

March 17, 1925.

1,530,173

R. HARRIS

PHOTOGRAPHIC COPYING, ENLARGING, AND REDUCING APPARATUS

Filed April 1, 1924

5 Sheets-Sheet 1

Fig. 1.

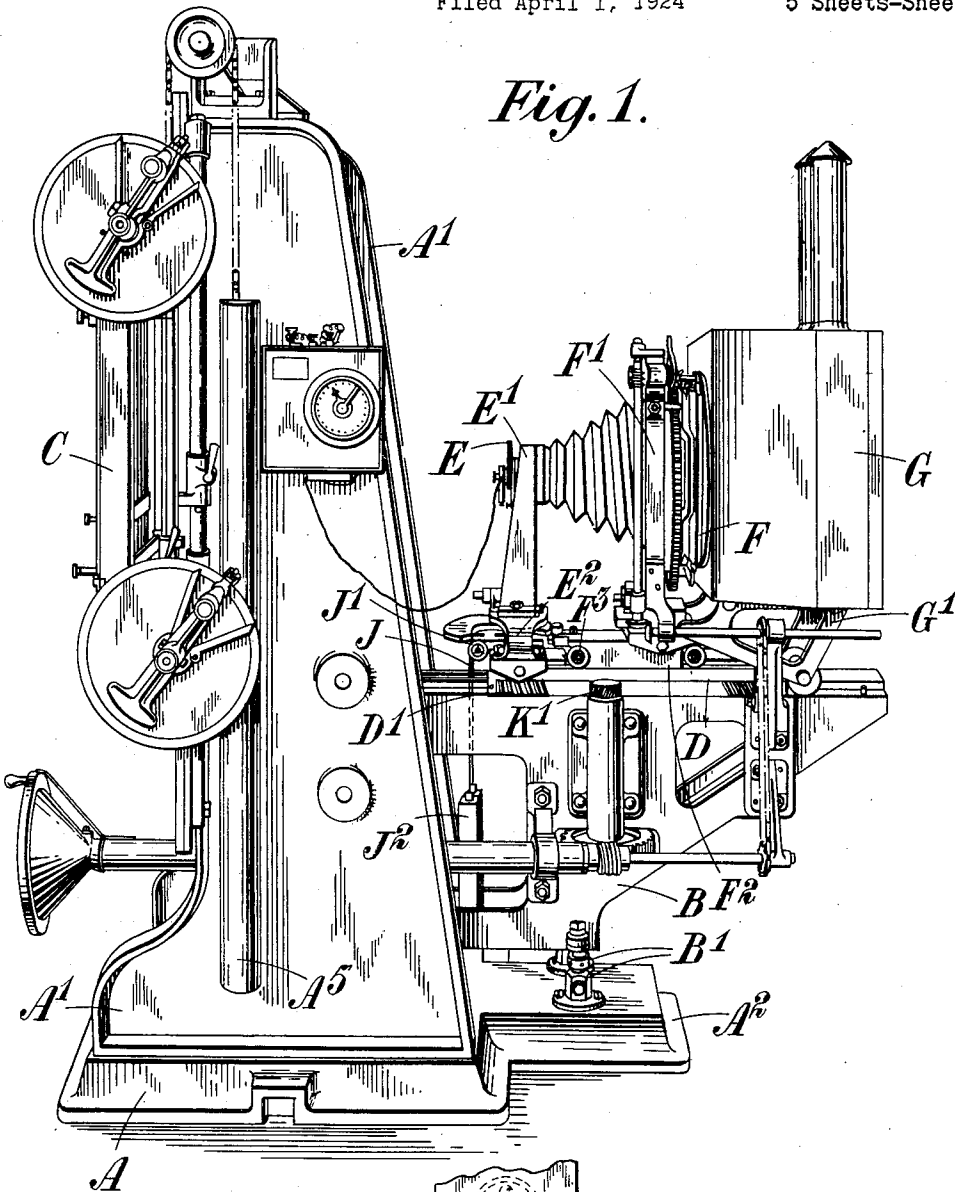
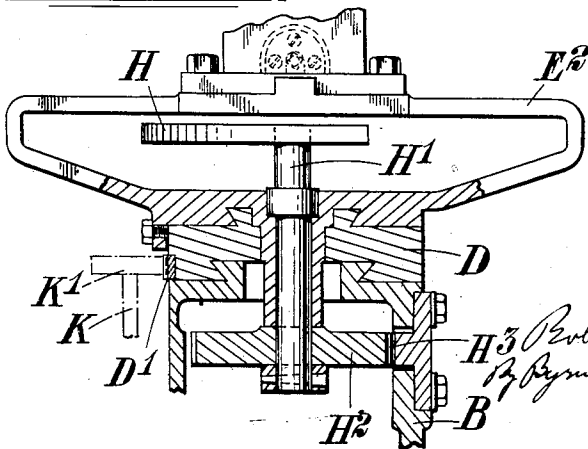


Fig. 7.



INVENTOR

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March 17, 1925.

1,530,173

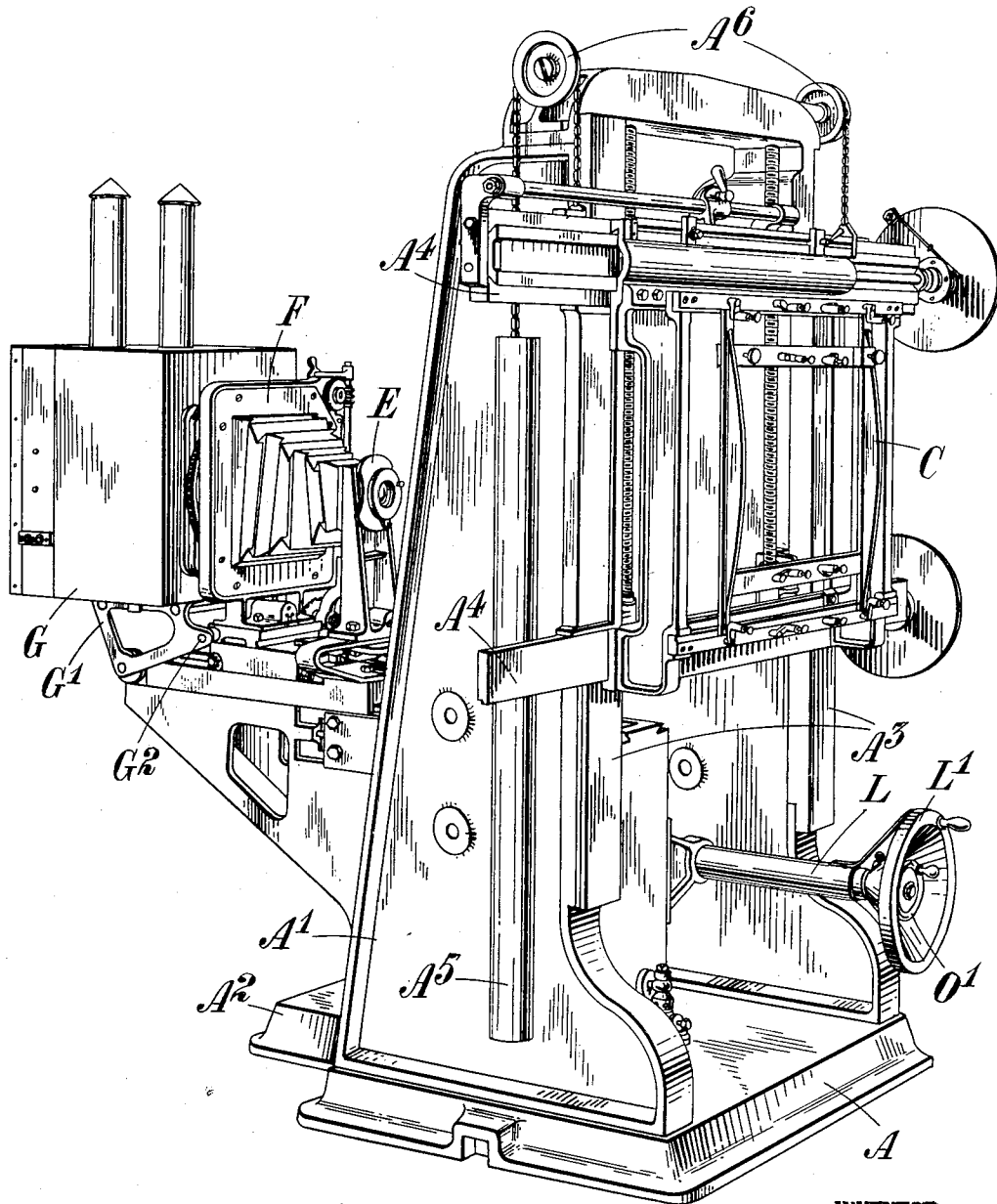
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5 Sheets-Sheet 2

Fig. 2.



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Filed April 1, 1924

5 Sheets-Sheet 3

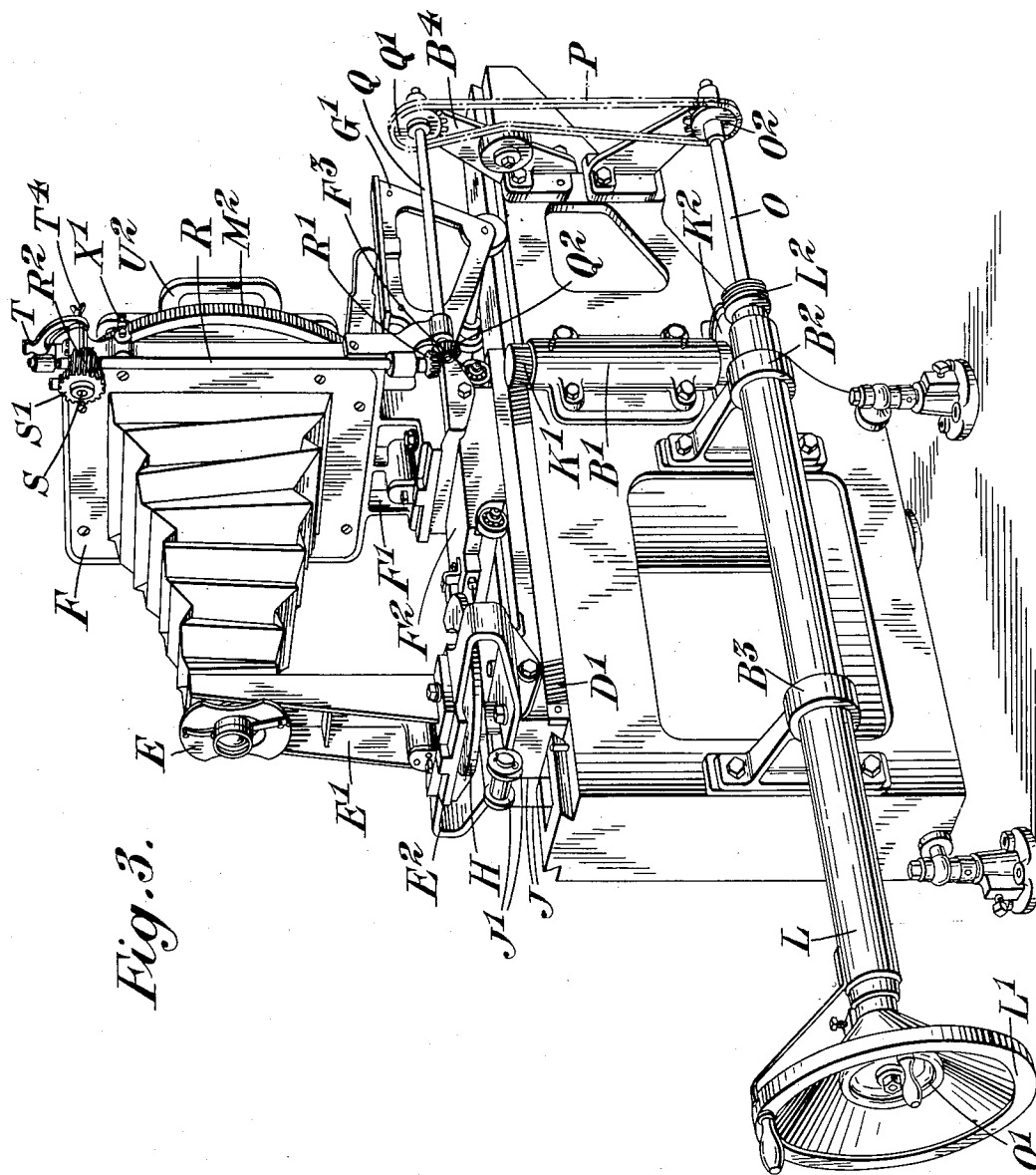


Fig. 3.

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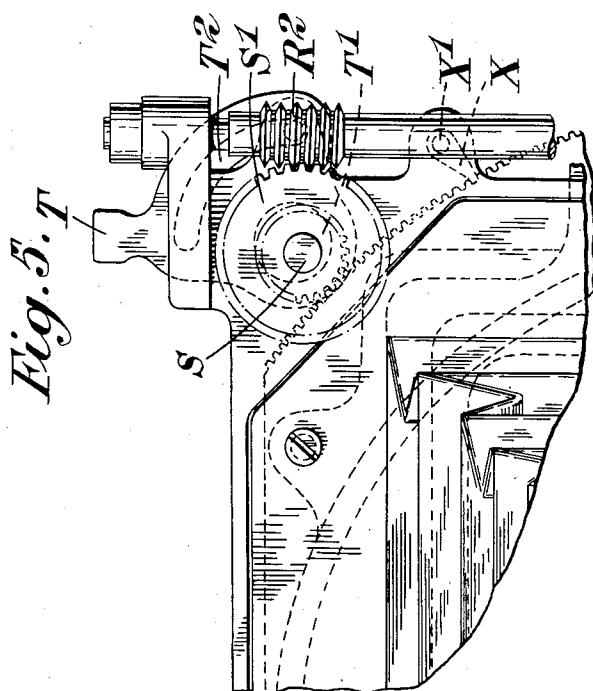
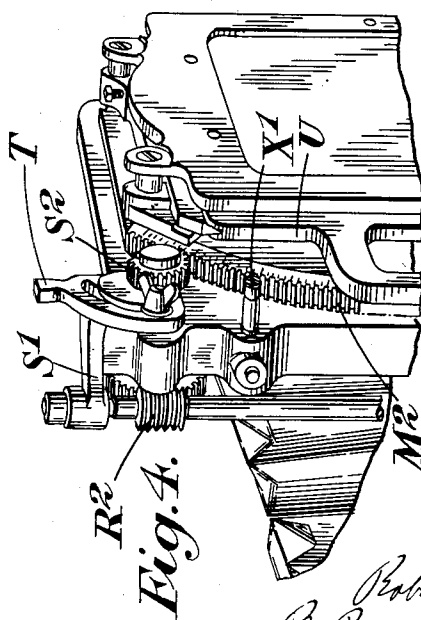
1,530,173

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PHOTOGRAPHIC COPYING, ENLARGING, AND REDUCING APPARATUS

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5 Sheets-Sheet 4



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1,530,173

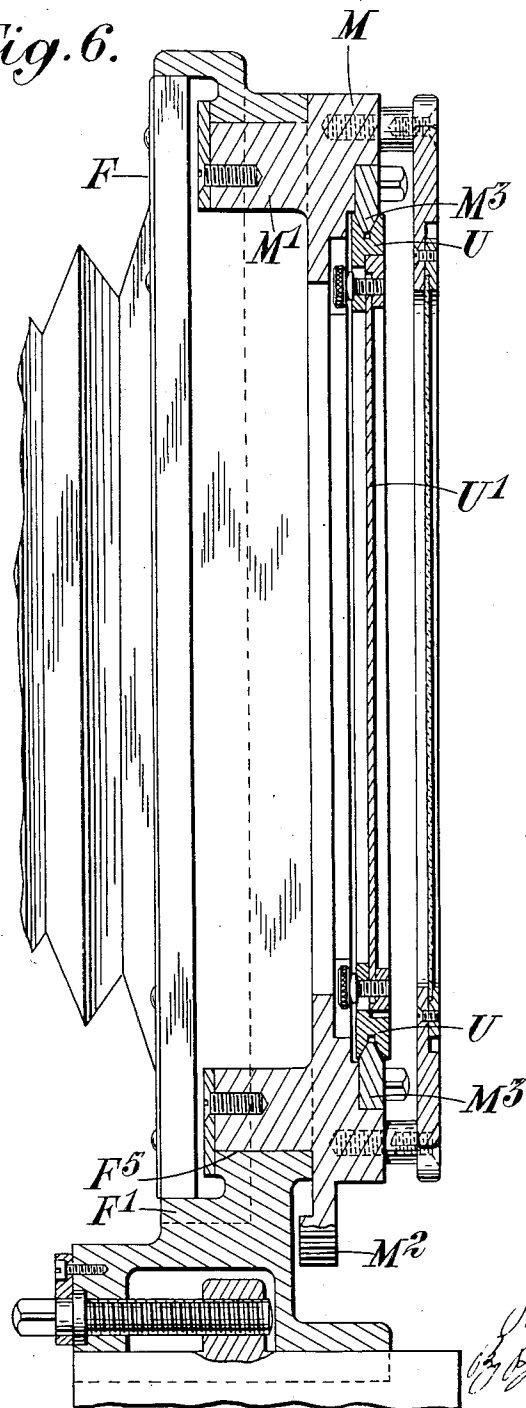
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PHOTOGRAPHIC COPYING, ENLARGING, AND REDUCING APPARATUS

Filed April 1, 1924

5 Sheets-Sheet 5

Fig. 6.



INVENTOR

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UNITED STATES PATENT OFFICE.

ROBERT HARRIS, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF TO PICTORIAL MACHINERY LIMITED, OF LONDON, ENGLAND, A BRITISH COMPANY.

PHOTOGRAPHIC COPYING, ENLARGING, AND REDUCING APPARATUS.

Application filed April 1, 1924. Serial No. 703,417.

To all whom it may concern:

Be it known that I, ROBERT HARRIS, a subject of the King of England, residing in London, England, have invented certain new and useful Improvements in Photographic Copying, Enlarging, and Reducing Apparatus, of which the following is a specification.

This invention is for improvements in or relating to photographic copying, enlarging and reducing apparatus and relates more particularly to step-and-repeat machines in which the image is automatically maintained in focus upon its screen when the degree of enlargement is varied.

An important object of the invention is to provide an improved construction of step-and-repeat machine of the kind referred to, wherein the movements of the principal components are controlled more conveniently than in machines known heretofore.

According to a primary feature of the invention a step-and-repeat machine comprises an image screen-holder, a lens-holder and a rotatable unit-holder, the two latter components being situated on one and the same side of the screen-holder and arranged to be movable relatively thereto at such different rates as automatically to maintain an image in focus, controlling means for rotating the unit-holder, and controlling means for causing the aforementioned relative movement, which two controlling means comprise controlling members disposed one within the other (for example co-axially) and operable manually from the same end.

Another feature of this invention consists in arranging the said controlling members to extend from the lens-holder and unit-holder beyond the image screen-holder, for the purpose of enabling the operator to manipulate the controls for moving the image screen and the controls for focussing the image from one position.

A further feature of the invention consists in providing the unit-holder with a circular or segmental rack with which engages a pinion, the pinion being so mounted that it may be brought into and out of engagement with the rack. The advantage of this arrangement is that the controlling

means for rotating the unit may be connected, and the unit then be rotated directly by hand.

A still further feature of the invention consists in providing the circular rack with a graduated scale and in so mounting a pointer upon the unit-holder that it may be moved over a short length of the scale, for the purpose described hereinafter.

Other features of the invention are described hereinafter and pointed out in the claims.

One embodiment of the invention is illustrated by way of example in the accompanying drawings, wherein—

Figure 1 is a perspective view of one form of step-and-repeat machine according to the invention as seen from that side on which are situated the controls for the lens-holder and unit-holder of the projector; and

Figure 2 is a like view of the same machine as seen from the other side thereof, showing the image screen-holder at the rear of the machine;

Figure 3 is a like view of the framework on which the projector and its controls are mounted, removed from the machine;

Figure 4 is a perspective view, and

Figure 5 is a rear end elevation of mechanism for rotating the unit-holder;

Figure 6 is a vertical section taken through the centre of the unit-holder; and

Figure 7 is a vertical transverse section taken through the base of the lens-holder.

Like reference characters designate like parts throughout the several views.

Referring to the drawings, a main frame having the form of an inverted U comprises a base A, two vertical standards A¹ thereon, and a longitudinal extension A² of the base. A horizontally disposed framework B is mounted on three feet B¹ adjustable in height secured to the base A, A². This framework B has its rear end situated substantially in line with the middle of the standards A¹, and extends to the front of the standards beyond the extension A² of the base.

A stage C for an image-screen is so mounted on the rear of the standards A¹ in the manner described hereinafter as to be

movable up and down and from side to side in a vertical plane.

A table D is mounted to slide horizontally on the top of the framework B towards and away from the image-screen and carries a lens-holder E, a unit-holder F and a lantern G which is mounted on a trolley G¹ pivotally connected at G² with the unit-holder. This unit-holder rotatably carries a unit-carrier U described hereinafter and comprises a main frame F¹ secured upon a base F² having rollers F³ arranged to run on the top of the table D. The lens-holder E which comprises a pedestal E¹ and a base E² is adjustably secured by a tongue-and-groove attachment to the table D, and the unit-holder F with the trolley G¹ and the lantern are arranged to run on the table D in a direction towards and away from the image-screen.

A cam H is mounted beneath the lens-holder on the upper end of a spindle H¹ (Figure 7) that extends down through the table, which spindle has a pinion H² secured to its lower end. This pinion H² meshes with a rack H³ carried inside the framework B near the top thereof. The cam H is so arranged that a roller F⁴ vertically disposed upon the base F² of the unit-holder F abuts against it owing to the unit-holder being constantly pulled towards the lens-holder E by cords J which run over pulleys J¹ mounted on the table, which cords have one end attached to the unit-holder and their other ends carry a weight J² movable vertically inside the framework B.

A horizontally disposed rack D¹ is securely carried on the side of the table D and engages with a pinion K¹ mounted on the upper end of a vertical shaft K carried in a bearing B¹ secured to the framework B. The lower end of the shaft K is provided with a worm-wheel K². The means for rotating the vertical shaft K and thereby driving the table comprise a tube L mounted to rotate in bearings B², B³ carried by the framework B, which tube carries at one end beyond the stage C a hand-wheel L¹, and has at its other end a worm L² for engaging with the said worm-wheel K².

It will be seen that when the table is moved endwise along the top of the framework B by turning the hand-wheel L¹, the lens-holder E will be brought nearer to or further away from the image-screen, and the cam H will be rotated so as to move the unit-holder F towards or away from the lens-holder E, whereby an image on the screen is automatically maintained in focus.

At the rear of the standards A¹ are provided two vertical guides A³ up and down which are movable two cross-bars A⁴ which slidably engage the same and are counterbalanced by weights A⁵ connected with them by cords running over pulleys A⁶. The stage C may be arranged to move horizontally

along the cross-bars A⁴ in any convenient manner. Owing to mounting the stage C in this manner the image-screen can be readily adjusted into a number of different positions within a relatively large area.

The frame F¹ of the unit-holder F is provided on its front face with a circular race F⁵ (Figure 6) in which is mounted a flange M¹ of a rotatable frame M that has a circular rack M² and supports the unit-carrier U. Means for controlling the rotation of the rotatable frame M, comprise a rod O located in the aforesaid tube L, on one end of which rod is mounted a hand-wheel O¹ lying within the hand-wheel L¹ and on the other end a sprocket-wheel O². This wheel O² is connected by a chain P to a second sprocket-wheel Q¹ which is carried upon a lay-shaft Q. This shaft Q is carried at the sprocket-wheel end by a bearing B⁴ secured to the framework B and is journaled at the other end in a bearing F³ carried by the unit-holder F. The sprocket-wheel Q¹ is splined on the lay-shaft Q so that they will rotate together but the shaft can slide endwise through the wheel. A bevel gear-wheel Q² is fixed on the unit-holder end of the lay-shaft. This bevel gear-wheel meshes with a second bevel gear-wheel R¹ carried at the lower end of a vertical shaft R which is journaled in bearings provided on the frame of the unit-holder F. The top end of the shaft R is provided with a worm R² (Figures 3, 4 and 5) which engages with a worm-wheel S¹ fast on a shaft S which is mounted eccentrically in the hub T¹ of a handle T rotatably mounted in the unit-holder frame. The other end of the shaft S carries a pinion S² which normally meshes with the circular rack M² of the frame M. The handle T has an arcuate slot T² through which extends a pin carrying a nut T⁴ by which the handle can be fixed in any position into which it is moved. By loosening the nut T³ and rocking the handle, the pinion S² and worm-wheel S¹ may be withdrawn from the rack M² and worm R² respectively.

One face of the circular rack M² is engraved with a graduated scale, and a pointer X (Figure 5) is pivotally mounted on a pin X¹ fixed on the unit-holder F, so that the pointer may be moved over a short length of the scale. The advantage of this arrangement is that when the unit-carrier has been set so that the image is projected in an upright position upon the image-screen, the pointer may be moved on to the zero graduation, and it is thus easier for the operator to calculate in his mind the figure of the graduation for the next required position of the unit-carrier which is generally at 90° from the original position.

The unit-carrier U is in the form of a rectangular frame which has one face re-

cessed to take the unit U^1 for example a sensitized photographic plate. The top and bottom edges of this frame are provided with V-grooves. The plane containing the bottom of the recess, in which plane the sensitized face of the unit is arranged to lie, passes through the apex of the said grooves. These grooves are located between two V-guides M^3 secured to the rotatable frame M of the unit-holder. The carrier-frame U is provided with a handle U^2 so that it can readily be slid in and out from between the V-guides. The advantage of this arrangement is that a surface of the unit will lie in the same plane for either of two reverse positions of the unit-carrier in the holder, so that the unit-carrier may be inserted in either position into the holder.

It will be appreciated that the described step-and-repeat machine has the advantage that both the adjustment of the focus and the rotation of the unit as well as the adjustment of the image screen-holder can be effected by an operator from one and the same end of the machine, so that there is no need for him to change his position when making such adjustments.

It is to be understood that various modifications in details of construction may be made without departing from the scope of the invention as defined by the claims.

What I claim as my invention and desire to secure by Letters Patent is:

1. In a step-and-repeat machine, the combination with an image screen-holder, a rotatable unit-holder, a lens-holder between the same, adjusting means comprising a controlling member for moving the unit-holder and lens-holder in a direction towards and away from the screen-holder and relatively thereto at such different rates as automatically to maintain an image in focus on the screen, and controlling means comprising a controlling member for rotating said unit-holder about an axis lying in said direction, which controlling members are disposed one within the other and are operable manually from the same end.

2. In a step-and-repeat machine, the combination with an image screen-holder, a lens-holder and a rotatable unit-holder arranged in a line with the two latter holders situated on one and the same side of the screen-holder, of controlling means comprising a controlling member for moving the unit-holder and lens-holder relatively to the screen-holder at such different rates as automatically to maintain an image in focus on the screen, and controlling means comprising a controlling member for rotating said unit-holder about an axis lying in the direction of said line, which controlling members are disposed coaxially one within the other and are operable manually from the same end.

3. In a step-and-repeat machine, the combination with an image screen-holder, a rotatable unit-holder, a lens-holder between the same, adjusting means comprising a controlling member for moving the unit-holder and lens-holder in a direction towards and away from the screen-holder and relatively thereto at such different rates as automatically to maintain an image in focus on the screen, and controlling means comprising a controlling-member for rotating said unit-holder about an axis lying in said direction, which controlling members extend respectively from said lens-holder and said unit-holder to beyond the said screen-holder, and are disposed one within the other and are operable manually at the end beyond the screen holder.

4. In a step-and-repeat machine, the combination with an image screen-holder, a lens-holder and a rotatable unit-holder arranged in a line with the two latter holders situated on one and the same side of the screen-holder, of controlling means comprising a controlling member for moving the unit-holder and lens-holder relatively to the screen-holder at such different rates as automatically to maintain an image in focus on the screen, and controlling means comprising a controlling member for rotating said unit-holder about an axis lying in the direction of said line, which controlling members are disposed coaxially one within the other and are operable manually each from the same end situated on the side of the screen-holder remote from the lens-holder and unit-holder.

5. In a step-and-repeat machine, the combination with a frame, an image-screen-holder, a lens-holder and a rotatable unit-holder arranged thereon in a line with the two latter holders situated on one and the same side of the screen-holder, of adjusting means for moving the unit-holder and lens-holder relatively to the screen holder at such different rates as automatically to maintain an image in focus on the screen, a controlling member in the form of a tube rotatably mounted on said frame in a direction of length thereof and extending beyond said screen-holder and having a hand-wheel at that end, a gear member at the other end of said tube operatively connecting the latter with said adjusting means, means for rotating said unit-holder about an axis lying in the direction of said line, a second controlling member in the form of a rod extending through said tube, a hand-wheel on the end of said rod situated beyond the screen-holder, and a gear member on the other end of said rod operatively connecting the same with said means for rotating the unit holder.

6. In a step-and-repeat machine, the combination with a framework, a longitudinal

table slidable endwise thereon in the direction of its length, a lens-holder carried by the table at one end thereof, and a rotatable unit-holder mounted to move along the table
 5 towards and away from the lens-holder, of mechanism for reciprocating said table on said framework and comprising a controlling member in the form of a tube, which tube is rotatably mounted on the frame-
 10 work parallel with the direction of length thereof and extends at one end beyond the end of the framework remote from the unit-holder, and carries at that end a hand-wheel, and means for rotating said unit-holder comprising a rod extending through said tube and carrying a hand-wheel located within the former hand-wheel.

7. In a step-and-repeat machine, the combination with an image screen-holder, a rotatable unit-holder, a lens-holder between the same, adjusting means comprising a controlling member for moving the unit-holder and lens-holder in a direction towards and away from the screen-holder and relatively thereto at such different rates as automatically to maintain an image in focus on the screen, said unit-holder comprising a frame, a curved toothed rack rotatable in the frame, a unit-carrier rotatable by said rack about an axis lying in said direction, means
 30 mounted on the frame and arranged to move towards and away from the rack, a pinion carried by said means and arranged to mesh with and to be disengaged from said rack, and controlling means comprising a controlling member for rotating said pinion, which controlling members are disposed one within the other and are operable manually from the same end.

8. In a step-and-repeat machine, the combination with an image screen-holder, a rotatable unit-holder, a lens-holder between the same, adjusting means comprising a controlling member for moving the unit-holder and lens-holder in a direction towards and away from the screen-holder and relatively thereto at such different rates as automatically to maintain an image in focus on the screen, said unit-holder comprising a frame, a curved toothed rack slidable in the frame, a unit-carrier rotatable by said rack about an axis lying in said direction, a handle mounted to rock on the frame and arranged to move towards and away from the rack, a pinion carried by said handle and arranged to mesh with and to be disengaged from said rack, and controlling means comprising a controlling member for rotating said pinion, which controlling members are disposed one within the other and are operable manually from the same end.

9. In a step-and-repeat machine, the combination with an image screen-holder, a rotatable unit-holder, a lens-holder between the same, adjusting means comprising a con-

trolling member for moving the unit-holder and lens-holder in a direction towards and away from the screen-holder and relatively thereto at such different rates as automatically to maintain an image in focus on the screen, said unit-holder comprising a frame, a circular toothed rack having a graduated scale rotatable in the frame, a unit-carrier rotatable by said rack about an axis lying in said direction, means mounted on the frame and arranged to move towards and away from the rack, a pinion carried by said means and arranged to mesh with and to be disengaged from said rack, a pointer so mounted on said frame as to be movable over a short length of said scale, and controlling means comprising the controlling member for rotating said pinion, which controlling members are disposed one extending through the other and are operable manually from the same end.

10. In a step-and-repeat machine, the combination with an image screen-holder, a rotatable unit-holder comprising a frame, a mount rotatable in the latter, and a unit-carrier detachably mounted in said mount and so arranged that a face of the unit in said carrier will be situated in the same plane for either of two reversed positions of the unit-carrier in said mount, a lens-holder between said screen-holder and said unit-holder, adjusting means comprising a controlling member for moving the unit-holder and lens-holder in a direction towards and away from the screen-holder and relatively thereto at such different rates as automatically to maintain an image in focus on the screen, and controlling means comprising a controlling member for rotating said unit-holder about an axis lying in said direction, which controlling members are disposed one within the other and are operable manually from the same end.

11. In a step-and-repeat machine, the combination with an image screen-holder, a rotatable unit-holder, a lens-holder between the same, adjusting means comprising a controlling member for moving the unit-holder and lens-holder in a direction towards and away from the screen-holder and relatively thereto at such different rates as automatically to maintain an image in focus on the screen, said unit-holder comprising a non-rotatable frame, a mount rotatable in the latter about an axis lying in said direction and having two parallel V-guides located one above the other, and a unit-carrier having two V-grooves, one along its top and the other along its bottom edge and arranged so to co-operate with said V-guides that a surface of the unit in said carrier will be situated in the plane containing the axes of said V-guides for either of two reversed positions of the unit-carrier in said mount, a circular toothed rack on said mount, a handle mount-

ed to rock on said frame towards and away the other and are operable manually from
from said rack, a pinion carried by said the side of said screen-holder remote from
handle and arranged to mesh with and be said unit-holder. 10
disengaged from said rack, and controlling In testimony whereof I affix my signa-
5 means comprising a controlling member for ture.
rotating said pinion, which controlling
members are disposed one extending through

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