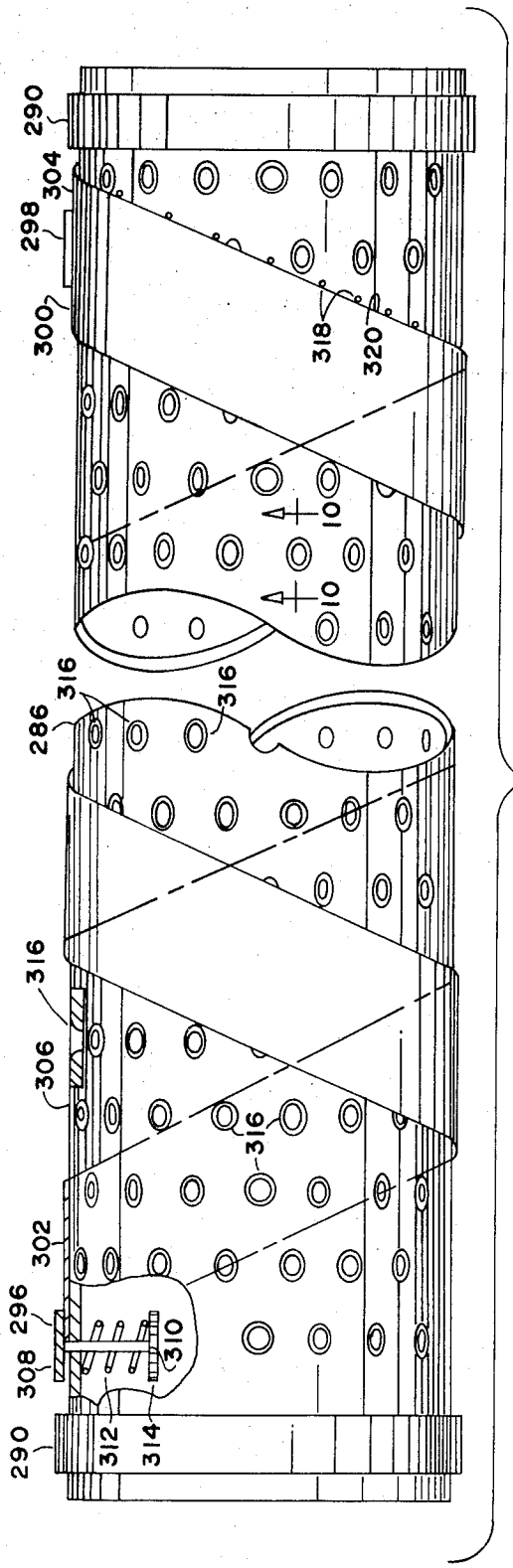


FIG. 2

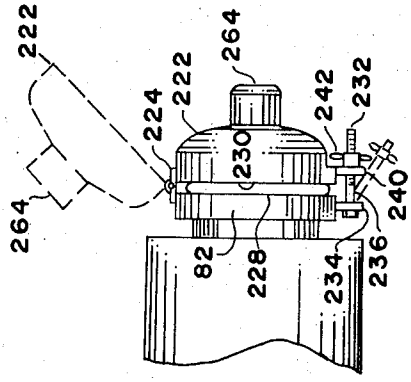


FIG. 8

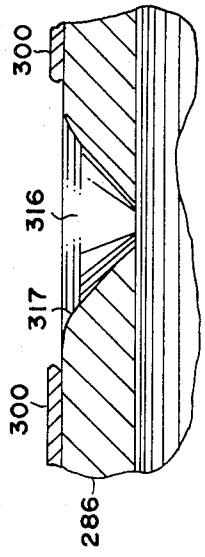


FIG. 10

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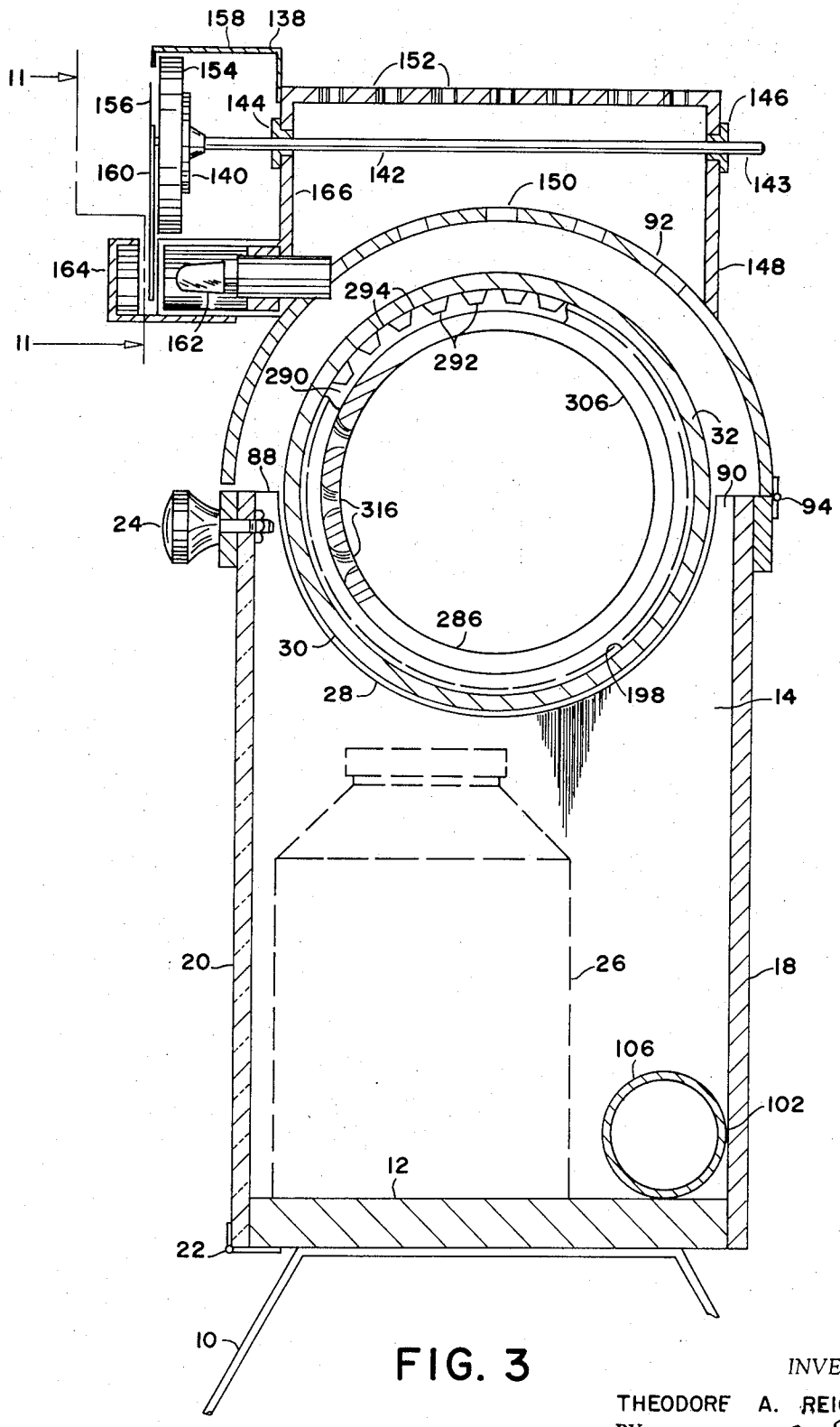


FIG. 3

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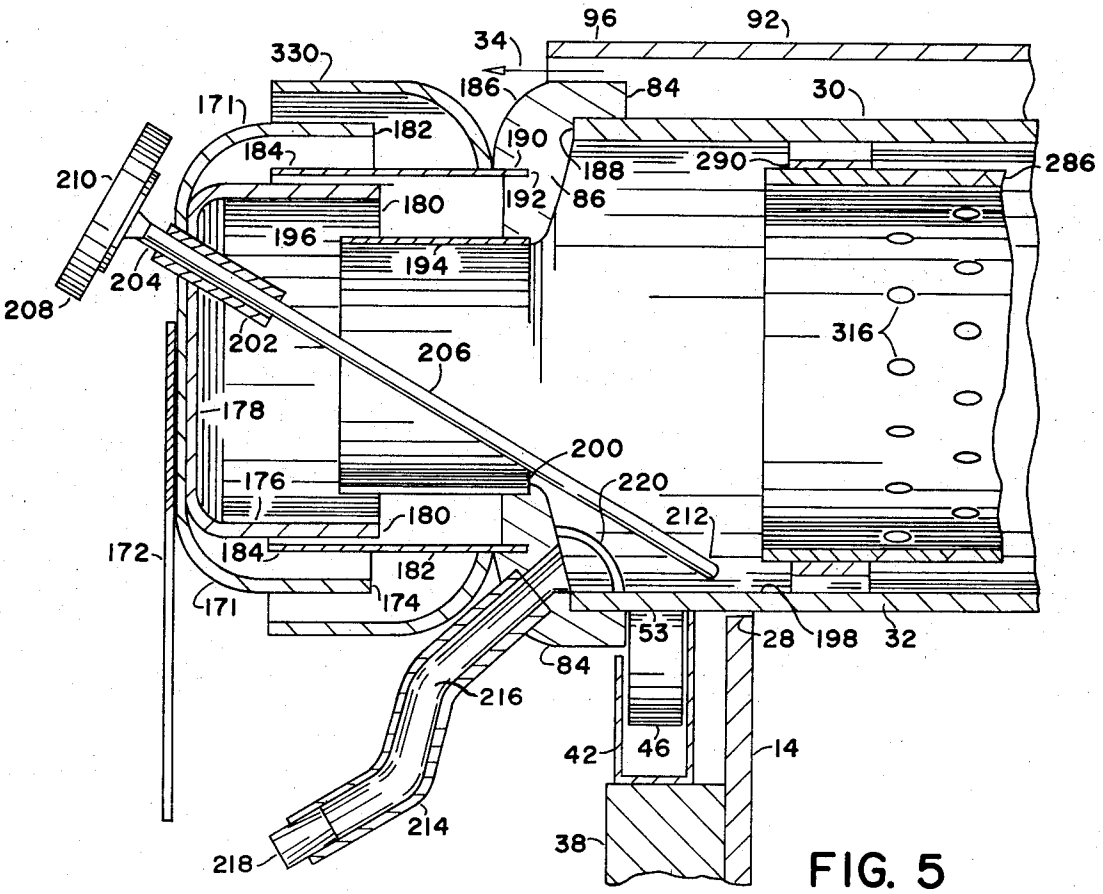


FIG. 5

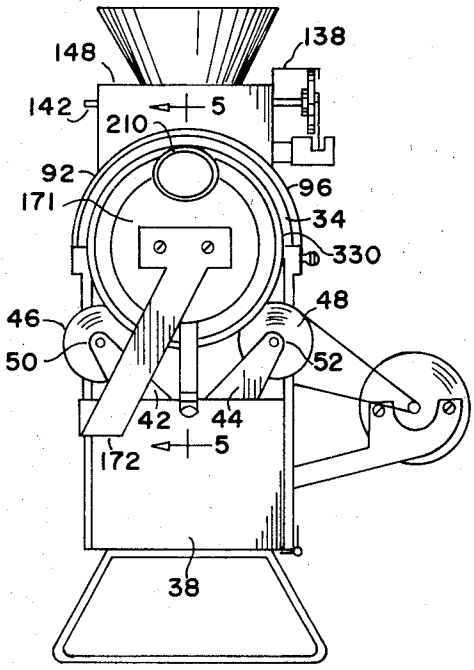


FIG. 4

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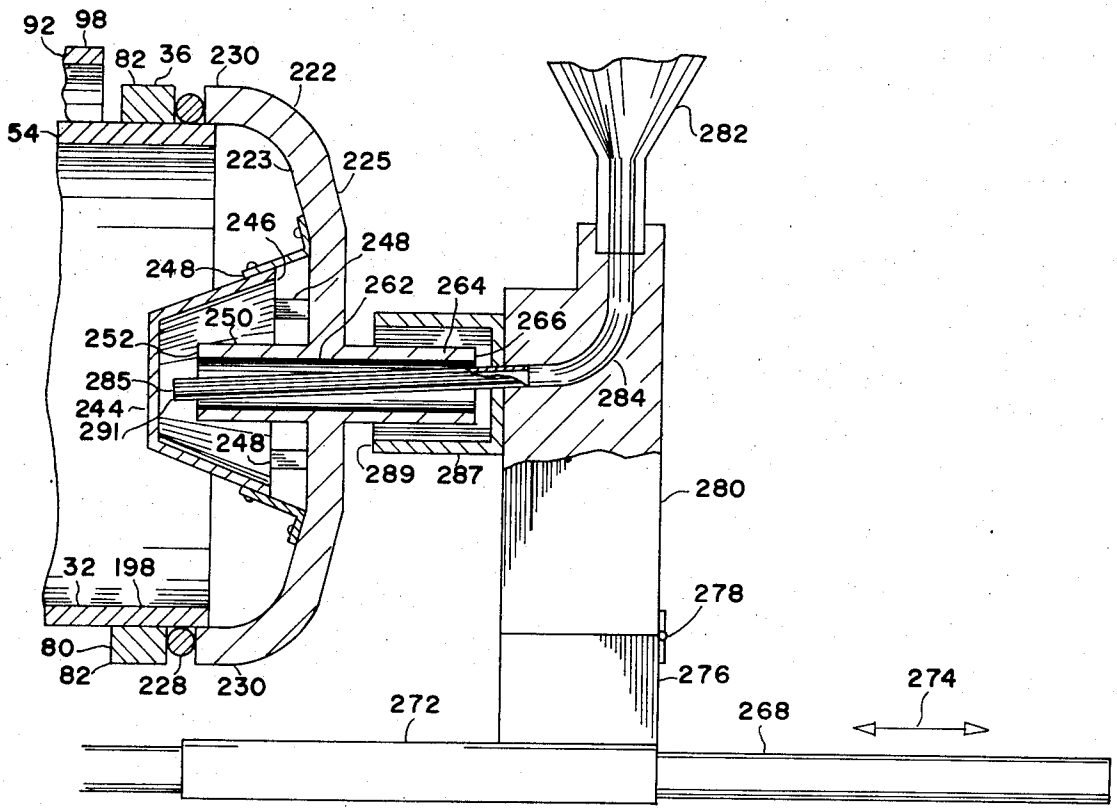


FIG. 7

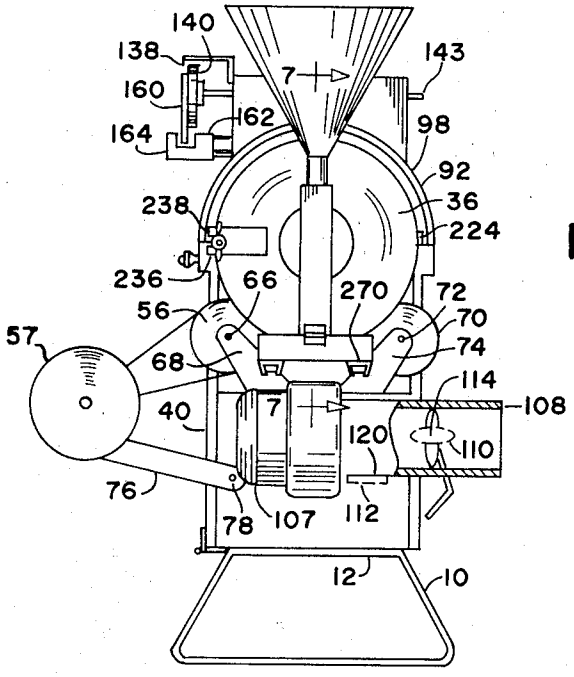


FIG. 6

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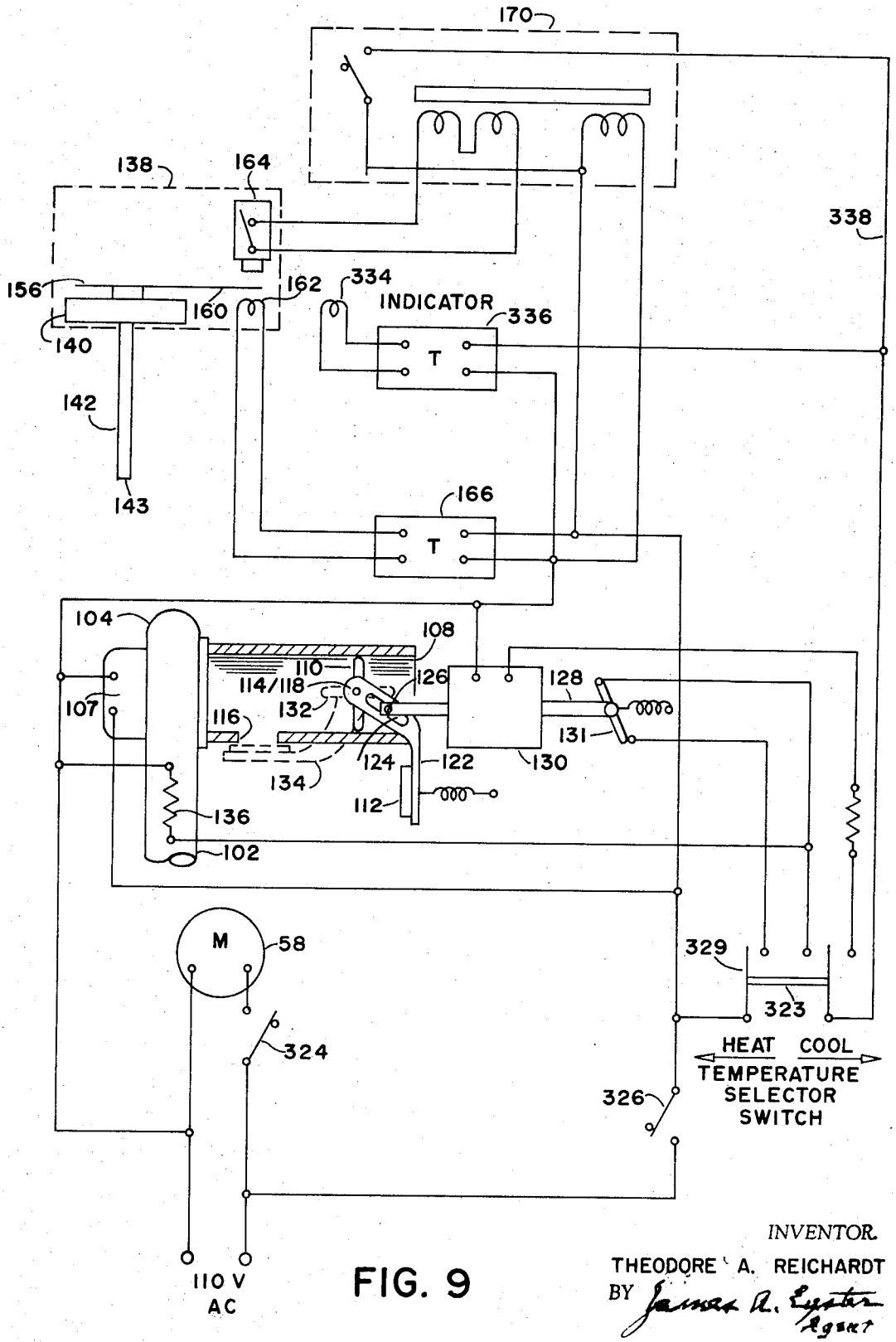


FIG. 9

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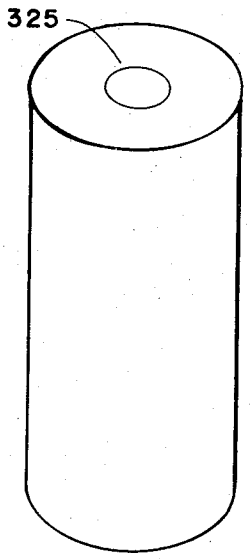


FIG. 13

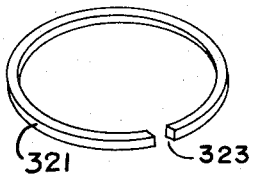


FIG. 12

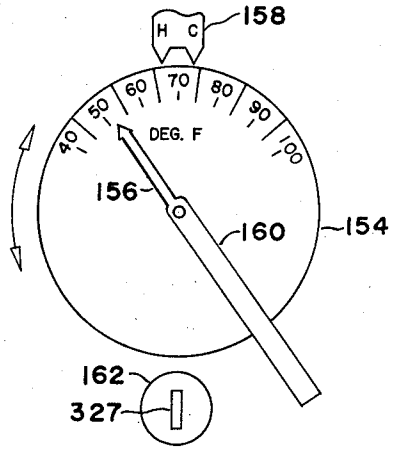


FIG. 11

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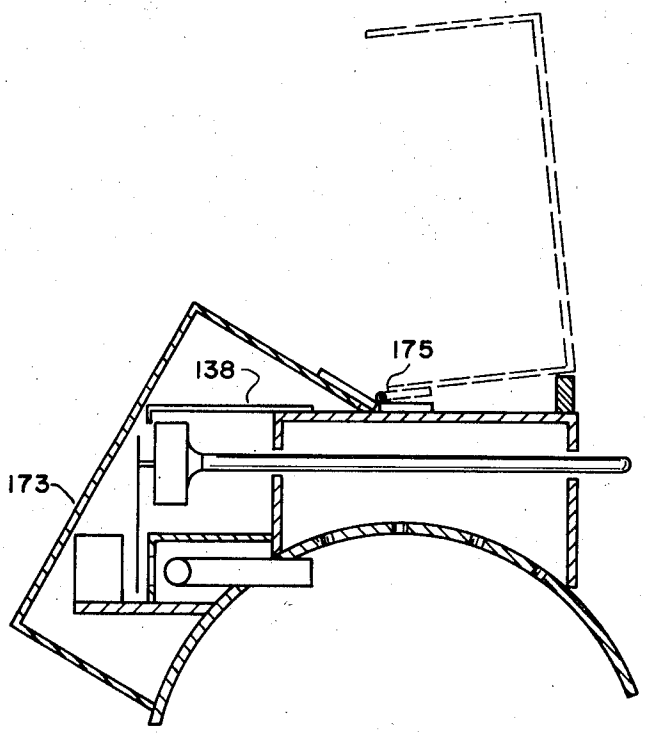


FIG. 14

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PHOTOGRAPHIC PRINT AND FILM PROCESSING MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of the copending application by the same applicant, Ser. No. 64,285., filed 17 Aug. 1970, now abandoned, for a photographic print and film processing machine.

BACKGROUND OF THE INVENTION

The processing of colored photographic film and prints is substantially more critical than the development of conventional black and white film due to the narrow range of temperature which must be maintained in the processing of colored film and prints.

The equipment used for the development of colored film and prints has, therefore, become much more complicated than that which has been used for developing black and white film, and the processing of colored film is, therefore, more difficult to perform. The processing of colored film requires critical temperature control or maintenance relative to the chemicals successively used to process film and/or prints in order to obtain the proper chemical reactions for attaining optimum results.

Accordingly, most apparatus for processing colored films and/or prints is quite complicated and expensive. Various means and controls have been utilized to maintain desirable temperatures of a plurality of successively used chemicals in processing colored exposed photographic materials and various means and controls have been used relative to print and/or film processing tanks wherein the print and/or film is subjected to various chemicals in certain succession.

SUMMARY OF THE INVENTION

In accordance with the present invention, a very simple housing and rotary processing drum are disposed in communication with a common temperature controlling means whereby chemicals containers in said housing, and said drum, are subjected to a common temperature control which greatly facilitates and simplifies the successive processing in said drum and the successive use of different chemicals from said containers housing and in said drum for the processing of colored prints or films therein.

The invention is provided with a novel thermostatic means utilizing a dial head thermometer and a photo cell; the dial head thermometer having a temperature sensing probe rotatably mounted such that the dial head of the thermometer moves relative to a pair of stationary pointers and whereby the temperature indicating hand, adjacent to the calibrated dial of the thermometer, carries a beam interrupter adapted to interrupt a beam relative to the photo cell for effectively maintaining on and off control of both the heating and the cooling means of the invention.

The invention also comprises novel rotary processing drum and film holding mechanism. The rotary drum is rotatably mounted on power driven cradle rollers and the film holding mechanism in the drum comprises a hollow cylindrical structure around which film is wrapped in a spiral disposition emulsion side out and the drum is provided with an operable hinged end cover adapted to permit loading and unloading of the

cylindrical film holder relative to the interior of the drum. The cylindrical film holder is provided at opposite ends with annular and radially extended means adapted frictionally to engage a bore in said drum so as to provide for rotation of said film holder with said drum so that chemicals in said drum will efficiently process film on said film holder.

The invention also comprises a novel light trap means at the loading end of the drum, whereby said loading end may contain a stationary chemicals feed tube while the drum rotates and remains light tight. The invention also comprises a novel light trap means at the drain end of the drum, whereby means is provided to allow insertion of a stationary temperature sensing probe, angularly through said light trap means and reaching into the bottom area of the drum, to gage the temperature of fluid therein also while the drum rotates and remains light tight.

Additionally, the invention comprises a means for forcing temperature controlling air through a chemicals container holding compartment as well as around the rotating film processing drum of the invention; the means for forcing air comprising a blower having an inlet controlled by a solenoid operated valve means; the solenoid being electrically operable in cooperation with a thermostat which senses the temperature of air flow delivered through the housing and around the film processing drum of the invention, the thermostat being coupled to the solenoid only when the heating-cooling selector switch is on "cool," whereby it is closed with respect to the solenoid circuit so as to allow passage, alternately, of cold air from a cold source which communicates with the inlet conduit, or room air which enters through a flapper valve and is subsequently heated, according to the requirement as determined by the action of the thermostat.

The present invention is electrically powered, and is especially designed to fulfill the processing requirements of color prints and films. The present invention is also especially designed to be operated in daylight or normal room light throughout the entire processing sequence.

Said processor is intended mainly for amateur, small studio, or other limited production use.

It is well known that the processing of color photographic materials requires strict control of time and temperature. While in certain cases either of these factors may be varied to suit conditions, such variation then requires that the other factor be adjusted in a compensating manner to within quite critical limits, if uniform results are to be obtained. In any case, therefore, exact measurement of the temperature of processing fluids while in actual contact with the materials being processed becomes of prime importance.

The present invention fulfills this requirement by means of the fluid temperature indicating thermometer, the sensing probe of which passes through the wash drain light trap assembly, thence through the wash drain pipe and into the lower part of the processing drum or cylinder, where it is immersed in whatever fluid is contained in said drum, and remains stationary and readable while said drum rotates, and throughout all processing operations.

It is also well known that certain color photographic materials, films being an example, must be processed at specific temperatures, within very narrow limits of variation and with practically no regulation or "-juggling" of the time-temperature factors being permissable.

The present invention fills this requirement, allowing a wide range of temperature selection, the selected temperature being automatically controlled to remain within acceptable limits of variation for the processing of any existing photographic material. Said temperature selection is accomplished by rotating the dial of the combination thermometer-thermostat until the desired temperature is read at the point of one of the air temperature setting indicators. Said automatic control of the selected temperature is accomplished by means of the following combination of parts: thermometer-thermostat assembly, heater-blower assembly (or, alternatively, cold control assembly and heating element), and air enclosure assembly.

The thermometer-thermostat assembly consists of the combination of: rotatable thermometer with photocell, masking arm, photocell with cover and slit-shaped aperture therein; photocell actuating light with cover and slit-shaped aperture therein; photocell actuated-relay which is physically separated from the thermometer-thermostat assembly, but electrically connected to the photocell; temperature setting indicators; and thermometer-thermostat housing which is actually an extension (in effect) of the air enclosure assembly and which is perforated at intervals along its top to permit exhaust of air flowing past the sensing probe of the rotatable thermometer.

The heater-blower assembly consists of the combination of an electric heating element and a motor driven fan to force air past said heating element into and through the air enclosure thereby affecting the temperature of the processing drum and its contents. The cold control assembly consists of the cold air duct with thermostatically controlled, interconnected cold air-ambient air portals, the blower assembly with its heating element, and a "cold source" which may be but need not necessarily be an integral part of the processor.

The air enclosure assembly consists of the combination of the hinged door, hinged top cover with attached thermometer-thermostat housing; left and right standards; back wall; and left and right air retaining panels. The air enclosure assembly, in addition to containing and guiding the flow of temperature-controlled air around the processing drum, also provides space (beneath the processing drum) for containers in which a supply of processing liquids, including wash water, may be stored and maintained at operating temperature; this feature is highly advantageous when a number of units of sensitized material is to be processed in consecutive operating sequences.

In the processing of photographic materials within an enclosure such as the processing drum described in the present invention, it is highly advantageous to be able to charge said enclosure with the required fluids and subsequently drain said fluids, each in its turn, without the necessity of removing said enclosure from the position it occupies while performing its processing functions.

The present invention allows this accomplishment by providing a means to charge the drum while in the (horizontal) operating position, a means to drain the drum while in the (horizontal) operating position and a means to allow wash water to course through and spill out of the drum while in the (horizontal) operating position and rotating.

In the processing of photographic materials, it is advantageous to be able to introduce the processing fluids in such manner that proper agitation be started before and maintained while the fluids are being introduced, to prevent said fluids from affecting certain portions of a sensitized material substantially before other portions.

The present invention fills this need by allowing the processing drum to be power-rotated while the fluids are being introduced by the means provided therefor.

In the "wash cycle" during the processing of photographic materials, it is advantageous to be able to provide constant agitation along with constant flow and release of wash water, thereby effecting maximum removal of residual chemicals from the sensitized material in a given length of time.

The present invention fills this need by allowing a constant flow of wash water to be directed into the drum (by the means provided therefor) while the drum is in constant rotation, and a means of continuously releasing the water at the other end of the drum, also while the drum is in constant rotation.

In the processing of photographic materials within an enclosure such as the drum used in the present invention, it is particularly advantageous to be able to perform all processing operations (after sensitized materials have been enclosed within the space provided) without turning off normal room lights.

The present invention is therefore constructed so as to exclude light from the interior of the processing drum, by means of a light trap surrounding the continuously open wash drain, a light trap at the charging end of the drum, which trap is also continuously open for the introduction of fluids, and a light tight drain, the internal orifice of which is, at its inside perimeter, coincident with the inside perimeter of the processing drum at its drain end. Said light tight drain, hereinafter called perimeter drain, when not stoppered, excludes light from the interior of the processing drum by means of a plurality of bends along its length plus a black, opaque shield facing its internal orifice.

Accordingly, it is an object of the present invention to provide a very simple and economical photographic film and print processing machine.

Another object of the invention is to provide a novel film and print processing machine wherein successively used chemicals are maintained at a desired temperature while a processing container is also maintained at said temperature by a common thermostatically controlled convective heating and cooling means.

Another object of the invention is to provide a novel thermostatic control for photographic film and print processing machines.

Another object of the invention is to provide novel rotary film processing drum and film holding structure therein which is particularly useful in the processing of photographic film.

Another object of the invention is to provide novel means for introducing chemicals into a rotating photographic processing drum and for the sensing of the temperature of liquid chemicals therein.

Further objects and advantages of the invention may be apparent from the following specification, appended claims and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevation view of a photographic print and film processing machine in accordance with the present invention and showing portions thereof broken away and in section to amplify the illustration and further showing varying positions of parts thereof by broken lines;

FIG. 2 is a fragmentary side elevational view showing a film holder of the invention, on enlarged scale, and showing portions thereof broken away and in section to amplify the illustration;

FIG. 3 is an enlarged transverse sectional view taken from the line 3—3 of FIG. 1;

FIG. 4 is an end view of the invention taken from the line 4—4 of FIG. 1;

FIG. 5 is an enlarged fragmentary sectional view taken from the line 5—5 of FIG. 4;

FIG. 6 is an end view of the invention taken from the line 6—6 of FIG. 1 showing portions broken away and in section to amplify the illustration;

FIG. 7 is an enlarged fragmentary sectional view taken from the line 7—7 of FIG. 6;

FIG. 8 is a fragmentary plan view taken from the line 8—8 of FIG. 1 showing by broken lines a varying position of the pivoted end cover of the rotary film processing drum of the invention;

FIG. 9 is a diagrammatic view of the electrical and mechanical control means of the invention;

FIG. 10 is an enlarged fragmentary view taken from line 10—10 of FIG. 2;

FIG. 11 is a front view of the thermometer/thermostat taken from the line 11—11 of FIG. 3;

FIG. 12 is a perspective view of the barrier/ring;

FIG. 13 is a perspective view of a spacing cylinder;

FIG. 14 is a side sectional view of the thermometer/thermostat showing its cover in place.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIGS. 1, 3 and 6 of the drawings, the processing machine of the invention is provided with a base 10 which supports a compartment floor 12. This compartment floor 12 carries opposite end walls 14 and 16 as well as a rear wall 18.

An access door 20 is pivotally mounted by means of a hinge 22 to the floor 12 and this access door 20 is provided with a manually operable latching knob 24 adapted to hold the door in closed position as shown best in FIG. 3 of the drawings. The floor 12, end walls 14 and 16, and rear wall 18 and access door 20 provide a housing compartment of the invention which is adapted to hold a plurality of chemicals containers 26 as shown best in FIG. 3 of the drawings.

The end wall 14 is provided with a substantially semi-circular upper edge portion 28 adjacent to which the periphery 30 of the rotary processing drum 32 is rotatably mounted.

Slight clearance is maintained between the arcuate or semi-circular edge portion of the end wall 14 and the drum 32 to permit rotary freedom thereof relative to the housing of the invention which is defined between the end walls 14 and 16, the rear wall 18 and the access door 20.

The end wall 16 is provided with an arcuate or semi-circular upper edge portion similar to the upper edge portion 28 of the end wall 14 and as shown in FIG. 1 of the drawings, these walls 14 and 16 are disposed near opposite end portions 34 and 36 respectively to the rotary processing drum 32.

Supported by the base 10 and standing upwardly adjacent the end walls 14 and 16 are cradle roller supports 38 and 40 respectively. As shown in FIG. 4 of the drawings, the cradle roller support 38 carries a pair of brackets 42 and 44 which support spaced apart cradle rollers 46 and 48. The cradle rollers 46 and 48 are rotatably mounted on pins 50 and 52 in connection with the brackets 42 and 44 respectively. Peripheries of the cradle rollers 46 and 48, being spaced apart, cradle a lower peripheral portion of the film processing drum 32 adjacent an end 53 thereof as shown best in FIG. 5 of the drawings.

As shown in FIG. 5, the processing drum 32 is provided with a peripheral portion 53 which is cradled between the rollers 46 and 48 and these rollers 46 and 48 are merely idler rollers while a similar roller 56 near the end 36 of the drum 32 is power driven by means of a motor 57.

The roller 56 is provided with a peripheral belt holding groove 58 as shown in FIG. 1 of the drawings and a belt 60 is engaged in the groove 58 and also engages a pulley portion 62 on a shaft 64 of the motor 57. Thus, the roller 56 is power driven and rotates about the axis of a pin 66 in a bracket 68.

Spaced from the cradle roller 56 is an opposed cradle roller 70 rotatably mounted on a pin 72 carried by a bracket 74 mounted on the cradle roller support 40.

The motor 57 is supported by a bracket 76 fixed to the cradle roller support 40 by means of a bolt 78.

The cradle rollers 56 and 70 operate adjacent to an edge 80 of a radially extending flange 82 at the end 54 of the drum 32 and the cradle rollers 46 and 48 as shown in FIGS. 4 and 5 of the drawings, operate adjacent to an edge portion 84 of an annular and outwardly extending end structure 86 at the end 53 of the drum 32. Thus the annular edges 80 and 84 maintain end play disposition of the drum 32 relative to the cradle rollers 46 and 48 and the cradle rollers 56 and 70 respectively. In this matter the drum is maintained in rotary disposition above the compartment defined between the end walls 14 and 16 and the rear wall 18 and the access door 20.

As shown in FIG. 3 of the drawings, it will be seen that the rear wall 18 and access door 20 are spaced apart a distance substantially greater than the external diameter of the drum 32 to thereby allow air flow passages to exist at 88 and 90 as shown in FIG. 3 of the drawings.

Disposed above the drum 32 is a cover 92 as shown best in FIG. 3 of the drawings. This cover 92 is arcuate in cross section and is provided with a hinge 94 pivotally coupling the cover 92 to an upper portion of the rear wall 18. The cover 92 extends longitudinally

over the elongated drum 32 and is provided with opposite ends 92 and 98 as shown in FIG. 1 of the drawings and these ends 96 and 98 are in close proximity to opposite end portions 34 and 36 of the drum 32.

As shown in FIGS. 5 and 7 respectively, the opposite ends 96 and 98 of the cover 94 are closely spaced from the periphery 30 of the drum 32 in order to allow only a minimum flow of air outwardly under the cover 94 and to thereby allow free rotation of the drum 32 as will be hereinafter described in detail.

As shown best in FIG. 1 of the drawings, the end wall 16 is provided with an opening 100 through which a blower outlet conduit 102 extends. This conduit 102 extends from a motor operated blower 104 and the conduit 102, as shown in FIGS. 1 and 3 of the drawings, is provided with air outlet openings 106 adapted to deliver air into the compartment in which the chemicals containers 26 are disposed. As shown in FIG. 6 of the drawings, the blower 104 is a centrifugal blower operated by an electric motor 107. The blower 104 is provided with an air inlet conduit 108 having inlet control valve means in connection therewith. This inlet control valve means comprises a butterfly valve 110 and a flapper valve 112, both pivoted about a common axis at 114 as shown in greater detail in FIG. 9 of the drawings. The inlet conduit 108 is adapted to conduct air to the inlet of the blower 104 around the butterfly valve 110 when in the dotted line position as shown in FIGS. 6 and 9 of the drawings, and the inlet conduit 108 is provided with a side inlet opening 116 adjacent to which the flapper valve 112 may be disposed for shutting off flow through the inlet opening 116 when the butterfly valve 110 is in open position.

The flapper valve 112 and the butterfly valve 110 are interconnected by a common shaft 118 which extends through the conduit 108 and is coupled to an arm 120 on one side of the conduit 108 as shown in FIG. 6 of the drawings. This arm 120 interconnects the butterfly valve 110 and the flapper valve 112. Another arm 122 is disposed on the opposite side of the conduit 108 from the arm 120 and this arm 122 is also coupled to the flapper valve 112 and the butterfly valve 110 through the common axis 114 and shaft 118 concentric therewith.

The arm 122 is provided with a slot 124, FIG. 9, engaged by a pin 126 actuated by a plunger 128 of an electrically operable solenoid 130. The plunger 128 of the solenoid 130 may be a conventional spring loaded plunger operable magnetically in one direction and by means of spring force in the opposite direction. The plunger 128 is extended so that at one end it operates the butterfly/flapper valves and at the other end operates an electrical switch 131.

The solenoid and valves are shown in FIG. 9 in the normal, unenergized position, with the butterfly valve 110 closed, the flapper valve 112 open and the switch 131 closed. When electrically energized, the solenoid opens the butterfly valve, closes the flapper valve and opens switch 131.

As shown in FIG. 9, a heating element 136 is disposed in the outlet conduit 102 of the blower 104 and this heating element is adapted to heat air delivered from the blower 104 into the housing of the invention via the openings 106 in the conduit 102 as hereinbefore described.

Supported on the cover 92 is a thermostatic means 138 which is also shown in greater detail in FIG. 3 of the drawings.

The thermostatic means 138, as shown in FIG. 3 of the drawings, is provided with a dial head thermometer 140 having an elongated temperature sensing probe 142 which is rotatably mounted in bearings 144 and 146 in a thermostat housing 148 mounted on the cover 92. This thermostat housing 148 is disposed to receive a flow of air which passes around the drum 32 and through an opening or openings 150 in the cover 92.

The thermostat housing 148 is provided with outlet openings 152 so that a constant flow of air may move around the temperature sensing probe 142 of the dial head thermometer 140.

As shown in FIGS. 1, 3 and 11, the dial head thermometer 140 is provided with a conventional calibrated dial 154 and a conventional temperature indicating hand 156 which rotates relative to the head of the thermometer and the calibrated dial 154 in response to variations in temperature sensing by the probe 142. A stationary pointer assembly 158 is carried by the housing 148 and is disposed adjacent to the calibrated dial 158 so that a desired operating temperature may be selected by rotating the dial head thermometer relative to the stationary pointer 158.

Coupled to the temperature indicating hand 156 is a beam interrupter 160 which is adapted to interrupt a beam between a beam projector or exciter lamp 162 and a photo cell means 164. The photo cell means 164 is simply indicated as a switch in FIG. 9.

The pointer assembly 158 is dual in that it carrier two pointers, marked H and C, as shown in FIG. 11. The distance between these two pointers is equal to the effective width of the beam interrupter or mask 160.

As shown in FIG. 9, relay 170 is energized by means of the photo cell switch 164 and the beam projector lamp 162 is energized by means of the transformer 166.

A novel means is employed in order to cause the thermostat to adjust itself automatically to compensate for possible significant changes in the external environment. To accomplish this automatic adjustment, a measured portion 143 of the thermostat probe projects from its housing into said external environment, thereby causing the temperature indicating hand with attached beam interrupter to respond partially to the environment while at the same time responding mainly to the temperature within the housing. For example, if the machine is being used in a very cold room, selector switch 323 being therefore closed to activate the heating system, a considerable amount of heat will be lost to the drum at its unprotected ends, this heat loss causing a drop in fluid temperature inside the drum. However by sensing this cold environment as described above, the thermostat tends to lengthen slightly the time during which the heater is energized and shorten the time when it is not energized, thus avoiding a confusing variance between indicated fluid temperature and indicated housing temperature.

Conversely, if the machine is being used in a very warm room, the selector switch being closed therefore to activate the cooling system, considerable heat from the environment will enter the drum 32 via its unprotected or uncontrolled ends, thereby causing a rise in fluid temperature inside the drum. However by sensing

this environment as described above, the thermostat tends to lengthen slightly the time during which the solenoid is activated to allow passage of refrigerated air into the housing, and shorten slightly the time during which the solenoid is de-energized to allow passage into the housing of air from the environment, again avoiding a confusing variance between indicated fluid temperature according to the fluid temperature indicating thermometer **208** and indicated housing air temperature according to the rotatable thermometer **140**.

The importance of the above described automatic compensating feature lies in the importance of maintaining a close cooperation between the thermostat and the fluid temperature indicating thermometer **140**. Without this close cooperation, either recalibration or manual readjustment would have to be made to the thermostat, for every significant change in the environment, in order that the temperature set on the thermostat would cause a corresponding temperature to be brought about and maintained within the drum, as indicated by the fluid temperature indicating thermometer **208**.

When loading sensitized material into the processing machine it is often necessary to work in darkness and stray light from the exciter lamp **162** would fog the film or paper. It is highly inadvisable to disconnect the processing machine from the electric power source because to do so, even for a short time, would cause air temperature in the machine to vary more than the allowed one-half degree Fahrenheit from the set temperature. Therefore a black cover, **173**, FIG. **14**, is provided as a light shield and light-obscuring masking means, hinged at **175** to permit the cover **173** to be lifted away, after loading of sensitive material and closing the end of the drum **32**, to permit setting and observing the thermometer/thermostat **138**.

The processing drum **32** at its end **53** as shown in FIGS. **4** and **5** of the drawings, is provided with a stationary end cover **171** supported by a stationary bracket **172** which is fixed to the cradle roller support **38**. The end cover **171** is generally cup-shaped and provided with an inwardly directed annular edge **174** which surrounds an annular wall **176** of a secondary cup-shaped member **178**. This cup-shaped member **178** is a light trap structure having an annular inner edge **180** axially overlapping a hollow cylindrical light trap sleeve **182** having an outer edge **184** overlapping and surrounding the cup-shaped member **176**. This sleeve **184** is fixed to a structure of an annular end member **86** secured to the drum **32**.

The end member **86** is provided with a cylindrical portion **186** surrounding an end **188** of the drum **32**. The end member **86** is provided with an annular groove **190**, in which an inner edge **192** of the light trap sleeve **182** is secured. Fixed to the end member **86** is a hollow cylindrical neck structure **194** having an outer edge **196** axially overlapping the inner edge **180** of the cup-shaped member **178**. The hollow cylindrical neck structure **194** is substantially smaller in diameter than a bore portion **198** of the drum **32** so that liquid chemicals may be retained in the drum **32** below the neck structure **194** as shown best in FIG. **5** of the drawings.

An inner annular edge **200** of the hollow cylindrical neck structure **194** is fixed to the end member **86** all as shown best in FIG. **5** of the drawings.

The overlapping relationship of the edges **180** and **184** of the cup-shaped member **178** and sleeve **182** provide an efficient light trap means in cooperation with the edge **196** of the neck structure **194** which axially overlaps the edge **180** of the cup-shaped member **178**. The stationary end member **171** and cup-shaped member **178** support a thermometer holding sleeve **202** which is disposed at an angle to the axis of the drum **32**. This sleeve **202** is provided with a bore **204** which supports an elongated temperature sensing probe portion **206** of a dial head thermometer **208** which is provided with a calibrated dial **210** projecting outwardly relative to the stationary end cover **171**.

The temperature sensing probe **206** may be retracted from or extended into the drum **32** through the neck structure **194** at an angle as shown in FIG. **5** of the drawings so that a normally lower end portion **212** of the temperature sensing probe **206** is near a lower interior portion of the bore **198** of the drum **32**.

Fixed to the end member **86** is a drain tube **214** which is provided with a joggled light trap portion **216**. This drain tube **214** is provided with a removable closure **218** and disposed in the drum **32** adjacent the end member **86** is a light trap baffle **220** all of which prevents light from entering the interior of the film processing drum **32** when the closure **218** is removed for draining liquid materials from the interior of the drum **32** as will be hereinafter described.

At the opposite end of the drum **32** from the stationary end cover **171** is a removable pivoted end cover **222**. This pivoted end cover is shown in detail in FIGS. **6**, **7** and **8** of the drawings. The pivoted end cover **222** is provided with a hinge **224** which is connected to the annular radially extending flange **82** on the drum **32** near its open end **226**.

Disposed adjacent the flange **82** is an O-ring gasket **228** against which an inner annular edge **230** of the cover **222** compressively bears to provide a liquid tight seal around the open end **226** of the drum **32**.

The cover **222**, at its annular edge **230**, surrounds the drum **32** in order to maintain a concentric disposition of the pivoted cover **222** relative thereto.

The hinge **224**, as shown in FIGS. **6** and **8**, is opposed by a latching fastener means **232** at an opposite side of said cover **222** from said hinge **224** as shown best in FIG. **8** of the drawings. This fastener means **232** comprises an outwardly directed bolt support **234**. This bolt support **234** is fixed to the annular flange **82** on the drum **32**. A bolt **236** is pivotally connected to the bolt support **234** and is engageable between spaced apart portions **236** and **238** of a bracket **240** which is fixed to the pivoted end member **222**. A wing nut **242** is screw-threaded onto the bolt **236** and is engageable with the bracket **240** for clamping the edge **230** of the pivoted end cover **224** against the gasket **228**.

When it is desired to open the cover **222** to the broken line position shown in FIG. **8**, the wing nut **242** is loosened on the bolt **236** and the bolt **236** is moved to a broken line position as shown in FIG. **8** of the drawings out of interference with the end portions **236** and **238** of the bracket **240** whereupon the pivoted end cover **222** may be pivoted about the axis of the hinge **224** to the broken line position as shown in FIG. **8** of the drawings.

The pivoted end cover 222 is provided with a substantially frusto-conical cup-shaped light trap shield 244 secured to the inner side of said cover 222 by means of a plurality of legs 248 so as to hold an open skirt edge 246 of the shield 244 in spaced relation to the inner side 223 so that liquid chemicals introduced into the interior of the drum 32 will gravitate on the frusto-conical structure of the shield 244 and downwardly into the lower area of the drum 32 as will be hereinafter described.

The pivoted cover 222 is provided with a concentric bore 262 surrounded by a hollow cylindrical light trap shield portion 250 which is integral with the inner side 223 of the cover 222. This hollow cylindrical light trap shield 250 is provided with an inner open end 252 considerably beyond the open skirt edge 246 of the cup-shaped light trap shield 244.

An integral hollow cylindrical light trap shield portion 264 extends from an outer side 225 of the cover 222 and surrounds the bore 262 therein. This hollow cylindrical light trap shield 264 is provided with an outer open end 266 which extends outwardly a considerable distance beyond the outer side 225 of the cover 222.

Disposed below and adjacent to the pivoted end cover 222 are a pair of slide tracks 268 and 270. A carriage 272 is slideable on the tracks 268 backward and forward in accordance with the double ended arrow 274.

The carriage 272 is provided with a base portion 276 having a hinge 278 to which is fixed an upstanding frame member 280 which carries a funnel 282 communicating with a passage 284 in the upstanding member 280.

Secured to the upstanding member 280 is a chemicals feed tube 285 which extends through the bore 262 in the cover 222 from the open end 266 of the light trap shield 264 to and beyond the open end 252 of the light trap shield 250. This tube 285 is declined downwardly from the outside toward the inside of the cover 222 for efficient gravitational flow of fluids into the drum 32 from the funnel 282. It will be seen that the frusto-conical shape of the light trap shield 244 allows fluids passing from the open end 291 of the feed tube 285 to gravitate directly downward toward the inner side of the cover 222 and between the legs 248 into the lower area of the drum 32.

When the carriage 272 is retracted away from the drum 32 on the slide rails 268 it may be moved to a broken line position as shown in FIG. 1 of the drawings wherein the upstanding member 280 is pivoted about horizontal axis of a hinge 278 to place the funnel 282 in downwardly directed suspended position and out of the way of the pivoted end cover 222. The upstanding member 280 as shown in FIG. 7 carries a cup-shaped cylindrical light trap shield 287 which overlaps and surrounds the sleeve 264 and this cup-shaped light trap shield 287 is also moved to the broken line position shown in FIG. 1 of the drawings. When the chemicals feed tube 285 and the funnel 282 are moved out of the way of the pivoted end cover 222 a film holding cylinder 286 may be inserted into the drum 32, or exposed photographic print material may be placed in the drum in a rolled up, cylindrical disposition so that when released the back of said print material may lie against the interior wall of the drum. Alternatively, the film or paper may be placed on a conventional processing reel, as will be described.

The film holding cylinder 286 is shown best in FIGS. 2 and 3 of the drawings. This cylinder 286 is frictionally held concentrically in the bore 198 of the drum 32 by means of notched rings 290 which are fixed to the peripheral portion of the cylinder 286 near opposite ends thereof. As shown in FIG. 2 of the drawings, there are a pair of the notched rings 290 and their cross-sectional shape is shown best in FIG. 3 of the drawings wherein peripherally disposed notches 292 allow for circulation or passage of liquid chemicals longitudinally in the bore 198 of the drum 32 to circulate about the sensing probe 206 and back into the bore of the film holding cylinder 286.

The notched rings 290 are provided with projecting land portions 294 which may be made of rubber or any other suitable material adapted to slide easily through the bore of the drum 32 and yet maintain frictional engagement with the bore 198 when fully inserted therein so that the film holding cylinder 286 may rotate in unison with the drum 32 during the processing of film on the cylinder 286 by chemicals in the drum 32.

As shown in FIG. 2 of the drawings, a pair of spring loaded clip mechanisms 296 and 298 hold a strip of film 300 at its opposite ends 302 and 304 respectively.

The film 300 as shown in FIG. 2 of the drawings is wrapped around the periphery 306 of the film holding cylinder 286 and the film is held in a spiral form and in closely but not tightly fitted relationship with the periphery 306 of the cylinder 286. Thus, the film is held in spaced relation to the bore 198 of the drum 32 since the rings 290 extend a substantial distance radially from the periphery 306 of the film holding cylinder 286.

To facilitate the film wrapping operation, especially because of the darkness conditions required for said operation, the film holding plates 296 and 298 are constructed in a special manner as follows: Plate 296 which initially secures an end of the film is arcuate in cross section and of a somewhat lesser arc as to its inner face than the arc of the cross section of the area which it covers on the outer surface of the film holding cylinder. Thus the central portion of the plate 296 is raised slightly from said surface while the two straight edges of the plate 296 are held under some tension against the outer surface of the cylinder by the compressive action of the retaining bolt which draws the raised center of the plate 296 slightly in the direction of the film holding cylinder. Thus a corner of the film may easily be slid under an arcuate edge of the plate 296 and then rotated slightly to become engaged frictionally between a straight edge of the plate 296 and the cylinder. After this engagement has been made, the position of the film-end is further adjusted to cause an edge of the film to lie against a row of guide pins as hereinafter described.

The plate 298 which is identical in construction but not in application to plate 296, is pulled with some tension against the outer surface of the film holding cylinder by means of a relatively long spring means which is attached to the plate 298 at its raised center and which passes loosely through the wall and thence through the diameter of the cylinder, whereupon it is

attached to the opposite wall; thus the length of said spring means may be utilized to provide certain tension while still allowing the plate **298** to be lifted a considerable distance from the surface of the cylinder. After the film has been wrapped spirally around the cylinder, the position of the free end of the film is predetermined and said free end cannot easily be rotated or otherwise maneuvered. Therefore the plate **298** is attached to the cylinder in such manner, as described above, as to allow it to be lifted completely away from the cylinder while the free end of the film is simply rolled into place. The plate **298** is then dropped back into position, where one of its straight edges firmly holds the end of the film against the cylinder.

As shown in FIGS. **2**, **5** and **10**, the film holding cylinder **286** is provided with perforations **316** adapted to allow fluids to flow to the back side of the film **300** while the emulsion side thereof makes direct contact with the liquid chemicals in the lower portion of the drum **32**. The perforations **316** are provided with smooth curved peripheries **317** adjacent to the film **300**.

The cylinder **286** is provided with a helically disposed row of outwardly projecting guide pins **318** which are adapted to provide a guide for an edge **320** of the film **300** when it is initially wrapped on the periphery **306** of the film holding cylinder **286**.

Thus, the pins **318** insure the installation of the film **300** on the cylinder **286** at a proper helical angle for efficient disposition of the film on the cylinder **286**.

When the film holding cylinder **286** is installed in the drum **32** as shown best in FIGS. **3** and **5** of the drawings, and when the pivoted end cover **222** is clamped shut by means of the fixture mechanism **232** shown in FIG. **8** of the drawings, film may be processed on the cylinder **286** by sequentially introducing various liquids and chemicals into the drum **232** via the funnel **282** and chemicals feed tube **285**. The various chemicals used sequentially in the drum **32** may be drained from the drum **32** through the drain **214** by removing the closure means **218**.

Instead of using the film-holding cylinder **286** depicted in FIG. **2**, a method may be employed for developing one or several rolls of film at the same time when the rolls are on conventional roll film processing reels, commonly used for tank development, having a diameter slightly less than the diameter of the bore **198** of drum **32**. These same reels can be used, of course, for developing sheet film of fitting sizes.

A barrier ring such as shown in FIG. **12**, having the diameter of its periphery **321** equal to that of bore **198**, is fastened inside drum **32** near its drain end. The barrier ring has a section cut out, as shown at **323**, and the opening created thereby is lined up with the perimeter drain in order that fluids may drain completely. The purpose of this barrier ring is to prevent interference between the shaft **212** of thermometer **208** and the film reel.

One or more reels carrying film are now inserted in drum **32** and pushed toward the closed end nearly against the spacer ring of FIG. **12**. The remaining longitudinal space in drum **32**, when fewer than the maximum number of reels is inserted, is now filled with one or more spacing cylinders.

Such a cylinder is shown in FIG. **13**. Its outside diameter is slightly less than the inner diameter **198** of drum **32**. The cylinder is provided with an axial cylindrical hole **325** large enough to avoid interference with light trap shield **244**. One function of such spacing cylinders is to permit processing with a minimum volume of processing chemicals by raising the level of any given quantity of said chemicals within the processing drum.

The successively used chemicals are stored in containers **26** in the compartment of the housing as shown in FIG. **3** and the chemicals in the containers **26** are heated or cooled while the drum **32** is also heated or cooled by convective action of air moved by the blower **104** through the conduit **102** and openings **106** therein. The air flows through the housing of the invention upwardly through the passages **88** and **90** as shown in FIG. **3** and around the drum under the cover **92**. Thus, heated or cooled air may be forced through the housing and around the drum **32** for maintaining a desired temperature of the chemicals in the containers **26** and in the drum **32** as desired. The thermostatic means **138** shown in FIG. **3** of the drawings may be set and operated as hereinbefore described to sense temperature of the air passing through the housing and around the drum **32** and to control operation of the heater **136** for heating or operation of the solenoid controlled valves for cooling respectively, said solenoid controlled valves being the flapper valve **112** and the butterfly valve **110** shown in FIG. **9**.

As shown in FIG. **9** of the drawings, when the cooling system is activated by means of the heating-cooling selector switch, the heater circuit is thereby de-activated, and a source of cooling fluid such as refrigerated air is provided in communication with the conduit **108**. When the thermostatic means **138** thence causes the solenoid to be activated, the butterfly valve **110** moves to open dotted line position to allow passage of cooling fluid to the blower **104**, while the flapper valve moves to closed dotted line position to prevent passage of ambient air to the blower **104**. When subsequently the thermostatic means **138** causes the solenoid to be de-activated, the butterfly valve **110** returns to closed solid line position to prevent passage of cooling fluid to the blower, while the flapper valve returns to open, solid line position to allow passage of ambient air to the blower.

As hereinbefore described, the thermostatic means **138** provides for a desired temperature for heating or cooling the air delivered by the blower **104** for maintaining a substantially constant temperature of the chemicals in the containers **26** and drum **32**.

A panel **321** at the front of the machine of the invention carries the switches **323-324** and **326** and also a relay indicator light **334**. The light **334**, as shown in FIG. **9** of the drawings, is energized by a transformer **336** coupled to an output conductor **338** of the relay **170**. Thus, the light **334** indicates operation of the relay **170**.

In the processing of colored film or prints, chemical reactions are dependent upon accurate control of the temperature of the chemicals in order to obtain the desired results. Therefore, the chemicals in the containers **26** and the chemicals in the drum **32** are maintained substantially constant and substantially at an

equilibrium with each other so that chemicals from the containers **26** which are successively poured through the funnel **282** and into the drum **32** are at a desired processing temperature.

When preparing to process film or prints in accordance with the present invention, the chemical containers **26** and the drum **32** may be brought to the desired temperature in accordance with the thermostatic means **138** by moving the double pole switch **323** to either heat or cool position as desired and by closing a pair of switches **324** and **326** as shown in FIG. **9** of the drawings. The switch **324** energizes the motor **58** and the switch **326** energizes the motor **107** which rotates the drum **32** and operates the blower **104** respectively. When these switches **323**, **324** and **326** are closed, the machine of the invention starts operating and may be preliminarily operated for a time in order to bring the chemicals containers **26** and drum **32** into equilibrium at a desired operating temperature.

Switch **324** is now opened and either exposed prints or the film holding cylinder **286** together with film **300** may be placed in the drum **32** as hereinbefore described and the switch **324** may again be closed to cause rotation of the drum **32**, before pouring the initial batch of chemicals through the funnel **282** into the drum **32**.

As chemicals from the containers are successively poured through the funnel into the drum **32**, the various processing steps may be carried out. One or more of the containers **26** may contain wash water which is thus maintained at desired temperature. During the wash cycle in processing either prints or films, the wash water is poured through the funnel into the drum and allowed to course through the length of the rotating drum and spill continuously through the wash drain **194** and between the light baffles surrounding said wash drain. When washing is completed the water remaining in the drum, below the level of the wash drain, is allowed to drain from the drum by means of the drain **214** after opening switch **324** to stop rotation of the drum, and making the manual adjustment necessary to insure that the drain **214** is in lowermost position. Setting of the thermostat means **138** is accomplished by rotating the dial-head thermometer **140** until the desired temperature setting appears adjacent the appropriate H or C point of the stationary pointer assembly **158**, FIG. **11**. If the set temperature is considerably above the ambient temperature, the H point is used; at other temperature settings, from below ambient to 2° or 3° above ambient, the C point is used. When the temperature indicating hand of said dial head thermometer reaches the set temperature, the attached beam interruptor simultaneously interrupts the light beam, thus causing the thermostatic means **138** to de-energize either the heater or the solenoid, depending upon whether the heating or the cooling circuit has been activated by means of the selector switch **323**. Subsequently, as the motor **106** continues to run causing either ambient air or heated air to replace the overheated or overcooled air in the housing, dependent on the position of the selector switch **323**, said beam interruptor gradually recedes until the light beam again strikes the photocell, thereby reactivating either the heater **136** or the solenoid **130**. Thus, although the air temperature within the housing varies according to the intermittent operation of either the heater or the solenoid controlled valves, the average temperature within said housing, as indicated by the dial head thermometer **140**, is automatically maintained within a fraction of a degree and consequently the temperature of the drum **32** and the chemicals therein, as well as the containers **26**, are also maintained with the same accuracy. When it is necessary to drain chemicals or residual wash water from the drum **32**, the outer sleeve **330** of the rotary light baffle is engaged by hand to rotate the drum **32** so that the drain **214** is in lowermost position as shown in FIG. **5**.

To operate the processor of the invention at considerably warmer-than-ambient (or room) temperature, for example at 100° F. when the ambient temperature is 70° F., the following sequence of steps is observed:

A. Installation
B. Warm-up
C. Insertion of sensitized materials
D. Introduction and release of processing fluids

Following are details (and explanations where applicable) of each of the foregoing steps:

A. Installation
   1. Processor is placed on a reasonably level surface with drain **214** of machine protruding over sink or other waste fluid receptor.
   2. Power cord is plugged into power source.
   3. Top cover **92** of air enclosure is closed.
   4. End cover **222** is closed and tightened against fluid seal ring by means of filler cap securing bolt assembly and wing nut catch bracket **232**.
   5. Filler funnel assembly **282** is slid to extreme left (FIG. **1**), with filler tube **284** entering fluid receiving cup through filler tube guide pipe.

B. Warm-up
   1. Turn heating-cooling selector switch **323** to HEAT.
   2. Turn temperature control switch **326** to "on" position, turning on the blower **104**.
   3. Turn rotatable thermometer **140** (of thermometer-thermostat assembly) until the H pointer indicates 100° F.
   4. Pour about 1 pint of water (preferably at or near operating or processing temperature) through funnel **282** into processing cylinder. The mask **160**, FIG. **11**, will be to the right of photocell exciter lamp **162**, so that its light excites the photocell **164**, FIG. **3**, closing relay **170**, FIG. **9**, and closing the circuit of heating element **136**. When air in the enclosure reaches the preset temperature of 100° F, the left edge of the mask will cover the photocell lamp slit **327**, turning off the heater **136**. The blower **104** continues to run, forcing room air into the enclosure. The thermometer/thermostat hand will overshoot to about 100.5 °, then recede. At 100° the heater will again be turned on and the thermometer/thermostat hand will overshoot to about 99.5°. By this oscillatory action the average enclosure temperature will be maintained at 100°.

When drum **32** and its contents have reached operating temperature, the temperature of fluid inside drum (the accurate maintenance of which is of course the

prime object of the entire temperature control system) will remain virtually constant, as lag in heating or cooling of drum plus contained fluid is necessarily much greater than lag in action of air temperature indicating thermometer.

In order to provide for automatic adjustment of action of thermometer-thermostat to compensate for possible significant ambient air temperature changes, (such changes necessarily affecting degree of heat loss through cylinder caps) a measured segment **143** (of experimentally determined length) of rotatable thermometer sensing probe protrudes through thermometer-thermostat housing into ambient air. This feature is necessary to preclude (or at least minimize) need for resetting thermometer-thermostat manually to compensate for heat loss variation whenever a significant change in ambient air temperature occurs.

5. Turn drum drive motor switch **324** to "on" position; allow machine to run until fluid temperature indicating thermometer reaches and remains at desired operating temperature. If rotatable thermometer **140** and fluid temperature indicating thermometer **208** do not respond identically at all useful temperatures, when machine is first being operated or when a new operating temperature has been set, a slight readjustment of rotatable thermometer **140** setting may be required at this point to bring fluid in drum to within very critical temperature limits, as indicated by fluid temperature indicating thermometer.
6. Turn drum drive motor switch **324** to "off" position.
7. Drain water from drum by removing stopper **218** from perimeter drain and rotating the drum **32** by hand until perimeter drain projects downward. A more thorough draining of the processing drum may then be accomplished by tilting it slightly as permitted by the space between the drum and the top cover of the air enclosure. This is not normally necessary with subsequent steps, but should be done at this point to minimize dripping from loading end of drum when loading door (filler cap) is opened for next step in operating sequence.

C. Insertion of sensitized materials

1. Slide filler funnel assembly **280** to extreme right, and rotate same clockwise, inverting funnel assembly to provide maximum clearance for subsequent loading operation.
2. Turn wing nut **242** to loosen; disengage bolt **236** and wing nut **242** from wing nut catch-bracket **240**; swing end cover **222** open.
3. Insert exposed print(s) or film(s). For prints, place in conventional processing reel or roll into cylindrical configuration with emulsion side in; place inside cylinder and release. If more than one print, not on reels, separate to prevent overlapping of edges by means of non-corrosive spring-action separator rings or other appropriate means. For films, place in conventional processing reel(s) or attach to cylindrical film holder and place inside processing drum.
4. Close end cover **222** against fluid seal ring; secure and tighten to seal against leakage.

D. Introduction and release of processing fluids

1. Turn drum drive motor switch **324** to "on" position.
2. Each chemical (pre-warmed to operating temperature) is poured, in its turn, into processing drum with exposed sensitized materials by way of filler funnel assembly **282** while drum **32** is rotating, allowed to remain in rotating processing drum **32** for required length of time, then drained through perimeter drain while drum drive motor switch **324** is "off."
3. At proper place in processing sequence, wash water at required temperature is poured into the rotating drum **32** by way of filler funnel assembly **282** and allowed to course through drum and out through wash drain pipe, thence between the several wash drain light baffles and out of the machine into waste fluid receptor.

After processing steps are completed, sensitized materials are removed from machine and dried in the same manner as such materials are dried after processing by any other method.

The present embodiment of the herein described invention has been constructed to provide and automatically control temperatures either warmer or colder than ambient or room temperature, or to operate at room temperature when such temperature is compatible with the work to be done.

To operate at room temperature, it is only necessary to turn the temperature control switch **326** to "off" position, thereby deactivating the temperature control circuits.

To provide automatic control of cooler than ambient air temperatures, selector switch **323** is turned to COOL, "temp control" switch **326** is turned to "on" position, and a cold source (which may consist of anything capable of cooling a flow of air, such as a coil of tubing carrying a refrigerant, an evaporative type cooling device where conditions permit, or even a suitable container of ice, dry ice, etc.) is provided at the intake portal **108** of the cold air duct.

To operate the processor at cooler-than-ambient temperatures, the following steps are taken:

1. Provide cold source at cold air duct intake portal **108**.
2. Turn selector switch **323** to COOL.
3. Rotate the thermometer/thermostat to cause the desired temperature to appear adjacent the pointer C.
4. Turn temperature control switch **326** to "on" position.

Explanation: Photocell actuating light strikes photocell; photocell actuated relay **170** closes solenoid circuit; solenoid **130** opens cold air valve **110** and closes ambient air valve **112**, allowing blower **104** to draw cooled air from duct, forcing said cooled air into air enclosure. When air in air enclosure drops to preset temperature (as indicated by rotatable thermometer), photocell mask **160** moves to right, interrupting light beam, causing relay **170** to open, thereby deactivating solenoid **130**, allowing cold air valve **110** to close, dependently connected ambient air valve **112** to open, and heater switch **131** to close. Blower motor **107** continues to run, forcing warm air into air enclosure. When sufficient warm air has entered air enclosure, rotatable thermometer **140** will indicate slight temperature rise; photocell masking arm **160** thereby recedes in a

clockwise direction, allowing light beam to again actuate photocell thereby re-establishing solenoid circuit to reopen cold air valve, reclosing dependently connected ambient air valve. The solenoid circuit thus closes and opens automatically to maintain desired (average) air temperature within air enclosure, as long as effective cold source is maintained at intake **108** of cold air duct.

To operate the processor at one or several degrees above room temperature, for example at 72° F. when the ambient temperature is 70° F., both heated and cooled air are used alternately.

1. Provide cold source at duct **108**.
2. Set 72° F. mark at C pointer.
3. Turn selector switch **323** to "COOL."
4. Turn switch **326** to "on."

The center of mask **160** will be to the left of slit **327**, but the right side of mask will still cover the light beam. Thus solenoid **130** will remain de-energized and switch **131** remain closed, energizing heater **136** through the closed switch arm **329**. When 72° F. is reached, the mask **160** will uncover the light beam, the solenoid will be energized, turning off the heater and turning on the cool air. This alternating action will continue, causing the temperature to oscillate between 71½° and 72½°.

To operate at room temperature when the room air temperature is fluctuating proceed as above, with selector switch at "COOL" and with the thermometer/thermostat set with its C pointer at the desired temperature. If this is the ambient temperature, the masking of the light beam will be at the critical point; if the photocell receives enough light to trip the relay, the solenoid will be energized and the cooling phase activated; if not, the solenoid is de-energized and the heating phase activated. The system will oscillate as heretofore described, to thus maintain the desired temperature.

While the present embodiment of the herein described invention utilizes a rotating drum to contain the sensitized materials being processed, an air enclosure along with an automatic heating and/or cooling system, such as is herein described, may be just as effectively used to control the temperature of any other type of processing container or plurality of containers, and such adaptation shall be considered a part of this invention.

While the present embodiment of the herein described thermometer-thermostat assembly utilizes a photocell and photocell actuating light to sense the position of the temperature indicating needle by means of a masking arm attached thereto, said position of the temperature indicating needle may instead be sensed by means of changes in electrical capacitance, wherein an electrical connection is made to a small metal plate attached to the indicator needle, or an arm attached thereto, another electrical connection is made to another small metal plate which is stationary and is placed adjacent to or within the arc described by said indicator needle or arm attached thereto, said two metal plates forming thereby a variable capacitor which with proper (well known) circuitry may be used to operate a relay as is necessary to open and close the temperature control devices described herein. Such adaptation shall be considered a part of this invention.

One film holder to be used in conjunction with and as a part of the present invention consists of a cylinder of suitable material, perforated throughout its length and circumference with holes which are approximately cone-shaped with the smallest diameter at the interior surface of the cylinder, and with the largest diameter at the exterior surface of said cylinder where the edges are smoothly rounded to prevent marking of the back of the film which is wound, emulsion side out and in spiral configuration on said cylinder, being retained by suitable clips at each end.

Said cylinder with film attached is inserted into processing cylinder, being guided safely into said cylinder in darkness by means of the wide rim on the "-forward" end of the cylinder, the exterior circumference of said rim being of very nearly as great a circumference as that of the interior wall of the processing cylinder. The rim at the "rear" end of the film holding cylinder fits snugly into the processing cylinder so that both cylinders rotate as one.

When drum and film-holding cylinder thus rotates, with processing fluid covering bottom interior surface of film holding cylinder, fluid is in effect "scooped" from interior of said cylinder through holes to exterior surface of said cylinder, thereby being caused to flow constantly across back of film and to flow also through the holes which are not covered by film; those between the adjacent edges of the spirally wound film. These two basic flow patterns combine to provide sufficiently random agitation as to prevent streaking or other film defects which may otherwise result. A plurality of sheet films or small prints may be processed in the same manner as roll films, by means of suitable clips and/or guides to attach them to the above-described film holder.

We claim:

1. In a photographic processing machine, the combination of:

a hollow circular-cross-section liquid-holding drum mounted for rotation on a horizontal axis;

a fixed housing mounting said drum;

first means for rotating said drum;

second means for holding sensitized photographic material to be processed in said drum;

a liquid-tight removable end cover for said drum, whereby the placement and removal of sensitized photographic material is permitted;

third means including a light trap for feeding a liquid, such as a chemical including water, into said drum while rotating as in the processing of photographic material;

fourth means, including a light trap, for removing liquid from said drum;

a thermometer arranged to measure the temperature of liquid maintained inside the drum;

a stationary cylindrical end cover for said drum, said cover being disposed at an opposite end of the drum from said removable end cover, said stationary end cover having cylindrically overlapping light trap means;

a reduced diameter neck portion rotatably disposed in said last-mentioned light trap means;

said thermometer being carried by said stationary end cover and having a sensing probe slideably mounted in the stationary end cover at an angle to the axis of the drum, the probe being adapted to be extended through said reduced diameter neck por-

tion of the drum into contact with liquids therein, whereby the liquid temperature can be measured while the drum is rotating, and whereby the probe is retractable out of said neck portion to permit the drum to be removed relative to the stationary end cover and said first means.

2. The invention as defined in claim 1 wherein said means for holding comprises

a hollow film-holding cylinder frictionally and thereby removably supported in said drum, said cylinder having an outer wall spaced concentrically from the interior of said drum; and

means for holding a strip of film in a spiral disposition on the outer side of said cylinder.

3. The invention as defined in claim 1 wherein said cylindrically overlapping light trap means permits free flow and discharge of liquid above a selected level in said drum to the exterior of the processing machine, whereby liquid can be discharged from the drum while it is rotating and without admitting light into the drum, and whereby when water is continuously charged into the rotating drum the water is continuously discharged.

4. The invention as defined in claim 1 further comprising a barrier ring secured within said drum to the interior wall thereof whereby sensitized material and holders thereof may not contact said thermometer.

5. The invention as defined in claim 1 wherein said fourth means includes

a liquid drain tube secured to said drum and penetrating the wall thereof near one end and extending outwardly from the drum;

said light trap being near the inner end of the drain tube; and

closure means for the drain tube, whereby when the drum is stationary with the drain tube at its lowermost position, all liquid can be drained from the drum.

6. The invention as defined in claim 1 further comprising:

a compartment in said housing adapted to hold a plurality of chemical containers;

fifth means for forcing air into said compartment and outwardly around the outside of said drum to maintain the temperature of liquids in said containers and said drum nearly at an equilibrium;

sixth means adapted thermostatically to sense the temperature of air passing through said housing, around said containers and said drum; and

heating and cooling means disposed to heat and cool air delivered from said fifth means to said housing, said sixth means being coupled to the heating and cooling means and adapted to vary operation of the heating and cooling means in response to the temperature of air passing around said drum to thereby maintain a desired temperature of said chemical containers and of liquid in the drum.

7. The invention as defined in claim 6 wherein said processing machine comprises:

switch means to connect the processing machine either to heat or to cool said forced air; and

seventh means controlled by both said switch means and by said sixth means whereby, when the switch means is thrown to HEAT, the forced air is either heated or not heated depending on the sensing of said sixth means, and when the switch means is thrown to COOL, the forced air is either heated or cooled depending on the sensing of said sixth means.

8. The invention as defined in claim 7 comprising:

an electric coupling between said sixth and seventh means whereby the latter is responsive to the former to allow passage to said fifth means of either refrigerated air or heated air, in an alternating manner, as determined by the action of said sixth means for the maintenance of a preselected temporally average air temperature within said housing, said seventh means comprising a flow-selecting valve means; and

a solenoid for operating said valve means.

9. The invention as defined in claim 6 wherein said housing has a top cover pivoted and hinged on an axis parallel to said drum axis, said cover being in spaced relation to the drum and adapted to permit the escape of air from the housing around said drum, the pivoted cover being adapted to be pivoted upward away from the drum to permit the drum to be removed from the housing.

10. The invention as defined in claim 9 wherein said sixth means includes:

a thermometer/thermostat having a concentric

temperature-sensing probe rotatably mounted relative to said housing, said probe being disposed to sense temperature of air passing through the housing and around said drum;

a temperature scale;

a temperature-indicating hand movable relative to the scale;

a dual stationary pointer having two points spaced apart relative to which the thermometer/thermostat scale is rotatable;

photocell means;

photocell exciter lamp means;

a beam interrupter mask coupled to said hand, the width of said mask being effectively and functionally equal to the distance by which said two points are spaced apart, the beam interrupter mask being so disposed relative to said photocell and exciter lamp means as to interrupt by a movement thereof the exciter lamp means beam; and

means responsive to said photocell means for controlling said heating and cooling means whereby the heating and cooling means are alternatively operated to maintain a selected temperature.

11. The invention as defined in claim 10 wherein said concentric probe is provided with a portion disposed to sense the temperature of ambient atmosphere to thereby compensate for ambient thermal effects on portions of said drum.

12. The invention as defined in claim 10 wherein said processing machine includes a light-obscuring masking means pivotably positioned around said photocell lamp exciter means and cooperating means adjacent thereto, whereby when in place all stray light from said photocell lamp exciter means may be effectively contained whenever such containment is necessary.

13. The invention as defined in claim 1 further comprising means for reducing the effective interior longitudinal dimension of said drum, whereby when the drum contains a reduced quantity of photographic materials, the volume of liquid chemical required is reduced.

14. The invention as defined in claim 13 in which said means for reducing the longitudinal dimension comprises at least one thick-walled spacer cylinder having a central bore, whereby liquids introduced by said third means may flow into the portion of the said drum containing material to be processed.

15. The invention as defined in claim 1 further comprising:

a pivot supporting said removable end cover whereby it is disposed to permit insertion and removal of said second means;

gasket sealing means for said removable end cover;

means for releasably locking said removable end cover in closed, sealed position relative to the gasket means;

a central opening in said removable pivoted end cover;

a liquids feed tube extending through said central opening and into said drum; and

said light trap for feeding a liquid including cylindrical overlapping light trap means secured to said pivoted end cover and surrounding said central opening and the end of said liquid feed tube internally of said drum, whereby liquids can be fed into the horizontal drum while rotating and without allowing light to enter.

16. The invention as defined in claim 15 further comprising:

slide track means for supporting said feed tube concentrically relative to said drum, said feed tube having a pivoted mount base slideably movable on said slide track means and adapted to be moved out of the way relative to said removable end cover when it is in the open position and when photographic materials are being placed in or removed from the drum; and

a funnel coupled to said feed tube and carried by said mount base and pivotal on a horizontal axis relative thereto for moving said funnel outwardly and downwardly away from the area adjacent to said pivoted end cover.

17. In a photographic processing machine, the combination of:

a hollow circular-cross-section liquid-holding drum mounted for horizontal rotation about its axis;

a fixed open frame mounting said drum;

first means for rotating said drum;

second means for holding sensitized photographic material to be processed in said drum;

a liquid-tight removable end cover for said drum, whereby the placement and removal of sensitized photographic material is permitted;

third means for feeding a liquid, such as a chemical including water, into said drum while rotating as in the processing of photographic material.

fourth means for removing liquid from said drum;

a first light trap means disposed at the opposite end of said drum from said end cover;

a second light trap means carried by said frame cooperating with said first light trap means; and

a thermometer including a scale and a sensing probe, said thermometer being supported by said second light trap means and extending through said second light trap means and said first light trap means into the lower part of the interior of said drum, whereby the temperature of any liquid in said drum may be read on the scale while the drum is rotating and without admitting any light to the drum interior.

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