(No Model.)

3 Sheets—Sheet 1.

R. M. HUNTER.

ELECTRIC SEARCH LIGHT.

No. 580,836. Patented Apr. 13, 1897.

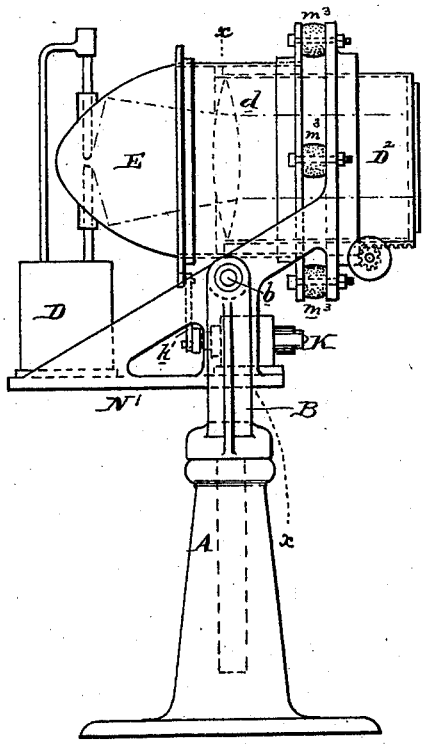

FIG. 5

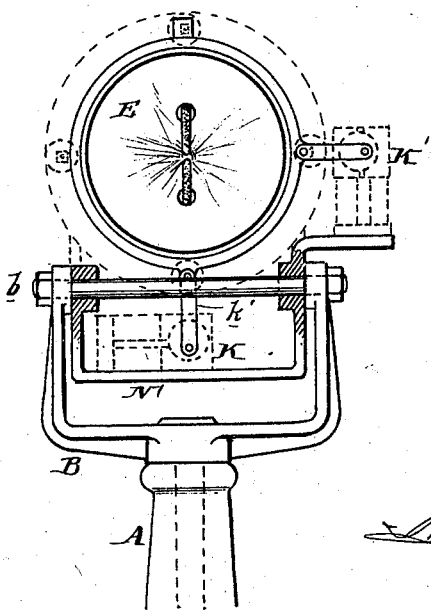

FIG. 6

Attest

J. A. Bramley

S. J. Yerkes

Inventor

R. M. Hunter

(No Model.) 3 Sheets—Sheet 2.

R. M. HUNTER.

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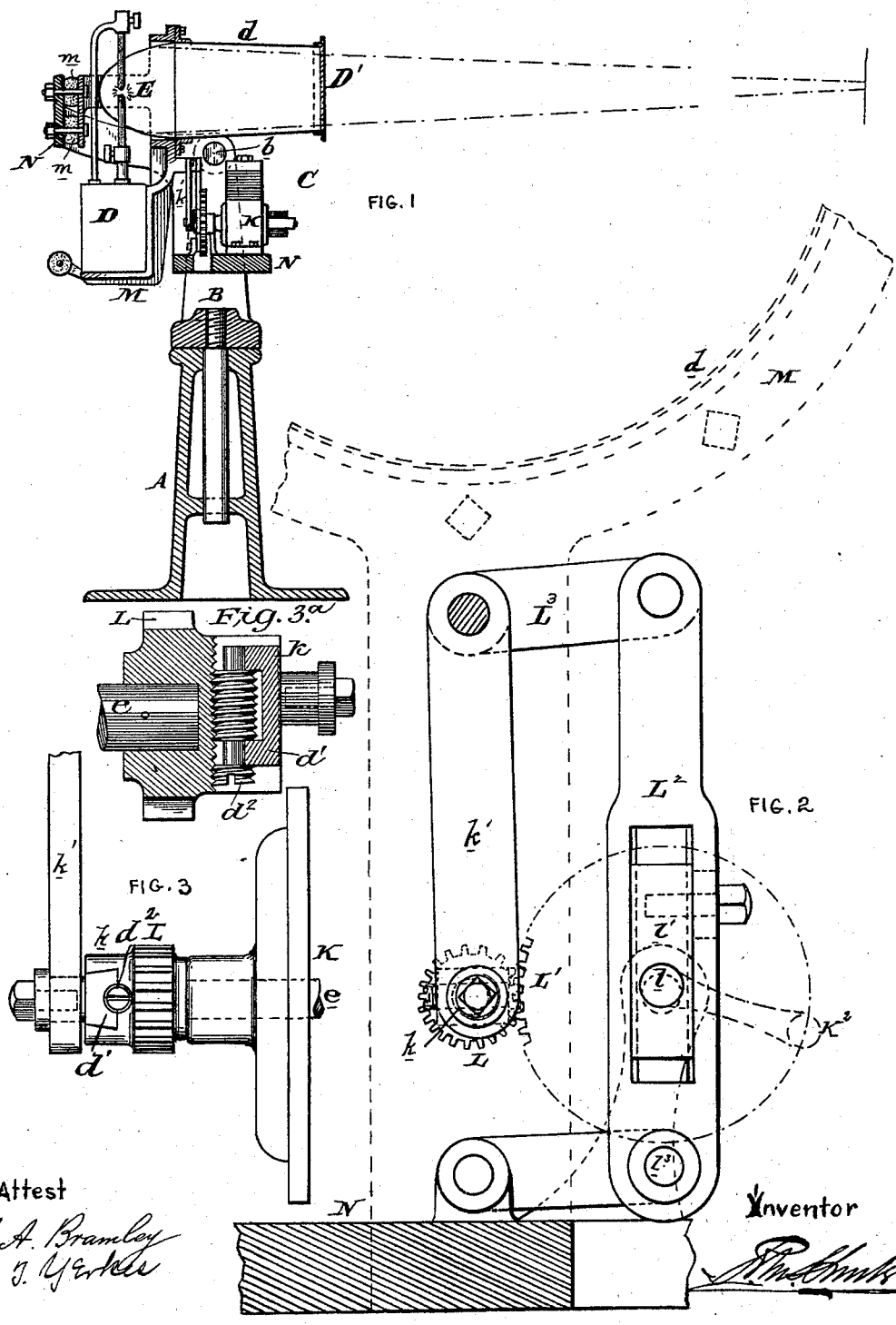

FIG. 1

Fig. 3ª

FIG. 3

FIG. 2

Attest

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(No Model.) 3 Sheets—Sheet 3.

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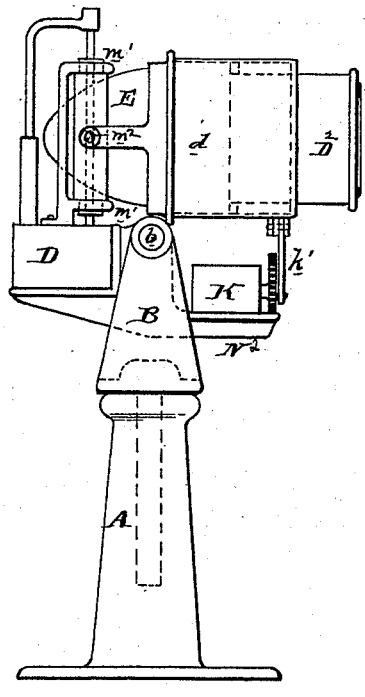

FIG. 4

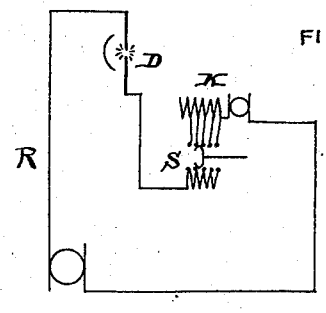

FIG. 7

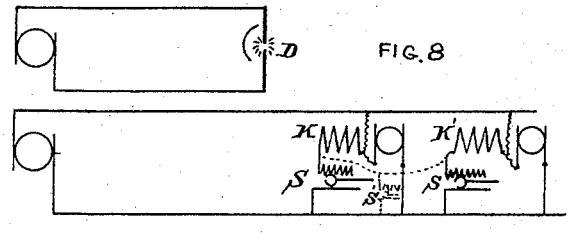

FIG. 8

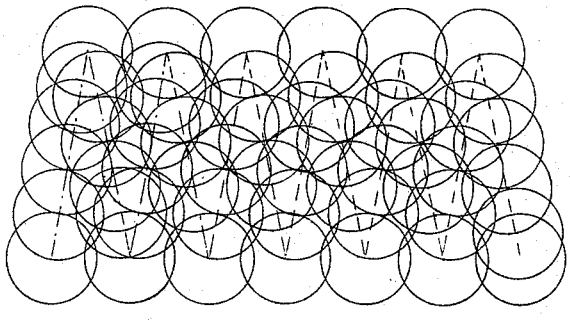

FIG. 9

Attest
J. A. Bramley
S. T. Yerkes

Inventor
R. M. Hunter

UNITED STATES PATENT OFFICE.

RUDOLPH M. HUNTER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

ELECTRIC SEARCH-LIGHT.

SPECIFICATION forming part of Letters Patent No. 580,836, dated April 13, 1897.

Application filed August 1, 1891. Serial No. 401,388. (No model.)

To all whom it may concern:

Be it known that I, RUDOLPH M. HUNTER, of the city and county of Philadelphia, and State of Pennsylvania, have invented an Improvement in Electric Lights and Methods of Lighting, of which the following is a specification.

My invention has reference to electric search-lights; and it consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

This application (Case No. 203) has particular reference to electric lamps technically known as "search-lights," but which are adapted for any purpose where the illumination of a distant object is required.

Prior to my invention it has been customary to construct lights with a focusing-lamp and a reflector arranged within a suitable casing having a plain glass front and mounted upon a standard through the mediation of a universal joint, whereby the light can be projected in any direction desired. Such lamps are commonly employed on ships. It has also been proposed to use electric lights of this class, with means for causing them to move about a vertical axis, in lighthouse-work for the purpose of flashing the beam of light over the horizon. In their operation the distance to which they can throw the light is limited and is not intense enough at any great distance to enable the eye to discern the object upon which the light has been projected. In these lamps the rays of the light diverge as they leave the lamp, so as to cover a sufficient area at a given distance to properly illuminate the object to such an extent as to render the nature of it perceptible.

The object of my invention is to overcome the existing objections of this form of search-light.

In carrying out my invention I cause the rays of light to be projected into the form of a beam concentrated and intense in its character, so as to penetrate to a great distance, and by means of mechanical devices cause the said beam of light to be rapidly moved over a considerable area at the distant end, and thereby illuminate the object to be observed. When the beam of light rapidly moves over the surface of the object, the impression left at any instant of time upon the retina of the eye remains until the beam of light has returned to the same spot. This taking place for all portions of the object illuminated, the concentrated beam may in this manner cause thirty or forty feet in length, or more, of the object in the distance to become highly illuminated to the eye, which may be assisted, if desired, by the use of a telescope.

My object is particularly to throw intensified light upon an object near at hand or to illuminate objects at great distances.

It is evident that the rays of light from the arc may be reflected by a reflector and thrown directly in a concentrated beam out toward the object to be illuminated, or said rays of light may be caused to be concentrated by means of focusing-lenses of the general nature, for instance, of condensing-lenses employed in magic lanters and telescopes. By means of these latter adjuncts the beam of light may be projected to various distances, so as to be very concentrated at one or more miles distant where it strikes the object being illuminated.

By my improved construction I have the following advantage over any ordinary light employing the same current, to wit: I am enabled with the employment of a given current to project a beam of light to a greater distance than by the use of those lamps wherein the rays of light diverge to cover large areas. With this intense light and without vibrating it I am enabled to discover very distant objects. After the object is discovered I may vibrate the light over it to ascertain its general nature. After ascertaining the nature of the object I may again direct the intense beam of light and hold it upon certain portions of the object, so that with a telescope the illuminated portions may be clearly perceived.

The details of construction of the apparatus may be greatly varied and yet carry out the same general principles of my invention, which are founded upon two main features—to wit, concentrating the rays of light and causing the beam so formed to be vibrated so as to cover a given area. The lamp proper

is supported upon a standard by means of a universal or other joint substantially in the manner of the search-lights heretofore employed, whereby the beam of light may be thrown in any direction desired and be readily changed at will.

Another use of my improved invention than that which has been described for lighting very distant objects is the employment of the lamp for illuminating a considerable area, which may be at any distance, either near or far, by projecting the concentrated rays of light over different portions of said area in rapid succession. This use would be more directed to those cases where engineering operations are being carried on, and where it is necessary to illuminate a large area of the works with a limited number of lamps.

In the drawings, Figure 1 is a sectional side elevation of a search-light embodying my invention. Figs. 2 and 3 are elevations of details thereof for imparting the necessary vibration to the beam of light. Fig. 3ª is a sectional elevation of part of Fig. 3. Fig. 4 is a side elevation of a modified construction of my improved search-light. Fig. 5 is an elevation of another modified form of my search-light. Fig. 6 is a front elevation of the upper portion of same. Fig. 7 is a diagram illustrating the circuits when operating the motor for vibrating the beam of light in series with the arc-lamp. Fig. 8 is a similar diagram wherein the motors are operated by an independent low-tension circuit, and Fig. 9 is a diagram illustrating the surface illuminated by the vibrating intense beam of light.

A is the standard upon which the light is supported.

B is a frame pivoted to the standard upon a vertical axis, and C is the electric-lighting apparatus, which is pivoted to the last-mentioned frame upon a transverse axis by means of suitable trunnions *b*. By this means the lamp may be adjusted to sweep any portion of the horizon or any height from the surface of the water or land.

D is an electric lamp, of any well-known construction and preferably of the focusing class.

E is a reflector in which the points of the carbons of the lamp are received and by which the rays of light from the arc formed are caused to be turned in one direction. These rays may be projected through a tubular cylinder *d*, which may be fitted on the end, if desired, with a plain glass front D′. The rays of light may be concentrated by the reflector E and thus form a beam which shall have great intensity at a given distance from the lamp.

Referring more specifically to Fig. 1, we have the reflector and the tubular part secured to a frame M, to which the focusing-lamp is also secured, and this frame is connected to a main frame N by means of an elastic or flexible joint *m*, which normally holds the parts in a fixed position, but permits the lamp-reflector and cylinder to be moved in any direction, if desired. The resiliency of the springs or elastic joint *m* will of course assist the reflector returning to a central position, but is not necessary beyond forming a universal joint or support. The main frame N is pivoted at *b* by trunnions to the frame B. Upon these trunnions *b* the lamp may be tilted in a vertical plane.

K is an electric motor which is supported upon the main frame N and by suitable devices is connected with the cylinder *d* or frame M, so as to cause the same to be vibrated vertically or laterally, or both vertically and laterally, the vertical vibrations being preferably at a far greater speed than the lateral vibrations. This is accomplished by means of a short crank or eccentric *k* upon the end of the motor-shaft *e*, which crank connects, by means of a link *k*′, with the frame M or cylinder *d*. The motor-shaft is geared by a pinion L with a spur-wheel L′, pivoted upon a bracket (indicated in dotted lines in Fig. 2) and forming part of the frame N. This wheel L′ is provided with a short crank or eccentric *l*, and this crank, by means of a lever L^2 and link L^3, is connected with the said frame M or cylinder *d* and produces the lateral vibrations thereof. The lever L^2 is supported upon the crank *l* and rises and falls with it, the vertical movement being permitted by the vertically-movable fulcrum-pivot l^3, and the horizontal movement of the upper part of the lever L^2 is transmitted to the lamp-reflector by the link L^3. By making the spur-wheel large and the pinion small any desired number of reciprocations of the beam of light may be had with each lateral vibration thereof and in this manner cause the beam to cover any given area desired. To change the extent of the vibrations, the cranks may be adjustable. Two methods of adjusting are shown in Figs. 1 to 3, in one of which the crank *k* is adjusted across the face of the pinion L by means of an adjustable block *d*′ and screw d^2, while in the other case the adjustment is made by a sliding block *l*′ in the lever L^2, so as to bring the crank nearer to or farther from the fulcrum-point l^3 of the said lever. Any other suitable method of adjusting the extent of the vibrations may be employed, if desired.

In another form of my invention the cylinder *d* is provided with focusing or concentrating glasses or lenses D^2, whereby the rays of light may be concentrated at any given distance from the lamp and produce great intensity at one or more miles distant. Any suitable arrangement of focusing or condensing lenses or concentrating glasses may be employed.

In the construction shown in Fig. 4 I have the focusing-lamp and the electric motor secured to the same main frame, (lettered in this case N^2,) and the reflector and lenses are movably supported or secured to said main frame N^2, so as to be capable of being vibrated inde-

pendently of the focusing-lamp, by means of the electric motor K and its connections, which latter may be similar to those previously described. The reflector and its connections are preferably hinged to the frame N^2, so as to vibrate upon a vertical and lateral axis, which shall pass through the arc of the lamp, though this would not be absolutely necessary owing to the smallness of the degree of vibration given to the said part. As shown in this figure, the reflector is pivoted upon a vertical axis at m' and upon a transverse axis at m^2. By this means the vibrations of the reflector and lenses may take place without changing the focal point on the reflector or the arrangement of the arc in the said focal point, which feature is covered by my Patent No. 493,358 of 1893.

In another construction of my invention I have the same general principles employed, but with the reflector and glasses or lenses pivoted at the forward end or at some point in advance of the arc. This construction is shown in Fig. 5. In this construction we have the reflector and the lenses supported to the main frame N' by means of four rubber or other springs m^3, Fig. 6, and by means of two electric motors K and K' the said reflector and lenses or glasses are vibrated both vertically and laterally. The motor K and its crank and connecting-rod vibrate the parts vertically, while the motor K' and its crank and connecting-rod vibrate the parts laterally. The particular direction of vibration may be changed, if desired. The crank of the motor K' is preferably of greater length of throw than the crank of the motor K, so as to make the beam cover a greater horizontal length than vertical. Furthermore, the motors may run at different speeds, as may be desired, so that the vertical motion may be greatly more rapid than the horizontal motion, substantially in the manner as first described. The regularity of said apparatus first described will not necessarily be found in the operation of the apparatus where there are two independent motors. This irregularity is more of an advantage than a defect, as with it a greater horizontal distance can be covered, as the vertical vibrations may be increased as desired.

In place of operating the apparatus by electric motors it is evident that the vibrations may be produced by hand mechanism, though this is not necessary, inasmuch as the current which runs the arc-lamp may also be employed to operate the electric motor or motors. If operated by hand, it may be accomplished by a crank K^3. (Shown in dotted lines in Fig. 2.)

R is an electric circuit, Fig. 7, which includes the motor or motors and lamp in series, and S is a regulator to control the speed of the motor. The regulator S, as shown in Fig. 7, is of that construction designed to vary the number of coils in circuit in the field of the motor. As the intermediate sliding piece is moved from the right to the left the speed of the motor increases, and when it is moved from the left to the right the speed of the motor decreases, and the motor stops when the slide reaches the right-hand section of the regulator, for in that condition the entire field-coils are cut out of circuit and a dead resistance is inserted to maintain resistance in the line uniform. In this position the motor remains at rest and the search-light has its beam projected without vibration. If desired, the motors may be shunt wound or adapted to incandescent circuits, which are found upon all vessels of any size, while the arc is fed from a very high tension circuit, which is desirable to obtain the greatest intensity of light. In practice I prefer to operate the motors upon incandescent or low-tension circuits, while the arc-lamp is operated from a high-tension independent circuit. The regulation of the motors by this latter employment is more simple. This is shown in Fig. 8. In this latter construction the motors are regulated by one or more current-regulators S. If desired, a separate regulator may be employed for each motor, or one regulator may be put into circuit for both motors, as indicated in dotted lines at S'. In this figure the method of regulation is somewhat different, as the motors are shunt wound. To slow down the motors, the slides are moved to the right with the object of gradually inserting resistances in the field-circuit, which arrests the flow of current. The motors are thereby slowed down until they move at an exceedingly slow speed, and a still further movement of the slide to the right hand breaks the circuit with the resistances on the motor side and cuts the field-coils out of circuit. This renders the motors absolutely inoperative until the slide is moved back again over the resistances to permit the current to again flow. The area covered by the vibrations of a small beam of light is shown by the diagram Fig. 9.

This application is generic to the invention set out and claimed. The specific feature of hinging or flexibly supporting the reflector so as to cause it to vibrate about the arc as a center is, however, covered by my Patent No. 493,358 of 1893, and the feature of condensing the direct rays by a condenser-lens is covered by my Patent No. 495,461 of 1893. Hence I do not claim these specific features in this application. I would further say that in this application I do not claim the combination, with an electric lamp, of a reflector to one side of the lamp, a motor to impart a rapid movement to the reflector, and means to vary the operation of the motor independently of the lamp, as that forms the subject-matter of my application, Serial No. 487,230, of 1893.

I do not limit myself to the mere details of construction, as any or all of the devices herein set out may be greatly modified and changed without in the least departing from the principles of my invention.

In this application I do not claim the method herein disclosed when limited to the case in which the beam of light is vibrated about the focal point as a center, as that forms the subject-matter of my application, Serial No. 405,842, filed September 16, 1891.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a search-light, the combination of an arc-lamp, a concentrating-reflector to reflect the rays of light in one direction, and means to cause the said reflector to be vibrated for the purpose of causing the beam of light to be vibrated at its distant end with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector if it were stationary.

2. In a search-light, the combination of an arc-lamp, a reflector to reflect the rays of light in one direction, focusing lenses or glasses for concentrating the rays of light at various distances from the lamp, and means to cause the reflector and lenses or glasses to be vibrated for the purpose of causing the beam of light to be vibrated at its distant end with sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector and lenses if they were stationary.

3. In a search-light, a main frame, a reflector connected to said main frame by means of springs, an arc-lamp having its electrodes extending within the reflector, and mechanical devices substantially as set out for vibrating the reflector.

4. In a search-light, the combination of a main frame, a reflector connected to said main frame by means of springs, an arc-lamp having its electrodes extending within the reflector, and mechanical devices substantially as set out for vibrating the reflector both vertically and laterally.

5. In a search-light, the combination of a main frame, a reflector connected to said main frame by means of springs, an arc-lamp having its electrodes extending within the reflector, and mechanical devices substantially as set out for vibrating the reflector vertically and also laterally and in which the lateral vibrations are greater in length than the vertical vibrations.

6. In a search-light, the combination of a main frame, a reflector connected to said main frame by means of springs, an arc-lamp having its electrodes extending within the reflector, and mechanical devices substantially as set out for vibrating the reflector both vertically and laterally and in which the vertical vibrations are of greater rapidity than the lateral vibrations.

7. In a search-light, the combination of a main frame, a reflector connected to said main frame by means of springs, an arc-lamp having its electrodes extending withing the reflector, concentrating or focusing lenses or glasses for focusing the rays of light at a given distance from the lamp, and mechanical devices substantially as set out for vibrating the reflector and focusing lenses or glasses simultaneously.

8. In a search-light for illuminating limited areas, the combination of an arc-lamp, a concentrating-reflector movably supported so as to be capable of small vibration independently of the lamp, and mechanical devices for vibrating the said reflector with great rapidity whereby a greater area is illuminated at any moment of time than would be possible with the same reflector if stationary or reciprocated slowly as in adjusting the beam of light over the horizon.

9. In a search-light, the combination of an arc-lamp, a reflector for reflecting the rays of the lamps in one direction, and an electric motor having its shaft mechanically connected to vibrate the reflector to cause the beam of light to be vibrated to a considerable extent at its distant end with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector if it were stationary.

10. In a search-light, the combination of an arc-lamp, a reflector for reflecting the rays of the lamp in one direction, an electric motor having its shaft mechanically connected to vibrate the reflector to cause the beam of light to be vibrated to a considerable extent at its distant end with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector if it were stationary, and a support for the motor-lamp and reflector whereby they may be moved as an entirety upon a vertical and transverse axis.

11. In a search-light, the combination of an arc-lamp, a concentrating-reflector for reflecting the rays of light from said lamp in one direction, and two independent electric motors for causing the said reflector to be vibrated simultaneously both vertically and laterally with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector if it were stationary.

12. In a search-light, the combination of an arc-lamp, a reflector for reflecting the rays of light from said lamp in one direction, two independent electric motors for causing the said reflector to be vibrated simultaneously both vertically and laterally with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector if it were stationary, and independent means for regulating said electric motors.

13. In a search-light, the combination of an arc-lamp, a reflector for reflecting the rays of light from the said lamp in one direction, an electric motor to vibrate the said reflector with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector if it were stationary, a high-tension circuit for supply-

ing electric current to the lamp, an independent low-tension circuit for supplying current to the motor, and means to regulate the speed of the motor.

14. In a search-light, the combination of a main frame, an arc-lamp, a reflector for said arc-lamp, concentrating lenses or glasses for concentrating the rays of light from said reflector, and mechanical devices substantially as set out for vibrating the said lenses or glasses independently of the electric lamp with very great rapidity whereby the beam of light may be vibrated.

15. In a search-light, the combination of an arc-lamp, a reflector therefor, lenses or glasses for concentrating the rays of light into a beam having a focus at a great distance from the lamp, and mechanical devices for vibrating the said lenses or glasses for the purpose of vibrating the beam of light with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the lenses or glasses if they were stationary.

16. In a search-light, the combination of an arc-lamp, a reflector therefor, lenses or glasses for concentrating the rays of light into a beam having a focus at a great distance from the lamp, mechanical devices for vibrating the said lenses or glasses for the purpose of vibrating the beam of light with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the lenses or glasses if they were stationary, and a flexible support for said lenses or glasses.

17. In a search-light, the combination of a main frame, a reflector connected to said main frame by means of springs, an arc-lamp having its electrodes extending within the reflector, concentrating or focusing lenses or glasses for focusing the rays of light at a given distance from the lamp, mechanical devices substantially as set out for vibrating the reflector and concentrating or focusing lenses or glasses, a pedestal, and a universal-jointed connection between the pedestal and main frame of the light.

18. The herein-described method of lighting which consists in maintaining an intense light, reflecting the rays of said light in one direction producing an intense straight beam of light, and vibrating the said beam of light about its source as a center to cause it to move over the object to be illuminated with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the impression of the light in all of its positions is impressed and retained upon the retina of the eye.

19. The herein-described method of lighting which consists in maintaining an intense light, concentrating or directing the rays of said light in one direction producing an intense straight beam of light, and vibrating the said beam of light about its source as a center to cause it to move over the object to be illuminated with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the impression of light in all of its positions is impressed upon the retina of the eye.

20. The herein-described method of illuminating an object which consists in maintaining an intense light, projecting the same in one direction to form a straight intense beam, focusing the beam of light so formed upon the object to be illuminated, and vibrating the said beam of light about its source as a center with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the impression of the light in all of its positions is impressed and retained upon the retina of the eye.

21. The herein-described method of illuminating an object which consists in maintaining an intense light, projecting the same in one direction in the form of an intense straight beam, focusing the beam of light so formed upon the object to be illuminated, and vibrating the said beam of light about its source as a center vertically and laterally simultaneously with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed and retained upon the retina of the eye.

22. The herein-described method of lighting which consists in maintaining an intense light, reflecting the rays of said light in one direction to produce an intense straight beam of light, and vibrating the said beam of light about its source as a center to cause it to move over the object to be illuminated vertically and laterally with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed and retained upon the retina of the eye.

23. The herein-described method of lighting a distant object which consists in maintaining an intense light, projecting the same in one direction, bending the rays of light by means of focusing lenses or glasses to form an intense straight concentrated beam of light, and vibrating the said beam of light about its source as a center with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed and retained upon the retina of the eye.

24. The herein-described method of light-

ing a distant object which consists in maintaining an intense light, projecting the same in one direction, bending the rays of light by means of focusing lenses or glasses to form an intense straight beam of light, and vibrating the said beam of light about its source as a center both vertically and laterally simultaneously with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed and retained upon the retina of the eye.

25. The herein-described method of illuminating a distant object which consists in maintaining an intense light, projecting the said light in one direction forming an intense straight beam of light, and vibrating the said beam of light about its source as a center both vertically and laterally at the same instant but in which the vertical vibrations are more rapid than the lateral vibrations and with a sufficient rapidity to continuously illuminate a solid area of a great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed and retained upon the retina of the eye.

26. The herein-described method of illuminating a distant object which consists in maintaining an intense light, reflecting the said light in one direction to form an intense straight beam of light, and vibrating the said beam of light about its source as a center both vertically and laterally at the same instant but in which the vertical vibrations are more rapid than the lateral vibrations and with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, and varying the relative vibrations of said beam whereby the light in all of its positions is impressed and retained upon the retina of the eye.

27. The method of illuminating a distant object consisting in projecting upon the object an intense straight beam of light, and vibrating the said beam of light about its source as a center over the surface of the object with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed and retained upon the retina of the eye.

28. The method of illuminating a distant object consisting in projecting upon the object an intense straight beam of light, and vibrating the said beam of light about its source as a center over the surface of the object both vertically and laterally with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed and retained upon the retina of the eye.

29. The herein-described method of illuminating a distant object which consists in projecting an intense straight beam of light in the direction of the object, vibrating the said beam of light about its source as a center over the surface of the object to be illuminated with a sufficient rapidity to continuously illuminate a solid area of great height and breadth and greater than the area which would be illuminated by the beam of light if it were stationary, whereby the light in all of its positions is impressed upon the retina of the eye, and simultaneously therewith moving the beam of light independently of its vibrations through space to cover the objects desired.

30. The combination of an arc-lamp, means for concentrating and reflecting the rays of light in one direction, and mechanical devices for causing said beam of light to be vibrated.

31. The combination with an illuminator, of a concentrating-reflector at one side of the illuminator, and means for imparting a vibratory movement to the reflector with a sufficient rapidity to continuously illuminate an area greater than the area which would be illuminated by the reflector if it were stationary.

In testimony of which invention I have hereunto set my hand.

R. M. HUNTER.

Witnesses:
ERNEST HOWARD HUNTER,
S. T. YERKES.