Jan. 5, 1960 S. W. LEVINE ET AL 2,919,635

PRINTING EXPOSURE MACHINE FOR PHOTOSENSITIVE MATERIALS

Filed Sept. 17, 1956 2 Sheets-Sheet 1

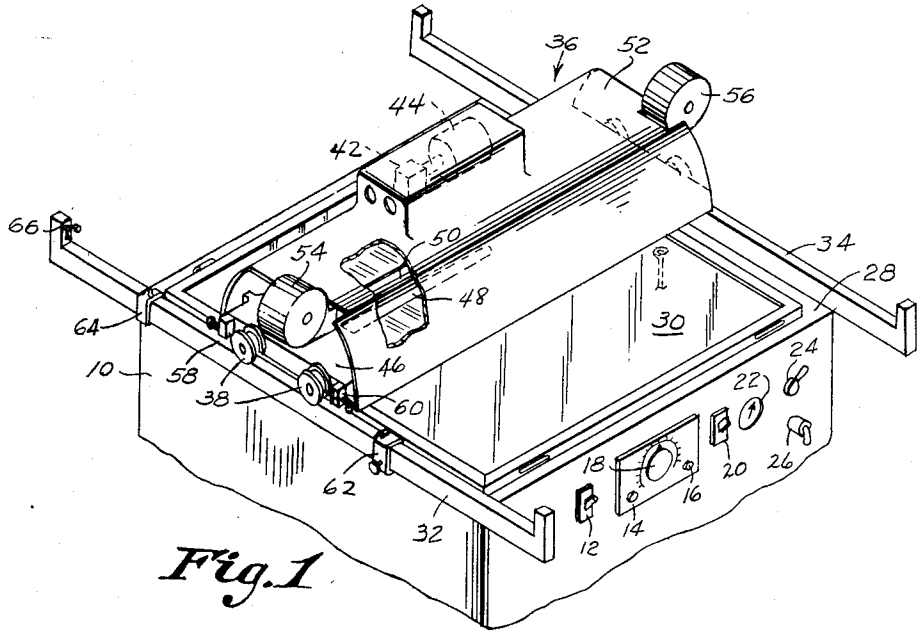

Fig. 1

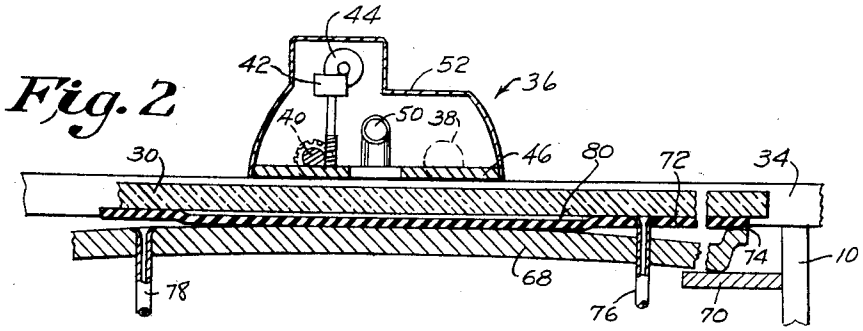

Fig. 2

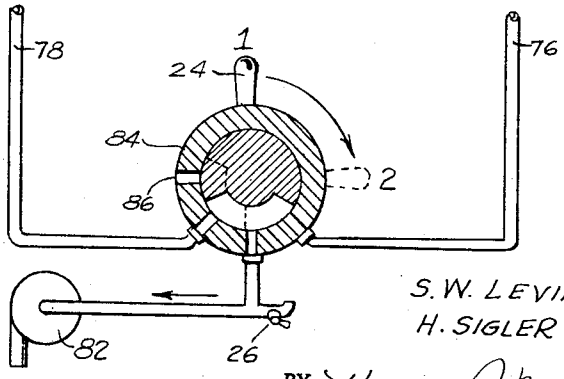

Fig. 3

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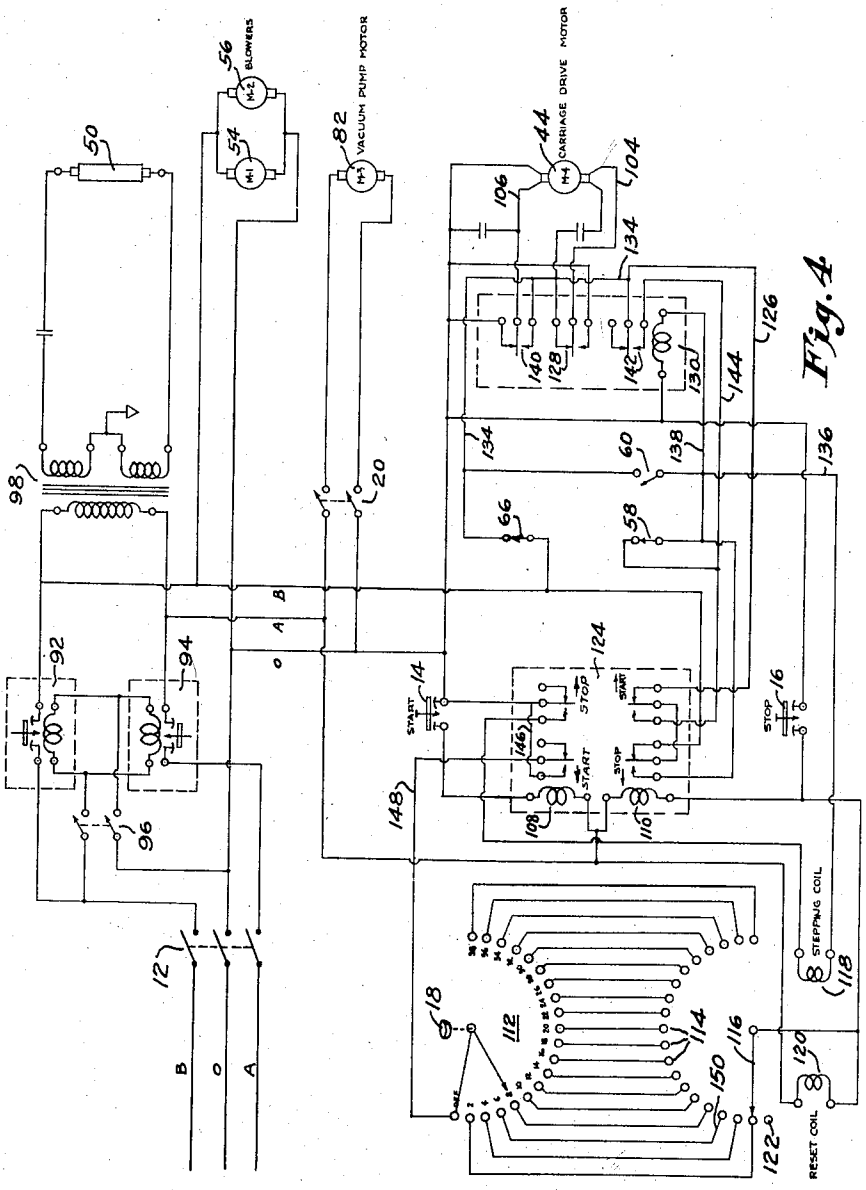

Fig. 4

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PRINTING EXPOSURE MACHINE FOR PHOTOSENSITIVE MATERIALS

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2 Claims. (Cl. 95—73)

This invention pertains to printing equipment of the photographic type; more specifically, it pertains to equipment in which a photosensitive material is held in close contact with a negative or other image bearing sheet, and subjected to rays of light passing through the latter to form a reproduction of the negative or master. The word "negative" is used here in an illustrative sense, because whether the original or master is a negative or a positive will depend both upon the nature of the photosensitive material and the use to which the reproduction is to be put. Various forms of such equipment have been proposed, especially for photographic printing; while the machine of the present invention is adaptable to printing upon conventional photographic materials, it has features which especially adapt it for the exposure of the so-called photopolymer materials characterized by the ability to be locally hardened by the action of actinic rays such as light or ultraviolet radiation. Such materials, of which the prior art affords many examples, can be exposed as indicated above to produce selective local hardening in accordance with the master image, and can be thereafter developed as by washing out the unhardened portions to product a relief image suitable for matting or even for direct surface printing by letter-press, offset or other familiar printing techniques.

Since materials, such as the photopolymers mentioned above, which are intended to yield a substantial relief image, will generally be thicker and often stiffer than simple photographic film or paper stock, the ability to maintain intimate contact of the original with the material is an especially desirable feature of the equipment. Also, certain types of the materials require a higher total exposure than is common with photo films or plates, which is not necessarily a disadvantage since it gives relative immunity to ambient light or fog exposure. The apparatus of the present invention permits closely regulated exposures of great magnitude to be given without any danger of movement between, or separation of, the original and the sensitive material.

In accordance with the invention, the sensitive material and the original are held in intimate contact by an improved form of vacuum frame including a transparent platen arranged in a horizontal plane, and a tubular or similar linear source of light is caused to move back and forth, just above the platen, to expose the desired area. The exposure format is made as large as will be needed for the largest originals, and the travel of the light source is adjusted to a shorter path for maximum efficiency and exposure speed in the case of shorter originals. To regulate the degree of exposure, the number of times the linear light source passes over the material is varied, and the traversing drive is arranged to reverse itself automatically until completion of the desired number of passes. During the exposure, the original and the sensitive material are held in intimate contact by vacuum arrangements which ensure good contact and positively eliminate any "bubbles" or trapped air between the two.

A simple single control valve ensures proper cycling of the vacuum lines to accomplish this object.

With the above considerations in mind, the invention will best be understood by referring now to the following detailed specification of a preferred embodiment thereof, given by way of example and illustration, and taken in connection with the appended drawings, in which

Fig. 1 is a perspective view of the apparatus as a whole.

Fig. 2 is a fragmentary enlarged view generally in side elevation looking at the left side of the machine, with certain parts shown in section.

Fig. 3 is a schematic illustration of the vacuum system of the equipment.

Fig. 4 is a complete wiring schematic of the electrical system of the machine.

Referring now to Fig. 1 of the drawings, numeral **10** designates a cabinet or the like which will preferably contain the vacuum pump and most of the electrical control components of the equipment. On the front panel of this cabinet are grouped the principal manipulative controls for the machine. These include the main power switch **12**, start and stop buttons **14** and **16** for the traversing light source carriage, a numerical dial **18** for pre-setting the number of traverses desired, a switch **20** for the vacuum pump motor, and the vacuum gauge **22**. Two-position vacuum valve **24** is for the control of the vacuum applied to the printing frame portion, and **26** is a vacuum relief valve, all to be described more particularly below.

The upper surface of cabinet **10** provides a table support **28** to which is hinged or otherwise movably secured the transparent glass, preferably tempered glass, hold-down plate or platen of the vacuum frame, this platen being designated by numeral **30**. Along the opposite side edges of the cabinet **10** are mounted a pair of guide rails **32** and **34** for a traversing carriage generally designated by numeral **36**, provided with flanged wheels such as **38** cooperating with the rails. One wheel at each end of the carriage is driven by a cross-shaft (**40** in Fig. 2) powered through gearing **42** by a reversible motor **44** also upon the carriage. The bottom plate **46** of the carriage has a light slot **48** above which is supported the high intensity tubular light source **50** extending almost from end to end of the carriage. A housing or cover on the carriage, numbered **52**, aids in reflecting the light downwardly through the slot, and prevents the actinic rays from reaching the operator and others. It also permits directed cooling ventilation of the tubular lamp, as by a pair of blowers supported at opposite ends of the carriage **36**, the blowers being arranged to direct air inwardly from both ends of the housing **52** and over the lamp. The air escapes through the light slot **48** or other edge slots in the plate **46**, and a part may escape through ventilating openings in the portion of housing **52** encompassing motor **44**. The blowers are numbered **54** and **56**.

Limit switches **58** and **60** are carried by the carriage to effect reversal of motor **44** when the switches are operated by suitable stops, conveniently positioned along rail **32**. At least one of these "stops," designated **62**, is arranged to be clamped to the rail in different positions to define the length of the carriage traverse, as for different size work. The stop **64** may or may not be adjustable, and in any event it preferably takes the form of an operating cam which will control the reversing switch **58** for successive traverses but, when the last traverse has been completed, will permit the switch **58** to pass over the stop to its extreme rearward rest position, in whch carriage **36** will be out of the way of the platen **30**. A rest position limit switch **66** then de-energizes the motor completely until a new cycle of operations is commenced.

The vacuum hold-down or printing frame arrangements of the invention are an improvement on a known form of printing frame, characterized by the use of vacuum for the removal of any occluded air or pockets between the glass platen and the sheet being copied, as well as the use of vacuum for maintaining the sheet firmly against the platen. As is known, a common vacuum source may be used for the purpose. The improvements provided by this invention will best be understood by referring now to Fig. 2 of the drawings. In this figure, the carriage, lamp, housing and other parts are designated by the same numerals as in Fig. 1, as is the far rail **34**. The base of the vacuum frame is a shallow pan-like casting **68** which is quite rigid and is supported as upon shelves or brackets **70** carried by the cabinet **10**. The rim of the pan is sealed to the conventional rubber blanket **72** as at the rim **74**, and the pan is slightly bowed upward in the region of the lateral center-line of the platen **30**. The amount of this bowing is exaggerated in Fig. 2. Blanket **72** also seals to platen **30** at the rim **74**, when the vacuum is applied.

A first vacuum duct **76** passes through a hermetic seal in pan **68** and communicates with the upper side of blanket **72**, which means, when contact is achieved, that this duct communicates with the region between the blanket and the platen **30**. A second vacuum duct **78** communicates with the space between the pan **68** and the underside of blanket **72**. Numeral **80** designates an original, negative or master sheet and the sensitive material lying below it, these being held in close contact with the platen by the blanket **72** when the vacuum is applied. To avoid local distortions, the ducts **76** and **78** enter the assembly near the rim, and if desired, the surface of blanket **72** may be ribbed slightly to encourage the removal of entrapped air.

In operation, a vacuum is pulled on the lower chamber (between pan **68** and blanket **72**) and simultaneously in the space between the rubber blanket and the platen **30**. When this is done, no more pressure exists between the platen and the films or sheets **80** than existed under atmospheric conditions. This complete vacuum eliminates all of the air between the films and the platen and between the blanket and pan. Now the duct **76** is closed, and the duct **78** is opened to the atmosphere. The external air pressure will now force the rubber blanket up and bring the films into intimate contact with each other against the underside of the platen.

In large sizes, there will be considerable atmospheric pressure on the glass platen, with consequent danger of its breaking. To alleviate this, as well as to secure a collateral advantage, the slight upward bow in pan **68** is provided. As the vacuum is pulled, the glass platen will bow down and the pan will bow up very slightly. The initial slight clearance will be taken up, with the center of the platen supported by the pan, of course through the intermediary of the intervening layers. As the vacuum increases, the contact area between the platen and the underlying parts (supported by the pan) will slowly increase, and will have the effect of rolling out any occluded air towards the rim, for most complete elimination thereof.

The vacuum control arrangements are detailed in schematic form in Fig. 3. The vacuum pump is designated **82** and it connects with a conventional two-position valve **84** having the operating handle **24** as in Fig. 1. In the position numbered "1" vacuum is applied to both ducts **76** and **78**, while in position "2" duct **76** is closed off and duct **78** is opened to the atmosphere at port **86**. When the exposure is completed, the valve is returned to position "1" and the relief valve **26** is opened to permit the platen **30** to be raised. This eliminates the necessity of having to stop the vacuum pump motor after each exposure.

As has been stated, an automatic control is provided

for permitting any desired number of exposure traverses of the light carriage to be effected; that is, since the carriage will always be wanted to return to its rest position at the completion of the exposure, any even number of traverses counting both directions of motion. The arrangement for providing this control will now be described in connection with Fig. 4 of the drawings, which also includes certain other wiring pertaining to the machine.

Numeral **12** in Fig. 4 designates a conventional main switch for a three-wire power supply for the apparatus. A subsidiary and lamp control switch **96**, not shown in Fig. 1, and mounted on carriage **36** or the front panel, controls the application of power to contactors **92**, **94** arranged to maintain the supply circuit to the lamp step-up transformer **98** so long as the switch **96** is closed. The secondary winding of transformer **98** energizes the lamp **50** directly, for example at a voltage of approximately 1,900 volts or such other value as corresponds to the lamp rating. For machine safety, the transformer secondary may be grounded to the machine frame, as shown. Blowers **54** and **56** are controlled from the same circuit, over the same switch **96**, so that they will be energized whenever the lamp is "on."

The power supply shown is of the three-wire 110–220 volt A.C. type, providing 110 volts between either conductor A or B and O, and 220 volts between conductors A and B. The latter voltage is applied only to transformer **98** for the lamp.

Subsidiary power leads O and A supply, through the manual vacuum-pump motor switch **20** (shown on the front panel in Fig. 1) the vacuum pump indicated at **82** (see also Fig. 3). Leads O and B additionally supply operating current to the reversible motor **44**. When motor lead **104** is energized by the control means to be described, the motor traverses the carriage **36** "forward" referring to Fig. 1, while when lead **106** is energized, the motor traverses the carriage in the opposite direction, i.e., towards its rest position. The common motor conductor returns to line O. The start and stop buttons for carriage traverse are again designated by the same numerals, **14** and **16**, used in Fig. 1. These momentary button switches control the coils **108** and **110** of a latching relay **124**, of known type, so arranged that when either coil is energized, its associated contacts are latched in their operated condition and remain so until the other coil is energized. The counter mechanism by which are obtained the desired (even) number of carriage traverses will now be described. Briefly, it utilizes the multipoint manual switch **112**, whose dial or control knob **18** is also so designated in Fig. 1. Switch **112** is here shown as having twenty contact points, all of which are connected to the corresponding contacts **114** of a twenty-point rotary stepping switch familiar to the automatic telephone art. This rotary switch includes, besides its contact points **114**, a wiper arm **116** which steps progressively along the arcuate array of contacts in response to successive energizations of its stepping magnet coil **118**. When the reset magnet coil **120** is energized, even momentarily, the wiper arm **116** is automatically restored to the zero, home or initial contact position designated by numeral **122**, and to which no circuit is connected.

The positions of the various relays and contacts in Fig. 4 are those prior to energization of the "start" button **14**, but with the manual switch **112** set on its third position to call for six traverses of the carriage, corresponding to three complete forward-and-back movements. The operation of the arrangement will be understood by tracing the circuits when the "start" button is now momentarily depressed, it being assumed of course that switch **12** is closed and lamp **50** up to its normal luminance, and the vacuum frame is suitably loaded. The latching relay **124** is assumed to have operated to its "stop" condition, as indicated by the labelled arrows on the relay contacts, as a result of completion of a prior exposure and return of the

carriage **36** to its "rest" position, in which the rest-position limit switch **66** will be open. The rear limit switch **58** will be closed at this time, and the front limit switch **60** will be open.

When start button **14** is momentarily depressed, it will energize coil **108** of the latching relay and shift the movable contacts in the directions indicated by "start." A circuit will be completed from power supply wire B, the back contact set of relay coil **110**, conductor **126**, the back contact **128** of the motor-reversing relay **130**, and conductor **104** to the motor, energizing the same in the forward direction. The carriage **36** will start forward, and when its rear limit switch **58** passes over cam stop **64**, the switch will be momentarily opened, but this will have no effect. As the carriage proceeds, its front limit switch **60** will ultimately be engaged by stop **62**, and will be closed. This completes a circuit from line conductor B, contacts of relay **110**, conductor **126**, conductor **134**, switch **60** and conductor **136** to the stepping coil **118**, contacts of relay **108** and line conductor O. The stepping coil will remain energized until switch **60** opens again as the carriage reverses, and this momentary energization of the stepping coil advances the rotary switch wiper **116** to the next contact position. Also, closure of front limit switch **60** energizes, over conductor **138**, the coil of motor reversing relay **130**, whose other terminal is permanently connected to supply conductor O. The contact **128** of relay **130** opens, the forward motion of motor **44** stops, and as contact **140** closes, the motor is energized in the opposite direction over conductor **106**. The remaining contacts associated with **128** and **140** provide good braking characteristics for the motor in a well-known way which forms no essential part of the present invention, so that detailed description thereof is deemed unnecessary.

During the return (rearward) motion of the carriage **36**, front limit switch **60** remains open, and rear limit switch **58** remains closed. It is noted that when reversing relay **130** became operated as above described, its contacts **142** were also closed, completing a circuit from conductor **126**, these contacts **142**, lead **144**, limit switch **58** and lead **138** to the coil of relay **130**, to maintain the motor relay in reversed condition during the rearward travel of the carriage. Otherwise, the rearward drive motor circuit would have been opened at limit switch **60**.

When the limit switch **58** engages cam stop **64** on the return trip, the switch opens and relay **130** becomes de-energized, its contacts again reversing the carriage motor **44** to commence another forward traverse. This back and forth motion of the carriage continues until the successive actuations of stepping coil **118** bring the wiper **116** to its third position away from home contact **122**, corresponding to the completion of two and a half complete traverses. Recalling that coil **108** (start) is still energized, it will be seen that a circuit is now completed from line conductor O, lead **146**, lead **148**, switch **112**, conductor **150**, wiper **116** and the "stop" coil **110** of the latching relay. The contacts of the latching relay will all be operated in the opposite directions to those formerly occupied, and will remain so until the start coil is again energized. Also, the reset coil **120** will be energized to restore the wiper **116** of the stepping or rotary switch to its off or home position **122**.

Notwithstanding the energization of the stop coil **110**, the carriage **36** will commence its rearward motion for the last half-traverse, because the motor circuit at motor lead **106** will be maintained over lead **134** and the normally-closed "rest" limit switch **66**, to line conductor B which circuit will not be opened until the carriage returns to its rest position out of the way of the vacuum frame. It will be noted, in this connection, that if the exposure is terminated by operation of stop button **16** before completion of the pre-set number of exposure traverses, the same condition will exist; that is, the carriage motion will not cease until the carriage has cleared the vacuum frame and returned to its rest position, regardless of the settings of stops **62** and **64**.

Since the reset coil **120** has restored the rotary switch to its starting position, and since the latching relay has returned to its "stop" position, the apparatus is ready for a succeeding exposure of one or more traverses as soon as the "start" button **14** is again depressed.

While the invention has been described herein in considerable detail in the interest of ready understanding, it will be understood also that the details can be varied as desired by those skilled in the art, without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A contact printing machine for photosensitive materials, comprising a horizontal table support for material to be exposed, rails paralleling opposite edges of said support, a relatively narrow carriage supported between said rails for travel therealong, an elongated light source on said carriage extending lengthwise thereof, motor means for propelling said carriage in both directions along said rails, adjustable carriage position sensing devices for controlling said motor means to cause the carriage to travel back and forth across the table between selected limits of travel, counter means for registering the number of complete back-and-forth traverse movements of said carriage, and means controlled by said counter means for de-energizing said motor means to discontinue the carriage traverse motion after completion of a pre-set number of traverses.

2. A contact printing machine in accordance with claim 1, including means for maintaining said motor means energized following substantial completion of its final traverse, and means operated by the carriage for discontinuing motor energization upon its arrival at a rest position substantially beyond an edge of said support.

References Cited in the file of this patent

UNITED STATES PATENTS

2,427,923	Reynolds	Sept. 23, 1947
2,464,793	Cooke	Mar. 22, 1949
2,739,516	Hosterman	Mar. 27, 1956
2,760,419	Gelb	Aug. 28, 1956

FOREIGN PATENTS

819,623	Germany	Nov. 5, 1951