United States Patent

[11] 3,525,295

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[21] Appl. No. **680,646**
[22] Filed **Nov. 6, 1967**
[45] Patented **Aug. 25, 1970**
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[54] **AUTOMATIC FILM PROCESSOR**
22 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **95/89,** 95/14, 95/93, 95/94, 118/429
[51] **Int. Cl.** **G03d 3/00,** G03d 3/08, G03d 15/02
[50] **Field of Search** 95/89, 93, 94, 14; 118/429, 421, 426

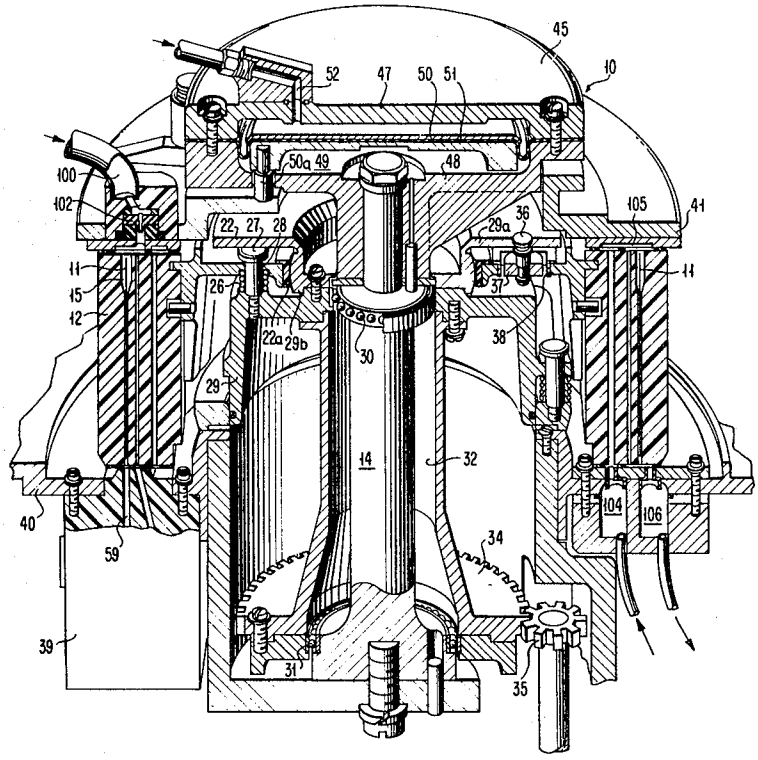
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ABSTRACT: An automatic wet process film processor having a film holder with a body portion forming a cavity for receiving the film to be developed. The automatic processor has several developing stations each including a device for pumping selected ones of the necessary processing fluids into the cavity to develop the film. The automatic processor also has components for effecting relative movement between the film holder and the developing stations, to introduce processing fluids into the cavity in a predetermined sequence. The cavity is positioned in a vertical plane and pumps introduce developing fluid into the bottom of the cavity to limit air entrapment. One configuration utilizes several film holders mounted equidistant from central supporting axis, and moved about the axis to processing stations positioned thereabout.



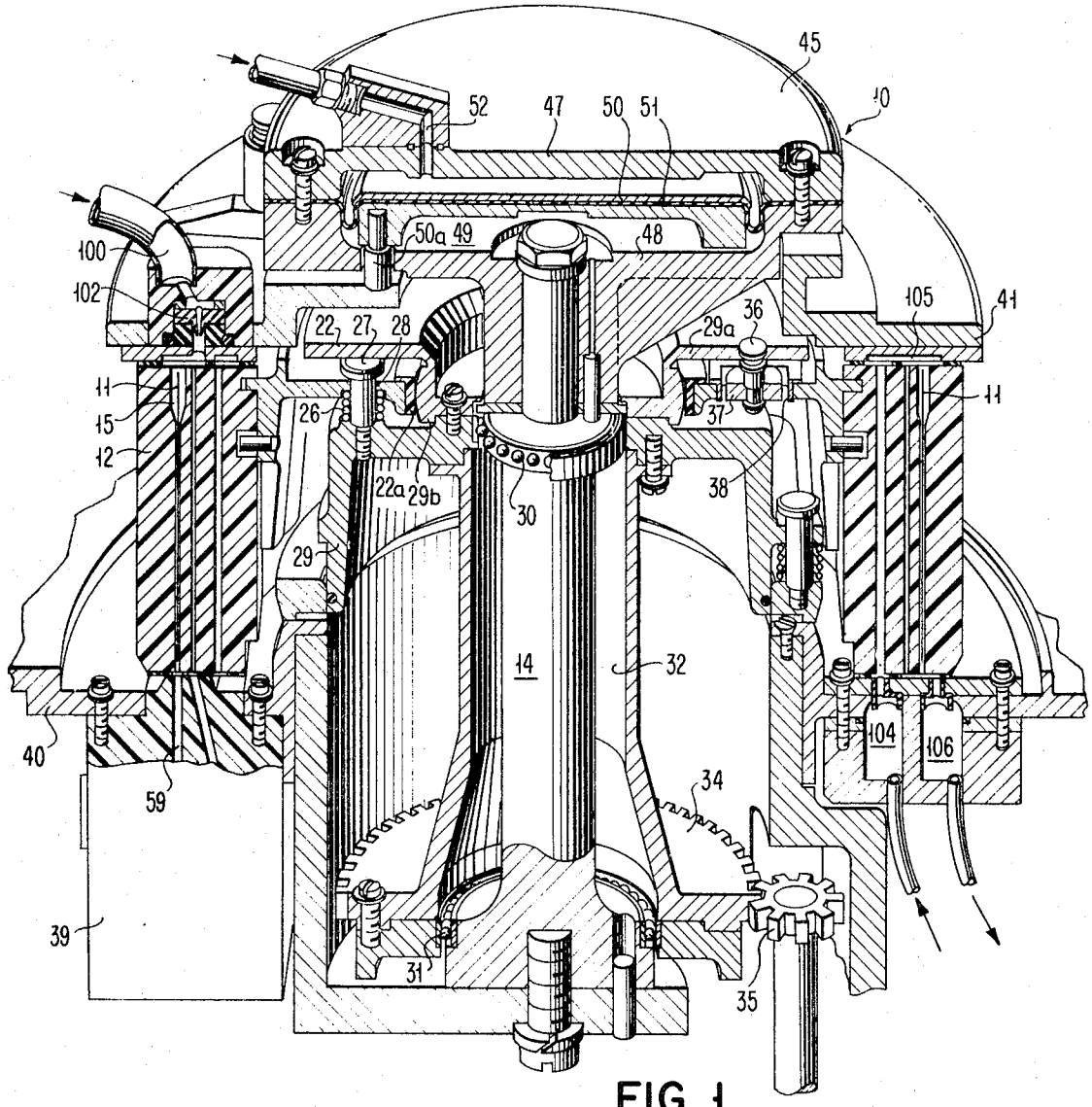


FIG. 1

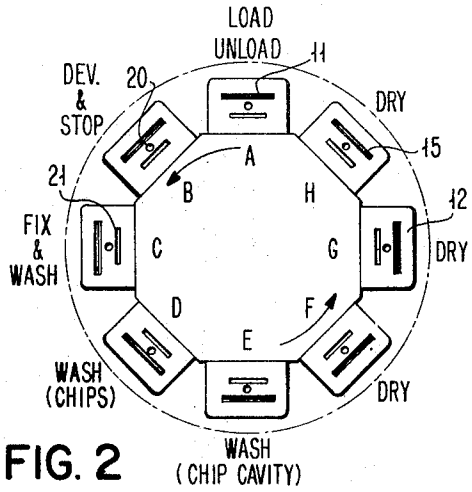


FIG. 2

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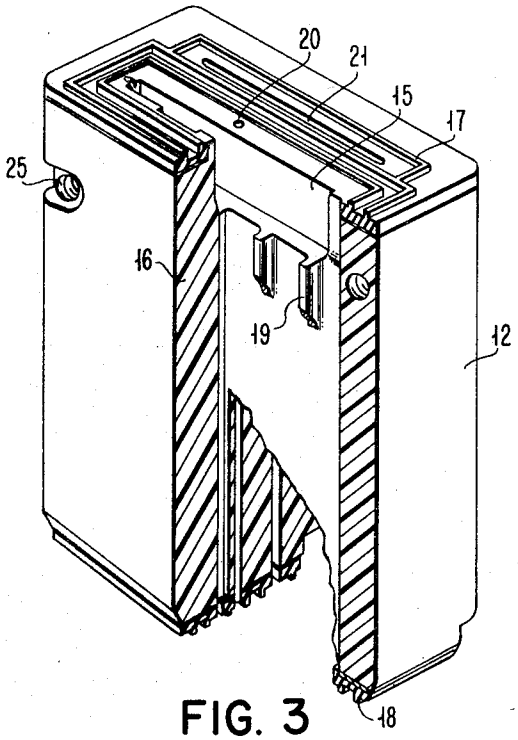


FIG. 3

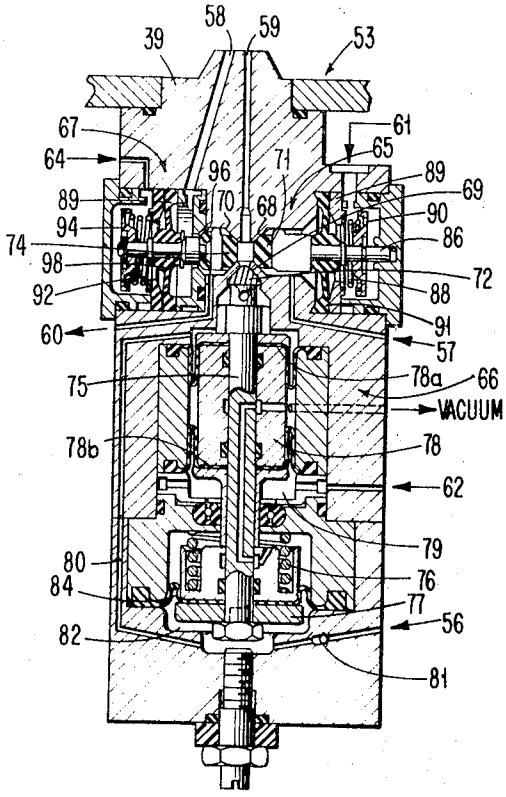


FIG. 5

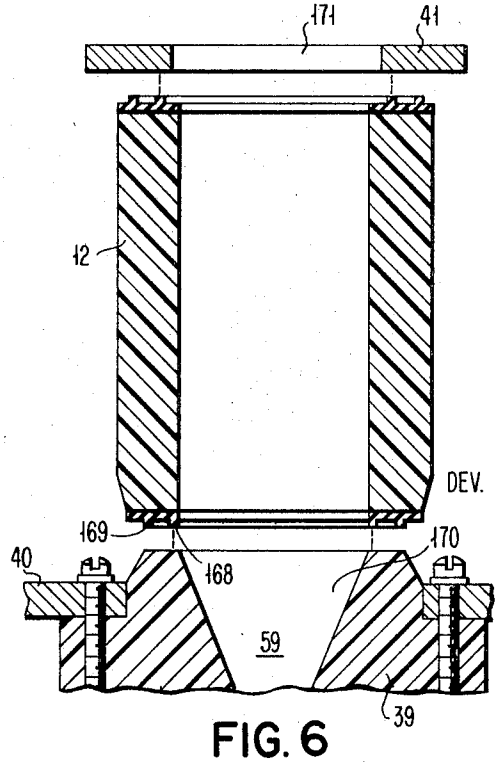


FIG. 6

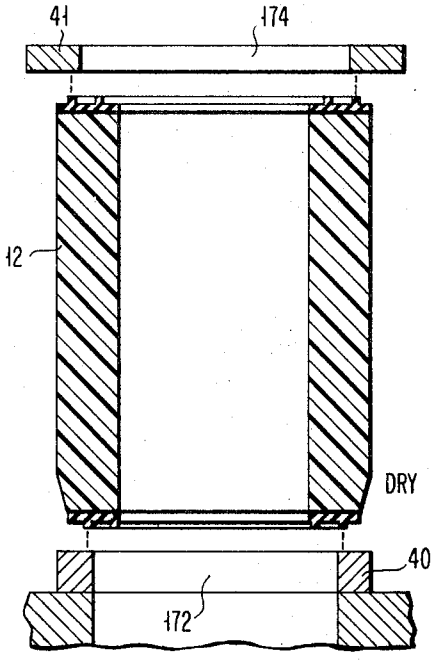


FIG. 7

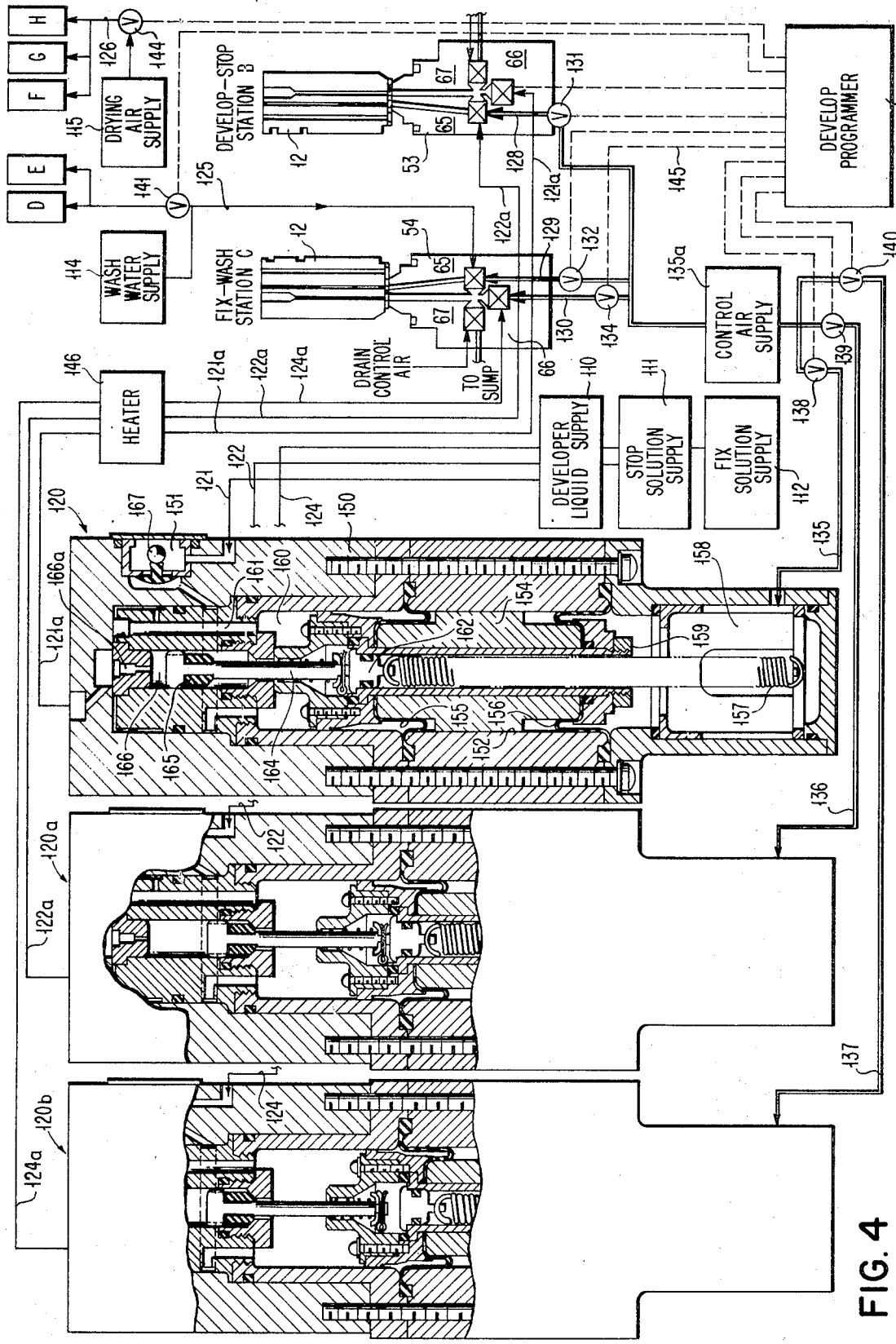

H
G
F
E
D
DRYING AIR SUPPLY
WASH WATER SUPPLY
DEVELOP-STOP STATION B
FIX-WASH STATION C
DRAIN CONTROL AIR
TO SUMP
HEATER
DEVELOPER LIQUID SUPPLY
STOP SOLUTION SUPPLY
FIX SOLUTION SUPPLY
CONTROL AIR SUPPLY
DEVELOP PROGRAMMER
120
120a
120b
122a
124a

FIG. 4

AUTOMATIC FILM PROCESSOR

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a wet process developer for photographic film, and more particularly to such a processor into which an exposed film chip can be inserted, automatically developed, and quickly returned ready for reading.

Description of the prior art

In wet process developing of film, it is well known that the film must be exposed to various liquids in a predetermined sequence. In attempting to automate such a developing process, various problems arise in trying to expose the film to bubble-free developing fluids in a properly timed sequence and at a satisfactory throughput rate. Naturally, any bubbles forming in the fluids will lead to an uneven distribution of the fluids over the film surface which can result in an imperfectly developed film.

Recently, photographic film having a very high resolution capability has been used for storing data in digital form at very high densities. Naturally, it is desirable to develop the film quickly but carefully since any irregularities in the developing process can result in the imperfect recording of such data. Due to the high densities, a very small bubble formed on the film surface can prevent the wetting of that area by the developing fluid and cause the loss of large amounts of information. With the use of such film comes the need for a quick, automatic wet process developer to permit the reading out of the information as soon as possible and to allow storage of the film soon after exposure to prepare the data processor for the receipt of further information to be stored. To handle the vast amounts of data which must be recorded frequently, the rate of processing of the chips must be as high as possible for the efficient use of the data system. While batch processors might satisfy the overall throughput rate, such devices provide the processed film to the system in a batch mode which the system usually cannot handle.

Thus, a primary object of this invention is to provide an improved wet processor for film chip developing.

A further object of this invention is to provide an automatic processor for photographic film utilizing the wet process and into which the exposed film can be inserted for quick return in the completely developed and dry state.

A further object of this invention is to provide a quick-acting wet process precision developer for developing high resolution photographic film suitable for use as a storage medium for digital data.

SUMMARY OF THE INVENTION

A film processor wherein the film chip is placed in a film holder which is moved relative to various processing stations. At each station the holder is placed in a fluid sealed relationship with a fluid supply conduit through which selected developing fluids are supplied with the solutions being supplied in substantially a bubble-free state for the effective immersion and processing of the film.

The foregoing objects, features and advantages of the invention will be apparent from the following description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective cut-away view of the processor apparatus of the invention;

FIG. **2** is a schematic drawing of the developing stations incorporated in the processor apparatus of FIG. **1**;

FIG. **3** is a perspective cut-away view of the film holder used in the processor of FIG. **1**;

FIG. **4** is a partially cross-sectioned and partially schematic drawing of the fluid supply apparatus for the processor;

FIG. **5** is a cross-sectional view of the fluid valve used in the developer;

FIG. **6** is a cross-sectional view of the film holder positioned at a developing station of the processor apparatus; and

FIG. **7** is a cross-sectional view of the film holder positioned at a wash or dry station in the developer.

DESCRIPTION OF A PREFERRED EMBODIMENT

In a normal wet processor for developing photographic film chip, the chip, after being exposed is immersed in various fluids to develop and fix the image. For instance, in such a processor there commonly is used the various chemicals such as hydroquinone and phenidone for developing the film, followed by a stop solution to neutralize the action of the developing fluid. One common type of stop solution is acetic acid. Thereafter, to fix the image the chip is immersed in such chemicals as sodium, potassium or ammonium thiosulfate. The film then must be washed and dryed before being used. Naturally, the sequence and time duration of immersing the film in each of the solutions must be closely controlled and accomplished in a manner so that the solutions completely wet the film for effective image development.

In accordance with the present invention, an automatic wet film processor developer **10** is provided wherein the film chip **11** is quickly and automatically developed, washed and dried. To achieve this, the chip is inserted into a holder **12** which is transported to various stations for pumping the processing liquids, including washing solutions and the drying air, into the holder to process the chip. Eight of the holders **12** are mounted for rotation about a fixed spindle **14** for positioning consecutively at the stations indicated in FIG. **2** and lettered A through H. Each holder includes an internal cavity or flow passage **15** in which one film chip is inserted. The film chip is loaded at station A (FIG. **2**) then moved to station B at which the developing and stop liquids are pumped into the cavity **15** in consecutive order. Thereafter, the holder is advanced to station C for immersion in the fix and wash solutions, stations D and E for washing, and stations F, G, and H at which drying air is passed through the internal cavity. The holder is advanced then to station A for the unloading of the now developed film chip from the holder and the insertion of an undeveloped film chip. The holder is positioned at each station in sequence and for an equal time to enable the processing of eight film chips concurrently thereby greatly increasing the number of chips during a time span. By moving the film chip with a holder, the film need be handled individually only at station A, thereby lessening the possibility of damage to the film or to the emulsion of the film. The cavity is washed and dried with the chip thus assuring a clean and dry cavity for the receipt of subsequent chips.

As shown in FIG. **3**, each holder **12** comprises an outer body **16** forming the vertically oriented internal cavity **15** in which the film chip is positioned. Deformable elastomer seals **17** and **18** are attached to the upper and lower ends of the holder encircling the cavity opening. Fresh processing fluids are used for the processing of each chip. To minimize the total quantity of fluids consumed, a thin minimum volume processing cavity is utilized. Protrusions or ribs **19** extend from the flat inner walls of the internal cavity **15** to hold the film in a central location and to permit the free flow of fluids and drying air over both surfaces of the chip to assure proper fluid processing and drying. The protrusions preferably are located so as to contact the film chip in border areas outside of data areas. The vertical orientation of internal cavity **15** and its contained chip facilitates the displacement of air by processing fluids without air void formulation. A drain port **20** extends from the top to the bottom of the body in a direction parallel to the cavity **15** for the drainage of overflow fluids passing from the cavity **15**. Additionally, a drying air passage **21** extends parallel to the cavity **15** from a top to the bottom of the holder.

For indexing the holders in unison from station to station, all are mounted at angularly spaced positions on an octagon-shaped ring member **22** (FIG. 1) by passage of the bolts (not shown) through openings **25** (FIG. 3) in each holder. The ring member is centrally located by spherical surface **29***b* attached to rotatable spindle **29** and by bushing **22***a*. The cylindrical bore of the bushing provides accurate central location of the ring member while permitting vertical motion and canting of the ring member. The ring member is supported on a plurality of springs **26**, each encircling one of a plurality of studs passing through openings **28** in the ring and being threaded into rotatable spindle **29**. Stud shoulders **27***a* serve to limit the upward travel of ring member **22** locating the holders **12** in a central position out of contact with both pressure plate **41** and valve blocks **39** when pressure plate **41** is in its upward position. The rotatable spindle is supported on bearings **30** and **31** fitting about the fixed spindle **14** which extends into the rotatable spindle center opening **32**. A spur gear **34** is mounted on the bottom outer edge of the spindle in engagement with a driving gear **35**. Thus, by intermittently turning the driving gear, the rotatable spindle is turned to index the film holders to the various stations A through H shown in FIG. 2. A driving connection between a rotatable spindle extension **29***a* and the ring member is provided through a pin **36** which is passed through the spindle to hold a square washer **37** which fits into an opening **38** in the ring member. By interconnecting the spindle and the ring member in this manner, the ring member may be accurately rotationally positioned while vertical positioning and axial alignment relative to spindle **29** are permitted by compression of springs **26**.

By rotating the rotatable spindle and the ring member, the film holders **12** are indexed to each of the stations for the introduction of the processing fluids. The developing, stop, fix and wash liquids are each passed through a passage **59** in a valve block **39** extending through a base **40** (positioned directly beneath the film holders at the stations B through E) to flow upward through the internal cavity **15** until the cavity is filled, and thereafter to flow over the top of the holder and down through the drain port **20**. In this manner, it is assured that the cavity **15** is completely filled for total immersion of the film in the processing fluids. The upper side of the film holder is closed by an annular-shaped pressure plate **41** supported on a cylinder assembly **45**. The pressure plate is held normally out of contact with the top of the film holders but is mounted for vertical movement and held against rotary movement relative to the fixed spindle **14**. To actuate the plate vertically, the cylinder assembly includes a top plate **47** and a mounting plate **48**, forming therebetween a piston cavity **49** across which a piston **50** of the pressure plate extends. A flexible diaphragm **51** is clamped between the top plate and mounting plate of the piston assembly and is attached to the piston **50** to seal against leakage past the piston. An air inlet **52** extends through the top plate and connects with the top half of the piston cavity **49** through which pressured air can be introduced for exerting a downward force on the piston **50**. Movement of the piston exerts a downward force on the pressure plate **41** through a connecting pin **50***a*. The pressure plate thereafter contacts each of the film holders and presses them downward against the valve block **39** mounted in the base **40**. Tilting of the ring member **22** holding the film holders is permitted to allow optimum alignment with the pressure plate **41** and the top of the valve blocks **39** and drying stations F, G, and H. Thus, the pressure plate exerts equal pressure completely about the fixed spindle to force the film holders against the valve block **39** and into fluid sealed relationship therewith at stations B through E, and against the base plate **41** at stations A and F through H. Thus, the top and bottom seals **17** and **18** are compressed between the pressure plate and the valve block and base plate to prevent fluid leakage past the ends of the film holders.

To develop the image on the film in an efficient and blemish-free manner, it is essential that the fluids be supplied to the film cavities for a timed period and with minimum turbulence so that no entrapped air bubbles can attach to the film surface and prevent the developing of a portion of the image. At station B (FIG. 2), the develop solution first is supplied followed immediately by the stop solution such that the film is immersed in each liquid for a predetermined time duration. The same is true at station C wherein the fix solution is applied and followed immediately by a wash or rinse cycle in which water is pumped across the film surface.

FIG. 4 shows the circuit diagram for supplying the fluids to the stations B and C. Beneath station B is a fluid control valve **53** and beneath station C is a similar control valve **54**. The purpose for the control valves is to regulate the flow of fluids to stations B and C in consecutive sequence while limiting the mixing of the fluids with each other and with air which might be drawn into the lines as the valves open. One such valve is shown in FIG. 5 and, for purposes of explanation, will be described as valve **53** with the realization that valve **54** is identical except for the type of fluids supplied thereto.

The valve assembly **53** (FIG. 5) is enclosed in the valve block **39** forming a housing and having an inlet **56** for receiving developing fluid, an inlet **57** for receiving a stop solution, an inlet **58** positioned to be aligned with the drain port of the film holder, a smooth walled vertically oriented transition passage or port **59** aligning at its upper end with the film cavity or passage of the holder and its lower end with valve port **69**, and an outlet **60** leading to a drain. In addition, inlets **61**, **62**, and **64** are provided through which control air can be passed for actuation of the valve assembly.

The control valve includes three valve assemblies **65**, **66**, and **67** which control the opening of the ports **68**, **69**, and **70** respectively by regulating the movement of the valve members **71**, **72** and **74**. The ports are placed in close juxtaposition to one another and are located close to the top of valve block **39** to permit the use of a minimum volume passage **59** thus minimizing the volume of fluids expended for each processing cycle. The initial fluid introduction flow is started at the lowermost point in passage **59** at port **69** so that normal buoyancy will aid the displacement of air by the rising column of fluid introduced into **59**. The close juxtaposition of second fluid introduction port **68** facilitates the displacement of the first fluid by the second. The close juxtaposition of the drain port **70** facilitates complete drainage of passage **59**. The valve **66** includes a shaft **75** connecting with the valve member **72** and spring-loaded by a spring **76** for movement of the valve member to the open position. This spring acts between the housing wall and a flange **77** fixed to the shaft **75**. The valve is held closed by the introduction of pressured air into the inlet **62** which pushes against a piston **78** fastened to the shaft **75** and positioned for reciprocal movement within a piston cavity **79**. A pair of diaphragms **78** seal against leakage past the piston. The valve can be opened by releasing the pressured air from the inlet **62** to allow the spring to move the shaft **75** and valve member **72** downward to a position spaced from the port **69**. Thereafter, fluid can flow from the inlet **56**, a check valve **81** and through the opened port **69** to the outlet passage **59** and the film cavity of the film holder at station B.

As pointed out before, it is important to prevent the mixing of air with the developing fluid because air bubbles can be carried by the fluid up into the film cavity and become attached to the film surface, thereby interrupting the developing process at the point of contact. Diaphragm type valves ordinarily are operated to an "open" position by moving the valve's orifice closing member and the attached center of the diaphragm in a direction away from the valve orifice. Minimum turbulence operation of the valve assembly used to introduce the first fluid into the outlet passage **59** requires that the valve be opened prior to the initiation of continuous fluid pumping action. The opening motion of a diaphragm valve expands the volume of the valve cavity and would tend to draw air into the cavity from the empty passage **59** to cause air bubbles being mixed with the fluid.

To prevent the mixing of air with the processing fluids, the valve members **71**, **72**, and **74** with the related openings are

placed close to the passage **59** to limit the space in which air and liquids can become entrapped as the valve member is moved to the closed position. Also, the developing fluid is introduced into a cavity **82** formed by the valve housing **55** and the flange **77** sealed by a diaphragm **84**. Upon movement of the flange **77** in the downward direction to open the valve, fluid is forced through a passage **80** and into the port **69** immediately below the valve member **72** to fill the evacuated volume resulting with the movement of the valve member relative to the passage **59** and prevent the sucking of air into the fluid flow area. In this manner, the mixing of air with the developing fluid is limited to make the developing process more efficient since the air already within the fluid conduits and valve is pushed upward by the fluid. Additionally, all changes in the cross-sectional size of the passage **59** (FIG. **5** and FIG. **6**) is effected by smooth transition passages to prevent further the entrapment of air and turbulence within the fluid passage. Diaphragm **84** is preferably of greater area than diaphragm **78***a* so that the opening motion of the valve will cause a net flow of fluid from the valve orifice into fluid passage **59**.

Positioned in close proximity to the valve member **69** are the inlet ports **68** and **70** opening into the passage **59** and being closed by the valve members **71** and **74** respectively. The valve member **71** is opened by movement of the shaft **86** to the right (FIG. **5**) which is effected by the force of the spring **88**. This spring acts between a ring member **89** attached to the housing of the valve and a flange **90** attached to the shaft **86**. The valve is maintained closed by introducing pressured air through the inlet port **61** to act against a flexible diaphragm **91** fixed between the shaft **86** and the housing wall. Thus, by release of the pressured air at the inlet **61**, the valve member is permitted to open port **68** under the force of the spring **88** to allow the flow of stop solution from the stop solution inlet **57**, through the port **68** and into the passage **59**. Of course the opening of the port **68** is coordinated to occur after the closing of the port **69** to prevent mixing of the developing and stop fluids. Since the fluid passage is filled with the develop fluid at the time the port **68** is opened, air is prevented from rushing into the valve which might otherwise cause further turbulence.

To drain the film cavity and the valve, the drain passage **58** and passage **59** are opened to the drain port **60** alternately by actuation of the valve member **74**. This valve member is held in the position shown in FIG. **5** for closing the port **70** under the force of air pressure acting against diaphragm **98** fixed to a shaft **95** holding the valve member. When in this position, any excess liquids passed into the film cavity **15** can flow over the top of the film holder and down through the drain passage **20** to the port **58** and out the port **96** to the drain port **60**.

After each introduction of fluids into the passage **59**, it also is desirable to drain the passage and thereby prevent the entrapment of air, etc. therein as well as preventing the mixing of the fluids. To drain the passage **59**, the valve member **74** is moved to the left (FIG. **5**) to open the port **70** and close a port **96**. The movement of the valve member is effected by releasing pressured air normally supplied to the inlet **64** and acting against a diaphragm **98** fixed between the housing wall and the shaft **82** to hold the valve member in the right hand position. Thus, the spring **92** is permitted to move the shaft **95** to the left position (FIG. **5**). When it is desired to close the port **70** and open the port **96**, pressured air again is pumped into the port **64** which moves the diaphragm **98** and attached shaft **95** to the right in the drawing. Thus, drainage of the passage **59** and port **58** is controlled by regulating the supply of pressured air to the port **64** of the valve actuator **67**.

Thus, the sequence of operation of the valve assembly **53** includes the opening of the port **69** to first allow the developing fluid to pass through the inlet **56** and into the film cavity **15**. After sufficient developing fluid has flowed to fill the cavity, the fluid will overflow through the drain port **20** of the film holder, the port **58**, and out the drain port **60**. After the film has been immersed in the fluid a sufficient time, the valve member **72** is moved to close the port **69** and subsequently the valve member **71** is actuated to open the port **68** and allow the stop solution to pass through the passage **59** and exhaust the developing solution through the drain port **20** of the film holder to the drain passage passages **58** and **60** of the control valve **53**. After the stop solution has remained in the film cavity for a sufficient time, the port **68** is closed and the port **70** subsequently is opened by actuation of the valve member **74** to allow the stop solution to drain through the passage **59** and out through the drain outlet **60**. Thus, it can be seen that the control valve **53** permits the introduction and drainage of the developing and stop solutions in sequence and with little turbulence into the film cavity since the introduction of air into the valve is limited. As stated before, the control valve **54** is identical to the control valve **53** except the fix solution is injected instead of the developing fluid and a wash solution is injected instead of a stop solution in the same valve. While not shown, a valve similar to the valve **65** is used for controlling the introduction of wash fluids at the stations D and E of the developer.

To facilitate the draining of the fluids from the film and drain cavities of the film holder at each station, purging air is introduced through an air inlet **100** (FIG. **1**) from a suitable source (not shown) for passage through a duck bill type check valve **102** in the pressure plate for parallel flow out through the film cavity **15** and the drain cavity **20** of the film holder. Naturally, the introduction of this purging air is coordinated with the opening of the drain port **70** of the valve **67** to facilitate the flow of the remaining fluid from the film holder. Additionally, at stations F, G, and H, drying air is injected from a source through a port **104** in the base **40** for passage upward through the film cavity, across the top of the film holder within the passage **105** formed in the pressure plate and downward through the drain port **20** and internal cavity **15** to be expelled through the passage **106** in the base. In this manner, the film is completely dry after passage through the stations F, G, and H before being unloaded at the station A.

To program the actuation of the fluid control valves heretofore described, and to supply the fluids to the valves for subsequent passage to the film cavity, the control system shown in FIG. **4** is provided. Herein are shown stations B through H at which the developing fluids are supplied to the film cavity. Film holders **12** are shown positioned at each station with the control valves **53** and **54** positioned below the respective stations B and C. Each control valve comprises the assemblies **65**, **66**, and **67** with the former two being used to control the flow of fluids to the film cavity while the actuator **67** controls the fluid flow from the cavity to a drain in the manner previously described. The fluids are supplied from reservoirs such as a developer fluid supply **110**, a stop solution supply **111**, a fix solution supply **112**, a wash water supply **114**, and a drying air supply **115**. Each of the developer, stop, and fix fluids are supplied through separate but identical two stage pumps **120**, **120***a* and **120***b* with lines **121** and **121***a* carrying the development fluid to the valve assembly **66** of the control valve **53**. Lines **122** and **122***a* carrying the stop solution to the valve assembly **65** of control valve **53** and lines **124** and **124***a* carrying the fix solution to the valve assembly **54**. Additionally, line **125** carries wash water from the supply to the valve assembly **65** of control valve **54** and stations D and E, and line **126** carries drying air to stations F, G and H.

As pointed out previously, the valve assemblies of the control valves **53** and **54** are energized by the presence or absence of pressured air in the piston cavities. As shown in FIG. **4**, the control of the developer mechanism is coordinated by a developer programmer **127**. Thus, lines **128**, **129**, and **130** supply pressured air to the valve assemblies from a supply **135***a* under control of valves **131**, **132** and **134** regulated by the developer programmer **127**. The developer programmer regulates this pressured air in timed sequence for the proper actuation of the valve actuators. Additionally, pressured air is supplied through the lines **135**, **136** and **137** to the pumps **120**, **120***a*, and **120***b* for actuation of the pumps. This air supply is

controlled also by the developer programmer **127** through regulation of the valves **138**, **139** and **140** respectively.

Thus, after the film holders have been indexed under regulation of a timer (not shown), the developer programmer will control the supply of pressured air in proper sequence to inject developer fluid followed by stop solution into the film holder positioned at station B and also to supply fix solution followed by a wash water flow to the film holder at station C. Concurrent with this, wash water is supplied to the stations D and E by actuation of a valve **141** of a common design (not shown) to that of the valve assembly **65** while a drying air flow from the supply **115** is regulated by the actuation of a valve **144** to permit drying air to flow to the stations F, G, and H. Regulation of the valves, etc. is achieved by the supplying of electrical signals through conductors represented by the dotted lines **145**.

Additionally, it has been found that to control the develop cycle closely, the temperature must be maintained within desired limits in the develop mechanism. For this purpose, the developer, stop, and fix liquids are passed through a temperature controlled heater **146** to heat the solutions to a selected temperature within the ranges of 105—130° F. while the wash water and drying air is passed through similar heaters (not shown).

In accordance with another feature of the invention, further turbulence, resulting in the mixing of air bubbles with the developing solutions, is limited by supplying the develop, stop, and fix solutions through two stage pumps **120** and **120*a***, respectively, which serve to slowly fill empty passages **59** with fluid then rapidly to inject fluid into the film cavity for processing the film. These pumps serve the additional purpose of supplying a measured quantity of fluid to the film cavities to conserve the amount used for each cycle since in the optimum embodiment the fluid is used only once and then vented to the drain. Accordingly, each pump operates first to pump fluid at a slow rate for the purpose of filling the passage **59** leading from the inlet ports of the control valves **53** and **54** (FIG. **5**) in which air can be entrapped since the passage forms the air-fluid interface within the fluid system of the developer. Secondly, after the passage **59** is filled, each pump supplies the fluid to the passage at a fast rate to fill the film cavity **15** quickly thereby to permit a close regulation of the time the film is immersed in the fluid. Each of the pumps functions in the same manner and comprises a housing **150** having an inlet **151** through which the developing process fluid is supplied. For instance, in the case of the pump **120**, the fluid is the developing fluid while the pump **120*a*** supplies the stop solution.

The housing of each pump forms an internal cavity **152** in which is held a piston **154** for lengthwise movement. Rolling diaphragms **155** and **156** prevent fluid and air flow past the sides of the piston. The piston usually is positioned as indicated by pump **120*b*** since the spring **157** normally pulls the piston to the lower position. However, pressured air supplied to the cavity **158** acts against the wall **159** of the piston to force the piston upward. Movement of the piston is retarded initially by the presence of liquid in the chamber **160** located to one end of the piston. This piston movement is regulated by the rate at which the trapped fluid can escape through the restricted annular flow orifice **161** to the conduit **121*a***. Movement of the piston until the bumper **162** contacts the shaft **164** (position of pump **120*a***) remains at the slow rate. At the time of contact between the bumper and shaft **164**, the valve member **165** is unseated to permit a rapid flow through the passage **166** (position of pump **120**) and high flow rate orifice **166*a***. The slower fluid flow follows by approximately one second in time the opening actuation of the actuator **66** in the valve **53** to permit the filling of the passage **59** with liquid, thereby limiting the entrapment of air therein by providing sufficient time for the air to escape. Fluid is supplied to the chamber **160** through the inlet **151** which includes the check valve **167** to prevent back flow through the feed line to the supply **110** when the pump is actuated. Thus, it can be seen that the supply of pressured air to actuate the pump causes a two stage flow with the first stage being sufficient to slowly fill the outlet passage **59** of the fluid control valve and thereafter quickly to fill the film cavity for accomplishing the developing process. Additionally, since the check valve **167** is held closed once the piston begins movement, only the volume of fluid within the chamber **160** is fed to the control valve for each piston actuation thereby serving to meter the amount of fluid supplied during each cycle.

6. upon stopping the flow of pressured air to the cavity **158**, the piston **154** is returned to the lower position under the force of the return spring **157** to seat the valve member **165**. Subsequently with the shutting off of the control air to the pump **120**, control air is supplied to actuate the pump **120*a*** and supply the stop solution to the control valve **53** and on into the film cavity immediately following develop solution. Naturally, the same sequence occurs in the control valve **54**; however, the first solution supplied by actuation of the pump **120*a*** is the fix solution.

A pump **120*a***, similar in operation to the pump **120** just described, is utilized to supply stop solution consecutively after the introduction of the develop solution into the film cavity. However, since the passage **59** is filled already with the develop solution, the air therein has been evacuated and there is no need for a two stage pumping action to evacuate the air. Thus, the pump functions the same as the pump **120**, previously described, except that the restricted flow orifice **161** is made larger so as not to slow the fluid flow from the chamber **160** which would impede the movement of the piston **154** to the left in the drawing. However, the amount of fluid still is metered by the volume of fluid the cavity **160** will contain.

As shown in the figures, the supply passage **59** and the pump cavities **160** are positioned vertically so that air cannot be entrapped by the fluid, but, instead, is forced upward and out ahead of the fluids to prevent its mixing with the fluids. Additionally, as shown in FIGS. **6** and **7**, the seals **17** and **18** positioned at the top and bottom of each film holder each include two projecting ridges **168** and **169**. FIG. **6** shows a typical seal arrangement encountered at stations B and C wherein the pressure plate **41** and base **40** have smaller fluid entrances **170**, **171** so as to seal against the inner ridge **168**. However, the fluid openings shown in FIG. **7** represent the wash and dry stations D through H and include larger fluid entrances **172** and **174** so as to seal against the outer ridge **169** such that the seal ridge **168** is completely washed and dried along with the film during each cycle. In this manner, deposits on the seals, which can frequently form when fluids such as those used in the developing process are handled, are prevented from building up on the seals, thereby extending the useful life of the processor.

While the invention has been particularly shown and described with a reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

We claim:

1. A film processing apparatus comprising:
   - a film holder including a body portion forming a cavity for receiving the film to be developed;
   - a plurality of developing stations each including means for pumping selected ones of the necessary processing fluids into said cavity to develop said film; and
   - means for effecting relative movement between said holder and said stations to introduce said processing fluids to said cavity in predetermined sequence.

2. A film processing apparatus as defined in claim **1** wherein said cavity is positioned in a vertical plane and said pumping means introduces said developing fluid into the bottom of said cavity to limit the entrapment of air therein.

3. A film processing apparatus as defined in claim **1** wherein said stations are substantially stationary and said holder is moved to said stations in consecutive order.

4. A film processing apparatus as defined in claim 3 wherein a plurality of holders are mounted equal distance from a central supporting axis and are moved about said axis to said stations positioned thereabout.

5. A film processing apparatus as defined in claim 1 wherein purging air is forced through the fluid introduction means after the fluids to clean the means of fluid droplets therein.

6. A film processing apparatus as defined in claim 1 wherein protrusions are extended from the internal surface of the walls of said cavity to hold said film in spaced relationship with said walls for effective wetting of said film by the developing fluids.

7. A film processing apparatus as defined in claim 1 wherein said fluid introducing means includes a two speed supply functioning first to supply the fluid at a slower rate for purging air from the supply lines transmitting said fluid and thereafter at a faster rate to introduce the fluid to the film cavity quickly.

8. A film processing apparatus as defined in claim 7 wherein the fluid supply conduits at said stations lead generally upward to limit the entrapment of air therein as the developing fluids are pumped into the holder cavities.

9. A film processing apparatus comprising:

a plurality of film holders each comprising a body portion forming a cavity for receiving and holding film to be developed;

a plurality of developing stations each including means for pumping fluid into the cavity of an adjacently positioned holder; and

means for effecting relative movement between the film holders and developing stations in unison.

10. A film processing apparatus as defined in claim 9 wherein said means for effecting relative movement comprises a support mounted for turning about a central axis and adapted to support said film holders at angularly displaced points equal distance from said axis for indexing to the various stations spaced about said axis.

11. A film processing apparatus as defined in claim 10 wherein said support includes a single actuator positioned at the axis for moving said holders axially into engagement with the stations after being indexed to the station.

12. A film processing apparatus as defined in claim 11 wherein said holders include at least one fluid passage positioned to receive fluid from the station and transmit it to said cavity for immersion of the film.

13. A film processing apparatus as defined in claim 12 wherein the fluids introduced at the various stations include various developing fluids, washing solutions and drying air.

14. A film processing apparatus as defined in claim 13 wherein seals are positioned around said fluid passage at the point of contact with said station to prevent fluid leakage when the fluid passes between the station and the holder.

15. A film processing apparatus as defined in claim 14 wherein said seals are immersed in said washing solutions when such solutions are pumped to said cavity thereby to clean said seals during each developing cycle.

16. A film processing apparatus as defined in claim 15 wherein the fluid conduits for supplying fluid to said stations lead generally upward to limit the entrapment of air therein as the fluids are injected into the holder cavities.

17. A film processing apparatus as defined in claim 9 including sealing means for sealing between the film holders and the stations for preventing leakage therebetween when said fluids are supplied to said cavity;

and means for supplying a washing fluid to said cavity and body portion for washing both the film and the seals at one of said stations thereby to maintain said seals clean to extend their useful life.

18. A film processing apparatus as defined in claim 9 wherein a flow passage in said body portion extends between said cavity and the outside of said holder;

said station pumping means includes a port which aligns with said passage for transmitting fluids to said cavity;

and a seal is affixed to said body portion encircling said passage to prevent fluid leakage from between the holder and station when fluids are supplied to said cavity.

19. A film processing apparatus as defined in claim 18 wherein a washing fluid is supplied to said cavity at one station;

and said port extends around said seal at that station to enable the washing of the seal by the washing fluid.

20. A film processing apparatus comprising:

a film holder including a body portion forming a cavity for receiving the film to be developed; and

means for supplying separate developing fluids in sequence through a connecting conduit and into said cavity for developing said film;

said supply means including a pumping means for supplying a first fluid at a slow rate to force the atmosphere from said passage thereby to limit turbulence therein and thereafter at a fast rate to supply the fluid quickly to said cavity.

21. A film processing apparatus as defined in claim 20 wherein said connecting conduit leads upward to connect to the bottom of said cavity thereby to force the atmosphere upwards ahead of said fluid.

22. A film processing apparatus as defined in claim 20 including means for forcing purging air through said fluid passage and cavity after selected ones of said fluids are introduced to the cavity to clean the residual fluid therefrom.