

PATENT SPECIFICATION

(11)

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- (21) Application No. 52050/74 (22) Filed 13 April 1972
 (62) Divided out of No. 1 393 921
 (31) Convention Application No. 133 649 (32) Filed 13 April 1971 in
 (33) United States of America (US)
 (44) Complete Specification published 14 May 1975
 (51) INT. CL.² G03B 27/78
 (52) Index at acceptance
 G2A 404 482 487 488 489 602 604 613 616 705 711 BH
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(54) PHOTOGRAPHIC PRINTER CONTROL APPARATUS AND METHOD

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of use of, and to control apparatus for, a photographic printer.

An object of the present invention is the provision of an improved method of operation of, and an improved control apparatus for, a photographic printer.

According to the present invention there is provided a method of printing photographic originals wherein a strip bearing the photographic originals is intermittently transported through an exposure station, the method comprising the steps of, directing radiation through at least first and second areas of each photographic original, sensing the intensity of the radiation transmitted by each area of the photographic original, comparing the signals corresponding to the sensed radiation intensities with a signal corresponding to a reference radiation intensity, transporting those photographic originals, from which the signals corresponding to the sensed radiation intensities are excessively high or excessively low in comparison with the signal corresponding to the reference radiation intensity, through the exposure station of the printer, without printing such original, successively transporting the remaining photographic originals into the exposure station of the photographic printer, and providing an exposure correction signal in response to said comparison, and controlling the exposure of each of the remaining photographic originals in accordance with the respective

exposure correction signal.

According to the present invention there is further provided an apparatus for printing photographic originals, comprising an exposure station, transport means for intermittently transporting a strip bearing photographic originals through the exposure station, a source of radiation for directing radiation through at least first and second areas of each photographic original, sensing means for sensing the intensity of the radiation transmitted by each area of the photographic original, comparator means for comparing the signals corresponding to a reference radiation intensity the transport means being arranged for transporting those photographic originals, of which the signals corresponding to the sensed radiations intensities are excessively high or excessively low in comparison with the signal corresponding to the reference radiation intensity, through the exposure station, without printing such originals; the transport means being further arranged for transporting the remaining photographic originals into the exposure station, the comparator means also being arranged for comparing the signals corresponding to the radiation intensities transmitted by each of the areas of each remaining photographic originals in succession, and for providing an exposure correction signal in response to said comparison, and for controlling the exposure of each of the remaining photographic originals in accordance with the respective exposure correction signal.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a fragmentary exploded perspective view of a control apparatus of the present invention showing the location of splice detection and negative density determining photosensitive devices of the apparatus with respect to a negative filmstrip;

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Fig. 2 is a schematic illustration of an electrical circuit for detecting an unprintable negative;

Fig. 3 is a schematic illustration of an electrical circuit for automatically advancing an unprintable negative through the printing station of a photographic printer;

Fig. 4 is a schematic illustration of an electrical circuit for detecting splices connecting negative filmstrips; and

Fig. 5 is a schematic illustration of an electrical circuit for classifying a printable negative.

The description hereafter refers to originals in the form of negatives. It will be appreciated that the invention is equally applicable to the printing of positive originals.

Referring now to the drawings and first to Fig. 1 there is shown a perspective view of an array of photosensitive devices situated with respect to a negative filmstrip 10 to produce a plurality of density signals and a first and second splice detection signal in accordance with the teachings of the present invention. The negative filmstrip 10 is advanced left to right in the direction of the arrow 12 from a supply reel (not shown) through the printing station 14 of a printer and to a take-up reel (not shown). The model 2620 colour printer manufactured and sold by Eastman Kodak Company constitutes one type of printer that is provided with transport means for intermittently advancing and printing negative filmstrips of a customer's order that have been spliced together end to end and wound upon a supply reel after processing of the filmstrips. Such a printer is normally provided with a viewing station at which an operator inspects the negative to be printed, determines if it is printable, and classifies the negative. The printer is provided with a series of classification correction factors which may be selectively employed to modify the LATD (large area transmission density) measurement output signal to correct for subject failures perceived by the printer operator. Closing the switch contact to select one of these factors also initiates the printing of the negative.

In accordance with the teachings of the present invention, the operation of an existing printer may be modified by the addition of control apparatus shown in Fig. 1 and the circuitry of Figs. 2-5 to eliminate the necessity of an operator for the machine. In Fig. 1, a first and a second light source 16 and 18, respectively, are arranged to direct light through the negative filmstrip 10 and upon a plurality of photosensitive devices arranged in a predetermined array in a compartmented housing 20. The compartmented housing 20 and the first and second light sources 16 and 18

are located in a negative examination station at least one negative distance away from the printing station 14 of the printer.

The compartmented housing 20 contains five cellular chambers 22, 24, 26, 28 and 30, that have a combined dimension along the negative filmstrip 10 equivalent to the dimensions of each negative 32 of the filmstrip 10. The chambers 22, 24, 26 and 28 of the housing 20 are arranged so that light from light source 16 passes through respective peripheral areas 22a, 24a, 26a and 28a of the negative 32 and onto respective photosensitive devices 22b, 24b, 26b and 28b (22b, 24b and 28b only being shown in the figure). Thus the light transmitted by four peripheral areas of the negative 32 is measured by the photosensitive devices 22b, 24b, 26b and 28b.

The fifth chamber 30 of the housing 20 contains a fifth photosensitive device 30b (not shown) which is responsive to light from light source 16 transmitted by the central area 30a of the negative 32. Electrical conductors 34, 36, 38, 40 and 42 are connected to the photosensitive devices 22b, 24b, 26b, 28b and 30b, respectively.

The negative filmstrip 10 consists of a plurality of negative originals and the filmstrips of individual customer orders are spliced together as shown, for example, at 44 by an opaque splice 46 which extends almost completely across the width of the negative filmstrips 10. The housing 20 contains a sixth chamber 48 having a shape corresponding to the perimeter 48a of the splice 46 and located within one negative frame distance from the first five chambers in the housing 20. Located within the sixth chamber 48 is a first splice detecting photosensitive device 48b sensitive to the light from light source 18 transmitted by the negative filmstrip 10 to produce a first signal on the conductor 50. A second splice detecting photosensor 48c is located within the first chamber 22 and is responsive to light from light source 16 transmitted by the negative filmstrip 10 to produce a second signal on conductor 52.

The splice 46 is opaque, and in the position of the negative filmstrip 10 shown in Fig. 1, absorbs light emitted by light source 18 and prevents it from falling into chamber 48 and upon the first splice detecting photosensitive device 48b. Therefore, in the presence of a splice 46, the light detecting photosensitive device 48b does not produce an output signal on the conductor 50. As the negative filmstrip 10 advances in the direction of the arrow 12, the splice 46 will also absorb light emitted by light source 16 and prevent light from falling upon the second splice detecting photosensitive device 48c. Thus, the splice 46 is detected by two separate splice detecting photosensitive de-

ices that produce two separate splice signals on conductors 50 and 52.

Thus the negative 32 is uniformly illuminated by the light source 16, and the photosensitive devices in each of the five chambers measure the transmission of each respective area of the negative covering each respective chamber. The particular arrangement of the chambers and their total number are selected so that negatives exhibiting subject failure due to back-lighting or front-lighting of the scene may be readily ascertained by a comparison of the negative transmittances of each area. If only a single photosensitive device looking at the entire area of the negative were employed or a number of separate photosensitive devices looking at the entire area of the negative were employed, unprintable negative detection and subject classification of such a negative would be difficult.

Referring now to Fig. 2 there is shown a circuit for the unprintable negative detector that responds to the output signals of the photosensitive devices of Fig. 1 to determine if a negative is printable. The photosensitive devices 22b, 24b, 26b, 28b and 30b are electrically connected in parallel between a source of positive voltage +V and a source of negative voltage -V through resistors 54, 56, 58, 60 and 62 and are respectively connected to the output conductors 34, 36, 38, 40 and 42. The output conductors 34, 36, 38, 40 and 42 are connected in parallel to the anodes of gating diodes 64 and 66, respectively. The cathodes of gating diodes 64 and the anodes of diodes 66 are commonly connected to the base electrodes of transistors 68 and 70. The NPN transistor 68 is connected at its collector electrode to a source of positive voltage +V and at its emitter electrode to one terminal of a resistor 72, the other terminal of which is connected to a negative voltage source -V. Similarly, the collector terminal of transistor 70 is connected to a negative voltage source -V, and the emitter terminal of transistor 70 is connected to one terminal of resistor 74, the other terminal of which is connected to a positive voltage source +V.

As shown in Fig. 1 each of the photosensitive devices 22b, 24b, 26b, 28b and 30b is responsive to light transmitted by predetermined areas of the negative 32. As shown in Fig. 2 the voltage on output conductors 34, 36, 38, 40 and 42, respectively, is directly dependent upon the amount of light striking each respective photosensitive device.

These voltage levels are transmitted by the gating diodes 64 and 66 to the base electrodes of the transistors 68 and 70, respectively. The output voltage developed at the emitter terminal of the transistor 68, which operates as an emitter-follower, corresponds

to the highest voltage of the voltage levels on the conductors 34, 36, 38, 40 and 42. This voltage signal developed at the emitter terminal of transistor 68 is conducted by resistor 76 to the negative input terminal 78 of amplifier 80. A source of positive voltage +V is also applied by variable resistor 82 to the negative input terminal 78 of the differential amplifier 80. A feedback network consisting of resistors 84 and 86 connect the positive input terminal 88 of the amplifier 80 with the output terminal 90 of amplifier 80. The positive feedback stabilizes the operation of the amplifier 80, and isolation diode 92 is connected at its anode terminal to the output terminal 90 and at its cathode terminal to the common output terminal 94.

The resistor 76 and the variable resistor 82 act as a voltage divider with respect to the positive voltage source +V and the output signal developed at the emitter terminal of transistor 68. As stated hereinbefore the transistor 68 operates as an emitter-follower amplifier the output of which corresponds in magnitude to the least negative signal developed by the photosensitive devices 22b, 24b, 26b, 28b and 30b. If a low amount of light is transmitted by the negative 32 upon all of the photosensitive devices 22b, 24b, 26b, 28b and 30b, the output signal of the emitter-follower amplifier is relatively negative.

The resistor 76, the variable resistor 82, the positive voltage source +V and the amplifier 80 operate as a voltage comparator which produces a positive output signal at output terminal 90 when the magnitude of the least negative signal developed by the photosensitive devices is less than the positive voltage provided by the setting of the variable resistor 82. The development of a positive voltage output signal at output terminal 90 indicates that the negative being examined is so dense that it is unprintable due to gross over-exposure or fogging of the negative. The adjustment of the variable resistor 82 determines the level at which the negative is considered unprintable.

Similarly the output signal developed at the emitter terminal of PNP transistor 70 is conducted by resistor 96 to the positive input terminal 98 of a second amplifier 100. A negative voltage source -V is also applied by a variable resistor 102 to the positive input terminal 98. Resistors 104 and 106 are also provided to stabilize the operation of the amplifier 100. A further isolation diode 108 is connected at its anode terminal to the output terminal 110 of amplifier 100 and at its cathode terminal to the common output terminal 94 of the unprintable negative detecting circuit.

The transistor 70 also operates as an emitter-follower that produces an output

signal at its emitter terminal that corresponds to the least positive of the voltages generated by the photosensitive devices 22b, 24b, 26b, 28b and 30b. This output signal is compared to the reference signal provided by the negative voltage source -V and the variable resistor 102. When the negative being examined is highly transmissive of light through all areas of the negative, the voltage signals developed at the cathodes of gating diodes 66 are positive in sign and relatively large. If all the photosensitive devices are sufficiently illuminated, the output signal of transistor 70 is sufficiently positive with respect to the negative reference signal level to provide a positive voltage signal at the input terminal 98 of the amplifier 100. Amplifier 100 responds to a positive input voltage signal to produce a positive output signal at its output terminal 110. When such a positive output signal is developed, the negative being examined is considered to be unprintable due to a blank negative or a grossly underexposed negative. The level of underexposure at which an output signal is developed at output terminal 110 may be controlled by the setting of the variable resistor 102.

The output signals of the two comparator circuits are transmitted to common point 94 by the isolation diodes 92 and 108. To summarize the operation of the circuit, fogged or over-exposed negatives cause the production of a positive output signal at the output terminal 90, and blank or underexposed negatives cause the production of a positive output signal at output terminal 110. Printable negatives cause neither output signal. Furthermore all five photosensitive devices 22b, 24b, 26b, 28b and 30b have to be relatively non-conductive before an output signal can be developed at the point 90 or have to be highly conductive before the output signal is produced at the output terminal 110. If any one of the five photosensitive devices generates a voltage level falling between the voltage level set by the variable resistors 82 and 102 (indicating some discernible subject matter on the negative frame), neither output signals can be generated. The provision of the five photosensitive devices operating independently in parallel ensures that printable subject failure negatives can be distinguished from unprintable negatives.

The common output terminal 94 of the unprintable negative detection circuit of Fig. 2 corresponds to point 94 of Fig. 3. Fig. 3 is a schematic illustration of the printer sequencing circuits of a photographic printer including the feature of an automatic unprintable negative advance circuit employed in the practice of the present invention. All of the elements of the circuit

of Fig. 3 are electrically connected in parallel between a conductor 112 connected to a -V supply and a ground return conductor 114. Each element will be described in terms of its operation in conjunction with the elements of Figs. 1 and 2. The common output terminal 94 of the unprintable negative detection circuit of Fig. 2 is connected at the junction of two resistors 116 and 118 which are connected by conductor 120 and diode 122 between the common lines 112 and 114. The base electrode of a transistor 124 is connected to the junction between the resistor 118 and the anode of diode 122. The emitter of transistor 124 is connected to common conductor 114, and the collector of transistor 124 is connected to one terminal of a PRINTABLE NEGATIVE relay 126, the other terminal of which is connected to the conductor 120. Normally, PRINTABLE NEGATIVE relay 126 is energized through the continuous conduction of transistor 124 which is biased on by resistor 116. However, when a positive unprintable negative signal is generated by the unprintable negative detector circuit of Fig. 2, the transistor 124 is rendered non-conductive, and the PRINTABLE NEGATIVE relay 126 is deenergized.

Referring now to the operation of the circuit of Fig. 3, the filmstrip 10 of Fig. 1 is advanced through the printing station 14 by depressing the FILM JOG button 128 which energizes the film advance mechanism 130 and disengages the film drive clutch 131 of a conventional printer, such as the aforementioned Model 2620 printer. As the negative frame under consideration advances to the negative examination station, the FILM ADVANCE relay 132 is energized through printer sequencing circuits of the printer which causes the normally-open relay contacts 132a to close and the normally-closed relay contacts 132b and 132c to open. When the normally-open relay contacts 132a close, the capacitor 134 charges to the negative voltage supply -V. At the end of the advance of the negative filmstrip, the film drive clutch 131 engages, normally-open relay contacts 132a reopen and normally-closed relay contacts 132b and 132c reclose. Capacitor 134 discharges through normally-closed relay contacts 132b, and READ OUT relay 136. When READ OUT relay 136 is energized, normally-open relay contacts 136a and 136b are closed. As, in the absence of an unprintable negative signal, PRINTABLE NEGATIVE relay 126 is energized, normally-closed relay contacts 126a are open and normally-open relay contacts 126b are closed.

As normally-open relay contacts 136a are closed but normally-closed relay contacts 126a are open, no current is allowed to flow in conductor 138, and FILM JOG relay 130

140 remains deenergized. However, as normally-open relay contacts 126b are closed, the closure of normally-open relay contacts 136b closes an energization circuit 142 across the PRINT button 144 of the printer, and the exposure memory circuit 146 of a conventional printer, such as the aforementioned Model 2620 printer, is connected to the supply voltage -V. Upon the energization of the exposure memory circuit 146, the exposure memory receives and stores a subject classification input signal on one of the three subject classification input terminals 148, 150 and 152 to be described in connection with Fig. 5. After storage of the subject classification input signal, the exposure memory circuit 146 advances the negative frame from the negative examination station into the printing station 14 of the photographic printer and initiates an exposure. Upon the advancement of the negative filmstrip, the film advance relay 132 is again energized, and the cycle explained hereinabove is repeated as long as an unprintable negative signal is not generated by the unprintable negative detector circuit of Fig. 2.

When, however, an unprintable negative signal is generated at terminal 94, the transistor 124 is reverse-biased and ceases to conduct current, and relay 126 is deenergized. When relay 126 is deenergized, normally-closed relay contacts 126a remain closed, and normally-open relay contacts 126b remain open. The sequence of operation differs to the extent that when READ OUT relay 136 is energized by the discharge of capacitor 134 upon the cessation of film advance, and the movement of the unprintable negative frame into the printing station 14, normally-open relay contacts 136a close and complete the circuit from the common conductor 112 through the normally-closed relay contacts 126a, conductor 138, FILM JOG relay 140 and common conductor 114, thus energizing FILM JOG relay 140.

While READ OUT relay 136 is still energized, FILM JOG relay 140 becomes energized as described above, and normally-open relay contacts 140a are closed, thus ensuring that the FILM JOG relay 140 remains energized after normally-open relay contacts 136a reopen upon the complete discharge of capacitor 134. The energization of FILM JOG relay 140 also closes normally-open relay contacts 140b which bypass the FILM JOG button 128 to conduct current to the film advance mechanism 130. The film advance mechanism 130 advances the negative frame found to be unprintable through the printing station 14 of the printer. While the negative filmstrip is advancing, film advance relay 132 is energized, and normally-closed relay contacts 132c reopen to deenergize FILM JOG relay

140. As soon as the film advance is completed, film advance relay 132 deenergizes and READ OUT relay 136 becomes energized again upon the discharge of capacitor 134. If, again, the negative is found to be unprintable this cycle repeats until a printable negative is detected. For as long as no printable photographic negatives are detected, the normally-open relay contacts 126b will remain open to prevent the energization of the exposure memory circuit 146 and the exposure of the negative in the printing station.

In the event that all of the negative frames of a particular customer's order are found to be unprintable by the unprintable negative detector of Fig. 2, it is still necessary to make at least one print in order that order sort and customer identification marks can be placed upon the print to keep the prints of successive customers' orders correlated with the customers' negatives. Normally the order sort mark is concurrently printed on the edge of the paper during the exposure of the first printable negative frame of each negative filmstrip. The splice detection circuit of Fig. 4 accomplishes this function and also prevents the erroneous printing of the spliced area of the negative filmstrip of Fig. 1.

Referring now to Fig. 4, there is shown a splice detection circuit incorporating the first splice detecting photosensitive device 48b and the second splice detecting photosensitive device 48c. The splice detecting photosensitive devices 48b and 48c are connected in series relation with resistors 154 and 156, respectively, and connected in parallel between a positive voltage source +V and a negative voltage source -V. The output conductors 50 and 52 are connected to the resistor 160 and the common point 158 of the splice detection circuits, respectively, through the splice detector amplifiers 157 and 159. The resistor 160 is connected to the base electrode of a transistor 162, and a clamp diode 164 connects the base electrode of the transistor 162 to the common conductor 166 of the ground return.

The common point 158 is connected by normally-closed PRINTABLE NEGATIVE relay contacts 126c to a terminal of SPLICE relay 172, the other terminal of which is connected to the common conductor 166. Connected between the common point 158 and the supply conductor are the normally-open relay contacts 172a. Also connected between the common point 158 and the common conductor 166 are the series connected capacitor 174 and SPLICE MEMORY CANCEL relay 176, and ORDER SORT PRINT relay 178 is connected between the common point 158 and the collector of transistor 162. Normally-open relay contacts 178a are also connected

ted to the collector of transistor 162 and to the common conductor 166. A further set of normally-open relay contacts 178b are connected across the PRINT button 144 of Fig. 3.

Referring now to the operation of the splice detector circuit of Fig. 4, it will be recalled from the discussion of Fig. 1 that the splice detecting photosensitive devices 48b and 48c were normally rendered conductive by predetermined wavelengths of light, which for example may be infrared radiation emitted by the first and second light sources 16 and 18 and transmitted by the negative filmstrip 10. Thus, as shown in the circuit of Fig. 4, when the splice detecting photosensitive devices 48b and 48c are rendered conductive, the voltage signals supplied by the splice detector amplifiers 157 and 159 to the base of transistor 162 and the common terminal 158, respectively, are positive, and no current flows through the relays 172, 176 or 178. However, the splice detecting photosensitive devices 48b and 48c cease to conduct current when the splice 46 of Fig. 1 passes between them and the light sources 16 and 18.

A frame with a splice applied will be detected by the unprintable negative detector as a printable negative since it is too narrow to cover all of the chambers of the housing 20. It is necessary therefore to cancel the normal print signal which would be generated, as described hereinbefore, by the circuit of Fig. 3. This cancellation is accomplished as the splice 46 advances over the splice detecting photosensitive device 48c. The sudden change in the polarity of the voltage signal from positive to negative at common point 158 is capacity coupled by the capacitor 174 to the SPLICE MEMORY CANCEL relay 176 which is energized thereby. The momentary energization of the SPLICE MEMORY CANCEL relay 176 opens the normally-closed relay contacts 176a to disconnect the exposure memory circuit 146 of Fig. 3 from the ground return conductor 114. As a result no exposure is initiated by the exposure memory circuit 146 after the film stops.

In the event that no printable negative exists in a customer's order, a print must be made of a frame between splices in order to keep each customer's order separate. The SPLICE relay 172 is also energized during the period that the SPLICE MEMORY CANCEL relay 176 is energized. The SPLICE relay 172, when energized, closes the normally-open relay contacts 172a in order to energize itself after the splice 46 moves past the splice detecting photosensitive device 48c. Splice relay 172 will remain energized until a printable negative is detected whereupon relay 126 of Fig. 3 is energized, and normally-closed relay con-

tacts 126c are opened. However, if a second splice 46 is detected by the first splice detecting photosensitive device 48b before a printable negative has released SPLICE relay 172, normally-open relay contacts 172a will remain closed. Upon the detection of a second splice 46 by the first splice detecting photosensitive device 48b, the output signal to resistor 160 abruptly changes from a positive voltage to a negative voltage. The negative voltage signal is transmitted by resistor 160 to the base of transistor 162 which is rendered conductive thereby. Upon the conduction of transistor 162, the ORDER SORT PRINT relay 178 is energized. The ORDER SORT PRINT relay 178 closes normally-open relay contacts 178a to energize itself upon the continued movement of the second splice 46.

Referring back to Fig. 3, the normally-open relay contacts 178b of the ORDER SORT PRINT relay 178 are closed, and a print is made by the energization of the exposure memory circuit 146 upon the advance of the last unprintable negative of the customer order into the printing station 14 of the photographic printer. Simultaneously, the exposure memory circuit 146 provides an order sort mark on the print in order to keep successive customers' print orders separate.

Thus apparatus has been shown for detecting unprintable photographic negatives and advancing such unprintable photographic negatives through a photographic printer without printing them, and further apparatus has been shown that responds to the situation where all negative frames of a customer's order are unprintable for making at least one print therefrom in order to keep subsequent customers' print orders separate.

Referring now to Fig. 5 there is shown a further circuit that is responsive to a predetermined comparison of the negative transmittances of the five areas 22a, 24a, 26a, 28a and 30a of the negative frame 32 for detecting abnormal density variations in the negative and providing classification correction signals for printing subject failure negatives. As noted hereinbefore, subject failure negatives usually fall into two categories, that is negatives carrying back-lit scenes or flash-lit scenes. These two categories may be recognized by an abnormally high negative density in the upper peripheral (sky) area or the central and the lower peripheral (flash subject) areas, respectively, of the negative. The abnormal density of a back-lit negative is compensated for during printing by shortening the total exposure time that would normally be provided by the LATD exposure control system. Conversely, the abnormal density of a flash-lit negative is compensated for by lengthening

the total exposure time of the negative provided by the LATD exposure control system. Normally the operator of a printer examines the negative to be printed and classifies it as a normal or subject failure negative, and he presses the appropriate classification button provided on the console of the printer. The depression of the classification button introduces the corresponding correction factor into the LATD monitoring circuitry of the printer. It has been found desirable automatically to classify the negative and to correct for abnormal density variations in the negative. This has been accomplished, as described in our co-pending Patent Application No. 40112/71 (Serial No. 1,375,415) by separately measuring the negative densities in the upper peripheral area, the lower peripheral area and the central area of a negative and combining these densities in a predetermined manner in order to produce the appropriate correction factor.

Referring now to Fig. 5 there is shown a negative classification circuit for use with the photosensitive devices 22b, 24b, 26b, 28b and 30b of Figs. 1 and 2. The conductors 34, 36, 38, 40 and 42 are connected to the base electrodes of respective transistors 180, 182, 184, 186 and 188, respectively, the collector electrodes of which are commonly connected to a positive voltage source +V and the emitters of which are commonly connected through respective resistors 190, 192, 194, 196 and 198 to a negative voltage source -V. Output conductors 200, 202, 204, 206 and 208 are respectively connected to the emitter terminals of transistors 180, 182, 184, 186 and 188.

Thus the transistors 180, 182, 184, 186 and 188 operate as the emitter-followers that produce an output signal on the respective output conductors that correspond in amplitude and polarity to the positive voltage signal having an amplitude falling within the range of +V to -V developed on the input conductors 34, 36, 38, 40 and 42, respectively. These input voltages are developed in the same manner as described in the discussion of the operation of the photosensitive devices 22b, 24b, 26b, 28b and 30b of Fig. 2.

The output conductor 206 is connected by resistors 210 and 212 to the positive input terminal of differential amplifier 214 and the negative input terminal of differential amplifier 216. The output conductors 200, 202, 204 and 208 are connected in summing relation through resistors 218, 220, 222 and 224 to the negative input terminal of differential amplifier 214 and in summing relation to the positive input terminal of differential amplifier 216 through resistors 226, 228, 230 and 232. The negative input terminal of differential amplifier 214 is

also connected to a negative voltage source connected to a negative voltage source -V through a variable resistor 234 that constitutes the (-) BUTTON adjustment. Similarly the positive input terminal of differential amplifier 216 is connected to a positive voltage source +V to a variable resistor 236 that constitutes the (+) BUTTON adjustment. The (-) BUTTON adjustment and (+) BUTTON adjustment are provided so that the sensitivity of the classification circuit may be adjusted to the point at which the maximum number of acceptable prints are produced by the classification correction circuit.

The output terminal of the differential amplifier 214 is coupled by resistor 238 and diode 240 to the base electrode of switching transistor 242. The emitter electrode of switching transistor 242 is grounded, and the collector electrode is coupled through (-) BUTTON relay 246 to a negative voltage source -V. A diode 244 is connected across the coil of relay 246.

Similarly the output terminal of differential amplifier 216 is coupled by a resistor 248 and diode 250 to the base electrode of transistor 252. The emitter electrode of transistor 252 is connected to ground potential, and the collector electrode is connected by (+) BUTTON relay 256 to a negative voltage source -V. A diode 254 is connected across the coil of relay 256.

Associated with the (-) BUTTON relay 246 are normally-open relay contacts 246a that connect a negative voltage source -V through the normally-closed contacts 256b to the (-) BUTTON input conductor 152. Associated with the (+) BUTTON relay 256 are the normally-open relay contacts 256a that connect the negative voltage source -V to the (+) BUTTON input conductor 148. The normally-closed relay contacts 246b and 256b are series connected between the negative voltage source -V and the normal (N) BUTTON input conductor 150. The (+) BUTTON input conductor 148, the (N) BUTTON input conductor 150 and the (-) BUTTON input conductor 152 are connected to the + N and - input terminals of the exposure memory circuit 146 of Fig. 3. In the practice of the invention, these relay contacts may be connected in the manner shown in Fig. 5 across the (+) BUTTON, (N) BUTTON and (-) BUTTON contacts on the console of a photographic printer.

Referring now to the operation of the negative classification circuit of Fig. 5, it will be noted that normally the transistors 242 and 252 are nonconductive and the (-) BUTTON relay 246 and the (+) BUTTON relay 256 are not energized. Therefore, the negative voltage source -V is normally connected to the (N) BUTTON

input conductor 150 by the normally-closed relay contacts 246b and 256b.

However, when the voltage developed at the positive input terminal of the differential amplifier 214 is more negative than the average of the voltages applied at the negative input terminal, a negative voltage is developed at the output terminal of the differential amplifier 214 and the transistor 242 is rendered conductive. The conduction of transistor 242 energizes the (—) BUTTON relay 246, causing the normally-open relay contacts 246a to close and the normally-closed relay contacts 246b to open. Therefore, the negative voltage —V is diverted to the (—) BUTTON conductor 152.

Similarly, a negative output signal is developed at the output terminal of differential amplifier 216 when the average of the voltage signals at the positive input terminal of the differential amplifier 216 is less negative than the voltage signal applied at the negative input terminal. The transistor 252 is rendered conductive by the negative output signal thus energizing the (+) BUTTON relay 256. The energization of the (+) BUTTON relay 256 closes the normally open-relay contacts 256a, thus energizing the (+) BUTTON input conductor 148.

Referring back to Fig. 1 it will be noted that the area 28a of the negative 32 constitutes a portion of the upper peripheral area of the negative scene and the photosensitive device 28b is responsive to the transmissivity of this upper area of the negative scene. Similarly the other photosensitive devices respond to the transmissivity of the other respective areas of the scene carried by the negative 32. When the transmissivity of the area 28a of the negative 32 is a certain amount lower than the average transmissivities of the remaining areas of the negative 32, it can be assumed that the scene carried by the negative 32 is back-lit, for example, by a bright sky. The output signal developed by the photosensitive device 28b in the circuit of Fig. 3 is applied by conductor 40 to the base electrode of transistor 186 of Fig. 5. When as stated, the transmissivity of the area 28a is relatively low, the voltage developed on conductor 40 is relatively large and negative. The emitter-follower transistor 186 responds to this voltage signal to develop a negative voltage signal on the output conductor 206 that is applied to the plus input terminal of the differential amplifier 214 and the minus input terminal of the differential amplifier 216. Similarly the signal developed by the remaining photosensitive developed on the output conductors 200, 202, 204 and 208 are averaged at the negative input terminal of the differential amplifier 214 and the positive input terminal of the

differential amplifier 216. When the magnitude of the signal developed on the output conductor 206 is more negative than the average magnitude of the signals developed on the output conductors 200, 202, 204 and 208 and the (—) BUTTON adjustment, the differential amplifier 214 produces a negative output signal that, as described hereinbefore, renders transistor 242 conductive and energizes (—) BUTTON relay 246. In this manner, the negative is classified as a back-lit scene, and a proper negative correction factor is introduced into the LATD measurement system to shorten the total exposure time of the negative.

Similarly when the average transmissivity of the areas 22a, 24a, 26a and 30a is a certain amount less than the transmissivity of the area 28a the negative probably is carrying a front-lit scene, such as a flash picture. This imbalance is characterised by the fact that the average of the output signals developed on the output conductors 200, 202, 204 and 208 be less than the magnitude of the signal developed on the output conductor 206, and the differential amplifier 216 responds to this imbalance to produce a negative output signal. The negative output signal, as stated hereinbefore, renders transistor 252 conductive and energizes the (+) BUTTON relay 256 which energizes the (+) BUTTON conductor 148. Thus the total exposure time for a front-lit scene is increased by the addition of a positive correction factor to the LATD exposure control system.

The circuit of Fig. 5 constitutes but one example of the combinations of particular areas of the negative 32 that is effective to determine that the scene carried by the negative is a normally illuminated scene, a back-lit scene or a front-lit scene and to provide necessary correction for the classified scene. It will be apparent that other combinations of predetermined areas of the negative 32 may be made in order to practice the present invention. For example the housing 20 of Fig. 1 may be provided with any number of chambers and respective photosensitive devices that are responsive to the transmissivity of respective areas of the negative 32. It is also apparent that the solid state photosensitive array described in the aforementioned copending Application may be substituted for the photosensitive devices 22a, 24a, 26a, 28a and 30a of the present invention. Appropriate circuit modifications may be made to the negative classification circuit of Fig. 5 and the unprintable negative detection circuit of Fig. 2.

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

vention as defined in the appended claims.

This application is divided out of Application No. 17021/72, Serial No. 1393921.

WHAT WE CLAIM IS:—

5 1. A method of printing photographic originals wherein a strip bearing the photographic originals is intermittently transported through an exposure station, the method comprising the steps of, directing radiation
10 through at least first and second areas of each photographic original, sensing the intensity of the radiation transmitted by each area of the photographic original, comparing the signals corresponding to the sensed
15 radiation intensities with a signal corresponding to a reference radiation intensity, transporting those photographic originals from which the signals corresponding to the sensed radiation intensities are excessively high or excessively low in comparison
20 with the signal corresponding to the reference radiation intensity, through the exposure station of the printer, without printing such original, successively transporting the remaining photographic originals into the exposure station of the photographic printer, and providing an exposure correction signal in response to said comparison, and controlling the exposure of each of the
25 remaining photographic originals in accordance with the respective exposure correction signal.

2. A method as claimed in Claim 1, further including the step, where no photographic original of a strip would otherwise be printed, of printing one of such originals.

3. A method as claimed in Claim 1 or 2, where a plurality of strips are joined end to end by splices further including the step of successively detecting each splice.

4. A method as claimed in Claims 2 and 3, wherein where no photographic originals have been printed between detection of two successive splices, the photo-

graphic original immediately preceding the second of the two successive splices is printed.

5. An apparatus for printing photographic originals comprising an exposure station, transport means for intermittently transporting a strip bearing photographic originals through the exposure station, a source of radiation for directing radiation through at least first and second areas of each photographic original, sensing means for sensing the intensity of the radiation transmitted by each area of the photographic original, comparator means for comparing the signals corresponding to the sensed radiation intensities with a signal corresponding to a reference radiation intensity the transport means being arranged for transporting those photographic originals, of which the signals corresponding to the sensed radiations intensities are excessively high or excessively low in comparison with the signal corresponding to the reference radiation intensity, through the exposure station, without printing such originals, the transport means being further arranged for transporting the remaining photographic originals into the exposure station, the comparator means also being arranged for comparing the signals corresponding to the radiation intensities transmitted by each of the areas of each remaining photographic originals in succession, and for providing exposure correction signal in response to said comparison, and for controlling the exposure of each of the remaining photographic originals in accordance with the respective exposure correction signal.

6. A method of printing photographic originals substantially as hereinbefore described.

L. A. TRANGMAR, B.Sc., C.P.A.,
Agent for the Applicants.



vention as defined in the appended claims.

This application is divided out of Application No. 17021/72, Serial No. 1393921.

WHAT WE CLAIM IS:—

- 5 1. A method of printing photographic originals wherein a strip bearing the photographic originals is intermittently transported through an exposure station, the method comprising the steps of, directing radiation through at least first and second areas of each photographic original, sensing the intensity of the radiation transmitted by each area of the photographic original, comparing the signals corresponding to the sensed radiation intensities with a signal corresponding to a reference radiation intensity, transporting those photographic originals from which the signals corresponding to the sensed radiation intensities are excessively high or excessively low in comparison with the signal corresponding to the reference radiation intensity, through the exposure station of the printer, without printing such original, successively transporting the remaining photographic originals into the exposure station of the photographic printer, and providing an exposure correction signal in response to said comparison, and controlling the exposure of each of the remaining photographic originals in accordance with the respective exposure correction signal.
2. A method as claimed in Claim 1, further including the step, where no photographic original of a strip would otherwise be printed, of printing one of such originals.
3. A method as claimed in Claim 1 or 2, where a plurality of strips are joined end to end by splices further including the step of successively detecting each splice.
4. A method as claimed in Claims 2 and 3, wherein where no photographic originals have been printed between detection of two successive splices, the photographic original immediately preceding the second of the two successive splices is printed.
5. An apparatus for printing photographic originals comprising an exposure station, transport means for intermittently transporting a strip bearing photographic originals through the exposure station, a source of radiation for directing radiation through at least first and second areas of each photographic original, sensing means for sensing the intensity of the radiation transmitted by each area of the photographic original, comparator means for comparing the signals corresponding to the sensed radiation intensities with a signal corresponding to a reference radiation intensity the transport means being arranged for transporting those photographic originals, of which the signals corresponding to the sensed radiation intensities are excessively high or excessively low in comparison with the signal corresponding to the reference radiation intensity, through the exposure station, without printing such originals, the transport means being further arranged for transporting the remaining photographic originals into the exposure station, the comparator means also being arranged for comparing the signals corresponding to the radiation intensities transmitted by each of the areas of each remaining photographic originals in succession, and for providing exposure correction signal in response to said comparison, and for controlling the exposure of each of the remaining photographic originals in accordance with the respective exposure correction signal.
6. A method of printing photographic originals substantially as hereinbefore described.

graphic original immediately preceding the second of the two successive splices is printed.

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