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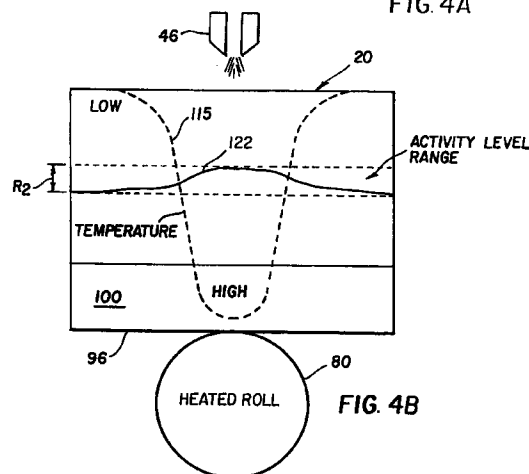
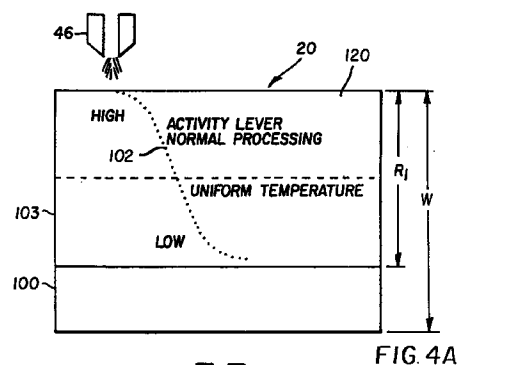
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(54) **Photographic processor**

(57) A photographic processor and method for developing photosensitive material (20). The apparatus comprises a processing tank (12) containing a processing solution (18) for processing of the photosensitive material (20); a transport mechanism (52,54,56,58,60) for moving of the photosensitive material (20) through the processing solution (18); and a heating and/or cooling mechanism for providing a temperature gradient across the photosensitive material (20).



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## Description

The present invention relates to the field of photography, and more particularly, to the method and apparatus for processing photosensitive material.

The processing of photosensitive material involves a series of steps when the photosensitive material is subjected to various different processing solutions. Typically, in a photographic processor, photosensitive material will be subjected to developing, bleaching, fixing, and washing solutions. Thereafter, the photosensitive material is subjected to a drying operation before leaving the apparatus. During each of the steps wherein the photosensitive material is subjected to a processing solution, it is critical that the temperature of the processed solution be held within parameters, and that fresh solution be brought to the surface of the photosensitive material so that the appropriate chemical reaction between the processing solution and the photosensitive material can take place. In prior art processors, the temperature of the processing solution is maintained by the use of heaters which heat the processing solution to a specified temperature and maintains the processing solution at the specified temperature within certain tolerances through the use of a temperature controller. In prior art processors, it is also known to utilize agitation of a processing solution next to the emulsion surface of the photosensitive material so as to provide fresh solution at the surface. This may be accomplished through the use of rollers, wiper blades, or impinging of the processing solution against the photosensitive material. In order to reduce the time required for processing the photosensitive material, processing parameters may be varied. These include the concentration and make-up of the processing solution themselves, the amount of agitation used to apply the solution of photosensitive material, and the temperature of the solution.

The changing of the constituents of the processing solution is difficult because most photographic processors must be able to successfully process photosensitive material from several different manufacturers with extremely reliable, repeatable results. Change in the make-up of the processing solution can introduce significant effects on the different manufacturing products introduced therein.

By using high impingement agitation, such as disclosed in US-A-5,270,762; US-A-5,355,190; and US-A-5,398,094, the time required for each processing solution can be reduced, but only to a point, since the chemical reaction required becomes limited by the diffusion rate of the solution through the gelatin emulsion of the photosensitive material. As soon as the method of agitation used reaches a certain level of supplying fresh solution to the photosensitive material surface, further improvement in this area becomes difficult, if at all possible, upon further agitation.

An effective way to shorten a photographic process time is to increase the temperature of processing solu-

tion through which the photosensitive material passes. However, increasing the temperature causes a chemical reaction to occur at an accelerated rate. The problem with increasing the temperature of the solution is that the processed solution may oxidize and generally decompose at a much faster rate. Additionally, the higher temperatures increase the rate of evaporation of processing solution. Further, when higher temperatures are used, greater care must be taken with the processing solution to prevent operators from getting burned, or being subjected to chemical vapors that are outgassed because of the higher temperatures. Furthermore, increased wear and tear occurs on the processing equipment due to the increase in the differential in temperature the equipment experiences between time when the device is in use and when the processor is not in use. All of the foregoing factors require increased cost of running the equipment.

It has been suggested in the prior art that in order to increase faster processing time, the photosensitive material be preheated before entering the processor. While this has been found to find a slight increase in efficiency and use of the solution and improvement in processing time, the down side is that the heat added by the preheated photosensitive material also brings additional problems associated with increased processing solution temperatures as previously discussed. Another problem with preheating of photosensitive material is that all the layers of the emulsion of the photosensitive material have the same temperature. As the processing solution diffuses in the various emulsion layers, the increase in chemical reaction is the same for the top layer, as well as the layers closest to the base.

An object of the present invention is to overcome the above problems experienced by processors by selectively raising or lowering the temperature of the photosensitive material after it has entered the processing solution and that the overall temperature of the processed solution is not increased. This is accomplished by applying heat or cooling directly to a very small area of the film in an area where fresh processing solution has broadened the contact with the surface of the photosensitive material.

Localized heating or cooling of the photosensitive material through the base creates a temperature gradient through the emulsion layer. The resulting temperature gradient results in the emulsion layer. This results in the emulsion layers, which are first subjected to processing solution, having a different reaction because they are at a different temperature. The resulting temperature gradient provided by an apparatus according to the present invention allows the photosensitive film designer more latitude where they can place the various light-sensitive emulsion. Presently, emulsions that react slower to processing solution must be located closer to the photosensitive material surface and faster reaction layers are placed closer to the base. This arrangement does not always correspond to the optimal placing of

emulsion layers for the capturing of light in the resulting layer and interactions and image sharpness. The overall result is usually a compromise that causes longer processing time, need for higher concentration of solutions, or inefficient use of processing solution.

In accordance with the present invention, there is provided a photographic processor and method for developing photosensitive material. The apparatus comprises a processing tank containing a processing solution for processing of said photosensitive material; a transport mechanism for moving of said photosensitive material through said processing solution; and a heating and/or cooling mechanism for providing a temperature gradient across the photosensitive material.

Other objects, advantages and features of the present invention will become apparent from the following specification when taken in conjunction with the drawings in which like elements are commonly enumerated and in which:

Figure 1 is a schematic drawing of an apparatus made in accordance with the present invention;  
Figure 2 is an enlarged cross-sectional view of a portion of Figure 1 illustrating the processing solution being impinged upon the photosensitive material passing therethrough and being heated by a heater in accordance with one aspect of the present invention;

Figure 3 is schematic diagram of the photosensitive material of Figure 2;

Figure 4 is a greatly enlarged view of a photosensitive material being processed by the apparatus of Figure 1 illustrating the chemical reactivity and temperature gradient of the emulsion layer as a function across its width;

Figure 5 is a view similar to Figure 2 illustrating a modified heater for the localized heating of the photosensitive material passing therethrough;

Figure 6 is a schematic view of a view similar to Figure 1 illustrating a modified processing section made in accordance with the present invention;

Figure 7 is a schematic view similar to Figure 1 illustrating another modified rack and tank made in accordance with the present invention;

Figure 8 is a schematic view similar to Figure 5 illustrating yet another modified form of the apparatus made in accordance with the present invention;  
Figure 9 is a schematic illustration of a film developing apparatus for providing a temperature differential between the front and back sides of the film;

Figure 10 is a cross-sectional view of the developing section as taken along line 9-9 of Figure 8;

Figure 11 is a graph illustration of the effect of the present invention on various color emulsion layers where heat was applied to the back side of the photosensitive material as compared to normal processing; and

Figure 12 is a graph illustration of the affect of the

present invention on various color emulsion layers where cooling was applied to the back side of the photosensitive material as compared to normal processing

Referring to Figure 1, there is illustrated in schematic form, an apparatus 10 made in accordance with the present invention. The apparatus 10 includes at least one processing section 11. In the embodiment illustrated, the processing section 11 comprises a processing tank 12 and rack 14 for placement in the tank 12. In the preferred embodiment illustrated, the processing section 11 is of the low volume thin tank type construction. Thus, the rack 14 and tank 12 are constructed so as to form a narrow processing channel 16 for containing a processing solution 18 through which a photosensitive material 20 passes for processing. The processing channel 16 includes a pair of outlets 22 for allowing processing solution to go through the recirculation system 24 and then return to the processing channel 16. In particular, the recirculation system 24 includes conduits 28 for fluidly connecting the outlets 22 of the processing channel 16 to a recirculation pump 30, which recirculates the processing solution 18 through the recirculation system 24. A conduit 32 is provided for directing processing solution 18 through a manifold 34 from recirculation pump 30. The manifold 34 is provided for introducing replenishment solution contained in reservoirs 36, 38, 40 which are introduced to the manifold 34 by pumps, not shown. The manifold 34 is fluidly connected to a filter 42 by conduit 44. The filter 42 is connected to inlet nozzle 46 by conduit 48. The inlet nozzle 46 is designed for introducing processing solution 18 against the top surface 50 of the emulsion side of the photosensitive material 20. A plurality of roller pairs 52, 54, 56, 58, 60 are provided for transporting and guiding the photosensitive material 20 through the processing channel 16. It is to be understood that any desired means may be used for transporting the photosensitive material 20 through the processor and that the photosensitive material may be of the continuous web or sheet form. A computer, not shown, is provided for controlling operation of the apparatus 10 as is conventionally done and, therefore, will not be discussed in any detail herein.

In Figure 1, only one processing section 11 is illustrated for containing a single processing solution for processing of the photosensitive material 20. It is to be understood that any desired number of processing sections 11 may be provided with each processing section containing any desired processing solution. The processing sections would serially subject the photosensitive material as is typically done in the prior art.

Referring to Figure 2, there is illustrated in greater detail a portion of the processing tank 12 made in accordance with the present invention. In particular, there is illustrated nozzle 46 which has a nozzle opening 62 which has a thickness T. The nozzle 46 is prefer-

ably disposed in an insulating jacket 63 provided in wall 64 of tank 12. The jacket 63 is made of low thermal conductive material, such as polystyrene, polypropylene and polyethylene, so as to minimize heat transfer to the processing solution 18 passing therethrough. Alternatively, or in addition, an air gap may be provided around nozzle 46. The opening 62 is in the form of an elongated slot which extends at least along the width of the photosensitive material 20 passing adjacent thereto. As previously discussed, a narrow processing channel 16 is provided such that the opening 62 is disposed closely adjacent the surface 50 of the photosensitive material 20. For the purposes of the present invention, a narrow processing channel 16 shall be considered a channel having a thickness T equal to or less than 100 times the thickness of photosensitive material. Preferably, processing channel 16 has a thickness T equal to or less than 50 times the photosensitive material when photographic paper is used, most preferably a thickness T equal to or less than 10 times the thickness of the photographic paper. In a processor for processing photographic film, the thickness T is most preferably equal to or less than 18 times the thickness of the film.

An example of a processor made in accordance with the present invention for processing photosensitive paper, the paper having a thickness of 0.008 inches, would have a processing channel 16 having a thickness T of 0.080 inches, and a processor for processing photographic film, the film having a thickness of 0.0055 inches, would have a channel 16 having a thickness T of .1 inches. However, it is to be understood that the thickness of the channel 16 may be varied as appropriate.

In order to provide efficient flow of the processed solution through the nozzle 46 into the processing channel 16, it is desirable that the nozzle opening 62 deliver processing solution to the processing channel in accordance with the following relationship:

$$1 > F/A > .40$$

wherein:

F is the flow rate of the processing solution through the nozzle in gallons per minute; and

A is the cross-sectional area of the nozzle provided in square inches.

Providing a nozzle in accordance with the foregoing relationship assures appropriate discharge of the processed solution against the photosensitive material so as to provide an impinging force for introducing new processing solution to the surface of the photosensitive material.

As previously discussed, the present invention is designed to provide localized heating of the photosensitive material 20 as it passes through the processing channel 16. In the particular embodiment illustrated, there is provided a heater 80, which is provided in rack

14. In the particular embodiment illustrated, the heater 80 comprises a first insulating block 82 made of a material having a low thermal conductivity and includes an elongated roller 92 disposed in a substantially circular cavity 94 formed therein. The insulating material may be of any desired low thermal conductive material, such as polystyrene, polypropylene and polyethylene. Alternatively, or in addition, an air gap may be provided around the heater 80. As can be seen, the cavity 94 closely conforms to the outer configuration roller 92, leaving only a small distance therebetween. Preferably, the distance D is sufficient to allow easy rotation of the roller 92 therein. As illustrated, only a small portion of the roller 92 is allowed to come in contact with the back side 96 of the photosensitive material 20. The roller 92 is of the conductive type which allows heat to flow from roller 92 against the back surface 96 of the photosensitive material 20. It is to be understood that roller 92 may be heated by any desired technique. In the particular embodiment illustrated, the roller 92 has an outer shell section 98 made of an appropriate conductive material and is heated by appropriate electrical wires, not shown, connected thereto. The shell construction minimizes the thermal mask of the roller 92, thereby allowing easy adjustment of the temperature such that the appropriate amount of heat transfer occurs between the photosensitive material 20 and the roller 92. As can be seen, the heater 80 is positioned in direct opposition to the inlet nozzle 46. This is done so that the photographic processing solution 18 will cause the photosensitive material 20 to be pushed into intimate and continuous contact with the heat transfer roller 92. In addition, this provides heat at the exact area in which there is a high degree of agitation and new fresh processing solution being brought to the emulsion surface of the photosensitive material 20.

Referring to Figure 3, there is illustrated a schematic diagram of photosensitive material 20. In particular, photosensitive material 20 comprises a support base 100 having top surface 95 on which an emulsion layer 102 is provided. As can be seen, the emulsion layer 102 comprises a plurality of separate layers 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114. These layers serve to provide color to the photosensitive material, control processing and protection against ultraviolet light and physical abrasion. The operation and description of these layers is well known to those skilled in the art. A detailed description of these and similar type photosensitive material structures may be found in an article in **Research Disclosure**, September 1996, No. 389, Item 38957, entitled "Photographic Silver Halide Emulsions, Preparations, Addenda, Systems and Processing", published by Kenneth Mason Publications, Limited, Dudley Annex, 12a North Street, Emsworth, Hampshire PO10 7DQ, England, which is hereby incorporated by reference in its entirety.

Referring to Figure 4A, there is illustrated in graphical form, the chemical reactivity of the emulsion layer

with respect to its distance from the surface of the emulsion layer 102 as illustrated by line 120, for a processor made in accordance with the prior art wherein the photosensitive material experiences a substantially uniform temperature across the width W of the photosensitive material. As can be seen, the chemical reactivity is greatest at the surface of the photosensitive material closest to nozzle 46 and the lowest at layer 103 of the emulsion layer 102 adjacent the support base 100. The variation in the range of chemical reactivity is illustrated by R1.

Referring to Figure 4B, there is illustrated a graph of the type illustrated in Figure 4A for an apparatus made in accordance with the present invention. A heating roller is used to heat the back side of the support layer 100 of the photosensitive material 20. The chemical reactivity of the emulsion layer 102 is illustrated by line 122. The temperature of the emulsion layer increases the closer it is to the heater 80 as illustrated by line 115. The area of the emulsion layers closest to the base 100 experience the greatest temperature, however, receive the least chemical reactivity due to the impinging processing solution. The variation of chemical reactivity R2 is substantially less than the range of variation R1 of the apparatus of Figure 4A. Thus, the present invention provides a compensating effect in that the emulsion layer receiving the least chemical reactivity experiences the greatest temperature, therefore, providing a more uniform overall chemical reactivity for all of the emulsion layers.

The foregoing allows the photosensitive manufacturer more latitude in designing and constructing emulsion layers for photosensitive material. Instead of providing reactive slower layers adjacent the top surface and requiring faster reactive emulsion layers to be placed closer to the base, greater latitude in designing desired emulsions layers to improve in the efficiency of processing, quality, or providing particular artistic effect, can more easily be achieved.

Referring to Figure 5, there is illustrated a partial view of a modified apparatus similar to Figure 2 illustrating a modified heater 130 made in accordance with the present invention, like numerals indicating like parts and operation as previously discussed. In particular, there is illustrated a heater 130 embedded into the rack 14, such that the surface 134 of the heater is substantially planar and substantially flush with the surface 136 of the rack 14. The heater 130 comprises a mounting body section 138, which is mounted in rack 14, and is made out of an insulating material. Disposed at the outer surface, and within the body section 138, there is provided a heat-conductive element 140 having an outer engaging surface 142, which is also coplanar with the surface 136 of the rack 14. The surface 142 is designed to engage the back surface 144 of the photosensitive material as illustrated. The heating element 140 is positioned to be substantially opposite the nozzle 46 such that the nozzle 46 will force the photosensitive material

20 against the heating element 140, thus encouraging the heat transfer from the heating element 140 to the photosensitive material 20. In this embodiment, the back surface 144 of the photosensitive material 20 slides against the surface 142. Therefore, the surface 142 is appropriately made as smooth as possible to avoid any unnecessary abrasive scratching to the surface of the photosensitive material.

Referring to Figure 6, there is illustrated in modified form an apparatus 10 made according to the present invention, like numerals indicating like parts and operation as previously discussed. In this embodiment, a pair of cooling coils 160 are provided in conduits 28 for cooling of a processing solution in the recirculation system 24 prior to reaching the pump 30. This is particularly important in a low volume thin tank type processor where a minimum amount of volume is provided, both in the processing channel and in the recirculatory system. This avoids the possibility of the overall temperature of the processing solution from increasing to an undesirable level. In the embodiment illustrated, a cross-conduit 152 connects the two conduits 28. A valve 170 is provided in conduit 152 where another conduit 180 is provided for providing fluid connection with section 155 of conduits 28 at a point after cooling coils 160. Valves 171, 172 are provided after the cooling coils 160 in conduits 28. When valve 170 is in the closed state and valves 171, 172 are in the open state, processing solution will be cooled by cooling coils 160. When valve 170 is in the open state and valves 171, 172 are in the closed state, there is no cooling of the processing solution. By controlling valves 170, 171, 172, cooling of the processing solution may be turned on and off as required for proper operation of the apparatus. Appropriate controls and sensors are provided in the apparatus for sensing when cooling of the processing solution is required and for turning on and off valves 170, 171, 172 as is conventionally employed for such purposes, for example, computer and temperature sensors. The employment and operation of such devices are well known to those of ordinary skill in the art.

While in the preferred embodiment, the processing tank is of a low volume thin tank type. It is to be understood that the present invention may be applied to other type construction. Referring to Figure 7, there is illustrated a modified apparatus 210 made in accordance with the present invention, like numerals indicating like parts and operation as previously discussed. In this embodiment, the tank 12 contains processing solution and a typical rack 212 is provided within the tank 12 for transporting and guiding the photosensitive material through the processing solution 18. The heater 80 and nozzle 46 are simply positioned within the tank 12 closely adjacent the path of the photosensitive material 20 such that the nozzle 46 will be closely adjacent for providing impingement solution against the photosensitive material 20 and the heater 80 being disposed in direct opposition to the nozzle 46 for providing heat to

the photosensitive material 20 at this area.

Referring to Figure 8, there is illustrated yet another modified apparatus made in accordance with the present invention, like numerals indicating like parts and operation as previously discussed. This embodiment is similar to that of Figure 7 except that cooling coils 160 are provided for cooling of the processing solution as it leaves the tank 12.

In the particular embodiment illustrated in Figures 1 and 2, the heater 80 is provided on one side of the photosensitive material. If desired, heater rollers 80 may be provided on both sides of the photosensitive material, for example, when emulsion layers are provided on both sides of the photosensitive material.

In the preceding embodiments, it has been shown that the development characteristics of the emulsion layers are controlled by providing heat to the front or back side of the photosensitive material. Alternatively, the film may be cooled for providing yet again a different temperature gradient across the photosensitive film for providing yet still further development characteristics of the film.

By adjusting the temperature difference between the top and bottom surfaces of the film, balancing color contrast can be corrected. This temperature difference between the front and back side of the film can also be used to correct films with different color imbalances. In order to demonstrate the effectiveness of the present invention, an experiment was conducted using the system illustrated in Figures 9 and 10. In particular, this system 220 includes a developmental block 222 having a retaining section 224 for holding a strip of photosensitive material 226 therein against a supporting back surface 228, which may be heated or cooled as appropriate. A processing solution is delivered to the front surface 230 of the strip of photosensitive material by a dispensing tube 232, which dispenses a processing solution along the width of the photosensitive material 226. The block 222 is disposed at an angle such that the processing solution will flow downward along the surface of the photosensitive material 226 and captured by retaining section 234. A pump 236 draws solution from the retention section 234 and delivers it back to the dispensing tube 232. A thermostat 238 is provided for monitoring the temperature of the processing solution that is circulated therethrough. The block section 222 is provided with passages for passing a cooling or heating solution therethrough, thereby controlling the temperature of surface 228. A color developer processing solution, such as shown in Table 1 below, was made and used to develop Kodak Gold 100 film in a system shown in Figures 9 and 10. Processing solution was pumped and provided on the film surface at 1 liter/minute and flows down the front of the film by gravity. Preferably, the device was set such that the surface 228 was disposed at an angle of 70°, although other angles may have been used.

TABLE 1

| Developer Composition          |          |
|--------------------------------|----------|
| Potassium carbonate(anhydrous) | 37.5 g/l |
| Sodium sulphite(anhydrous)     | 4.25 g/l |
| Potassium iodide               | 1.2 mg/l |
| Sodium bromide                 | 1.3 g/l  |
| Hydroxylamine sulphate         | 2.0 g/l  |
| Anti-calcium agent             | 6.5 ml/l |
| Color developing agent         | 4.5 g/l  |
| pH                             | 10.00    |

The process cycle used is shown in Table 2.

TABLE 2

| Process Cycle |             |
|---------------|-------------|
| Develop       | 195 seconds |
| Bleach        | 180 seconds |
| Fix           | 180 seconds |
| Wash          | 180 seconds |

where the bleach is Kodak C-41 flexicolor bleach III, fix is Kodak C-41b fixer.

A control experiment was carried out with the back and the front of the film heated to normal C-41 developer temperature of 37.8° C. These are shown as the solid lines in Figure 11.

A second experiment was done in which the back of the film was heated to 55° C and the developer flowing down the front of the film to 30.5° C. The data are shown as the dashed lines in Figure 11. Here it can be seen that the red speed and contrast are fairly well matched with the desired effect in this experiment in which the blue (top) and green (middle) layers are lower in activity compared with the red (bottom), or alternatively, the red layer is high in activity compared with the blue and green.

In the next case, the back of the film was kept at 23° C and the developer flowing down the front of the film heated to 42° C. These data are shown as the dashed lines in Figure 12 with the solid lines as the control with the front and back at 37.8° C. Here it can be seen that again the red speed and contrasts match the control fairly well, but that the blue and green are now higher than the control. This is the desired effect in this experiment, showing that the upper layers can be increased relative to the bottom layer by cooling the back and heating the front of the film.

It has been demonstrated that by heating or cooling the back of a the film relative to the front, that the relative activity of the upper and lower layers in a multilayer film can be either increased or decreased.

The present invention provides a processing apparatus which increases the efficiency of the processor without adversely affecting the processing solution. 5

## Claims

1. A photographic processor for developing photosensitive material (20), characterized in that the photographic processor comprises: 10

a processing tank (12) containing a processing solution (18) for processing of the photosensitive material (20); 15

a transport mechanism (52,54,56,58,60) for moving of the photosensitive material (20) through the processing solution (18); and 20

a heating and/or cooling mechanism for providing a temperature gradient across the photosensitive material (20).

2. A photographic processor as claimed in 1, characterized in that the photosensitive material (20) has a front side (95) and a back side (96) and an emulsion layer (102) provided on the front side, the mechanism for heating or cooling being disposed adjacent the back side (96) of the film. 25 30

3. A photographic processor as claimed in 1, characterized in that the processing solution (18) flowing adjacent the emulsion side (102) is at a temperature greater than the temperature of the mechanism for cooling the film which is disposed adjacent the back side (96) of the film. 35

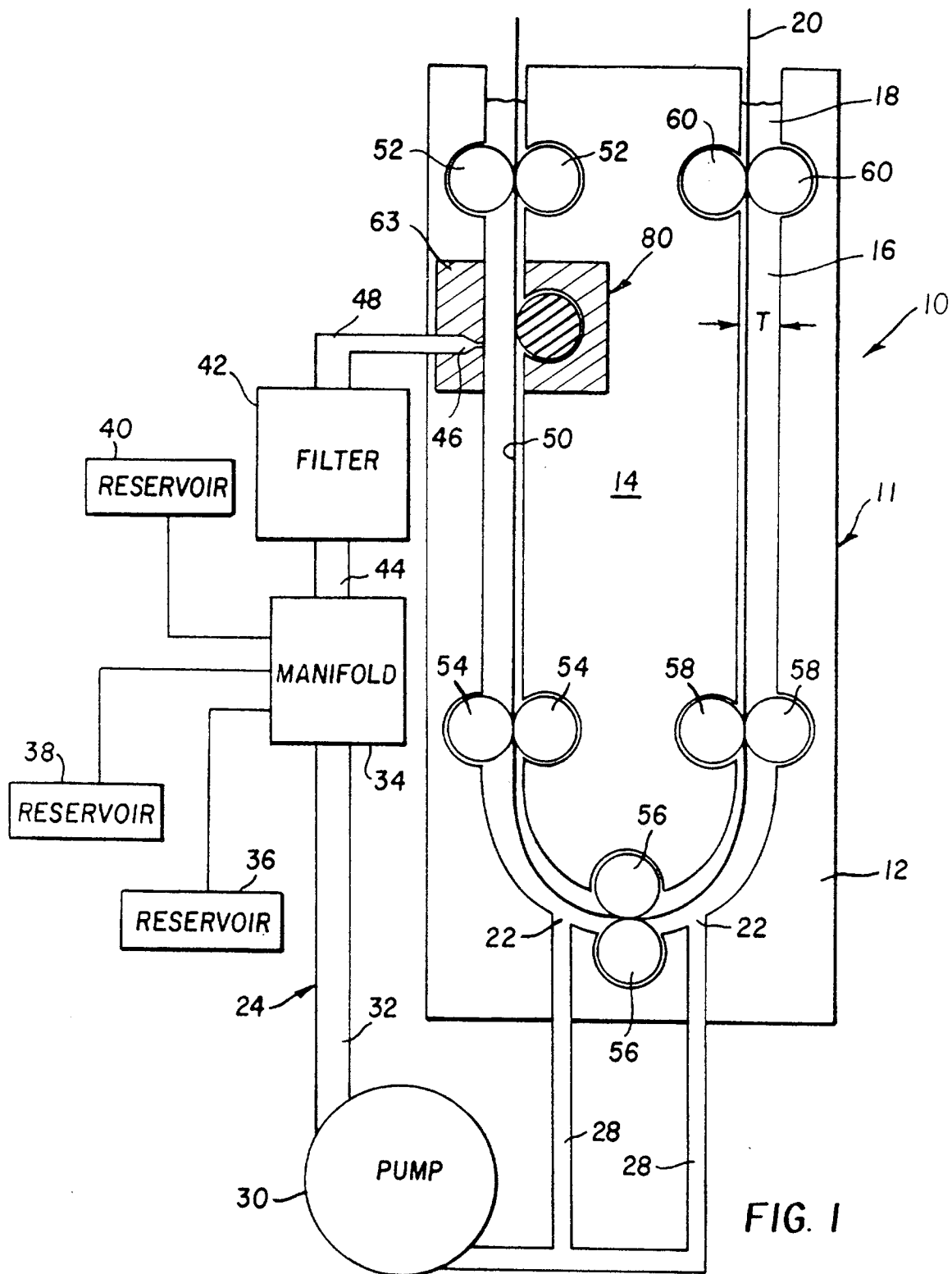
4. A photographic processor as claimed in 1, characterized in that the processing solution (18) flowing adjacent the emulsion side (102) is at a temperature greater than the temperature of the mechanism for heating the film which is disposed adjacent the back side (96) of the film. 40 45

5. A photographic processor as claimed in 1, characterized in that the heating and/or cooling mechanism provides localized heating and/or cooling.

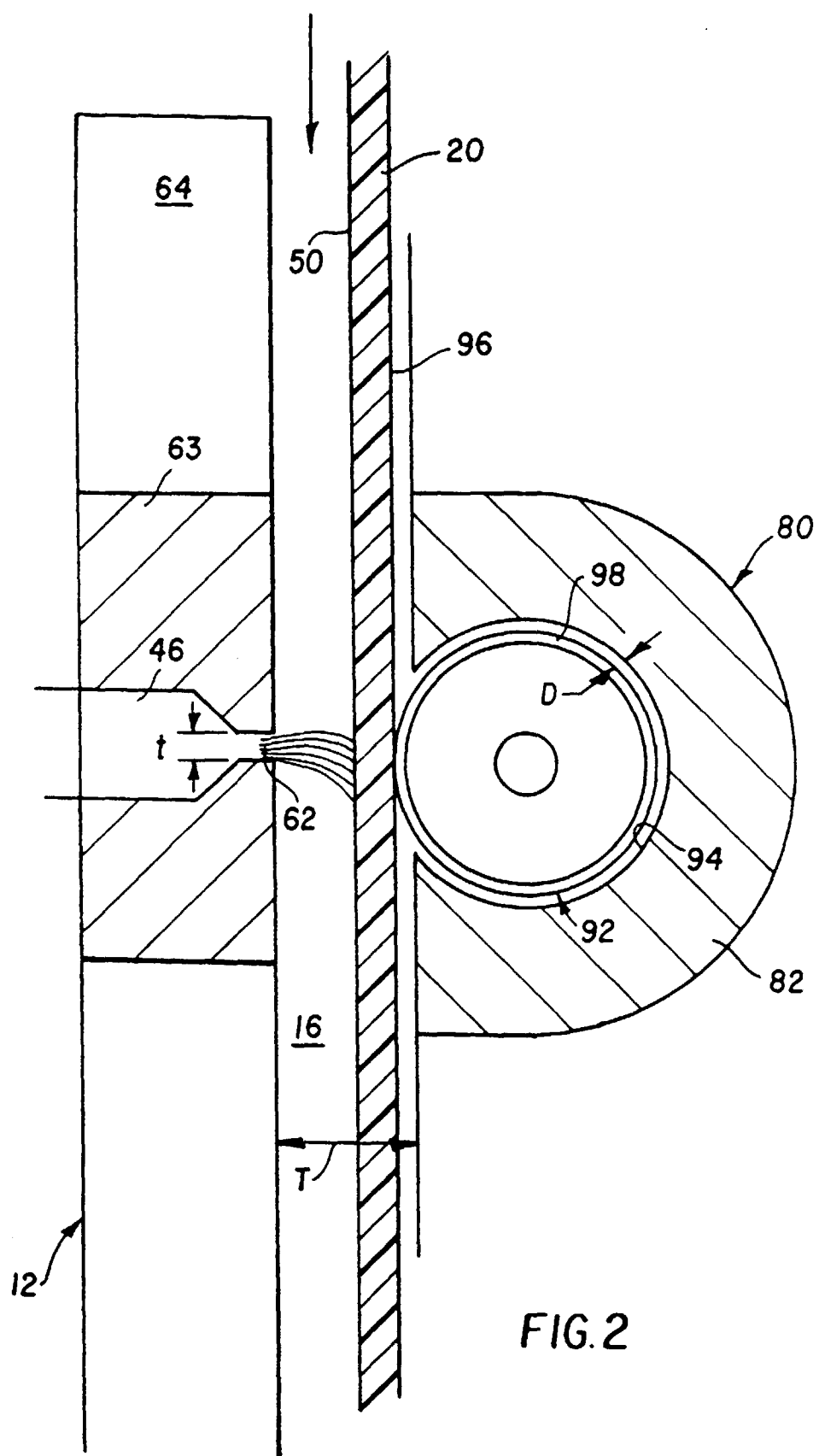
6. A method of processing a photosensitive material (20) by passing the photosensitive material (20) through a processing tank (12) containing a processing solution (18), the photosensitive material (20) having an emulsion layer (102) comprising a plurality of different photosensitive layers, , characterized in that the method comprises the steps of: 50 55

moving the photosensitive material (20)

through the processing solution (18); and  
subjecting the photosensitive material (20) to localized heating or cooling so as to provide a temperature gradient across the emulsion layer (102).







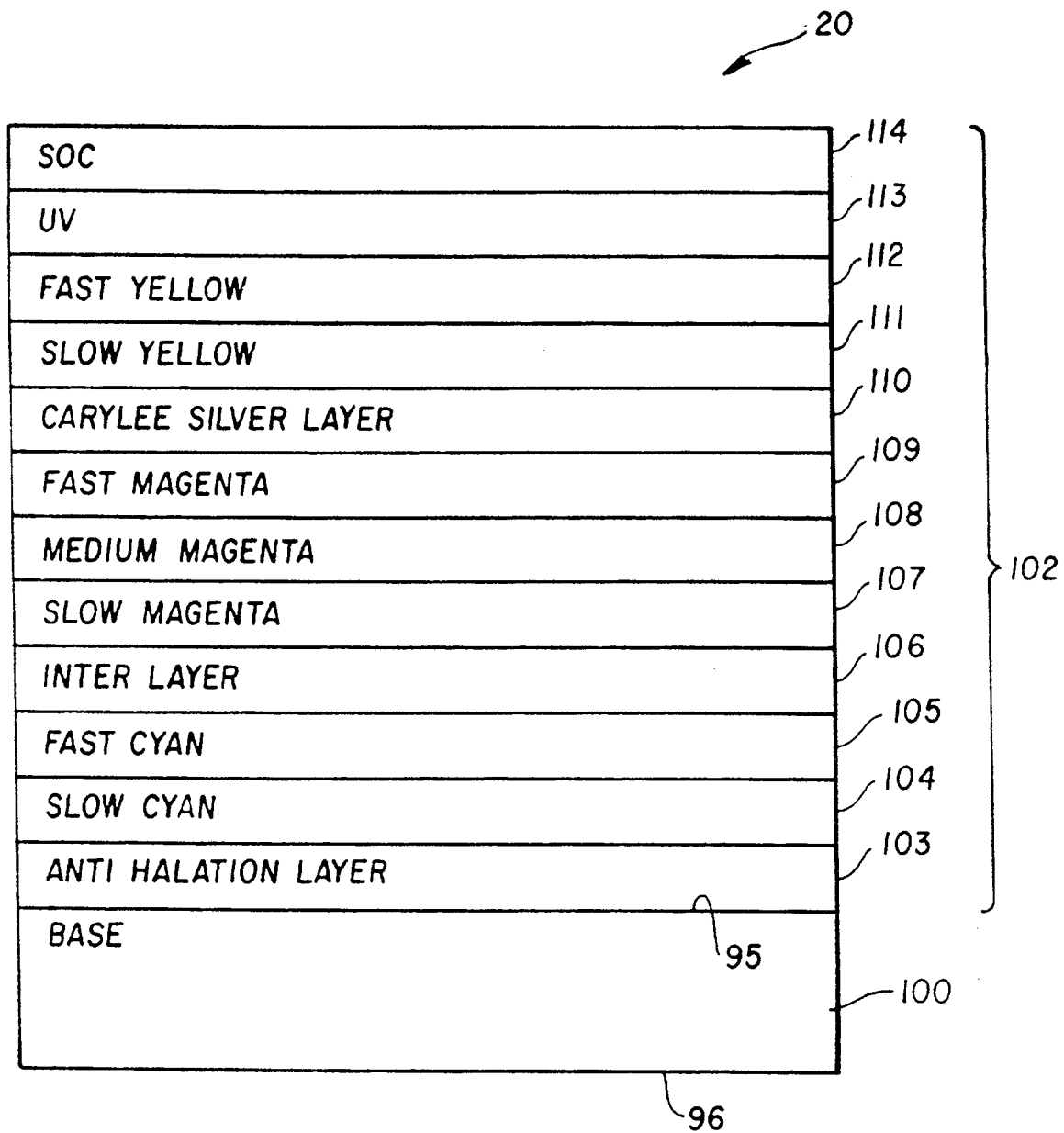
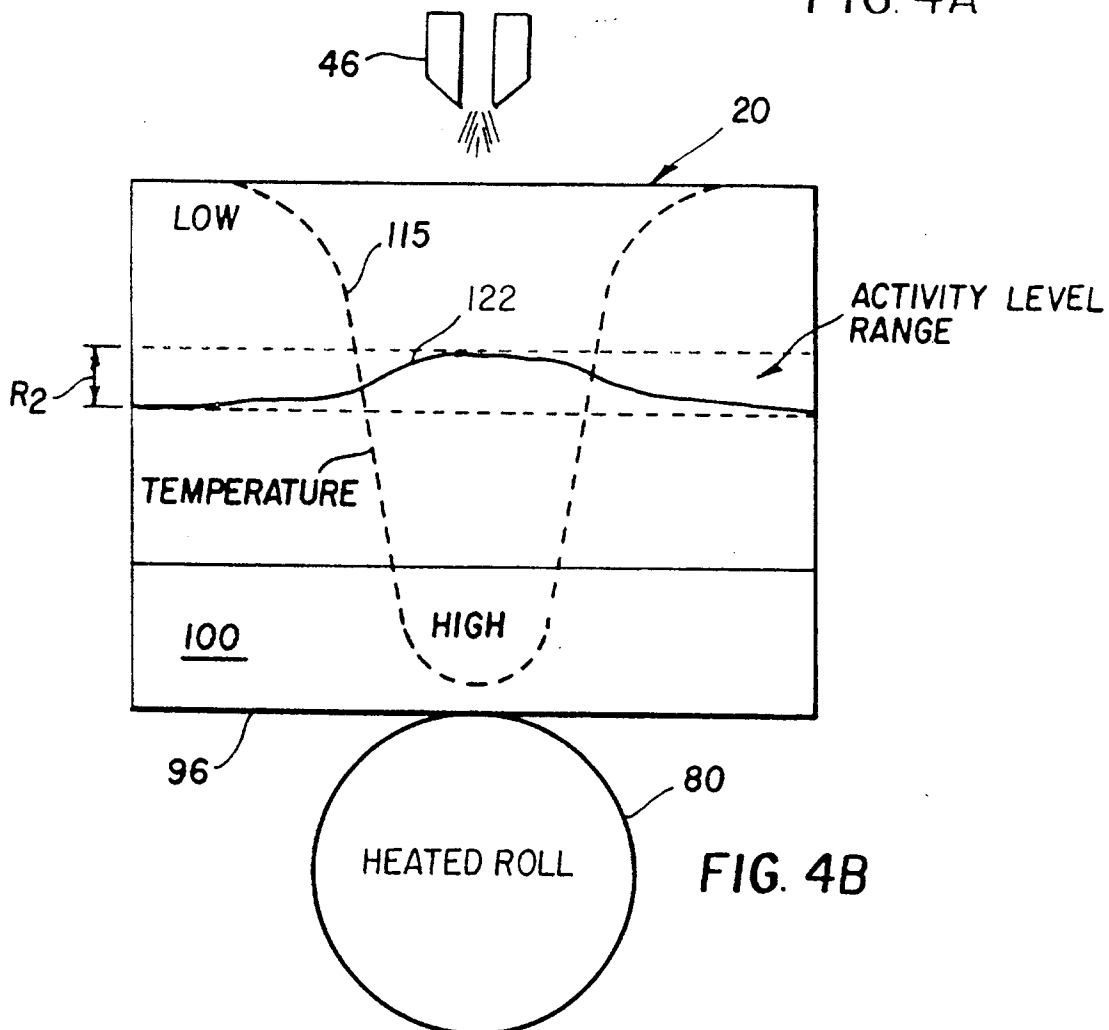
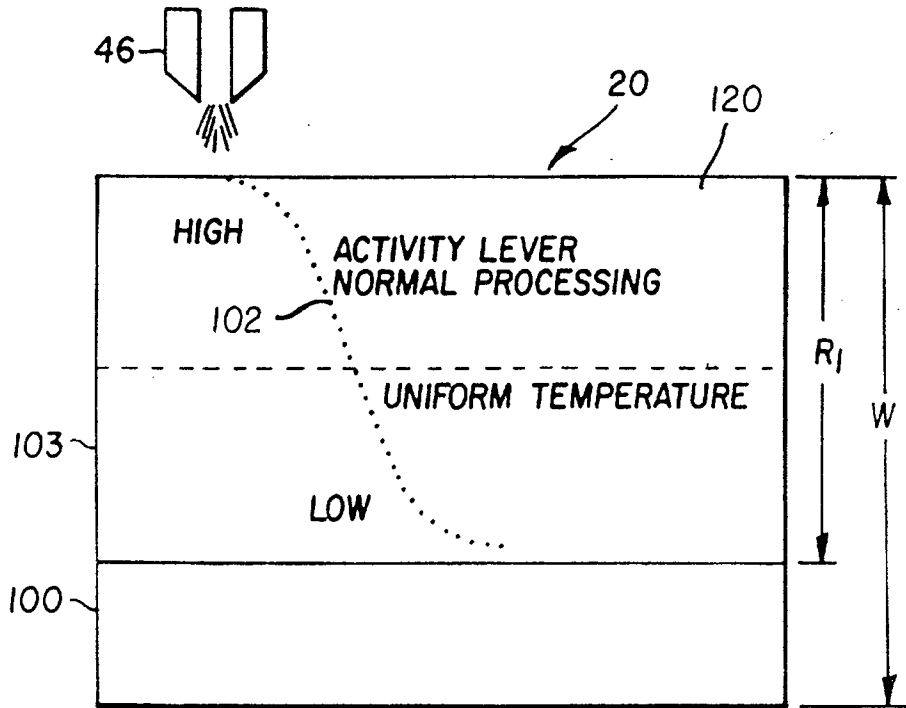


FIG. 3



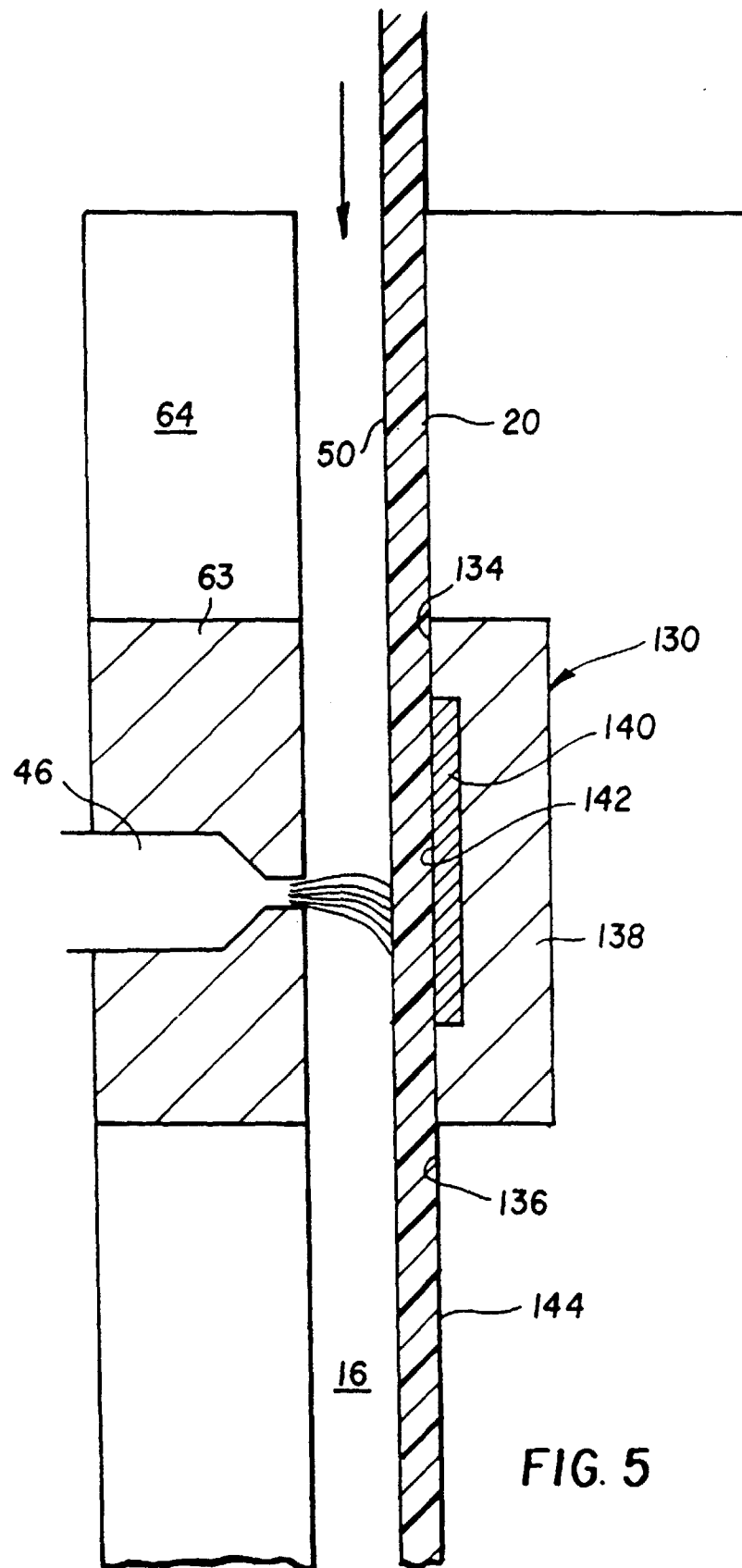


FIG. 5

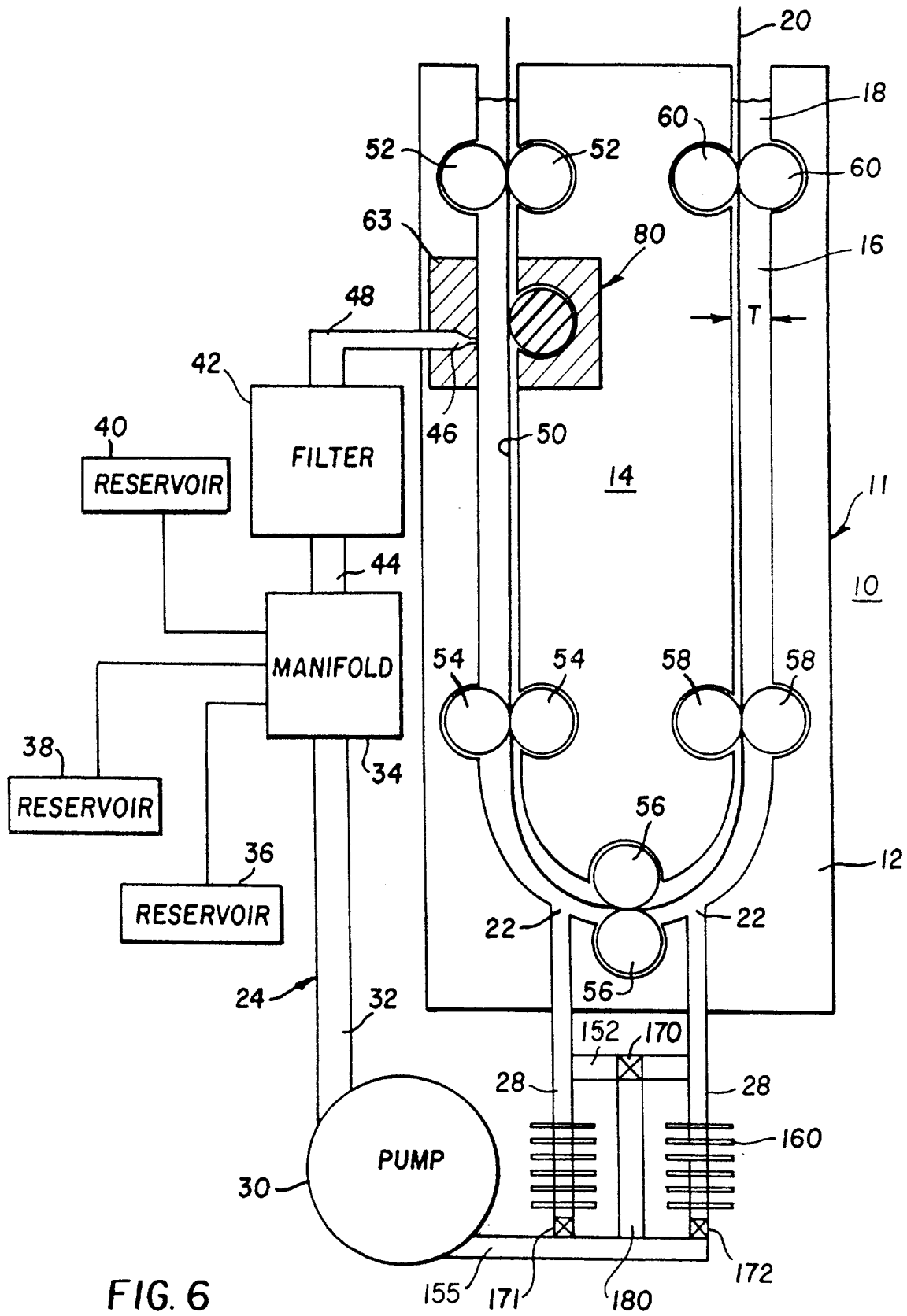
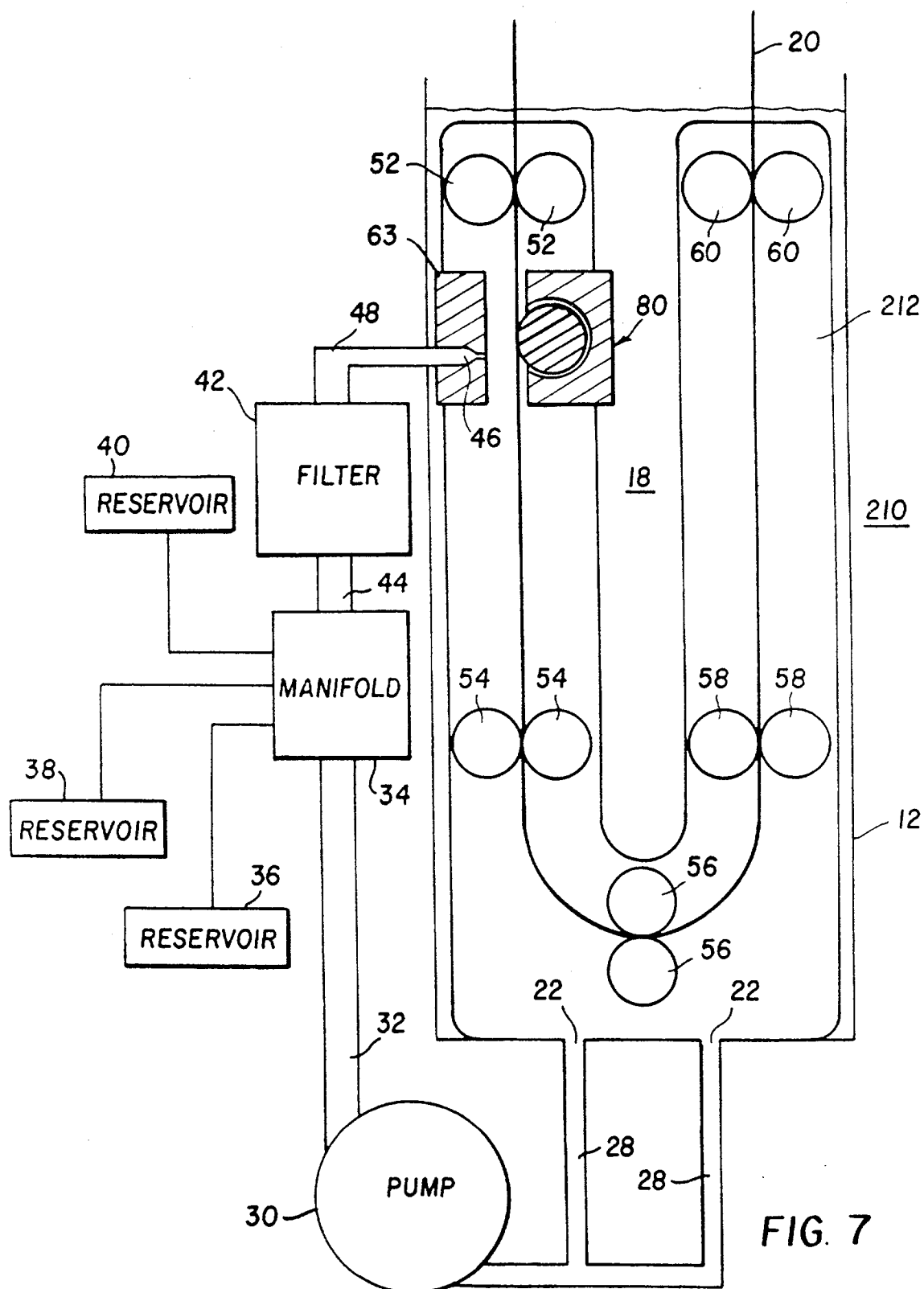


FIG. 6



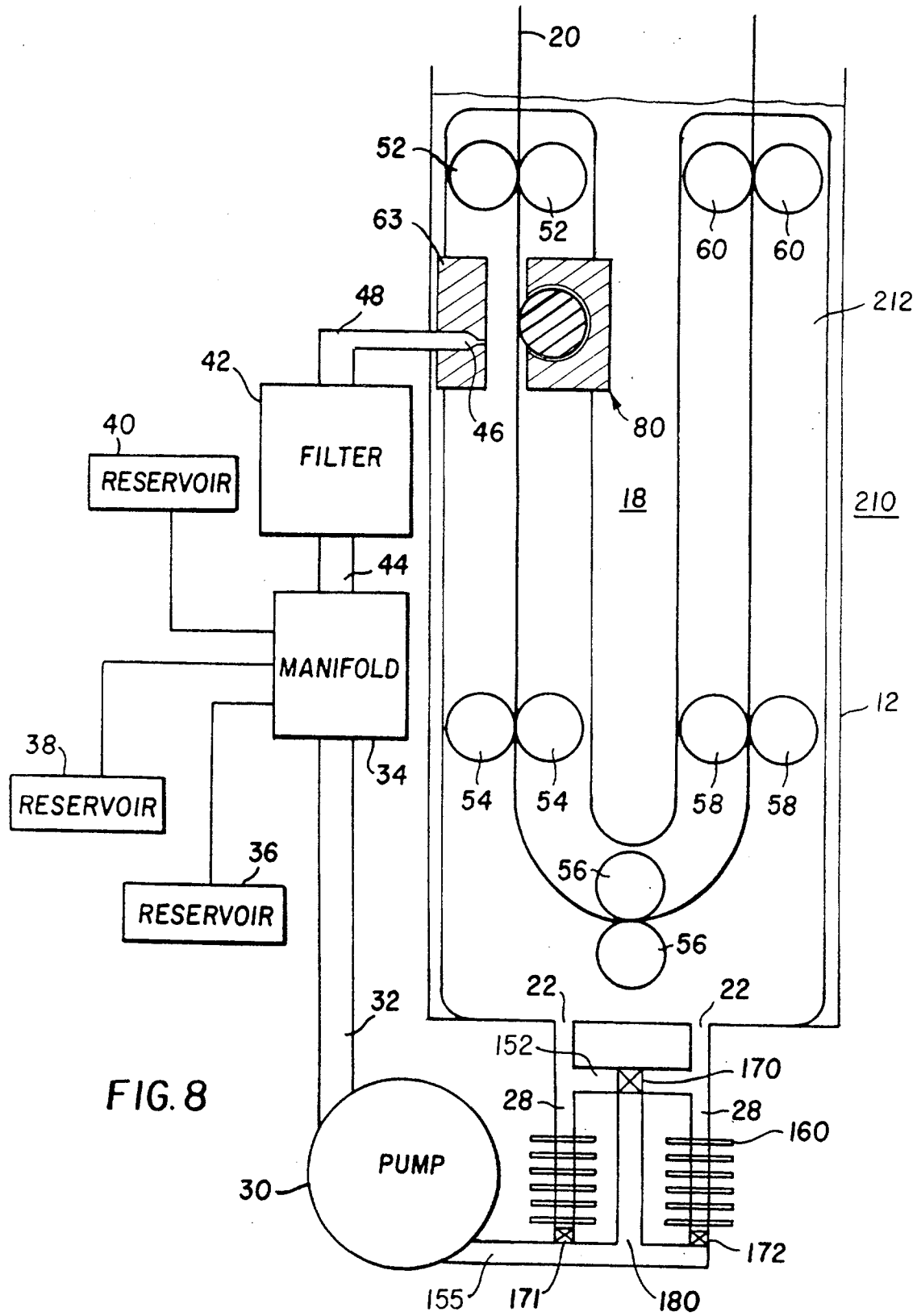


FIG. 8

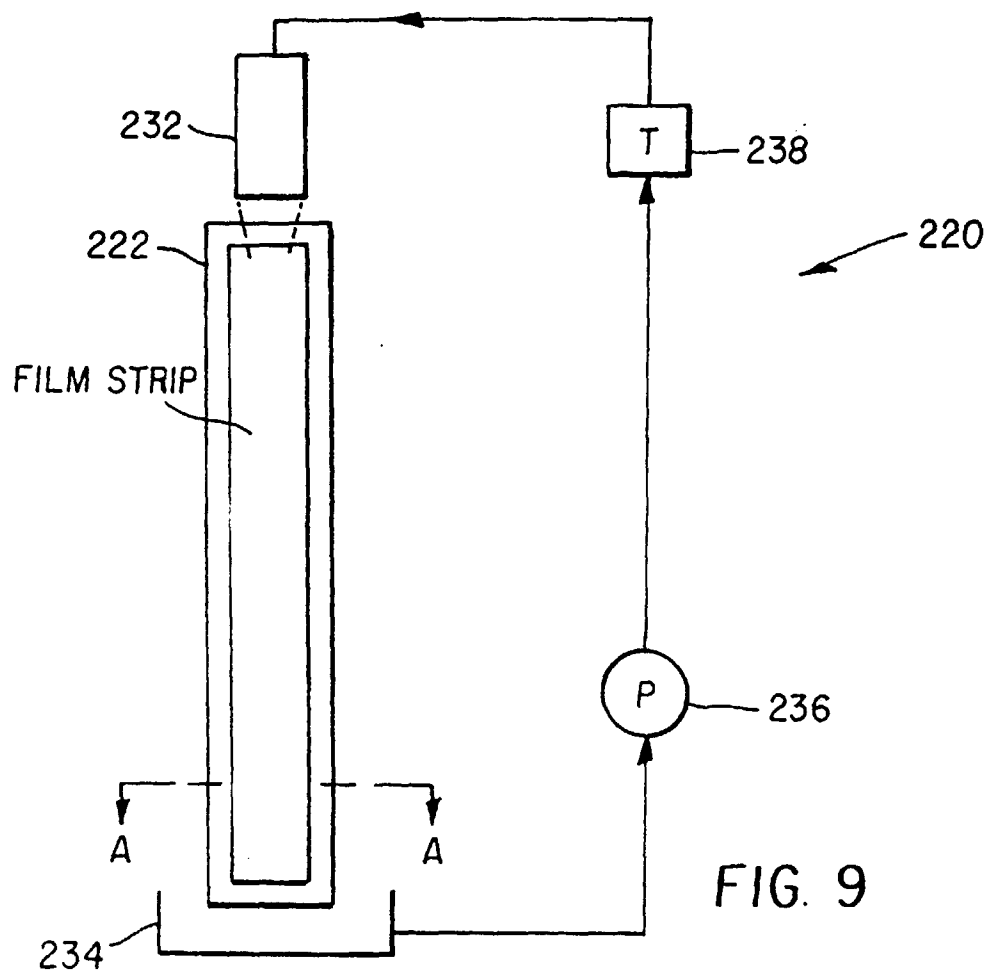


FIG. 9

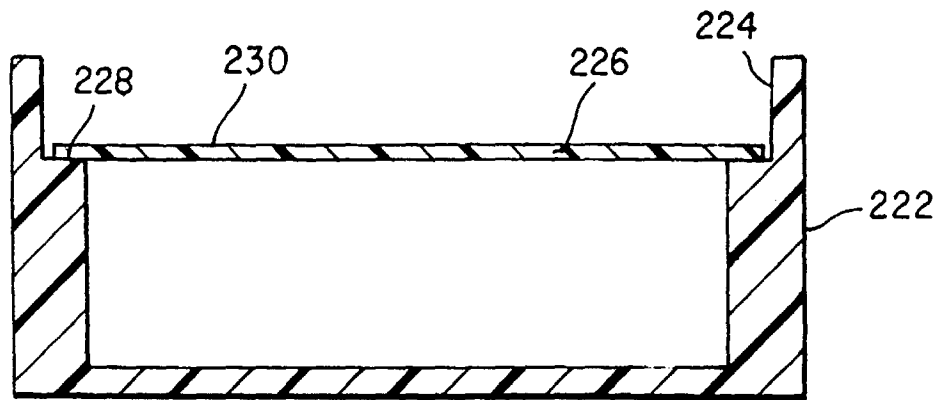


FIG. 10



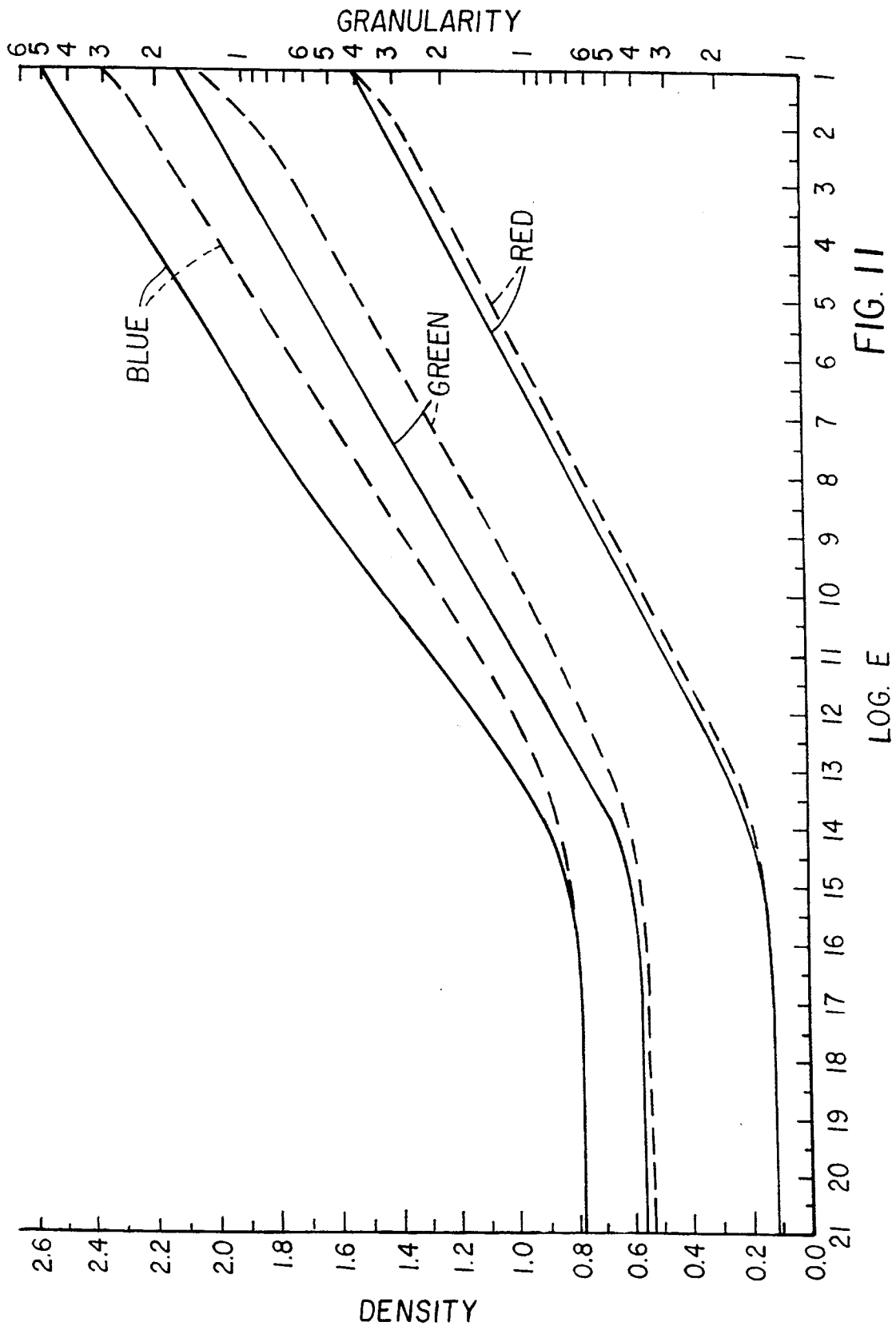


FIG. 11

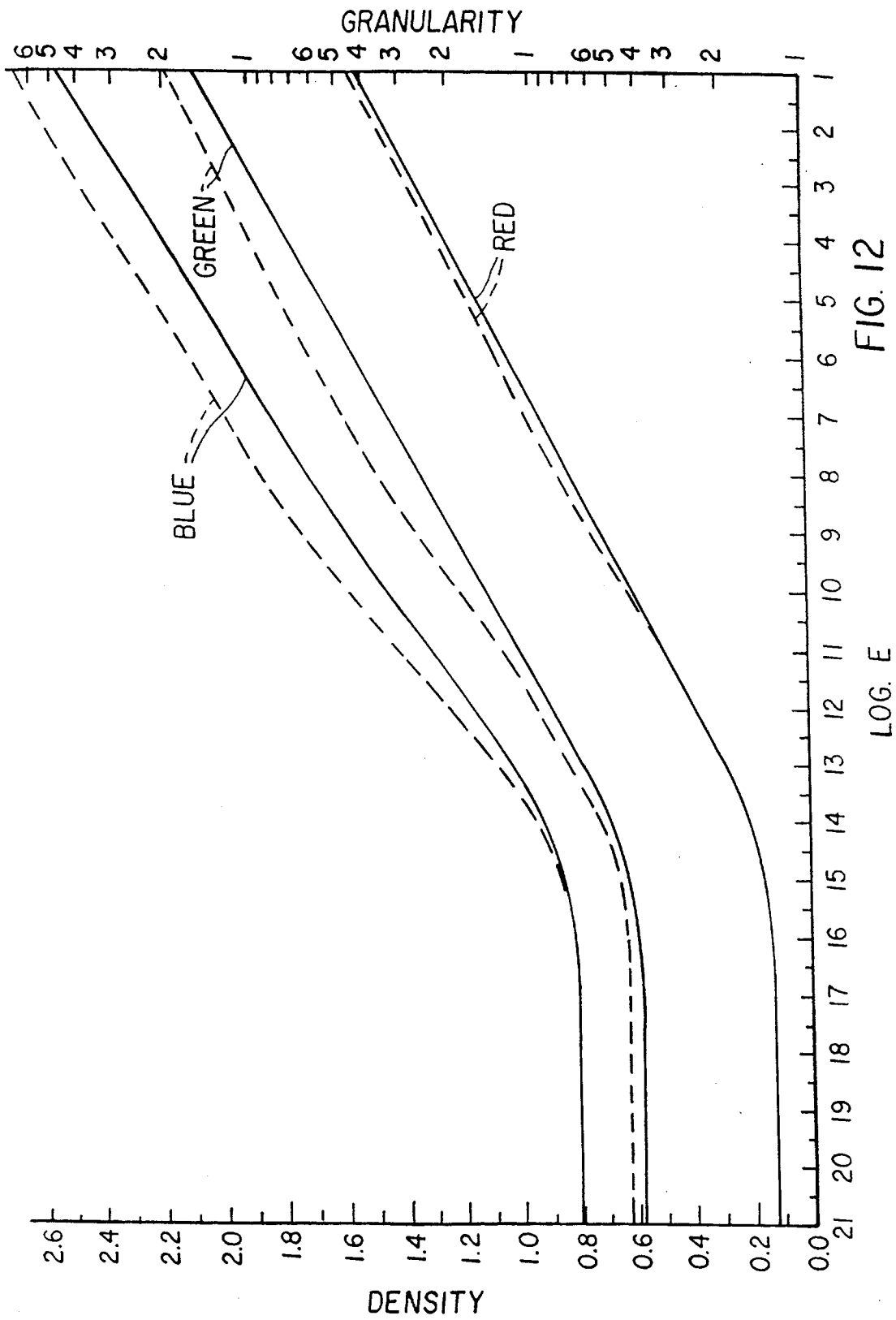


FIG. 12

LOG. E



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 98 20 1611

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                              |                                                                                                                                                                                                                                                                              |                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Category                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                | Relevant to claim                                                                                                                                                                                                                                                            | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
| A                                                                                                                                                                                                                                                      | US 3 850 635 A (M.L.LEAVITT) 26 November 1974<br>* column 2 - column 4; figures 1-3 *                                        | 1,2,5,6                                                                                                                                                                                                                                                                      | G03D13/00                                    |
| A                                                                                                                                                                                                                                                      | EP 0 581 567 A (EASTMAN KODAK CO.LTD.) 2 February 1994<br>* column 1 - column 3; figure 1 *                                  | 1                                                                                                                                                                                                                                                                            |                                              |
| A                                                                                                                                                                                                                                                      | PATENT ABSTRACTS OF JAPAN<br>vol. 96, no. 11, 29 November 1996<br>& JP 08 171337 A (CANON INC.), 2 July 1996<br>* abstract * | 1                                                                                                                                                                                                                                                                            |                                              |
|                                                                                                                                                                                                                                                        |                                                                                                                              |                                                                                                                                                                                                                                                                              | TECHNICAL FIELDS SEARCHED (Int.Cl.6)         |
|                                                                                                                                                                                                                                                        |                                                                                                                              |                                                                                                                                                                                                                                                                              | G03D                                         |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                              |                                                                                                                                                                                                                                                                              |                                              |
| Place of search<br>THE HAGUE                                                                                                                                                                                                                           |                                                                                                                              | Date of completion of the search<br>4 September 1998                                                                                                                                                                                                                         | Examiner<br>Boeykens, J                      |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                              | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                              |

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