

April 4, 1939.

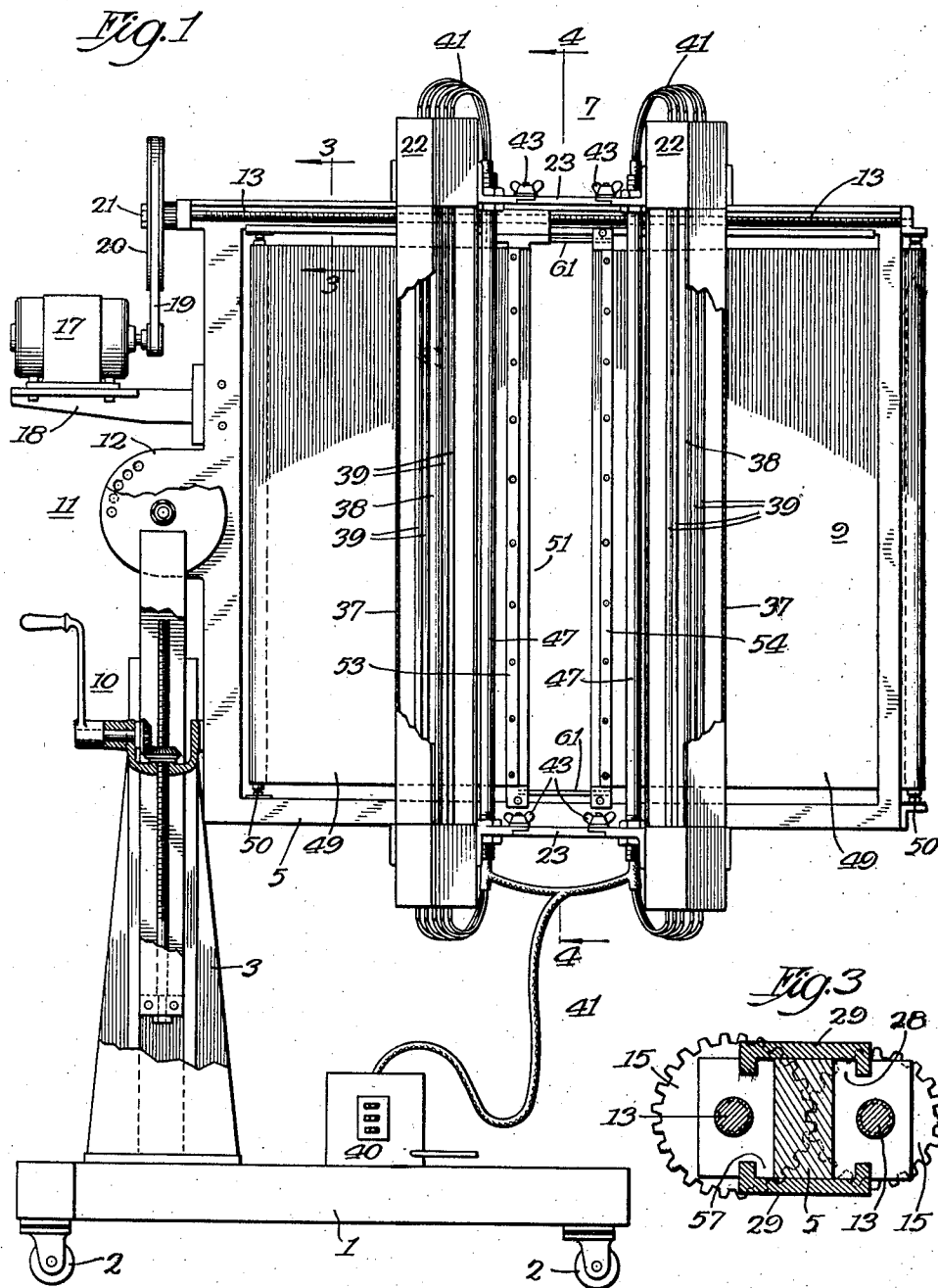
C. L. HENDERSON

2,153,186

SCANNING MACHINE

Filed May 25, 1936

4 Sheets-Sheet 1



Inventor:
Charles L. Henderson
By Fisher, Clapp, Soano & Pond Attys

April 4, 1939.

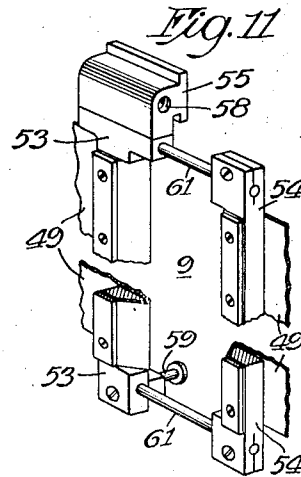
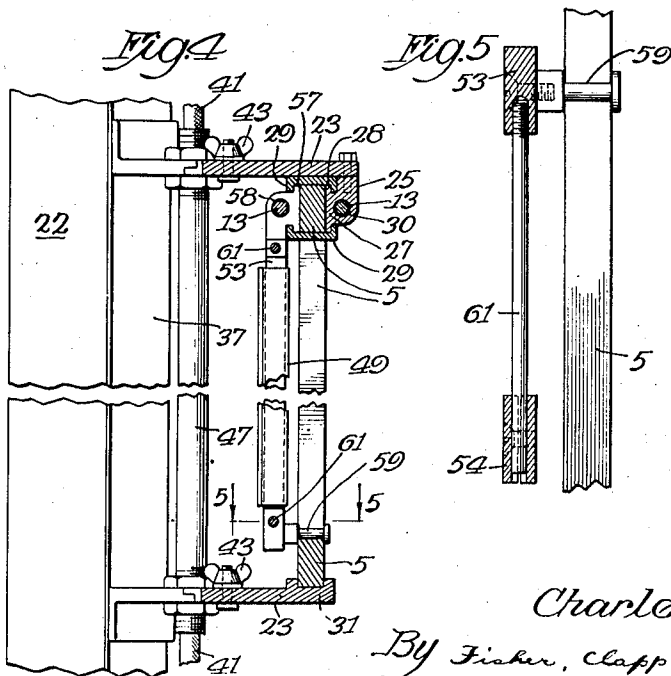
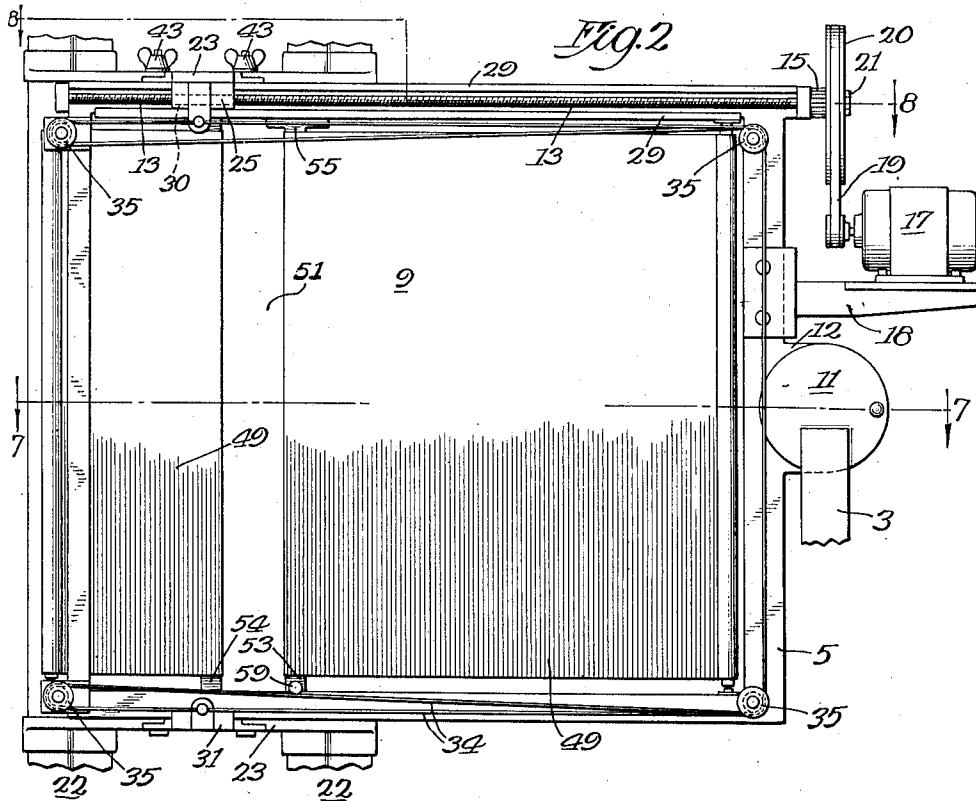
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SCANNING MACHINE

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4 Sheets-Sheet 2



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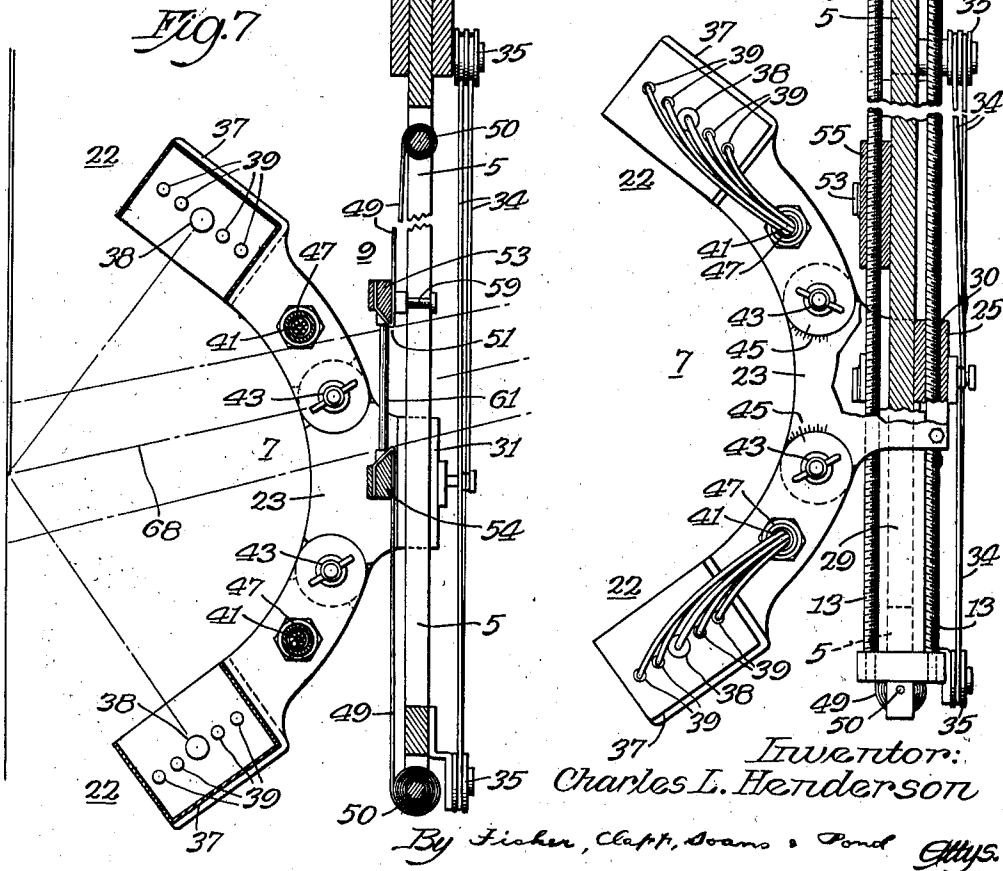
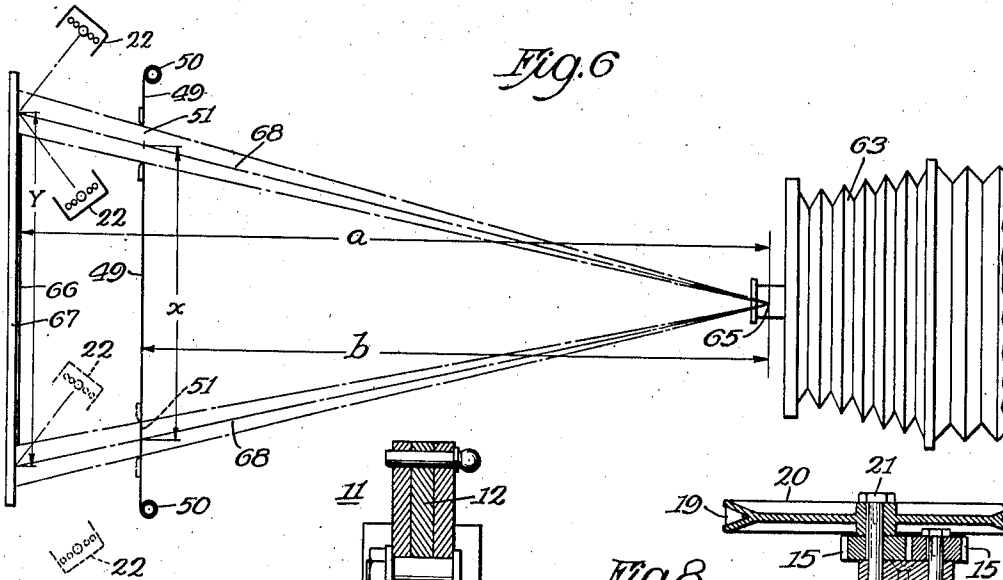
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SCANNING MACHINE

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4 Sheets-Sheet 3



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2,153,186

SCANNING MACHINE

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4 Sheets-Sheet 4

Fig. 9

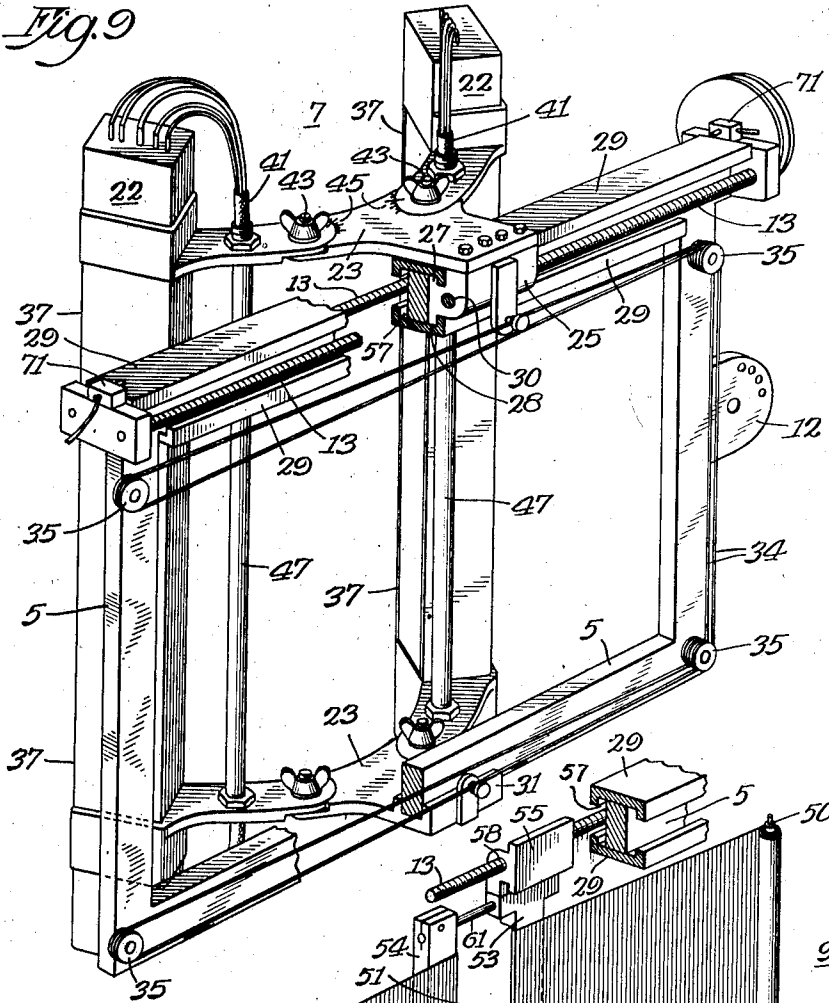
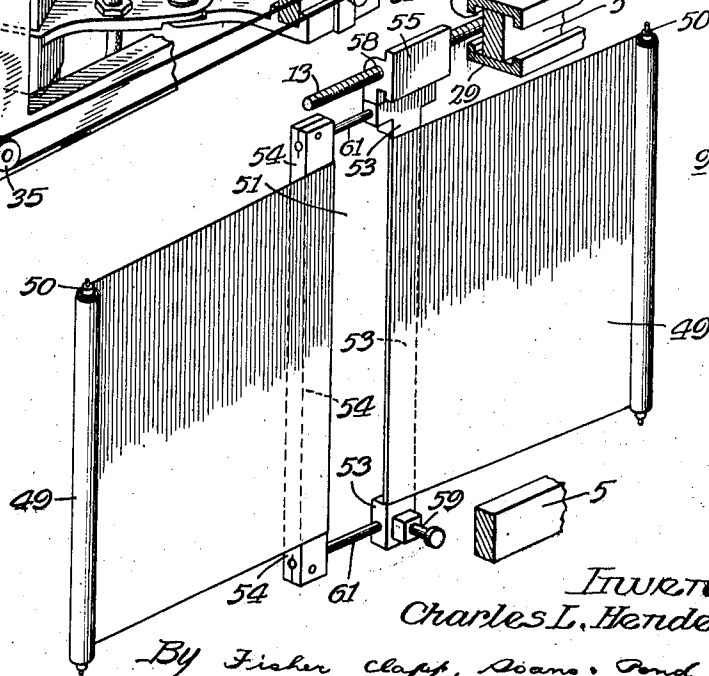


Fig. 10



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UNITED STATES PATENT OFFICE

2,153,186

SCANNING MACHINE

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Application May 25, 1936, Serial No. 81,598

11 Claims. (Cl. 88—24)

My invention relates generally to photographic processes and particularly to light sources and related equipment for illuminating objects to be photographed, as for example by a copying camera.

In the photographing of copy intended for continuous patterns, such as box cover paper, textiles, and wall paper, in which it is essential to show relief or shadows, it has been impossible heretofore to attain sufficiently uniform lighting of the copy to produce a satisfactorily uniform density copy plate except in a so-called daylight gallery. When this class of work is attempted with the use of one arc lamp to give the proper relief to the copy, an undue amount of retouching is necessary on the negative or positive plate before the plate is acceptably uniform.

The provision of reasonably simple, inexpensive apparatus capable of accomplishing uniform lighting of copy or objects to be photographed without requiring the use of a daylight gallery or comparable equipment thus constitutes the principal object of the present invention. A further object of the invention is to provide apparatus of this type which shall be easy to operate, and which also shall be conveniently portable and readily adjustable to meet the differing situations which may be encountered during its use. Other objects and advantages of the invention will be made apparent by reference to the following specification and drawings wherein,

Fig. 1 is a front elevational view, partially in section, of a device embodying the principles of my invention;

Fig. 2 is a fragmentary rear elevational view of certain portions of the device illustrated completely in Fig. 1;

Fig. 3 is a fragmentary sectional view on the general line 3—3 of Fig. 1;

Fig. 4 is an enlarged, fragmentary sectional view on the general line 4—4 of Fig. 1;

Fig. 5 is an enlarged fragmentary sectional view on the line 5—5 of Fig. 4;

Fig. 6 is a schematic view illustrating the manner of operation of my invention;

Fig. 7 is an enlarged sectional view on the general line 7—7 of Fig. 2;

Fig. 8 is an enlarged sectional view on the general line 8—8 of Fig. 2;

Fig. 9 is a perspective view illustrating the lamp assemblage portion of the device illustrating in the other figures of the drawings;

Fig. 10 is a perspective view of the scanning screen forming a part of the device illustrated in the other figures of the drawings; and

Fig. 11 is a fragmentary perspective view showing certain of the features of the scanning screen illustrated completely in Fig. 10.

In the preferred form of my invention illustrated in the drawings, I provide a suitable light source for illuminating the copy board or other object to be photographed, and an apertured scanning screen which is used in conjunction therewith, and during the operation of the apparatus, the light source and the scanning aperture in the scanning screen are simultaneously moved across the object to be photographed. To assure the attainment of even illumination of the object and hence even exposure of the plate in the copying camera, the rates of movement of the light source and the scanning aperture are so correlated that the scanning orifice and the light source are at all times maintained in the same relative position with respect to the optical center of the lens of the camera.

More specifically, the preferred form of my invention includes a suitable base 1 preferably mounted upon castors 2 so that it may conveniently be moved from place to place, a pedestal support 3 mounted upon the base, a frame 5 mounted upon the pedestal support 3, a lamp assemblage 7 supported upon the frame 5, and a suitable scanning screen mechanism 9 likewise mounted on the frame 5. A lifting screw mechanism, indicated at 10, is provided for accomplishing vertical adjustment of the frame 5, and a disk and pin connection 11 is provided for permitting tilting of the frame 5.

The frame 5 has the general form of a hollow rectangle and is preferably formed of a light cast metal, as for example an aluminum alloy. A suitable projection 12 is cast integrally with the frame 5 for cooperating with the disk and pin connection 11 which serves as the support for the frame. A pair of horizontally extending drive screws 13 are supported upon the upper end of the frame, one screw at either side thereof. These screws 13 constitute the means for moving the lamp assemblage and the scanning screen mechanism during the operation of the apparatus. The screws 13 are freely rotatable in either direction and are interconnected by means of two gears 15 having differing numbers of teeth, as is illustrated particularly in Fig. 3.

A reversible motor 17, preferably of the variable speed type, is supported on the frame 5 through the use of a suitable bracket 18 and is operatively connected with the drive screws 13 by means of a belt 19 and pulley 20, the pulley 20 being keyed to the outer end of one of the

drive screws and held in position by a suitable cap screw 21. The gear wheels 15 which interconnect the drive screws are arranged so as to be readily removable to permit the substitution therefor of gear wheels having differing numbers of teeth, in order to accomplish variation in the relative speeds of the drive screws and hence of the scanning screen and the light assemblage.

The lamp assemblage 7 comprises a pair of light units 22 which are supported for slidable, rectilinear movement upon the frame 5 by means of a pair of generally Y-shaped brackets 23. The central portion of the upper bracket 23 is affixed to a guide member 25 having a tongue element 27 which is adapted to engage a suitable groove 28 formed by a pair of channel members 29 affixed to the upper portion of the frame 5 as is indicated particularly in Figs. 4 and 9. The guide member 25 is provided with a suitable threaded passageway 30 for cooperating with the drive screw 13 for the lamp assemblage. The lower bracket 23 terminates in a grooved end portion 31 which is adapted to slidably engage the lower portion of the frame 5. To assure smooth movement of the lamp assemblage, the upper and lower guide members 25 and 31 are mechanically interconnected by means of suitable ropes 34 and pulleys 35.

Each of the light units 22 includes a generally rectangularly shaped reflector 37 and a plurality of electrically energized, tubular light sources disposed therewithin. To assure adequate color reproduction, each of the units preferably includes one mercury vapor tube indicated at 38 and four neon gas tubes indicated at 39. Preferably, the tubes 38 and 39 have an active length substantially greater than the width of the central opening within the frame 5. The neon tubes are energized by the use of suitable transformer means indicated at 40 and the mercury vapor tube is energized through the usual auxiliary (not shown), the electrical connections being supplied through cables 41.

To permit adjustment of the lamp units during use of the apparatus, each of the arm portions of the Y-shaped support brackets 23 is formed in two relatively movable, dove-tailed sections which are bolted together, as shown particularly in Figs. 4, 7, and 8, by suitable bolts and wing nuts 43. It will be apparent that this arrangement permits the convenient positioning and adjustment of the relative angular positions of the light units. If desired, a suitable indexing scale as illustrated at 45 in Fig. 8 may be provided. The conduit 47 for the cables 41 for the gas discharge tubes preferably comprises a length of pipe of suitable dimensions which extends between, and is rigidly bolted to each pair of lamp supporting brackets 23, this arrangement being of substantial value in increasing the rigidity of the lamp assemblage.

The scanning screen assemblage 9 comprises a suitable screen 49 preferably formed of opaque, rubberized, black cloth which is supported upon a pair of spring rollers 50 in a manner similar to the conventional focal plane shutter. A scanning aperture 51, comprising a generally rectangular slot, is formed in the screen intermediate the ends thereof, the ends of the screen being held in place and the dimensions of the aperture being determined by a pair of support members 53 and 54. The main screen support member 53 is affixed at its upper end to a generally T-shaped guide member 55 which is adapted to engage and to slide within the groove 57 defined

by the channel shaped members 29 at the upper portion of the frame 5 in a manner exactly similar to the guide support 25 for the lamp assemblage 7. The guide member 55 for the scanning screen is provided with a suitable threaded passageway 58 for engaging the driving screw 13. The lower end of the support member 54 for the scanning screw is provided with a guide roller 59 for engaging the upper surface of the bottom portion of the frame 5, as is indicated particularly in Figs. 5 and 10. The support 54 for the scanning screen is adjustably mounted upon the main support 53 by means of a pair of pins 61. This arrangement provides a convenient means for adjusting the width of the scanning aperture 51.

The operation of the illuminating and scanning apparatus of my invention may be best understood in conjunction with Fig. 6 which illustrates diagrammatically the relative positions of the screen 49, the scanning aperture 51, and the lamp assemblage 7 at the beginning and at the end of a scanning operation. In Fig. 6 the copying camera is indicated at 63, and the optical center of the lens used in conjunction therewith is indicated at 65. The design to be copied is on a flat sheet 66 which is supported upon a suitable copy board indicated at 67. At the beginning of the operation, the lamp assemblage and the scanning screen are preferably arranged so that the copy is entirely screened from the camera by the inner edge of the scanning aperture 51. The lamp reflectors 37 are so positioned that the point of maximum intensity coincides with the median optical axis of the slot, indicated by the line 68 in Figs. 6 and 7. Either one or both of the lamp units 22 may be used depending upon the desired result. After the lamp units have been adjusted, and the camera properly focused, the combined scanning and illuminating of the object to be photographed may be carried out. This is done by starting the motor 17 which actuates the drive screws 13. Each of the screws 13 is rotated at a uniform rate throughout the illuminating and scanning operation, but due to the differing numbers of teeth on the gear wheels 15 the lamp assemblage 7 is moved across the object to be photographed at a more rapid rate than the aperture 51 in the scanning screen. The relative speeds of the drive screws 13 are properly correlated so that the light source and the slot are maintained in a uniform position with respect to median optical axis 68 throughout the illuminating and scanning operation. It is apparent that this necessitates that the light source and the scanning screen shall be moved across the object at speeds which are substantially proportional, respectively, to the relative distance between the object to be illuminated and the optical center of the lens of the copying camera and the distance between the scanning means and the optical center of the lens of the copying camera, these distances being indicated on Fig. 6 of the drawings as *a* and *b*, respectively.

In the apparatus disclosed, this increased rate of movement of the lamp assemblage is accomplished, as mentioned above, by use of a gear for rotating the lamp assemblage drive screw which has a smaller number of teeth than the driving gear therefor, which gear is rotated at the same peripheral speed as the drive screw for the scanning screen. Once the apparatus has been set up and adjusted for any particular type of work, such variations as may be required in the image size of the object to be photographed is accomplished by first focusing the camera on the subject to

give the correct size negative and then locating the plane of the shutter of the scanning machine so that the distance b is to distance a as dimension x is to dimension y (Fig. 6). For instance if the gear ratio is 5:4 then dimension b will always be $\frac{4}{5}$ of dimension a when this ratio of gearing is used regardless of the size of the subject or the size of the image on the negative. If necessary, however, suitable gearing for any particular requirement may be easily installed. The relative angular position of the two lamp units are likewise readily adjustable to maintain proper illumination of the object being scanned.

Exposures are controlled by varying the width of the scanning aperture, the speed at which the illuminating and scanning equipment traverses the object, and the lens stop. The object can be illuminated and scanned once or several times; the usual procedure is to scan with the mercury and neon tubes at high speed and to repeat with the neon tubes at low speed. The inherent capability of the apparatus to permit multiple scanning of the object to be photographed under differing lighting conditions makes possible the accomplishing of many unusual and highly desirable effects in the resultant plate, particularly when it is desired to show relief or shadows. The apparatus is obviously very flexible and can readily be adapted to meet varied operational requirements. If desired, automatic cut-off switches, as are indicated at 11 in Fig. 9 may be provided for automatically stopping the motor 17 and cutting off the lights at the conclusion of each traverse of the object to be photographed by the light assemblage and the scanning aperture.

From the foregoing it will be seen that I have disclosed a novel apparatus for illuminating and scanning an object to be photographed in such manner that an exceedingly uniform exposure of the photographic plate is attained. The apparatus of my invention is relatively simple in design considering the manner of its operation, and it is easily and conveniently adjustable during use. The apparatus of my invention includes means for simultaneously illuminating and scanning the object to be photographed while automatically maintaining the scanning aperture and the light source in the same relative position with respect to the optical center of the lens of the camera. This assures much more even illumination of the copy than has been heretofore possible. In fact, tests have shown that the average variation in the intensity of illumination of copy to be photographed can, by use of my illuminating and scanning apparatus, be maintained under four per cent. When it is realized that variation in intensity of the illumination within even a daylight gallery is often in the neighborhood of 15% or more, the excellence of the apparatus may be better understood. The operation of my improved apparatus may be conveniently and accurately controlled by the operator, and once initiated is completely automatic, suitable cut-off switches being readily applicable to the structure disclosed. Further, the apparatus may be used by relatively unskilled persons without more than a reasonable amount of training.

Various modifications may be made in the form of the invention without departing from the principles disclosed in the foregoing. It is my intention, therefore, that the accompanying claims shall be construed as broadly as possible consistent with the prior art.

I claim the following as my invention:

1. In apparatus of the class described, a light source, means supporting said light source for generally rectilinear movement across the object to be photographed, a screen having an aperture formed therein, means supporting said screen for rectilinear movement across the object to be photographed in a plane substantially parallel to the plane of movement of said light source, means for moving said light source and said aperture across the object at differing, predetermined rates of movement, and means whereby said rates of movement may be varied within predetermined limits.

2. In apparatus of the class described, a frame, a light source slidably supported on said frame for rectilinear movement across the object to be illuminated, a screen having a scanning aperture formed therein, means supporting said screen on said frame for movement across the object, a pair of drive screws supported on said frame, one of said screws being adapted to move said light source and the other of said screws being adapted to move said apertured screen, and means for actuating said drive screws.

3. In apparatus of the class described, a frame, a light source supported on said frame for slidable movement across the object to be illuminated, a screen having a scanning aperture formed therein, means supporting said screen on said frame for movement across the object, a pair of drive screws supported on said frame, one of said screws being adapted to move said light source and the other of said screws being adapted to move said apertured screen, and means for actuating said drive screws in such manner that the rates of movement of said light source and said aperture are substantially proportional, respectively, to the distances between the object and said aperture and a predetermined reference point.

4. In apparatus of the class described, a frame, a light source supported on said frame for rectilinear movement across the object to be illuminated, a pair of rollers, a screen having a slot-like scanning aperture formed therein and being supported upon said rollers for rectilinear movement across the object to be illuminated, and means for simultaneously moving said light source and said aperture across the object to be illuminated during the operation of said apparatus, said means including a pair of drive screws and means for rotating said screws.

5. In apparatus of the class described, a frame having the general form of a hollow rectangle, a light source comprising at least one electrically energized, light emitting tube supported upon said frame for rectilinear movement across the central opening therein, a screen supported on said frame at a position intermediate said light source and the photographic equipment with which said apparatus is used, said screen having a narrow, rectangularly shaped, scanning aperture formed therein and said aperture being movable across the central opening within said frame, means for simultaneously moving said light source and said aperture from one side of said frame to the other at rates of motion which are substantially proportional, respectively, to the distance between the object to be illuminated and scanned by said apparatus and the photographic equipment with which said apparatus is used, and the distance between said aperture and the photographic equipment.

6. In apparatus of the class described, a frame

having the general form of a hollow rectangle, a light source comprising a plurality of electrically energized tubes having a length at least equal to the length of one of the sides of said frame, and a pair of guide members for supporting said light source on said frame, one of said members slidably engaging the top of said frame and the other of said members slidably engaging the bottom of said frame, means for slidably moving the upper of said guide members along said frame and a rope and pulley means for connecting the lower guide member with the upper guide member so as to assure free slidable movement of said light source with respect to said frame.

7. In apparatus of the class described, a frame having the general form of a hollow rectangle, a light source, means comprising a pair of guide members each of which is adapted to slidably engage an opposite side of said frame for supporting said light source for slidable movement transversely across said frame, a pair of rollers each of which is supported upon said frame, a screen having a slot aperture therein carried by said rollers in such manner that said slot aperture may be moved transversely from one side of said frame to the other, and means for moving said light source and said screen at differing predetermined rates of speed, said means comprising a pair of drive screws supported upon said frame, and gearing for driving said screws at uniform but differing rates of speed.

8. In apparatus of the class described, a light source for illuminating the object to be photographed, means supporting said light source for movement across said object in a plane substantially parallel thereto, a screen having a scanning aperture formed therein, means supporting said screen for movement across said object in a plane substantially parallel to, but spaced some distance from, the plane of movement of said light source, and means for moving said light source and said aperture across said object at differing, predetermined rates of movement.

9. In apparatus of the class described, a light source for illuminating the object to be photographed, a screen having an aperture formed therein for scanning the object illuminated by said light source, separate means independently supporting said light source and said apertured screen for movement across the object to be photographed at differing distances therefrom, and means for independently moving said light source and said scanning aperture across said object in planes substantially parallel thereto

during the operation of said apparatus, said means being so arranged that the rates of movement of said light source and said aperture are substantially proportional, respectively, to the distance between said object and a predetermined reference point and to the distance between said scanning aperture and a predetermined reference point.

10. In apparatus of the class described, a light source for illuminating the object to be photographed, means supporting said light source for movement across said object in a plane substantially parallel thereto, a screen having a scanning aperture formed therein, means supporting said screen for movement across said object in a plane substantially parallel to, but spaced some distance from, the plane of movement of said light source, and means for independently moving said light source and said scanning aperture across said object during the operation of said apparatus, said apertured screen being disposed intermediate said light source and the camera and said light source being disposed intermediate said screen and said object, said means for moving said light source and said apertured screen being so arranged that the rates of movement of said light source and said aperture across said object are at all times during the operation of said apparatus substantially proportional, respectively, to the distance between said object and the optical center of the camera lens and the distance between said scanning aperture and the optical center of the camera lens.

11. In apparatus of the class described, a frame having a central opening of generally rectangular form, a support for an object, a light source, means comprising a pair of guide members each of which is adapted to slidably engage an opposite side of said frame for supporting said light source for movement transversely across said central opening, a screen having an elongated scanning aperture formed therein supported on said frame separately from said light source in such manner that the scanning aperture in said screen may be moved transversely across said central opening along a path of movement spaced some distance from the path of movement of said light source, and separate means for moving said light source and said screen at predetermined differing rates of movement, the planes of movement of the screen and light source being generally parallel to the plane of the object supported.

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