

beams reflected by the human body when subjected to the spot light can be detected by the light receiving elements.

In the above-mentioned publicly known prior art light projector and light receiver, the human body detection range is determined by the range of irradiation of spot light emanated by the light projector, i.e., the number of the spot light beams. Therefore, in order to obtain a wide range of detection of the human body, a multiplicity of spot light beams are required so that provision of a large number of combinations of light projecting elements with concave mirrors as well as the corresponding number of combinations of light receiving elements with concave mirrors is necessarily required. Accordingly, both the light projector and the light receiver become large-sized, thus increasing the manufacturing cost thereof and the space required for installation thereof. These are disadvantages in the previously produced active type human body detection apparatus.

SUMMARY OF THE INVENTION

The present invention has been contemplated and devised to eliminate the above-mentioned disadvantage in the prior art active type human body detecting apparatus, and has for its object to provide a human body detecting apparatus, having a light projecting section consisting of a set of split concave mirrors and a plurality of light projecting elements, and a light receiving section consisting of at least one set of split concave mirrors and a plurality of light receiving elements, and arranged such that spot light beams equivalent in number to a product of the number of the concave mirrors and

set forth in the first aspect consists of a plurality of concave mirrors combined with one another so as to have a common or the same focus.

5 According to a third aspect of the present invention, there is provided a human body detecting apparatus, characterized in that the light projecting elements and the light receiving elements as set forth in the first aspect are installed in vicinity of the focuses of their respective sets of split concave mirrors.

10 According to a fourth aspect of the present invention, there is provided a light projecting and receiving unit for use in a human body detecting apparatus, comprising a unit body comprised of a substantially rectangular member; two side walls formed integrally with the unit body at both the longitudinal ends thereof and projecting vertically from the surface
15 of the unit body and in parallel relationship with each other; a partition wall formed integrally with the unit body at the longitudinal central part thereof and projecting vertically from the surface of the unit body and in opposed and parallel relationship with the side walls; a first light projecting section
20 and a second light projecting section formed on one side of the surface of the unit body divided by the partition wall, each of the first and second light projecting sections being a split concave mirror set comprised of a plurality of parabolic concave mirrors arranged so as to have common or the same focuses,
25 respectively; a first light receiving section and a second light receiving section formed on the other side of the surface of the

concave mirrors is formed to incline more sideways and outward than the two concave mirrors formed on both sides thereof.

5 According to a sixth aspect of the present invention, there is provided a light projecting and receiving unit, characterized in that each of the split concave mirror sets of the second light projecting section and the light receiving section in the light projecting and receiving unit as set forth in the fourth aspect consists of a combination of two parabolic concave mirrors arranged sequentially in the longitudinal direction of the unit body.

10 The above and many other advantages, features and additional objects of the present invention will become apparent to those skilled in the art upon making reference to the following detailed description and accompanying drawings in which preferred structural embodiments incorporating the principles of the present invention are shown by way of illustrative example.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic explanatory view of a human body detecting apparatus embodying the present invention;

20 Fig. 2 is a schematic perspective view of a light projecting and receiving unit for use in the human body detecting apparatus embodying the present invention;

25 Fig. 3 is a plan view of the light projecting and receiving unit shown in Fig. 2;

Fig. 4 is a sectional view taken along the line IV-IV in Fig. 3;

Fig. 5 is a sectional view taken along the line V-V in

rear, and the left and right of the apparatus as shown in Fig. 1. Stating in more detail, the human body detection range "B" is a region which overlaps the light receiving spot for the light receiving section 2 in the light spot irradiation range.

5 The light projecting and receiving unit "A" for use in the human body detecting apparatus according to the present invention will now be described with reference to Figs. 2 to 6.

As shown by a schematic perspective view in Fig. 2, the light projecting and receiving unit "A" has a generally rectangular-shaped unit body "C" and two side walls C_1 and C_2 formed integrally with the unit body "C" at both the longitudinal ends thereof and projecting vertically from the unit body "C" and in parallel relationship with each other. (But, in Fig. 2, the side wall C_1 is not shown.) Further, a partition wall C_3 is formed integrally with the unit body "C" in the longitudinal central part thereof and in opposed parallel relationship with the side walls C_1 and C_2 , and projects vertically from the unit body "C". A light projecting section 1 is provided between the partition wall C_3 and the side walls C_1 , whilst a light receiving section 2 is provided between the partition wall C_3 and the side wall C_2 . Further, installed in the substantially transverse central part of the unit body "C" is a light shielding plate 7 which extends along the whole length of the unit body "C" and fitted integrally and vertically in the unit body "C" at right angles to the side walls C_1 and C_2 and the partition wall C_3 . The light shielding plate 7 divides the light projecting section 1 into first and second light

so as to have one and the same focus 12'.

Moreover, the seventh concave mirror 11_2 in the three-split concave mirror set formed in the first light receiving section is formed to incline more sideways and outward of the unit body "C" than the concave mirrors 11_1 and 11_3 formed on both sides thereof.

Further, mounted on the above-mentioned light shielding plate 7 on the side of the light projecting section 1 is a light projecting element mounting member 8 having a first, a second, a third and a fourth light projecting elements 9_1 , 9_2 and 10_1 , 10_2 mounted, respectively, in the vicinity of the focuses 5' and 6' of the three-split concave mirror set and the two-split concave mirror set, respectively. Mounted, in like manner, on the light shielding plate 7 on the light receiving section 2 is a light receiving element mounting member 14 having a first, a second, a third and a fourth light receiving elements 15_1 , 15_2 and 16_1 , 16_2 mounted, respectively, in the vicinity of the focuses 11' and 12' of the three-split concave mirror set and the two-split concave mirror set, respectively.

Further, Fig. 3 is a plan view of the light projecting and receiving unit "A" shown in Fig. 2, and Figs. 4, 5 and 6 are sectional views taken along lines IV-IV, V-V and VI-VI, respectively, in Fig. 3.

Moreover, each of the concave mirrors should preferably have a parabolic surface, and is formed by cutting an aluminium material into the unit body "C" and then subjecting it to a mirror surface finish or alternatively by subjecting the

mirrors 11_1 and 11_2 in the split concave mirror set of the first light receiving section, whilst the light beams reflected by the human body when subjected to the spot light beams 4_1 to 4_4 are allowed to be incident on the third and fourth light receiving
5 elements 16_1 and 16_2 , respectively, through the concave mirror sets 12_1 and 12_2 in the split concave mirror set of the second light receiving section.

When the respective light receiving elements 15_1 , 15_2 and 16_1 and 16_2 detect the reflective light beams from the human
10 body, a door control device, not shown, is actuated to open the door "D".

In view of the foregoing description, according to the light projecting and receiving unit of the present invention, spot light beams which are equivalent in number to a product of
15 the number of the concave mirrors and that of the light projecting elements provided in the light projecting section 1 can be irradiated, and therefore many spot light beams can be produced by means of a combination of a less number of light projecting elements and a compact set of split concave mirrors. Moreover,
20 the reflective light beams from the human body when approaching the door can be received in like manner by means of a combination of a less number of light receiving elements and a compact set of split concave mirrors. Thus, by using this small-sized
25 installation, a wide human body detection range "B" can be obtained and the manufacturing cost of the unit can be reduced significantly.



CLAIMS:-

1. A human body detecting apparatus, comprising
a light projecting section consisting of at least one set of split concave mirrors and a plurality of light projecting elements, and a light receiving section consisting of at least one set of split concave mirrors and a plurality of light receiving elements; said light projecting section being arranged such that it can irradiate spot light beams equivalent in number to a product of the number of the concave mirrors and that of the light projecting elements; and said light receiving section being arranged such that it can receive at least the number of the spot light beams irradiated by the light projecting section.
2. A human body detecting apparatus as claimed in claim 1, wherein each of said sets of split concave mirrors consists of a plurality of concave mirrors combined with one another so as to have a common or the same focus.
3. A human body detecting apparatus as claimed in claim 1 or 2, wherein the light projecting elements and the light receiving elements are installed in the vicinity of the focuses of their respective sets of split concave mirrors.
4. A light projecting and receiving unit for use in a human body detecting apparatus, comprising a unit body comprised of a substantially rectangular member; two side walls formed integrally with the unit body at both the longitudinal ends thereof and projecting vertically from the surface of the unit body and in parallel relationship with each other; a partition



mounted on the light shielding plate so as to locate a plurality of light receiving elements in the vicinity of each of the focuses of the split concave mirror sets in said light receiving section.

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5. A light projecting and receiving unit as claimed in claim 4, wherein each of the split concave mirror sets in said first light projecting section and said first light receiving section, respectively, consists of a combination of three parabolic concave mirrors arranged sequentially in the longitudinal direction of the unit body, and each of the central concave mirrors is formed to incline more sideways and outward than the two concave mirrors formed on both sides thereof.

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6. A light projecting and receiving unit as claimed in claim 4 or 5, wherein each of the split concave mirror sets in said second light projecting section and said second light receiving section, respectively, consists of a combination of two parabolic concave mirrors arranged sequentially in the longitudinal direction of the unit body.

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7. A light projecting and receiving unit as claimed in claim 4, 5 or 6, wherein said unit body is made of aluminum, and each of the concave mirrors is formed by cutting the body into the predetermined shape and then subjecting it to a mirror surface finish.

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8. A light projecting and receiving unit as claimed in claim 4, 5 or 6, wherein said unit body is formed by molding ABS resin or acrylic resin, and each of the concave mirrors is formed by subjecting the surface of the molded unit

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