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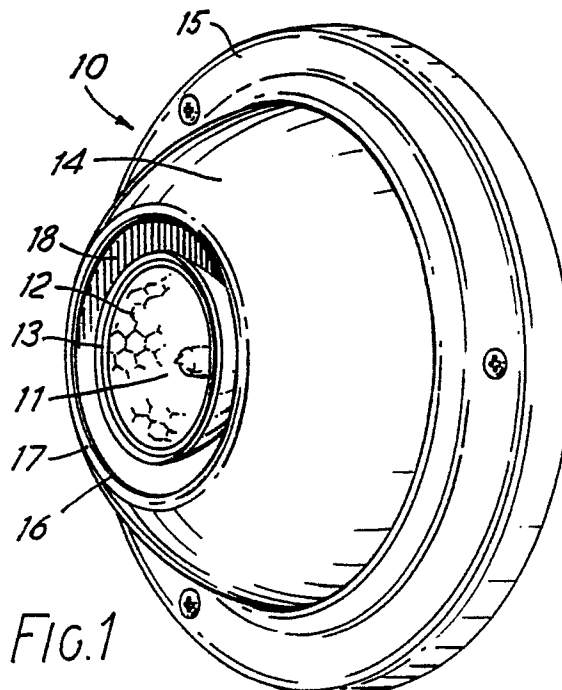
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⑤④ **Display lighting arrangement.**

⑤⑦ A lighting arrangement includes a spot light (13) supported within a tapered duct (20) which is mounted in a housing (15) by means of an eye-ball bearing.

A pressurising unit (31) and a booster unit (32) produce a flow of air along the duct in the direction of light emission. The reflector (12) of the spotlight constricts the air flow path producing a convergent jet of cooling gas in front of the spot light.



DISPLAY LIGHTING ARRANGEMENT

This invention relates to a lighting arrangement for illuminating a particular area or object and more particularly to spot lights used for such purposes. A particularly useful lamp in this connection is a pinch sealed tungsten halogen incandescent filament lamp fitted within an integral faceted mirror reflector. An example of this type of spot light is that low voltage tungsten halogen lamp marketed under the name "Lightstream" by applicant company which emits an intense beam of light concentrated in a small area and is, for example, used extensively for the display of jewellery and such like goods. Other lamps which could be particularly useful for spot light work because of the relatively small bulk are the metal halide compact source lamps, CIS and CID, and also the metal halide discharge lamp known as Arcstream also marketed by applicant company and all being pinch sealed.

With any display lamp or spotlight, the radiant energy contained in the intense beam of light tends rapidly to heat up the object or target on which the beam is concentrated. For the low voltage "Lightstream" lamps in part because the reflector incorporates a dichroic filter such heating is much reduced but even so the use of this spotlight is limited to goods which are not adversely affected by the heat generated.

An object of this invention is to provide a lighting arrangement which is capable of being more easily used without the limitations mentioned above.

According to a first aspect of the invention there is provided a lighting arrangement comprising a duct, a light source and a reflector for the light source supported within the duct, and means to produce a flow of gas along the duct in the direction of light emission whereby the reflector constricts the flow path along the duct creating a convergent jet of cooling gas.

The duct, which may be tapered in the direction of gas flow, is preferably mounted in, and displaceable with respect to, a housing thereby allowing the light source to be trained in a selected direction. The duct may be mounted displaceably in the housing by means of an eye-ball fitting.

In a preferred embodiment the means for producing a flow of gas comprises pressurising means, suitable for an air conditioning unit, in combination with a booster and preferably the flow producing means produces a pressure in excess of 25Pa and typically from 100Pa to 200Pa.

Preferably the light source is a pinch sealed lamp e.g. a pinch sealed integral reflector lamp with the pinch seal of the lamp being emergent from the rear of the reflector.

According to a further aspect of the present invention there is provided a method of irradiating an object comprising the steps of supporting a light source and a reflector for the light source, in a duct such that the light source can illuminate the object, and causing a flow of gas along the duct in the direction of light emission thereby to cool the reflector and to produce a convergent jet of cooling gas.

In some arts it is known to combine a cooling jet of air with a lamp for illumination. UK patent 1065644, for example, discloses a surgical lamp arranged to direct the combination of light and sterilized air onto the operating table in a surgical operating theatre. Sterilized air, which additionally can be cooled air, is arranged to flow into a reflector housing and is thereby directed into the required area of the operating theatre. German patent application no. DE 331299 also discloses a surgical lamp which combines the use of cooling air and light for the illumination and cooling of the operating table. The lamp disclosed in this patent application comprises a central housing which is large enough to contain several lamps and acts as a plenum for supply air. A number of adjustable jets are situated around the periphery of the central housing to provide a curtain of pure air to surround the operating area.

In both these surgical applications the air is being directed into the area generally around, or onto, the person lying on the operating table and would be subject to recommended practice for air conditioning services. For example, the Chartered Institute of Building Service Engineers requires that the air velocity in standard air conditioning should be between 0.15 to 0.2 metres per min (30 to 40) ft/min) and certainly not greater than 0.25m/s (50 ft/min) In our experience this air velocity would not be sufficient to provide the forced convection necessary to dissipate the heat built up on the target spotlight which would require a velocity at least an order of magnitude greater. In UK patent 1,065644 the air is delivered into the interior of the reflector or into a skirt member at the rim of the reflector. In either case, the air would have little cooling effect on the reflector. In DE 3331299 the arrangement is designed to flood the central position with sterilized air and surround this with a curtain of faster moving air. The relatively large areas between the individual lamps would make it difficult if not practically impossible to produce a fast moving jet of air at the volumes required to remove heat built up on the goods by the spotlight.

In a preferred embodiment of the present invention an air jet velocity of 15msec^{-1} (3,000 ft/min) is used. With this air jet velocity and with an air flow of 20 litre/sec (42ft³/min) it has been found, by experiment, that a pat of butter weighing approximately 80 grams and placed 530 mm distance from a 50 Watt Lightstream spotlight retained its shape for more than 1.5 hours with no visible signs of melting. With no cooling air in operation the butter melted within 20 minutes. Typically air jet velocities in the range from 5msec^{-1} to 20msec^{-1} - (1,000 ft min⁻¹ to 4,000 ftmin⁻¹) could be used. When a pinch sealed tungsten halogen incandescent filament lamp is used as the light source it has been found that the air has a very useful cooling effect on the lamp pinch. The pinch seal can get very hot during running for example, as high as 340°C, however, using the air jet this can be reduced to about 180°C. This pinch cooling effect allows a 75-100 Watt lamp to be used where, otherwise, a maximum of 50W might be the limit. The high velocity forced convection air can absorb this amount of heat and still be able to dissipate the heat build up in the target area.

While the cooling of the pinch seal would not affect the tungsten halogen cycle any cooling air directed into the interior of the reflector and onto the lamp bulb could well affect the cycle and could even cause thermal shock sufficient to shatter the bulb.

One example of the invention will now be described with reference to the undemoted drawings wherein:

Figure 1 is a perspective front view of a lighting arrangement according to the present invention.

Figure 2 is a sectional view of the lighting arrangement of figure 1.

Figure 3 is a representation of a lighting arrangement using a standard air conducting unit and booster unit.

In figure 1 reference numeral 10 represents a display lighting arrangement in accordance with the present invention wherein a pinch sealed, tungsten halogen incandescent filament lamp 11 is fitted within a integral faceted mirror reflector 12 to form a spot light 13 positioned centrally within an inner casing member 14. Inner casing member 14 fits within outer casing member 15 and these are arranged to swivel relative to each other in the manner of a known eyeball fitting so that the light beam from the spotlight 13 can be trained on an object to be displayed. The rim 16 of reflector 12 and rim 17 of the inner casing member 14 form a constricted annular opening 18 so that a high speed jet of

cooling air can be directed onto the object or target being displayed. This cooling air offsets the rise in temperature of the object which occurs because of the heating effect of the spotlight.

From figure 2 it can be seen that inner and outer casing members 14 and 15 respectively, form a part spherical bearing which allows for the swivelling movement of spotlight 13. Inner casing member 14 has a hollow construction and includes bore 19 forming a duct or nozzle 20 through which cooling air is directed onto and past the rear 21 of reflector 12. The cooling air has direct contact on the pinch seal 22 of the tungsten halogen lamp 11 so that the operating temperature of the pinch can be lowered. Spotlight 13 complete with tungsten halogen incandescent bulb 23 is fitted to lamp holder 24 and is supported within bore 19 by spring bracket 25 which is made up of strip material and designed to take up minimum space within bore 19. Electrical leads 26,27 connect the lamp to a suitable electrical supply.

Inner casing member 15 carries mounting flange 28 by which it is attached to air plenum 29, which is connected to a suitable source of pressurised air. A glass cover or filter 30 can be attached to the front of the reflector as a precaution against UV radiation if present. From Figure 2 it can be seen that the spotlight 13 is recessed slightly from the rim 17 of inner casing member 14. It has been found that hooding of the spotlight 13 by the inner casing member 14 in this manner materially assists in maintaining the coherence of the cooling jet so that it can converge better on the target. With this feature and with an air velocity of 15m/s (3,000 ft/min) it has been found the cooling jet maintains its effectiveness on target at 2 metres.

In a typical lighting arrangement the average diameter of the "eyeball" bearing arrangement is 120 mm and the bore tapers from 88mm to 63mm. A 50 watt pinch sealed tungsten halogen incandescent lamp with a reflector diameter of 56mm would be recessed back a distance of some 15mm. The spring clip supporting the lamp holder within bore 19 is made from 16 gauge steel by 6mm wide. With these dimensions the area of the annulus 18 would be approximately 12000mm² and with an air supply of 20 litres per sec (42ft³/min), since velocity times area equals flow rate, the air velocity would be 15m/s (3,000 ft/min).

The light source is not restricted to a tungsten halogen incandescent filament lamp but such a lamp is particularly suited to display lighting because it closely simulates a point source of light. With display lighting, of course, the light source must be capable of generating radiation in the visible range 400 to 700 nanometers. For the display of food or liquids which may require sterilizing, a light source producing radiation in the

wavelength range 200 to 280 nanometers may be desirable. The spotlight need not be in a swivel mounting but could be in a fixed mounting. In one test a Lightstream spotlight alone heated a target to 27°C with a room ambient air temperature of 22.5°C. Use of the air cooling jet reduced the target temperature to 23°C using supply air of 17°C at 20 liters/sec. A supply of 20 litres/sec is not unduly high but even so a standard air conditioning unit which operates at about 25 Pascals would not provide sufficient velocity pressure. The pressure of the air conditioning unit would have to be of the order 100Pa to 175Pa and possibly as high as 200Pa. A standard air conditioning unit could be used provided a booster unit is incorporated somewhere in the system and figure 3 is a diamgrammatic representation of a standard air conditioning unit 31, connected to a booster unit 32. Target 33 is illuminated by light from spotlight 13 whilst being cooled by the converging cooling airjet emergent from annulus 18.

Reference has been made extensively herein to airflow. It will be appreciated that while the gas used will generally be air, it is possible that in specialised environment other gases will be used and these are considered to be within the scope of this invention.

Claims

1. A lighting arrangement comprising a duct, a light source and a reflector for the light source supported within the duct, and means to produce a flow of gas along the duct in the direction of light emission whereby the reflector constricts the flow path along the duct creating a convergent jet of cooling gas.

2. A lighting arrangement according to Claim 1 wherein the duct is tapered in the direction of gas flow.

3. A lighting arrangement according to Claim 1 or Claim 2 wherein the duct is mounted in, and displaceable with respect to, a housing thereby allowing the light source to be trained in a selected direction.

4. A lighting arrangement according to Claim 3 wherein said duct is mounted displaceably in the housing by means of an eyeball fitting.

5. A lighting arrangement according to any preceding claim wherein the means to produce a flow of gas along the duct is operable at a pressure from 100Pa to 200Pa.

6. A lighting arrangement according to claim 5 wherein the means to produce said flow of gas comprises pressurising means, suitable for an air conditioning unit, in combination with a booster.

7. A lighting arrangement according to any preceding claim wherein the light source is a pinch sealed lamp.

8. A lighting arrangement according to Claim 7 wherein the light source is a pinch sealed integral reflector lamp, the pinch seal of the lamp being emergent from the rear of the reflector.

9. A lighting arrangement according to any preceding claim wherein said jet of cooling gas has a velocity of from 5msec⁻¹ to 20msec⁻¹ (1000 ft min⁻¹ to 4000 ft min⁻¹).

10. A method of irradiating an object comprising the steps of supporting a light source, and a reflector for the light source, in a duct such that the light source can illuminate the object, and causing a flow of gas along the duct in the direction of light emission thereby to cool the reflector and to produce a convergent jet of cooling gas.

11. A method according to Claim 10 wherein the light source is a pinch sealed lamp and in which gas is caused to flow onto the lamp pinch.

