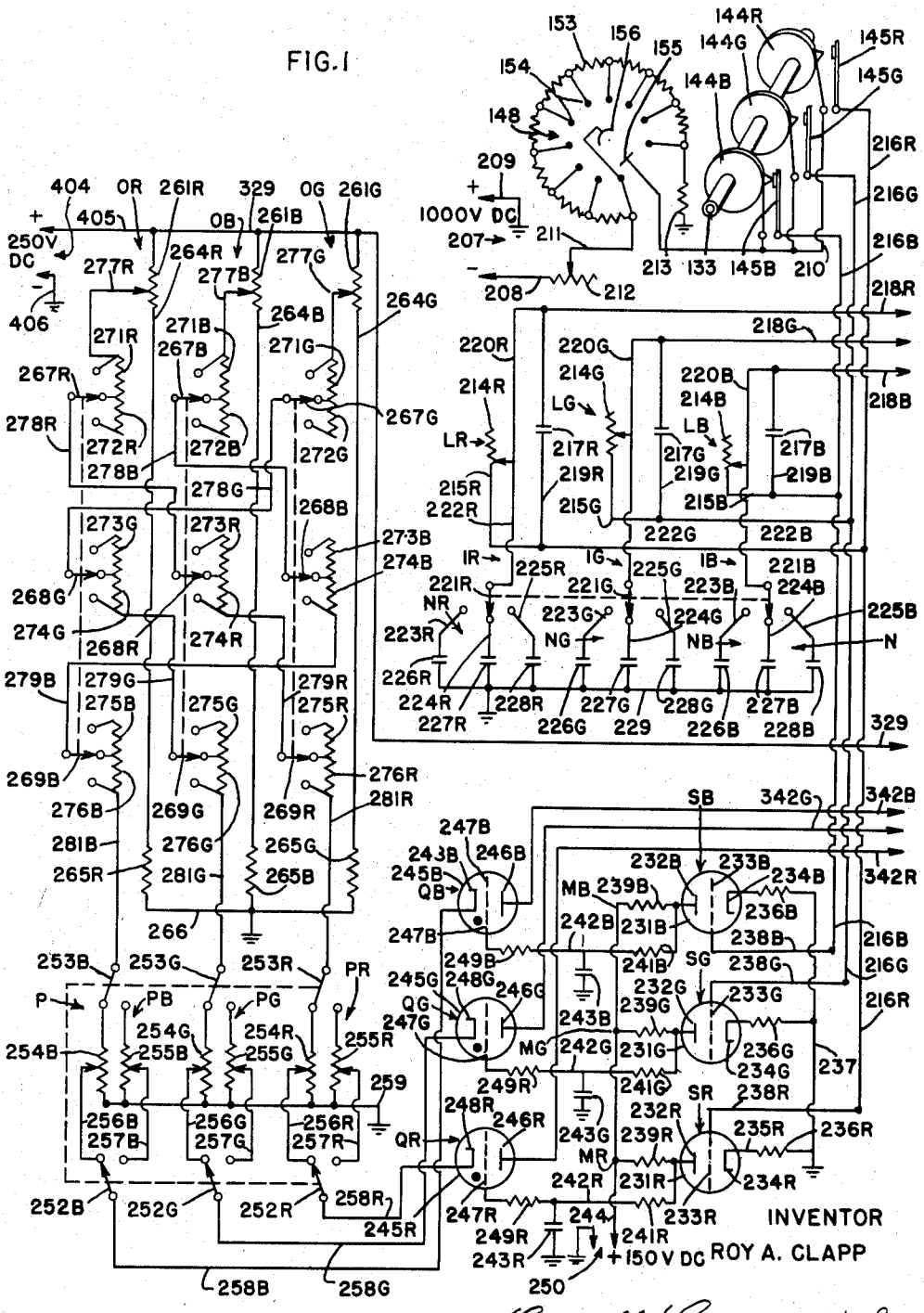
Nov. 30, 1965 R. A. CLAPP 3,220,304

PHOTOGRAPHIC PRINTER

Original Filed Jan. 30, 1959 2 Sheets-Sheet 1

FIG. 1



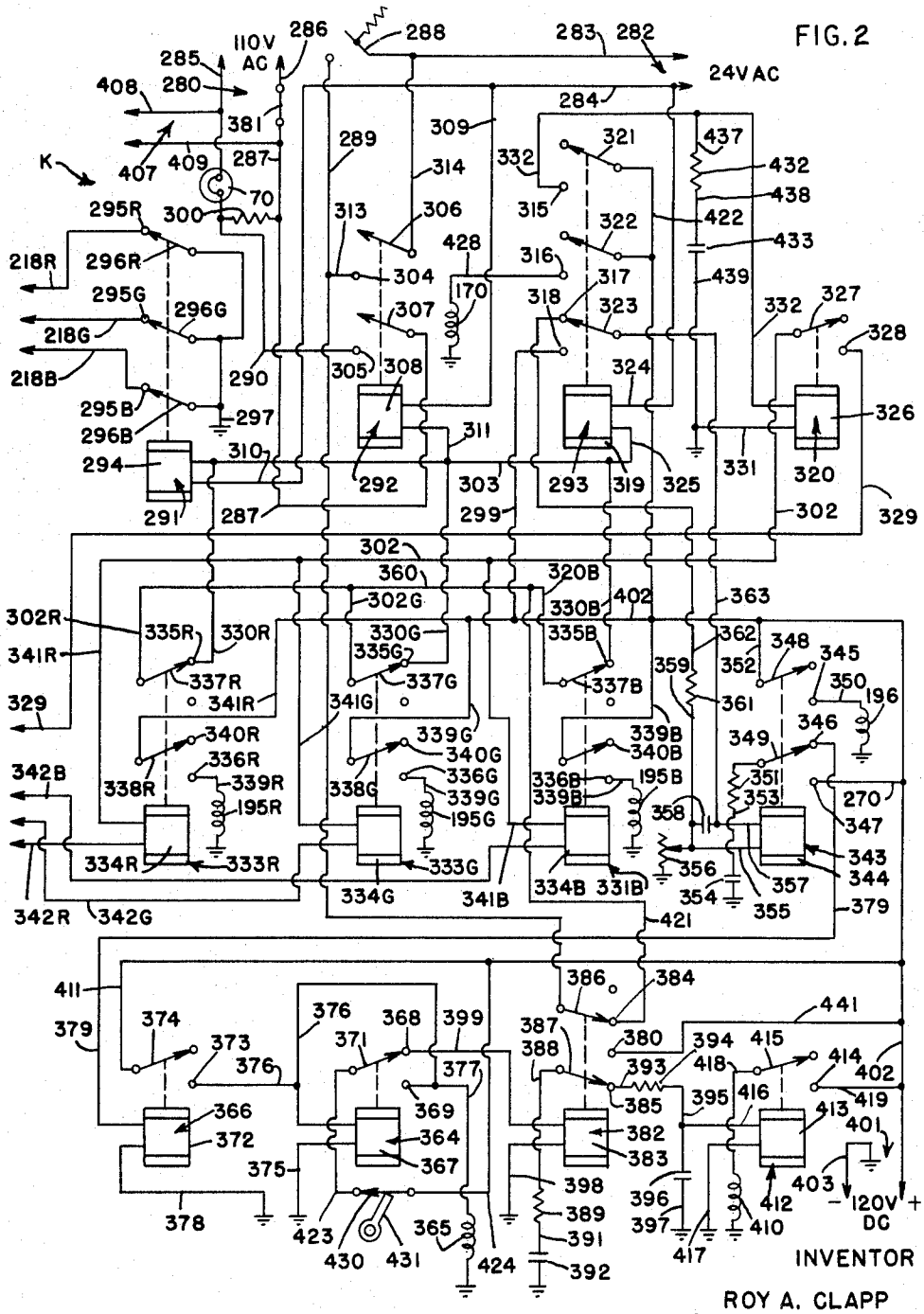
Caswell Lagaard & Wicks
ATTORNEYS

Nov. 30, 1965 R. A. CLAPP 3,220,304

PHOTOGRAPHIC PRINTER

Original Filed Jan. 30, 1959 2 Sheets-Sheet 2

FIG. 2



United States Patent Office 3,220,304 Patented Nov. 30, 1965

3,220,304

PHOTOGRAPHIC PRINTER

Roy A. Clapp, Coon Rapids, Minn., assignor to Pako Corporation, Minneapolis, Minn., a corporation of Delaware

Original application Jan. 30, 1959, Ser. No. 790,226, now Patent No. 3,100,419, dated Aug. 13, 1963. Divided and this application Sept. 20, 1962, Ser. No. 225,099

8 Claims. (Cl. 88—24)

This application for patent relates to photographic printers and is a division of my copending application for patent for Photographic Printer, Serial No. 790,226, filed January 30, 1959, now U.S. Patent No. 3,100,419, issued Aug. 13, 1963.

The invention further relates to the printing of photographic materials having two or more emulsions by the use of light having components to which the emulsions are sensitive and in the printing of which the light of any component is cut off when sufficient exposure to such component has been procured.

An object of the invention resides in providing a photographic printer in which the desired color balance of the print may be procured without altering the density of the print.

Another object of the invention resides in providing for each color, color modifying means and cut off means operated thereby, and in further providing interlocking means between the modifying means operable upon increasing the length of exposure by one light component to decrease the length of exposure by certain of the other components.

An object of the invention resides in providing adjustable emulsion controls for varying the exposure in accordance with emulsion characteristics of the paper without disturbing the basic color balance.

A still further object of the invention resides in providing electrical circuits for procuring the desired results.

An object of the invention resides in providing a control circuit for each color and cut off means for each color controlled thereby and in providing color modifying circuits having time varying elements therein to vary the exposure of the emulsions and interlocking means between said elements causing upon varying one element to vary the length of exposure of one emulsion, variation of certain of said other elements in a manner to cause a decrease in the length of exposure of the emulsions for the corresponding other colors.

Another object resides in utilizing trigger circuits for operating said cut off means and including electronic valves and in utilizing said modifying circuits for controlling the operation of said valves.

A still further object of the invention resides in utilizing in said trigger circuits electronic valves adapted to become operative upon the application of a predetermined voltage thereto and in utilizing in said modifying circuits variable resistors for controlling the voltages applied to said valves.

An object of the invention resides in gang operating certain of said resistors to produce upon increase of the resistance of the resistor for one color in each of said modifying circuit the decrease of the resistance of the resistors for certain of the other colors in the other modifying circuits.

Other objects of the invention reside in the novel construction and arrangement of parts and in the details of construction hereinafter illustrated and/or described.

In the drawings:

FIG. 1 is a wiring diagram of a portion of the electrical system of a photographic printer illustrating an embodiment of the invention.

FIG. 2 is a wiring diagram of the remainder of the electrical system of the photographic printer.

The invention disclosed in this application for patent is for use in printing color material and is particularly applicable for use with photographic printing paper having three emulsions sensitive to red, green and blue light. To simplify the description of the invention and to prevent needless repetition, the parts and components pertaining to the printing of the red emulsion will be described and reference numerals with the letter R added. The parts and components corresponding thereto and pertaining to the green and blue emulsions will not be again described but will be given the same reference numerals as those applied to the red parts and components and to which will be appropriately added the letters G and B. The same reference numerals used in the parent case will also be used in this case to indicate the like parts. While the entire electrical system of the invention has been shown in the drawings, only so much of the same as directly pertains to the present invention will be described, reference to the parent case being had for the balance of the circuits and the structural parts of the printer.

The photographic printing apparatus in which the instant invention is employed is mounted on a table which supports the various sections of the same. Extending upwardly from said table at one end thereof is a column which supports a paper section and an optical section. These two sections are movable in an up and down direction to focus the image on the paper. Mounted on the table at the intermediate portion of the same is an illuminating section by means of which light may be passed through a negative carried by a negative holder disposed at the upper surface of the table. A light valuating section is used in conjunction with the optical section to sample the light and to alter the exposure time of the light component of the printing light in accordance with the requirement for the particular negative being printed. The sample light is directed to a distributor which distributes samples of the primary colors to three different channels. In these channels, timers for the three colors are employed, which control the photographic exposure of the respective color emulsions on the photographic material. Cut off means in the form of filters are used in conjunction with the light source which is operated by the timers and which alters the color of the printing light to compensate for the color deficiencies of the negatives.

The electrical section of the apparatus of which the instant invention forms a part receives signal pulses from the distributor and feeds it to three exposure compensating circuits LR, LG and LB. The exposure compensating circuits LR, LG and LB are used for compensating for grossly overexposed and underexposed negatives. The energy from these circuits is fed to three timers IR, IG and IB which control the duration of the exposure for each color and which include interpolating circuits MR, MG and MB and trigger circuits QR, QG, and QB. The interpolating circuits MR, MG, and MB are employed for producing continuous operations with a pulse type signal. The trigger circuits are employed to operate the cut off means for terminating the printing of each emulsion of the photographic material. The operation of the cut off means is further controlled by manually operated density modifying means N including density modifying circuits NR, NG and NB, light compensating means P including light compensating circuits PR, PG and PB. The light compensating circuits PR, PG and PB are used for selectively printing prints from negatives exposed either by flash illumination or outdoor illumination, and by the color modifying system O comprising color modifying means or circuits OR, OG, and OB and which forms the subject matter of the instant invention. All these

circuits and the various functions of the machine are controlled by the programming section K. The programming section of the invention is illustrated in FIG. 2 while the other electrical sections of the invention are illustrated in FIG. 1.

The photographic printing apparatus embodying the instant invention is illustrated in FIG. 1 and comprises the three color modifying circuits OR, OG, and OB. Power for operating these circuits is derived from a

the three gangs of switches are moved from one position to another to increase or decrease the resistance in one of the color circuits, the resistance in each of the other color circuits is decreased or increased by an amount equal to one-half of the increase or decrease in the denoted circuit, thus maintaining the entire resistance in the three circuits the same.

Applicant has found by actual use that the following types and values of components give satisfactory results:

Resistors			Resistors			Condensers		
	OHMS	Watts		OHMS	Watts		M.F.	Type
212	0.5M	½	274R	2.2K	½	228R	1,375 μf., 200 v	Paper.
213	120K	½	274G	2.2K	½	228G	.375 μf., 200 v	
214R	0.5M	½	274B	2.2K	½	228B	.375 μf., 200 v	
214G	0.5M	½	275R	2.2K	½	243R	0.1 μf., 200 v	
214B	0.5M	½	275G	2.2K	½	243G	0.1 μf., 200 v	
236R	1K	½	275B	2.2K	½	243B	0.1 μf., 200 v	
236G	1K	½	276R	2.2K	½	354	4 μf., 350 v	Electrolytic.
236B	1K	½	276G	2.2K	½	358	60 μf., 150 v	
239R	150K	½	276B	2.2K	½	396	2 μf., 450 v	
239G	150K	½	261R	10K	2	433	4 μf., 350 v	
239B	150K	½	261G	10K	2	217R	0.1 μf., 200 v	Moulded.
241R	470K	½	261B	10K	2	217G	0.1 μf., 200 v	
241G	470K	½	300	25	100	217B	0.1 μf., 200 v	
241B	470K	½	351	100	2	226R	.14 μf., 200 v	Paper.
249R	220K	½	356	5K	2	226G	.14 μf., 200 v	
249G	220K	½	361	68	2	226B	.14 μf., 200 v	
249B	220K	½	389	33	1	227R	.26 μf., 300 v	
254R	15K	2	394	4.7K	1	227G	.26 μf., 300 v	
254G	15K	2	432	5.6K	1	227B	.26 μf., 300 v	
254B	15K	2	153	120K	½	392	2 μf., 450 v	Electrolytic.
255R	15K	2						
255G	15K	2						
255B	15K	2						
265R	18K	2						
265G	18K	2						
265B	18K	2						
271R	4.3K	½						
271G	4.3K	½						
271B	4.3K	½						
272R	4.3K	½						
272G	4.3K	½						
272B	4.3K	½						
273R	2.2K	½						
273G	2.2K	½						
273B	2.2K	½						

Tubes	
	Type
148	931A
231R	6AF4-A
231G	6AF4-A
231B	6AF4-A
245R	2D21
245G	2D21
245B	2D21

power line **404** connected to a source of direct current of about 250 volts. This line comprises a conductor **405** which is connected to the positive side of the source of power and a conductor **406** which is connected to the negative side and which is grounded. The circuits OR, OG and OB include potentiometers **261R**, **261G** and **261B**. One end of each of these potentiometers is connected to a conductor **329** which in turn is connected to the positive side **405** of the line **404**. The other ends of these potentiometers are connected through conductor **264R**, **264G** and **264B** to resistors **265R**, **265G** and **265B**. These resistors are all grounded through a conductor **266**. These potentiometers are calibrated in terms of emulsion factors and are adjusted to correspond to the emulsion factor of the particular paper being used. The circuits OR, OG and OB utilize three single pole three-position switches for each color designated by the numerals **267R**, **267G**, **267B**, **268R**, **268G**, **268B**, **269R**, **269G** and **269B**. The switches **267R**, **268G** and **269B** are ganged and move in unison. Similarly, the switches **267B**, **268R** and **269G** are ganged and also the switches **267G**, **268B** and **269R** are ganged and likewise move in unison. The switches **267R**, **268R** and **269R** have connected to the fixed contacts of the same resistors **271R**, **272R**, **273R**, **274R**, **275R** and **276R**. Similar resistors are connected to the other switches. The resistor **271R** is connected through a conductor **277R** to the movable contact of the potentiometer **261R**. The movable contact of the switch **267R** is connected by a conductor **278R** to the movable contact of switch **268R**. The resistor **274R** is connected by a conductor **279R** to the movable contact of the switch **269R**. The resistor **276R** is connected by a conductor **281R** to the movable contact of the switch **253R** forming part of the light compensating circuit PB. When any of

The operation of the invention is as follows: The color modifying circuits OR, OG and OB through the power supply **404**, furnish three voltages which are impressed on the three light compensating circuits PR, PG and PB. These circuits contain switches **253R**, **253G**, and **253B**, and resistors **254R**, **254G**, **254B**, **255R**, **255G** and **255B** which vary the voltages impressed on the circuits PR, PG and PB and provide terminal voltages which are proper to give the correct exposure for either daylight or artificial illumination in the taking of the picture. The resulting voltages are impressed upon the cathodes **247R**, **247G** and **247B** of the trigger tubes **254R**, **254G** and **254B** of trigger circuits QR, QG and QB and provide bias voltages for the same, thus controlling to a certain extent the amount of time elapsing before each of said trigger tubes fires. The timers of the printer activated by the light valuating section furnish grid voltages for the buffer circuits SR, SG and SB and which in turn provide grid current for the grids **247R**, **247G** and **247B** of the trigger tubes **245R**, **245G** and **245B** thus further controlling the amount of time elapsing before each trigger tube fires. As the tubes fire the cut off means for each color is operated and the proper exposure for each emulsion results.

The advantages of the invention are manifest. The color balance of the printed material may be manually varied to suit the requirements and the density of the print automatically maintained constant. The desired result is procured by the use of ordinary resistors and ganged electric switches which are arranged so that when the resistance for one color is increased the resistances for the other colors are reduced and visa versa. Once the proper resistances have been selected the device needs no further attention. With the invention, each color may be separately varied and similarly any two may be varied.

Changes in the specific form of the invention, as herein described, may be made within the scope of what is claimed without departing from the spirit of the invention.

Having described the invention, what is claimed as new and desired to be protected by Letters Patent is:

1. In a photographic printer for color printing comprising a holder for an image bearing support, means for supporting multiple sensitized material having three emulsions in printing relation to said support, illuminating means containing three light components of different colors for illuminating said support, individual cut off means for individually cutting off each of said light components, individual color modifying means controlling the operation of each of said cut off means, and interlocking means between said modifying means whereby increasing the length of exposure by one light component a certain amount decreases the length of exposure of each of the other two light components by an amount equal to one half of the amount of increase of the length of exposure of the first referred to light component.

2. In a photographic printer for color printing having three separate trigger circuits to control the exposure of the several emulsions of sensitized printing material having three emulsions, said circuits each including an electronic valve normally inoperative and functioning to control the exposure of one of the emulsions of the sensitized material when the voltage applied thereto reaches a predetermined value, the combination of three individual color modifying circuits one for each trigger circuit, each adapted to apply a voltage to one of the elements of the valve of one of said trigger circuits, a principal variable resistor in each of said modifying circuits for one of said emulsions and two auxiliary variable resistors in each of said color modifying circuits for the same emulsions and of one half the value of the principal resistor said resistors being connected in series and varying the voltage applied to said valves and three dependent gang operating means each simultaneously operating one principal variable resistor for one emulsion and an auxiliary resistor for each of the other emulsions in a manner to cause upon increase of the resistance of the principal resistor in one modifying circuit the decrease of the resistance of the auxiliary resistors in the other two modifying circuits for the other emulsions.

3. In a photographic printer for color printing having separate trigger circuits to control the exposure of the several emulsions of the sensitized printing material, said circuits including gas filled electronic valves with plates, grids and cathodes, the combination of color modifying circuits, one for each trigger circuit connected to the cathodes of said valves and to a source of voltage, a principal variable resistor in each of said modifying circuits for one of said emulsions and auxiliary variable resistors in each of said color modifying circuits for the same emulsions and of lesser value than the principal resistor said resistors being connected in series and independent gang operating means for simultaneously operating one principal variable resistor for one emulsion and a variable resistor for certain of the other emulsions in a manner to cause upon increase of the resistance of the principal resistor in one modifying circuit the decrease of the resistance of the auxiliary resistors in the modifying circuits for said other certain emulsions.

4. In a photographic printer for color printing having separate trigger circuits to control the exposure of the several emulsions of the sensitized printing material, said circuits including gas filled electronic valves with plates, grids and cathodes, the combination of color modifying circuits, one for each trigger circuit connected to the cathodes of said valves and to a source of voltage, a variable bias control voltage divider in each of said circuits normally set to produce the proper color balance for a particular kind of multiple sensitized photographic material, an emulsion factor variable voltage divider in each of said color modifying circuits controlling the voltage applied to said first named voltage dividers and calibrated in terms of the corresponding emulsion factor of the multiple sensitized photographic material.

5. In a photographic printer for color printing having separate trigger circuits to control the exposure of the several emulsions of the sensitized printing material, said circuits including gas filled electronic valves with plates, grids and cathodes, the combination of color modifying circuits, one for each trigger circuit connected to the cathodes of said valves and to a source of voltage, a variable bias control voltage divider in each of said circuits normally set to produce the proper color balance for a particular kind of multiple sensitized photographic material, an emulsion factor variable voltage divider in each of said color modifying circuits controlling the voltage applied to said first named voltage dividers and calibrated in terms of the corresponding emulsion factor of the multiple sensitized photographic material, a number of variable resistors connected in series in each color modifying circuit and disposed between the voltage dividers therein, and manually controlled resistance varying devices connected to and varying a resistor in each of said color modifying circuits to compensate for color unbalance.

6. In a photographic printer for color printing having separate trigger circuits to control the exposure of the several emulsions of the sensitized printing material, said circuits including gas filled electronic valves with plates, grids and cathodes, the combination of color modifying circuits, one for each trigger circuit connected to the cathodes of said valves and to a source of voltage, a variable bias control voltage divider in each of said circuits normally set to produce the proper color balance for a particular kind of multiple sensitized photographic material, an emulsion factor variable voltage divider in each of said color modifying circuit controlling the voltage applied to said first named voltage dividers and calibrated in terms of the corresponding emulsion factor of the multiple sensitized photographic material, a number of variable resistors connected in series in each color modifying circuit and disposed between the voltage dividers therein, manually controlled resistance varying devices connected to and varying the resistance of a resistor in each of said color modifying circuits to compensate for color unbalance, and interlocking means between a resistance varying device of each of said color control circuits causing simultaneous variation of the resistance of said resistor to produce increase of resistance of one of said resistors and decrease the resistance of the other of said resistors.

7. In a photographic printer for color printing having separate trigger circuits to control the exposure of the several emulsions of the sensitized printing material, said circuits including gas filled electronic valves with plates, grids and cathodes, the combination of color modifying circuits, one for each trigger circuit connected to the cathodes of said valves and to a source of voltage, a variable bias control voltage divider in each of said circuits normally set to produce the proper color balance for a particular kind of multiple sensitized photographic material, an emulsion factor variable voltage divider in each of said color modifying circuits controlling the voltage applied to said first named voltage dividers and calibrated in terms of the corresponding emulsion factor of the multiple sensitized photographic material, a number of variable resistors connected in series in each color modifying circuit and disposed between the voltage dividers therein, manually controlled resistance in each of said color modifying circuits to compensate for color unbalance, and interlocking means between a resistance varying device of each of said color control circuits causing simultaneous variation of the resistance of said resistor to produce increase of resistance of one of said resistors and decrease the resistance of the other of said resistors, said resistors and resistance varying devices being constructed so that the sum of the resistance in all of the

color modifying circuits remains constant upon variation of said resistance varying devices.

8. In a photographic printer for color printing having three separate trigger circuits to control the exposure of the several emulsions of sensitized printing material having three emulsions, said circuits each including an electronic valve normally inoperative and functioning to control the exposure of one of the emulsions of the sensitized material when the voltage applied thereto reaches a predetermined value, the combination of three individual color modifying circuits one for each trigger circuit, each adapted to apply a voltage to one of the elements of the valve of one of said trigger circuits, a principal variable resistor in each of said modifying circuits for one of said emulsions and two auxiliary variable resistors in each of said color modifying circuits for the same emulsions and of one half the value of the principal resistor, said resistors being all similar in construction and each comprising an elongated resistive element having a connected end and an open end and each having a contactor contacting

with and movable along said resistive element from one end to the other, means for causing simultaneous movement of said contactors in the same direction, said means when bringing the contactor of the principal resistor into contact with the connected end of the resistance element of the principal resistor also bringing the other two contactors in contact with the free ends of the resistive elements of the auxiliary resistors.

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