

[54] **APPARATUS FOR RAPID PROCESSING PHOTOGRAPHIC FILM**

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[51] Int. Cl. **G03d 13/00**

[58] Field of Search **95/89 R, 89 G**

[56] **References Cited**

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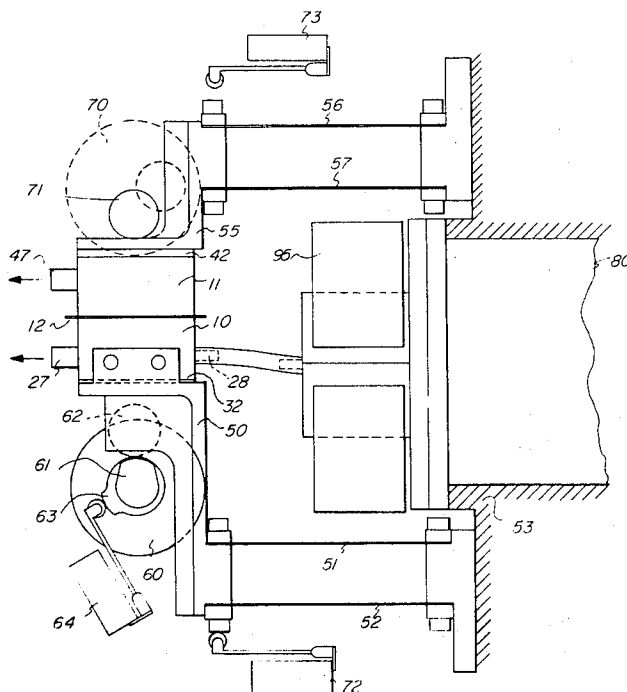
Attorney—Robert W. Hampton et al.

[57]

ABSTRACT

A latent image on a sheet or strip of film is rapidly processed to produce a dry, developed film by positioning it between a pair of spaced platens. The one platen is moved into contact with the film and then the other platen is moved into position so as to clamp the film therebetween. The other platen is also provided with a resilient frame member which provides a seal with respect to the support side of the film. A recess in the one platen is interconnected to the processing solutions through a metering valve so that each solution is moved into the recess in a required order so as to develop the latent image area. The flow of solution is maintained at a generally consistent and uniform temperature from the point of introduction into the recess to the point at which it is withdrawn after processing has been completed. A suction applied to a configuration of passages in the other platen draws the film toward the facing surfaces so as to maintain it in a spaced and generally parallel relation to the recess in the one platen. The uniform space so provided permits the flow of solution to be moved across and in contact with the emulsion surface of the film.

4 Claims, 10 Drawing Figures



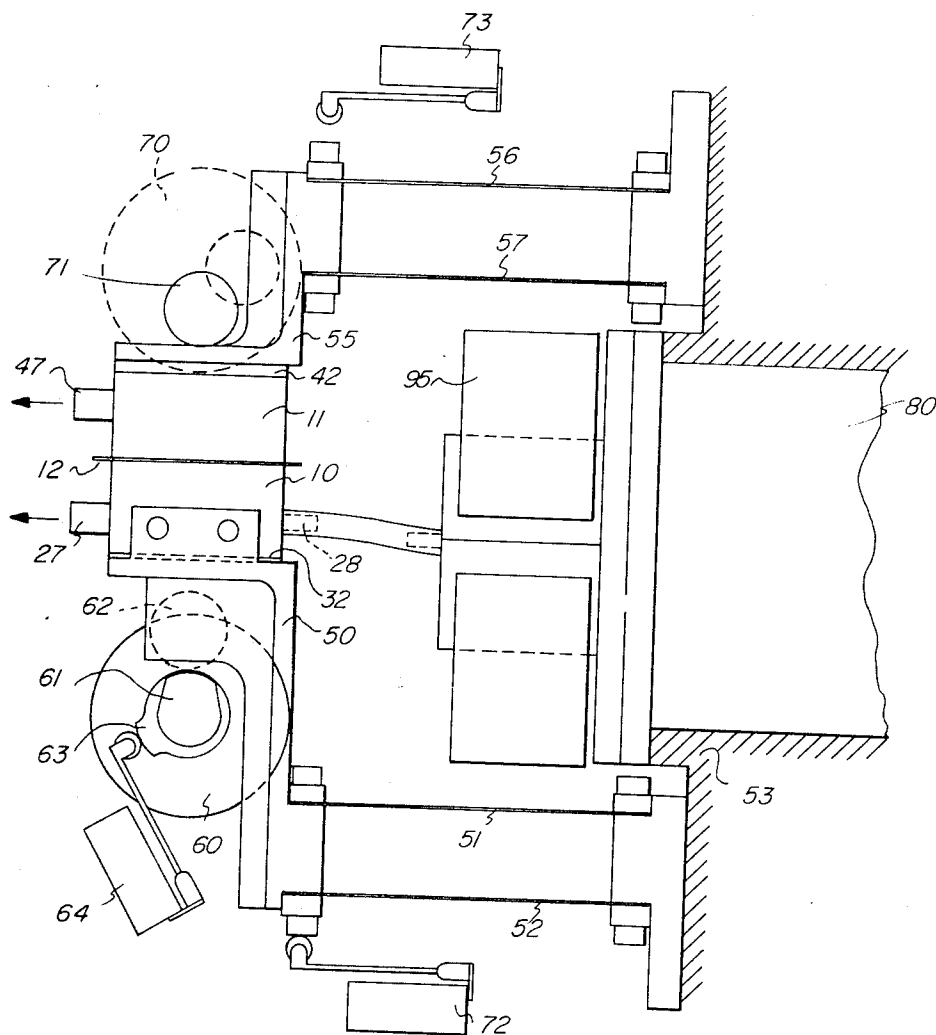


FIG. 1

SHEET 2 OF 5

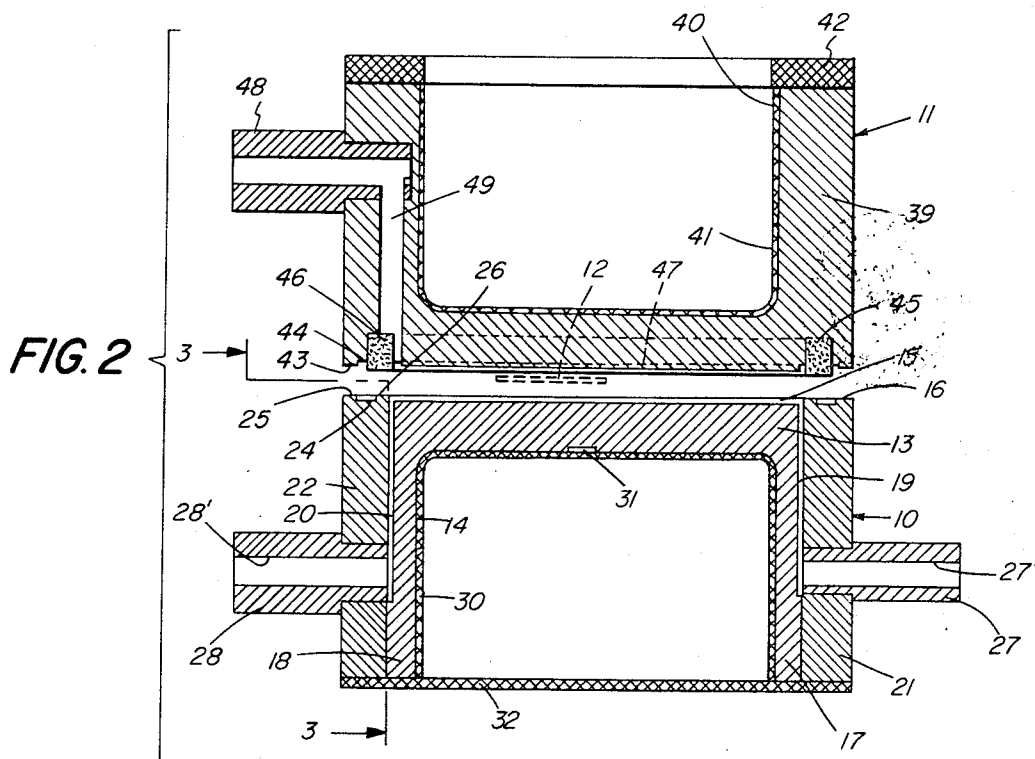
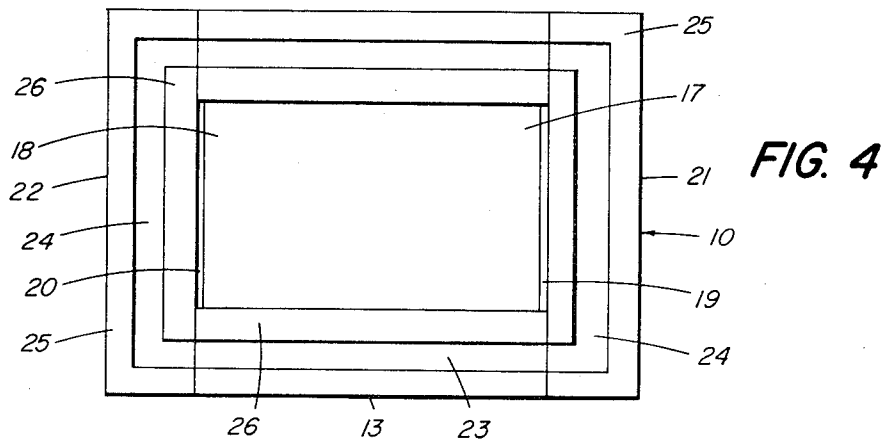
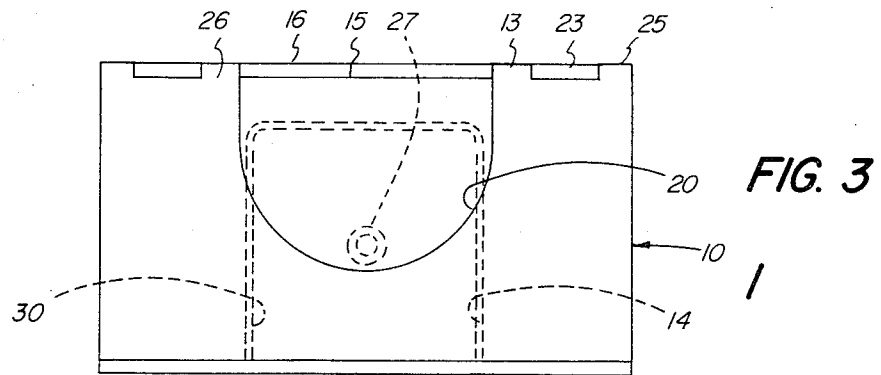


FIG. 5

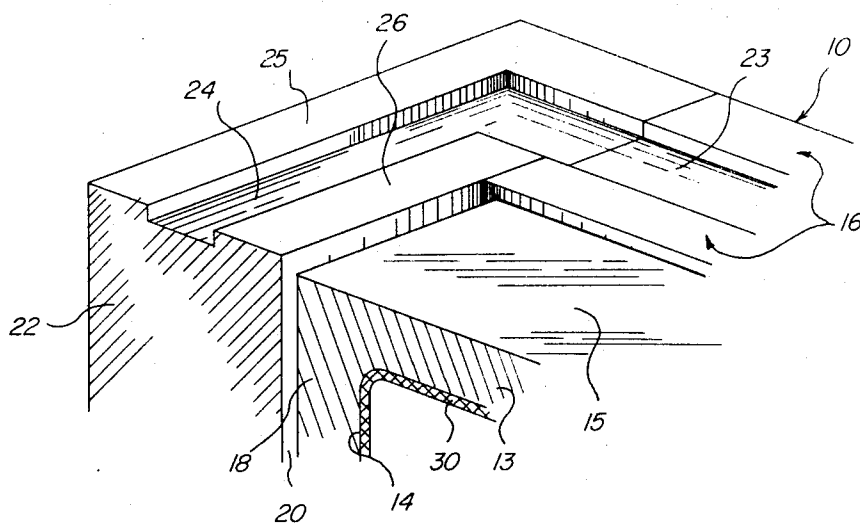


FIG. 6

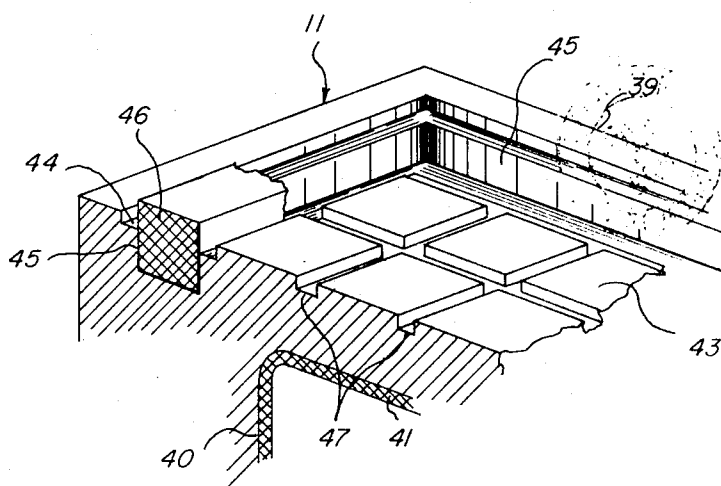


FIG. 9

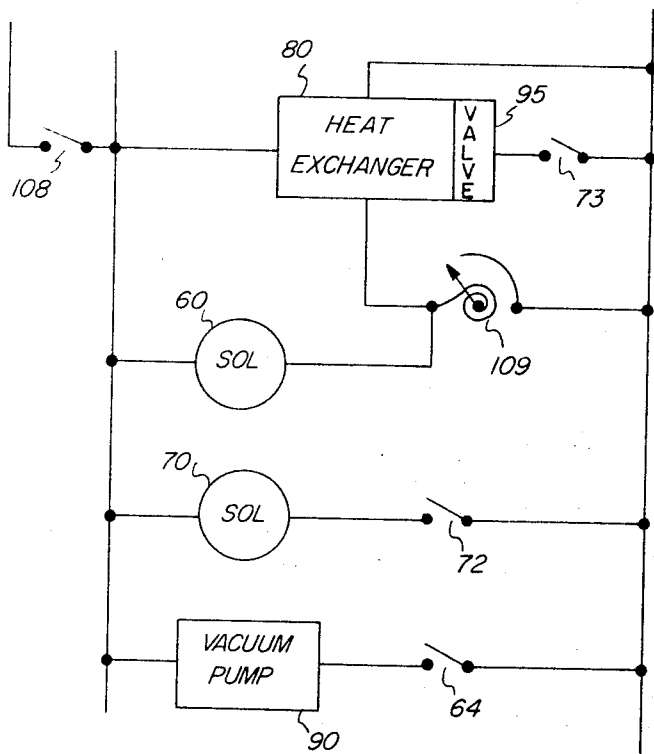
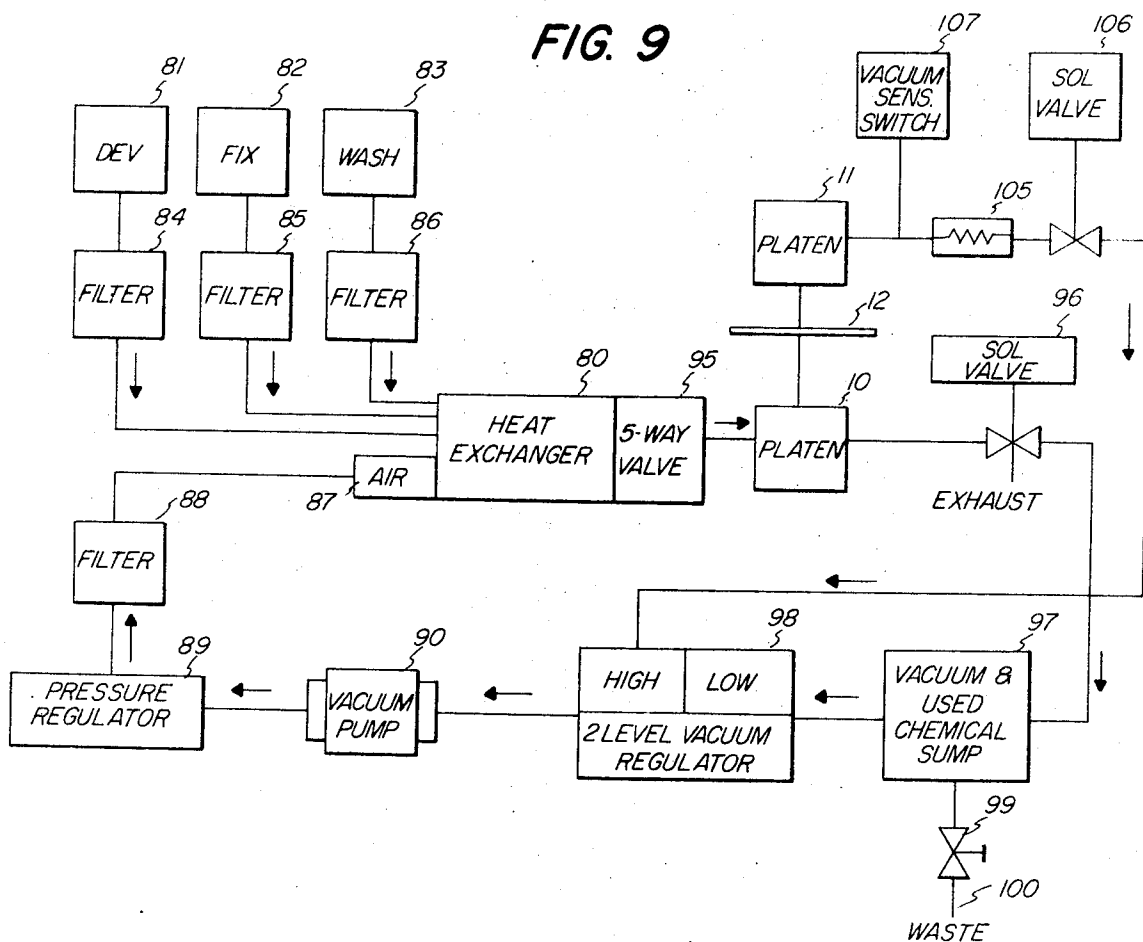


FIG. 10

APPARATUS FOR RAPID PROCESSING PHOTOGRAPHIC FILM

FIELD OF THE INVENTION

The invention relates to apparatus for rapid processing of a photographic film and, more particularly, to a high speed processing apparatus which produces a dry, developed film ready for viewing in a very short period of time.

DESCRIPTION OF THE PRIOR ART

Many attempts have been made to provide an apparatus wherein a piece or strip of photographic film having one or more latent image areas can be developed and processed in a very short time. Other important factors that have also been sought are optimum density and contrast in the finally developed image. In many instances, it is of great importance that the exposed, sensitized material be rapidly developed so that the resultant image can be observed or inspected without delay.

In apparatus disclosed by the prior art, the latent image area on a sheet of film or a film strip can be developed by movement of the film relative to successive processing solutions applied thereto in a fixed location. In some instances, the developing solution is brought into intimate contact with the image bearing surface of the film by a direct flow or an atomized spray of the solution. Recycling of the solution is usually practiced, and this results in a solution that is continuously weakened in its development strength so that the development time is and must be, of necessity, lengthened as the strength of the solution is weakened due to repeated use.

One of the primary factors for obtaining a visual image of optimum density and contrast is that the developing solution be maintained at a generally uniform temperature during processing of the film. In a spray system this is rather difficult because the developing solution is atomized into the space between the atomizer and the emulsion surface of the film for contacting the latter. In a flow type of process, the heating element is usually mounted or arranged within a platen or support which must be heated, but with large heat loss, in order to maintain the temperature of the solution generally uniform.

In an intermittent system wherein a latent image area is processed by movement relative to successive processing areas or stations, a considerable amount of time is consumed in merely transporting the film. Such a process is not only time consuming but requires an apparatus of much larger size which is dependent on the number of stations required.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a processing apparatus for a sheet or strip of photographic film having a latent image area thereon in which processing of the image area with one or more than one processing solution can be accomplished in a very short period of time.

It is another object of the invention to provide an apparatus for rapid processing of a latent image area on a photographic film in which a fixed and even flow of processing solution at a generally uniform temperature is applied only to the image area.

It is yet another object of the invention to provide an apparatus for rapid processing of a photographic film in which the apparatus is continually cleaned so that no additional cleaning time is required between the processing of successive image areas.

It is a further object of the invention to provide an apparatus for rapid processing of a latent image area on a photographic film in which the image area is effectively sealed against any external and internal leakage of a processing solution applied to said image area.

It is still a further object of the invention to provide an apparatus for rapid processing of a latent image area on a photographic film which can be used with different types of processing solutions and which requires no cleaning between processing of successive image areas.

The above objects and advantages are attained by an apparatus in which a latent image area on a sheet or strip of film is positioned between a pair of spaced platens. One platen is provided with a recess in its receiving surface that conforms generally in size and shape to the image area to be processed. The other platen has a facing surface in which a configuration of passages is provided which open on the facing surface and to which configuration a suction is applied. When a piece of film is positioned between the platens with the emulsion surface facing the recess, the one platen is moved into contact with the film and then the other platen is moved into position so as to clamp the film therebetween. The other platen is also provided with a resilient frame member which provides a seal with respect to the support side of the film. The recess in the one platen is interconnected to the processing solutions through a metering valve so that each solution is moved into the recess in a required order so as to develop the latent image area. Each platen is provided with a cavity in which a foil heating element is arranged in contact with the cavity surface. With this arrangement, the flow of solution is maintained at a generally consistent and uniform temperature from the point of introduction into the recess to the point at which it is withdrawn after processing has been completed. The suction applied to the configuration of passages in the other platen draws the film toward the facing surface so as to maintain it in a spaced and generally parallel relation to the recess in the one platen. The uniform space so provided permits the flow of solution to be moved across and in contact with the emulsion surface of the film.

The structure of the platens as well as the manner in which the platens are moved relative to one another and the film arranged therebetween provide for an efficient sealing arrangement. Also, with such platen structure and movement, mislocation of the film is eliminated and the one platen can be located or held in position by an actuator exerting a relatively small force thereagainst. With such an improved seal between the platen and the film, the air pressure that is used to dry the film is limited only by the amount of sealing pressure that can be obtained by the platen moving mechanism.

Other objects and advantages of the invention will be apparent to those skilled in the art by the description which follows.

DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying drawings wherein like reference numerals and characters designate like parts and wherein:

FIG. 1 is a side elevational view showing that portion of the apparatus for supporting and moving the platens relative to a sheet or strip of film;

FIG. 2 is a vertical section through the platens shown in FIG. 1 and showing the arrangement of the sealing members and the heating elements;

FIG. 3 is an end view of the lower platen shown in FIG. 2 with one of the side plates removed to show the configuration of the end recess;

FIG. 4 is a plan view showing the film contacting surface of the lower platen;

FIG. 5 is a partial perspective view of a corner of the lower platen showing the general relationship of the recess and lands which contact the emulsion side of the film;

FIG. 6 is a partial perspective view of a corner of the upper platen that has been inverted to more clearly show the resilient sealing member and configuration of passages in the facing surface thereof;

FIG. 7 is a partial sectional view through the platens showing the manner in which the seal is formed between the platens and the surfaces of the film;

FIG. 8 is a partial vertical section similar to FIG. 7 in which the film to be processed is shown as being retained within an aperture card;

FIG. 9 is a flow diagram showing the manner in which the various solutions, air and suction, are controlled for entry into and out of the platens; and

FIG. 10 is a simplified circuit diagram for controlling movement of the platens and a processing cycle of operation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With particular reference to FIGS. 1 and 2, a pair of platens designated by the numerals 10 and 11 are arranged relative to one another such that a piece of film 12 can be positioned therebetween when the platens are in a spaced, parallel relation as shown in FIG. 2. The film 12 can be automatically positioned between the platens by a form of intermittently movable carrier or by manually positioning it on the platen 10. Normally, as the present invention is practiced, a carrier, not shown, moves a chip or small piece of film 12 into a position between the platens and holds it in this position until clamped therebetween as described hereinafter.

The platen 10, see FIGS. 2 and 5, comprises a central block 13 having a cavity 14 and a shallow recess 15 in the film contacting or supporting surface 16. The side walls 17 and 18 are provided with a respective recess 19 and 20, both of which intersect recess 15 at opposite ends and have a shape as best seen in FIG. 2. Side plates 21 and 22 are secured to block 13 by suitable screws or fasteners not shown. Each plate 21 and 22 is provided with a respective channel 24 that aligns with the channel 23 in block 13 to provide a continuous channel and a pair of spaced lands 25 and 26 surrounding recess 15 for contacting the emulsion side or surface of the film 12, as shown in FIGS. 2 and 5 and described in more detail hereinafter. Plate 21 is provided with connector 27 having an opening 27' that terminates at the recess 19. In a like manner, the side plate 22 is provided with a connector 28 having an opening 28' that terminates at the recess 20. With this arrangement, a processing solution, water, or air can be introduced at the inlet or connector 28 and a flow will then

be maintained through recess 20, recess 15 and recess 19 to the outlet or connector 27, or vice versa.

The cavity 14 is lined with a foil heating element 30. This heating element is adhered to the surface of the cavity and a small bead thermistor 31 protrudes through the heating element and is potted or encapsulated with a thermally conductive epoxy. The thermistor 31 can be arranged in an area near the bottom of the cavity to monitor the temperature of the platen 10. The heating element 30 can be retained in cavity 14 with a silicone rubber adhesive or a thermally and electrically conductive epoxy which will withstand the temperature range for the developing solutions. The cavity 14 is enclosed with a pad 32 which acts as a thermal insulator between the platen and the mounting device therefor, as described hereinafter.

The platen 11, see FIGS. 2 and 6 comprises a block 39 provided with a cavity 40 that is lined with a foil heating element 41 in the same manner as described hereinabove with respect to platen 10. A pad 42 is arranged between the platen 11 and the support therefor and is preferably of an insulating and resilient material so that it will deform under applied pressure as will be described in more detail hereinafter. The facing surface 43 of platen 11, that is, the surface facing contacting surface 16 of platen 10 is provided with a channel 44, which is of such size that a relationship such as that shown in FIG. 7 is established between platens 10 and 11 and film 12. A groove 45 is arranged in the channel 44 and carries a resilient frame member 46 that is generally aligned with the land 26 of platen 10. The facing surface 43 is also provided with a configuration 47 of interconnecting passages, see FIG. 6, to which a suction is applied via a connector 48 and a hole 49 that interconnects the connector 48 with channel 44, see FIG. 4. The configuration 47 can be a group of parallel grooves, a group of parallel intersecting grooves, a plurality of interconnected holes in block 39, a recess in surface 43 covered by a perforated plate, etc. Such a configuration being such that when a suction is applied thereto, the film will be drawn toward block 39.

The platen 10 is mounted on a support member 50 that is mounted on the free ends of a pair of spaced, cantilever-mounted leaf springs 51 and 52. The fixed ends of springs 51 and 52 are mounted on a frame member 53 which forms a part of the apparatus. In a like manner, the platen 11 is carried by a support member 55 that is mounted on the free ends of a pair of leaf springs 56 and 57. The fixed ends of these latter springs are also mounted on the frame member 53, see FIG. 1.

The means for moving the platens relative to one another comprises a rotary solenoid 60, which, when energized, rotates a cam 61 relative to a follower 62 mounted on the support member 50 to move platen 10 toward platen 11. A cam 63 is also rotated by solenoid 60 to actuate microswitch 64. A similar solenoid 70 carries an eccentric bearing member 71 and, when energized, moves member 71 against the support member 55 to move platen 11 toward platen 10. It will be noted with respect to FIG. 1 that each of support members 50 and 55 actuates a respective microswitch 72 and 73, upon movement toward and away from film 12 for a purpose to be described hereinafter.

The frame member 53 carries a heat exchanger designated by the numeral 80. The heat exchanger 80 is one having a folded path for each fluid, e.g., solution, water, etc., that is of sufficient length to heat each fluid

to its required temperature. With reference to FIG. 9, it will be noted that the various solutions used in the processing of the film, for example, developer 81, fixer 82 and water 83 for washing the film are introduced through respective filters 84, 85, 86 to the heat exchanger 80. In addition, air is supplied to the heat exchanger 80 through an independent air heater 87 having an outlet which discharges the heated air through the heat exchanger for control by valve 95 for its entry into platen 10. The air for heater 87 is obtained from the exhaust side of a vacuum pump 90 through a filter 88 and a pressure regulator 89.

The heat exchanger 80 also includes a 5-way valve generally designated by the numeral 95. This valve is cyclically operated by a presettable timing mechanism built into the valve and meters the flow time interval of each fluid. As a result, the developer, fixer, wash water and air can be introduced sequentially into the platen 10 via connector 28 in the required order and for the required time to fully develop, fix, wash and dry the film 12.

In order to facilitate the flow of the fluids and air through the recesses 20, 15, 19 in the platen 10, the latter is connected to vacuum pump 90 via a solenoid-actuated valve 96 to a sump 97 which, in turn, is connected to the low side of a 21-level vacuum regulator 98. With the application of a low vacuum to the outlet side of the platen 10 (outlet 27), a uniform and positive flow of fluids and air is obtained. The fluids and air drawn from the platen 10 are exhausted from sump 97 as waste through the valve 99 in line 100.

The platen 11 is connected through a restriction 105 and a solenoid valve 106 to the high side of the vacuum regulator 98. The platen 11 also includes in its vacuum or suction system a switch 107 which monitors or senses the presence of the vacuum with respect to the platen 11. With such a metering system, a vacuum cannot be obtained unless film 12 has been positioned and is clamped between the platens 10 and 11. When a piece of film 12 is not present between platens 10 and 11, the vacuum developed by pump 90 is such that switch 107 can be readily actuated. However, with the addition of restriction 105, the drop in vacuum occurs across restriction 105 and the pressure level in platen 11 remains high enough so switch 107 is not actuated.

The operation of the apparatus described hereinabove can be best understood by describing a complete cycle of operation. The solutions or fluids used in the processing of the film are stored in containers which are heat sealed and puncturable when positioned and moved into engagement with a specially designed probe. Each fluid will then flow through its respective filter 84, 85 or 86 and into the heat exchanger 80. At the same time, assuming that the apparatus has been turned on, the vacuum pump 90 supplies air to air heater 87 via the pressure regulator 89 and the filter 88, the heated air being introduced to platen 10 via valve 95 associated with the heat exchanger 80.

With reference to FIG. 10, a cycle of operation is accomplished by the closing of switch 108 which then completes the circuit through the heat exchanger 80. Also, with the closing of switch 108, solenoid 60 can be energized when a normally operable timing switch 109 is closed and set to establish the timing sequence of the valve 95. At this time, the solenoid 60 will move the cam 61 into engagement with follower 62 thereby moving the platen 10 toward the film 12 until the surface

16 engages the emulsion side of the film 12. As the platen 10 moves in an upward direction, the switch 72 which is normally held open by support 50, when platen 10 is in its "home" position, will close. When platen 10 engages film 12 (uppermost position), switch 64 will be closed by cam 63. Vacuum pump 90 and solenoid 70 will then be energized. The eccentric bearing 71 will then move the support 55 and platen 11 toward and into engagement with support surface of film 12.

With reference to FIGS. 2, 6 and 7, the surface of resilient member 46 extends beyond the facing surface 43 of platen 11, so that a seal is first established by contact of frame member 46 with the support surface or side of film 12. With establishment of this seal and the application of further pressure, the emulsion side of film 12 will also be moved against the land 26. With the application of still additional pressure, there will be further movement of platen 11 toward platen 10. This movement deforms frame member 46 into channel 44 and establishes a metal-to-film-to-metal seal with the engagement of land 43 and land 25 with the opposite surfaces of film 12. This will effectively establish a double seal relative to film 12 and prevent any external or internal leakage relative to the film and particularly the image area of the film that will be processed. While both platens are moved in the present disclosure, the same results can be attained with very little, if any, modification by moving only one platen relative to the other.

After platen 11 starts to move toward film 12, switch 73 which is normally held open by support 55 in its "home" position will close and energize the timing sequence and cycle of the 5-way valve 95. This takes place provided the vacuum sensing switch 107 has not been opened due to the lack of a vacuum in the upper platen. Once the seal has been attained with respect to film 12, the vacuum applied to connector 47 will withdraw air via the configuration of passageways 48 in the surface 43, thereby drawing the film toward the surface to retain it in a spaced and generally parallel relationship to surface 16. If a film is not positioned between the platens 10 and 11 and the switch 107 is closed, then the vacuum system and configuration of passageways 48 will be open to the recess 15. Under this condition a vacuum cannot result and sensing switch 107 will not permit the release of the processing solutions via the 5-way valve 95.

With the platens 10 and 11 and film 12 in a sealing relationship, the valve 95 introduces a flow of each solution successively into the connector 28. Via recesses 20, 15 and 19, the successive solutions flow into contact with the emulsion side of the film and then via connector 27 to the sump 97, as shown diagrammatically in FIG. 9. The timing sequence for the application of the solutions to the emulsion side of the film in recess 15 is determined by switch 109; and when this switch reaches an open position, the respective solutions and air will have been applied to the film so that it will then have been processed and dried and, hence, ready for release from platens 10 and 11.

When switch 109 reaches an open position, solenoids 60 and 70 and solenoid valves 96 and 106 are deenergized. Platen 10 will then move away from film 12 due to the resilient reaction of solenoid 60 and the spring members 51, 52. Cam 63 will then open switch 64 to cut out vacuum pump 90. Likewise, the resilient action of solenoid 70 and the springs 56, 57 will move the

platen 11 away from film 12. Again, in its "home" position, member 55 will actuate switch 73. The film 12 can then be removed from between platens 10 and 11. The heat exchanger 80 can remain energized so long as film is being processed. Suitable controls built into the heat exchanger will maintain the requisite temperatures.

The springs 51, 52, 56, 57, which support the platens 10 and 11 for movement toward one another, allow the platens to adjust to any angular mismatch that might occur. This permits a uniform seal between the platen and the film. It is for this reason that the pad 42 is made considerably thicker, thereby permitting a relatively large deformation compared to that of the resilient frame member 46.

With respect to FIG. 8, another embodiment is disclosed in which a piece of film 120 is mounted in an aperture 121 in a card 122 by means of an adhesive frame member 123, as is well-known in the art. By varying the dimensions of the lands and surfaces of both platens, it can be seen that the same general platen structure can be utilized for processing only the image area of such a piece of film. The platen movement as well as the application of the solutions and the vacuum can be accomplished in the same manner as described above.

Inasmuch as the apparatus disclosed and described hereinabove can be used with respect to a chip, sheet or strip of film having one or a number of image areas, or a chip of film mounted in an aperture card, the term "film" as used herein is meant to be generic as to all of these forms. With an apparatus of the type described, photographically stored high resolution CRT light images can be processed and dried within 5.5 sec. Also, processing temperatures can be used which shorten the total cycle time. Since a temperature range greater than 10°F can be allowed in recess 15, a low thermal conductivity, moldable material, such as any one of several plastic materials, can be used as a platen material. Further, since the apparatus is completely cleaned with each processing cycle, there is no contamination of the platens, so that the next film to be processed is insured of clean and proper processing conditions and solutions.

This invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. Apparatus for rapid processing of the latent image area on a surface of a photographic film, comprising: two platens between which said film is positioned and at least one of which is movable toward and away from the other; one of said platens having a planar surface for engaging the surface of said film, a recess in said film engaging surface conforming generally in size and shape to that of said image area, an inlet interconnected to one end of said recess and an outlet interconnected to the other end of said recess, and a

cavity adjacent to the planar surface thereof; the other of said platens having a planar surface arranged in spaced, parallel relation to and facing said film engaging surface and the surface of said film, a configuration of interconnecting passages opening on its facing surface, and a cavity adjacent the facing surface thereof;

means carried by each of said platens for cooperating with said film, when said platens are moved relative to each other, to establish a uniform seal about said image area and a relative position between the planar surfaces of said platens such that the surfaces are spaced one from the other by a distance greater than the thickness of said film;

means operatively connected to said platens for moving the latter relative to each other, when said film is arranged therebetween, for establishing said relative position;

means interconnected to the passages of the other of said platens and rendered operable when said platens are in said relative position for releasably holding said film against the planar facing surface thereof;

means interconnected to the one of said platens and rendered operable when said platens are in said relative position for introducing successively a number of different solutions into a space formed between the surface of said film and the recess in said one platen;

means comprising a metallic foil heating element contiguous to the surfaces of the cavity in each respective platen for maintaining each of said solutions at a generally uniform temperature during movement thereof from said inlet to said outlet for processing said image area; and

means responsive to the movement of said platens into said position for controlling said holding means and said introducing means, whereby each solution is maintained in contact with the surface of said film for a period of time sufficient to effect processing of said image area.

2. The apparatus in accordance with claim 1 wherein said moving means includes means operatively connected to each of said platens for resiliently supporting each respective platen relative to the other.

3. The apparatus in accordance with claim 2 wherein said supporting means comprises a cantilever-mounted spring member having its free end coupled to a respective platen.

4. The apparatus in accordance with claim 3 wherein said moving means includes a cam member in engagement with the free end of each respective spring member and rotatable to move the corresponding platen between a first position in which said platens are separated and a second position in which said film is retained between said platen for processing of an image area.

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