

Apparatus and method for detecting the passage of coins

The present invention relates to an apparatus and a method for detecting the passage of coins and is especially concerned with detecting the presence of a coin in a vertical or near vertical coin passageway.

In coin-operated machines it is sometimes necessary to detect the presence of a coin in a vertical or near vertical coin passageway. For example in a coin testing device it may be necessary to detect the presence of a coin that has been inserted into and is falling down a vertical entry passageway in order to provide a signal which sets the coin testing circuitry in readiness for the arrival of the coin at a coin testing station. It is also sometimes necessary to detect when a coin which has been tested and found to be acceptable has passed an entry gate leading to a coin acceptance passageway in order that the gate may then be closed and the acceptance signal may be passed to a totaliser which accumulates the values of coins accepted.

One known arrangement for detecting the passage of a coin along a coin passageway consists of a light source in one wall of the coin passageway and a light detector on the opposite wall positioned so that a beam of light from the source normally crosses the passageway and falls on the light sensor. The passage of a coin causes temporary interruption of the beam of light and thus is detected by a temporary change in the output of the sensor (see, for example, US—A—3998 309 and US—A—4089 400).

For the coin machine manufacturer making mechanisms for testing different sets of coins to meet the requirements of customers throughout the world, it is desirable, so far as possible, to use one size of part for all coin sets. Coins vary considerably in size. For example, the Dutch 10 cents coin has a diameter of 15 mm whereas the Danish 5 Krone has a diameter of 33 mm. Therefore in a mechanism which is designed for universal application the coin passageways must be large enough to allow the 33 mm Danish 5 Krone coin to pass with clearance. However, detecting the passage of a 15 mm Dutch 10 cent coin down a vertical passageway which is large enough to pass the 5 Krone coin using the known arrangement of light source and sensor is unreliable because the coin can pass by the side of the light beam without interrupting the light beam and thus be undetected.

It is also known from US—A—2237 132 to sense a coin at positions along a guideway by means of photoelectric apparatus in which a beam of light is caused to cross the guideway a number of times at different positions along the length of the guideway.

British Patent Specification No. 1,278,363 does not relate to detecting coins. It relates to

counting small parts such as nuts and bolts. A light beam from a source is reflected many times back and forth across an approximately square detection plane and finally is detected by a detector located behind a small collimating inlet 56. Although successive passes of the beam may be contiguous, the small inlet 56 means that only a limited part of the beam cross-section is effective. Flat objects could slide edgewise between these parallel effective parts of the beam and so a proportion of such objects would not be counted. Thus this apparatus is not suited to reliably detecting coins. Furthermore, the apparatus relies upon "total" coverage of a plane with the light beam to achieve detection of objects which may pass through the plane at any position and in any orientation. In one case eight and in another case four passes of the beam are needed to achieve this.

The invention provides apparatus for detecting the passage of a coin in a predetermined region said region being part of a coin-receiving passageway of the apparatus comprising a light source, means for causing a beam of light from said source to cross said region of a plurality of times at a respective plurality of positions, and means for detecting interruption of said beam by a coin, characterised in that means is provided for orientating the coin substantially in a predetermined plane which intersects the light beam, and the positions at which the beam crosses the passageway are spaced apart in a direction generally transverse to the direction in which the coin passes along the passageway.

The present invention thus offers a way of detecting coins, using a common structure which will achieve reliable detection over a wide range of coin diameters, and without the need to cover a detection plane with light.

The term "light source" is intended to include infrared light sources and ultra violet light sources. Conveniently the light source may comprise a light-emitting diode and the light detector may comprise a photo-transistor.

The apparatus to be described has the further advantage that because the light source and detector are on the same side of the coin passageway, electrical connections to the light source and light detector are from one side only. This facilitates the design and construction of machines incorporating the apparatus according to the invention.

The reflecting means may be provided by a prism of transparent material, the first and second reflecting means comprising first and second surfaces of the prism arranged at approximately 45° to the wall of the coin passageway, the beam being reflected by total internal reflector in the prism.

According to the present invention in a second aspect there is provided a method of

detecting the passage of a coin in a predetermined region which is part of a coin-receiving passageway, comprising causing a light beam to cross the region a plurality of times at a respective plurality of positions, and detecting the interruption of the beam by a coin which has entered said region, characterised in that before entering the region, the coin is orientated to lie substantially in a predetermined plane which intersects the light beam, and the beam is caused to cross the passageway at positions which are spaced apart in a direction generally transverse to the direction in which the coin passes along the passageway.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawings of which:

Figure 1 shows a side elevation, partly in section, of part of a coin testing mechanism incorporating the present invention;

Figure 2 shows a fragmentary horizontal section of the part of the mechanism shown in Figure 1;

Figure 3 shows a diagrammatic exploded perspective view of the apparatus of Figures 1 and 2; and

Figure 4 shows a block circuit diagram showing how the signal from the sensor of Figures 1 to 3 may be used.

Referring to the drawings, these show part of a coin testing mechanism 11 which includes a passageway 12 where coins inserted into the mechanism are tested for authenticity and denomination by electronic circuitry with sensors 13 located adjacent the passageway 12. The coin testing circuitry and sensor may for example be of any suitable design, for example they may be as described in our British patent No. 1,397,083.

Below the passageway 12 are an acceptance passageway 14 and a reject passageway 15. The passageways are near vertical and have an oblong horizontal cross-section. The walls of the passageway 14 are provided by two closely spaced moulded plastics plates 16 and 17.

The entrance to the acceptance passageway is normally closed by a gate 18 which can pivot about a horizontal axis 19 but which is biased into the closed position by means of a leaf spring 20 which is secured to the plate 17 and bears against the gate 18. The gate 18 can be opened by energising a solenoid 21 which has an armature 22 which passes through a hole in the plate 16 and bears against the gate 18 at a point above the hinge axis. As indicated in Figure 4 when the test circuitry 23 determines that a coin inserted into the mechanism is acceptable it causes the solenoid 21 to be energised to open the entrance to the acceptance channel.

To provide a signal to indicate that the coin has arrived in the acceptance passageway a coin presence sensing arrangement 24 is provided.

The sensing arrangement 24 comprises an

infra-red emitting diode 25 and a photo diode 26 mounted in two horizontally spaced holes 27 in the plate 16. In the plate 17 are two holes 28 aligned with the holes 27 and behind these holes is a prism 29. The prism 29 is mounted on a plate 50 of moulded plastics material which also serves to form one wall of the reject passageway. The plate 50 is mounted against the plate 17 with the prism positioned over the holes 28.

The prism 29 is made of clear acrylic plastics material and has flat front and rear faces 30 and 31 which are disposed perpendicular to the axes of the holes 27 and 28. The end faces 32 and 33 are inclined at 45° to the axes of the holes 27 and 28 and the normals to the end faces lie in a common plane with the axes of the holes. The inclined end faces of the prism are opposite the ends of the holes 28.

The infra-red emitting diode 25 is connected to a suitable supply of electricity (not shown) so as to act as a light source. The light from the diode 25 is collimated by the hole 27 so that a beam of light crosses the passageway 14, passes through the corresponding hole 28 and enters the prism 29 passing perpendicularly through its front surface 30. At the inclined end surface 32 the light beam undergoes total internal reflection through 90° and passes parallel to the wall of the passage, inside the prism towards the end surface 33. At the surface 33 the light beam undergoes total internal reflection through 90° to emerge from the prism perpendicularly to the front face and parallel to the part of the beam entering the prism. The emergent beam passes through the corresponding hole 28, crosses the coin passageway and enters the hole 27 to fall on the photo-transistor 26. The photo-transistor is connected in an electrical circuit (not shown), the output of which is amplified and used to provide a signal for indicating the presence of a coin in the acceptance passageway.

The sides of the coin passageway 14 adjacent the sensing arrangement are formed by a vertical moulded strip 34 on the plate 16 and a metal plate 35 of the housing for the coin mechanism. The width of the coin passageway 14 between the strip 34 and the plate 35 is about 40 mm to allow a Danish 5 Krone coin to be accepted and pass with clearance down the acceptance passageway. The spacings between the strip 34 and the light source 25, the light source and the light detector 26 and the light detector and the plate 35 are all about 13.5 mm. Thus when a coin as small as the Dutch 10 cents coin passes down the passageway the light source and the detector will be interrupted at at least one of the two positions where it crosses the passageway. In this way the sensing arrangement detects coins which might not be detected by a centrally arranged sensor and light source on opposite sides of the passageway.

The interruption of the light falling on the

photo-transistor 26 causes a change in output from its circuit which serves as a signal to indicate the presence of a coin in the acceptance passageway 14.

Figure 4 illustrates in a much simplified form how this signal might be used. As has been mentioned above a signal from the coin testing circuitry 23 indicative of an acceptable coin is used to cause the solenoid 21 to be energised, thus opening the accept gate 18. The sensing arrangement 24 detects the presence of the coin when it has entered the acceptance passageway 14. The signal from the sensing arrangement 24 is combined in the AND gate 37 with the accept signal from the testing circuitry and passed to the totaliser 36 so as to initiate the accumulation in the totaliser 36 of the value of the coin accepted and to cancel the "accept" signal, thereby causing the gate 18 to close. If no accept signal is received after a delay of about 300 milliseconds the accept signal is cancelled and no value is credited in the totaliser 36.

Claims

1. Apparatus for detecting the passage of a coin in a predetermined region, said region being part of a coin-receiving passageway (14) of the apparatus comprising a light source (25), means (27, 28, 29) for causing a beam of light from said source to cross said region a plurality of times at a respective plurality of positions, and means (26) for detecting interruptions of said beam by a coin, characterised in that means (12, 18) is provided for orientating the coin substantially in a predetermined plane which intersects the light beam, and the positions at which the beam crosses the passageway are spaced apart in a direction generally transverse to the direction in which the coin passes along the passageway.

2. Apparatus according to claim 1, characterised in that the light source comprises a light-emitting diode and the detecting means comprises a photo-transistor.

3. Apparatus according to claim 1 or 2, characterised in that said means for causing the beam to cross the region a plurality of times comprises a prism (29) of transparent material having first and second surfaces (32, 33) arranged at approximately 90° to each other, the beam being reflected by total internal reflection in the prism so as to cross the passageway twice.

4. Apparatus as claimed in claim 1 and for use in coin mechanisms, characterised in that the passageway has an oblong cross-section and is defined by two generally parallel closely spaced walls (16, 17), the light source and detecting means are located in or adjacent one of the said walls (16), the light source and detecting means are spaced from one another across the width of the passageway and from sides (34, 35) of the passageway, first and

second reflecting means (32, 33) are located in or adjacent the other said wall (17) of the passageway opposite the light source and detecting means respectively so that the first reflecting means reflects a light beam crossing the passageway from the light source towards the second reflecting means and the second reflecting means reflects the beam reflected by the first reflecting means across the coin passageway towards the detecting means, the spacing of positions where the beam crosses the passageway from each other and from the sides of the passageway all being less than the size of the smallest coin which the apparatus is intended to detect.

5. Apparatus as claimed in any preceding claim, characterised in that the coin-receiving passageway is an accept passageway of a coin validating apparatus, the beam crosses the passageway just downstream of a gate (18) operable to open and close the passageway to coins tested by the validating apparatus, and means (21, 22) is provided, responsive to detection of the passage of a coin, for operating the gate to close the passageway.

6. Apparatus as claimed in any preceding claim, wherein the light beam is narrowed by passing through a hole (27) into the passageway.

7. Apparatus as claimed in claim 6, wherein incidence of light on the detecting means is restricted by a hole (27) between the passageway and the detecting means.

8. A method of detecting the passage of a coin in a predetermined region which is part of a coin-receiving passageway, comprising causing a light beam to cross the region a plurality of times at a respective plurality of positions, and detecting the interruption of the beam by a coin which has entered said region, characterised in that before entering the region, the coin is orientated to lie substantially in a predetermined plane which intersects the light beam, and the beam is caused to cross the passageway at positions which are spaced apart in a direction generally transverse to the direction in which the coin passes along the passageway.

9. A method as claimed in claim 8 characterised in that the coin-receiving passageway is of oblong cross-section dimensioned to orientate the coin substantially into said predetermined plane, in that the beam is directed across the passageway at a first position, is reflected to cross the passageway at a second position spaced across the width of the passageway in a direction generally transverse to the direction in which the coin passes along the passageway from the first position, the first and second positions being spaced from one another and from the sides of the coin passageway by distances which are less than the size of the smallest coin which is to be detected, and in that interruption of the beam is sensed after said beam has crossed the passageway at the second position.



Revendications

1. Appareil pour détecter le passage d'une pièce de monnaie dans une zone prédéterminée faisant partie d'un passage (14) de réception de pièces de monnaie, que comporte l'appareil, comprenant une source de lumière (25), des moyens (27, 28, 29) destinés à faire traverser ladite zone plusieurs fois en plusieurs positions respectives par un faisceau de lumière délivré par ladite source, et des moyens (26) pour détecter des interruptions dudit faisceau par une pièce de monnaie, caractérisé en ce que des moyens (12, 18) sont prévus pour orienter la pièce de monnaie essentiellement dans un plan prédéterminé qui intersecte le faisceau de lumière, et que les positions, dans lesquelles le faisceau croise le passage, sont distantes suivant une direction dans son ensemble transversale par rapport à la direction suivant laquelle la pièce de monnaie circule dans le passage.

2. Appareil selon la revendication 1, caractérisé en ce que la source de lumière comporte une diode luminescente et que les moyens de détection comprennent un phototransistor.

3. Appareil selon la revendication 1 ou 2, caractérisé en ce que lesdits moyens destinés à faire traverser la zone plusieurs fois par le faisceau comportent un prisme (29) constitué en un matériau transparent possédant des première et seconde surfaces (32, 33) disposées à environ 90° l'une par rapport à l'autre, le faisceau étant réfléchi sous l'effet d'une réflexion totale interne dans le prisme de manière à intersecter deux fois le passage.

4. Appareil selon la revendication 1 et destiné à être utilisé dans des mécanismes fonctionnant avec des pièces de monnaie, caractérisé en ce que le passage possède une section transversale allongée et est défini par deux parois rapprochées (16, 17) parallèles dans leur ensemble, que la source de lumière et les moyens de détection sont situés dans ou au voisinage de l'une desdites parois (16), que la source de lumière et les moyens de détection sont distants l'une de l'autre, suivant la largeur du passage et sont distants de côtés (34, 35) du passage, que des premiers et seconds moyens réfléchissants (32, 33) sont situés dans ou au voisinage de ladite autre paroi (17) du passage, respectivement en vis-à-vis de la source de lumière et des moyens de détection de telle sorte que les premiers moyens réfléchissants réfléchissent un faisceau de lumière croisant le passage depuis la source de lumière en direction des seconds moyens réfléchissants et que les seconds moyens réfléchissants réfléchissent le faisceau réfléchi par les premiers moyens réfléchissants en travers du passage pour pièces monnaie, en direction des moyens de détection, les distances entre les positions où le faisceau croise le passage et par rapport aux côtés du passage étant toutes inférieures à la taille de la pièce de monnaie la plus petite que

l'appareil est censé détecter.

5. Appareil tel que revendiqué dans l'une quelconque des revendications précédentes, caractérisé en ce que le passage de réception des pièces de monnaie est un passage d'acceptation d'un appareil de validation de pièces de monnaie, que le faisceau croise le passage juste en aval d'une porte (18) pouvant être actionnée de manière à ouvrir et fermer le passage pour les pièces contrôlées par l'appareil de validation et qu'il est prévu des moyens (21, 22) sensibles à la détection du passage d'une pièce de monnaie et servant à actionner la porte pour fermer le passage.

6. Appareil tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel le faisceau de lumière est rétréci lors de sa traversée d'un trou (27) débouchant dans le passage.

7. Appareil tel que revendiqué dans la revendication 6, dans lequel l'incidence de la lumière sur les moyens de détection est limitée par un trou (27) situé entre le passage et les moyens de détection.

8. Procédé pour détecter le passage d'une pièce de monnaie dans une zone prédéterminée qui fait partie d'un passage de réception de pièces de monnaie, consistant à faire traverser cette zone plusieurs fois en plusieurs positions respectives par un faisceau de lumière, et à détecter l'interruption du faisceau par une pièce de monnaie qui a pénétré dans ladite zone, caractérisé en ce que, avant de pénétrer dans ladite zone, la pièce de monnaie est orientée de manière à être située essentiellement dans un plan prédéterminé qui intersecte le faisceau de lumière, et que le faisceau de lumière est tenu de croiser le passage dans des positions qui sont distantes suivant une direction dans son ensemble transversale par rapport à la direction suivant laquelle la pièce de monnaie circule dans le passage.

9. Procédé tel que revendiqué dans la revendication 8, caractérisé en ce que le passage de réception des pièces de monnaie possède une section transversale allongée, dimensionnée de manière à orienter la pièce de monnaie essentiellement dans ledit plan prédéterminé, que le faisceau est dirigé en travers du passage dans une première position, et est réfléchi de manière à croiser le passage dans une seconde position distante de la première position suivant la largeur du passage, dans une direction dans son ensemble transversale par rapport à la direction suivant laquelle la pièce de monnaie circule dans le passage, lesdites première et seconde positions étant écartées l'une de l'autre et par rapport aux côtés du passage pour pièces de monnaie à des distances qui sont inférieures à la taille de la pièce de monnaie la plus petite qui doit être détectée, et qu'une interruption du faisceau est détectée après que ledit faisceau a croisé le passage, dans la seconde position.



Patentansprüche

1. Gerät zur Erfassung des Durchtritts einer Münze in einem vorgegebenen Bereich, wobei dieser Bereich Teil einer münzaufnehmenden Laufbahn (14) des Gerätes ist, mit einer Lichtquelle (25), einer Einrichtung (27, 28, 29), die bewirkt, daß ein Lichtstrahl von dieser Quelle den Bereich mehrmals an einer entsprechenden Vielzahl von Positionen kreuzt, und einer Einrichtung (26) zur Erfassung von Unterbrechungen des Strahls durch eine Münze, dadurch gekennzeichnet, daß eine Einrichtung (12, 18) zur Ausrichtung der Münze im wesentlichen in einer vorgegebenen, den Lichtstrahl schneidenden Ebene vorgesehen ist, und daß die Positionen, an denen der Strahl die Laufbahn kreuzt, mit einem Abstand in einer Richtung im allgemeinen quer zu der Richtung angeordnet sind, in der sich die Münze entlang der Laufbahn bewegt.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Lichtquelle eine Leuchtdiode und die Erfassungseinrichtung einen Fototransistor aufweist.

3. Gerät nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Einrichtung, die bewirkt, daß der Strahl den Bereich mehrmals kreuzt, ein Prisma (29) aus transparenten Material mit ersten und zweiten Oberflächen (32, 33) aufweist, die in einem Winkel von annähernd 90° zueinander angeordnet sind, wobei der Strahl durch Totalreflexion in dem Prisma so reflektiert wird, daß er die Laufbahn zweimal kreuzt.

4. Gerät nach Anspruch 1 zur Anwendung in Münzautomaten, dadurch gekennzeichnet, daß die Laufbahn einen länglichen Querschnitt hat und von zwei im allgemeinen parallelen, mit geringem Abstand angeordneten Wänden (16, 17) festgelegt ist, daß die Lichtquelle und die Erfassungseinrichtung in oder in unmittelbarer Nähe einer dieser Wände (16) angeordnet sind, daß die Lichtquelle und die Erfassungseinrichtung mit Abstand voneinander über der Breite der Laufbahn und mit Abstand von Seiten (34, 35) der Laufbahn angeordnet sind, daß eine erste und eine zweite reflektierende Einrichtung (32, 33) in oder in unmittelbarer Nähe der anderen Wand (17) der Laufbahn gegenüber der Lichtquelle bzw. der Erfassungseinrichtung angeordnet ist, so daß die erste reflektierende Einrichtung einen die Laufbahn kreuzenden Lichtstrahl von der Lichtquelle in Richtung der zweiten reflektierenden Einrichtung reflektiert und die zweite reflektierende Einrichtung den von der ersten reflektierenden Einrichtung reflektierten Strahl über die Münzlaufbahn in Richtung der Erfassungseinrichtung reflektiert, wobei alle Abstände von Positionen, an denen der Strahl die Laufbahn kreuzt, voneinander und

von den Seiten der Laufbahn geringer als die Größe der kleinsten Münze sind, die das Gerät erfassen soll.

5. Gerät nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die münzaufnehmende Laufbahn eine Annahmelaufbahn eines die Gültigkeit der Münze nachweisenden Gerätes ist, daß der Strahl die Laufbahn unmittelbar unterhalb einer Sperre kreuzt, die die Laufbahn für von dem die Gültigkeit nachweisenden Gerät überprüfte Münzen öffnen und schließen kann, und daß eine Einrichtung (21, 22) vorgesehen ist, die auf die Erfassung des Durchtritts einer Münze anspricht, um die Sperre so zu betätigen, daß sie die Laufbahn schließt.

6. Gerät nach einem der vorhergehenden Ansprüche, wobei der Lichtstrahl verengt wird, indem er durch eine Öffnung (27) in die Laufbahn eintritt.

7. Gerät nach Anspruch 6, wobei der Einfall von Licht auf die Erfassungseinrichtung durch eine Öffnung (27) zwischen der Laufbahn und der Erfassungseinrichtung beschränkt wird.

8. Verfahren zur Erfassung des Durchtritts einer Münze in einem vorgegebenen Bereich, der Teil einer münzaufnehmenden Laufbahn ist, wobei bewirkt wird, daß ein Lichtstrahl den Bereich mehrmals an einer entsprechenden Vielzahl von Positionen kreuzt, und die Unterbrechung des Strahls durch eine Münze, die in diesen Bereich eingetreten ist, erfaßt wird, dadurch gekennzeichnet, daß die Münze vor Eintritt in den Bereich so ausgerichtet wird, daß sie im wesentlichen in einer vorgegebenen Ebene liegt, die den Lichtstrahl schneidet, und daß der Strahl veranlaßt wird, die Laufbahn an Positionen zu kreuzen, die mit einem Abstand in einer Richtung im allgemeinen quer zu der Richtung angeordnet sind, in der sich die Münze entlang der Laufbahn bewegt.

9. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß die die Münze aufnehmende Laufbahn einen länglichen Querschnitt aufweist, der so dimensioniert ist, daß die Münze im wesentlichen in die vorgegebene Ebene ausgerichtet wird, daß der Strahl an einer ersten Position quer zur Laufbahn geführt wird, daß er so reflektiert wird, daß er die Laufbahn an einer zweiten Position kreuzt, die über die Breite der Laufbahn in einer Richtung im allgemeinen quer zu der Richtung, in der sich die Münze entlang der Laufbahn bewegt, mit einem Abstand von der ersten Position angeordnet ist, wobei die erste und die zweite Position voneinander und von den Seiten der Münzlaufbahn in Abständen angeordnet sind, die kleiner als die Größe der kleinsten Münze sind, die erfaßt werden soll, und daß die Unterbrechung des Strahls wahrgenommen wird, nachdem der Strahl die Laufbahn an der zweiten Position gekreuzt hat.

