United States Patent

Starr

[15] **3,654,451**

[45] **Apr. 4, 1972**

[54] FLOODLIGHT

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[22] Filed: **Sept. 18, 1969**

[21] Appl. No.: **865,227**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 693,220, Dec. 18, 1967, abandoned.

[52] **U.S. Cl.** **240/3,** 240/41.3, 240/41.35, 240/106, 313/110

[51] **Int. Cl.** **F21p 5/00**

[58] **Field of Search** 240/3, 41.3, 41.35, 93, 106, 240/106.1, 22, 7.5; 313/110, 113

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[57] **ABSTRACT**

A floodlight for providing a high efficiency rectangular beam of light having a narrow beam in the vertical dimension. The floodlight includes a vertically elongated light source, a reflector spaced behind and to the opposite sides of the light source, and a sleevelike refractor or Fresnel lens around the light source for refracting the rays of light from the light source into horizontal rays of light to provide the substantially rectangular beam of light. In a modified arrangement, there is provided an auxiliary reflector for reflecting the upwardly and downwardly emitted rays from the light source into substantially horizontally extending rays of light. Also, there is included an alternate embodiment in which the glass envelope of the lamp of which the light source is a part is formed into a condensing lens instead of having a separate Fresnel lens. In addition, there is included another embodiment in which the refractor is provided in the interior thereof with a plurality of vertical prisms, with a part of the prisms refracting the light rearwardly onto a reflector for reflection into a center portion of the beam pattern and with the remaining part of the prisms refracting the light to either side of the center portion of the beam pattern.

11 Claims, 9 Drawing Figures

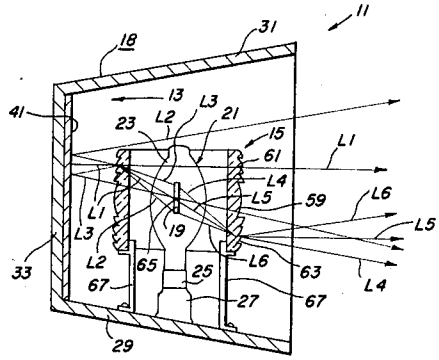


FIG. 1

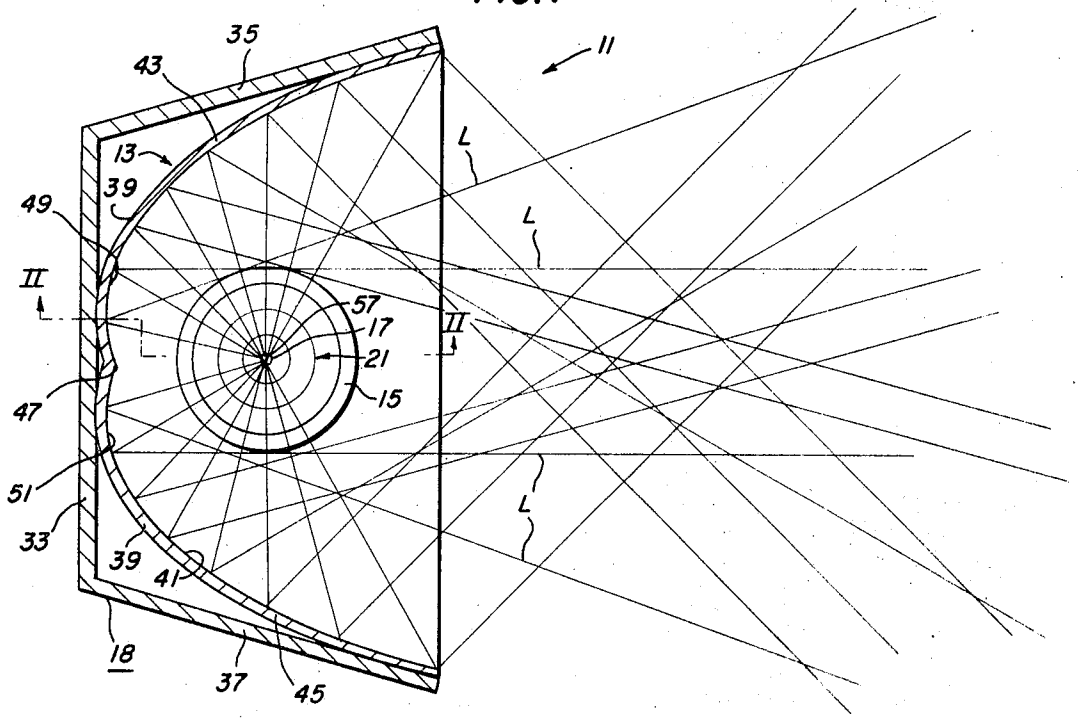


FIG. 2

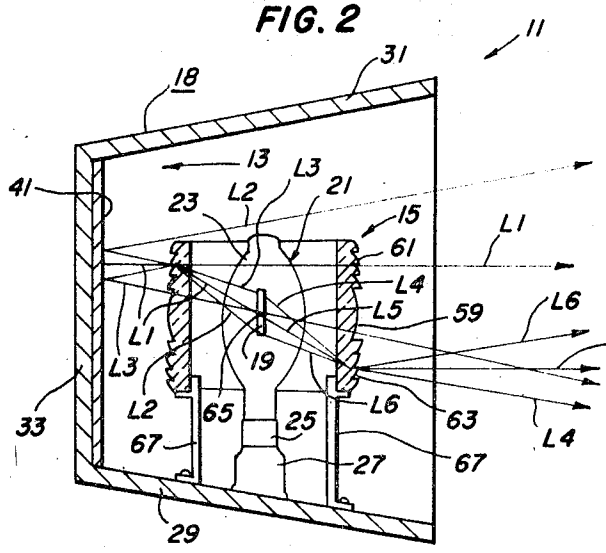


FIG. 3

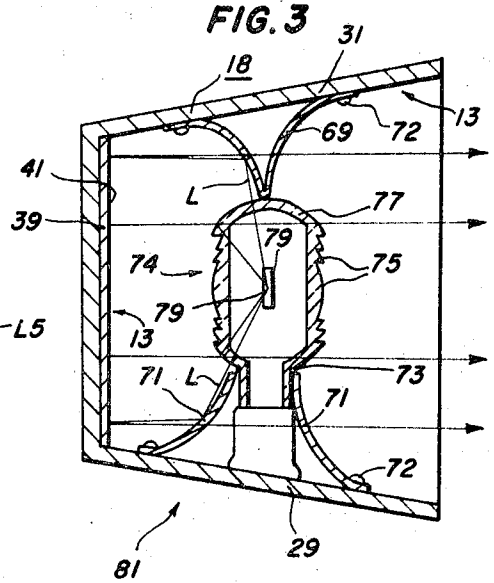
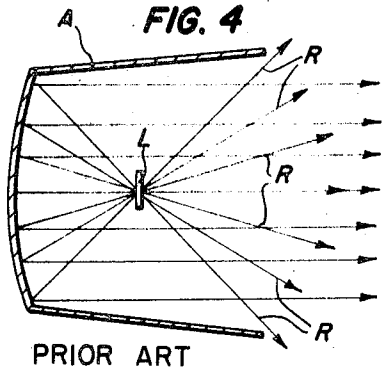


FIG. 4



PRIOR ART

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FIG. 5

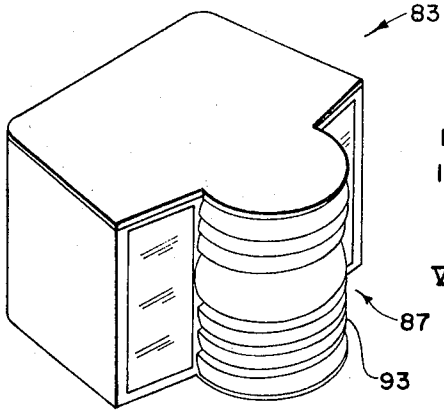


FIG. 6

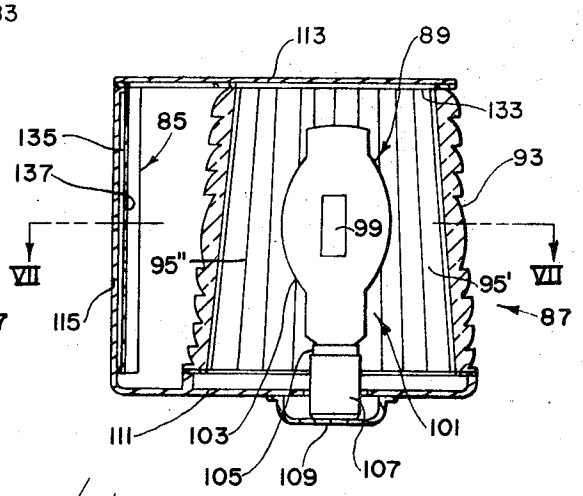


FIG. 7

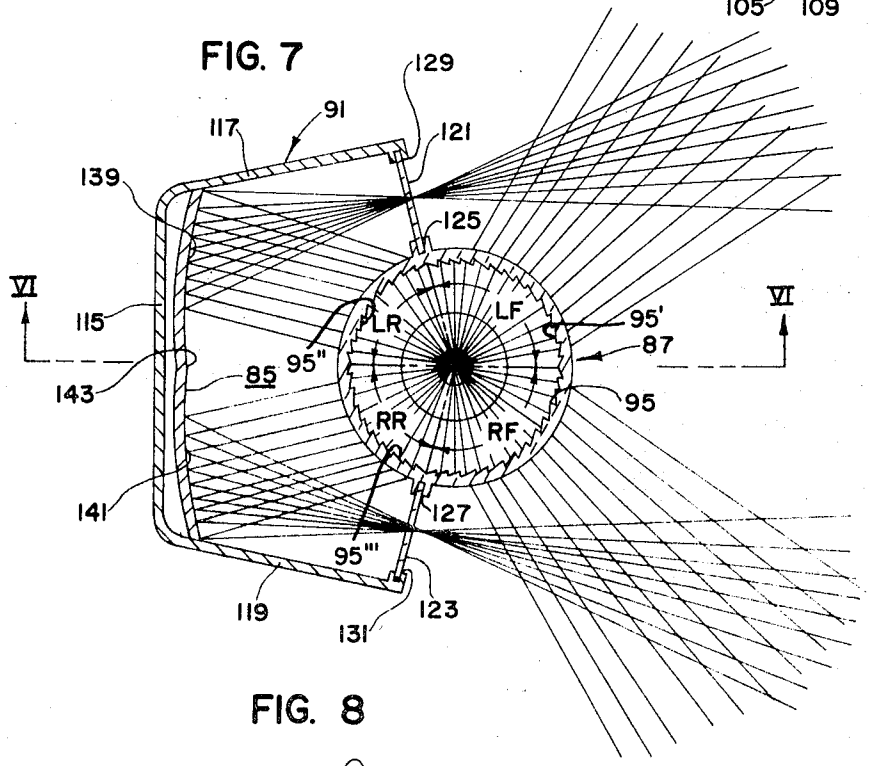


FIG. 8

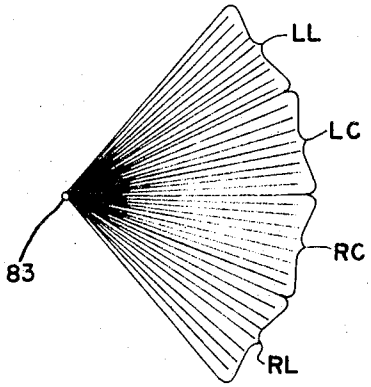
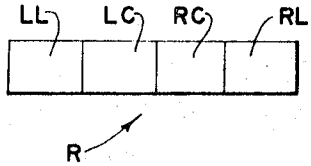


FIG. 9



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FLOODLIGHT

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my co-pending application, Ser. No. 693,220, filed Dec. 18, 1967, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to lighting and particularly to floodlights.

2. Description of the Prior Art

The typical floodlight presently available that is used in applications requiring beams of rectangular proportions is shown in FIG. 4. In this FIG., L represents the light source and A the reflector in vertical cross section. It will be seen that the reflector has a somewhat parabolic shape at the rearward portion thereof in order to achieve the desired narrow vertical spread (all reflected rays coming out more or less parallel). It is the non-reflected rays of light shown as at R which cause the undesirable characteristics of glare and inefficiency to be present in this fixture. Thus, in FIG. 4 it can be seen that rays R are radiating in directions other than the desired narrow vertical limits and thus contribute to glare and inefficiency. It will be understood that the horizontal cross-sectional shape of reflector A is any suitable shape that will give the desired beam characteristics in the horizontal plane.

SUMMARY OF THE INVENTION

The present invention is directed towards overcoming the heretofore-mentioned and other disadvantages of prior reflectors. Thus, the floodlight of the present invention provides a high efficiency rectangular beam of light, with a minimum of glare and yet with a reduction in the cost of the manufacture of the reflector. The present invention accomplishes these results by controlling the light rays so that they give a narrow beam in the vertical dimension with the use of an annular refractor including a condensing lens around the light source which redirects the rays of light into substantially horizontal rays of light and by providing reflector means, spaced behind and to the sides of the light source, that has substantially straight walls in vertical section for reflecting a portion of the substantially horizontal rays of light to produce with the unreflected rays a high efficiency rectangular beam. Although the reflector is straight or perfectly flat in the vertical cross section, the beam spread coming off the reflector will not exceed that of the lens. This is a unique feature of this invention in that it permits close vertical control without the use of a complicated and necessarily expensive reflector. It can be seen that a fixture of this type places virtually all the light available from the source in the desired beam pattern, thus making it efficient beyond anything now being used. It can be appreciated that the fact that the reflector has straight walls makes it much more economical to manufacture than the reflectors of the type shown in FIG. 4 which have the walls formed of a compound curve such as a paraboloid of revolution.

Another feature of the present invention in a modified arrangement is the use of auxiliary reflector means for reflecting the upwardly and downwardly emitted rays from the light source into substantially horizontally extending rays of light. The use of these auxiliary reflector means causes a gain in control, which would otherwise be unavailable, and an increase in utilization, all of which will be brought out in more detail in the description of the preferred embodiment. In addition, there is included an alternate embodiment in which the glass envelope, which is a part of the lamp, is formed into a condensing lens.

Still another feature of the present invention in another modified embodiment is the use of vertical prisms on the inside of the annular refractor which permits the use of a reflector of a much reduced size and therefore a substantial savings in manufacturing cost. The vertical prisms in the inner forward part of the refractor redirect the light into a portion of the rectangular light pattern and the vertical prisms in the inner rearward part of the refractor redirect the light onto the reduced reflector which in turn reflects the light to fill in the remaining portions of the rectangular light pattern.

DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic sectional view taken as on a horizontal plane through the floodlight of the present invention, showing the reflection of some of the rays of light.

FIG. 2 is a vertical sectional view of the same taken as on the line II—II of FIG. 1.

FIG. 3 is a view similar to FIG. 2 of an alternate embodiment of the present invention, showing the reflection of some of the rays of light.

FIG. 4 is somewhat of a diagrammatic view of a prior device.

FIG. 5 is a perspective view of a modified embodiment of the present invention.

FIG. 6 is a vertical sectional view of the same taken as on the line VI—VI of FIG. 7.

FIG. 7 is a horizontal sectional view of the same taken as on the line VII—VII of FIG. 6.

FIG. 8 is a somewhat diagrammatic plan view showing the rays of light emanating from the floodlight of FIGS. 5–7.

FIG. 9 is a diagrammatic view showing the beam pattern on a vertical surface.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. 1 and 2 the floodlight 11 of the present invention includes in general a reflector 13, sleevelike refractor or condensing lens 15, and a light source 17. Also, a housing 18 is preferably provided for the components of the floodlight 11.

It should be noted that when the term "condensing lens" is used herein, it will be deemed to include not only the plano-convex lens but also Fresnel lens and prismatic refractors which yield essentially the same type of control.

The light source 17 is preferably any suitable elongated source such as the mercury arc tube 19, which is part of the lamp 21 that also includes the usual outer glass envelope 23, base 25 and suitable lead wires, not shown. The base 25 of lamp 21 is received in the usual socket of support 27 which in turn is preferably mounted on the upper surface of the bottom 29 of housing 18 so that the lamp 21 is arranged vertically and the elongated light source 17 is arranged along a vertical axis. In addition to bottom 29, housing 18 preferably includes a top 31, a back 33, and sides 35, 37 which diverge forwardly from back 33. The housing 18 is open at the front or the right as viewed in FIGS. 1 and 2 for the passage of light therethrough. Also, it will be noted that bottom 29 and top 31 preferably diverge from back 33, as best seen in FIG. 2. If desired, a glass, not shown, is mounted across the front of housing 18. Reflector 13 has substantially straight vertical walls 39. In other words, the reflecting surfaces 41 of the reflector in vertical section are substantially straight or flat, as best seen in FIG. 2. Stated another way, a vertical section taken through the wall 39 anywhere along the reflector 13 would show that the wall is straight vertically, and the reflecting surfaces 41 thereof are vertically straight or flat. However, if desired, a pattern such as facets or the like, not shown, may be embossed in a well known manner on the surfaces 41 of the reflector 13 to smooth out the light, without departing from the spirit and scope of the present invention. This could mean no more than variations in surface finishes, such as satin or semi-specular. Reflector 13, in the horizontal cross section (FIG. 1), is shaped to give the desired beam characteristics in the horizontal plane. In the particular example shown, the reflector 13 comprises a pair of similar parabolic segments 43, 45 which are symmetrically arranged with respect to light source 17 with the segments preferably, though not necessarily, integrally formed and meeting along an edge 47 directly behind

light source **17** and providing reflecting curved surfaces in the area **49, 51** to cause the rays of light L to miss the light source **17** and lens **15**.

Condensing lens **15** preferably is in the form of a so-called "Fresnel" lens. This well-known type of lens is briefly described as follows: The Fresnel lens is annular and is a solid of revolution. For example, the section shown in FIG. **2** is the same throughout the lens and is revolved about an imaginary vertical axis indicated as at **57** in FIG. **1**. The center portion **59** of the Fresnel lens is rounded and the upper and lower portions **61, 63** are respectively stepped, as best seen in FIG. **2**. The Fresnel lens is a condensing lens and the characteristic thereof is that rays of light emanating from the center shown as at **65**, when they pass through the lens, are redirected into horizontal rays of light. Rays of light, such as the ray L_1 coming from the center of the elongated tube **19** striking the lens **15** at any point will come out horizontal. Light coming from the ends of the arc tube **19**, such as the rays L_2 and L_3 will not come out quite horizontal but substantially so and will be restricted to a spread dependent on the size relationship between the tube **19** and the lens **15**. As a practical matter, this spread should be limited to approximately 20° with available sizes of lamps and lenses. It will be noted that since the reflector walls **39** are perfectly flat in the vertical cross section, the spread of light rays coming off the reflector will not exceed that of the lens. Thus, a highly efficient rectangular beam pattern is provided that has a narrow vertical spread.

The unreflected rays of light such as the rays L_4, L_5 and L_6 pass through the front part of the lens **15** and with the other rays that are reflected make up the horizontal beam having a narrow vertical spread. It will be noted that the lens **15** completely surrounds the light source **17** with the light source and the lens being concentric, and with the lens **15** being supported in such a position by suitable means as the brackets **67**. It will also be noted that the axes of light source **17** and condensing lens **15** are parallel with walls **39** and reflector surface **41**.

As is known, the radiation pattern of a vertically arranged lamp **21** is in the form of a toroidal pattern extending 360° around the light source **17** and principally between limits of about 60° upwardly from the horizontal plane to about 60° below the horizontal plane so that little light is radiated upwardly and downwardly from the light source **17**. However, if it is desired to utilize this light that is radiated upwardly and downwardly, beyond the 45° limit which the Fresnel lens is capable of controlling, auxiliary reflectors as the upper auxiliary reflector **69** and lower auxiliary reflector **71** may be provided adjacent the upper and lower portions of the light source, as seen in FIG. **3**. The reflectors **69, 71** are preferably paraboloids of revolution and so arranged that the upwardly and downwardly emitted rays of light such as those shown as at L in FIG. **3** will strike the reflectors **69, 71** and be reflected substantially horizontally therefrom, with some of the rays being again reflected from reflector **13** and some extending forwardly without being reflected by reflector **13**. It will be understood that the rays reflected from reflector **13** will miss reflectors **69, 71** because of the areas **49, 51**, heretofore described. Reflectors **69, 71** are respectively attached to top **31** and bottom **29** by suitable means, as rivets **72**, and reflector **71** is truncated to provide an opening **73** for the lower part of lamp **74**. In FIG. **3**, lamp **74** is shown as an alternate embodiment, wherein it will be seen that instead of having a separate condensing lens as in FIGS. **1** and **2**, the condensing lens **75** is made an integral part of the other transparent envelope **77** of the lamp **74**. The lamp **74** also includes the usual vertically elongated light source such as the elongated mercury arc tube **79**, base, lead wires, etc., not shown, which are the usual parts of a lamp necessary to provide illumination. The remaining parts of the modified flood lamp **81** shown in FIG. **3** are substantially like those of the principal embodiment of FIGS. **1** and **2** and corresponding parts are shown by the same numbers. Although the reflectors **69, 71** are shown with a different embodiment in FIG. **3**, that is, with a modified lamp and lens it will be understood that these reflectors may be provided with the floodlights of FIGS. **1** and **2**.

Referring now to FIGS. **5–9**, the modified floodlight **83** includes in general a reflector **85**, a sleevelike refractor **87**, and a light source **89**. Also, a housing **91** is preferably provided for the components of the floodlight **83**. Refractor **87** includes a condensing lens **93** on the exterior thereof which is similar to condensing lens **15**. As previously mentioned relative to the previous embodiments described, the term "condensing lens" as used herein will be deemed to include not only the plano-convex lens but also Fresnel lens and prismatic refractors which yield essentially the same type of control. Condensing lens **93** preferably is in the form of a so-called "Fresnel" lens and is constructed substantially like the Fresnel lens illustrated in FIGS. **1** and **2**, except, if desired, rather than being of the same diameter from the top to the bottom thereof, it might be slightly tapered as shown in FIG. **6**. Thus, the only substantial difference between refractor **87** and condensing lens **15** is that refractor **87** includes in addition to condensing lens **93** a plurality of vertical prisms **95, 95′, 95″**, and **95‴** on the interior of refractor **87**, the purpose of which will be described in more detail later in the specification.

The light source **89** is similar to light source **17** and is preferably any elongated source such as the mercury arc tube **99**, which is part of the lamp **101** that also includes the usual outer glass envelope **103**, base **105** and suitable lead wires, not shown. The base **105** of lamp **101** is received in the usual socket or support **107** which in turn is preferably mounted in the depressed part **109** of the bottom **111** of housing **91**. In addition to bottom **111**, housing **91** preferably includes a top **113**, a back **115**, and sides **117, 119** which diverge forwardly from back **115**. A pair of glass panes **121, 123** respectively angle outwardly and rearwardly from refractor **87** on opposite sides thereof and together with the forward part of refractor **87** form the front of floodlight **83**. Preferably, the glass of the refractor **87** is formed to establish vertical grooves **125, 127** to receive respectively the inner edges of the glass panes **121, 123**, as best seen in FIG. **7**. Also, the forward edges of sides **117, 119** are respectively formed with vertical grooves **129, 131** to receive the outer edges of panes **121, 123**. In addition, the portions of bottom **111** and top **113** that engage the bottom and upper edges of glasses **121, 123** are preferably also formed with grooves, not shown, which receive the lower and upper edges of the glass in the same manner that the side edges are received. In addition, gaskets, not shown, are preferably provided to seal the edges of the glasses **121, 123**. If desired, glass panes **121, 123** may be omitted without departing from the spirit and scope of the present invention. Gasket **133** is also preferably provided between top **113** and the upper edges of back **115**, refractor **87**, and sides **117, 119**. The top **113** is removably held in place by suitable means, not shown, so that the top can be removed for access to the interior of the housing **91**. The back **115** and sides **117, 119** are preferably integrally formed.

As will be noted from FIG. **7**, the light source emits rays of light therefrom in substantially all directions including substantially a 360° arc as considered relative to horizontal planes through floodlight **83**. Reflector **85** is disposed in a minor sector of the above mentioned arc (that is, in an arc less than 180°). The reflector **85** has substantially straight vertical walls **135**. In other words, the reflecting surfaces **137** of the reflector in vertical section are substantially straight or flat, as best seen in FIG. **6** and in fact in vertical section are substantially like that of reflector **13** of the preferred embodiment. Also, relative to the vertical control of the light beam, reflector **85** and condensing lens **93** function in the same manner as reflector **13** and condensing lens **15** to provide a beam having a narrow vertical spread. Although in vertical control of the beams the floodlights **83** and **11** are similar, the two embodiments are different in their direction or control of the light as considered in horizontal planes. In the floodlight **11** the distribution in this respect was achieved principally by the reflector **13**, whereas with the floodlight **83** the desired pattern is achieved partially

by means of a part of the vertical prisms **95**, **95'**, **95''**, **95'''** and partially by the smaller reflector **85** working in conjunction with the remainder of the vertical prisms **95**, as will be better understood in the description to follow:

For purposes of clarity in description, the rays of light emanating from the light source **89**, as viewed in plan, as in FIG. **7**, will be broken up into the various sectors shown, that is, the left front sector, LF, the right front sector, RF, the left rear sector, LR, the right rear sector, RR. It will be understood that the two front sectors, LF and RF, comprise a major sector, i.e., a sector greater than, 180° and the part of the refractor **87** in this sector extends around the front of the floodlight between glass panes **121**, **123**; and the rearward sectors LR and RR together are in a minor section, i.e., a sector less than 180°, and extend in the interior of the floodlight between glasses **121**, **123**. The vertical prisms **95'** in the part of refractor **87** in section LF are arranged to direct the rays of light into the left lateral portion or the portion LL of the total rectangular beam R as shown in FIGS. **8** and **9**. It will be understood that FIG. **9** shows the beam pattern of beam R as would appear on a vertical surface upon which the floodlight **83** was shining. The vertical prisms **95** in the part of refractor **87** in sector RF are arranged so that the light rays from light source **89** are directed to the right lateral portion RL of beam R as seen in FIGS. **8** and **9**. The vertical prisms **95''** in the part of refractor **87** in sector LR are arranged to direct the rays of light from light source **89** onto the segment **139** of reflector **85** which in turn is preferably configured to reflect the rays of light into the left center portion, LC of beam R. The vertical prisms **95'''** in the part of refractor **87** in sector RR are arranged to direct the rays of light onto the segment **141** of reflector **85** which preferably is configured to reflect the rays of light into the right center portion RC of the beam R. Thus, the completed beam R is made up of the portions LC and RC which form the center part of the beam and the portions LL and RL which form the lateral portions thereof. It will be noted that in the particular example shown, the segments **139**, **141** are essentially parabolic and are symmetrically arranged with respect to light source **89** with the segments preferably, though not necessarily, integrally formed and meeting along an edge **143** directly behind the light source **89**. Also, it should be pointed out that, if desired, the vertical prisms **95**, **95'**, **95''**, **95'''** and reflector **85** could be arranged to give the reverse of the above-described filling out of the beam R. In other words, the vertical prisms **95** **95** in the part of refractor **87** in sectors LF and RF may be arranged to direct the light into the center portions, LC and RC of the beam R, and the vertical prisms **95''**, **95'''** in the part of refractor **87** in the sectors LR and RR with the reflector **85** may be arranged to direct and reflect the rays of light into the lateral portions LL and RL of the beam R.

Although preferred embodiments of the present invention have been described, it will be understood that various modifications in the disclosed structures may be made without departing from the scope of the invention.

I claim:

1. A floodlight for providing a substantially rectangular beam comprising a reflector means spaced behind said light source and having substantially straight walls in vertical section, and condensing lens means disposed in a 360° ARC around said light source in concentric relationship therewith and interposed between said light source and said reflector means with said light source being disposed medially of said condensing lens means for causing the rays from said light source passing through said lens means to be refracted substantially perpendicular to said vertically elongated light source and substantially parallel with one another as considered along vertical planes through said floodlight and to be reflected from said reflector means in a substantially rectangular beam wider than said reflector means.

2. The floodlight of claim **1** in which upper and lower auxiliary reflector means are provided for reflecting the upwardly and downwardly emitted rays from said light source into substantially horizontally extending rays of light.

3. The floodlight of claim **1** in which said lamp includes an outer transparent envelope and in which said lens means is integrally provided as a part of said envelope.

4. The floodlight of claim **1** in which said reflector means comprises a pair of similar segments symmetrically arranged with respect to said source of light and with the segments meeting along an edge directly behind said light source and providing reflecting curved surfaces to cause the rays of light from said lens means that are reflected by said reflector means to miss said light source and said lens means.

5. A floodlight for providing a substantially rectangular beam comprising a lamp including an elongated light source emitting rays of light therefrom, lens means revolved around an imaginary axis and concentrically disposed 360° around said light source for refracting said rays of light from said light source into rays of light substantially perpendicular to said axis, said light source being disposed medially of said condensing lens means, reflector means substantially parallel with said light source and disposed in spaced relationship to said lens means and around a portion thereof for reflecting a portion of the refracted rays of light to provide with the unreflected ones of the refracted rays a substantially rectangular beam wider than said reflector means.

6. The floodlight of claim **5** in which upper and lower auxiliary reflector means are provided for reflecting the upper and downwardly emitted rays from said light source into substantially horizontally extending rays of light.

7. The floodlight of claim **5** which said lamp includes an outer transparent envelope and in which said lens means is integrally provided as a part of said envelope.

8. A floodlight for providing a substantially rectangular light beam pattern as considered relative to a vertical plane spaced in front of said floodlight, said floodlight comprising a light source emitting rays of light therefrom in substantially all directions including substantially a 360° arc as considered relative to horizontal planes through said floodlight, reflector means spaced behind said light source and having substantially straight walls in vertical section, and refractor means disposed around said light source in substantially a 360° arc including a major sector and a minor sector, said reflector being positioned with respect to said refractor so that only rays of light from said source passing through said minor sector strike said reflector, said refractor means including condensing lens means in said major and minor sectors, said condensing lens means in said minor sector being interposed between said light source and said reflector means for causing the rays of light from said light source passing through said condensing lens means in said minor sector to be reflected by said reflector means substantially parallel with one another and substantially parallel with the unreflected rays passing through said condensing lens means in said major sector as considered in vertical planes through said floodlight and to establish with the unreflected rays a beam having a narrow vertical spread.

9. The floodlight of claim **8** in which said refractor means includes vertical prisms in at least a portion of the interior thereof and said reflector means includes curved portions when considered relative to horizontal planes through said floodlight for reflecting the rays of light passing through said vertical prisms into at least a portion of said rectangular light beam pattern.

10. The floodlight of claim **9** in which said refractor means includes vertical prisms in substantially the remaining portions of the interior thereof for refracting the unreflected rays of light from said light source passing therethrough into the remaining portions of said rectangular light beam pattern.

11. The floodlight of claim **8** in which said refractor means includes vertical prisms in said minor sector and said reflector means includes curved portions when considered relative to horizontal planes passing through said floodlight for reflecting the rays of light passing through said vertical prisms in said minor sector to either side of said refractor means and into the central portion of said rectangular light beam pattern, and said refractor means includes vertical prisms in said major sector

for refracting the unreflected rays of light from said light source passing therethrough into lateral portions of said rectangular light beam pattern.

* * * * *