

SPECIFICATION

A photoelectric apparatus for sensing obstacles to machines, automatically-operated doors, self-propelled trucks and like

- 5 The present invention relates to a photoelectric apparatus for sensing objects, such as obstacles to machines, automatically-operated doors, self-propelled trucks and the like.

- 10 In extant photocell systems for the above-mentioned field of use, the light is focussed to a relatively narrow beam. Thus a small, point-shaped sensing field is obtained. Furthermore, a sensing resistance which varies in accordance with the surface structure and reflective capacity of the material of the obstacle will also be obtained.

In general, it is desirable to be able to detect an obstacle within a much broader field.

- 20 Accordingly, the present invention provides photoelectric apparatus for sensing objects, comprising a plurality of emitting elements which emit divergent beams of electromagnetic radiation, said emitting elements being arranged with such mutual spacing that the radiation beams of mutually adjacent emitting elements overlap at a desired minimum object sensing distance, and a plurality of receiving elements sensitive to the electromagnetic radiation and being disposed such that adjacent receiving elements have divergent fields of vision overlapping at the desired minimum object sensing distance, an object being sensed by any of said receiving elements by reflection of the electromagnetic radiation from the object.

- 35 The advantages of an arrangement in accordance with the present invention compared with existing systems are as follows:

- (a) the diffusion of the light and extent of the light sensitive surface give a homogeneous and well surveyed scanning field both in depth and width;

- (b) the effects of various reflection properties inherent in the obstacle are reduced; and

- (c) a much greater angular deviation may be permitted in totally reflective surfaces.

- 45 One embodiment of the apparatus according to the present invention comprises, as will be apparent from the accompanying drawing, a row of several light-emitting diodes *a*, and several light-sensitive elements, such as phototransistors *b*. These two types of elements may be of conventional design and may be disposed in respective rows in zigzag formation, that is to say such that the light-emitting diodes alternate with the phototransistors to form a zigzag pattern. Each light-emitting diode *a* emits a divergent radiation beam, preferably outside the visible light spectrum, through an aperture which provides a beam divergent angle α such that adjacent beams overlap one another at a predetermined minimum obstacle detecting distance. The divergent field of vision of each phototransistor *b* is at such an angle

β that adjacent fields of vision overlap one another at the predetermined minimum obstacle detecting distance. Preferably, α and β are quite large,

- 65 advantageously about 90° or more. The light emitting diodes *a* are series-connected and are fed with a pulsating direct current of suitable frequency from a pulse generator *c*. The phototransistors *b* are parallel-connected and are connected to the input of an amplifier *d*. The signal from the phototransistors *b* is rectified after amplification and may, thereafter, for example, drive a relay.

- 75 By supplying all of the light-emitting diodes *a* with the same signal and impressing the signal voltage from all of the phototransistors *b* on the common amplifier *d*, it is possible for any light emitting diode or diodes, via reflection from an obstacle *e*, to actuate any phototransistor or phototransistors and, thereby the amplifier *d*.

- 80 In one application of the invention, the above-described apparatus is mounted horizontally on both sides of a swing door, the one apparatus being arranged for opening the swing door when a person approaches the door from one side and enters into the scanning field of the apparatus. The second apparatus is arranged to counteract the opening movement when another person or object is located in the scanning field of the second apparatus, that is to say the apparatus mounted on the opposite side of the door from the first apparatus.

CLAIMS

1. Photoelectric apparatus for sensing objects, comprising a plurality of emitting elements which emit divergent beams of electromagnetic radiation, said emitting elements being arranged with such mutual spacing that the radiation beams of mutually adjacent emitting elements overlap at a desired minimum object sensing distance, and a plurality of receiving elements sensitive to the electromagnetic radiation and being disposed such that adjacent receiving elements have divergent fields of vision overlapping at the desired minimum object sensing distance, an object being sensed by any of said receiving elements by reflection of the electromagnetic radiation from the object.

2. Apparatus as claimed in claim 1, wherein said emitting elements and said receiving elements are each disposed in respective rows such that the two types of elements form a zigzag pattern.

3. Apparatus as claimed in claim 1 or 2, wherein said emitting elements are series-coupled and are connected to a pulse generator, and wherein said receiving elements are parallel-coupled and are connected to a common amplifier.

4. Apparatus as claimed in claim 1, 2 or 3,

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wherein said emitting elements are operative to
emit radiation outside the visible light spectrum.
5. Photoelectric apparatus for sensing objects,

constructed substantially as hereinbefore
5 described with particular reference to the
accompanying drawing.

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