

May 12, 1970

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3,511,160

PHOTOGRAPHIC PROCESSING DEVICE

Filed Aug. 28, 1967

4 Sheets-Sheet 1

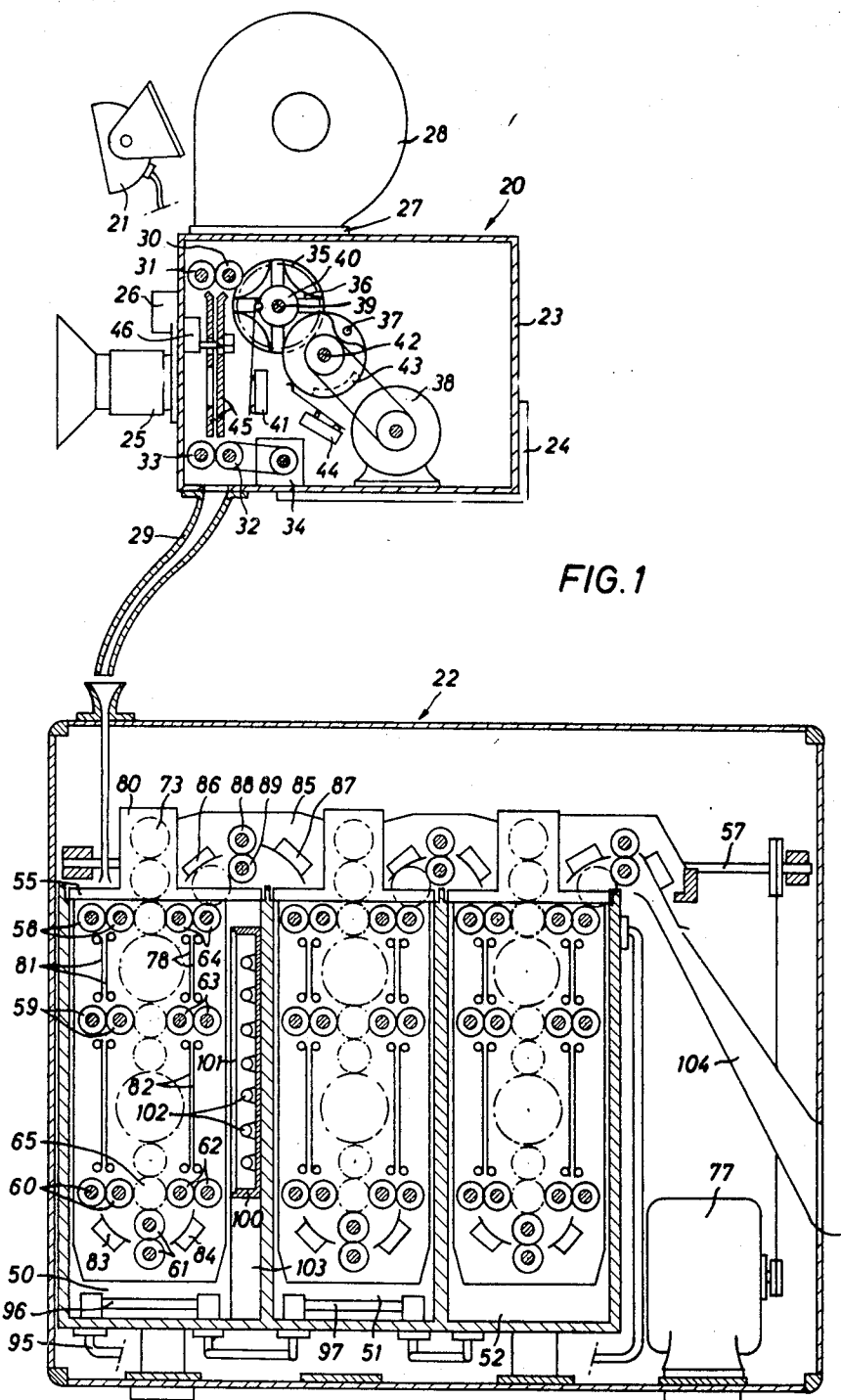


FIG. 1

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4 Sheets-Sheet 2

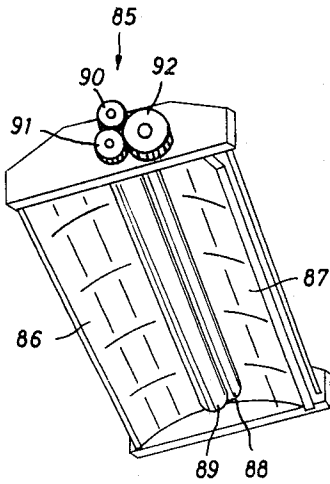


FIG. 2a.

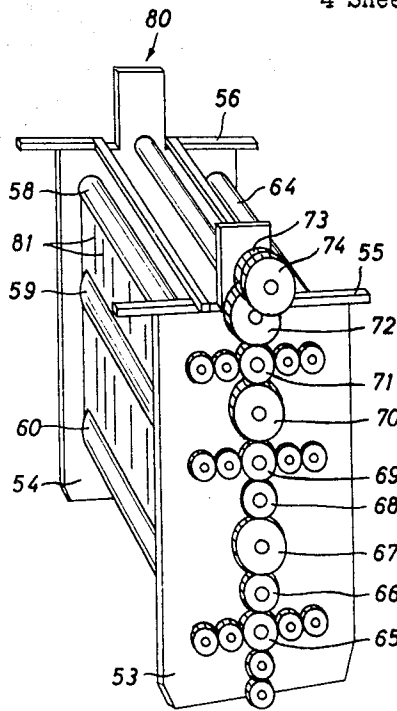


FIG. 2b.

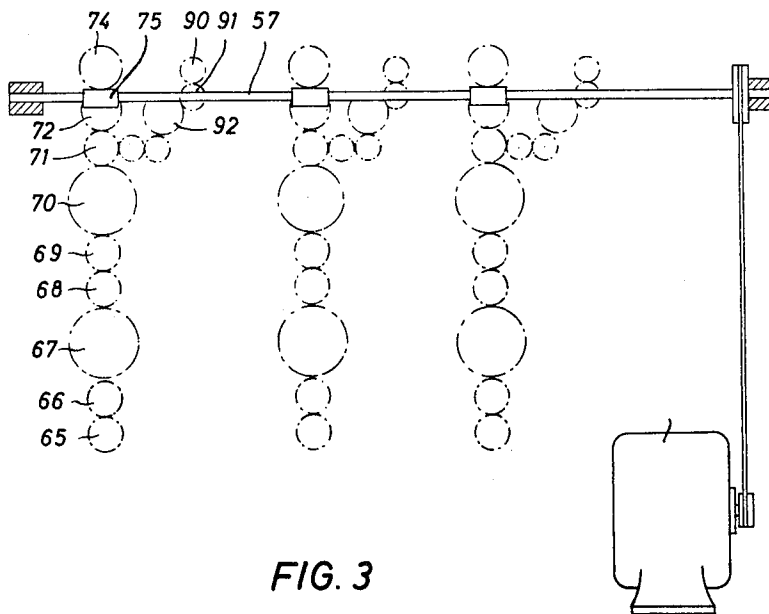


FIG. 3

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4 Sheets-Sheet 3

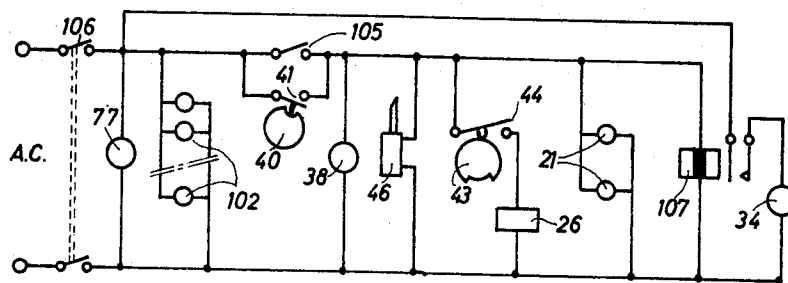


Fig. 4

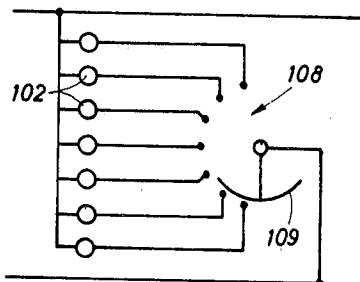


Fig. 5

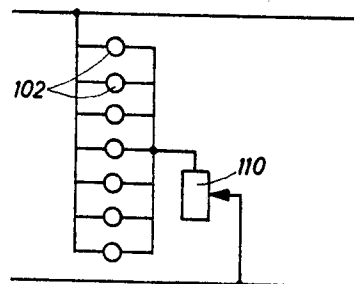


Fig. 6

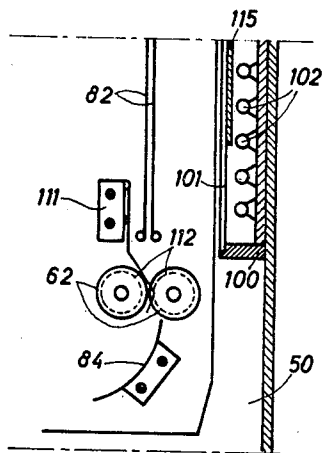


Fig. 7

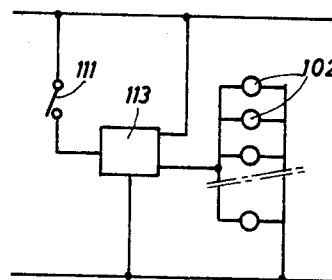


Fig. 8

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4 Sheets-Sheet 4

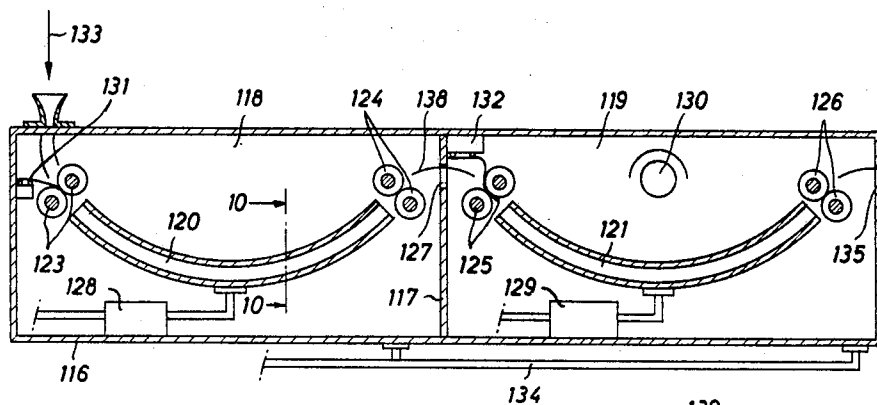


FIG. 9



FIG. 10

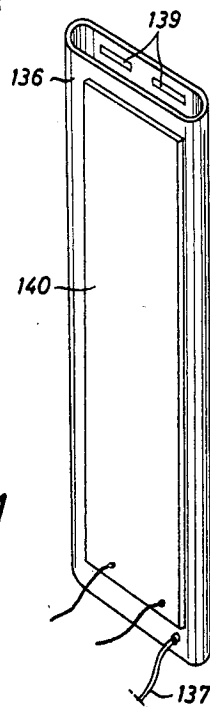


FIG. 11

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## PHOTOGRAPHIC PROCESSING DEVICE

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Claims priority, application Great Britain, Aug. 26, 1966, 38,473/66

Int. Cl. G03d 3/12

U.S. Cl. 95—89

9 Claims

### ABSTRACT OF THE DISCLOSURE

Automatic developing apparatus for developing exposed light-sensitive photographic material to produce a direct positive in which the material is advanced through a developing station containing a developing solution and is uniformly exposed to low intensity actinic light during passage through the developing station. The exposure is controlled by a detector actuated by the arrival of the material at a predetermined stage of the developing cycle. A timer is effective to prolong the exposure for a predetermined period of time after the detector is no longer actuated by the material.

The present invention relates to a photographic processing device for processing photographic material which has been exposed image-wise.

The invention relates particularly to a device for processing photographic material of the type which permits to produce rapidly direct positive images of an original, with a high maximum and a low minimum density.

A method for producing such images comprises the steps of:

Image-wise exposing a light-sensitive material that comprises a layer of a silver halide emulsion that mainly forms internal latent image and little external latent image and that contains at least one compound setting free iodide ions in an aqueous medium and/or at least one compound setting free bromide ions in an aqueous medium in effective contact with the silver halide emulsion layer,

Developing the light-sensitive material thus exposed with an energetic "surface" developer, and

Overall exposing the light-sensitive material during the developing stage to actinic light of low intensity.

In order to stabilize the photographic direct positive image obtained after the steps of developing and overall exposure the material is generally fixed e.g. in a usual fixing solution such as a thiosulphate solution, is then washed, whereupon it may be dried or glazed.

The said method is described in the published Dutch patent application 66/5,890 filed May 2, 1966 by Gevaert-Agfa N.V.

The object of the present invention is to provide a processing device for treating a photographic material of a type as described hereinbefore.

Another object of the invention is to provide a processing device wherein the developing station is provided with an exposure arrangement for uniform exposure, more particularly, wherein the intensity and the duration of the exposure of said arrangement are adjustable.

According to the invention, a processing device for processing light-sensitive material comprises at least a developing station for applying developing solution to the light-sensitive material, transport means for advancing said material through said station, and exposure means for generally uniformly exposing the light-sensitive material to actinic light of low intensity during at least part of its staying in the developing station.

In addition to the developing station, the device may comprise a plurality of other stations, including e.g. a rinsing, a stabilising or a bleaching station.

The term "stabilising station" applies to a station wherein, after the direct positive image has been formed, the undeveloped silver halide is eliminated. Generally, this occurs by fixing. In another way, the unexposed silver halide may be stabilised by converting it into a water-insoluble, light-insensitive silver compound.

The term "the treating solution is applied" points to arrangements wherein the light-sensitive material is immersed in a body of processing liquid, as well as to arrangements wherein the liquid is only applied to the emulsion side of the material by a lick-roller applicator, or through a nozzle either by spraying or in the form of a more or less viscous layer.

The immersion of the light-sensitive material in processing solutions may occur either by frames wherein strips of the material are gripped or tensioned and which are lowered and raised in the solutions by appropriate means, or the immersion may occur by continuous operating transport means such as an endless conveying belt or a plurality of driven roller pairs which transport strips or webs of the material in an uninterrupted movement through the different solutions.

The invention will be further described in referring to the accompanying drawings wherein:

FIG. 1 is a diagrammatic vertical sectional view of an automatic photo vending apparatus.

FIG. 2a is a perspective lateral view of a cross-over roller section.

FIG. 2b is a perspective lateral view of a roller section of a processor tank.

FIG. 3 is a diagrammatic side elevation of the drive mechanism for the processing unit.

FIG. 4 is the electric circuit of the apparatus.

FIG. 5 is a modification of a part of the electric circuit according to FIG. 4, for setting the duration of the uniform exposure of the light-sensitive material during the development.

FIG. 6 is a modification of a part of the electric circuit according to FIG. 4, for setting the intensity of the uniform exposure of the light-sensitive material during the development.

FIG. 7 is an arrangement for starting the uniform exposure at the attainment of a given stage.

FIG. 8 is a timing device in the electric circuit.

FIG. 9 is another embodiment of the developing station.

FIG. 10 is a cross-sectional view on line 10—10 of FIG. 9.

FIG. 11 is another embodiment of a container of the processing unit.

The apparatus which is shown in FIG. 1 is an automatic photo-vending apparatus, of the type which delivers a strip with a small number of pictures, say 4 to 6, of the photographed person.

Apparatus of this type are currently located at chain-stores, transportation centers, amusement parks, etc.

The apparatus shown generally comprises a camera unit 20, a series of photo flood lamps 21 and a processor 22. These parts are located in one vertical half of a cabinet (not shown), the other half of the cabinet being located at the left side of the drawing and being reserved for the person to be photographed.

The camera unit 20 comprises a housing 23 which is removably fitted to a fixed support 24. To the housing 23 are fitted the lens system 25, which has an adjustable iris diaphragm, an electromagnetic shutter which is opened by a solenoid 26, the support 27 for holding the paper magazine 28, and the chute 29.

The paper transport in the housing is done by two pressure roller pairs 30, 31 and 32, 33. The roller 30 carries a gear which meshes with the gear 35. The mentioned gears as well as the other gears which will be described hereinafter, and which are not shown perspective-ly, are shown in dash and dot lines. The gear 35 is driven through a Geneva movement 36, 37 by the motor 38. The Geneva driven shaft 39 is provided with a cam 40 which controls the microswitch 41. The Geneva driving shaft 42 is provided with a cam 43 which controls a microswitch 44. The roller pair 32, 33 is driven by the motor 34 through the intermediary of a slip clutch (not shown) which permits the motor to continue rotating when the roller pair 32, 33 is prevented from rotation because the strip gripped between them is withheld by the rollers 30, 31 upon their arrest.

Further in the housing are provided the paper guides 45 and the cutter mechanism 46. The cutter mechanism comprises a stationary knife, and a movable knife which is spring-biased. Upon energizing the solenoid of the mechanism, the movable knife is removed from the stationary knife, and upon de-energizing the solenoid, the movable knife effects a cutting operation.

The processor 22 comprises three tanks disposed in side-by-side relation, viz. the first tank 50 containing a developing solution, the second tank 51 containing a fixing solution, and the third tank 52 containing rinsing water.

Each of the tanks 50, 51, 52 is provided with a roller section removably insertable in the tank, and at the exit of each tank is provided a removable cross-over roller section.

As the roller sections of each tank are substantially similar to each other, only the roller section 80 inserted in the developing tank 50 and the cross-over section 85 provided at the exit of said tank will be described hereinafter.

The roller section of tank 50 shown in FIG. 2b comprises two side members 53, 54 which are laterally spaced by rod means, not shown. At their top the side members are provided with lateral supports 55, 56, the extremities of which engage corresponding recesses in the vertical walls of the tank, in order to properly locate the roller section in the tank. The roller pairs 58, 59, 60, 61, 62, 63 and 64 are rotatably journaled in the side members 53, 54. Each roller is provided with a shaft extension which carries a gear. The driving of the roller pairs is performed through the intermediary of a number of intermediate gears 65 to 73. Coaxially with the gear 73 is further mounted a worm gear 74 that meshes with a worm 75 when the section is inserted into the tank. Said worm 75 is mounted on a horizontal shaft 57 which is located beside the tanks, and which is driven by a motor 77 with inbuilt reduction gear.

Between the different roller pairs of the roller section 80 are further provided guide fingers such as 81, 78 and 82, and deflecting plates such as 83 and 84. The guide fingers have the function of preventing the paper strip conveyed by the different roller pairs from diverging from its intended path. The deflecting plates perform the function of turning the strip through an angle of 180°.

A similar function of turning the film through 180° is performed by the cross-over roller section 85 which is provided at the exit of the tank. The cross-over section shown in FIG. 2a is composed of two parallel side members spaced by rod means similar to those of the roller section 80. The side members carry two arcuate deflecting plates 86, 87 leading at either side to the nip of the roller pair 88, 89. The shaft extremities of the rollers 88, 89 are provided with the gears 90, 91. When the section 85 is put into place in the processor as shown in FIG. 1, the gear 92 engages the gear of the roller at the exit side of the roller section 80 in the tank 50.

The developing and the fixing solutions are kept at a temperature of about 25° C. by means of the conduit

95 of thermostatised water for the rinsing tank 52, which is passed in the form of spirals 96, respectively 97, through the tanks. The temperature of the solution of the developer tank may further be kept constant or even raised, in providing the tank with an electric heating member which is controlled by a thermostat.

The developing tank 50 is further provided with exposure means for generally uniformly exposing the strip to actinic light during the second half of its staying in the developer. The exposure means is composed of a water-tight plastic casing 100 which is fitted to the vertical wall separating the developing and the fixing tank. The casing has a diffusing front plate 101, and is provided with a plurality of small light tubes 102, either of the incandescent or of the fluorescent type. The casing 100 is vertically slidable fitted to the wall of the tank, and rests on a support 103. The guide fingers 78 and 82 follow an inclined path with respect to the line of travel of the strips whereby the exposure of the strip is not always disturbed in the same longitudinal line of the material.

The distance between the path of the strip between the guide fingers 78, 82 and the diffusing plate 101 is sufficiently small to permit the proper exposure of the material whereas the distance from the diffusing plate 101 to the left wall (in the figure) of the tank 50 and back from this wall to the path between the guide fingers 81 is sufficiently great to reduce the radiation from the exposure means to an insignificant value.

In the present embodiment the uniform exposure of the material has been shown as occurring during only about the second half of its development, because in this way often optimum results are obtained.

In case the reduction of the radiation would be insufficient to avoid exposure of the material during the first part of its development, a vertical opaque baffle or the like may be provided between the roller pairs 58, 59, 60 and 62, 63, 64.

At the exit of the processor a chute 104 is provided wherein the processed strips are collected. No additional drying means has been provided, since the paper strips treated in the described kind of apparatus are generally impervious to water, and the water adhering to the surface of the strips is generally wiped off by passing the strips through the fingers.

The electric circuit of the apparatus is shown in essential lines in FIG. 4. The circuit comprises an A.C. supply, a mains switch 106, the motor 77 driving the processor rollers, the lamps 102 of the exposure means, a start switch 105, the cycle switch 41 controlled by the cam 40, the motor 38 driving the rollers 30, 31 of the camera unit, the cutter mechanism 46, the shutter switch 44 controlled by the cam 43, the solenoid 26 of the shutter, the photo-flood lamps 21, and a delay relay 107 which controls the motor 34 driving the rollers 32, 33 of the camera unit.

The operation of the apparatus is as follows:

A person who likes to obtain a strip of photographs takes place in front of the lens 25 and starts the apparatus by closing the start switch 105. Generally, this switch is located in a coin mechanism unit, and the contact is briefly closed by an accepted coin. The switch closes the electric circuit of the motor 38, the solenoid of the cutter 46, the flood lamps 21, and the relay 107.

The motor 38 rotates the Geneva driving shaft 42 in anti-clock-wise direction. After having effected about a quarter of a revolution, the pin 37 engages the part 36 of the Geneva movement and rotates it over about 90°. The gear 35 which rotates solidly with the part 36 and which engages a gear on the roller 30, makes the roller pair 30, 31 rotate and a length of photographic material is drawn from the roll contained in the magazine 28. During the further completion of the revolution of the part 37, the part 36 is immobilised. When the part 37 has turned through about 270°, the recess of the cam 43 which rotates solidly with the part 37, has attained the location

of the extremity of the lever of microswitch 44, so that this microswitch becomes closed for a short time and energizes the solenoid 26, thereby opening the shutter. Immediately after the first rotation of the Geneva driven shaft 39 the contact of the microswitch 41 is closed since the cam 40, rotating solidly with the shaft 39, lifts the lever of said microswitch. The closed contact 41 keeps the electrical circuit closed after the start switch 105 has opened again.

The electric circuit remains closed until the shaft 42 has performed four revolutions and consequently the shaft 39 just one revolution. At that stage the cam 40 takes again its initial position whereby the switch 41 is opened, and the electric circuit is interrupted. The motor 38 arrests, the flood lamps 21 are extinguished, the knife of the cutter 46 is released so that the length of material, which has been drawn four times from the roll and also four times successively exposed, is severed from the remaining material. Since the contacts of the delay relay 107 only open about some seconds after its deenergizing, the motor 34 continues rotating for some seconds after the other parts have become inoperative. Thereby the rollers 32, 33 pull the severed strip downwards which finally drops through the chute 29 into the processor 22.

In the processor, the strip is successively engaged by the continuously rotating roller pairs and is transported according to a downward movement, followed up by an upward movement, through the developing, the fixing and the rinsing tank until it is received in the chute 104.

During the upward movement of the strip in the developing tank, the strip is subjected to a uniform exposure of low intensity by the light-source 100, whereby a direct positive image is reproduced on the strip.

According to the characteristics of the photographic material used, a determined time and intensity of the uniform exposure will yield an optimum quality of the positive image. Therefore it may be interesting to arrange the exposure means in an adjustable way.

A first improvement of the exposure means is shown in FIG. 5. The lamps 102 are no longer connected all in parallel, but one lead of each lamp socket is connected to a contact of a step-switch 108 which may be located e.g. at the control panel of the apparatus.

By means of a slider 109 a desired number of lamps may be connected in the circuit so that actually the length of the path over which the strip of photographic material is exposed may be changed, or in other words, the duration of the exposure is adjustable.

A second improvement, which may occasionally be combined with the one just described, is shown in FIG. 6. The lamps 102 are connected in series with an adjustable resistor 110. Said resistor permits to adjust the current through the circuit, and thus permits to set the intensity of the exposure.

A third improvement is shown in FIG. 7. This figure shows partially the lower interior part of the developing tank 50. A water-tight microswitch 111 has been provided, the spring-biased lever of which extends in opposite grooves 112 which are provided in about the middle of the roller pair 62. When a strip of material is being deflected through 90° by the deflecting plate 34 and enters the nip of the roller pair 62, the lever of the microswitch is pressed to the left side by the leading end of the strip. Thereby the contact of the switch is closed and through a delay device 113 (FIG. 8) the lamps 102 are lit. After the trailing edge of the strip has left the roller pair 62, the lever of the switch returns to its initial position thereby opening the contact of the switch. The delay device 113, however, keeps the circuit of the lamps 102 further closed during a time which is sufficient for permitting the trailing edge of the strip to pass fully beyond the light source 100. An arrangement of the type just described is particularly useful in case it cannot be made sure that the strip of material becomes always subjected to the uniform exposure at the same moment in the

development cycle. As a cause of the mentioned difficulty the increasing sludging of the developing solution is to be cited, whereby the light from the exposure source becomes diffused and impinges at reduced intensity onto the strip when it advances downwardly in the developing tank. Even the provision of a baffle in the tank, as described hereinbefore, may insufficiently prevent the premature exposure of the material.

Still another way to adjust the duration of the uniform exposure of the material consists in partially covering the exposure means with a light screening panel. Such screen has been diagrammatically shown by the member 115 in FIG. 7. It has about half the height of light casing 100 and extends over its width. It is vertically slidable. A similar screen (not shown) is provided in the upper half of the casing but is fixed. In vertically displacing the slidable screen part, the exposure source may be more or less screened so that the uniform exposure time is changed correspondingly.

The sludging of the processing solutions is directly related to the regeneration of the solutions, a point which has not yet been dealt with hereinbefore, since in principle any known arrangement for replenishing and regenerating the solutions may be used.

The most safe way to ensure the continuous clearness of the processing solutions, more particularly of the developing solution, is to replace the maximum portion of the solution contained in the tank by fresh solution at the passage of each strip. In order to avoid an excessive consumption of developing liquid, only a portion say 5 to 20% of the total amount of liquid contained in the tank shall be replaced each time, and the contents of the tank shall be kept as small as possible.

An arrangement which responds to the requirements just described is shown diagrammatically in FIG. 9. In this figure, only the development station of the processor has been shown. The fixing and rinsing stations may have a similar construction, or another conventional form.

The arrangement comprises a housing 116 which is divided by a partition 117 into two compartments 118 and 119. In these compartments are provided the conduits 120, 121 which are constituted by a tube of translucent or transparent plastic material with ellipsoidal cross section as shown in FIG. 10, the driven transport roller pairs 123 to 126, the deflecting member 138 for directing a strip of material which leaves the nip of the roller pair 124 through the opening 127 from compartment 118 to 119, the volumetric replenishing devices 128, 129, the light source 130 and the microswitches 131 and 132 controlling the devices 128 and 129. In the operation of the apparatus, a strip of image-wise exposed material, the length of which exceeds the distance between two roller pairs in the developing device, is fed according to the arrow 133 between the inlet roller pair 123. The lever of microswitch 131 which protrudes through the rollers as in the arrangements described hereinbefore, is pushed away and the contact of the switch, which closes, operates the replenishing device 128 which pumps a determined quantum of developing solution from a supply, not shown, into the conduit 120. The excess of liquid streams out at both ends of the conduit and flows in the housing 116 from which it is carried off through the conduit 134.

The strip is gripped by the rollers 123 and advanced at a uniform speed through the conduit 120. When the development of the strip is done about half-way, the strip is gripped by the rollers 124 and after deflection by the plate 138 the strip is also gripped by the rollers 125 whereafter the second half of the development occurs. During said second half of the development, the strip is uniformly exposed to the actinic light from the source 130, which may be a fluorescent or an incandescent bulb or tube. The light reaches the material at reduced intensity through the translucent wall of the conduit 121. After leaving the conduit, the strip is conveyed through an opening 135 to a further processing station.

In the devices described hereinbefore, the strip always performed a continuous movement in one direction through the processing conduits or tanks.

It may be interesting to refer to other devices in the art, wherein a strip of photographic material is slid with its longitudinal edges into corresponding grooves of a strip carrier, or is tensioned by means of its transverse margins in a frame. The strip carrier or the frame is transported by suitable means according to an up and down movement and also to a lateral movement from one vertical processing tank to another.

For performing the uniform exposure of the strip in a device of the type just described, while the liquid contents of the tank are kept as small as possible, a tank of a design as shown in FIG. 11 is extremely suited. The tank consists of a vertical container 136 with an elongate cross section, the width of which just suffices to permit the vertical entrance of a frame carrying the strip (not shown). The container preferably consists of translucent or transparent plastic material, e.g. uncoloured high density polyethylene or rigid polyvinyl chloride.

Occasionally, the upper end of the container may be slightly widened so as to form a kind of funnel in order to facilitate the smooth entering of the strip carrier in the container.

Near the bottom, the container is provided with an inlet conduit 137 through which the replenishing solution is pumped from a main supply (not shown). The container is further provided with horizontal openings 139 which define the maximum level of the liquid, and through which the surplus flows away in a pan or the like located below the container. At one flat side the container is provided with a light source 140 consisting of an electroluminescent strip connected with two leads to the main supply, which faces with its light emitting side the emulsion side of the strip which is developed in the container. The electroluminescent strip 140 may either be continuously connected to the main supply or only be lit when the strip is immersed already for a given time in the developing liquid.

A developer unit of the kind described is extremely compact, the liquid contents is small so that even after the development of a few strips the developing liquid may be completely replaced by fresh developer, without making the process turn out too expensive.

Further, an apparatus comprising containers of the kind described may have relatively reduced dimensions. The feature of the compactness of the processing containers is particularly important when a plurality of such containers must be provided in the apparatus e.g. for developing, rinsing, fixing, bleaching, rinsing, hardening, etc. the photographic material. In case a photographic colour material of the type which forms a direct positive image is processed, the number of processing tanks may still be greater.

In the exposure means for the uniform exposure as described hereinbefore, no particular filter means have been provided. It is clear that a colour filter may be provided for transmitting light only in the region where the material is sensitive to the uniform exposure, in order to occasionally limit the radiation towards other strips or parts of the material which have not yet been exposed image-wise. Further, a neutral grey filter or occasionally a heat absorbing filter may be provided for reducing the radiation towards the strip.

The uniform exposure of the material need not necessarily occur below the level of the developing liquid. The exposure means may be located above the said level, and the uniform exposure effected while the strip of material is out of the body of developing liquid, the emulsion side, however, still being covered with a layer of developing liquid which adheres thereto so that the development still continues.

In connection with the latter embodiment, reference may be had to other techniques for applying a layer of a processing liquid to a support, e.g. by means of a kiss-roller, by spraying, by extrusion from a slit which extends transversely of the strip, etc.

What I claim is:

1. Processing device for processing light-sensitive material, comprising at least one developing station for applying developing solution to the light-sensitive material, transport means for advancing said light-sensitive material through said station, exposure means for generally uniformly exposing the light-sensitive material to actinic light of low intensity during at least part of its passage through the developing station, sensing means in the developing station for controlling said exposure means, said sensing means being actuated by the arrival of said material at a predetermined stage in the developing cycle, and timing means controlled by said sensing means and which continues to operate said exposure means during a given period after said sensing means is no longer actuated by said material.

2. Processing device according to claim 1, wherein the radiation of actinic light by the exposure means is limited to only part of the exposure station.

3. Processing device according to claim 1, wherein there is provided means for adjusting the distance in the direction of travel of the material over which the material is exposed to the actinic light.

4. Processing device according to claim 3, wherein said means is constituted by switch means for switching off part of the light sources of the exposure means in said direction of travel of the material.

5. Processing device according to claim 3, wherein said means is constituted by shield means which is located between the exposure means and the path followed by the material, and which is displaceable in said direction of travel of the material.

6. Processing device according to claim 1, wherein there is provided means for adjusting the intensity of the radiation of the exposure means.

7. Processing device according to claim 1, wherein the exposure means for uniformly exposing the material is located outside of the developing station, and wherein at least the wall of the station facing the exposure means is translucent or transparent, so as to permit the exposure of the material through the said wall.

8. Processing device according to claim 7, wherein said exposure means consists of an electroluminescent light source.

9. Processing device according to claim 8, wherein the developing station comprises a container of reduced dimensions, a substantial portion of the liquid content of which is replaced at the passage of each length of material.

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U.S. Cl. X.R.

95-94, 14