

Exhibit 2030

Claims 1-9 of ‘729 patent (earliest priority date: 2007-1-26)	References
1. An illuminator device for illuminating one or more users in front of a web camera and a communication terminal comprising:	Reference 1 - KR200316985Y1 (Kwak Translation) The present utility model relates to <i>a PC webcam stand with a lighting function</i>, including: a fixing component; a connecting pipe, one side end of which is coupled to the fixing component and through an inside of which a USB cable is extended; a mounting component, to a bottom surface of which the other side end of the connecting pipe is coupled, on an upper surface of which a PC webcam is positioned, and on a rear surface of which a USB port electrically connected to the PC webcam is arranged; and <i>a lamp for lighting an object, arranged at a predetermined position of the mounting component to enable the PC webcam positioned on the mounting component to clearly photograph the object.</i> According to the present utility model, <i>the lighting function is provided to light an object, thus enabling the object to be clearly photographed and transmitted regardless of the brightness of the surroundings. Besides, in addition to the lighting function, the lighting angle may be freely adjusted, thus effectively lighting the object.</i> Moreover, the PC webcam may be easily arranged and fixed in a detachable manner by means of a magnetic force, and is very easy to separate, thus providing a very practical effect. See Kwak Translation at abstract (emphasis added). Then, <i>at a position (for example, a display, a computer body, a desk lamp) suitable for photographing the photographed object, the stand 100 is fixed by the fixing component 10, and the flexible pipe 20 is adjusted with reference to the photographed picture, so that the position of the PC webcam 50 is adjusted more finely.</i> See Kwak Translation at page 4, lines 26-29 (emphasis added).

a bulb having a toroidal shape for emitting light;

Reference 1 – Kwas Translation

a fixing component; a connecting pipe, one side end of which is coupled to the fixing component and through an inside of which a USB cable (C) is extended; a mounting component, to a bottom surface of which the other side end of the connecting pipe is coupled, on an upper surface of which a PC webcam is positioned, and on a rear surface of which a USB port electrically connected to the PC webcam is arranged; and *a lamp provided at a predetermined position of the mounting component to light an object so that the object can be clearly photographed by the PC webcam positioned on the mounting component*. See Kwak Translation at page 2, line 39 – page 3, line 4 (emphasis added).

Reference 2 - U.S. Pat. No. 6238060 (Bourn).

In one embodiment, the ring light source includes *a ring-shaped flashtube* located substantially along a circle disposed perpendicular to and centered on the optical axis, and further includes an enclosure having a slit located between the ring-shaped flashtube and the ring reflector, wherein the slit allows light from the flashtube to fall on a reflecting surface of the ring reflector. See Bourn at col. 3, line 50-56. (emphasis added).

The present invention takes advantage of the efficiency of high-brightness red, infra-red, blue, white, or other color LEDs arranged in one or more circular rows, and the properties inherent to a reflective focusing element such as a turned angled reflective ring to produce an illumination source for machine-vision systems. *The illumination source exhibits multi-directional ring-illumination properties which are useful for illumination of small components* (which are being inspected or

	measured) <i>without unwanted shadows</i> . See Bourn at col. 2, line 32-39 (emphasis added).
a reflector having a circular configuration to conform to the toroidal shape of said bulb for projecting the emitted light;	Reference 2 - Bourn In this embodiment, camera 140 is disposed to view object 160 through an opening in <i>ring-reflector illumination source 200</i> which directs light downward and inward. In the exemplary system shown, <i>it is desired to illuminate the top edge, inside walls and inside bottom surface of object 160 for viewing by camera 140 with even, high intensity, short-duration illumination of a fixed intensity</i>. See Bourn at Col. 6, line 34 - 41. FIG. 2B is a cut-away side view of ring-reflector illumination source 200 according to one embodiment of the present invention. In the embodiment shown, <i>ring-reflector illumination source 200 includes bottom enclosure 210, replaceable/changeable ring reflector 220 (designed to fit into a complementary opening 215 in bottom enclosure 210), ring illumination source 230</i> (in this embodiment, this is an LED light source 230 having a single row of LEDs 231 closely spaced in a circle that is centered on optical axis 299 of camera 140, the focal centerlines 298 of each LED directed along a line parallel to optical axis 299), and top cover 240 that is attached to bottom enclosure 210, for example by four screws 242 that pass through spacers 241 used to maintain the desired spacing and placement of the LED light source 230 within ring-reflector illumination source 200. See Bourn at Col. 8, line 7 - 22 (emphasis added). The present invention provides a method and apparatus which provide an illumination source for illuminating an object in a machine-vision system having a machine-vision camera, the camera having an optical axis. One embodiment of the illumination source includes a ring-light source emitting light

	from a plurality of points, the points being along one or more circles, a focusing element, the focusing element including an angled ring reflector to direct rays from the ring light source at an angle generally towards the optical axis. One embodiment provides a replaceable ring reflector for changing the light-source-to-optical-axis and/or changing the spread and/or focus of the light from ring light source. One embodiment provides light from multiple directions in order to reduce shadowing. One embodiment provides light to illuminate the inside of, for example, an aluminum beverage can before it is filled and sealed. See Bourn at Col. 2, line 60 - Col. 3, line 8.
and an arm disposed between said bulb and the terminal for connection to the terminal,	Reference 1 – Kwak Translation The PC webcam stand 100, as shown in FIG. 2 and FIG. 3, includes a fixing component 10, attached to a display 1; a connecting pipe 20, one side end of which is coupled to the fixing component 10 and through an inside of which a USB cable (C) is extended; <i>a mounting component 30, to a bottom surface of which the other side end of the connecting pipe 20 is coupled</i>, on an upper surface of which a PC webcam 50 is positioned, and on a rear surface of which a USB port 31 electrically connected to the PC webcam 50 is arranged; and <i>a lighting device 40 provided at a predetermined position on the mounting component 30 to light an object so that the object can be clearly photographed by the PC webcam 50 positioned on the mounting component 30</i>. See Kwak Translation at page 3, lines 22-29 (emphasis added) and Figures 2-3. Then, <i>at a position (for example, a display, a computer body, a desk lamp) suitable for photographing the photographed object, the stand 100 is fixed by the fixing component 10</i>, and the flexible pipe 20 is adjusted with reference to the photographed

	picture, so that the position of the PC webcam 50 is adjusted more finely. See Kwak Translation at page 4, lines 26-29 and Figure 1 (emphasis added).
wherein said bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera.	Reference 1 – Kwak Translation One side of the connecting pipe 20 is coupled to the fixing component 10, a USB cable extends through the inner side thereof, and the USB cable is electrically connected to the USB port (not shown) of the computer body. In addition, <i>the connecting pipe 20 is preferably formed by a flexible pipe, so that the lighting angle of the lamp 41 can be easily adjusted.</i> See Kwak Translation at page 3, lines 37-40. First, the USB cable C of the PC webcam stand 100 is inserted into the USB port (not shown) of the computer body, and the USB cable C' of the PC webcam 50 is inserted into the USB port 31 in the rear surface of the mounting component 30 of the stand 100. At this time, the PC webcam 50 and the computer body will be electrically connected according to the USB cables C-C'. At this time, <i>the PC webcam 50 is mounted on the upper surface of the mounting component 30 of the stand 100. As described above, the position the of PC webcam is determined according to the reference wall 33. Since the assembling and disassembling can be achieved by magnetism, the PC webcam can be easily relocated.</i> See Kwak Translation at page 4 at lines 18-25 (the position of the PC video camera is determined by its position on the reference wall (33) or depending on where it is installed on the reference wall, the PC video camera position may change easily) See Kwas Translation at page 4, lines 18-25 (emphasis added). Reference 3 - U.S. Pat. Pub. 2005/0151042 (Watson)

	A camera mount supports a web camera thereon. The mount includes a bracket for supporting a light source thereon and a platform supported on the bracket for receiving the base of the web camera thereon. The light source may be operable in either flash or steady-on modes to provide optimum lighting for the web camera. The platform ensures various designs of web cameras and web camera bases can be accommodated and supported thereon. The bracket also readily permits the camera mount to be supported on an upright supporting surface to remove the clutter of cords from the workspace on a desk supporting a computer thereon. See Watson at abstract. The camera is preferably adjustable in position relative to the bracket, so as to be pivotal about two axes, oriented transversely to one another, relative to the bracket. Additional, <i>there may be provided a telescoping arm supporting the platform on the bracket for</i> adjusting a relative spacing therebetween. See Watson at 0017 (emphasis added). <i>the light source is adjustable in position relative to the camera.</i> See Watson claim 12. In some embodiments the platform 14 may be provided by itself with the support bracket simply for supporting the camera thereon out of the way of the user. It is desirable however to provide a combination of a support for lights and for a web camera to ensure adequate lighting when using the video mode of the web camera. See Watson at paragraph 0044.
2. The illuminator device of claim 1, wherein said reflector is positioned proximate said bulb to	Reference 1 – Kwak Translation The bottom surface of the mounting component 30 is coupled to the other side end of the connecting pipe 20. Therefore, a fastening pipe 32 is provided on the bottom surface of the

project light towards a face of said user or said users.

mounting component 30, so that the other side end of the connecting pipe 20 can be inserted. The connecting pipe 20 is fixed by a usual fastening device or adhesive material in a state of being inserted into the fastening pipe 32. In addition, a specified space portion is formed on the front inner side of the mounting component 30, *so that the lamp 41 can be easily arranged, and moreover, a reflecting cover 42 is arranged behind the lamp 41, and a convex lens 43 is provided in front of the lamp 41.* In addition, a reference wall 33 is formed in a protruding manner on one side of an upper surface of the mounting component 30 for positioning the PC webcam 50, and a magnet or a metal plate 34 is provided on the upper surface thereof to easily fix the PC webcam 50 according to a magnetic force. That is, when the magnet is attached to the bottom surface of the camera 50, the metal plate is provided on the upper surface of the mounting component 30, and when a shell of the camera 50 is of a metal material or is attached to the metal plate, the magnet is attached to the upper surface of the mounting component 30. In addition, a USB port 31 is provided on a rear surface of the mounting component 30, so that the USB cable C extending through the connecting pipe 20 is easily connected to the PC webcam 50.

The lamp 41 is configured to light the photographed object photographed by the PC webcam 50 and receives a power supply through an electric wire of the USB cable C. Namely, an electric wire of about 5V of the USB cable C is electrically connected in a state that the electric wire is branched to the sides of the lamp 41 and the PC webcam 50. In addition, the lamp 41 is connected to a dimmer 44 between the lamp 41 and the electric wire of the USB cable C, so that the brightness thereof may be adjustable. To facilitate operation, a handle portion of the

	dimmer 44 protrudes from the bottom portion of the mounting component 30. See Kwak Translation at page 3, line 41 – page 4, line 15 (emphasis added) Reference 2 - Bourn The present invention provides a method and apparatus which provide an illumination source for illuminating an object in a machine-vision system having a machine-vision camera, the camera having an optical axis. One embodiment of the illumination source includes a ring-light source emitting light from a plurality of points, the points being along one or more circles, a focusing element, <i>the focusing element including an angled ring reflector to direct rays from the ring light source at an angle generally towards the optical axis</i>. One embodiment provides a replaceable ring reflector for changing the light-source-to-optical-axis and/or changing the spread and/or focus of the light from ring light source. One embodiment provides light from multiple directions in order to reduce shadowing. One embodiment provides light to illuminate the inside. See Bourn at Col. 2, line 60 - Col. 3, line 8 (emphasis added).
3. The illuminator device of claim 1, wherein said reflector is lined with a reflective material or film.	Reference 2 - Bourn The present invention provides a method and apparatus which provide an illumination source for illuminating an object in a machine-vision system having a machine-vision camera, the camera having an optical axis. One embodiment of the illumination source includes a ring-light source emitting light from a plurality of points, the points being along one or more circles, a focusing element, <i>the focusing element including an angled ring reflector to direct rays from the ring light source at an angle generally towards the optical axis</i>. One embodiment provides a replaceable ring reflector for changing the light-

	source-to-optical-axis and/or changing the spread and/or focus of the light from ring light source. One embodiment provides light from multiple directions in order to reduce shadowing. One embodiment provides light to illuminate the inside of, for example, an aluminum beverage can before it is filled and sealed. See Bourn at Col. 2, line 60 - Col. 3, line 8 (emphasis added).
4. The illuminator device of claim 1, wherein said arm is a flexible arm that permits said bulb to be positioned relative to the web camera.	Reference 1 – Kwak Translation One side of the connecting pipe 20 is coupled to the fixing component 10, a USB cable extends through the inner side thereof, and the USB cable is electrically connected to the USB port (not shown) of the computer body. In addition, <i>the connecting pipe 20 is preferably formed by a flexible pipe, so that the lighting angle of the lamp 41 can be easily adjusted.</i> See Kwak Translation at page 3, lines 37-40. (emphasis added)
5. The illuminator device of claim 1, wherein said arm is connected to the terminal by a clamp.	Reference 3 - Watson While various embodiments of the camera are illustrated in the accompanying figures, the common elements will first be described herein. The camera mount 10 includes a platform 14 for supporting the camera thereon. The camera includes a broad flat supporting surface which readily accepts the base of various types of commercially available web cameras 12 to be supported thereon. <i>A support bracket 16 is provided which can be mounted on a suitable supporting surface such as a wall and the like or may be adapted for attachment to a laptop screen in some embodiments.</i> A support arm 18 couples the platform to the support bracket for supporting the camera 12 on the supporting surface to which the bracket is attached. A light mount 20 is provided on the bracket 16 for supporting a light source 22 thereon. See Watson at paragraph 0029.

	Turning now to the embodiment of FIG. 3, the bracket 16 is adapted to include inverted <i>U-shaped clips 60 which can be secured overtop of the top edge of a lap top display</i> monitor 62 in a snap fit engagement therewith. The remaining features of the bracket including the adjustable support arm 18 and light sources 22 remain identical to the previous embodiment. See Watson at paragraph 0035 (emphasis added)
6. The illuminator device of claim 5, wherein the clamp is movable along an edge of the terminal to adjust the location of said bulb.	Reference 1 – Kwak Translation In the above technical structure, although the fixing component 10 is shown attached to the display 1, the fixing component can be attached to any position where the photographed object can be photographed during the video chat. Therefore, an adhesive surface (for example, a double adhesive tape: 11) is arranged on the bottom surface of the fixing component 10. See Kwak Translation at page 3, lines 30-33.
7. The illuminator device of claim 1, wherein the arm has a base that supports the illuminator device on a flat surface adjacent to the terminal.	Reference 1 – Kwak Translation In the above technical structure, although the fixing component 10 is shown attached to the display 1, the fixing component can be attached to any position where the photographed object can be photographed during the video chat. Therefore, an adhesive surface (for example, a double adhesive tape: 11) is arranged on the bottom surface of the fixing component 10. See Kwak Translation at page 3, lines 30-33.
8. The illuminator device of claim 1, wherein said reflector has a piece of fabric thereon disposed between said bulb and a user's face for diffusing the light emitted from said bulb.	Reference 2 - Bourn In one embodiment, <i>ring reflector 220 is fabricated by turning on a lathe a blank of aluminum, stainless steel, plastic, glass or other suitable material to generate a circularly symmetric reflective face</i> (e.g., conical-section face 2211) (i.e., the surface of the cross section shown is a straight line at an angle of 52 degrees from the plane of exit opening, i.e., 38 degrees from the optical axis 299), which is then polished and/or chrome plated to

enhance its reflectivity at a wavelength of ring-light source 230. In another embodiment, ring reflector 221 is cast, e.g., by injection molding, from a suitable plastic, and then coated by well known methods with a reflective coating of chrome, gold or other metal, alloy, or multiple optical coating layers to enhance its reflectivity at one or more selected wavelengths of ring-light source 230. (These manufacturing methods can apply to any of the ring reflectors described below.) See Bourn at Col. 11, line 16-31 (emphasis added).

The present invention provides a method and system for generating rays of light with suitable brightness and evenness from a source surrounding, for example, the lens of a machine-vision camera. The rays are directed generally towards the optical axis of the camera. One embodiment provides *a diffuse source circumferentially* such that even extremely small objects can be adequately inspected and accurately measured by a machine-vision system 100. See Bourn at Col. 5, line 64 – col. 6, line 4 (emphasis added).

Reference 4 - U.S. Pub. No. 2006/0007666 (“Cook”)

The light modifier 10 has a collapsible housing 13 that defines a sidewall 17. The sidewall 17 is usually formed of a four separate panels 19, 21, 23 and 25 respectively that are joined together to form the sidewall 17 of the collapsible housing 13. The panels of the sidewall 17 are generally trapezoidal in shape and are made of a fabric material. The fabric panels 19, 21, 23, and 25 are assembled to form the sidewall 17 of the housing so that the housing 13 defines a first end 29 and a second end 31.

The panels 19, 21, 23 and 25 are usually formed of a fabric

	material having an outer layer 37 and an inner layer 41. The outer layer 37 of fabric is typically black and is opaque to light that is contained within the housing 13. The inner layer of fabric is typically reflective in nature and the inner layer 41 of fabric forms the interior of the collapsible housing 13. A loop or passageway 45 is formed in the inner layer 41 of fabric along at least a portion of the edges where the panels 19, 21, 23 and 25 are joined together to form the sidewall 17. Normally the passageways 45 are created by sewing in an additional layer of fabric that forms the inner layer 41 to create the passageway. However, other methods can be utilized to form the passageways in the interior of the collapsible housing 13. See Cook at paragraph 0013.
9. The illuminator device of claim 8, wherein said fabric is silk or muslin.	Reference 4 – Cook the baffle is white nylon fabric that diffuses the light from a light source. See Cook Claim 7. at least one layer of netting is made of a fabric selected from the group of nylon, polyester or cotton. See Cook Claim 11.



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(12) **United States Patent**
Bourn et al.

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(45) **Date of Patent:** **May 29, 2001**

(54) **MACHINE-VISION RING-REFLECTOR
ILLUMINATION SYSTEM AND METHOD**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/499,250**

(22) Filed: **Feb. 7, 2000**

Related U.S. Application Data

(62) Division of application No. 08/914,441, filed on Aug. 19, 1997, now Pat. No. 6,022,124.

(51) **Int. Cl.**⁷ **F21Y 103/02**; G03B 15/03

(52) **U.S. Cl.** **362/216**; 362/3; 362/33

(58) **Field of Search** 348/131, 132, 348/370, 371; 356/237; 359/387; 362/3, 11, 33, 216, 297, 346

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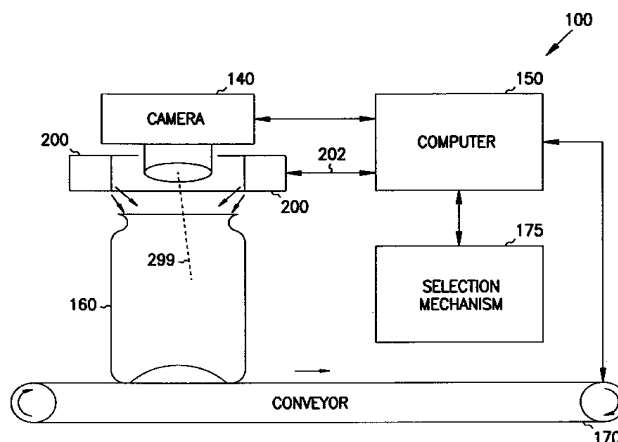
Primary Examiner—Alan Cariaso

(74) *Attorney, Agent, or Firm*—Schwegman, Lundberg, Woessner & Kluth, P.A.

(57) **ABSTRACT**

An illumination method and apparatus for machine-vision systems, including a ring-light source (e.g., LEDs arranged in one or more circular rows), and a reflective-ring focusing element. The illumination source exhibits multidirectional ring-illumination properties which are useful for illumination of small components (which are being inspected or measured) without unwanted shadows. One embodiment provides a dark field illumination system. One embodiment of the present invention uses a strobed (or pulsed) power supply to drive the LEDs. Yet another embodiment of the present invention uses a xenon strobe ring-light source and a backplane slit in place of the row of LEDs. In one such xenon strobe embodiment, a color filter is also placed in series with the light path in order to obtain a monochromatic light. While xenon flashtube light sources tend to exhibit a five per cent (5%) flash-to-flash variation in intensity which makes accurate measurements of certain characteristics difficult, they are useful in certain cases where intense white, or especially ultraviolet, light is desired. Strobed LEDs provide very little flash-to-flash variation in intensity. The compact ring-light generator has little, if any, shadowing. The present invention also provides an inexpensive apparatus and method for changing the light-source-to-optical-axis angle.

22 Claims, 22 Drawing Sheets



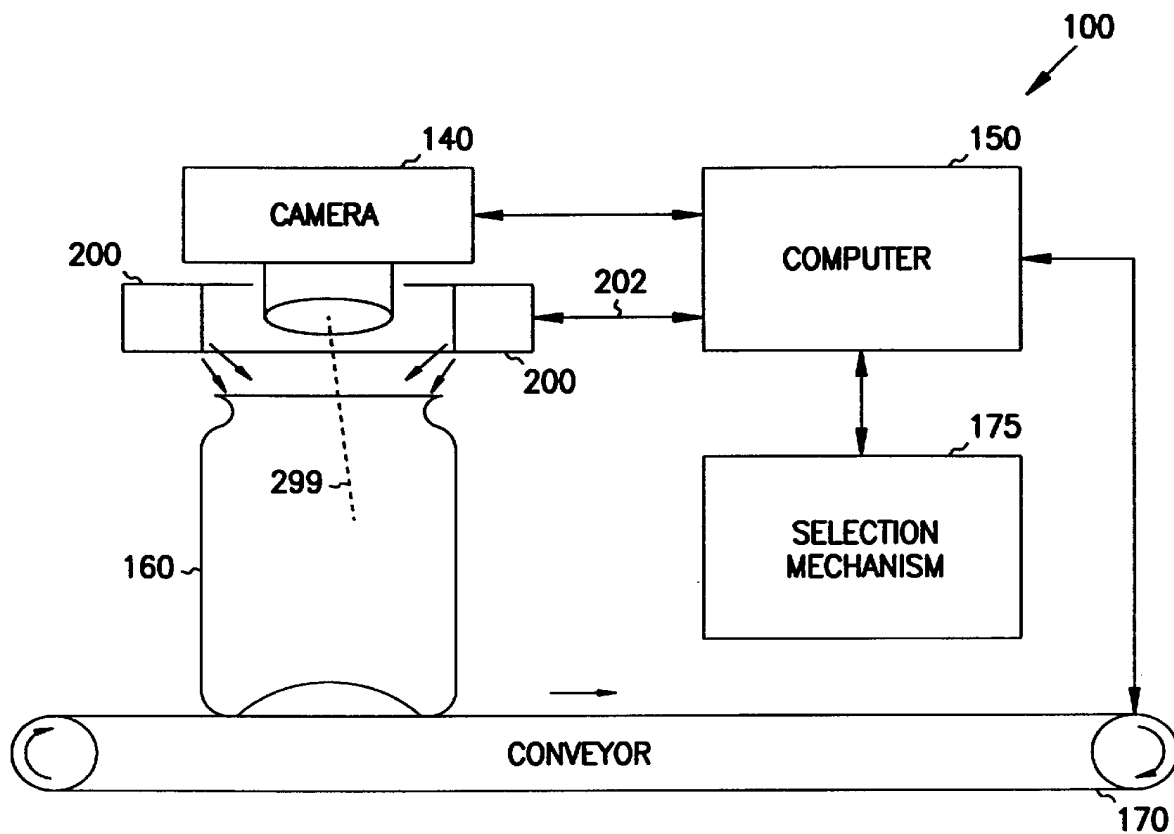


FIG. 1A

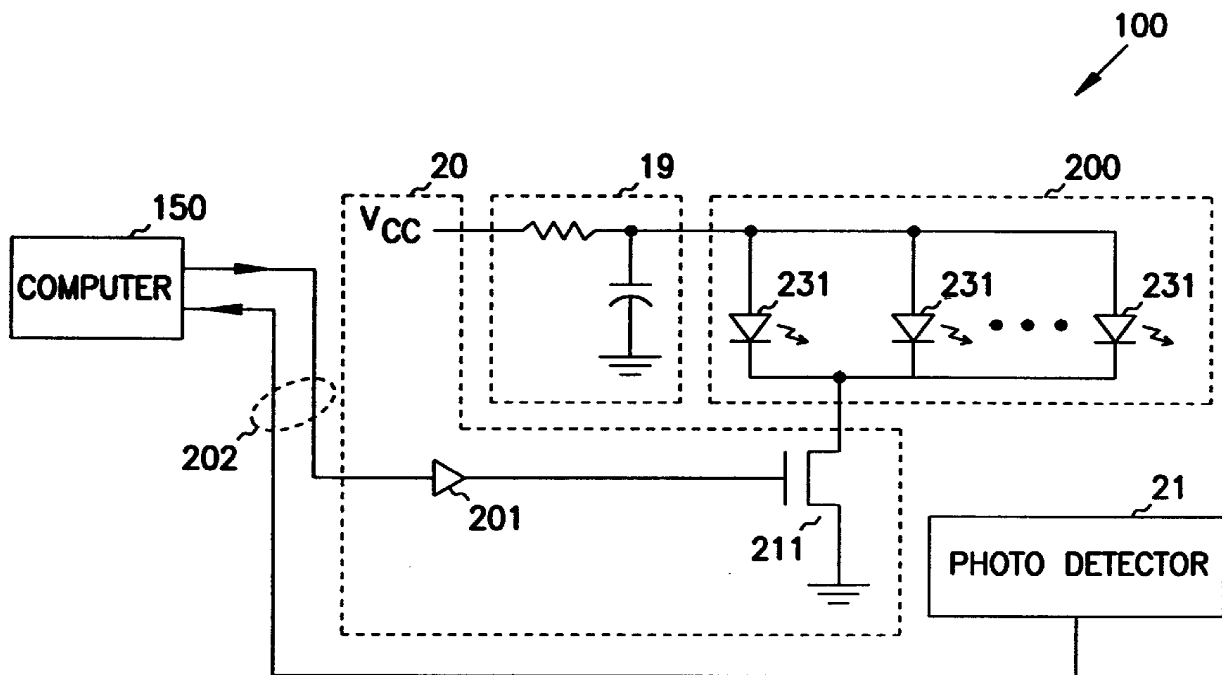


FIG. 1B

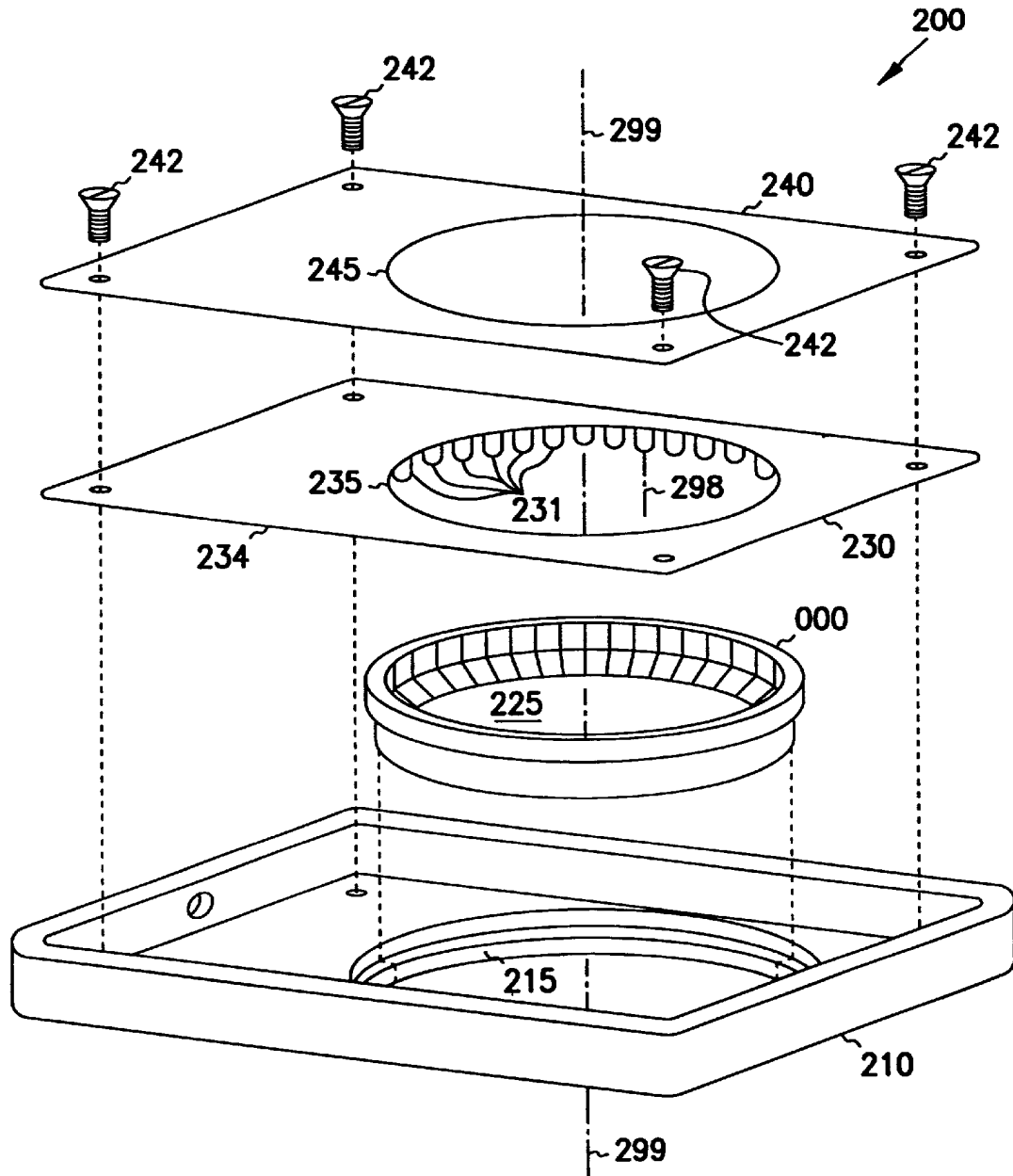


FIG. 2A

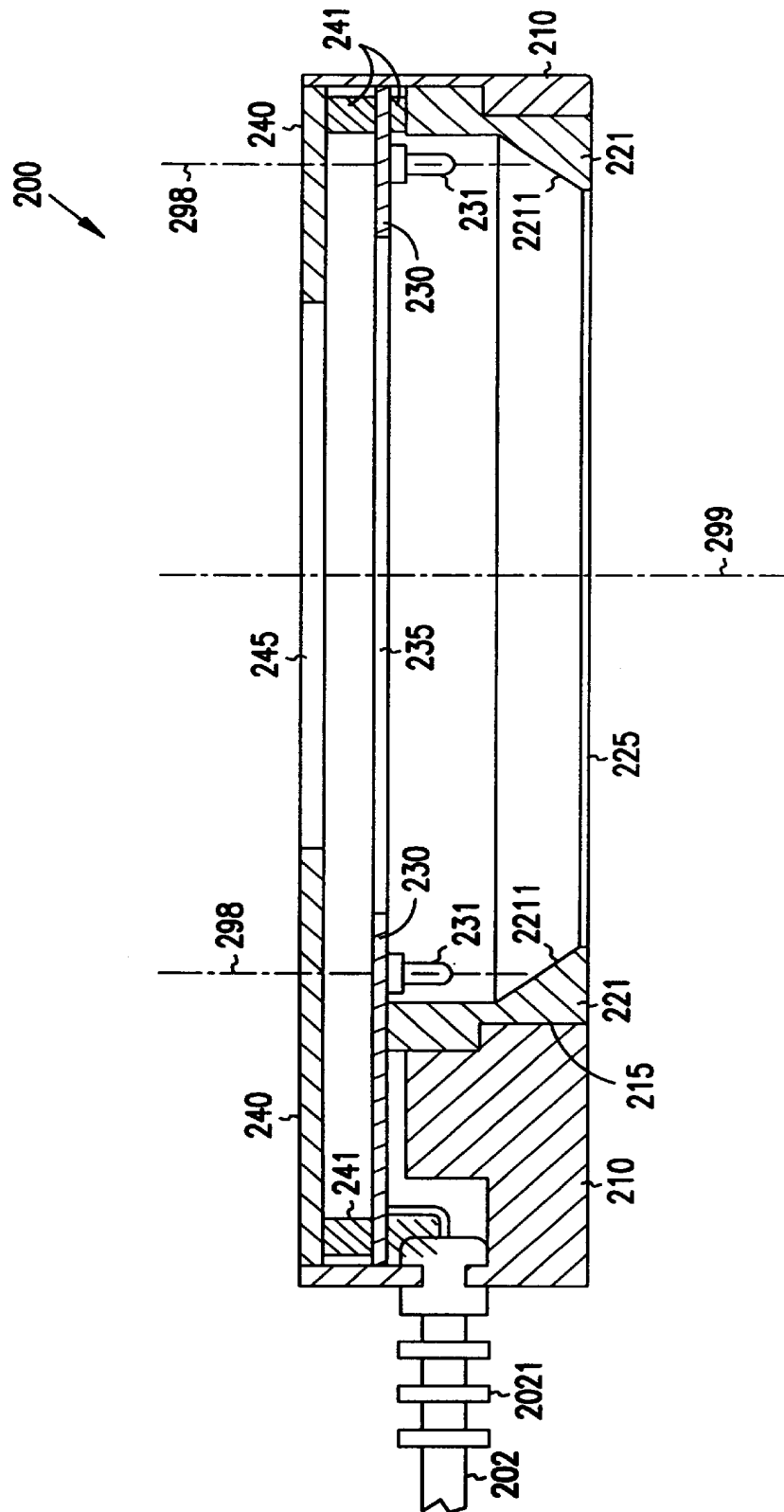


FIG. 2B

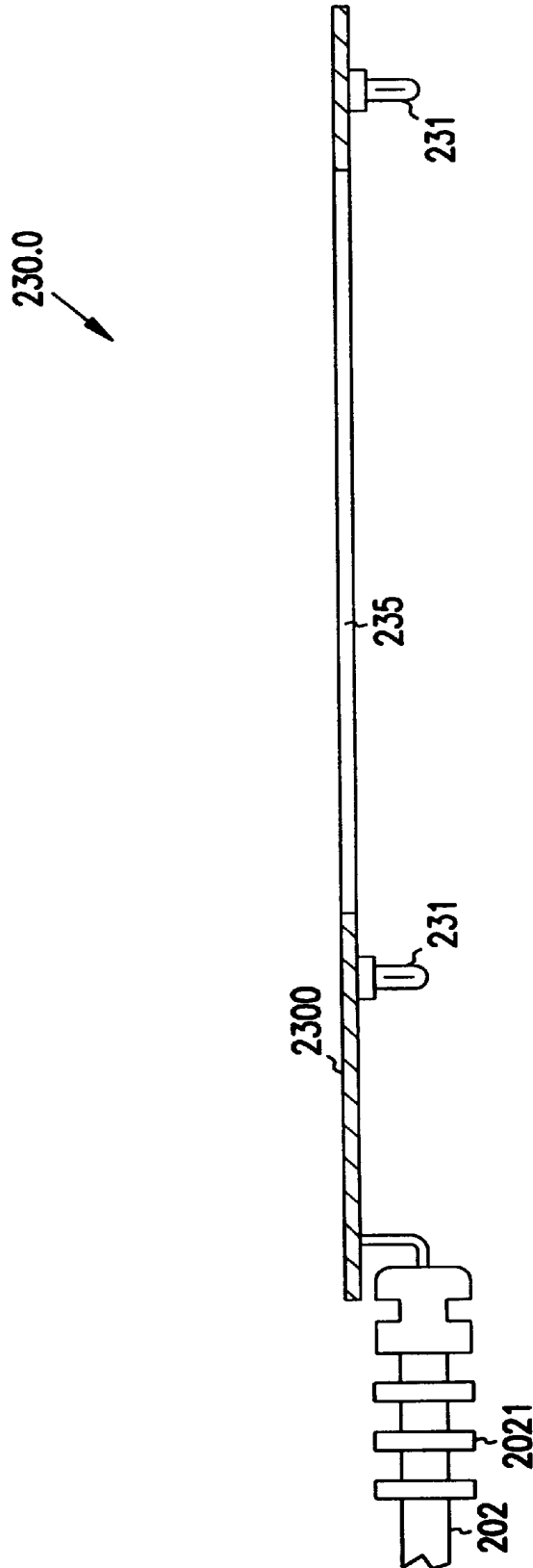


FIG. 2C

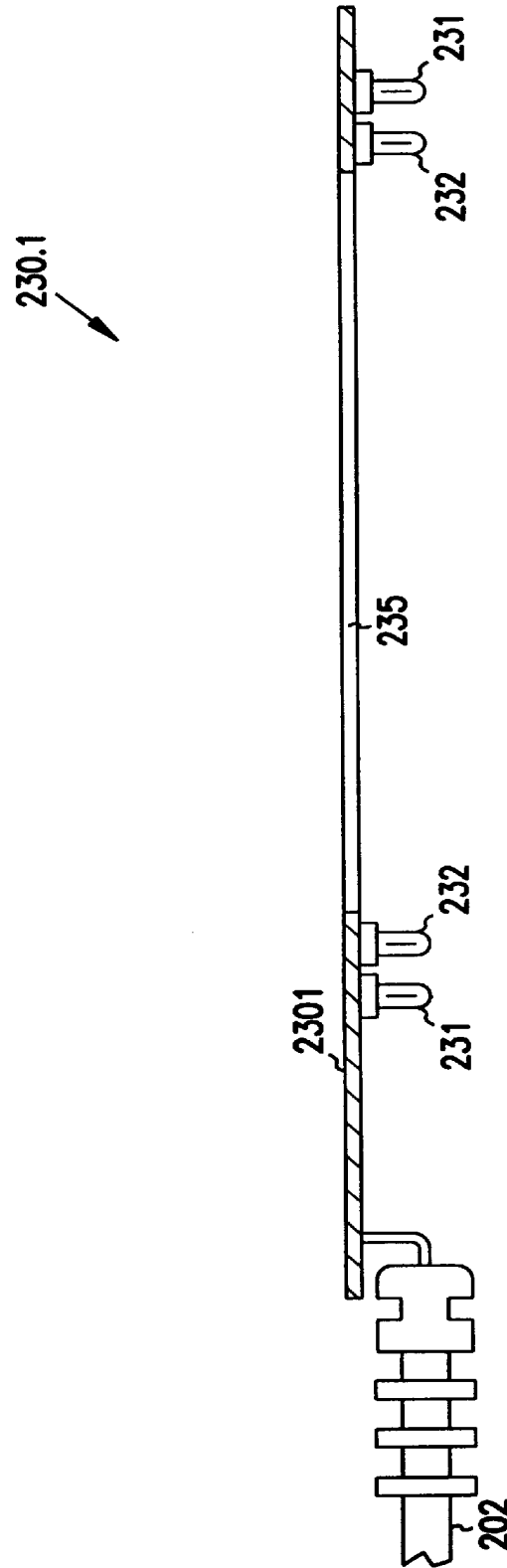


FIG. 2D

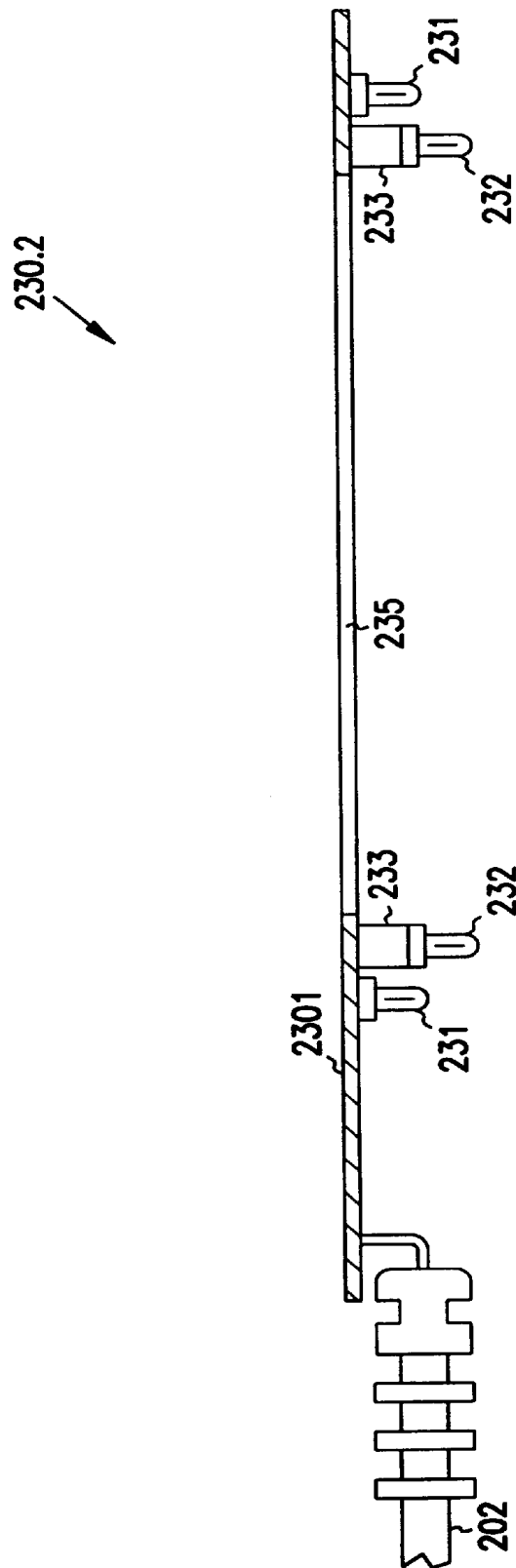


FIG. 2E

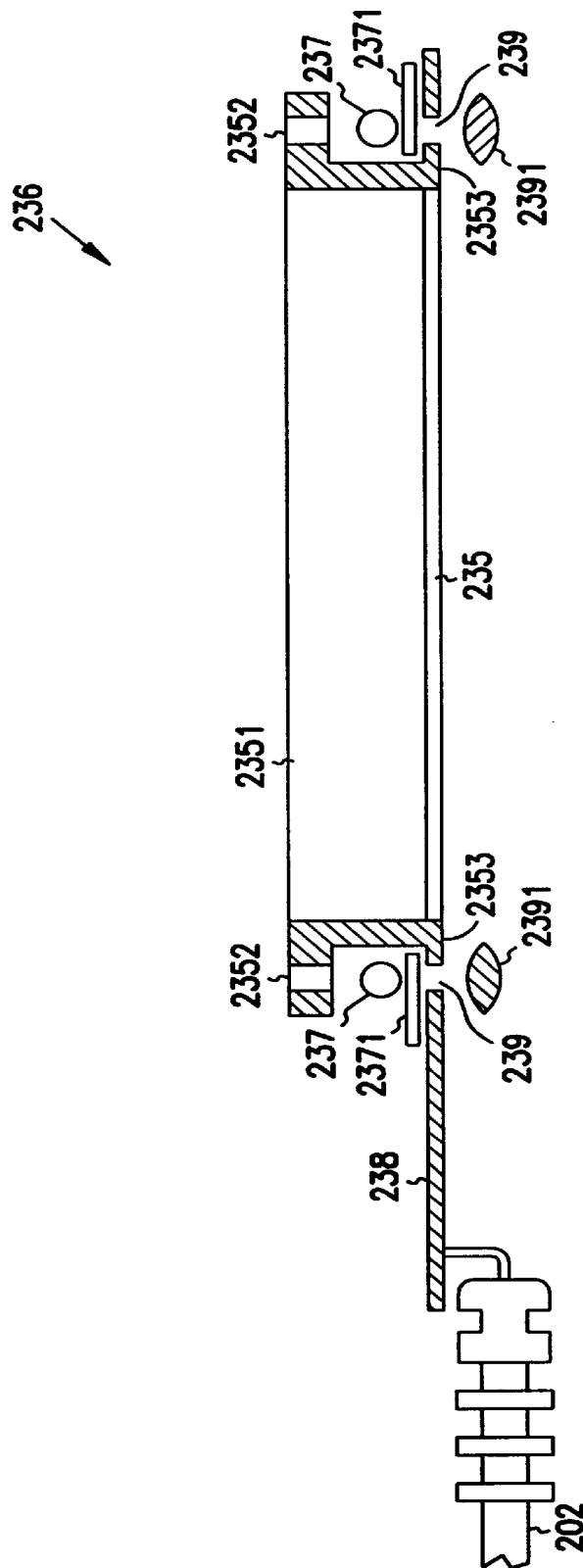


FIG. 2F

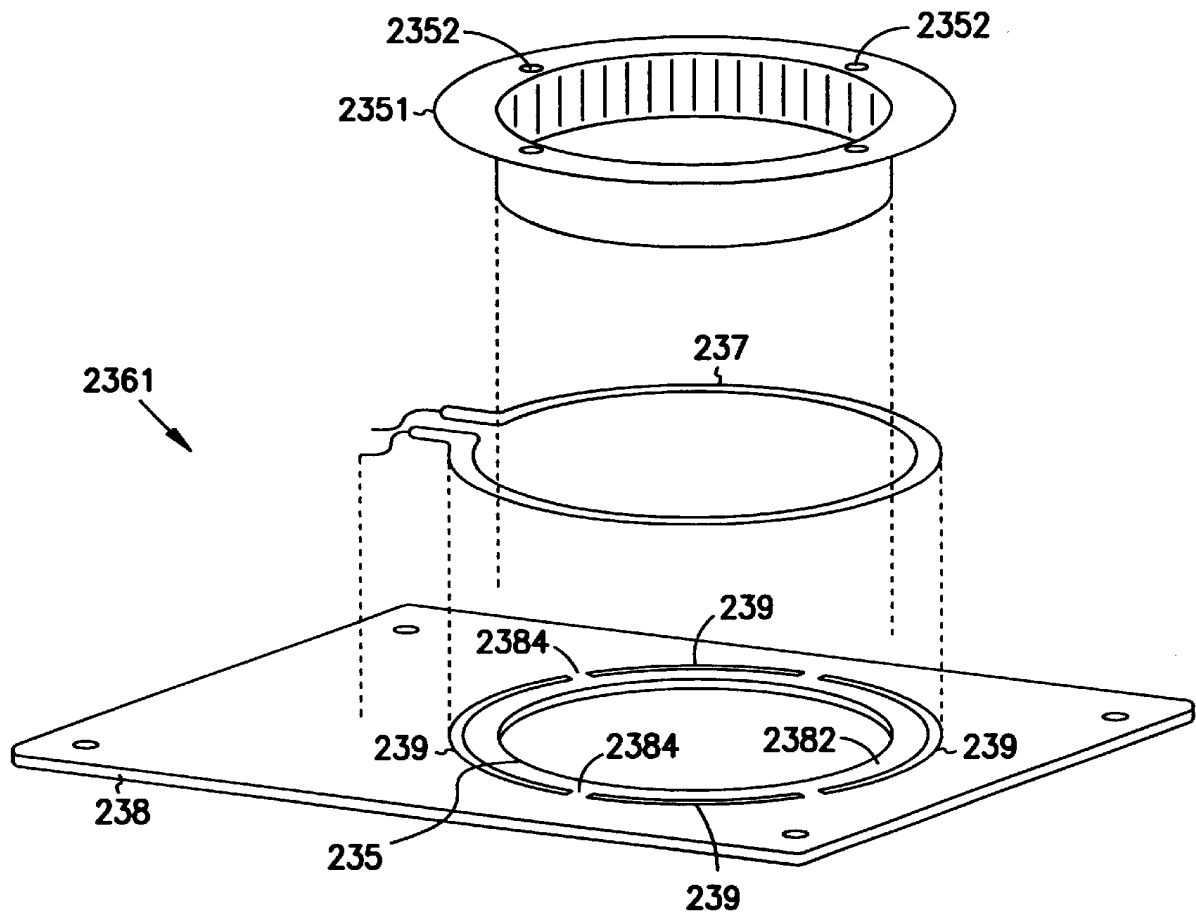


FIG. 2G

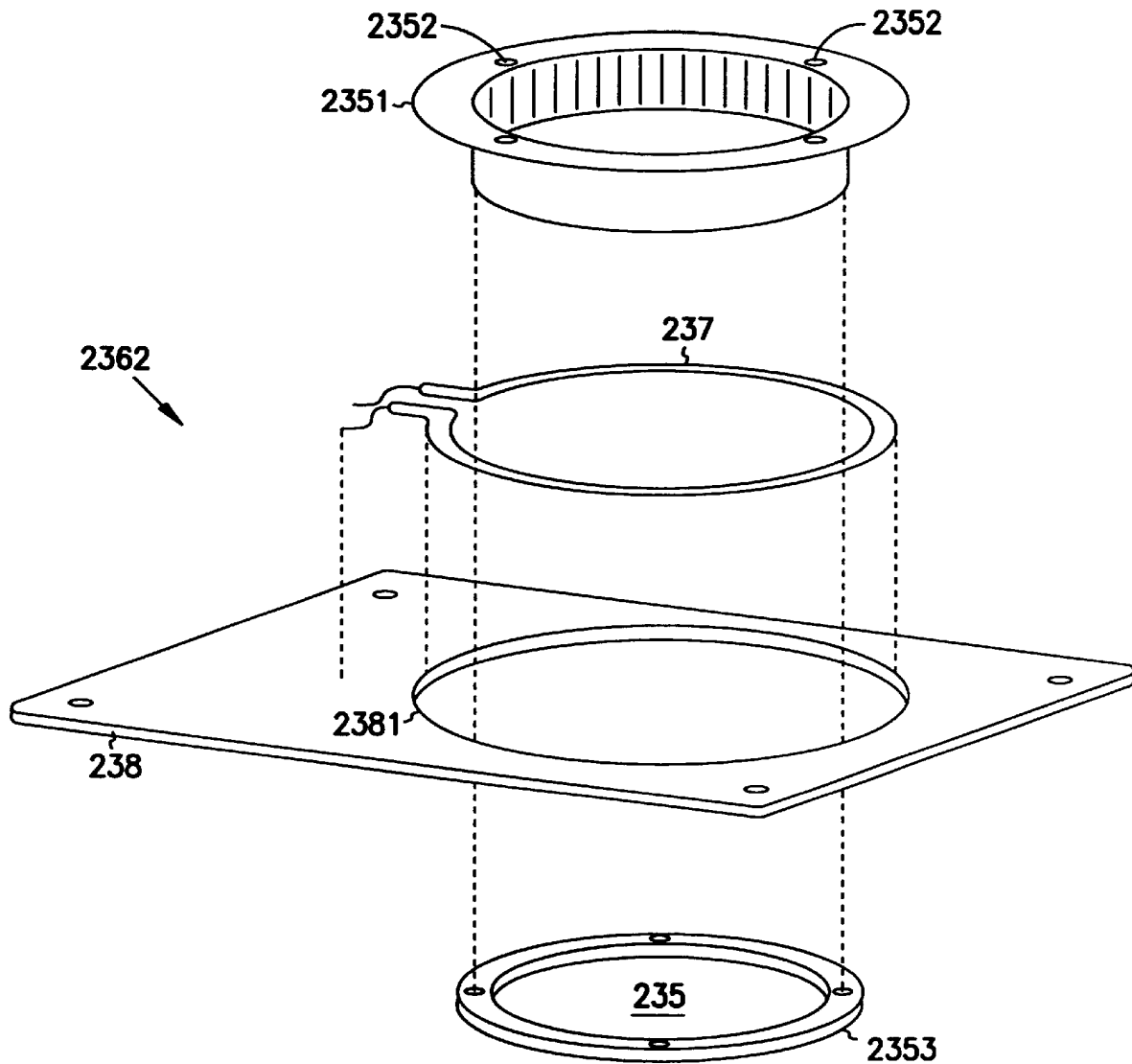


FIG. 2H

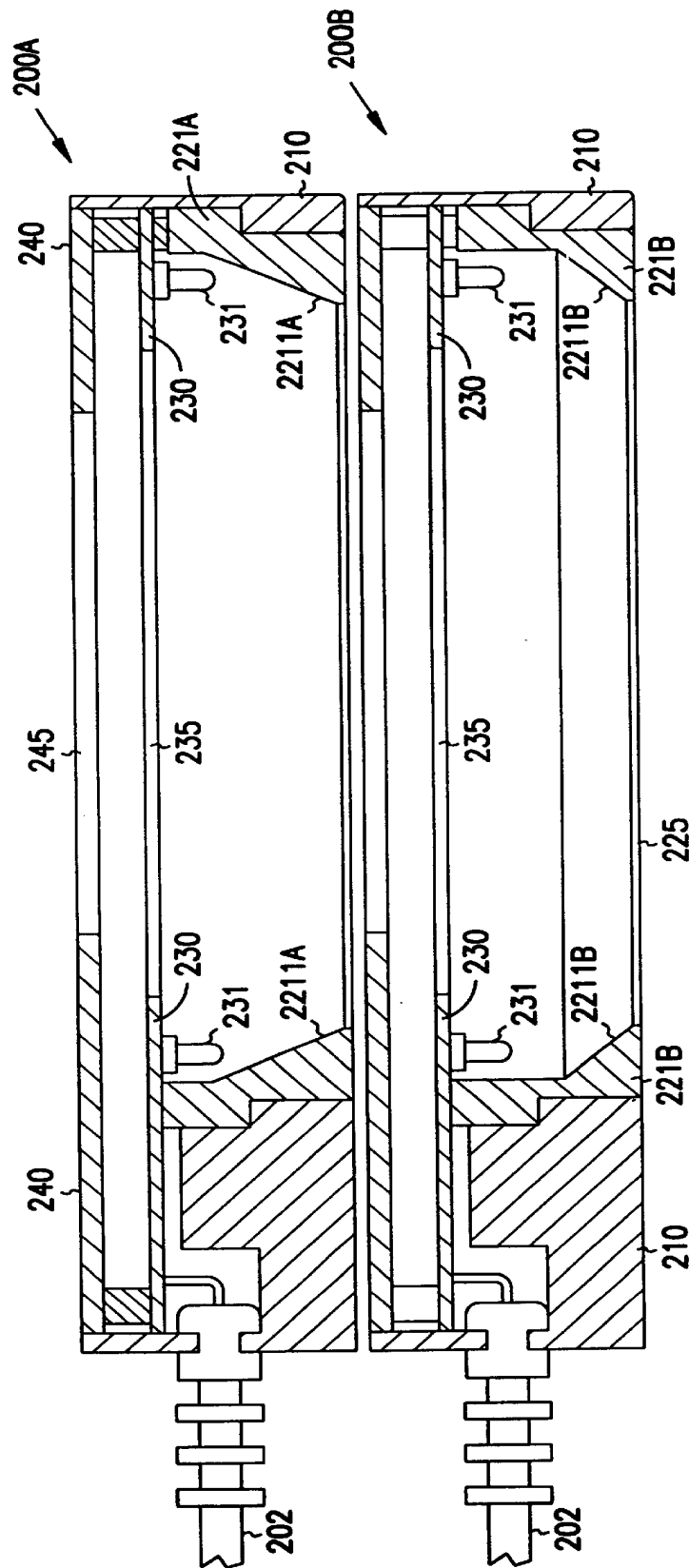


FIG. 2I

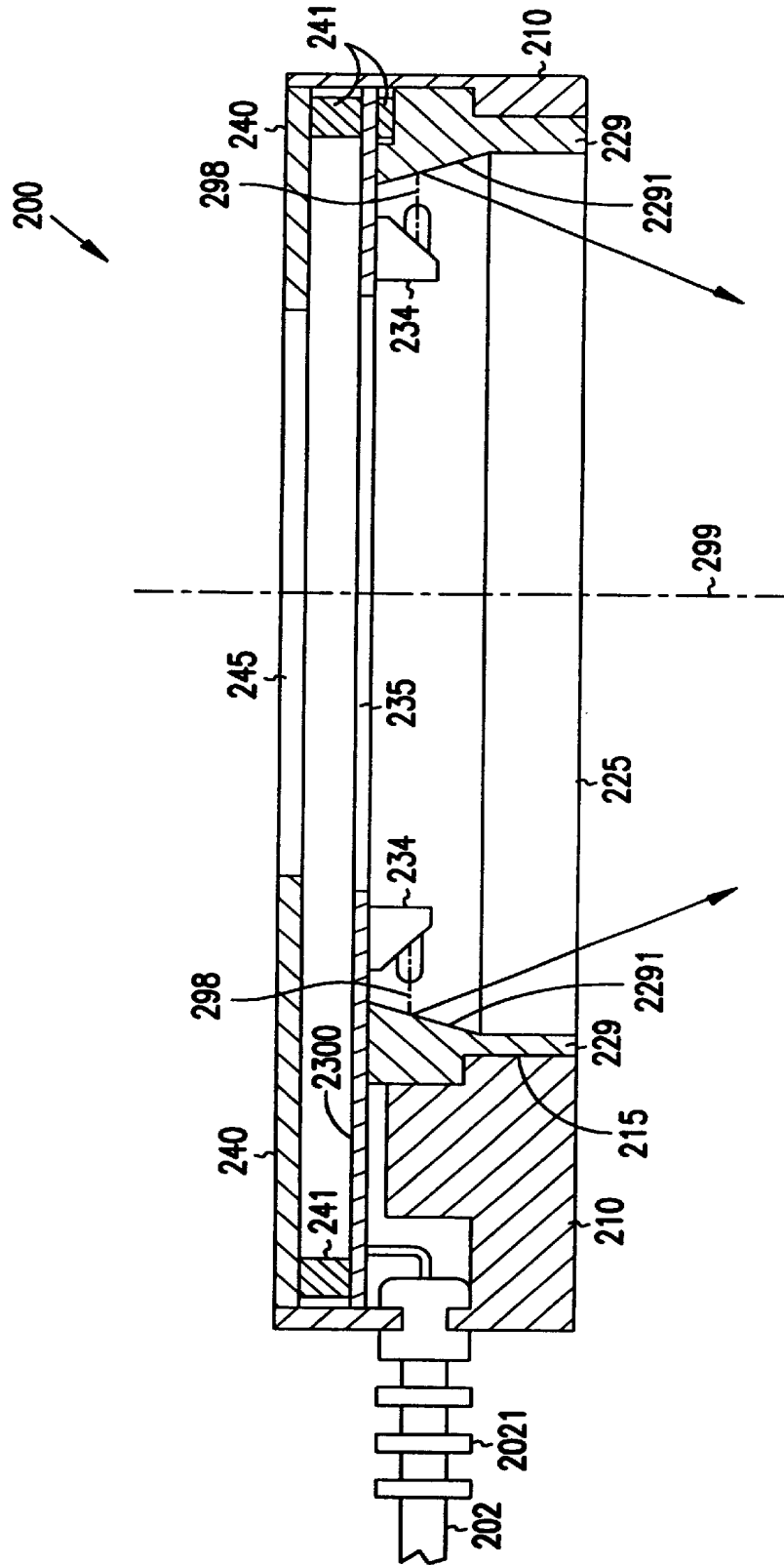


FIG. 2J

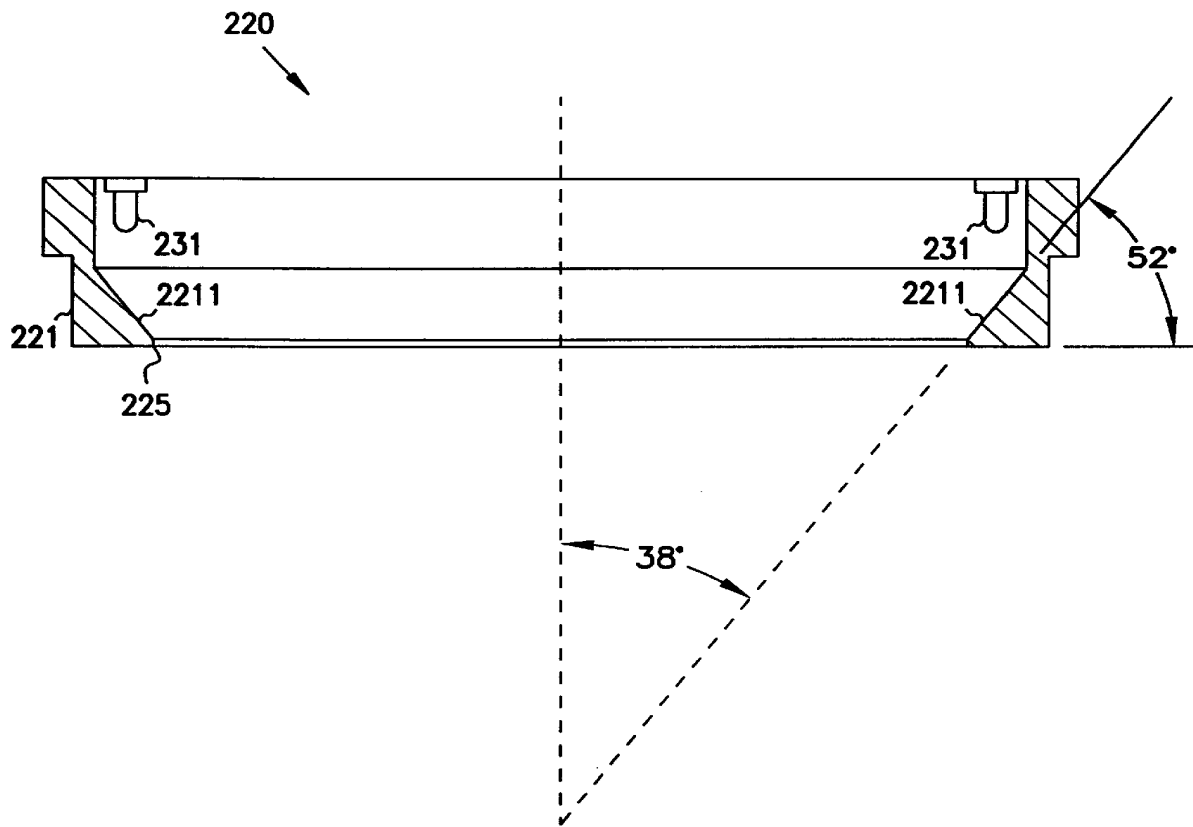


FIG. 3A

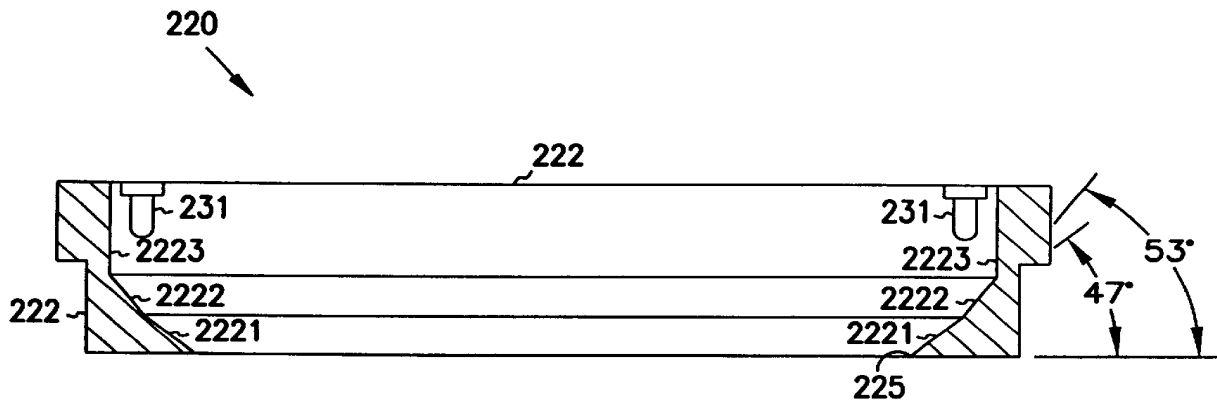


FIG. 3B

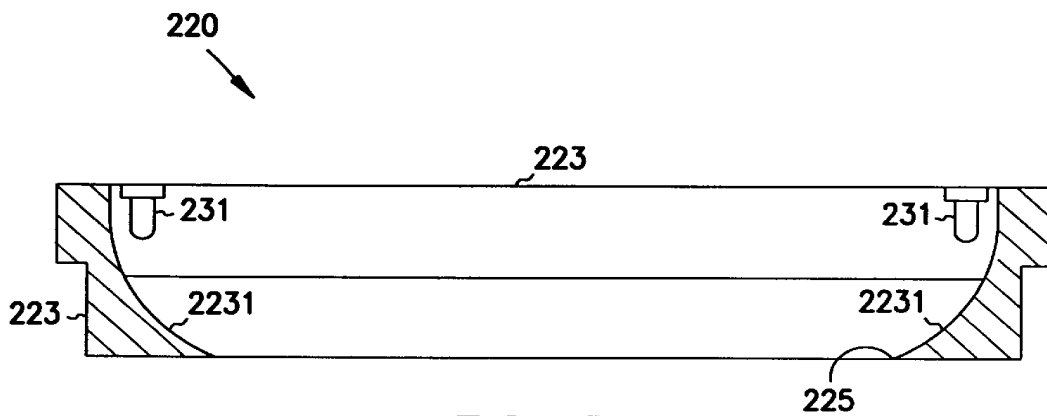


FIG. 3C

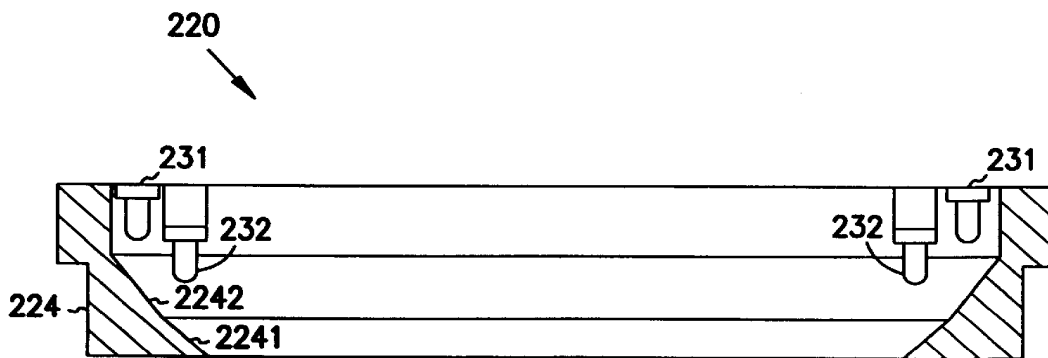


FIG. 3D

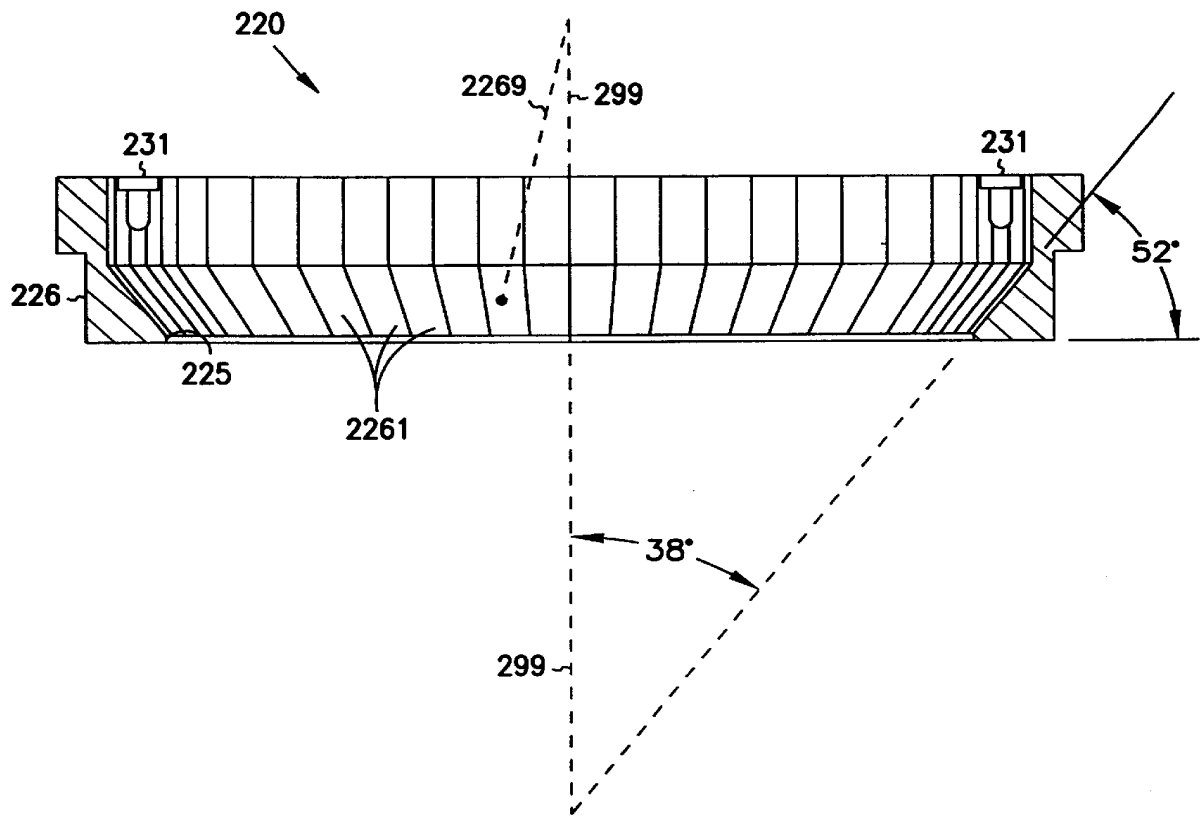


FIG. 3E

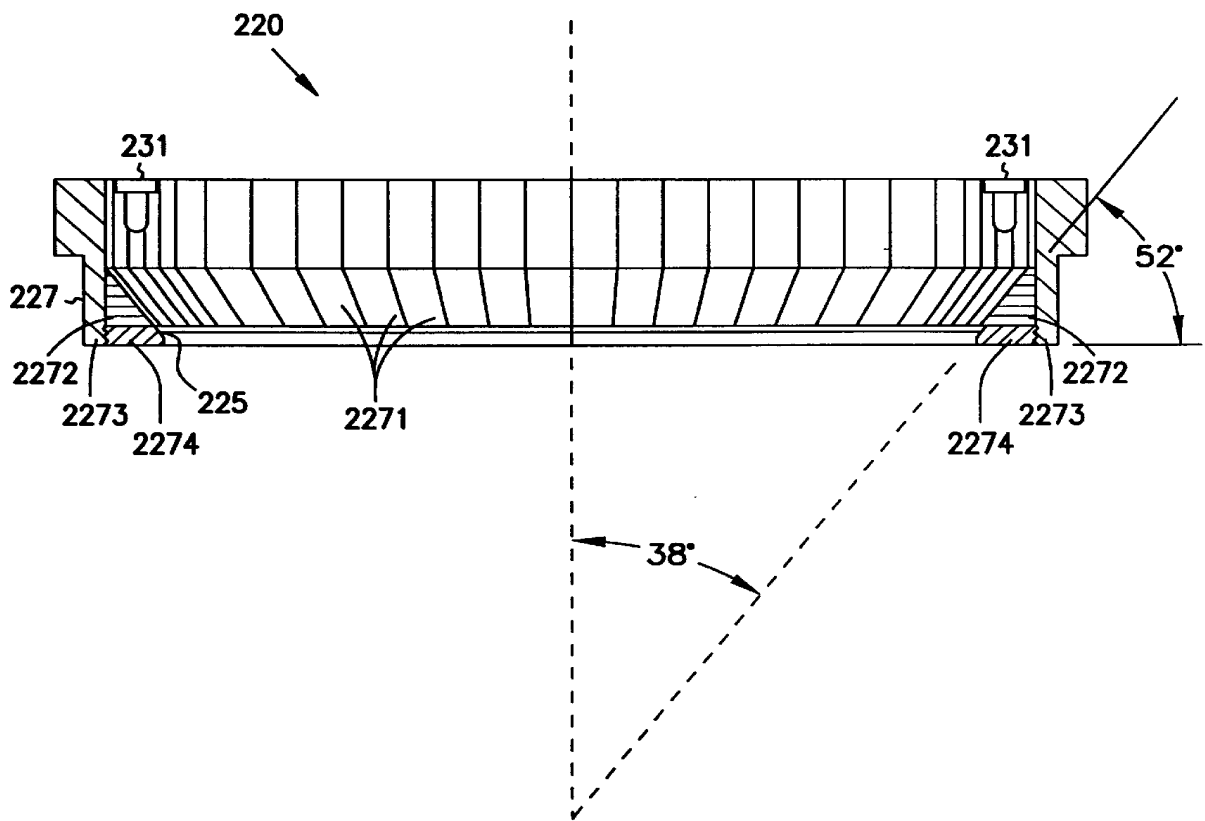


FIG. 3F

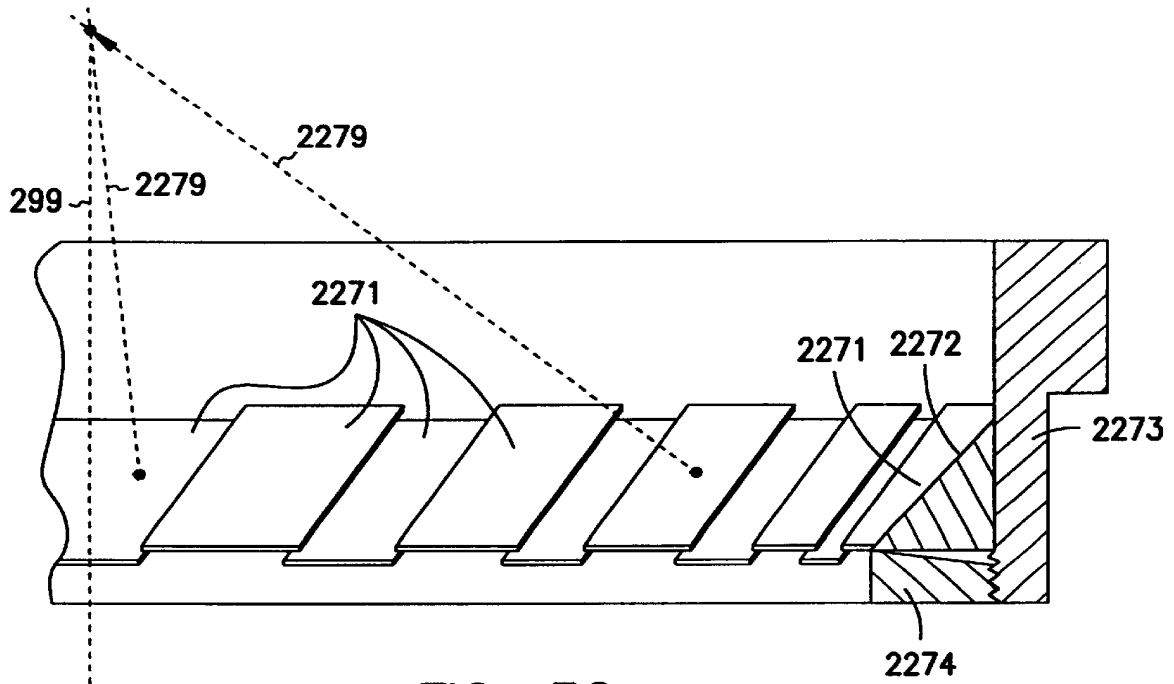


FIG. 3G

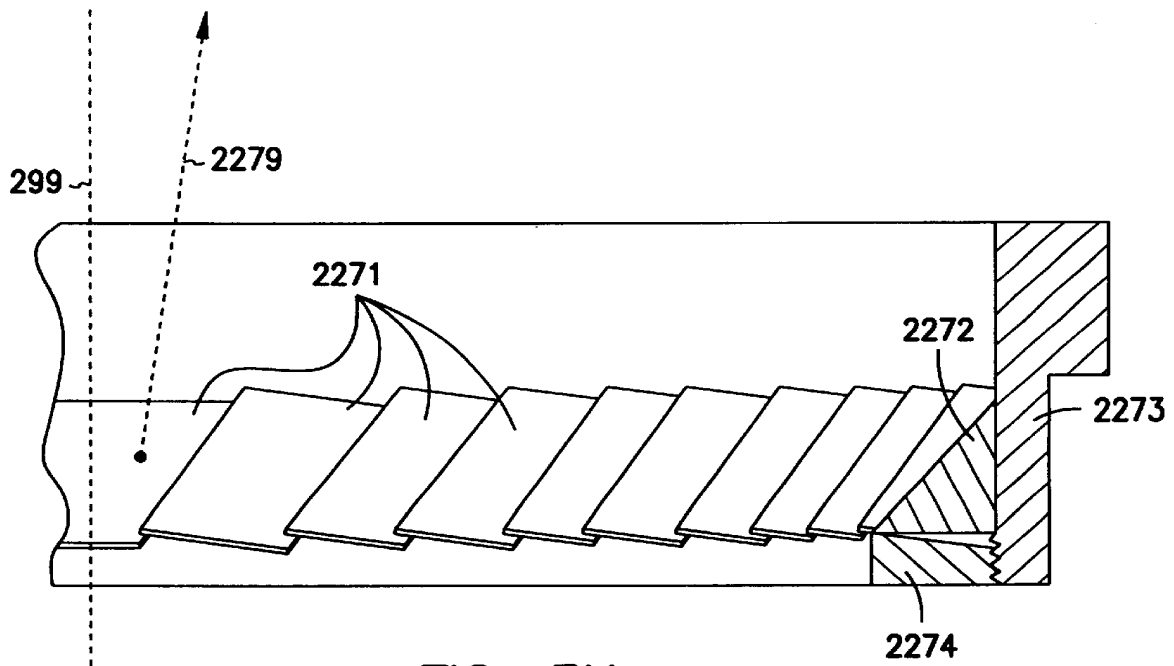


FIG. 3H

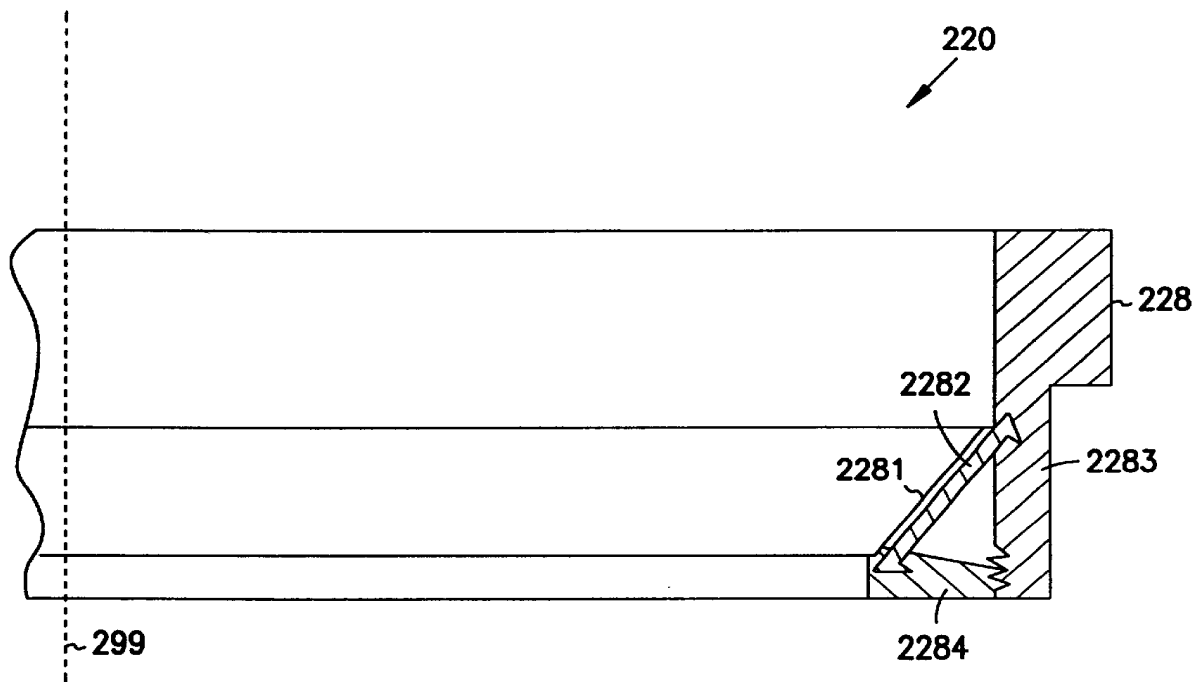
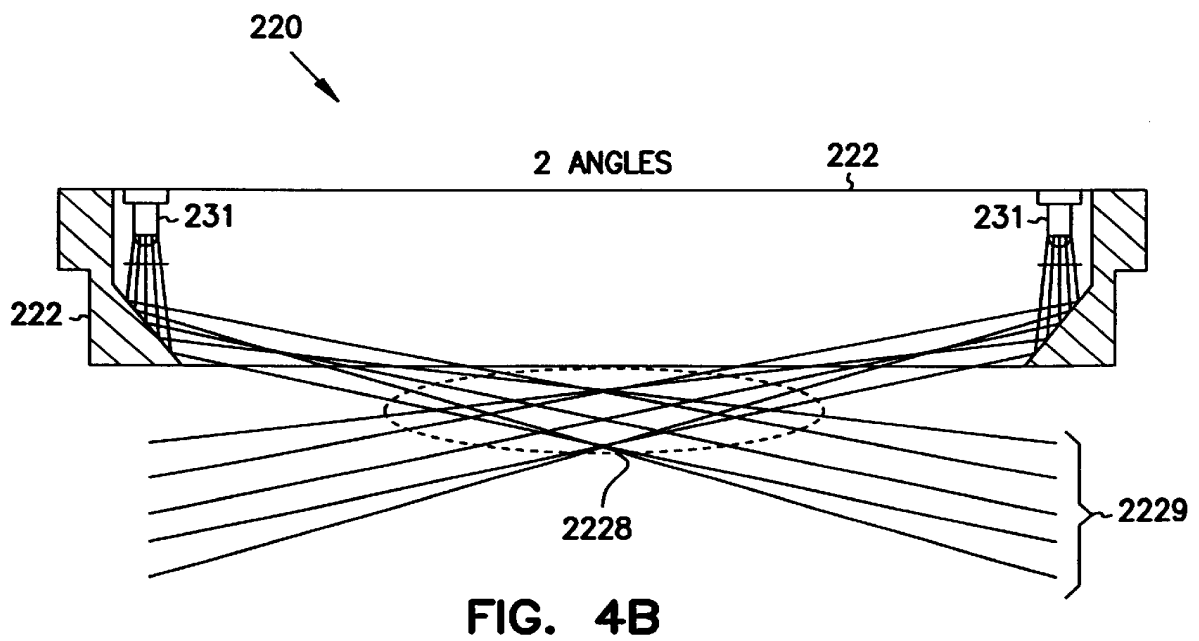
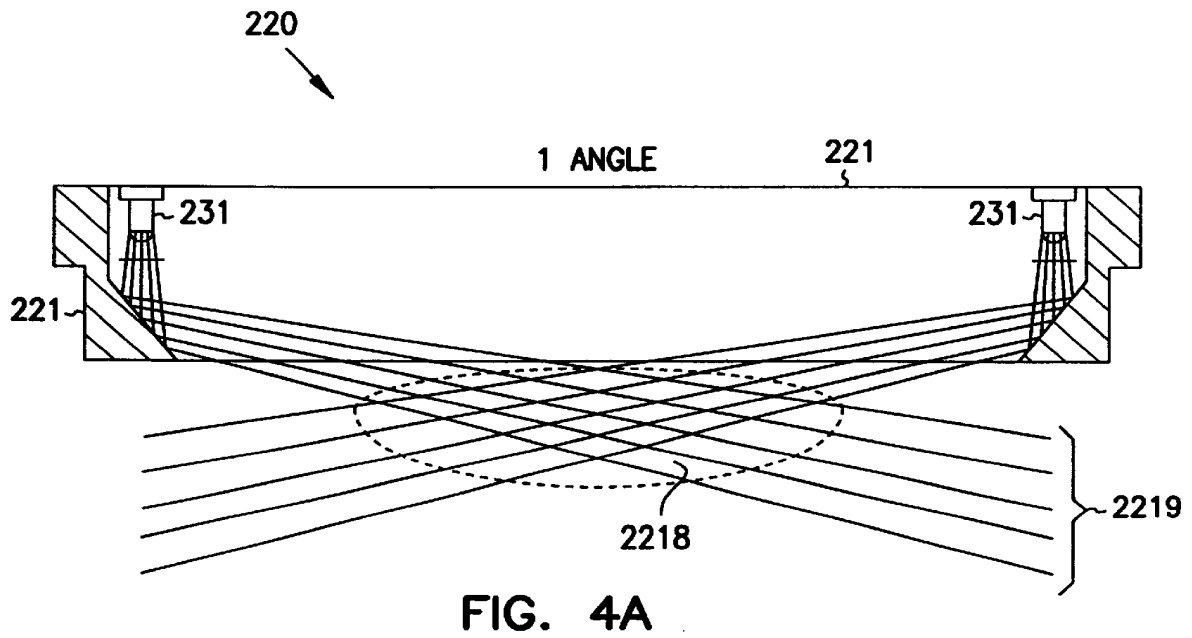


FIG. 3I



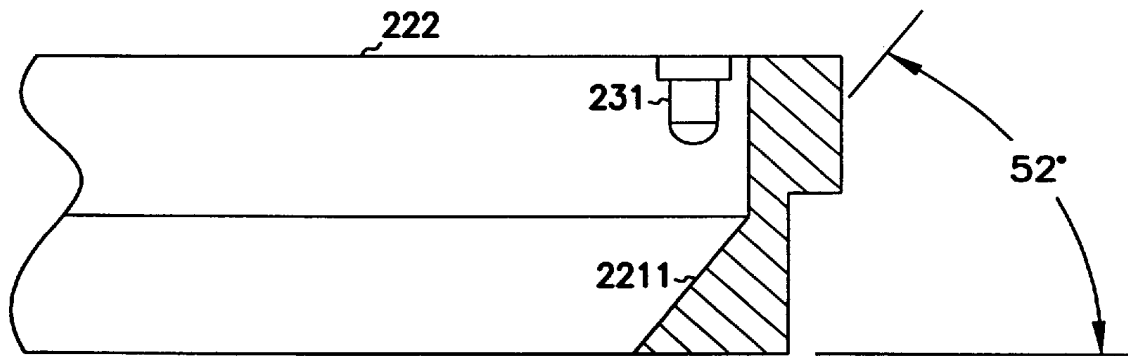


FIG. 5A

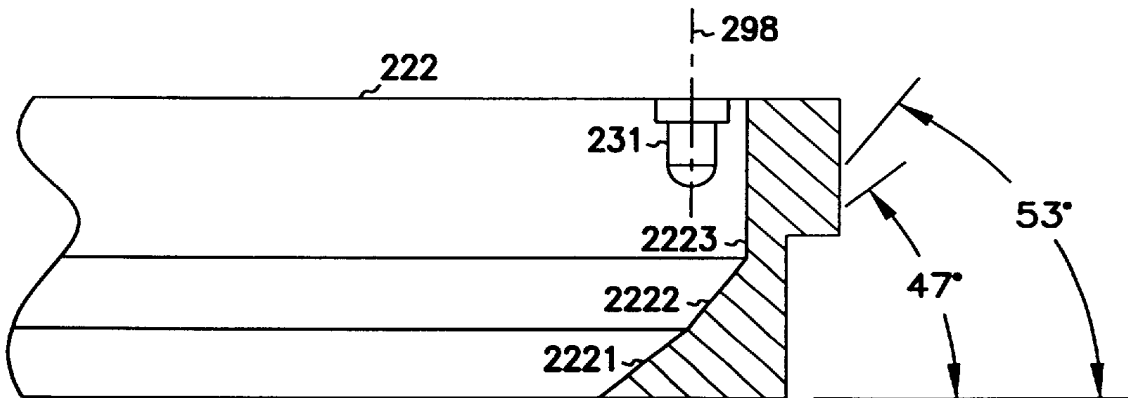


FIG. 5B

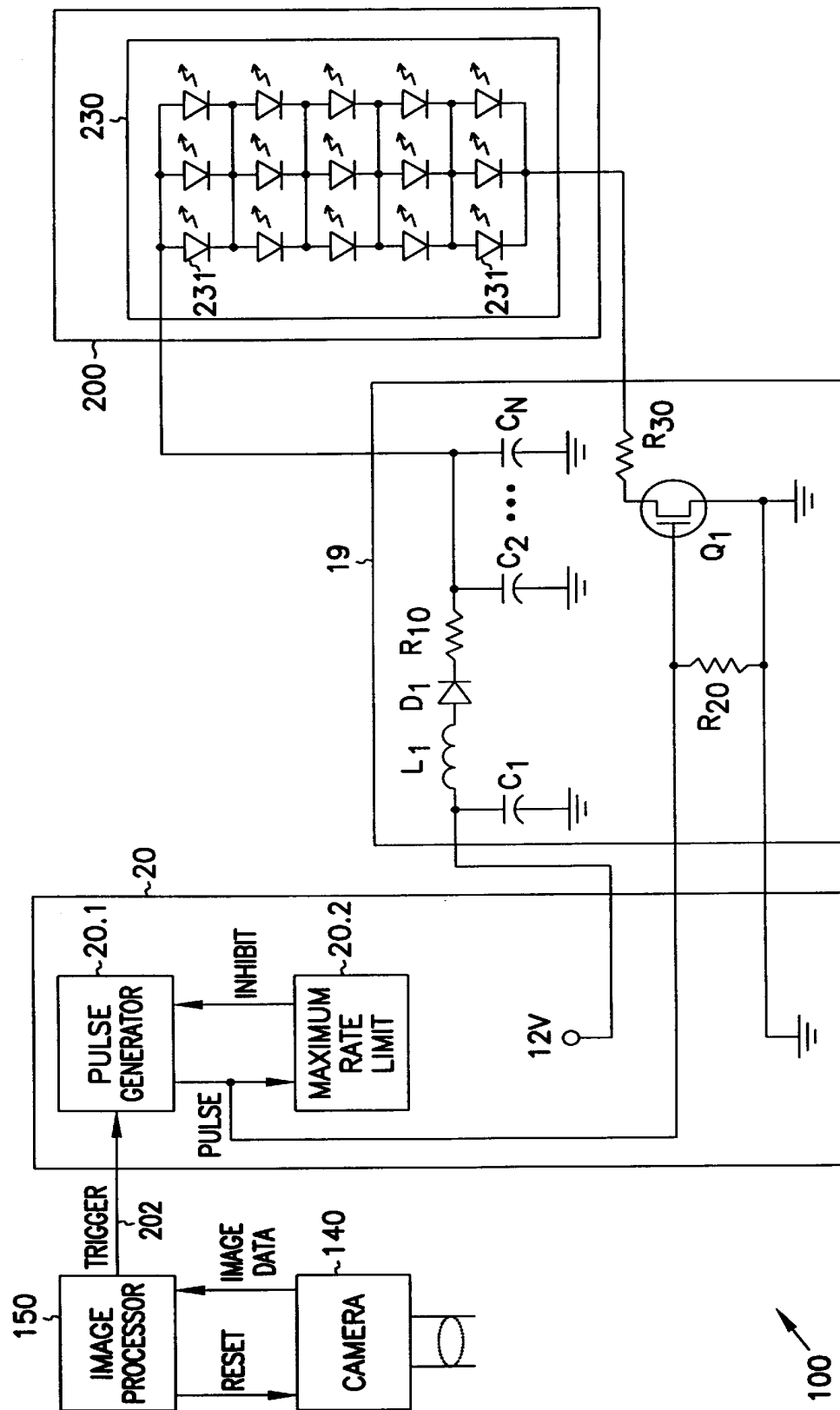


FIG. 6

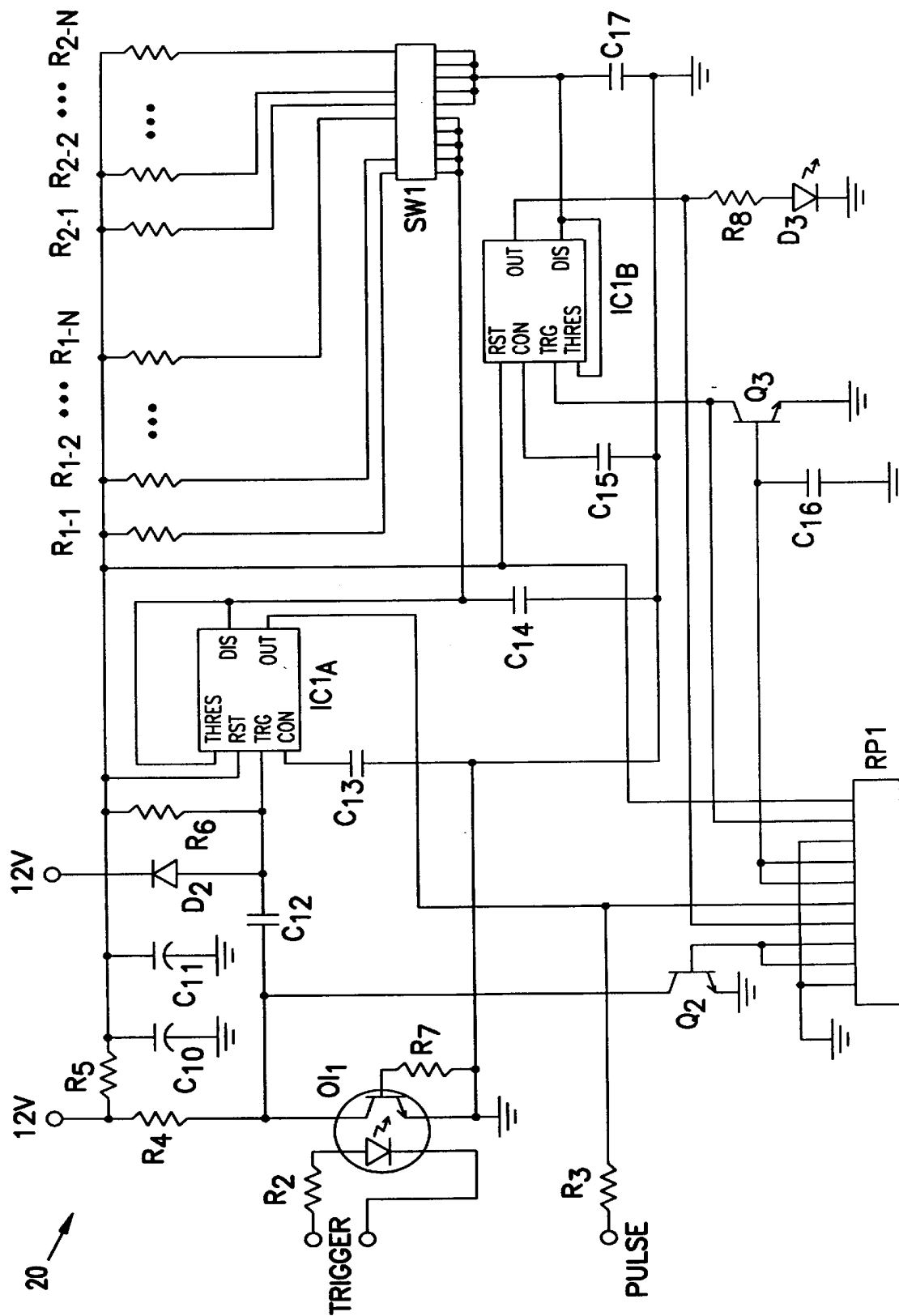


FIG. 7

MACHINE-VISION RING-REFLECTOR ILLUMINATION SYSTEM AND METHOD

This application is a divisional of U.S. patent application Ser. No. 08/914,441, filed Aug. 19, 1997, now U.S. Pat. No. 6,022,124 which application is incorporated by reference.

TECHNICAL FIELD OF THE INVENTION

The present invention pertains generally to illumination optics, and more particularly systems and methods for illumination of objects in machine-vision systems.

BACKGROUND OF THE INVENTION

During the manufacture of certain products, such as electrical components, it is necessary to be able to provide high-intensity illumination so that components can be thoroughly inspected with a machine-vision system. Often, the light source needed includes one or more light sources, for example a ring-shaped flashtube or a number of light-emitting diodes arranged along a circle or a remote light source that drives light into a number of optical fibers arranged along a circle, surrounding the lens of a video camera such that the object being imaged by the video camera is illuminated with light angled in towards the optical axis of the camera from the light source surrounding the lens. It is desirable that the light source or sources are arranged such that no light shines directly from the light sources into the lens.

Typically, a xenon flashtube or laser-based single-point source or other high-intensity light source is used for providing light into fiber-optic-based ring source. Such systems, however, are costly, very large and bulky, and can interfere with the placement of other components in the machine-vision system. This is particularly troublesome when the components being measured or inspected are extremely small. Xenon flashtube light sources also tend to exhibit up to about a five per cent (5%) flash-to-flash variation in intensity which makes accurate measurements of certain characteristics difficult. Single-point source systems are also generally limited to emitting light radially from only one single point, which is of limited value when shadows are problematic, such as, when inspecting a grid of electrical connectors. Specifically, light from only one or just a few point sources only illuminates the first over-sized or over-height electrical connector and, due to shadows from the first object encountered, does not provide proper illumination which would determine if other objects behind this particular first object are missing, of the incorrect size or height, or perhaps in the wrong position.

Conventional illumination systems produce a light which can be too bright in certain areas and too dim in other areas. Often, the end-result is "bloom", especially when viewing white, lightly colored, or very reflective objects which are near other objects which need to be viewed by a machine-vision camera. In order to get enough light on the other objects which need to be viewed, the aperture on the camera cannot be "stopped down" in order to prevent overexposure of the bright objects. Specifically, the area is illuminated to such an extent that the entire image appears to be the same bright saturated white color (or, if a monochromatic light source is used, saturated at whatever color is used) as viewed by the machine-vision camera and system. Such extreme brightness also poses a danger of blinding, at least temporarily, human workers nearby.

Quite often, illumination sources either leave certain portions of the scene in shadows, or provide too much light

in certain areas, while leaving other areas with too little light. In other cases, the illumination source is too bulky and gets in the way of other components of the machine-vision system, associated robots, manipulators, and/or human workers.

The optimal light-source-to-optical-axis angle can vary depending on the object being inspected. One shortcoming of conventional ring light sources is the cost and difficulty in changing the angle between the light sources relative to the optical axis, and in changing the spread and/or focus of the light from ring-light source.

Thus, what is needed is an ring-light illumination system and method which is compact, provides control over both the angle between the light source and the optical axis of the camera, as well as the spread and/or focus of the light from ring light source, so that even extremely small parts can be quickly and adequately inspected and accurately viewed or measured with a machine-vision system. Another need is to provide a compact illumination source, preferably monochromatic, which can be focused to provide uniform multi-directional light onto objects from all sides while avoiding light going directly from the light sources to the lens of the camera. Another need is to provide a compact monochromatic LED (light-emitting diode) illumination source, which can be changeably focused to provide uniform multi-directional light onto objects. Another need is to have such an LED illumination source be pulsed with a relatively high-power, low duty-cycle power source.

SUMMARY OF THE INVENTION

The present invention takes advantage of the efficiency of high-brightness red, infra-red, blue, white, or other color LEDs arranged in one or more circular rows, and the properties inherent to a reflective focusing element such as a turned angled reflective ring to produce an illumination source for machine-vision systems. The illumination source exhibits multi-directional ring-illumination properties which are useful for illumination of small components (which are being inspected or measured) without unwanted shadows. One embodiment provides a darkfield illumination system. One embodiment of the present invention uses a strobed (or pulsed) power supply to drive the LEDs. Yet another embodiment of the present invention uses a xenon strobe ring-light source and a backplane slit in place of the row of LEDs. In one such xenon strobe embodiment, a color filter is also placed in series with the light path in order to obtain a monochromatic light. While xenon flashtube light sources tend to exhibit a five per cent (5%) flash-to-flash variation in intensity which makes accurate measurements of certain characteristics difficult, they are useful in certain cases where intense white, or especially ultraviolet, light is desired.

The present invention provides a compact ring-light generator which has little, if any, shadowing. The present invention also provides an inexpensive method for changing the light-source-to-optical-axis angle. The present invention also provides an inexpensive method for changing the spread and/or focus of the light from ring light source.

The present invention provides a method and apparatus which provide an illumination source for illuminating an object in a machine-vision system having a machine-vision camera, the camera having an optical axis. One embodiment of the illumination source includes a ring-light source emitting light from a plurality of points, the points being along one or more circles, a focusing element, the focusing element including an angled ring reflector to direct rays from

the ring light source at an angle generally towards the optical axis. One embodiment provides a replaceable ring reflector for changing the light-source-to-optical-axis and/or changing the spread and/or focus of the light from ring light source. One embodiment provides light from multiple directions in order to reduce shadowing. One embodiment provides light to illuminate the inside of, for example, an aluminum beverage can before it is filled and sealed.

One embodiment uses a ring-reflector focusing element which includes a first conical section reflective surface at a first conical angle to the optical axis. Another embodiment further includes a second conical section reflective surface at a second conical angle to the optical axis.

One embodiment includes an illumination source for illuminating an object in a machine-vision system, the system having an optical axis. The illumination source includes a ring light source and a ring reflector. The ring light source emits light from a plurality of points or from a line, the points or line being substantially in a plane that intersects the optical axis, each of the points or the line disposed at least a first distance from the optical axis and less than a second distance from the optical axis. The ring reflector has an exit opening through which the optical axis passes, the emitted light from the ring light source being generally directed centered on lines that intersect a reflecting surface of the ring reflector, the ring reflector reflecting the emitted light from the light source through the exit opening inwards and generally towards the optical axis or an area around the optical axis.

In one such embodiment, the ring light source includes a plurality of light-emitting diodes (LEDs) arranged substantially along a circle disposed perpendicular to and centered on the optical axis. In another such embodiment, each LED has a focal centerline emission axis along which emission is centered, and each LED's emission axis is parallel to the optical axis. In yet another such embodiment, each LED has an focal centerline emission axis along which emission is centered, and each LED's emission axis is perpendicular to the optical axis.

In one embodiment, the light emitted from the LEDs is two or more selected from the following: infra-red, red, amber, yellow, green, blue, violet, ultraviolet, or white in color. In another such embodiment, the light emitted from the LEDs is primarily within an angle of about 5° from a focal centerline of each individual LED.

One embodiment further includes a focusing element that includes a cylindrical ring lens having at least one convex face.

In one embodiment, the ring light source includes a ring-shaped flashtube located substantially along a circle disposed perpendicular to and centered on the optical axis, and further includes an enclosure having a slit located between the ring-shaped flashtube and the ring reflector, wherein the slit allows light from the flashtube to fall on a reflecting surface of the ring reflector.

In one embodiment, the ring reflector has a surface that enhances its reflectivity at one or more selected wavelengths of the ring light source.

In one embodiment, the ring reflector and ring light source are configured to produce a darkfield illumination.

Another aspect of the present invention is a method for illuminating an object located along an optical axis. The method includes the steps of (a) emitting light from a plurality of points or from a line, the points or line being substantially in a plane that intersects the optical axis, each of the points or the line disposed at least a first distance from

the optical axis and less than a second distance from the optical axis; and (b) reflecting the emitted light from the light source inwards and generally towards the object at the optical axis or in an area around the optical axis.

In one such embodiment, the object is an electrical connector, and the method further includes the step of acquiring a machine-vision image of the electrical connector. One application for such a method is inspecting ball-grid arrays.

Another aspect of the present invention provides a machine-vision illumination system. The system includes an imaging device, an image processor coupled to the imaging device, and an illumination source coupled to the image processor. The illumination source includes a ring light source and a ring reflector. Other aspects of such a system are described above.

Another aspect of the present invention provides a ring reflector for use in reflecting light from a ring light source. The ring reflector includes a substantially circular exit opening through which the optical axis passes and a reflective surface surrounding the exit opening. The reflective surface extends from approximately a first circle having a first radius, to approximately a second circle and having a second radius, the second radius being larger than the first radius, the first radius being larger than the difference between the second radius and the first radius.

In one such embodiment, the reflective surface includes a conical section. In another such embodiment, the reflective surface includes a plurality of adjoining conical sections. In yet another such embodiment, the reflective surface includes a circularly-rotated parabolic section. In still another such embodiment, the reflective surface includes a plurality of reflective facets. In one such embodiment, for a plurality of the facets, a line normal to the facet surface passes through the optical axis. Another aspect of the present invention provides a reflective surface that is configurable to change the angle at which it reflects light.

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a side-view schematic diagram of one embodiment of machine-vision illumination system **100**.

FIG. 1B is a circuit schematic diagram of a portion of one embodiment of machine-vision illumination system **100**.

FIG. 2A is an exploded isometric view of ring-reflector illumination source **200** according to one embodiment of the present invention.

FIG. 2B is a cut-away side view of ring-reflector illumination source **200** according to one embodiment of the present invention.

FIG. 2C is a cut-away side view of one ring-light source **230** using LEDs according to one embodiment of the present invention.

FIG. 2D is a cut-away side view of another ring-light source **230** using LEDs according to one embodiment of the present invention.

FIG. 2E is a cut-away side view of yet another ring-light source **230** using LEDs according to one embodiment of the present invention.

FIG. 2F is a cut-away side view of ring-light source **236** using a xenon flashtube according to one embodiment of the present invention.

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FIG. 2G is an exploded isometric view of a flash-tube light source **2361** according to one embodiment of the present invention.

FIG. 2H is an exploded isometric view of a flash-tube light source **2362** according to one embodiment of the present invention.

FIG. 2I is a cut-away side view of two stacked ring-reflector illumination sources **200A** and **200B** according to one embodiment of the present invention.

FIG. 2J is a cut-away side view of an alternative ring-reflector illumination source **200** according to one embodiment of the present invention.

FIG. 3A is a cut-away side view of one ring reflector **220** according to one embodiment of the present invention.

FIG. 3B is a cut-away side view of another ring reflector **220** according to one embodiment of the present invention.

FIG. 3C is a cut-away side view of yet another ring reflector **220** according to one embodiment of the present invention.

FIG. 3D is a cut-away side view of still another ring reflector **220** according to one embodiment of the present invention.

FIG. 3E is a cut-away side view of a faceted ring reflector **226** according to one embodiment of the present invention.

FIG. 3F is a cut-away side view of a configurable ring reflector **227** according to one embodiment of the present invention.

FIG. 3G is an enlarged cut-away side view of a configurable ring reflector **2273** having overlapped facets **2271** each pointing towards the optical axis **299**.

FIG. 3H is an enlarged cut-away side view of a configurable ring reflector **2283** having overlapped facets **2281** each pointing off to the side of the optical axis **299**.

FIG. 3I is an enlarged cut-away side view of a configurable ring reflector **2283** having a stretchable reflective membrane **2281**.

FIG. 4A is a cut-away side schematic of the ring reflector **220** of FIG. 3A showing the light pattern generated.

FIG. 4B is a cut-away-side schematic of the ring reflector **220** of FIG. 3B showing the light pattern generated.

FIG. 5A is an enlarged cut-away side schematic of the ring reflector **220** of FIG. 3A.

FIG. 5B is an enlarged cut-away side schematic of the ring reflector **220** of FIG. 3B.

FIG. 6 is a schematic diagram of the LED drive electronics for one exemplary system **100**.

FIG. 7 is a schematic diagram of one exemplary power supply **20**.

DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings which form a part hereof, and in which are shown, by way of illustration, specific embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

The present invention provides a method and system for generating rays of light with suitable brightness and evenness from a source surrounding, for example, the lens of a machine-vision camera. The rays are directed generally

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towards the optical axis of the camera. One embodiment provides a diffuse source circumferentially such that even extremely small objects can be adequately inspected and accurately measured by a machine-vision system **100**.

The unique ability of the method and apparatus of the LED illumination system of the present invention to provide an inexpensive and changeable light source within these constraints distinguishes this system from other illumination systems purporting to provide suitable high-intensity illumination for machine-vision inspecting or measuring purposes.

An illumination system is described in MACHINE-VISION ILLUMINATION SYSTEM AND METHOD, U.S. patent application Ser. No. 08/532,213, filed Oct. 12, 1995, by Gary A. Lebens and assigned to PPT Vision, Inc., the assignee of the present invention, and which is hereby incorporated by reference.

A serial machine-vision interconnection system is described in HIGH-SPEED DIGITAL VIDEO SERIAL LINK, U.S. patent application Ser. No. 08/825,774, filed Apr. 2, 1997, which is a file-wrapper continuation of Ser. No. 08/410,119, filed Mar. 24, 1995 by Joseph C. Christianson and Larry G. Paulson and assigned to PPT Vision, Inc., the assignee of the present invention, and which is hereby incorporated by reference.

FIG. 1A is a side-view schematic diagram of an embodiment of machine-vision illumination system **100** according to the present invention. In FIG. 1, an object **160** (for example, a beverage can or other food or drink container, or an electronics assembly or other manufactured item) is illuminated for inspection by a machine-vision camera (or other imaging device) **140** which is coupled to computer/image processor **150**. In this embodiment, camera **140** is disposed to view object **160** through an opening in ring-reflector illumination source **200** which directs light downward and inward. In the exemplary system shown, it is desired to illuminate the top edge, inside walls and inside bottom surface of object **160** for viewing by camera **140** with even, high intensity, short-duration illumination of a fixed intensity. In one embodiment camera **140** is a video camera, such as a Panasonic model GPMF702, having a telecentric lens, such as an Invaritar-brand lens made by Melles-Griot. In one such embodiment, the telecentric lens, which has uniform magnification across the field of view, of camera **140** is made larger in diameter than the diameter of object **160** being viewed (e.g., one embodiment uses a 6-inch diameter lens for 3-inch diameter objects) in order to reduce lens distortion, such as pin-cushioning and barrel distortion. Camera **140** is coupled to image processor **150** with suitable cables, for example, a digital-serial link such as described in patent application Ser. No. 08/825,774 cited above, or other suitable electrical or fiber-optical signal cables. In one embodiment, camera **140** is positioned above and facing objects **160** moving by action of conveyor mechanism **170** across the camera field of view, so that camera **140** can obtain and send a captured image of object **160** to image-processing computer **150**. In one embodiment, computer **150** analyzes the captured image and activates selection mechanism **175** to accept or reject each successive object (e.g., diverting rejected items into a reject bin) based on predetermined criteria, all using methods and apparatus well known to those skilled in the art of machine vision.

Camera **140** is implemented as any one of a number of device technologies including vidicon, CCD (charge-coupled device) line- or array-imaging devices, metal-oxide semiconductor (MOS) video cameras, and so forth. In one

embodiment, camera **140** is a solid-state MOS camera having a peak wavelength sensitivity of about 550 nanometers (nm), and range of approximately 500 to 600 nm at about 97% of peak. In one embodiment, the aperture on the lens of camera **140** is suitably small in order that a relatively large depth-of-field is obtained. The type and size of lens is chosen to match the field-of-view to the size/depth of object **160**.

In one embodiment, shown in FIG. 1B (FIG. 1B is a circuit schematic diagram of a portion of one embodiment of machine-vision illumination system **100**), each ring-reflector illumination source **200** is connected to a capacitor box **19**, which is connected to a power supply **20**, which is connected to image processor **150**. The charge on capacitor box **19** is discharged through LEDs **231** in ring-reflector illumination source **200** when computer **150** drives a pulse on signal cable **202** to amplifier **201** which in turn drives power MOSFET (metal-oxide-semiconductor field-effect transistor) **211** to substantially short to ground. In one embodiment, a short-duration pulse (approximately 10 microseconds to 100 microseconds long) to provide a short, intense pulse of light. Further details of power supply **20** and capacitor box **19** are found on Ser. No. 08/532,213 cited above. In one such embodiment, a photodetector **21** is used to detect the light output and provides feedback to computer **150** which is used to control the duration or frequency of the light pulses.

In the embodiment shown in FIG. 1, ring-reflector illumination source **200** is enclosed to light except for the lens opening **245** through back plate **240** and opening **225** in ring reflector **220**.

FIG. 2A is an exploded isometric view of ring-reflector illumination source **200** according to one embodiment of the present invention. Ring-reflector illumination source **200** includes bottom enclosure **210**, replaceable/changeable ring reflector **220**, ring illumination source **230** (in this embodiment, this is an LED light source **230** having a single row of LEDs arranged in a circle that is centered on optical axis **299** of camera **140**, the focal centerlines **298** of each LED is directed along a line parallel to optical axis **299**), and top cover **240** that is attached to bottom enclosure **210**, for example by four screws **242**. In the embodiment shown, bottom enclosure **210** has an opening **215** having a lip or collar into which reflector ring **220** fits.

It is contemplated that a user will have more than one reflector ring **220**, each having a different reflective angle or reflective configuration/focus, so that the ring reflector **220** in ring reflector illumination source **200** may be changed according to the needs of the object being inspected, the particular camera or lens being used, etc., without replacing other parts in ring-reflector illumination source **200**. Alternatively, a configurable ring reflector **2205** can be used in place of multiple replaceable/changeable ring reflectors **220**, thus allowing the user to change the reflective angle or reflective configuration/focus by changing the configuration of reflector **2205** (explained further below). It is further contemplated that a user may have more than one ring-light source **230**, each having a different configuration of LEDs, dispersion angle, color or wavelength configuration, intensity or pulse response, so that the ring-light source **230** in ring-reflector illumination source **200** may be changed according to the needs of the object being inspected, the camera being used, etc., without replacing other parts in ring-reflector illumination source **200**. FIG. 2A shows one configuration that makes possible the exchange of ring reflector **220** and/or ring-light source **230**, however other configurations are contemplated that make changing of the

ring reflector **220** and/or ring-light source **230** easier and faster, such as by threading with matching complementary threads the outer circumference of ring-light source **230** and the inner circumference of opening **215**, such that ring reflector **220** can be exchanged without otherwise disassembling ring-reflector illumination source **200**.

FIG. 2B is a cut-away side view of ring-reflector illumination source **200** according to one embodiment of the present invention. In the embodiment shown, ring-reflector illumination source **200** includes bottom enclosure **210**, replaceable/changeable ring reflector **220** (designed to fit into a complementary opening **215** in bottom enclosure **210**), ring illumination source **230** (in this embodiment, this is an LED light source **230** having a single row of LEDs **231** closely spaced in a circle that is centered on optical axis **299** of camera **140**, the focal centerlines **298** of each LED directed along a line parallel to optical axis **299**), and top cover **240** that is attached to bottom enclosure **210**, for example by four screws **242** that pass through spacers **241** used to maintain the desired spacing and placement of the LED light source **230** within ring-reflector illumination source **200**. In one embodiment (see FIG. 2C), LED light source **230** includes a printed circuit board **2300** onto which are soldered (or otherwise mechanically and electrically connected) a plurality of individual LEDs **231** (e.g., in one embodiment, high-brightness red LEDs 1200 millicandles (mcd) at a peak wavelength of approximately 621 nm., for example, HLMA-KH00-type T1-sized lights having a half-angle of approximately 22.5° available from Hewlett-Packard; In another embodiment, a Toshiba part number TLRH160 emitting red light (644 nm at 1800 typical mcd) with a 5-degree half angle is used), spaced as closely as possible in a single row, the row centered on a circle that is perpendicular to and has a center on the optical axis **299**. (In other embodiments, other LEDs having different colors/wavelengths, half-angles, intensity, or power capabilities are used. In one such embodiment, LED light source **230** is configured to be replaced/changed in order to let the user choose a suitable combination of colors/wavelengths, half-angles, intensity, or power capabilities for a particular application.)

In the following discussion, ring reflector **220** refers generally to any ring reflector (e.g., ring reflector **221** of FIG. 3A, ring reflector **222** of FIG. 3B, ring reflector **223** of FIG. 3C, or ring reflector **224** of FIG. 3D, or other similar ring reflector). Similarly, ring light source **230** refers generally to any ring light source (e.g., ring light source **230.0** of FIG. 2C, ring light source **230.1** of FIG. 2D, ring light source **230.2** of FIG. 2E, ring light source **236** of FIG. 2F, or other similar ring light source).

In the embodiments shown in FIGS. 2A–2F, printed circuit board (PCB) **2300** has a circular opening **235** also having a center on the optical axis **299**. Signal wire **202** passes through insulating strain relief **2021** which is mounted to bottom enclosure **210**. Signal wire **202** is soldered to PCB **2300**, which then distributes the electrical power from signal wire **202** to each of the LEDs **231**.

FIG. 2C is a cut-away side view of one ring-light source **230** using a single circular row of LEDs **231** according to one embodiment of the present invention. In one embodiment, all LEDs **231** are of the same color and type. In another such embodiment, a mix of LED colors are used in order to get a polychromatic light. In yet another such embodiment, white phosphor/LED devices, such as a blue LED having a broad-spectrum phosphor that absorbs the blue light and re-emits a broad-spectrum centered at yellow to achieve a compact, very-long-life, efficient white light

source (e.g., white LEDs such as manufactured by Nichia Chemical Industries, Ltd. of Japan; for example Part No. NLPB 510; see internet address <http://www1a.meshnet.or.jp/nichia/wled-e.htm>) are used in order to get a polychromatic, white-appearing light. In one embodiment, a pulsed electrical drive current is used (described in further detail below) in order to increase light efficiency (particularly during the time that the camera 140 is and/or to strobe the light pulse thereby reducing any blurring due to motion of the object being observed. In another embodiment, a direct-current (DC) electrical drive is used.

In the embodiments shown in FIGS. 2C–2E, each individual LED 231 and 232 has a built in focussing arrangement, typically including a cone-shaped reflector holding an LED chip, and a convex plastic lens package, that together direct and “focus” the light emitted from the LED chip in a direction centered about a focal centerlines 298 along an axis of the package. Such LED packages can be purchased at a number of dispersion angles (generally specified as the “half-angle” for the LED package), and at a variety of intensity capabilities (generally specified as millicandies (mcd) or milliwatts (mw) of light output). Conventionally, this arrangement has required that the axis of each LED package be pointed in the direction that light is wanted, i.e., at one or another angle pointed obliquely towards the optical axis of camera 140. It has been expensive to fabricate such a ring of LEDs, each pointed obliquely towards the optical axis of camera 140. Further, it is cumbersome and expensive to change the angle at which the LEDs point towards the optical axis (i.e., to move the angle of all of the LEDs, or to replace the ring with another having the desired angle.

The present invention provides an inexpensive and elegant solution to these problems. By providing an LED ring-light source having all the LEDs with the axes of their packages (i.e., the LED’s individual focal centerlines 298) aligned parallel to the optical axis 299 (i.e., perpendicular to PCB 238), the cost of manufacture is minimized. In order to direct the light obliquely towards the optical axis 299, one or more inexpensive and easily changeable reflective rings 220 are provided. In order to change the intensity of light provided, a variable pulse-width and/or variable pulse-frequency LED power supply is provided.

FIG. 2D is a cut-away side view of another ring-light source 230 using a circular double row of LEDs 231 and 232 according to another embodiment of the present invention. In this embodiment, PCB 2301 is configured to mechanically and electrically connect to two rows of LEDs (outer circular row 231 and inner circular row 232). In one such embodiment, a two-angle reflector (e.g., 222 or 224 of FIG. 3B or FIG. 3D) is used, and the outer row 231 of LEDs is reflected at a shallow angle (e.g., by a face 2222 that is at an angle of approximately 53 degrees from the plane of exit opening 225) in order to achieve a deep area of illumination (i.e., further from exit opening 225), and the inner row 232 of LEDs is reflected at a less-shallow angle (e.g., by a face 2221 that is at an angle of approximately 47 degrees from the plane of exit opening 225) in order to achieve a shallower area of illumination (i.e., closer to exit opening 225). In one embodiment, both rows of LEDs (231 and 232) are simultaneously illuminated, in order to simultaneously get both deep and shallow illumination. In another embodiment, each row is flashed at different times, in order to get either deep or shallow illumination.

FIG. 2E is a cut-away side view of yet another ring-light source 230 using a circular double row of LEDs 231 and

232, wherein row of LEDs 232 is mounted at a small distance from PCB 2301, for example, by inserting spacers 233 between each LED and the PCB 2301, according to another embodiment of the present invention. In this embodiment, PCB 2301 is configured the same as for FIG. 2D, however, spacers 233 or other means, are used to drop the position of LEDs 232 relative to the PCB 2301, thus moving the plane of the circle for those LEDs closer to ring reflector 220 (e.g., ring reflector 222, 223 or 224).

FIG. 2F is a cut-away side view of ring-light source 236 using a xenon flashtube according to one embodiment of the present invention. In one embodiment, a xenon strobe light source 237, e.g., any suitable circular short-arc flashlamp bulb, and a diaphragm 238 having backplane slit 239, are used in place of the row of LEDs. In one such embodiment, raised collar 2351 is fabricated to be bolted to top cover 240 through screw holes 2352, then inner slit ring 2353 (having opening 235) is fastened to the lower edge of collar 2351, in order that only light passing through slit 239 is used (i.e., reflected and directed by ring reflector 220). The gap between the outer circumference of slit ring 2353 and the inner edge of the hole 2381 in diaphragm 238 defines a continuous (e.g., circular) slit 239 having no breaks. In another embodiment (see FIG. 2G which shows four struts holding the inner ring to the diaphragm 238), such breaks are due to, for example, support struts that are needed to hold inner slit ring 2382 to diaphragm 238. In one such xenon strobe embodiment, an optional color filter 2371 is also placed in series with the light path in order to obtain a monochromatic light, which can be more sharply focused by the lens of camera 140 than white light.

In one such xenon strobe embodiment, an optional circular cylindrical ring lens 2391 (i.e., equivalent or similar to the cross-section of a convex-convex cylindrical lens as shown, that is rotated in a circle centered on optical axis 299; another embodiment uses a plano-convex) is also placed in series with the light path in order to focus light from the circular xenon source (i.e., focusing the emitted light to a circular line). In another embodiment, such a cylindrical ring lens 2391 is placed in series with light emitted from a ring-LED source such as ring light source 230.0 of FIG. 2C.

Ring-light source 236 refers generally to a flashtube-slit assembly such as flash-tube light source 2361 of FIG. 2G or flash-tube light source 2362 of FIG. 2H. In some embodiments, flashtube 237 is replaced by a similarly shaped enclosed incandescent filament circular tube, or a fluorescent circular tube, or linear LED chips arranged in a polyhedron, or other continuous circular light source.

FIG. 2G is an exploded isometric view of a flash-tube light source 2361 according to one embodiment of the present invention. Struts 2384 hold inner slit ring 2382 to diaphragm 238. Raised collar 2351 is fabricated to be bolted to top cover 240 through screw holes 2352, and for its lower edge to be light-tight against inner slit ring 2382 when assembled in ring-reflector illumination source 200.

FIG. 2H is an exploded isometric view of a flash-tube light source 2362 according to another embodiment of the present invention. In this embodiment, as described above, raised collar 2351 is fabricated to be bolted to top cover 240 through screw holes 2352, then inner slit ring 2353 (having opening 235) is fastened to the lower edge of collar 2351, in order that only light passing through slit 239 is used (i.e., reflected and directed by ring reflector 220). The gap between the outer circumference of slit ring 2353 and the inner edge of the hole 2381 in diaphragm 238 defines a continuous (e.g., circular) slit 239 having no breaks.

FIG. 2I is a cut-away side view of two stacked ring-reflector illumination sources **200A** and **200B** according to one embodiment of the present invention. In this embodiment, ring-reflector illumination source **200A** is configured to have the light from its LEDs **231** reflected at a shallow angle (e.g., by a face **2211A** that is at an angle of approximately 53 degrees from the plane of exit opening **225**) in order to achieve a deep area of illumination (i.e., further from its exit opening **225**). Ring-reflector illumination source **200A** is configured to have the light from its LEDs **231** reflected at a less-shallow angle (e.g., by a face **2211B** that is at an angle of approximately 47 degrees from the plane of its exit opening **225**) in order to achieve a shallower area of illumination (i.e., closer to exit opening **225**).

In one embodiment, ring reflector **220** is fabricated by turning on a lathe a blank of aluminum, stainless steel, plastic, glass or other suitable material to generate a circularly symmetric reflective face (e.g., conical-section face **2211**) (i.e., the surface of the cross section shown is a straight line at an angle of 52 degrees from the plane of exit opening, i.e., 38 degrees from the optical axis **299**), which is then polished and/or chrome plated to enhance its reflectivity at a wavelength of ring-light source **230**. In another embodiment, ring reflector **221** is cast, e.g., by injection molding, from a suitable plastic, and then coated by well known methods with a reflective coating of chrome, gold or other metal, alloy, or multiple optical coating layers to enhance its reflectivity at one or more selected wavelengths of ring-light source **230**. (These manufacturing methods can apply to any of the ring reflectors described below.)

FIG. 2J is a cut-away side view of an alternative ring-reflector illumination source **200** according to one embodiment of the present invention. In this embodiment, each LED **234** is mounted on PCB **2300** in a circle around PCB opening **235** such that its light-emission focal centerline **298** is directed along a line radially perpendicular to optical axis **299** (i.e., the light is directed radially outward, centered on an emission plane that is perpendicular to optical axis **299**). Ring reflector **229** is configured so that the emission plane intersects its operative reflective surface **2291**, which redirects the light to a darkfield pattern (such as pattern **2218** as shown in FIG. 4A).

Darkfield illumination patterns, often used in microscopy applications, involve illumination in which light approaches the object (i.e., object **160**) at an angle oblique or perpendicular to the optical axis, in order to minimize or eliminate light from the illumination source entering the camera (or microscope) lens either directly, or by reflection off some background object behind the object of interest. Thus, one application of the present invention is to provide darkfield illumination within, for example, a food container or beverage can **160**, without illuminating the bottom of the can, e.g., in order to check for foreign objects within a clear beverage. One embodiment of darkfield illumination of the present invention is thus particularly useful for spotting foreign objects within open opaque aluminum cans, while minimizing light reflecting off the bottom of the can towards the camera. In one such embodiment, a pattern **2218** is designed so as to illuminate as deep as possible within a can **160** while minimizing illumination of the bottom of the can **160**. The embodiments **221**, **222**, **223** of ring reflector **220** are particularly useful for generating such darkfield illumination patterns, since these ring reflectors **220** block the light from LEDs **231** that travels generally in the direction of the optical axis and that otherwise could illuminate background below the object of interest.

In contrast, other applications benefit from a deep illumination pattern which also illuminates the bottom of the can or food container. In one such embodiment, a pattern **2218** is designed so as to illuminate as deep as possible within a can **160** including illumination of the bottom of the can **160**. The embodiments **229** (FIG. 2J) of ring reflector **220** is particularly useful for generating such darkfield illumination patterns, since these ring reflectors **220** block the light from LEDs **231** that otherwise could illuminate below the object of interest.

All of the embodiments shown are useful for inspecting electrical components, and in particular, components or substrates having ball-grid arrays of connector pads. Ball-grid arrays, such as IBM Corporation's C4 controlled-collapse connectors, generally include rectangular grids of spherical connector balls (i.e., tiny solder balls), that are used to simultaneously connect multiple signals from chips to modules, or modules to boards.

In the embodiment shown in FIG. 2J, the reflective surface **2291** is a single conical section; in other embodiments, this reflective surface is replaced by two conical sections (in a manner similar to that shown in FIG. 3B below); a circularly symmetric parabolic or other curved section (in a manner similar to that shown in FIG. 3C below); a series of facets (in a manner similar to that shown in FIG. 3E below), or a configurable reflective surface (in a manner similar to that shown in FIGS. 3F, 3G, or 3H below).

FIG. 3A is a cut-away side view of one ring reflector **220** according to one embodiment of the present invention. In this embodiment, ring reflector **221** is a circularly symmetric conical-section reflective face **2211** (i.e., the surface of the cross section shown is a single straight line at an angle of approximately 52 degrees from the plane of exit opening, i.e., approximately 38 degrees from the optical axis **299**). In this embodiment, the spread half-angle of light emission from the LEDs **231** is not significantly changed by reflecting off of surface **2211**, and continues to diverge at approximately the same half-angle as before reflection (although now directed along a cone converging towards optical axis **299**) thus providing a relatively broad spread of light below exit opening **225**, as shown in FIG. 5A. Since the angle of incidence (approximately 38 degrees) is equal to the angle of reflection (also approximately 38 degrees), the cone of the centerlines of the LEDs approached the optical axis **299** at an angle of approximately 76 degrees. In other embodiments, the angle of face **2211** is set to other values to achieve the lighting pattern desired. In one embodiment, the lower edge of face **2211** is given a small chamfer (e.g., 0.02 inches) to reduced the danger to a user of otherwise sharp edges. In one embodiment, the length of face **2211**, the distance from face **2211** to LEDs **231** (e.g., in one embodiment, this is made as close as possible), and the half-angle of light emission of the LEDs **231** (e.g., in one embodiment, LEDs are specified to have a small half-angle), are together configured such that most or all of the light emitted from LEDs **231** is reflected by face **2211** (rather than passing directly through exit opening **225**). FIG. 5A is an enlarged cut-away side schematic of the ring reflector **220** of FIG. 3A.

In one such embodiment, particularly useful for darkfield microscopy, ring reflector **221** is a circularly symmetric conical-section reflective face **2211** having an angle of approximately 45 degrees from the plane of exit opening, i.e., approximately 45 degrees from the optical axis **299**. In this embodiment, the spread half-angle of light emission from the LEDs **231** is not significantly changed by reflecting off of surface **2211**, and continues to diverge at approxi-

mately the same half-angle as before reflection (although now directed along a cone diverging towards optical axis **299**) thus providing a relatively broad spread of light within ring reflector **221** within exit opening **225**. Since the angle of incidence (approximately 45 degrees) is equal to the angle of reflection (also approximately 45 degrees), the cone of the centerlines of the LEDs approached the optical axis **299** at an angle of approximately 90 degrees (perpendicular). For example, a glass slide could be placed flush against exit opening **225**, with the specimen suspended in water above the slide and within such a ring reflector **221**, whereby only light impinging on the specimen is visible through the lens of the camera or microscope.

In another such embodiment, the arrangement of FIG. 2B is inverted (i.e., with cover **240** further from the lens of camera **140** (or the microscope) and exit opening **225** closer to camera **140** (or the microscope)), such that the lens of the camera **140** (or microscope) is above, and on the same side of ring-reflector illumination source **200** as, exit opening **225**. In this case, the glass slide is placed on top of exit opening **225** (towards the lens) with the specimen in a liquid above the slide, an opening **245** (now at the bottom) is covered with a non-reflective black surface such as black felt. In this way, the specimen is illuminated at oblique angles from below, with a darkfield illumination.

FIG. 3B is a cut-away side view of another ring reflector **220** according to one embodiment of the present invention. In this embodiment, ring reflector **222** is a circularly symmetric reflective face having two adjacent conical-sections **2221** and **2222** (i.e., the surface of the cross section shown is two straight-line chords at angles of approximately 47 and 53 degrees respectively from the plane of exit opening, i.e., approximately 37 and 43 degrees from the optical axis **299**, the chords meeting at a concave intersection). In this embodiment, the spread half-angle of light emission from the LEDs **231** is narrowed by reflecting off of surfaces **2221** and **2222**, and continues to diverge at a smaller half-angle than before reflection (although now redirected along a cone converging towards optical axis **299**) thus providing a relatively smaller spread of light below exit opening **225**, as shown in FIG. 5B. Since the two conical-section surfaces **2221** and **2222** form a somewhat concave surface having an average angle of incidence and reflection of 40 degrees, the cone of the centerlines of the LEDs approached the optical axis **299** at an angle of approximately 80 degrees. In other embodiments, the angles of faces **2221** and **2222** are set to other values to achieve the lighting pattern desired. In one embodiment, the angles of faces **2221** and **2222** are approximately 53 and 47 degrees respectively from the plane of exit opening (i.e., the reverse of the above case), thus forming a convex reflecting cross-section, and thus increasing the half-angle of dispersion of the emitted light.

FIG. 5B is an enlarged cut-away side schematic of the ring reflector **220** of FIG. 3B.

FIG. 3C is a cut-away side view of yet another ring reflector **220** according to one embodiment of the present invention. In this embodiment, ring reflector **223** is a circularly symmetric reflective face having a cross section that is concave circular or concave parabolic **2231** (i.e., the surface of the cross section shown is a curved concave section of a circle or parabola at continuously varying angles from the plane of exit opening). In this embodiment, the spread half-angle of light emission from the LEDs **231** is narrowed by reflecting off of surface **2231**, and continues to converge at a smaller half-angle than before reflection (although now redirected along a cone converging towards optical axis **299**) thus providing a relatively smaller spread of light below exit

opening **225**, similar to as shown in Figure 5B. By choosing an appropriate curved concave section, the focus provided by reflector ring **223** can be determined to the degree desired. By extension, by choosing an appropriate curved convex section, the additional divergence provided by reflector ring **223** can alternatively be determined to the degree desired.

FIG. 3D is a cut-away side view of still another ring reflector **220** according to one embodiment of the present invention. In this embodiment, ring reflector **224** is a circularly symmetric reflective face having two adjacent conical-sections **2241** and **2242**, and is otherwise identical to ring reflector **222** of FIG. 3B. Ring reflector **224** is configured to have the light from an outer row of LEDs **231** reflected by surface **2242**, and to have the light from an inner row of LEDs **232** reflected by surface **2241**. In one such embodiment, outer row of LEDs **231** emits light of a first color, and inner row of LEDs **232** of a second color, and are lit alternatively or simultaneously to achieve lighting effects as desired. In another such embodiment, outer row of LEDs **231** and inner row of LEDs **232** both emit light of the same color, and are lit alternatively or simultaneously to achieve lighting effects as desired (i.e., shallow lighting, deep lighting, or both).

FIG. 3E is a cut-away side view of a faceted ring reflector **226** according to one embodiment of the present invention. In one such embodiment, for every facet **2261**, a line **2269** drawn from the center of the facet perpendicular to the plane of the facet will intersect the optical axis **299** on order that the most amount of light will be centered on the optical axis. In another such embodiment, for every facet **2261**, a line **2269** drawn from the center of the facet perpendicular to the plane of the facet will pass to the side of the optical axis **299** (e.g., approximately 1 or 2 centimeters (cm) to the side) in order that the light is spread onto a wider volume (still centered around the optical axis) than in the just-before described example. In a third such embodiment, for every facet **2261**, a line **2269** drawn from the center of the facet perpendicular to the plane of the facet will pass through or pass to the side of the optical axis **299** by successively different amounts (e.g., a first facet perpendicular passes through the optical axis **299**, the next adjacent facet perpendicular passes approximately 1 cm to the clockwise side, the next adjacent facet perpendicular passes approximately 2 cm to the clockwise side, and then the pattern repeats for each successive three facets) in order that the light is spread onto a wide volume, but now slightly more centered around the optical axis, than in the just-before described example.

FIG. 3F is a cut-away side view of a configurable ring reflector **227** according to one embodiment of the present invention. In this embodiment, each facet **2271** is made of a thin reflective material such as a small trapezoid of aluminum, aluminized silicon, aluminized mylar, or other reflective chip, and is fastened to pliable focusing gasket **2272** preferably made of rubber or pliable plastic. Outside ring **2273**, preferably made of metal such as aluminum, is permanently attached to pliable focusing gasket **2272** at their junction (e.g., by adhesive), and is threaded at the bottom of its inside circumference to accept threaded, tapered compression ring **2274**. As compression ring **2274** is rotated into the threads of the inner bottom of outside ring **2272**, it first contacts the inner diameter edge of pliable focusing gasket **2272**, thus deflecting each facet **2271** upward at their bottom edges, while the top edges of each facet **2271** remains at the junction of pliable focusing gasket **2272** and outside ring **2273**. This changes the angle of each facet **2271** (e.g., from a nominal undeflected angle of approximately 38 degrees to

a larger angle). In one such embodiment, for every facet 2271, a line 2269 drawn from the center of the facet perpendicular to the plane of the facet will intersect the optical axis 299 on order that the most amount of light will be centered on the optical axis. In one such embodiment, every other facet has edges that overlay above the edges of each of its closest neighbors, as shown in FIG. 3G. In another such embodiment, every facet 2271 has its, e.g., left edge overlaying above the right edge of each of its closest left-hand neighbor, as shown in FIG. 3H, in order that, for every facet 2271, a line 2279 drawn from the center of the facet perpendicular to the plane of the facet will pass to the side of the optical axis 299 (e.g., approximately 1 or 2 centimeters (cm) to the right side in the example FIG. 3H) in order that the light is spread onto a wider volume (still centered around the optical axis) than in the just-before described example.

FIG. 3I is a cut-away side view of a configurable ring reflector 228 according to one embodiment of the present invention. In this embodiment, thin reflective surface 2281 is fastened to (or deposited on the surface of) stretchable focusing membrane 2282 preferably made of rubber or pliable plastic. Outside ring 2283, preferably made of metal such as aluminum, is permanently attached to stretchable focusing membrane 2282 at their junction (e.g., by adhesive or a dovetail joint), and is threaded at the bottom of its inside circumference to accept threaded, tapered stretching ring 2284. As stretching ring 2284 is rotated into the threads of the inner bottom of outside ring 2282, it releases some of the stretch of stretchable focusing membrane 2282, thus deflecting reflective surface 2281 upward at its bottom edge, while the top edge of reflective surface 2281 remains at the junction of stretchable focusing membrane 2282 and outside ring 2283. This changes the angle of reflective surface 2281 (e.g., from a nominal undeflected angle of approximately 38 degrees to a larger angle).

FIG. 4A is a cut-away side schematic of the single-conical-section ring reflector 221 of FIG. 3A showing the light pattern generated (having highest intensity within the dotted line volume 2218), which is sometimes called a darkfield-illumination pattern. In such a darkfield-illumination pattern, an object 160 located within A deeper pattern is generated by a shallower angle in reflector 221, and/or a wider half-angle of LEDs 231.

FIG. 4B is a cut-away side schematic of the concave dual-conical-section ring reflector 222 of FIG. 3B showing the light pattern generated (having highest intensity within the dotted line volume 2228). A deeper pattern is generated by a shallower angles in reflector 222, and/or a wider half-angle of LEDs 231.

FIG. 5A is an enlarged cut-away side schematic of the ring reflector 220 of FIG. 3A.

FIG. 5B is an enlarged cut-away side schematic of the ring reflector 220 of FIG. 3B.

FIG. 6 is a block diagram of the electrical connections for one embodiment of machine-vision illumination system 100. Image processor 150 sends a reset signal to camera 140, then shortly thereafter (or simultaneously) sends a trigger signal to power supply 20. Within power supply 20, the trigger signal activates pulse generator 20.1 to generate a control pulse of a predetermined length. The control pulse is used to turn on transistor Q1 to generate a flash on LEDs 231, which is current-limited (if desired) by resistor R30. The control pulse also activates the maximum-rate-limit circuit 20.2, which inhibits any further control pulses from pulse generator 20.1 for a predetermined amount of time.

The 12-volt signal from power supply 20 is filtered by the low-pass filter comprising C1, L1, D1, and R10, and charges capacitors C2 through C_N (in one embodiment, N is 12). In one such embodiment, C1 through C12 are each 2200 μ F, L1 is 40 μ H iron-core, D1 as a 1N4001 diode, and R10 is a 0 ohm conductor (i.e., a short). C2 through C_N are discharged through, e.g., fifteen LEDs 231 as shown in the circuit diagram, which in this embodiment are wired in a parallel-series manner as shown, (in another embodiment, sixty LEDs arranged in a single row are used; in another embodiment, 150 LEDs are used, each in a similar serial-parallel-wired connection circuit), and R30 and Q1, as activated by the above-described control pulse. In one such embodiment, R30 is replaced by a zero-ohm conductor, and the voltage drop across the LEDs 231 and Q1 is used to self-limit the current through the LEDs 231. The control pulse is fed across resistor R20, which in one embodiment is 100K Ω , to develop the necessary voltage for driving transistor Q1, which in this embodiment is a MTP75N05HD MOSFET.

FIG. 7 is a more-detailed schematic diagram of power supply 20. The input trigger is fed through resistor R21 to drive the input of opto-isolator OI1. The output of opto-isolator OI1 is coupled through capacitor C12 (and the associated circuit R4, R6 and D2) to the TRG input of timer circuit 1C1A. (In one embodiment, timers 1C1A and 1C1B are each $\frac{1}{2}$ of a 556-type dual timer.) The timing constant of timer 1C1A is set by C14 and R1-x, (where x is selected from 1 through N), and determines the pulse width of the control pulse driving Q1, and thus the LEDs 231. In one embodiment, five selectable pulse widths are predetermined and selected by SW1, which is a five-way exclusive dual-pole-single-throw switch, wherein one resistor of the set R1-1 through R1-N is selected for connection to the DIS input pin of 1C1A, and a corresponding one resistor of the set R2-1 through R2-N is selected for connection to the DIS input pin of 1C1B. The timing constant of timer 1C1B is set by C17 and R2-x, (where x is selected from 1 through N), and determines the minimum time between control pulses driving Q1, and thus the LEDs 231. In one embodiment, the five selectable predetermined pulse widths are 25 microseconds (μ s), 50 μ s, 100 μ s, 200 μ s and 500 μ s; the corresponding maximum pulse rates controlled by maximum rate limit circuit 20.2 are 200 Hz, 120 Hz, 60 Hz, 30 Hz, and 10 Hz, respectively, and are predetermined and selected by SW1. Thus, in the embodiment which uses a 60 Hz camera image rate, 100 μ s-long control pulses are used to activate LEDs 231. In one embodiment, it is desired to have an average LED illumination intensity of at least ten times the ambient light; thus, when camera 140 is taking one frame every 16.7 milliseconds, a 100 microsecond pulse should be at least 1670 times as intense as the ambient light. In one such an embodiment, a shroud is used to reduce the ambient light, and a red filter (substantially transparent to the peak wavelength of ring-reflector illumination source 200) is placed over the lens of camera 140 in order to reduce ambient light and pass the light of ring-reflector illumination source 200. The control pulse output signal is driven through resistor R31.

In one embodiment, opto-isolator OI1 is a 4N37-type part, resistor R2 is 100 Ω , resistor R3 is 1000 Ω , resistor R7 is 1 M Ω , resistor R8 is 1K Ω and visible-color LED D3 indicates when the circuit is active, resistor R4 is 4700 Ω , resistor R5 is 10 Ω , resistor R6 is 10K Ω , diode D2 is a 1N914, resistor R1-1 is 2.26K Ω , resistor R1-2 is 4.53K Ω , resistor R1-3 is 9.0K Ω , resistor R1-4 is 18.2K Ω , resistor R1-5 is 45.3K Ω , resistor R2-1 is 37.4K Ω , resistor R2-2 is 75K Ω , resistor

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R2-3 is 150K Ω , resistor R2-4 is 301K Ω , resistor R2-5 is 909K Ω , C14 is 0.01 μ F, C17 is 0.1 μ F, C12 is 0.001 μ F, C10 is 100 μ F, C11 is 0.1 μ F, C13, C15, and C16 are each 0.01 μ F, Q2 and Q3 are each 2N3904 NPN transistors, and RP1 is a 10K Ω resistor pack.

“Chromatic aberration” is where a lens focuses different wavelengths of light at different focal points. “Spherical aberration” occurs when light from the edges of a circularly-curved lens are focused at different distances that light through the center of the lens. Circularly curved lenses are used since they are cheaper to produce a lens with a spherical curved surface than one in which the curvature changes. The problem, however, is that spherical aberration can occur, where the edges of the lens focus the light waves at a different point from the center of the lens, causing lack of sharpness. Regarding the oblique rays passing through the lens, these fall on different parts of the “image plane,” in a blur rather than being superimposed. This slightly different aspect of spherical aberration is called coma. To overcome this can be costly, but mirror-type ring-reflector focusing elements 220 do not suffer from these aberrations.

The process of the present invention is unlike conventional illumination sources since it is compact, generates a light source from more than one point source with suitable brightness in order to reduce shadows, focuses the light source into a broad, deep, multidirectional source illuminating a volume with light rays that approach generally the optical axis of the machine-vision system at oblique angles from a ring that surrounds the optical axis, so that even extremely small parts can be adequately inspected and accurately viewed or measured with machine-vision system 100. Another aspect of the present invention is to provide a compact illumination source, preferably monochromatic, which can be focused to provide uniform multi-directional light onto all surfaces that are viewable by the machine vision camera. Yet another aspect of the present invention is to have such an LED illumination source be pulsed with a relatively high-power, low duty-cycle power source.

In one embodiment, most or all interior surfaces of ring-reflector illumination source 200 except the operative reflecting surface (e.g., surfaces 2211, 2221, 2222, or 2231) have an anti-reflective (e.g., flat black) surface to prevent stray reflections. In one embodiment, the flat black surface is obtained by applying flat black paint. In another embodiment, the flat black surface is obtained through use of a standard black anodization process.

It is to be understood that the above description is intended to be illustrative, and not restrictive. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

What is claimed is:

1. An illumination system for illuminating an object for machine-vision, the system having an optical axis, comprising:

a ring light source that comprises:

a substantially ring-shaped flashtube emitting light from a light-emitting region disposed substantially in a plane that intersects the optical-axis, the light-emitting region disposed at least a first distance from the optical axis and less than a second distance from the optical axis; and

a first ring reflector, the ring reflector having an exit opening through which the optical axis passes, the

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emitted light from the ring light source being generally directed centered on lines that intersect a reflecting surface of the ring reflector, the ring reflector reflecting the emitted light from the light source through the exit opening inwards and generally towards the optical axis; and

an enclosure generally surrounding the flashtube but having a elongated aperture disposed between the ring-shaped flashtube and the ring reflector, wherein the elongated aperture allows light from the flashtube to fall on a reflecting surface of the ring reflector.

2. The illumination system as recited in claim 1, further comprising a focusing element, disposed in a path of the emitted light from the ring light source, and that includes a cylindrical ring lens having at least one convex face.

3. The illumination system as recited in claim 1, wherein the ring reflector has a surface that enhances its reflectivity at one or more selected wavelengths of the ring light source.

4. The illumination system as recited in claim 3, wherein the first ring reflector and ring light source are configured to produce a darkfield illumination.

5. The illumination system as recited in claim 1, wherein the first ring reflector includes a reflective surface that comprises a first conical section.

6. The illumination system as recited in claim 5, wherein the first conical section includes a reflective surface at a first conical angle to the optical axis.

7. The illumination system as recited in claim 1, wherein the first ring reflector includes a reflective surface that comprises a plurality of adjoining conical sections.

8. The illumination system as recited in claim 7, wherein the plurality of adjoining conical sections includes a first conical section having a reflective surface at a first conical angle to the optical axis, and a second conical section having reflective surface at a second conical angle to the optical axis, the second conical angle being different than the first conical angle.

9. The illumination system as recited in claim 1, wherein the first ring reflector includes a reflective surface that comprises a circularly-rotated parabolic section.

10. The illumination system as recited in claim 1, wherein the first ring reflector includes a reflective surface that is configurable to change at least one angle at which the reflective surface reflects light.

11. The illumination system as recited in claim 1, wherein the first ring reflector includes a reflective surface that comprises a plurality of reflective facets.

12. The illumination system as recited in claim 11, wherein, for a plurality of the facets, a line normal to a facet surface passes through the optical axis.

13. A method for illuminating an object located along an optical axis, comprising the steps

(a) emitting light from a light source that includes a ring-shaped flashtube disposed substantially along a circle disposed perpendicular to and centered on the optical axis, the light-emitting portion of the flashtube disposed at least a first distance from the optical axis and less than a second distance from the optical axis; and

(b) reflecting the emitted light from the light source inwards and generally towards the object at the optical axis or in an area around the optical axis, wherein the object is an electrical connector, and further comprising the step of acquiring a machine-vision image of the electrical connector.

14. A method for illuminating an object located along an optical axis, comprising the steps

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- (a) emitting light from a light source that includes a ring-shaped flashtube disposed substantially along a circle disposed perpendicular to and centered on the optical axis, the light-emitting portion of the flashtube disposed at least a first distance from the optical axis and less than a second distance from the optical axis; and
- (b) reflecting the emitted light from the light source inwards and generally towards the object at the optical axis or in an area around the optical axis,
- further comprising the step of focusing the emitted light to a circular line.
- 15.** A method for illuminating an object located along an optical axis, comprising the steps of:
- (a) emitting light from a light source that includes a ring-shaped flashtube disposed substantially along a circle disposed perpendicular to and centered on the optical axis, the light-emitting portion of the flashtube disposed at least a first distance from the optical axis and less than a second distance from the optical axis;
- (b) focussing the emitted light through a circular cylindrical ring lens; and
- (c) reflecting the emitted light from the light source inwards and generally towards the object at the optical axis or in an area around the optical axis.
- 16.** A machine-vision illumination system, comprising:
- an imaging device disposed along an optical axis to receive an image of an object;
- an image processor coupled to the imaging device that processes the image and produces machine-vision information; and
- a ring-light source to illuminate the object, wherein the ring light source comprises:
- a ring-shaped flashtube disposed substantially along a circle disposed perpendicular to and centered on the optical axis;
- a ring reflector configured to reflect light along at least one conical angle; and

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an enclosure having a slit disposed between the ring-shaped flashtube and the ring reflector, wherein the slit allows light from the flashtube to fall on a reflecting surface of the ring reflector.

17. The illumination system as recited in claim **16**, further comprising a focusing element that includes a cylindrical ring lens having at least one convex face.

18. The machine-vision illumination system as recited in claim **16**, wherein the ring reflector has a surface that enhances its reflectivity at one or more selected wavelengths of the ring light source.

19. The machine-vision illumination system as recited in claim **16**, wherein the ring reflector and ring light source are configured to produce a darkfield illumination.

20. A method for illuminating an object located along an optical axis, comprising the steps

- (a) emitting light from a light source that includes a ring-shaped flashtube disposed substantially along a circle disposed perpendicular to and centered on the optical axis, the light-emitting portion of the flashtube disposed at least a first distance from the optical axis and less than a second distance from the optical axis; and

- (b) reflecting the emitted light from the light source inwards and generally towards the object at the optical axis or in an area around the optical axis,

wherein the step of emitting light further comprises passing the emitted light through a circular slit.

21. The method for illuminating an object as recited in claim **15**, wherein the step of reflecting light further comprises reflecting light at a plurality of discrete conical angles each defined by a conical section reflecting surface having a straight line cross section.

22. The method for illuminating an object as recited in claim **21**, wherein the plurality of conical angles include a first conical angle to the optical axis, and a second conical angle to the optical axis, the second conical angle being different than the first conical angle.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,238,060 B1
DATED : May 29, 2001
INVENTOR(S) : Bourn et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5,

Line 7, delete "FIG. 21" and insert -- FIG. 2I --, therefor.

Column 18, claim 13,

Line 52, delete "steps" and insert -- steps of: --, therefor.

Column 18, claim 14,

Line 67, delete "steps" and insert -- steps of: --, therefor.

Column 20, claim 20,

Line 16, delete "steps" and insert -- steps of: --, therefor.

Signed and Sealed this

Eleventh Day of December, 2001

Attest:

Nicholas P. Godici

Attesting Officer

NICHOLAS P. GODICI
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REQUEST FOR *EX PARTE* REEXAMINATION TRANSMITTAL FORM

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Attorney Docket No.: EXRE_PI_729

Date: April 22, 2025

1. ☒ This is a request for *ex parte* reexamination pursuant to 37 CFR 1.510 of patent number 7,841,729
issued _____. The request is made by:
☐ patent owner. ☒ third party requester.
2. ☒ The name and address of the person requesting reexamination is:
Jialin Zhong
Zhong Law, LLC
51 JFK Parkway, First Floor West, Short Hills, New Jersey 07078
3. Requester ☐ asserts small entity status (37 CFR 1.27) or ☐ certifies micro entity status (37 CFR 1.29). Only a patent owner requester can certify micro entity status. Form PTO/SB/15A or B must be attached to certify micro entity status.
4. This request is accompanied by payment of the reexamination fee as set forth in:
☐ 37 CFR 1.20(c)(2); **or**
☒ 37 CFR 1.20(c)(1). **In checking this box for payment of the fee set forth in 37 CFR 1.20(c)(1), requester asserts that this request has forty (40) or fewer pages and complies with all other requirements of 37 CFR 1.20(c)(1).**
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37 CFR 1.26(c). If payment is made by credit card, refund must be to credit card account.
6. ☒ A copy of the patent to be reexamined having a double column format on one side of a separate paper is enclosed. 37 CFR 1.510(b)(4).
7. ☐ CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
☐ Landscape Table on CD

[Page 1 of 3]

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- b. Specification Sequence Listing on:
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- ii. ☐ paper
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9. ☐ A copy of any disclaimer, certificate of correction or reexamination certificate issued in the patent is included.
10. ☒ Reexamination of claim(s) 1-9 is requested.
11. ☒ A copy of every patent or printed publication relied upon is submitted herewith including a listing thereof on Form PTO/SB/08, PTO-1449, or equivalent.
12. ☐ An English language translation of all necessary and pertinent non-English language patents and/or printed publications is attached.
13. ☒ The attached detailed request includes at least the following items:
- a. A statement identifying each substantial new question of patentability based on prior patents and printed publications. 37 CFR 1.510(b)(1).
- b. An identification of every claim for which reexamination is requested, and a detailed explanation of the pertinency and manner of applying the cited art to every claim for which reexamination is requested. 37 CFR 1.510(b)(2).
14. ☐ A proposed amendment is included (only where the patent owner is the requester). 37 CFR 1.510(e).
15. ☒ It is certified that the statutory estoppel provisions of 35 U.S.C. 315(e)(1) or 35 U.S.C. 325(e)(1) do not prohibit requester from filing this *ex parte* reexamination request. 37 CFR 1.510(b)(6).
16. Service
- a. ☒ It is certified that a copy of this request (if filed by other than the patent owner) has been served in its entirety on the patent owner as provided in 37 CFR 1.33(c).
- The name and address of the party served are:
- Finn IP Law, PC, 11400 W. Olympic Blvd, 9th FL, Los Angeles, CA 90064
- and
- Pathway IP LLC, 400 Rella Blvd, STE 156, Montebello, NY 10901
- Date of Service: April 22, 2025
- OR**
- b. ☐ A duplicate copy is enclosed since service on patent owner was not possible. An explanation of the efforts made to serve patent owner **is attached**. See MPEP 2220.

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18. ☐ The patent is currently the subject of the following concurrent proceeding(s):

- a. ☐ Copending reissue Application No. _____
- b. ☐ Copending reexamination Control No. _____
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- _____

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/Jialin Zhong/

Authorized Signature

April 22, 2025

Date

Jialin Zhong

Typed/Printed Name

62,937

Registration No.

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US007841729B2

(12) **United States Patent**
Geddes

(10) **Patent No.:** **US 7,841,729 B2**
(45) **Date of Patent:** **Nov. 30, 2010**

(54) **WEBCAM ILLUMINATOR DEVICE**

(75) Inventor: **Henry Geddes**, Delray Beach, FL (US)

(73) Assignee: **Splashlight Studios**, Miami Beach, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 234 days.

(21) Appl. No.: **12/011,090**

(22) Filed: **Jan. 24, 2008**

(65) **Prior Publication Data**

US 2008/0180933 A1 Jul. 31, 2008

Related U.S. Application Data

(60) Provisional application No. 60/897,600, filed on Jan. 26, 2007.

(51) **Int. Cl.**
G03B 15/02 (2006.01)

(52) **U.S. Cl.** **362/16**

(58) **Field of Classification Search** 362/3,
362/8, 16, 11

See application file for complete search history.

(56) **References Cited**

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* cited by examiner

Primary Examiner—Stephen F Husar

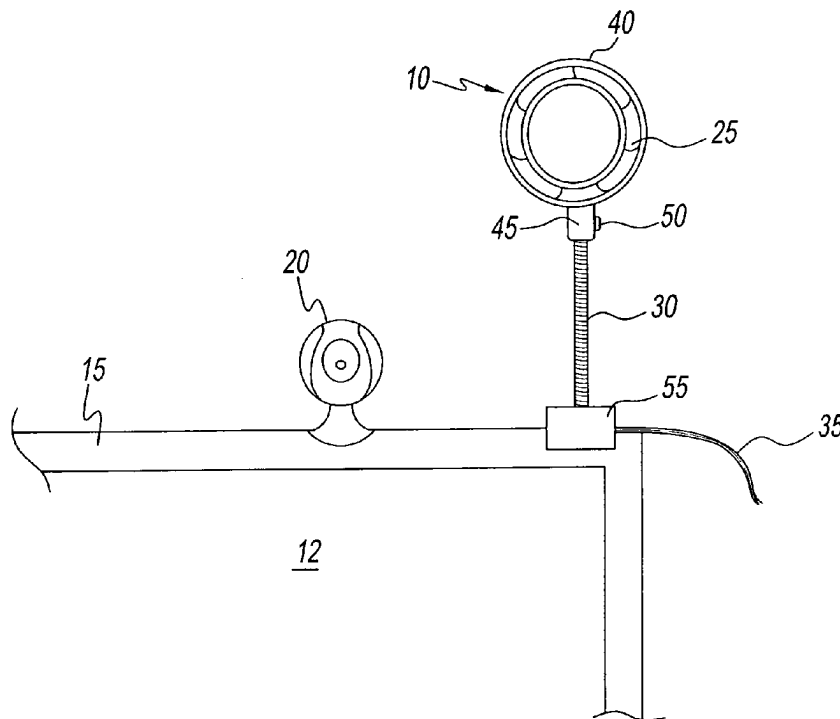
Assistant Examiner—James W Cranson

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(57) **ABSTRACT**

An illuminator device for illuminating one or more users in front web camera and a communication terminal having a bulb for emitting light; a reflector operatively associated with the bulb for projecting the emitted light; and an arm disposed between the bulb and the terminal for connection to the terminal are provided. The bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera. An illuminator device for illuminating one or more users in front of a webcam and a communications terminal having a frame and a screen having a plurality of bulbs, wherein the plurality of bulbs are disposed in the frame of the terminal to provide illumination to the face or faces of the users.

13 Claims, 6 Drawing Sheets



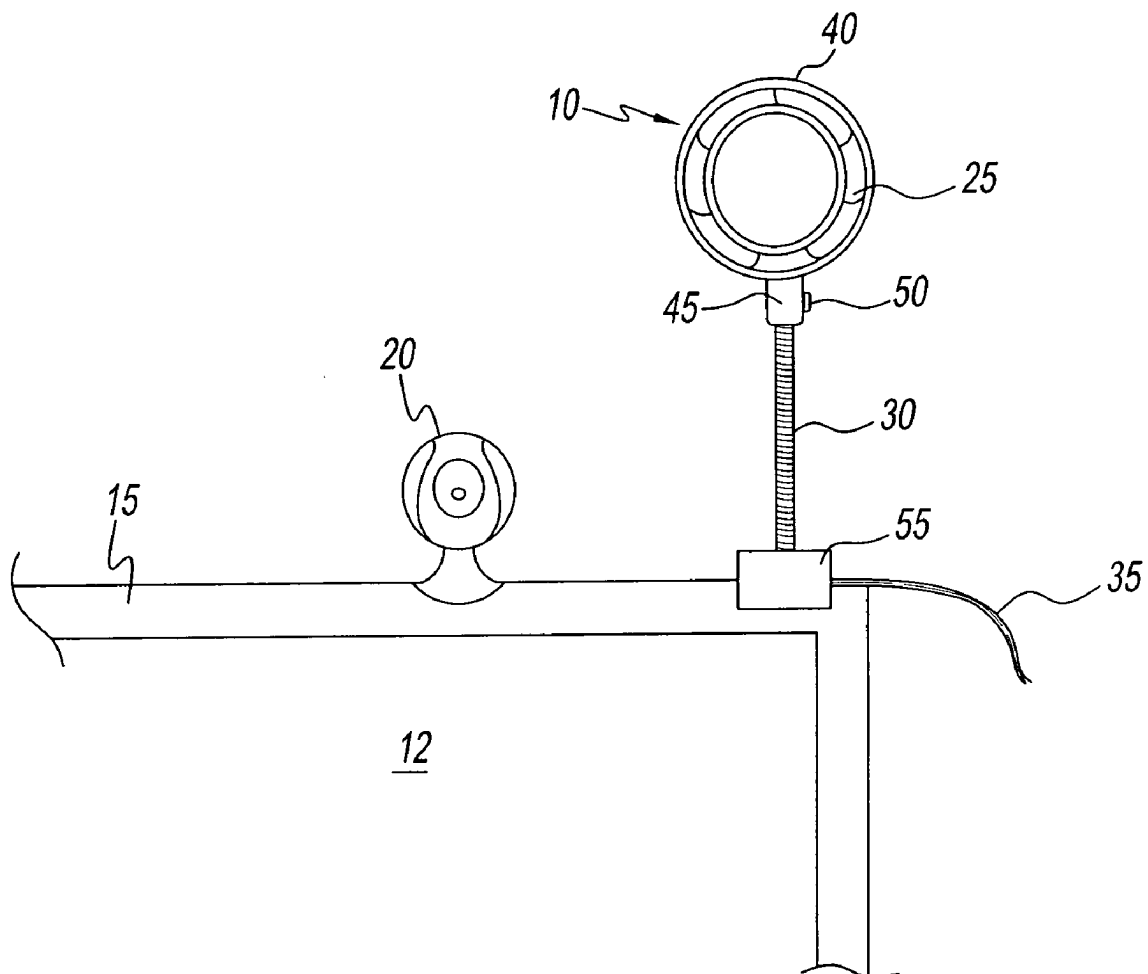


Fig. 1

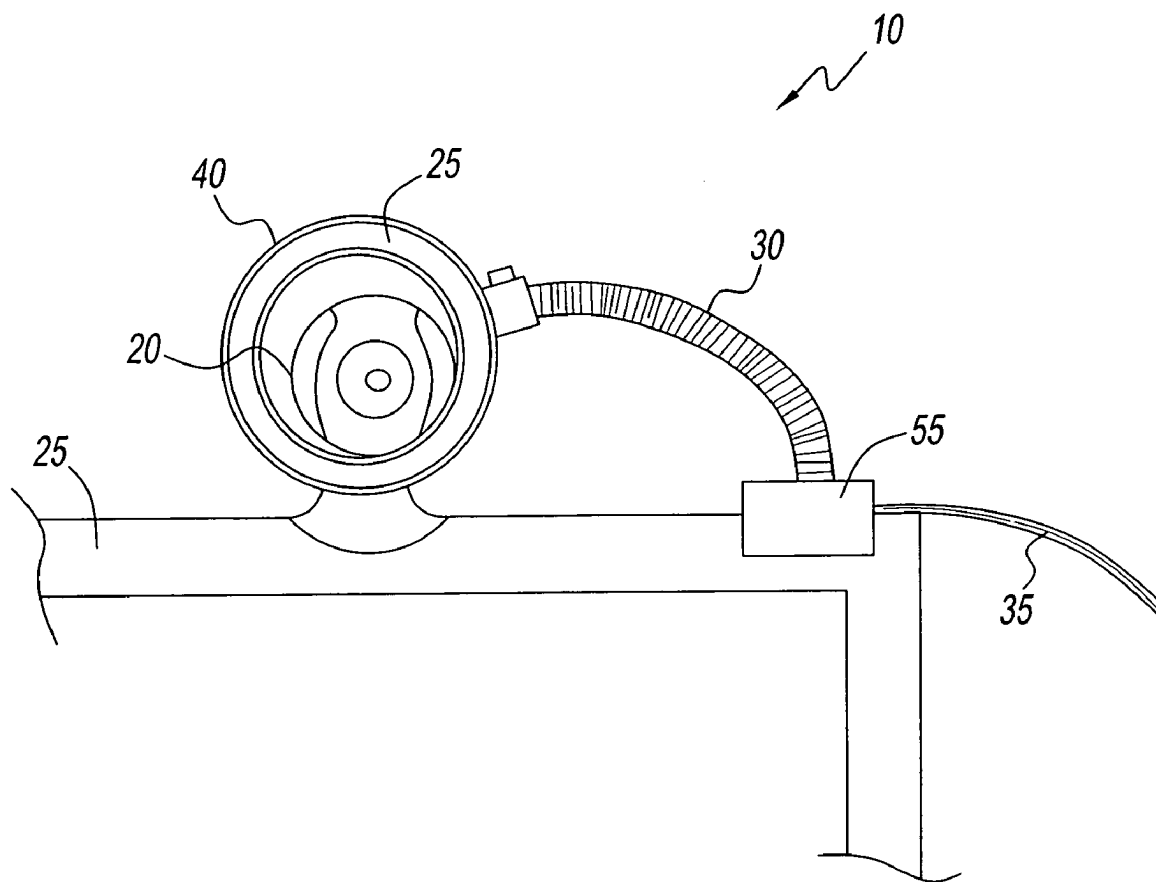
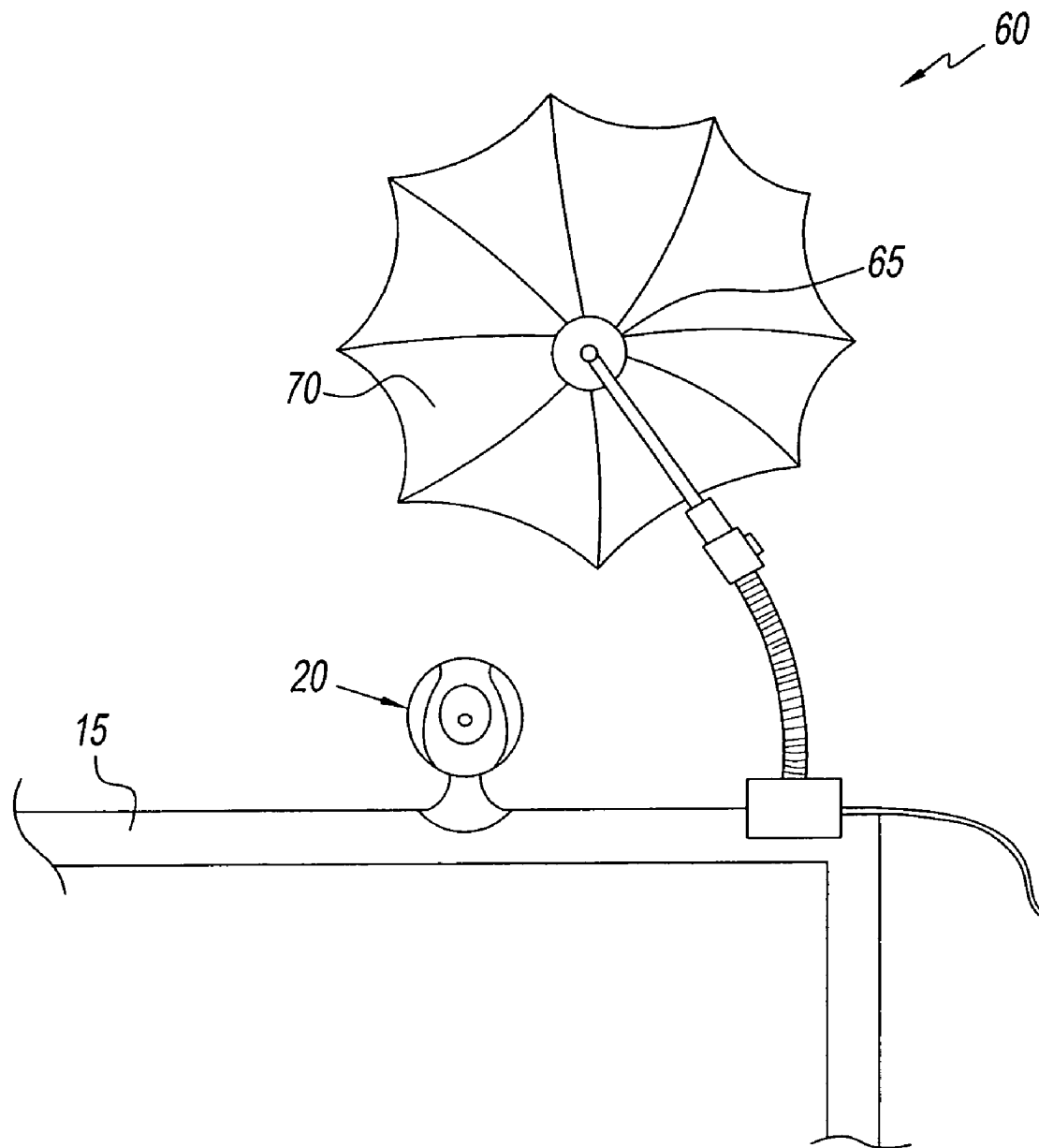


Fig. 2

*Fig. 3*

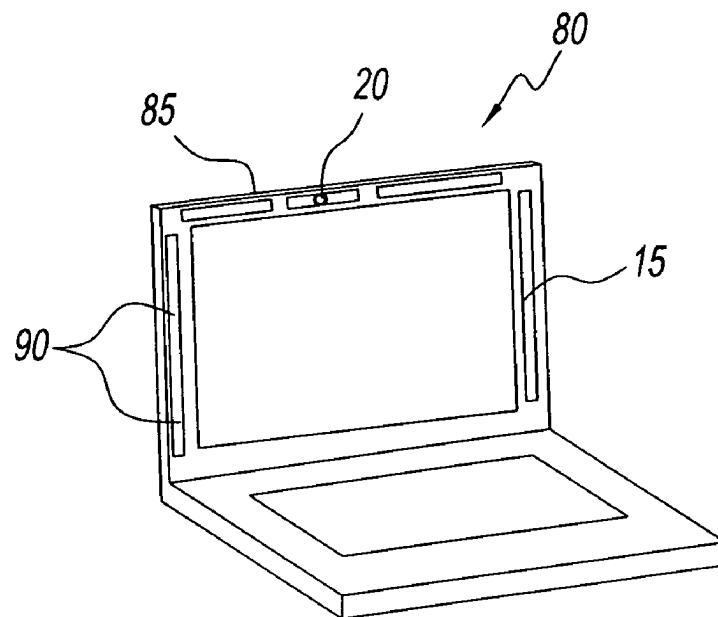


Fig. 4

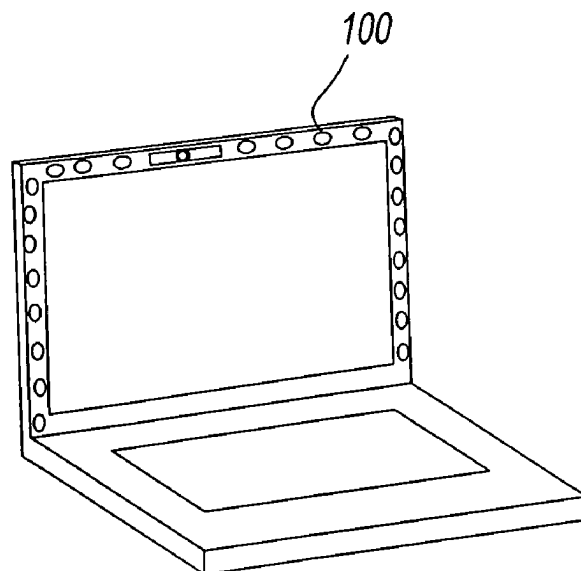


Fig. 5

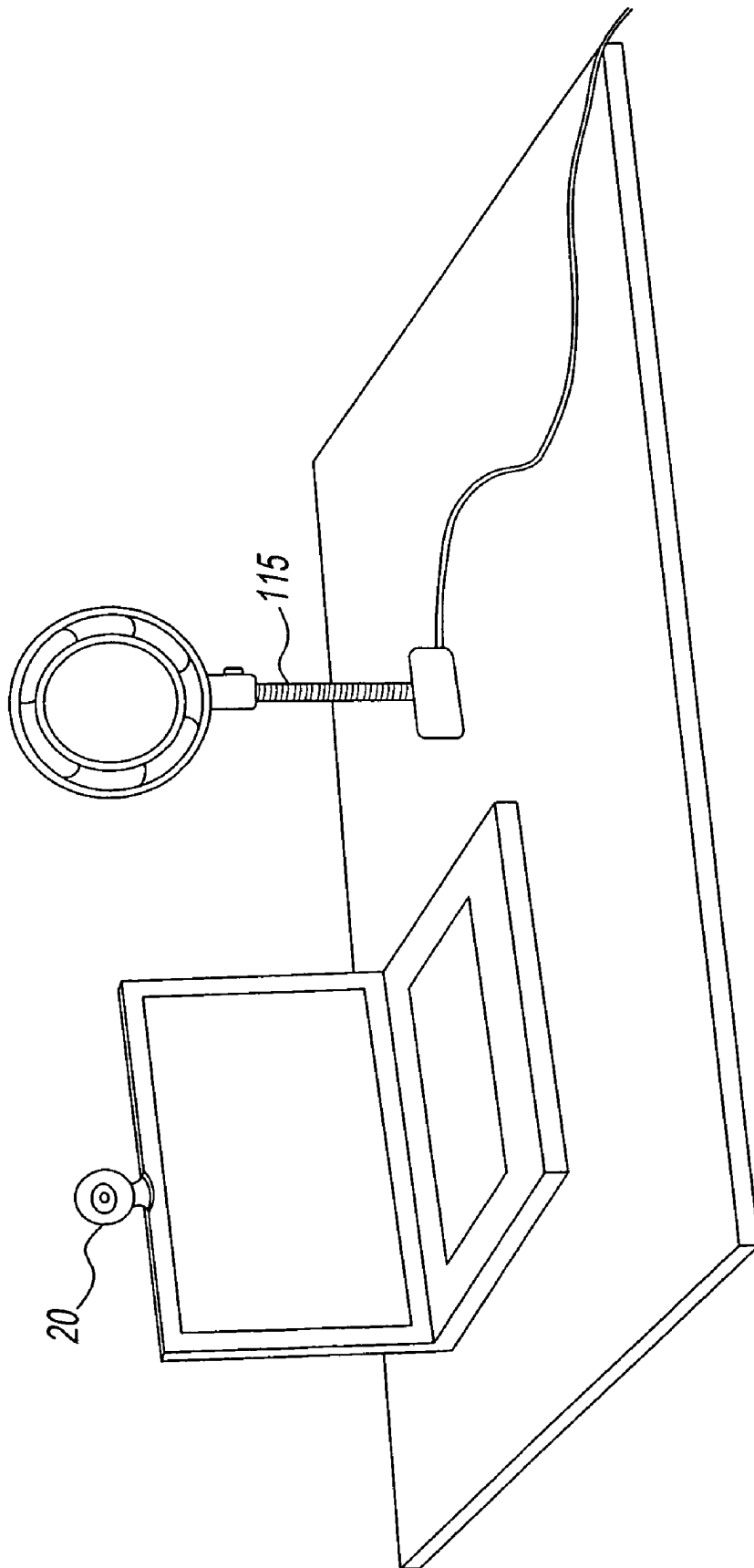


Fig. 6

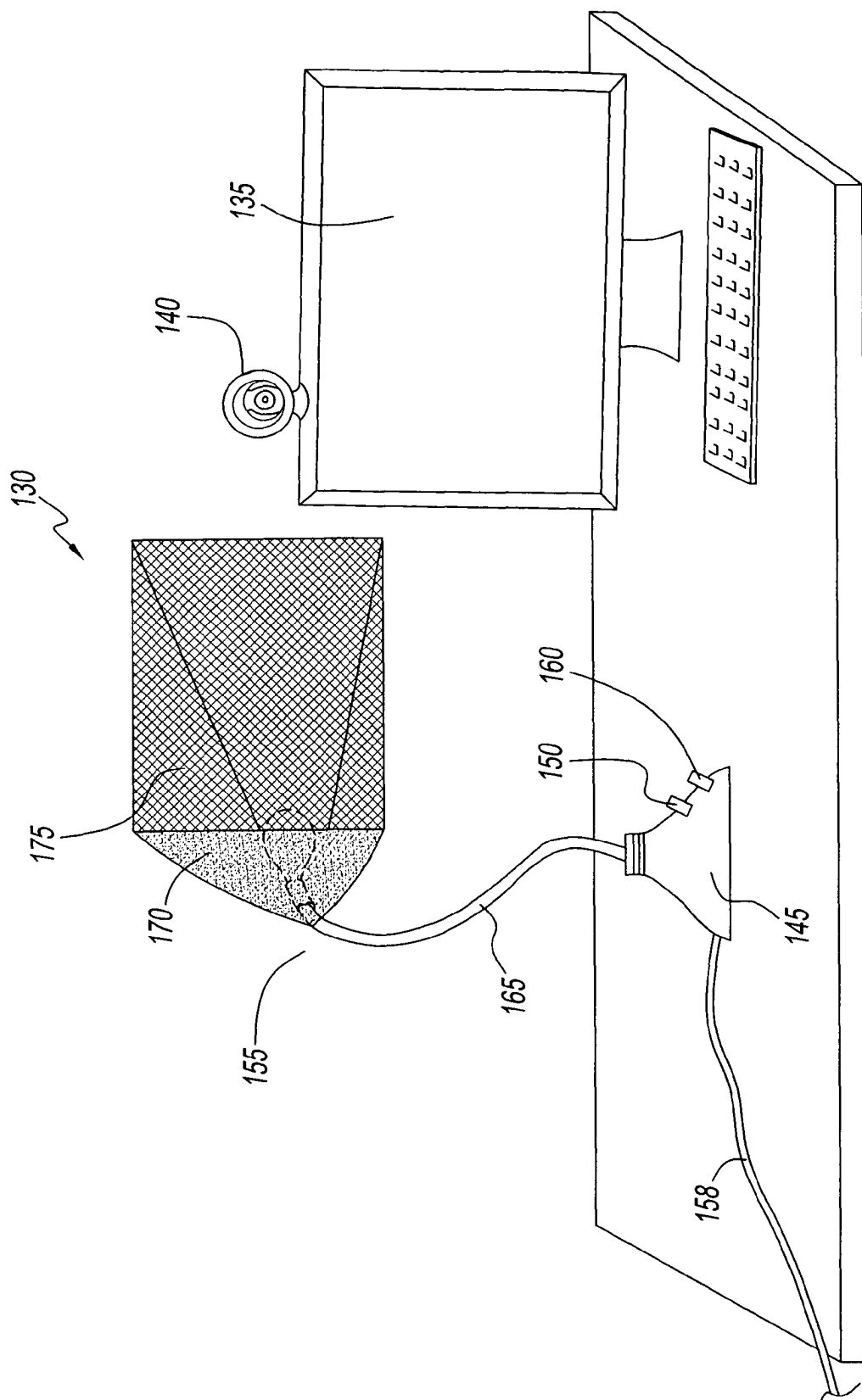


Fig. 7

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WEBCAM ILLUMINATOR DEVICE

This application claims the benefit to U.S. Provisional Application Ser. No. 60/897,600 filed on Jan. 26, 2007, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

This invention relates to an illuminator device. More particularly, this invention relates to an illuminator device for a web camera (hereinafter "webcam") that illuminates the face of the person who is viewed using a webcam.

2. Description of Related Art

Video conference calls are a common method for people to communicate when the parties are remote and wish to be simultaneously viewed. Generally, during video conferencing, the parties are not concerned about the appearance of the individuals, because the purpose of the call is of greater importance than the individuals' appearance.

However, as online viewing using the Internet has become more popular, users are now able to have their image files uploaded to a website for online viewing. While these uploaded images can be for business purposes, they are increasingly used for social purposes. For example, in online chatting or dating sites, a user desires to appear as attractive as possible during communications using personal computers equipped with a webcam.

Poor lighting is one of the primary reasons for the poor appearance of facial images that are viewed online from webcams. The individual does not appear as attractive as they otherwise would in person. The proper lighting ensures an aesthetically pleasing appearance of an individual's face.

Accordingly, there is a need to provide proper lighting for users that are viewed through a webcam to ensure that they appear aesthetically pleasing.

SUMMARY OF THE INVENTION

The present disclosure provides for an illuminator device for the face of the user viewed through a webcam, wherein the illuminator provides diffuse illumination to the face of the user.

The present disclosure also provides for an illuminator device for the face of the user viewed through a webcam, in which the illuminator device has a bulb that is shaped as one of a toroid, a sphere and a semi-sphere.

The present disclosure further provides for an illuminator device for the face of the user viewed through a webcam in which the illuminator device is embedded in the periphery of a screen of a monitor to provide illumination to the face of a user.

The present disclosure yet further provides for an illuminator device for the face of the user viewed through a webcam, in which the illuminator device has a bulb that is surrounded by a reflector to reflect the light of the bulb towards the face of the user.

The present disclosure yet still further provides for an illuminator device for the face of the user viewed through a webcam, in which the illuminator is movable on a surface relative to the user and the webcam for optimal adjustability.

The present disclosure still yet further provides for an illuminator device that is covered by a diffusion cover to provide diffuse light to the face of the user when the face is viewed through a webcam.

An illuminator device for illuminating one or more users in front web camera and a communication terminal having a

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bulb for emitting light; a reflector operatively associated with the bulb for projecting the emitted light; and an arm disposed between the bulb and the terminal for connection to the terminal are provided. The bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera.

An illuminator device for illuminating one or more users in front of a webcam and a communications terminal having a frame and a screen having a plurality of bulbs, wherein the plurality of bulbs are disposed in the frame of the terminal to provide illumination to the face or faces of the users.

BRIEF DESCRIPTION OF THE DRAWINGS

Other and further benefits, advantages and features of the present invention will be understood by reference to the following specification in conjunction with the accompanying drawings, in which like reference characters denote like elements of structure and:

FIG. 1 illustrates a front view of the first embodiment of the webcam illuminator of the present invention;

FIG. 2 illustrates a front view of the webcam illuminator of FIG. 1 of the present invention proximate the webcam;

FIG. 3 illustrates a front view of the webcam illuminator according to a second embodiment of the present invention;

FIGS. 4 and 5 illustrate a perspective view of a third embodiment of the present invention in which the illuminator is integrated into the frame of the screen and surrounds the webcam;

FIG. 6 illustrates a perspective view of a fourth embodiment of the present invention; and

FIG. 7 illustrates a perspective view of a fifth embodiment of the present invention in which the illuminator has a diffusion fabric.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a webcam illuminator of the present invention is shown and is generally represented by reference numeral 10. Illuminator 10 of the present invention is a connected frame 15 of screen 12 of a computer proximate a webcam 20. A webcam 20 is a video camera that is used to send periodic images or continuous frames to a Web site for display. Webcam software typically captures the images as JPEG or MPEG files and uploads them to the Web server. Illuminator 10 has a bulb 25 for illumination of the user, and particularly of the face of the user of the webcam 20. Illuminator 10 preferably has a flexible arm 30 and a clamp 55 that permit adjustment of the location of bulb 25 relative to webcam 20. While illuminator 10 is shown as having an alternating current power cord 35, illuminator 10 could also be battery powered to enable portable use of webcam 20 and illuminator 10.

Illuminator 10 further has a reflector 40 that surrounds or encases bulb 25. Bulb 25 has a toroidal or ring configuration that is capable of diffusing and shaping light through its surface. Such a configuration permits light illuminating the face of the user to be as diffuse as possible. Further, reflector 40 reflects the light of bulb 25 back onto the face of the user. Illuminator 10 has a base 45 that is capable of receiving different sized or shaped bulbs and reflectors. Illuminator 10 has a switch 50 for easy activation of the bulb during use.

Referring to FIG. 2, the illuminator 10 is shown in use in a position surrounding and in front of webcam 20. By surrounding webcam 20, the direct light from bulb 25 and the reflected light from bulb 25 illuminate the face with diffuse

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light. The diffuse light is the most flattering light to view a person's face because it prevents any shadows from being cast on a user's face. Diffuse light also prevents any facial imperfections from being highlighted on the face of the user. Illuminator **10** can be affixed to screen **15** of computer at any point along the edge to maximize direct and diffuse light from bulb **25**. Because illuminator **10** is movable along the length of screen **15**, a recipient of the image over the internet may request that the user adjust the location of the illuminator **10** for enhanced viewing of the user. The ability to move the device allows for the user to adjust how they want to be seen, as well. The different positions that the device can be positioned will create different looks and effects allowing for more choice and control.

Referring to FIG. 3, second embodiment of the illuminator present invention is shown and generally reference with reference numeral **60**. Similar features of the first embodiment will be referred to using the same reference numerals in the second embodiment. In FIG. 3, illuminator **60** has similar elements as the first embodiment except that bulb **65** has a semi-spherical or spherical shape. The reflector **70** of this embodiment has an umbrella shape that is capable of reflecting light onto the users face from bulb **65**. Bulb **65** is substantially a point source and its light is reflected by the relatively large umbrella reflector. Similar to the first embodiment, the purpose of the second embodiment is to move light forward onto the user's face and to create as much diffuse light as possible so that the user's face will be illuminated in the most flattering manner during webcam use. In the absence of a mechanism to diffuse light, the user's face would appear harsh with many shadows. In the absence of diffuse light, wrinkles or crevices would be deepened and highlighted on the surface of the skin making the user appear not as attractive when viewed by a recipient via webcam **20**. Further the diffuse light makes the whites and the color of the eyes appear clearer. By casting the light on to the user's face the overall illumination of the face is achieved.

Reflectors **40** and **70** of the first and second embodiment, respectively, have an inside surface that is preferably coated with a thin film of silver or a white film to maximize reflective capability. Additionally, reflectors **40** and **70** are able to direct the light to the user's face and away from screen **15**. By highlighting the user's face and projecting the maximum amount of light on to the user's face, the resolution of webcam **20** is optimized. A brighter subject enhances the resolution of webcams **10** and **60**. Further, the readability of screen **15** is increased because the light that would otherwise be directed toward the screen is minimized and redirected to the face to enhance the contrast of colors on the screen. Illuminators **10** and **60** simulate the lights are used in photographic studios that use professional lighting to enhance a user's appearance.

A further benefit of the webcam illuminator **10**, **60** and reflectors **40** and **70**, respectively, is that they together simulate natural light. Natural light or average noon daylight has a temperature of 5500 degrees Kelvin. Light at 5500 degrees Kelvin is has the quality of white light that is identical to the color of the sun at midday. The temperature that reflectors **40**, **70** of the present invention reflect on the face of the user is approximately 5500 Kelvin, a value that is neither too hot like blue light or too cold like orange light. A user seen using the webcam will have a flattering appearance.

In the third embodiment shown in FIGS. 4 and 5, illuminator **80** is built into a frame **85** of screen **15** of computer. Illuminator **80** is in the form of a plurality of lights **90** configured to achieve a similar effect to the bulbs of earlier embodiments. Plurality of lights **90** surround the webcam **20** and cast diffuse light on the face of the user to minimize any

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shadows that would not be as flattering to the user. Lights **90** are set back from the screen **15** of computer to enhance the contrast of the screen with the background for easier viewing by the user. By highlighting the face of the user, the function of the webcam **20** is maximized. By providing a greater degree of light to the user's face, the resolution of the webcam is increased.

FIG. 5 shows a more decorative arrangement of lights or electrodes **100** much like a make-up mirror. The illuminators shown in FIGS. 4 and 5 can be automatically activated when webcam is brought into service. Lights **90** are mounted in the frame are compact and thus very convenient. Lights **90** occupy less space and are more discreet, than a frame mounted illuminator of embodiment one or two. Furthermore, the third embodiment is useful for people who travel and work exclusively with laptops, thus eliminating the need of carrying around an additional device.

A benefit of the illuminator of the present invention is to provide the most flattering lighting and viewing of a user of a webcam during conference calls or any on-line scenario using a webcam such as an on-line dating scenario.

In the embodiments described above, the illuminator is shown as being connected to or integral with the computer screen. Referring to FIG. 6, it is also within the scope of the instant invention to have a fourth embodiment in which an illuminator **115** is placed on a table surface proximate user and webcam **20** to illuminate the face of user. In this embodiment, a user is able to position illuminator as desired on a flat surface flat surface relative to webcam **20**.

Referring to FIG. 7, a fifth embodiment of the present invention is shown, and generally referenced using reference numeral **130**. The fifth embodiment shows illuminator **130** on a surface adjacent to computer screen **135** with web camera **140**. Illuminator **130** has a base **145** having a dimmer switch **150** to adjust the brightness of bulb **155**. Base **145** has a power cord **158** and a switch **160** to enable operation. Bulb **155** is connected to base by an adjustable arm **165** to adjust the position of bulb **155** relative to user and webcamera. In this embodiment, bulb **155** is surrounded by and attachable box **170** that is covered with a diffusion fabric **175**. Inside surface of attachable box **170** is lined with a white reflective film to reflect light from bulb **155**. The shape of box **170** ensures that light from bulb **155** will project forward from bulb **155** towards diffusion fabric **175**. Diffusion fabric **175** provides a diffuse light to the face of the viewer positioned proximate webcamera and computer screen. The diffusion fabric minimizes the harshness that direct light being projected from box **170** would cast on the face of the user. Diffusion fabric **175** is able to scatter directional light rays that pass therethrough to enable scattering. The resulting light on the user's face appears softer and more general, to minimize or even eliminate shadows. The resultant softer light that is achieved by passing through diffusion fabric **175** has several advantages. The resultant light is natural and more like daylight or uniform overhead office lighting. This light flatters subjects by diplomatically suppressing wrinkles and other facial blemishes. Further, the light that passes through diffusion fabric **175** reduces uncomfortable glare in a subject's eyes. The diffusion fabric is preferably made from a material such as silk or white muslin.

While the instant disclosure has been described with reference to one or more exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope thereof. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without

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departing from the scope thereof. Therefore, it is intended that the disclosure not be limited to the particular embodiment(s) disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

I claim:

1. An illuminator device for illuminating one or more users in front of a web camera and a communication terminal comprising: a bulb having a toroidal shape for emitting light; a reflector having a circular configuration to conform to the toroidal shape of said bulb for projecting the emitted light; and an arm disposed between said bulb and the terminal for connection to the terminal, wherein said bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera.

2. The illuminator device of claim 1, wherein said reflector is positioned proximate said bulb to project light towards a face of said user or said users.

3. The illuminator device of claim 1, wherein said reflector is lined with a reflective material or film.

4. The illuminator device of claim 1, wherein said arm is a flexible arm that permits said bulb to be positioned relative to the web camera.

5. The illuminator device of claim 1, wherein said arm is connected to the terminal by a clamp.

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6. The illuminator device of claim 5, wherein the clamp is movable along an edge of the terminal to adjust the location of said bulb.

7. The illuminator device of claim 1, wherein the arm has a base that supports the illuminator device on a flat surface adjacent to the terminal.

8. The illuminator device of claim 1, wherein said reflector has a piece of fabric thereon disposed between said bulb and a user's face for diffusing the light emitted from said bulb.

9. The illuminator device of claim 8, wherein said fabric is silk or muslin.

10. An illuminator device for illuminating one or more users in front of a web camera and a communications terminal having a frame and a screen comprising: a plurality of bulbs, wherein said plurality of bulbs are disposed in the frame of the terminal and one of said plurality of bulbs surrounds the web camera.

11. The illuminator device of claim 10, wherein one of said plurality of bulbs is on one side of the web camera and another of said plurality of bulbs is on the other side of the web camera.

12. The illuminator device of claim 10, wherein in each of said plurality of bulbs are rectangularly shaped.

13. The illuminator device of claim 10, wherein said plurality of bulbs are a plurality of electrodes spaced in the frame of the screen.

* * * * *



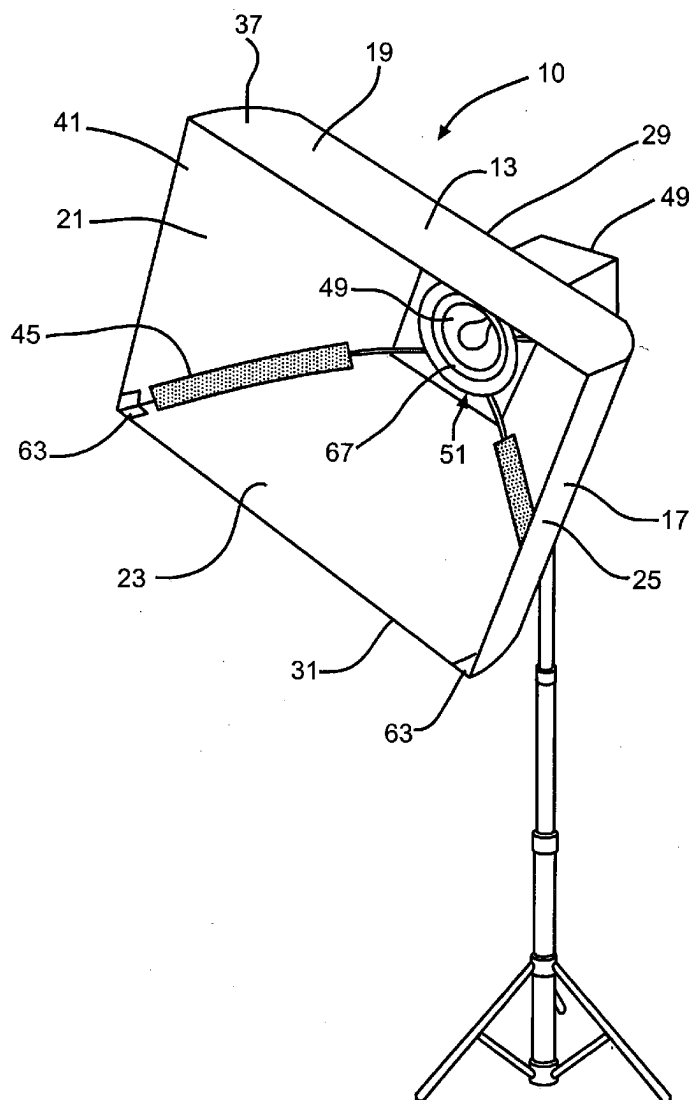
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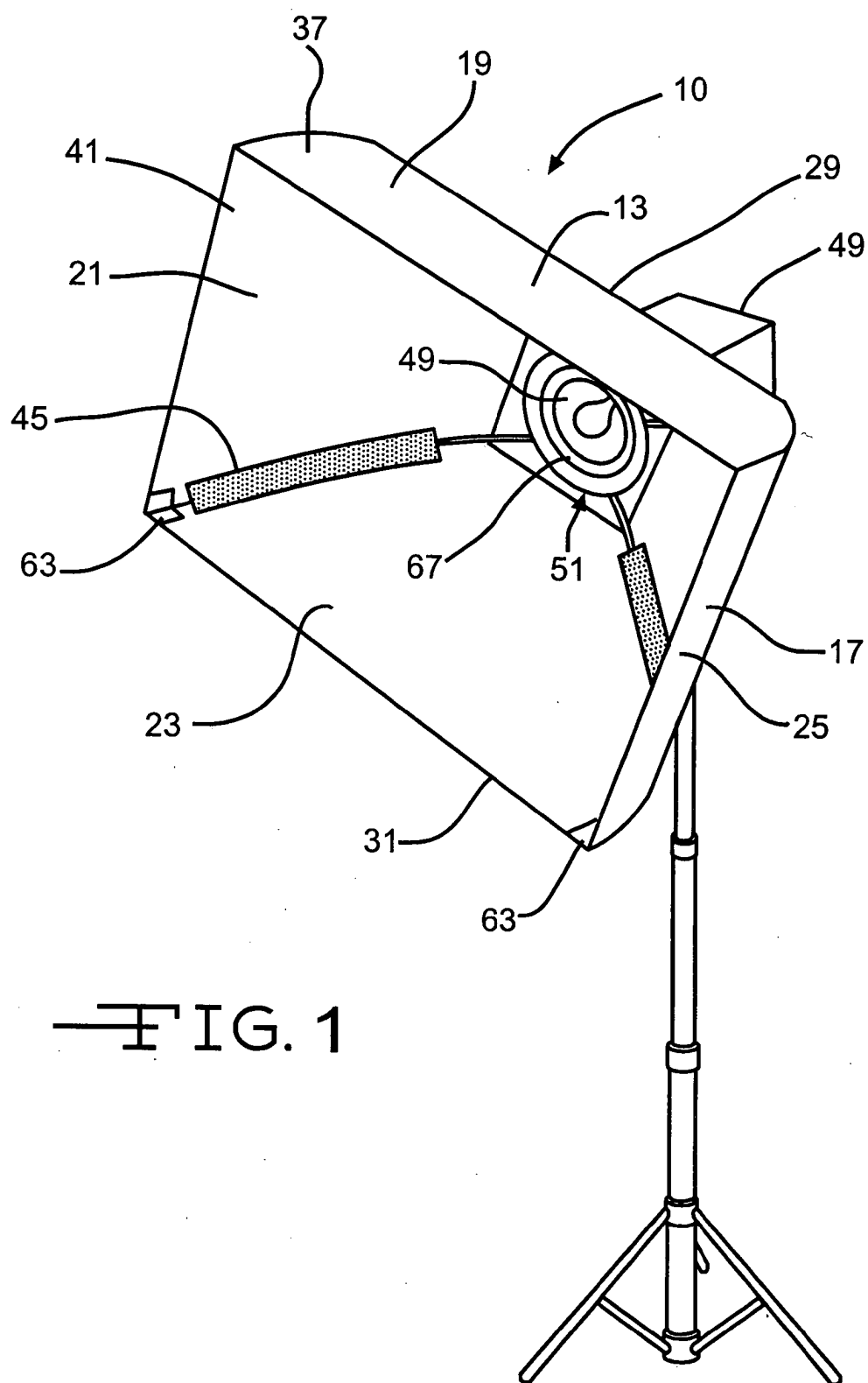
(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0007666 A1****Cook**(43) **Pub. Date:****Jan. 12, 2006**(54) **LIGHT MODIFIER**(52) **U.S. Cl. 362/16; 362/351; 362/355**(76) **Inventor: Kenneth O. Cook, Salinas, CA (US)**

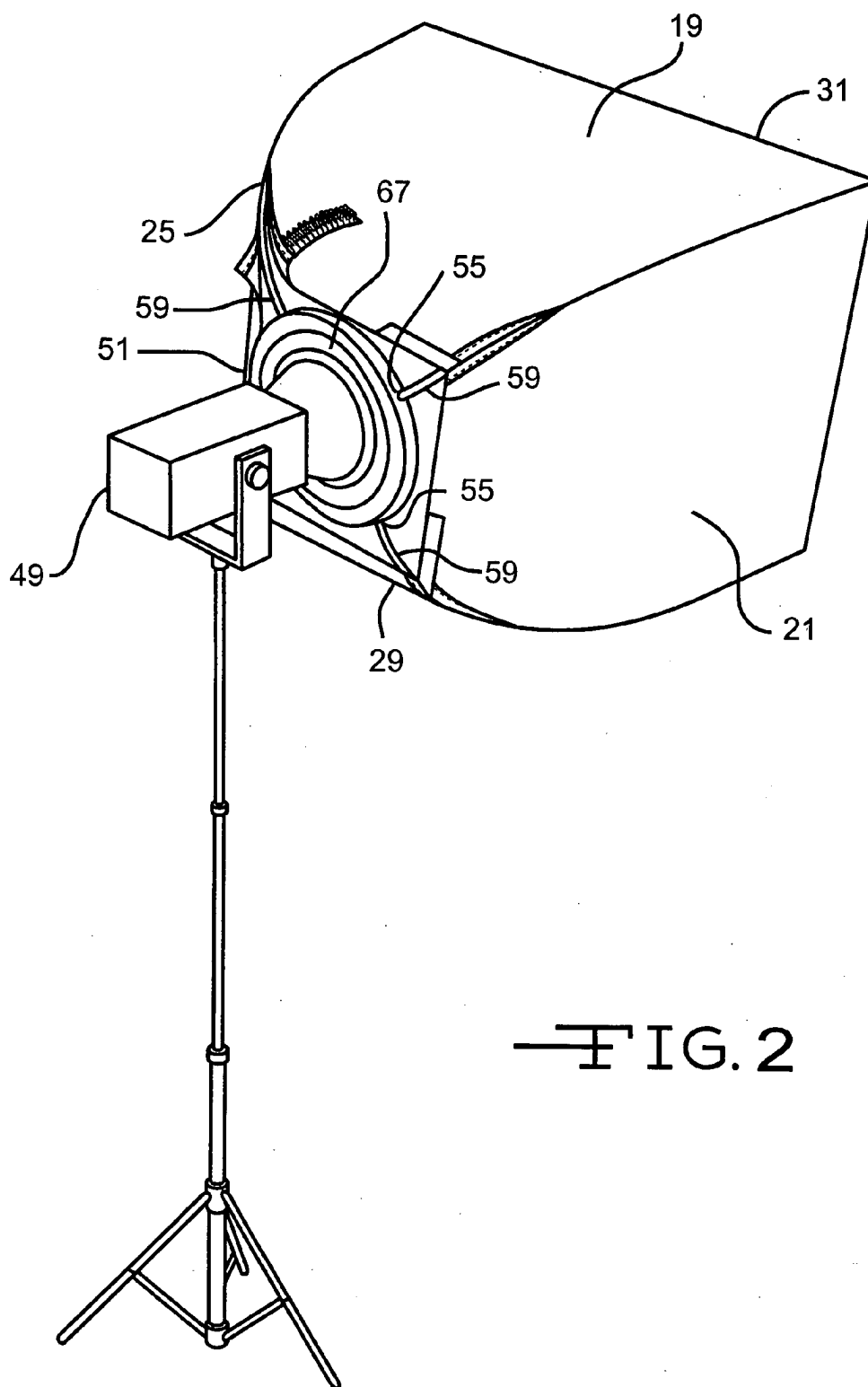
Correspondence Address:

**EMCH, SCHAFFER, SCHAUB & PORCELLO
CO****P O BOX 916****ONE SEAGATE SUITE 1980****TOLEDO, OH 43697**(21) **Appl. No.: 10/887,463**(22) **Filed: Jul. 8, 2004****Publication Classification**(51) **Int. Cl.**
G03B 15/02 (2006.01)(57) **ABSTRACT**

A light modifier for creating an enhanced depth of lighting on a subject. The light modifier has a housing with a sidewall that defines a first and second end. The first and second ends are in opposed relationship. The first end is adapted to mount a light source in the housing. A panel is positioned on the second end of the housing. The panel has at least one layer of netting having an aperture. Light that passes through the netting has different characteristics than the light passing through the aperture whereby the light modifier creates enhanced depth of lighting on a subject.







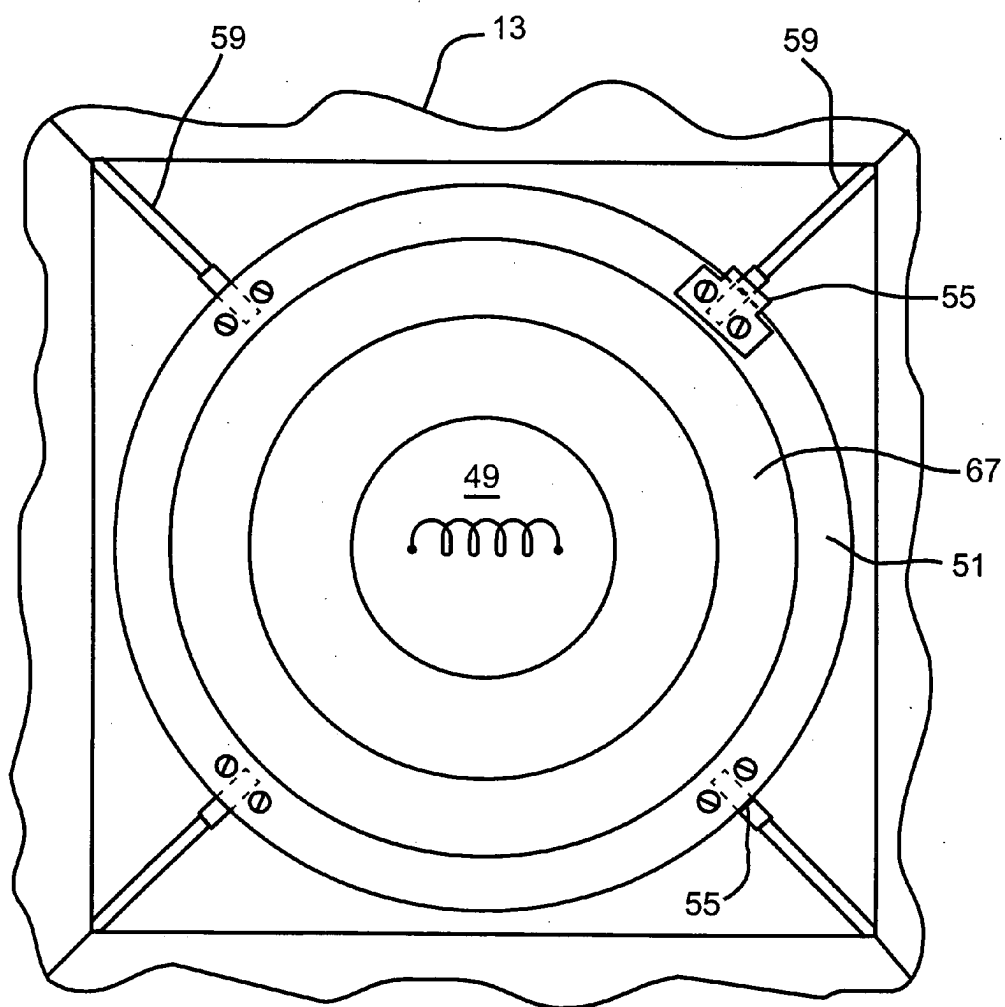


FIG. 3

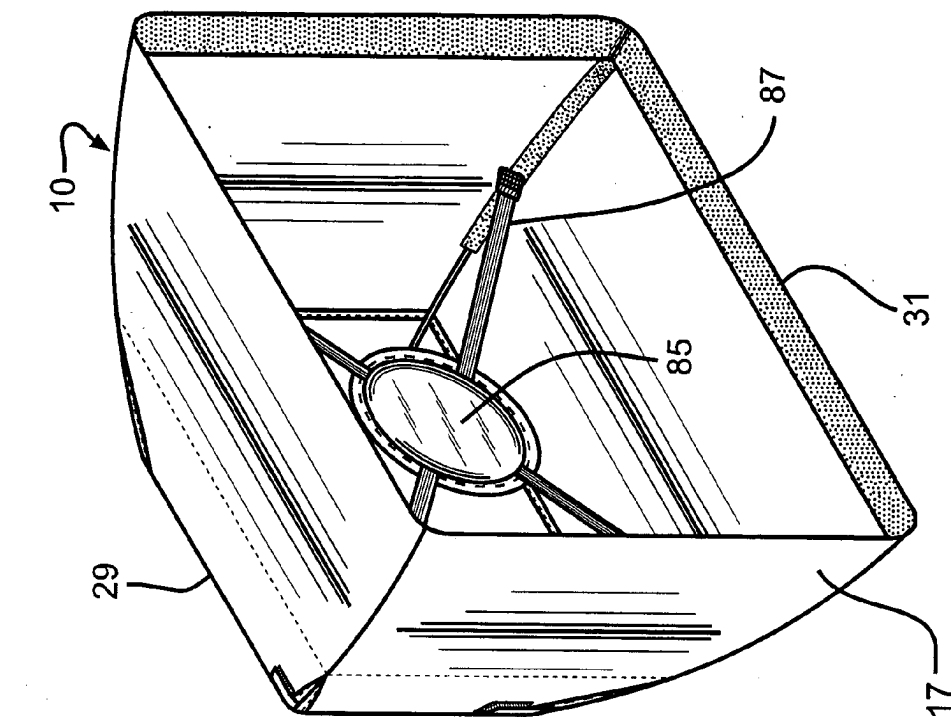


FIG. 4

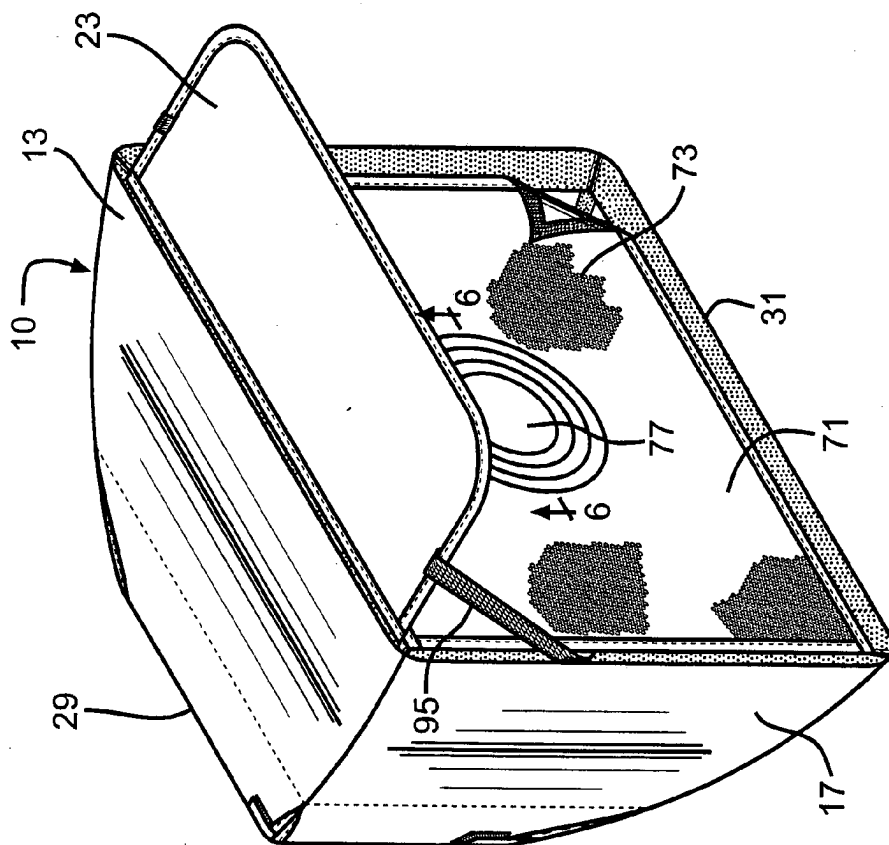


FIG. 5

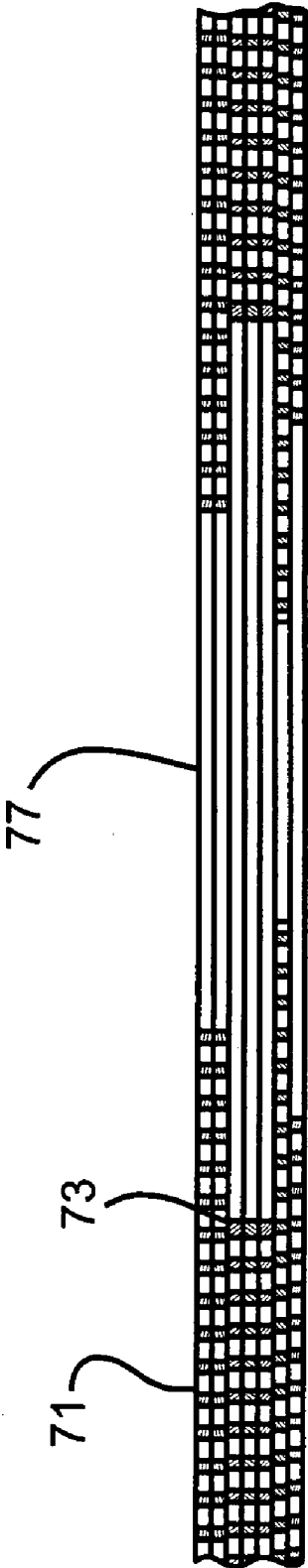


FIG. 6

LIGHT MODIFIER

[0001] This invention relates to improvements to a light modifier that is used to modify light from a light source. The light modifier is used by photographers and image makers to modify the light that is presented to a subject or an image to create the desired depth of field and shadowing.

BACKGROUND OF THE INVENTION

[0002] Light modifiers have been used in the photography industry for quite some time. A well-known example is light diffusion boxes, which have been used by photographers and others to defuse or soften the lighting on a subject. These diffusion boxes have an outer housing with a light source at one end and a diffusion panel at the other end through which the light from the light source must pass before striking the subject. This type of light modifier has been focused on obtaining a uniform quality to the light that is presented on the subject that is to be photographed. These light boxes can be collapsible in nature or have a fixed outer structure. However, all of these prior light boxes are trying to achieve a uniform distribution of light on the subject that is to be photographed or otherwise captured.

SUMMARY OF THE INVENTION

[0003] The present invention is directed to a light modifier having a collapsible outer housing with a light source mounted on one end with a panel positioned on the other end of the outer housing in an opposed relationship to the light source. However, the light modifier of the present invention is not directed to achieving a uniform quality for the light produced from the light source. The panel that is placed across the end of the outer housing has a hole or aperture in the center that allows at least some of the light from the light source to pass through the panel without being modified or diffused by the panel. The panel can have several layers and the aperture or hole in the center of the layers can vary in size whereby the light from the light source is modified or diffused at different levels across the face of the panel. It is the intent of the present invention to produce a lighting and shadowing effect on the subject that is similar to the lighting patterns utilized by the old masters in their oil paintings. The lighting patterns that make these paintings unique and desirable vary across the subject that is being painted and produce dramatic characteristics for these paintings.

[0004] It is an object of the present light modifier to replicate the lighting patterns and characteristics utilized by the old masters in their master piece oil paintings.

[0005] These and other objects and advantages of the invention will be more fully understood by reference to the following written description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a perspective view of the light modifier of the present invention;

[0007] FIG. 2 is a perspective view of the light modifier;

[0008] FIG. 3 is a front elevation view of the housing of the light modifier;

[0009] FIG. 4 is a perspective view of the housing of the light modifier;

[0010] FIG. 5 is a perspective view of a portion of the housing; and

[0011] FIG. 6 is a cross sectional view taken along line 6-6 in FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] The invention is directed to a light modifier that is used to provide lighting for a subject. More particularly, the light modifier modifies the characteristics of light from a light source to create enhanced depth of lighting on a subject or image that is being photographed, video taped or captured on film. The features of the invention will be more readily understood by referring to the attached drawings in combination with the following description.

[0013] The light modifier 10 has a collapsible housing 13 that defines a sidewall 17. The sidewall 17 is usually formed of a four separate panels 19, 21, 23 and 25 respectively that are joined together to form the sidewall 17 of the collapsible housing 13. The panels of the sidewall 17 are generally trapezoidal in shape and are made of a fabric material. The fabric panels 19, 21, 23, and 25 are assembled to form the sidewall 17 of the housing so that the housing 13 defines a first end 29 and a second end 31. The panels 19, 21, 23 and 25 are usually formed of a fabric material having an outer layer 37 and an inner layer 41. The outer layer 37 of fabric is typically black and is opaque to light that is contained within the housing 13. The inner layer of fabric is typically reflective in nature and the inner layer 41 of fabric forms the interior of the collapsible housing 13. A loop or passageway 45 is formed in the inner layer 41 of fabric along at least a portion of the edges where the panels 19, 21, 23 and 25 are joined together to form the sidewall 17. Normally the passageways 45 are created by sewing in an additional layer of fabric that forms the inner layer 41 to create the passageway. However, other methods can be utilized to form the passageways in the interior of the collapsible housing 13.

[0014] The first end 29 of the housing 13 is adapted to receive a light source 49 and a cylindrical fixture 51 is positioned in the first end 29 for removably receiving the light source 49. The cylindrical fixture 51 has 4 holes 55 positioned in the outer perimeter of the cylindrical fixture. The holes 55 are spaced equidistantly from each other around the outer periphery of the cylindrical fixture 51 so that the holes 55 are in alignment with the four seams where the panels 19, 21, 23 and 25 are joined together to form the collapsible housing 13. A flexible rod 59 can be positioned in each of the holes 55 so that the rods extend from the cylindrical fixture 51. The flexible rod 59 can be positioned in the passageways 45 formed in the sidewall 17 of the housing 13. The flexible rods 59 provide a support structure that is suitable to support the panels 19, 21, 23 and 25 in a manner to form the collapsible housing 13 of the light modifier 10. In some applications, it is desirable to have a pocket 63 formed in the panels 19, 21, 23 and 25 to receive the ends of the flexible rods 59. The pocket 63 can be formed as part of the passageways 45 or they can be formed as a separate element. The pocket 63 are normally positioned adjacent the second end 31 of the housing 13. Suitable adaptors 67 can be utilized with the cylindrical fixture 51 to secure a light source 49 to the light modifier 10. The adaptor 67 allow the light source to be mounted so that the light

source is positioned in the interior of the collapsible housing 13 or at least directs the light produced by the light source into the interior of the collapsible housing 13.

[0015] A panel 71 is removably secured to the second end 31 of the collapsible housing 13. The panel 71 can be held in place by hook and loop type fasteners or other suitable securing means. The panel 71 is formed of at least one layer of netting 73 having an aperture 77 located essentially in the center of the panel 71. The layer of netting 73 acts to diffuse or modify the light that it receives from the light source 49 and the aperture 77 does not modify or diffuse the light that it receives from the light source 49. Accordingly, the light modifier 10 can create an enhanced depth of field for the lighting that is used to illuminate a subject. The panel 71 can have several layers of netting 73 to create a larger variation between the light passing through the netting and the light passing through the apertures 77 in the center of the layers of netting. In practice it has been found that between 1 and 20 layers of netting can be used to form the panel 71. Examples of netting that are particularly useful are cotton, nylon, polyester or similar fabric netting having the ability to withstand high heat applications. In particular, a cotton bobbin net with round holes has been found to work effectively as the netting 73 that forms the panel 71. Netting is used to form the panel 71 as the netting has a plurality of openings that alter the density of the light from the light source 49 but does not change the quality of the light from the light source. The quality of the light refers to the specular nature of the light and is directly related to the clarity or sharpness of the light. Woven or knit textile diffusion type of fabrics are not preferable for the panel 71 as such fabrics change the quality of the light in addition to altering the density of the light. The netting is also usually black in color as the black fabric portion of the netting absorbs or blocks a portion of the light from the light source 49 and reduces the density of the light from the light source. Other colors can be used for the netting but other colors are not as effective as black in reducing the density of the light from the light source 49. As more layers of netting are used to form the panel 71, there will be a layer reduction in the density of the light from the light source that passes through the panel 71, as there will be more fabric present to absorb the light. The aperture 77 formed in the layers of netting 73 can have the same diameter and location in the layers of netting or the diameters of the apertures can vary between the individual layers of netting 78 to form the panel 71. However, it is usually desirable to have the apertures 77 have a common center point and be concentrically positioned in the panel 71. Although the apertures 77 have been shown as being circular in shape it should be understood that other geometric shapes could be used to form the apertures and as such other geometric would change the pattern of the lighting that is presented to the subject. It is also possible to utilize apertures in the panel 77 that have different geometric shapes in some or all of the layers of netting that form the panel.

[0016] In applications where multiple layers of netting 73 are used to form the panel 71 it is possible to create different levels of diffusion or modification for the light by increasing the size of the apertures 77 in the various layers of netting. If different sized aperture 77 are utilized the light from the light source will pass through more layers of netting as the light moves away from the center of the panel 71 to the outer periphery of the panel 71. The light closer to the center of the panel 71 will pass through fewer layers of netting and

therefore receive less diffusion or modification than the light around the outer periphery of the panel 71. The light passing through the open aperture 77 formed in the center of the panel 71 will not be diffused or modified by the panel and will have a different impact on the subject. The number of layers of netting 73 and the size and shape of the aperture 77 can be selected to produce the desired lighting effect on the subject. In FIG. 6 the aperture 77 in the layers of netting 73 are shown as being randomly spaced. However, in practice it has been found to be desirable to have the layers of netting 73 that form the panel 71 be positioned so that the aperture 77 are progressively larger or smaller as light from the light source 49 moves through the panel 71.

[0017] To further modify the light from the light source 49 is possible to position a removable baffle 85 in the interior of the collapsible housing 13. The removable baffle 85 is positioned in the interior of the housing so that the light from the light source 49 must pass through the baffle before engaging the panel 71 on the second end 31 of the housing 13. As shown in the drawings the removable baffle is a circular piece of fabric that is connected to the sidewall 17 of the housing 13 by resilient straps 87. The resilient straps can be removably secured to the sidewall 17 by loop and hook type fastening means or other suitable releasable securing means. The fabric for the removable baffle can be white nylon or other suitable fabric that can be used to diffuse the light from the light source 49. Although the removable baffle 85 has been shown as being circular in shape it should be appreciated that other geometric shapes can be used for the baffle. The baffle can also be positioned at different locations within the housing 13 with respect to the light source 49 to alter the diffusion that is created by the baffle 85. In most applications, the baffle 85 is configured and positioned to diffuse the light that passes through the aperture 77 in the panel 71. However, if different light patterns are desired the baffle 85 can be of a shape or size to impact or diffuse more or less than the light that passes through the aperture 77.

[0018] Spill light panels 93 can be removably secured to the second end 31 of the housing 13. The spill light panels are formed of a fabric material that is usually similar to the fabric utilized for the outer layer 37 of the panels 19, 21, 23 and 25 that form the sidewall 17 of the housing 13. The spill light panels 93 can be positioned at the end of each panel 19, 21, 23 and 25 that form the second end 31 of the housing 13. Alternatively, the spill light panels can only be secured to a portion of the panels that form the sidewall 17. The spill light panels are movably positioned on the housing 13 so that the spill light panels can be moved to cover a portion of the panel 71 located on the second end 31 of the housing 13. The spill light panels 93 cover the portion of the panel 71 that forms the outer periphery of the light modifier 10. The spill light panels 93 are held in the desired position with respect to the panel 71 by straps 95 that secure to the panels 19, 21, 23 and 25. The straps 95 can be secured to the panels by hook and loop type fasteners or other suitable fastening means.

I claim:

1. A light modifier for lighting a subject comprising:

a housing having a sidewall; the housing having a first end and a second end, the first and second ends being in opposed relationship, the first end adapted to mount a

light source in the housing, a panel positioned on the second end of the housing, the panel having at least one layer of netting having an aperture whereas light from the light source passing through at least one layer of netting has different characteristics than the light passing through the aperture whereas the light modifier creates enhanced depth of lighting on a subject.

2. The light modifier of claim 1 wherein the panel has a plurality of layers of netting.

3. The light modifier of claim 2 wherein the aperture is in the center of each of the panels.

4. The light modifier of claim 3 wherein the layers of netting have different size apertures whereby there are more layers of netting that impact the light generated by the light source at the perimeter of the panel than in the center of the panel.

5. The light modifier of claim 4 wherein the layers of netting increase in a uniform manner from the center aperture to the perimeter of the panel.

6. The light modifier of claim 1 wherein an interior baffle is positioned between the first and second ends of the housing, the baffle acting to diffuse light from a light source before the light reaches the second end of the housing.

7. The light modifier of claim 6 wherein the baffle is white nylon fabric that diffuses the light from a light source.

8. The light modifier of claim 7 wherein the baffle is removable positioned in the housing.

9. The light modifier of claim 7 wherein the baffle is circular in shape and is sized to diffuse all of the light projected from a light source that passes through the aperture in the panel.

10. The light modifier of claim 5 wherein the apertures in the layers of netting are positioned concentrically in the layers of netting.

11. The light modifier of claim 1 wherein at least one layer of netting is made of a fabric selected from the group of nylon, polyester or cotton.

12. The light modifier of claim 1 wherein the at least one layer of netting is a cotton bobbin net material having the characteristics that allow the material to be used in high heat applications.

13. The light modifier of claim 12 wherein the cotton bobbin net material has round holes.

14. The light modifier of claim 1 wherein at least one spill light panel is moveably positioned on the second end of the housing and can be positioned to cover a portion of the panel to create different light patterns.

15. The light modifier of claim 14 wherein the spill light panel is made of a dark fabric.

16. The light modifier of claim 1 wherein the at least one layer of netting is made from a black fabric.

* * * * *

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Alexandria, VA 22313 - 1450
www.uspto.gov**ELECTRONIC ACKNOWLEDGEMENT RECEIPT**APPLICATION #
90/019,924RECEIPT DATE / TIME
04/22/2025 02:10:37 PM Z ETATTORNEY DOCKET #
EXRE_PI_729**Title of Invention**

WEBCAM ILLUMINATOR DEVICE

Application Information

APPLICATION TYPE Utility / ex parte reexam

PATENT # 7841729

CONFIRMATION # 7059

FILED BY Jialin Zhong

PATENT CENTER # 70108270

FILING DATE -

CUSTOMER # 140225

FIRST NAMED
INVENTOR Henry GeddesCORRESPONDENCE
ADDRESS -

AUTHORIZED BY -

Documents**TOTAL DOCUMENTS: 8**

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
EXRE_PI_729_EX PARTE REEXAMINATION TRANSMITTAL.pdf	4	Transmittal Letter	602 KB
Streamlined Request for Ex Parte Reexamination USP 7841729.pdf	26	Receipt Original Ex Parte Reexamination by 3rd party fewer then 40 Pages Rule 1.20(C)(1)	420 KB
EXH1 US7841729.pdf	10	Copy of patent for which reexamination is requested	568 KB
EXH2 KR200316985Y1 and Translation.pdf	15	Other reference- Patent/Application/Search Documents	851 KB
EXH3 US6238060.pdf	34	Other reference- Patent/Application/Search	2092 KB

Documents

EXH4 US20060007666A1.pdf	9	Other reference- Patent/Application/Search Documents	546 KB
EXH5 US20050151042A1.pdf	8	Other reference- Patent/Application/Search Documents	691 KB
EXH6 claim chart.pdf	12	Receipt Original Ex Parte Reexamination by 3rd party fewer then 40 Pages Rule 1.20(C)(1)	148 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
EXRE_PI_729_EX PARTE REEXAMINATION TRANSMITTAL.pdf	A6A57C5C8D858CBF4CE0008AA999AA9B677D04A400A8AB0C 317D4DBD9AFF8A76729F59791EB981E4171E10DF62C2754B3 D176704B202024B1B491662297293A6
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EXH6 claim chart.pdf	80CA810EC712B1F7CD018D67CCF60F4DDEE65590E910B1F6 583F25758A802BFD1166EF77AB50D0447D7CE991456D056560 BF96FC1F0B2DA66DCA350C97E98E32

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



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ELECTRONIC PAYMENT RECEIPT

APPLICATION #
90/019,924

RECEIPT DATE / TIME
04/22/2025 02:10:37 PM Z ET

ATTORNEY DOCKET #
EXRE_PI_729

Title of Invention

WEBCAM ILLUMINATOR DEVICE

Application Information

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PATENT # 7841729

CONFIRMATION # 7059

FILED BY Jialin Zhong

PATENT CENTER # 70108270

AUTHORIZED BY -

CUSTOMER # 140225

FILING DATE -

CORRESPONDENCE ADDRESS -

FIRST NAMED INVENTOR Henry Geddes

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Jialin Zhong

FEE CODE	DESCRIPTION	ITEM PRICE(\$)	QUANTITY	ITEM TOTAL(\$)
1831	EX PARTE REEXAMINATION (1.510(A)) STREAMLINED	6775.00	1	6775.00
TOTAL AMOUNT:				\$6,775.00

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

Pathway - Exh. 2030-74, Shenzhen Ronglida v. Pathway IP, IPR 2025-01231

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Reexamination of:	) Examiner: Unassigned
	)
Henry Geddes	) Art Unit: Unassigned
	)
U.S. Patent No. 7,841,729	) Confirmation No.:
Filed: January 24, 2008	)
Issued: November 30, 2010	) CERTIFICATE OF ELECTRONIC
	) FILING
For: WEBCAM ILLUMINATOR DEVICE	) I hereby certify that this correspondence is being
	) submitted electronically via EFS Web on the date
	) shown below.
	)
	) <u>/Jialin Zhong /</u>
	) Date: April 22, 2025

**STREAMLINED REQUEST FOR EX PARTE REEXAMINATION OF
U.S. PATENT NO. 7,841,729 PURSUANT TO 37 C.F.R. §1.510**

E-Filed via EFS-Web
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir/Madam:

This is a request for *ex parte* reexamination pursuant to 37 C.F.R. §1.510 *et seq.* of claims 1-9 of U.S. Patent 7,841,729 (hereinafter “the ‘729 patent”), with a title of “Webcam Illuminator Device,” which issued November 30, 2010 from U.S. App. No. 12/011,090 filed January 24, 2008 (the ‘090 application). The ‘090 application on its face claims benefit from U.S. Provisional App. No. 60/897,600 filed January 26, 2007.

The *ex parte* reexamination fee of \$6,775.00 for a streamlined request is paid herein by credit card. The Commissioner is hereby authorized to charge any shortage to the Deposit Account No. 60-2313.

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A. Proposed Rejection 1. Claims 1-9 should be rejected under pre-AIA 35 U.S.C. §103(a) as unpatentable over Kwak, Bourn, Watson, and Cook.....	24
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I. List of Exhibits

<u>Exhibit No.</u>	<u>Description</u>
Exhibit 1	U.S. Patent 7,841,729 (patent to be reexamined)
Exhibit 2	KR 200316985 (“Kwak”) and its translation (“Kwak Translation”)
Exhibit 3	U.S. Patent 6,238,060 (“Bourn”)
Exhibit 4	U.S. Pub. No. 2005/0151042 (“Watson”)
Exhibit 5	U.S. Pub. No. 2006/0007666 (“Cook”)
Exhibit 6	Claim chart of claims 1-9 compared to disclosures of Kwak, Bourn, Watson, and Cook

II. Identification of Claims for Which Reexamination is Requested

Ex parte reexamination of claims 1-9 of U.S. Patent 7,841,729 is requested pursuant to 37 CFR 1.510.

III. Summary of Substantial New Questions of Patentability and Proposed Rejections

In this request, a substantial new question of patentability is set forth, as summarized below in Table I. The substantial new questions of patentability listed in Table I are based on the references cited herein. The proposed rejections for each substantial new question of patentability are summarized in Table III below.

A. Table I – Summary of Substantial New Questions of Patentability

Substantial New Question (SNQ) of Patentability	Page Number
SNQ1. Claims 1-9 of the '729 patent are unpatentable under pre-AIA 35 U.S.C. §103 or obvious under pre-AIA 35 U.S.C. §103 over Kwak, Bourn, Watson, and Cook	9

B. Table II – Summary of References that Raise Substantial New Questions of Patentability

Reference	Short Name	Previously Discussed in Office Actions?	Previously Considered On The Record?
KR 200316985	Kwak	No	No
U.S. Pat. No. 6,238,060	Bourn	No	No
U.S. Pat. Pub. 2005/0151042	Watson	No	No
U.S. Pat. Pub. 2006/0007666	Cook	Yes	Yes

IV. Table III – Summary of Proposed Rejections

Proposed Rejection	Detailed Discussion Page
Claims 1-9 of the '729 patent are obvious under pre-AIA 35 U.S.C. §103 or are obvious under pre-AIA 35 U.S.C. §103 over Kwak, Bourn, Watson, and Cook	23

V. Summary of the Prosecution History of the ‘729 patent

The ‘729 patent was issued November 30, 2010 from U.S. App. No. 12/011,090, filed January 24, 2008 (the ‘090 application). The ‘090 application on its face claims benefit from U.S. Provisional App. No. 60/897,600 filed January 26, 2007. Thus, the earliest possible priority date of the ‘729 patent is January 26, 2007.

At the time of filing, the ‘090 application included 16 claims including independent claims 1 and 13.

The Examiner issued the first Office Action dated November 27, 2009 in which claims 1-10 were rejected as being anticipated by U.S. Pat. 3,604,913 (“Crete”); claims 11 and 12 were rejected as unpatentable over Crete in view of U.S. Pat. Pub. 2006/0007666 (“Cook”); claims 13-16 were rejected as being anticipated by U.S. Pat. Pub. 2007/0139515 (“Du Breuil”).

Applicant of the ‘090 application submitted a response dated March 1, 2010 to the first Office Action. The response canceled claims 3 and 5 and amended claims 1, 4, and 13.

The Office issued a Notice of Allowance May 12, 2010.

Applicant of the ‘090 application subsequently R312 amendment including cancellation of claim 2 and amendments to claims 7 and 10-13. The R312 amendment was entered August 23, 2010.

The applicant submitted the Issue Fee August 12, 2010. The ‘729 patent was issued February 17, 2023.

VI. Detailed Explanation of Substantial New Questions of Patentability

Kwak, Bourn, and Watson were not considered or listed as considered by the Examiner during the prosecution of the '729 patent. As explained herein below, various combinations of the cited references raise substantial new questions (SNQ) of patentability with respect to claims 1-9 of the '729 patent.

As a preliminary matter, the filing date of the '729 patent (or the '090 application) as listed on its face was January 24, 2008 which was prior to the adaptation of the America Invents Act (AIA). Therefore, the reexamination of claims 1-9 of the '729 patent is governed by the pre-AIA 35 U.S.C. The '729 patent claims benefit to U.S. Provisional App. 60/897,600 filed January 26, 2007. Thus, the earliest possible priority date of the '729 patent was January 26, 2007.

Kwak was filed as a Korean utility model patent application April 3, 2003 and was granted and published June 19, 2003 which was more than one year earlier than the January 26, 2007 effective filing date of the '729 patent. Therefore, Kwak is a pre-AIA 35 U.S.C. 102(b) prior reference to the '729 patent. A certified translation of Kwak (Kwak Translation) is provided as Exhibit 2.

Bourn is a U.S. patent granted May 29, 2001 which was more than one year earlier than the January 26, 2007 effective filing date of the '729 patent. Therefore, Bourn is a pre-AIA 35 U.S.C. 102(b) prior reference to the '729 patent. Bourn is provided as Exhibit 3.

Watson is a U.S. patent publication published July 14, 2005 which was more than one year earlier than the January 26, 2007 effective filing date of the '729 patent. Therefore, Watson is a pre-AIA 35 U.S.C. 102(b) prior reference to the '729 patent.

Cook is a U.S. patent publication published January 12, 2006 which was more than one year earlier than the January 26, 2007 effective filing date of the '729 patent. Therefore, Cook is a pre-AIA 35 U.S.C. 102(b) prior reference to the '729 patent. Cook was considered in the Office action dated November 27, 2009 against dependent claims 11 and 12 (which corresponds to dependent claims 8 and 9 of the '729 patent).

A. (SNO1) Claims 1-9 of the ‘729 patent are obvious under pre-AIA 35 U.S.C. §103(a) over Kwak, Bourn, Watson, and Cook

The combination of Kwak, Bourn, Watson, and Cook raises a substantial new question of patentability with respect to claims 1-9 of the ‘729 patent because the combination, while pertaining to the same technical field, discloses or teaches all of the elements of each of claims 1-9.

Kwak is concerned with “a PC webcam stand with a lighting function.” See Kwak Translation at abstract. The applicant of Kwak recognizes that “in most PC cafes, the PC webcam is arranged on a display, so that a video chat with an opposite side can be performed” and the associated issue that “because most users in the PC cafes use computers, the overall lighting is darker. Therefore, the image photographed by the camera is not clear during video chats, limiting the enjoyment of the video chats.” The invention of Kwak was made “to provide a PC webcam stand with a lighting function, thereby *enabling a photographed object to be lighted during a video chat.*” See Kwak Translation at page 2, lines 14-30 (emphasis added).

In the same and related field of illumination technology, Bourn is concerned with an “illumination method and apparatus for machine-vision systems, including a ring-light source (e.g., LEDs arranged in one or more circular rows), and a reflective-ring focusing element.” See Bourn at abstract. Therefore, Bourn is in the same and related technical field of illumination technology as Kwak.

In the same and related field of webcam and lighting, Watson is concerned with a camera mount that “supports a web camera thereon. The mount includes a bracket for supporting a light source thereon and a platform supported on the bracket for receiving the base of the web camera thereon. The light source may be operable in either flash or steady-on modes to provide optimum lighting for the web camera.” See Watson at abstract.

In the same and related field of lighting, Cook is concerned with a light modifier for creating an enhance depth of lighting on a subject. See Cook at abstract.

Therefore, it is obvious for a person of ordinary skill in the art, if needed, to combine Kwak, Bourn, Watson, and Cook because the combination is a “predictable variation” or a “combination of familiar elements according to known methods [that] does no more than yield predictable results,” within the same technical field and such combination is obvious under *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 415-16, 82.

Claim charts mapping the teachings of the applied references to the elements of claims 1-9 are attached hereto as Exhibit 6 and incorporated herein by reference.

Independent claim 1

- **An illuminator device for illuminating one or more users in front of a web camera and a communication terminal comprising:**

With respect to the substantial new question of patentability of the ‘729 patent, Kwak discloses:

The present utility model relates to *a PC webcam stand with a lighting function*, including: a fixing component; a connecting pipe, one side end of which is coupled to the fixing component and through an inside of which a USB cable is extended; a mounting component, to a bottom surface of which the other side end of the connecting pipe is coupled, on an upper surface of which a PC webcam is positioned, and on a rear surface of which a USB port electrically connected to the PC webcam is arranged; and a lamp for lighting an object, arranged at a predetermined position of the mounting component to *enable the PC webcam positioned on the mounting component to clearly photograph the object*.

According to the present utility model, *the lighting function is provided to light an object, thus enabling the object to be clearly photographed and transmitted regardless of the brightness of the surroundings. Besides, in addition to the lighting function, the lighting angle may be freely adjusted, thus effectively lighting the object*. Moreover, the PC webcam may be easily arranged and fixed in a detachable manner by means of a magnetic force, and is very easy to separate, thus providing a very practical effect. See Kwak Translation at abstract (emphasis added).

Kwas further recognizes that “in most PC cafes, the PC webcam is arranged on a display, so that a video chat with an opposite side can be performed.” and the associated issue that “because most users in the PC cafes use computers, the overall lighting is darker. Therefore, the image photographed by the camera is not clear during video chats, limiting the enjoyment of the

video chats.” The invention of Kwak was made “[t]o solve the above technical problem, the objective of the present utility model is *to provide a PC webcam stand with a lighting function, thereby enabling a photographed object to be lighted during a video chat.*” See Kwak Translation at page 2, lines 14-30 (emphasis added). Therefore, Kwak is concerned with the same technology field and solves the same challenges as those of the ‘729 patent.

Therefore, Kwak discloses and teaches “[a]n illuminator device for illuminating one or more users in front of a web camera and a communication terminal” recited in claim 1.

- **a bulb having a toroidal shape for emitting light;**

Kwak discloses:

a fixing component; a connecting pipe, one side end of which is coupled to the fixing component and through an inside of which a USB cable (C) is extended; a mounting component, to a bottom surface of which the other side end of the connecting pipe is coupled, on an upper surface of which a PC webcam is positioned, and on a rear surface of which a USB port electrically connected to the PC webcam is arranged; and *a lamp provided at a predetermined position of the mounting component to light an object so that the object can be clearly photographed by the PC webcam positioned on the mounting component.* See Kwak Translation at page 2, line 39 – page 3, line 4 (emphasis added).

The PC webcam stand 100, as shown in FIG. 2 and FIG. 3, includes a fixing component 10, attached to a display 1; a connecting pipe 20, one side end of which is coupled to the fixing component 10 and through an inside of which a USB cable (C) is extended; a mounting component 30, to a bottom surface of which the other side end of the connecting pipe 20 is coupled, on an upper surface of which a PC webcam 50 is positioned, and on a rear surface of which a USB port 31 electrically connected to the PC webcam 50 is arranged; and *a lighting device 40 provided at a predetermined position on the mounting component 30 to light an object so that the object can be clearly photographed by the PC webcam 50 positioned on the mounting component 30.* See Kwak Translation at page 3, lines 22-29 (emphasis added).

The bottom surface of the mounting component 30 is coupled to the other side end of the connecting pipe 20. Therefore, a fastening pipe 32 is provided on the bottom

surface of the mounting component 30, so that the other side end of the connecting pipe 20 can be inserted. The connecting pipe 20 is fixed by a usual fastening device or adhesive material in a state of being inserted into the fastening pipe 32. In addition, a specified space portion is formed on the front inner side of the mounting component 30, *so that the lamp 41 can be easily arranged, and moreover, a reflecting cover 42 is arranged behind the lamp 41, and a convex lens 43 is provided in front of the lamp 41.* In addition, a reference wall 33 is formed in a protruding manner on one side of an upper surface of the mounting component 30 for positioning the PC webcam 50, and a magnet or a metal plate 34 is provided on the upper surface thereof to easily fix the PC webcam 50 according to a magnetic force. That is, when the magnet is attached to the bottom surface of the camera 50, the metal plate is provided on the upper surface of the mounting component 30, and when a shell of the camera 50 is of a metal material or is attached to the metal plate, the magnet is attached to the upper surface of the mounting component 30. In addition, a USB port 31 is provided on a rear surface of the mounting component 30, so that the USB cable C extending through the connecting pipe 20 is easily connected to the PC webcam 50.

The lamp 41 is configured to light the photographed object photographed by the PC webcam 50 and receives a power supply through an electric wire of the USB cable C. Namely, an electric wire of about 5V of the USB cable C is electrically connected in a state that the electric wire is branched to the sides of the lamp 41 and the PC webcam 50. In addition, the lamp 41 is connected to a dimmer 44 between the lamp 41 and the electric wire of the USB cable C, so that the brightness thereof may be adjustable. To facilitate operation, a handle portion of the dimmer 44 protrudes from the bottom portion of the mounting component 30. Kwak Translation at page 3, line 41 – page 4, line 15 (emphasis added)

Therefore, Kwak discloses and teaches *a bulb . . . for emitting light* recited in claim 1. Although Kwak discloses a lamp 41 without a limitation on the shape of the lamp, Kwak is silent as to the shape of lamp 41. In the same and related technical field of illumination systems, Bourn discloses and teaches:

In one embodiment, the ring light source includes *a ring-shaped flashtube* located substantially along a circle disposed perpendicular to and centered on the optical axis, and further includes an enclosure having a slit located between the ring-shaped flashtube and the ring reflector, wherein the slit allows light from the flashtube to fall on a reflecting surface of the ring reflector. See Bourn at col. 3, line 50-56 (emphasis added).

The present invention takes advantage of the efficiency of high-brightness red, infra-red, blue, white, or other color LEDs arranged in one or more circular rows, and the properties inherent to a reflective focusing element such as a turned angled reflective ring to produce an illumination source for machine-vision systems. The illumination source exhibits multi-directional ring-illumination properties which are useful for illumination of small components (which are being inspected or measured) without unwanted shadows. See Bourn at col. 2, line 32-39 (emphasis added).

A person of ordinary skill in the art (POSITA) would be motivated to substitute the lamp 41 of Kwak with the ring-shaped light because the ring-shaped light “exhibits multidirectional ring-illumination properties which are useful for illumination” without unwanted shadows. See Bourn at abstract and col. 2, line 32-39 for the motivation. Therefore, Kwak in view of Bourn teaches *a bulb having a toroidal shape for emitting light*.

- **a reflector having a circular configuration to conform to the toroidal shape of said bulb for projecting the emitted light;**

Kwak discloses and teaches that *a reflector 42 is provided behind the lamp 41*. Further, Bourn discloses and teaches:

The present invention provides a method and apparatus which provide an illumination source for illuminating an object in a machine-vision system having a machine-vision camera, the camera having an optical axis. One embodiment of the illumination source includes a ring-light source emitting light from a plurality of points, the points being along one or more circles, a focusing element, *the focusing element including an angled ring reflector to direct rays from the ring light source at an angle generally towards the optical axis*. One embodiment provides a replaceable ring reflector for changing the light-source-to-optical-axis and/or changing the spread and/or

focus of the light from ring light source. One embodiment provides light from multiple directions in order to reduce shadowing. One embodiment provides light to illuminate the inside of, for example, an aluminum beverage can before it is filled and sealed. See Bourn at Col. 2, line 60 - Col. 3, line 8 (emphasis added).

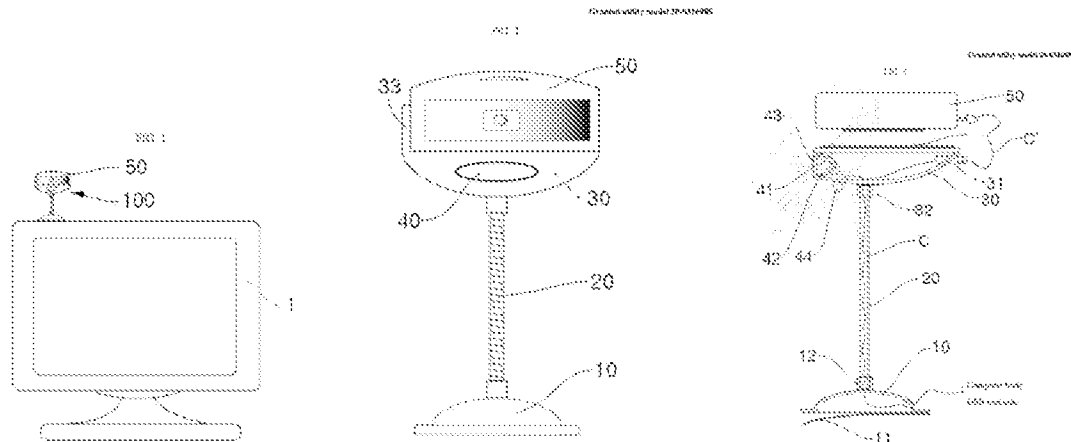
Therefore, Kwak in view of Bourn teaches *a reflector having a circular configuration to conform to the toroidal shape of said bulb for projecting the emitted light* recited in claim 1.

- **and an arm disposed between said bulb and the terminal for connection to the terminal;**

Kwak discloses:

The PC webcam stand 100, as shown in FIG. 2 and FIG. 3, includes a fixing component 10, attached to a display 1; a connecting pipe 20, one side end of which is coupled to the fixing component 10 and through an inside of which a USB cable (C) is extended; *a mounting component 30, to a bottom surface of which the other side end of the connecting pipe 20 is coupled, on an upper surface of which a PC webcam 50 is positioned*, and on a rear surface of which a USB port 31 electrically connected to the PC webcam 50 is arranged; and a lighting device 40 provided at a predetermined position on the mounting component 30 to light an object so that the object can be clearly photographed by the PC webcam 50 positioned on the mounting component 30. See Kwak Translation at page 3, lines 22-29

Then, at a position (for example, a display, a computer body, a desk lamp) suitable for photographing the photographed object, the stand 100 is fixed by the fixing component 10, and *the flexible pipe 20* is adjusted with reference to the photographed picture, so that the position of the PC webcam 50 is adjusted more finely. See Kwak Translation at page 4, lines 26-29 (emphasis added).



See also Figures 1-3 of Kwak (showing connecting pipe 20 disposed between light device 40 (including lamp 41) and the computer.

Therefore, Kwak discloses and teaches *an arm disposed between said bulb and the terminal for connection to the terminal* recited in claim 1.

- **wherein said bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera.**

The description of the '729 patent does not provide a definition for the meaning for the term "positionable." Further, the English dictionary does not have an entry for this term. See Merriam-Webster's Collegiate Dictionary, Eleventh Edition. Claim 1 of the '729 patent only requires that "bulb is positionable relative to the web camera" without limiting how the bulb is positionable relative to the web camera. Claim 4 which depends from claim 1 recites that "said arm is a flexible arm that *permits said bulb to be positioned relative to the web camera,*" (emphasis added), which provides one way to position the bulb with respect to the web camera. Therefore, that "bulb is positionable" can be achieved by bending the flexible arm. Kwak in various portions discloses that the position of its lamp 41 can be changes or positionable. See, e.g., Kwak at page 3, lines 37-40 ("the connecting pipe 20 is preferably formed by a flexible pipe, so that the lighting angle of the lamp 41 can be easily adjusted"). Therefore, Kwak discloses or teaches "said bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera."

Kwak further discloses that "[a]nother objective of the present utility model is to *provide a PC webcam stand that allows the lighting angle to be freely adjusted.*" See Kwak Translation at page 2 at lines 31-32. Kwak further discloses "*a lighting device 40 provided at a*

predetermined position on the mounting component 30 to light an object so that the object can be clearly photographed by the PC webcam 50 positioned on the mounting component 30.” See Kwak Translation at page 3 at lines 27-29. Kwak further states:

First, the USB cable C of the PC webcam stand 100 is inserted into the USB port (not shown) of the computer body, and the USB cable C' of the PC webcam 50 is inserted into the USB port 31 in the rear surface of the mounting component 30 of the stand 100. At this time, the PC webcam 50 and the computer body will be electrically connected according to the USB cables C-C'. At this time, *the PC webcam 50 is mounted on the upper surface of the mounting component 30 of the stand 100. As described above, the position the of PC webcam is determined according to the reference wall 33. Since the assembling and disassembling can be achieved by magnetism, the PC webcam can be easily relocated.* See Kwak Translation at page 4 at lines 18-25 (the position of the PC video camera is determined by its position on the reference wall (33) or depending on where it is installed on the reference wall, the PC video camera position may change easily) See Kwas Translation at page 4, lines 18-25 (emphasis added).

Kwak discloses that the position of the PC video camera can be mounted at different positions easily by magnetic force on the reference wall and also discloses “a lighting device 40 provided at a predetermined position on the mounting component 30 to light an object so that the object can be clearly photographed by the PC webcam 50 positioned on the mounting component 30.” Therefore, Kwak discloses and teaches that *said bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera* because by adjusting the position of the PC video camera on mounting component 30 -- thereby adjusting the relative position between the PC video camera 30 and lamp 41, Kwak achieves a clear capture of the subject or achieving optimal view of the user through the PC video camera.

Further, Watson in the related and same technical field discloses a camera mount for supporting a web camera on a supporting surface and more particularly relates to a camera mount for supporting a light source in combination with a web camera. See Watson abstract. Figs. 1-3 of Watson shows a web camera 12 and a light bulb 44, where the camera is preferably adjustable in position relative to the bracket. See Watson at paragraph 0017. Watson also explicitly states that the light source is adjustable in position relative to the camera. See Watson

claim 12. Therefore, Watson discloses and teaches *said bulb is positionable relative to the web camera*.

Watson discloses that “the light source is adjustable in position relative to the camera.” See Watson claim 12.

Watson discloses that “In some embodiments the platform 14 may be provided by itself with the support bracket simply for supporting the camera thereon out of the way of the user. *It is desirable however to provide a combination of a support for lights and for a web camera to ensure adequate lighting when using the video mode of the web camera*. See Watson at paragraph 0044.

Watson is in the same technical field of a camera mount support and illumination technology as Kwak. A POSITA would be motivated to combine Watson with Kwak because the POSITA would have known that adjusting the position of the light source relative to the camera can help achieve optimum imaging. Therefore, Kwak in view of Watson discloses and teaches that *said bulb is positionable relative to the web camera to provide optimal viewing of the user through the web camera* recited in claim 1.

For at least the above-discussed reasons, Kwak in view of Bourn further in view of Watson teaches all features recited in claim 1 of the ‘729 patent. Therefore, claim 1 is unpatentable under pre-AIA 35 U.S.C. 103(a) over Kwak in view of Bourn further in view of Watson.

Dependent claim 2

- **wherein said reflector is positioned proximate said bulb to project light towards a face of said user or said users.**

Claim 2 depends from claim 1. As explained herein above, Kwak teaches *a lighting device 40 provided at a predetermined position on the mounting component 30 to light an object so that the object can be clearly photographed by the PC webcam 50 positioned on the mounting component 30 and a reflector 42 is provided behind the lamp 41*. Therefore, Kwak discloses and teaches the reflector is positioned proximate said bulb to project light towards a face of said user or said users. Bourn teaches a focusing element, *the focusing element including an angled ring reflector to direct rays from the ring light source at an angle generally towards the optical axis*. See Bourn at Col. 2, line 60 - Col. 3, line 8.

Therefore, Kwak in view of Bourn teaches that said reflector is positioned proximate said bulb to project light towards a face of said user or said users recited in claim 1.

Dependent claim 3

- **wherein said reflector is lined with a reflective material or film.**

Claim 3 depends from claim 1. It is well known that a reflector is commonly lined with reflective materials. Further, Bourn discloses:

In one embodiment, *ring reflector 220 is fabricated by turning on a lathe a blank of aluminum, stainless steel, plastic, glass or other suitable material to generate a circularly symmetric reflective face* (e.g., conical-section face 2211) (i.e., the surface of the cross section shown is a straight line at an angle of 52 degrees from the plane of exit opening, i.e., 38 degrees from the optical axis 299), which is then polished and/or chrome plated to enhance its reflectivity at a wavelength of ring-light source 230. In another embodiment, ring reflector 221 is cast, e.g., by injection molding, from a suitable plastic, and *then coated by well known methods with a reflective coating of chrome, gold or other metal, alloy, or multiple optical coating layers to enhance its reflectivity at one or more selected wavelengths of ring-light source 230*. (These manufacturing methods can apply to any of the ring reflectors described below.) See Bourn at Col. 11, line 16-31 (emphasis added).

Therefore, Kwak in view of Bourn teaches that “said reflector is lined with a reflective material or film” recited in claim 3.

Dependent claim 4

- **wherein said arm is a flexible arm that permits said bulb to be positioned relative to the web camera.**

Claim 4 depends from claim 1. Kwak discloses:

One side of the connecting pipe 20 is coupled to the fixing component 10, a USB cable extends through the inner side thereof, and the USB cable is electrically connected to the USB port (not shown) of the computer body. In addition, *the*

connecting pipe 20 is preferably formed by a flexible pipe, so that the lighting angle of the lamp 41 can be easily adjusted. See Kwak Translation at page 3, lines 37-40.

(emphasis added)

Therefore, Kwak discloses *a flexible arm* that permits said bulb to be positioned relative to the web camera. Further, Watson discloses an elongate flexible rod 42 connecting to a light bulb 44, where the flexible rod 42 can be manually adjusted such that the light bulb is positioned relative to web camera 12. See Watson at Figures 1 and 2; and at paragraph 0033 (“The lights 22 each include an elongate flexible rod 42 which carries wiring therethrough from a base end received in the receptacles 38 to a free end supporting a light bulb 44 thereon. The rods 42 are flexible and are sufficiently stiff to remain in a selected orientation once manually adjusted.”)

Therefore, Kwak in view Watson teaches that *said arm is a flexible arm that permits said bulb to be positioned relative to the web camera* recited in claim 4.

Dependent claim 5

- **wherein said arm is connected to the terminal by a clamp.**

Claim 5 depends from claim 1. Kwak discloses a fixing component 10 attached to display 1. See Kwak Translation at Fig. 2. Further, Watson discloses:

While various embodiments of the camera are illustrated in the accompanying figures, the common elements will first be described herein. The camera mount 10 includes a platform 14 for supporting the camera thereon. The camera includes a broad flat supporting surface which readily accepts the base of various types of commercially available web cameras 12 to be supported thereon. *A support bracket 16 is provided which can be mounted on a suitable supporting surface such as a wall and the like or may be adapted for attachment to a laptop screen in some embodiments.* A support arm 18 couples the platform to the support bracket for supporting the camera 12 on the supporting surface to which the bracket is attached. A light mount 20 is provided on the bracket 16 for supporting a light source 22 thereon. See Watson at paragraph 0029.

Turning now to the embodiment of FIG. 3, the bracket 16 is adapted to include inverted *U-shaped clips 60 which can be secured overtop of the top edge of a lap top display monitor 62 in a snap fit engagement therewith.* The remaining features of the

bracket including the adjustable support arm 18 and light sources 22 remain identical to the previous embodiment. See Watson at paragraph 0035 (emphasis added).

Therefore, Kwak in view of Watson teaches that said arm is connected to the terminal by a clamp recited in claim 5. Further, it is well known in the art that a clamp is designed for and can be used for connecting a lamp to a support.

Dependent claim 6

- **wherein the clamp is movable along an edge of the terminal to adjust the location of said bulb.**

Claim 6 depends from claim 5. Kwak discloses “In the above technical structure, although the fixing component 10 is shown attached to the display 1, the fixing component can be attached to any position where the photographed object can be photographed during the video chat. Therefore, an adhesive surface (for example, a double adhesive tape: 11) is arranged on the bottom surface of the fixing component 10.” See Kwak Translation at page 3, lines 30-33. Thus, Kwak teaches the fixing component 10 can be attached to any position on display 1. Further, Watson discloses that “the bracket **16** is adapted to include inverted U-shaped clips **60** which can be secured overtop of the top edge of a lap top display monitor **62** in a snap fit engagement therewith.” See Watson at paragraph 0018 and Fig. 3 (U-shape clip 60 that is movable along the edge of monitor 62).

Therefore, Kwak in view of Watson teaches that *the clamp is movable along an edge of the terminal to adjust the location of said bulb* recited in claim 6.

Dependent claim 7

- **wherein the arm has a base that supports the illuminator device on a flat surface adjacent to the terminal.**

Claim 7 depends from claim 1. Kwak discloses a fixing component 10 that corresponds to a base that supports lamp 41 on a flat surface adjacent to display 1. See Kwak at Figures. 1 and 2 (fixing component 10 is on a flat surface adjacent to display 1).

Therefore, Kwak discloses that the arm has a base that supports the illuminator device on a flat surface adjacent to the terminal recited in claim 7.

Dependent claim 8

- **wherein said reflector has a piece of fabric thereon disposed between said bulb and a user's face for diffusing the light emitted from said bulb.**

Claim 8 depends from claim 1. It is well known at the effective filing date of the '729 patent that a piece of fabric can be disposed between a light bulb and the subject for diffusing the light emitted from the light bulb. Further, Bourn discloses:

In one embodiment, *ring reflector 220 is fabricated by turning on a lathe a blank of aluminum, stainless steel, plastic, glass or other suitable material to generate a circularly symmetric reflective face* (e.g., conical-section face 2211) (i.e., the surface of the cross section shown is a straight line at an angle of 52 degrees from the plane of exit opening, i.e., 38 degrees from the optical axis 299), which is then polished and/or chrome plated to enhance its reflectivity at a wavelength of ring-light source 230. In another embodiment, ring reflector 221 is cast, e.g., by injection molding, from a suitable plastic, and then coated by well known methods with a reflective coating of chrome, gold or other metal, alloy, or multiple optical coating layers to enhance its reflectivity at one or more selected wavelengths of ring-light source 230. (These manufacturing methods can apply to any of the ring reflectors described below.) Bourn at Col. 11, line 16-31 (emphasis added).

The present invention provides a method and system for generating rays of light with suitable brightness and evenness from a source surrounding, for example, the lens of a machine-vision camera. The rays are directed generally towards the optical axis of the camera. *One embodiment provides a diffuse source circumferentially* such that even extremely small objects can be adequately inspected and accurately measured by a machine-vision system 100. Bourn at Col. 5, line 64 – col. 6, line 4 (emphasis added).

Therefore, Bourn teaches providing *a diffuse source circumferentially*. Although Kwak in view Bourn further in view of Watson does not specifically teach the use of a piece of material of fabric as a diffuser. Cook in a light modifier teaches the use of a piece of material of fabric in a

light box as a diffuser. See Cook at paragraph 0013. It would be obvious to a person of ordinary skill in the art at the time of the invention to incorporate the teaching of Cook and provide a piece of fabric material as a diffuser. The reason, as stated by Cook, is to create an enhanced depth of lighting.

Therefore, Kwak in view of Bourn further in view of Cook teaches “said reflector has a piece of fabric thereon disposed between said bulb and a user's face for diffusing the light emitted from said bulb” recited in claim 8.

Dependent claim 9

- **wherein said fabric is silk or muslin.**

Claim 9 depends from claim 8. Cook discloses that various materials may be diffuse light. It is well known that silk or muslin is a type of fabric that can be used as a diffuse material. See Cook claims 7 and 11. Therefore, Kwak in view of Bourn further in view of Cook teaches “said fabric is silk or muslin” recited in claim 9.

VII. Proposed Rejections

A. Proposed Rejection 1. Claims 1-9 should be rejected under pre-AIA 35 U.S.C. §103(a) as unpatentable over Kwak, Bourn, Watson, and Cook

Claims 1-9 should be rejected under pre-AIA 35 U.S.C. §103(a) as unpatentable over Kwak, Bourn, Watson, and Cook.

The combination of Kwak, Bourn, Watson, and Cook raises a substantial new question of patentability with respect to claims 1-9 as discussed above.

Elements of the above-referenced claims are item-mapped to the teachings of Kwak, Bourn, Watson, and Cook in the claim chart attached as Exhibit 6, which is incorporated herein by reference.

VIII. Conclusion

For the foregoing reasons, Requester respectfully submits that reexamination should be ordered, and claims 1-9 of the '729 patent should be rejected.

Please charge any shortage to our Deposit Account No. 60-2313.

Respectfully submitted,

ZHONG LAW, LLC

Date: April 22, 2025

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that this *ex parte* reexamination request with all appendices and certificates was served on the patent owner by placing a copy in first class mail with sufficient postage addressed to counsel of record for U.S. Pat. No. 7,841,729:

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(54)피씨용 화상 카메라 거치대

요약

본 고안은 조명기능이 부가된 피씨(PC)용 화상 카메라 거치대에 관한 것으로, 고정부재와, 고정부재에 그 일측단이 체결되고 그 내측을 통하여 USB케이블이 연장형성된 연결관과, 연결관의 타측단이 그 저면에 체결되고 그 상면에 피씨용 화상 카메라가 위치되며 그 후면에 피씨용 화상 카메라가 전기적으로 접속되는 USB포트가 마련된 장착부재와, 장착부재에 위치된 피씨용 화상 카메라를 통하여 피사체를 선명하게 촬영할 수 있도록 장착부재의 소정위치에 피사체를 조명하기 위한 램프가 구비된 것을 특징으로 한다.

본 고안에 따르면, 피사체를 조명할 수 있도록 조명기능이 구비됨으로써 주변의 밝기에 관계없이 피사체를 선명하게 촬영하여 전송할 수 있다. 또한, 조명기능과 함께 조명 각도를 자유롭게 조절할 수 있어, 피사체를 보다 효과적으로 조명할 수 있다. 그리고 자력(磁力)에 의한 착탈 방식으로, 피씨용 화상 카메라를 손쉽게 설치 · 고정시킬 수 있고, 분리 또한 매우 간편하다는 매우 실용적인 효과가 있다.

대표도

도 2

색인어

화상 카메라, USB케이블, 가요관, 조명, 램프

명세서

도면의 간단한 설명

도 1은 본 고안에 따른 피씨용 화상 카메라 거치대의 사용 예시도이다.

도 2는 본 고안에 따른 피씨용 화상 카메라 거치대의 정면도이다.

도 3은 본 고안에 따른 피씨용 화상 카메라 거치대의 단면도이다.

도면의 주요부분에 대한 부호의 설명

1 : 모니터 100:거치대

10: 고정부재 20: 연결부재

30: 장착부재 40: 조명수단

50: 피씨용 화상 카메라

고안의 상세한 설명

고안의 목적

고안이 속하는 기술 및 그 분야의 종래기술

본 고안은 피씨용 화상 카메라 거치대에 관한 것으로, 더욱 상세하게는 조명기능이 부가된 피씨(PC)용 화상 카메라 거치대에 관한 것이다.

일반적으로 컴퓨터를 통한 화상회의나 화상 채팅 등에 주로 사용되는 작은 카메라를 피씨용 화상 카메라라 일컫는다.

이와 같은 피씨용 화상 카메라는 카메라에 찍힌 영상을 리얼 타임으로 보여 준다는 점에서 큰 인기를 끌고 있다.

이에 따라, 대부분의 PC방에는 상대방의 얼굴을 보며 채팅할 수 있도록 모니터 상에 피씨용 화상 카메라가 설치되어 있다.

그러나 PC방에서의 화상 채팅 시 다음과 같은 문제점이 있었다.

즉, PC방은 다수의 이용자들이 컴퓨터를 사용하므로 전체적인 조명이 어둡다. 그에 따라, 화상 채팅시 카메라로 찍힌 영상이 선명하지 못해 화상 채팅의 묘미를 즐기는데 한계가 있었다.

고안이 이루고자 하는 기술적 과제

본 고안은 전술한 문제점을 해결하기 위하여 안출된 것으로, 그 목적은 화상채팅 시 피사체를 조명할 수 있도록 조명 기능이 구비된 피씨용 화상 카메라 거치대를 제공하는데 있다.

본 고안의 다른 목적은 조명 각도(角度)를 자유롭게 조절할 수 있도록 한 피씨용 화상 카메라 거치대를 제공하는데 있다.

본 고안의 또 다른 목적은 피씨용 화상 카메라를 용이하게 착탈시킬 수 있도록 한 피씨용 화상 카메라 거치대를 제공하는데 있다.

고안의 구성 및 작용

본 고안은 상기의 기술적 과제를 달성할 수 있도록 고정부재와, 고정부재에 그 일측단이 체결되고 그 내측을 통하여 USB케이블이 연장형성된 연결관과, 연결관의 타측단이 그 저면에 체결되고 그 상면에 피씨용 화상 카메라가 위치되며 그 후면에 피씨용 화상 카메라가 전기적으로 접속되는 USB포트가 마련된 장착부재와, 장착부재에 위치된 피씨용 화상 카메라를 통하여 피사체를 선명하게 촬영할 수 있도록 장착부재의 소정위치에 피사체를 조명하기 위한 램프가 구비된 것을 특징으로 한다.

또, 장착부재는 그 상면 일측에 피씨용 카메라를 정위치 시키기 위한 기준벽이 돌출 형성되고, 그 상면에 피씨용 카메라를 자력(磁力)에 의해 용이하게 고정시킬 수 있도록 자석 또는 금속판이 구비된 것을 특징으로 한다.

또한, 연결관은 램프의 조명 각(角)을 용이하게 조절할 수 있도록 가요관으로 형성된 것을 특징으로 한다.

또, 램프는 상기 USB케이블을 통하여 전원을 공급받되 상기 램프의 밝기를 조절할 수 있도록 램프와 USB케이블의 사이에 조광기가 더 구비된 것을 특징으로 한다.

이하, 첨부도면을 참조하여 본 고안에 따른 피씨(PC)용 화상 카메라 거치대의 바람직한 실시예를 상세히 설명한다.

도 1은 본 고안에 따른 피씨용 화상 카메라 거치대의 사용 예시도이다.

도 2는 본 고안에 따른 피씨용 화상 카메라 거치대의 정면도이다.

도 3은 본 고안에 따른 피씨용 화상 카메라 거치대의 단면도이다.

일반적으로 피씨용 화상 카메라(50)는 별도의 거치대에 설치되고, 보다 바람직하게는 도 1에 도시한 바와 같이 모니터(1) 상에 부착된 거치대(50)에 설치된다.

이와 같이 설치된 피씨용 화상 카메라(50)는 컴퓨터 본체의 USB(Universal Serial Bus, 범용 직렬 버스)포트(미도시)에 전기적으로 접속되고, 그에 따라 촬영된 영상은 컴퓨터 상의 소정의 프로그램과 규약된 전송방식에 의해 외부로 전송되게된다.

상기의 피씨용 화상 카메라의 거치대(100)는 도 2 및 도3에 도시한 바와 같이, 모니터(1) 상에 부착되는 고정부재(10)와, 고정부재(10)에 그 일측단이 체결되고 그 내측을 통하여 USB케이블(C)이 연장형성된 연결관(20)과, 연결관(20)의 타측단이 그 저면에 체결되고 그 상면에 피씨용 화상 카메라(50)가 위치되며 그 후면에 피씨용 화상 카메라(50)가 전기적으로 접속되는 USB포트(31)가 마련된 장착부재(30)와, 장착부재(30)에 위치된 피씨용 화상 카메라(50)를 통하여 피사체를 선명하게 촬영할 수 있도록 장착부재(30)의 소정위치에 피사체를 조명하기 위한 조명수단(40)이 구비된다.

전술한 기술적 구성에서 고정부재(10)는 모니터(1) 상에 부착되는 것으로 예시하였으나, 화상 채팅시 피사체를 촬영할 수 있는 위치면 어디든 가능하고, 이를 위하여 고정부재(10)의 바닥면에는 집착면(일례로 양면테이프;11)이 마련된다. 또한 고정부재(10)의 상면에는 연결관(20)을 끼움 결속시킬 수 있도록 체결관(12)이 구비되며, 연결관(20)은 체결관(12)에 끼워진 상태에서 통상의 체결수단 또는 집착재에 의해 고정된다.

연결관(20)은 일측단이 고정부재(10)에 결속되고, 그 내측에 컴퓨터 본체의 USB포트(미도시)와 전기적으로 접속된 USB케이블(C)이 연장형성된다. 또한, 연결관(20)은 램프(41)의 조명 각(角)을 용이하게 조절할 수 있도록 보다 바람직하게 가요관으로 형성된다.

장착부재(30)는 그 저면이 연결관(20)의 타측단에 결속되고, 이를 위하여 장착부재(30)의 저면에는 연결관(20)의 타측단을 끼움 결속시킬 수 있도록 체결관(32)이 구비되며, 연결관(20)은 체결관(32)에 끼워진 상태에서 통상의 체결수단 또는 집착재에 의해 고정된다. 또, 장착부재(30)는 그 전방 내측에 램프(41)를 용이하게 설치할 수 있도록 소정의 공간부가 형성되고, 램프(41) 후방에 반사갓(42)이, 그리고 램프(41) 전면에 볼록렌즈(43)가 구비된다. 또한, 장착부재(30)는 그 상면 일측에 피씨용 카메라(50)를 정위치 시키기 위한 기준벽(33)이 돌출 형성되고, 그 상면에 피씨용 카메라(50)를 자력(磁力)에 의해 용이하게 고정시킬 수 있도록 자석 또는 금속판(34)이 구비된다. 즉, 카메라(50) 저면에 자석이 부착된 경우 장착부재(30) 상면에 금속판을 구비시키고, 카메라(50) 케이스가 금속제이거나 금속판이 부착된 경우 장착부재(30) 상면에 자석을 부착시키면된다. 또, 장착부재(30)는 그 후면에 연결관(20)을 통하여 연장형성된 USB케이블(C)을 피씨용 화상 카메라(50)와 용이하게 접속시킬 수 있도록 USB포트(31)가 구비된다.

램프(41)는 피씨용 화상 카메라(50)에 찍히는 피사체를 조명하기 위한 것으로, USB케이블(C)의 전력선을 통하여 전원을 공급받는다. 즉, USB케이블(C)의 대략 5볼트(V)의 전력선은 램프(41)와 피씨용 화상 카메라(50) 측으로 분기된 채 전기적으로 접속된다. 또한, 램프(41)는 그 밝기를 조절할 수 있도록 램프(41)와 USB케이블(C)의 전력선 사이에

조광기(44)가 연결되며, 조광기(44)는 그 조작이 용이하도록 손잡이부가 장착부재(30)의 저면부에 돌출형성된다.

다음은 전술한 기술적 구성 및 첨부도면을 참조하여 본 고안에 따른 피씨용 화상 카메라 거치대의 작동과정을 설명한다.

먼저, 피씨용 화상 카메라 거치대(100)의 USB케이블(C)을 컴퓨터 본체의 USB포트(미도시)에 삽입하고, 피씨용 화상 카메라(50)의 USB케이블(C')을 거치대(100)의 장착부재(30)의 후면에 형성된 USB포트(31)에 삽입한다. 그 결과, 피씨용 화상 카메라(50)와 컴퓨터 본체는 USB케이블(C-C')에 의해 전기적으로 접속되게된다. 이때, 피씨용 화상 카메라(50)는 거치대(100)의 장착부재(30) 상면에 장착되는데, 이는 전술한 바와 같이 기준벽(33)에 의해 그 위치가 정해지며 자력에 의한 착탈식이라 용이하게 설치가능하게된다.

이후, 피사체를 촬영하기에 적당한 위치(일례로 모니터, 컴퓨터 본체, 책상 위 등)에 고정부재(10)를 이용하여 거치대(100)를 고정시키고, 촬영된 화면을 참조하여 가요관(20)을 조절함으로써 보다 세밀하게 피씨용 화상 카메라(50)의 위치를 조정한다.

이때, 촬영된 피사체가 어둡게 나타난 경우 장착부재(30)에 구비된 램프(41)를 점등시켜 조명하고, 촬영된 화면을 참조하여 조광기(44)를 조절함으로써 피사체를 보다 선명하게 촬영할 수 있도록 램프(41)의 밝기를 조절한다.

그 결과, 주변의 밝기에 상관없이 피사체를 선명하게 촬영하여 전송할 수 있게된다.

고안의 효과

이상에서 상세히 설명한 바와 같이, 본 고안에 따르면 피사체를 조명할 수 있도록 조명기능이 구비됨으로써 주변의 밝기에 관계없이 피사체를 선명하게 촬영하여 전송할 수 있게된다. 그 결과, 화상 채팅시 상대방의 얼굴을 보며 채팅하는 화상 채팅의 묘미를 효과적으로 즐길 수 있다.

또한, 본 고안에 따르면 조명기능과 함께 조명 각도를 자유롭게 조절할 수 있어, 피사체를 보다 효과적으로 조명할 수 있게된다.

그리고 본 고안에 따르면 자력(磁力)에 의한 착탈 방식으로, 피씨용 화상 카메라를 손쉽게 설치 · 고정시킬 수 있고, 분리 또한 매우 간단하여 사용상 매우 편리하다는 효과가 있다.

(57) 청구의 범위

청구항 1.

피씨용 화상 카메라 거치대에 있어서,

고정부재와,

상기 고정부재에 그 일측단이 체결되고 그 내측을 통하여 USB케이블이 연장형성된 연결판과,

상기 연결판의 타측단이 그 저면에 체결되고 그 상면에 상기 피씨용 화상 카메라가 위치되며 그 후면에 상기 피씨용 화상 카메라가 전기적으로 접속되는 USB포트가 마련된 장착부재와,

상기 장착부재에 위치된 상기 피씨용 화상 카메라를 통하여 피사체를 선명하게 촬영할 수 있도록 상기 장착부재의 소정위치에 상기 피사체를 조명하기 위한 램프가 구비된 것을 특징으로 하는 피씨용 화상 카메라 거치대.

청구항 2.

제 1항에 있어서,

상기 장착부재는 그 상면 일측에 상기 피씨용 카메라를 정위치 시키기 위한 기준벽이 돌출 형성되고, 그 상면에 상기 피씨용 카메라를 자력(磁力)에 의해 용이하게 고정시킬 수 있도록 자석 또는 금속판이 구비된 것을 특징으로 하는 피씨용 화상 카메라 거치대.

청구항 3.

제 1항에 있어서,

상기 연결관은 상기 램프의 조명 각(角)을 용이하게 조절할 수 있도록 가요관으로 형성된 것을 특징으로 하는 피씨용 화상 카메라 거치대.

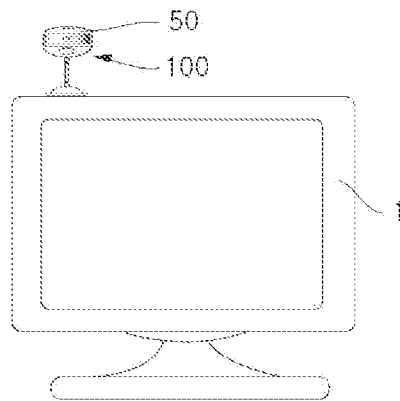
청구항 4.

제 1항에 있어서,

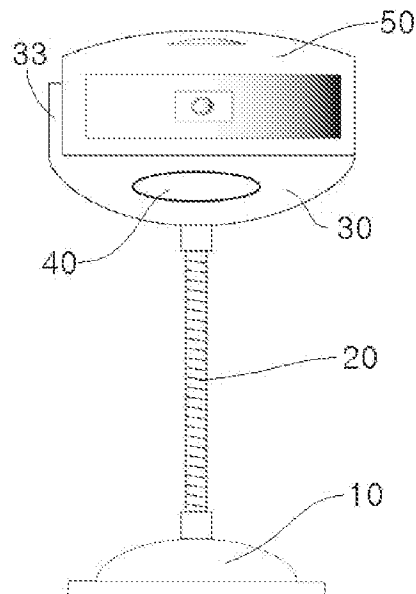
상기 램프는 상기 USB케이블을 통하여 전원을 공급받되 상기 램프의 밝기를 조절할 수 있도록 상기 램프와 상기 USB케이블의 사이에 조광기가 더 구비된 것을 특징으로 하는 피씨용 화상 카메라 거치대.

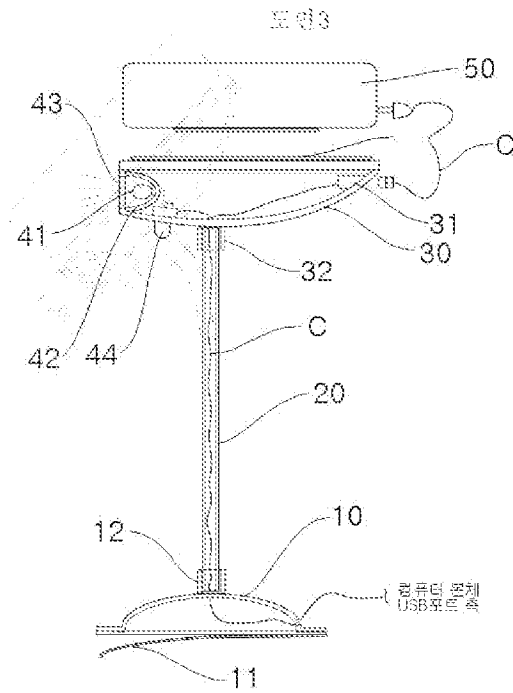
도면

도면1



도면2





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(Y1)

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H04N 5/225

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Basic Requirement Examiner JANG, Hyun-kwon

Request Technical Evaluation: None

(54) PC webcam stand

ABSTRACT

The present utility model relates to a PC webcam stand with a lighting function, including: a fixing component; a connecting pipe, one side end of which is coupled to the fixing component and through an inside of which a USB cable is extended; a mounting component, to a bottom surface of which the other side end of the connecting pipe is coupled, on an upper surface of which a PC webcam is positioned, and on a rear surface of which a USB port electrically connected to the PC webcam is arranged; and a lamp for lighting an object, arranged at a predetermined position of the mounting component to enable the PC webcam positioned on the mounting component to clearly photograph the object.

According to the present utility model, the lighting function is provided to light an object, thus enabling the object to be clearly photographed and transmitted regardless of the brightness of the surroundings. Besides, in addition to the lighting function, the lighting angle may be freely adjusted, thus effectively lighting the object. Moreover, the PC webcam may be easily arranged and fixed in a detachable manner by means of a magnetic force, and is very easy to separate, thus providing a very practical effect.

DRAWING OF ABSTRACT

FIG. 2

Index terms

Webcam, USB cable, flexible tube, lighting, lamp

SPECIFICATION

Description of drawings

FIG.1 is a diagram of a usage example of a PC webcam stand according to the present utility model.

FIG.2 is a main view of a PC webcam stand according to the present utility model.

FIG.3 is a sectional view of a PC webcam stand according to the present utility model.

5 Descriptions of numerals of main portions in the drawings

1: display; 100: stand

10: fixing component; 20: connecting component

30: mounting component; 40: lighting device

50: PC webcam

10

Detailed description of the present utility model

Objective of the present utility model

Technical field and background

15 The present utility model relates to a PC (personal computer) webcam stand, and more specifically to a PC webcam stand with an integrated lighting function.

Small cameras mainly used for video conferences or video chats through computers are usually referred to as PC webcams.

Such PC webcam represents an image photographed by the camera in real time, and thus, it is widely accepted.

20 Therefore, in most PC cafes, the PC webcam is arranged on a display, so that a video chat with an opposite side can be performed.

However, there are the following problems when video chats are performed in the PC cafes:

25 Namely, because most users in the PC cafes use computers, the overall lighting is darker. Therefore, the image photographed by the camera is not clear during video chats, limiting the enjoyment of the video chats.

Technical problem to be solved by the present utility model

30 To solve the above technical problem, the objective of the present utility model is to provide a PC webcam stand with a lighting function, thereby enabling a photographed object to be lighted during a video chat.

Another objective of the present utility model is to provide a PC webcam stand that allows the lighting angle to be freely adjusted.

Yet another objective of the present utility model is to provide a PC webcam stand that the PC webcam is easily disassembled.

35

Structure and effects of the present utility model

To achieve the aforementioned technical objectives, the present utility model provides a PC webcam stand, including:

40 a fixing component; a connecting pipe, one side end of which is coupled to the fixing component and through an inside of which a USB cable (C) is extended; a mounting component, to a bottom surface of which the other side end of the connecting pipe is coupled, on an upper surface of which a PC

webcam is positioned, and on a rear surface of which a USB port electrically connected to the PC webcam is arranged; and a lamp provided at a predetermined position of the mounting component to light an object so that the object can be clearly photographed by the PC webcam positioned on the mounting component.

- 5 In addition, a reference wall is protruded on one side of an upper surface of the mounting component to position the PC webcam, and a magnet or a metal plate is provided on the upper surface thereof to easily fix the PC webcam according to a magnetic force.

In addition, the connecting pipe is formed by a flexible pipe, so that the lighting angle of the lamp is easily adjustable.

- 10 In addition, the lamp receives a power supply through the USB cable, and a dimmer is further provided between the lamp and the USB cable to adjust the brightness of the lamp.

Preferred embodiments of the PC webcam stand according to the present utility model are described in detail below with reference to drawings.

FIG. 1 is a diagram of a usage example of a PC webcam stand according to the present utility model.

- 15 FIG.2 is a main view of a PC webcam stand according to the present utility model.

FIG. 3 is a sectional view of a PC webcam stand according to the present utility model.

Usually, a PC webcam 50 is provided on an independent stand. Preferably, as shown in FIG. 1, it is arranged on a stand 50 attached to a display 1.

- 20 Such PC webcam 50 is electrically connected to a universal serial bus (USB) port (not shown) of a computer body. Therefore, a photographed image is transmitted to the outside through an established procedure and an established transmitting mode on a computer.

- 25 The PC webcam stand 100, as shown in FIG. 2 and FIG. 3, includes a fixing component 10, attached to a display 1; a connecting pipe 20, one side end of which is coupled to the fixing component 10 and through an inside of which a USB cable (C) is extended; a mounting component 30, to a bottom surface of which the other side end of the connecting pipe 20 is coupled, on an upper surface of which a PC webcam 50 is positioned, and on a rear surface of which a USB port 31 electrically connected to the PC webcam 50 is arranged; and a lighting device 40 provided at a predetermined position on the mounting component 30 to light an object so that the object can be clearly photographed by the PC webcam 50 positioned on the mounting component 30.

- 30 In the above technical structure, although the fixing component 10 is shown attached to the display 1, the fixing component can be attached to any position where the photographed object can be photographed during the video chat. Therefore, an adhesive surface (for example, a double adhesive tape: 11) is arranged on the bottom surface of the fixing component 10. In addition, a fastening pipe 12 is provided on the upper surface of the fixing component 10, so that the connecting pipe 20 can be inserted. The connecting pipe 20 is fixed by a usual fastening device or adhesive material in a state of being inserted into the fastening pipe 12.

- 40 One side of the connecting pipe 20 is coupled to the fixing component 10, a USB cable extends through the inner side thereof, and the USB cable is electrically connected to the USB port (not shown) of the computer body. In addition, the connecting pipe 20 is preferably formed by a flexible pipe, so that the lighting angle of the lamp 41 can be easily adjusted.

- 45 The bottom surface of the mounting component 30 is coupled to the other side end of the connecting pipe 20. Therefore, a fastening pipe 32 is provided on the bottom surface of the mounting component 30, so that the other side end of the connecting pipe 20 can be inserted. The connecting pipe 20 is fixed by a usual fastening device or adhesive material in a state of being inserted into the fastening pipe 32. In addition, a specified space portion is formed on the front inner side of the mounting component 30, so that the lamp 41 can be easily arranged, and moreover, a reflecting cover 42 is arranged behind the lamp 41, and a convex lens 43 is provided in front of the lamp 41. In addition, a

reference wall 33 is formed in a protruding manner on one side of an upper surface of the mounting component 30 for positioning the PC webcam 50, and a magnet or a metal plate 34 is provided on the upper surface thereof to easily fix the PC webcam 50 according to a magnetic force. That is, when the magnet is attached to the bottom surface of the camera 50, the metal plate is provided on the upper surface of the mounting component 30, and when a shell of the camera 50 is of a metal material or is attached to the metal plate, the magnet is attached to the upper surface of the mounting component 30. In addition, a USB port 31 is provided on a rear surface of the mounting component 30, so that the USB cable C extending through the connecting pipe 20 is easily connected to the PC webcam 50.

The lamp 41 is configured to light the photographed object photographed by the PC webcam 50 and receives a power supply through an electric wire of the USB cable C. Namely, an electric wire of about 5V of the USB cable C is electrically connected in a state that the electric wire is branched to the sides of the lamp 41 and the PC webcam 50. In addition, the lamp 41 is connected to a dimmer 44 between the lamp 41 and the electric wire of the USB cable C, so that the brightness thereof may be adjustable. To facilitate operation, a handle portion of the dimmer 44 protrudes from the bottom portion of the mounting component 30.

Next, a working process of the PC webcam stand according to the present utility model is described with reference to the above technical structure and drawings.

First, the USB cable C of the PC webcam stand 100 is inserted into the USB port (not shown) of the computer body, and the USB cable C' of the PC webcam 50 is inserted into the USB port 31 in the rear surface of the mounting component 30 of the stand 100. At this time, the PC webcam 50 and the computer body will be electrically connected according to the USB cables C-C'. At this time, the PC webcam 50 is mounted on the upper surface of the mounting component 30 of the stand 100. As described above, the position the of PC webcam is determined according to the reference wall 33. Since the assembling and disassembling can be achieved by magnetism, the PC webcam can be easily relocated.

Then, at a position (for example, a display, a computer body, a desk lamp) suitable for photographing the photographed object, the stand 100 is fixed by the fixing component 10, and the flexible pipe 20 is adjusted with reference to the photographed picture, so that the position of the PC webcam 50 is adjusted more finely.

In this case, when the photographed object is darker, the lamp 41 provided on the mounting component 30 is turned on for lighting, and the dimmer 44 is adjusted with reference to the photographed picture, so that the brightness of the lamp 41 is adjusted, and the photographed object can be photographed more clearly.

As a result, it enables the object to be clearly photographed and transmitted regardless of the brightness of the surroundings.

Effects of the present utility model

As described above in detail, according to the present utility model, in order to light the photographed object, the PC webcam stand has the lighting function, thus enabling the object to be clearly photographed and transmitted regardless of the brightness of the surroundings. Therefore, a user can enjoy the interestingness of performing the video chat while watching the face of the opposite side during the video chat.

Besides, according to the present utility model, in addition to the lighting function, the lighting angle may be freely adjusted, thus effectively lighting the object.

Moreover, the PC webcam may be easily arranged and fixed in a detachable manner by means of a magnetic force, and is very easy to separate, thus providing a very practical effect in terms of use.

(57) CLAIMS

Claim 1

A PC (personal computer) webcam stand, comprising:

a fixing component;

- 5 a connecting pipe, one side end of which is coupled to the fixing component and through an inside of which a USB cable is extended;

a mounting component, to a bottom surface of which the other side end of the connecting pipe is coupled, on an upper surface of which a PC webcam is positioned, and on a rear surface of which a USB port electrically connected to the PC webcam is arranged; and

- 10 a lamp for lighting an object, arranged at a predetermined position of the mounting component to enable the PC webcam positioned on the mounting component to clearly photograph the object.

Claim 2

The PC webcam stand according to claim 1, wherein

- 15 a reference wall is formed in a protruding manner on one side of an upper surface of the mounting component to position the PC webcam stand, and a magnet or a metal plate is provided on the upper surface thereof to easily fix the PC webcam according to a magnetic force.

Claim 3

The PC webcam stand according to claim 1, wherein

the connecting pipe is formed by a flexible pipe, so that a lighting angle of the lamp is easily adjustable.

- 20 Claim 4

The PC webcam stand according to claim 1, wherein

the lamp receives a power supply through the USB cable, and a dimmer is further provided between the lamp and the USB cable to adjust the brightness of the lamp.

25

DRAWINGS

FIG. 1

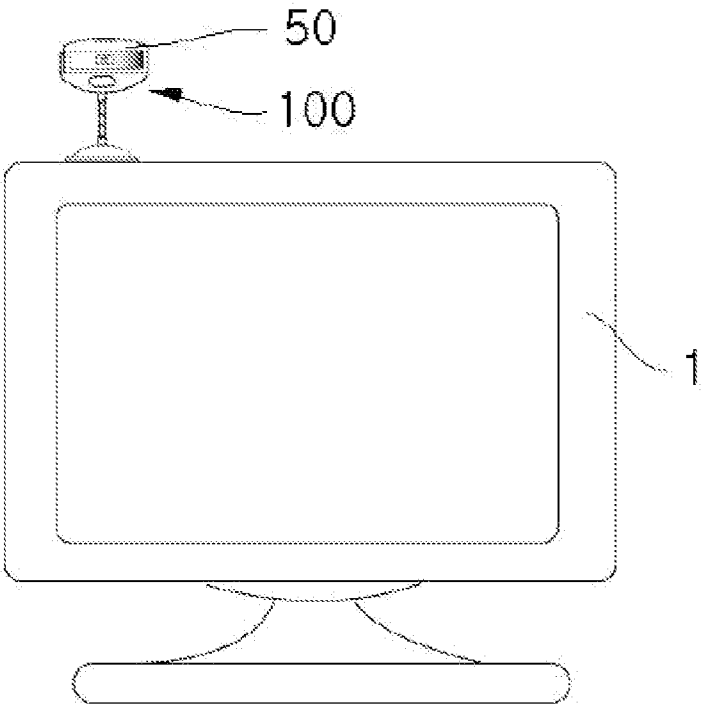


FIG. 2

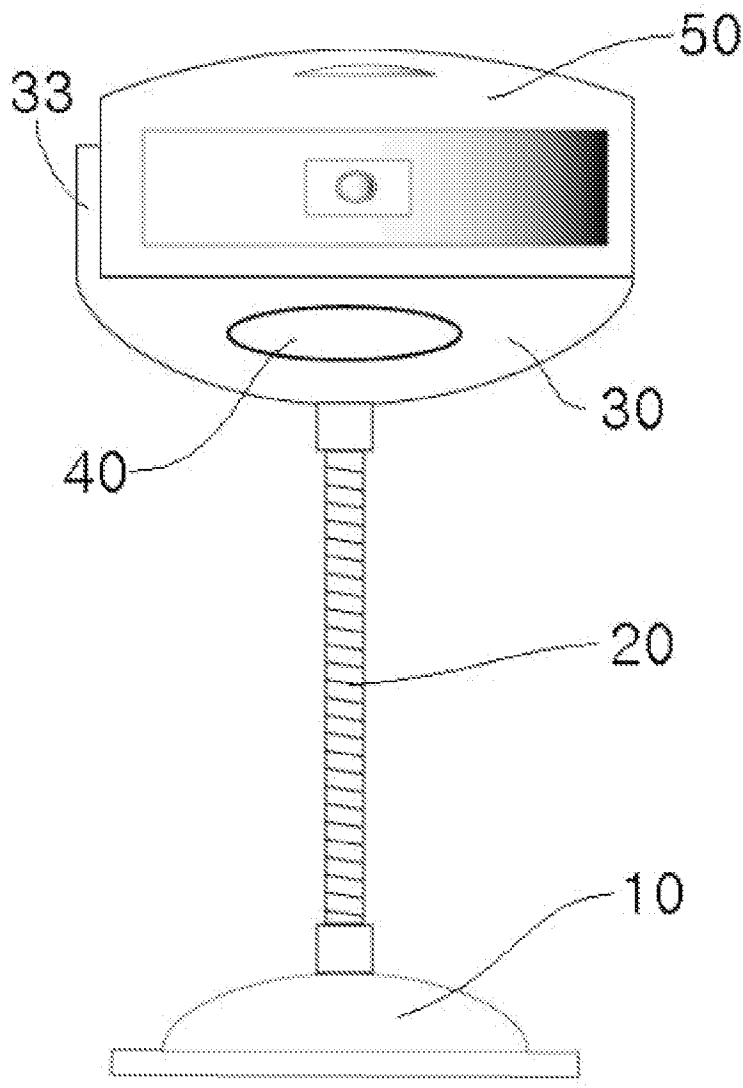
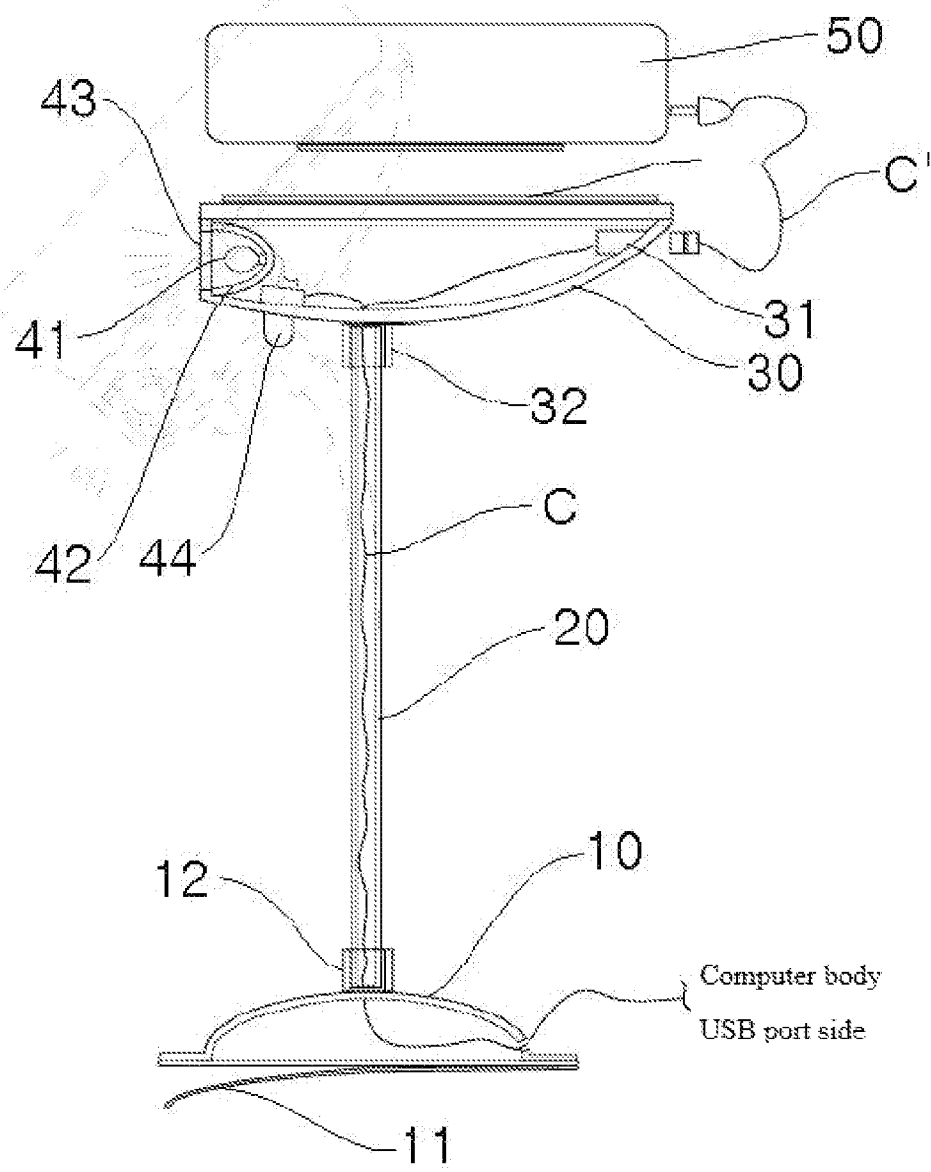


FIG. 3



VERIFICATION OF TRANSLATION

I, BeomJin Kim

of Room 1005A, Global New Times Plaza, 1666 Sichuan RD. (NORTH), Hongkou District, Shanghai China,

do hereby declare that I am well acquainted with the **Korean and English** languages, and that the attached is to the best of my knowledge and belief a true and accurate translation into the **English** language of the text of KR200316985Y1.

Signature: BEOMJIN KIM

Date: March 14, 2025



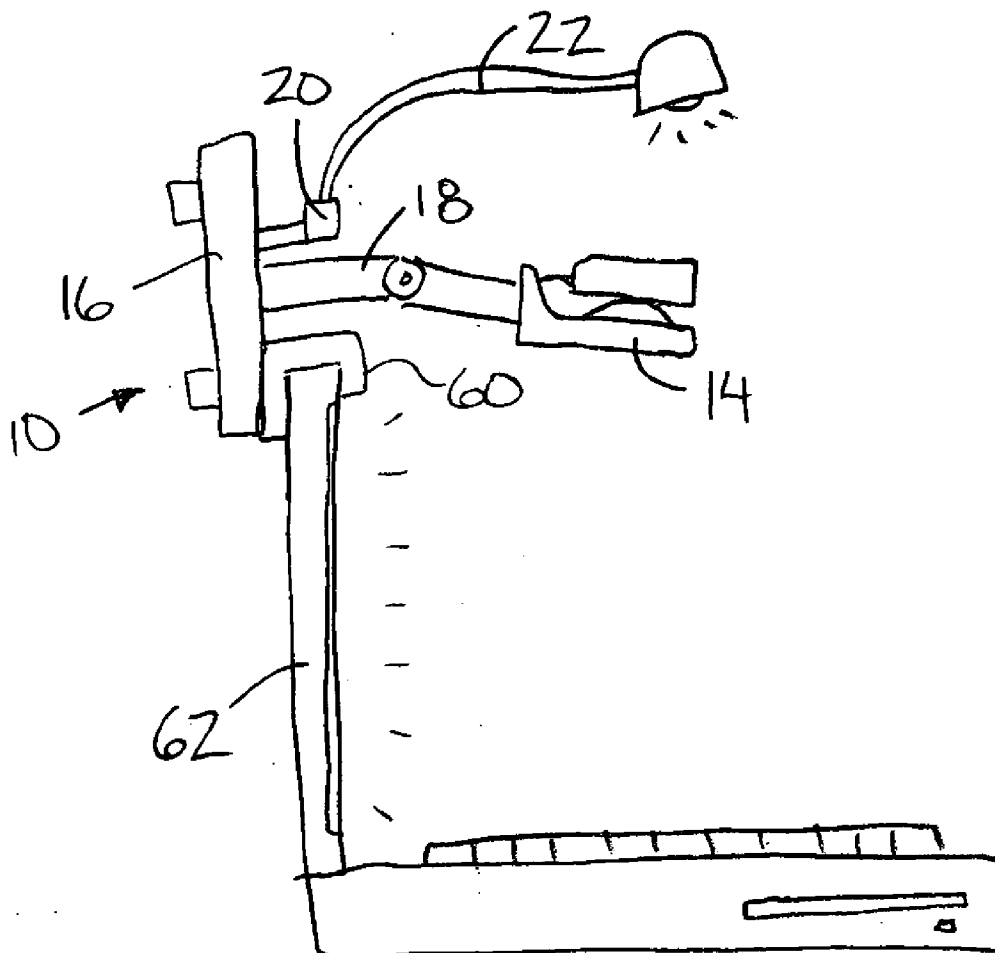
US 20050151042A1

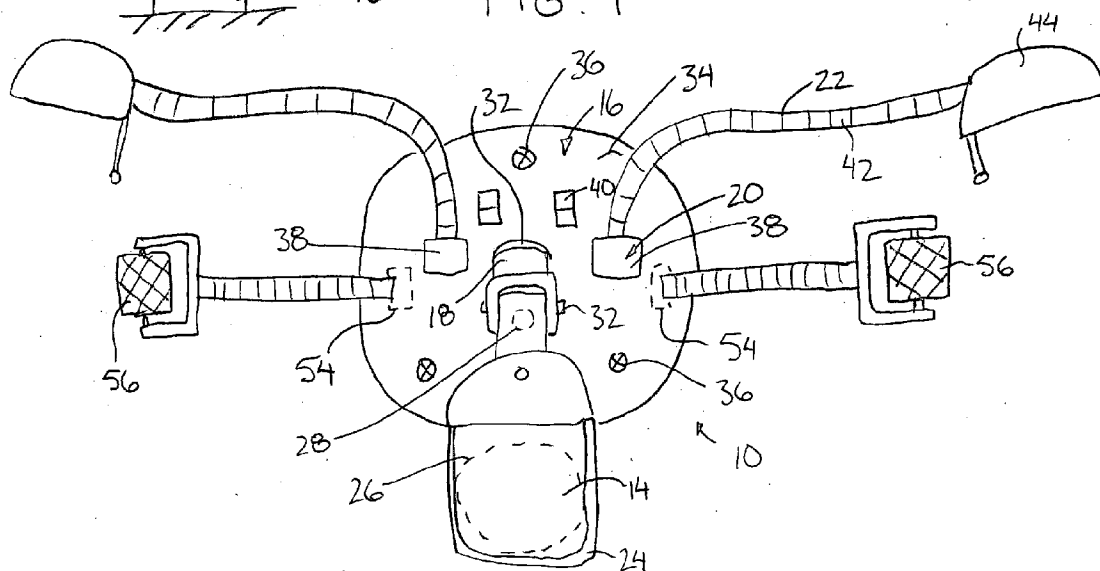
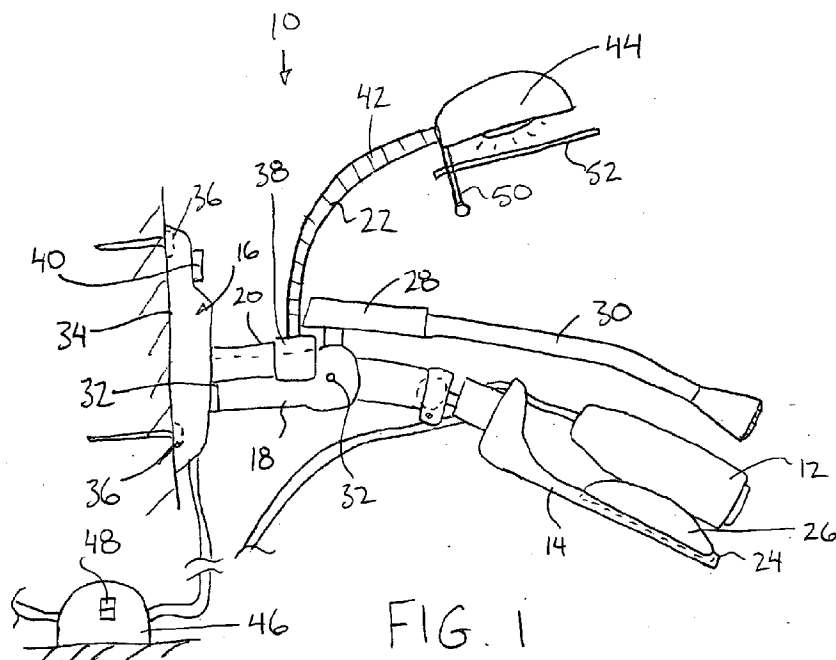
(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0151042 A1****Watson**(43) **Pub. Date: Jul. 14, 2005**(54) **CAMERA MOUNT**(52) **U.S. Cl. 248/226.11**(76) **Inventor: Robert Watson, Beausejour (CA)**(57) **ABSTRACT**

Correspondence Address:

ADE & COMPANY**1700-360 MAIN STREET****WINNIPEG, MB R3C3Z3 (CA)**(21) **Appl. No.: 10/752,553**(22) **Filed: Jan. 8, 2004****Publication Classification**(51) **Int. Cl.⁷ A47K 1/00**

A camera mount supports a web camera thereon. The mount includes a bracket for supporting a light source thereon and a platform supported on the bracket for receiving the base of the web camera thereon. The light source may be operable in either flash or steady-on modes to provide optimum lighting for the web camera. The platform ensures various designs of web cameras and web camera bases can be accommodated and supported thereon. The bracket also readily permits the camera mount to be supported on an upright supporting surface to remove the clutter of cords from the workspace on a desk supporting a computer thereon.





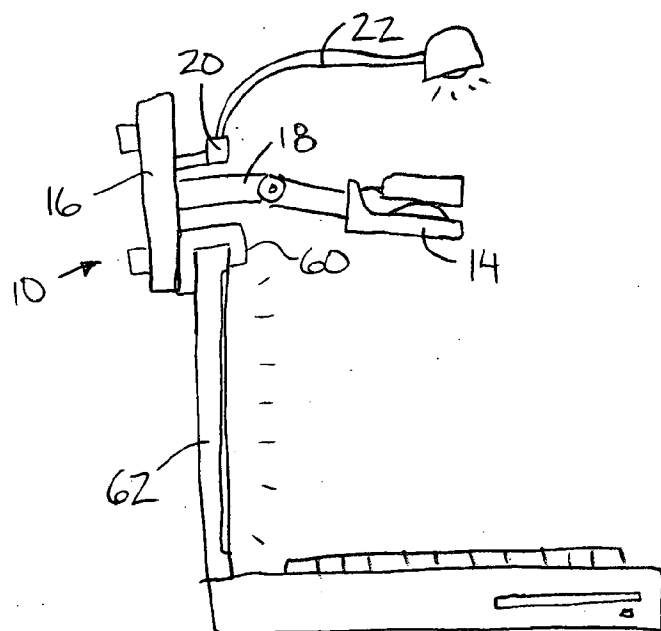


FIG. 3

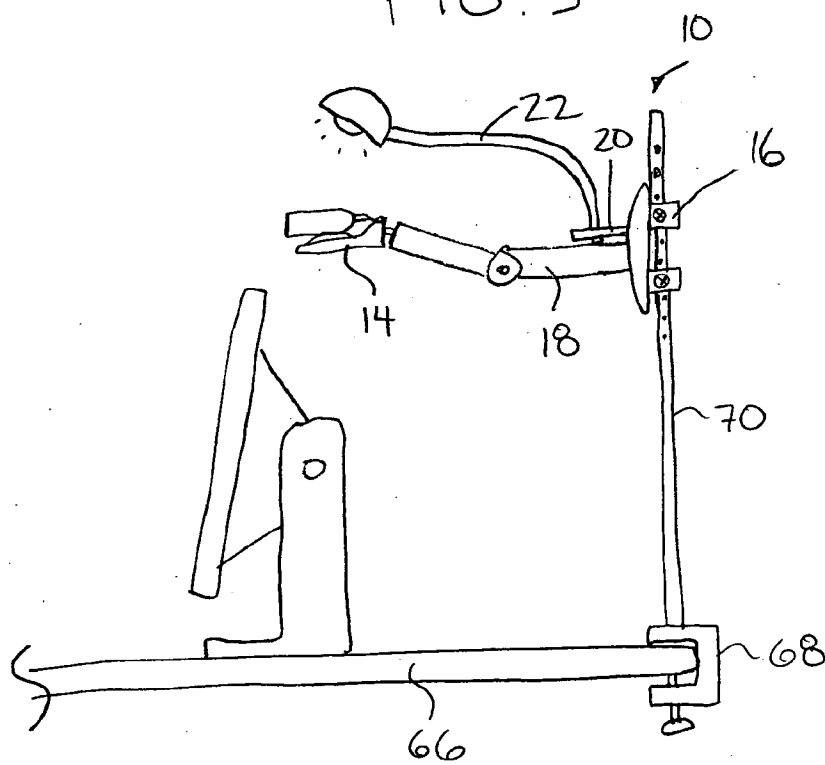


FIG. 4

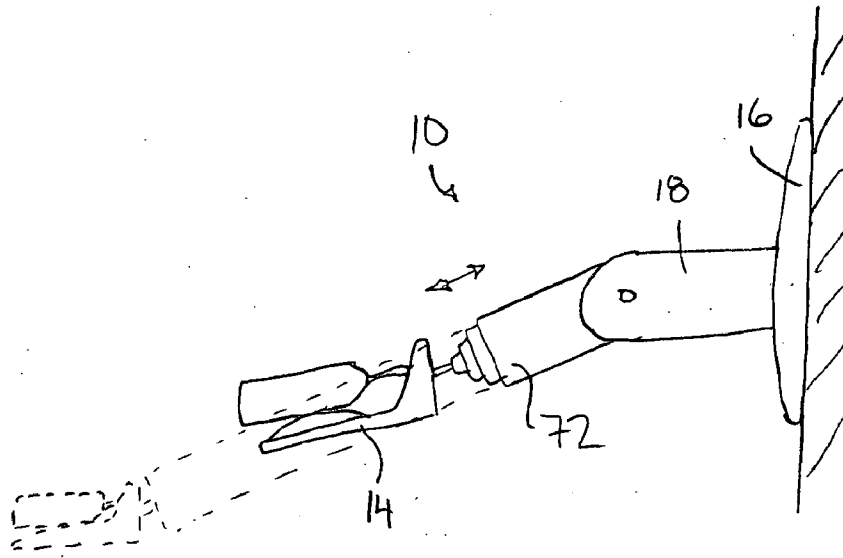


FIG. 5

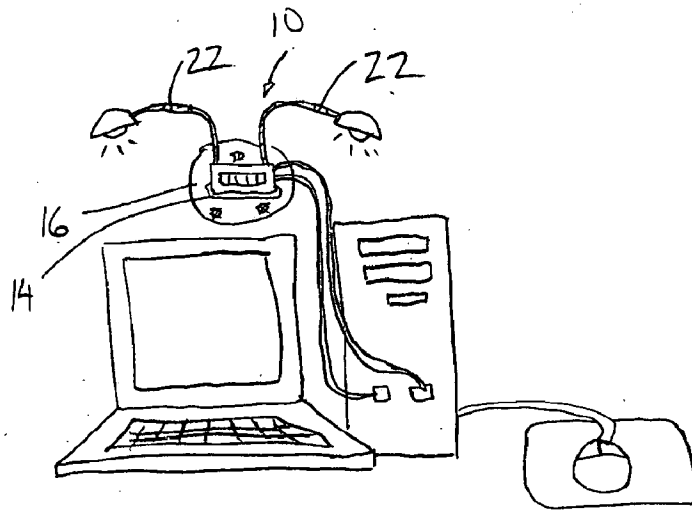


FIG. 6

CAMERA MOUNT

FIELD OF THE INVENTION

[0001] The present invention relates to a camera mount for supporting a web camera on a supporting surface and more particularly relates to a camera mount for supporting a light source in combination with a web camera.

BACKGROUND

[0002] The use of a web camera with a computer is well known. Typically the web camera has a housing supporting a lens therein for capturing a digital image to be recorded on the computer and a base for supporting the housing of the lens thereon. The web camera is typically connected to the computer through a USB port of the computer by an elongate cord. Various other multimedia related accessories for the computer including microphones and speakers and the like, also include elongate cords which can be messy and occupy considerable desk space surrounding a computer. Other problems typically associated with web cameras is poor performance as a result of insufficient lighting.

[0003] Typically, web cameras are supported on an upper, generally horizontal surface of the computer's monitor with tape and the like. Many current computers make use of flat screens however which are difficult to accommodate conventional web camera designs.

[0004] US patents U.S. Pat. No. 4,398,815 to Barzee et al and U.S. Pat. No. 5,921,523 to South et al each disclose camera mounts for supporting a camera thereon, however neither is suitably arranged to support a conventional web camera thereon. Neither camera mount would permit a web camera to be supported on an upright supporting surface. Furthermore, the prior art relating to camera mounts propose no means for supporting a light source suitable for increasing performance of a web camera.

SUMMARY

[0005] According to one aspect of the present invention there is provided a camera mount for supporting a web camera having a lens for capturing a digital image to be recorded on a computer and a base for supporting the lens thereon, the camera mount comprising:

[0006] a bracket for supporting a light source thereon; and

[0007] a platform supported on the bracket for receiving the base of the web camera thereon.

[0008] The use of a bracket for supporting a light source operable in either flash or steady-on modes and a web camera ensures sufficient lighting for optimum performance of the web camera. The use of a platform ensures various designs of web cameras and web camera bases can be accommodated and supported thereon. The bracket also readily permits the camera mount to be supported on an upright supporting surface to remove the clutter of cords from the workspace on a desk supporting a computer thereon.

[0009] The camera mount may be provided in combination with the light source, wherein the light source is supported rearward of the platform when the camera is supported on the platform to face forwardly.

[0010] Preferably the light source and the camera are independently adjustable relative to the bracket.

[0011] There may be provided switch means for operating the light source on the bracket and/or when the light source includes a remotely positioned power source connected to the light source by an electrical cord, switch means may be provided at the power source.

[0012] The light source and the camera mount are preferably connectable to a computer through USB ports. Preferably software is provided in this instance for controlling operation of the light source and the camera independently of one another. The software may permit operation of the light source in various modes, for example a flash camera mode or a strobe mode.

[0013] There may be provided a clamp member for clamping to an edge of a horizontal supporting surface and an upright support slidably supporting the bracket thereon for height adjustment relative horizontal supporting surface.

[0014] According to a second aspect of the present invention there is provided a camera mount for supporting a web camera having a lens for capturing a digital image to be recorded on a computer and a base for supporting the lens thereon, the camera mount comprising:

[0015] a bracket for attachment to an upright supporting surface;

[0016] a platform supported on the bracket for receiving the base of the web camera thereon.

[0017] The camera is preferably adjustable in position relative to the bracket, so as to be pivotal about two axes, oriented transversely to one another, relative to the bracket. Additional, there may be provided a telescoping arm supporting the platform on the bracket for adjusting a relative spacing therebetween.

[0018] There may be provided a pair of inverted U-shaped clips on the bracket for securement to a laptop monitor.

[0019] The bracket may also include a microphone mount, a pair of speakers, or various light sources supported thereon.

[0020] The platform may include a peripheral lip for supporting the base of the camera snugly within a perimeter of the peripheral lip in a snap-fit configuration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] In the accompanying drawings, which illustrate exemplary embodiments of the present invention:

[0022] **FIG. 1** is a side elevational view of a first embodiment of the camera mount.

[0023] **FIG. 2** is a front elevational view of the camera mount according to **FIG. 1**.

[0024] **FIG. 3** is a side elevational view of a further embodiment of the camera mount for support on a laptop monitor.

[0025] **FIG. 4** is a side elevational view of a further embodiment of the camera mount for support above a horizontal supporting surface.

[0026] FIG. 5 is a side elevational view of a telescoping embodiment of the camera mount.

[0027] FIG. 6 is a schematic view of the camera mount in combination with a desktop computer.

DETAILED DESCRIPTION

[0028] Referring to the accompanying drawings, there is illustrated a camera mount generally indicated by reference numeral 10. The camera mount is suitable for supporting a web camera 12 of the type typically connected to a computer by suitable cable for recording either video or still images to the computer in a digital format.

[0029] While various embodiments of the camera are illustrated in the accompanying figures, the common elements will first be described herein. The camera mount 10 includes a platform 14 for supporting the camera thereon. The camera includes a broad flat supporting surface which readily accepts the base of various types of commercially available web cameras 12 to be supported thereon. A support bracket 16 is provided which can be mounted on a suitable supporting surface such as a wall and the like or may be adapted for attachment to a laptop screen in some embodiments. A support arm 18 couples the platform to the support bracket for supporting the camera 12 on the supporting surface to which the bracket is attached. A light mount 20 is provided on the bracket 16 for supporting a light source 22 thereon.

[0030] Turning now to the embodiment of FIGS. 1 and 2 the platform 14 includes a raised peripheral lip which snugly receives a base 26 of the camera 12 snugly within the perimeter of the lip 24 such that the web camera can be securely snap-fit onto the platform. A microphone mount 28 is positioned on the bracket for supporting a microphone 30 thereon.

[0031] The support arm 18 is formed with two pivot joints 32 therein which pivot about respective axis oriented perpendicularly to one another. Also, the platform connects to the free end of the support arm 18 with a ball and socket joint so that the platform 14 can be freely positioned in various orientations relative to the support bracket 16. The joints are all friction joints permitting the joints to remain in a set position once manually adjusted while additionally supporting the weight of the camera 12 and microphone 30 in the selected orientation of the support arm 18.

[0032] The bracket 16 generally comprises a mounting plate 34 having fastener apertures 36 formed therein to permit the use of fasteners for attachment of the mounting plate to a wall or other suitable supporting surface. Receptacles 38 are supported on the mounting plate 34 for selectively supporting lights 22 thereon. A pair of the receptacles 38 are provided at spaced positions on opposing sides of the support arm 18 mounted to the bracket. The mounting plate 34 also supports a pair of switches 40 thereon which can be wired in series with the lights 22 respectively.

[0033] The lights 22 each include an elongate flexible rod 42 which carries wiring therethrough from a base end received in the receptacles 38 to a free end supporting a light bulb 44 thereon. The rods 42 are flexible and are sufficiently stiff to remain in a selected orientation once manually adjusted. Wiring delivering power to the bulbs 44 is connected through the switches 40 to respective power convert-

ers 46 formed in desk top units locating additional switches 48 therein. The elongate cords connecting the power converters 46 to the bracket 16 permits the switches 48 to be positioned remotely from the light sources 22. Adjacent the bulb 44 of each light, a rod 50 is provided which acts as a handle for readily positioning the bulb. A series of lenses 52 are provided which include a snap fit socket which can be secured to the rod 50 to position the lenses to span an opening of the housing locating each bulb 44 therein.

[0034] The bracket 16 also includes two speaker receptacles 54 formed on the mounting plate which selectively receive respective speaker mounts. The receptacles 54 are located on opposing sides respectively of the arm 18 mounting the camera thereon to permit speakers 56 to be mounted on opposing sides of the camera and light source. Each speaker mount generally comprises an elongate flexible support arm with a bracket at a free end thereof for supporting a respective one of the speakers 56 thereon to permit speaker position to be manually adjusted as desired.

[0035] Turning now to the embodiment of FIG. 3, the bracket 16 is adapted to include inverted U-shaped clips 60 which can be secured overtop of the top edge of a lap top display monitor 62 in a snap fit engagement therewith. The remaining features of the bracket including the adjustable support arm 18 and light sources 22 remain identical to the previous embodiment.

[0036] Turning now to FIG. 4 a further embodiment of the bracket 16 is illustrated for support on a horizontal desk top surface 66 and the like. A clamp 68 adjustably clamps over an edge at a periphery of the desk surface 66. A pair of mounting rods 70 extend vertically upward therefrom for slidably supporting the support bracket 16 thereon. The support bracket 16 in this instance includes mounting apertures slidably receiving the rod therethrough. The rod in this instance is notched at spaced positions for cooperation with a spring loaded bearing located in the apertures of the support bracket which receive the rods therethrough. The bearings cooperate with the notches and the rods 70 for selectively supporting the bracket 16 at any one of the spaced notches along the rod similar to many conventional click-stop mounting configurations.

[0037] As illustrated in FIG. 5, in a further embodiment of the support arm 18, the arm may be provided with telescopic sections 72 to permit the platform 14 to be extended away from the bracket as desired. Preferably the telescopic sections 72 are located between the pivot joints 32 of the arm and the platform to permit telescopic extension in any desired direction as set by the joints 32.

[0038] As illustrated in FIG. 6 both the camera and the lights supported on the bracket 16 may be coupled to the USB ports of a computer including suitable software thereon for controlling activation of the camera and lights independently of one another by selecting options displayed on the monitor using a mouse. The software control permits the light source to be activated as a camera flash when taking still pictures with the camera, or may cause the lights to remain in a steady on position when using the camera for video. Independently of camera use, the lights can also be controlled for strobe operation or for dimming and the like. In combination with the various lenses that can be snap-fit onto the rod of the light sources 22, various lighting configurations are possible.

[0039] In the various embodiments described herein, the support arm may be extendable and provided with various joints including knuckle joints or knee joints to permit the camera or a mic to be readily positioned in relation to the mounting bracket supporting the camera thereon. Various platform designs are possible to accommodate different styles of cameras. In some embodiments the support arm 18 may be controlled by actuators to adjust the position thereof remotely or manually as desired. Variation of the platform may also be accomplished to support various designs of mics thereon.

[0040] The incorporation of speakers are also possible as described above by either providing mounting locations on the support bracket 16 or on the platform 14 in which case the position of the speakers are adjustable with the camera.

[0041] When using software control, an icon may be provided of the task bar of the computer desktop to permit control of the lights including dimming functions and the like.

[0042] Installation of a chip would permit the lights to work as a flash for still pictures powered by a computer via USB ports and the like. The platform itself can be designed to form various shapes representative of any desired object of which the appearance is desirable.

[0043] By providing a camera mount according to the present invention, much of the clutter and mess from cables and the like are removed from the desk surface supporting the computer thereon. Furthermore no sticky tape or other mounting configurations including screw holes and the like are required to be attached to the monitor. The wires operating the camera and light sources can instead run along the wall behind a desk or other supporting surface of the computer. The camera mount also permits a web camera to be supported in instances where flat screens previously did not permit support of the camera at all. The lighting is operable independently of the camera to permit lighting of a workspace surrounding the computer as desired. The light sources preferably operate from twelve volt transformers which consume minimal power while permitting operation through the computer control as desired.

[0044] In some embodiments the platform 14 may be provided by itself with the support bracket simply for supporting the camera thereon out of the way of the user. It is desirable however to provide a combination of a support for lights and for a web camera to ensure adequate lighting when using the video mode of the web camera. The lights in this instance are supported rearwardly of the camera to eliminate glare on the camera lens. In some embodiments the bracket may be adapted to support a combination of a camera, a microphone, light sources and speakers to permit all wiring of accessories relating to multimedia computer tools to be held out of the way rearwardly of the computer.

[0045] While various embodiments of the present invention have been described in the foregoing, it is to be understood that other embodiments are possible within the scope of the invention. The invention is to be considered limited solely by the scope of the appended Claims.

1. A camera mount for supporting a web camera having a lens for capturing a digital image to be recorded on a computer and a base for supporting the lens thereon, the camera mount comprising:

a bracket for attachment to an upright supporting surface;

a platform supported on the bracket for receiving the base of the web camera thereon.

2. The camera mount according to claim 1 wherein the camera is adjustable in position relative to the bracket.

3. The camera mount according to claim 1 wherein the camera is pivotal about two axes, oriented transversely to one another, relative to the bracket.

4. The camera mount according to claim 1 wherein there is provided a pair of inverted U-shaped clips on the bracket for securement to a laptop monitor.

5. The camera mount according to claim 1 wherein there is provided a microphone mount on the bracket.

6. The camera mount according to claim 1 wherein the platform includes a peripheral lip for supporting the base of the camera snugly within a perimeter of the peripheral lip.

7. The camera mount according to claim 1 wherein there is provided a telescoping arm supporting the platform on the bracket.

8. The camera mount according to claim 1 wherein there is provided a pair of speakers supported on the bracket.

9. The camera mount according to claim 1 wherein there is provided a pair of lights supported on the bracket.

10. A camera mount for supporting a web camera having a lens for capturing a digital image to be recorded on a computer and a base for supporting the lens thereon, the camera mount comprising:

a bracket for supporting a light source thereon; and

a platform supported on the bracket for receiving the base of the web camera thereon.

11. The camera mount according to claim 10 in combination with the light source, wherein the light source is supported rearward of the platform when the camera is supported on the platform to face forwardly.

12. The camera mount according to claim 11 wherein the light source is adjustable in position relative to the camera.

13. The camera mount according to claim 10 wherein the light source and the camera are independently adjustable relative to the bracket.

14. The camera mount according to claim 10 wherein the bracket is suitably arranged for being supported on an upright supporting surface.

15. The camera mount according to claim 10 in combination with the light source, wherein there is provided switch means for operating the light source on the bracket.

16. The camera mount according to claim 10 in combination with the light source, wherein the light source includes a remotely positioned power source connected to the light source by an electrical cord and switch means at the power source.

17. The camera mount according to claim 10 in combination with the light source, wherein the light source and the

camera mount are connectable to a computer and wherein there is provided software for controlling operation of the light source.

18. The camera mount according to claim 17 wherein the software permits operation of the light source in a flash camera mode.

19. The camera mount according to claim 17 wherein the camera and the light source are independently controlled by the light source.

20. The camera mount according to claim 10 wherein there is provided a clamp member for clamping to an edge of a horizontal supporting surface and an upright support slidably supporting the bracket thereon for height adjustment relative horizontal supporting surface.

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