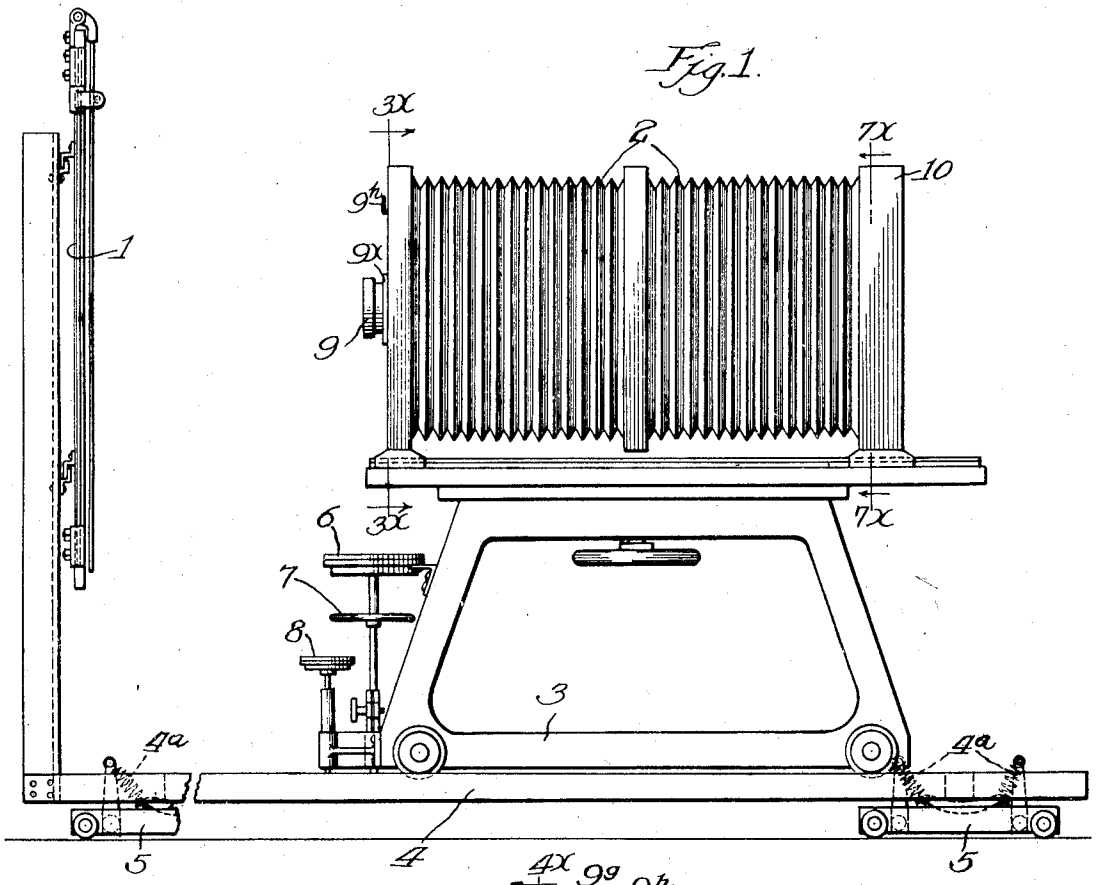
Jan. 3, 1933. R. R. ROBERTSON 1,892,683

SINGLE PLATE MULTIPLE PHOTOGRAPHIC REPRODUCTION

Filed June 27, 1929 6 Sheets-Sheet 1

Fig. 1.



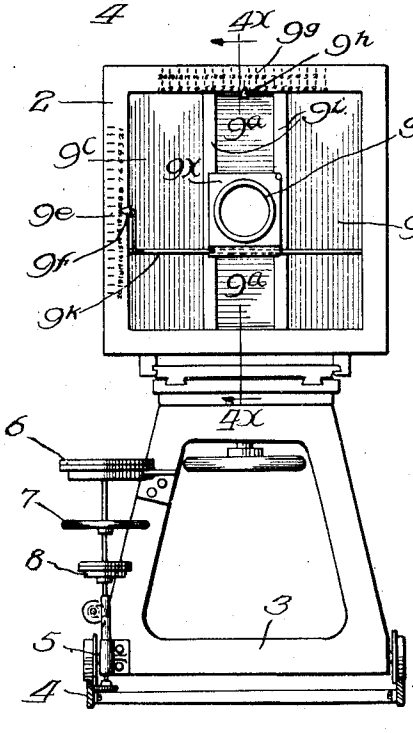


Fig 2.

Witness

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Jan. 3, 1933. R. R. ROBERTSON 1,892,683

SINGLE PLATE MULTIPLE PHOTOGRAPHIC REPRODUCTION

Filed June 27, 1929 6 Sheets-Sheet 2

Fig. 3.

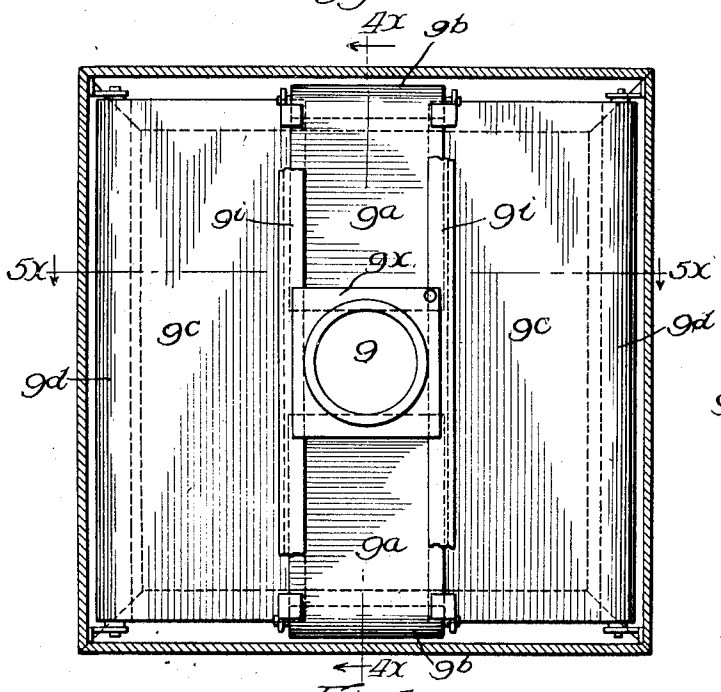


Fig. 4.

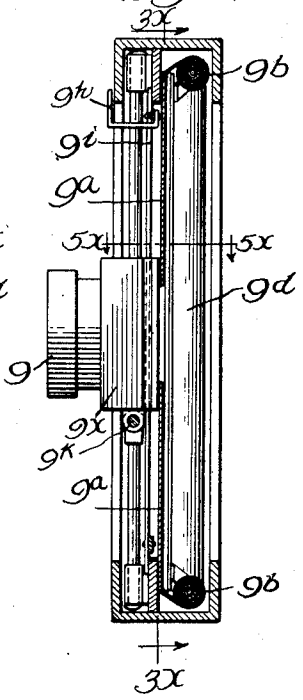


Fig. 5.

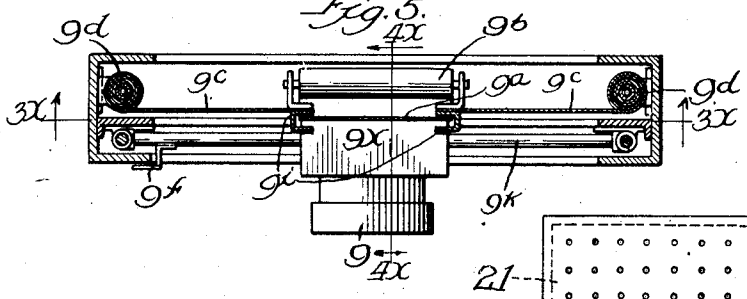
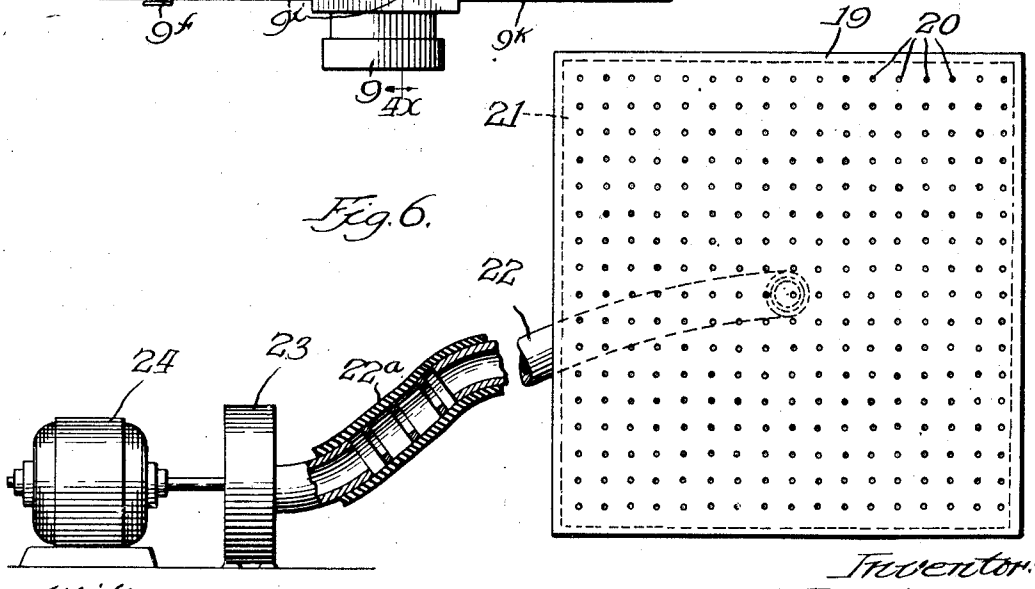


Fig. 6.



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SINGLE PLATE MULTIPLE PHOTOGRAPHIC REPRODUCTION

Filed June 27, 1929 6 Sheets-Sheet 3

Fig. 9.

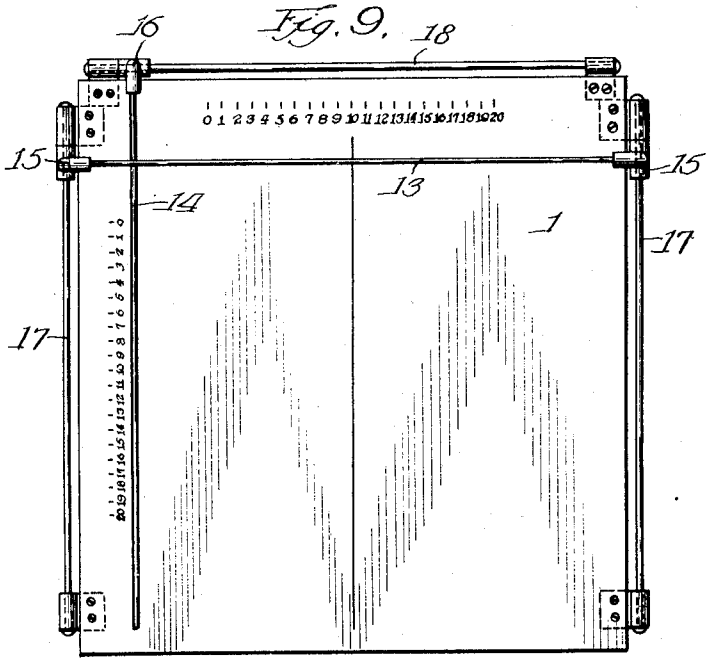


Fig. 10.

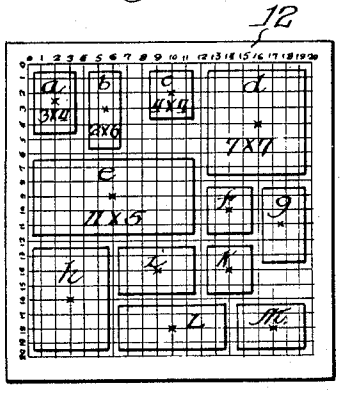


Fig. 7.

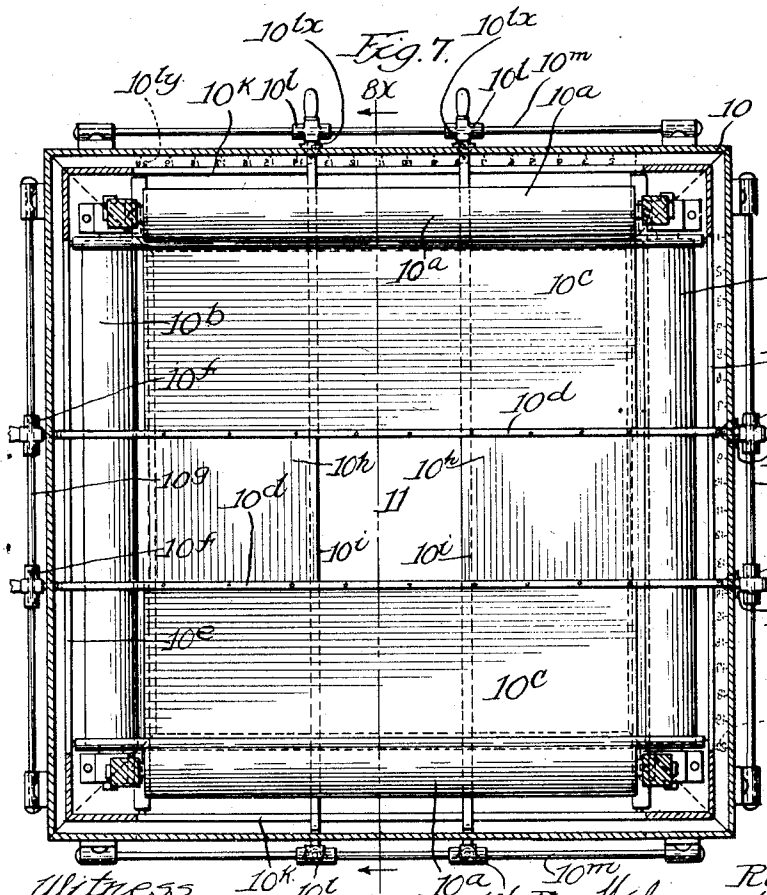
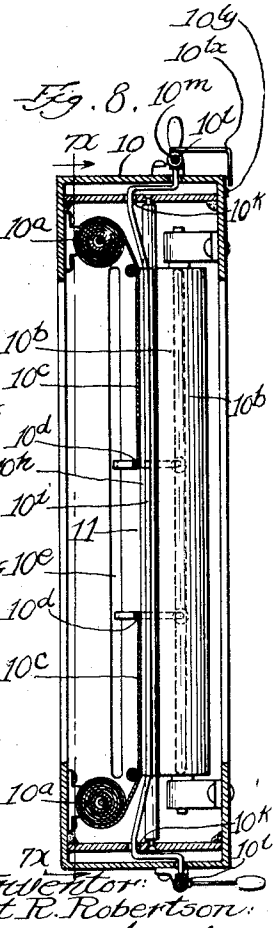


Fig. 8.



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SINGLE PLATE MULTIPLE PHOTOGRAPHIC REPRODUCTION

Filed June 27, 1929 6 Sheets-Sheet 4

Fig. 11.

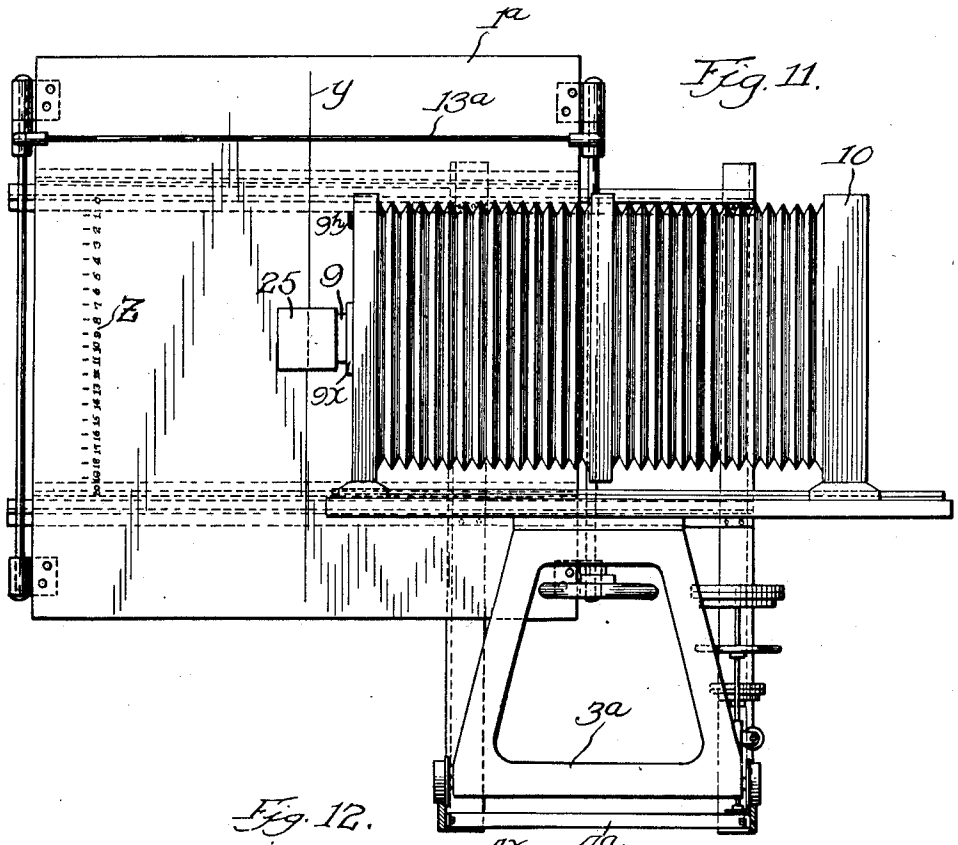
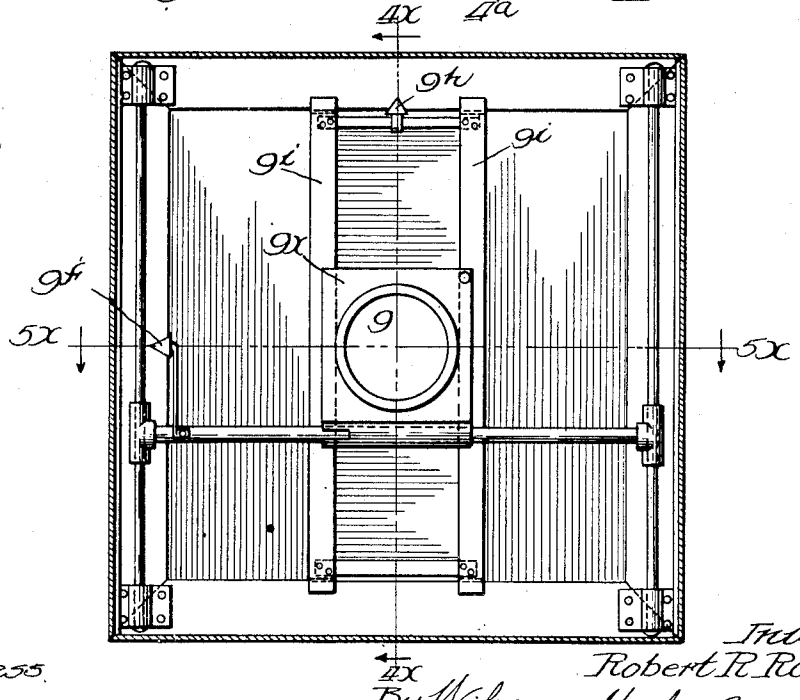


Fig. 12.



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SINGLE PLATE MULTIPLE PHOTOGRAPHIC REPRODUCTION

Filed June 27, 1929 6 Sheets-Sheet 5

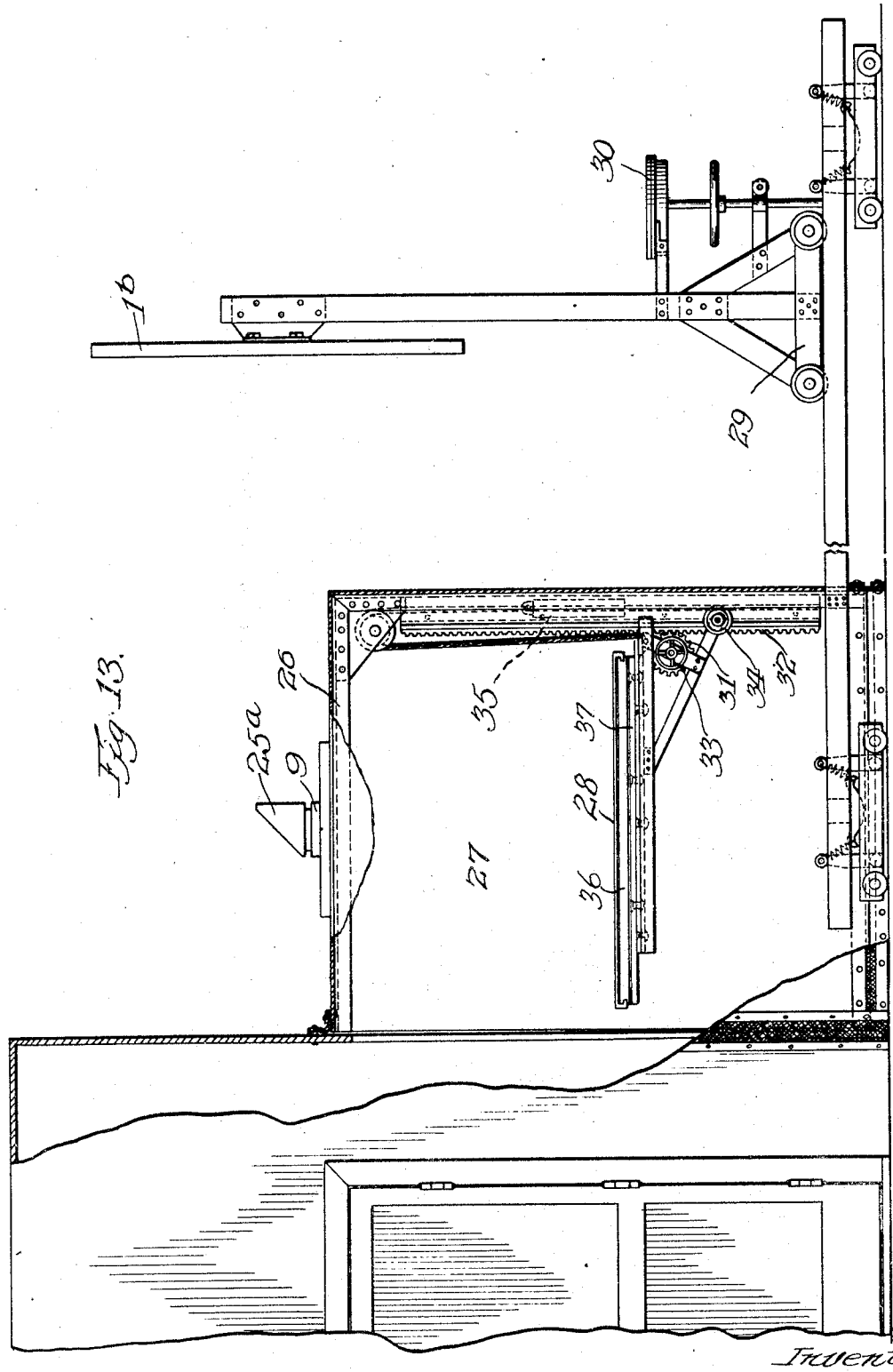


Fig. 13.

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Jan. 3, 1933. R. R. ROBERTSON 1,892,683

SINGLE PLATE MULTIPLE PHOTOGRAPHIC REPRODUCTION

Filed June 27, 1929 6 Sheets-Sheet 6

Fig. 14.

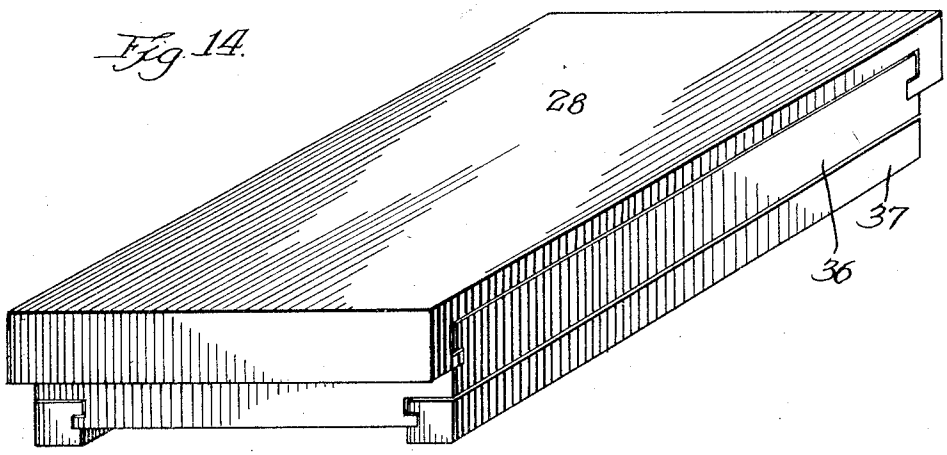
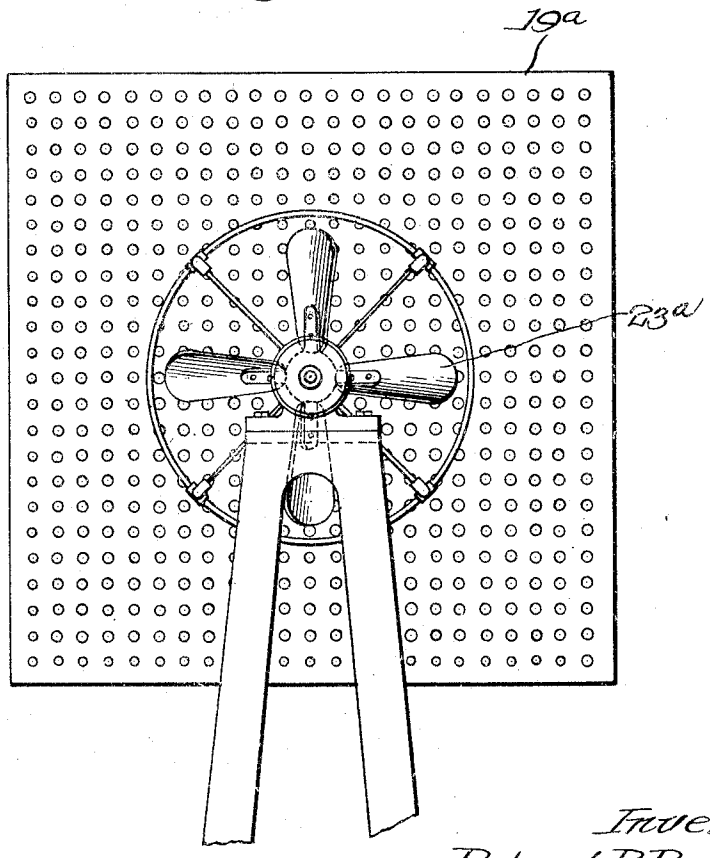


Fig. 15.



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Patented Jan. 3, 1933 1,892,683

UNITED STATES PATENT OFFICE

ROBERT R. ROBERTSON, OF EVANSTON, ILLINOIS

SINGLE PLATE MULTIPLE PHOTOGRAPHIC REPRODUCTION

Application filed June 27, 1929. Serial No. 374,250.

This invention relates to reproduction, by the process of photography, of copy subjects, for instance, photographic reproduction practiced as a step in the art of producing printing forms, and has for its object to economize in time and expense of materials used in performing the step which relates particularly to making negatives of a plurality of copy subjects.

Heretofore, in making negatives of copy subjects as a preliminary to the production of printing forms, it has been necessary to take each copy subject and photograph it upon a special plate which is then handled and treated through the remaining steps of of the process, with the result that the greater portion of the work, being multiplied according to the number of copy subjects handled, was very expensive in point of time and materials consumed, and very uneconomical in the consumption of the sensitized photographic plate or film that had to be subjected to exposure in producing the negative.

The present invention proceeds upon the principle of photographing a considerable number of copy subjects all upon one and the same sensitized surface, under conditions which afford the same range of independent treatment of the copy subject, as to size and intensity of exposure, as if a separate plate were used for each copy subject. Collateral features of the invention have to do with a method of indicating by previously formed plat or chart, the precise arrangement of exposures upon the sensitized surface that should be made in order to carry out the process most economically; also with apparatus for accurately locating copy subjects upon a copy holder in positions corresponding to the chart, and correspondingly locating the image upon the sensitized surface within the camera; also with means for effecting necessary adjustments of the lens of the camera to insure proper projection of the image upon a predetermined limited space of the sensitized surface; also with means for screening, at will, any restricted portion of a sensitized surface with effective screening and protection of the remainder of the surface against light; also with means whereby the several features of the invention may be adapted to photography through means of apparatus having the focal axis of the lens parallel with the surface of the copy holder; and with improved means for holding the copy subject or a sensitized film or sheet upon a supporting surface or any selected portion thereof without the use of means penetrating or otherwise engaging the sheet to be held.

In the accompanying drawings—

Figure 1 is a side elevation of a commercial camera of known form in which the several features of my invention are embodied.

Figure 2 is a front elevation of the same with the copy holder removed.

Figure 3 is a section on the line $3x$—$3x$ of Figures 1, 4, and 5.

Figure 4 is a section on the line $4x$—$4x$ of Figures 2, 3, 5, and 12.

Figure 5 is a section on the line $5x$—$5x$ of Figures 3, 4, and 12.

Figure 6 is a detail view showing one method of holding a copy subject or a sensitized film or sheet to a supporting surface by air suction.

Figure 7 is a section on the line $7x$—$7x$ of Figure 8.

Figure 8 is a section on the line $8x$—$8x$ of Figure 7.

Figure 9 is a front view of the copy holder shown in Figure 1.

Figure 10 is a face view of the guide chart previously made up to indicate the location of copy subjects in a manner to insure most economical arrangement of their images upon the sensitized surface and as a preliminary to which corresponding placement of the copy subjects upon the copy holder of Figure 9 must be resorted to.

Figure 11 is a view showing the arrangement of the copying camera with its focal axis parallel to the plane of the copy holder.

Figure 12 is a view corresponding to Figure 3 showing the means through which to effect adjustment of the lens required in using the arrangement of Figure 11.

Figure 13 is a view illustrating the application of the invention to a dark room into which an immovable lens projects its beam, with a constantly positioned axis upon a sen-

sitized surface supported with universal adjustment in order to bring any desired restricted portion of the surface under the influence of the beam.

Figure 14 is a detail perspective view of the universally adjustable support for the sensitized surface in Figure 13; and

Figure 15 shows a modified construction of means for holding a sheet against a support through means of air suction without mutilation of the sheet.

Referring first to the illustrative embodiment of the invention disclosed in Figures 1 to 10 inclusive, where the invention is shown applied to a copying camera operating with the axis of the lens perpendicular to the plane of the copy subject, 1 represents a conventional copy holder modified to embody that part of the present invention which has to do with facilitating the location of the copy subject on the holder in correspondence with the position which the image is to occupy in the multiple subject photograph. 2 represents the standard commercial copying camera modified according to the present invention to adapt it to shift its lens and expose limited portions of its sensitized surface in correspondence with the required location of each image on the multiple negative to be produced. 3 represents a known construction of carriage upon which the camera is mounted with such movement as is required for determining focal distance, and which carriage is preferably mounted in a known manner through the medium of a bed 4 and shock absorbing suspension means 4*a* upon trucks 5; a gauge 6 being provided to indicate the position of the carriage 3 upon the bed 4, which position may receive its fine adjustment through means of the hand wheel 7. 8 represents a compensating gauge indicating corrective carriage positions hereinafter referred to.

9 indicates, generally, the lens of the camera which, for purposes of that application of the invention illustrated in Figures 1 to 10, is adapted to receive the horizontal movement registered by the scale 9*g* traversed with the indicator 9*h* that moves with the lens, and the vertical movement registered by the scale 9*e* traversed by index 9*f* which partakes of the vertical movement of the lens; these movements of the lens being accompanied by shifting of light screens that protect the interior of the camera from the admission of light otherwise than through the lens, for instance, vertically acting light screens consisting of curtains 9*a* which extend from the top and bottom of the lens frame 9*x* to spring rollers 9*b*, and horizontally acting curtains 9*c* which extend from spring rollers 9*d* to guideways 9*i* which light-seal the edges of the curtains 9*a*. It is to be noted that the rollers 9*b* on curtains 9*a* are mounted on or otherwise arranged to travel laterally with the guides 9*a*. By this arrangement, the lens 9 may be moved laterally until its frame encounters one or the other of the rollers 9*d* and while in either of these positions, or any position intermediate thereof, may be moved vertically upon the guides 9*i* until it encounters one or the other of the curtain rollers 9*b*, or may be stopped in any position intermediate thereof. Index 9*f* receives movement of the lens 9 through the medium of the cross bar 9*k* upon which the frame 9*x* of lens 9 slides laterally, and the index is thus affected only by the vertical movements of the lens. Index 9*h*, as shown in Figure 4, is supported between the guides 9*i* which have only lateral movement, and therefore this index partakes of lateral movements of the lens but is unaffected by vertical movements.

In order to protect the main area of the sensitized surface in the camera while exposing a limited area of any desired dimensions to the beam projected by the lens, I employ the arrangement shown in Figures 7 and 8, wherein 10 represents the focus frame of the camera, 10*a* represent top and bottom spring curtain rolls therein, and 10*b* represent laterally disposed spring curtain rolls. From the rolls 10*a*, curtains 10*c* extend vertically upward and downward to controlling bars 10*d* to which the free edges of said curtains are united in a manner to control said edges both as to vertical movement and the plane in which they lie; said rods 10*d* being extended outwardly through slots 10*e* in the focus frame 10 to slide bearings 10*f* arranged for manipulation and vertical movement upon the vertical slide bars 10*g*. Similarly, curtains 10*h* extend from the rollers 10*b* laterally to controlling rods 10*i* which, like the rods 10*d*, extend through slots 10*k* in the focal frame 10 to slide bearings 10*l* guided by horizontal slide rods 10*m* and through which said vertical rods 10*i* may be manipulated. Spacing of the two pairs of curtains 10*c* and 10*h* establishes the confines of an exposure area 11 over the focal plane of the camera; the pair 10*c* overlap the pair 10*h* so that whatever vertical dimension may be given to the exposure space 11 by regulation of the distance between the two rods 10*d* will leave the lateral confines of the exposure space unchanged; and, similarly, whatever horizontal dimension may be given to the space 11 by changing the distance between the bars 10*i* will not affect the vertical dimension of said space. Moreover, since the bars 10*d*, with any selected spacing, may be located anywhere within the vertical range of the focal area, and the bars 10*i*, with any selected spacing, can be moved anywhere within the horizontal dimension of the focal area, the exposure area defined by the four bars can be given any desired rectangular form and located in any part of the area.

With a camera equipped for adjustment of its lens and limitation of exposure area as to dimensions and location, as above described, it is merely necessary to appropriately locate the copy subjects on the copy holder 1 as each copy subject is photographed in order to project its image upon the desired portion of the sensitized surface within the camera, completely fill a sensitized plate or film of relatively large dimensions with independent non-interfering exposures without danger of any of them becoming light-struck, and thereby produce an exposed plate or film upon which all of the exposures can be developed simultaneously, with the expenditure of labor, time, and materials incident to but a single development. The negative thus produced can thereafter be used through various steps of the reproduction process incident to the making of printing forms or other industrial processes in a very economical manner.

In order to facilitate accurate location of the copy subjects upon the copy holder 1, and to do so pursuant to instructions of a skilled director who may have before him the entire grist of work to be done within a given period and thus be enabled to prescribe their best arrangement from an economical viewpoint, the invention provides for the use of a chart 12 (Figure 10), which is made up of rectangular forms drawn to scale and representative of individual copy subjects selectively grouped upon a sheet representative of the area of the copy holder as well as the area of the sensitized surface within the camera; and these prescribed figures, bearing suitable index characters, for instance, A, B, C, D, etc. which are likewise borne upon the copy subject, and preferably also being marked with the dimensions of the reproduction image to be projected onto the sensitized surface, are read off as to the position to be selected for their counterparts on the copy holder by reference to marginal figures extending in two rectangular directions. And to facilitate establishing the loci of the copy subjects on the copy holder 1, the copy holder is provided with range bars 13, 14 mounted through means of slide bearings 15, 16 upon a pair of vertical bars 17 and a single horizontal bar 18, so that if from among the copy subjects furnished to the cameraman, a subject marked "A" is selected, the cameraman looks at the chart 12 (Figure 10) and finds that this copy subject is to be located on the copy holder with its center defined by the vertical line 2 and a horizontal line intermediate of the horizontal lines 2 and 3, whereupon he adjusts the range bar 14 until it overlies the figure 2 in the upper horizontal series of figures on the copy holder 1, and the horizontal bar 13 until it lies between the figures 2 and 3 of the vertical series of figures on the copy holder 1; and he then attaches the copy subject A to the copy holder 1 with the geometrical center of the copy subject behind the intersection of the bars 13 and 14, and, after returning the range bars to unobstructed position, proceeds to make the exposure in the camera. But before making the exposure, the cameraman adjusts the lens 9 of the camera until the indexes $9h$ and $9f$ point to corresponding figures to insure projection to the proper limited exposure area on the sensitized surface, and adjusts the slide bearings $10f$, $10l$ (Figure 7) until they, respectively, reach positions defined by their pointers $10fx$, $10lx$ in conjunction with graduations $10fy$, $10ly$ on the back of the camera, as shown in dotted lines corresponding with marginal readings of the rectangle representing the selected copy subject on the chart 12; whereupon, the proper distance adjustment of the lens 9 from the copy holder 1 having been made appropriate to the size indicated on the rectangle A (or on the copy subject if preferred), and the focal adjustment appropriate to said distance having been made with the focal plane of the camera, the exposure of the particular copy subject is completed and another copy subject is selected and the operation repeated. This continues until selectively defined, reduced exposure areas aggregating substantially the whole sensitized area have been used up, whereupon the plate or film will be removed and all of the exposures are treated collectively in the ensuing development, as well as in other steps in the industrial process for which the exposures were made, for instance, in the process of producing printing forms, the steps which consists in light-printing from the multiple subject photograph negative upon a surface to be etched, then etching said surface and otherwise finishing the printing form before cutting up the etched plate into individual halftones or the like. Thus, the procedure is carried out with economy commensurate with the use of a single manipulation for each step (in the present invention) as compared with as many manipulations as there were copy subjects (in the old method of procedure).

As a convenient method of causing paper copy subjects to adhere to any selected position on the copy holder without mutilation incident to the usual mechanical means for attaching the paper, Figure 6 represents a copy holder consisting of a board 19 having perforations 20 and backed by an exhaust chamber 21 connected through suction hose 22 with a fan 23 driven by electric motor 24; suction hose 22 and fan 23 being connected by flexible connection $22a$ to eliminate vibration. By permitting the motor 24 to run constantly during the use of the copy holder and having the suction capacity of the fan 23 materially in excess of the total capacity of the perforations 20, sufficient suction will

exist at all times through any group of perforations 20 to draw a paper copy subject firmly and smoothly to the surface of the board 19 while it is being photographed.

If the invention is to be embodied in a camera mounted with the axis of its lens parallel with the plane of the copy holder, for instance, as illustrated in Figures 11 and 12 wherein light is received from the copy subject on the copy holder 1*a* through a reflecting prism 25, the lens 9 (Figure 12) will have its frame 9*e* sliding vertically upon the curtain bars 9*i* to positions registered by the index 9*f*, as already described with reference to Figure 2, and similarly will have its curtain bars 9*i* sliding horizontally to give the lens a position registered by the index 9*h*. In other words, lens adjustment and construction permitting the same may be substantially as in the form of the invention described in Figures 1 to 10, as also may be the curtain adjustments over the sensitized surface in the focus frame 10. But the adjustment of the camera relatively to the copy holder 1*a* will be different for the reason that horizontal travel of the lens 9, while determining the position of delivery of its beam upon the sensitized surface, does not change horizontally in its relation to the copy holder; it merely affects focal distance, which is neutralized by corresponding adjustment of the camera as a whole through the medium of its carriage 3*a* upon the bed 4*a* (Figure 11) through a corrective distance registered by the compensating gauge 8, the readings of which will preferably be in figures identical with the laterally extending position-indicating figures on the chart 12 (Figure 10). Therefore, all copy subjects placed upon the holder 1*a* will be on the vertical line Y or some other line in a vertical plane central to the reflector 25 and perpendicular to the holder 1*a*, and only vertical variations are taken into account in positioning copy subjects on the holder 1*a*, namely, variations corresponding to vertical adjustments of the lens 9 or the vertical distance from top or bottom of the restricted exposure area selected within the camera. Thus, to use the camera disclosed in Figures 11 and 12, a copy subject will be placed upon the holder 1*a* with its center approximately in the vertical line Y and behind the vertically adjustable cross bar 13*a* when the latter is occupying a position in relation to the vertical series of figures Z called for by the vertical marginal figures in the chart 12 (Figure 10). The horizontal marginal figures in the chart 12 (Figure 10) would be taken into account in selecting the position of the indicator 9*h* in Figure 12, but not in determining the location of the copy subject on the holder 1*a* (Figure 11), because in this arrangement of the camera, the lens does not move in the direction of its axis (unless it be as a convenient way of correcting inaccuracies in locating the copy subject).

The arrangement shown in Figures 11 and 12 lends itself with peculiar advantage to the use of a dark room as the camera obscura for operating with copy subjects outside of the dark room and bringing the image through the medium of the lens (and preferably the prismatic reflector) through a wall (for instance, the top wall) of the dark room and projecting it upon a sensitized surface supported upon a table conveniently located for observation and manipulation of the actinized film or plate, as well as protecting curtains manipulated to selectively limit exposure areas as taught by the present invention.

In Figure 13, 1*b* represents the copy holder, 25*a* represents a reflecting prism, and 9 a lens located to receive light reflected from the copy holder 1*b* and project the image through the top wall 26 of the dark room 27 to a horizontal focal table 28, upon which may be placed a sensitized film or plate to be exposed to images of copy subjects mounted upon the holder 1*b*. In this arrangement, lens 9, with its reflector 25, is preferably stationary on the top wall 26 of the dark room 27; distance between the lens and the copy holder which determines the size of reproduction, is regulated by movably mounting the copy holder 1*b* through the medium of carriage 29 equipped with a known type of distance gauge 30; and focal adjustments are accomplished by movement of the focus table 28 vertically through the medium of pinion 31 engaging with rack 32; such vertically adjustable mounting being equipped with such other accessories as may be desirable or convenient, such, for instance, as hand wheel 33 for turning the pinion 31, a bracket wheel 34 for sustaining the table at any adjustment, and counterbalance 35 for facilitating the work of raising the table. With an arrangement of this kind, as may be readily seen from Figure 14, any desired subdivision of the surface of the table 28 may be presented in line with the focal axis of the lens 9 by moving the base 36 on the sub-base 37 in one direction, for instance, from right to left in Figure 13, and the table 28 upon the base 36 in the other direction, for instance, from front to rear as viewed in Figure 13. In thus using the feature of the present invention which has to do with successively exposing restricted areas of the sensitized surface in Figure 13, manually placed overlapping curtains or light-intercepting boards or the like may be employed; or the arrangement shown in Figure 7 could be bodily substituted for the table 28.

It is to be understood that the device shown in Figures 7 and 8 is to be applied to the camera much after the manner of a separately constructed plate or film holder, as,

for instance, by placing it in rear of the camera shown in Figure 1, or the camera shown in Figure 11, or otherwise combining it with a camera having the laterally and vertically adjustable lens herein disclosed.

An alternative method of causing copy subjects or, if desired, sensitized film, to adhere to the plane surface of a holder without the use of mechanical attachments, is illustrated in Figure 15, in which the perforated screen 19*a* is subject to the vacuum effect of a fan 23*a* so located in relation to the opposite side of the screen from the sheet to be held as to develop a partial vacuum sufficient to hold the sheet in place by suction.

The means shown in Figure 15 for holding a sheet or film is preferable to that shown in Figure 6, for the reason that, while in Figure 6 the portion 22*a* of the air conduit is rubber and largely avoids transmission of vibration from the motor to the holder, there is in Figure 15 a total absence of mechanical or vibration-transmitting connection between the fan and the holder.

It is to be understood that in the cameras herein shown any desired light-controlling cap may be employed, such, for instance, as caps or shutters for the lens, as well as adjustable diaphragms, timing mechanism, and the like. These have not been disclosed because they form no part of the present invention.

I claim:

The improvement in the art of photographically exposing different portions of a single sensitized surface to a corresponding number of separate copy subjects, which consists in preparing a master chart having designated positions corresponding to the respective copy subjects, then mounting the copy subjects upon a copy board having designations capable of defining positions corresponding to the positions designated upon the chart, then manipulating the lens of a camera into a plurality of positions designated similarly to the positions of the copy subjects on the copy board and from which the lens projects images upon portions of the sensitized surface corresponding to the chart, and successively exposing the lens in the respective positions to which it is adjusted while masking the portions of the sensitized surface other than that upon which the image is to be projected.

Signed at Chicago, Illinois, this 15th day of June, 1929.

ROBERT R. ROBERTSON.