United States Patent [19]

Weihsmantel et al.

[11] **3,738,748**

[45] **June 12, 1973**

[54] **PHOTOGRAPHIC PRINTER**

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[22] Filed: **June 9, 1971**

[21] Appl. No.: **151,253**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 880,716, Nov. 28, 1969, abandoned.

[52] **U.S. Cl.** **355/121,** 355/71, 355/93, 355/101

[51] **Int. Cl.** **G03b 27/04**

[58] **Field of Search** 355/91, 93, 121, 355/71, 101, 69

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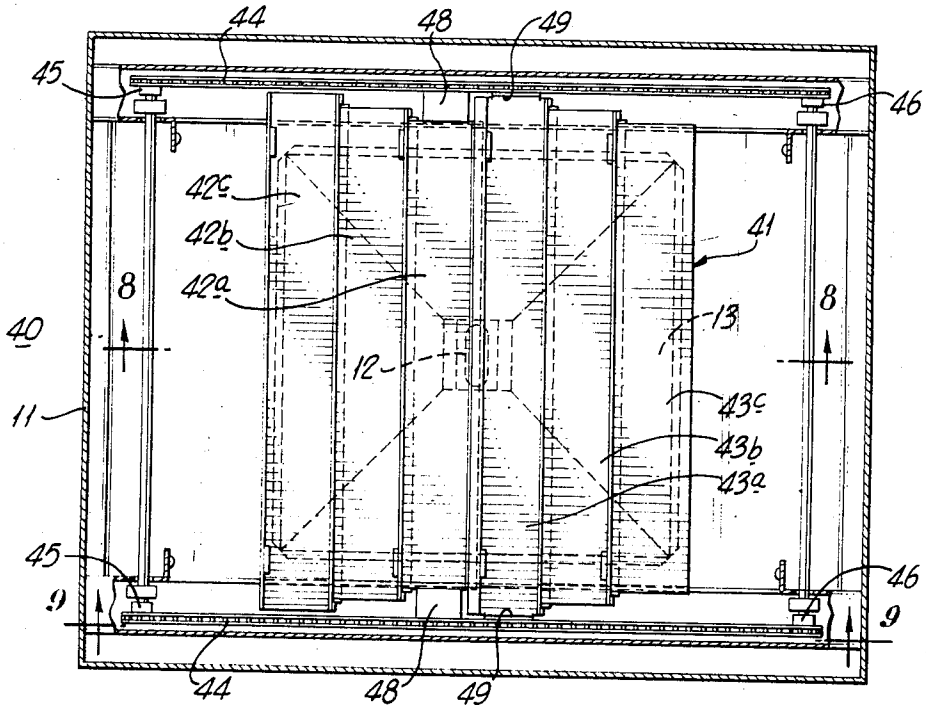
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[57] **ABSTRACT**

There is provided a contact printer comprising a cabinet having a high intensity light source mounted within the cabinet, with a reflector fixedly mounted in the cabinet for directing a uniform beam of light toward the top of the cabinet where a printing frame is pivotally mounted about a central axis thereof. Because of the mounting of the frame, the top side of the frame may be loaded and then the loaded side may be pivoted downwardly toward the light source. It is desirable to use a high intensity light source in a suitable spectrum range to provide rapid exposure of the sensitized materials. One such light source advantageously is maintained in a reduced standby condition when the materials are not actually being exposed. When the lamp is in such standby condition, a shade or curtain is closed over the lamp to prevent blinding of an operator during pivoting of the printing frame.

4 Claims, 21 Drawing Figures



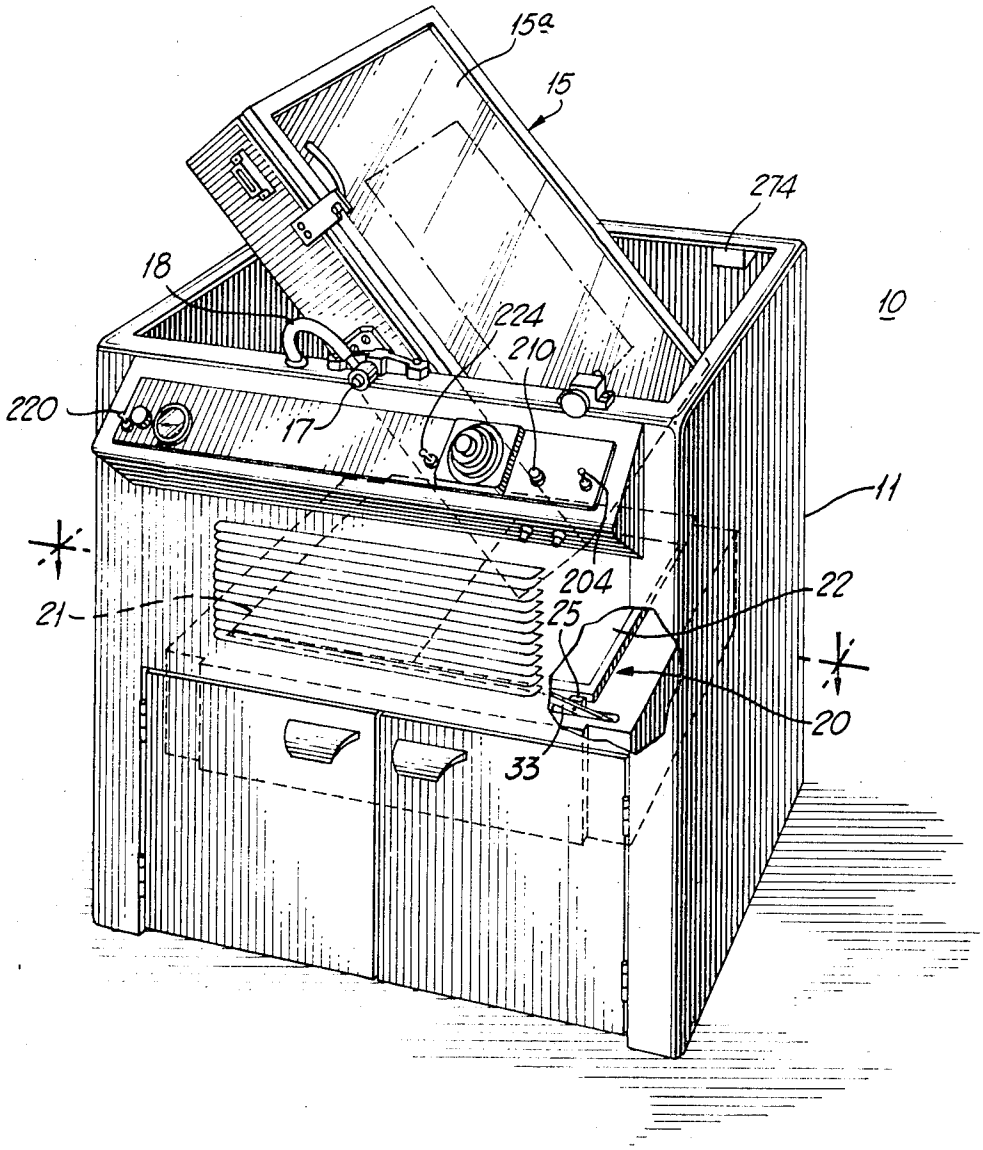


Fig. 1

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Fig. 2

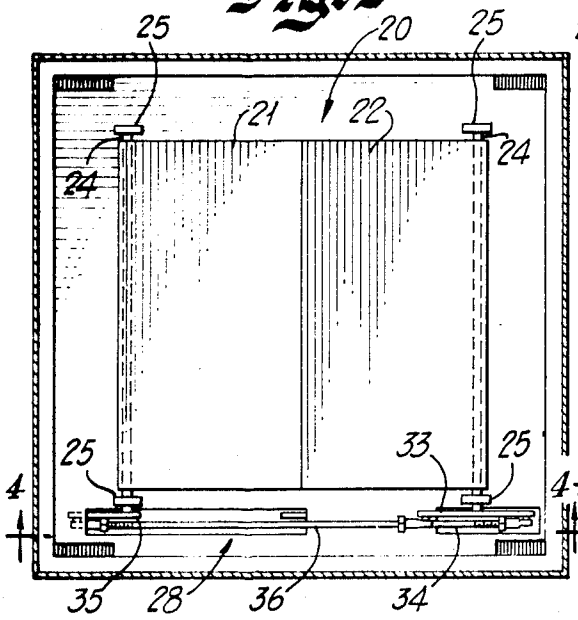


Fig. 3

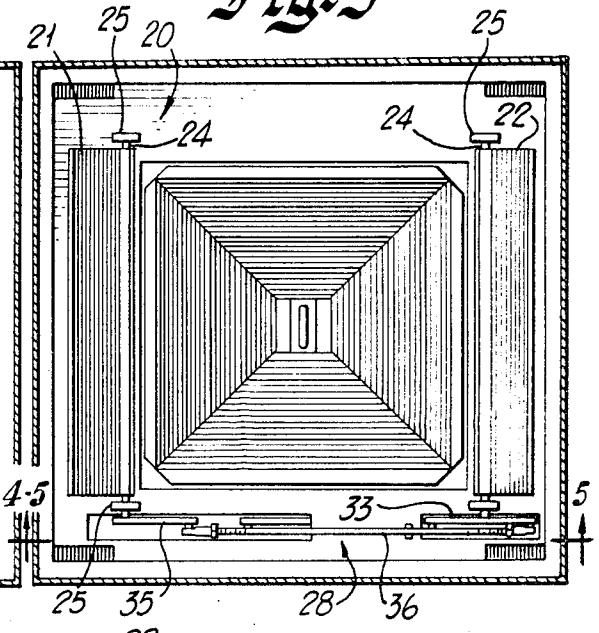


Fig. 4

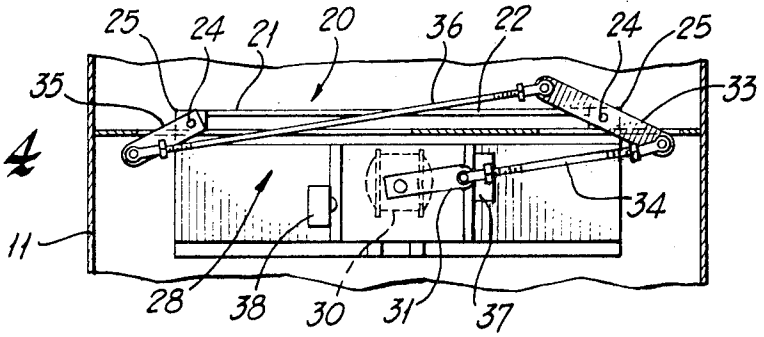
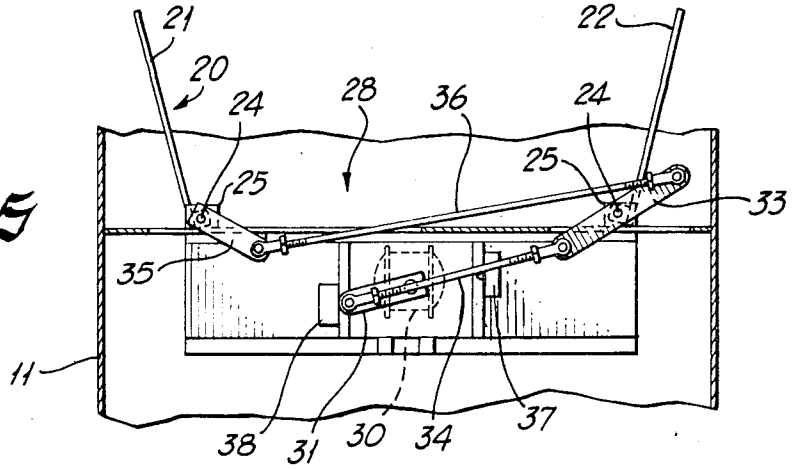


Fig. 5



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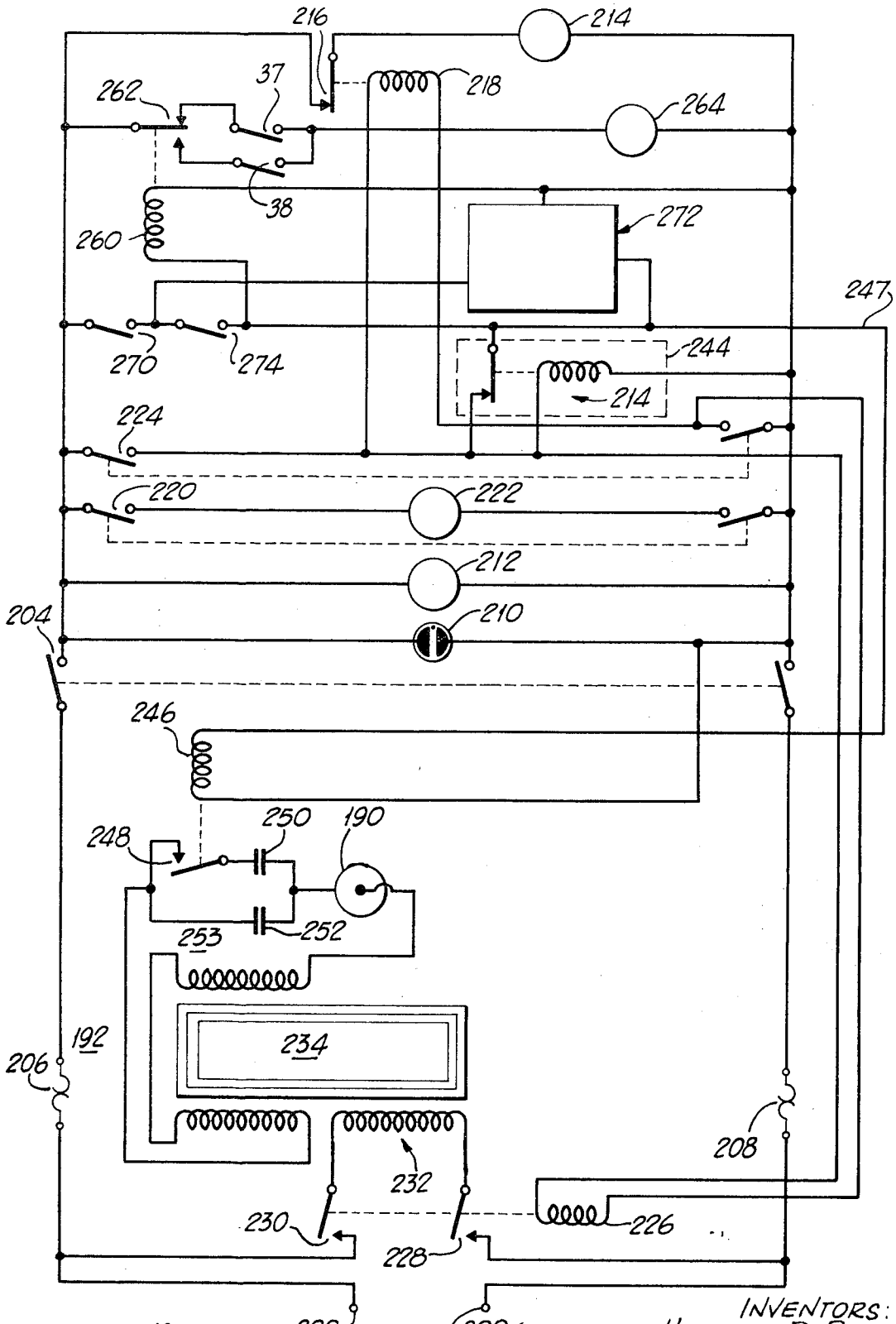


Fig. 6

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Fig. 7

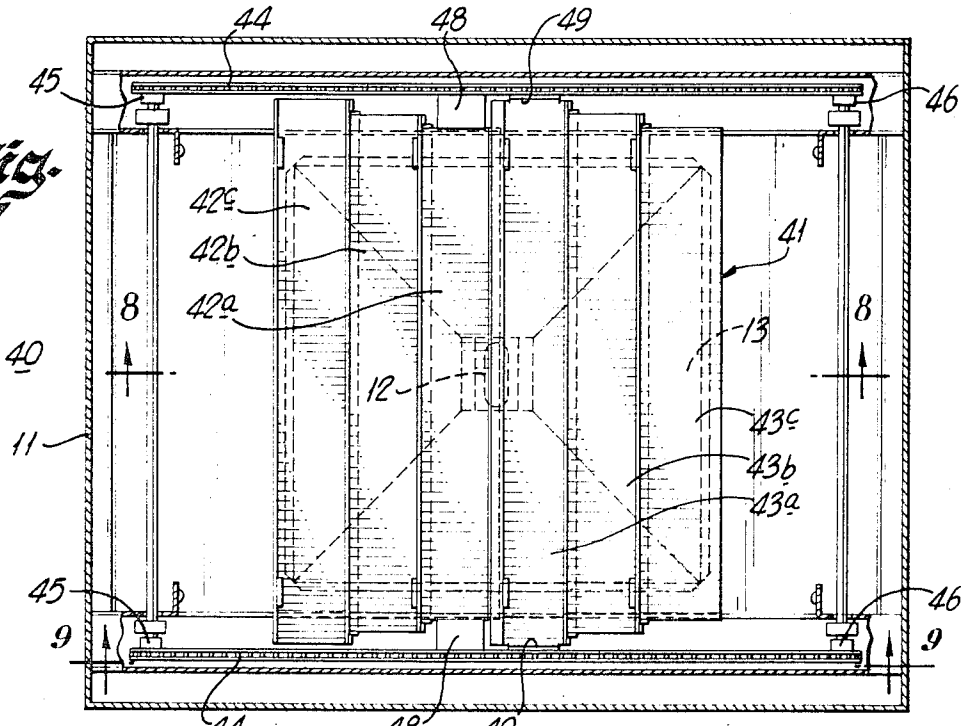


Fig. 8

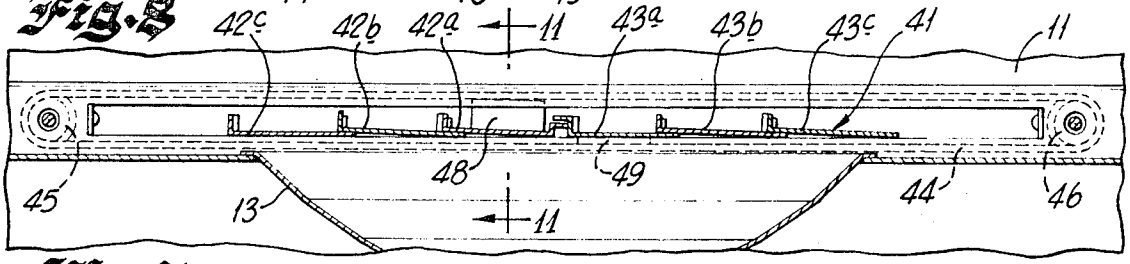


Fig. 9

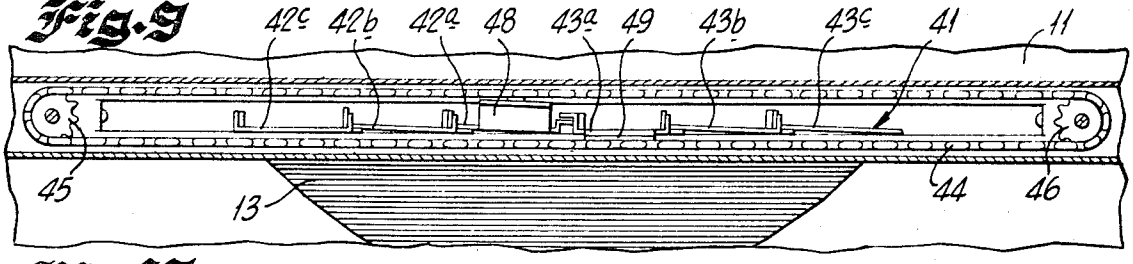


Fig. 10

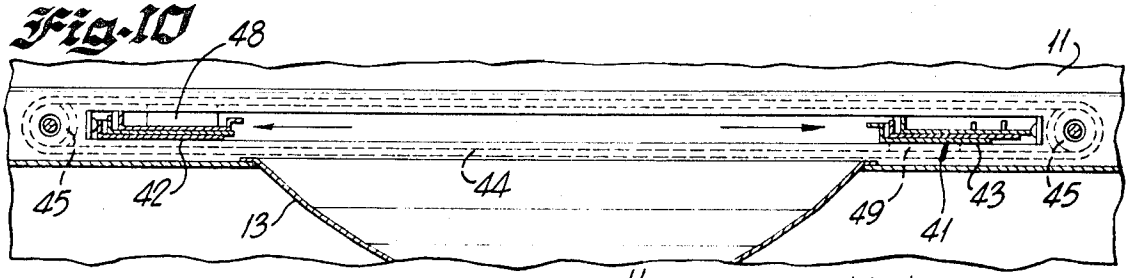
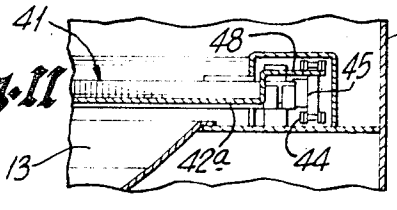


Fig. 11



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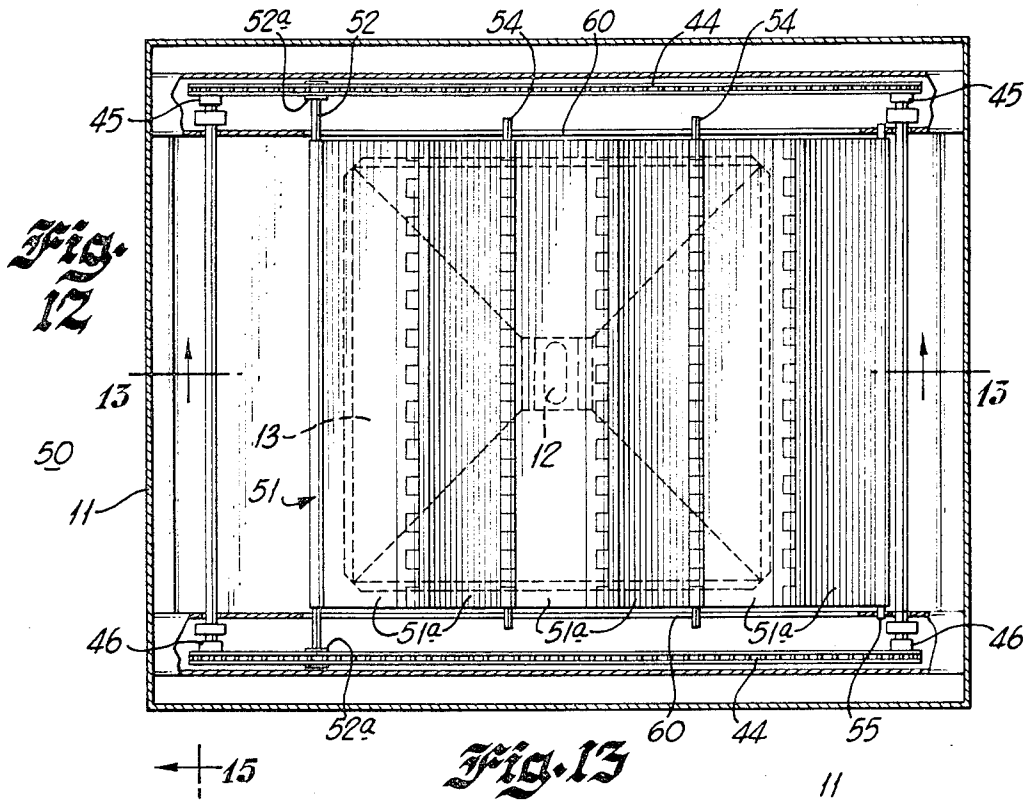


Fig. 12

Fig. 13

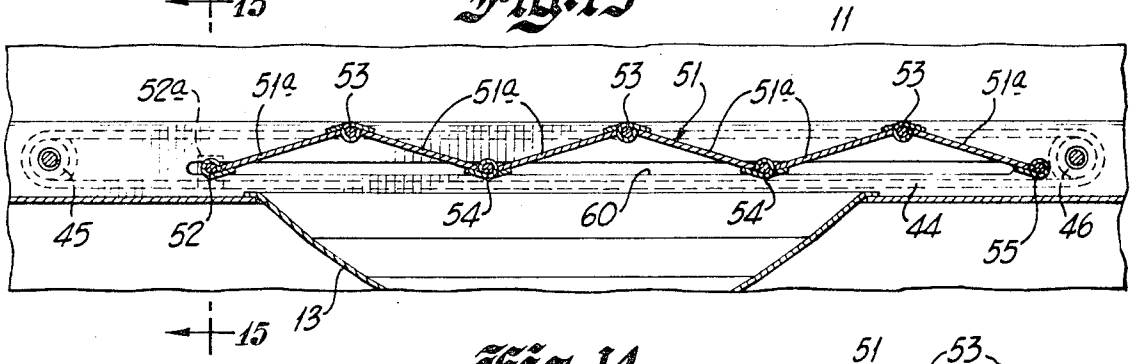
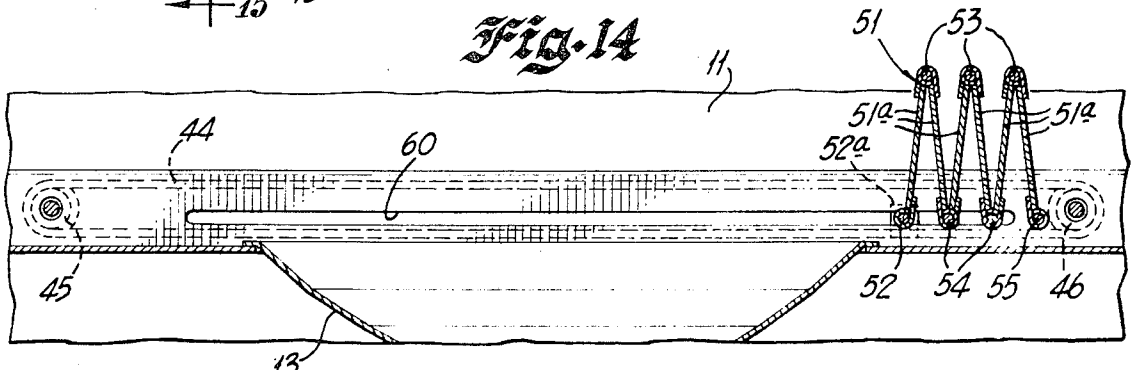


Fig. 14



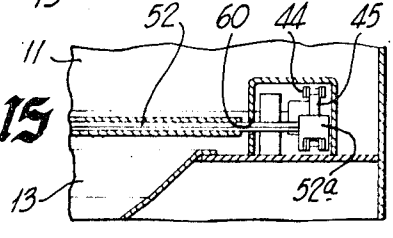


Fig. 15

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Fig. 16

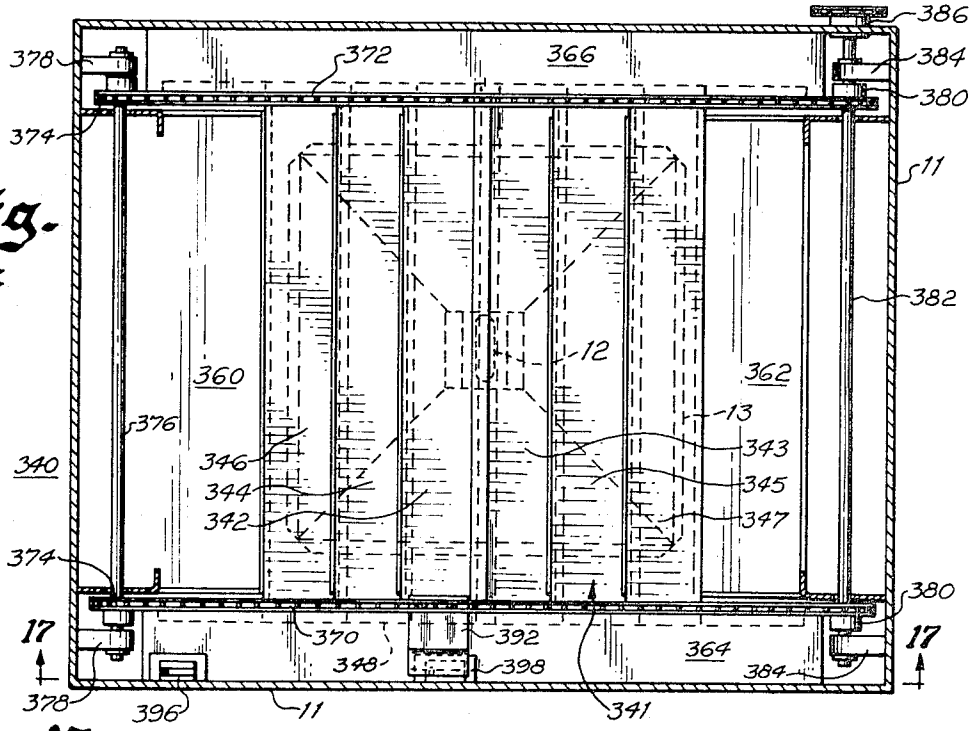


Fig. 17

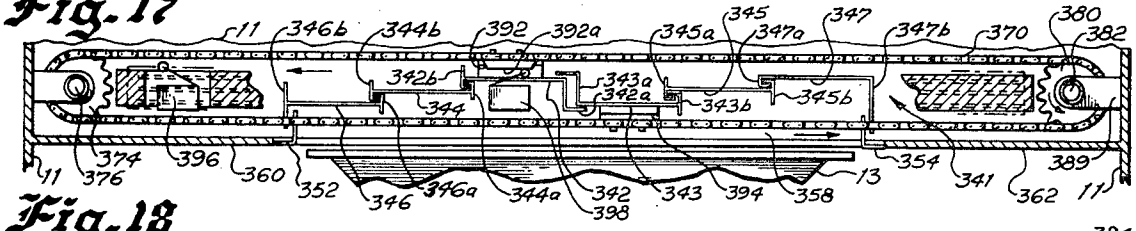


Fig. 18

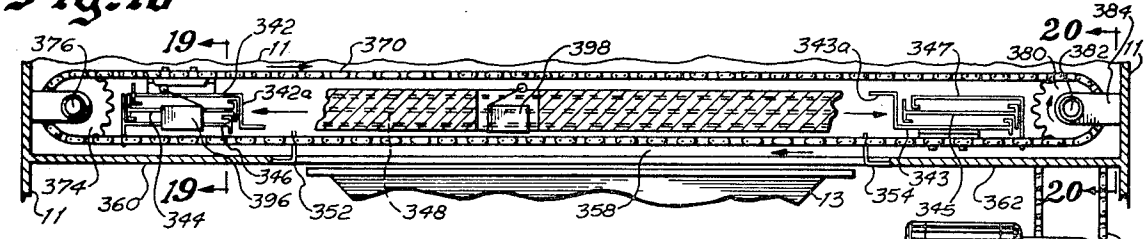


Fig. 19

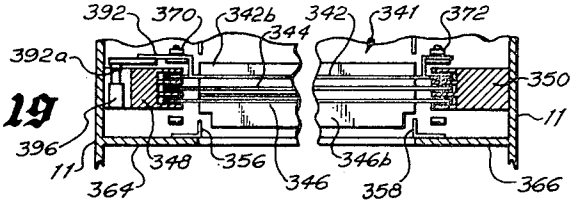
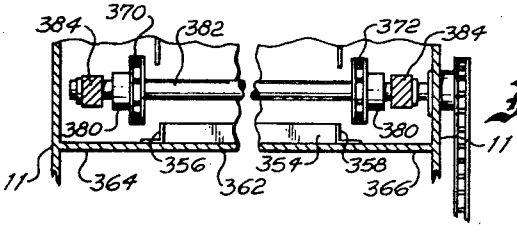


Fig. 20



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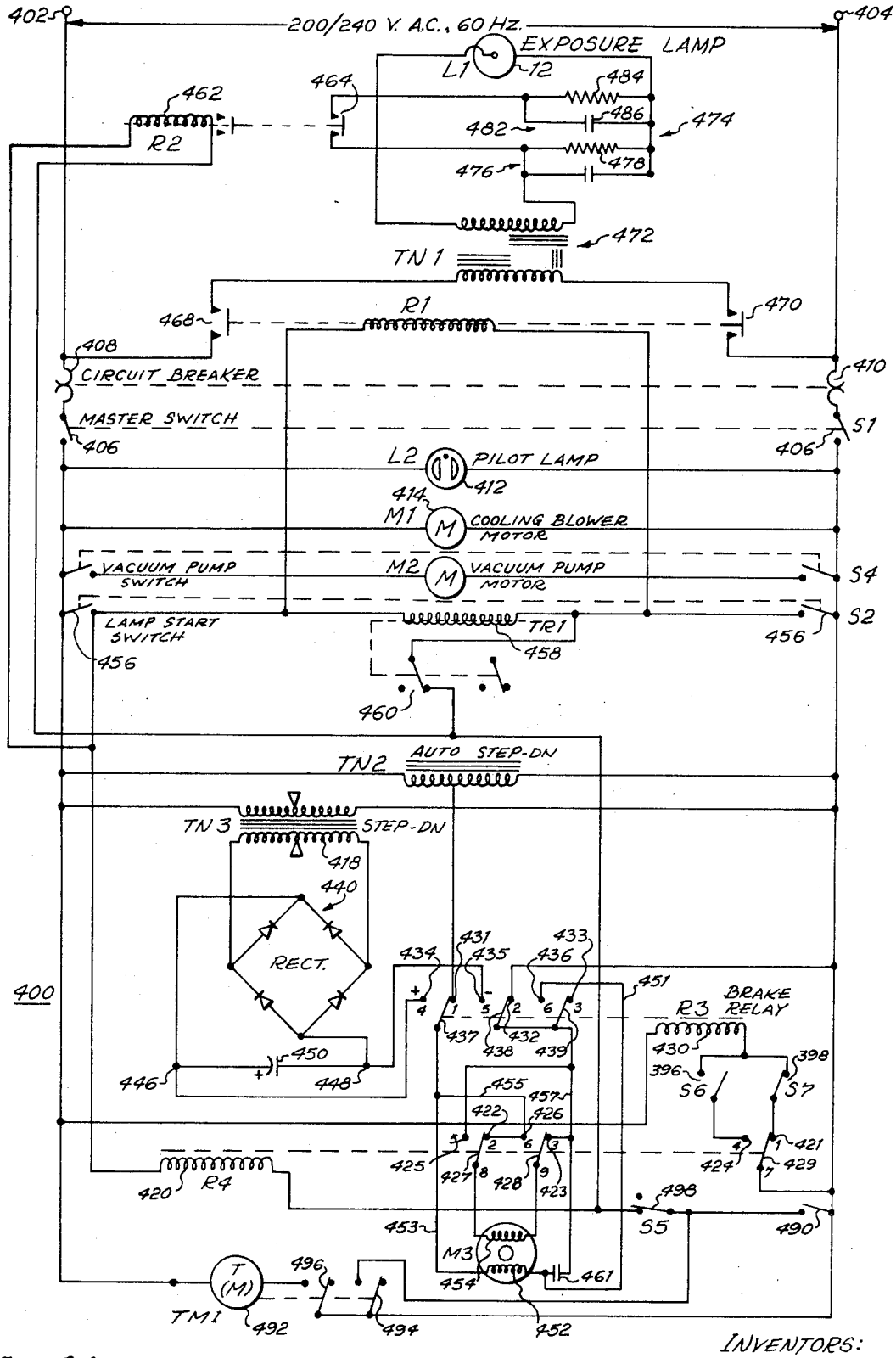


Fig. 21

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PHOTOGRAPHIC PRINTER

The present application is a continuation-in-part of application, Ser. No. 880,716, now abandoned filed Nov. 28, 1969.

The present invention relates to printers and, more particularly, to contact printers used for exposing sensitized materials. The present invention may be considered an improvement over the photographic printers illustrated in Letters Patent of the U.S. Pat. Nos., 3,043,204 and 3,266,403 granted to the inventor of the invention, , wherein there is disclosed a contact printer comprising a cabinet having a light source mounted in the cabinet and a reflector fixedly mounted in the cabinet for directing a uniform beam of light upwardly toward the top of the cabinet. A printing frame is pivotally mounted over the top of the cabinet about a central axis thereof. The frame may be pivoted to one position in which one side thereof is toward the light source, nd to a second position wherein that one side of the printing frame is toward the top of the cabinet away from the light source for loading and unloading of the materials therein. The frame may be of the single loading or double loading type, as disclosed in the above-mentioned patents.

Advantageously, it has become desirable to use a high intensity mercury vapor lamp as the exposure source in such photographic exposure machines. High intensity mercury vapor lamps preferably are maintained at a reduced intensity level when not actually in the process of exposing, so that they may be immediately brought to exposing intensity at the desired time. However, difficulty is experienced in the turning or flipping of the printing frame about its axis in that the light from the exposing source, although at a reduced level, may shine into the face of the operator causing temporary blindness and other disturbances. Accordingly, it is desirable to shield or shade the light source during its period of reduced intensity.

It is therefore an object of the present invention to provide a new and improved photographic printer.

A further object of the present invention is to provide an improved photographic printer in which the light source thereof is shielded when not at the exposing intensity.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty will be pointed out in the claims annexed to and forming a part of this specification.

In accordance with these and other objects, there is provided an improved printer for use in exposing sensitized materials and the like. The printer includes a cabinet having a source of exposing light mounted in the lower part thereof for directing light toward the top of the cabinet. A printing frame is pivotally mounted in the top of the cabinet for pivotal movement about a central axis of the frame, thereby permitting the positioning of the frame with either side thereof facing toward the light source. The light source may be of the mercury vapor type wherein it is desirable to maintain the lamp at a reduced intensity when in the standby position, and the intensity thereof is brought to exposure level during the actual exposing process. In accordance with the present invention, the light source is covered or shielded during the pivoting of the printing frame. The shielding of the light source prevents disturbances

of the light when the top of the printer is opened by the pivoting of the frame.

For a better understanding of the present invention, reference may be had to the accompanying drawings wherein:

FIG. 1 is a perspective view of an improved photographic printer according to the present invention;

FIG. 2 is a cross-sectional view of the photographic printing apparatus taken along line 2—2 of FIG. 1 and illustrated with the shutter mechanism thereof closed;

FIG. 3 is a cross-sectional view of the photographic printer apparatus of FIG. 1, taken along line 2—2 of FIG. 1, and illustrated with the shutter mechanism thereof open;

FIG. 4 is a fragmentary front view of the photographic printing apparatus illustrating the drive linkage for the shutter mechanism with the shutter in the closed position;

FIG. 5 is a fragmentary front view of the photographic printing apparatus of FIG. 1, illustrating the drive linkage for the shutter mechanism with the shutter in an open position;

FIG. 6 is a schematic circuit diagram for the improved photographic printer;

FIG. 7 is a cross-sectional view of a photographic printing apparatus according to another embodiment of the present invention, and illustrating the shutter mechanism thereof in a closed position;

FIG. 8 is a fragmentary sectional front view of the photographic printer of FIG. 7, taken along line 8—8 of FIG. 7;

FIG. 9 is a fragmentary front cross-sectional view of the photographic printing apparatus of FIG. 7, taken along line 9—9 of FIG. 7;

FIG. 10 is a fragmentary front cross-sectional view of the printing apparatus of FIG. 7, similar to that of FIG. 8, but illustrating the shutter mechanism thereof in an open position;

FIG. 11 is a fragmentary side cross-sectional view of the shutter mechanism according to the embodiment of FIG. 7, and taken along line 11—11 of FIG. 8;

FIG. 12 is a cross-sectional plan view of photographic printing apparatus according to yet another embodiment thereof illustrated with the shutter mechanism thereof in a closed position;

FIG. 13 is a fragmentary front cross-sectional view of the photographic printing apparatus of FIG. 12, taken along the line 13–13 of FIG. 12;

FIG. 14 is a fragmentary front cross-sectional view of the photographic printing apparatus of FIG. 12, illustrated with the shutter mechanism in the open position;

FIG. 15 is a fragmentary side sectional view of the shutter mechanism of FIG. 12, taken along line 15—!15 of FIG. 13;

FIG. 16 is a horizontal, cross-sectional view of a photographic printing apparatus in accordance with the features of the present invention according to another embodiment thereof and illustrating the shutter mechanism in a closed position;

FIG. 17 is a vertical, cross-sectional view taken substantially along line 17—17 of FIG. 16;

FIG. 18 is a vertical, cross-sectional view similar to FIG. 17 but illustrating the shutter mechanism in an open position;

FIG. 19 is a transverse, vertical, sectional view taken substantially along line 19—19 of FIG. 18;

FIG. 20 is a transverse, vertical, sectional view taken substantially along line 20—20 of FIG. 18, and

FIG. 21 is a modified, schematic, electrical diagram for use with the printing apparatus.

Referring now to the drawings, and particularly to the embodiment of FIGS. 1 to 6 thereof, there is provided in accordance with the present invention a photographic printer 10 comprising a generally rectangular cabinet 11 having a suitable light source including a printing lamp 12 (FIG. 3) mounted toward the bottom of the cabinet 11. Included in the cabinet 11 is a generally parabolic reflector 13 for directing the light from the lamp 12 in a beam of uniform intensity throughout a predetermined area toward a printing frame 15 pivotally mounted about the central axis thereof to the top of the cabinet 11. The printing frame 15 may be of any suitable type, and in the illustrated embodiment is similar to that more fully described in h prior Letters Patent of the U.S. Pat. No. 3,04204. However, briefly, the top of the frame 15, as shown in FIG. 1, comprises a loading station in which can be placed suitable sensitized material for exposure by the light from the lamp 12. The printing frame 15 may be pivoted from the position illustrated such that a translucent cover 15a may be opened and suitable sensitized material for exposure by the lamp 12 inserted therein. Thus the frame 15 may be loaded from the top, and after this has been done it is rotated through 180° so that the loading station faces toward the lamp 12. Following this, the lamp 12 is energized to an exposing illuminating level for a predetermined period of time to properly expose the sensitized material within the frame 15 with a light pattern corresponding to the light ad dark areas being copied. Upon completion of the exposure operation, the light is deenergized from the high exposing intensity level and the printing frame 15 is rotated 180° so that the cover 15a thereof may be opened to permit removal therefrom of the exposed sensitized materials.

The printing frame 15 may be of the type illustrated in the above mentioned patent wherein the frame is pivoted about horizontal pivots 17 so that the translucent cover 15*a* is turned upwardly for loading, and is pivoted through 180° downwardly during exposure. To this end, the printing frame 15 may be provided with a suitable vacuum blanket for firmly pressing the materials within the frame together, and maintaining close contact thereof. A vacuum line 18 connects with the horizontal pivot 17 to provide a vacuum connection to the printing frame 15.

The lamp 12 is of the mercury vapor type, being extremely effective for the exposing process, both as to the intensity of illumination and to the spectral wavelength of its emissions. Lamps of this type require a finite starting or warmup time. Accordingly, means are provided for maintaining the lamp 12 at a reduced illumination level for standby conditions. Thus, when it is desired to expose the lamp 12, the lamp may be immediately brought to exposing intensity from the standby level. In one particular commercial embodiment, the lamp 12 is energized with 1,500 watts during exposing thereby, and the energization is reduced to 500 watts during standby condition of the lamp 12.

Although the lamp 12 is energized to the reduced standby level of illumination during the flipping or rotation of the printing frame 15 between its loading and its printing position, nevertheless the standby level of illumination of the lamp 12 can be disturbing to an operator. Accordingly, in accordance with the present invention, there is provided a shutter assembly 20 which opens during exposure of the frame 15, but which is closed intermediate the light source 12 and the top of the cabinet 11 during the standby condition of the lamp 12. More specifically, and as best illustrated in FIGS. 2 through 5, the shutter arrangement as therein illustrated comprises a pair of shutter doors or leaves 21 and 22, each mounted adjacent an outer edge to a hinge pin 24 journaled within suitable supports 25. The hinge pins 24 may be pivoted by suitable drive mechanism 28 so as to swing the shutter doors 21 and 22 from the closed position illustrated in FIGS. 2 and 4 to an open position illustrated in FIGS. 3 and 5.

The drive mechanism 28 includes a suitable rotary motor 30 driving a crank 31, which in turn is connected to a first crosshead 33 by a connecting rod 34. The crosshead 33 in turn is connected to a second crosshead 35 by a connecting link 36 in a manner such that the crossheads 33 and 35 pivot simultaneously but in opposite directions. The crank 31 of the motor 30 is positioned to control the rotation of the motor 30, and to this end a first position responsive switch 37 is activated by the drive mechanism 28 when the shutter doors 21 and 22 are closed, as best illustrated in FIG. 4, and a second position responsive switch 38 is activated by the drive mechanism 28 when the shutter doors 21 and 22 are open, as best illustrated in FIG. 5. Thus the shutter doors 2 and 22 will be opened by approximately a one-half turn of the rotary motor 30, until the crank 31 thereof strikes the switch 38, and will close through approximately a one-half turn of the rotary motor 30 until the crank arm 31 thereof strikes the switch 37.

FIG. 6 illustrates schematically a circuit diagram for carrying out the functions of the printer. More specifically, referring to FIG. 6, the circuit therein is illustrated with the power to the printer 10 turned off. The shutter assembly 20 is closed when the power to the printers is off. The unit contains a plurality of switches and relays to control the operation of the shutter assembly and the lamp 12 which in turn is controlled by a power supply 192.

The circuit is impressed with a voltage across a pair of terminals 200 and 202, that, in a particular commercial embodiment, may range from 200 to 240 volts at 60 cycles single phase without affecting the operation of the printer. The circuit is energized by closing a switch 204 located on the control panel of the printer. Circuit breakers 206 and 208 are included in series with switch 204 to protect the printer against faults that may occur during operation. Upon the closing of the switch 204, a pilot light 210 located in the central panel is turned on to indicate that the printer is energized. In addition, an exhaust blower motor 212 is activated, and a lamp cooling blower 214 is energized through a normally closed contact 26 controlled by a coil 218. The closing of a switch 220 energizes a vacuum pump motor 222 which establishes the desired vacuum pressure within the printing frame 15.

After the switch 204 is closed, a lamp switch 224 (also located on the control panel) may be closed in order to energize the coil 226 and close the contacts 228 and 230. Upon the closing of contacts 228 and 230, a primary winding coil 232 is energized in a transformer 234 which supplies power to the lamp 12. Since a time-delay relay 244 is normally closed, the closing

of switch 224 energizes coil 246 through conductor 247 and capacitor contact 248 closes, establishing a capacitor 250 in parallel relation with a capacitor 252. The impedance of a series circuit 253 including the parallel combination of capacitors 250 and 252, the lamp 12 and the transformer 234 is less when the capacitor 250 is in circuit 253. Therefore, the lamp 12 is at a full or exposure level intensity during starting and warmup. The relay 244 opens after a time-delay, such as 50 seconds after switch 244 is closed, de-energizing coil 246 and thereby opening contact 248. With capacitor 250 eliminated from the series circuit 253, the impedance is increased, and the lamp 12 is maintained at a lower intensity. Also, upon the closing of lamp switch 224, coil 218 opens contact 216 so that the lamp cooling blower 214 is turned off and does not retard the warmup of lamp 12.

During warmup, the shutter assembly is opened to allow proper heating of lamp 12 by energizing coil 260. Upon the energization of coil 260, a switch 262 is moved to its alternate position so that the shutter moor 30 is activated through a closed limit switch 38 and the shutter 20 is opened. When the shutter has fully opened, switch 38 opens and the shutter motor 30 is turned off. When the relay 244 is open, after the 50 second warmup period, coil 260 is de-energized and switch 262 returns to its initial position so that the shutter motor 30 is now energized, closing the shutter 20 through the limit switch 268 that has been closed upon the opening of the shutter and which opens when the shutter has closed.

When it is desired to expose the frame 15 manually, the manual expose switch 270 is closed energizing coil 260 so that the shutter motor 30 being activated through closed switch 38 opens the shutter. The closing of switch 270 also energizes coil 246, closing the contact 248 so that the capacitor 250 is in parallel relation with the capacitor 252 and the intensity of lamp 12 is returned to its full exposure intensity. The manual expose switch 270 is kept closed until the exposure time is completed. Upon the opening of switch 270, coil 246 is de-energized causing lamp 12 to return to its lower intensity standby state by the elimination of the capacitor 250 from the lamp circuit 253. Simultaneously, coil 260 is de-energized allowing switch 262 to return to its original position and the shutter motor 30 is activated through the switch 37 closing the shutter.

A timer 262 is in parallel relation with the manual expose switch 275 and can be used to automatically expose a print for a specified time. A safety switch 274 is inserted in series with switches 270 and 272 so that exposure cannot occur when the frame 15 is not closed to expose position.

FIGS. 7 through 11 illustrate an embodiment of the invention wherein the shutter mechanism comprises a plurality of overlapping leaves and installed in a photographic printer similar to that heretofore described. Accordingly, similar parts of the photographic printer of the embodiment of FIGS. 7 and 11 and of the embodiment of FIGS. 1 through 6 will be identified by the same reference numerals. Referring now to the embodiment of FIGS. 7 through 11, there is provided in accordance with the present invention, a photographic printer 40 including the generally rectangular cabinet 11 provided with a suitable light source including the printing lamp 12, FIG. 7, mounted toward the bottom of the cabinet 11. Included in the cabinet 11 is the reflector 13 for distributing the light from the lamp 12 in a beam of uniform intensity throughout a predetermined area toward a printing frame (not shown in FIGS. 7 through 11) movably mounted across the top of the cabinet 11. it will be understood that, as heretofore described, the printing frame may be moved between a loading position and an exposing position in the manner heretofore described. Moreover, preferably, the lamp 12 will be reduced to a standby level of illumination whenever the printing frame is moved from the exposing position. Thus, although the lamp 12 is energized to the reduced standby level during movement of the printing frame between its loading and its printing position, nevertheless the standby level of illumination of the lamp 12 can be disturbing to an operator. Accordingly, in accordance with the present invention, there is provided a shutter assembly 41 which opens during exposure of the printing frame, but which is closed intermediate the light source 12 and the top of the cabinet 11 during the standby condition of the lamp 12. More specifically, the shutter assembly 41, as illustrated in FIGS. 7 through 11, comprises two sets 42, 43 of leaves, individually identified as 42*a*, 42*b*, 42*c*, and 43*a*, 43*b*, 43*c*. Each of the leaves is of somewhat L-shape, having a short upstanding leg and interlocking with suitable projections of the adjacent leaf so that the leaves may be extended to form a closed shutter, as illustrated in FIGS. 7, 8, and 9, or may be retracted in overlapping relation, as illustrated in FIG. 10, to provide open shutter.

The drive mechanism for the shutter assembly 41 includes a suitable reversible motor driving a pair of chains 44 over spaced sprockets 45, 45 defining spaced upper and lower runs of the chain 44. The innermost leaf 42a of one set of the leaves 42 has its edges secured to the upper run of the chain 44 by a suitable connecting portion 48, while the innermost leaf 43*a* of the other set 43 has connecting portions 49 secured to the lower run of the chain 44. Thus, as the upper run of the chain moves to the left, as viewed in FIGS. 7 through 10, the lower run thereof will move to the right and the shutter mechanism 41 will open from the position illustrated in FIGS. 7, 8, and 9 to the position illustrated in FIG. 10. Reversal of the directions of movement of the chain 44 will close the shutter by reversing the travel of the leaves 42 and 43.

Opening and closing of the shutter mechanism 41 will be under the combined control of the position of the printing frame and by suitable position responsive switches actuated by the position of the shutter mechanism 41, in a manner similar to that more fully described in connection with FIG. 6. 15, there is illustrated yet another form of shutter arrangement for use in a photographic printer according to the present invention. Accordingly, similar components of the embodiment of FIGS. 12 through 15 and of the preceding embodiments will be identified by the same reference numerals. Referring now to FIGS. 12 through 15 there is provided, in accordance with the present invention, a photographic printer 50, similar to the photographic printer 50 heretofore described and including the cabinet 11 having a suitable light source including the printing light 12, FIG. 12, mounted toward the bottom of the cabinet 11. Included in the cabinet 11 is the reflector 13 for directing the light from the lamp 12 in a beam of uniform intensity throughout a predetermined area toward a printing frame (not shown in FIGS. 12

through 15) movably mounted across the top of the cabinet 11. The printing frame may be of the type previously described and is movable between an exposing position and a loading position. Lamp 12 may be of the mercury vapor type, being extremely effective for the exposing process and connected to be maintained at a reduced illumination level or standby level of intensity when it is not being used for exposure. Thus, the lamp 12 is energized to the reduced standby level of illumination during movement of the printing frame between its loading and its printing position. Nevertheless, this reduced level of illumination of the lamp 12 can be disturbing to an operator. Accordingly, in accordance with the present invention, there is provided a shutter assembly 51 which opens during exposure of the printing frame, but which is closed intermediate the light source 12 and the top of the cabinet 11 during the standby condition of the lamp 12. More specifically, the shutter assembly 51, as illustrated in FIGS. 12 through 15, comprises a plurality of shutter leaves 51*a* connected at their adjacent edges by suitable hinge pins 52, 53, 54, and 55. The shutter mechanism 51 is movable between a closed position, illustrated in FIGS. 12 and 13, to an open position, illustrated in FIG. 14, wherein the individual leaves 51a move in accordion style to clear the opening of the reflector 13.

The drive mechanism for the shutter assembly 51 includes a pair of chains 44 at the front and rear of the cabinet 11 and fitted over the spaced sprockets 45, 46. An outer end leaf 51*a* of the shutter mechanism 51 is connected to one of the chain runs, as best illustrated in FIGS. 12 and 15, and the leaf at the opposite end of the shutter is connected to the pin 55 which is pivotally secured to the walls of the cabinet 11. Additionally, alternate ones of the pins, illustrated as pins 54, have their ends slidably received within spaced parallel slots 60 in the cabinet 11 to provide guiding movement thereof. Thus, upon movement of the chain 44, such that the lower run thereof moves to the right, as viewed in the drawings, the hinge block 52*a* carrying the hinge pin 52 will move to the right, and will fold the shutter mechanism 51 in accordion style, as illustrated in FIG. 14. Reversal of the direction of travel of the chain 44 will close the shutter mechanism to the position illustrated in FIGS. 12 and 13.

The chain 44 is driven automatically upon movement of the printing frame between its loading and exposing positions, and the chain is stopped under the control of suitable position-responsive switches similar to the arrangement illustrated and described with reference to FIG. 6.

Thus it will be seen that there is provided an improved photographic printer wherein advantageously the printing lamp is maintained in a standby position of reduced intensity during idle periods of the printer, so that the lamp may be promptly brought to exposure intensity to provide the shortest exposure time. Advantageously, the shutter assembly automatically closes off the light when the lamp is on the standby position so that the bright light is not directed toward an operator. The shutter assembly automatically opens when the light is brought to exposure intensity to provide exposure of the sensitized materials.

The shutter mechanisms of the embodiments of FIGS. 7 through 20 are substantially planar assemblies in contrast to the pivotal shutter panels of the embodiment of FIGS. 1 through 6. In consequence, the latter embodiments require less vertical spacing between the shutter mechanism and the printing frame than the former.

FIGS. 16 through 21 illustrate yet another embodiment of the invention employing a modified shutter mechanism and electrical circuit. Similar parts of the printing apparatus of FIGS. 16 through 21 and those of prior embodiments will be identified by the same reference numerals and only the differences will be described in detail.

In accordance with the invention, there is provided a modified embodiment of a photographic printer designated with the numeral 340 (FIG. 16) and including a generally rectangular cabinet or housing 11 having a suitable light source therein including a printing lamp 12 adjacent the bottom portion thereof. The lamp 12 is adapted to provide a light source for the printing apparatus and a reflector 13 in combination therewith generates an upwardly directed light beam of relatively uniform intensity throughout. The light beam has a cross section of predetermined area and is directed towards a printing frame, not shown, which is mounted on the top of the cabinet 11. It should be understood that as heretofore described, the printing frame may be moved between a loading position and exposing position. Moreover, the lamp 12 is reduced to a standby level of illumination whenever the printing frame is moved out of the exposing position. The lamp is thus energized to a reduced or standby level during the movement of the printing frame between its loading and its printing position, but even so the standby level can be disturbing to an operator when aligning copy materials on the printing frame.

In accordance with the present invention, there is provided a modified shutter assembly indicated generally as 341 in FIGS. 16, 17, and 19 which opens during exposure of the printing frame and which is closed between the light source 12 and the top of the cabinet during a standby condition of the lamp when the frame is moved out of the exposing position. The shutter assembly 341 includes a plurality of sliding shutter members which are nested together in a unique manner in order to preclude the possibility of any slight leakage when the shutter assembly is closed. The assembly includes a pair of closing leading edge members 342 and 343, respectively, intermediate shutter members 344 and 345, respectively, and outer shutter members 346 and 347, respectively.

The shutter panels or leaves 342, 344, and 346 make up one half of the shutter assembly and are interconnected to move together when the shutters are opened or closed. Shutter leaves 343, 345, and 346 form the other half of the shutter assembly and, likewise, move together when the shutter is opened or closed. Each of the shutter members includes a horizontal planar web section having outer ends which are slidable within longitudinal grooves provided in a pair of shutter supporting side rails 348 and 350, respectively. Shutter panels 343 and 346 are slidable in the lower grooves in the guide members 348 and 350, while the intermediate panels 344 and 345 are slidable in the intermediate grooves. The shutter panels 342 and 347, on the other hand, slide in the upper grooves in the respective side members 348 and 350, as best shown in FIGS. 17, 18, and 19.

For the purpose of insuring that there is no light leakage between the shutter panels 342 and 343 when the

shutter is closed, the shutter panel **342** includes a downwardly extending flange portion **342a** along its leading edge. The flange portion **342***a* takes the form of an angle in cross section and is adapted to cooperate with a similar but upwardly extending flange portion **343***a* provided on the leading edge of the closing shutter panel **343.** The rearward edges of the shutter panels **342** and **343** are provided with interlocking flange members **342***b* and **343***b*, respectively, which are adapted to interlock with leading edge flange portions **344***a* and **345***a*, respectively, on the intermediate shutter panels.

As best shown in FIG. **17,** it is seen that the interlocking flange portions **344***a* and **342***b* on the one hand and **345***a* and **343***b* on the other hand, along with the leading edge interlocking arrangement between the flanges **342***a* and **343***a*, provide means for insuring that no light leakage exists when the shutter is in the closed condition. The intermediate shutter panels **344** and **345** are provided with similar angle flange arrangements **344***b* and **345***b*, respectively, along their rearwardly facing edges for interconnection with flanges **346***a* and **347***a*, respectively, on the outermost shutter panels **346** and **347.**

The outer edges of the outer shutter panels **346** and **347** are provided with vertical end flanges **346***b* and **347***b*, respectively, which serve as limit stops and are engageable within respective shutter opening defining framing angles **352** and **354.** The shutter framing angles **352** and **354** are provided around the inner edges of a pair of light blocking, horizontal panels **360** and **362.** Similarly, a pair of angles **356** and **358** (FIGS. **19** and **20**) are provided along transverse edges at the inner edges of horizontal light blocking panels **364** and **366.** The light blocking panels **362, 364** and **366** project inwardly from the vertical sidewalls of the housing **11** and define the shutter opening which is bordered by the upstanding angles **352, 354, 356,** and **358,** respectively. The shutter assembly **341** is adapted to open and close the opening so that light from the lamp **12** and reflector **13** can be controlled to selectively illuminate the printing frame.

In accordance with the invention, the shutter assembly is opened or closed by means of a pair of endless chain loops indicated generally as **370** and **372.** The chain loops are trained around idler sprockets **374** carried on an idler shaft **376,** and the idler shaft is supported in the housing **11** by a pair of pillow block type bearings **378.** Opposite ends of the endless chain loops **370** and **372** are trained around drive sprockets **380.** The drive sprockets **380** are mounted on a common drive shaft **382** which is supported in a pair of pillow block bearings **384** mounted in the housing **11.** The shaft **382** projects outwardly through an opening in the housing sidewall and a sprocket **386** is mounted thereon for driving connection through a chain **388** to a gear motor **390** (FIG. **18**).

The gear motor **390** is reversible and rotates the drive shaft **382** at a relatively low speed. The shutter assembly **341** is in the closed position, as shown in FIGS. **16** and **17,** and when it is desired to open the shutter, the drive sprockets **380** are rotated by the drive motor **390** in a counterclockwise direction. The upper runs of the chains are connected to the opposite ends of the shutter panel **343** by connector brackets **394** (FIG. **17**). Counterclockwise rotation of the drive sprockets **380** causes the upper runs of the drive chains to move to the left and the lower runs to move to the right. This carries the leading edge shutter panels **342** and **343** in a similar direction and, as they move away from each other, the leading edge flanges **342***a* and **343***a* of the panels eventually engage the leading edge flanges on the respective intermediate panels **344***a* and **345***a*. When this occurs, the intermediate panels also are carried along with the outwardly moving leading edge panels. Similarly, when the edge flanges **344***a* and **345***a* of the intermediate panels engage the leading edge flanges of the respective outer panels **346***a* and **347***a*, these panels also are carried along outwardly to the shutter open position of FIG. **19** wherein each set of panels making up one-half of the shutter assembly is arranged in a nested position, as shown.

In order to stop the drive chains **370** and **372** when a shutter is fully open, an open limit siwtch **396** is mounted outwardly of the center of the shutter assembly for engagement by a cam member **392***a* on the bracket **392,** best shown in FIG. **17.** When the cam **392***a* touches the operator of the limit switch **396,** power to the drive motor **390** is shut off.

When it is desired to close the shutter assembly, the motor **390** is re-energized to drive the sprockets **380** in a clockwise direction. When this occurs, the lower runs of the drive chains **370** and **372** move to the left while the upper runs move to the right (FIG. **18**). As this occurs, the brackets **392** and **394** cause the leading edge shutter panels **342** and **343** to start moving towards one another. The trailing edge flanges **342***b* and **343***b* engage the leading edge flanges **344***a* and **345***a* on the respective intermediate panels **344** and **345** and carry these panels toward one another along with the leading edge panels. The edge flanges **344***b* and **345***b* engage the leading edge flanges **346***a* and **347***a* on the outer shutter panels **347,** and these panels likewise begin to move toward the closing position. Movement of the panels toward the closed position continues until the leading edge flange portions **342***a* and **343***a* of the leading edge shutter panels engage one another in a light blocking, closed position, as shown in FIG. **17.** As this occurs, the cam **392***a* engages the operator of a closing limit switch **398** and shuts off power to the drive motor **390.**

While the operation of the shutter assembly has been described in some detail, it will be appreciated that the leading edge and trailing edge flange portions on the shutter panels cooperate to prevent light leakage and, in addition, cooperate to mechanically move the shutter panels when opening and closing the shutter assembly. Preferably, the shutter panels are formed of integral, lightweight, metal extrusions and the leading edge and trailing edge flange portions terminate short of the outer ends of the horizontal webs of the panels, which ends slide within the recesses or grooves of the guide members **348** and **350,** as best shown in FIG. **19.** While the operation has been described in great detail, it will be appreciated that opening and closing of the shutter assembly takes only a matter of a few seconds.

Referring now to FIG. **21,** therein is shown a schematic diagram of a control circuit for the photographic printer **340,** which circuit is generally indicated as **200.** As illustrated, all the relays and switches are in the circuit in the turned off or de-energized condition and the shutter assembly **341** is closed. The control circuit **400** is connectable through a pair of terminals **402** and **404** to an appropriate power supply, such as a 60 HZ, sin-

gle-phase, power supply having a design voltage in the range from 200 to 240 volts A.C. The circuit controls the intensity of the exposure lamp **12** so that the lamp is only in its full intensity condition after its warmup cycle and during exposure of sensitized material on the printing frame.

When it is desired to turn on the printer and thereafter initiate a warmup cycle for the exposure lamp **12**, a double pole master switch **406** is closed so that power is supplied to the control circuit **400** from the terminals **402** and **404** through a pair of circuit breakers **408** and **410**, respectively. Closing of the master switch **406** energizes a pilot light **412**, a cooling blower motor **214** which circulates air through the printer housing, and a pair of step-down transformers **416** and **418**, but does not energize a polarity relay **420** having pairs of contacts **421** through **426** and switch armatures **227**, **228**, and **229**. Additionally, closing of the master switch **406** does enable the energization of a brake relay **430** having pairs of contacts **431** through **436** and switch armatures **437**, **438**, and **439** through a holding circuit including the "shutter closed" limit switch **398** and the closed contact **421** and switch armature **429** of the relay **420**.

When the step-down transformer **418** is energized, a rectifier **440** provides a supply of D.C. potential through output terminals **446** and **448** having a capacitor **450** connected therebetween for filtering the D.C. output. The terminal **446** is maintained at a relatively positive potential and is directly coupled to the contact **434**, whereas the terminal **448** is maintained at a relatively negative potential and is directly coupled to the contact **435**.

The energization of the relay brake **430** closes the switch armature **437** against the contact **434**, the switch armature **438** against the contact **435**, and the switch armature **439** against the contact **436**, so that the D.C. potential appearing across the terminals **446** and **448** is supplied to a first winding **452** of the shutter drive motor **390** through a line **451** and a line **453**. In addition, the D.C. potential is supplied to a second winding **454** of the drive motor **390** through the leads **453** and **455** and closed contact **422** and switch armature **434** on the one hand, and through a line **457** and the closed contact **435** and switch armature **438** on the other hand. With the polarity relay **420** energized, the D.C. potentials applied to the windings **452** and **454** of the motor **390** are of the same polarity so that an effective dynamic braking force is maintained and the shutter assembly **341** is held in the closed position.

The warm up cycle for the exposure lamp **12** is then initiated and is activated by the closing of a double pole lamp start switch **456** which energizes a relay **458** having a normally closed switch **460**. The relay **458** is of a time delay type so that the switch **460** remains closed for a specified delay period of time (such as for two minutes) after the relay **458** is energized. In addition, the closing of the lamp start switch **456** energizes the polarity relay **420** through the closed switch **460**. As a result of the relay **420** being energized, the contact between the switch armature **429** and terminal **421** is broken and the brake relay **430** is then de-energized.

When the relay **430** is de-energized, the contact between switch terminals **434**, **435**, **436** and the adjacent switch armatures **437**, **438**, and **439** is opened and the output terminals **446** and **448** of the rectifier **440** are no longer connected to the windings **452** and **454** of the shutter drive motor **390**. On the other hand, contact is established between terminals **431**, **432**, and **433** and the respective switch armatures **437**, **438**, and **439**, and this enables the step-down transformer **416** to supply power to the winding **452** of the shutter drive motor **390** through the lead **453** on one hand and the lead **457** on the other through capacitor **461**. The winding **454** is also energized through the contact and switch armature pairs **425**, **427**, and **426**, **428**. With the A.C. power supplied to the windings **452** and **454**, the shutter drive motor **390** runs in a direction causing the shutter assembly **341** to open. When the shutter opens,the limit switch **398** is then opened.

The initial closing of the lamp start switch **456** also supplies power through the closed switch **460** to a lamp relay **462** which closes a switch **464** and also energizes a relay **466** so that a pair of switches **468** and **470** are closed to supply power to a lamp power supply transformer **472**. The transformer **472** in turn supplies the exposure lamp **12** with power through an appropriate lamp intensity control circuit **474**.

The lamp control circuit **474** contains a first parallel combination **476** including a resistor **478** and a capacitor **480**, which combination **476** is in series relation with the exposure lamp **12** and the output of the transformer secondary. Because the switch **464** is closed, a second parallel combination **482**, including a resistor **484** and a capacitor **486**, is maintained in the lamp circuit **474** in parallel relation with the first parallel combination **476**, and the exposure lamp **12** is placed in its full intensity condition in order to be properly warmed up before being used.

After the shutter drive motor **390** has completely opened the shutter assembly **341**, the "shutter open" limit switch **396** is closed and the relay **430** is energized through this limit switch and the closed engagement between the contact **424** and switch armature **429** of the energized relay **420**. With both of the relays **420** and **430** energized, the D.C. potential from the output terminals **446** and **448** of the rectifier **440** is supplied to both of the windings **452** and **454** of the shutter drive motor **390**. When both the windings **452** and **454** have a D.C. potential of opposite polarity applied thereto, the shutter drive motor **390** is provided with an effective dynamic braking force and ceases to rotate so that the shutter assembly **341** is then maintained in its open position.

Once the specified period of time has elapsed after the lamp start switch **456** was initially closed and the lamp **12** has been warmed up, the relay **458** allows the normally closed switch **460** to open so that the relay **462** is de-energized and the switch **464** opens. The opening of the switch **464** decouples the parallel circuit combinations **476** and **482** from the lamp circuit **474**, and the exposure lamp **12** is reduced to its low intensity state. In addition, the opening of the switch **460** de-energizes the relay **420** and breaks connection between the contact **424** and the armature **429**, which causes the brake relay **430** to be de-energized.

With both of the relays **420** and **430** de-energized, the transformer **416** supplies power to the winding **452** of the shutter drive motor **390** through the closed contact **431**, and switch armature **437** on one hand and through the capacitor **461** and the closed contact **432** and switch armature **438** on the other hand. In addition, the winding **454** is energized through the closed contact **422** and switch armature **427** and the terminal

423 and armature 428. The supply of power to the windings 452 and 454 by the step-down transformer 416 in this manner enables the drive motor 390 to begin to close the shutter assembly 341, and the shutter open limit switch 396 is opened. Once the shutter assembly 341 is fully closed, the "shutter closed" limit switch 398 is closed.

The closing of the limit switch 398 energizes the relay 430 through the switch and the closed contact 421 and switch armature 429 of the relay 420. The rectifier 440 supplies the D.C. potential of like polarity to both of the windings 452 and 454 of the drive motor 390, and the resulting effective dynamic braking force enables the drive motor 390 to maintain the shutter assembly 341 in its closed position. With the shutter assembly 341 now closed and the exposure lamp 12 warmed up, the photographic printer 240 is ready for use in exposing sensitized materials, and the like.

As is apparent from the foregoing, the energization of the relays 420 and 430 controls the type of power supplied to the windings 452 and 454 of the shutter drive motor 390 and thereby the operation of the motor. Whenever the relay 420 is energized and the relay 430 is de-energized, the shutter drive motor 390 opens the shutter assembly 341, whereas whenever both of the relays 420 and 430 are de-energized, he shutter drive motor 390 closes the shutter assembly 341. On the other hand, if both of the relays 420 and 430 are energized, the drive motor 390 maintains the shutter assembly 341 in its open position, but if only the relay 430 is energized and the relay 420 is de-energized, the drive motor 390 maintains the shutter assembly 341 in its closed position.

To initiate the exposure of sensitized material, or the like, a separate manual control switch 490 is closed or a timer 492 can be set to a specified exposure time. If the timer 492 is used for automatic exposure, a switch 494, which is in parallel relation to the switch 490, is closed, as well as a switch 496 which supplies power to the timer 492. The closing of the switch 490, or the switch 494, energizes the relays 462 and 420. The energization of the relay 462 closes the switch 464 so that the second parallel combination 482 is placed in the lamp circuit 474 and the exposure lamp 12 is placed in its full intensity condition.

The energization of the relay 420 opens the switch armature 429 from contact 421 so that the relay 430 is de-energized. With the relay 420 energized and the relay 430 de-energized, the shutter drive motor 390 is supplied with power from the step-down transformer 416 and the drive motor 390 opens the shutter assembly 341 which causes the switch 398 to open. Once the shutter assembly 341 is completely open, the open limit switch 396 is closed so that the relay 430 is energized through the switch 396 and the closed armature 429 and contact 424 of the relay 420. Since both of the relays 420 and 430 are energized, the shutter drive motor 390 is supplied with a D.C. potential from the rectifier 440, such that the drive motor 390 maintains the shutter assembly 341 in its open position.

After the sensitized material has been exposed to the exposure lamp 12 for the required length of time, the switch 490 can be manually opened or, in the alternative, the timer 492 allows the switch 494 to open. With the switch 490 or the switch 494 open, the relay 462 is de-energized so that the switch 464 opens and removes the second parallel combination 482 from the lamp circuit 474. Since only the first parallel combination 476 is in the lamp circuit 474, the exposure lamp 12 is returned to its low intensity state. In addition, the opening of the switch 490, or the switch 494, de-energizes the relay 420 so that the contact between the armature 429 and terminal 424 is opened and the relay 430 is de-energized. As a result of the de-energization of both of the relays 420 and 430, the drive motor 390 is supplied with power from the step-down transformer 416 in the manner described so that the drive motor 390 closes the shutter assembly 341, and the switch 396 opens.

After the shutter assembly 341 is completely closed, the switch 398 is closed and the relay 430 is energized through the switch 498 and the closed armature 429 and contact 421. With the relay 430 energized and the relay 420 de-energized, the rectifier 440 supplies a D.C. potential to the shutter drive motor 390 in the manner described, and the drive motor 390 maintains the shutter assembly 341 in its closed position. The photographic printer 240 then is again ready to be used for additional exposures of sensitized material placed on the printing frame.

It should be noted that during an exposure operation, in which the exposure lamp 12 is in its full intensity state and while the shutter assembly 341 is open, if the printing frame on the top of the cabinet of the photographic printer is opened, a safety switch 498 is automatically opened. Opening of the safety switch 498 de-energizes the relays 420 and 462 so that the exposure lamp 12 is returned to its low intensity state and the shutter assembly 341 is closed by the shutter drive motor 390.

The photographic printer 240 can easily be turned off by the opening of the master switch 406 so that the control circuit 400 is no longer coupled to the appropriate power supply through the terminals 402 and 404. With the opening of the master switch 406, the relay 462 is de-energized, and the switches 468 and 470 are opened. The lamp power supply transformer 472 no longer supplies power to the exposure lamp 12 and the control circuit 400 is then in the state illustrated by the schematic diagram shown in FIG. 21 and can be again energized by the closing of the master switch 406.

While there have been illustrated and described several embodiments of the present invention, it will be appreciated that numerous changes and modifications will occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications which fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A contact printer for use in exposing sheet sensitized material and the like, comprising a cabinet, a source of printing light mounted in the lower portion of said cabinet for directing light toward the top of said cabinet, a printing frame including a planar surface for supporting said sheet material in a horizontal position by exposure, mounting means for supporting said frame in the top of said cabinet, light controlling shutter means between said light source and said printing frame, said shutter means including a plurality of shutter panels mounted for relative sliding movement in a direction generally transverse of the direction of light between said source and said frame each of said shutter panels including at least one edge flange interlockable with a flange of an adjacent panel permitting relative

sliding movement therebetween in one direction and interconnecting said panels for movement together in an opposite direction when said shutter is opened and closed, and means for controlling said light source to operate at a low, standby level and a high intensity, exposing level, and shutter drive means for opening and closing said panels in synchronism with changes in level of said light source.

2. A contact printer as set forth in claim **1** wherein a pair of said shutter panels is movable from an open position nested upon one another adjacent an outside portion of said cabinet toward a closed position adjacent the center of said cabinet wherein a minimum of overlapping between the edges of adjacent shutter panels is provided.

3. A contact printer for use in exposing sheet sensitized material and the like, comprising a cabinet, a source of printing light mounted in the lower portion of said cabinet for directing light toward the top of said cabinet, a printing frame including a planar surface for supporting said sheet material in a horizontal position by exposure, mounting means for supporting said frame in the top of said cabinet, light controlling shutter means between said light source and said printing frame, said shutter means including a plurality of shutter panels mounted for relative sliding movement in a direction generally transverse of the direction of light between said source and said frame, said shutter means comprising opposite half portions, each portion comprising a plurality of said shutter panels pivotally connected together along opposite edges and movable between an open position wherein said connected panels are in accordionlike arrays adjacent opposite sides of said cabinet and a closed position wherein said panels are substantially aligned edge to edge in a common plane, and means for controlling said light source to operate at a low, standby level and a high intensity, exposing level, and shutter drive means for opening and closing said panels in synchronism with changes in level of said light source.

4. The contact printer as set forth in claim **3** including a plurality of pivotal pins for hingedly connecting adjacent shutter panels, alternate ones of said pivotal pins including opposite end portions extending outwardly of opposite ends of said panels, and support means engaging said end portions of said pivotal pins for supporting the same for sliding movement along a shutter plane.

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