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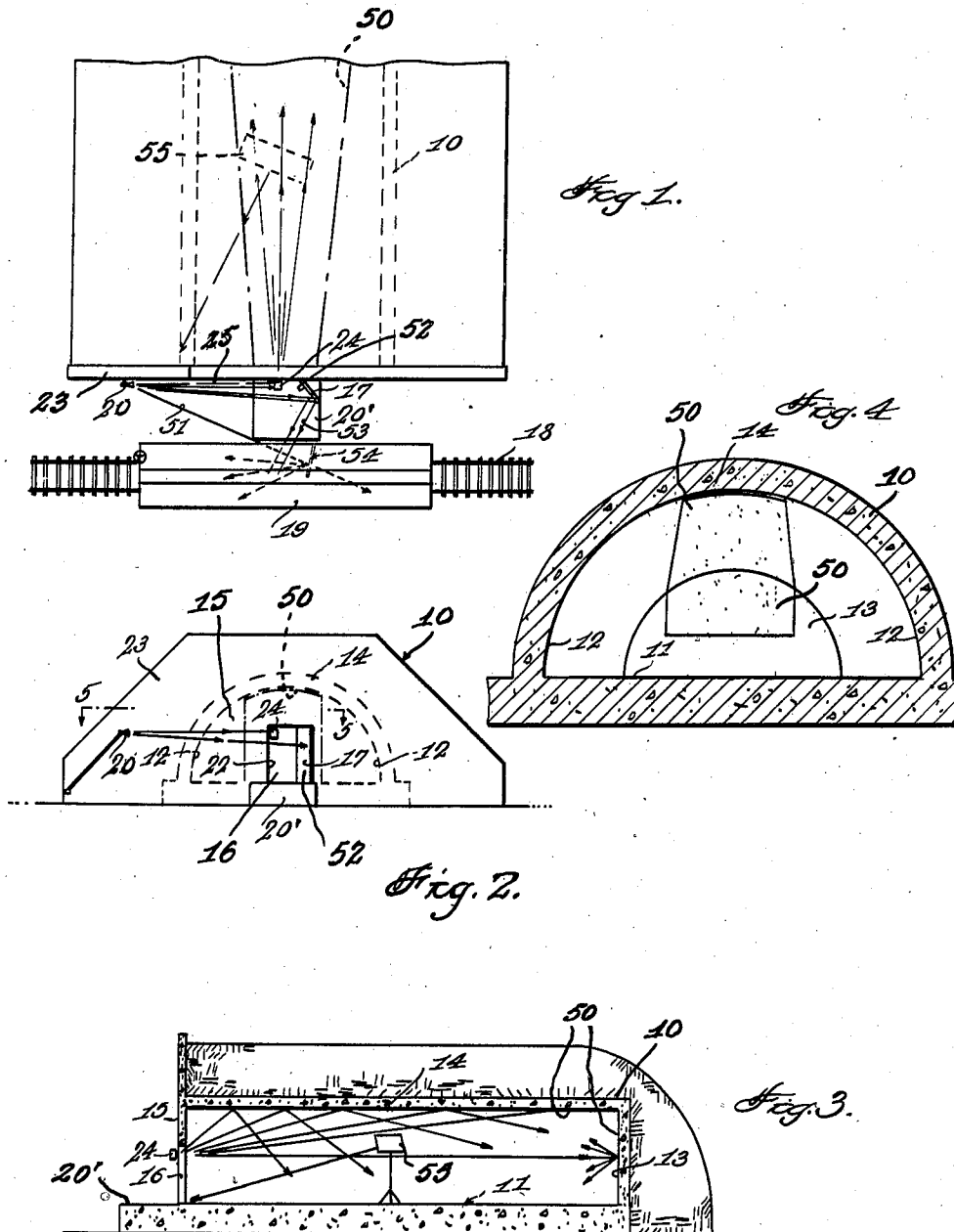
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2,329,501

ILLUMINATION OF EXPLOSIVE CHAMBERS

Filed Aug. 21, 1942

5 Sheets-Sheet 1



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ILLUMINATION OF EXPLOSIVE CHAMBERS

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5 Sheets-Sheet 2

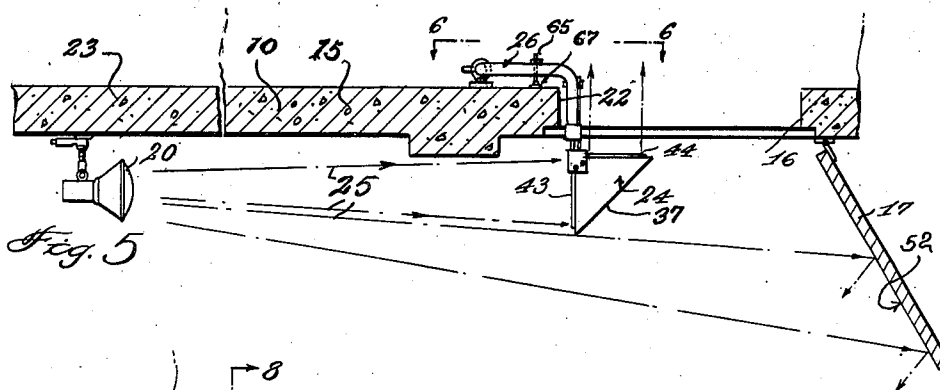
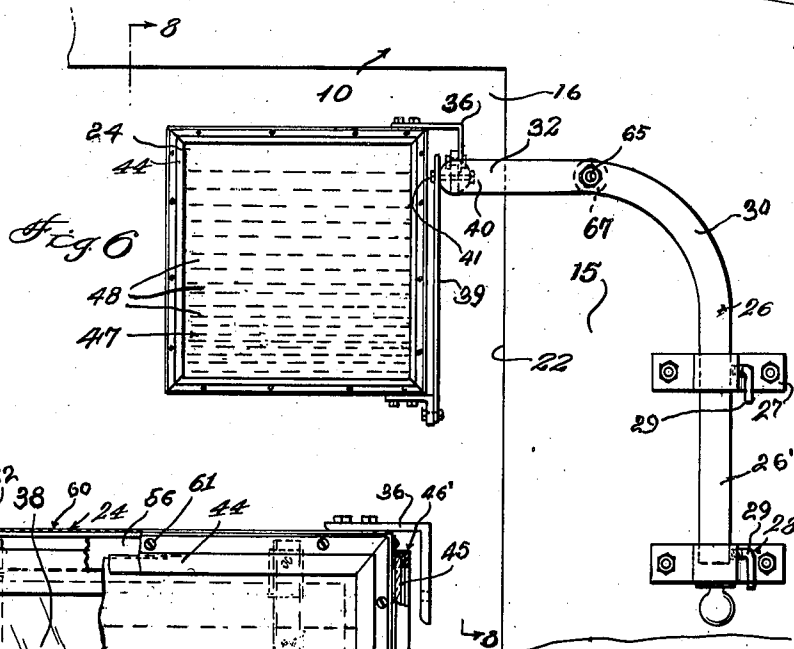
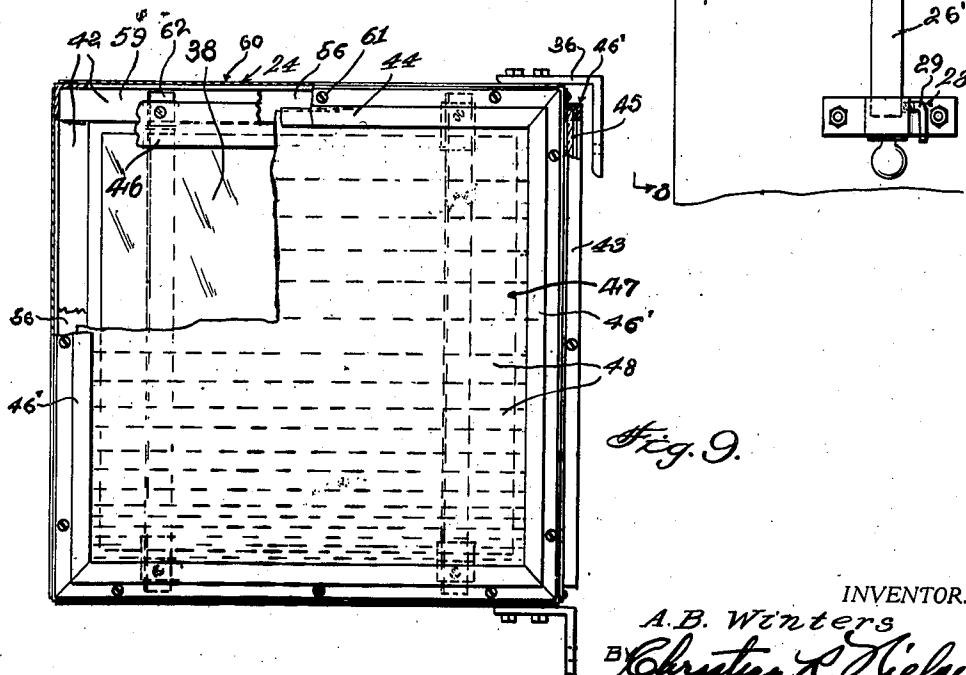


Fig. 9.

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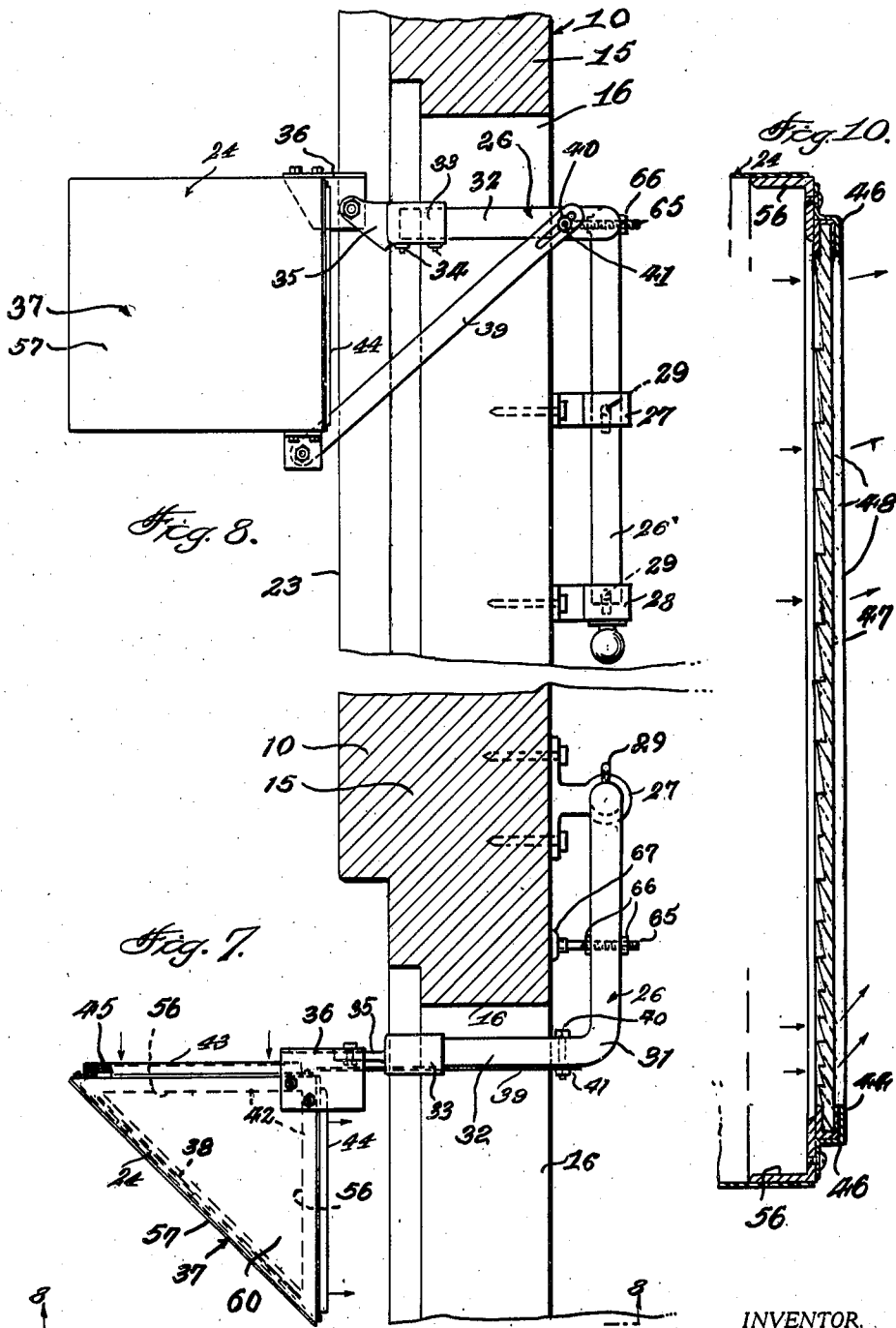
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ILLUMINATION OF EXPLOSIVE CHAMBERS

Filed Aug. 21, 1942

5 Sheets-Sheet 3



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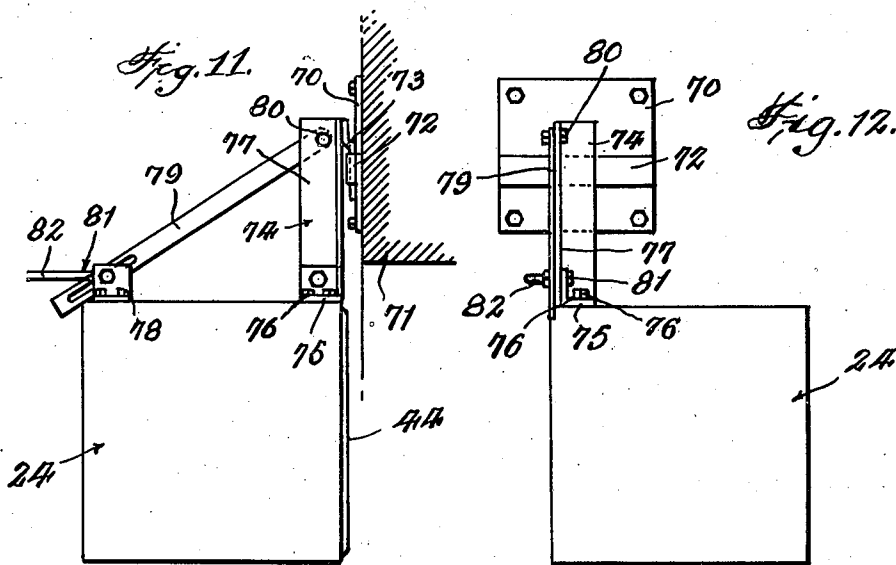
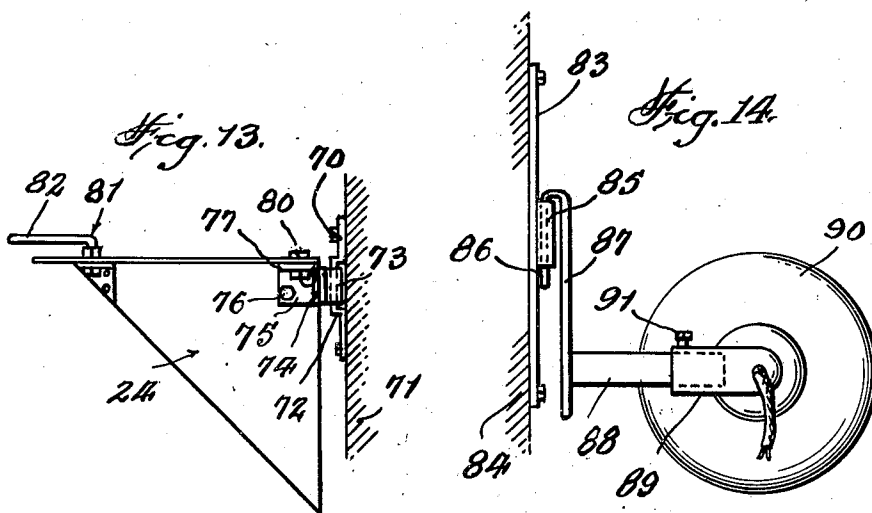
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ILLUMINATION OF EXPLOSIVE CHAMBERS

Filed Aug. 21, 1942

5 Sheets-Sheet 4



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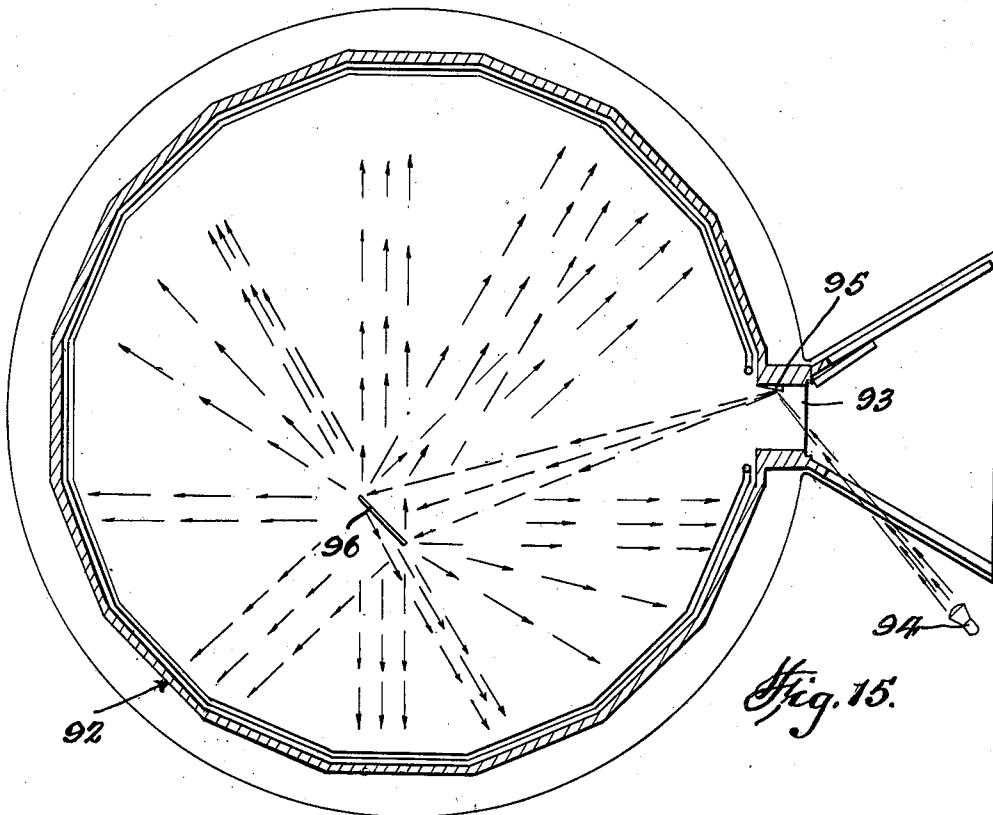
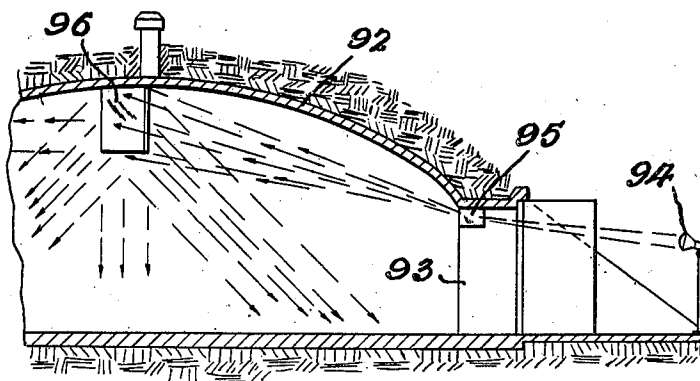
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ILLUMINATION OF EXPLOSIVE CHAMBERS

Filed Aug. 21, 1942

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,329,501

ILLUMINATION OF EXPLOSIVE CHAMBERS

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Application August 21, 1942, Serial No. 455,668

6 Claims. (Cl. 240-2)

The invention relates to means for illuminating structures in the nature of enclosures where it is not practicable or is unsafe to install electrical wiring or other electrical devices, or other conventional illuminating devices, and while especially applicable to the illumination of chambers in which explosives are to be restored, may also be used for the illumination of other structures where similar requirements of safety or expediency are involved.

The device is specifically adapted to use in the illumination of interiors of what are known as "igloos," which are subterranean chambers used for the storage of high explosives. For safety of the contents, from access in various ways, and particularly for safety from observation from the exterior, these structures are formed with a minimum of openings, and without any equipment or structural features involving possible elements of fire, sparks, and shock, as well as a minimum of light. In consequence, they are constructed ordinarily as a large room or masonry concrete, with a single opening, through which men may enter to carry packages of the explosive in moderate quantities. It is a general rule that no electrical circuits are permitted within these structures, nor within a given distance of the access opening to the chamber. In addition to this requirement, which must be met by my invention, there is the further fact that explosives taken in or taken from these structures are handled in very large quantities, requiring the use of railway cars, trucks and the like, and it is a practice to have a railway track or drive way located exteriorly of the structure and extending across a line normal to the entrance opening, so that a car of conventional construction may be drawn up very close to the opening, with the side doors of the car open immediately adjacent the opening of the igloo, so that packages of explosives may be transferred to and from the igloo and car by usual stevedore operations.

It is therefore an important object and accomplishment of my invention to provide means by which the interior of an igloo may be illuminated from a light source located at a distance from said openings, exteriorly of the igloo, while a box car is drawn up in front of the opening and without interruption to the illumination within the igloo by the passage of men and hand trucks or the like through the opening.

It is a further important aim of the invention to present novel construction in means for refracting and reflecting light in a manner to

attain the necessary high efficiency of illumination within the structure under the limitations before stated.

A further important object of the invention, in one form thereof, is the provision of lighting fixtures which are of a portable or demountable character, permitting the use of the apparatus on different igloos, as occasion demands, thus eliminating the use of a particular set of fixtures for each igloo.

Additional objects, advantages and features of the invention reside in the construction, arrangement and combination of parts involved in the embodiment of the invention, as will be more readily understood from the following description and accompanying drawings, wherein,

Figure 1 is a plan view of an igloo structure, railway siding and box car in loading position, with my invention installed and incorporated.

Figure 2 is a front elevation thereof, with the box car removed.

Figure 3 is a longitudinal sectional view of the igloo showing the installation of my invention and its functional operation.

Figure 4 is a perspective view of the interior of the igloo from near the entrance.

Figure 5 is a horizontal section of the front end of the igloo, showing the lighting apparatus in plan.

Figure 6 is a detail elevation of the inner right hand side of the entrance opening of the igloo, showing my interceptor unit and its mounting, enlarged.

Figure 7 is a plan view of the latter.

Figure 8 is an elevation from the left of Figure 6.

Figure 9 is an enlarged elevation of the inner side of the interceptor unit, showing the refractor lens in elevation, partly broken away to show the reflector and its mounting.

Figure 10 is a vertical section of one form of refractor lens which may be used.

Figure 11 is a view similar to Figure 8, illustrating a portable interceptor unit and its mounting.

Figure 12 is a front view thereof.

Figure 13 is a top plan view thereof.

Figure 14 is a view illustrating the demountable support of a lighting fixture employed with the device.

Figure 15 is a horizontal cross section through a modified form of igloo embodying a further means of illuminating the interior thereof.

Figure 16 is a fragmentary vertical cross section thereof.

There is illustrated an igloo structure 10, consisting substantially in a rectangular chamber structure of concrete, in which there is provided a simple floor 11, side walls 12, a back wall 13, a roof portion 14, and a front wall 15, in which there is provided a door opening 16 of rectangular form, adapted to be closed by a conventional door 17 hinged at one side thereof and adapted to be swung backwardly against the outer face of the front wall 15. Customarily, the side walls 12 and roof 14 are formed integrally in one piece, as a simple arch, as indicated in Figure 4.

In front of the door, and spaced a distance from the front wall parallel to the latter, there is a railway track 18, on which a box car 19 is shown in Figure 1, the details of construction of such cars being well known and therefore not illustrated in detail herein, as it is well known that they include large side openings, and the car is drawn up with such opening aligned with the doorway 16. Ordinarily, the trackway is located at a level much below the top level of the floor 11, and the loading platform 20' is extended at a common level with the floor from the door opening 16 to a point close beside the car 19, to facilitate unloading or loading of materials to be stored or removed from the chamber.

Briefly, the invention comprises the use of a lamp 20 of conventional construction, adapted to project a powerful beam of light, and located preferably removable, at a distance of at least 20 feet from the near side of the door opening 16 on a line nearly or quite parallel to the major plane of the opening, and spaced a short distance from the flat wall surface of the chamber structure. In practice, in order to minimize obstruction of the beams from the lamp, it is mounted preferably at a height in the neighborhood of six or seven feet above the level of the floor 11, and is preferably so constructed as to project a beam, the effective part of which has a maximum divergence of 10 degrees for the specific embodiment herein disclosed. In the present instance, a concrete wall portion 23 is extended on each side of the igloo at its flat end, and forming a continuation of the front wall 15 of the chamber, and the wall 23 is utilized as a mounting for the lamp 20, although any other mounting may be employed, as found desirable. The lamp 20 is preferably detachably connected with a suitable electrical source located at the wall 23, or such other support as may be utilized, in the location shown in Figures 1 and 2.

A refracting interceptor device 24 is located immediately in front of the opening 16, and very close to the top of the opening, constructed to intercept a major portion of the beam 25 projected from the lamp 20 as indicated in Figures 1 and 2 and to deflect the intercepted portions of the beam into the chamber 10 with certain characteristics as will be more definitely indicated. The interceptor 24 is mounted on supports at the inner side of the chamber and arranged to be swung from within the chamber to a position exteriorly thereof, for operation. The mounting in the present instance consists of a crane device 26, having a lower vertical rectilinear portion 27 mounted revolvably in two vertically spaced brackets 27 and 28, the latter being a step bearing receiving the lower end of the stem portion. Thumb screws 29 are engaged through the sides of these brackets to impinge upon the stem portion 26', manually operable to secure

the device in retracted inoperative position or in extended operable position.

The crane member is formed of one piece of pipe suitably bent, being curved suitably to a radius of 90 degrees above the upper bracket 27, as at 30 so as to extend horizontally a distance at its upper part, and is then curved in a horizontal direction over a radius of 90 degrees, as at 31, so as to extend normally to the plane of the opening 16 and very close to the side of the side or jamb 22 of the opening when the device is swung to an outer position, as illustrated in Figure 5. In the present instance, the extremity of the upper curved portion is extended in rectilinear from a distance, constituting an arm 32, the extremity of which stops closely adjacent the plane of the outer face of the wall 23 when the crane is in the outermost position. A pipe fitter sleeve 33 is engaged slidably on the extremity of the arm 32, having set screws 34 therein to engage the inserted portion of the pipe, and hold the fitting securely in adjusted position thereon, this permitting rotative adjustment of the interceptor unit 24 about the axis of the pipe. The sleeve 33 is provided on its outer end with a heavy pivot ear 35, in a vertical plane projected longitudinally from the fitting 33 against which there is set a pivot flange of the mounting bracket 36 or the like, forming a part of the frame of the interceptor device 24 at the extreme upper corner of the latter, toward the lamp 20, and next to the igloo structure 10.

The interceptor device consists of a box-like structure in the form of a right triangle in plan, and rectangular in its three elevations, the hypotenuse side 37 of which is provided with a mirror 38 which serves as the reflecting means by which a substantial part of the beams from the light 20 is intercepted and deflecting inwardly through the opening 16. The bracket 36 is secured to the ear 35 by means of a suitable heavy pivot bolt, and the lower part of the boxing of the interceptor at the lower part beneath the bracket 36 has engaged pivotally therewith a diagonal stay 39, which is extended upwardly and inwardly, its inner extremity being longitudinally slotted and receiving therethrough a screw on the bracket piece 40 fixed on the crane at its upper part, the stay 39 being definitely held thereon by means of a binding nut 41, as shown.

The construction of the boxing of the interceptor device may include any suitable framing 42 so as to afford clear openings at the outer and inner sides 43 and 44 of the box where the beam and reflected beam may pass, and including clear glass enclosures 45 and 47 mounted replaceably, while the top and bottom of the box may be formed of sheet metal or other opaque material, and the hypotenuse side of the box may also include an opaque sheet metal wall. At the outer side 43 of the box, toward the lamp 20, and at the inner side 44 toward the door opening 16, as well as around the hypotenuse side thereof, suitable means may be provided as at 46, for removably holding the mirror, and suitable closure glass at the side 43, as well as a lens plate or other light-transmitting glass of the like 47 at the side 44. In the present instance, clear glass is used at the side 43 where the incident beam of the lamp 20 passes inwardly to the mirror, but at the inner side 44 of the box where the reflected beam passes outwardly from the mirror, I use either a sheet of horizontally ribbed glass, so that the light passing therethrough will

be refracted upwardly and downwardly, or I may use a lens plate substantially as shown in Figure 10, with prismatic elements 48 extending transversely thereon and having refractive surfaces of diminishing angle progressively from the upper part toward the lower part of the lens, with respect to the horizontal, so that the upper portion of the reflected beam from the mirror is directed upwardly, while the lower reflected rays are directed upwardly at an acute angle and any horizontal rays will be well above the eye level of workmen so as to avoid glare.

With the lamp 20 set up and arranged and constructed so as to project concentrated beams of light through the sides 43 of the interceptor 24, it will be reflected by the mirror 38 approximately at right angles to its incident direction toward the door opening 16. In passing through the lens plate 47 the beam will be refracted upwardly, and will principally illuminate the ceiling of the chamber, constituting the upper wall portion 14, and will reach the rear wall 13 in a somewhat broadened form, the zone of the ceiling surface illuminated being gradually broadened toward the rear of the chamber, as will be readily understood. With the proper construction of the lens, the major portion of the refracted beams will all be located above a line in the neighborhood of six feet above the floor 11, so that it will not be projected into the eyes of persons moving about within the chamber and facing toward the door opening 16. In order to effect a good illumination of the floor and materials stacked thereon, the ceiling surface and the surface of the rear wall 13 are preferably coated with a light-reflective material, substantially as indicated at 50, in Figure 4, and by forming the surfaces of the ceiling and walls of a suitable texture, this light will be reflected in all directions within the chamber, so as to afford a satisfactory illumination of the floor and all materials thereon, without causing objectionable glare, and eliminating any blinding effects or eye-strain, or interference with normal vision of persons within the chamber.

In practice, the roof portion of the chamber being constructed of concrete ordinarily, and therefore having more or less rough surface, it has been found that painting the zone 50 on the surfaces of the chamber with a good quality of white paint produces the light spreading and diffusing effect, with high efficiency, ordinarily a matte surface paint being utilized.

As the light projected upwardly from the interceptor lens 48, from a given area of the lens at its upper part will produce a more brilliant illumination of the surface of the ceiling of the chamber upon which it falls than light from a similar area at the lower part of the lens will produce upon the surfaces at the rear part of the chamber, there will result a uniform illumination of the chamber throughout its length, although the reflective surface is less at the forward or outer end of the chamber than at its rear part. Also, the light engaging the walls 13 will be reflected back to the forward end of the chamber, adding to the illumination therein.

With the car 19 located as shown in Figure 1, it may be seen that a certain amount of stray light from the lamp 20 will pass downwardly inward through the opening of the door of the car, as indicated by the dotted arrow in Figure 1, tending to illuminate the far end of the car, as indicated at 51. To further augment the illumination of the interior of the car by light from

the lamp 20, without requiring additional light sources, and utilizing that portion of the beam of the lamp which passes outwardly of the interceptor 24, I have shown in Figure 1 a second interceptor 52, consisting of a simple reflector, which may be either a mirror or a mat white surface or aluminum painted reflector, set up beyond the door opening 16, adjacent the side furthest from the lamp 20, and arranged at such angle as to reflect incident light through the side of the car 19 at its doorway, as indicated at 53.

In order to distribute such refracted light from the lamp 20 within the car 19 to better advantage, I have provided a third reflector device 54, which may be set up in the car to intercept either the light 51 or the light 53, and to throw it into corners or such other parts of the car as may be found desirable. The reflector 52 may be set upon a high portable stand of light construction, adapted to be removed when not needed, and the reflector 54 may also be set upon a suitable base on the floor of the car 19 in such position as required to properly direct the light thrown through the door of the car by my lamp and reflector 52. In this way, it is made practicable to illuminate the interior of the car by night with an externally located light source, without involving illumination of adjacent areas objectionably, or in such manner as to be conspicuous, in an airplane or the like, and with the same safety that is obtained in illuminating the interior of the igloo, with the further advantage that a single source of light may be utilized for most purposes, obtaining all the advantages of a powerful electric light without requiring the location of any wiring, or the lamp itself or other electrical conductors within such distance of the opening to the igloo or the car as to involve any risk from short circuits in the electric devices, heat from the lamp, or otherwise involved by the nature of the light source.

It is of course also possible to utilize a gas lamp as well as an electric lamp at 20, but I have thus far used only an electric lamp, a 400 watt bulb being installed therein with suitable reflector and focusing lens devices to project a beam of the character desired, so that the major portion of the light emitted by the lamp will be projected through the box 24. As actually embodied, the second interceptor 52 consists of the door 17 with a suitable surface painted upon its inner side, and after the lamp 20 has been suitably located, the desirable angle for the door 17 to throw incident light into the car 19 may be insured by locating a door stop at a proper position for the purpose. With a lamp of the power indicated, it has been found satisfactory to form the interceptor box at 24 with openings at its sides 43 and 44 approximately fourteen inches square, the hypotenuse side 37 being in proportion.

In case there is found need for special illumination of corners of the chamber 19 at each side of the opening 16, this may be attained by setting up a portable reflector on a suitable stand so as to intercept a portion of the light from the upper part of the refracted beam in the desired direction, substantially indicated at 55.

The interceptor box in the present instance consists of two rectangular frames 56, of angle steel with flanges projected at the sides of the openings, and extending inwardly at the top and bottom, a single angle being utilized at the junction of the sides 43 and 44, and the bracket 36 being secured to the two top members of these frames, as indicated in Figure 9. The clear glass

45 is secured to the outer side of the frame at 43, by means of a Z channel piece 45 held by small screws to the angle iron of the frame. The lamps 47 may be secured in a similar manner, the glass of these plates being made sufficiently larger than the fourteen inch openings to be suitably held. Any usual gasket material to protect the glass from shock may be interposed between the mounting means and the glass, as will be readily understood. Thin sheet steel 57 cut to proper shape may be welded to diagonal connecting pieces 59 between the rectangular frames, and triangular shaped sheet steel pieces 60 may be similarly welded upon the top of the boxing, to form a complete closure. The diagonal pieces 53 may be secured detachably to the rectangular frames by means of screws 61, and the mirror 38 is secured to the inner sides of these diagonal members substantially in the same manner that the glass and lens 46-47 are mounted. Suitable vertical members 62 may be connected between the diagonal members of the hypotenuse side of the boxing to afford sufficient rigidity, these being located between the diagonal members 56 outwardly of the mirror. Replacement of the mirror may be effected by removal of the screws 61, as will be readily understood, in order to permit access to the fastenings that directly hold the mirror in place.

In the use of this invention, the lamp device will preferably be mounted detachably, so that no conspicuous device will be visible when the invention is not in use. In order to utilize the invention, the lamp device is mounted and suitable connections made in the conventional manner, utilizing ordinary electric conduits and fittings terminating at an outlet spaced from the chamber and the chamber openings to the desired distance as before mentioned. The door 11 being opened, the interceptor unit 24 and mounting being installed and drawn inwardly within the chamber previously, the crane element may be swung from its innermost position to position as illustrated in Figure 5, after loosening of the hand screws 23. In order to check the crane when it has reached a proper outer limit of its movement, a threaded stud or pin 65 is engaged slidably through the upper part of the crane adjacent the termination of the stem portion 39, this pin being threaded on each side of the crane and provided with nuts 66 by which the pin may be adjusted longitudinally to determine its extent of projection toward the wall 15 of the chamber, so that it will act as a stop to limit the outward movement of the crane at the proper position. The end of the pin 65 may be fitted with a rubber cap 67, so as to avoid liability of spark when the stop engages the wall.

In the portable form of the interceptor as shown in Figures 11, 12 and 13, the construction of the interceptor remains the same as previously described, and only the means of mounting the apparatus on the wall of the igloo is changed. In the portable form, a mounting plate 70 is permanently fixed upon the wall 71 of the igloo, suitably located for support of the interceptor 24 at the doorway. Upon the plate 70 there is an open loop bracket 72 adapted to snugly accommodate a tongue 73 rigidly formed upon a suspension arm 74, the lower end of which is pivotally mounted upon a footing 75 fixed upon the upper wall of the interceptor housing, as by bolts 76 or otherwise. The arm 74 in the present instance, is substantially L-shaped, the flange 77 thereof being extended outwardly at right angles

to the wall of the igloo. At the outer end of the interceptor 24 a lug 78 is fixed, suitably apertured at its upper end for a purpose as will appear. A link 79 is pivoted at one end to an upper portion of the flange 77 of the suspension arm, as indicated by the reference character 80. The link 79 of a length to extend outwardly beyond the lug 78 and lie flatly thereagainst so as to present a longitudinally disposed slot in alignment with the aperture of the lug 78. A suitable clamping means 81 is mounted in the aligned aperture and slot so as to maintain the interceptor 24 in an adjusted position. In the present instance, the clamping means comprises a threaded shank of a size to pass through the aperture and slot and respective lock nuts in clamping engagement upon respective sides of the lug and link. A handle portion 82 formed integrally with the shank facilitates rotation thereof to effect tightening or loosening of the lock nuts. Adjustment of the interceptor may be effected as previously explained.

In Figure 14 there is illustrated a portable mounting for the lighting fixture, and as shown consists of a base mounting plate 83 which is constructed for permanent mounting upon the exterior surface of the wall 84 of the igloo. The mounting plate includes a loop bracket 85 adapted to receive a tongue 86 of a suspension arm 87. It will be noted that the tongue 86 and arm 87 lie in parallel relation and that the tongue enters the bracket 85 from above so that the weight of the fixture will draw the tongue downwardly into the bracket in snug relation so as to afford a stable support of a lighting fixture.

Adjacent the lower end of the arm 87 there is provided a length of tubing 88 extended outwardly at right angles to the arm and receives telescopically thereon a slip fitting 89 of a lamp unit 90. It will be apparent that the lamp unit 90 may be adjusted longitudinally along the tubing as well as rotated thereabout for the purpose of obtaining proper placement thereof, in order to direct light rays to the interceptor. A set screw 91 is threadedly engaged in the fitting 89 and may be manipulated to secure adjustment of the lamp unit.

From the foregoing, it will be seen that the interceptor and the lamp unit may be readily dismantled or removed from their respective supporting brackets and likewise applied in brackets of other igloo structures.

Attention is now invited to Figures 15 and 16 of the drawings wherein a modified form of igloo is shown, which has recently been employed in certain localities, due to the saving of steel in construction thereof. The igloo is round or polygonal in shape and for this reason, the lighting problem is somewhat different from that of the first form described.

The igloo is indicated by the reference character 92 and embodies an entrance 93 through which the explosives are carried, and since the particular construction of the igloo is no part of the present invention, a detailed explanation thereof is not believed essential to the understanding of the illumination of the interior thereof.

A source of light 94 is suitably mounted exteriorly of the igloo, the light rays from which are directed to a reflector or mirror 95 suitably mounted at an upper portion of the entrance 93. A panel of flashed opal glass is suspended from the ceiling near the center of the igloo and in a path of the light rays re-directed by the reflector

tor or mirror 95. By constructing the panel 96 from material such as flashed opal glass, not only are some of the light rays transmitted there-through, but a portion of the light rays will be reflected, and by properly adjusting the panel 96 with respect to the reflector or mirror 95, the entire interior of the igloo will be fully illuminated.

I claim:

1. In a device of the character described, an intercepting refractor device comprising a crane element, means to mount the said crane for horizontal swinging from the inner wall of a chamber and the like, said crane being extended horizontally at its upper part, and then further extended horizontally in a direction at right angles to the first named horizontal part, and a reflector device carried at the extremity of the last named part of the crane, depending therefrom and being set at an angle of substantially 45 degrees to the direction of said terminal part.

2. The structure of claim 1, in which a transverse horizontally adjustable wall engaging stop is mounted in said first named horizontal extension.

3. An explosive storage chamber and illuminating means therefor comprising a chamber body having an access opening at one side, a light source located outside said chamber body at a distance from said opening on a line at right angles to a line normal to the plane of the opening, an intercepting reflector and refractor device adjacent the upper part of said opening constructed to intercept light from said source and reflect it inwardly through said opening, said intercepting device being constructed to refract

the light from a reflector in vertical direction only, and whereby a major portion of the refracted light will be thrown upon the ceiling of said chamber, and light reflecting material upon the ceiling of said chamber.

4. The structure of claim 3, in which said light source is constructed to project a beam to said interceptor above eye level, and said interceptor device is constructed to refract the intercepted beam in a zone extended upwardly from eye level, only.

5. A storage chamber and illuminating means therefor comprising a chamber body having an access opening at one side, a reflecting means at said access opening located at an upper portion thereof, a light transmitting and reflecting panel suspended within the chamber substantially centrally thereof, said panel consisting of flashed opal glass, the panel being positioned to receive light rays reflected from said reflecting means, and a source of light exteriorly of the chamber positioned to direct light rays upon the reflecting means.

6. A storage chamber and illuminating means therefor comprising a chamber body having an access opening at one side, a demountable reflecting means at said access opening, a light transmitting and reflecting panel within the chamber body positioned to receive light rays reflected from said reflecting means, and a demountable light source located outside said storage chamber at a distance from said access opening on a line at right angles to a line normal to the plane of the access opening and positioned to direct light rays upon the reflecting means.

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