Aug. 3, 1937. R. B. BENJAMIN 2,089,049

EXPLOSIONPROOF LIGHTING FIXTURE

Original Filed Jan. 25, 1933 3 Sheets-Sheet 1

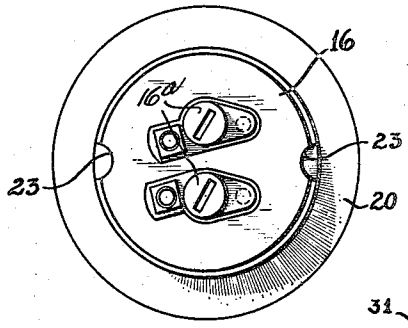


Fig 4

Fig 1

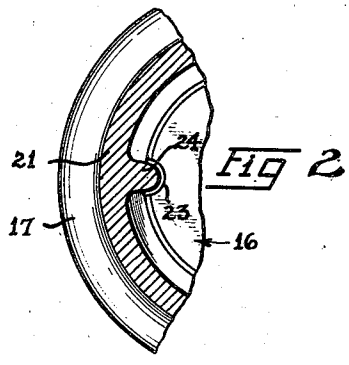


Fig 2

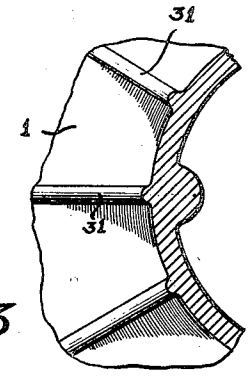


Fig 3

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Fig 5

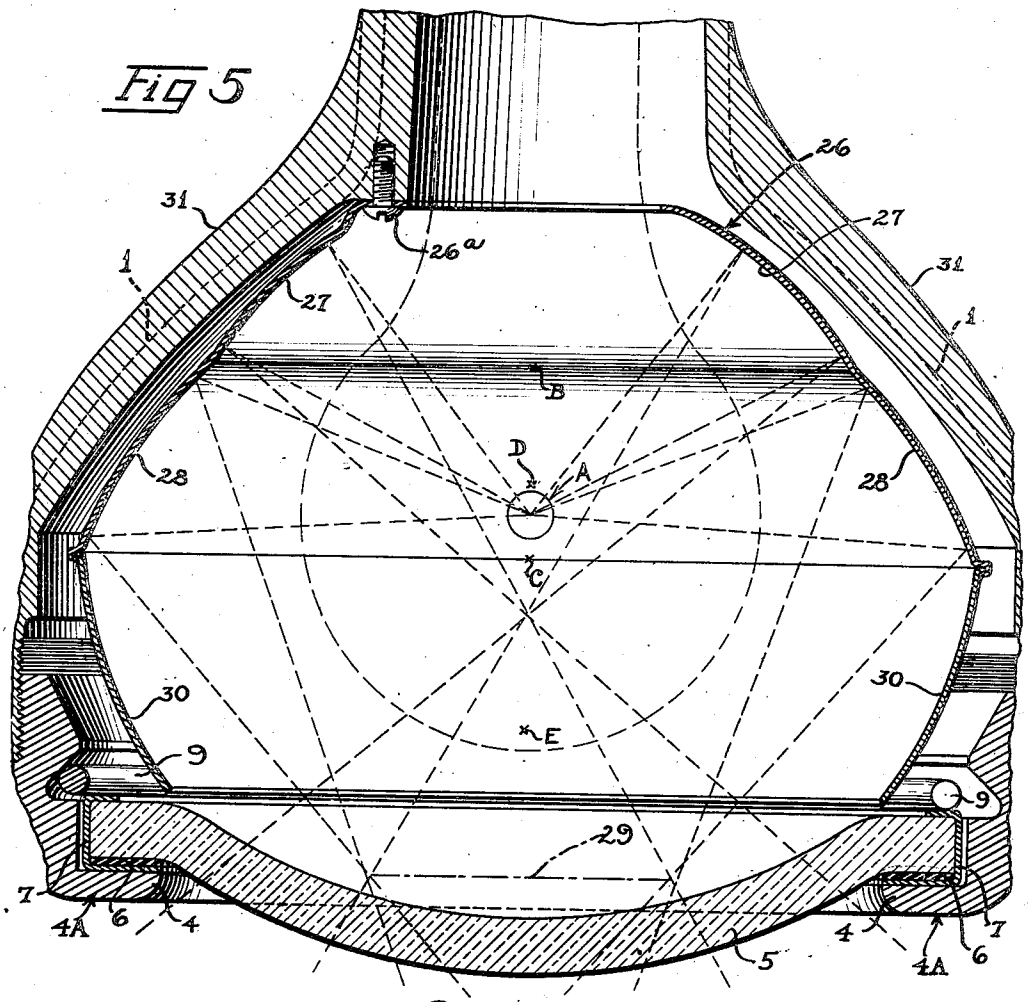
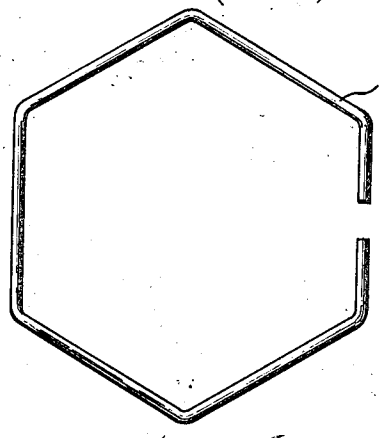


Fig 6



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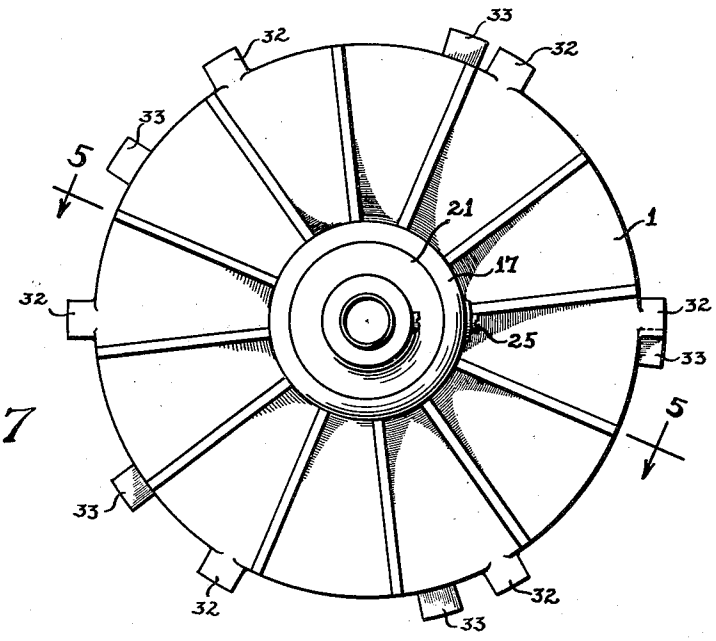


Fig 7

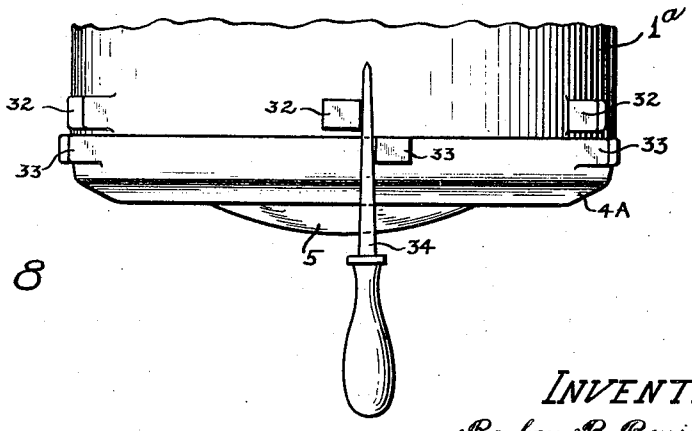


Fig 8

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UNITED STATES PATENT OFFICE

2,089,049

EXPLOSIONPROOF LIGHTING FIXTURE

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Application January 25, 1933, Serial No. 653,414
Renewed September 8, 1936

6 Claims. (Cl. 240—11.2)

This invention relates to lighting fixtures and more particularly to that type known as explosion-proof lighting fixtures, and is especially constructed and adapted for use in hazardous places where inflammable or explosive gases are present.

In this invention it is very desirable that it should be so constructed that a widely divergent beam of light may be projected through a relatively small opening in such a manner as to illuminate large areas with substantially uniform intensity.

It is, therefore, an object of the present invention to provide a comparatively small, compact, lighting unit in which all direct rays are directed through a relatively small opening to provide a widely divergent beam, and all reflected rays are caused to converge and be directed through the opening to effect a widely divergent beam of reinforcing rays, the combined effect of all of the rays causing substantially uniform intensity over a large area.

It is also an object to provide an explosion-proof device which is extremely small relative to the size of lamp used and the area illuminated in which the parts are so designed and related that if the surrounding gases leak into the fixture and become ignited the housing and associated parts will be strong enough to resist the explosion without damage thereto.

In a device of this type it is neither necessary nor desirable that the joints should be air-tight, but only that the leak path through the joints be long enough between heat-conducting parts to cool the gases sufficiently as they pass out after being ignited, thereby preventing the ignition of the gas on the outside of the fixture.

Another object is to provide a comparatively small fixture having a housing and a light source therein with a main reflector portion positioned about the rear of the light source, and a relatively small opening in one side thereof through which is emitted a widely divergent beam of intersecting rays, a second reflector portion having a diameter not substantially greater than that of the main reflector portion and positioned forwardly thereof for reflecting rearwardly, through or near the light source, to the rear reflector substantially all the light rays which are received by it and thus redirecting the rays back through the opening in substantially the same direction as the direct rays from the light source passing through the small opening in the housing. The small opening is made possible by the combination of reflectors and the construction and arrangement of the component parts of the fixture.

The front reflector is so formed and positioned that the twice reflected rays which are first reflected by the front reflector, and then again by the main reflector portion, strengthen and reinforce the divergent beam of light at the outer portion of the beam so that the beam is of progressively higher intensity from the center outwardly on any arcuate surface formed with the light source as a center, whereby the light distribution over a flat surface such as a floor wall or roadway is of substantially uniform intensity over the entire illuminated area. Such a construction is unusually efficient and is suitable for lighting large areas with a substantially uniform intensity.

A further object of the present invention is to provide a lighting fixture of the character herein described having a plurality of substantially spherical reflecting surfaces and in which the focal points and the centers of curvature of the various reflecting portions are so positioned relative to each other and to a light source that the reflected rays will not be concentrated at any definite conjugate focus point, but in which the conjugate foci will be widely distributed and therefore there will be no hot spot on or within the material of the glass or lens or outside the fixture to cause a so-called hot spot to ignite the surrounding gases.

In the past, so-called explosion-proof lighting fixtures have been provided with a hood above the lamp and a heavy glass cylinder or globe with a spherical lower end. The glass globe was clamped to the hood and the reflector placed above and outside the globe was necessarily of large diameter in order to intercept and reflect a sufficient number of the rays from the lamp to provide ordinary distribution. In such a structure it is difficult to protect the glass globe against breakage and a heavy wire guard is usually provided for that purpose. This guard intercepts a considerable number of light rays and decreases the efficiency of the fixture; also the globe is comparatively large and in a position to be easily broken and if broken the bulb is also apt to break and ignite the surrounding gas.

In some locations the hazard consists of dust which may easily explode and the large external reflectors as well as the globe of previous fixtures are subject to accumulations of dust and dirt which decrease the efficiency and necessitate frequent cleaning and the necessary removal of the guard.

The fixture disclosed herein is much more compact, the distribution is more uniform, and the fixture is more efficient. Also the glass is small and protected by the housing against damage from any angle above the horizontal, and its strength may be sufficient to obviate the necessity for a guard. The outside contour is such that accumulation of dust is not likely to occur. The small size and shape prevents dirt settling thereon in any large quantities.

In the fixture shown in this application, the glass is reduced to a small size and is not easily broken but if broken is more cheaply replaced, and in view of the fact that all the rays, whether direct or reflected, pass through this glass, changes in the surface of the glass can be made to vary the distribution quite materially and this can readily be done when the glass is molded.

By employing a plurality of reflecting portions, suitably positioned relative to a light source, substantially all the light from the light source may be reflected or directed through a comparatively small lens opening, while, at the same time, the diameter of the reflectors and the dimensions of the fixture may be kept within extremely small limits relative to the wattage of the lamp used.

As the device is of a comparatively small size and a relatively small light-emitting opening is required, the entire device may be much lighter in weight and smaller in diameter than the usual construction wherein outside reflectors are used, and a considerable saving in manufacturing and shipping costs results. Furthermore, the circumferential length of the seals between the various parts whereby the device may be made explosion-proof is considerably reduced, the danger of breakage of the lens is materially lessened, and the device may be more easily made completely weather-proof.

While this structure is designed primarily as an explosion-proof unit for use in hazardous locations, it is also intended for outdoor lighting as it is weather-proof as well and is particularly suitable for use in oil fields and around gasoline filling stations.

It is evident that a great advantage is derived in constructing an explosion-proof fixture of comparatively small size and having a relatively small lens or glass front through which substantially all the light from the light source is projected to illuminate a large area.

It is an object of the present invention to provide a fixture of the character described which will successfully withstand all of the normal and overload tests of the Underwriters Laboratories. Therefore, in the development of this lighting fixture, samples were submitted to the Underwriters Laboratories and pipe connections were made to the interior of the housing. The fixture was then located in a bomb-proof outer housing. A spark plug was inserted in the lamp housing and gasoline fumes were admitted into both housings with the lamp lighted. Tests were made with various mixtures of gasoline and air, the pressures in some cases running to over 100 pounds per square inch. Numerous explosions were caused in the fixture and in no case was the mixture outside the fixture ignited, nor was the lamp broken in any instance by the explosion within the lamp housing.

Another object is to provide a fixture of the character described which will be of few parts, cheap to manufacture, easy to assemble, and in which efficient self-contained means is provided whereby the lens may be easily removed or replaced and snugly fitted in position in a manner whereby there will be no tending to loosen other parts of the fixture or of the conduit system.

Further objects and advantages will be apparent from the specification and the appended claims.

In the drawings:

Figure 1 is an axial cross-sectional view through an explosion-proof fixture illustrating one embodiment of my invention;

Fig. 2 is a fragmentary detail section taken on a line corresponding to line **2—2** of Figure 1, and illustrates the means for locking the socket against rotation;

Fig. 3 is a fragmentary transverse section through one side of the casing and taken on a line corresponding to line **3—3** of Fig. 1;

Fig. 4 is a top plan view of the socket;

Fig. 5 is a somewhat diagrammatic view illustrating the relation of the reflectors and lens opening and the approximate light distribution;

Fig. 6 illustrates the split ring for securing the lens in its support;

Fig. 7 is a top plan view of an embodiment similar to that illustrated in Figure 1, but provided with a modified self-contained means for tightening the lens holder in the casing; and

Fig. 8 is a fragmentary side elevation of the embodiment illustrated in Fig. 7 and illustrates the method of tightening the lens holder by means of an ordinary screw driver.

Referring to the drawings in detail, the embodiment illustrated comprises a comparatively thick casing **1** of heat conducting material, preferably cast iron, having a tubular extension **2** and a lens holder **3** threaded into the front end of the casing. The lens holder is also of comparatively thick heat conducting material similar to the housing and comprises a ring having an inturned shoulder **4** to receive a lens or spherical glass plate **5**.

The glass is provided with a gasket-like compression washer **6**, preferably of asbestos, and the washer is covered and secured by a soft metal gasket **7**, which may be of thin lead, which is spun or otherwise formed around and over the outer and upper edge of the glass. Certain underwriters' rules require glass to metal contact; therefore a thin metal washer may, if desired, be provided between the glass and compression washer.

The surface of the shoulder **4** on which the glass rests is usually accurately finished or machined, and, as the glass may not be perfectly flat, the compression washer and lead gasket are provided so that in case of an explosion the pressure against the glass will make the joint between the glass and ring such as to prevent the hot gases from readily passing out and causing an explosion. This construction allows the use of a molded lens which is always more or less inaccurate.

The lens supporting ring **3** is provided with a lateral groove **8** arranged to receive a resilient split ring **9** for engaging the lens and retaining it snugly in position in its support.

In the embodiment shown, threaded connections have been provided throughout as they are well suited for cooling the hot gases which may escape only through the long path of the threads after an explosion in the housing.

On account of friction which might be caused between the glass-holder and the housing, means are provided for loosening or tightening the glass-holder, which means is self-contained so

far as leverage is concerned, thereby preventing unscrewing the casing from the hood or the hood from the conduit.

In the embodiment illustrated in Fig. 1, the lens supporting ring **8** is provided with external annular gear teeth **10**, and a wrench **11** is provided with corresponding teeth **12** and an extension **13**. The extension **13** may be inserted in a suitable opening in a lug **14** on the casing **1** to retain the teeth **12** in engagement with the corresponding teeth on the ring. The wrench **11** may then be rotated to tighten the ring snugly in the casing **1**, or the ring may be easily loosened thereby in order to remove the lens for cleaning or for the replacement of the lamp within the fixture.

The extension **2** of the casing **1** is provided with an inturned annular flange or shoulder **15** for supporting a lamp socket **16**. This lamp socket is provided with an annular flange **17** and a gasket **18** of lead, or other suitable material, is spun around this flange as illustrated and in a manner to retain an asbestos compression washer **19** in position against the socket as shown.

The usual shell and center contacts in the socket are electrically connected to suitable binder screws **16***a* (Fig. 4) thus permitting conductor connections to be made without the necessity for pig-tails or cementing to prevent gases from passing through the socket and into the conduit.

The socket flange **17** is preferably provided with an angularly disposed upper surface **20**, and a hood **21** is threaded on the extension **2** and is provided with a shoulder **22** cooperating with the inclined surface of the socket flange and gasket thereon to thereby clamp the socket snugly in position and provide a substantially air-tight connection.

By this construction the socket is sealed so that it is not necessary to fill back of the socket with a sealing compound as is ordinarily done to keep gases passing from the fixture into the rest of the system, and there are no openings past or through the socket for gases to leak through. They are of such a nature that they are substantially air tight. The socket is preferably of molded material and so constructed that gases cannot pass therethrough.

A vertical groove **23** in the side of the socket is arranged to receive a lug **24** on the hood **21** whereby the socket is prevented from rotation during the insertion or removal of a lamp. A set-screw **25** in the hook **21** is arranged to lock the hood snugly in place on the housing extension **2**.

A main reflector **26** is positioned within the casing **1** and attached thereto by screws **26***a*. The main reflector is provided with a suitable opening in alignment with the casing extension **2** to receive a lamp stem. The main reflector **26** also comprises a plurality of substantially spherical reflecting surfaces **27** and **28**.

The construction of the device is such that a light source will be maintained substantially on the axis of the reflectors and substantially at point A (Fig. 5) relative to the reflecting surfaces and in a suitable relation to the focal points of the plurality of reflector portions and their centers of curvature, in order to produce the desired results and to prevent hot spots on or in the glass or lens or on the outside thereof.

In the embodiment illustrated, the focal point of the reflector portion **27** is indicated at B and its center of curvature is at C. The focal point of the reflector portion **28** is indicated at D and its center of curvature at E and the light source A is between the centers of curvature C—E and the focal points B—D. By this arrangement, as illustrated in Fig. 5, the reflected light rays from the reflector portion **27** will cross adjacent the light source and within the casing and remote from the lens whereby they will not cause a hot spot on the lens or outside thereof to cause an explosion outside the casing. Also as these reflected rays are directed through the light bulb they will not cross at a definite conjugate focus of the rays but they will be somewhat diffused and the crossing points will be distributed around the axial line.

The crossing points of substantially all the reflected rays from the reflector portion **28** will be distributed in a comparatively large circle inside the casing and around the axial line as indicated by the dot and dash line **29**.

With the above described construction and arrangement, all crossing points of the rays outside of the fixture will be widely distributed and there will be no tendency to cause hot spots on any surface on which the light may be directed. The relation of the reflector surfaces, together with the proper distribution of focal points and centers of curvature relative to a light source also provide for a suitably wide and substantially uniform distribution of the light beams over a large area.

A front converging reflector **30** is secured to the reflector portion **26** or adjacent thereto and provides a substantially spherical extension thereof. This reflector may be called a zonal reflector and the center of curvature is substantially at the light source so that substantially all the direct rays in the zone between the reflector **26** and the light opening are intercepted thereby and reflected back adjacent or through the light source and against either the reflector portion **27** or the portion **28** whereby they are again reflected by the reflector portions **27** and **28** and then pass through the lens and on substantially the same lines as the reflected rays described previously.

The reflecting surface of the zonal reflector **30** is adjacent the inner surface of the casing **1** and intercepts substantially all the rays which otherwise would strike the casing. With such an arrangement of reflectors, substantially all the light from the light source is projected through the comparatively small lens opening and this result is accomplished while at the same time decreasing the diameter and the length of the casing and permitting an opening small in comparison to the diameters of the reflectors used.

In order to provide room for the light bulb and to assist in the further distribution of the light rays, the front lens **5** is preferably spherical in shape thereby allowing sufficient distance between the lamp and the lens without increasing the length of the casing.

The particular embodiment herein shown is designed to distribute a cone of light rays with approximately a ninety degree angle but this distribution may be varied by suitable slight variations in the reflectors or their arrangement relative to the light source or by a suitable change in the type of lens used.

The method of attaching the lens ring to the casing **1**, as well as the construction of the casing, is a very important feature of this invention for the reason that while it does not provide an air tight joint, the passage through which the gases from an explosion may escape is small and

comparatively long and all of the escaping gases must pass between the casing and ring which are comparatively thick heat-conducting bodies.

That portion of the casing 1 enclosing the main reflector 26 is concave and conforms substantially to the contour of the reflector while a threaded cylindrical extension surrounds the zonal reflector 30. This provides for a long threaded engagement of the glass supporting ring 3 with the casing 1.

The casing 1 is preferably provided with ribs 31, as indicated in detail in Fig. 3, for the purpose of strengthening the casing and also providing a heat radiating surface.

Figs. 7 and 8 illustrate a slightly modified form of securing means in which the casing 1a is provided with a plurality of outwardly extending lugs 32, while the lens holding ring 4a is provided with a plurality of outwardly extending lugs 33.

In the embodiment illustrated, the casing 1a is provided with an even number of lugs equally spaced around the casing, while the ring 4a is provided with an odd number of lugs also equally spaced around the ring. By this means, one of the lugs 32 on the casing will always be adjacent one of the lugs 33 on the ring when the ring is screwed into the casing. In order to tighten the ring, it is only necessary to insert any suitable tool such as a screw driver 34 between adjacent lugs, and using the screw driver as a lever the ring may be suitably tightened.

It will be apparent to those skilled in the art that various modifications may be made without departing from the spirit and scope of this invention, and, therefore, I desire to be limited only by the prior art and the scope of the appended claims.

What I claim and desire to secure by Letters Patent is:

1. An explosion-proof lighting fixture of the character described comprising a comparatively small housing having a small light opening and means for supporting a relatively large electric bulb with a concentrated light source, said light source being positioned to direct a comparatively wide angle light beam of direct rays through said light opening, a plurality of substantially concave reflecting surfaces remote from said light opening and having spaced centers of curvature for reflecting substantially one-half of all direct rays from the light source through said light opening in a comparatively wide distribution, and a zonal reflecting surface positioned to reflect substantially all of the remaining direct rays against said plurality of reflecting surfaces to be again reflected on substantially the same lines as the single reflected rays.

2. An explosion-proof lighting fixture of the character described comprising a comparatively small housing having a small light opening and means for supporting a relatively large electric bulb with a concentrated light source, said light source being positioned to direct a wide angle light beam of direct rays through said light opening, a plurality of substantially concave reflecting surfaces remote from said light opening and having spaced centers of curvature for reflecting substantially one-half of all direct rays from the light source through said light opening in a wide angle beam, and a zonal reflecting surface positioned to reflect substantially all of the remaining direct rays against said plurality of reflecting surfaces to be again reflected on substantially the same lines as the single reflected rays, all of said reflected rays converging to distributed crossing points within said fixture in a manner to prevent a concentrated focus outside said fixture.

3. An explosion-proof fixture of the character described comprising a relatively small concave casing, means for supporting a relatively large electric bulb in said casing, a relatively small concave reflector around the stem of said bulb and terminating in a plane remote from and behind the light source, a relatively large concave reflector forming substantially a continuation of said small reflector and terminating in a plane adjacent to and in front of said light source, a glass plate mounted in an opening in said casing and spaced from said reflectors to provide a conical light beam through said opening from said light source, a zonal reflector located entirely in front of said light source and forming substantially a continuation of said large reflector and arranged to reflect rearwardly substantially all of the direct rays in the zone between said large reflector and said light opening and against said small and said large reflectors, said last named reflectors being arranged to reflect and converge substantially all rays in a manner to cross inside said fixture and to prevent concentrated crossing points outside.

4. An explosion-proof fixture of the character described comprising a substantially gas-proof casing having a light source therein and a comparatively small glass-covered light opening therethrough, a plurality of concave reflecting surfaces in said casing for reflecting the light from said light source forwardly and causing the rays to converge and cross within said casing, and a zonal reflector for reflecting rearwardly against said plurality of reflectors the direct rays which otherwise would pass between said first plurality of reflectors and said glass, said light source being located between the centers of curvature of said plurality of reflectors and their focal points whereby all concentrated focus points will be within the fixture and all of the crossing points of said light rays outside of said fixture will be widely distributed.

5. A housing for an explosion-proof fixture of the character described comprising a concave casing having a tubular portion extending from the vertex and terminating in a socket receiving shoulder, a hood threaded on said tubular portion and having a socket-engaging shoulder, said shoulders being arranged to clamp a lamp socket therebetween, said concave portion having a cylindrical portion extending forwardly therefrom, a lens supporting ring in threaded relation on said cylindrical portion and having an inturned flange to receive a lens and to provide a light opening of smaller diameter than said cylindrical portion, and a lens in said ring.

6. An explosion-proof fixture comprising a casing capable of withstanding the internal pressure due to an explosion within said casing and sufficiently gas-tight so that the hot gaseous products, due to explosion, will be cooled in escaping sufficiently to prevent ignition outside of the casing, said casing having a light aperture and a cover glass extending across said light aperture, said casing having also an externally threaded neck portion having an upwardly facing annular shoulder, a lamp socket for supporting an electric lamp bulb within said casing having a downwardly facing shoulder having gas-tight engagement with said upwardly facing shoulder, a hood surrounding said socket

having a skirt portion threaded onto said externally threaded neck portion, said socket having a second annular shoulder above the first shoulder, said hood having an annular shoulder bearing on the upper shoulder of the socket for clamping the socket in sufficiently gas-tight relation with respect to the casing so that hot gaseous products due to explosion will be cooled in escaping sufficiently to prevent ignition by the escaping gases and wiring terminals mounted on the socket above the upper shoulder of the socket whereby the hot gases are prevented from reaching the space in the hood above the upper shoulder of the socket.

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