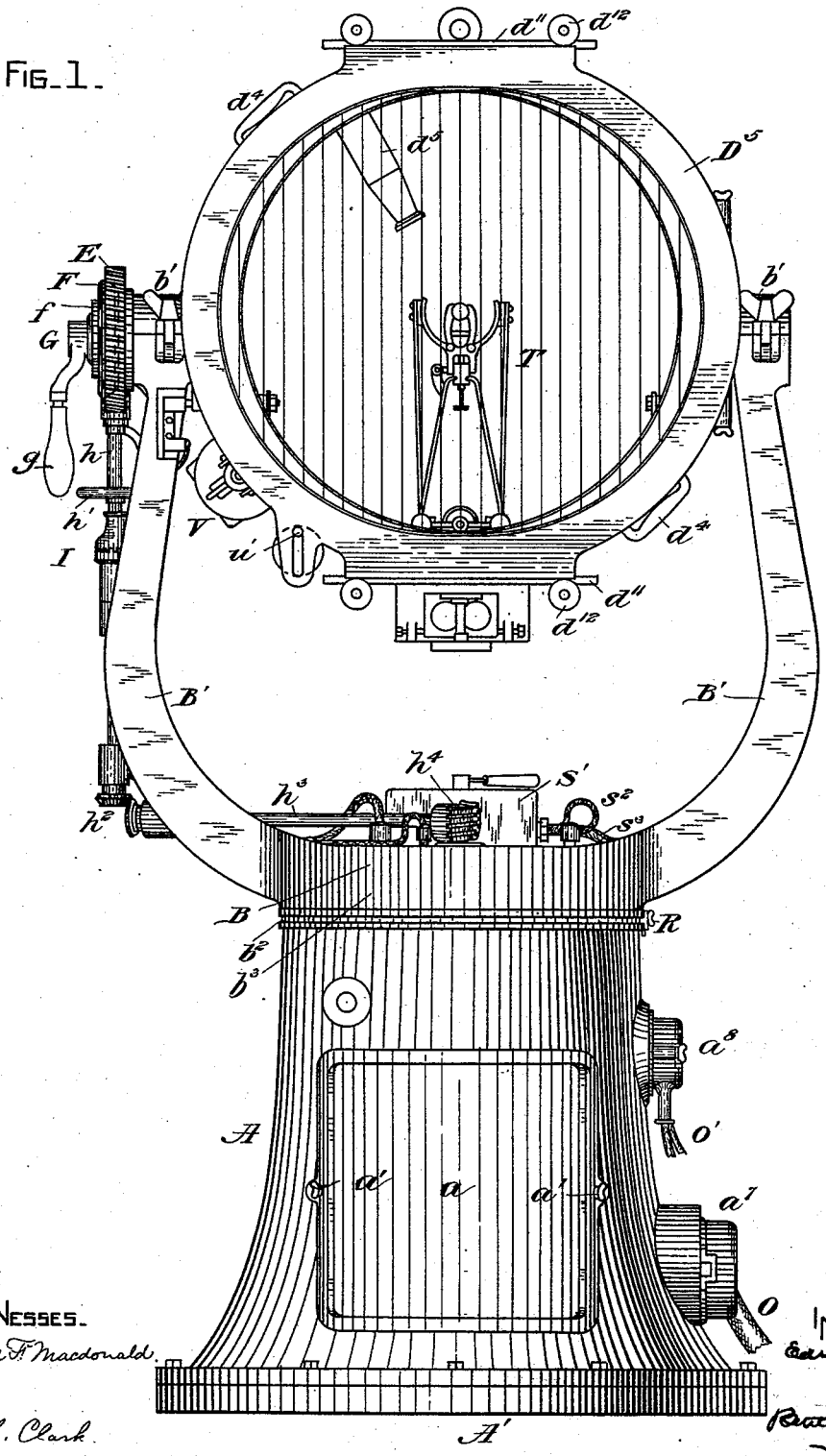
(No Model.) 5 Sheets—Sheet 1.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 524,388. Patented Aug. 14, 1894.

FIG. 1.



WITNESSES.
Alec F. Macdonald.
P. L. Clark.

INVENTOR.
Edward R. Knowles,
by Bradley & Goodridge,
Attys.

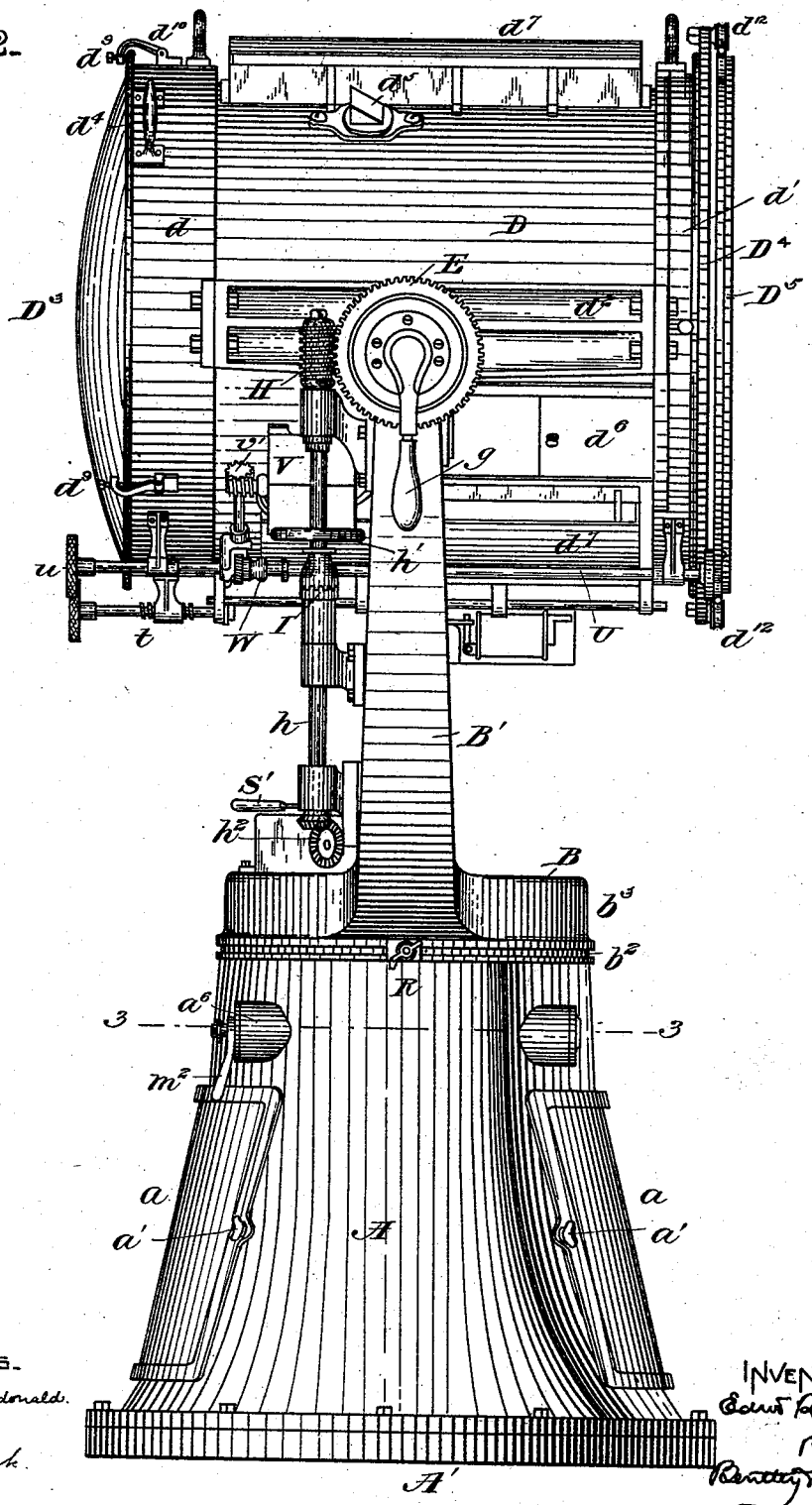
(No Model.) 5 Sheets—Sheet 2.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 524,388. Patented Aug. 14, 1894.

FIG. 2.



WITNESSES.
Alex F. Macdonald.
P. L. Clark.

INVENTOR.
Edwin R. Knowles,
By Bakewell & Bledgett,
Attys.

(No Model.) 5 Sheets—Sheet 3.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 524,388. Patented Aug. 14, 1894.

FIG. 3.

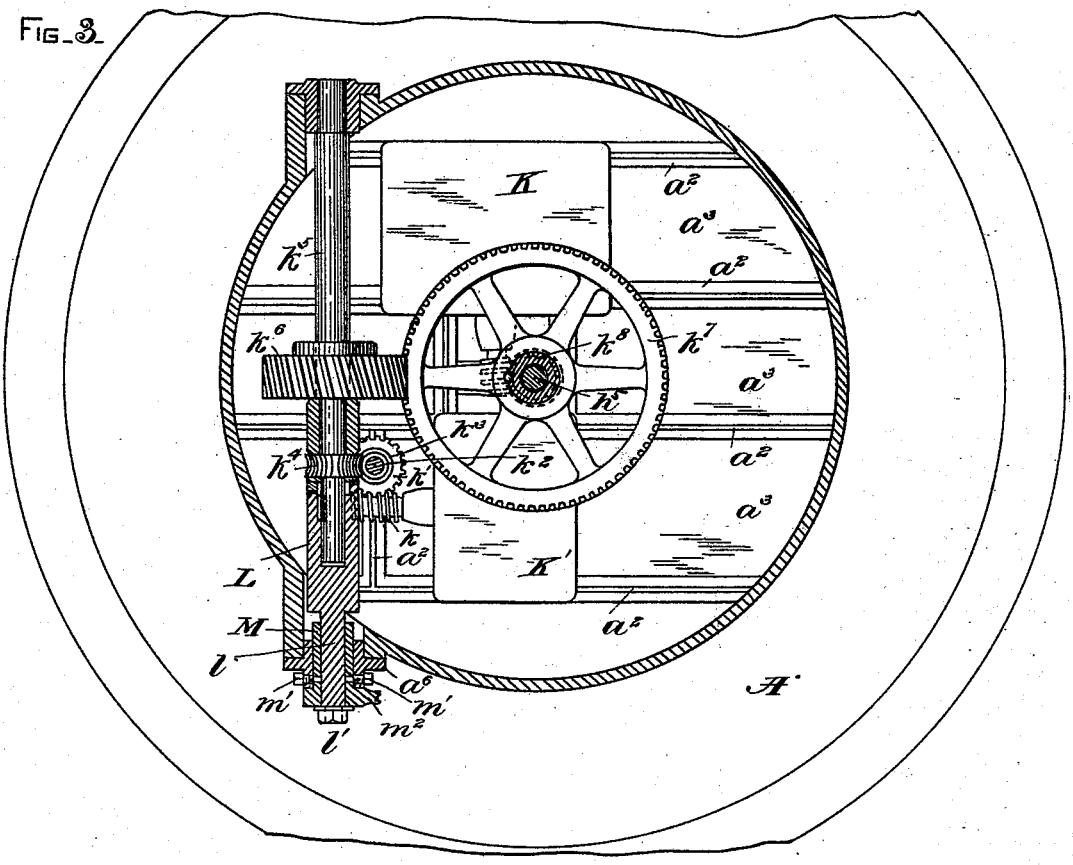


FIG. 4.

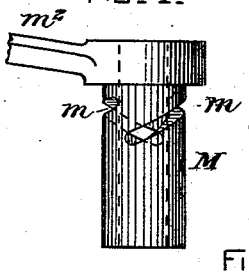
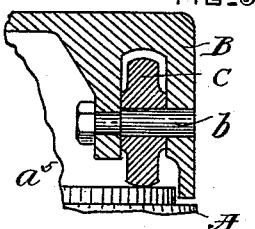


FIG. 5.



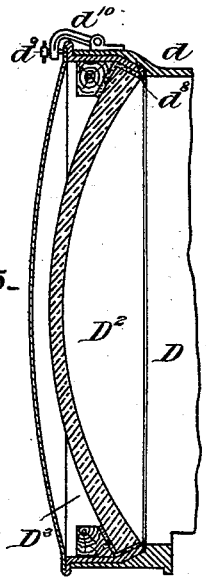


FIG. 6.

FIG. 7.

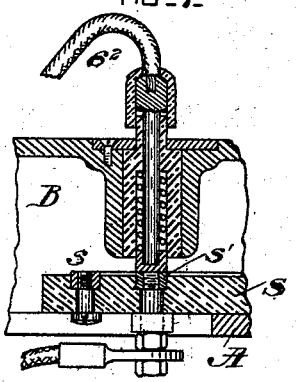
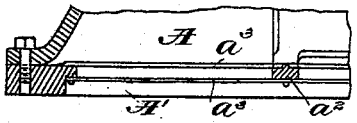


FIG. 8.

FIG. 9.



WITNESSES.

Alec F. Macdonald.

P. L. Clark.

INVENTOR.

Edward R. Knowles

By Bennett & Bladgett

Attys.

(No Model.) 5 Sheets—Sheet 4.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 524,388. Patented Aug. 14, 1894.

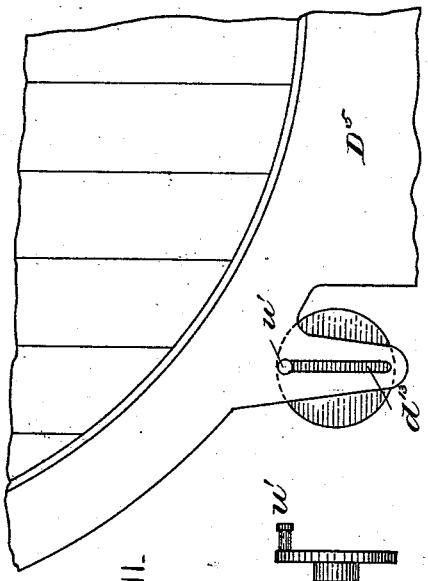


Fig. 11.

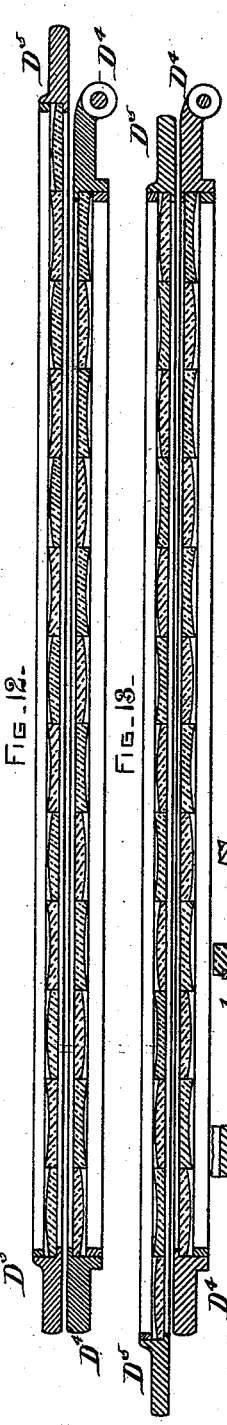


Fig. 12.

Fig. 13.

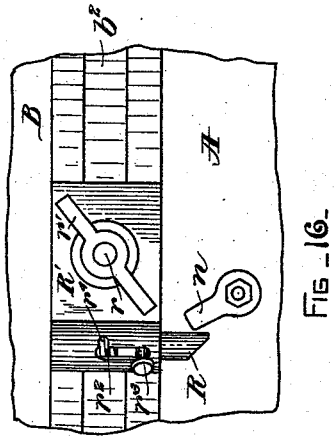


Fig. 16.

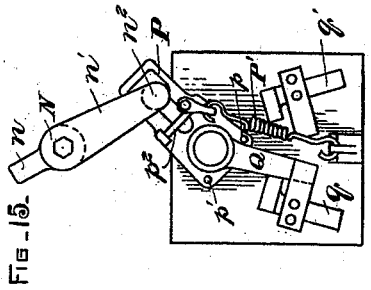


Fig. 15.

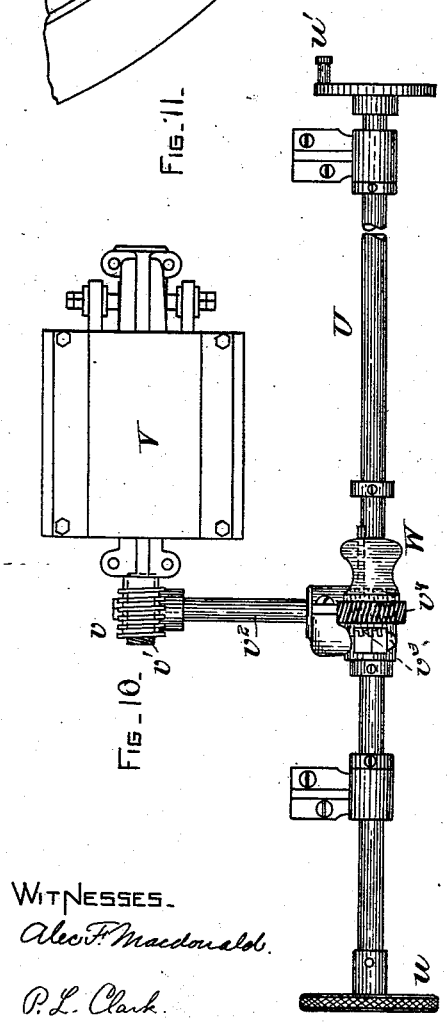


Fig. 10.

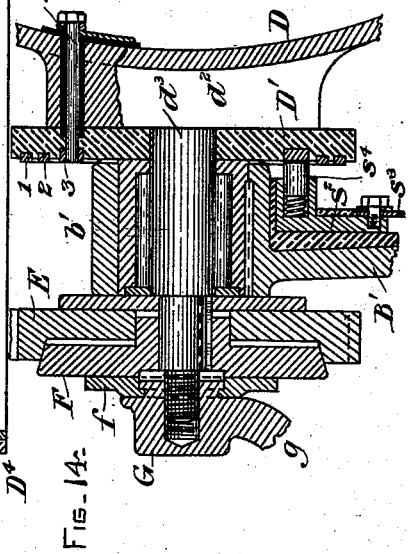


Fig. 14.

WITNESSES.

Alec. F. Macdonald.

P. L. Clark.

INVENTOR.

Edward R. Knowles

By Baxter & Bridgett

Atty.

(No Model.) 5 Sheets—Sheet 5.

E. R. KNOWLES.

ELECTRIC SEARCH LIGHT.

No. 524,388. Patented Aug. 14, 1894.

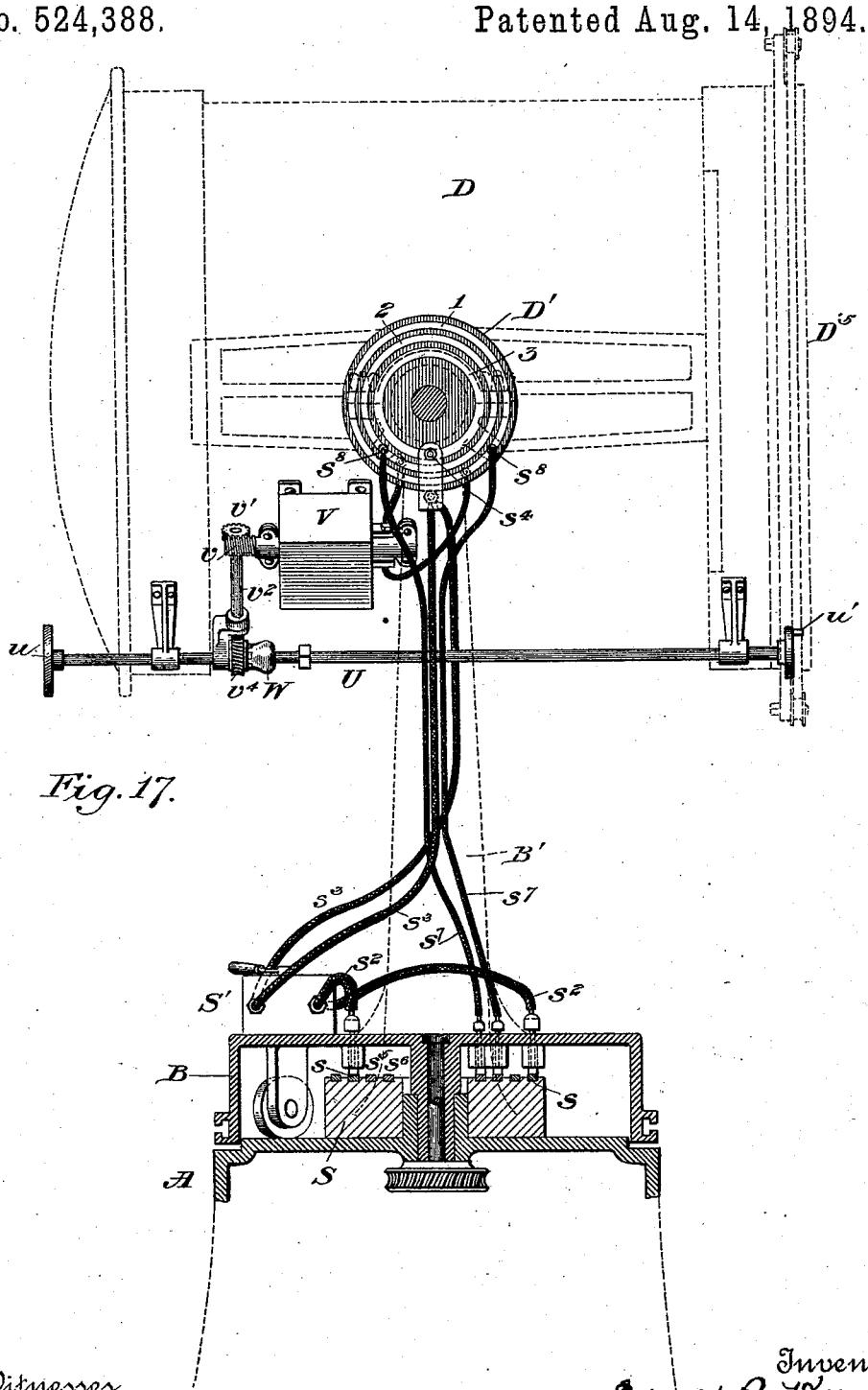


Fig. 17.

Witnesses
T. A. Connors
Gales P. Moore.

Inventor
Edward R. Knowles,
By Geo. P. Whittemore
Attorney

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. 524,388, dated August 14, 1894.

Application filed January 9, 1893. Serial No. 457,814. (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.

My invention is an improvement on the search-light shown and described in my Patent No. 516,821, and it consists in rendering the mirror or reflector readily removable from the drum, in providing an electric motor to operate the diverging lens, and in certain details of the gearing, pedestal doors, and electric contact devices, as hereinafter described and particularly set forth in the claims.

In the drawings,—Figure 1 is a front elevation of a search-light embodying my improvements. Fig. 2 is a side elevation. Fig. 3 is a horizontal section on line 3—3, Fig. 2. Fig. 4 is a detail of the traversing hub of the clutch shown in Fig. 3. Fig. 5 shows one of the friction wheels supporting the turn-table. Fig. 6 is a section of the mirror and its removable holder. Fig. 7 is a section of a traveling contact on the turn-table. Fig. 8 is a section of a pedestal door. Fig. 9 is a section of a portion of the base of the pedestal. Fig. 10 shows the motor and crank-shaft for operating the diverging lens. Fig. 11 shows a portion of said lens where the crank-shaft is connected with it. Figs. 12 and 13 are sections of the diverging lens. Fig. 14 is a section of one of the bearings for the drum. Figs. 15 and 16 illustrate the automatic reversing switch. Fig. 17 illustrates the arrangement of conductors for conveying current to the lamp and the lens motor.

The frame of the projector comprises a hollow stationary base or pedestal A, having doors a secured by thumb-screws a'. For the sake of lightness, each door is composed of a rigid frame having a panel of sheet metal, as shown in Fig. 8. To this end, also, the bottom A′ of the pedestal is made up of bars a^2 to support the motors, the spaces between the bars being filled with plates of sheet metal a^3. A rubber gasket a^4 is placed between each door and the pedestal, to render the door water-tight.

On top of the pedestal is mounted the turn-table B, supported on wheels C, which are journaled on pins b, and run on an annular track a^5 on the pedestal. 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 with annular cast metal heads d, d', to which are bolted the rigid girders d^2, extending along each side of the drum. At the middle of each girder is a trunnion d^3, which is journaled in a roller bearing b' at the upper end of one of the arms B′. One trunnion projects beyond the bearing to receive a worm gear E, loosely sleeved thereon, but provided with a clutch to lock it thereto. This may be a conical disk F splined to the trunnion and entering a conical recess in the outer face of the gear E. A nut G provided with a handle g and meshing with a screw-thread on the end of the trunnion serves to clamp the disk to the gear. The nut is preferably secured to the disk by a washer f fastened to the disk and engaging with a groove around the nut. When the clutch is loosened, the drum is free to be moved vertically by means of the handles d^4. When the clutch is tightened, the drum can be moved by the worm H keyed on the shaft h and provided with a hand-wheel h', the hub of which is splined upon the shaft so as to be axially movable thereon. The shaft is made in two parts, and the upper end of the lower part carries one part of a clutch I, the hub of the hand-wheel h' forming the other half of the clutch. When closed, as shown in Figs. 1 and 2, the clutch connects the upper and lower parts of the shaft h. The lower end of the shaft is geared by bevel gears h^2 with a shaft h^3, the end of which lies adjacent to the center of the turn-table B, and is coupled by a worm gear and worm h^4 with a vertical shaft h^5 passing centrally down through the turn-table into the pedestal A, and suitably geared to an electric motor K. This is a high speed motor, capable of instant reversal when necessary. It is preferably such a motor as I have shown and described in my application, Serial No. 457,816. It

rests upon the bottom bars a^2 of the pedestal. By means of this motor the drum can be turned in either direction in a vertical plane.

To rotate the turn-table horizontally by power, a separate motor K′ is provided, in the pedestal A, connected by suitable gearing, such as the worm k, worm gear k', shaft k^2, worm k^3 and worm gear k^4, with a horizontal shaft k^5, journaled in bearings in the walls of the pedestal, and connected by the spiral gears k^6, k^7, with a sleeve k^8 encircling the shaft h^5, and rigidly attached to the turn-table B. To disconnect the horizontal shaft k^5 from the motor, the worm gear k^4 is loosely sleeved on said shaft, and provided with clutch teeth which engage with similar teeth on a sleeve L splined on the shaft k^5. The axial movement of the sleeve L may be effected in any suitable manner, but it is preferred to use a sleeve M mounted on an extension l of the clutch L, and journaled in a bearing a^6 in the pedestal. In the sleeve M are cut one or more spiral slots m with which engages a stud m' projecting from the bearing a^6. The sleeve M abuts at its inner end against a shoulder on the extension l and at its outer end against a washer and nut l' on the end of said extension. When the sleeve M is rotated by the handle m^2, it rides in and out through its bearing on the studs m' and carries with it the sleeve L, thereby closing or opening the clutch. When the clutch is open, the yoke can be rotated by hand.

To effect an automatic vibration of the light through a greater or less horizontal arc, a reversing switch is inserted in the circuit of the motor K′, and the turn-table is provided with adjustable tappets for operating said switch, which may be of any suitable construction. It is preferred, however, to use the construction shown in Figs. 15 and 16. Journaled in the pedestal is a short rock-shaft N carrying on one end outside the pedestal an upright arm n, which lies in the path of the tappets on the turn-table. The inner end of the shaft carries a crank n' provided with a wrist pin n^2, riding in a radial slot in the rock-arm P, which is provided with two pins p, 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^2 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. There 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 undercut groove b^2 formed in the flange b^3. 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 motors are formed into a cable O, which is brought into the pedestal through a cable-box a^7. The lamp mains O′ are connected with the cable-box a^8, from which conductors lead to the annular terminals s, s' on the insulating block S mounted on the top of the pedestal. The turn-table carries spring contact pins, shown in section in Fig. 7, 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 spring contact pins s^4 sliding in socket pieces S^2 insulated from the arms B′, and adjacent to the bearings of the drum trunnions. The block S also carries two annular contact rings s^5 s^6, from which current is taken by contact pins and conveyed by two conductors s^7 to suitable pins s^8 supported on the yoke similar to the pin s^4. Concentric with each trunnion is a face-plate D′ of insulating material, to one of which are secured annular contact rings 1, 2, 3, the first two being the terminals of the lens motor circuit, and the third being connected by an insulated rod 4 with one of the lamp terminals inside the drum. The other face-plate has a single annular contact ring similarly connected with the other lamp terminal. The contact pins in the yokes bear against these rings, and thus maintain an unbroken connection with the lamp and the lens motor whatever the inclination of the drum.

The lamp T is of any suitable focusing type, and is longitudinally adjustable in the drum by means of the screw t. The arc can be inspected through a radial tube d^5 in the side of the drum, the outer end of the tube having a prism to reflect the image of the arc in a line parallel with a tangent to the drum, the tube being rotatable on its axis. In the side

of the drum is a slide d^6, to give access to the lamp; and the drum is provided at top and bottom with light-tight ventilators d^7.

The mirror reflector D^2 is rendered removable or detachable from the drum, in any suitable manner; preferably by being mounted in a cap D^3 which slides into the rear head d. The inner end of the cap is contracted to fit against a beveled shoulder d^8 on the head. Clamping screws d^9 are mounted in hooks d^{10} hinged to the head d, and when the screws are loosened the hooks can be turned back out of the way to permit the cap and the mirror to be readily pulled out.

The mirror D^2 is held at its periphery only, an air space being left between it and the outer shell of the cap, to protect it from external blows, and from exposure to atmospheric changes, at its rear side.

The front of the drum is provided with a diverging lens, to spread the rays when illuminating an area close at hand. The lens is made up of two doors D^4, D^5, one in front of the other, each composed of a metal frame, preferably annular, holding a series of narrow vertical glass lenses, placed edge to edge. The lenses are alternately plano-convex and plano-concave, the plane faces being all on the same side and the plane sides of the two doors being adjacent. The door D^4 is hinged to the front head d' of the drum, and the door D^5 is supported on the door D^4 in such a manner as to be laterally movable thereon; as by means of upper and lower parallel rails d^{11} attached to the door D^5 and running on grooved rollers d^{12} mounted on the door D^4. When the lenses occupy the position shown in the horizontal section, Fig. 12, the divergence of the rays is at the maximum. When in the other position, Fig. 13, the divergence is at a minimum; and it can be varied to any degree between these limits.

For the purpose of readily shifting the movable door, a shaft U is mounted in bearings on the side of the drum, having a hand-wheel u at its rear end, and at its front end a crank-pin u' engaging with a vertical slot d^{13} in an ear on the frame of the door D^5. The throw of the crank is equal to the width of one of the lenses.

In order to operate the lens from a distant point by means of electricity, an electric motor V is attached to the drum, in circuit with the contact rings 1, 2. By means of suitable gearing v, v', shaft v^2 and worm v^3, the motor drives a gear-wheel v^4 splined on the shaft U. A knob W enables the gear to be slid along the shaft to engage with the worm v^3 when the motor is to be used to drive the shaft; or to be disengaged from the worm when the shaft is to be turned by hand.

The movements of the projector in altitude and azimuth, the automatic vibration in azimuth, the adjustment of the diverging lens, and the operation of the lamp are, by my improvements, rendered perfectly controllable from a distance by means of electric circuits and suitable switches, as fully explained in the application Serial No. 468,473, filed March 31, 1893, by myself and Edwin H. Park. By using contact rings to convey the current to the lamp and the lens motor, the drum can be turned completely over, if desired.

Having thus described my invention, what I claim is—

1. In a search-light, the combination with the drum, of a diverging lens, and an electric motor supported on the drum, and moving therewith and arranged to operate the lens, substantially as described.

2. In a search-light, a diverging lens, having a laterally movable door, a crank-shaft for operating it, and an electric motor geared to the shaft, substantially as described.

3. In a search-light, the combination with the drum, of a diverging lens, a crank-shaft for operating it, an electric motor, and means for connecting and disconnecting said motor and shaft, substantially as described.

4. In a search light, a closed watertight pedestal provided with a bottom composed of a rigid frame and cross-bars, and panels of sheet metal filling the openings between said bars, substantially as described.

5. In a search light, the combination with the pedestal, of a motor therein, a transverse shaft, having a bearing at one end in the wall of the pedestal, an axially movable sleeve receiving the other end of the shaft and splined thereto, clutch teeth on the end of said sleeve, a gear-wheel loosely mounted on said shaft and having teeth to interlock with those of the sleeve, an extension on said sleeve journaled in the wall of the pedestal, means for moving said sleeve axially, and a motor in the pedestal geared to said loose wheel, substantially as described.

6. In a search-light, the combination with a motor, of a shaft, a gear-wheel loosely mounted on the shaft and in gear with the motor, an axially sliding clutch for locking the gear to the shaft, a sleeve on said clutch having one or more spiral slots, and stationary studs engaging with said slots, substantially as described.

7. A search light provided with a drum movable in altitude and azimuth, a diverging lens, a motor for adjusting said lens, and electrically driven mechanism for moving the drum, and electric conductors leading to a distant point, whereby the movement of the drum, the adjustment of the lens, and the control of the lamp are all effected electrically from said distant point, 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.