July 26, 1938. P. S. PIRMOV 2,124,954

PHOTOGRAPHIC ENLARGING AND PRINTING MACHINE

Filed Feb. 14, 1935 2 Sheets-Sheet 1

Fig. 1.

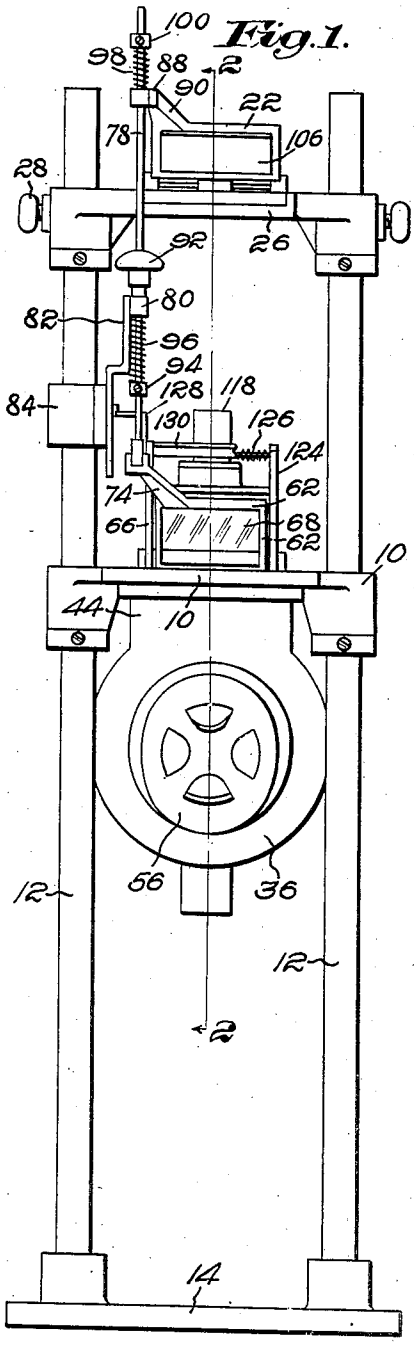
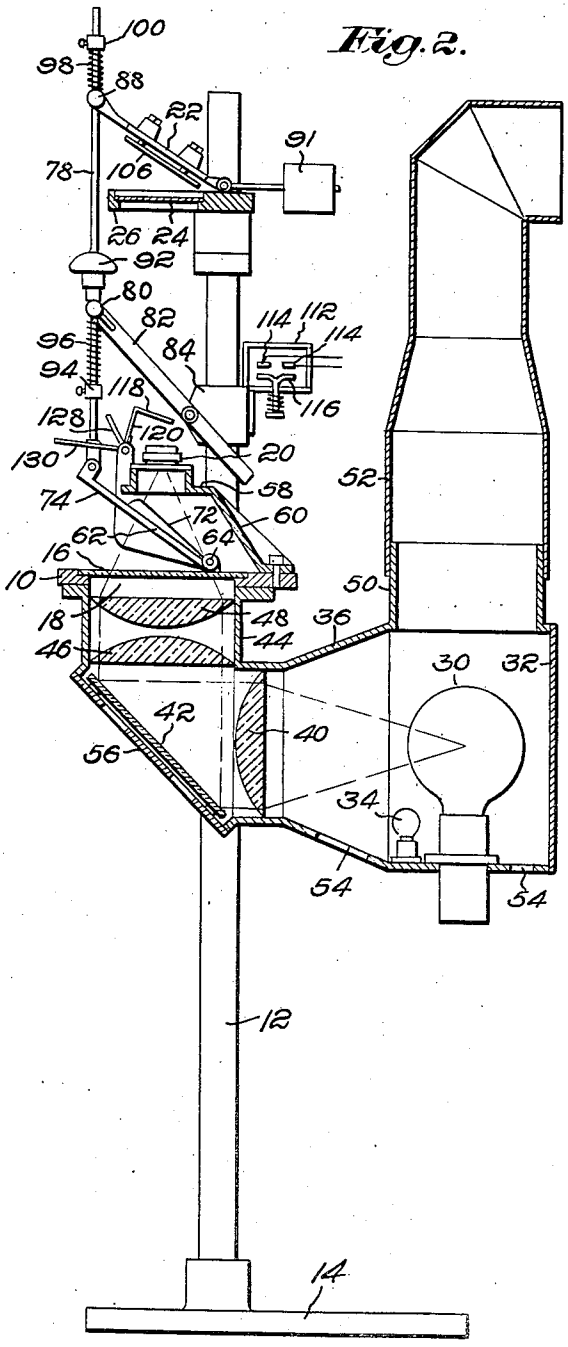


Fig. 2.



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Fig. 3.

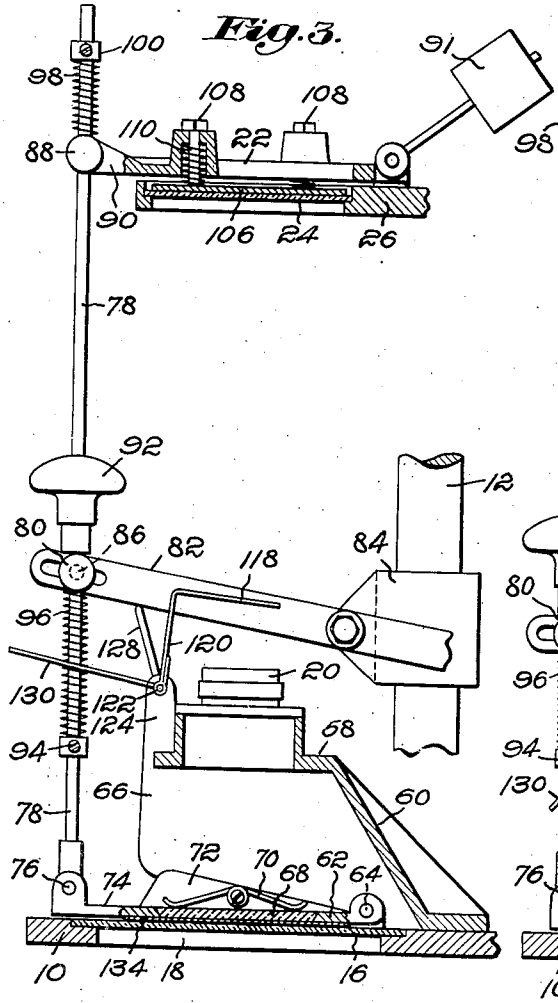


Fig. 4.

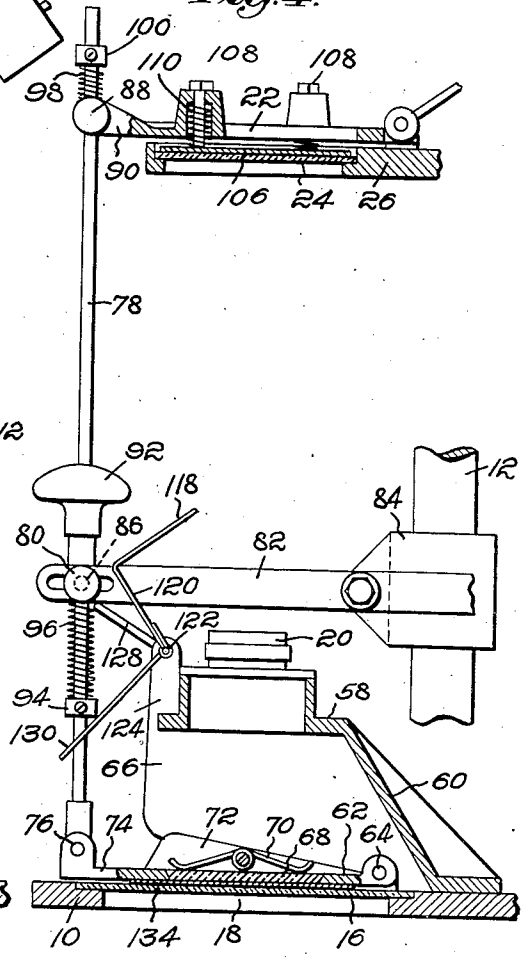
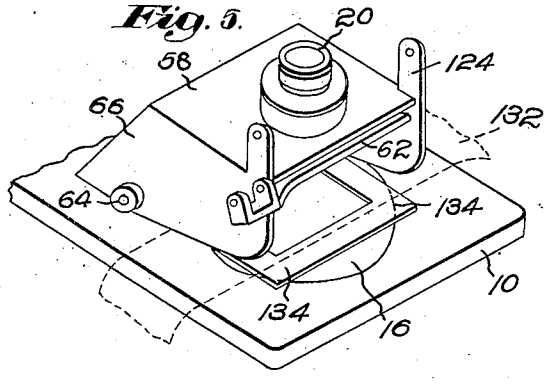


Fig. 5.



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Patented July 26, 1938

2,124,954

UNITED STATES PATENT OFFICE

2,124,954

PHOTOGRAPHIC ENLARGING AND PRINTING MACHINE

Paul S. Pirmov, Cambridge, Mass., assignor, by mesne assignments, to Max B. Klubock, and himself, both of Boston, Mass., trustees

Application February 14, 1935, Serial No. 6,531

8 Claims. (Cl. 88—24)

This invention relates to photo enlarging and printing machines of the type where the enlarged print is made directly on sensitized paper from negatives, which latter may be either in the form of cut or strip films.

The object of the invention, among other things, is to so improve the facility with which the successive steps of printing may be carried out as to increase both the rapidity and simplicity of operation and to insure a more accurate and faithful reproduction.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings:—

Fig. 1 is a front elevation of a machine embodying one form of the invention, showing the movable parts in the open or raised position preparatory to printing;

Fig. 2 is a sectional elevation on the line 2—2 in Fig. 1;

Fig. 3 is a sectional elevation on an enlarged scale showing the film supporting table with the principal movable parts in a depressed position just prior to printing;

Fiy. 4 is a similar sectional elevation showing the subsequent position of the parts at the instant of printing; and

Fig. 5 is a perspective, with the visor and lens shutter removed, showing the negative resting on the film supporting table as it appears to the operator.

Referring to the drawings and to the embodiment of the invention therein shown for purposes of illustration, the latter comprises a film or negative supporting table **10** having a flat top and fixedly secured on and between two upright posts **12**, the latter being supported by the base **14** adapted to rest on the floor. The table is fixed at a height convenient to the operator for viewing and handling the negative, preferably from a sitting position.

The table is provided with transparent walls, conveniently presented by the glass plate **16** set flush with the top of the table and covering the aperture **18**. Light rays are transmitted from below to illuminate the negative resting on the plate and to project the image thereon upwardly through an enlarging lens **20** by which it is directed upwardly on the sensitized paper, the latter at the time of exposure being held clamped by the paper clamp **22** in flattened and prefocused position on a transparent glass or image receiving plate **24** covering an aperture in the paper supporting table **26**. The latter is also secured to the upright posts **12** above the film supporting table **10** but adjustable vertically on the posts by means of clamping screws **28** to vary, if desired, the scale of enlargement or desired ratio of magnification.

In prior machines of this general class, the rapidity of printing has been seriously hampered by the fact that attempts to shorten the time of exposure by increasing the intensity of illumination have resulted in abnormally increasing the heat accompanying the high power illumination, which, in proximity to the film, tends to overheat or even burn or scorch the negative. This has enforced the use of supersensitive paper with relatively low candle power illumination and has been commonly confined to such illumination as arises, for example, from an electric lamp of from 100 to 150 watts capacity. One object of the invention is to provide greatly intensified illumination, such, for example, as is represented by an electric lamp of from 1000 to 1500 watts or more, this being employed under such conditions that no detrimental heating effect on the negative takes place and such that paper of ordinary sensitiveness may be employed with an equally low or even lesser time required for exposure.

Herein the illumination is provided by a high candle power electric lamp **30**, which, as stated, may be of from 1000 to 1500 watts capacity, this being enclosed within and supported at the bottom of a cylindrical casing **32** at the back of the machine and constituting a part of the light box or housing. By the side of the lamp **30** there is also provided a lamp **34** of low candle power, such, for example, as 10 watts, the latter being permanently in circuit and employed for the purpose of creating a faint illumination sufficient to examine and position the negative preparatory to printing, the lamp **30** being cut into circuit only at the instant of printing to project the image on the sensitized paper.

The lamp casing **32** is provided with an open, laterally extending, conical throat **36**, in the mouth of which is positioned a condensing lens **40** to receive the light rays from the lamp and project them in parallelism against a mirror **42**. The latter is held at the end of the extension **38** in such position and at such an angle as to receive the light rays from the lens **40** and project them upwardly in parallelism with a vertical axis passing through the center of the aperture **18** of the film table and the focusing lens **20**.

Above the mirror the light housing terminates in an upright cylindrical casing 44 containing the lenses 46 and 48 which transmit the light rays upwardly first in parallelism and then through the film-supporting glass plate 16 in converging relation to and through the focusing lens 20.

The cylindrical casing 44 is provided with a flange by which it is bolted or otherwise secured to the bottom of the film table 10 so that the lamp housing is fixedly carried thereby with the lamp compartment 32 in lateral overhanging relation well removed at the rear of the machine away from the vertical axis of the lens and out of proximity to the negative.

To conduct the heat generated by the lamps still further away from any point where it might detrimentally affect the negative, the top of the lamp casing is provided with a flue opening 50 which is surmounted by a chimney 52 by which the heated currents may be diverted upwardly and backwardly away from the machine. Draft is induced through the chimney as by the provision of one or more openings 54 in the bottom of the light housing, the cool air entering therethrough also assisting in keeping cool the lenses and other parts within the housing. Preferably an air space is provided back of the mirror 42, the backing plate 56 therefor having one or more openings for circulation of air about the mirror.

Another object of the invention is to insure precision in the position and adjustment of the focusing lens at all times, to maintain the film within the field of vision of the operator and to facilitate and assure the accurate position of the film flatwise on the glass covered aperture in the table. To secure these results the film or negative is maintained within the vision of the operator up to and even during the time of exposure so that its adjustment and condition may at all times be observed.

To this end the enlarging lens 20, mounted in the usual sliding lens-holding sleeve for purposes of focal adjustment, is carried in the tubular walls of a lens carrier comprising the plate 58 above and overhanging the table 10 and supported by the inclined arm or plate 60 which is fixedly secured to the table. Accordingly the lens holder is maintained immovable at all times and in a fixed established position during the successive steps of the printing operation and, when the lens is once adjusted, no further attention is required thereto, the only movable elements in immediate proximity to the negative being those comprising the relatively light negative clamping and compressing means about to be described and which is applied to the negative just prior to the time of exposure.

Such clamping means herein comprises the light rectangular metal frame 62 (Figs. 1 and 2) hinged at its rear end to the table. This is normally held tilted up in raised position (as shown in Fig. 2), but through the actuating mechanism hereinafter described, may be depressed down against the film (as shown in Figs. 3 and 4). The frame is pivoted at its rear end on a pin or rod 64 which is carried by the opposite frame-hinging walls 66, the latter being herein formed as parts of the fixed lens carrier to impart stiffness and rigidity thereto and also serving as guiding walls to guide the frame in its rocking movement.

It will be seen that these walls 66 rest on and contact with the table 10 at the rear of the glass plate but diverge upwardly and forwardly therefrom so as to interfere at no time either with the free shifting of the negative over the table or with the free open vision of the operator in viewing the film, which vision (as indicated in Fig. 5) is unobscured at all times by the lens carrier.

Within the rectangular opening of the frame 62 there is held a transparent glass panel 68 with beveled edges which seat against similarly beveled walls in the frame. The glass panel is yieldably held to its seat in the frame by two springs 70 carried by upturned ears 72 on opposite sides of the frame and engaging the back or top of the panel along its opposite sides but leaving an intermediate unobstructed transparent area in the panel equal at least to the maximum area on the negative from which it may be desired to print.

The face or underside of the glass panel normally projects slightly below the underside of the rectangular frame so that, when the frame is depressed (as hereinafter described) the glass panel has prior contact with the film or negative to be printed and, as pressure is continued, yields slightly in the frame. This acts to squeeze the film between the two transparent surfaces, that of the glass plate 16 and that of the glass panel 68, compressing the film and leaving it in a completely flattened state free from any condition of buckling or the like. This insures a uniform sharpness in the projectness of the image on the sensitized paper which is otherwise unobtainable. The application of such film contacting and compressing device also serves to cool the film by conduction in the event of unusually long exposures to the light rays, additionally reducing any danger from overheating the film. In the event of the use of a mat or mask over the film, such mat or mask is ordinarily so thin that the clamping and compressing action of the glass panel 68 is substantially as described.

To raise or lower the frame 62, the latter has a forwardly projecting arm 74 which is pivotally connected at 76 to an upright vertically movable actuating rod 78. This rod is mounted for sliding movement in a collar 80 carried by the arm 82 pivoted on a sleeve member 84 fastened to one of the posts 12. The collar 80 is carried by a pin 86 having a limited movement in a slot in the arm 82 to permit the necessary depression of the arm without binding. Near its upper end the rod 78 also has sliding movement through a second collar 88 secured to an arm 90 projecting forwardly from one side of the pivoted paper clamp 22. An arm extending rearwardly from the pivot of the paper clamp carries a counterweight 91 which serves normally to maintain the parts in the position shown in Fig. 2 and to restore them to that position when the rod 78 is free to rise.

Slidably mounted on the rod 78 is a knob or handle 92 at a height easily accessible to the operator and through which the depression of the rod and the frame 62 is effected. On the rod 78 below the collar 80 there is provided a fixed abutment 94 and between the abutment and the collar also a coiled spring 96. On depression of the knob, the latter engages the collar moving the collar downward with its attached arm 82, and, acting through the spring and the abutment 94, depresses the rod and swings the film clamping frame down from the position shown in Figs. 1 and 2 to that shown in Fig. 3, compressing and flattening the film. Further downward movement of the knob additionally compresses the spring and increases the pressure on the film plate, the parts then moving from the position shown in Fig. 3 to that shown in Fig. 4.

The depression of the rod 78 and the film plate 62 is accompanied by a similar downward movement of the paper compressing plate 22. This is provided for by the interposition of a coiled spring 98 on the rod 78 between the collar 88 and a fixed abutment 100 on the rod above the collar.

The paper clamp comprises a backing or carrier plate 22 hinged at its rear end to the paper supporting table 26 and carrying a presser plate 106 which is yieldably supported thereon with a certain amount of lost motion. This is provided by studs 108 encircled each by a coiled spring 110 normally holding the presser plate slightly away from the backing plate. When the latter is swung down by the depression of the rod, the presser plate overlies and engages the sensitized paper which has previously been placed over the image-receiving plate 24. This acts to press the paper flat, the pressure being increased as the knob is moved down to its final position shown in Fig. 4.

The depression of the knob to the final position shown in Fig. 4 not only depresses the negative and paper clamps, clamping and flattening both the film and the paper, but is herein utilized simultaneously to close the circuit through the high power lamp 30. This may be accomplished in any desired manner but herein there is indicated more or less diagrammatically a switch box 112 secured to the sleeve member 84 on the post 12 carrying spaced contacts 114 normally holding open the lamp circuit. These contacts are adapted to be closed, however, by the bridging member 116 normally depressed by a spring but adapted to be lifted to close the switch when engaged by the rearwardly projecting end of the lever 82 when it rises to the substantially horizontal position shown in Fig. 4. This corresponds to the finally depressed position of the knob 92 and rod 78 and is contemporaneous with and maintained during the period of exposure.

As soon as pressure is relieved on the knob 92, the lever 82 swings from the position shown in Fig. 4 to that shown in Fig. 3, instantly breaking the lamp circuit. The period during which the knob is held depressed (as shown in Fig. 4) measures the interval during which exposure continues and may of course be accurately timed.

A feature which renders uncertain the effective period of exposure where an electric lamp is employed is the afterglow of the lamp following the breaking of the lamp circuit. This is apt to be particularly troublesome in the case of high wattage lamps. Such afterglow often results in an over exposure due to the persistence of the image projecting light beyond the intended timing. It may also produce a double image or light streaks on the sensitized paper, particularly under high speeds of operation, caused by the persistence of light after the film or paper or both have been subject to some slight displacement, such as might occur in the described machine after the release stroke of the paper and film clamping plates has been initiated.

To eliminate the detrimental effect of such afterglow or displacement of the paper or negative before the light can be cut off, there is here provided means for interposing an opaque wall or shutter in the path of the light rays. Such shutter is automatically withdrawn from that path when exposure is designed to start, as determined by the final depression of the knob 92 (Fig. 4), but is automatically re-established in that path the instant the predetermined time of exposure has elapsed, as determined by the release of the knob and its upward movement.

This is most conveniently provided in the form of a thin metallic plate 118 and most conveniently positioned immediately above the lens 20 in such relationship that it may be moved over the lens to cut off all light rays transmitted upwardly therefrom (Figs. 2 and 3), or may be moved reversely to permit the transmission of such light rays without interference (Fig. 4).

Herein the shutter plate 118 has a portion 120 bent at right angles thereto, the opposite end of which is secured to a horizontal, transverse, rocking rod 122 mounted for turning movement in the two ears 124 which are formed on the opposite frame-hinging walls 66, the shutter being normally urged to its light interrupting position (Figs. 2 and 3) by a torsion spring 126 (Fig. 1). To rock the shutter, the rod 122 carries at one end an upwardly and forwardly projecting pin 128 having a laterally bent end lying within the path of the arm 82, the pin being presented at such an angle that when engaged by the arm it is swung forwardly and downwardly rocking the shutter from the closed or light-interrupting position (Fig. 3) to the open or light-unobstructing position (Fig. 4).

Accordingly, in the normal raised position of the clamping plates, the shutter is closed as shown in Fig. 2 and remains closed until and after the clamping plates are applied as shown in Fig. 3.

In the ensuing downward stroke of the rod 78, the shutter is slowly rocked toward open position so that when the rod reaches the end of its travel, with the resulting increased pressure on the clamping plates and the final closing of the lamp circuit, the shutter has been withdrawn entirely out of the path of the light transmitted by the lens. On the release of the knob, however, and the first upward motion of the rod 78, the shutter snaps back to the closed position, cutting off the passage of light from the lens to the sensitized paper.

To permit the operator to view without eye fatigue, if desired, the brightly illuminated negative during its exposure to light from the high wattage lamp, there may be provided a visor or anti-glare element 130, normally positioned out of the field of vision of the operator in looking at the negative, but adapted to be moved at the time of exposure into such position as to interpose such element within his normal line of vision. Such visor may be in the form of a plate of colored, clouded or semi-transparent material such as Celluloid or glass.

To provide for its required movement, it is herein attached to the shutter actuating rod 122 and projects therefrom at such an angle that prior to the instant of exposure it occupies the position shown in Figs. 2 and 3, where there is no interference with the operator's clear vision of the negative. In Fig. 1 the visor is shown broken away at the left to leave visible the spring 126. At the instant of exposure, however, it is swung down to such a position, as shown in Fig. 4, that the operator in his normally assumed attitude may without eye strain view the brightly illuminated field of the negative through the visor. The visor may be of such size or area as to entirely screen or dull the bright illumination transmitted from the negative in the direction of the operator, or it may be of such size as to interrupt only the rays reaching him in the normal position of his head, so that by inclining or

moving his head he may, should he so desire, still view the brilliantly lighted negative from beneath or around the sides of the visor.

The operation of the machine, which is carried out in the usual photographer's dark room or its equivalent, will be readily understood from the previous description of the parts and their functions, but may be briefly summarized as follows.

With the parts in position shown in Figs. 1 and 2 and the paper and negative clamping members raised, the negative (herein shown in strip form and indicated at 132 in Fig. 5) is placed on the flat table 10 over the transparent plate 16 where its image becomes visible through the relatively feeble illumination afforded by the constantly burning low wattage lamp 34. This enables the operator to judge of the density and quality of the negative and estimate the required time for exposure, as well as to adjust it in properly aligned position.

Normally the negative will be covered by an opaque mask or mat, such as 134 (Fig. 5), formed of thin sheet-metal, paper or other material and cut to a size suited for the size of the negative. The mask being suitably positioned on the table 10, the negative is then quickly adjusted to the proper position as defined by the mask.

Immediately following the adjustment of the negative, the operator places the sensitized paper face down against the top of the transparent image receiving plate 24 and presses the rod 78 by the knob 92, bringing the parts to the position shown in Fig. 3. In that position the paper and the negative have been clamped, compressed and flattened by their respective clamping members but the shutter still remains closed and the visor tilted up. This gives opportunity to view the negative and check its finally clamped position before exposure.

The knob is then finally depressed, bringing the parts as shown in Fig. 4, simultaneously lighting the high power lamp, withdrawing the shutter, lowering the visor and causing the image to be projected on the sensitized paper, the knob being held depressed for an interval conforming to the predetermined time of exposure.

The knob is then released, this serving instantly and simultaneously to cut out the lamp 30, close the shutter and raise the visor, this being then followed by the tilting up of the clamping plates on the succeeding upward movement of the rod and the knob. The paper is then removed and replaced by another piece, and the operation repeated with a different negative or with the same negative, as may be desired. These successive steps may be carried out with great rapidity but with the assurance that a clean cut exposure is had through the flattened negative, while at the same time the position of the negative is at all times within the observation of the operator.

While I have herein shown and described for the purposes of illustration one specific embodiment of the invention, it is to be understood that extensive deviations may be made in the form and mechanical arrangement of the parts herein illustrated and that extensive changes may be made therefrom, all without departing from the spirit of the invention.

I claim:

1. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible to the operator the image on a negative placed on said transparent flat support, means for intensifying the illumination for purposes of exposure, side walls and a back wall projecting downwardly from said enlarging lens and largely encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, a movable shutter normally in the path of the light emanating from said lens, a movable shield for largely blocking off light from the front of said encompassed space, said shield being movable out of light-blocking position to leave the negative fully exposed to the view of the operator while said source of illumination is in non-intensified condition and being movable into light-blocking position while said source of illumination is intensified, means for simultaneously withdrawing the shutter from the path of the light emanating from said lens and for moving said shield into light-blocking position, and a single manually manipulable means for actuating said last-named means.

2. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible to the operator the image on a negative placed on said transparent flat support, means for intensifying the illumination for purposes of exposure, side walls and a back wall projecting downwardly from said enlarging lens and largely encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, a movable shutter normally in the path of the light emanating from said lens, a movable shield for largely blocking off light from the front of said encompassed space, said shield being movable out of light-blocking position to leave the negative fully exposed to the view of the operator while said source of illumination is in non-intensified condition and being movable into light-blocking position while said source of illumination is intensified, means for withdrawing the shutter from the path of the light emanating from said lens and for moving said shield into light-blocking position simultaneously with the intensification of said source of illumination, and a single manually manipulable means for actuating said last-named means.

3. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible the image on the negative, means for intensifying the illumination for purposes of exposure, side walls and a back wall projecting downwardly from said enlarging lens and largely encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, a movable shutter normally in the path of the light emanating from said lens, a movable shield for largely blocking off light from the front of said encompassed space but permitting view therethrough of the highly illuminated negative, said shield being movable out of light-blocking position to leave the negative fully exposed to

the view of the operator while said source of illumination is in non-intensified condition and being movable into light-blocking position while said source of illumination is intensified, and means for simultaneously withdrawing the shutter from the path of the light emanating from said lens and for moving said shield into light-blocking position.

4. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible the image on the negative, means for intensifying the illumination for purposes of exposure, side walls and a back wall projecting downwardly from said enlarging lens and largely encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, a movable shutter normally in the path of the light emanating from said lens, a movable shield for largely blocking off light from the front of said encompassed space but permitting view therethrough of the highly illuminated negative, said shield being movable out of light-blocking position to leave the negative fully exposed to the view of the operator while said source of illumination is in non-intensified condition and being movable into light-blocking position while said source of illumination is intensified, and means for withdrawing the shutter from the path of the light emanating from said lens and for moving said shield into light-blocking position simultaneously with the intensification of said source of illumination.

5. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible to the operator the image on a negative placed on said transparent flat support, means for intensifying the illumination for purposes of exposure, walls projecting downwardly from said enlarging lens and substantially encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, at least one of said walls being movable out of light-confining position to expose fully the negative to the view of the operator while said source of illumination is in non-intensified condition and being movable into light-confining position when said source of illumination is intensified, a movable shutter normally in the path of the light emanating from said lens, means for simultaneously withdrawing the shutter from the path of the light emanating from said lens and for moving said movable wall into light-confining position, and a single manually manipulable means for actuating said last-named means.

6. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible to the operator the image on a negative placed on said transparent flat support, means for intensifying the illumination for purposes of exposure, walls projecting downwardly from said enlarging lens and substantially encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, at least one of said walls being movable out of light-confining position to expose fully the negative to the view of the operator while said source of illumination is in non-intensified condition and being movable into light-confining position when said source of illumination is intensified, a movable shutter normally in the path of the light emanating from said lens, means for withdrawing the shutter from the path of the light emanating from said lens and for moving said movable wall into light-confining position simultaneously with the intensification of said source of illumination, and a single manually manipulable means for actuating said last-named means.

7. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible the image on the negative, means for intensifying the illumination for purposes of exposure, walls projecting downwardly from said enlarging lens and substantially encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, at least one of said walls being of sufficient light-transmitting properties to permit view therethrough of the highly illuminated negative but being movable out of light-confining position to expose fully the negative to the view of the operator while said source of illumination is in non-intensified condition, a movable shutter normally in the path of the light emanating from said lens, and means for simultaneously withdrawing the shutter from the path of the light emanating from said lens and for moving said movable wall into light-confining position.

8. In a photographic enlarging and printing machine, a transparent flat support against which a negative may be placed, an enlarging lens immovably fixed in spaced relationship from said support, a source of illumination sufficient to render visible the image on the negative, means for intensifying the illumination for purposes of exposure, walls projecting downwardly from said enlarging lens and substantially encompassing space in the line of vision of the operator between said support and said enlarging lens to confine largely through said lens the light emanating from said source of illumination, at least one of said walls being of sufficient light-transmitting properties to permit view therethrough of the highly illuminated negative but being movable out of light-confining position to expose fully the negative to the view of the operator while said source of illumination is in non-intensified condition, a movable shutter normally in the path of the light emanating from said lens, and means for withdrawing the shutter from the path of the light emanating from said lens and for moving said movable wall into light-confining position simultaneously with the intensification of said source of illumination.

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