Nov. 10, 1936. J. H. HAMMOND, JR 2,060,205

TORPEDO

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Fig. 1.

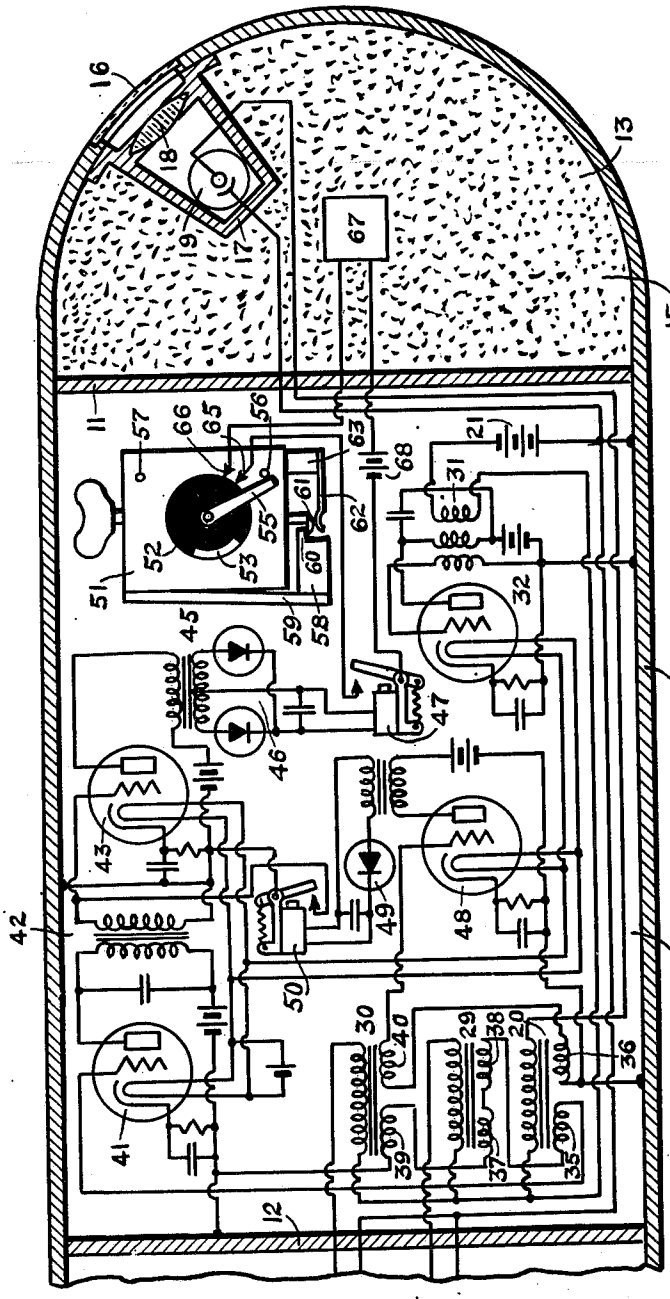

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Fig. 2.

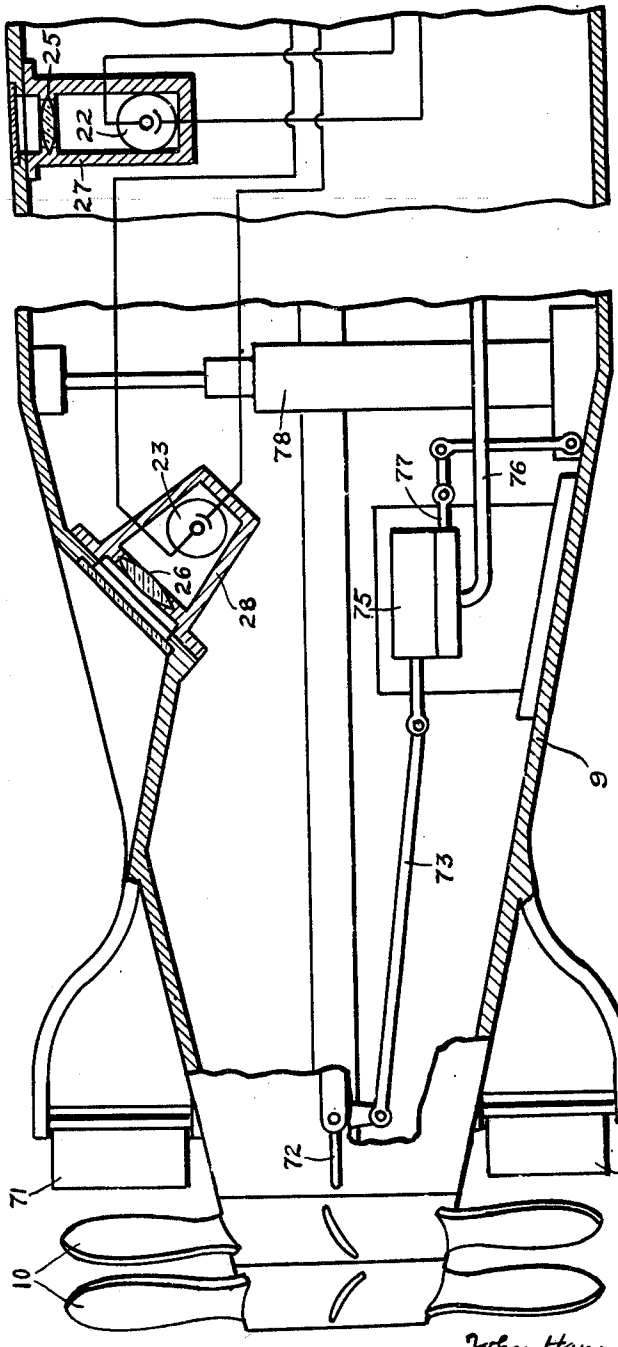

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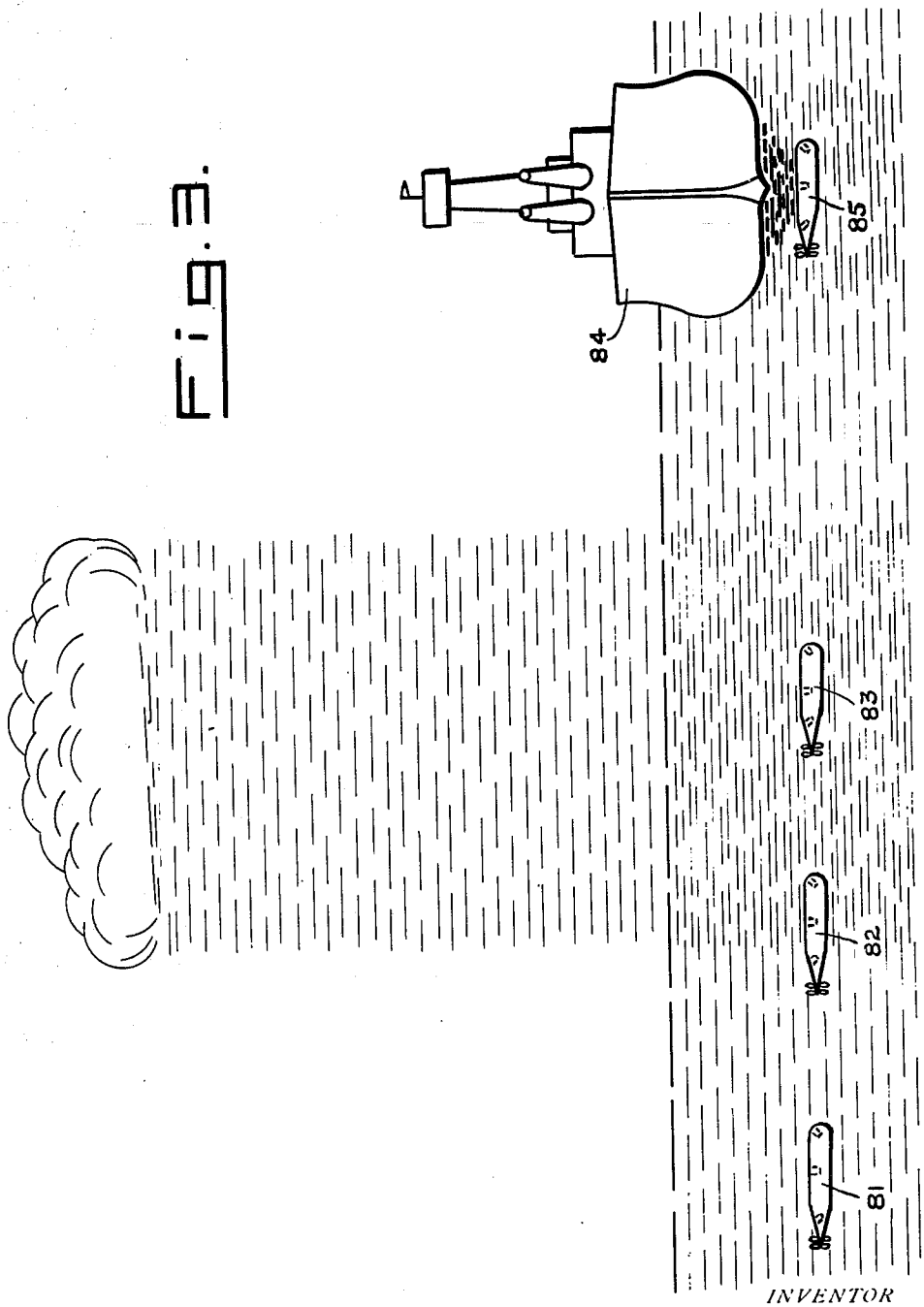
Fig. 3.



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2,060,205

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2,060,205

TORPEDO

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Application February 6, 1935, Serial No. 5,220

17 Claims. (Cl. 114—21)

This invention relates to ordnance devices, and more particularly to torpedoes.

According to one form of the invention, a torpedo is provided with light sensitive devices which control the detonation of the explosive charge thereof when the torpedo passes beneath a ship. The torpedo mechanism includes a set of photoelectric cells which are energized by the light of day transmitted through the water above the torpedo. These cells are normally balanced to maintain the control mechanism inoperative as long as all the cells receive the same intensity of illumination. When the torpedo passes beneath a ship and enters the shadow cast thereby, the illumination of certain of the cells changes to such an extent that there is a definite predetermined relationship between the illumination received by the various cells and the control mechanism operates to produce detonation of the explosive charge.

The invention provides means for preventing the actuation of the detonating mechanism when the torpedo passes through a shadow cast by a cloud, which mechanism operates to differentiate between the shadow effects produced by a cloud and those produced by the hull of a ship. The shadow produced by a cloud is different from that produced by a ship, as a cloud is at a greater distance than a ship and of much greater extent, so that its shadow is not as dense and is not confined to such a small area. In the operation of the device contemplated by this invention, advantage is taken of this difference and the control mechanism is so adjusted that it will be operated only when a shadow is encountered by the torpedo which is very dense at the center and diminishes in density at the two sides, as would be the case a short distance below the hull of a ship.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which:

Fig. 1 represents diagrammatically the forward portion of a torpedo provided with this invention;

Fig. 2 represents diagrammatically a central section and the afterbody of the same torpedo; and

Fig. 3 diagrammatically illustrates the course of a torpedo attacking an enemy vessel.

Like reference characters denote like parts in the several figures of the drawings.

In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring to the accompanying drawings, and more particularly to Figs. 1 and 2, there is shown a water-borne body, such as a carrier of explosives, having a water tight torpedo hull **9**, and arranged to be propelled in the usual manner by propellers **10** located at the after end. The hull **9** is provided with two transverse bulkheads **11** and **12** providing two compartments **13** and **14**, the former compartment being filled with an explosive charge **15**, such, for example, as TNT.

An aperture is provided in the hull **9** at the top of the compartment **13**. This aperture is covered by a sheet **16** of glass or other transparent material. Mounted in a receptacle **17** secured to the interior wall of the forward compartment **13** is a lens **18** which is positioned directly below the aperture in the hull. The interior of the receptacle **17** is painted a flat black so as to prevent reflection of any light entering the receptacle. Positioned within the receptacle and at the focus of the lens **18** is a photoelectric cell **19**, one terminal of which is connected to the primary of a transformer **20** and the other terminal to one terminal of a battery **21** and to two other photoelectric cells **22** and **23** located at the center and after end of the torpedo respectively, as shown in Fig. 2. The cells **22** and **23** are situated at the foci of two lenses **25** and **26** respectively, mounted in two tubes **27** and **28**, respectively, which are secured to the hull **9**. Apertures in the hull **9**, covered by sheets of glass or other transparent material, are located at the ends of the tubes **27** and **28**. These tubes are painted flat black on the interior surface, so as not to reflect any light.

The other terminals of the photoelectric cells **22** and **23** are connected to the primaries of two transformers **29** and **30** respectively. The other terminals of the three primaries of the transformers **20**, **29** and **30** are connected to one terminal of a coupling coil **31** of an oscillator **32**, which is of any well known form of construction which need not be more fully described herein.

Each of the three transformers **20**, **29** and **30**

is provided with two secondary windings 35, 36, 37, 38 and 39, 40 respectively. The four secondaries 35, 37, 38 and 39 are connected in series to the input circuit of an amplifier 41, the output circuit of which is connected through a transformer 42 to the input circuit of a power amplifier 43. The output circuit of the amplifier 43 is connected through a transformer 45 to a power rectifier 46, the output circuit of which includes the winding of a relay 47.

The two secondaries 36 and 40 are connected in series to the input circuit of an amplifier 48, the output circuit of which includes a rectifier 49 and a relay 50. When energized, this relay acts to short circuit the secondary of the transformer 42.

A clockwork mechanism 51 is provided which drives a commutator 52. This commutator is provided with a conducting segment 53. To the shaft of the commutator is secured an arm 55 which normally engages a pin 56. A second pin 57 is provided for limiting the motion of the arm 55 and the commutator 52.

For automatically starting the clockwork mechanism 51 a heavy weight 58 is secured to the end of a flat spring 59, the upper end of which is fastened to the casing of the clockwork mechanism 51. The weight 58 is provided with a projection 60 which normally engages a finger 61 which controls the starting of the clockwork mechanism. Engaging the end of the finger 61 is a spring 62 which is supported on a bracket 63.

Engaging the commutator 52 are two brushes 65 and 66. The brush 65 is connected to the contact of the relay 47 and the brush 66 to one side of a detonator 67, the other side of which is connected through a battery 68 to the armature of the relay 47.

The torpedo is provided with the usual vertical and horizontal rudders 71 and 72. The latter are operated by means of a link 73 from the horizontal steering engine 75 which is supplied with fluid under pressure from a pipe 76 and is controlled by a valve 77 operated in a well known manner from a depth control mechanism 78.

In the operation of this system when the torpedo is fired, the inertia of the weight 58 causes it to be moved backward relative to the torpedo, thus disengaging the projection 60 from the finger 61 which is moved upwardly under the action of the spring 62, thus causing the clockwork mechanism to start turning the commutator 52 at a predetermined speed. This rotation will continue until the arm 55 engages the pin 57 at which time the segment 53 will have moved into engagement with the brushes 65 and 66, thus connecting the detonator 67 to the relay 47. By this means there is prevented any accidental detonation of the explosive charge 15 while the torpedo is on or near the firing ship, owing to accidental operation of the light controlled mechanism.

As the torpedo proceeds towards the enemy target and assumes the position indicated by reference numeral 81 in Fig. 3, the three photoelectric cells 19, 22 and 23 all will be illuminated with approximately equal intensity, as the apertures in the hull over the cells are proportioned so as to produce this result when the torpedo is illuminated with uniform intensity over its entire length. This will cause alternating currents of equal intensities to flow through the primaries of the transformers 20, 29 and 30.

The secondary windings 35 and 39 are wound so as to oppose the windings 37 and 38, so that no voltage will be fed to the amplifier 41 as long as the three photoelectric cells are illuminated equally. The secondary windings 36 and 40 are wound so as to oppose each other, so that no voltage will be fed to the amplifier 48 as long as the two photoelectric cells 19 and 23 are equally illuminated. Under these conditions neither relay 47 nor 50 will be energized.

When the torpedo enters the shadow of a cloud and takes a position as indicated by numeral 82, the photoelectric cells 19 and 23 are unequally illuminated, as the cell 23 receives more light than the cell 19. Under these conditions there is more voltage from the secondary 40 than from the secondary 36, with the result that operating voltage is supplied to the amplifier 48. The output from this amplifier is rectified by the rectifier 49 and energizes the relay 50, thus short circuiting the secondary of the transformer 42. The sum of the voltages from the secondaries 35 and 39 is greater than the sum of the voltages from the secondaries 37 and 38, so that operating voltage is fed to the amplifier 41. The output of this amplifier cannot pass to the amplifier 43, as the secondary of the transformer 42 is short circuited by the relay 50. Under these conditions the relay 47 will still remain open.

After the torpedo has passed entirely into the shadow of the cloud to the position indicated at 83, the three photoelectric cells are illuminated with reduced but equal intensities. Under this condition, the currents flowing in the primaries of the three transformers 20, 29 and 30 are equal and the conditions are similar to those described in connection with the torpedo when in the position indicated at 81. Under these conditions, both relays 47 and 50 will be open.

The photoelectric cells may be of such a type that they are sensitive to specific bands of the solar spectrum, such as the band which includes the infra red rays, which rays pass more readily through clouds than do visible rays. Color filters may be provided in front of the photoelectric cells. The material covering the openings in the hull over the photoelectric cells may be of ground glass, so as to diffuse the light and minimize the effect of direct rays.

When the torpedo passes beneath the hull of an enemy ship 84 into the position indicated at 85, the shadow of the ship cuts off nearly all the illumination from the photoelectric cell 22. A certain amount of light will pass around the hull of the ship 84 and will illuminate the photoelectric cells 19 and 23 with approximately equal intensity, so that these cells will receive considerably more light than the cell 22.

As the two cells 19 and 23 receive the same amount of illumination, the relay 50 will remain open, as already described. The sum of the voltages from the secondaries 35 and 39 will be greater than the sum of the voltages from the secondaries 37 and 38, so that operating voltage will be fed to the amplifier 41. The output from this amplifier will pass through the transformer 42 to the power amplifier 43 where it will be further amplified and fed to the power rectifier 46. The output of this rectifier will energize the relay 47 which will close the circuit through the detonator 67, thus exploding the charge 15 beneath the hull of the enemy ship.

It is thus seen that when the two photoelectric cells 19 and 23 receive equal illumination and at the same time the cell 22 receives less illumination than cells 19 and 23, the explosive charge will be detonated. This condition can only occur when the torpedo passes beneath the hull of an

enemy ship and not when the torpedo passes into, through and out of the shadow of a cloud.

Although only a few of the various forms in which this invention may be embodied have been shown herein, it is to be understood that the invention is not limited to any specific construction, but might be embodied in various forms without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In combination with a movable body, an explosive charge carried thereby, three or more light receptive means spaced along said body for receiving light from an external source, and detonator means operable by said light receptive means for detonating said explosive charge when the intensity of light received by an intermediate light sensitive means is less than that received by the outer light sensitive means.

2. In combination with a movable body, an explosive charge carried thereby, a plurality of light receptive means mounted on said body for receiving light approaching said body from a plurality of different directions respectively, and detonator means operable by said light receptive means for detonating said explosive charge when the intensity of light received from a predetermined one of said directions is less than the intensity of light received from another of the said directions.

3. In a torpedo, an explosive charge, three light sensitive means located at the bow, center and stern of said torpedo, and detonator means operable by said light sensitive means for detonating said explosive charge when the intensity of light received by a predetermined one of said light sensitive means is less than that received by the other two light sensitive means.

4. In a torpedo, an explosive charge, a plurality of light sensitive devices for receiving light from different directions, and a detonator controlled by said devices and responsive to a change in intensity of light received by one of the devices with respect to the light received by the other devices.

5. In a torpedo, a hull, an explosive charge carried thereby, a detonator for said charge, three or more light sensitive means on said hull, and means active to actuate said detonator when the intensity of illumination on two of said light sensitive means is greater than the intensity of illumination on another and predetermined one of said light sensitive means.

6. In a torpedo, a hull, an explosive charge, a detonator for said charge, a light sensitive means mounted on the bow, midship and stern of said hull respectively, and means active to actuate said detonator when the intensity of illumination on the light sensitive means at the bow and stern of the hull is greater than the intensity of illumination on the light sensitive means located amidships of the hull.

7. In a torpedo, a hull, an explosive charge carried thereby, a detonator for said charge, a plurality of light sensitive devices disposed on said hull to receive light from at least three different directions respectively, and means for actuating said detonator when the intensity of the light illuminating two of said light sensitive devices is greater than the intensity of the light reaching another and predetermined one of said light sensitive devices.

8. In a torpedo, a hull, an explosive charge carried thereby, a detonator for said charge, a plurality of light sensitive means disposed on said hull to receive light from forwardly of. vertically above the hull and rearwardly of said hull, and means for actuating said detonator only when the intensity of illumination on those of the light sensitive means which receive light from a forwardly direction and a rearwardly direction is greater than the intensity of illumination on the light sensitive means which receives light from vertically above the hull.

9. In a torpedo, a hull, an explosive charge carried thereby, a detonator for said charge, light sensitive means disposed on the bow, midship and stern of said hull respectively, balanced circuit means for energizing said detonator when the light sensitive means are not all equally illuminated, and means for rendering said balanced circuit ineffective to energize said detonator except when intensity of illumination on the light sensitive means at the bow and stern is greater than on the light sensitive means disposed amidships of the hull.

10. A torpedo including a hull, an explosive charge carried thereby, a detonator for said charge, light sensitive means spaced along said hull, means controlled by said light sensitive means for actuating said detonator, lock-out means for rendering said actuating means ineffective to actuate said detonator when the light received amidships is less than that received at the bow and stern, and means actuated by the initial forward movement of said torpedo for releasing said lock-out means.

11. In a torpedo, a hull, an explosive charge carried thereby, a detonator for said charge, three or more light sensitive means disposed on said hull, means actuated by said light sensitive means and active to operate said detonator when the illumination on a pair of said light sensitive means has a predetermined intensity relative to that received on the other light receptive means.

12. In a torpedo, a hull, an explosive charge carried thereby, a detonator for said charge, three or more light sensitive means, control means for controlling the energization of said detonator, balanced circuit means connected to said light sensitive means and said control means for energizing said control circuit when the intensity of illumination is not equal on all of said light sensitive means, and means controlled by said balanced circuit for preventing the energization of said control means, except when the intensity of illumination on a predetermined pair of said light sensitive means is greater than on a third predetermined light sensitive means.

13. In combination, a first body, a second body, three or more light receptive devices carried by said second body, a utility carried by said second body, and means active when the intermediate light receptive devices lie in a deeper shadow of said first body than the outer light receptive devices for actuating said utility.

14. In combination, a body, a utility carried by said body, three or more spaced, light receptive devices on said body, and means active when a predetermined pair of said light receptive devices receive more illumination than other of said devices for operating said utility.

15. A water borne body containing an explosive, three or more devices spaced along said body responsive to radiations received through the water, and means active when the radiation received by a predetermined pair of said devices is greater than on other of said devices for discharging said explosive.

16. In combination, a water borne body, a

utility carried by said body, three or more devices spaced along said body and responsive to radiations received through the water and means active when the radiations received by a predetermined pair of said devices is greater than that received by other of said devices for operating said utility.

17. In combination with a movable body, a utility carried thereby, a plurality of devices mounted on said body for receiving radiations approaching said body from a plurality of different directions respectively and means actuated by said radiation receptive means for operating said utility when the intensity of radiations received from a predetermined one of said directions is less than that received from other of said directions.

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