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Geyken et al.

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[54] **APPARATUS FOR PROCESSING PHOTOGRAPHIC FILMS**

[75] Inventors: **Erwin Geyken; Gerhard Schwarzmaier; Peter Dawidowitsch,** all of Munich, Germany

[73] Assignee: **Agfa-Gevaert Aktiengesellschaft,** Leverkusen, Germany

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Related U.S. Application Data

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[30] **Foreign Application Priority Data**

Sept. 2, 1972 Germany 2243276

[52] **U.S. Cl.** **354/299;** 354/319

[51] **Int. Cl.²** **G03D 13/00**

[58] **Field of Search** 354/299, 319-322, 354/324; 137/340; 165/66

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Primary Examiner—Richard L. Moses
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A processing apparatus for photographic material wherein a first vessel for a supply of developing solution is followed by a second vessel for a fixing bath and the latter is followed by a third vessel for a rinse bath which, in turn, is followed by a dryer. The duct for evacuation of spent gaseous fluid from the dryer contains a heat exchanger whose coil conveys a stream of fresh water which is heated in the coil prior to entering a single additional heat exchanger in the first vessel whose coil conveys a stream of fresh water which is heated in the coil prior to entering a single additional heat exchanger in the first vessel or two additional series-connected heat exchangers which are connected in series and are respectively installed in the first and second vessels. Alternatively, the coil of the heat exchanger in the duct can discharge heated water directly into the third vessel; the apparatus then employs a pump which draws water from the third vessel and causes it to flow through a single additional heat exchanger in the first vessel or through two series-connected additional heat exchangers which are connected in series and are respectively mounted in the first and second vessels.

10 Claims, 4 Drawing Figures

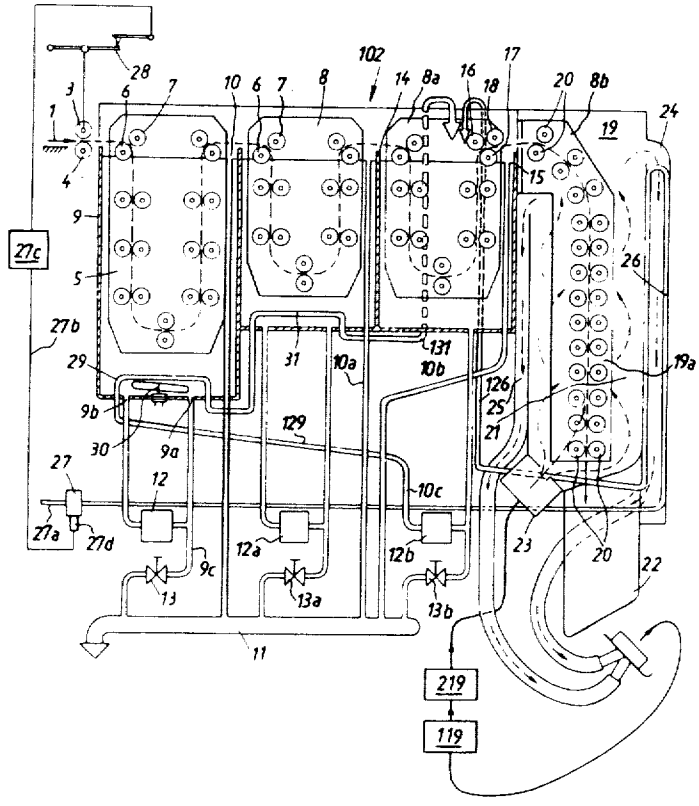


Fig.1

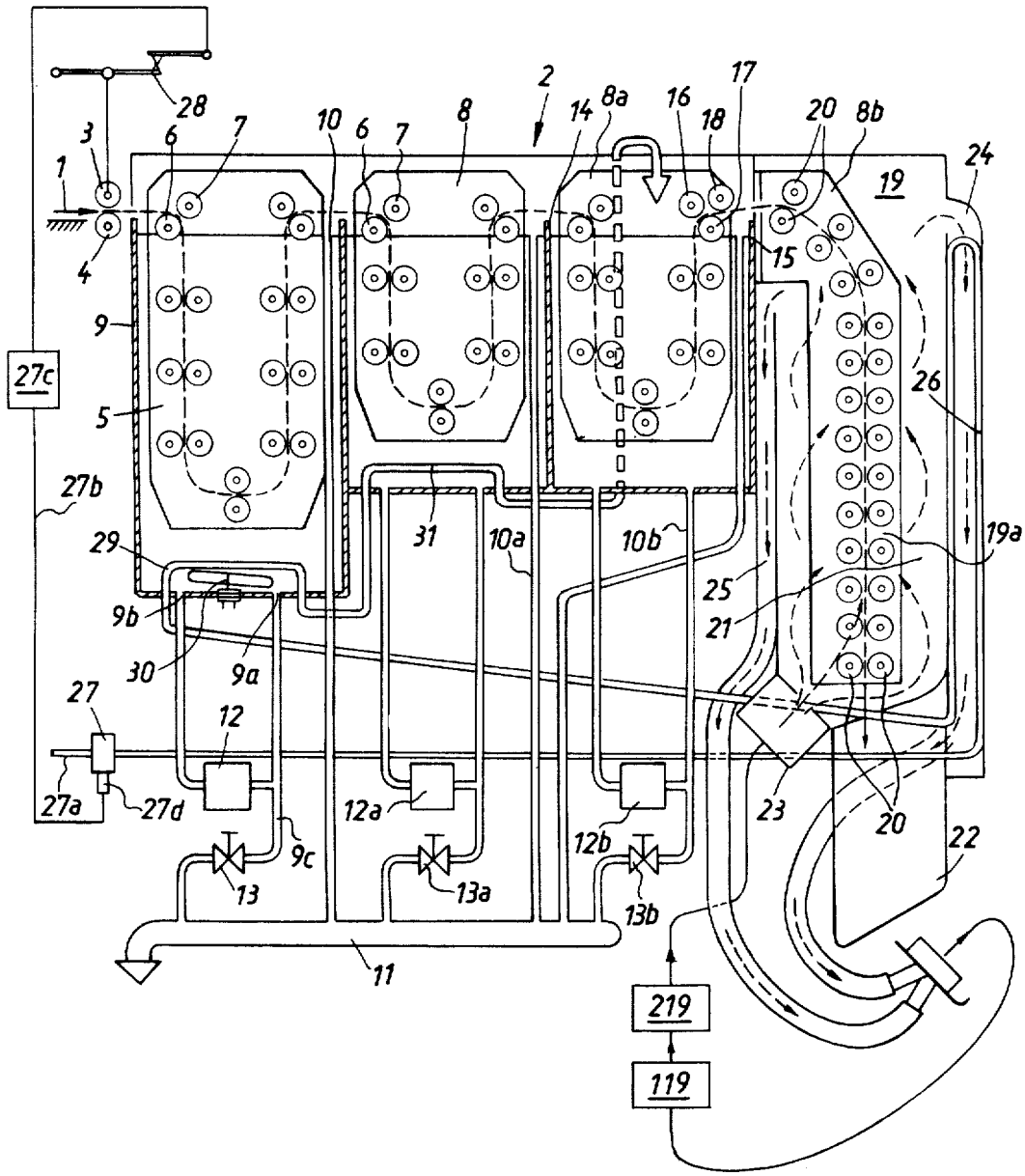

28
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10
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8a
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17
20
8b
24
1
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9
27c
26
5
27b
29
31
10a
10b
19a
25
9b
21
30
9a
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12
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27d
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12b
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9c
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13a
13b
11
219
119

Fig. 2

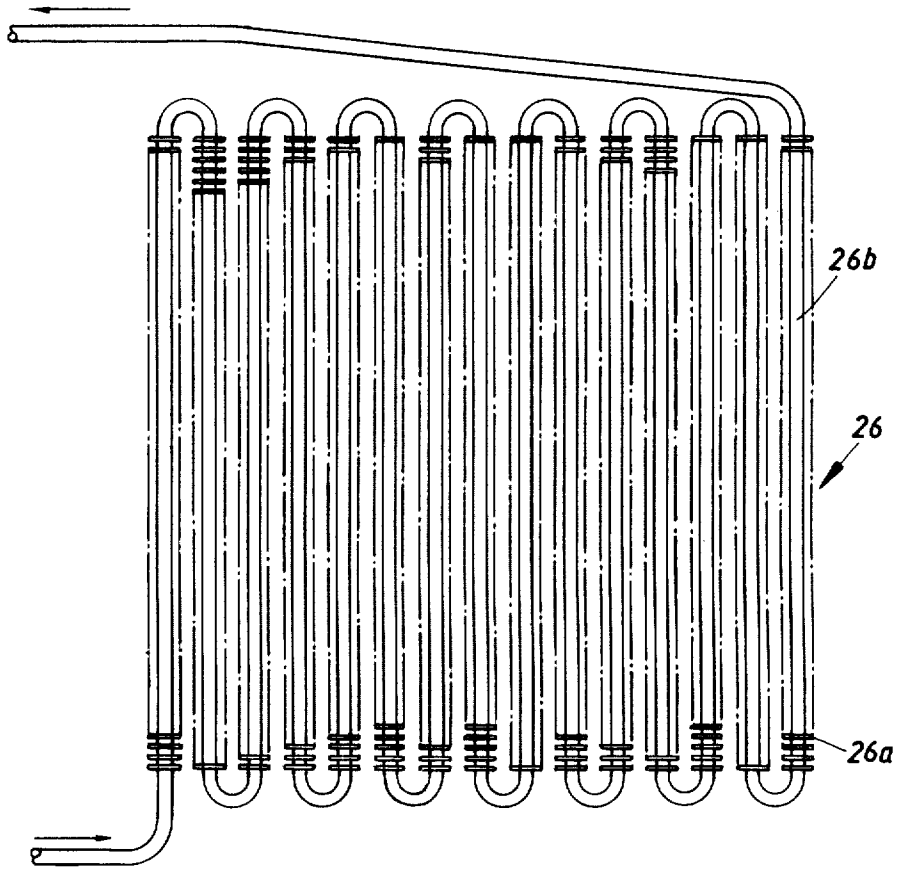


Fig.3

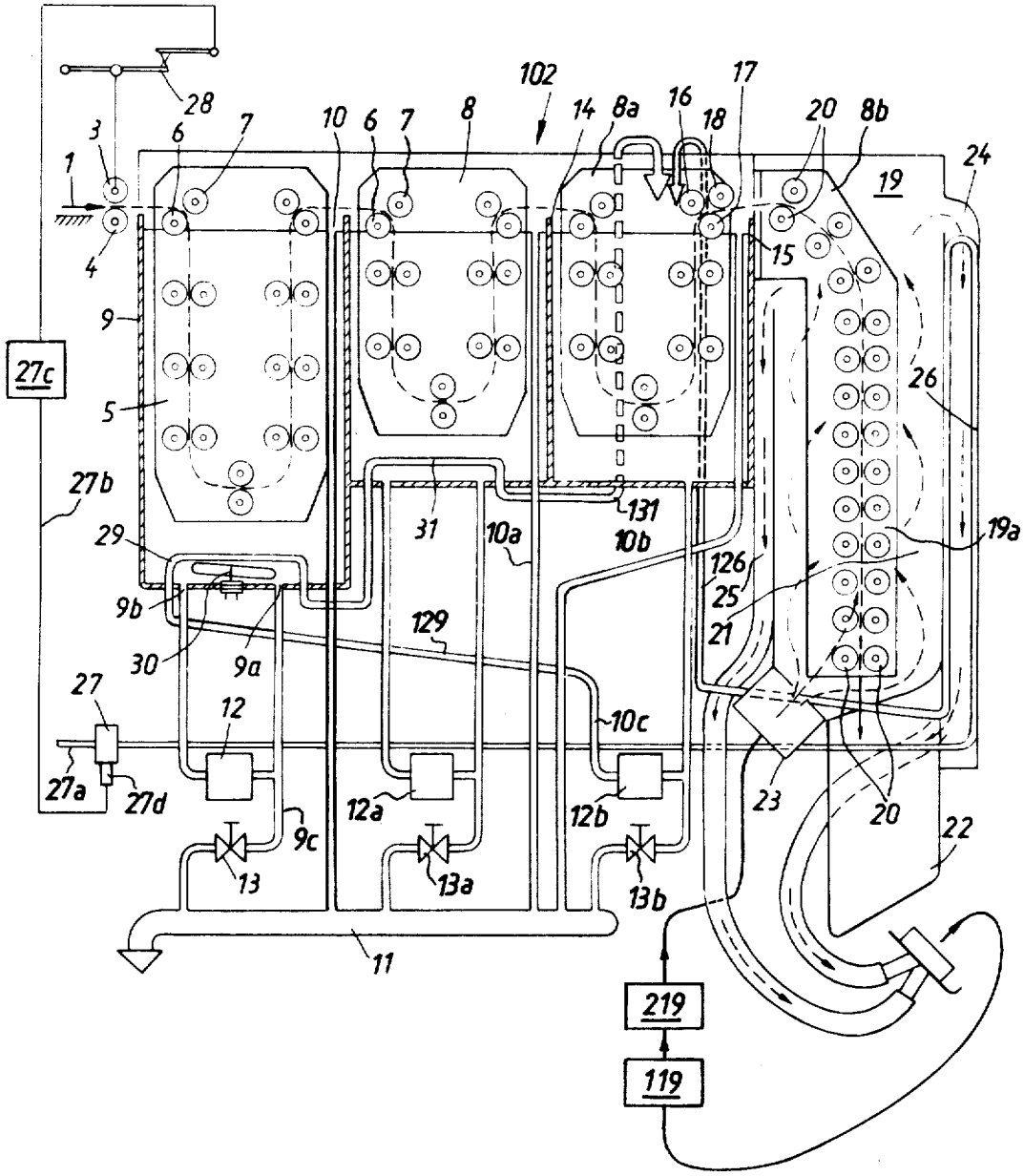
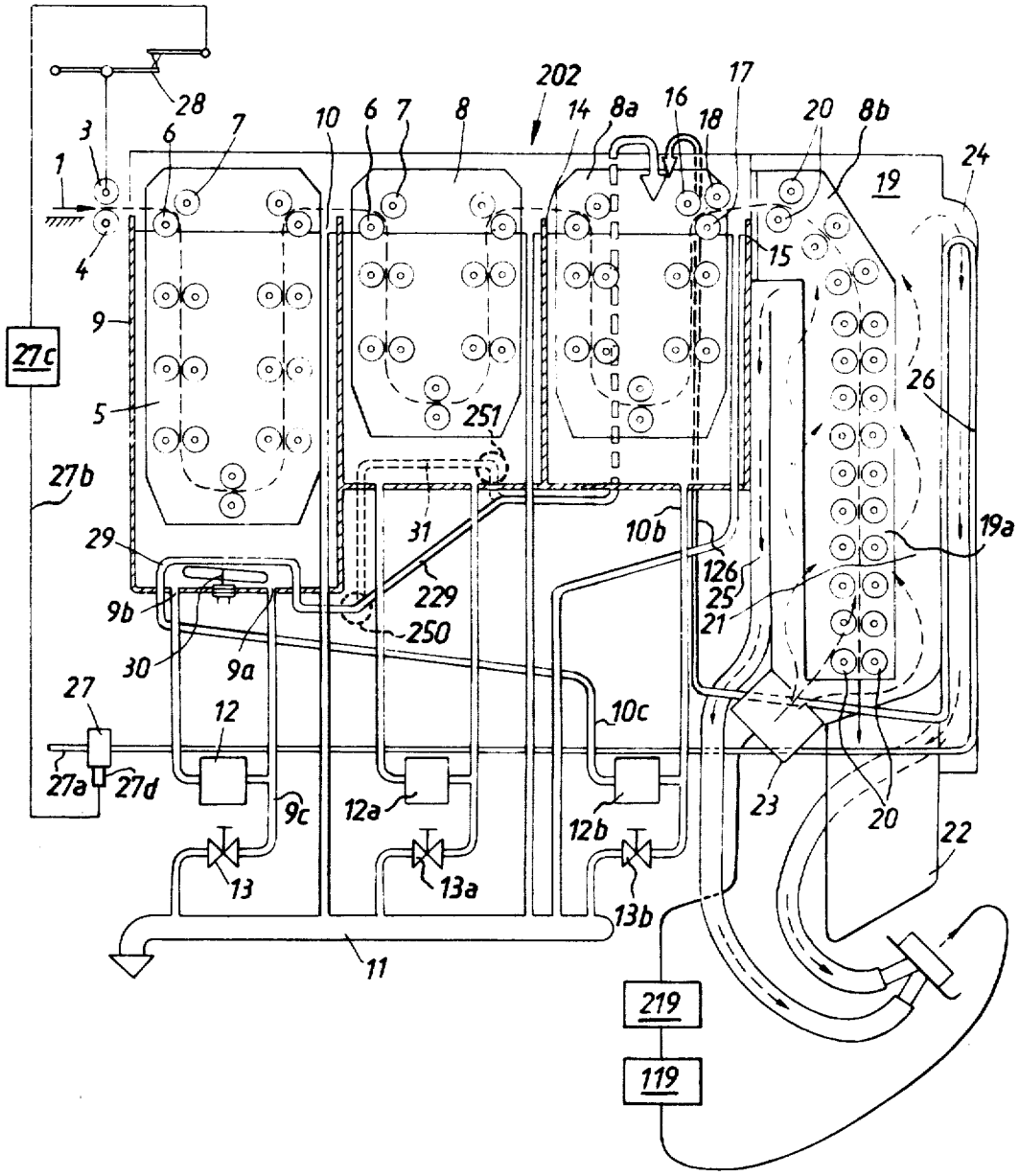

28
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8a
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8b
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24
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27c
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27b
131
10b
29
31
10a
19a
126
9b
129
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9a
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10c
27a
27d
12a
12b
23
20
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9c
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13a
13b
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219
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Fig.4


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8a
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8b
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15
9
27c
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251
26
27b
31
10b
19a
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126
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9b
229
250
30
9a
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10c
27a
27d
9c
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12b
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13a
13b
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APPARATUS FOR PROCESSING PHOTOGRAPHIC FILMS

CROSS-REFERENCE TO RELATED APPLICATION

This is a contination-in-part of our copending application Ser. No. 393,834 filed Sept. 4, 1973, now U.S. Pat. No. 3,832,730 granted Aug. 27, 1974.

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for processing photographic films or the like, and more particularly to improvements in processing apparatus wherein successive films or analogous carriers of photosensitive material are conveyed along an elongated path extending seriatim through at least one developing or fixing bath, thereupon through a rinse bath and finally through a dryer. Still more particularly, the invention relates to improvements in means for heating the liquid or liquids which contact the films during travel through a processing apparatus. Processing apparatus of the just outlined character are used, for example, in treatment of exposed X-ray films.

A drawback of presently known processing apparatus of the type wherein the films must pass through one or more baths which contain various chemicals and thereupon through a rinse bath and a dryer is that the apparatus must be provided with connections for hot and cold water. The connections for hot and cold water serve to deliver hot and cold water to a thermostatically controlled mixer valve which regulates the temperature of the water stream entering the processing apparatus, for example, the rinsing station. As a rule, the mixer valve is designed to insure that the temperature of water flowing to the rinsing station remains constant or fluctuates negligibly within a narrow range. The mixer valve and the temperature regulating means therefore are expensive and bulky. Moreover, such apparatus can be used only in locations having outlets for cold and hot water.

Still further, the presently known processing apparatus fail to meet the existing and anticipated future regulations governing the prevention of penetration of chemicals into the supply of drinking water.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel and improved automatic or semi-automatic processing apparatus for X-ray films and/or other types of carriers for photosensitive material wherein the temperature of liquid agents which come into contact with films can be regulated with a necessary degree of accuracy without resorting to complex, expensive and sensitive thermostatically controlled mixer valves or the like.

Another object of the invention is to provide a processing apparatus for exposed photographic films or the like with novel and improved means for heating at least one of two or more liquid agents which contact the films during transport toward the dryer.

A further object of the invention is to provide a processing apparatus for exposed photographic films wherein the temperature of one or more liquid agents can be regulated with a requisite degree of accuracy even if the laboratory wherein the apparatus is installed does not have an outlet for hot water.

An additional object of the invention is to provide a novel and improved dryer for use in a processing apparatus of the above outlined character.

An ancillary object of the invention is to provide novel and improved means for conditioning one or more liquid agents in a processing apparatus in automatic response to introduction of exposed films into the apparatus.

A further object of the invention is to provide a processing apparatus which is capable of processing large numbers of exposed films per unit of time and which is constructed and assembled in such a way that the temperature of one or more liquid agents therin does not drop appreciably in response to shorter-lasting or even longer-lasting interruptions in the operation of processing apparatus.

An additional object of the invention is to provide a processing apparatus which is constructed and assembled in such a way that it invariably prevents the penetration of deleterious chemicals into the supply of drinking water.

The invention is embodied in a processing apparatus for exposed films or analogous sheet-or web-like carriers of photosensitive material. The apparatus comprises a series of vessels each of which contains a supply of a processing liquid (such as a developing solution, a fixer and a rinse bath), a dryer, means for circulating in the dryer a heated gaseous fluid, means for transporting carriers of photosensitive material through successive vessels and thereupon through the drier, a source of unheated liquid (e.g., fresh water), and a heat exchanger which is connectable with the source of unheated liquid and is installed in (and may form part of) the dryer so that unheated liquid which is supplied by the source is heated while flowing in the first heat exchanger and is thereupon discharged into one of the vessels, preferably into the vessel containing the rinse bath. The apparatus may comprise at least one additional heat exchanger which is connected with the outlet of the first mentioned heat exchanger (i.e., the latter than does not discharge directly into a vessel) and serves to circulate heated liquid in one of the vessels so that heated liquid which is supplied by the first heat exchanger and flows through the additional heat exchanger heats the supply of liquid in the one vessel prior to being discharged by the additional heat exchangers into another vessel.

The vessel containing the additional heat exchanger may further contain thermostatically controlled heating means. Such heating means may be installed, for example, in the vessel for a developing solution which is circulated in the respective vessel by a pump or the like. The heating means is preferably located downstream of the additional heat exchanger, as considered in the direction of circulation of developing solution.

It is also within the purview of the invention to employ a first heat exchanger which is installed in the dryer and heats fresh liquid prior to discharging into a first vessel (e.g., the one which contains the rinse bath). This first vessel has an outlet which supplies liquid to an additional heat exchanger in a second vessel or to several series-connected additional heat exchangers in second, third, etc. vessels. The additional heat exchanger(s) may discharge liquid into the first vessel.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved processing apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific

embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic partly elevational and partly longitudinal vertical sectional view of a processing apparatus which embodies one form of the invention;

FIG. 2 is an enlarged view of a heat exchanger in the dryer of the processing apparatus shown in FIG. 1;

FIG. 3 is a schematic partly elevational and partly longitudinal vertical sectional view of a second apparatus; and

FIG. 4 is a schematic partly elevational and partly longitudinal vertical sectional view of a third apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a first processing apparatus **2** for photographic films **1**. The leader of an exposed film **1** which is fed into the processing apparatus **2** is engaged by two advancing rolls **3, 4** which introduce the film into a first vessel or tank **9** containing a holder or rack **5** for several sets of pairwise arranged transporting rollers **6, 7** serving to move the film along a substantially U-shaped path having a downwardly and an upwardly extending section. The tank **9** contains a supply of a developing solution whose upper level is determined by an overflow pipe **10** which is connected with an evacuating pipe **11**. The tank **9** preferably consists of a synthetic thermoplastic material which is resistant to the corrosive influence of developing solution. The bottom wall of the tank **9** has an outlet **9*a*** which is connected with the intake of a pump **12** serving to circulate developing solution in the tank **9**. The outlet of the pump **12** is connected with an inlet **9*b*** in the bottom wall of the tank **9**.

A thermostatically controlled heating unit **30** in the bottom portion of the tank **9** serves to maintain the developing solution at a predetermined temperature. The heating unit **30** may comprise one or more rod-like heaters which are preferably adjacent to the inlet **9*b*** in the bottom wall of the tank **9**.

The outlet **9*a*** is further connected with the evacuating pipe **11** by means of a conduit **9*c*** which contains a normally closed shutoff valve **13**. The valve **13** is opened when the pump **12** is arrested and the operator wishes to evacuate the contents of the tank **9**.'

The film **1** which leaves the tank **9** is introduced into a second vessel or tank **14** which is somewhat shallower than the tank **9**. The tank **14** contains a rack **8** with sets of pairwise arranged transporting rollers **6, 7** which move the film **1** along a second U-shaped path. The tank **14** contains a supply of a fixing agent or fixer whose level is determined by an overflow pipe **10*a*** connected to the evacuating pipe **11**.

The tank **14** is followed by a third vessel or tank **15** for a rinse bath. The level of water in the tank **15** is determined by an overflow pipe **10*b*** which is connected to the evacuating pipe **11**. The tank **15** contains a rack **8*a*** with sets of transporting rollers **16, 17** and a guide roller **18** which directs the film **1** into a dryer **19**. The transporting rollers **16, 17** define for the film **1** a substantially U-shaped path similar to the path defined by the rollers **6, 7** on the rack **8** in the tank **14**. The reference characters **12*a*** and **12*b*** denote pumps which respectively serve to circulate fixer and water in the tanks **14** and **15**. The contents of the tanks **14** and **15** can be evacuated in response to opening of normally closed shutoff valves **13*a*, 13*b***. The dimensions of the tank **15** equal or approximate the dimensions of the tank **14**.

The last pair of transporting rollers **16, 17** in the tank **15** serves to remove surplus water from the film **1** and the guide roller **18** is preferably heated by hot gaseous fluid in the dryer **19**. The dryer **19** contains a rack **8*b*** for sets of pairwise arranged transporting rollers **20** which advance the film **1** along an elongated downwardly extending path including one or more arcuate sections. The film which is advanced by the transporting rollers **20** moves counter to the direction of flow of a stream **21** of hot drying gas, preferably air, and the dried film is allowed to descend into an intercepting receptacle **22** located at the lower end of the dryer **19**. The air stream **21** issues from the outlet of a suitable blower **119** and is heated by a thermostatically controlled heater **219** before it enters the dryer **19**. The heated air stream **21** enters the dryer **19** by way of an opening **23** which is adjacent to the receptacle **22** and spent air is evacuated by way of two channels or ducts **24, 25** whose intake ends are adjacent to the upper end of the path along which the film **1** moves through the dryer **19**. The discharge ends of the channels **24, 25** are connected to the suction inlet of the blower **119** so that the stream **21** is circulated along a substantially closed path. A certain amount of fresh air is preferably added to the stream **21**, for example, at the suction inlet of the blower **119**. This insures that the moisture content of air which forms the stream **21** does not exceed a predetermined maximum value.

A heat exchanger **26** (see also FIG. 2) is installed in the channel **24** to withdraw heat from the respective portion of the air stream **21**. As shown in FIG. **2**, the heat exchanger **26** comprises a meandering coil **26*b*** which is provided with disk-shaped fins or ribs **26*a***. If desired, the fins **26*b*** can be replaced by one or more helical fins preferably having large exposed surfaces to insure a satisfactory exchange of heat between unheated liquid in the coil **26*b*** and hot air around the coil. The liquid in the coil **26*b*** is assumed to be fresh water and the air in the channel **24** has a relatively high moisture content.

The intake end of the coil **26*b*** is connected with a supply pipe **27*a*** for fresh water which constitutes a source of unheated liquid. The pipe **27*a*** is connected with the coil **26*b*** by a flow regulating valve **27** which is preferably electromagnetically operated valve and opens in automatic response to introduction of a film **1** into the inlet of the tank **9**. To this end, the processing apparatus **2** comprises a control means including a detector **28** (e.g., a normally open switch) which generates a signal to energize the electromagnet **27*d*** of and to thus open the valve **27** in response to introduction of a film **1** into the nip of the advancing rolls **3, 4**. As shown, the roll **3** constitutes a follower which is moved away from the roll **4** to thereby close the switch **28** as soon as the leader of a film **1** is introduced between the advancing rolls. The arrangement is preferably such that the valve **27** remains open for an interval of time which is required to transport a film through the processing apparatus **2**. To this end, the conductor means **27*b*** between the detector switch **28** and the electromagnet **27*d*** of the valve **27** contains a time-delay relay **27*c*** or the like which insures that the delay with which the valve **27** closes subsequent to opening of the switch **28** suffices to guarantee that the last film **1** of a series of films has reached the receptacle **22**.

A second heat exchanger (similar to or different from the heat exchanger **26**) can be installed in the duct **25** of the dryer **19**, and such second heat exchanger can be connected in series or in parallel with the heat exchanger **26**. It is further clear that the heat exchanger **26** can be installed in the duct **25**.

The discharge end of the coil **26***b* is connected to the intake end of a coil forming part of a first additional heat exchanger **29** which is installed in the lower portion of the tank **9**. The liquid which issues from the coil of the heat exchanger **29** enters the coil of a second additional heat exchanger **31** in the lower portion of the tank **14**. The discharge end of the coil of the heat exchanger **31** admits water into the tank **15**.

It will be noted that the transporting rolls **20** move the films **1** downwardly through a first portion **19***a* of the dryer wherein the films are contacted by the ascending stream **21** of hot air, and that the heat exchanger **26** is installed in that portion (duct **24**) of the dryer **19** which receives spent air from the portion **19***a*. This insures that unheated liquid flowing in the coil **26***b* withdraws heat from the air stream **21** after the air stream has completed the drying of films **1** in the dryer portion **19***a*.

The operation is as follows:

The cross-sectional area of the passage defined by the valve **27** for the flow of cold water from the source or pipe **27***a* into the coil **26***b* of the heat exchanger **26** is selected in such a way that the pipe **27***a* admits water at a rate which is needed for continuous operation of the processing apparatus **2**. For example, when the apparatus **2** is to process 400 X-ray films per hour, the valve **27** can be set to admit into the coil **26***b* cold water at a rate of 2½ liters per minute. The thus admitted stream of fresh water flows in the coil **26***b* and is heated by moist air in the duct **24**. As explained above, the coil **26***b* can discharge preheated water into a similar coil of a second heat exchanger in the duct **25** of the dryer **19**. The fins **26***a* insure a highly satisfactory exchange of heat between water in the coil **26***b* and air in the duct **24**. For example, the temperature of air which enters the duct **24** may approximate 45°C. which is well above the temperature of fresh water in the pipe **27***a*. The temperature of water leaving the coil **26***b* depends on the rate of water flow through the heat exchanger **26**; for example, the temperature of such water may be raised to 20°C. or thereabout. The valve **27** is opened in automatic response to introduction of a film **1** into the nip of the advancing rolls **3, 4** because the roll **3** then closes the switch **28** which energizes the electromagnet **27***d* of the valve **27**. As mentioned before, the relay **27***c* insures that the valve **27** remains open as long as at least one film **1** travels from the advancing rolls **3, 4** toward the intercepting receptacle **22**. Thus, the valve **27** remains open continuously as long as the films **1** are fed at a rate which suffices to insure that a fresh film **1** is introduced into the nip of the advancing rolls **3, 4** before the preceeding film reaches the receptacle **22**. Eventual heating of water in the coil **26***b* beyond a preferred average temperature does no harm; on the contrary, heated water in the coil **26***b* and in the coils of additional heat exchangers **29, 31** then prevents excessive cooling of processing liquids in the tanks **9, 14,** and **15** when the apparatus **2** is at a standstill, for example, between the treatment of the last film **1** of a first series and treatment of the foremost film of the next series.

The temperature of water in the coil **26***b* and in the coils of additional heat exchangers **29, 31** reaches a desirable optimum value shortly after the valve **27** opens. The water remains at such optimum temperature regardless of whether the apparatus **2** is used intermittently or continuously. As mentioned above, eventual slight overheating of water in the heat exchangers does no harm and is even useful because slightly overheated water prevents an abrupt cooling of processing liquids in the tanks **9, 14** and **15**. If the moisture content of hot air which leaves the dryer **19** through the duct **24** is very high, and especially if the flow of water in the coil **26***b* is counter to the direction of air flow in the duct **24**, the external surface of the coil **26***b* and the exposed surfaces of the fins **26***a* are likely to be coated with condensate. This is desirable when the duct **24** does not discharge spent air into the atmosphere, i.e., when the outlet of the duct **24** is connected to the inlet of the blower **119** which admits the air stream **21** into the dryer **19** through the opening **23**. Thus, the accumulation of condensate on parts of the heat exchanger **26** reduces the moisture content of air which flows in the duct **24**. The condensate can be evacuated at the colder (intake) end of the coil **26***b*.

The difference between the temperature of water which leaves the coil **26***b* and the temperature of developing solution in the tank **9** is normally slight, e.g., in the range of a few degrees C. If the heat exchanger **29** is placed close to the outlet **9***a* of the tank **9**, such small difference (in the range of one or more degrees C.) suffices to insure that water flowing in the coil of the heat exchanger **29** maintains the developing solution which flows into the pump **12** at a temperature which is constant or substantially constant, i.e., which differs from the desired optimum temperature of developing solution in the tank **9** by a substantially constant value. If the heating unit **30** is placed upstream of the heat exchanger **29**, as considered in the direction of circulation of developing solution in the tank **9**, the heating unit **30** can raise the temperature of liquid entering via inlet **9b** to the optimum temperature for treatment of films in the tank **9**. It has been found that the heating unit **30** can be controlled with such a high degree of accuracy that the temperature of developing solution fluctuates negligibly and is normally within one or more tenths of 1°C. of the desired optimum temperature.

The temperature of water which flows in the coil of the heat exchanger **31** is only slightly less than the temperature of developing solution in the tank **9**. Consequently, the heat exchanger **31** can raise the temperature of fixing bath in the tank **14** well above room temperature and such temperature is only slightly less than the temperature of liquid in the tank **9**. The fixing bath in the tank **14** is further heated owing to exchange of heat with developing solution through the wall which separates the tanks **9** and **14**. Such dual exchange of heat normally suffices to maintain the temperatures of liquid in the tank **14** within a narrow range without resorting to additional temperature regulating devices.

The discharge end of the coil in the heat exchanger **31** delivers water into the rinse bath in the tank **15**. This insures that the temperature of liquid in the tank **15** is well above room temperature and is not appreciably below the temperature of developing solution in the tank **9**. It has been found that such heating of rinse bath insures a highly satisfactory rinsing of films **1** in spite of the fact that the amounts of circulated water in the tank **15** are relatively small. For example, the pumps **12, 12***a* and **12***b* can be designed to circulate the respective liquids at the rate of 22 liters per minute. The rate of out-

flow of chemicals-containing water via pipe **11** equals the rate of admission of fresh water through the valve **27**.

The processing apparatus **2** need not be connected to a hot water supply line and need not employ any valves for the mixing of hot and cold water. The operation is satisfactory regardless of whether the films **1** are fed continuously or intermittently.

It is clear that the developing apparatus of FIGS. **1** and **2** can be modified in a number of ways without departing from the spirit of the invention. For example, the heat exchanger **31** in the tank **14** can be omitted. Also, the heat exchanger **26** can be connected with the heat exchanger **31** and the heat exchanger **29** omitted if the heating unit **30** is capable of maintaining the temperature of developing solution in the tank **9** within a desired range. The heating unit **30** can be omitted if the heat exchanger **29** is capable of preventing excessive fluctuations of liquid temperature in the tank **9** above or below an optimum temperature. For example, the heating unit **30** or the heat exchanger **29** will be omitted if the nature of films and/or the nature of developing solution is such that the temperature of liquid in the tank **9** can fluctuate within one or more degrees C.

The heat exchanger **26** constitutes but one form of means for withdrawing heat from gaseous fluid which leaves the dryer **19**. For example, the frame of the dryer **19** can be assembled of pipes which are welded together and form one or more coils for fresh water. Also, the rack **8***b* and/or other parts (e.g., a heat-insulating jacket) of the dryer **19** can be provided with internal compartments for circulation of fresh water which is thereby heated prior to exchanging heat with liquid in the tank **9, 14** and/or **15**. The rack **8***b* and/or the frame of the dryer **19** may be made hollow and can receive one or more heating coils for fresh water. As a rule, heat can be withdrawn from all such parts which are heated automatically when the processing apparatus is in use.

An important advantage of the heat exchanger **26** is that the stream of water entering the heat exchanger **29** is heated well above the temperature of fresh water in the pipe **27***a*. As mentioned before, the temperature of water leaving the coil **26***b* is normally only a few degrees C. below the desired optimum temperature of developing solution in the tank **9**. This insures that the heat exchanger **29** withdraws from developing solution only such quantities of heat as are necessary to insure that the heating unit **30** can maintain the developing solution at the optimum temperature. Moreover, the liquid which leaves the heat exchanger **31** is sufficiently hot to insure an optimum heating of the rinse bath.

The detector **28** and relay **27***c* for the valve **27** can be replaced with other types of control means for regulating the rate of admission of fresh water in dependency on the number or combined surface area of films which are transported from the advancing rolls **3, 4** toward the receptacle **22**. For example, such regulation can be effected by resorting to a control system of the type disclosed in German Pat. No. 1,237,789 which describes a pulse storing unit serving to receive and store a number of pulses and to erase the pulses at given intervals. Such storing unit can be used to control the valve **27** by receiving a number of pulses each of whcih corresponds to a film of a series of films to be treated by maintaining the valve **27** in open position during erasure of successive pulses while the films pass through the tanks **9, 14, 15** and dryer **19**, and by closing the valve **27** upon completion of treatment of the last film.

FIG. **3** shows a portion of a second apparatus **102** wherein fresh liquid which has been heated in the coil of the heat exchanger **26** is discharged directly into the tank **15** (see the pipe **126**). The outlet **10***c* of the pump **12***b* is not connected with the tank **15**, i.e., the pump does not circulate the rinsing liquid in the tank **15** but supplies liquid to the additional heat exchanger **29** in the tank **9** (see the pipe **129**). Such liquid thereupon flows through the heat exchanger **31** in the tank **14** and is discharged into the tank **15** via pipe **131**.

The apparatus **102** exhibits the advantage that it further reduces the likelihood of penetration of chemicals into the supply pipe **27***a* for fresh water. Thus, when the valve **27** is open, fresh water can flow through the coil of the heat exchanger **26** and is discharged into the tank **15**. Eventual return flow of water from the coil of the heat exchanger **26** into the pipe **27***a* cannot contaminate the source of fresh water since the liquid in the heat exchanger **26** is free of chemicals. Eventual leakage of the coil of the heat exchanger **26** can result in contact between fresh water and the gases in the duct **24**; however, such gases are free of toxic ingredients.

Eventual leakage of coils forming part of the heat exchangers **29, 31** will result in contamination of liquid which is supplied by the outlet **10***c* of the pump **12***b*. However, such chemicals will enter only the rinse bath in the tank **15**. The contents of the tank **15** can flow only into the pump **12***b* and/or into the evacuating pipe **11**. Thus, by the single expedient of discharging the contents of the coil of the heat exchanger **26** into the tank **15** and of filling the coils of the heat exchangers **29, 31** with liquid which is being withdrawn from the tank **15**, the apparatus **102** insures that eventual leakage of the coil in the heat exchanger **26, 29** and/or **31** cannot result in contamination of the fresh water supply.

FIG. **4** shows a third apparatus **202** wherein the heat exchanger **31** is omitted, i.e., the coil of the heat exchanger **29** in the tank **9** delivers liquid directly into the tank **15** via pipe **229**. If desired, and as shown by broken lines, the heat exchanger **31** can remain and the pipe **229** which discharges the contents of the coil of the heat exchanger **29** into the tank **15** contains a first valve **250** and the discharge end of the coil of the heat exchanger **31** contains a shutoff valve **251**. The valve **250** is installed at the junction of the inlet of coil of the heat exchanger **31** with the pipe **229** and can be set to permit entry of liquid into the heat exchanger **31** or to seal the heat exchanger **31** from the pipe **229**; in the latter instance, the shutoff valve **251** is also closed.

The apparatus **202** constitutes a simplification of the apparatus **2** or **102**, especially if the heat exchanger **31** is omitted in its entirety. This heat exchanger is optional because the temperature of fixer in the tank **14** need not always be maintained within a narrow range, i.e., the requirements regarding the temperature of fixer are not as stringent as those regarding the temperature of liquid in the tank **9**. If the heat exchanger **31** is omitted or sealed from the heat exchanger **29**, the fixer in the tank **14** is heated by the partition (s) between the tank **14** and the tank **9** and/or **15**.

It is further within the scope of the invention to utilize the pump **12***b* of FIG. **3** or FIG. **4** in the same way as the pump **12***b* of FIG. **1** (i.e., for circulation of rinse bath in the tank **15**) and to provide an additional pump

which performs the function of the pump **12b** in FIG. 3 or **4**, namely to draw liquid from the tank **15** and to supply such liquid to the coil of the heat exchanger **29**. Referring to FIG. **3**, this would merely involve connecting the pipe **129** with the tank **15** below the upper surface of the rinse bath, installing an additional pump in the pipe **129**, and connecting the outlet **10***c* of the pump **12***b* with the tank **15** in the same way as shown in FIG. **1**.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. In a processing apparatus for exposed films or analogous sheet — or web-like carriers of photosensitive material, a combination comprising a series of vessels each containing a supply of a processing liquid; a dryer; means for circulating in said dryer a heated gaseous fluid; means for transporting carriers of photosensitive material through successive vessels and thereupon through said dryer; a source of unheated liquid; and a heat exchanger connectable with said source and installed in said dryer so that unheated liquid which is supplied by said source is heated in said heat exchanger, said heat exchanger having an outlet which discharges heated liquid into one of said vessels.

2. A combination as defined in claim **1**, further comprising at least one additional heat exchanger which is installed in a first vessel and means for circulating through said additional heat exchanger liquid which is being withdrawn from a second vessel.

3. A combination as defined in claim **2**, wherein said second vessel is said one vessel and said additional heat exchanger has an outlet which discharges liquid back into said one vessel.

4. A combination as defined in claim **1**, wherein said series includes a first, a second and a third vessel, said outlet of said heat exchanger being arranged to discharge heated liquid into said third vessel and further comprising an additional heat exchanger in one of said first and second vessels and means for conveying through said additional heat exchanger liquid which is being withdrawn from said third vessel.

5. A combination as defined in claim **4**, wherein said additional heat exchanger has an outlet which discharges liquid into said third vessel.

6. A combination as defined in claim **4**, wherein said additional heat exchanger is installed in said first vessel.

7. A combination as defined in claim **1**, wherein said series includes a first, a second and a third vessel, said outlet of said heat exchanger being arranged to discharge heated liquid into said third vessel and further comprising first and second additional heat exchangers connected in series with each other and respectively installed in said first and second vessels, and means for supplying to one of said additional heat exchangers liquid which is being withdrawn from said third vessel, the other of said additional heat exchangers having an outlet with discharges liquid into said third vessel.

8. A combination as defined in claim **7**, wherein said one additional heat exchanger is installed in said first vessel.

9. A combination as defined in claim **1**, further comprising means for circulating the liquid in at least one of said vessels.

10. A combination as defined in claim **1**, wherein the liquid in said one vessel is a rinse bath.

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