

June 4, 1929.

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1,715,526

PHOTOGRAPHIC ENLARGING AND REDUCING APPARATUS

Filed Aug. 6, 1927

2 Sheets-Sheet 1

Fig. 1.

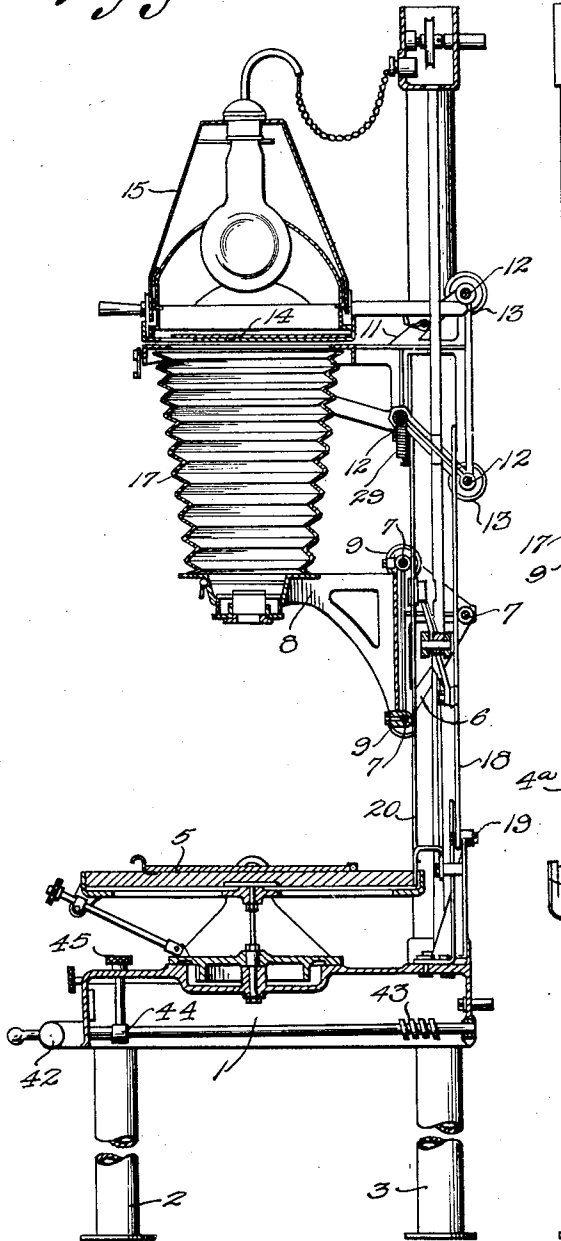
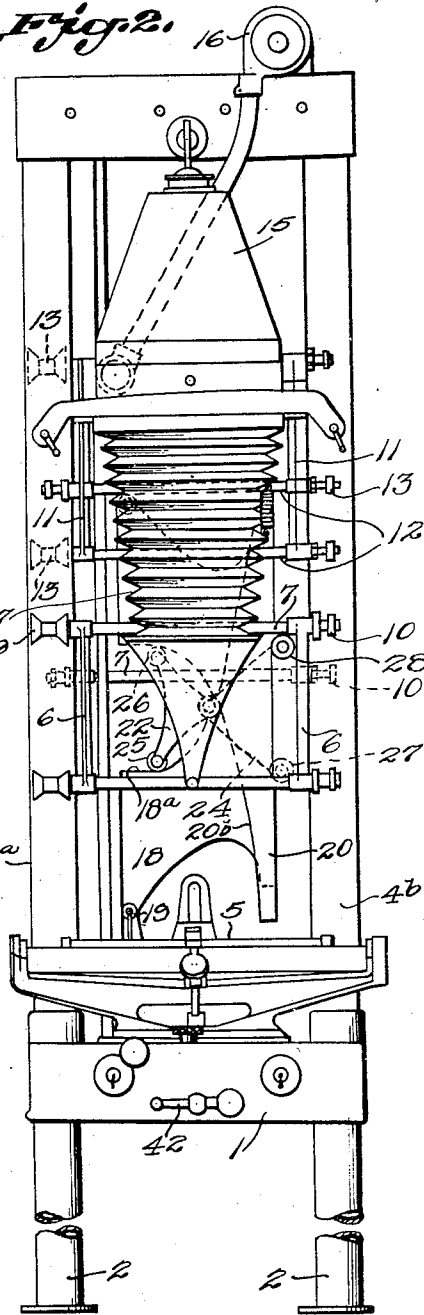


Fig. 2.



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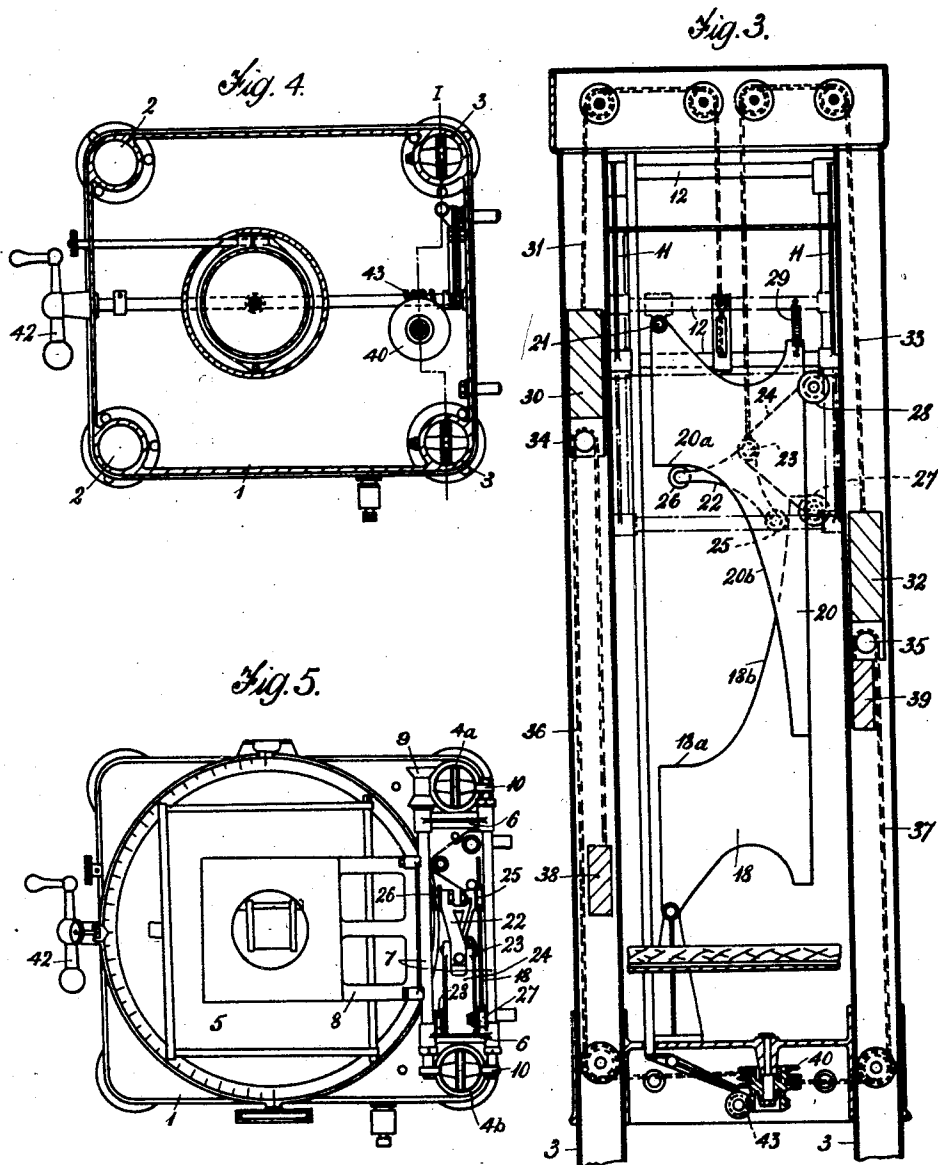
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2 Sheets-Sheet 2



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PHOTOGRAPHIC ENLARGING AND REDUCING APPARATUS.

Application filed August 6, 1927, Serial No. 211,137, and in Great Britain August 28, 1926.

Photographic enlarging or reducing apparatus consists essentially of three elements, a negative carrier, a support for the sensitized paper or the like and a lens between them.

5 This invention relates to such apparatus of the kind wherein the adjustment of one element in relation to a second automatically adjusts the third through a transmission which includes a cam of suitable contour so
10 that the projected image is always kept in focus.

For any distance apart of the negative carrier and paper support greater than the minimum (at which the projected image is
15 equal in size to the object i. e. the negative) there are two possible positions of the lens. In one the lens will be nearer the negative and an enlarged image will be formed, in the
20 other it will be nearer the paper and a reduced image will be formed, the ratio of enlargement in the one case being equal to the ratio of reduction in the other. It is obvious
25 therefore that a given over-all length of apparatus will allow of the same range of enlargement and reduction if suitable adjusting mechanism can be provided. A single
30 cam mechanism for both enlarging and reducing over a large range suffers as a general rule from certain mechanical difficulties due to the variation in relative speed of the
moving elements.

The object of the present invention is to provide automatic focussing mechanism of
35 the type first herein set forth in which the whole enlarging and reducing range for the maximum length is available, in which this whole range is traversed without interruption or reconnection of parts preferably by
40 means of a single manually operated gear and which satisfies the mechanical requirement that the rapidly moving element shall be manually operated and the cam gear shall
operate the slower moving element.

According to this invention the negative
45 carrier and the paper support are each provided with a cam, while the lens support carries a cam follower which engages one cam for one part of the range and the other cam for the other part of the range. The moving
50 carriages can be adjusted by hand if desired, but preferably operating gear with a single manually controlled handle is provided which during the appropriate part of the range moves the rapidly moving element.

The change over from one cam to the other
55 conveniently takes place at the 1:1 position and a bell crank lever pivoted to the lens carrier has a cam follower, such as a roller, on each arm, one for each cam. For the
60 enlarging range of adjustment, when both the lens and negative carrier move away from the paper support, the lens is manually adjusted, and the cam attached to the paper support
65 is operative. The follower for the cam on the negative carrier bears on a plain part of this cam which thus acts as a link to move
the negative carrier. For the reducing range, when the lens moves towards the paper support and the negative carrier away from the
70 paper support, the negative carrier is manually adjusted and the cam thereon is operative, while the follower on the other cam bears on a plain portion thereon.

The manually operated mechanism conveniently consists of a pair of cords or chains,
75 each provided with a stop, which are moved in opposite directions by a single handle. One stop is arranged to contact with a member connected to the lens support when this
80 is to be directly adjusted, and the other stop to contact with a member connected to the negative carrier when that member is to be directly adjusted. The cord or chain may
85 if desired be endless, and pass over pulleys or sprockets one of which is adapted to be rotated by hand. Instead rack and pinion or any other convenient mechanism such as a
90 lever train may be used. It will be understood that in the arrangement just described the paper carrier is on the stationary part of the apparatus. If desired the negative
95 carrier may be stationary when the above description would still apply if the terms "enlarging" and "reducing" are interchanged.

The cams may comprise slots in suitable
members to ensure the followers being positively operated. Preferably, however, they
100 are single surfaces or edges against which the followers are pressed, in order to avoid back-lash due to wear and clearance. Springs may be used for this purpose, or where the
apparatus is vertical, the weight of the parts
105 may be arranged to provide the necessary pressure.

The accompanying drawings illustrate by way of example a vertical enlarger embodying the invention.

Figure 1 is a side view in section, and Figure 2 is a front view, of the complete apparatus in the 1:1 position.

Figure 3 is a section on the line I—I of Figure 4 with the parts in position for the maximum ratio of enlargement.

Figure 4 is a horizontal section through the base, and

Figure 5 is a horizontal section taken between the moving carriages.

The framework of the apparatus is formed by a base 1, a pair of front legs 2 and a pair of tubular rear legs 3 extended upwards to form standards 4^a, 4^b. On the base 1 is carried a suitable paper support 5 of any convenient kind. A lens carriage comprising a pair of side members 6 joined by cross bars 7 and a lens bracket 8 is provided with front rollers 9 and rear rollers 10 engaging the standards 4 so that the carriage can run up and down. This carriage and its associated parts are partly counter-balanced by a weight 32 within the standard 4^b, connected by a chain 33 running over suitable pulleys. A negative carriage comprising side members 11 joined by cross bars 12 carrying rollers 13 also runs on the standards, above the lens carriage. This carriage carries a negative holder 14 of suitable construction and a lamp house 15 which can be supplied with a current of air from a blower 16 in order to keep it cool. This carriage and its associated parts are partly counter-balanced by a weight 30 running in the standard 4^b. A bellows 17 joins the negative carriage to the lens carriage.

A fixed cam 18 is secured to the base 1 by a bolt 19 and a moving cam 20 is secured to the negative carriage by a bolt 21. A bell crank lever 22 is pivoted at 23 to a bracket 24 on the lens carriage and bears rollers 25, 26, at each end respectively engaging the cams 18, 20, the weight of the parts maintaining contact. The respective operative edges of these cams are made up of plain parts 18^a, 20^a, and contoured parts 18^b, 20^b. In the 1:1 position shown in Figures 1 and 2 the rollers 25, 26, are at the junctions of the plain and contoured parts of the cam edges. The cams are respectively prevented from turning laterally about their securing bolts by rollers 27, 28 on the bracket 24 running against the straight sides of the cams. In the case of the cam 18 its weight prevents it from swinging away from the roller 27. In the case of the cam 20, where its weight tends to swing it away from the roller 28, a tension spring 29 secured between the negative carriage and the cam maintains contact.

Starting with the 1:1 position if the negative carriage be raised the lens carriage will descend at a slower speed under the control of the plain cam portion 18^a, the contoured cam portion 20^b, and the bell crank lever 22. If the lens carriage be raised, the negative carriage will rise at a slower speed under the

control of the plain cam portion 20^a, the contoured cam portion 18^b and the bell crank lever 22. In each case if one carriage is directly moved the other moves more slowly under cam control so that the forces involved are small and friction has a low value and in consequence both in design and action the apparatus will be free from mechanical difficulties. It will be understood that the cam contours 18^b, 20^b are set out to maintain the image automatically in focus at all adjustments. The characteristics of the lens being known, and the dimensions of the bell crank lever, the contours can easily be set out in accordance with Newton's law of conjugate foci, by any skilled person.

In order to adjust the apparatus by a single handle enabling it to be taken right through the range from the extreme position of maximum enlargement to the extreme position of maximum reduction, the application of the direct force being automatically changed from one carriage to the other at the 1:1 position, there are provided a winding gear and chains adapted to co-act with the counter-weights 30 and 32. The counter-weights respectively carry pulleys 34, 35, over which pass chains 36, 37. These chains at one end carry weights 38, 39 and at their other ends are wound on a drum 40 in such direction that when one is wound on the other is wound off at substantially the same rate. The drum 40 is rotated from a handle 42 through a worm gear 43. This renders fine adjustment easy and being irreversible ensures the parts remaining as adjusted. For greater security the worm spindle can be locked when adjusted by a screw clamp 44 having a milled operating head 45. The weights 38, 39 are adapted to form stops when they contact with the counter-weights 30, 32 and the lengths of the chains 36, 37, are such that in the 1:1 position they are just taut with the weights 38 and 39 in contact with the counter-weights. If now the handle is turned to pay out the chain 36 and wind up the chain 37, the counter-weight 32 will be drawn down and the lens carriage directly lifted. The cam gear will cause the negative carriage to rise and the counter-weight 30 and weight 38 will run downwards. The parts will finally reach the position of extreme enlargement shown in Figure 3. If the rotation of the handle is now reversed, the parts will return to the 1:1 position of Figures 1 and 2 and from here without interruption the counter-weights 30 will be drawn down and the negative carriage lifted directly. The lens carriage will automatically descend under the control of the cams until the extreme reduction position is reached with the negative carriage in the same position as for extreme enlargement. The descent of the lens carriage causes the counter-weight 32 to rise, but since the speed of descent is slower than the speed at which

the negative carriage rises, the chain 37 is paid out more rapidly than the rise of the counter-weight 32 so that the weight 39 lags behind and there is no interference with the proper action of the parts. Obviously the apparatus can be run straight from any one adjustment to any other. It will further be understood that the stationary element may carry the negative and lamp house if desired and the paper or the like may be carried on the moving carriage.

What I claim is:—

1. In automatic focussing photographic enlarging and reducing apparatus, a negative support, a sensitive surface support, a cam fixed on each of said supports, a lens support and a cam follower on said lens support engaging one cam for one part of the range and the other cam for the other part of the range, said cams being separately in action.

2. In automatic focussing photographic enlarging and reducing apparatus, a negative support, a sensitive surface support, a cam fixed on each of said supports, a lens support, a cam follower on said lens support engaging one cam for one part of the range and the other cam for the other part of the range, said cams being separately in action and operating gear with a single manually operated handle for automatically actuating directly the more rapidly moving support.

3. In automatic focussing photographic enlarging and reducing apparatus, a negative support, a sensitive surface support, a cam fixed on each of said supports, a lens support, and a bell crank lever pivoted to said lens support with its ends co-acting respectively with said cams which act separately at different parts of the range.

4. In automatic focussing photographic enlarging and reducing apparatus, a fixed support, a travelling support, a travelling lens carriage intermediate said supports, a focussing cam covering the enlarging range, a second focussing cam fixed on the other of said supports covering the reducing range, a plain portion on each of said cams and a bell crank lever pivoted on said lens carriage having each arm co-acting with one of said cams, one arm co-acting with the plain part of the enlarging cam when the other arm co-acts with the active part of the reducing cam, and vice versa.

5. In automatic focussing photographic enlarging and reducing apparatus, a fixed support, a travelling lens carriage, a travelling support, a cam fixed on said fixed support, a cam fixed on said travelling support, a cam follower on said lens carriage, a single manually controlled handle, means for connecting said manually controlled handle with said lens carriage when said lens carriage and said travelling support are both moving in the same direction, and means for connecting said handle with said travelling support

when they are both moving in the opposite directions.

6. In automatic focussing photographic enlarging and reducing apparatus, a fixed support, a travelling lens carriage, a travelling support, a cam on said fixed support, a cam on said travelling support, a cam follower on said lens carriage, a one way flexible coupling connected to said lens carriage, a one way flexible coupling acting in the opposite direction to said first flexible coupling, connected to said travelling support, and manually operated means for actuating both said flexible couplings in opposite directions simultaneously.

7. In vertical automatic focussing photographic enlarging and reducing apparatus, a fixed support, a travelling lens carriage, a first weight partly counter-balancing said lens carriage, a travelling support above said lens carriage, a second weight partly counter-balancing said travelling support, a cam on said fixed support, a cam on said travelling support, coupled cam followers on said lens carriage co-acting respectively in turn with said cams, an operating handle, a drum rotated by said operating handle, a pair of flexible members wound on said drum, and a stop on each flexible member co-acting respectively in turn with said weights.

8. In automatic focussing photographic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling support, a focussing cam on one of said supports covering the enlarging range, a second focussing cam on the other of said supports covering the reducing range, a cam follower for each cam, on said lens carriage, a single manually operated handle, and means for coupling said handle to feed said lens carriage and travelling support in turn.

9. In automatic focussing photographic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling support, a cam held stationary by a pivot on said fixed support and a lateral stop on said lens carriage.

10. In automatic focussing photographic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling support, a cam held stationary with respect to said travelling support by a pivot thereon and a lateral stop on said lens carriage.

11. In automatic focussing photographic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling support, a cam secured in stationary relation to said fixed support, a second cam secured in stationary relation to said travelling support, each of said cams being held by a pivot on its respective support and a lateral stop on said lens carriage.

12. In vertical automatic focussing photographic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling

support, an edge cam on said fixed support, an edge cam on said travelling support, a plain portion on each of said cams, a bell crank lever on said lens carriage, and a roller on each end of said bell crank lever each co-acting with one of said cams, one roller being on the plain part of one cam when the other roller is on the active part of the other cam.

13. In vertical automatic focussing photographic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling support, an edge cam on said fixed support, an edge cam on said travelling support, a plain portion on each of said cams, a bell crank lever on said lens carriage, a roller on each end of said bell crank lever each co-acting with one of said cams, one roller being on the plain part of one cam when the other roller is on the active part of the other cam and manually operated irreversible means for directly operating said lens carriage, when said lens carriage and travelling support are moving in the same direction and for directly operating said travelling support when said lens carriage and travelling support are moving in opposite directions.

14. In vertical automatic focussing photo-

graphic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling support, an edge cam secured at one point on said fixed support, an edge cam secured at one point on said travelling support, rollers on said lens carriage locating said cams laterally, a plain portion on each of said cams, a bell crank lever on said lens carriage, and a roller on each end of said bell crank lever each co-acting with one of said cams, one roller being on the plain part of one cam when the other roller is on the active part of the other cam.

15. In vertical automatic focussing photographic enlarging and reducing apparatus, a fixed support, a lens carriage, a travelling support, an edge cam on said fixed support, an edge cam on said travelling support, a plain portion on each of said cams, and a bell crank lever on said lens carriage having each end co-acting with one of said cams, one end co-acting with the plain part of one cam when the other end is co-acting with the active part of the other cam.

In testimony whereof I have signed my name to this specification.

STUART WILLIAMSON.