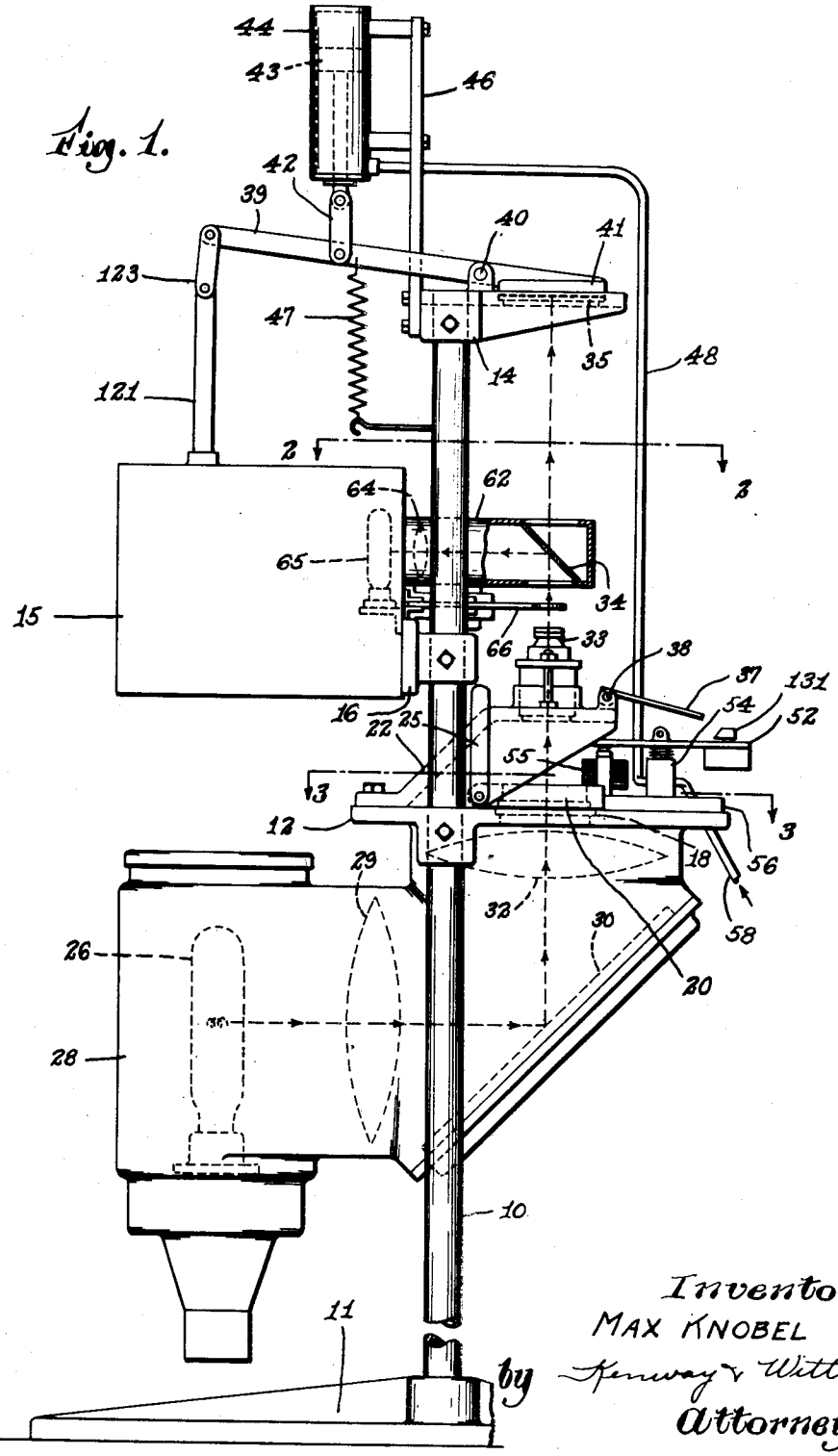
May 16, 1939. M. KNOBEL 2,158,903

PHOTO-PRINTING APPARATUS

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Fig. 1.



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Fig. 2.

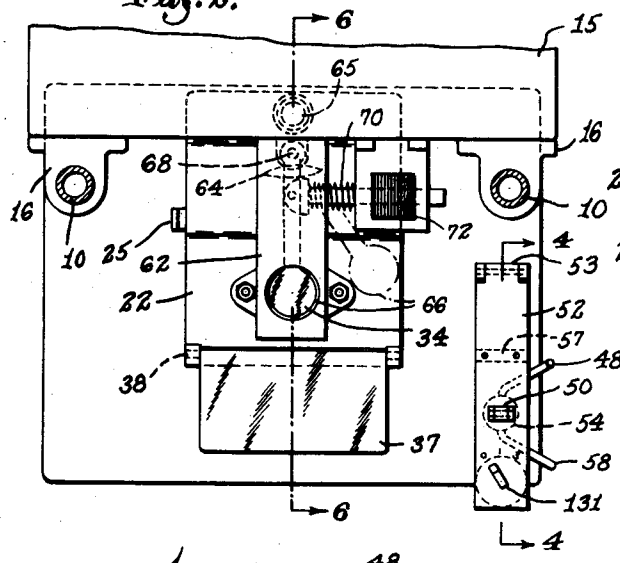


Fig. 3.

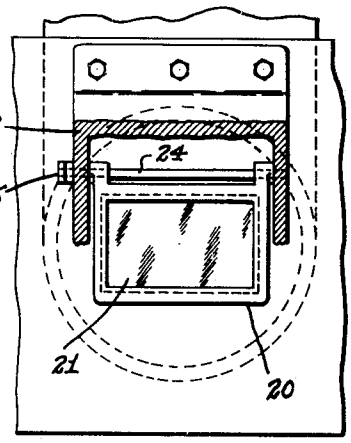


Fig. 4.

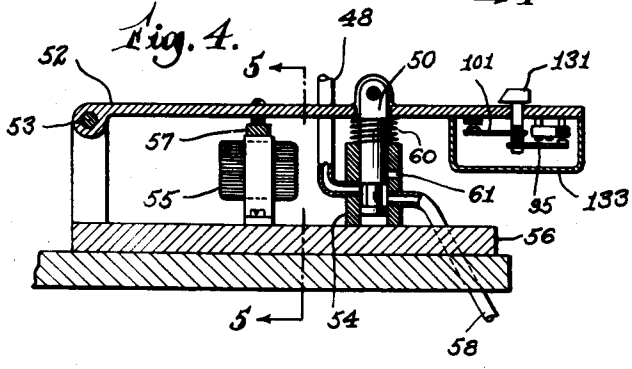
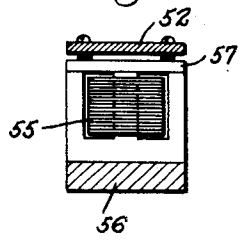


Fig. 5.



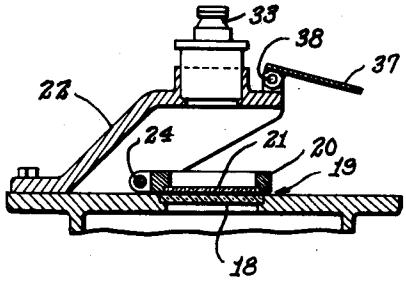
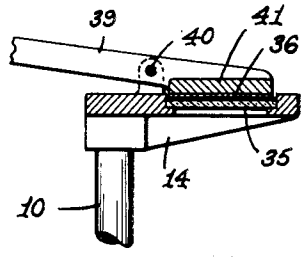


Fig. 6.

Fig. 7.



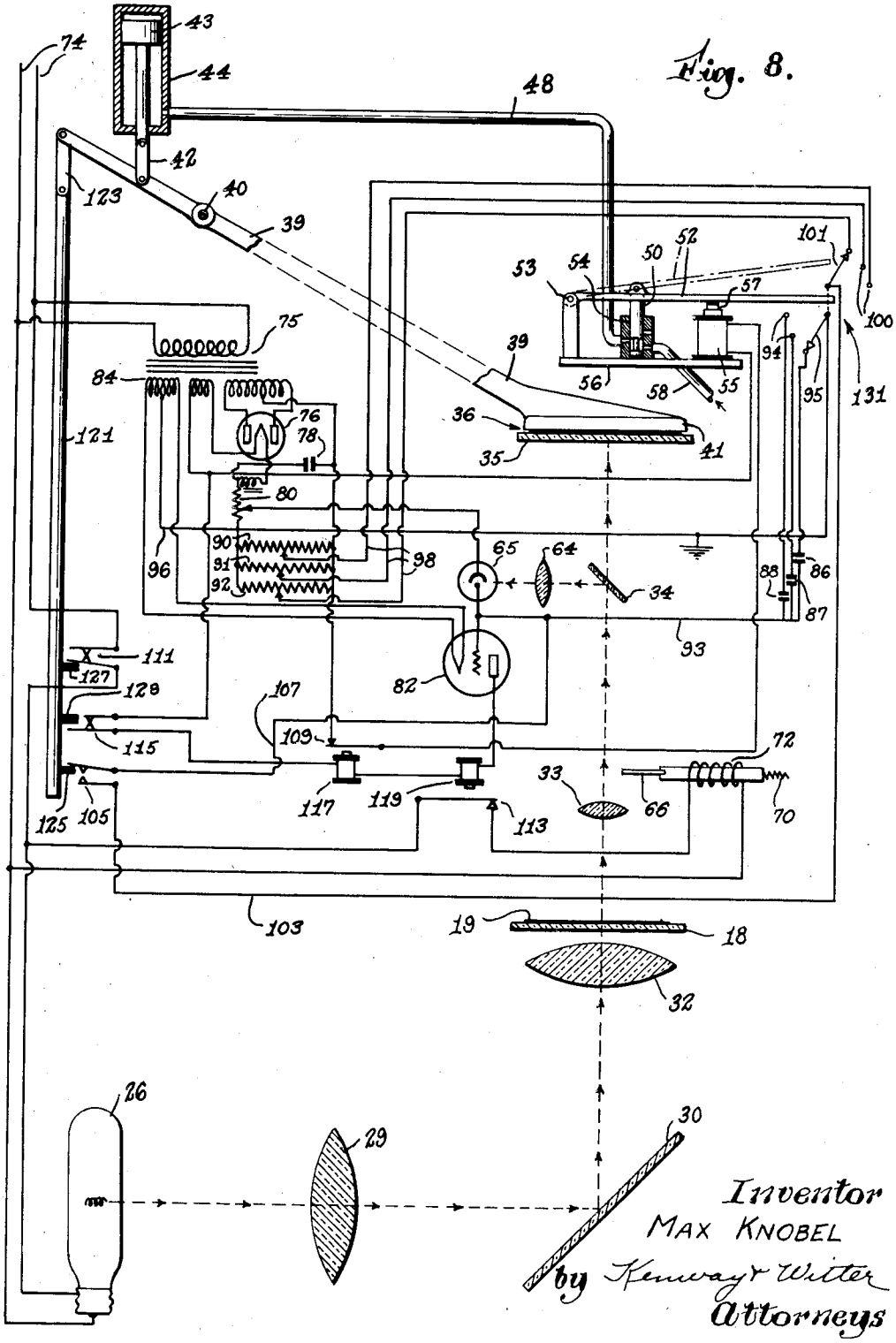
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Fig. 8.



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Fig. 10.

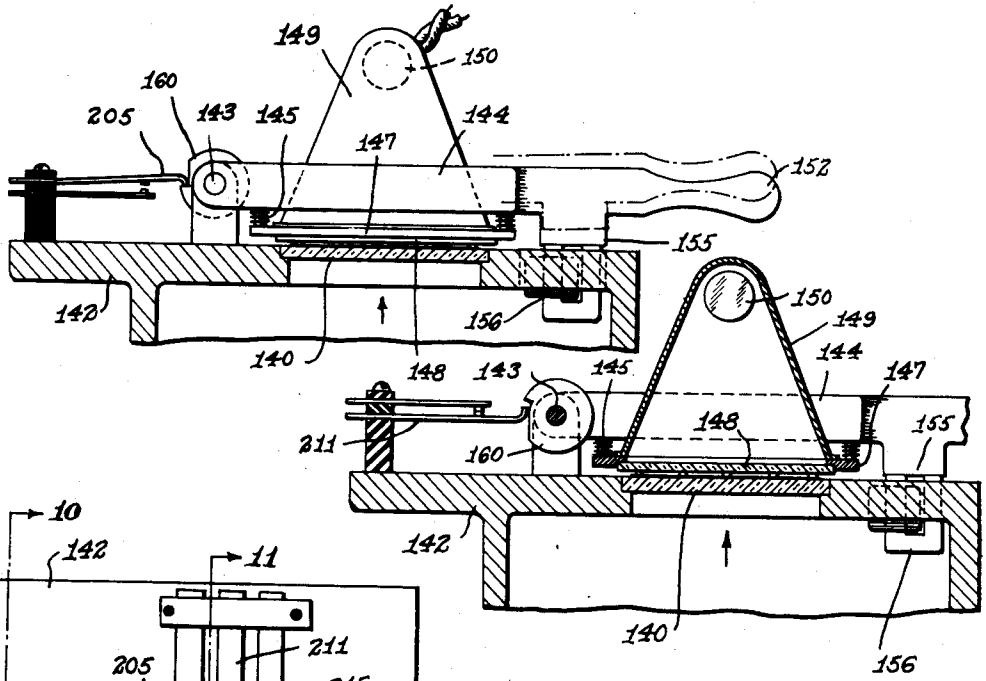


Fig. 11.

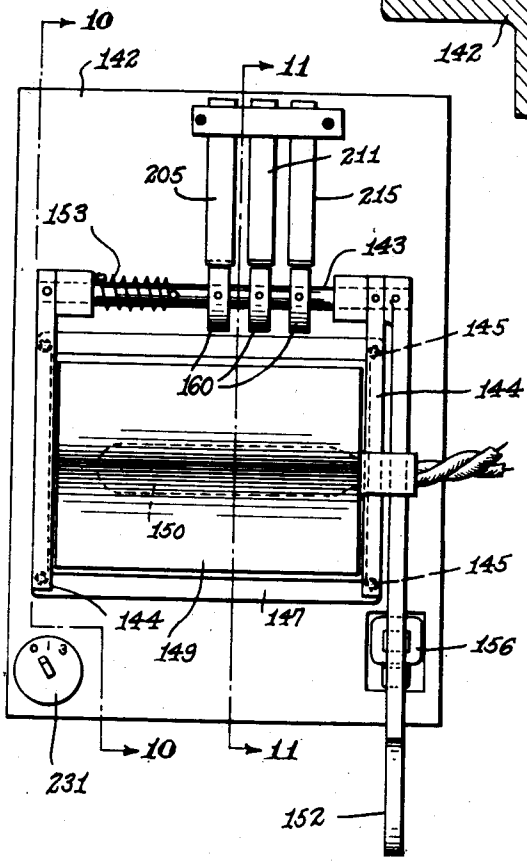


Fig. 9.

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UNITED STATES PATENT OFFICE

2,158,903

PHOTO-PRINTING APPARATUS

Max Knobel, Arlington, Mass., assignor to Block-Jones Photo Co., Inc., Dorchester, Mass., a corporation of Massachusetts

Application January 20, 1938, Serial No. 185,879

8 Claims. (Cl. 88—24)

This invention relates to an improved photo-printing apparatus constructed and arranged automatically to make prints from negatives by either contact or projection printing. I am aware that mechanism of this nature and for this purpose has been suggested heretofore, and the primary object of my invention is to produce such an improved apparatus which will function more accurately and successfully than like apparatuses heretofore known and which will produce superior results with greater efficiency.

It is well known that negatives vary in many respects requiring different grades and speeds of printing paper, different timing exposures, etc., and one object of my invention is to provide an improved apparatus which will efficiently care for these varying conditions. To serve these functions, the invention contemplates the employment of a light sensitive cell in combination with a thyratron tube and electric storage means, the tube preferably being of the gas-filled thermionic type adapted to change instantly from a non-conductor to a conductor at a definite grid voltage and the electric storage means preferably being a plurality of condensers of varying capacities. Also cooperating with the tube and condensers are preferably a plurality of potentiometers serving to regulate the charging of the condensers. The employment of these various elements in a novel manner and in cooperation with switches and corresponding mechanism, all as hereinafter more specifically described, provides a substantially automatic photo-printing apparatus capable of producing a superior product at a very substantially greater efficiency than has been heretofore possible.

Further novel features of the invention relate to means for supporting and holding the printing paper and switch mechanism cooperating therewith and with the light sensitive cell for releasing the paper, terminating the printing exposure, charging the condenser for the next exposure, etc., all of which operations are carried out automatically.

These and other features of the invention will be best understood and appreciated from the following description of preferred embodiments thereof, selected for purposes of illustration and shown in the accompanying drawings, in which

Fig. 1 is a side elevation of a projection printing apparatus embodying my invention,

Fig. 2 is a plan sectional view taken on line 2—2 of Fig. 1,

Fig. 3 is a plan sectional view taken on line 3—3 of Fig. 1,

Fig. 4 is a sectional view taken on line 4—4 of Fig. 2,

Fig. 5 is a sectional view taken on line 5—5 of Fig. 4,

Fig. 6 is a sectional detail taken on line 6—6 of Fig. 2,

Fig. 7 is a sectional detail of the print holding mechanism,

Fig. 8 is a diagrammatic view showing the wiring circuits of the apparatus,

Fig. 9 is a plan view of a contact printing apparatus employing the invention,

Fig. 10 is a sectional view taken on line 10—10 of Fig. 9, and

Fig. 11 is a like view taken on line 11—11 of Fig. 9.

Referring first to Figs. 1–8 of the drawings, 10 indicates a post mounted on a base 11 and carrying the projection printing apparatus illustrated herein and comprising my invention. The negative support and the light projecting means cooperating therewith are carried by a bracket 12 secured to the post. The printing paper support and cooperating mechanism are carried by a bracket 14 on the post. The light sensitive cell and cooperating circuit and parts are carried in a housing 15 supported by a bracket 16 on the post.

A transparent plate 18 is arranged to receive and support the photographic negative 19 and a hold-down member 20 carrying a transparent plate 21 for engaging the negative is pivoted to a bracket 22 at 24, an arm 25 being provided for pivoting the member 20 upwardly. The printing lamp 26 is mounted in a housing 28 on the bracket 12 and the light is directed therefrom through a lens 29 onto a mirror 30 and from thence upwardly through a lens 32, the negative 19, a lens 33, a glass plate 34 set at an angle of 45 degrees, and then through the transparent support 35 onto the printing paper 36. The operator is protected from the glare of the lamp by a shield 37 pivoted at 38.

The printing paper support 35 is carried on the bracket 14 which bracket also carries an arm 39 pivoted thereto at 40. On the forward end of the arm is a foot 41 for engaging the printing paper and holding it against the support 35. Rearwardly of the pivot 40 a link 42 connects the arm to a piston 43 operating within a cylinder 44. The cylinder is supported on a vertical post 46 carried by the bracket 14. A spring 47 normally swings the arm downwardly and the piston and arm are adapted to be moved upwardly by the pressure of air from a pipe 48.

Air pressure to the pipe 48 is controlled by a valve comprising a plunger 50 hung from a key 52 pivoted at its rear end 53, the plunger being slidable within a cylinder 54. An electro-magnet 55 mounted on the support 56 beneath the key and cooperating with an armature 57 carried by the key is adapted when energized to hold the key down to the position of Figs. 4 and 8 wherein air pressure from a supply pipe 58 is conducted to the cylinder to force the piston upwardly. A spring 60 serves normally to raise the key 52 upwardly to a position wherein the pipe 48 is connected with an exhaust port 61.

The glass plate 34 is mounted within a tube 62 projected outwardly from the housing 15 and its function is to reflect a portion of the light passing through the negative through a condensing lens 64 and onto a photo-electric cell 65 in the housing 15. A shutter 66 pivoted at 68 is normally held in the light beam beneath the plate 34 by a spring 70, the shutter being pivoted out of the beam when a solenoid coil 72 cooperating therewith is energized.

The sole source of power supply for the apparatus is the 110 volt line 74. This power supply operating through the transformer 75 and rectifier tube 76 gives about 400 volts D. C. across the 16 microfarad condenser 78. A drop wire is connected across this condenser consisting of a resistance 80 and three potentiometers 90, 91 and 92. Power for the filament of a thyratron tube 82 is taken from the transformer at a secondary coil 84.

The apparatus as illustrated employs three condensers 86, 87 and 88 of different capacities for respective varying the time of printing exposure, and cooperating with these condensers are the three potentiometers 90, 91 and 92 each of which is individually adjustable, the potentiometers being adapted to bias the charging voltages to the condensers for the purpose of varying the time of printing exposure in accordance with the grade of printing paper used, all as hereinafter more specifically described. The condensers are connected to the grid of the tube 82 at 93 and respectively to three terminals 94 with which cooperates a switch pole 95. A wire 96 connects this switch pole to a tap on the secondary 84.

The potentiometers 90, 91 and 92 are connected to the source of electrical supply from the tube 76 and the condenser 78, and three adjustable taps 98 thereto connect with three terminals 100 with which cooperates a switch pole 101. A wire 103 connects this switch pole with one side of a normally closed switch 105. The other side of this switch is connected by a wire 107 to the wire 93. The cell 65 is connected to the grid of the tube 82 and to the resistance 80. The electro-magnet 55 is under the control of a normally closed switch 109.

The main lamp 26 and the solenoid 72, which latter serves to withdraw the shutter 66, are under the control of a normally open switch 111 and the portion of the circuit to the solenoid 72 passes through a normally closed switch 113. The circuit from the lower terminal of a normally closed switch 115 passes through two electromagnets 117 and 119 and to the plate of the tube 82. The electromagnets 117 and 119 are adapted respectively when energized to open the switches 109 and 113.

The switches 105, 111 and 115, are arranged to be automatically operated from a rod 121 connected to one end 123 of the pivoted arm 39, the rod carrying three laterally extending lugs 125, 127 and 129 cooperating with the switches for this purpose. While the switch poles 95 and 101 may be operated independently if desired, it is more convenient that they shall be connected to a single operating knob 131, it being understood that these poles are insulated from each other. The switch mechanism operated by this knob may be mounted in any place convenient to the operator as in a box 133 on the arm 52.

The operation of the apparatus is substantially as follows: The operator first adjusts the taps 98 respectively to positions on the potentiometers suitable to compensate for the grade of printing paper which is to be used, these taps usually being adjusted only when a new or different batch of paper is to be employed, it being understood that the grade or speed of the same paper may vary in different batches. The operator then sets the double-pole switch 131 to cut into the circuit 93 the condenser 86—88 which is most suitable for the grade or speed of paper being used and simultaneously therewith to place the corresponding potentiometer in the circuit.

The parts are shown in the printing position in Figs. 1 and 8. With the parts in the non-printing position, the switches 105, 109 and 113 are closed and the switches 111 and 115 are open. With the parts in such non-printing position, one of the three condensers 86—88 is connected between the grid and the filament of the tube 82 and the voltage across this condenser is set by the corresponding potentiometer through a circuit including switches 101 and 105.

After placing the negative and printing paper in place, the operator depresses the key 52 from its inoperative position shown in broken lines in Fig. 8, to the operative position, shown in full lines, the electro-magnet 55 thereupon serving to hold the key thus depressed. Air pressure thereupon passes through the pipe 48 and swings the arm 49 to the position shown in Figs. 1 and 8. The rod 121 thereupon serves to open switch 105 and close switches 111 and 115. Opening of the switch 105 disconnects the biasing circuit from the potentiometer selected to the grid of tube 82. Closing of the switch 111 causes the main lamp 28 to operate and energize the solenoid 72 whereupon withdrawing the shutter from the path of the light beam received from the negative. Closing of the switch 115 completes the circuit from the plate of the tube 82 through the electro-magnets 117 and 119. However, the tube is of the gas-filled thermionic type which is a non-conductor until it reaches a definite grid voltage and no current will therefore immediately pass through this closed circuit.

The glass plate 34 reflects onto the photo-electric cell 65 a definite portion of the light received from the negative and this cell thereupon allows current to flow to the selected condenser in proportion to the light thus received, whereby the voltage across the condenser is drawn down from the original negative value to which it was set. When this voltage reaches the value of about minus 1 volt, the tube 82 starts to conduct current through the electro-magnets 117 and 119, which thereupon open the switches 113 and 117. The spring 70 thereupon closes the shutter and the spring 60 raises the key 52 to its inoperative position.

Upon upward movement of the key 52, the pipe 48 is placed in communication with the exhaust port 61 and the arm 39 is swung counter-clockwise under the action of the spring 47. The rod

121 thereupon closes the switch 105 and opens the switches 111 and 115. Closing of the switch 105 again cuts in the biasing circuit. Opening of the switch 111 throws off the lamp 26 and breaks the circuit to the solenoid 72. Opening of the switch 115 breaks the circuit through the electro-magnets 117 and 119, it being noted that the switch 111 is opened and the switch 105 is closed slightly prior to the opening of the switch 115. Opening of the switch 115 opens the circuit to the plate of the tube 82 and permits switches 109 and 113 to close, whereupon the electro-magnet 55 is again energized and the circuit to the solenoid 72 will be closed upon subsequent closing of the switch 111. Thus opening of the switch 115 stops the tube 82 from conducting and such tube will not again start conducting until it again reaches a definite grid voltage.

It should be understood that the condensers 86—88 are of fixed values approximately in such a ratio as corresponds to the necessary timing for three grades of printing paper. The potentiometers 90—92 allow adjustment independently for each grade of paper to give the proper speed and the more negative the C bias is made the longer is the resulting exposure time. We have found it advantageous to use relatively high voltages for the charging of the condensers 86, 87 and 88. The higher this voltage, within suitable limits, the greater the accuracy of the timing cycle and while the apparatus will work with voltages from 20 volts up to reasonably high limits, we have found it preferable to use relatively high voltages in the order of from 100 to 150 volts.

In Figs. 9–11, I have illustrated my invention as adapted to contact printing. In this apparatus the negative and printing paper are supported in contact with each other on a transparent plate 140 inset on a support 142. Fixed to a shaft 143 on this support is a pair of arms 144 having posts 145 carrying a frame 147 having a transparent foot 148 for engaging the print and negative. A hood 149 is mounted over the top surface of the foot and carries a photo-electric cell 150 therein corresponding to the cell 65. This pivoted unit is provided with an operating handle 152 secured to the shaft. A spring 153 normally holds the unit in its raised position, indicated in broken lines in Fig. 10, and an armature 155 carried by the handle and cooperating with an electro-magnet 156 is adapted to hold the unit down after it is depressed into the down position, the electro-magnet and its operation being like the electro-magnet 55 already described.

Rearwardly of the shaft 143 are three switches 205, 211 and 215 corresponding respectively to the switches 105, 111 and 115, and cooperating with these switches are three shouldered elements 160 fixed to the shaft. The arrangement is such that when the unit is in its up position the switch 205 is closed and the switches 211 and 215 are open. When the unit is in its down position the switch 205 is open and the switches 211 and 215 are closed. A double pole switch 231, like the switch 131, may be mounted on the support 142 as illustrated in Fig. 9.

This form of my invention otherwise employs the circuit and parts illustrated in Fig. 8 and the operation thereof is substantially the same as has already been described in reference to Figs. 1–8. Light from the lamp 126 passes through the combined negative and printing paper and onto the cell 150, the amount of such light reaching the cell being a definite portion of the light passing through the negative.

It will now be apparent that I have produced a photo-printing apparatus which is substantially automatic and which will perform desired printing operations from negatives with great efficiency. In fact, this apparatus, constructed in accordance with Figs. 1–8, has been in commercial use in the regular production of prints from negatives for a period of some months and during such period it has produced a substantially superior product with an operating efficiency of better than 99%, i. e., the print rejects have been considerably less than 1%, and has furthermore made more prints per hour than has been heretofore possible by using manual methods.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. In a photo-printing apparatus, a light sensitive cell arranged to receive a definite portion of light passing through the negative being printed, a plurality of electric condensers respectively of different capacities arranged to be selectively associated with the cell and to have the electric charge thereof varied by the cell in accordance with the light received by the cell, a plurality of variable potentiometers respectively associated with the condensers to predetermine the original voltage across the condensers, a switch for selectively associating the condensers with the cell, and means associated with the cell for terminating the printing exposure when the condenser selected is brought to a predetermined charge, variation of said original voltage by the potentiometers being adapted to vary the time period for said termination of the printing exposure.

2. In a photo-printing apparatus, a light sensitive cell arranged to receive a definite portion of light passing through the negative being printed, a plurality of electric condensers respectively of different capacities arranged to be selectively associated with the cell and to have the electric charge thereof varied by the cell in accordance with the light received by the cell, a plurality of variable potentiometers, switch means for selectively associating the potentiometers with the condensers and the condensers with the cell, the association of the potentiometers with the condensers being adapted to predetermine the original voltage across the condensers, and means associated with the cell for terminating the printing exposure when the condenser selected is brought to a predetermined charge, variation of said original voltage by the potentiometers being adapted to vary the time period for said termination of the printing exposure.

3. In a photo-printing apparatus, a light sensitive cell arranged to receive a definite portion of light passing through the negative being printed, a plurality of electric condensers respectively of different capacities arranged to be selectively associated with the cell and to have the electric charge thereof varied by the cell in accordance with the light received by the cell, a plurality of variable potentiometers respectively associated with the condensers to predetermine the original voltage across the condensers, a unitary double-pole multiple-throw switch for selectively associating the potentiometers with the condensers and the condensers with the cell, and means associated with the cell for terminating the printing exposure when the condenser selected is

brought to a predetermined charge, variation of said original voltage by the potentiometers being adapted to vary the time period for said termination of the printing exposure.

4. In a photo-printing apparatus employing a light sensitive cell arranged to receive a definite portion of light passing through the negative being printed and a condenser associated with the cell and arranged to have the electric charge thereof varied by the cell in accordance with the light received by the cell, a support, means movable to operative and inoperative positions and arranged in the former position to clamp a printing paper on the support, means including an electro-magnet for holding the clamping means in operative position, a normally closed switch in the electro-magnet circuit, a second electro-magnet arranged in position to open the switch, means associated with the cell for terminating the printing exposure and energizing the second electro-magnet whereby to release the holding electro-magnet when the condenser is brought to a predetermined charge, a second switch in the circuit of the second electro-magnet, and means for opening the second switch when the holding electro-magnet is released.

5. The apparatus defined in claim 4 wherein said second switch is normally closed and wherein said means for opening the second switch is carried by the first-named means and operates to open the second switch while the first-named means is moving to the inoperative position.

6. In a photo-printing apparatus employing a light sensitive cell arranged to receive a definite portion of light passing through the negative being printed, a condenser associated with the cell and arranged to have the electric charge thereof varied by the cell in accordance with the light received by the cell and a gas-filled thermionic tube associated with the cell and condenser and adapted to change instantly from a non-conductor to a conductor at a definite grid voltage, a support, means movable to operative and inoperative positions and arranged in the former position to clamp a printing paper on the support, means for holding the clamping means in operative position, means including a circuit and switch therein for biasing the charge of the condenser through the tube when the switch is closed, a second switch in the circuit to the plate of the tube, means associated with the cell for releasing said holding means when the condenser is brought to a predetermined charge, and means operative thereupon by movement of the first-named means to terminate the printing exposure, close the first switch and open the second switch.

7. In a photo-printing apparatus employing a light sensitive cell arranged to receive a definite portion of light passing through the negative being printed, a shutter normally in the path of such light, an electromagnet for withdrawing the shutter, a condenser associated with the cell and arranged to have the electric charge thereof varied by the cell in accordance with the light received by the cell and a gas-filled thermionic tube associated with the cell and with the condenser and adapted to change instantly from a non-conductor to a conductor at a definite grid voltage, a support, means movable to operative and inoperative positions and arranged in the former position to clamp a printing paper on the support, means including an electromagnet for holding the clamping means in operative position, two normally closed switches respectively in the circuits of said electromagnets, two electromagnets arranged respectively to open said normally closed switches, a switch in circuit to the plate of the tube and through the said two electromagnets, and means associated with the cell for opening the last named switch when the condenser is brought to a predetermined charge.

8. In a photo-printing apparatus employing a light sensitive cell arranged to receive a definite portion of light passing through a negative being printed, a plurality of electric condensers of different capacities associated with the cell and arranged to have the electric charge thereof varied by the cell in accordance with the light received by the cell and a plurality of variable potentiometers respectively associated with the condensers to predetermine the original voltage thereacross, a support, means movable to operative and inoperative positions and arranged in the former position to clamp a printing paper on the support, means for holding the clamping means in operative position, a switch for selectively associating the potentiometers with the condensers, a second switch in series circuit with the first switch, and means associated with the cell for terminating the printing exposure, releasing said holding means and closing the second switch when the condenser selected is brought to a predetermined charge.

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