OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

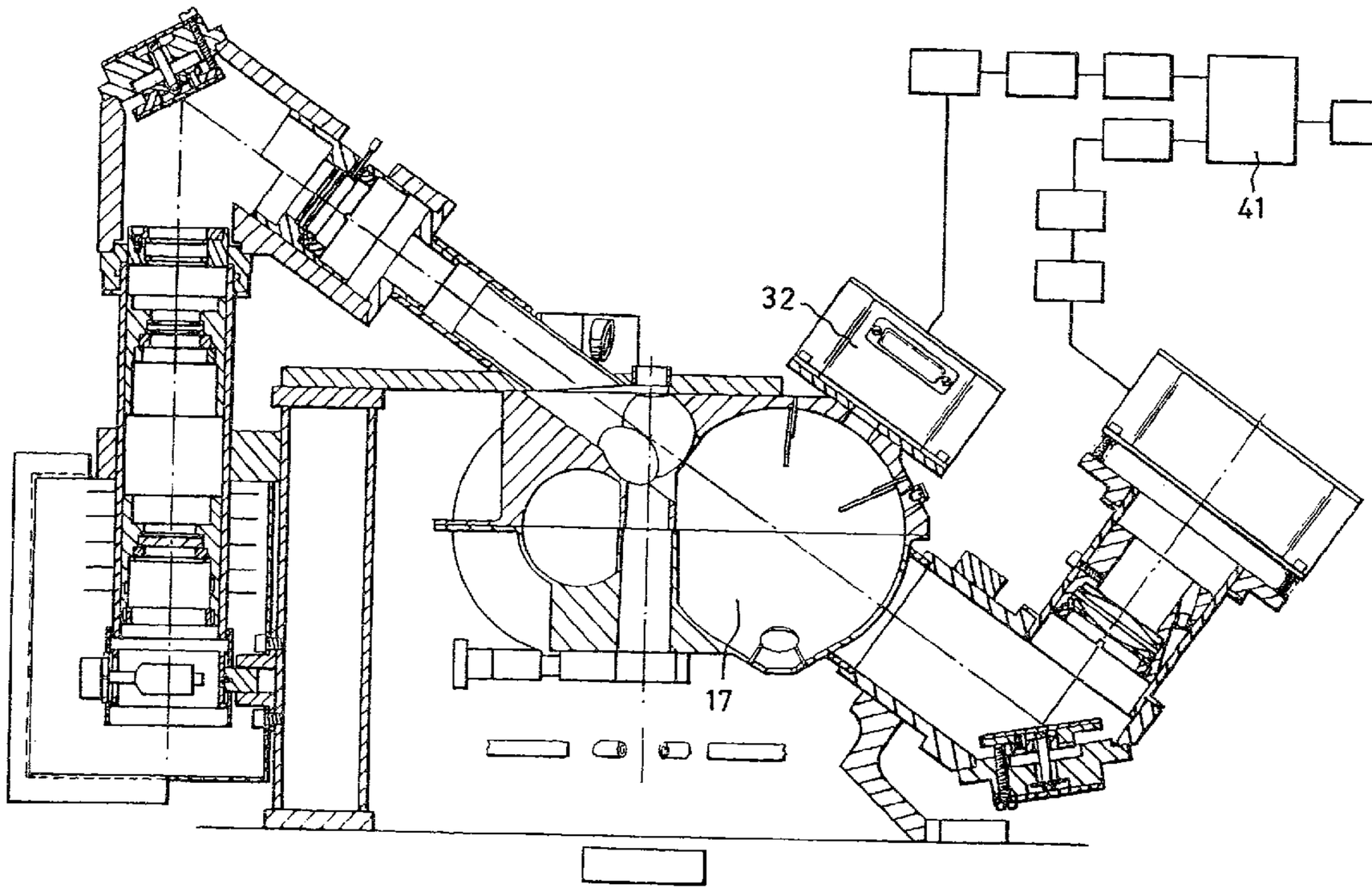
(12) (19) (CA) **Brevet-Patent**

(11) (21) (C) **2,000,274**
(22) 1989/10/06
(43) 1990/04/07
(45) 2001/03/27

(72) Smith, Martin Phillip, GB
(72) Saunders, Colin David, GB
(73) Spandrel Establishment, LI

(51) Int.Cl.[5] B07C 5/10
(30) 1988/10/07 (8823570) GB

(54) **MATERIEL DE CLASSIFICATION**
(54) **CLASSIFYING OBJECTS**



(57) Objects are dropped in succession through a viewing zone, where they are viewed in bright field illumination by three viewers along orthogonal axes, using radiation of different wave-lengths (or viewing in rapid succession). The viewers sense the presented area. The presented areas are compared in a microprocessor in order to obtain a rough determination of the shape of the object. The presented areas can be e.g. summated to obtain a rough determination of the size of the object.

2000274

M&C FOLIO: 230P56438 WANGDOC: 1684R

ABSTRACT

CLASSIFYING OBJECTS

Objects are dropped in succession through a viewing zone, where they are viewed in bright field illumination by three viewers along orthogonal axes, using radiation of different wave-lengths (or viewing in rapid succession). The viewers sense the presented area. The presented areas are compared in a microprocessor in order to obtain a rough determination of the shape of the object. The presented areas can be e.g. summated to obtain a rough determination of the size of the object.

15

M&C FOLIO: 230P56438 WANGDOC: 1681R

CLASSIFYING OBJECTS

Background of the invention

EP-A-0 227 404 describes a way of sorting objects according to shape, which can provide an accurate sort. However, such accuracy is not always required, and it is desirable to be able to make a rough sort using less expensive equipment.

The Invention

The present invention provides a method and apparatus in which the objects are passed in succession through a viewing zone in which the presented area of each object is sensed with at least three viewers which view along at least three respecive angularly-spaced axes, and the signals from each respective viewer are compared to make a rough determination of the shape of the object.

Fundamentally, it has been realised that the arrangement of GB-A-2 165 943 can be used for making a rough sort according to shape, employing only the part of the arrangement which senses the reduction in flux along the axis of projection, thereby detecting the presented

FC

area. The detector which senses the forward-scattered illumination is not employed.

The invention also provides a method and apparatus for making a rough determination of the size, by summing the signals from each viewer, or selecting the signal representing the largest or smallest presented area sensed.

It is desirable to substantially prevent cross-talk, which can be a significant source of inaccuracy. There would be optical cross-talk if the same wave-lengths were used simultaneously for detecting area in different directions, for instance due to reflection from the surfaces of the objects, and, if the objects are translucent or transparent, due to refraction within the objects. Cross-talk can be prevented by using different wave-lengths, or by viewing in rapid succession. The advantage of using different wave-lengths is that the object can be viewed simultaneously with each wave-length, avoiding inaccuracy due to say spinning of the object. However, it is possible to obtain reasonable accuracy by viewing the object along the respective axes in succession; the object must be viewed by the different viewers in sufficiently rapid succession so that its orientation has not changed grossly between views; the rapidity of succession will depend on the amount that the object is expected to be

spinning or turning, but normally the views will be taken in as rapid succession as possible and nearly simultaneously.

Normally, the axes along which the object is viewed would substantially intersect at the position of the object when viewed. There are preferably three axes in orthogonal arrangement.

Although this not need necessarily be so, it is preferred that the object be in free flight i.e. unconstrained motion under gravity (preferably falling vertically) when it is viewed; although the motion is unconstrained, when viewed the object is preferably projected by an accelerator to give greater throughput and a better defined time interval between successive objects (less time scatter).

Preferred Embodiment

The accompanying drawing reproduces Figure 2 of GB-A-2 165 943. Just one source and detector are shown, but there will be three such sources and detectors, viewing along orthogonal axes. GB-A-2 165 943 can be referred to for details.

The apparatus of Figures 1-4 of GB-A-2 165 943 is used, with the detector unit 32 switched off. The object is

viewed in bright field illumination. It is preferred to use different wave-length bands, rather than pulsing, and the near infra-red is preferred for objects such as diamonds, because of the reduction in signal absorption due to diamond colour, all appearing grey under infra-red; preferred band centres are 800, 900 and 1,000 nm. The microprocessor 41 is programmed to compare the three areas as detected. If they are roughly equal, the object can be sorted as a roughly cubic or spherical object. If the areas are very unequal, the object can be sorted as a flat.

If desired, the microprocessor 41 can also provide a rough sort according to the size of the object, as determined from the value of the presented area along the orthogonal axes, for instance by summating the three areas or by selecting the maximum or minimum size presented i.e. one of the following, where A, B and C are the three presented areas:-

a) $\frac{A + B + C}{3}$

b) Maximum of A, B and C.

c) Minimum of A, B and C.

The apparatus shown is primarily for sorting for clarity, and is more complicated than it need be for the

present invention. For instance, the integrating spheres 17 could be completely omitted.

Though diamonds are referred to above, and one use of the invention is for sorting diamonds and boart, the invention is also applicable for instance to sorting foodstuffs to reject foreign matter - such foodstuffs could be natural products such as peas or beans, or manufactured items such as sweets.

The invention can be used for providing a physical sort, ie separating out at least one category of the objects. However, more generally, the sort can merely be a classification - for instance an indication could be given of the number of flats in a parcel of the objects, without picking out the flats.

. . . .

The present invention has been described above purely by way of example, and modifications can be made within the spirit of the invention.

B

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of making a rough classification of objects according to shape, comprising:

passing the objects in succession through a viewing zone;

in the viewing zone, viewing each object with at least three viewers which view along angularly spaced axes and thereby sensing respective areas presented to said viewers whereby said viewers give signals representative of said respective presented areas; and

comparing said signals from each respective viewer to make a rough determination of the shape of the object.

2. The method of Claim 1, wherein there are three said axes, in orthogonal arrangement.

3. The method of Claim 1 or 2, wherein the respective radiation is projected towards the viewer, and is interrupted in part by the object.

4. The method of Claim 1, wherein near infra-red radiation is used.

5. The method of Claim 1, 2 or 4, wherein cross-talk is substantially prevented by using radiation of a different wave-length for each viewer.

6. The method of Claim 1, 2 or 4, wherein cross-talk is substantially prevented by viewing with each viewer in succession.

7. The method of Claim 1, 2 or 4, wherein a rough determination of the size of the object is also made.

8. A method of making a rough classification of objects according to size, comprising:

passing the objects in succession through a viewing zone;

in the viewing zone, viewing each object with three viewers which view along orthogonal axes and thereby sensing respective areas presented to said viewers whereby said viewers give signals representative of said respective presented areas, while substantially preventing cross-talk; and

summing said signals from each viewer to make a rough determination of the size of the object.

9. A method of making a rough classification of objects according to size, comprising:

passing the objects in succession through a viewing zone;

in the viewing zone, viewing each object with three viewers which view along orthogonal axes and thereby sensing respective areas presented to said viewers whereby said viewers give signals representative of said respective presented areas; and

selecting said signal representing the largest presented area of said respective presented areas sensed.

10. A method of making a rough classification of objects according to size, comprising:

passing the objects in succession through a viewing zone;

in the viewing zone, viewing each object with three viewers which view along orthogonal axes and thereby sensing respective areas presented to said viewers whereby said viewers give signals representative of said respective presented areas; and

selecting said signal representing the smallest presented area of said respective presented areas sensed.

11. Apparatus for making a rough classification of objects according to shape, comprising:

means defining a path of the objects through a viewing zone;

at least three viewers directed along angularly spaced axes for sensing each successive object when it is in the viewing zone and thereby giving signals representative of areas of the object as presented to the respective viewers; and

means for comparing said signals and thereby giving a signal according to the shape of the object.

12. Apparatus for making a rough classification of objects according to size, comprising:

means defining a free-flight path of the objects through a viewing zone;

at least three viewers directed along orthogonal axes for sensing each successive object when it is in the viewing zone and thereby giving signals

means for substantially preventing cross-talk; and

means for summing the presented areas as viewed by the respective viewers and thereby giving a signal according to the size of the object.

13. The apparatus of Claim 11 or 12 and comprising means for receiving said signal according to the shape of the object and for physically sorting the objects according to said signal.

14. Apparatus for making a rough classification of objects according to size, comprising:

means defining a path of the objects through a viewing zone;

at least three viewers directed along othogonal axes for sensing each successive object when it is in the viewing zone and thereby giving signals representative of areas of the object as presented to the respective viewers;

means for substantially preventing cross-talk; and

means for selecting said signal representing the largest said presented area and thereby giving a signal according to the size of the object.

15. Apparatus for making a rough classification of objects according to size, comprising:

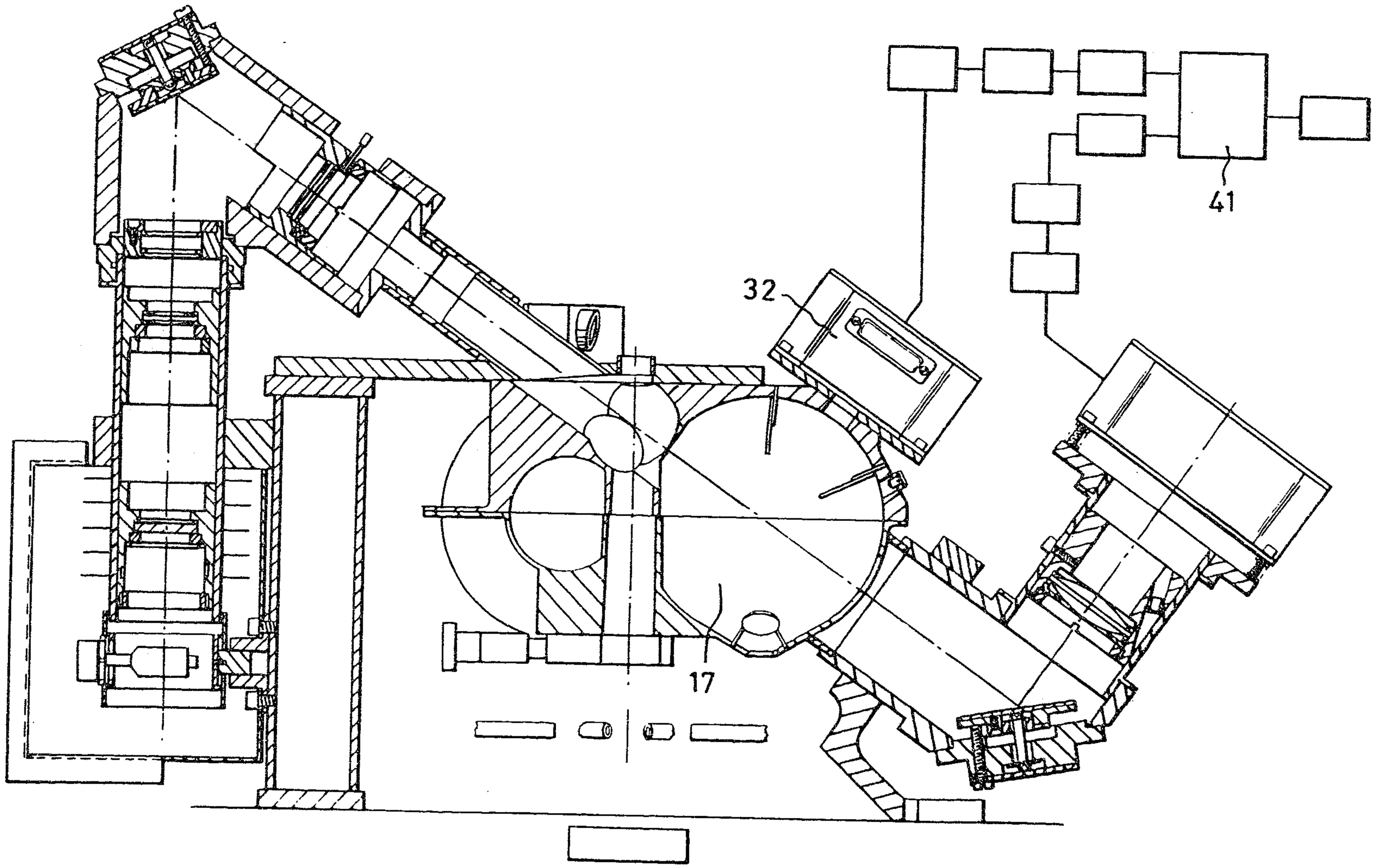
means defining a path of the objects through a viewing zone;

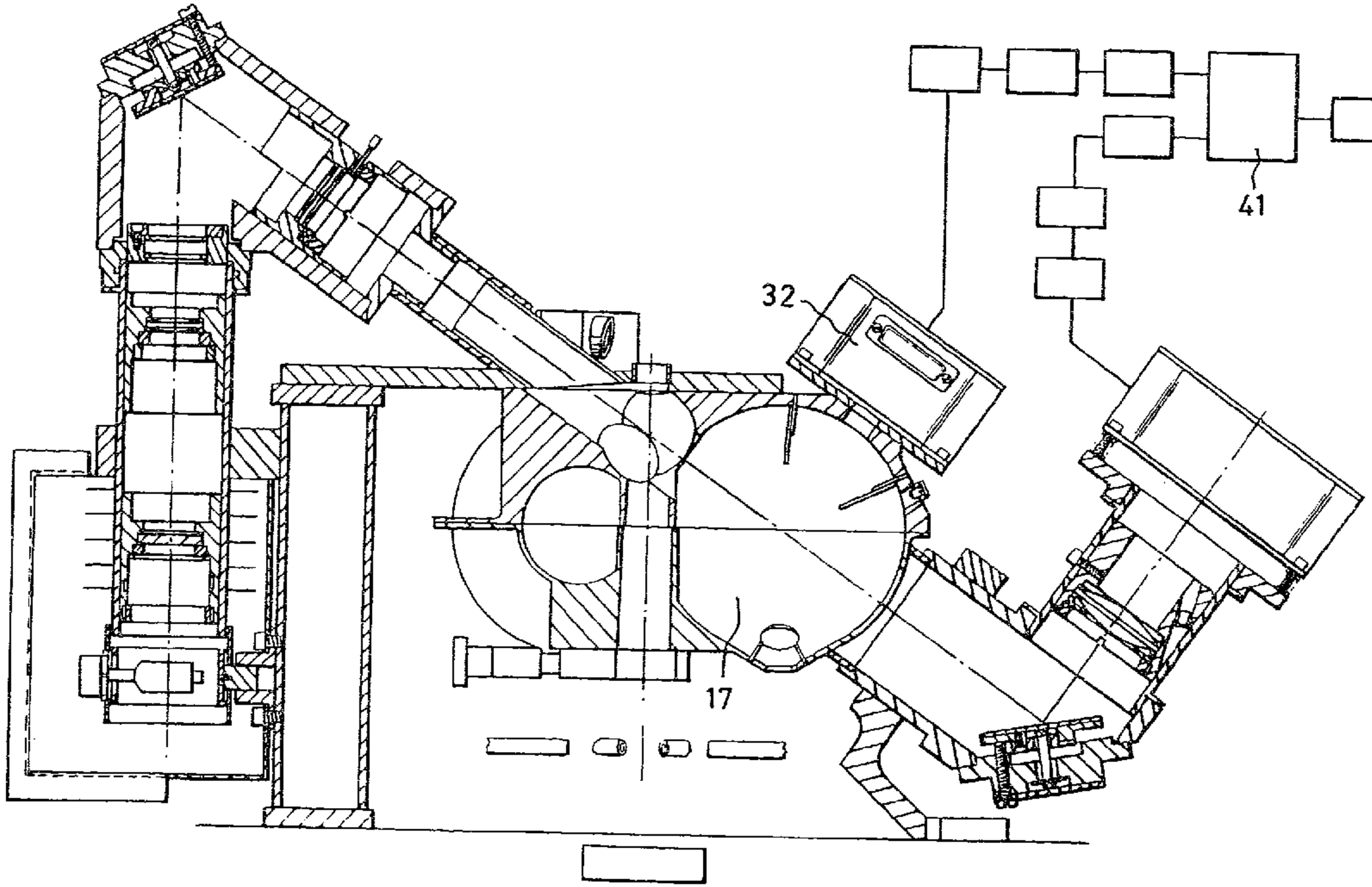
at least three viewers directed along orthogonal axes for sensing each successive object when it is in the viewing zone and thereby giving signals representative of areas of the object as presented to the respective viewers;

means for substantially preventing cross-talk; and

means for selecting said signal representing the smallest said presented area and thereby giving a signal according to the size of the object.

16. The apparatus of Claim 14 or 15 and comprising means for receiving said signal according to the shape of the object and for physically sorting the objects according to said signal.




41
32
17