(No Model.)

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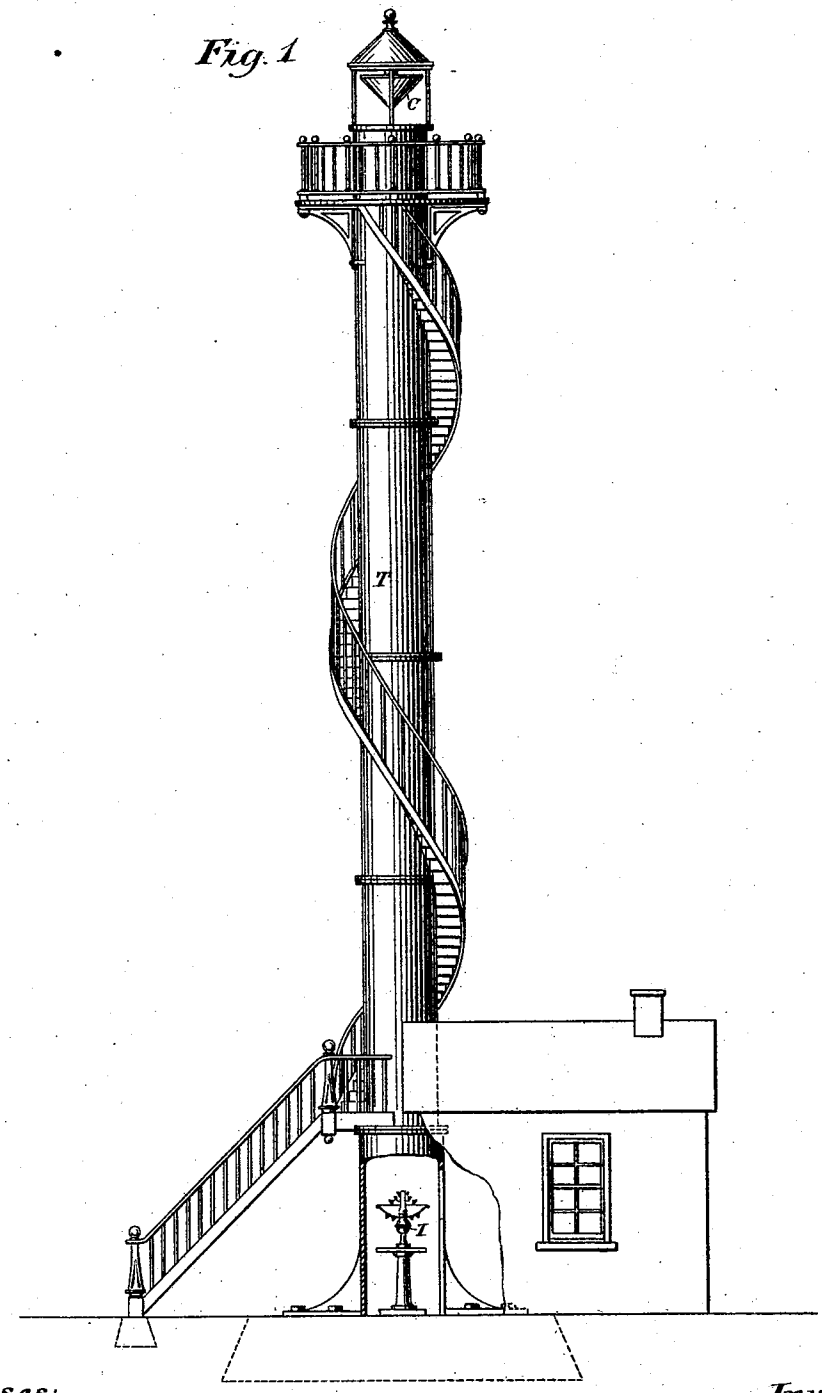
D. P. HEAP.

LIGHT SIGNAL.

No. 543,730. Patented July 30, 1895.

Fig. 1



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(No Model.) 5 Sheets—Sheet 2.

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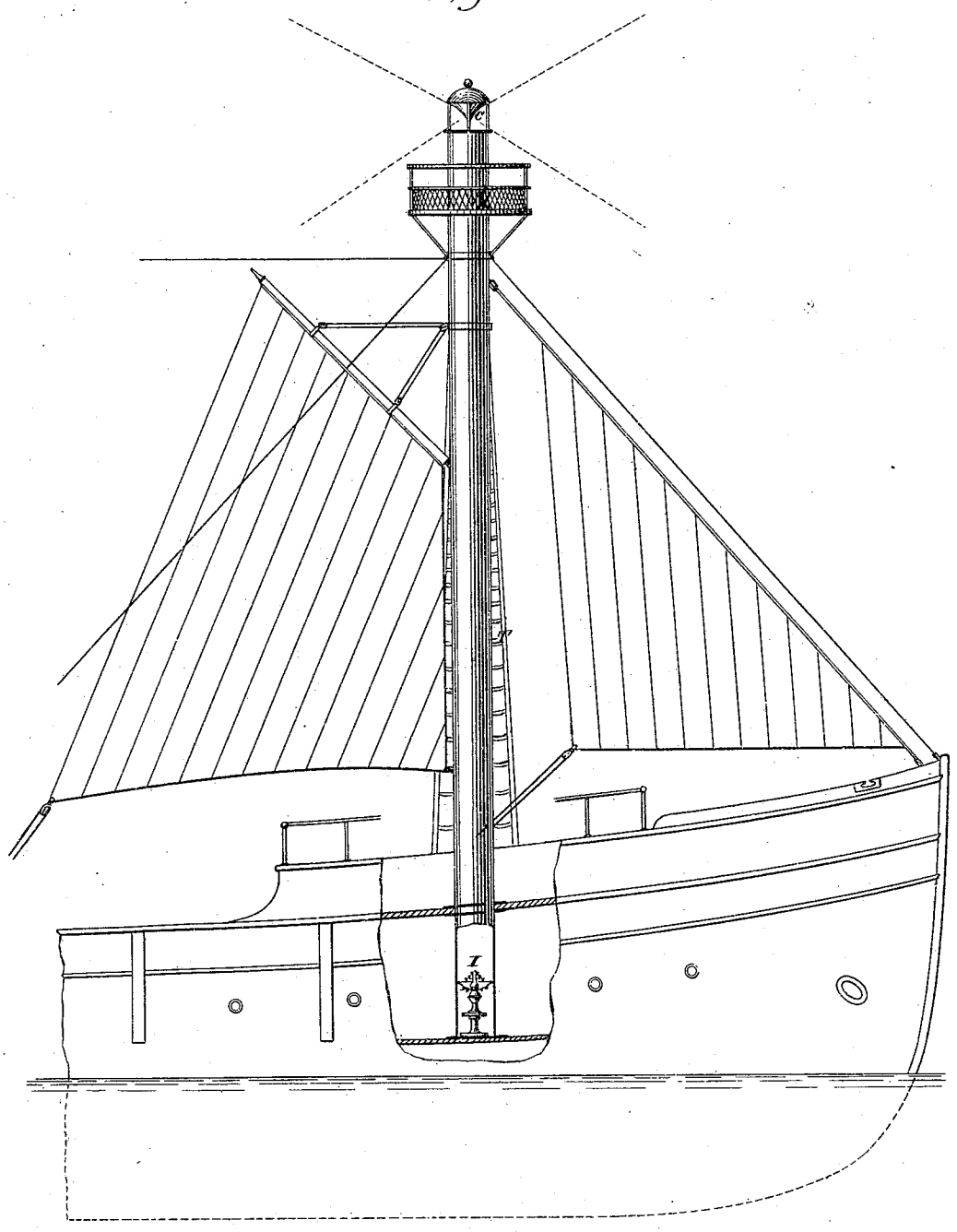
LIGHT SIGNAL.

No. 543,730. Patented July 30, 1895.

Fig. 2.



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No. 543,730. Patented July 30, 1895.

Fig. 3.

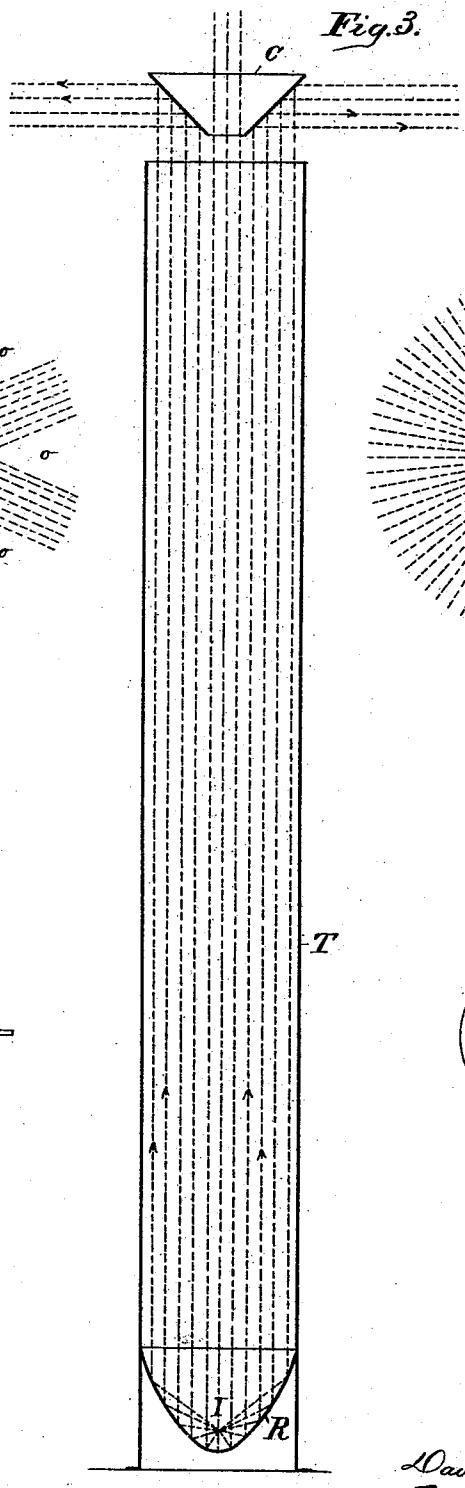


Fig. 5.

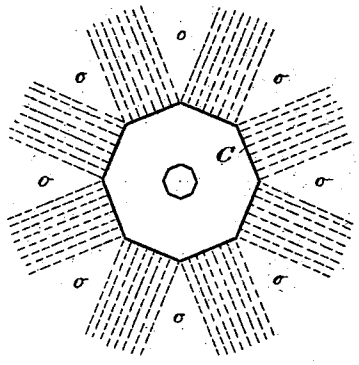


Fig. 4.

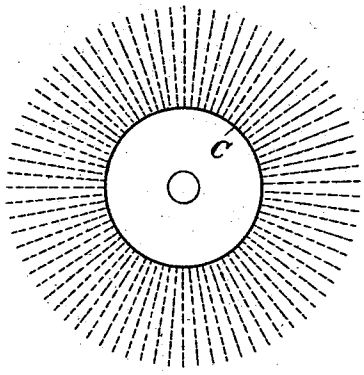


Fig. 6.

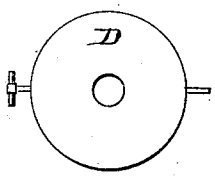
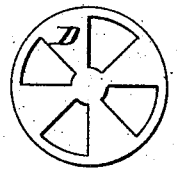


Fig. 7.



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No. 543,730. Patented July 30, 1895.

Fig. 8.

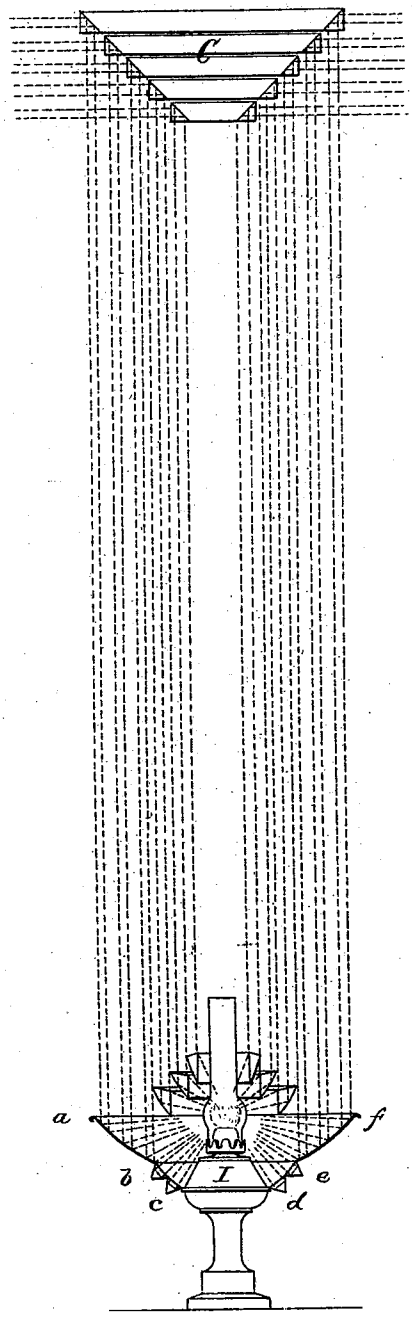
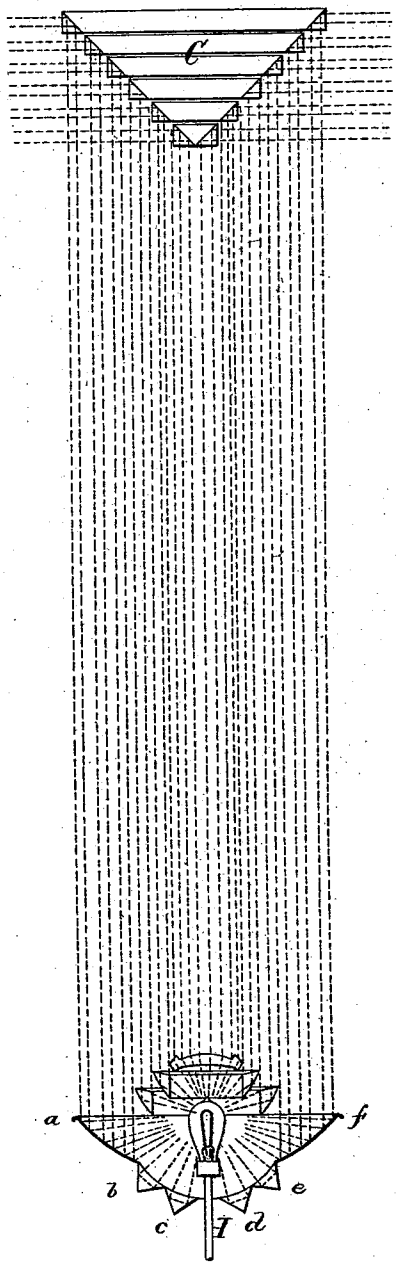


Fig. 9.



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(No Model.) 5 Sheets—Sheet 5.

D. P. HEAP.

LIGHT SIGNAL.

No. 543,730. Patented July 30, 1895.

Fig. 10.

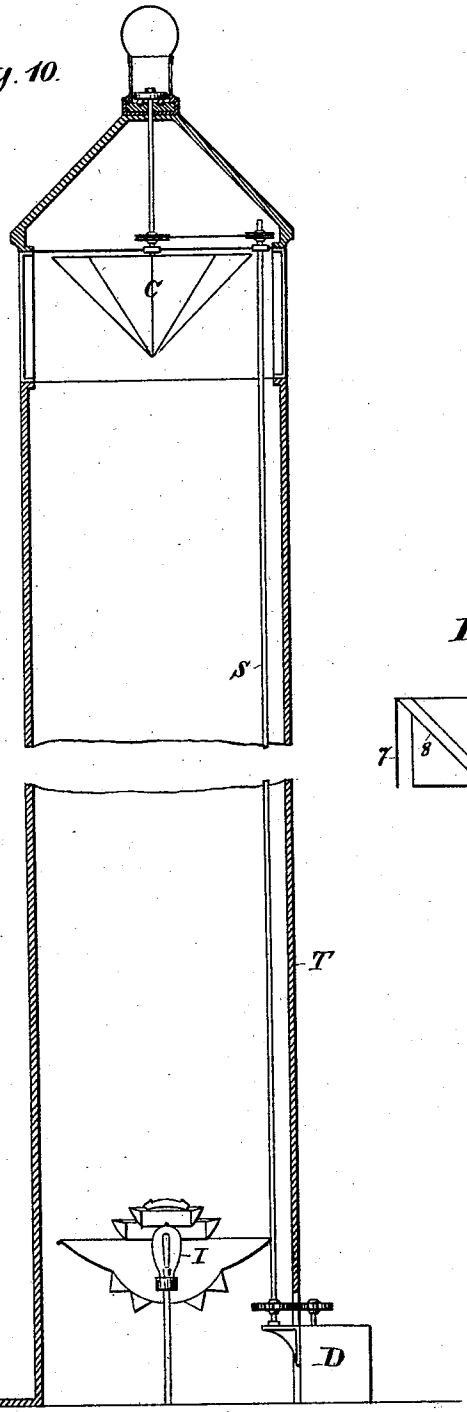


Fig. 11.

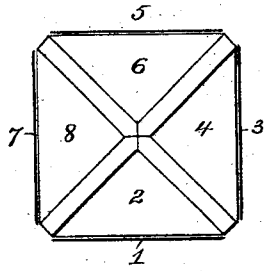
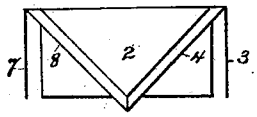


Fig. 12.



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UNITED STATES PATENT OFFICE.

DAVID PORTER HEAP, OF THE UNITED STATES ARMY.

LIGHT-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 543,730, dated July 30, 1895.

Application filed April 19, 1893. Serial No. 470,964. (No model.)

To all whom it may concern:

Be it known that I, DAVID PORTER HEAP, of the United States Army, a citizen of the United States, now residing at New Brighton, county of Richmond, and State of New York, have invented certain new and useful Improvements in Light-Signals, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates more particularly to light-signals which require to be displayed at a considerable elevation above their basic support, and, although the invention as herein embodied is especially adapted for use in light-houses and light-vessels, it is also applicable where the rays of light produced by the illuminant are concentrated and displayed in a beam or beams.

Light-houses as ordinarily constructed require a tower of considerable height for the display of the signal, which tower must not only be equal to the support of a costly and weighty lantern, an illuminating apparatus and its accessories located near its upper end, but in order to capacitate it to maintain such a heavy load at its top at all times it must additionally be strong enough to resist the action of storms. Such a lantern, illuminating apparatus, and accessories weigh about three tons in light-houses of the fourth, fifth, and sixth orders, and in the higher orders these parts are proportionately heavier. This weight and bulk at the top of the tower and other conditions necessitate an extensive, strong, and, consequently, expensive structure, and the location of the illuminating apparatus at the top of the tower entails a costly maintenance. That the cost of such towers will be largely reduced if they can be relieved of the heavy weights which they now carry at their tops is apparent, since they will then only have to be constructed sufficiently strong to resist damage from storms, and the difficulty and expense of attending and maintaining the illuminating apparatus will be greatly reduced by concentrating the illuminating machinery at the base of the tower.

Light-vessels as now built are supplied with two lanterns, which are each displayed from special masts provided in addition to the sail-masts. These lanterns are each furnished with eight lamps and require to be made very strong and consequently very heavy, each weighing about one ton. They are provided with a hoisting apparatus for raising them at night to a height determined by the attachment of the stays for their carrying-masts, so that the light is exhibited at a point about forty feet above the vessel's deck, which elevation gives it a limited range. These lanterns require to be lowered into houses at the base of their masts for trimming, &c., and when raised their heavy weight near the tops of the special masts necessarily causes the vessel to roll unduly, thus tending to constantly vary the direction of the emergent beams of light, which defective action is partially overcome by hanging the lamps on gimbals. Their lights are not visible from the deck, and should any one be extinguished or defectively burn the fault is not readily discernible, and if apparent the entire lantern must be lowered to the deck to correct it, an operation requiring time, during which the light from that lantern would not be shown, and which lowering and rehoisting is a difficult operation, especially during a storm, when the light is most liable to become defective. The cost of the lighting apparatus of a light-vessel will therefore be greatly reduced, the existence of a heavy weight near the tops of the masts and the resulting bad effects due to the excessive rolling be avoided, the hoisting devices become unnecessary, the care of the light be simplified, its maintenance rendered more certain, and greater facility be afforded in attending to and maintaining the illuminating apparatus by concentrating the illuminating machinery at the base of a tubular mast.

The many disadvantages existing in light-houses and light-vessels constructed and operated according to the present systems are not only overcome, but great advantages are attained and a simple, cheap, and effective light-signal is produced by my improved system, which provides for operating the light at or near the basic support of the apparatus, while its displayed beam or beams of light are deflected horizontally from a reflector sustained at such elevation as to produce an increased effect.

More particularly stated, the invention con-

sists in the combination, with a reflector and means for sustaining it in an elevated position, of an illuminating apparatus at its base, consisting of a light and means for concentrating its rays into a beam and directing it onto the reflector which deflects the beam toward the horizon.

In a more limited sense the invention comprehends the combination, with a supporting-tower or tubular mast sustaining a reflector in an elevated position, of an illuminating apparatus at its base, consisting of a light and means for concentrating its rays into a beam and directing it onto the reflector, which deflects the beam toward the horizon.

The invention also includes various means whereby the emergent beams of light may be acted upon or controlled, so as to impart to the signal any desired predetermined characteristic.

In the accompanying drawings, Figure 1 is an elevation of a light-house embodying this invention. Fig. 2 is a side elevation of the forward part of a light-vessel provided with a light-tower embodying this invention. Fig. 3 is a diagrammatic vertical sectional elevation of a tower or tube more particularly illustrating the arrangement of the light, a parabolic reflector for concentrating its rays into a vertical beam and directing the same onto the upper reflector for horizontal deflection, the directions of the light being indicated by dotted lines. Fig. 4 is a diagrammatic plan view of a conical reflector, with the radiating rays of light deflected thereby indicated by dotted lines. Fig. 5 is a similar view of a pyramidal reflector having eight equal sides in which the beams of light reflected thereby are indicated by dotted lines. Fig. 6 is an elevation of a flat opaque damper adapted to swing on a horizontal axis. Fig. 7 is an elevation of a damper adapted to turn in a horizontal plane and having broad spokes and intervening openings. Figs. 8 and 9 show some of the many practical constructions of upper reflectors and lower concentrators. Fig. 10 is a sectional elevation of a light-tower embodying this invention and including one of the many modes which may be employed to rotate its upper reflector. Fig. 11 is a bottom plan view of a pyramoidal reflector, alternate sides of which are provided with colored screens; and Fig. 12 is a side elevation of the same with the nearest screen removed.

In the practical embodiment of this invention the means for supporting the upper reflector must be of such a structure that while it will maintain the upper reflector at the desired altitude and provide for its rotation when such movement is desired it shall also primarily have a construction that will provide an unobstructed passage for the concentrated rays or beam of light from below to the reflector above, and although this means may be a structure composed of one or more supporting members its preferable form is a tubular tower or mast, and for the purposes of this description this supporting means will be referred to as a "tower." This tower will preferably be a tubular metal structure, as that form adapts it to protect interior parts from the weather, and its height will be suitable to the display of the signal at the required elevation, and whether continuous or sectional it will have a diameter or shape suited to the strength required for its own support and that of the reflector sustained at its top. This tower will be maintained upon the ground by an appropriate foundation, as in Fig. 1, or from the deck of a vessel by suitable attachments. At or near its base it is provided with a concentrator R, so arranged with respect to the light I as to concentrate its rays in a circular beam and direct the same vertically onto a reflector C, sustained at the top of the tower in such a manner as to deflect the concentrated rays or beam of light horizontally or approximately horizontally.

The tube or tower may be constructed at its top to carry the reflector, properly support a roof, and maintain the usual glazed windows, and at its bottom it will have an opening through which the interior may be reached.

The light indicated by I in Fig. 3, which is shown in Figs. 1, 2, and 8 as produced by an oil-lamp I and in Figs. 9 and 10 as produced by an incandescent electric lamp I, may be any suitable one, and the light-concentrator may have any construction that will so reflect and refract its rays that the emergent beam will approximately be a cylinder. As examples of the many practical concentrators that may be so used, I have illustrated in Fig. 8 a construction adapted to an oil-lamp and in Figs. 9 and 10 one suitably modified to be used with an incandescent electric light.

In Figs. 8 and 9 the part marked *a b e f* represents a silvered parabolic reflector having its focus in the center of the flame, and *b c d e* indicate totally-reflecting glass prisms so constructed that the light will be reflected to a point near the top of the flame. Above the flame is arranged a range-lens with the bull's-eye omitted in Fig. 8 for the passage of the lamp-chimney. As is shown by the dotted lines, which indicate the directions of the rays of light, all the light below the line *a f* is either reflected directly upward by the parabola or is returned by the prisms to a point a little above the flame. All the light above the line *a f* is refracted and reflected upward by the range-lens, and therefore the resultant beam is a cylinder.

The upper reflector may be constructed to deflect the concentrated beam in one direction or divide it into several beams deflected in as many directions; but, as it is desirable, especially in light houses and vessels, to display beams of light simultaneously in many directions it will preferably have the shape of a pyramid, as in Figs. 5 and 10, or that of a cone, as in Figs. 1 and 2, or that of a pyramoid, as in Figs. 11 and 12, according to the

characteristic which it may be desired to show, their apexes being underneath, and their sides make an angle of forty-five degrees with the horizontal and will, therefore, reflect the vertical beams of light in a horizontal direction. This upper reflector may be constructed in many ways. Thus it might be of metal with a polished surface or made of polished glass mirrors; but it is preferable in some cases to use a set of totally-reflecting prisms, as shown in Figs. 8 and 9, since with them there is the least loss of light and they may be conveniently kept in an efficient state. As a pyramid or pyramoid, the reflector may have any number of sides, as the eight shown in Figs. 5, 10, 11, and 12, and the reflected beams will be proportioned in intensity to the area of the faces. If its faces are equal, as in Fig. 5, and it remains stationary, its faces will reflect eight beams of light and there will be dark angles, as *o o*, between them, and if this reflector is revolved around its vertical axis the light will be alternately visible and invisible and will have the appearance of a flashing light. By either changing the shape of the pyramid or pyramoid or the speed of revolution, or both, many varieties of signals may be obtained.

In conoidal form the stationary reflector C will transmit a beam of light deflected equally to all points of the horizon, as is shown in Fig. 4, and if the apex of the reflector is cut off, as in Figs. 3, 4, and 5, so as to allow a portion of the light to be reflected through it toward the zenith, this portion will be continually visible by reflection from the dust or haze in the air, while the horizontal beams will retain their characteristics unaffected thereby. A flashing effect can be produced in several ways. Thus by providing the tower with a damper interposed between the concentrator and the reflector at some convenient point for operation by suitable clockwork or otherwise the whole or any desired portion of the light may be periodically cut off. A circular, flat, opaque plate or damper, such as is shown in Fig. 6, mounted in the tower above the light and caused to revolve on a horizontal axis, will alternately obstruct and admit the passage of the beam, thus producing the flashing effect. If this damper has a hole in its center, as shown, the only portion of the beam which will be seen at the top of the tower, when the damper is horizontal, will be the central portion of the vertical beam, and when such damper is vertical both vertical and horizontal beams will be visible. By providing a damper adapted to horizontally rotate, and constructed, as shown in Fig. 7, with alternating openings and opaque parts, with or without a central hole, and caused to rotate appropriately and by suitably varying the relative extent of the opaque portions and the intervening openings many varieties of obstruction and flash may be obtained. In this example the damper has four openings and four intervening opaque parts, corresponding to the eight sides of the reflector shown in Fig. 5. By this structure the opaque parts of the damper will, when it is stationary, obscure or cut off four alternate beams, which otherwise would be visible, as in Fig. 5, while the remaining four beams will be displayed; but when this damper is rotated sets of four alternate beams will be successively displayed. Thus, according to the opening in the damper, one or any number of beams will be displayed. Any other form of damper operating to wholly or partially obscure the beam of light may be adopted. Still another method, especially applicable in case gas or electricity were the illuminant, would be to entirely extinguish and relight the light in accordance with the characteristic desired. In case magnesium powder were flashed at the base of the tower the characteristic would be determined by the number of flashes and the intervals between them.

In order to obtain a very powerful light the light I and concentrator therefor may be what is known as a "search-light," so arranged as to throw a vertical beam of light; but any appropriate light and concentrator therefor may be used at or near the base of the tower or tube, and if for convenience of arrangement or operation they are located out of the axial center of the tower appropriate reflecting-surfaces may be added to cause the rays of light to be directed upward as a circular beam within the tower.

Although there are many ways whereby rotary movement may be given to the upper reflector, one mode of causing such rotation is shown in Fig. 10, where the upper reflector C is hung on a vertical axis that turns on ball-bearings and is rotated by pulleys and a rope or band from a vertical shaft S, that is regularly rotated by suitable gearing from a clock or other driving mechanism located at D; but when all of the rays are concentrated so as to be directed as a single beam by a rotative reflector the latter may be supported on a universal joint.

If it is desired to give characteristic color effect to the signal, it may be done by providing the totally-reflecting prisms, either when arranged in a stationary cone or pyramid, with screens of colored glass to the extent required, according as the signal is to be partially or wholly colored.

To produce a combination of colored and white flashes the conoidal or pyramoidal rotating reflector may carry a sheet of colored glass in front of one or more faces or portions of it. In Figs. 11 and 12 such reflector is shown as provided with colored screens 1 3 5 7 dependent before its faces 2 4 6 8.

In order to modify the absorption of light by the inner walls of the tube or tower, it may be coated with a light color, and to increase the amount of light received on the

reflector C it would be of some advantage to make the interior surface of the tube or tower a reflective surface.

By this invention, which provides for the placing and operating of the illuminating apparatus at the base of a tubular tower or mast, the cost of a light-house is greatly reduced, and in the case of a light-vessel the number of the masts is also reduced. In both cases, the illuminating apparatus and watch-room being at or near the base of the tower or mast, the maintenance of the light is simplified and made easier. The oil in the one case will no longer have to be carried to the top of the tower, and in the other the lanterns will not be required to be hoisted and lowered. Moreover, as the labor of attendance is diminished, the number of attendants and consequent cost of maintenance will be lessened. The watching of the light may be performed at the base of the tower or mast, and ascension to the top of either will only be necessary to keep the reflector in condition, this being accomplished by a spiral staircase in the light-house and by means of the shrouds in the light-vessel. In the light-vessel instead of four masts two will suffice, since they may perform the double function of sail-masts and light towers or tubes, and in view of the facility afforded by these improvements in the production of varying characteristics only one mast need be lighted; and, furthermore, the upper reflector need not have the permanently-glazed windows now required to protect the illuminant, and the latter, being located in the most accessible place, may be easily kept in continuous operation, since, should the light from any cause be extinguished, become defective, the lamp smoke, a chimney break, or an electric filament cease to operate, substitutes may be quickly and conveniently supplied.

The upper reflector has been spoken of as conical or pyramidal. The surfaces of either may be so curved as to cause the emergent beams to issue in a cone the angle of the apex of which is of any appropriate extent to increase, as may be desired, the divergence of the light, in which case the diminished intensity of the light may be compensated for by an increase in the initial intensity of the illuminant.

When there is a protecting-deck, as in the vessel, Fig. 2, and as would be the case if the tower projected from a house, the tower need not necessarily be continued below such deck or the roof of the house, although the illuminating apparatus may be situated some distance below the immediate basic support of the tower, as is apparent.

What is claimed is—

1. The combination with an upper reflector and means for sustaining it in an elevated position, of an illuminating apparatus, at the base, consisting of a light and means for concentrating its rays into a beam and directing the same onto the upper reflector which deflects the beam toward the horizon, substantially as described.

2. The combination with an upper reflector and a supporting tower or mast sustaining the same in an elevated position, of an illuminating apparatus at the base consisting of a light and means for concentrating its rays into a beam and directing the same onto the upper reflector which deflects the beam toward the horizon, substantially as described.

3. The combination with a supporting tower, of a reflector at its top and concentrator at its base, and, a light interposed between them, substantially as described.

4. The combination with a supporting tower, of a revolving reflector at its top, and, at its base, a light and means for concentrating its rays into a beam and directing the same onto the revolving reflector, which deflects the beam toward the horizon, substantially as described.

5. The combination with a tower supporting a reflector at its top, and having at its base, a light and means for concentrating its rays into a beam, of means alternately obscuring and displaying the light from the upper reflector, substantially as described.

6. The combination with a tower supporting a reflector at its top, and having at its base, a light and means for concentrating its rays into a beam, of a rotating damper operating to alternately obstruct and clear the path through which the light passes upward, substantially as described.

7. The combination with a tower supporting a reflector at its top, and having at its base, a light and means for concentrating its rays into a beam, of a horizontally rotative wheel having opaque portions which obscure the light rays they intercept, substantially as described.

8. The combination with a supporting tower, of a revolving pyramoidal reflector at its top, and at its base, a light and means for concentrating its rays into a beam and directing the same onto the reflector, substantially as described.

9. The combination with a protecting deck and means for supporting the reflector above the same, of a light below said deck and means for concentrating its rays and directing the same onto the reflector, substantially as described.

10. The combination with a protective deck and a revolving reflector supported above the same, of a light below said deck, and means for concentrating its rays and directing the same onto the reflector, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

DAVID PORTER HEAP.

Witnesses:
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