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(54) **Thermal processor**

(57) A thermal processor (7) and method is adapted to process a film having a resistive heating layer (39). The thermal processor includes a voltage source (30) which applies a current to a conductive member such as a conductive roller (25b, 27b) of the processor. The

conductive roller contacts a film (5) having a resistive heating layer so as to pass the current to the resistive heating layer and heat the resistive heating layer. The heat from the resistive heating layer serves to heat the film to develop images on the film.

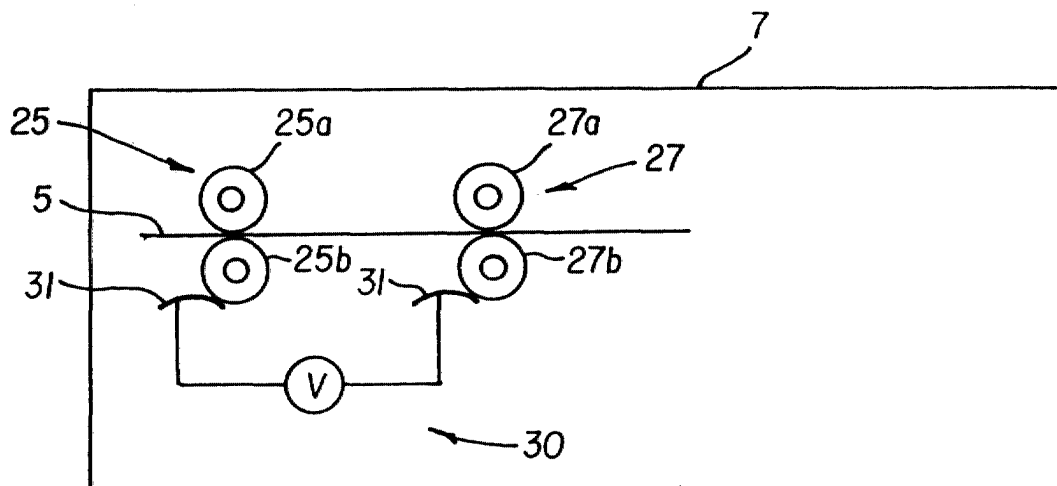


FIG. 3

Description

[0001] The present invention relates to a thermal processor and method for processing film. More specifically, the invention relates to a processor and method for processing film, wherein the film contains a resistive heating element, as well as a film structure which contains a resistive heating element.

[0002] In the conventional practice of color photography, silver halide film is developed by a chemical technique requiring several steps which include latent image developing, bleaching and fixing. While this technique has been developed over many years and results in exceptional images, the technique requires several chemicals and precise control of times and temperatures of development. Further, the conventional silver halide chemical development technique is not particularly suitable for utilization with compact developing apparatuses. The chemical technique which is a wet processing technique is also not easily performed in the home or small office.

[0003] Imaging systems that do not rely on conventional wet processing have received increased attention in recent years. Photothermographic imaging systems have been employed for producing silver images. Typically, these imaging systems have exhibited very low levels of radiation-sensitivity and have been utilized primarily where only low imaging speeds are required. A method and apparatus for developing a heat developing film is disclosed in US patent number 5,537,767. Summaries of photothermographic imaging systems are published Research Disclosure, Volume 170, June 1978, Item 17029, and Volume 299, March 1989, Item 29963. Heat development color photographic materials have been disclosed, for example, in US patent number 4,021,240 and US patent number 5,698,365.

[0004] US patent number 6,048,110 discloses an apparatus for thermal development which comprises the use of a thrust cartridge. Also, commercial products such as Color Dry Silver supplied from Minnesota Mining and Manufacturing Company and Pictography™ and Pictostat™ supplied by Fuji Film Co., Ltd. have been on the market.

[0005] An objective of a thermal processor is to provide a low cost processing equipment for film. Typically this has been accomplished by using a free standing resistive heater in the form of a plate or drum that contacts the film and promotes image development. Although this system is low in cost relative to a wet process, it still requires the utilization of extra equipment for the resistive heater which can add to the complexity of the processor.

[0006] An object of the present invention is to provide for a thermal processor which is lower in cost and complexity in relation to traditional wet processing arrangements or thermal processing arrangements with free standing heating elements.

[0007] In one feature of the present invention, a thermal

processor comprises a conductive assembly that comprises a conducting member adapted to contact a photosensitive medium; and a voltage source for applying a current to the conducting member to transfer heat to a photosensitive medium in contact with the conducting member.

[0008] In a further feature of the present invention, a conductive backing or resistive heating element is integrated into or coated on a film structure. As an example, the resistive heating element is coated on the front side, or preferably on the rear side of a film strip, and heating of the film is accomplished by passing a current through this resistive heating element.

[0009] In a further feature of the present invention, a film structure comprises a film support having at least one imaging layer on a first surface and a conductive backing or resistive heating element on a second surface which is opposite the first surface. The conductive backing is adapted to heat and develop the at least one imaging layer when a current is passed through the conductive backing.

[0010] In another feature of the present invention, a thermal processor for processing film comprises a first pair of rollers which define a first nip for a conveyance of film therethrough along a film path, and a second pair of rollers which define a second nip for the conveyance of the film therethrough along the film path. The second pair of rollers is located downstream of the first pair of rollers with respect to a direction of conveyance of the film. One roller of the first pair of rollers and one roller of the second pair of rollers each comprise a conductive coating and are located on a first side of the film path so as to contact one side of the film as the film is conveyed along the film path. The processor also comprises a variable voltage source adapted to apply a current to the one roller of the first pair of rollers and the one roller of the second pair of rollers to heat a film which contacts the one roller of the first pair of rollers and the one roller of the second pair of rollers.

[0011] In another feature of the present invention, a thermal processor for processing thermal film comprises a roller arrangement which includes a first non-conductive roller and a first conductive roller positioned so as to define a first nip therebetween for a passage of thermal film therethrough; a second roller arrangement which includes a second non-conductive roller and a second conductive roller positioned so as to define a second nip therebetween for a passage of the thermal film therethrough; and a variable voltage source adapted to apply a current to the first and second conductive rollers so as to convey heat to a thermal film in contact with the first and second conductive rollers and develop images on the film.

[0012] In another feature of the present invention, a thermal processing method comprises the steps of passing a thermal film along a film path which includes at least one conductive member, and heating the thermal film by applying a current to the at least one con-

ductive member, so as to cause a development of images on the thermal film.

[0013] In another feature of the present invention, a method of assembling a thermal film comprises the steps of providing at least one imaging layer on a first side of a support of the thermal film; and providing a conductive layer on a second side of the support.

Fig. 1 schematically illustrates an overall thermal processing workflow in accordance with the present invention;

Fig. 2 shows a film structure having a resistive heating element in accordance with the present invention; and

Fig. 3 is an illustration of a thermal processor in accordance with the present invention.

[0014] Referring now to the drawings, wherein like reference numerals represent identical or corresponding parts throughout the several views, Fig. 1 illustrates an overall thermal processing workflow. As shown in Fig. 1, a cassette or cartridge 50 having a photosensitive medium, such as an exposed film or thermal film 5 therein, is supplied to a processor 7 for development and processing. Film 5 is preferably located in a thrust cartridge. The thrust cartridge may be any cartridge that allows film to be withdrawn from the cartridge and re-wound onto the cartridge multiple times while providing light-tight storage, particularly prior to exposure and development. Typical of such cartridges are those utilized in the advanced photo system (APS) for color negative film. These cartridges are disclosed in U.S. Pat. No. 4,834,306 to Robertson et al and U.S. Pat. No. 4,832,275 to Robertson. U.S. Patent no 6,048,110 to Szajewski et al. illustrates a further example of an apparatus for thermal development of thermal film using a thrust cartridge, with the apparatus including a magnetic reader and writer. However, the present invention is not limited thereto, and other methods or types of cassettes for delivering the film to processor 7 can be utilized. Also, processor 7 can be adapted to receive and/or extract film from a specially designed one time use camera.

[0015] Processor 7 processes film 5 to develop images on the film. Film 5 is then conveyed to an image scanner 11 to scan and digitize the images generated on the thermally processed film 5. A central processing unit (CPU) 14 digitally process the scanned images so as to provide a suitable digital file. A monitor 15 can be used to view the images and the progress/status of the film processing. After scanning, the digital file can be forwarded to a printer 19 to print the digital files thus rendering a hardcopy output. As a further option, a file output or digital file writer 21 such as a compact disc writer or a floppy disc writer can be enabled to deliver a digital file output. Also, the digital file can be transmitted through, for example, the internet through the use of a network service provider 17. The thermal process of thermally developable film in accordance with the

present invention typically involves the application of heat at processor 7 to thermal film to develop the images on the film. In conventional approaches the application of heat is through the use of, for example, a separate heating element such as a heating plate.

[0016] In a feature of the present invention as shown in Fig. 2, a separate heating element is not necessary. More specifically, in the present invention, film 5 acts as the heat applicator and includes a resistive heating element, heating layer, conductive portion or conductive backing 39. More specifically, film 5 includes a support 37, with a resistive heating layer or conductive backing 39 being applied to or integrated into one side of support 37. A second side of support 37 includes imaging layers 35. Therefore, the application of a current through resistive heating layer 39 serves to heat resistive heating layer 39 and transfer heat to film 5. The heat is transmitted to imaging layers 35 for the purpose of developing images on film 5.

[0017] Resistive heating layer 39 could be any material that gives the proper sheet resistance to promote film heating and development within a range of voltages that would be practical in a piece of automated equipment. As a non-limiting example, assuming a 15cm film path, a voltage of 100 V available for processing the film, and assuming that approximately 100W of power must be supplied along each centimeter of film width to develop the film in the time frame required, resistive heating layer 39 on film 5 would need to have sheet resistivity of approximately $10 \Omega/\square$. Thus, sheet resistivities in the range of 1 to $100 \Omega/\square$ would be desired. This can be accomplished by using resistive heating layers in the form of metalized resistive heating layers or backings, conductive oxides such as tin oxide or indium tin oxide, conductive polymers such as polyacetylene, or polymers impregnated or rendered conductive by the inclusion of a sufficient amount of conductive particles or conducting particulate material such as graphite or metal particles.

[0018] A schematic detailed view of processor 7 in accordance with the present invention is shown in Fig. 3. Processor 7 includes a conductive assembly having conducting members. More specifically, processor 7 includes a first roller arrangement, assembly or pair 25 that includes a first non-conductive roller 25a and a first conductive roller 25b; and a second roller arrangement, assembly or pair 27 that includes a second non-conductive roller 27a and a second conductive roller 27b. Non-conductive rollers 25a and 27a are located on one side of a film path for film 5 so as to contact a first side of film 5. Conductive rollers 25b and 27b are located on a second side of film path 5 so as to contact a second side of film 5. Also, rollers 25a and 25b define a first nip therebetween for the conveyance and passage of film 5 therethrough, while rollers 27a, 27b are located downstream of rollers 25a, 25b with respect to a conveying direction of film 5 and define a further nip therebetween for the conveyance and passage of film therethrough.

[0019] Processor 7 further includes a variable voltage source 30 for applying a current to conductive rollers 25b and 27b. In a feature of the invention, voltage source 30 can include contact brushes 31 for transferring the current from the voltage source to rollers 25b, 27b. In the present invention, film 5 having a resistive layer 39 as shown in Fig.2 is transported through processor 7 in a manner in which resistive layer 39 faces and/or contacts conductive rollers 25b, 27b; while imaging layers 35 face or contact non-conductive rollers 25a, 27a. Current from voltage source 30 is transferred to conductive rollers 25b and 27b through contact brushes 31 or some other type of conductive medium. Through the contact of conductive rollers 25b and 27b with resistive layer 39, the current passes to resistive layer 39 to heat resistive layer 39. The current heats resistive layer 39 so as to heat film 5 including imaging layers 35 and develop images on film 5.

[0020] Processor 7 may further include a temperature sensor 40 that can determine the surface temperature of the film. Temperature sensor 40 may include a pyrometer, thermocouple, or any convenient temperature-sensing device. The output from temperature sensor 40 may be used in a feedback control to control the voltage applied across the rollers 25b and 27b by variable voltage source 30.

[0021] Non-conductive rollers 25a, 27a could be rubber rollers or rubber coated rollers; while conductive rollers 25b, 27b could be metal or metal coated rollers.

[0022] Thus, the present invention provides for a unique thermal processor and film structure in which heat for development of the film is applied via a voltage source and a resistive heating layer applied on or integrated into the film.

[0023] It is noted that the present invention is not limited to a conductive roller arrangement as shown. Other devices which are capable of uniformly contacting the resistive heating layer of the film in a manner in which a current passes uniformly through a known length of film, and in which a region through which the current passes can be made to move along the film as the film is fed through the processor, can be utilized within the context of the present invention.

[0024] For example, rather than a roller, the conductive arrangement could comprise a bar or lever urged into contact with the film by, for example, a spring; with enough force to maintain contact with the film, and at the same time permit the conveyance of the film. The bar or lever could be attached to a voltage source as described. This alternative arrangement could be retrofitted into an existing processor having, for example, rubber rollers.

Claims

1. A thermal processor (7) comprising:

a conductive assembly comprising a conducting member (25b, 27b) adapted to contact a photosensitive medium (5); and
a voltage source (30) for applying a current to said conducting member to transfer heat to a photosensitive medium in contact with said conducting member.

2. A processor according to claim 1, wherein said conductive assembly is a roller arrangement and said conducting member is a conductive roller.

3. A processor according to claim 1, wherein said photosensitive medium is a film having a resistive heating element.

4. A film structure comprising:
a film support (37) having at least one imaging layer on a first surface and a conductive backing (39) on a second surface which is opposite the first surface, said conductive backing being adapted to heat and develop the at least one imaging layer when a current is passed through the conductive backing.

5. A thermal processor for processing film, the processor comprising:

a first pair of rollers (25a, 25b) which define a first nip for a conveyance of film therethrough along a film path, and a second pair of rollers (27a, 27b) which define a second nip for the conveyance of the film therethrough along the film path, the second pair of rollers being located downstream of the first pair of rollers with respect to a direction of conveyance of the film, wherein one roller (25b) of said first pair of rollers and one roller (27b) of said second pair of rollers each comprise a conductive coating and are located on a first side of the film path so as to contact one side of the film as the film is conveyed along the film path; and
a variable voltage source (30) adapted to apply a current to said one roller of said first pair of rollers and said one roller of said second pair of rollers to heat a film which contacts said one roller of said first pair of rollers and said one roller of said second pair of rollers.

6. A processor according to claim 5, wherein said voltage source comprises a first contact brush which contacts said one roller of said first pair of rollers and a second contact brush which contacts said one roller of said second pair of rollers.

7. A thermal processor for processing thermal film, the processor comprising:

a roller arrangement (25) which includes a first non-conductive roller (25a) and a first conductive roller (25b) positioned so as to define a first nip therebetween for a passage of thermal film therethrough; 5

a second roller arrangement (27) which includes a second non-conductive roller (27a) and a second conductive roller (27b) positioned to as to define a second nip therebetween for a passage of the thermal film therethrough; and 10

a variable voltage source (30) adapted to apply a current to said first and second conductive rollers so as to convey heat to a thermal film in contact with the first and second conductive rollers and develop images on the film. 15

8. A processor according to claim 7, wherein the thermal film in contact with the first and second conductive rollers comprises a resistive layer that is heated by the current from said voltage source. 20

9. A thermal processing method comprising the steps of:

passing a thermal film (5) along a film path which includes at least one conductive member (25a, 27b); and 25

heating said thermal film by applying a current to said at least one conductive member, so as to cause a development of said thermal film. 30

10. A method of assembling a thermal film (5), the method comprising the step of:

providing at least one imaging layer (35) on a first side of a support (37) of the thermal film; and 35

providing a conductive layer (39) on a second side of the support. 40

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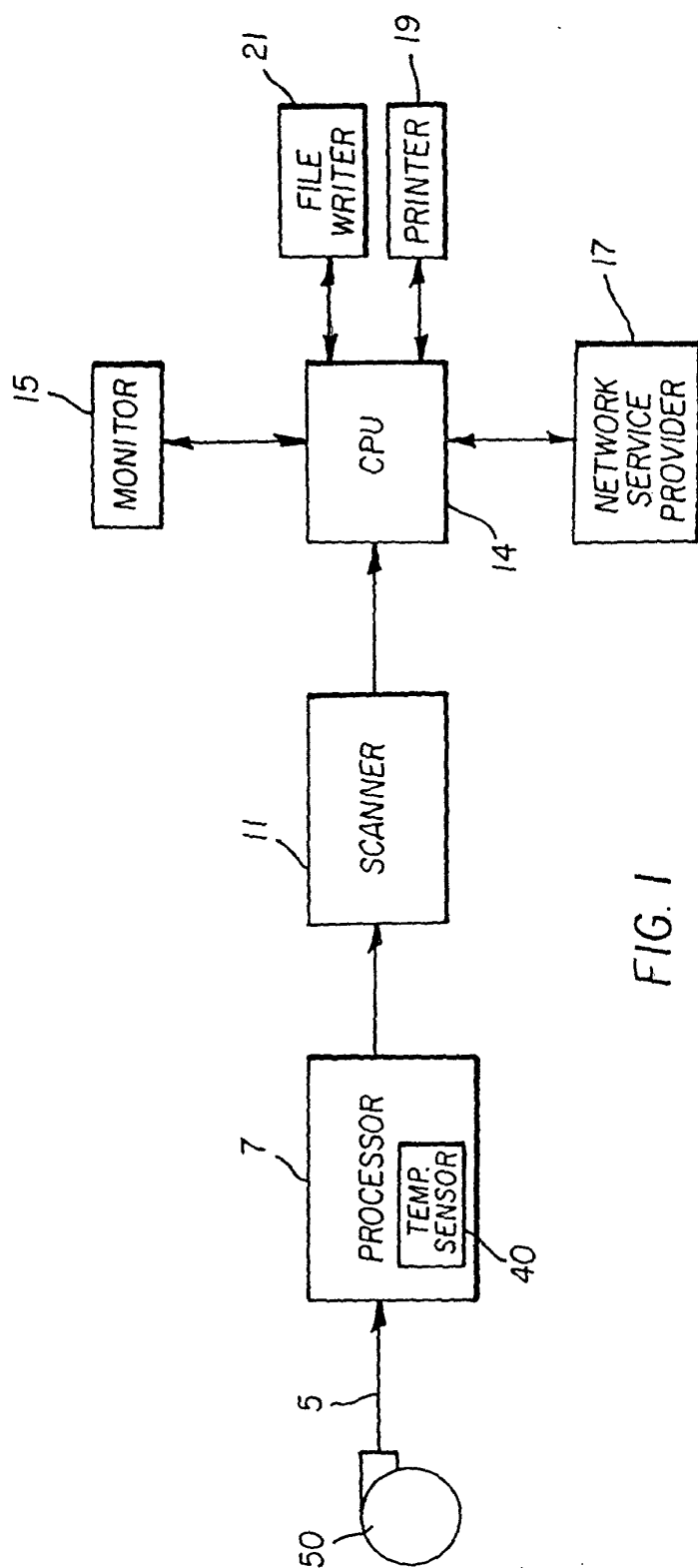


FIG. 1

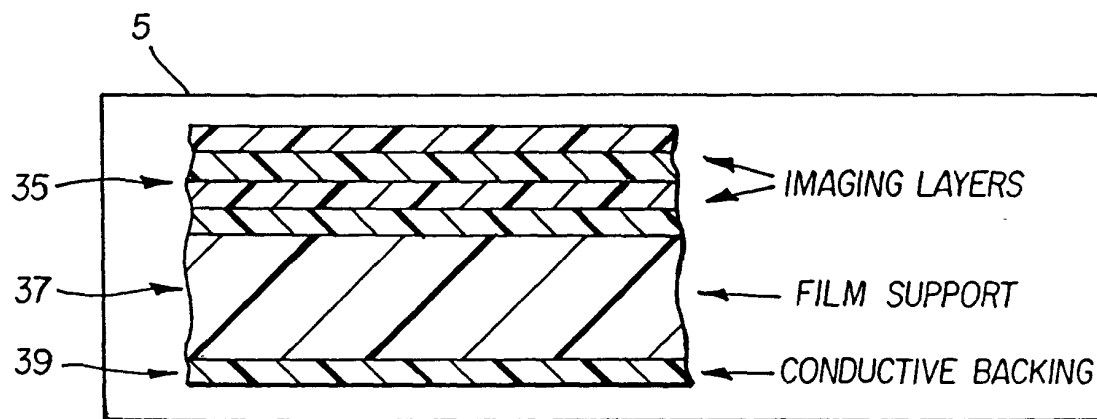


FIG. 2

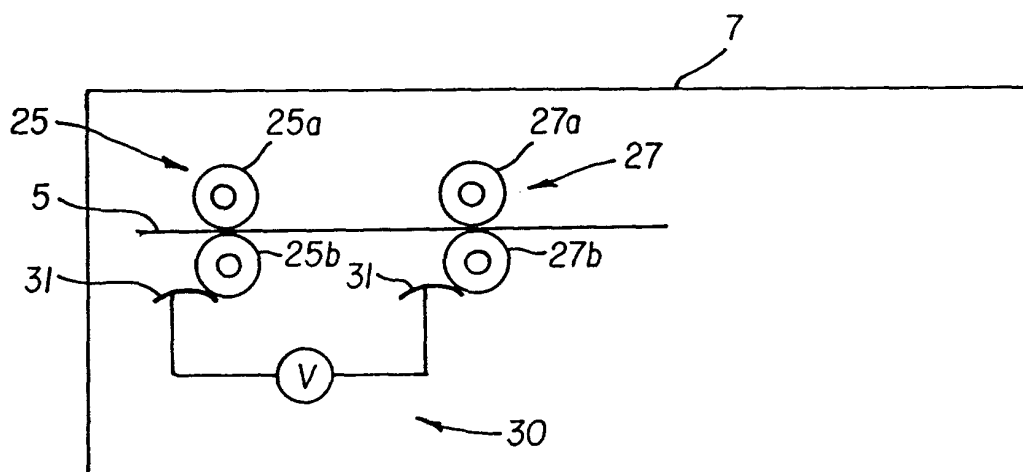


FIG. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 20 2102

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The present search report has been drawn up for all claims			
Place of search THE HAGUE Date of completion of the search 31 August 2001 Examiner Romeo, V			
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 20 2102

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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