Nov. 29, 1938. P. DAUTZENBERG 2,138,445

PHOTOGRAPHIC PRINTING APPARATUS

Filed Nov. 28, 1936 3 Sheets-Sheet 1

Fig. 1

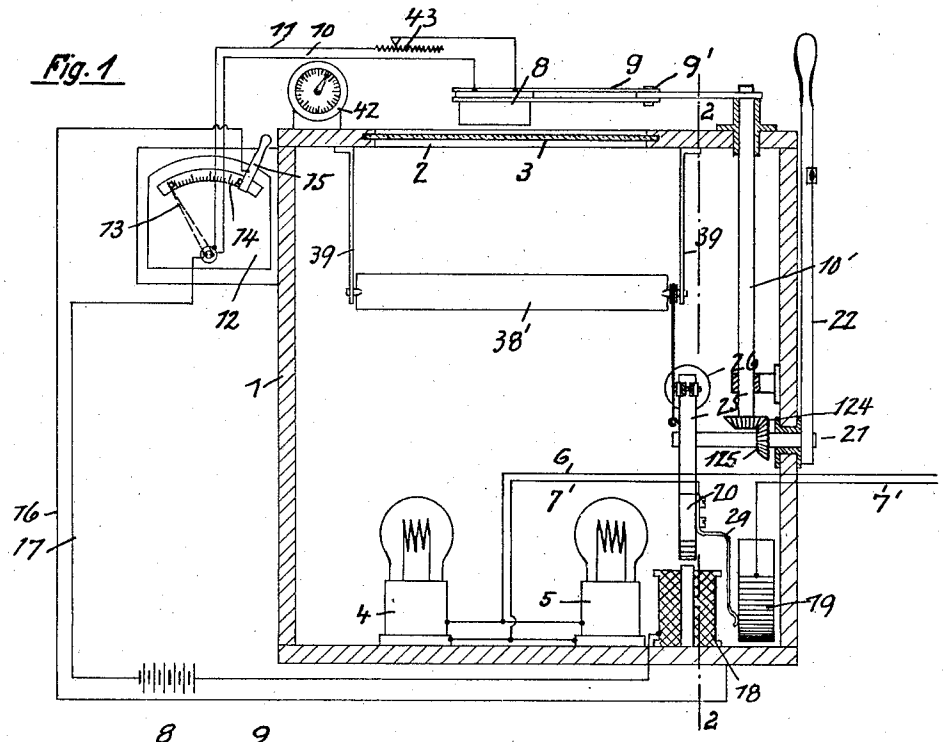


Fig. 3

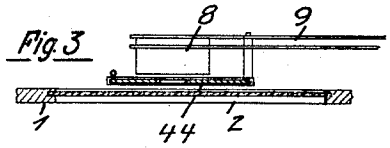
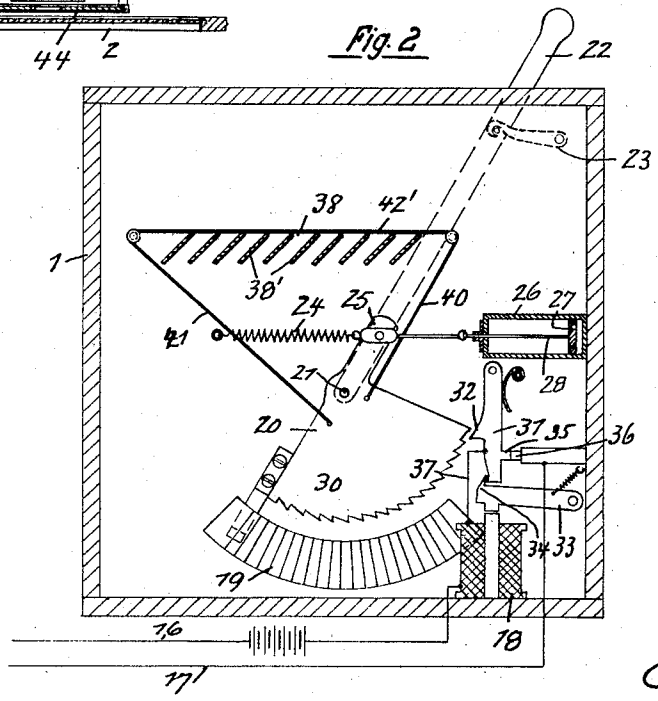


Fig. 2



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Fig. 4

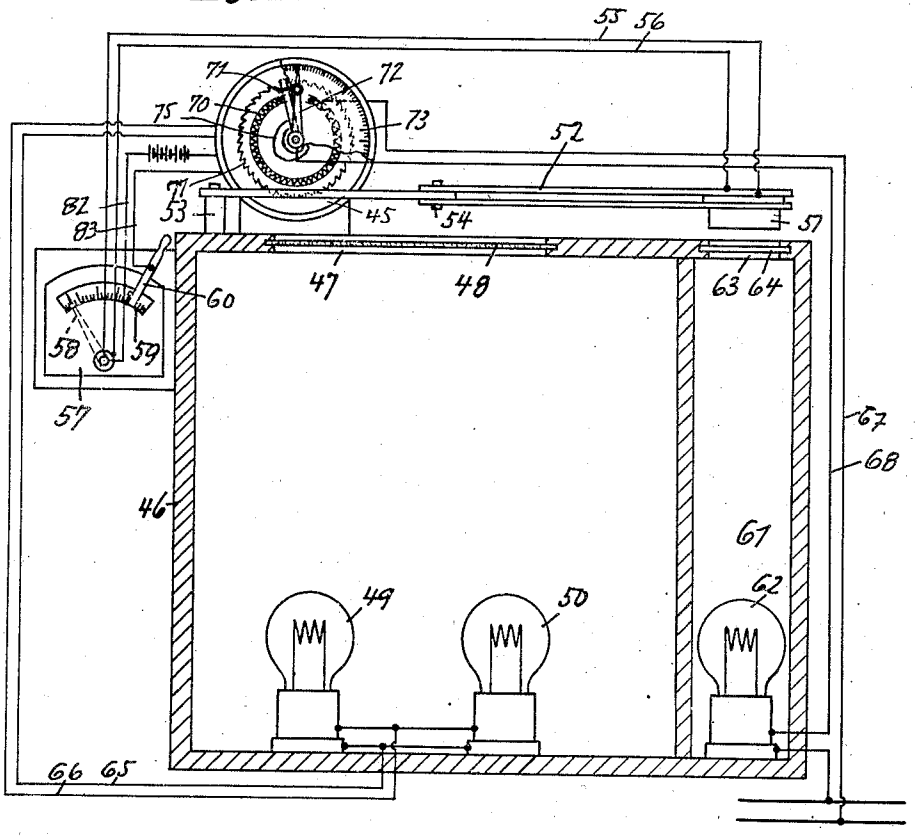
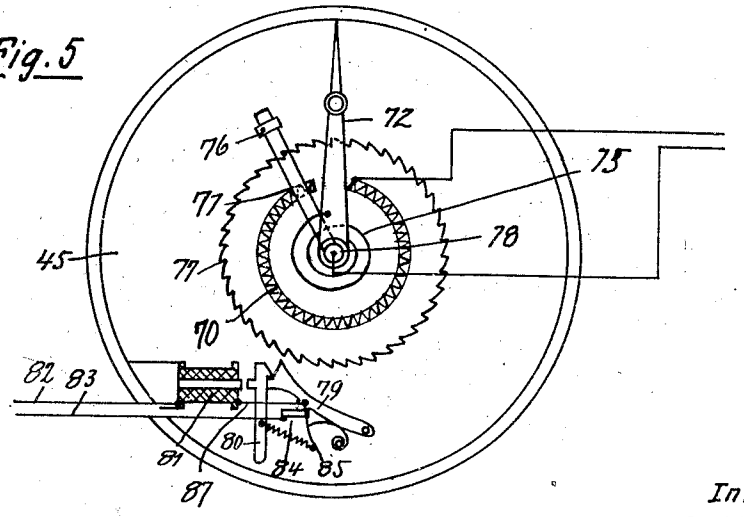


Fig. 5



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PHOTOGRAPHIC PRINTING APPARATUS

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Fig. 6

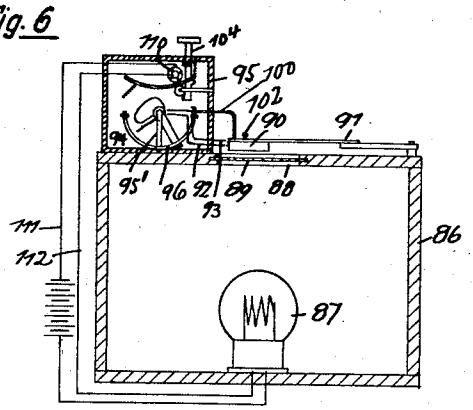


Fig. 10

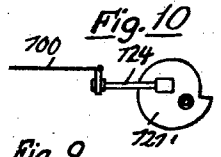


Fig. 9

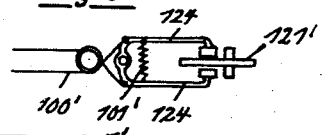


Fig. 7

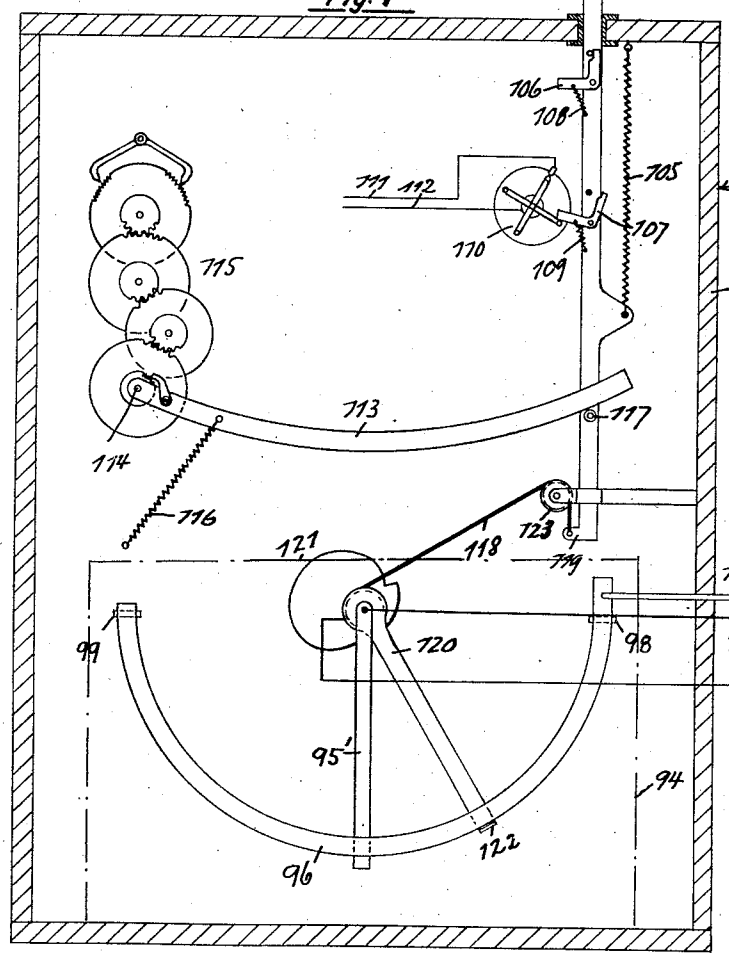
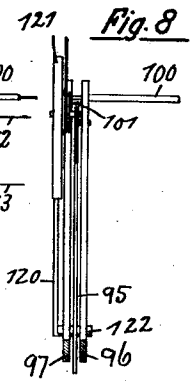


Fig. 8



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Patented Nov. 29, 1938

2,138,445

UNITED STATES PATENT OFFICE

2,138,445

PHOTOGRAPHIC PRINTING APPARATUS

Paul Dautzenberg, Aachen, Germany, assignor to Zeiss Ikon Aktiengesellschaft, Dresden, Germany

Application November 28, 1936, Serial No. 113,223
In Germany November 30, 1935

10 Claims. (Cl. 95—73)

This invention relates to photography and more particularly to photographic printing apparatus especially adapted for single prints.

One of the objects of the invention is to provide photographic printing apparatus in which either the quantity of printing light flowing in a predetermined period of time to the negative or the period of exposure in photographic printing is adjusted in accordance with the transparency or density of a negative to be printed so that uniform results are always obtained.

Another object of the invention is to provide devices for adjusting the light flowing to the negative or the period of exposure comprising a photoelectrical-element adapted to be influenced by the printing light passing through the negative and means controlled by the current of the photoelectric-element, which means itself control a mechanism controlling the quantity of light flowing to the negative or the period of exposure.

Other objects and advantages of my invention will appear from the following description when read in connection with the accompanying drawings.

In the drawings—

Fig. 1 is a vertical sectional view of one form of the photographic printing apparatus;

Fig. 2 is a vertical sectional view along lines 2—2 of Fig. 1;

Fig. 3 is a view of a modified form of the photoelectric-cell;

Fig. 4 is a vertical sectional view of a further modified form of the photographic printing apparatus;

Fig. 5 is a sectional view of the time-switch-clock employed in the embodiment of the invention, shown in Fig. 4;

Fig. 6 is a vertical sectional view of another modified form;

Fig. 7 is a vertical sectional view of the time-switch-device employed in the embodiment shown in Fig. 6 on an enlarged scale;

Fig. 8 is a detail of the clamping mechanism employed in the form of the invention, shown in Fig. 7;

Figs. 9 and 10 illustrate in plan view and elevation view respectively a modified form of the clamping means for locking the pointer of the measuring instrument.

In the embodiment of the invention shown in Figs. 1–3 of the drawings 1 is a casing. This casing has a window 2 with a glass plate 3 in its top for receiving first the negative and afterwards the negative and the positive such as a sensitized paper for the print. The negative and the positive are held in position in the known manner by a closing-cover not shown. Two lamps 4 and 5 for furnishing the printing light are adapted to be connected to a source of supply through wires 6, 7, and 7'. A light-sensitive element 8 such as a photoelectric-cell, i. e., a selenium cell is mounted on an arm 9 journaled on the top of the casing 1. The arm 9 consists of two parts connected by a link 9'. By moving of the arm 9 about its pivot-journal 10' the photoelectric-cell 8 may be brought above the window 2 and away. The photoelectric-cell 8 is connected by connectors 10 and 11 to a moving-coil instrument 12 having a pointer 13, a scale 14 and a contact 15. If the pointer 13 touches the contact 15 an electric circuit 16, 17, 37 is closed. An electro-magnet 18 is arranged in this circuit. An adjustable resistance 19 is disposed in the circuit 6, 7, 7' for the lamps 4 and 5. The resistance 19 is regulated by the lever 20 having sliding contact 29. The lever 20 is pivoted by a shaft 21 in a wall of the casing 1. Mounted on the outer end of this shaft 21 is a handle 22 which may be locked in its initial position by the spring catch 23. If this catch is released, the lever 22 and thereby the lever 20 are moved to the left (Fig. 2) by the spring 24 fastened to an extension 25 of the lever 20. This spring 24 is tensioned on moving the lever 20 to its initial position to the right (Fig. 2). The speed of movement of the lever 20 after releasing of the catch 23, is regulated by a fluid brake comprising a cylinder 26, a piston 27, and a piston-rod 28 connected to the lever extension 25. In order to lock the lever 20 in the different positions a locking mechanism is provided comprising ratchet segment 30 fastened to the lever 20, spring pawl 31 with tooth 32, and a spring pawl 33 with hook 34 for locking the pawl 31. If the pawl 33 is released, pawl 31 meshes with the teeth of the segment 30 and thereby the movement of the lever 20 is interrupted and the lever 20 is locked in this position. Releasing of pawl 33 is obtained by energizing of electro-magnet 18. The pawl 33 forms the armature of the electro-magnet 18. Spring pawl 31 has a contact 35. In the position of the pawl 31, in which it is locked by the pawl 33, contact 35 touches a contact 36 mounted on a wall of the casing 1. The conducting wire 17 to the electromagnet 18 is connected to the contact 36 and a wire 37 connects pawl 31 with the electromagnet 18. Therefore, if pawl 31 is released in order to lock the lever 20 the circuit 16, 17, 37 of the electro-magnet 18 is interrupted. The purpose of the adjustable resistance 19 is to control the luminous intensity of the lamps

4 and 5. Furthermore a mask 38 for regulating the quantity of light flowing from the lamps 4 and 5 to the window 2 is disposed between the lamps 4 and 5 and the window 2. This mask consists of a Venetian-blind, the blades 38' of which are rotatably mounted in arms 39 fastened to the top of the casing 1. The blades 38' are rotated by drawing straps 40, 41, and straps 42', connecting the blades 38'. The straps 40 and 41 are connected to the lever 20 on opposite points of its pivot-shaft 21. But only one of the two adjusting means for the printing light is necessary either the adjustable resistance 19 for controlling the luminous intensity of the printing lamps 4 and 5 or the mask 38 for controlling the quantity of actinic light reaching the negative and positive.

In operation first only the negative, which is to be printed, is laid on window-glass 3 and the photoelectric-cell 8 is moved above the negative. At the same time the controlling lever 20, 22 for the resistance 19 and the mask 38 has been moved in its initial position (Fig. 2). After releasing of the spring catch 23, the lever 20 begins its movement to the left (Fig. 2) under the action of the spiral spring 24. During this movement of the lever 20 the lamps 4 and 5 are placed in circuit. At the beginning of the retrograde movement of the lever 20 there exists the greatest resistance and therefore the printing lamps 4 and 5 have the lowest luminous intensity. The luminous intensity increases in accordance to the progressive retrograde movement of the resistance controlling lever 20. As soon as the flux of light passing through the negative has reached a quantity which corresponds to the luminous intensity necessary for the printing, the pointer 13 of the moving-coil-instrument 12 touches the contact 15. Thereby the circuit 16, 17, 37 is closed, the electro-magnet 18 is energized and its armature formed by the pawl 33 is attracted. Therefore the pawl 31 is released and it meshes with the teeth of the ratchet segment 30. Consequently the lever 20 is locked and therefore the resistance 19 and the luminous intensity of the lamps 4 and 5 are adjusted accordingly. The mask 38 has been adjusted at the same time by the lever 20. Consequently the quantity of light reaching the negative is controlled in accordance with the transparency or density of the negative. The time of exposure is the same for each quality of paper for the print.

The time of exposure is controlled by a time-switch-clock 42 of known construction as employed in connection with photographic printing apparatus. The electrical connection of the clock 42 with the circuit 6, 7, 7' for the lamps 4 and 5 is not shown.

In order to adjust the quantity of light flowing to the negative in accordance to the degree of sensitiveness of the printing paper the contact 15 of the moving-coil-instrument is arranged adjustably on the scale 14. Therefore the movement of closing the contact between the pointer 13 and the contact 15 may be varied according to the degree of sensitiveness of the printing paper. The contact takes place sooner in connection with highly sensitive printing paper and later with printing paper of lower sensitiveness. This purpose can be reached also by arranging an adjustable resistance 43 in the circuit 10, 11 of the photoelectric-cell 8. Furthermore this purpose can be obtained by combining with the photoelectric-cell an adjustable mask 44 as shown in Fig. 3 of the drawings. By moving this mask the quantity of printing light from the lamps 4 and 5 reaching the photoelectric-cell may be adjusted.

Before the beginning of the printing operation, the arm 9 will be moved to bring the cell 8 away from the window 3. Hereafter the printing material f. i. paper will be laid on the negative and the whole is closed by a cover not shown. As soon as the printing operation is finished the controlling levers 20, 22 may be moved to their initial position (Fig. 2). Hereby the teeth of the ratchet-segment 30 press back the tooth 32 and the pawl 31, the pawl 33 locks the pawl 31 by its tooth 34 and the contacts 31, 36 are closed. Then the apparatus is ready for a new printing operation.

The apparatus may be built in such a manner that the movement of the closing-cover for the negative and positive or the turning-movement of the arm 9 of the photoelectric-cell are transmitted to the controlling lever 20, 22 in order to move it in its initial position. In this case proper transmission means are arranged between the above-mentioned cover or the arm 9 and the lever 20, 22.

According to the modified form of the apparatus shown in Figs. 4 and 5 the period of exposure is controlled in accordance with the transparency or density of the negative, while the quantity of printing light passing in the unit of time to the negative and positive may be the same for all negatives.

46 is the casing of the apparatus, 47 the window with the glass-plate 48 for receiving the negative and positive, which are held in position by a cover not shown. 49 and 50 are the printing lamps, 51 is the photoelectric-cell, 52 the swinging arm for the cell, which is journaled at 53 and which consists of two parts connected by link 54. 55 and 56 are the connecting wires between the cell 51 and the moving-coil-instrument 57, which has the pointer 58, the scale 59 and the adjustable contact 60. The casing 46 has a separate compartment 61 with a lamp 62 and a window 63 with glass-plate 64 for receiving the negative. These parts 61, 62, 63, 64 serve to adjust the time-switch-clock 45. The lamp 62 is placed in circuit 67, 68.

45 is a switch-clock for controlling the period of exposure and this clock is connected electrically with the lamps 49 and 50 by wires 65 and 66. The clock is controlled by the rotating arm or pointer 72 lying on the outside of the dial 73 in the known manner. This pointer is mounted on the clock-shaft 78 and this shaft or the lever 72 is under the action of the spiral spring 75. This spiral spring 75 moves the lever 72 and the shaft 78 in a counter-clockwise direction, when the lever is released in its initial position. An adjustable resistance 70 for controlling the luminous intensity of the lamp 62 is mounted in the housing of the time-switch-clock 45 and a controlling lever 71 for the resistance 70 is mounted on the clock-shaft 78. Further a ratchet-disc 77 is mounted on the clock-shaft 78. The resistance 70 is placed in the circuit 67, 68 for the lamp 62. The levers 71 and 72 are held in their initial position by a spring-catch 76, which may be actuated from the outside of the clock. The initial position, Figs. 4 and 5, corresponds to the greatest degree of resistance.

The locking mechanism for the ratchet disc 77 is in its essentials the same as shown in the

form, Figs. 1 and 2, 78 is the spring pawl for meshing with the ratchet teeth of the disc 77. 80 is the spring pawl for locking the pawl 79, when it does not mesh with the teeth of the disc 77. 81 is an electro-magnet placed in the circuit 82 and 83 closed by the pointer 58 and contact 60 of the moving-coil-instrument. This pointer is moved by the circuit 55, 56 of the photoelectric-cell 51. The contacts 84 and 85 and the wire 87, which complete the connection between the wires 82 and 83, interrupt the circuit 82, 83 as soon as the pawl 79 locks the ratchet disc 77. The other parts of the time-switch-clock are of known construction.

As soon as the lever 72 is released the clock shaft 78 is rotated by the spring 75 in a counter-clockwise direction and thereby the resistance 70 is decreased and the luminous intensity of the lamp 62 is increased. When the light from lamp 62, reaching the cell 51 has obtained a fixed degree, the circuit 82, 83 is closed by the pointer 58 and contact 60. The period which is necessary for closing this circuit depends on the density or transparency of the negative. On closing of the circuit 82 and 83 the ratchet disc 77 and thereby the clock-shaft 78 are locked by the locking mechanism above-described. Thereby the time-switch-clock is adjusted and this clock controls the period of exposure in the known manner. Evidently with negatives having higher transparency the locking of clock-shaft 78 takes place sooner than with negatives having a lower transparency. Therefore the period of exposure corresponds to the degree of rotation of the clock-shaft 78 before its locking.

For the purpose of adjusting the period of exposure in accordance with the degree of sensitiveness of the printing material (paper), an adjustable resistance may be placed in the circuit of the photoelectric-cell or an adjustable mask may be mounted on the photoelectric-cell in the same manner as shown in connection with Figs. 1–3.

In the modified form shown in Figs. 6, 7 and 8 the time of exposure is controlled in accordance with the transparency or density of the negative. 86 is a casing containing a lamp 87, a window 88 and glass-plate 89 for receiving the negative or the negative and the positive, held in position by a cover not shown. 90 is the photoelectric-cell, mounted on a swivel arm 91, adapted to swing the cell 90 above the window 88 and away. Electrical wires 92, 93 lead to the moving-coil-instrument 94, shown in broken lines. This moving-coil-instrument is combined with a time-switch-clock 95, which controls the time of exposure. The pointer or lever 95' of the moving-coil-instrument can be locked in different positions by two clamping jaws 96 and 97 of semi-circular shape. These clamping jaws 96 and 97 are rotatably mounted on horizontal stub-axles 98 and 99 and the jaws are opened by a Bowden-cable 100 and they are closed by a spiral spring 101. The Bowden-cable 100 is led to the casing of the photoelectric-cell 90 and 102 is a push for the Bowden-cable. In the opened position the pointer 95' can swing between the two jaws 96 and 97. When the pressure on the push 102 is released, the jaws 96 and 97 move to closed position and the pointer is locked in its position.

103 is the casing of the time-switch-clock. A slide-bar 104 with push-button 105' is mounted in the top of the casing and the bar 104 is adapted to be moved up by a spiral spring 105 and down against the tension of the spring 105. 106 and 107 are two noses, movably mounted on the slide-bar. These noses are under the action of spiral springs 108 and 109. 110 is a turning switch and 111 and 112 are electrical wires leading to the circuit for the lamp 87. A brake lever 113 is mounted on a shaft 114 of a brake gear 115. 116 is a tension spring drawing the brake lever 113 against a stop 117 mounted on the slide bar 104. 118 is an elastic strap, fastened with one end to a nose 119 on the lower end of the slide bar 104 and fastened with the other end to lever 120, rotatably mounted on an axle concentric with the axis of rotation of the pointer 95'. 123 is a guide-roller for the strap 118. Fastened to the lever 120 is a cam disc 121 adapted to be rotated with the lever 120. The lever 120 has a stop 122, adapted to be moved against the locked pointer 95.

The operation of this apparatus is as follows: Pointer 95' is rotated by the circuit of the cell 90 in accordance to the density or transparency of the negative. As soon as the intensity of the cell-current has reached a predetermined degree, the push button 102 is released and the pointer is locked by the jaws 96 and 97. Then the slide-bar 104 is pushed down. Thereby the spring 105 is tensioned and the lever 120 with cam disc 121 is rotated by the strap 118 until stop 122 contacts the pointer 95'. The slide bar may be moved further down on account of the elasticity of the strap 118. The brake lever 113 moves down in accordance with the lowering of slide bar 104 until it contacts the cam disc 121. If slide bar 104 is released from the pressure it moves upwardly under the action of the spring 105. On moving upwardly the nose 106 closes by turning switch 110 the circuit for the printing lamp and this lamp circuit is interrupted by the nose 107. The speed of the upward-movement of slide bar 104 is decreased by the brake-lever 113. The distance travelled after application of the brake 113 is adjusted by the position of cam disc 121, which controls the position of brake lever 113. The period between closing and interrupting of the circuit 111, 112 by switch 110 corresponds to the distance travelled after application of the brake. In this manner the period of exposure is controlled by the cam disc 121 which in turn is controlled by lever 95' of moving-coil-instrument 94 and the cell-circuit. In order to adjust the period of exposure also in accordance to the sensitiveness of the printing material the controlling elements f. i. cam 121, lever 95, brake lever 113 and nose 106 may be adjusted in advance. For the same purposes an adjustable resistance may be placed in the cell-circuit or an adjustable mask may be combined with the cell (see Figs. 1 and 2).

According to the embodiment shown in Fig. 9 the cam 121' moved by the moving-coil-instrument 94 is locked directly by jaws 124, opened by a Bowden-cable 100' and closed by a spring 101'.

In the embodiment shown in Figs. 1 and 2 the transmission of the movement from cell arm 9 to lever 20, 22 is obtained by shaft extension 10' and bevel-gear wheels 124 and 125. The gear wheel 125 has only teeth on a part of its circumference.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with means for supporting

a photographic negative in position to be exposed to light-rays, a photoelectric-cell movable above the negative and away therefrom, a moving-coil-instrument electrically connected to the photoelectric-cell, an adjustable resistance for the printing lamps and a controlling lever for this resistance movable by a spring and means for locking the controlling lever in different positions which means are actuated by a circuit closed by the moving-coil-instrument.

2. In a photographic printing apparatus, the combination of a source of light, means for supporting a photographic negative in a position to be exposed to said source of light, a photoelectric cell movable into a position in which it will be energized by light passing through a negative on said supporting means, a moving-coil instrument electrically connected with said photoelectric cell, an adjustable resistance for said source of light, a controlling lever for said resistance movable by a spring, and means for locking said controlling lever in different positions, said last named means being actuated by a circuit closed by said moving-coil instrument.

3. In a photographic printing apparatus, the combination of a source of light, means for supporting a photographic negative in a position to be exposed to said source of light, a photoelectric cell movable into a position in which it will be energized by light passing through a negative on said supporting means, a moving-coil instrument electrically connected with said photoelectric cell, an adjustable resistance for said source of light, a controlling lever for said resistance movable by a spring, means for locking said controlling lever in different positions, said last named means being actuated by a circuit closed by said moving-coil-instrument, and adjustable masking means between said source of light and said negative supporting means for varying the amount of light reaching the negative, said masking means being adjusted by said controlling lever at the same time the same varies said resistance.

4. In a photographic printing apparatus, the combination of a source of light, means for supporting a photographic negative in a position to be exposed to said source of light, a photoelectric cell movable into position to be energized by light passing through a negative on said supporting means, a moving-coil-instrument electrically connected with said photoelectric cell, an adjustable resistance for said source of light, a controlling lever for said resistance movable by a spring, means for locking said controlling lever in different positions, said last named means being actuated by a circuit closed by said moving-coil-instrument, an adjustable mask between said source of light and said negative supporting means for varying the light reaching the negative, said mask being adjusted by said controlling lever at the same time the same varies said resistance, and an indicator mechanically connected with said controlling lever has been locked by said locking means the length of time the negative should be exposed when being printed.

5. In combination with means for supporting a photographic negative in position to be exposed to light-rays, a light-electric-cell movable above the negative and away therefrom, a moving-coil-instrument electrically connected to the light-electric-cell, printing lamps below said supporting means, an adjustable resistance for said printing lamps, a controlling lever for said resistance movable by a spring, means for locking the controlling lever in different positions, said locking means being actuated by a circuit closed by the moving-coil-instrument, and a time-switch-clock electrically connected with said printing lamps for limiting the energization of the same to a predetermined length of time during the printing operation.

6. In a photographic printing apparatus, the combination of a source of light, means for supporting a photographic negative in a position in which it is exposed to said source of light, a photoelectric cell movable into a position in which it is energized by light passing through a negative on said supporting means, a moving-coil-instrument electrically connected with said photoelectric cell, an adjustable resistance for said source of light, a controlling lever for said resistance movable by a spring, means for locking said controlling lever in different positions, said last named means being actuated by a circuit closed by said moving-coil-instrument, and a time-switch-clock electrically connected with said source of light for limiting the energization of the same to a predetermined length of time during the printing operation.

7. In a photographic printing apparatus, the combination of a source of light, means for supporting a photographic negative in a position to be exposed to said source of light, a photoelectric cell movable into a position in which it will be energized by light passing through a negative on said supporting means, a moving-coil-instrument electrically connected with said photoelectric cell, an adjustable resistance for said source of light, a controlling lever for said resistance movable by a spring, means for locking said controlling lever in different positions, said last named means being actuated by a circuit closed by said moving-coil-instrument, and an indicator mechanically connected with said controlling lever for indicating in the position in which said controlling lever has been locked by said locking means the length of time the negative should be exposed when being printed.

8. In a photographic printing apparatus, the combination of a casing having two separate compartments, each of which being provided with a source of light and means for supporting a photographic negative in a position in which it is exposed to the source of light therein, a photoelectric cell movable into a position in which it is energized by light passing through a negative placed on one of said supporting means, a moving-coil-instrument electrically connected with said photoelectric cell, an adjustable resistance for the source of light which energizes the photoelectric cell through said negative, a controlling lever for said resistance movable by a spring, means for locking said controlling lever in different positions, said last named means being actuated by a circuit closed by said moving-coil-instrument, and an indicator mechanically connected with said controlling lever for indicating in the position in which said controlling lever has been locked by said locking means the length of time the negative should be exposed when placed for printing on said other supporting means.

9. In a photographic printing apparatus, the combination of a casing having two separate compartments, each of which being provided with a source of light and means for supporting a photographic negative in a position in which it is exposed to the source of light therein, a photoelectric cell movable into a position in which it

is energized by light passing through a negative placed on one of said supporting means, a moving-coil-instrument electrically connected with said photoelectric cell, an adjustable resistance for the source of light which energizes the photoelectric cell through said negative, a controlling lever for said resistance movable by a spring, means for locking said controlling lever in different positions, said last named means being actuated by a circuit closed by said moving-coil-instrument, and a time-switch-clock for controlling the energization of the source of light which illuminates the negative when the latter is placed for the printing operation on the other one of said supporting means, said time-switch-clock including a rotatable shaft on which said controlling lever is fixedly attached, and a pointer on said shaft for indicating in the position in which said controlling lever has been locked by said locking means the length of time the negative should be illuminated when placed for printing on said last named supporting means.

10. In a photographic printing apparatus, the combination of a source of light, means for supporting a photographic negative in a position to be exposed to said source of light, a photoelectric cell movable into a position in which it is energized by light passing through a negative placed on said supporting means, a moving-coil-instrument electrically connected with said photoelectric cell, said moving-coil-instrument having a rotatable pointer, means for locking said pointer in the position it is rotated by the current produced in said photoelectric cell, an electric circuit including said source of light and a switch, means controlling the opening and closing of said switch, said means including a manually operable member adapted to be moved in engagement with said locked pointer, spring means for returning said manually operable member to initial position, spaced switch operating elements for closing and opening respectively said switch during the return movement of said manually operable member, and braking means for controlling the length of the time period between the closing and opening of said switch by said switch operating elements, said braking means being adjusted by said manually operable member in accordance with the position the latter assumes when engaging said locked pointer.

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