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(54) Method and an apparatus for identifying coins.

(57) A method for identifying coins (2) in apparatus wherein coins are introduced and channeled along a runway (4) provides for the passage of the coin between two points at a predetermined mutual spacing on the runway to be sensed by optical means (7a,9a,10a), measuring of the travel time between such points, and computing the coin diameter as a function of the ratio of the obscuration time of one of said means to the travel time.

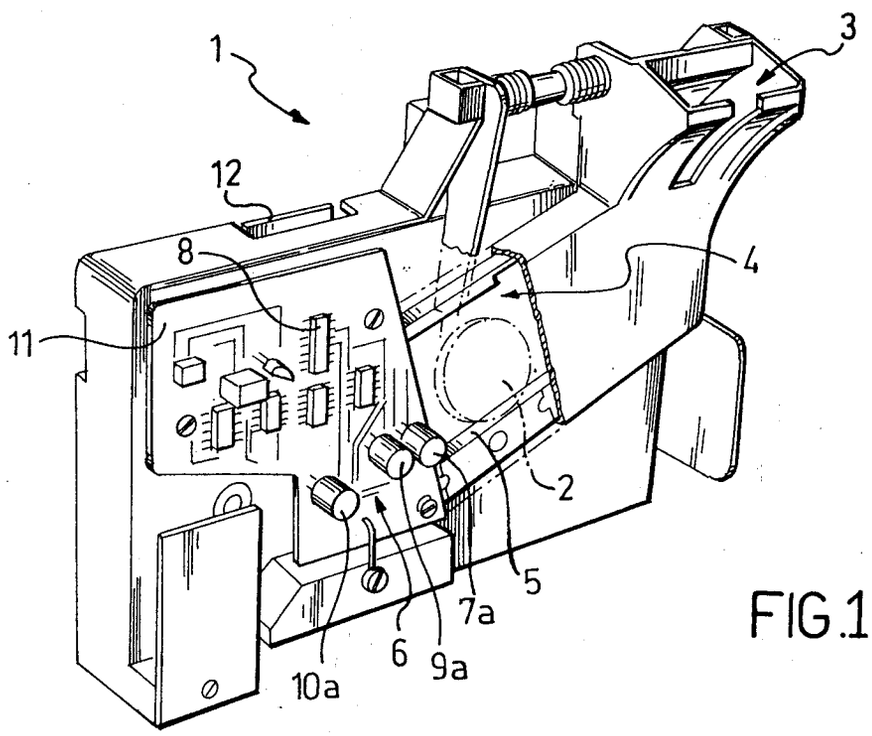

FIG.1

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This invention relates to a method for identifying coins in apparatus wherein coins are introduced and channeled along a runway.

The invention also concerns an apparatus operating in accordance with the above-outlined method.

It is a known fact that in the specific technical field of this invention, there exists a need for an accurate and reliable recognition of coins introduced to operate telephone apparatus or vendor machines of various description.

The prior art provides a number of proposals to meet this demand.

As an example, known are various methods which share the notion of subjecting a coin to be identified to a mechanical shock effective to set it into vibration, followed by an analysis of the corresponding resonance frequency.

Such a technique is disclosed, for instance, in Swiss Patent No. 591126 and German Patent No. 2005038.

While being advantageous from several aspects, these prior methods cannot lead as such to any correct identification of the various coin denominations.

In general, an additional item of information must be provided in relation, for example, to the coin diameter, and in this respect, a number of methods for measuring the coin diameter are also known.

A presently obsolete technique provided a plurality of slots with different widths and gating passages, whereby the user could effect a first selection by introducing coins whose diameters would match such gates.

Modern coin recognizers have a single acceptance slot, and the diameter of each coin introduced therethrough is sensed either by magnetic induction or by obscuring photocells across the coin travel path.

In the former case, the magnetic flux of an inductive coupling crossed by a coin undergoes a perturbation which is tied to the dimensions, and hence the diameter, of a coin.

In the latter case, the photocells are arranged a predetermined distance away from the coin running plane and adapted to become selectively obscured according to the coin size.

These prior technical approaches, while achieving their objective, have a drawback in that they tend to be inflexible, being unable to adjust themselves for the acceptance of new coin sizes or types. In fact, the coin recognition process is based on pre-set parameters (like the coin size) which involve costly adaptations of the recognition device for their change.

Further drawbacks of conventional devices come from that the diameter measurement is taken indirectly by means of a parameter which is related to it but is liable to inaccuracies and variations sometimes quite significant.

Finally, conventional devices are cost-intensive and generally unreliable in their measuring action.

The underlying technical problem of this invention is to provide a method and an apparatus having such characteristics as to afford accurate assessment of the coin diameters, thereby to overcome the prior art drawbacks.

This technical problem is solved by a method of the type specified hereinabove providing for the use of optical means to sense the passage of a coin between two points on the runway set a predetermined distance apart, measurement of the travel time between said points, and computation of the coin diameter as a function of the ratio of the obscuration time of one of said means to said travel time.

The technical problem is further solved by an apparatus for identifying coins accepted over a runway, being characterized in that it comprises optical sensing means supported at a fixed spacing from each other, and electronic control means operative to compute the coin travel time between said sensing means and the ratio of the obscuration time of the first of said sensing means to the travel time.

The features and advantages of the method according to this invention will become apparent from the following detailed description of an embodiment thereof, given in connection with an apparatus for implementing it shown, by way of illustration and not of limitation, in the accompanying drawings.

In the drawings:

Figure 1 is a perspective view of an apparatus according to the invention; and

Figure 2 is a front view of the apparatus shown in Figure 1.

With reference to the drawing views, generally shown at 1 is an apparatus embodying this invention, intended for identifying coins 2.

The apparatus 1 may be incorporated to a vendor machine or a telephone apparatus, not shown because conventional.

Further, the apparatus 1 is adapted to accept coins 2 in varying denomination sizes, specifically different diameters, to be introduced through an invitation slot 3.

The invitation slot 3 leads to a runway 4 including a ramp 5 set at a slight inclination angle.

Coins 2 would be led to roll over the ramp 5.

Advantageously, there are provided along the runway 4 optical sensing means 6 which lie in the travel path of the coins 2.

More specifically, these means 6 are photo-sensors comprising three photodiode/phototransistor pairs, indicated at 7a, 7b, 9a, 9b, 10a, 10b, of which only the photodiodes 7a, 9a and 10a are shown in the drawing figures.

The photodiode-phototransistor in each pair are supported coaxially on opposite sides of the runway 4 a predetermined height above the ramp 5 on respective electronic boards 11, 12.

The directional character of the light beam between each pair is enhanced by a perforated metal screen at the location of each photo-sensor.

In particular, the photo-sensor pair 7a, 7b are effective to actuate the recognition step the moment a coin 2 is intercepted.

The other photo-sensor pairs, 9a, 9b, 10a, 10b, are supported a distance S apart on the boards 11, 12 and operative to sense the travel time of the coin 2.

The apparatus 1 also includes electronic control means 8 connected to the photo-sensors for storing obscuring time data relating to the photo-sensor pair 9a, 9b, and for computing the travel time of the coin 2 from the last-named photo-sensor pair to the next, 10a, 10b.

Thus, the method of this invention provides for the measuring step to start the moment that the coin moves past the photo-sensor pair 7a, 7b.

The latter are kept constantly under power, and in order to reduce their power consumption, only active on a partial basis with a duty cycle of 1/20.

The signal frequency has been selected at 500 Hz because, in viewof that the coins 2 would travel along the ramp 5 a mean distance of 10 mm every 20 ms, this affords an accuracy of about 1 mm in detecting the passage of the coin, adequate to timely actuate the measuring step.

Thus, the inventive method provides for measurement of the obscuration time t1 for the photo-sensor pair 9a, 9b, as well as of the travel time T between the photo-sensor pairs 9a, 9b and 10a, 10b.

Since the distance S between the last-named photo-sensor pairs is a fixed one, the coin diameter, or at least the chord at the height h of the axis of the photodiodes 9a, 9b and 10a, 10b above the ramp 5, can be readily obtained.

In essence, it is a matter of computing the ratio of the obscuration time to the travel time, as the distance S between the axes of the two photo-sensor pairs 9a, 9b and 10a, 10b is fixed.

The diameter D is computed with the following formula:

$$D = S * t1/T$$

It matters to observe that since the measurement is based on a ratio, it will be unaffected by the accuracy of the sensing means.

By providing a runway 4 of appropriate length, it becomes also possible to take a measurement of the obscuration time t2, for the photo-sensor pair 10a, 10b, thereby the diameter D can be obtained from the following formula:

$$D = S * tm/T$$

where: $tm = (t1 + t2)/2$

The use of tm, being the mean value of the obscuration times t1 and t2, advantageously makes for a more precise computation of the coin diameter because it can accommodate possible variations in the travel speed of the latter along the runway 4.

The method of this invention solves, therefore, the technical problem in a simple and effective manner.

After the coin 2 has travelled the full length of the runway 4, it can be routed to further means of analysis, known per se, incorporated to the apparatus 1, e.g. of the kind adapted to analyze the coin resonant frequency on striking a surface.

Thus, the diameter measurement taken with the method of this invention may be used in combination with such additional methods of analysis to identify the coin type with great accuracy.

In addition, the method and apparatus of this invention afford the following advantages over the prior art:

ability to adjust for new coin sizes or types with no structural alterations to the sensing apparatus;

reduced number of photo-sensors with evident savings in cost; and

improved reliability and reproducibility of the sensing process.

Claims

1. A method for identifying coins in apparatus wherein coins (2) are introduced and channeled along a runway (4), characterized in that it comprises the steps of sensing by optical means (6) the passage of a coin (2) between two points on the runway (4) set a predetermined distance apart, measuring the travel time (T) between said points, and computing the coin (2) diameter (D) as a function of the ratio of the obscuration time (t1,t2) of one of said means (6) to said travel time (T).

2. A method according to Claim 1, characterized in that said sensing action is provided by infrared photodiodes/phototransistors (7a,9a,10a).

3. A method according to Claim 1, characterized in that the start of the measuring step is controlled by the passage of a coin (2) along said runway (4) being sensed.

4. An apparatus for identifying coins (2) accepted over a runway (4), characterized in that it comprises optical sensing means (6) supported at a fixed spacing from each other, and electronic control means operative to compute the coin (2) travel time (T) between said sensing means (7a,9a,10a) and the ratio of the obscuration time (t1) of the first (9a) of said sensing means to said travel time (T).

5. An apparatus according to Claim 4, characterized in that said optical sensing means (7a,9a,10a) are infrared photodiodes/phototransistors.

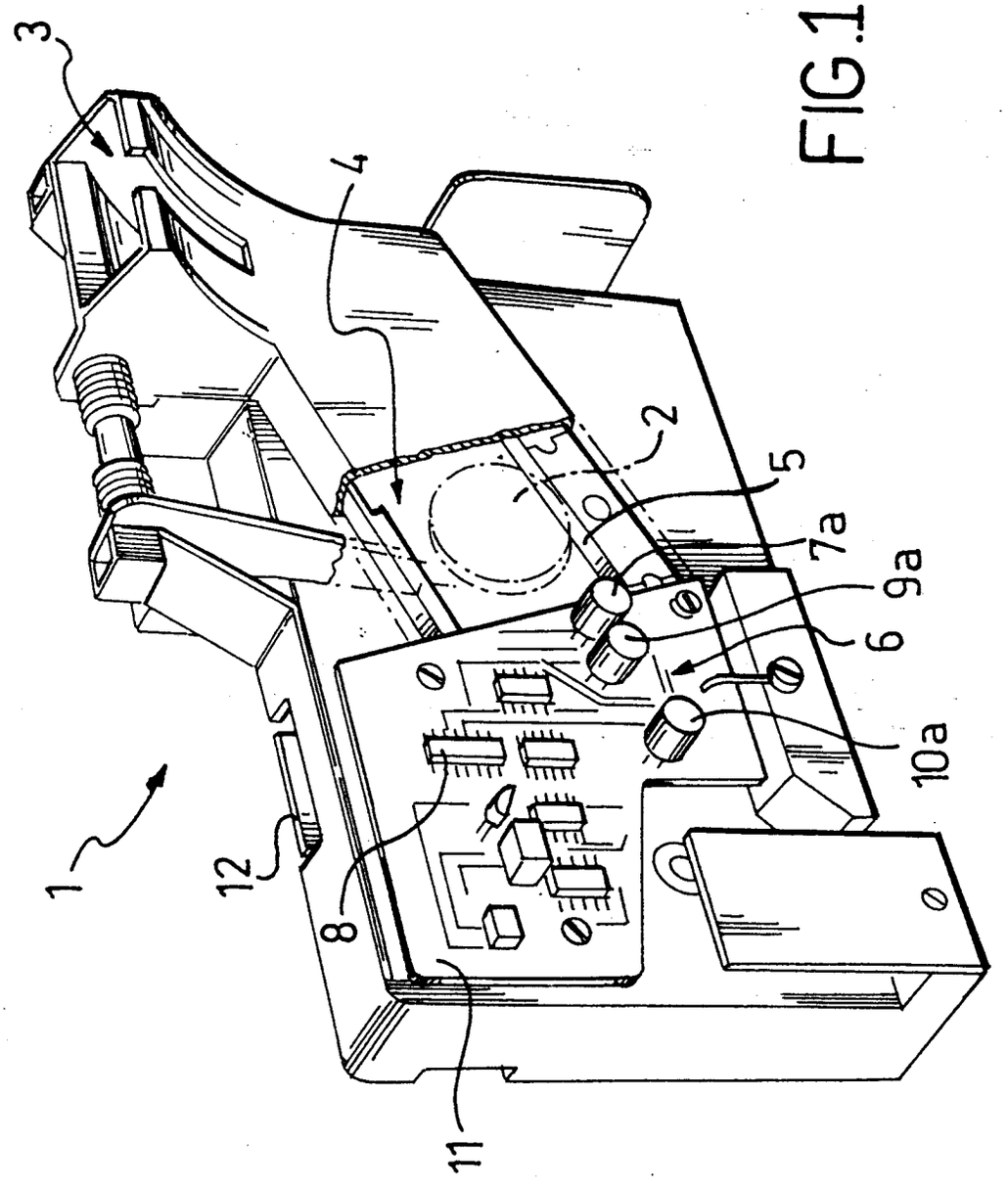
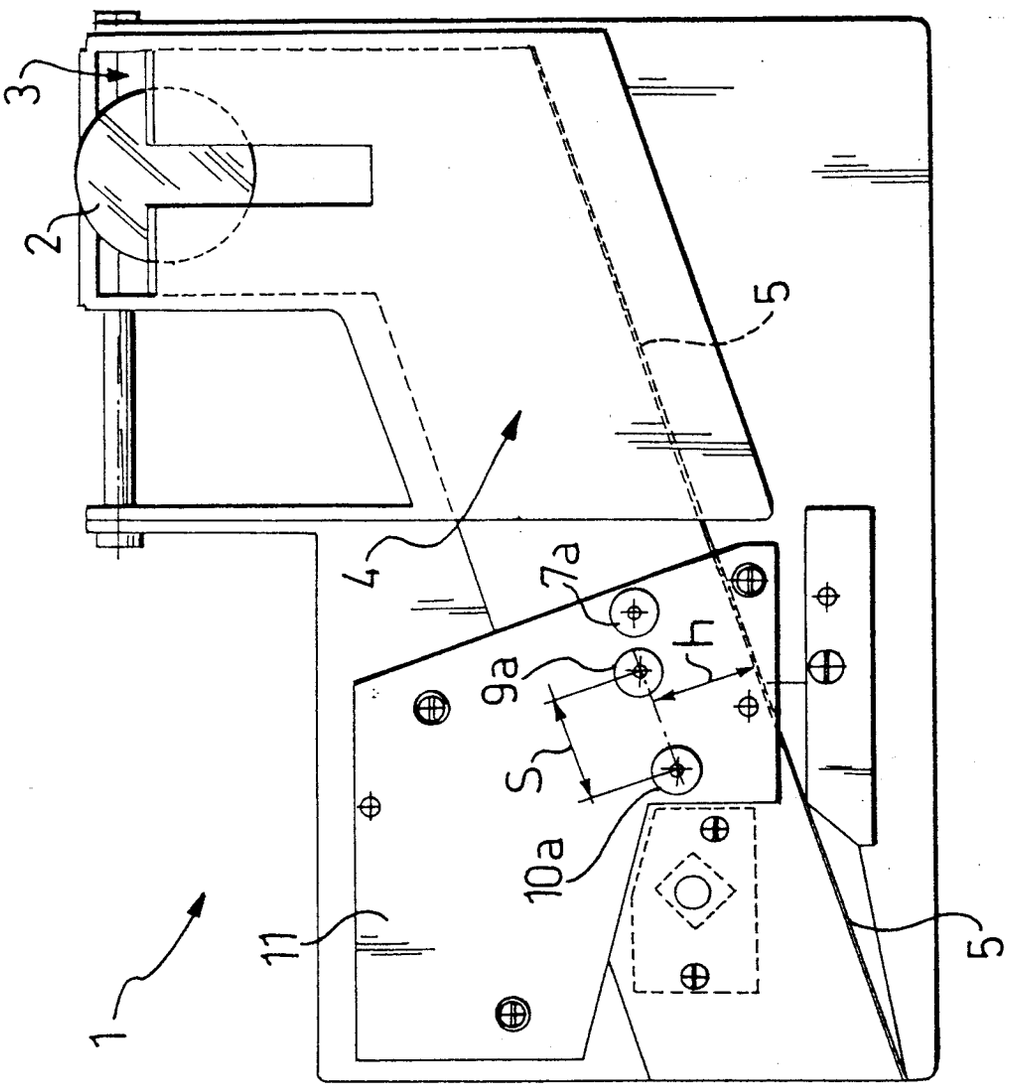


FIG.1

FIG.2



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EUROPEAN SEARCH REPORT

Application Number

EP 91 10 9021

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 585 936 (C. SELLIER) * column 2, line 48 - column 3, line 45; figures 1-3 * * column 5, line 19 - line 39 *	1,2,4,5	G07D5/02 G07F3/02
X	US-A-4 474 281 (M. ROBERTS) * abstract; figures * * column 5, line 9 - column 6, line 23 * * column 7, line 37 - line 56 *	1,2,4,5	
A	US-A-3 797 307 (R.H. JOHNSTON) * column 3, line 35 - column 5, line 33; figures 1,2 *	1-5	
A	US-A-4 509 633 (E.E. CHOW)		
A	US-A-4 646 904 (R.A. HOORMANN)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
G07F G07D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 FEBRUARY 1992	DAVID J.Y.H.

CATEGORY OF CITED DOCUMENTS

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