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LIGHTING SYSTEM AND LIGHTING UNIT FOR USE THEREIN

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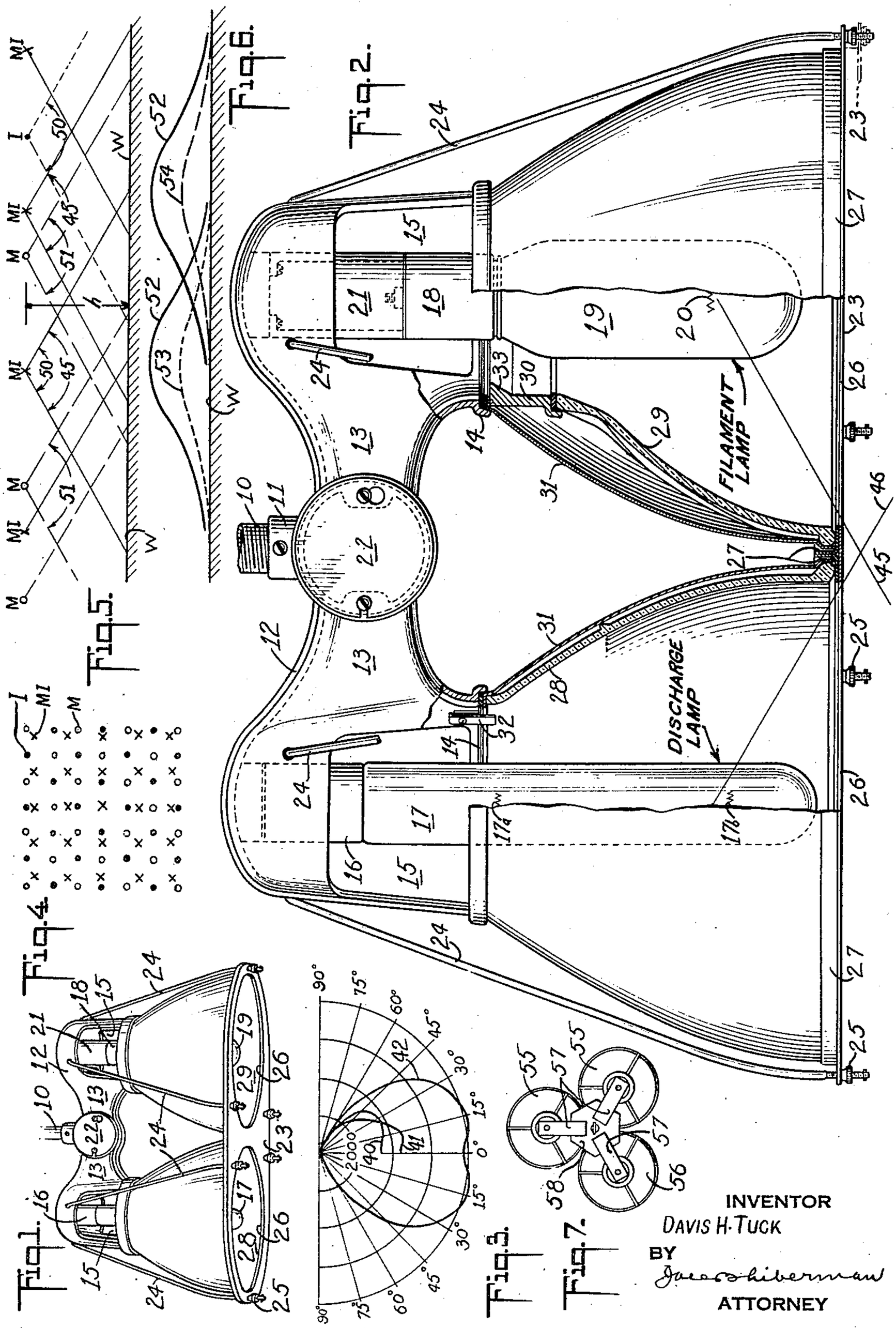

Fig. 2.

Fig. 5.

Fig. 6.

Fig. 1.

Fig. 3.

Fig. 7.

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LIGHTING SYSTEM AND LIGHTING UNIT FOR USE THEREIN

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7 Claims. (Cl. 240—9)

The present invention relates to lighting systems and lighting units for use therein, and is more particularly directed toward lighting systems employing both high intensity mercury vapor lighting and incandescent lighting.

High intensity mercury vapor lamps have a greater light output per watt than incandescent filament type lamps, but are unsuited for general lighting alone because a momentary drop in voltage will cause the mercury lamps to go out and remain unlighted for about five minutes and because of the color characteristic of the mercury light.

In factory lighting it has been usual to provide two lighting systems, one for the mercury lamps, and the other for the incandescent lamps, each having separate wiring outlets and fixtures, the fixtures being arranged alternately in rows, and as a result horizontal areas in the region generally below a unit were lighted brightly by light of the corresponding color, while vertical areas in that region received little light of the corresponding color and considerable of the other color from the adjacent lighting unit. Furthermore the spaced unlike sources produce shadows, one appearing red and the other green. The effect on the eye was that of a very spotty illumination.

It is an object of the present invention to provide a lighting system and lighting unit for use in such system whereby the economies resulting from the use of the more efficient high intensity mercury vapor source, may be had and yet obtain a very high degree of uniformity of light intensity and color throughout the working area and on horizontal, vertical or oblique surfaces.

The present invention also contemplates that these advantages may be had without an increase in the current consumption, or increase in wiring and installation costs.

Other and further objects will hereinafter appear as the description proceeds.

The accompanying drawing shows, for purposes of illustrating the present invention, two embodiments in which the invention may take form, it being understood that the drawing is illustrative of the invention rather than limiting the same.

In the drawing:

Figure 1 is a perspective view showing a combination lighting unit;

Figure 2 is a side elevational view of the unit with parts in section;

Figure 3 is a photometric diagram illustrating the light distribution for each part of the complete lighting unit and for the complete lighting unit;

Figures 4 and 5 are fixture layout diagrams, Figure 4 showing horizontal positions and Figure 5 vertical positions;

Figure 6 illustrates light intensities over a working area; and

Figure 7 illustrates a combination unit employing three lamps.

The lighting unit shown in Figures 1–3 is adapted to be supported from a pendent tubular stem **10** which threads into a boss **11** disposed at the middle of the upper part of a body **12**. This body is in the form of a casting and has two tubular arms **13**, **13** which extend horizontally and then are turned so as to provide downwardly facing annular seats **14**, **14**. The body member **12** is skeletonized near the ends, as indicated at **15**, **15**. One of the arms carries a downwardly facing lamp socket **16** adapted to support a high intensity mercury vapor lamp **17** whose electrodes are indicated at **17***a*, **17***b*. The other arm supports a lamp socket **18** which carries a bi-post lamp **19** with a filament at **20**. To properly locate the light center a spacer **21** is used above the lamp socket **18** and the length of this spacer may be changed when a mogul base incandescent lamp and lamp socket are employed. It will be noted that all the wiring for the two lamps may be brought in through the single support and carried to the sockets, a cover plate **22** providing access to the fixture body to facilitate splicing of the wires.

A bottom plate **23** is supported from the body **13** by tie rods **24** and nuts **25**. The bottom plate is provided with two apertures **26**, **26** and carries two rings **27**, **27**. These rings receive specular reflectors **28** and **29** preferably made of prismatic glass. The reflector **28** is deeper than reflector **29** and is designed to control the distribution of light from the high intensity mercury vapor lamp, while the reflector **29** is shallower and is designed to control the distribution of light from the filament of the incandescent lamp. A spacer **30** is spaced above the reflector **29**. The reflectors **28** and **29** may be provided with thin metal covers **31**, **31** to protect them, if desired, or these covers may be omitted when an upward component of light is desired, sufficient light leaking through the prismatic glass reflectors to provide low intensity of upward light. The length of the arms **13** of the body is such that the reflectors are close together.

The supporting rods **24** are made long enough so that when the nuts are lowered, as indicated at the right of Figure 2, the plate **26** can be

dropped sufficiently to permit (after removal of an adjacent tie rod) insertion of or removal of a reflector, with its protecting cover, where used.

The side of the unit carrying the mercury lamp socket is provided with a removable strap **32** which extends down below the corresponding seat. The collar **30** above the reflector **29** is provided with a flange **33** which makes it impossible for one to place the reflector **29** (for the incandescent lamp) and the collar **30** below the socket for the mercury lamp. By making the two sides of the fixture body symmetrical and employing the collar for the shorter reflector, it is possible to also provide parts for lighting units which can use two collars and carry two incandescent lamps (strap **32** having been removed) or dispense with collars and carry two mercury lamps, if desired.

In Figure 3 the photometric curve **40** illustrates the distribution of light for the incandescent lamp-reflector combination (typically a 750 watt lamp) and the curve **41** illustrates the distribution of light for the mercury lamp-reflector combination (typically a 400 watt lamp). The curve **42** shows the output of the complete unit. Each side of the unit has a cut off line at 30° below the horizontal, these lines being indicated in Figure 2 of the drawing at **45** and **46**, respectively.

It will be noted that curves **40** and **41** have a very similar shape, and hence it is apparent that in any direction, out to 60° from the nadir, surfaces at right angles to the direction of light from the unit and at a reasonable distance from the unit will receive about the same amount of light from one source as from the other, so that there will be a complete color mixing.

Figure 4 illustrates a comparable layout of combined mercury-incandescent fixtures of the type above described, together with the layout which would be employed if the conventional staggered mounting system were employed using separate mercury and incandescent lamp units. Where the staggered system is employed on centers the incandescent units would be located in the positions indicated by the dots marked by the letter I in Figure 4, and the mercury units will be designated by small circles marked by the letter M. A lighting layout of the same load employing the combined units would have the units spaced about 1.4 times the row spacing of the rows of staggered units. The combination units are indicated in the diagram by a small *x* and the symbol MI. From Figure 4 it will therefore be apparent that twice as many outlets are required for the staggered system of lighting as for the system proposed herein. Each outlet would have a unit of the same output as the corresponding side of the unit of Figures 1–3.

Figure 5 illustrates the overlapping action of the light from a row of combination mercury-incandescent fixtures. These fixtures are again designated by a small *x* and are spaced one and a half times the mounting height (*h*) above the working area W. With a 30° cut off angle, as above described, the light spreads, as indicated at **45**, and it will be seen that over the entire working area every point receives light from at least two units in the row, and, of course, receives light from rows to the side of the row under consideration. This means that the horizontal surfaces generally under each fixture are very well lighted with mixed light from the fixture above, while the other surfaces generally under a unit are very well lighted by mixed light coming from the surrounding fixtures. Thus horizontal, vertical and oblique surfaces over the entire working area receive mixed light from the fixtures and there is an absence of spottiness either in intensity or color value of the illumination and an absence of colored shadows.

Superposed on the full lines of Figure 5, showing the mercury-incandescent units, is a showing in dotted lines of the light spread from the incandescent lamps I and a showing in dash lines of the light spread from the mercury lamps M, the center lamp of the diagram being taken as a common mounting position for an incandescent lamp. The light distribution embraced in the arcs **50** in Figure 5 shows that areas under and reasonably near the incandescent units I receive the dominant amount of incandescent light on the horizontal areas and none on the vertical areas, except that coming from very remote units. The vertical areas under the incandescent units receive a dominant amount of light from the mercury units M. Under the mercury units the light spread is indicated at **51** and similar conditions obtain, horizontal surfaces being dominantly lighted by the mercury light, vertical surfaces being dominantly lighted by the incandescent source. While the light meter will show a satisfactory evenness in light intensity over the entire area on both horizontal and vertical surfaces, the eye gets a different impression as the vertical surfaces are lighted differently than adjacent horizontal surfaces and spottiness is apparent.

Figure 6 indicates light received on a horizontal working plane. Each full line curve **52** shows the light from the mercury-incandescent unit above the summit of the curve, the dotted curve **53** light from an incandescent lamp alone, and the dash line curve **54** light from a mercury lamp alone, the curves **53** and **54** being each approximately one-half the height of curve **52**. The overall result caused by all the lighting equipment placing light on the working area shows a very high uniformity of light intensity and color. If the staggered system were used, the curves **53** and **54** would be closer to one another, i. e., spaced according to the spacings of the mercury and incandescent units indicated in Figure 5.

In highbay lighting the mounting heights are sometimes such as to require units of greater output and in such cases units may be provided as sketched in Figure 7. Here two 400 watt mercury lamps and suitable reflectors **55—55** occupy two-thirds of the unit, while one 1500 watt incandescent lamp and suitable reflector **56** occupies the other third. Such units may be designed for spacing mounting height ratios of .6 to 1 and may have the same cut off angles as before. Each lamp reflector combination is carried on an arm **57** of a spider **58**.

Since it is obvious that the invention may be embodied in other forms and constructions within the scope of the claims, I wish it to be understood that the particular form shown is but one of these forms, and various modifications and changes being possible, I do not otherwise limit myself in any way with respect thereto.

What is claimed is:

1. A direct lighting system for lighting an extended working area, comprising a plurality of lighting units, each unit having two pendent, bulb type lamps, one having an incandescent filamentary source, the other having a high intensity mercury vapor source, and a specular reflector about each lamp, the mouths of the reflectors

being in the same plane, close together and below the lamps to provide a shielding angle of substantially 30° below the horizontal, each reflector having a contour to reflect light from the corresponding lamp into the same portion of the working area as that reflected by the reflector about the other lamp whereby both horizontal and vertical surfaces in the region of the working area receive substantially uniformly mixed light from the superposed lighting unit.

2. In a luminaire, a pendently supported body carrying two downwardly opening lamp sockets and adapted to be mounted above a working area, a pendent concentrated filament type lamp in one socket, a pendent mercury lamp in the other socket, an annular specular reflector about each lamp, the reflectors having parallel axes and horizontal mouths at the same level and close together and being shaped to redistribute the light in light patterns of substantially identical character so that the output of one lamp falls on substantially the same working area as the output of the other lamp whereby all the light from the luminaire falling on the working area is mixed, and means for holding the reflectors in place relative to the support.

3. A luminaire such as claimed in claim 2, wherein the reflector holding means includes a skeleton plate having two apertures opposite the reflector mouths and tie rods between the plate and body.

4. A luminaire such as claimed in claim 2, wherein the reflector holding means includes a skeleton plate having two apertures opposite the reflector mouths and tie rods between the plate and body, the rods having threaded ends extending a substantial distance below the plate whereby the plate may be supported in a lowered position to permit removal of one or both of the reflectors.

5. A luminaire comprising a pendently supported body having two similar hollow arms to receive wiring and disposed on opposite sides of a vertical axis, the inner portions of the arms extending generally horizontally and the outer ends having downwardly facing horizontal annular seats, a downwardy facing lamp socket carried by each arm above the center of the corresponding seat, a pendent lamp in each socket with its light source below the level of the seat, one lamp being a filament lamp and the other lamp being a discharge lamp, and a downwardly acting reflector below each seat, the reflectors being symmetrical about vertical axes through the lamp centers and shaped to reflect light downwardly and give a light pattern of substantially identical character, the length of each arm being substantially one-half the diameter of the corresponding reflector mouth, whereby the sources of direct and reflected light are close together and the light originating in one source is mixed with that originating in the other source throughout the entire working area illuminated by the luminaire.

6. A luminaire such as claimed in claim 5, having reflector securing means including a plate having apertures opposite the reflector mouths and tie rods between the body and plate.

7. In a direct lighting system for lighting an extended working area, comprising a plurality of regularly spaced lighting units each having two light sources of unlike color characteristic close to one another, and a downwardly opening specular reflector about each source, each source and reflector cooperating to provide a substantial shielding angle of the order of 30° below the horizontal and provide substantially the same light distribution below the shielding angle, the improvement according to which the ratio of unit spacing to mounting height above a plane of reference is in the order of 1½ to 1 and is such that light from both of the sources and associated reflectors of a unit spreads out to reach the area directly below the next adjacent unit whereby horizontal, vertical as well as oblique surfaces throughout the area and at the general level of the plane of reference receive mixed light of both colors.

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