

No. 883,895.

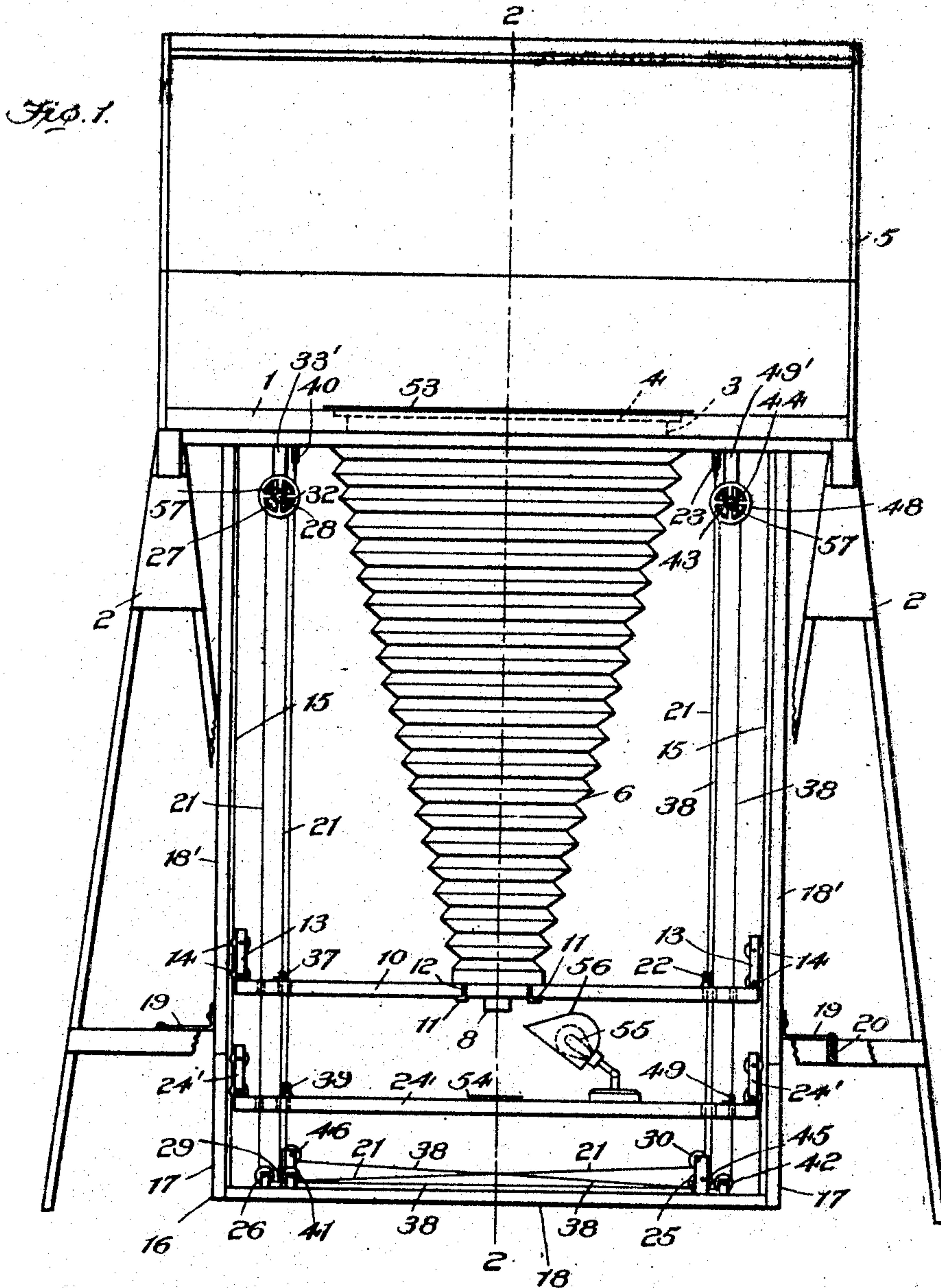
E. O. LIEGHLEY.

PATENTED APR. 7, 1908.

APPARATUS FOR ENLARGING OR REDUCING DRAWINGS.

APPLICATION FILED NOV. 16, 1907.

8 SHEETS—SHEET 1.



Witnesses

James T. Hunter.

Ralph Wornelle.

Inventor

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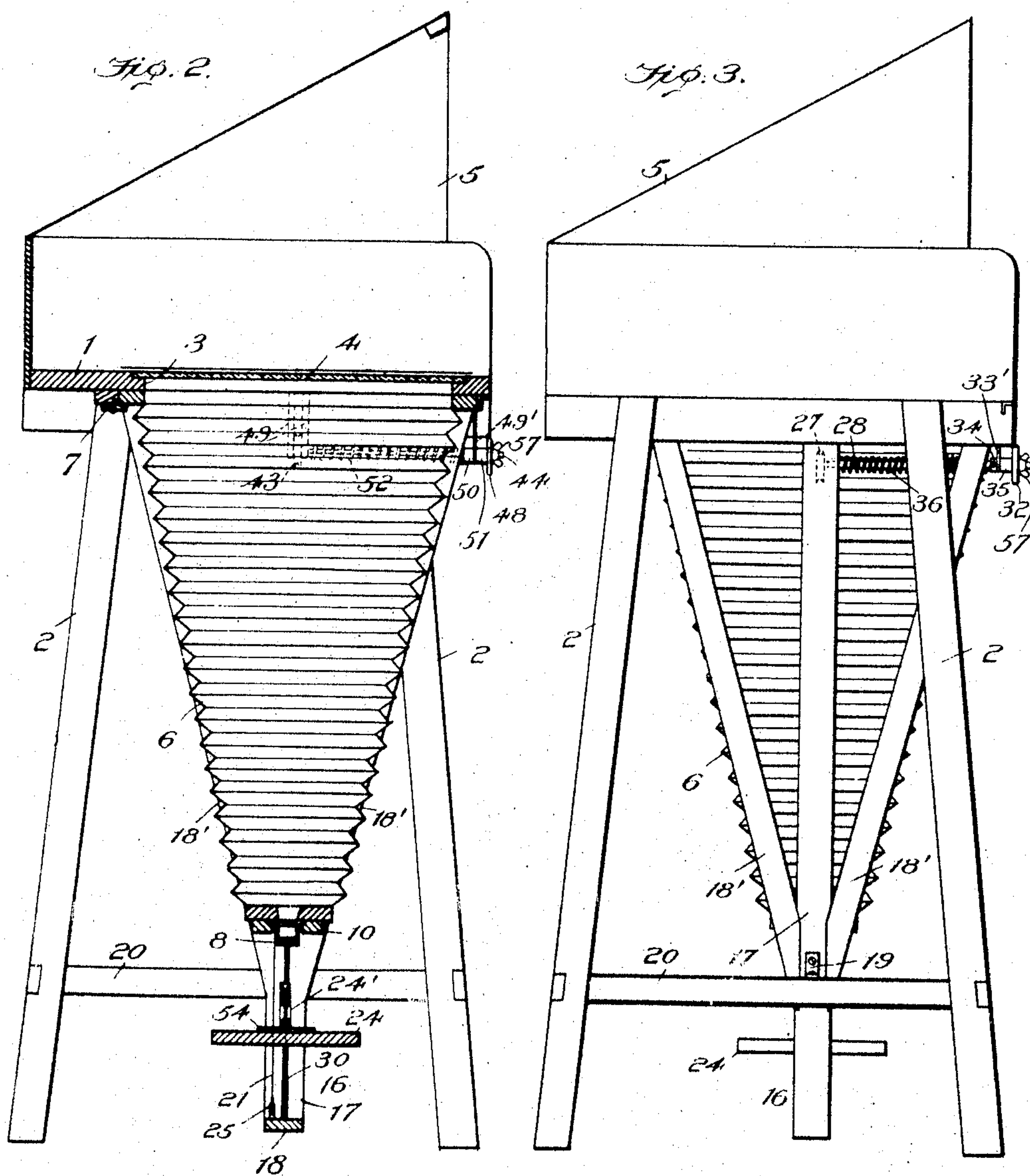
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E. O. LIEGHLEY.

APPARATUS FOR ENLARGING OR REDUCING DRAWINGS.

APPLICATION FILED NOV. 18, 1907.

3 SHEETS—SHEET 2.



Witnesses

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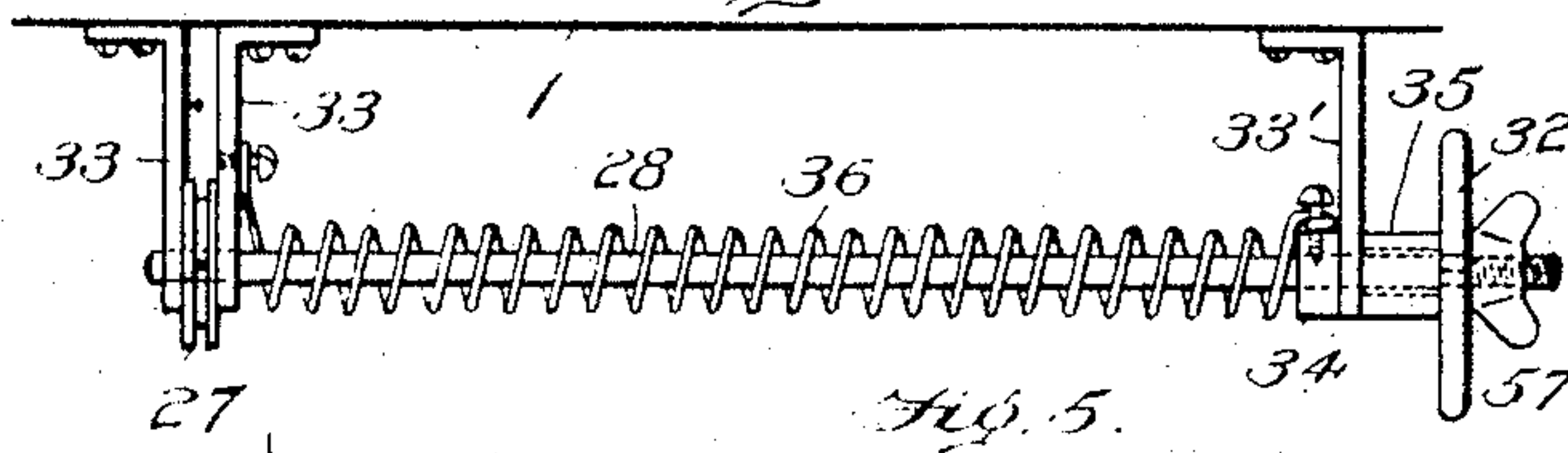
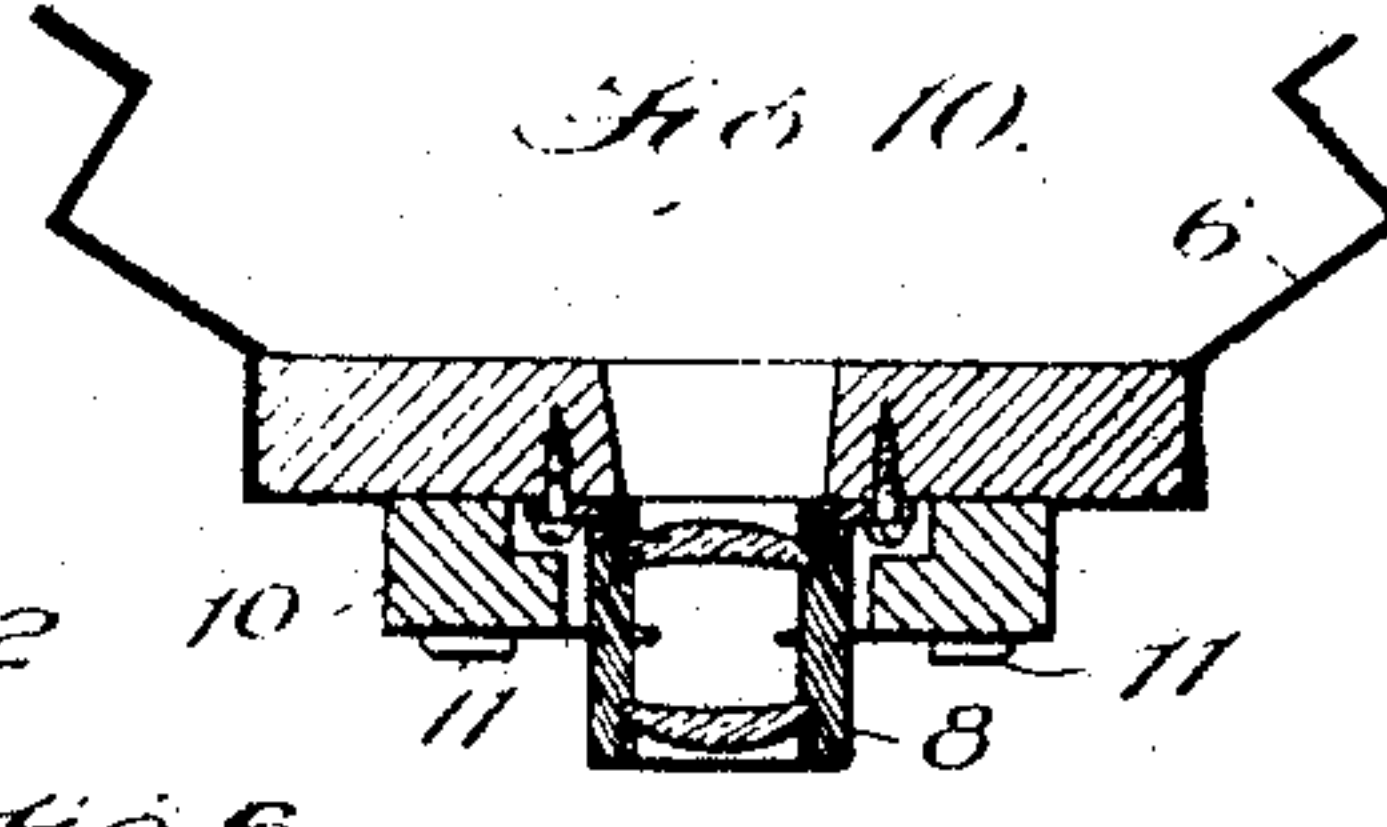
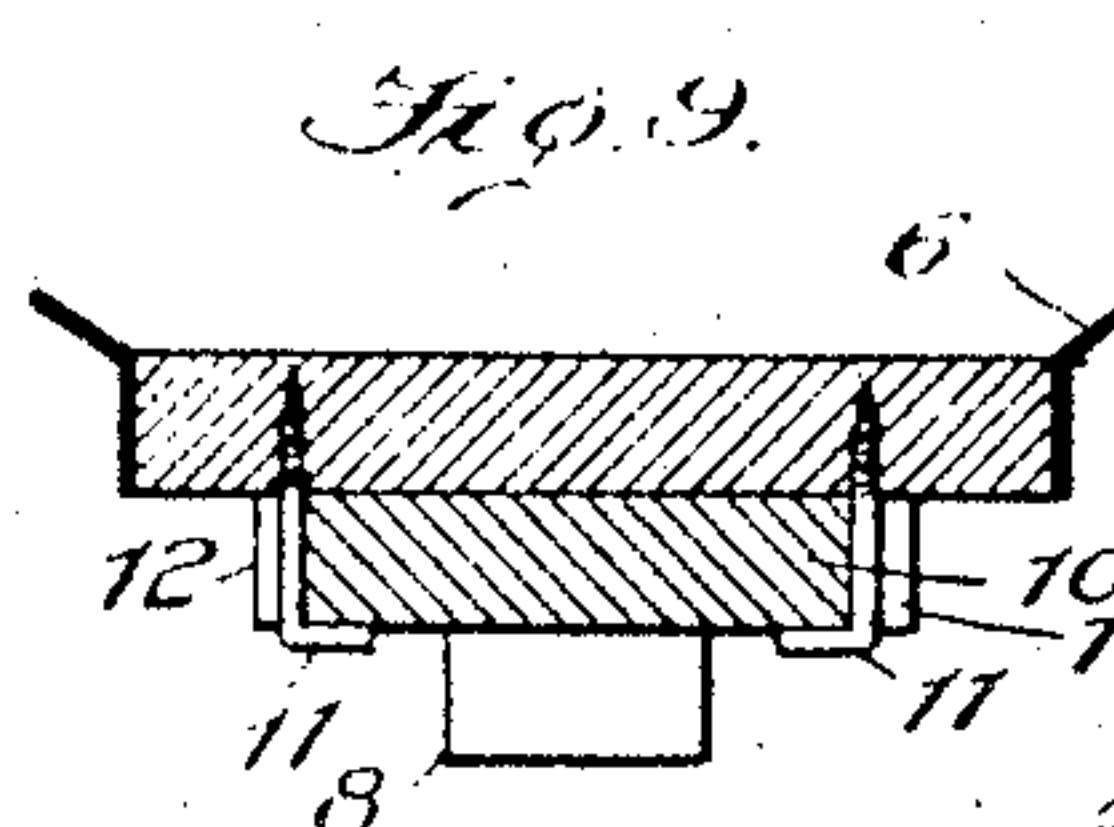
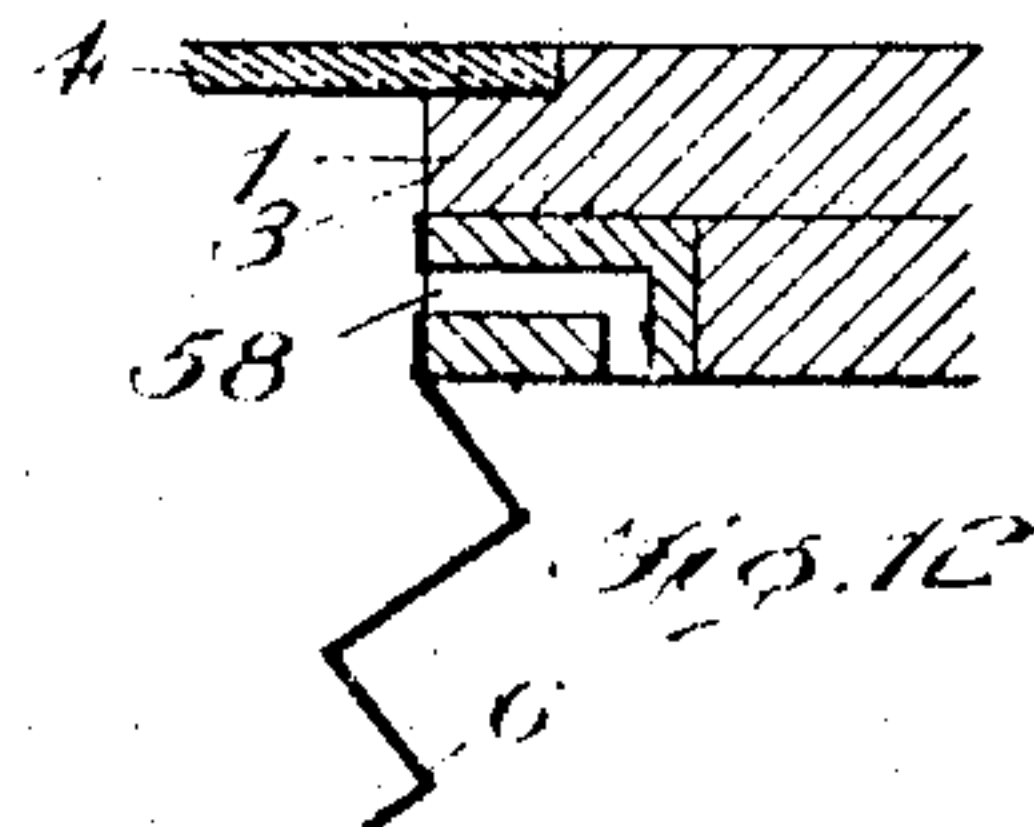
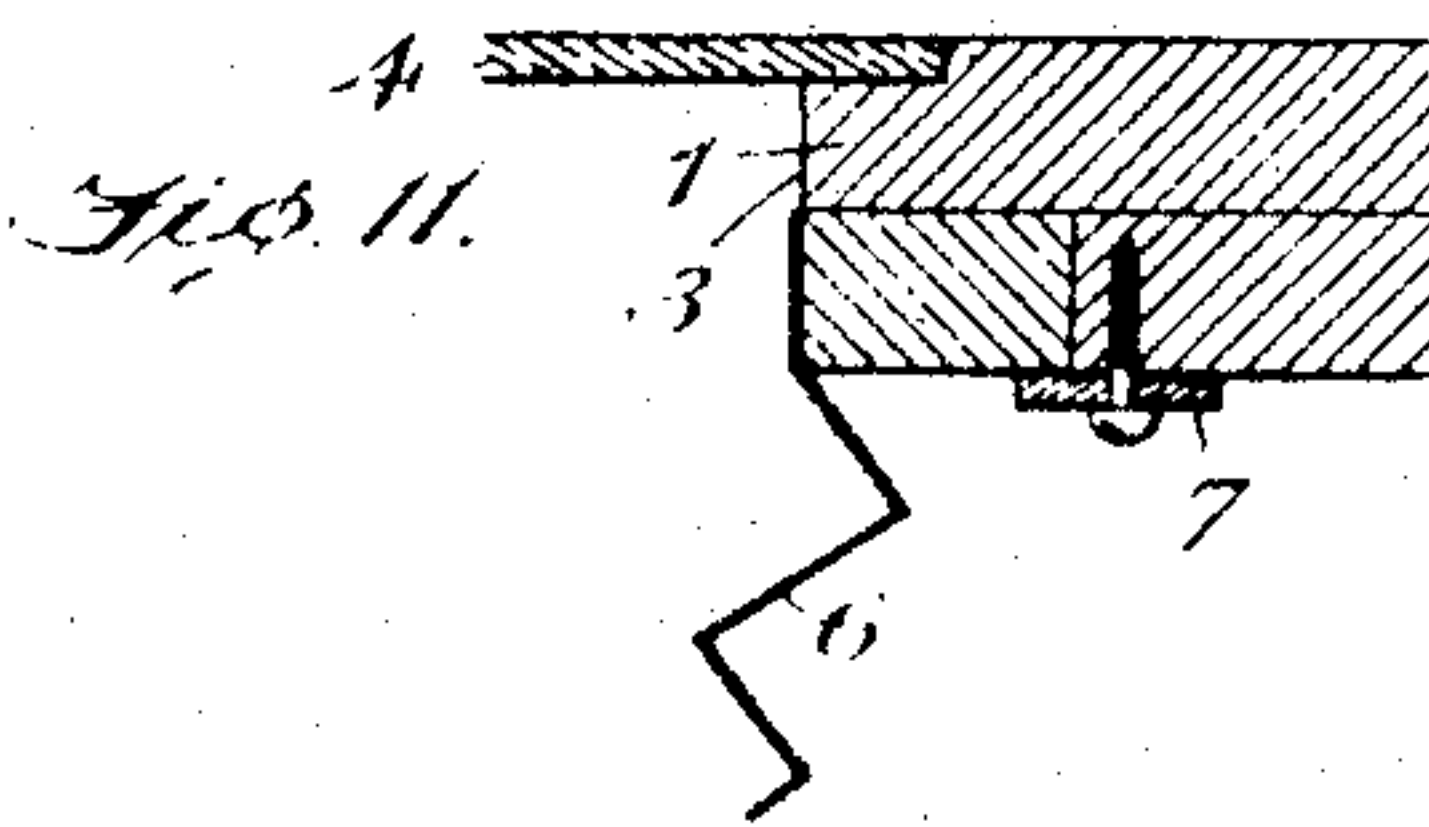
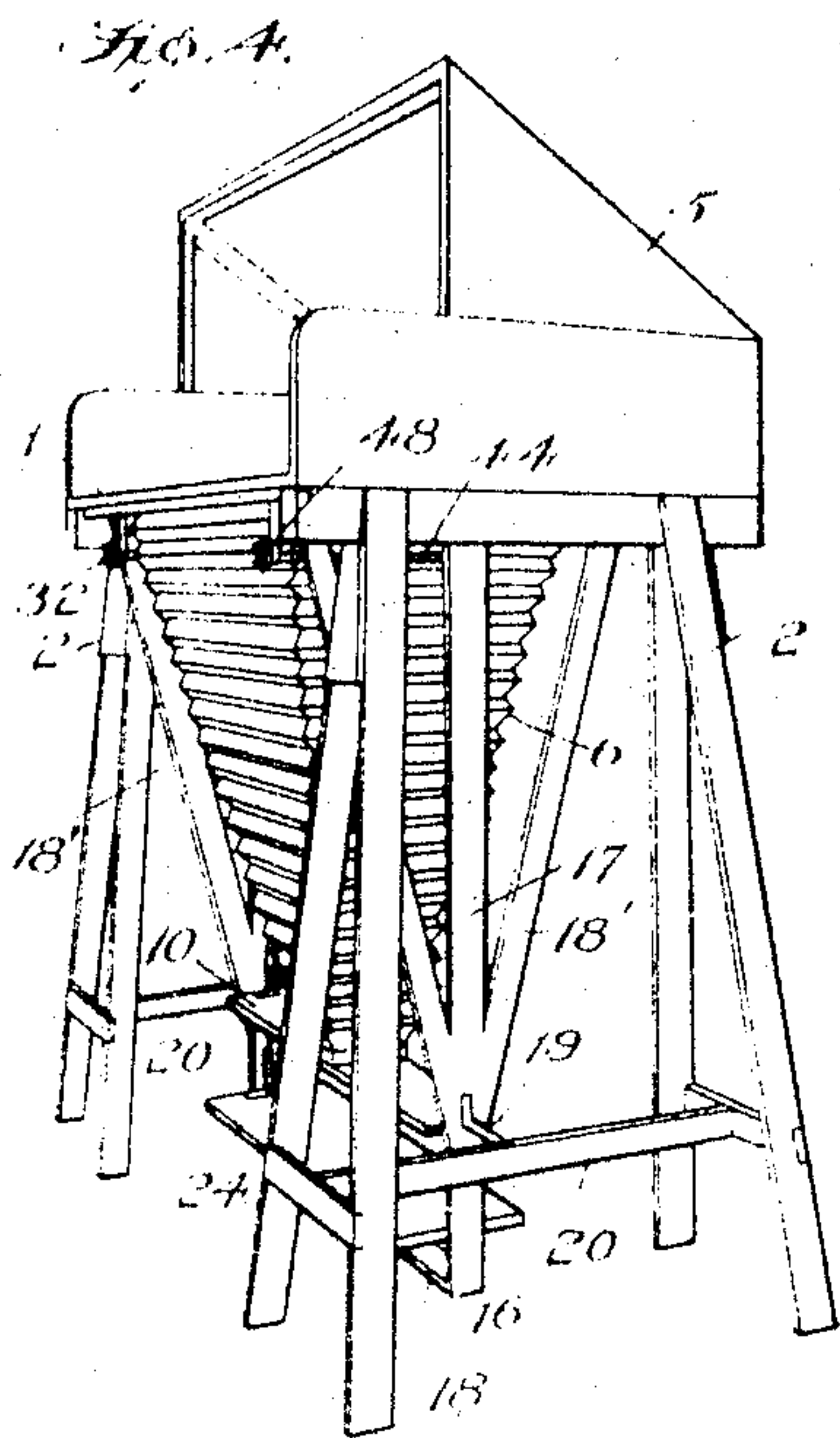
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APPARATUS FOR ENLARGING OR REDUCING DRAWINGS.

APPLICATION FILED NOV. 16, 1907.

3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

ERNEST O. LIEGHLEY, OF BALTIMORE, MARYLAND.

APPARATUS FOR ENLARGING OR REDUCING DRAWINGS.

No. 883,895.

Specification of Letters Patent.

Patented April 7, 1908.

Application filed November 16, 1907. Serial No. 402,510.

To all whom it may concern:

Be it known that I, ERNEST O. LIEGHLEY, a citizen of the United States, residing at Baltimore, in the county of Baltimore City and State of Maryland, have invented certain new and useful Improvements in Apparatus for Enlarging or Reducing Drawings, of which the following is a specification.

This invention relates to apparatus for enlarging or reducing drawings, maps, prints, etc.; and it consists generally of the combination of a suitable drafting-table, a camera-bellows, an object-holder, and mechanism for moving the lens-end of the bellows and the object-holder, all so constructed and arranged that the object to be copied may be moved relatively to the surface or top of the table, so that a sharply focused, visible image, of any desired size, may be produced upon the surface of a sheet of transparent or semi-transparent material upon which it is to be traced, placed upon a glass plate, forming a portion of the surface or top of the table.

The invention further consists of the general arrangement and combination of the several parts, as will be hereinafter fully described in this specification and briefly stated in the claims thereof.

The main object of the invention is to produce copies of an original object, in which the proportions will be exact, but the size of the copy produced will be as much larger or smaller than the original as may be desired.

Other objects of the invention will become apparent upon a full disclosure thereof.

In the drawing, Figure 1 is a front elevation of my improved apparatus; Fig. 2, a section on line 2-2 of Fig. 1; Fig. 3, a side elevation; Fig. 4, a perspective of the apparatus complete, somewhat reduced; Fig. 5, an enlarged front elevation, broken in two, of the lower portion of the frame, showing an exaggerated arrangement of the cable or cord for raising and lowering the object-holding board; Fig. 6, an enlarged elevation of one of the mechanisms for moving the cord or cable, for counterbalancing the respective boards, and for locking the moving mechanism when required; Figs. 7 and 8, detail views of one of the winches employed as a fastener for the ends of the cord or cable, and for maintaining the same in a taut or tight condition; Figs. 9 and 10, detail sectional views of the lens-holder, and Figs. 11 and 12 similar views, showing means for de-

tachably-connecting the bellows to the table, and the vent through which air enters the bellows and is expelled therefrom, respectively.

In the several views, the numeral 1 indicates a suitable drafting-table mounted upon trestles 2, 2, and provided with a central opening 3, preferably square, over which is fitted a glass plate 4. The table is provided with a suitable hood 5, for excluding the light from above a camera-bellows 6, removably-attached to the underside of the table by means of turn-buttons 7, spaced around the edge of the opening 2 in the table, one of said turn-buttons being shown in Fig. 11. Other suitable and well-known fastening devices may be substituted for the turn-buttons to removably-attach the bellows to the table.

The bellows is of the ordinary type, and is provided with the usual lens 8, attached to the lens-block in the usual manner, as shown in Fig. 10. The lower or lens-end of the bellows is detachably-connected to a lens-board 10 by means of screw-hooks 11, 11, operating in slots 12, 12, made in the side edges of the lens-board, as clearly shown in Fig. 9. The lens-board is provided at each end with a truck or carriage 13, having grooved wheels 14, 14, which are adapted to run on guide-rail 15 secured to the inner side of a frame 16, depending from the underside of the table; said frame consisting of two vertical side-pieces 17, 17, connected together at their lower ends by a cross-bar 18, and firmly braced from the underside of the table by braces 18', 18', as shown in Figs. 3 and 4. The frame is further braced by angle-irons 19, 19 secured to the cross-bars 20, 20 of the trestles 2, as shown in Figs. 1, 3, and 4.

The mechanism for lowering and raising the lens-board 10, consists of a cord or wire-cable 21 running from a small winch 22, mounted upon one end of said lens-board, up over a pulley 23 and down through guide-holes in the lens-board and an object-holding board 24, around pulley 25; then around pulley 26, up through guide-holes in the object-holding and lens-boards and over a grooved pulley 27, secured on the inner end of an operating shaft 28; down through guide-holes in the lens and object-holding boards and around pulley 29; then around pulley 30 and up through guide-holes in the object-holding and lens-boards back to the winch, both ends of the cord or cable being

secured in holes in the drum 31 of the winch. As both ends of the cord or cable are secured to the drum of the winch 22, it will be obvious that any slack in said cord or cable may be readily taken up by turning the winch, the latter serving as a tightener to keep the cord or cable always taut. The cord or cable is operated by the shaft 28, rotated by hand-wheel 32' secured on the outer end of said shaft. The shaft is mounted in hangers 33 and 33', depending from the underside of the table, and is provided with a fixed collar 34 on one side of the hanger 33' and with a loose collar 35 on the other side of said hanger, as shown in Fig. 6. The shaft is surrounded by a coil-spring 36, which has one end fastened to the hanger 33 and the other end to the fixed collar, so that when the shaft is turned in one direction the spring will be wound up to serve as a counterbalance to the lens-board.

The lens-board is fastened to the cord or cable at two points, at one point by the winch 22 and at the other point by an adjustable clamp 37, fixed to the lens-board at the end opposite the winch. These two points are on that portion of the cord or cable which moves in the same direction in raising or lowering the lens-board. By means of the adjustable clamp the lens-board is readily adjusted to a horizontal position, and as both ends of the cord or cable are shortened or lengthened equally, it will be evident that the lens-board, after adjustment, will always be in a horizontal position. The object-holding board 24 is also provided with trucks or carriages 24', 24', and is raised or lowered by a cord or cable 38, arranged and operated similarly to the cord or cable for raising or lowering the lens-board. One end of the cord or cable 38 is fastened to the drum of a winch 39, from which it passes up through a guide-hole in the lens-board over a pulley 40, then down through guide-holes in the lens and object-holding boards around pulley 41, around pulley 42 and up through guide-holes in the object-holding and lens-boards over grooved pulley 43, secured on the inner end of an operating-shaft 44, similar to shaft 28 shown in Fig. 6, then down through guide-holes in the lens and object-holding boards around pulley 45, then around pulley 46 and up through a guide-hole in the object-holding board back to the winch, where the end is fastened to the drum thereof. The winch 39 also serves as a cord or cable tightener, and the cord or cable is fastened to the object-holding board by a clamp 49, fixed to said board at the end opposite the winch, which is similar in all respects to clamp 37. The cord or cable is operated by the shaft 44, and said shaft is operated by a hand-wheel 48 secured on its outer end. The shaft 44 is mounted in hangers 49, 49', similar to shaft 28, and is provided with a fixed collar 50 and

a loose collar 51. The shaft is also provided with a counterbalancing spring 52, one end of which spring is fastened to the fixed collar 50 and the other end to the hanger 49.

In Fig. 5 I have shown, in exaggerated form, the arrangement of the cord or cable 38 and the pulleys over which it moves. All of the pulleys for both cords or cables, except pulleys 23, 27, 40, and 43, are attached to the cross-bar 18 of the frame 16.

In operation, a sheet of semi-transparent material 53 is placed upon the glass plate 4, and the object to be copied is placed on the board 24, as shown at 54 Fig. 1. A light 55, provided with a suitable reflector 56, is placed in such a position as will illuminate said object, and cause its image to be projected upon the sheet 53. By changing the position of the lens- and object-holding boards, relative to the surface of the table, the image may be made of any desired size. When both boards have been adjusted to the required position, they are held in such position by tightening a set-screw 57 on each of the operating shafts, which operation forces the loose collars against the hangers and draws the fixed collars into close contact with said hangers, thus binding the parts together and locking the shafts against rotation. After the parts have been locked together, the reflected image may be traced upon the sheet 53 accurately and with great ease.

The bellows frame is provided with a vent 58, through which air enters the bellows and is expelled therefrom, during the focusing process or operation of raising or lowering the lens and object-holding boards. By detaching the camera-bellows from the table, the latter may be used for making full-size copies or tracings of objects drawn or printed upon thin or transparent material, such as blue-prints, by causing the light to be reflected upon the underside of the glass plate. By substituting a ground glass plate for the glass plate 4, a reflected image may be copied upon a sheet of transparent material placed over said ground glass.

Various changes or modifications, in the details of construction, may be made without departing from the spirit of my invention or sacrificing the principle thereof.

Having thus fully described my invention what I claim, is—

1. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being detachably-connected to the table below said plate, a source of light, and means for moving the lens-end of the bellows relatively to the glass plate.

2. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a

camera-bellows provided with a projecting-lens, said bellows being detachably-connected to the table below said plate, a cord or cable, pulleys over which the cord or cable is moved, a source of light, and means for operating the cord or cable to move the lens-end of the bellows relatively to the glass plate.

3. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being detachably-connected to the table below said plate, an object-holding board, a source of light, and means for moving said board relatively to the glass plate.

4. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being detachably-connected to the table below said plate, an object-holding board, a source of light, a cord or cable, pulleys over which the cord or cable is moved, and means for moving said cord or cable to raise or lower said board.

5. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, an object-holding board, a source of light, means for moving said board relatively to the glass plate, and means for moving the lens-end of the bellows relatively to said plate.

6. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below the plate, a lens-board attached to the lens-end of the bellows, means for moving the lens-board relatively to the glass plate, an object-holding board, a source of light, and means for moving said board relatively to said plate.

7. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being detachably-connected to the table below said plate, an object-holding board, a source of light, a cord or cable and an operating-shaft for moving said board relatively to the glass plate, and means for moving the lens-end of the bellows relatively to said plate.

8. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being detachably-connected to the table below the plate, a lens-board

connected to the lens-end of the bellows, a cord or cable and an operating-shaft for moving the lens-board relatively to the glass plate, an object-holding board, a source of light, and means for moving said board relatively to said plate.

9. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being detachably-connected to the table below the glass plate, a lens-board detachably-connected to the lens-end of the bellows, a cord or cable and an operating-shaft for moving said lens-board, an object-holding board, and a source of light, and a cord or cable and an operating shaft for moving said object-holding board.

10. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the lens-end of the bellows, a cord or cable, pulleys over which the cord or cable is moved, means for attaching the lens-board to the cord or cable, a source of light, and an operating-shaft for moving the cord or cable to raise or lower said lens-board.

11. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said glass plate, an object-holding board, a source of light, a cord or cable, pulleys over which said cord or cable is moved, means for attaching the object-holding board to the cord or cable, and an operating-shaft adapted to move the cord or cable to raise or lower said object-holding board.

12. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said glass plate, a lens-board attached to the lens-end of the bellows, a cord or cable, pulleys over which the cord or cable is moved, means for attaching the lens-board to said cord or cable, an operating-shaft for moving the cord or cable to raise or lower said lens-board, a source of light, an object-holding board, and means for raising or lowering said board.

13. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the lens-end of the bellows, means for moving said lens-board, an object-holding board, a source of light, a cord or cable, pulleys over

which said cord or cable is moved, means for attaching the cord or cable to the object-holding board, and an operating-shaft for moving the cable or cord to raise or lower said board.

14. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the lens-end of the bellows, a cord or cable, pulleys over which said cord or cable is moved, means for attaching the lens-board to the cord or cable, an operating-shaft for moving said cord or cable, an object-holding board, a source of light, a cord or cable, pulleys over which the cord or cable is moved, means for attaching the object-holding board to said cord or cable, and an operating-shaft for moving said board.

15. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the lens-end of the bellows, means for raising and lowering said lens-board, means for locking the lens-board at any desired position, and a source of light.

16. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, an object-holding board, a source of light, means for raising and lowering said board, and means for locking the object-holding board at any desired position.

17. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the lens-end of the bellows, means for raising and lowering the lens-board, means for locking said lens-board at any desired position, an object-holding board, means for raising and lowering said board, a source of light, and means for locking said board at any desired position.

18. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the

lens-end of the bellows, means for raising and lowering the lens-board, a source of light, and means for counterbalancing said lens-board.

19. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, an object-holding board, a source of light, means for raising and lowering said board, and means for counterbalancing the board.

20. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the lens-end of the bellows, means for raising and lowering said lens-board, means for counterbalancing the lens-board, a source of light, an object-holding board, means for raising and lowering the object-holding board, and means for counterbalancing said board.

21. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of a camera-bellows provided with a projecting-lens, said bellows being attached to the table below said plate, a lens-board attached to the lens-end of the bellows, means for raising and lowering the lens-board, means for locking said lens-board at any desired position, an object-holding board, means for raising and lowering said board, means for locking the board at any desired position, and means for reflecting light upon the underside of the glass plate.

22. In an apparatus for copying drawings, etc., the combination with a suitable table provided with a glass plate in its top, of an object-holding board, means for raising and lowering said board, and means for reflecting light upon the underside of the glass plate.

23. In an apparatus for copying drawings, etc., the combination with a table provided with a glass plate in its top, of an object-holding board, means for raising and lowering said board, means for locking the board at any desired position, and means for reflecting light upon the under surface of the glass plate.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST O. LIEGHLEY.

Witnesses:

C. REUTLINGER,
W. B. BLAKESLEE.