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(71) Applicant (for all designated States except US): **PUR-SUIT ENGINEERING LLC** [US/US]; 1280 Holden Road, Suite 109, Milford, MI 48381 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **DEAN, David, A.** [US/US]; 3880 Watuga Street, Commerce Township, MI 48390 (US). **DRUMSTA, Richard** [US/US]; 1130 Abigail Court, Walled Lake, MI 48390 (US). **YACOBELLI, Fred, I** [US/US]; 791 Harvey Lake Road, Highland, MI 48356 (US). **WESLEY, Zaydel** [US/US]; 1280 Holden Road, Suite 109, Milford, MI 48381 (US). **ZAYDEL-WINOWSKI, Michelle, A.** [US/US]; 1280 Holden Road, Suite 109, Milford, MI 48381 (US).

(74) Agent: **DORT, David, Bogart**; Dort Patent, P.c., Pox 26219, Crystal City Station, Arlington, VA 22215 (US).

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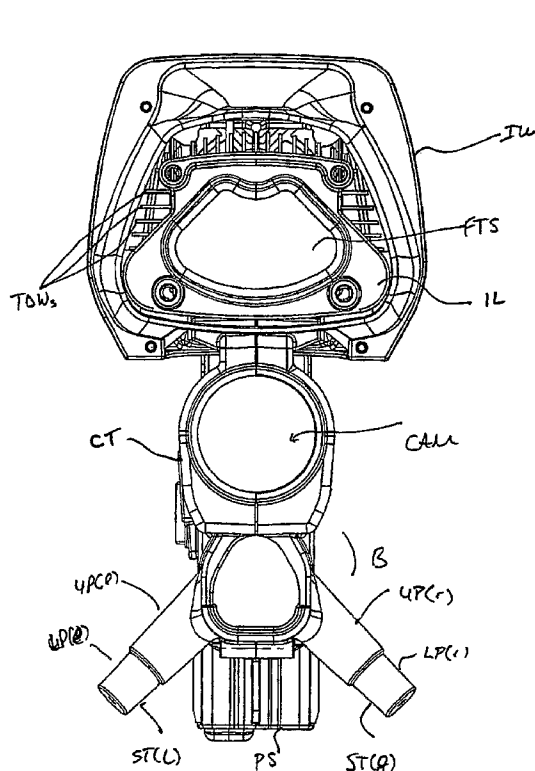
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(54) Title: REDUCED-FOOTPRINT SURVEILLANCE SYSTEM USING NIGHT ILLUMINATION LASER SYSTEM



(57) Abstract: The present invention provides for a surveillance unit that is configured in the form a "rifle" or hand-held upright, that includes a camera that is illuminated by a laser diode light diffusion unit that comprises a casing with a lens cover that holds a laser diode mounted on a heat sink, a mirror, a collimator lens and a holographic diffusion screen. The casing of the diffusion unit is made of a rigid thermally conducting material, and the heat sink is mounted within the casing such that a concentrated beam of light produced by the laser diode is directed at the mirror. The concentrated beam of light directed at the mirror is reflected at approximately 90° into the base of the collimator lens where the collimator lens converts the concentrated beam of light into a plane of light that is projected over and in opposite direction to the path of the concentrated beam of light. The plane of light then passes through the holographic diffusion screen, where the holographic diffusion screen spreads the plane of light at predetermined angles which then passes through the lens cover and out of the casing so that the camera can allow a viewer to see in night-time, smoke, fog or other adverse conditions. The camera is kept in a rugged plastic unit on top of a base, to which a viewing unit is also attached. The base includes a rechargeable power supply. Optional stabilizers allow the surveillance unit to be placed in strategic locations.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Reduced-Footprint Surveillance System Using Night Illumination Laser System

Cross-Reference to Related Applications

[0001] This Application claims priority under 35 USC §120 and is a continuation-in-part of co-pending application Serial No. 11/675,252, filed February 15, 2007, which is a continuation of US Application 10/978,829 filed October 29, 2004 by David A. Dean et al, now US Patent 7,186,006, issued March 6, 2007, which is fully incorporated by reference herein, for all purposes, which claims priority to US provisional application 60/522,525, filed October 8th, 2004, by David Dean, et al.. All of the above mentioned documents are all hereby incorporated by reference.

[0002] This application also claims priority under 35 USC §119(e) to US Provisional Application Serial No. 60/794,104, filed April 24, 2006, and is incorporated by reference for all purposes.

Summary of the Invention

[0003] The present invention contemplates the application of specialized infrared illumination units in compact and rugged surveillance units. The illumination units, *inter alia*, facilitate illumination of an area with a laser diode light source that has been diffused by the light diffusion unit, so that the area may be observed by an appropriate camera and shown on a visual display for surveillance purposes. The surveillance unit can be configured such that it is a portable rugged form that is useful in the field and in a first embodiment is in a "rifle form" in which the "barrel" acts as the camera tube and the stock act as stabilizers. In a second embodiment, the surveillance unit is upright instead of in a "rifle" form and may be more appropriate for other field uses. The light diffusion unit of the surveillance system is generally encased in a thermally conductive material that is approximately 6 inches (15 cm) long, 3.0 inches (7.5 cm) wide

and 3.5 inches (8.75 cm) high and approximately 2 pounds (0.9 kg). one or more laser diode light sources direct a concentrated light beam at a mirror that then reflects the light into the base of a collimator lens. The collimator lens turns the concentrated beam of light into a plane of light projected normal to the source beam. The radiation field in the form of a "plane" projects the plane of light passes over the path of the concentrated beam of light. This plane of light then passes through a light diffuser that spreads the light in a determined pattern and generally acts as a Fourier transform (or other desirable non-linear transform) for the radiation (light) plane. In the illumination unit, the intensity of illumination is directly related to the power of the laser diode and the efficiency of the system. Laser diodes in the 10-20 watt range will typically be used, although wattages outside this range can also be used depending on the application. The efficiency of the system depends in large part on the quality of the parts used; however, an efficiency of 65% is readily obtainable and can reach higher efficiencies depending on the type may be reached and quality of various components, needed by the end-user, particularly the lenses. The frequency of the illuminating light can also be varied, but in certain embodiments, it is in the 800-950 nm range (infrared).

[0004] These and other objects, features, and advantages in accordance with the present invention provide particular embodiments with a portable laser diode light diffuser that comprises a casing. The casing is comprised of rigid, thermally conductive materials and one or more laser diode light source, where the one or more laser diode light source emits a concentrated beam of light at a predetermined wavelength. A mirror reflects the concentrated beam of light from the laser diode into a collimator lens. The collimator receives the concentrated beam of light and projects the concentrated beam of light into a "plane" of light and then into a diffusion screen, where the diffusion screen spreads the plane of light a predetermined amount. The portable laser diode light diffuser illuminates an area in front of the portable laser diode light diffuser, and the efficiency of the portable laser diode light diffuser is approximately 65% but can go higher. Also,

in most embodiments, the path of the plane of light passes over and in an opposite direction to the concentrated beam of light.

Brief Description of the Figures

[0005] The invention is explained in more detail by way of example with reference to the following drawings:

FIG. 1 illustrates a side view of a first embodiment of the surveillance unit;

FIG. 2A illustrates a front view of the surveillance unit;

FIG. 2B is a rear side view of a first embodiment of the surveillance unit;

FIG. 2C is front-side angle view of a first embodiment of the surveillance unit;

FIG. 2D is a second front side angle view of a first embodiment of the surveillance unit;

FIG. 3A illustrates the details of the base of the surveillance unit;

FIG. 3B illustrates the details of the base from a second side;

FIG. 3C illustrates the mounting of the visual display on the base;

FIG. 4 illustrates a second embodiment of the surveillance unit in a first view;

FIG. 5 illustrates a cutaway view of the light diffuser unit as may be implemented in various units;

FIG. 6 illustrates a light diffuser unit as may be used in various embodiments;

FIG. 7 illustrates an intensity spread of planar light emitting from a collimated lens as would occur in one embodiment of the present invention.

Detailed Description of the Invention

[0006] FIG. 1 shows a first embodiment of the invention from a side-view. The invention is a surveillance unit, particularly suitable for night use, but is also usable for other difficult viewing conditions such as fog, smoke, and may even be suitable for underwater use in other embodiments.

[0007] FIG 1 shows the basic components of the surveillance unit 100, which includes a specially-adapted (infrared) illumination unit IU and a base unit B. The illumination unit IU provides much of the radiation necessary for the improved surveillance, due to the novel radiation distribution features of the illumination unit, which are the subject of US Patent Application 10/978,829, published as 2006-77662, fully incorporated by reference herein. Also included in the base B of the unit 100 are stabilization handles SH(f) and SH(r), which in the first embodiment are in the form of a "gun handle" for easy and versatile handling of the surveillance unit. Other structural features that help stabilize the unit 100 include stabilizers ST, which may help form a "tripod" structure so that the unit may be placed in a position for long periods of time without user effort. The visual screen VS allows for the viewing of the camera unit CAM which is illuminated by the infrared illumination unit IU. In general, a standard LCD display can be used, but specialized LCD units may be chosen based on any specific needs of the end-user. For example, low-power units may be specifically desirable for embodiments of the invention that require use in the field for long durations.

[0008] The unit may be powered by any of several ways without departing from the scope of the invention. However, in the first embodiment, the unit includes a power supply PS and recharge unit RU in the base B of the surveillance unit.

[0009] FIG. 2A shows the detail of the first embodiment of the surveillance unit 100 from the front view. The illumination unit IU can be seen in more detail and includes an illuminator IL and supporting structural configurations. The illuminator IL is the subject of US Patent Application 10/978,829, filed October

29, 2004 and provisional application 60/522,525, filed October 7, 2004. Most of the text of the application is included herein in the Application below.

[0010] The camera CAM is located in the from center of the unit in the camera tube CT and as shown in the first embodiments can be a mode of video camera that is capable of viewing under harsh conditions and illuminated by the special infrared radiation, and rugged enough to withstand the environment of the desired end-use of the surveillance unit 100.

[0011] As will be detailed more below in a description of the illumination unit IU, the unit has features that allow it to be used in the rugged environment. One of the key features is the heat-sinking characteristics of the illumination unit. Thermal dispersion wings TDWs are form the outer portion of the illuminator IL and are generally made of aluminum or other heat dispersion material. In other embodiments, certain plastics may also be used.

[0012] The optional stabilization structures ST(l) and ST(r) may be folded into the base of the unit 100 and provide the option of placing the unit a "rotating position" in certain embodiments. The stabilization structures ST(l) and ST(r) may also option include upper and lower parts which fold into each other. The base B, includes a built-in and optionally removable power source PS. The power source PS is generally charges through a charging unit (see FIGS. 4A-F) and powers the illuminator IL, the camera C and the visual display VS.

[0013] FIG. 2B provides a rear side view of the assembled surveillance unit 100. The optional folding handle unit FH, allows for compact storage of the unit, or for additional maneuverability. The forward stabilization handle SH(f) may also optionally fold up so that it is generally parallel to the base B. In general, the unit 100 is primary made of hard and lightweight durable plastic into which the electrical components may be easily assembles and protected for rugged field use. FIG. 2C is a front-side view of the first embodiment of the surveillance unit 100 and FIG. 2D is an opposite front-side view of the first embodiment.

[0014] FIGS. 3A and B show the base B and camera tube CT in a disassembled state from the surveillance unit 100 shown in FIGS. 1-2D. Also shown are the particular mounting units. The mounting bracket for the visual display MB(v) may be the single bracket unit as shown, or any time. The illumination mounting bracket MB has adjustable left and right portions MB(l) and MB(r) in which the illumination unit IU may be moved forward or backward over the camera tube CT, as is needed for field use.

[0015] FIG. 3C shows the surveillance unit 100 with the visual display VS mounted, but without the illumination unit IU. One of the features of the surveillance unit 100 is that in certain alternate embodiments, different illumination units may be interchanged depending on the end-use needs of the invention. Thus, a low-power infrared illumination component IU may be substituted when longer battery life is necessary.

[0016] Referring now to FIG. 4 a second embodiment of the surveillance unit 100' is shown. The second embodiment is more 'upright' than the first embodiment, but generally includes all of the same basic components save the stabilization supports and handles. The "upright" model shown in FIG. 4 may be more appropriate for certain types of field uses in which a shorter "footprint" is needed. This may include surveillance uses on vehicles, hand-held models, uses on robots, and other end-use needs that may require a smaller "footprint."

[0017] FIGS. 5-7 discuss elements of the illumination unit IU as shown in FIGS 1-4, as may be implemented in the invention. . Particular embodiments of the invention are useful in illumination in conjunction with many night-vision technologies or other applicable areas, such as surveillance, search and rescue, robot vision, machine vision, etc. Laser diodes are an excellent source of illumination and can provide radiation for a variety of different spectrums, particularly infrared. Unfortunately, the laser diodes produce a very tight beam of light, which essentially over-illuminates a very small area, as well as creates damage to the human eye.

[0018] The present invention diffuses the laser diode light beam so that a much larger area can be thoroughly illuminated than would otherwise be possible with laser diode illumination sources. The spreading of the light beam is controlled by a variety of diffusers and lenses, and can be adjusted according to the needs of the user. However, the size of the laser light diffuser is reduced in comparison to that of the prior art. The reduction is partly accomplished by redirecting the light beam source back over itself as it is being diffused.

[0019] Referring to Fig. 5, one embodiment of a illumination unit IU as used in the embodiments of the invention shown in FIGS. 1-4,. The illumination unit IU illustrated comprises a laser diode source 2 that projects light into a collimator lens 4. In this manner, a single beam of high intensity light is transformed into a plane of projected light 6. The plane of projected light 6 passes out of the light diffuser unit, usually through a diffuser screen 8 to illuminate an area.

[0020] The laser diode 2 may be of a variety of types, such as an Osram™ diode. In some embodiments, the light from the diode is non-collimating, but can also be divergent in particular embodiments. Typical diodes project light as a tight rectangle. A non-collimating diode projects light as an expanding rectangle. The dimensions of the rectangle will vary depending on application, as well as on the internal geometries of the light diffusion unit. In particular embodiments, the wavelength of the light produced by the diode does not change by being diffused by the light diffusion unit.

[0021] In the embodiment illustrated in Fig. 5, a single laser diode 2 is used. In other embodiments, a plurality of laser diodes can be used in close conjunction with one another. The plurality of laser diodes may be of the same frequency, to produce a stronger projected light, or they may be of a variety of frequencies so that a diffuse light with a greater frequency range is produced.

[0022] In addition to the above, particular embodiments allow specific color effects to be accomplished. These color effects may be accomplished by a second type of laser diode, or may be accomplished by flooding the unit with

another type of light external to the illustrated light path. For example, in the 808 nm range discussed below, the light diffusion unit will illuminate an area with invisible light, however, a small amount of red spectrum visible light will also be produced. Since red lights have particular meanings in many industries, it may not be desirable to have the light diffusion unit shine red. A second visible light source can be added almost anywhere within the light diffusion unit. For instance, green floods out the red glow, creating an 808 nm invisible light source that also appears to shine green. Of course the second light source, unless emitted from a diode and forced through the illustrated pathway, will not illuminate in the same manner as the first.

[0023] Alternately, the plurality of laser diodes can be pulsed so that diodes of the same frequency can produce a continuous stream of plane projected light, or at least continuous enough to the human eye or equipment monitoring the light diffuser unit. In this embodiment, the pulsing of the diodes reduces their heat output and also increases the life expectancy of the diodes. It is also possible that a light diffuser unit can function at a variety of different states, such that if a stronger light source is required, multiple diodes turn on simultaneously, while a more heat/energy/life conservative mode can be used in default that pulses the diodes. Additionally, the rate of pulse between the diodes can be changed depending on what is using the light diffuser as a light source. For instance, a camera outfitted with the appropriate filters and lenses for recording the illuminated area, might require more or less pulses of light to function optimally(similar to certain machine vision technologies) than the human eye looking through goggles.

[0024] Efficiency, as used herein, refers to the total intensity of the light as emitted from the laser diode to the total intensity of the light emitted from light diffusion unit. For example, it is preferable if the collimator lens reduces the efficiency of the system by approximately 15% or less. As is known in the art, high-efficiency collimators can be made of expensive materials that are labor intensive to produce, but that can increase efficiency.

[0025] Various types of collimators **4** can be used with the present invention. The basic principle of the collimator is to receive a light source and convert it into a broader column or cone, referred to herein as a plane of light.

[0026] As the projected planar light **6** leaves the casing **10**, it passes through a diffusion screen **8**. The diffusion scatters the light over a broader area, and preferably spreads the light in an even manner, although in some applications, an uneven spreading of the light may be desirable. One type of filter, known as a holographic diffuser, generally acts in a non-linear manner (generally as a Fourier transform) and spreads the light in a uniform way or other intended pattern (depending on the Fourier pattern) without changing its frequency and without a large impact on the net illumination. Holographic diffusers are generally in the form of a thin polycarbonate film or screen, supplied by POC™ of Torrance, CA. The specifications regarding these holographic diffusion systems are available from POC; and included are both "standard" (off the shelf) and "custom" solutions from the aforementioned company. In addition to spreading the light evenly or not, exactly how the light is spread can vary depending on the application and the needs of the end user. Essentially, a wider area of illumination can be spread in exchange for illumination distance and vice versa. A particular range of spread would be 10° vertically, both up and down, and 20° horizontally, to both sides, but will vary depending of the needs of the end user. For example, robot vision for search and rescue will require a different range than a camera recording night surveillance photos.

[0027] A holographic diffuser will reduce the overall efficiency of the light diffuser unit by 5-8%. Therefore optimizing the spread of the light with fewer light diffusers is preferable. However, as given in an embodiment below, sometimes additional light diffusers are added to improve the light spread so that the overall efficiency is optimized and/or the desirable non-linear transform of the light plane emanates from the system. Other components that reduce efficiency but improve the system as a whole may also be used. For example, putting a protective lens, such as a glass or acrylic lens, over the end of the unit may reduce efficiency by about 2-5%, but will provide protection for the diffusion

screen and internal components, and may be part of the end-user's needs, such as manufacturing costs (plastic mold injection, snap-on, etc.). A plastic-mold injection system that can incorporate the holographic diffuser system because of its polycarbonate properties with a tough acrylic lens that can snap into the rigid body is particularly efficient for cost reduction and reduced manufacturing error.

[0028] In this embodiment the casing **10** of the light diffuser is made with rigid, thermally conducting lightweight materials, such as, but not limited to, aluminum. The purpose of the casing **10** is two fold. It provides protection to the instruments within and it diffuses heat (heat sink). Although the collimator lens **4** and mirrors **12** can be themselves made with a variety of materials, ranging from very fragile to relatively non-fragile, it is still preferred that they not be exposed to impact damage. The surfaces of the collimator lens **4** and mirrors **12** further need to be kept as clean and clear as possible, so that the casing **10** is air tight, and in some embodiments filled with gasses that do not scatter the projected light **6**. To aid in the diffusion of heat, the casing **10**, as illustrated in Fig. 1, has a plurality of fins that further aid in the diffusion of heat without adding significant weight.

[0029] The casing itself can be a closed system, in that it can be an air tight unit. This would prevent dust and other materials from collecting on the internal surfaces. However, a particular embodiment allows for the flow of air into the unit while filtering dust particles. GortexTM seals are an example of a passive air filter that does not allow in particle contaminants or water.

[0030] The heat produced from the laser diode can further be dissipated in a number of different ways. One such way is to place the diode on a heat sink **16**, such as a copper block, which may include up to 100 percent copper (which is preferably not machined directly). Although heat sinks will increase the weight of the light diffuser unit, there is a trade off between weight and heat diffusion. This trade-off is also dependent on the use of the light diffuser unit. Hand-held models will optimally include a heat sink, while those mounted on machinery

could do without. The addition of a heat sink also limits the infrared light pollution that might otherwise contaminate the projected light 6 in some applications.

[0031] The heat sink itself might have an interface between itself and/or the diode and the casing. For example, indium foil can be placed between the diode and a copper block to improve dissipation. Also, other materials such as Wakefield Thermal Compound heat conductive grease can be used between the heat sink and the casing. Fans, both internal and external can also be used. An internal fan would optimally blow on or near the laser diode, while an external fan would supply air to the internal space. In addition, thermal electric coolers or TE coolers can be used to move heat from the heat sink to the external housing for greater heat transfer.

[0032] In Fig.5, a mirror 12 reflects the laser diode light to the collimator lens 4. To make a light diffusion unit effective, the light emitted from the laser diode 2 needs to travel a certain distance before contacting the collimator lens 4. By reflecting the light in a mirror, the light is able to travel the required distance, but the space required in the light diffusion unit is essentially halved. This allows for the size of the light diffusing unit to be greatly reduced. In Fig. 1, the light from the diode travels approximately 2-3 inches (5-7.5 cm) to the mirror and then a short distance to the collimator lens. The use of a mirror in this manner will reduce the overall efficiency by approximately 1% to 5% or even less depending on the quality of the mirror.

[0033] The angles of the mirror in relation to the diode can be adjusted depending on what angle the diode is in relation to the collimator lens originally. In the embodiments illustrated, the light from the diode is changed by a 90° angle before contacting the collimator lens. Without the mirror, the laser diode needs to hit the collimator lens directly from below, however, the diode cannot be positioned too close to the lens. This is because the light from the diode needs to travel a certain distance so that proper spread is achieved. Also, the heat from the diode may damage some types of lenses.

[0034] In the embodiments shown, the light beam produced by a laser diode is passed back over itself as it is being diffused. The figures therefore have a sense of "up" for clarity. It would be apparent to one of ordinary skill in the art, however, that the configurations shown can be rotated at almost any angle to produce the same result. In fact, in some embodiments, it may be desirable to have the layout rotated 90° or 180° so that heat produced by the diode interferes less with the projected planar light. Therefore, in referring to the planar light passing "over" the concentrated light beam, this can be equally interpreted as "under," "beside," etc.

[0035] Referring to Fig.6A and 6B, the light path is illustrated from a side view as well as from above. One or more laser diodes 2 provide a concentrated beam of light 3 that reflects 90° in a mirror 12 to the base of a collimator lens 4. The concentrated beam of light 3 is naturally a tight beam as it emerges from the diode; however, some diodes produce a slightly rectangular beam, which aids in the diffusion.

[0036] To further aid in diffusion, in particular embodiments, the light may first pass through a first holographic diffusing film 14 which properly spreads the emitting light, generally through a non-linear (usually Fourier) transform. Although passing the light through additional mediums or multiple diffusers reduces overall light efficiency, at this stage it is more desirable to fill the base of the collimator lens. If the concentrated beam of light is produced from a non-collimating laser diode, then this step may not be necessary.

[0037] The concentrated beam of light 3 reflects in the mirror 90° to then strike the base of the collimator lens. The position of the laser diode 2 to the mirror 12 can vary depending on the type of diode used, but is approximately 2-3 inches (5-7.5 cm). Also, in Figs 6A and 6B, the laser diode is positioned straight at the mirror. However, if multiple laser diodes are being used, the diodes would need to be staggered so that the light strikes the mirror at an angle. The change in the light angle after striking the mirror would still be 90° with respect to the vertical, but there would also be a slight shift in regards to the horizontal as well

so that the concentrated beam of light strikes the collimator lens at about the center of its base.

[0038] Once the concentrated beam of light **3** strikes the base of the collimator lens **4**, the light is diffused into a plane of light **6** at a 90° from which it was received. The plane of light **6**, also referred to as projected planar light, is described as such since photons traveling in it are traveling in the same direction and are fairly evenly distributed.

[0039] The plane of light **6** is then spread by a diffusion screen **8**. The diffusion screen in most embodiments spreads the light in a uniform manner, though horizontal spreading may be favored over vertical spreading for certain applications and vice versa, as described above.

[0040] In the embodiments illustrated, there is shown a concave section **20** towards the back of the casing **10**. This is a preferred location for objects such as a fan or monitoring equipment.

[0041] The dimensions of a portable light diffusion unit can vary, but in one embodiment the external casing is approximately 6 inches (15 cm) long, 3.0 inches (7.5 cm) wide and 3.5 inches (8.75 cm) high. Similarly, the weight of the unit can vary, but in the embodiments illustrated is approximately 2 pounds (0.9 kg), with approximately 6 ounces (0.17 kg) of that weight being the heat sink.

[0042] In the applications thus described, the invention has been applicable to any type of light. However, particular embodiments of the invention are used in conjunction with night vision technologies. Light in the range of approximately 800 to 950 nm is particularly useful for this application, though other ranges can also be used. For instance, 808 nm wavelength light is essentially invisible, although a dull red glow may still be seen. 915 nm wavelength light is even more invisible to the human eye. However, night vision equipment, such as a WatchTM CCD black and white camera, reads light at the 808 nm range better than the 915 nm range. So, at the 808 nm range less power is required, since a less intense beam at the 808 nm can be observed with the night vision equipment better than an equivalently powered beam at 915 nm.

Therefore, the wavelength can be varied depending on the corresponding night vision equipment. Some light diffusion units may even have multiple wavelength applications. Other wavelengths may be desirable in trying to make the light invisible to different types of animals for nighttime zoological studies.

[0043] The intensity of invisible light is measured in watts, which is directly a result of the power intensity of the laser diode being used. For example, an 808 nm laser diode that is powered at 10 to 20 watts will produce, at 65% efficiency, a 6.5 to 13 watts diffuse light. Diodes of 7-20 watts and even greater, will typically be used with the present invention, although different intensity diodes can also be used. As the technological development of laser diodes increases, it is expected that upper watt ranges of the present invention will also increase or may also be reduced in (downward) scalable embodiments of the invention.

[0044] Referring to Fig. 7, a typical distribution of the intensity of planar light emitted from a collimator lens 4 is shown. This is a front on view of an embodiment of a collimator lens 4 showing that although the planar light is described above as substantially evenly distributed, areas of intensity are often still present. The planar light will be more intense towards the base of the collimator lens, with a gradual decrease in intensity moving up the lens. Although the intensity change is not abrupt, it does tend to resemble a Gaussian curve 5, or a double Gaussian curve if two light sources are being used.

[0045] Although the present invention is described as illuminating an area in front of the light source, whether with visible or invisible light, like any strong light source area, the sides and even behind the light source become illuminated as the light reflects off of the surfaces.

[0046] In one embodiment, the present invention provides for a portable laser diode light diffuser that comprises a casing, where the casing is comprised of rigid, thermally conductive materials and one or more laser diode light source. One or more of the laser diode light sources emits a concentrated beam of light at a predetermined wavelength. A mirror reflects the concentrated beam of light

from the laser diode into a collimator lens. The collimator receives the concentrated beam of light and projects the concentrated beam of light into a plane of light and then into a diffusion screen, where the diffusion screen spreads the plane of light a predetermined amount. The portable laser diode light diffuser illuminates an area in front of the portable laser diode light diffuser. The efficiency of the portable laser diode light diffuser is approximately 65%. Also, the path of the plane of light passes over and in an opposite direction to the concentrated beam of light.

[0047] In a related embodiment, the mirror is positioned approximately 3 inches (7.5 cm) from the laser diode light source. The casing is composed of aluminum and may have fins to aid in thermal conductivity and also a controlled air intake. The diffusion screen is a holographic diffusion screen. The diffusion screen spreads the plane of light, such as 10° up and down and 20° side to side. However, it can be appreciated that positions and spreads may be adjustable and dimensions scalable, depending on the end uses and the energy requirements of the device.

[0048] In still another embodiment, the casing is approximately 6 inches (15 cm) long, 3.0 inches (7.5 cm) wide and 3.5 inches (8.75 cm) high and weighs approximately 2 pounds (0.9kg) using a laser diode of 7-20 watt strength.

[0049] In another related embodiment, the predetermined wavelength is invisible to the human eye, such as 800-950 nm. In another embodiment, an additional light source is present within the casing to flood visible light produced by the laser diode.

[0050] In one embodiment, the diode is mounted to a heat sink, such as copper, which may include up to 100 percent copper that also may be non-machined.

[0051] In some embodiments, multiple laser diodes are used. These laser diodes may pulse at different times, providing a continuous stream of light to the collimator lens, or they may be activated together to provide an enhanced beam

of light to the collimator lens. The laser diodes may all be of the same wavelength or they may have different wavelengths.

[0052] In another embodiment, the present invention provides for a laser diode light diffusion unit that comprises a laser diode, a mirror and a collimator lens. The laser diode produces a concentrated beam of light that reflects in the mirror into the base of the collimator lens, where the collimator lens converts the concentrated beam of light into a plane of light that is projected over and in an opposite direction to the path of the concentrated beam of light.

[0053] The embodiment may also use a first holographic diffusion screen present between the laser diode and the mirror that spreads the concentrated beam of light such that the concentrated beam of light fills the base of the collimator lens. Alternately, the laser diode is a non-collimating laser diode.

[0054] While specific embodiments of the invention have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the invention which, is to be given the full breadth of the claims appended and any and all equivalents thereof.

What is claimed is:

1. A surveillance unit comprising:
 - a camera operatively coupled to a power supply and a display screen and housed in a hard plastic housing;
 - an illumination unit mounted on a camera containing structure, said illumination unit including:
 - a portable laser diode light diffuser comprising:
 - a casing, wherein said casing is comprised of rigid, thermally conductive materials;
 - at least one laser diode light source, wherein said at least one laser diode light source emits a concentrated beam of light at a predetermined wavelength;
 - a mirror;
 - a collimator lens;
 - wherein said above components are configured such that said mirror reflects said concentrated beam of light from said at least one laser diode to said collimator lens;
 - wherein the path of said plane of light passes over and in an opposite direction to said concentrated beam of light,
 - wherein said collimator receives said concentrated beam of light and projects said concentrated beam of light into a plane of light; and
 - a diffusion screen, wherein said diffusion screen spreads said plane of light a predetermined amount;
 - wherein said plane of light illuminates the area in the viewing area of said camera,
2. The surveillance unit as recited in claim 1, wherein said camera housing structure is a tube mounted on a stabilizing base.
3. The surveillance unit as recited in claim 2, wherein said stabilizing base includes a power pack unit.

4. The surveillance unit as recited in claim 1, wherein said predetermined wavelength is from 700-950 nm.
5. The surveillance unit as recited in claim 1, wherein said casing of said illumination unit is substantially composed of aluminum or an aluminum alloy.
6. The surveillance unit as recited in claim 5, wherein said casing has a series of fins to aid in thermal conductivity.
7. The surveillance unit as recited in claim 1, wherein said base and said housing forms the shape of a rifle structure.
8. The surveillance unit as recited in claim 1, wherein said diffusion screen of said illumination unit is a holographic diffusion screen.
9. The surveillance unit as recited in claim 1, wherein said diffusion screen spreads said plane of light 10° up and down and 20° side to side.
10. The surveillance unit as recited in claim 1, wherein said laser diode light source is mounted on a heat sink.
11. The surveillance unit as recited in claim 1, wherein said stabilization base includes a foldable stock.
12. The surveillance unit as recited in claim 1, wherein said unit is formed upright such that a handgrip extends downward from said camera housing unit, and is taller than said illumination and camera housing..
13. A surveillance unit including:
 - a base;
 - a camera encased in a housing resting on top of said base; said camera operatively coupled to a power supply and a viewing unit;
 - an illumination unit configuring to provide infrared illumination in the direction of said camera, said illumination unit using a laser diode light diffusion unit comprising:
 - a laser diode; a mirror; and a collimator lens;
 - wherein said laser diode produces a concentrated beam of light that reflects in said mirror into the base of said collimator lens;

wherein said collimator lens converts said concentrated beam of light into a plane of light that is projected over and in an opposite direction to the path of said concentrated beam of light.

14. The surveillance unit as recited in claim 13, wherein said laser diode light diffusion unit of claim 18, wherein the frequency of said concentrated beam of light is 800-950 nm.

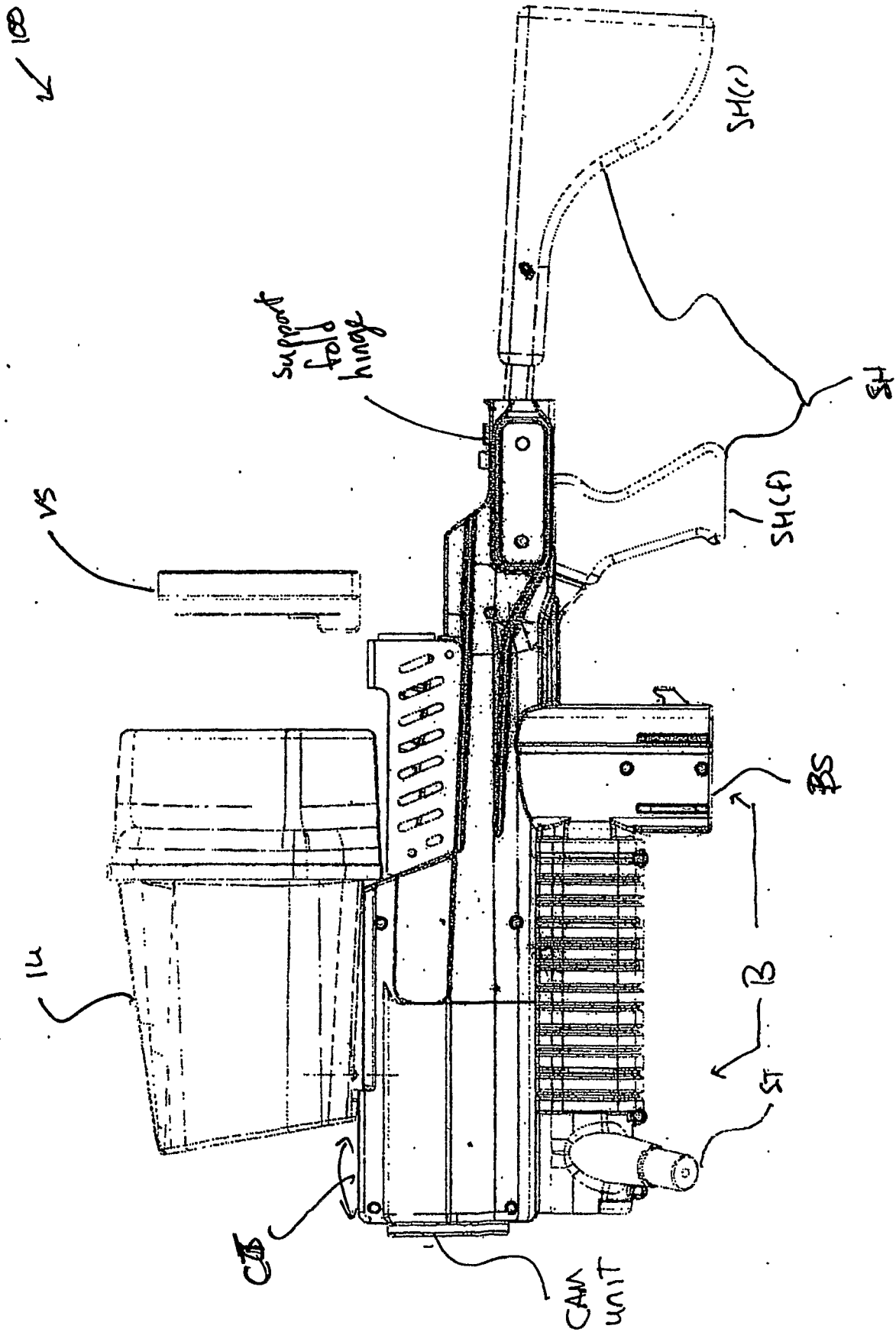


Fig. 1

100
←

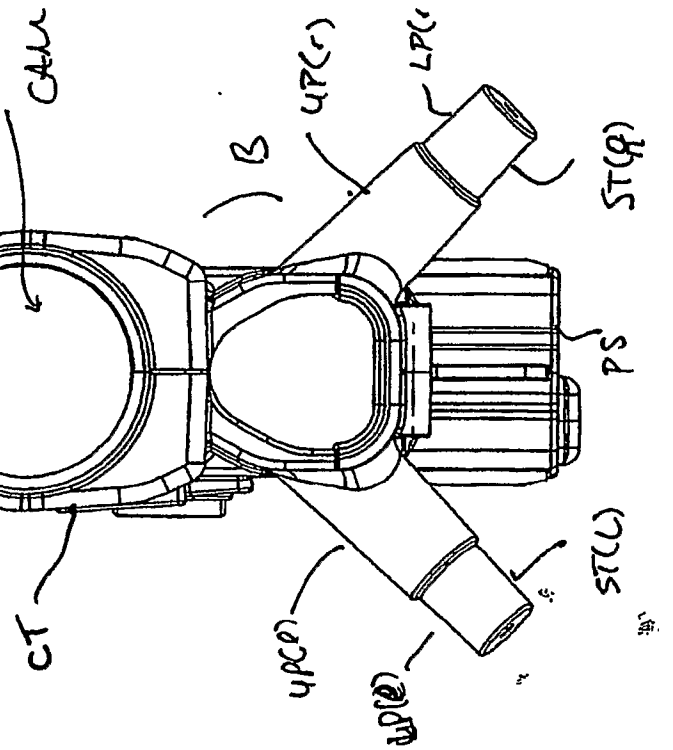
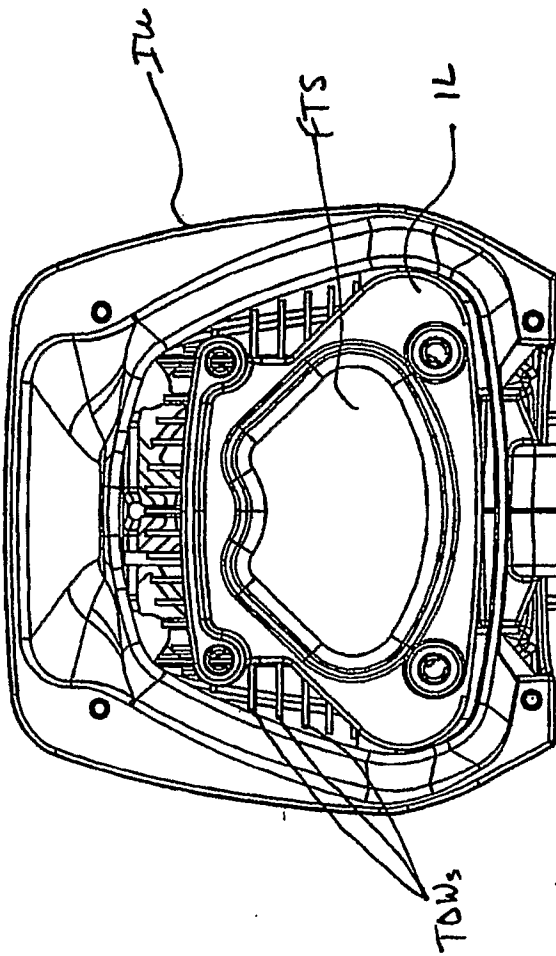


Fig. 2A

100 →

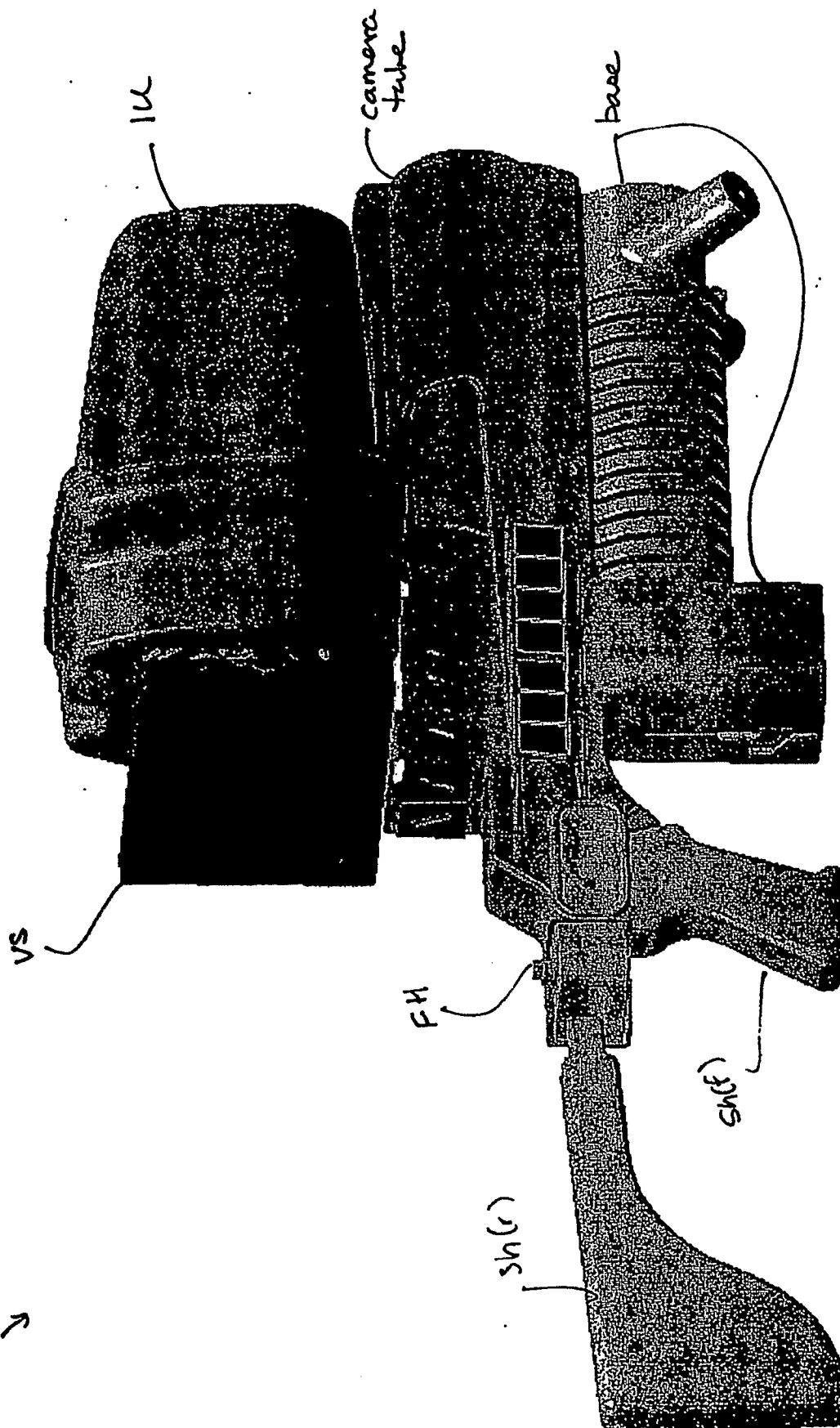


Fig. 28

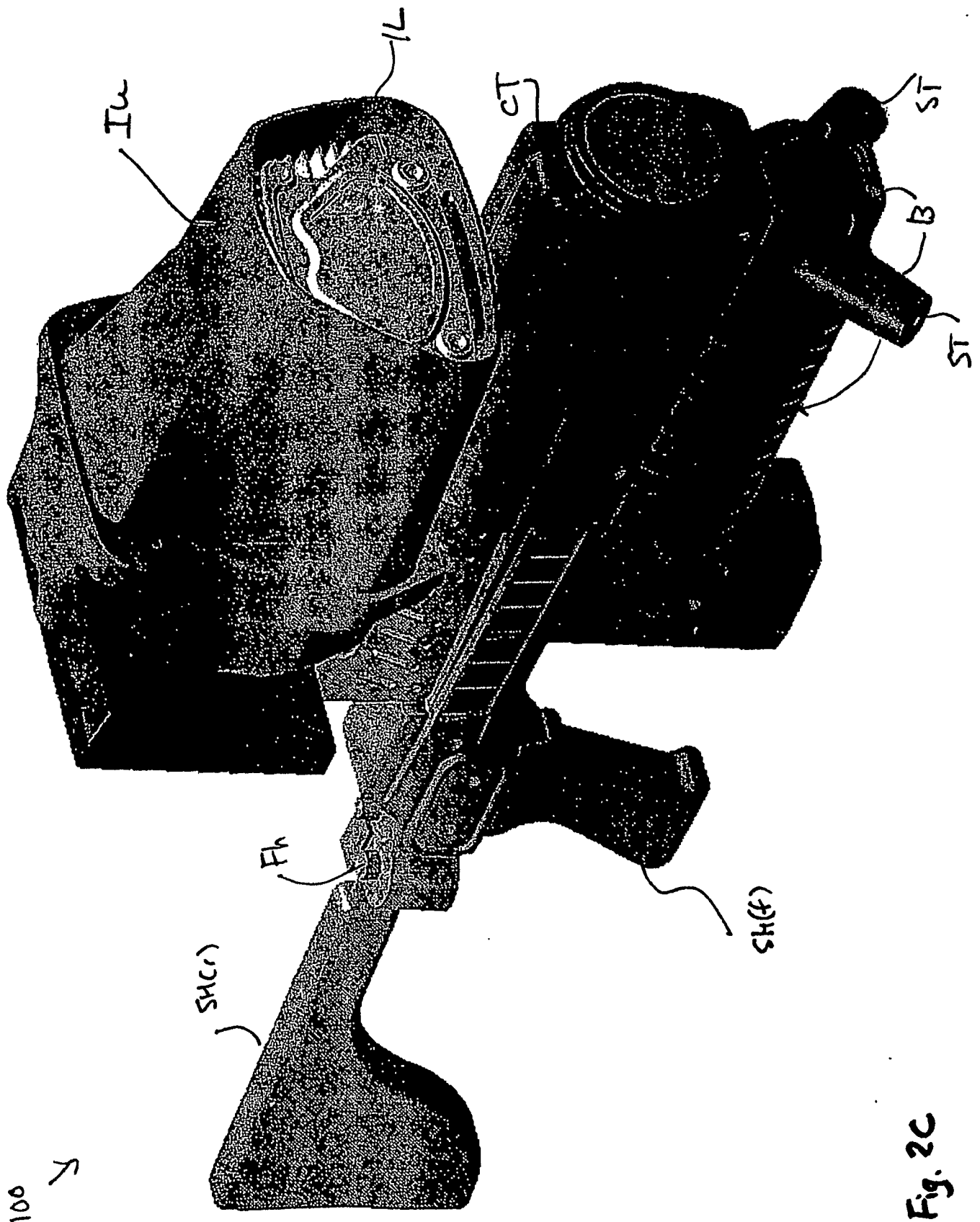
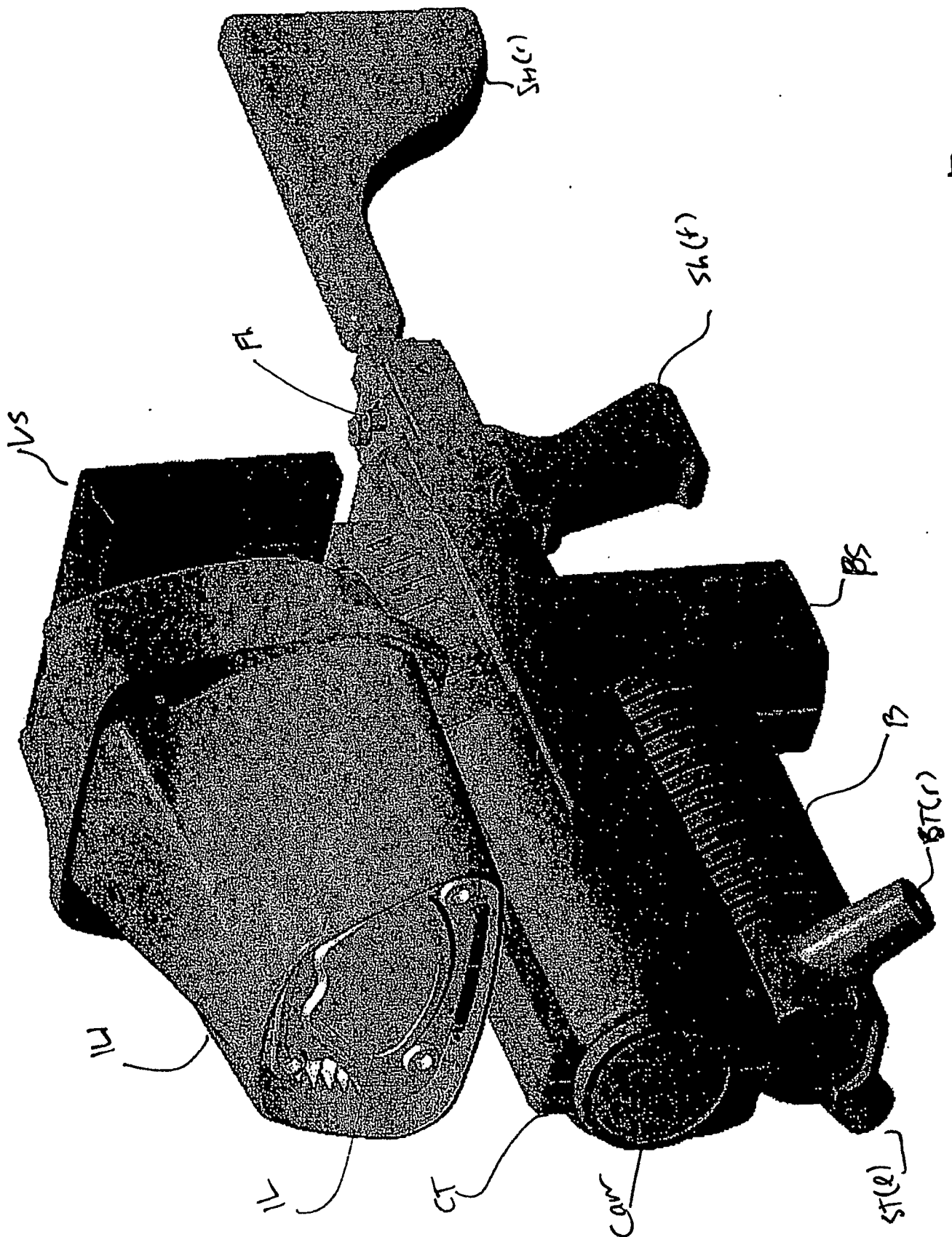


Fig. 2c



25

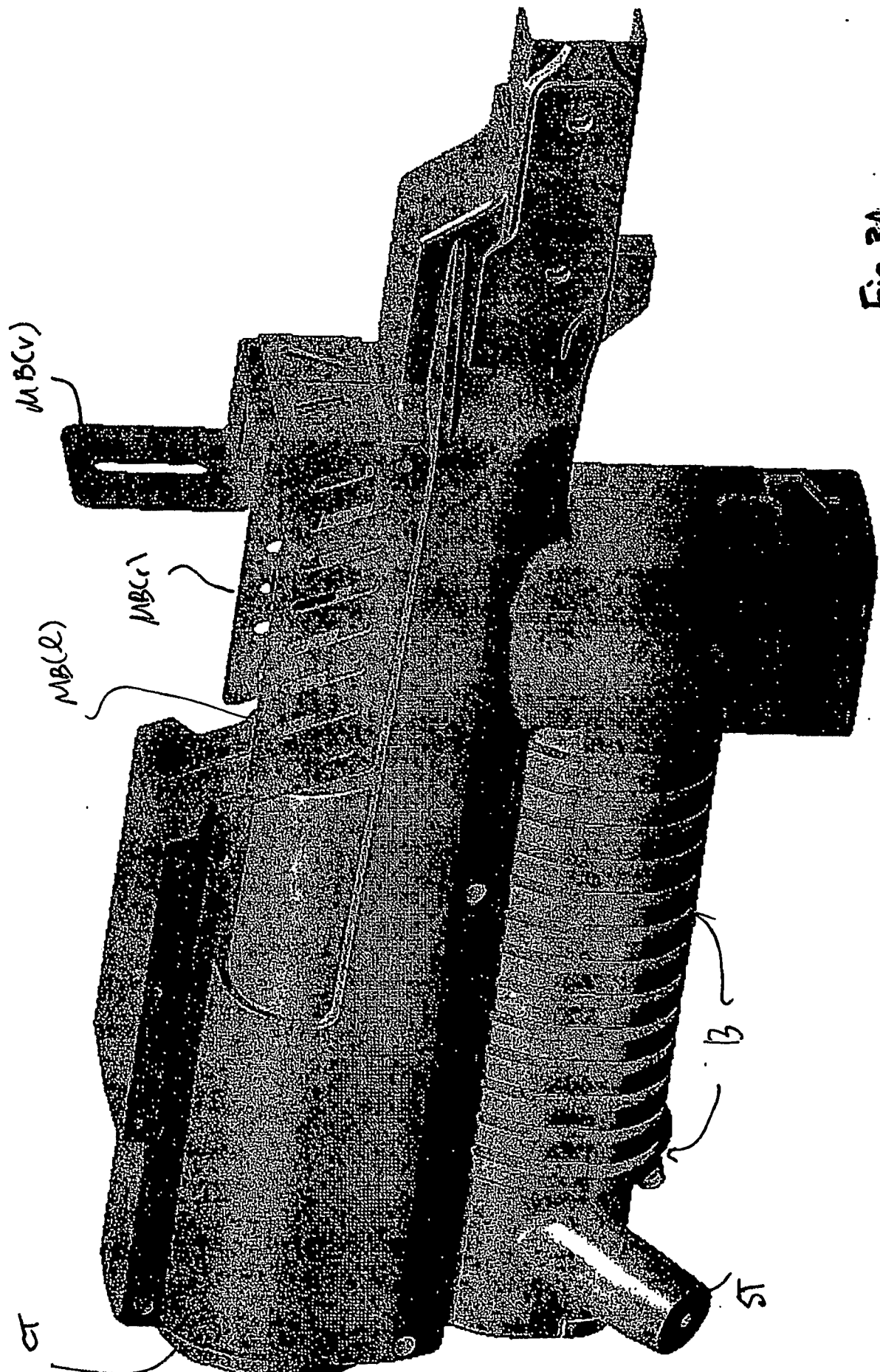


Fig. 3A

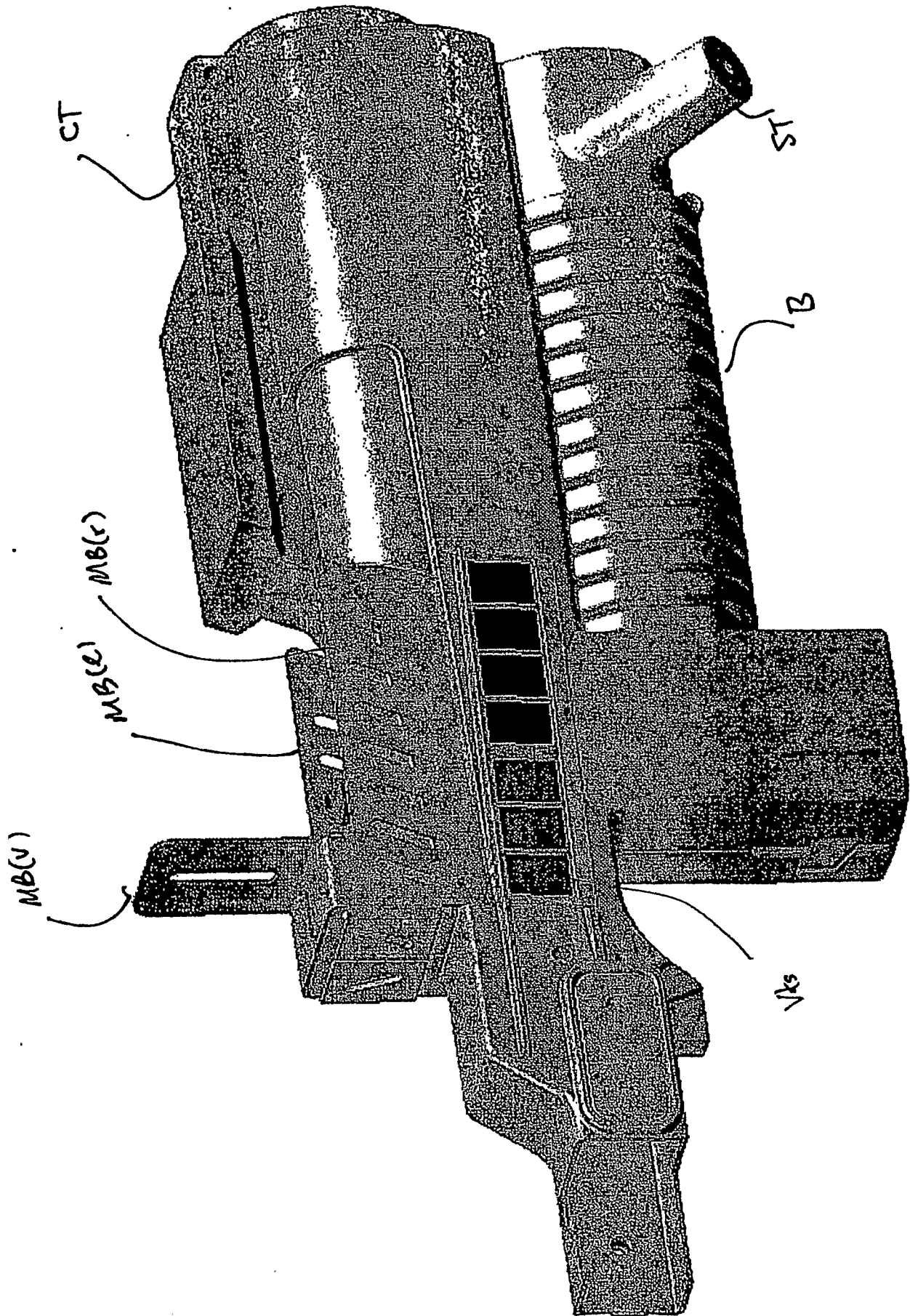


Fig. 3B

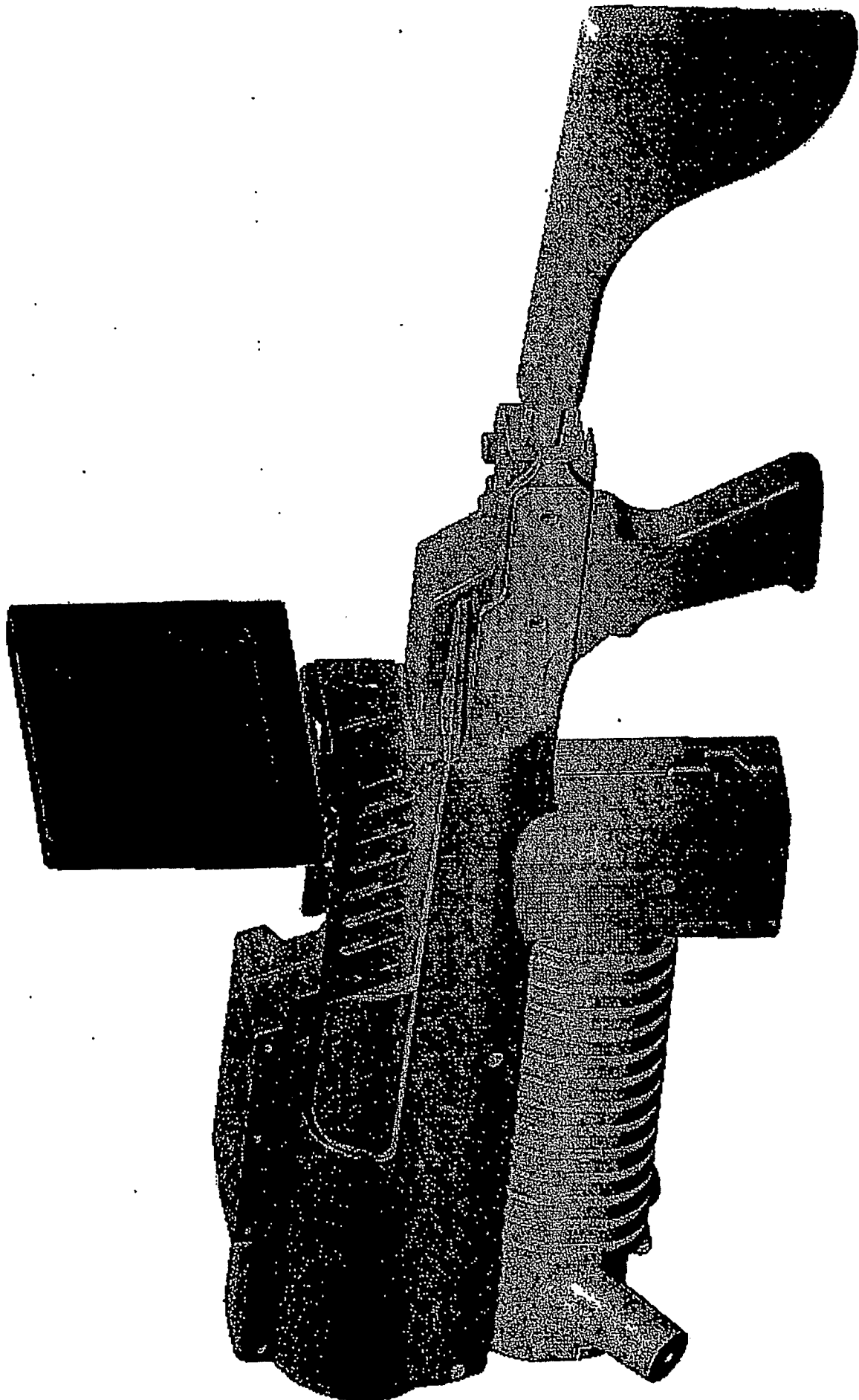


Fig. 3C

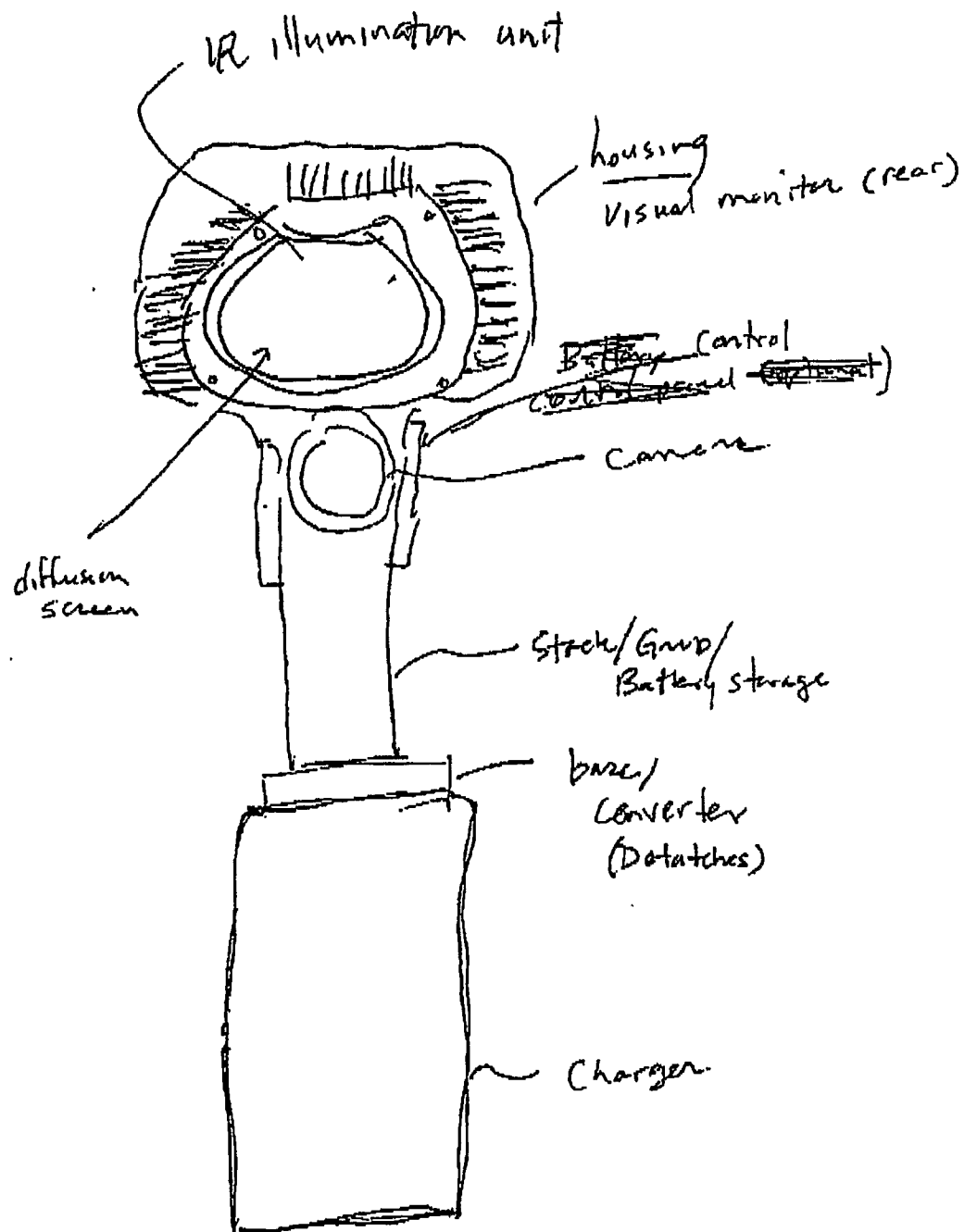


Fig. 4A
(front)

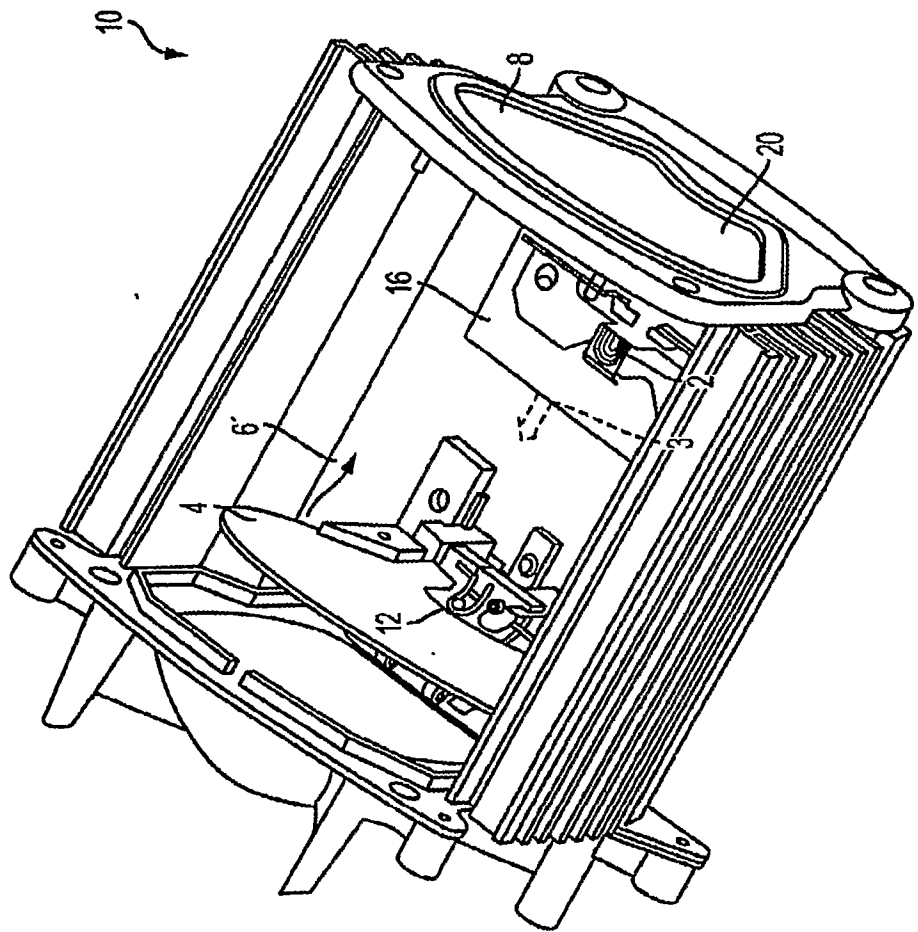


FIG. 5

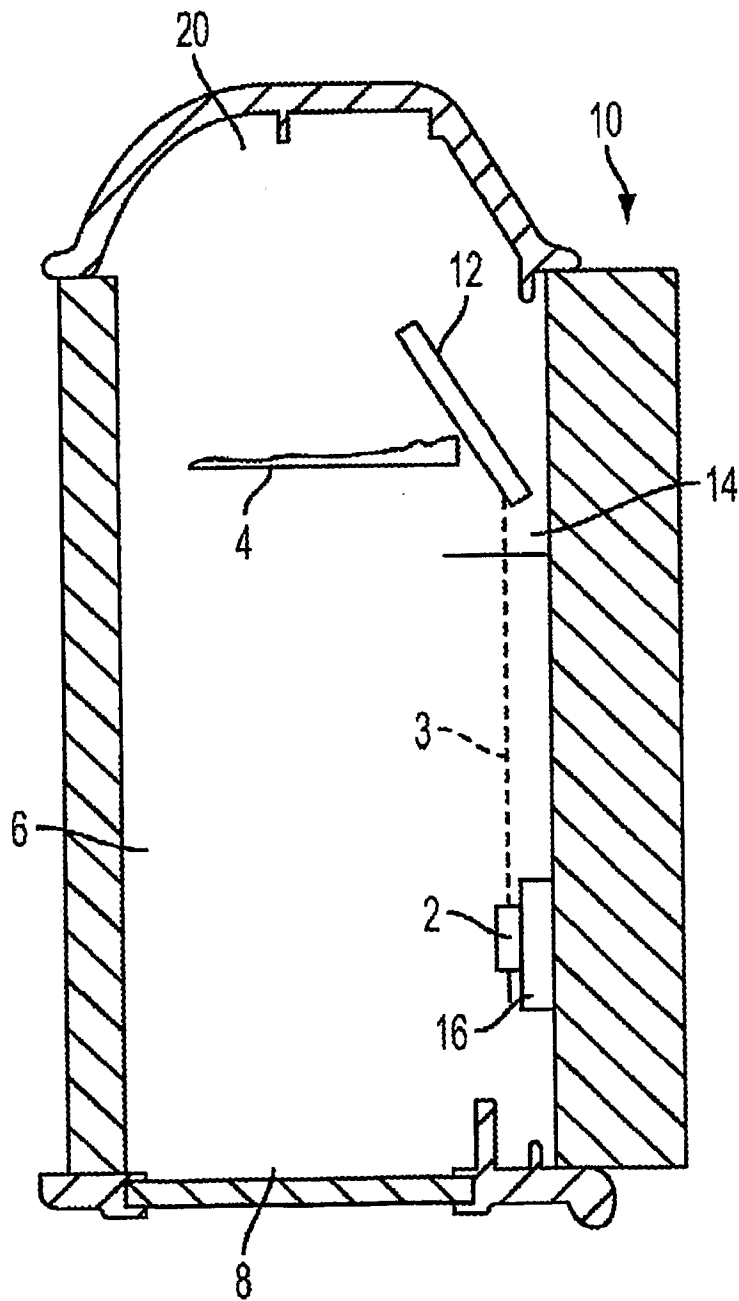


FIG. 2A

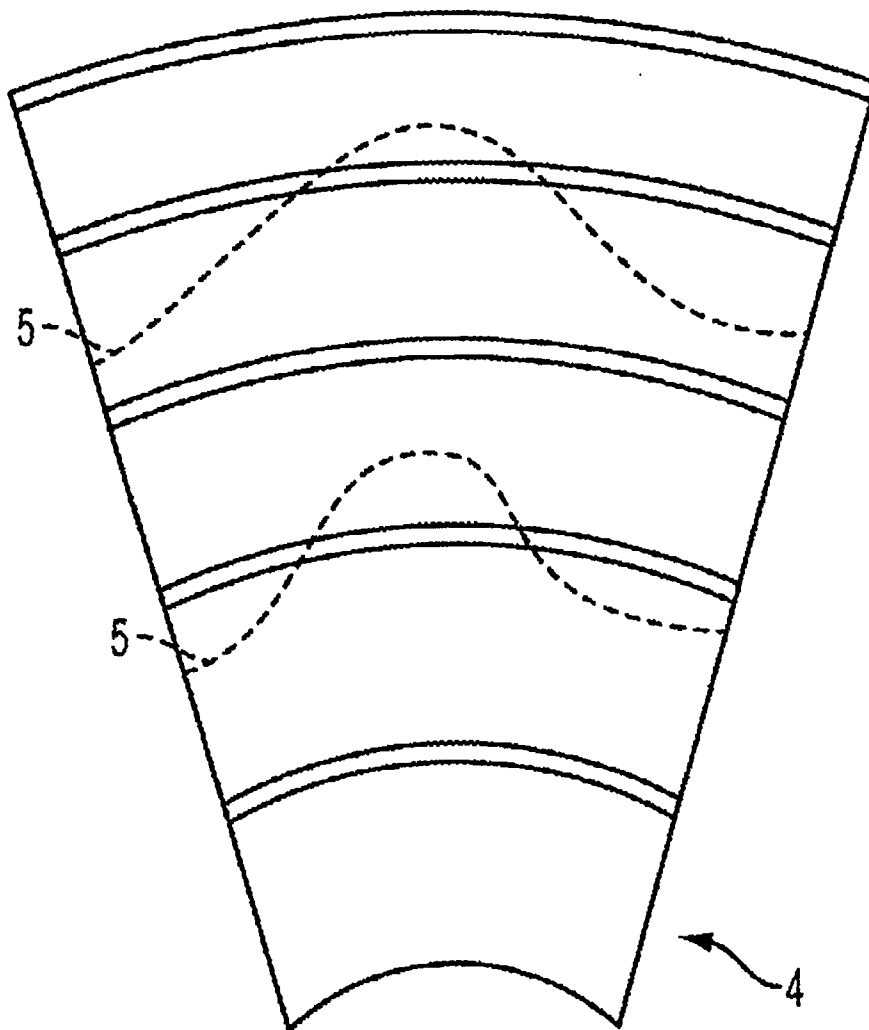


FIG. ~~8~~ 7