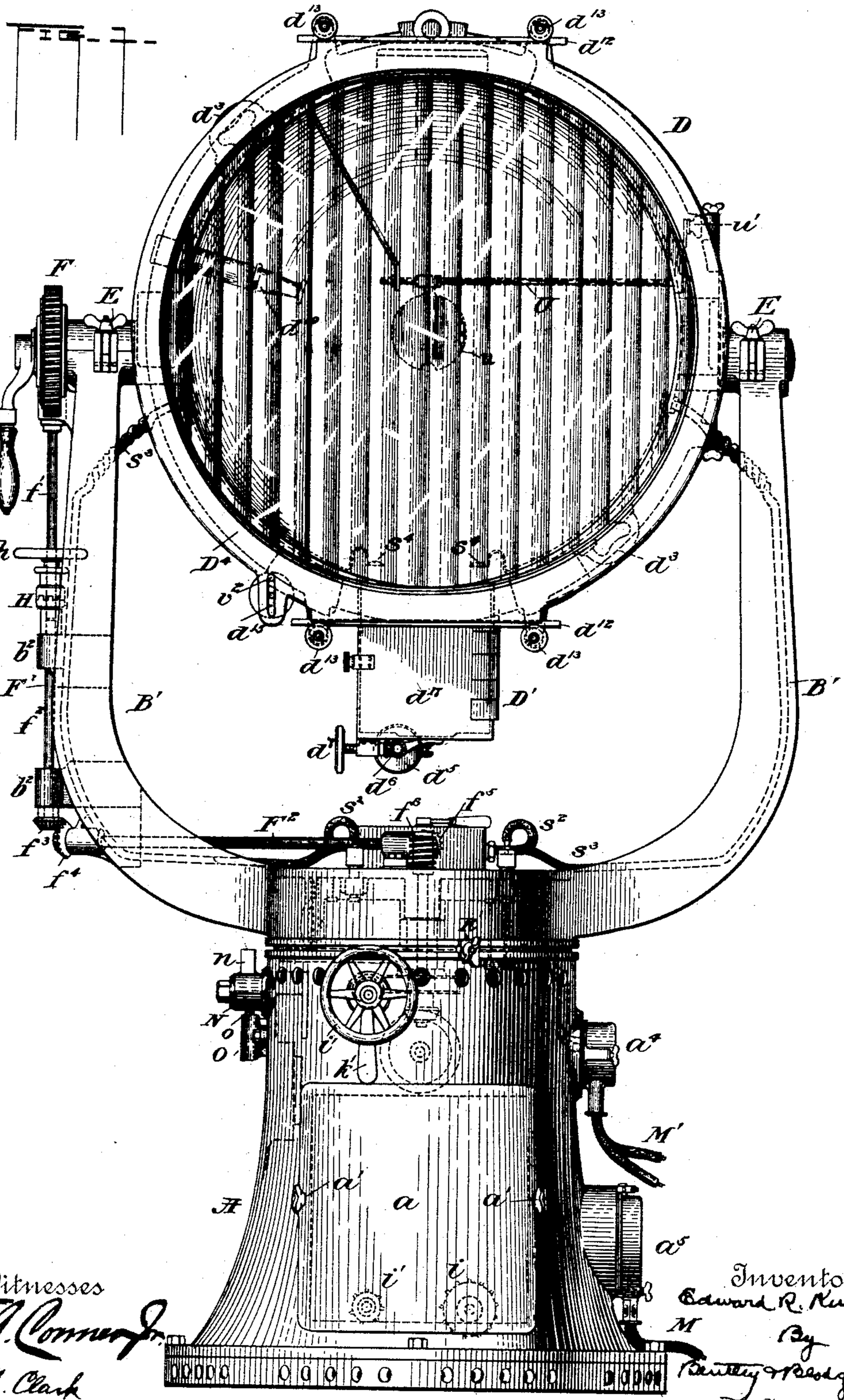
(No Model.)

5 Sheets—Sheet 1.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 516,821. Patented Mar. 20, 1894.



THE NATIONAL LITHOGRAPHING COMPANY.
WASHINGTON, D. C.

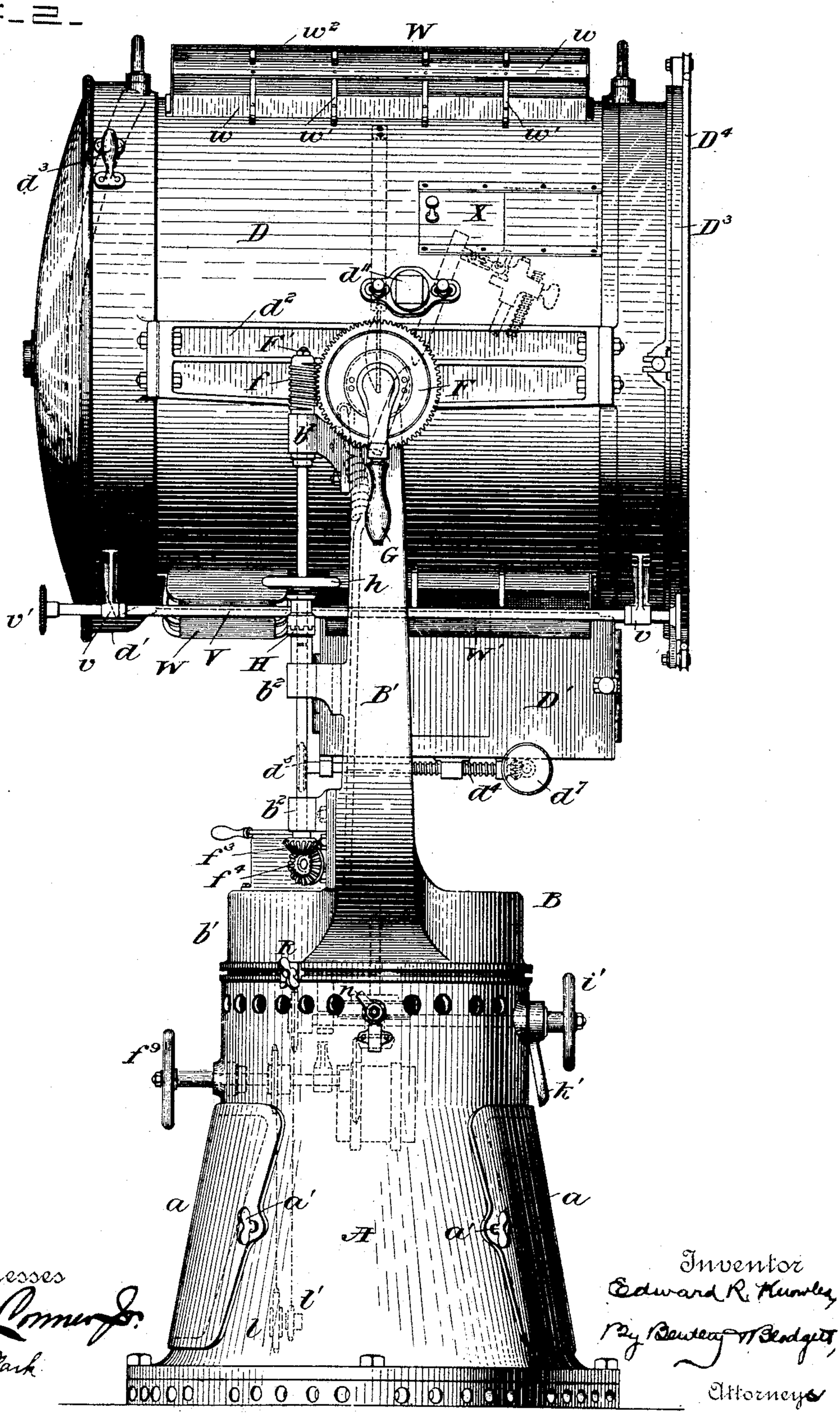
(No Model.) 5 Sheets—Sheet 2.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 516,821. Patented Mar. 20, 1894.

FIG. 2.



Witnesses
L. A. Commings
O. L. Clark

Inventor
Edward R. Knowles,
By Bowley & Bedgett,
Attorneys

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

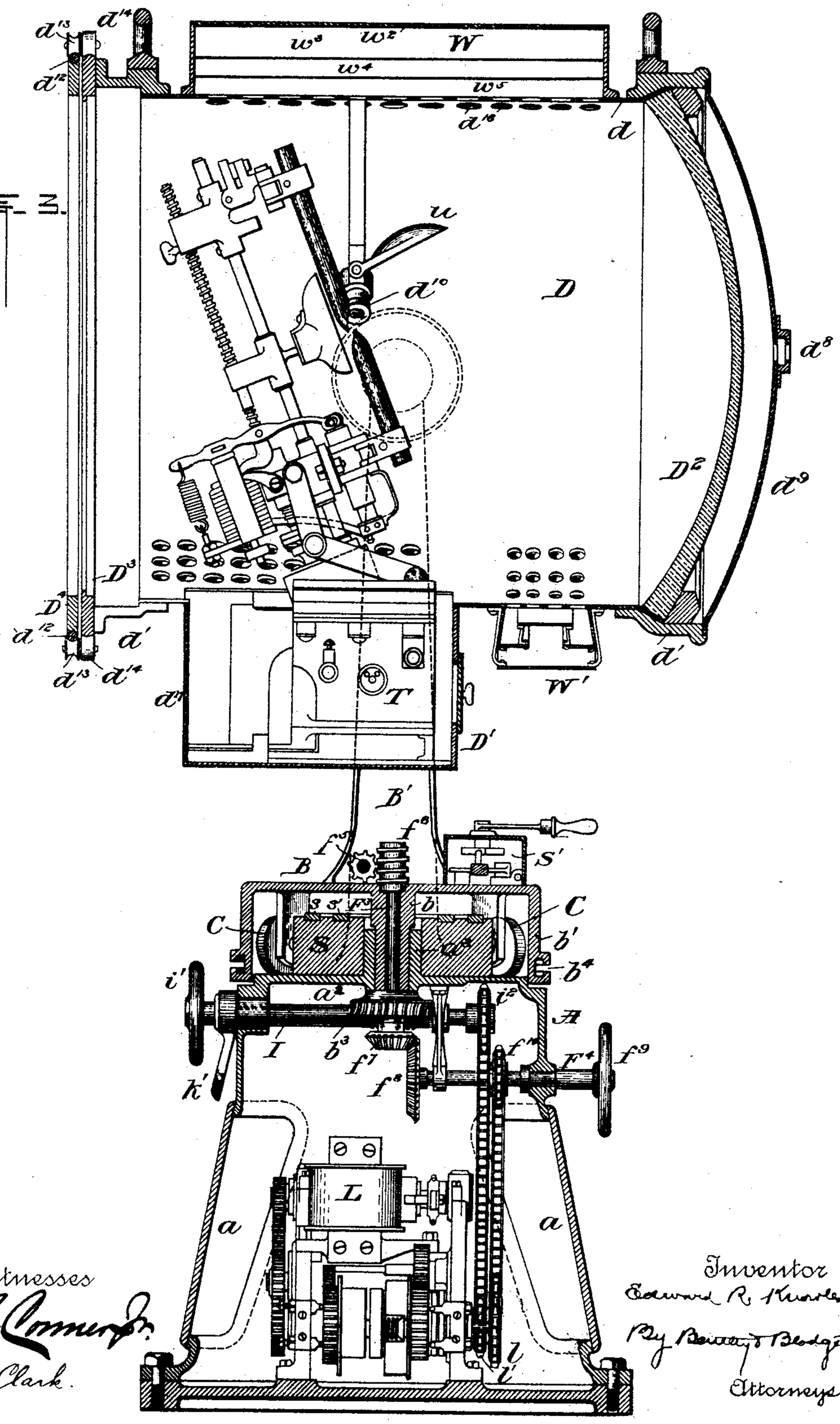
(No Model.) 5 Sheets—Sheet 3.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 516,821. Patented Mar. 20, 1894.

FIG. 3.



Witnesses
T. A. Connor Jr.
P. L. Clark.

Inventor
Edward R. Knowles
By Bowers & Bedgett
Attorneys

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.) 5 Sheets—Sheet 4.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 516,821. Patented Mar. 20, 1894.

FIG. 4.

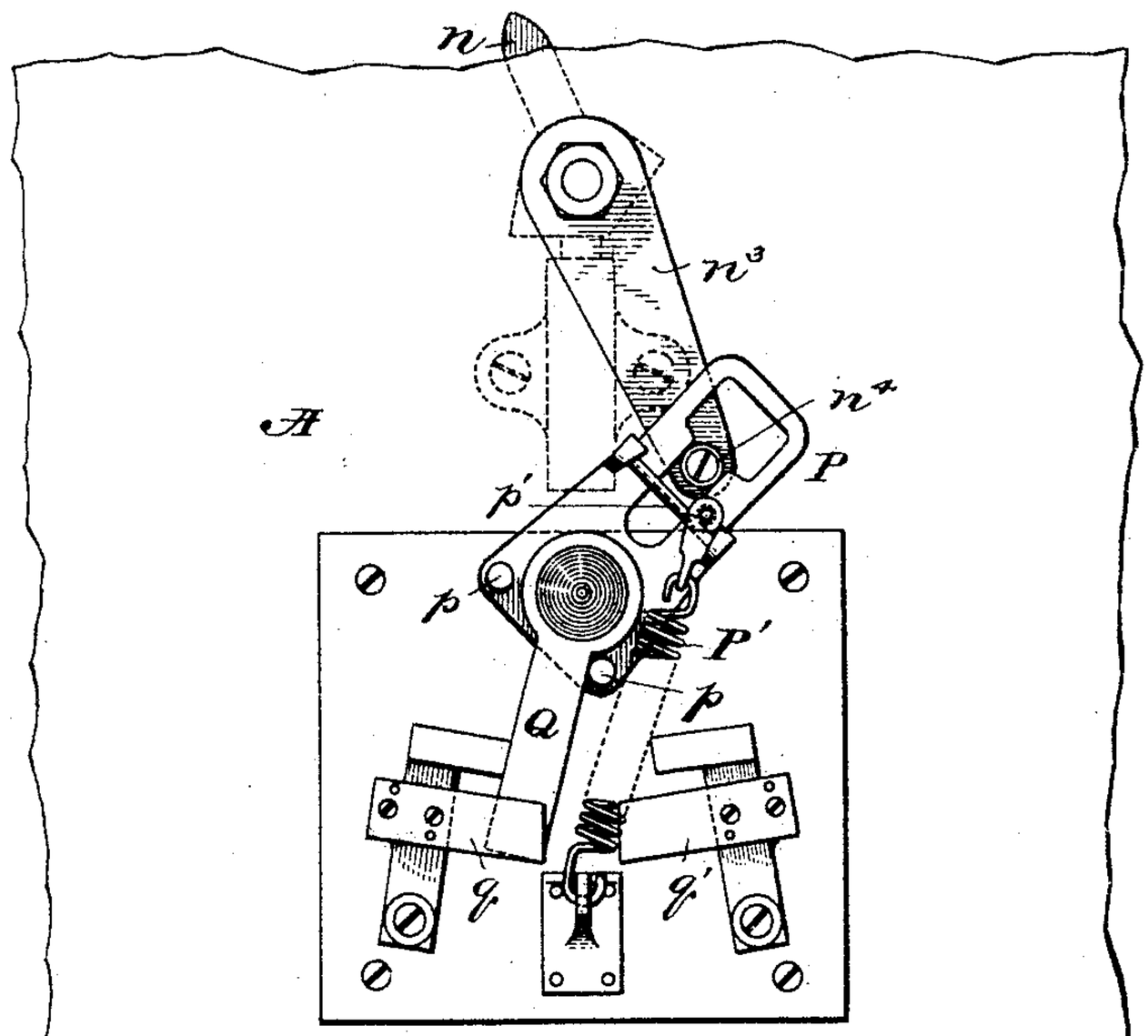


FIG. 5.

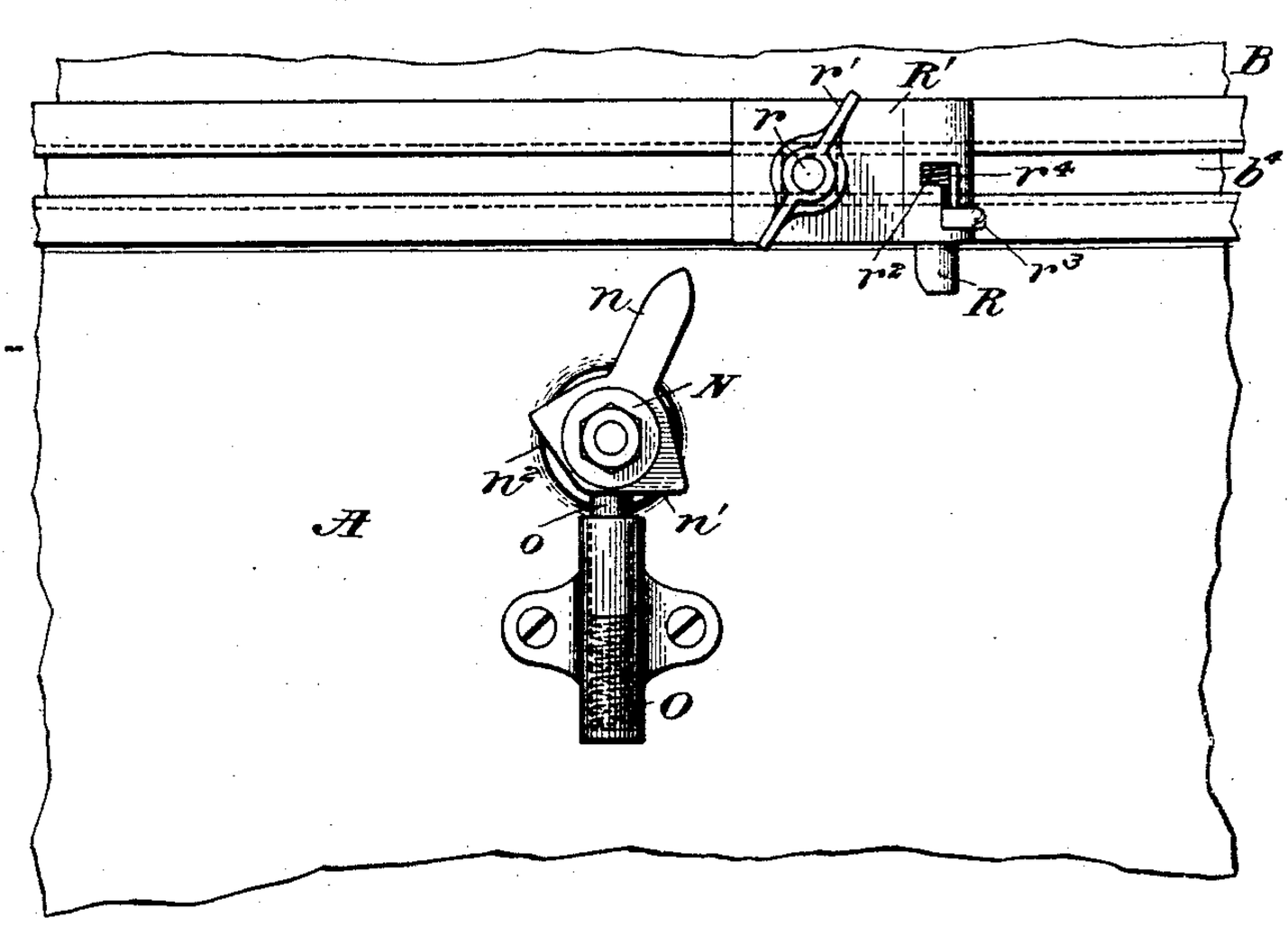
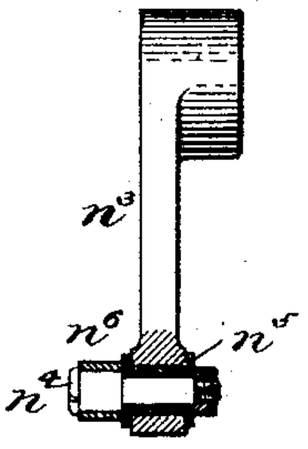


FIG. 6.



Witnesses
L. A. Commerford
P. L. Clark.

Inventor
Edward R. Knowles,
By Bartley & Bedgett
Attorneys

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

(No Model.) 5 Sheets—Sheet 5.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 516,821. Patented Mar. 20, 1894.

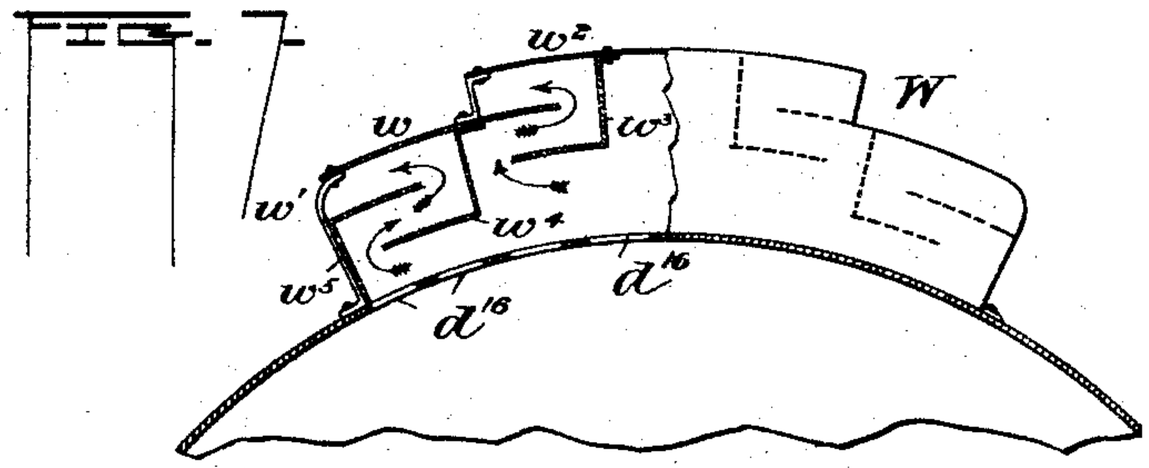


FIG. 11.

FIG. 8.

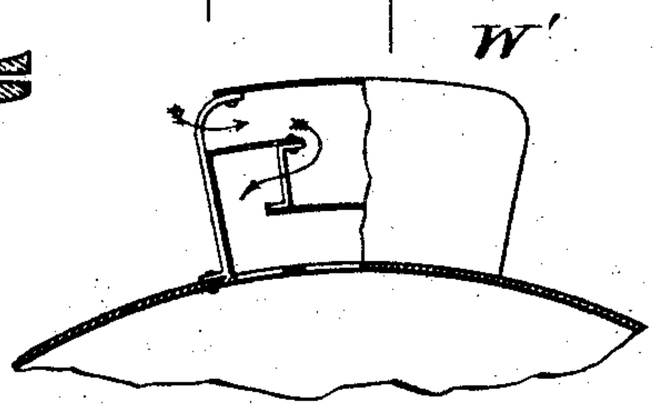


FIG. 12.

FIG. 9.

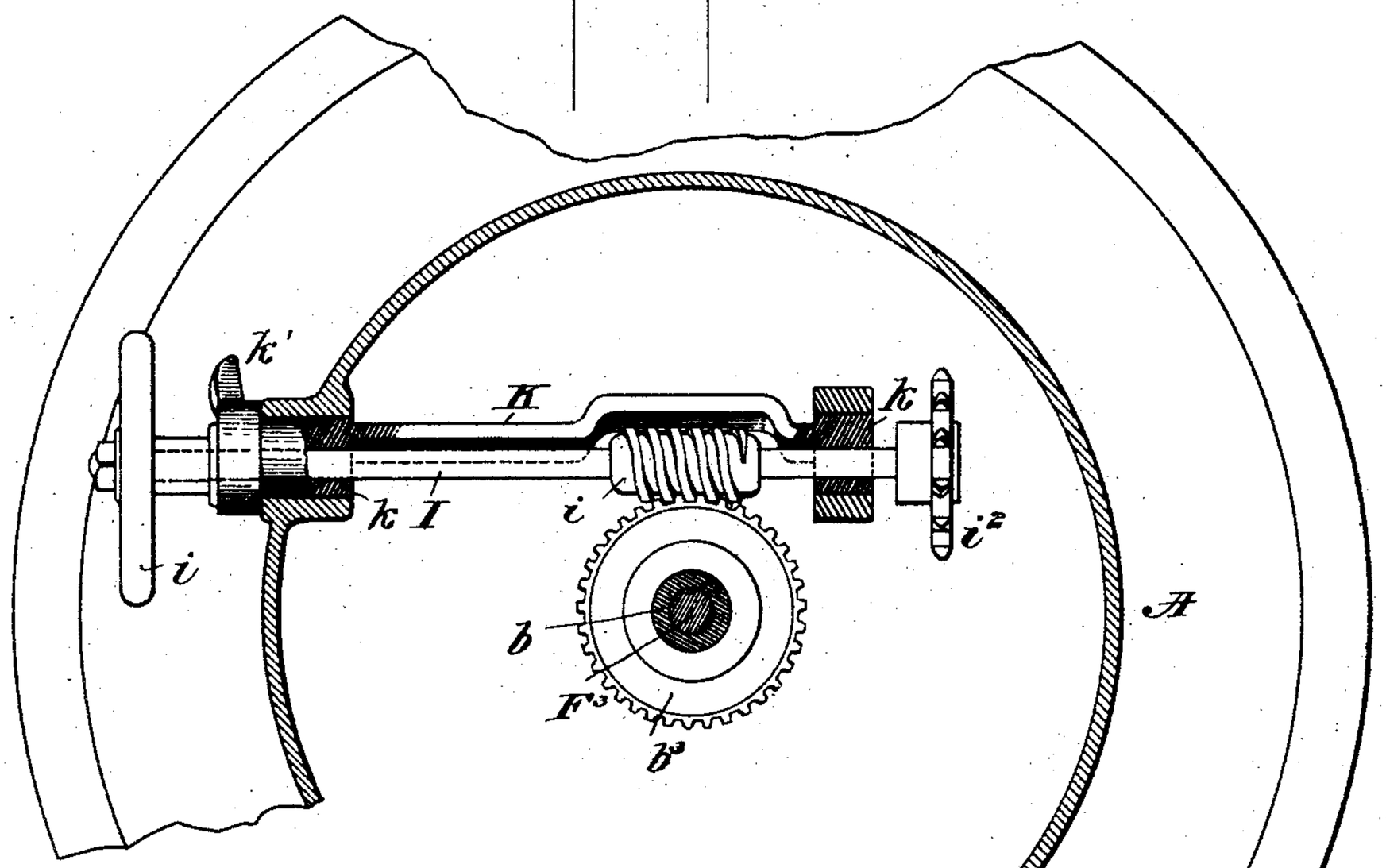
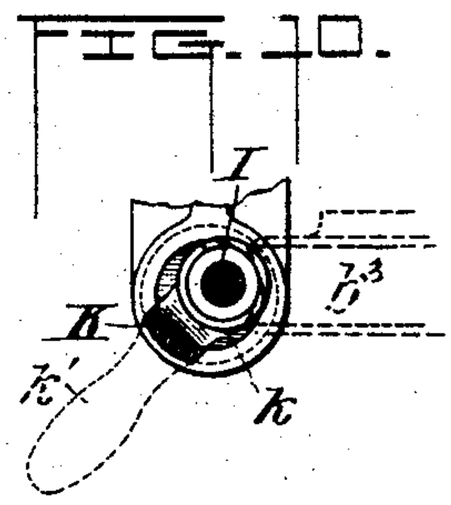


FIG. 10.



Witnesses
L. A. Commerford
P. L. Clark.

Inventor
Edward R. Knowles
By Bentley & Bridgett
Attorneys

THE NATIONAL LITHOGRAPHING COMPANY.
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EDWARD R. KNOWLES, OF MIDDLETOWN, CONNECTICUT, ASSIGNOR TO THE SCHUYLER ELECTRIC COMPANY, OF CONNECTICUT.

ELECTRIC SEARCH-LIGHT.

SPECIFICATION forming part of Letters Patent No. 516,821, dated March 20, 1894.

Application filed January 9, 1893. Serial No. 457,813. (No model.)

To all whom it may concern:

Be it known that I, EDWARD R. KNOWLES, a citizen of the United States, residing at Middletown, in the county of Middlesex and State of Connecticut, have invented certain new and useful Improvements in Electric Search-Lights, of which the following is a specification.

My invention relates to search-lights or projectors, and especially to those using an electric arc lamp and the present application is a companion to another filed by me of even date herewith, Serial No. 457,814.

The modern search-light must be entirely automatic in its operation. It must be capable of controllable operation, either from a distance, or by hand, as desired. It must throw a beam of light whose rays may be maintained substantially parallel or variably divergent, at will. The beam must be revoluble horizontally in either direction, or automatically back and forth over a specified arc of the horizon. It must also be capable of movement in a vertical plane, either when at rest or when revolving. The speed of its movement must be variable at will. The drum containing the light must be light-tight in every direction but the front, yet it must admit of perfect ventilation to prevent the heat of the lamp from injuring the reflector. There must also be means for cutting off the light at will, to produce flashes for signaling.

My invention aims to accomplish these objects, and to afford at least three separate modes of effecting the movements of the projector, viz., directly by hand, mechanically by hand, and from a distance. The general features of construction are similar to the search-light patented to Gaston Sautter, No. 454,604, but the details have been altered and improved, so that the projector is more easily handled and kept in order.

The invention consists in certain constructions, combinations and arrangements hereinafter described, and particularly pointed out in the claims.

In the drawings,—Figure 1 is a front elevation of my improved search-light. Fig. 2 is a side elevation. Fig. 3 is a vertical section. Figs. 4, 5 and 6 show the reversing switch for the automatic movement. Figs. 7 and 8 are sections of the ventilators. Figs. 9 and 10 are details of the gearing; and Figs. 11 and 12 are sections of the diverging lens.

The frame of the projector comprises a hollow stationary base or pedestal A, having doors a, secured by thumb-screws a'. The top a^2 of the pedestal is flat, and at its center is a tubular neck a^3, in which is mounted the vertical shaft or center-pin b of the turn-table B, which is circular, to register with the top of the pedestal, and has a depending flange b' fitting an annular rabbet around the edge of the top a^2. Friction wheels C are mounted in bearings on the inside of the turn-table, and rest on the top a^2. From opposite sides of the turn-table rise the curved arms B', forming the yoke in which the drum D is hung. The drum is made of sheet metal d, with annular cast metal heads, d'. Along each side of the drum is a stiff girder d^2, bolted at each end to the heads d'. At the middle of each girder is a trunnion, which is received in a bearing in one of the arms B'. The upper half of the bearing is preferably hinged to the arm B', and has on the side opposite to the hinge a pair of lugs between which is received a clamping bolt E, the lower end of which is hinged to the arm B', so that it can be turned down out of the way when loosened. Sleeved on one of the trunnions is a worm-gear-wheel F, which can be locked to the trunnion by a clutch, preferably a friction cone clutch, operated by the handle G. When this clutch is loosened, the drum is left free to be swung up and down by hand, suitable handles d^3 being secured to the rear head of the drum.

In order to move the drum in altitude mechanically, by hand, a worm f is keyed upon a vertical shaft F', and in mesh with the worm-gear F. The shaft F' is journaled in bearings in brackets b^2, bolted to the arm B', and it is made in two parts, an upper f' and a lower, f^2, the ends of which abut in the middle bracket b^2. On one part, preferably the lower, is keyed half of a clutch H, the other half of which is splined upon the upper part of the shaft, and is provided with a hand-wheel h. When this half of the clutch is disengaged from the other, by sliding it up on the shaft, the two parts of the shaft are disconnected, and the upper part with its

worm f can be rotated by the hand-wheel h, to operate the drum. The lower end of the shaft f^2 has a bevel gear f^3 meshing with a similar gear f^4 on a horizontal shaft F^2, the other end of which lies adjacent to the center of the turn-table B, and carries a pinion f^5 meshing with a worm f^6, which is keyed upon a vertical shaft F^3 journaled centrally in the tubular center-pin. The lower end of this shaft F^3 has a miter gear f^7 meshing with a similar gear f^8 on a horizontal shaft F^4, which projects through the side of the base A and carries a hand-wheel f^9. When the clutch H is closed, the drum can be swung up and down by turning the hand-wheel f^9. The lower end of the center pin b is provided with a worm-gear b^3, with which meshes a worm i on a horizontal shaft I, projecting through the side of the base A, and carrying a hand-wheel i'. By means of this wheel, the turn-table, yoke and drum can be turned horizontally. The shaft is made laterally movable by any suitable means, in order to throw the worm out of gear, when a rapid movement by hand is to be given the yoke. The arrangement shown is preferred, the shaft I being journaled eccentrically in the cylindrical hubs k of a carrier K, mounted in bearings in the base A. The outer hub has a handle k', by means of which the carrier can be partially rotated, so as to carry the shaft I and worm i away from or up to the gear b^3.

It is frequently desirable that the projector be controllable from a distant point, such as the bridge of a steamship. To this end, an electric motor L is placed within the pedestal A, and suitably geared to the shafts F^4 and I. Each shaft carries a sprocket wheel $l\,l'$, which is connected by a chain belt with a sprocket f^{10}, i^2, on the shafts F^4 and I, respectively. The clutches are electro-magnetic, and can be operated from a distance by means of an electric current conveyed through suitable conductors. The projector can thus be caused to move in azimuth or altitude by closing the circuit through the proper clutch. The several conductors are formed into a cable M, which is led into a cable-box a^5 on the pedestal, where the conductors are connected with the terminals of the wires running to the motor brushes and the clutches.

In searching for an object within certain limits, or in illuminating a considerable area, it is necessary to move the beam of light back and forth horizontally through a greater or less arc. In order to accomplish this automatically, a reversing switch is inserted in the motor circuit, and arranged to be operated by tappets on the movable part of the projector. These tappets are preferably adjustable in position, and may be conveniently mounted on the turn-table B. The reversing switch may be of any suitable construction, but it is preferred to use the one shown in Figs. 4, 5 and 6. Through the side of the pedestal A projects a short shaft N, carrying on the outer end an upright arm n, the hub of which has two flat faces n', n^2 arranged at an obtuse angle. Attached to the pedestal A is a casing O in which is a spring plunger o, with its axis in the same plane as the axis of the shaft N. When the arm n stands in one position, the end of the plunger engages the face n', and holds the shaft from accidental rotation. Sufficient force applied to the arm will turn the shaft, and the plunger will then engage with the other face n^2 and hold the shaft in that position. The shaft will be always in one or the other position. The inner end of the shaft carries a crank n^3 provided with a wrist-pin n^4, which in insulated by a bushing n^5 of fiber, or the like. The wrist-pin has preferably an anti-friction roller n^6, riding in a radial slot in the rock-arm P, which is provided with two pins p between which is hung on the same stud as the rock-arm a switch Q. On the rock-arm is a transverse bar p' on which slides a shackle attached to a spring P', the lower end of which is fastened to the pedestal in the plane passing through the axis of rotation of the rock-arm and midway between the switch terminals q, q'. The instant the rock-arm passes this plane in either direction, the shackle slides to the forward end of the bar, and the spring gives the arm a sudden pull, which causes the pin p or p' to strike the switch Q and throw it instantly across against the opposite terminal; said terminals being preferably elastic blades between which the switch enters. This constitutes a good form of snap switch, and prevents injurious arcing.

To actuate the arm n, and reverse the switch, the turn-table is provided with adjustable tappets. These may be made solid blocks, as shown in Figs. 1 and 2, but it is preferred to use pins R projecting downwardly from said blocks R', which are adjustably secured to the turn-table B by means of T-headed bolts r and thumb-nuts r'; the heads of the bolts sliding in the under-cut groove b^4 formed in the flange b'. The pins R are normally held down by springs r^2, but they can be lifted and held out of operative position, when desired, by means of the handles r^3, and the inverted L-shaped slots r^4. One side of each pin is beveled, so as to ride over the arm n when approaching it in one direction. The other side of the pin is vertical, to engage with and throw over the arm n, when approaching it in the other direction. By setting the pins R and closing the circuit through the switch, the projector will automatically vibrate to and fro horizontally through the arc of a circle inclosed by the pins. This arc may be made as large or as small as may be desired. The supply mains for the lamp are brought in through the cable M' and cable-box a^4, and are connected thereby with the annular terminals s, s' on the insulating block S mounted on the top a^2 around the neck a^3. The turn-table carries spring contact pins, shown in dotted lines in Fig. 1, which press upon the rings s,

s', and take off the current through the conductors s^2 to the double pole switch S', inclosed in a water-tight box, and operated by a handle on the outside thereof. From the switch the current is carried by the flexible conductors s^3 to the contact strips s^4 on the inside of the drum, with which the lamp T makes connection when it is slid into the drum. The base of the lamp is received in a box D' depending from the drum, and open at the top. Its front end is closed by a door d^{17}. The lamp can be longitudinally adjusted in the box by means of a screw d^4, operated by a hand-wheel d^5, or by a pair of miter gears d^6 and a hand-wheel d^7.

The lamp is of any suitable pattern, and need not be described. It is, of course, a focusing lamp, and the arc is arranged to be in the axis of the drum, and at the focus of the concave reflector D^2, which is preferably an aplanatic mirror of the Mangin type. The arc can be observed through a peep-hole d^8 in the center of the rear end d^9 of the drum, the silvering of the mirror being removed at its center, and through an adjustable tube d^{10} inserted in the side of the drum, and having a mirror set at forty-five degrees in a case d^{11} on the outside of the drum, to enable the operator to see the arc from the rear of the projector. Journaled in suitable bearings inside of the drum is a rock-shaft U carrying a shield u, which by means of an outside handle u' can be turned down between the arc and the reflector to cut off the light and enable it to be flashed for signaling. The front of the drum is closed by a glass door hinged to the annular head d'. The glass may be plain, but it is preferred to so construct the door that the rays of light can be spread apart at will to a greater or less extent, in order to illuminate a larger area near at hand. To this end, the door is made in two parts, one in front of the other, and each composed of an annular metal frame D^3, D^4 holding a series of narrow vertical strips of glass placed edge to edge. The strips are alternately plano-convex and plano-concave, the plane faces being all on the outside of the inner part and on the inside of the outer part. The frame D^3 is hinged to the front annular head d' of the drum, and the frame D^4 is supported on the frame D^3 by means of the upper and lower parallel rails d^{12} attached to the frame D^4 and held in the grooved wheels d^{13} mounted on ears d^{14} projecting from the upper and lower edges of the hinged frame D^3. This construction renders the outer frame D^4 movable laterally with reference to the hinged frame. When the plano-concave strips of glass in the sliding frame are made to coincide with the plano-convex strips in the fixed door, as shown in Fig. 11, the two sets of strips or lenses act substantially like a plane glass, and the divergence of the rays is at a minimum; but if the frame D^4 is moved so as to bring its plano concave strips opposite to the plano-concave strips in the fixed door, as shown in Fig. 12, the divergence is at a maximum; and it can be varied between these limits by changing the position of the sliding door.

To give the operator control of the lens from the rear of the drum, a shaft V is mounted in bearings v on the side of the drum, having a hand-wheel v' at its rear end, and at its front end a crank disk carrying a crank-pin v^2, which engages with a vertical slot d^{15} in an ear on the frame D^4. The rotation of the shaft causes the crank-pin to shift the position of the sliding frame, the throw of the pin being equal to the width of one of the glass strips.

The drum must be amply ventilated to prevent the intense heat of the electric arc from cracking the costly reflector. Ventilators are accordingly provided along the top and bottom of the drum and across the rear end of its bottom. These are composed of rows of holes in the drum, covered by sheet metal plates arranged to permit a free ingress and egress of air while effectually screening the light. The outlet ventilator W along the top of the drum comprises two plates w supported on irons w' a suitable distance above the holes d^{16} and separated by a short space, which is covered by an overlapping top plate w^2 similarly supported on the plates w. From the top plate depend two L-shaped plates w^3, underlapping the inner edges of the plates w. A similar plate w^4 depends from each plate w, and secured to the irons w' is an inverted L-shaped plate w^5, whose horizontal member projects into the space between the plates w, w^4. The course of the heated air is shown by the arrows.

The construction of the inlet ventilators W' is clearly shown in Fig. 8, and will be readily understood from the description of the outlet ventilators.

In one or both sides of the drum is a slide X, for giving access to the lamp.

Having thus described my invention, what I claim is—

1. A search light having movement both in altitude and azimuth, and provided with three independent means for operating it, to-wit, handles for moving it quickly by hand, gearing for operating it slowly by hand, and an electric motor for driving said gearing by power and means for disconnecting the movable parts of the search light from said operating gearing substantially as shown and described.

2. A search-light having a revoluble yoke, a drum hung on trunnions in said yoke, a worm gear loosely sleeved on one of said trunnions, a clutch for connecting the gear with the trunnion, and a worm shaft for operating the gear, substantially as described.

3. A search-light having a revoluble yoke, a drum hung therein on trunnions, a worm gear on one of said trunnions, a worm shaft engaging with said gear, said shaft being made in

two abutting parts, and a clutch for connecting the two parts of the shaft, substantially as described.

4. A search-light having a pedestal provided with a flat top and a central neck, a yoke having a tubular center pin received in said neck, a vertical worm-shaft journaled in said center pin, a horizontal shaft geared to said worm-shaft, an upright shaft driven by said horizontal shaft, a drum mounted in said yoke, and worm gearing connecting said upright shaft with said drum, substantially as described.

5. A search-light having a pedestal provided with a flat top and a central neck, a yoke having a tubular center pin received in said neck, a vertical shaft journaled in said center pin, a drum mounted in the yoke, gearing connecting the drum with the shaft, and a horizontal shaft journaled in bearings in the pedestal, having at one end a miter gear meshing with a similar gear on the worm-shaft, and provided with a hand-wheel outside of the pedestal, substantially as described.

6. A search-light having a pedestal, a turn-table supported thereon, and having a center pin depending into the pedestal and carrying a worm gear, a horizontal shaft carrying a worm adapted to mesh with said gear, and means for moving said shaft up to and away from said gear, to engage and disengage said worm and gear, substantially as described.

7. The combination with the pedestal, of a turn-table mounted thereon and having a depending center pin carrying a worm gear, a horizontal shaft having a worm, and a carrier for said shaft mounted in bearings in said pedestal, and movable to and away from said worm gear, substantially as described.

8. The combination with the pedestal of a turn-table mounted thereon and having a depending center pin carrying a worm gear, a carrier having hubs turning in bearings in said pedestal, a shaft eccentrically journaled in said hubs, and a worm mounted on said shaft adjacent to the gear, substantially as described.

9. In a search light having a motor to effect its movement in azimuth, means for automatically reversing the direction of rotation of said motor when the light reaches either end of a predetermined arc of vibration, substantially as described.

10. In a search light having a motor to effect its movement in azimuth, a device operated by the moving part of the search light for automatically reversing the direction of rotation of said motor when the light reaches each end of a predetermined arc of vibration, substantially as described.

11. In a search-light having an electric motor to effect its movement in azimuth, a reversing switch for such motor mounted on a stationary part of the projector, and tappets carried by the movable part to operate said switch, substantially as described.

12. In a search-light, the combination with the pedestal, of a turn-table mounted thereon, a motor for driving said turn-table, a reversing switch attached to the pedestal, and tappets on the turn-table to actuate said switch, substantially as described.

13. In a search-light, the combination with the pedestal, of a turn-table mounted thereon, a motor for driving said turn-table, a reversing switch having an arm adjacent to said turn-table, and adjustable tappets on the turn-table to engage with said arm, substantially as described.

14. In a search-light, the combination with a pedestal, of a turn-table mounted thereon, and having a circumferential undercut groove, tappets having T-headed clamping bolts sliding in said groove, a reversing switch having an arm lying in the path of said tappets, and a motor controlled by said switch and operating to drive said table, substantially as described.

15. In a search-light, the combination with the turn-table, of the tappet blocks carrying spring-actuated pins, and a reversing switch adapted to be operated by said pins, substantially as described.

16. In a search-light, the combination with the pedestal of a shaft projecting through its side, an upright arm on said shaft having two adjacent flat faces, a spring plunger attached to the pedestal and adapted to engage with either of said faces, and a reversing switch operated by the movement of said arm, substantially as described.

17. In a search-light, the combination with two terminals, of a switch arm pivoted on a stud and adapted to contact with either terminal, a rock-arm pivoted on the same stud having a radial slot, and carrying two pins adapted to strike and actuate the switch-arm, a spring arranged to pull the rock-arm in either direction off its center position, and a crank-shaft having a wrist pin engaging with the slot in the rock-arm, substantially as described.

18. A diverging lens for a search-light, comprising two frames, each holding a set of alternating plano-convex and plano-concave strips of glass, substantially as described.

19. A diverging lens for a search-light, comprising two frames, each holding a set of alternating plano-convex and plano-concave strips of glass, the plane sides being all on the same side in each frame, and those sides of the frames being adjacent, substantially as described.

20. A diverging lens for a search-light, comprising two frames, each holding a set of vertical lenses, one frame being movable horizontally with reference to the other, and in the plane of the frame substantially as described.

21. A diverging lens for a search-light, comprising two frames, each holding a set of vertical lenses, and means for moving one frame

laterally with reference to the other, and in the plane of the frame substantially as described.

22. The combination with the drum of a search-light, of a frame secured to one end thereof and holding a set of vertical lenses, and a similar frame supported in front of the other frame, and free to move laterally, and in the plane of the frame substantially as described.

23. In a search-light, the combination with a frame secured to the drum, and having ears on its upper and lower edges provided with anti-friction wheels, of a second frame having parallel rails sliding on said wheels, said frame being adapted to receive lenses substantially as described.

24. In a search-light, the combination with the drum, of a laterally movable diverging lens, and a shaft provided with a crank pin engaging with said lens for operating it, substantially as described.

25. In a search-light, the combination with the drum, of a diverging lens, composed of a fixed and a laterally movable part, and means for moving said latter part, in its own plane substantially as described.

26. In a search-light, the combination with the drum, of a diverging lens having a laterally movable part, provided with a vertical slot, a shaft mounted in bearings on the drum, and a crank-pin on the front end of the shaft, engaging with said slot, substantially as described.

27. A drum for a search-light having in its side an adjustable observing tube provided with a mirror at its outer end set at an angle, substantially as described.

28. In a search light, the combination with a drum having openings, of a top plate lying above said openings, irons for supporting said top-plate, an L-shaped plate depending from the top plate, and an inverted L-shaped plate rising from the drum and interposing between the top plate and the depending L-shaped plate, substantially as described.

In testimony whereof I have hereunto affixed my signature in presence of two witnesses.

EDWARD R. KNOWLES.

Witnesses:
MAX LOEWENTHAL,
J. A. KENISTON.