

COIN STORAGE ASSEMBLY

This invention relates to a coin storage assembly comprising one or more coin storage containers. The invention is particularly but not exclusively applicable
5 to containers incorporating mechanisms for dispensing coins therefrom.

Such containers are often used in coin handling apparatus such as is found in vending machines, change-giving machines, etc. Coins inserted in the machines
10 are directed to one or more containers. There is a separate container for each coin denomination which is to be stored and the coins are stored in a stack in each container. The use of such containers enables the machine to dispense coins in a change-giving operation. Also,
15 storing different denomination coins in different containers makes it easier to count the coins when the containers are emptied, and avoids the need for manual separation of the different denominations if such separation is desired.

20 Once the container is full, coins which are normally directed to the container are instead delivered to a cashbox. In order to determine whether the container is full, it is conventional to provide a sensor which provides a signal when the stack of coins in the container
25 exceeds a predetermined level. The sensor is positioned

at that level so that as the level is reached by the stack the sensor provides a detection signal.

Inductive sensors have been used for this purpose, because they are inexpensive. However, one difficulty
5 with this arrangement is that in some cases a coin entering the container or storage tube may come to rest in an upright orientation on the stack, instead of a horizontal orientation, especially if the container is nearly full and the coin does not fall far enough to
10 build up a substantial velocity. This could result in the upright coin being spaced from the sensor by a distance which exceeds the range of the sensor.

Although the fact that the coin is positioned in an upright orientation might not itself cause problems
15 because the coin would probably eventually settle in the correct orientation as the level of the stack decreases, due for example to the vibration caused by dispensing the coins, the fact that the coin has not been sensed would mean that any subsequently-inserted
20 coins of the same denomination would be delivered to the container and this could cause jamming before the coins have had the opportunity to settle down to the correct positions in the container.

There are forms of optical sensor which could
25 be used in place of the inductive sensor and which would

detect a coin in the upright orientation. However, these are less simple to mount to the container, particularly because one or more light paths through the container are needed.

5 According to one aspect of the present invention, there is provided a coin storage assembly which comprises a container for storing a stack of coins and which has a sensor for detecting when the stack exceeds a predetermined level so that overfilling of the container and
10 jamming of the assembly can be prevented in response to said detection, wherein the container has a region into which coins are constrained to travel edge-first to reach the stack, so that a coin while in the region is in a predetermined orientation, and wherein the sensor is
15 arranged to detect a coin which is located in said region and supported by the stack.

 The invention enables very reliable sensing of the coin stack reaching a certain level, because the next coin to arrive is made to occupy a predetermined position
20 and the sensor is arranged to detect a coin when in that predetermined position.

 The sensor is preferably positioned in proximity to the face of a coin located in the entry to the container.

5 The above arrangement ensures that a coin in the entry will be detected, so that if the level of the stack of coins is such that a coin remains in the entry, then a control device can detect this using the sensor and can arrange for further coins to be directed elsewhere.

 The sensor is preferably inductive, but the advantages of increased reliability of sensing would also be achieved if other forms of sensor, such as optical, were used.

An arrangement embodying the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a
5 coin storage assembly according to the invention;

Figure 2 is a side elevation showing part of a container of the storage assembly of Figure 1;

Figure 3 is a partial view of another container of the assembly;

10 Figure 4 is a schematic view of the interior of the upper end of the container; and

Figure 5 is a sectional view of a dispensing mechanism of the container.

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Referring to Figures 1 and 2, the coin storage assembly 2 of the present embodiment is positioned beneath a coin separator (not shown). The separator receives from a validator coins which have been
5 tested and found to be genuine, and separates the different denominations of coins in order to deliver them via respective supply passages 4 to the coin storage assembly.

The assembly of the present embodiment comprises
10 a plurality of, and in this particular case four, storage units 6. Each unit 6 has a storage space 8 for storing a stack 10 of coins received from a supply passage 4, a secondary passage 12 which can also receive coins from the supply passage 4, and an
15 additional passage 14.

The stacked coins in the storage space 8 can be dispensed one at a time by a dispensing mechanism generally indicated at 16.

Coins from a supply passage 4 are normally
20 delivered to the storage space 8, but if the storage space is full they are instead delivered to the secondary passage 12, which leads to a cashbox. In the present embodiment, the secondary passages 12 lead to

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separate cashboxes. A gate 18 determines whether the coins from a supply passage 4 go to the storage space 8 or the secondary passage 12.

5 Each additional passage 14 receives coins from a respective separator passage 20. These coins may be of a denomination which the apparatus is not required to dispense, and the coins may be routed by the additional passages 14 to separate cashboxes, or a common cashbox. In the preferred embodiment, one of
10 the additional passages 14 is used to route coins which have been rejected by a validator to an exit slot for retrieval by the user of the apparatus.

Each unit 6 is formed in two longitudinal halves. Figure 2 shows the left-hand half of one of
15 the units. Each half is formed by injection moulding. If desired, the two halves could be formed in a single mould, with the halves linked together by a flexible hinge along the edge 22 so that the halves can be readily closed to form the storage unit 6 after ejection from
20 the mould. The halves are fastened together by screws through bosses 24.

The storage space 8 is formed between an outer wall part 26 and an inner wall part 28. The secondary passage 12 is formed between the inner wall part 28 and a further inner wall 30, and the additional passage 14

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between the wall 30 and a rear wall 32.

The storage space 8 is cylindrical, and has a diameter which is slightly greater than that of the coins intended to be stacked in the space.

5 It is intended that the unit 6 be usable with coins of various diameters. However, for coins of substantially different diameters, other units 6, having different diameter storage spaces 8, would be used. Figure 3 shows part of another such unit 6 having a
10 reduced diameter space 8 for smaller diameter coins. This can be achieved simply by changing an insert in the injection mould used to form the container units, so that the wall part 26 remains of the same thickness, but wall part 28 becomes thicker. This arrangement
15 ensures that the left-most edges of the coins in the stack 10 (as seen in Figure 2) are always at substantially the same position irrespective of the diameter of the coins; this simplifies the design of the dispensing mechanism.

20 The container unit 6 is secured in position at its top end by a screw through a hole 38 in a mounting structure 40, which has an inclined face engaging a similarly inclined face of a wall 41 of the separator. At its bottom end, the container unit is located by a
25 boss 34 and hook 35 engaging with mating portions of an enclosure case (not shown).

The coins from the supply passage 4 reach the storage space 8 via an entry 42. The entry 42 comprises a narrow space 44 between a wall 46 of the separator and a ledge 48 at the upper end of the inner wall 28. The shape and size of the space 44 are such that coins can pass through the space only if they are travelling edge-first.

When the stack 10 reaches a certain level (which will be different for coins of different diameters), as shown in Figure 2, the next coin 50 to be delivered through the entry 42 will come to rest on the top of the stack, with its upper edge supported on the ledge 48.

The coin 50 is supported in a generally upright, but inclined orientation with its centre of gravity located over the stack 10. An inwardly-inclined, flat upper edge 54 of the outer wall 26 assists in guiding the coin 50 to this orientation. An inductive sensor 52 is mounted in the separator in such a position that it will be in proximity to the face of the coin 50. The sensor 52 is able to detect the presence of coin 50 which indicates that the storage space 8 is full, which detection is reliable because the position of the last coin to enter the storage space is predetermined by the configuration of the entry 42 in co-operation with the stack 10.

If a coin is now dispensed

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from the stack 10, so that the top of the stack moves down by a distance corresponding to the thickness of the dispensed coin, the upper edge of the coin 50 will no longer be supported by the ledge 48, and the
5 coin will then fall directly face-down on the top of the stack.

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Figure 4 schematically shows in more detail the interior configuration of the upper end of the storage space 8. The inclined portion 54 is joined to the inner sidewalls of the storage space 8 by curved portions 56. The portions 56 form parts of a surface of a notional cone having a downwardly-directed apex and an axis concentric with that of the storage space 8. Assuming that the stack 10 is at a fairly low level, the edges of a coin entering the storage space 8 will engage the curved surfaces 56, which will tend to flip the coin about a horizontal axis as indicated by the arrow A, so that the coin will tend not to be on edge when it lands on the stack 10.

Referring again to Figure 2, the inter-engaging surfaces of the mounting structure 40 and the support wall 41 are inclined so that they are substantially parallel to the coin 50. The purpose of this arrangement is to compensate for possible variations in the length of the container unit 6, caused for example by different rates of shrinkage during the injection moulding of the container.

The unit 6 is fixed at its bottom end, so that any variations in the length of the unit will result in slight variations in the height of the top of the unit. However, because of the inclination of the engaging

surfaces between the mounting structure 40 and the support wall 41, any differences in the height of the upper end of the unit 6 will result in slight changes in the horizontal positioning of the upper end.

- 5 The overall effect of this is to ensure that the separation between the sensor 52 and the face of the coin 50 is constant irrespective of minor variations in the length of the unit 6.

A similar effect could be achieved if only one
10 of the inter-engaging surfaces of the mounting structure 40 and the support wall 41 were to be inclined parallel to the coin 50, rather than both of these surfaces.

As shown in Figure 1, the gates 18 of the four storage units 6 are all mechanically connected
15 together, and indeed may be integrally formed. The gates all have a common actuator, which is a solenoid 60.

The gates are all pivoted about a common axis 62 located near the upper ends of the gates. When the solenoid 60 is de-energized, the gates 18 adopt the positions shown in phantom in Figure 2. In this position, the gates do not obstruct the travel of the coins from the supply passages 4, which therefore all fall into the respective secondary passages 12.

When the solenoid 60 is energized, the gates all move to the position shown in solid lines in Figure 2. Coins from the supply passages 4 are thus deflected by the gates 18 toward the entries 42 of the storage spaces 8.

The circuit for controlling the solenoid 60 operates as follows. The circuit receives signals from a validator to indicate the denominations of coins received thereby. Assuming that the coin is of a denomination which is stored in one of the storage units 6, the circuit checks the appropriate sensor 52 for that unit to determine whether the storage space 8 of the unit is full. Assuming that the unit is full, the circuit ensures that the gates 18 are all in the position shown in phantom in Figure 2 before the coin arrives at the respective gate by de-energizing the solenoid 60 if it is not already de-energized. The circuit

also resets a timer, and is arranged so that the solenoid 60 cannot be energized until at least a predetermined amount of time has elapsed, which amount is such as to ensure that the coin will have passed the gate 18 before
5 the solenoid 60 can be energized.

If then a further coin is tested by the validator and found to be of a denomination stored in one of the units 6, and further assuming that the sensor 52 for that unit indicates that the storage space 8 is not yet full,
10 then the circuit will determine that the solenoid 60 should be energized in order to direct that coin to its storage space. However, if the preceding coin was directed to the secondary passage 12 within a predetermined amount of time prior to the arrival of the
15 present coin, then the energization of the solenoid 60 is delayed until that predetermined amount of time has elapsed. Accordingly, the gates 18 might still be in the position shown in phantom in Figure 2 by the time the present coin arrives at the gate, in which case
20 the coin will be directed to the secondary passage 12 instead of to the storage space 8. This however, is not of any serious disadvantage.

The solenoid 60 is de-energized at a predetermined amount of time after the detection of the coin which was

destined for the storage space 8.

However, if a further coin is inserted into the validator, and it is determined that this should be delivered to a secondary passage 12, then the solenoid 60 is de-energized (as before) in sufficient time for the gates to have moved to the position shown in phantom in Figure 2 before the arrival of this subsequent coin. This may result in premature de-energization of the solenoid 60, so that in this case also the coin destined for the storage space 8 is delivered instead to the secondary passage 12. Again, this is of no particular disadvantage, because it will occur only in the relatively rare instances in which coins destined for storage spaces 8 are followed very quickly by a coin intended for a secondary passage 12.

It will be appreciated from the above discussion that, by the time a coin originally intended for the storage space 8 arrives at the gate 18, the gate 18 could in fact be moving toward or away from the position shown in solid lines in Figure 2. This could result in the coin being trapped between the gate 18 and the wall 28. However, because the gates 18 are pivoted about an axis which is upstream of the coin-deflecting surfaces of the gates 18, the subsequent de-energization

of the solenoid 60 will free the trapped coin as the gate 18 moves back to the position shown in phantom in Figure 2.

5 If the gate 18 is moving away from the position shown in solid lines in Figure 2, the coin might come to rest on top of the edge 48 of the wall 28. However, the next time the solenoid 60 is energized, the gate 18 will knock the coin toward the storage space 8 (which is the originally-intended destination of the 10 coin). Accordingly, the described arrangement provides a simple but effective way in which two or more gates can be operated by a common actuator without producing jamming or overfilling of coin storage spaces, but which nevertheless allows for the arrival of coins in 15 rapid succession.

The dispenser mechanism 16 is shown in more detail in Figure 5. The unit 6 has a base plate 70 located underneath the stack 10 of coins and provided with an aperture 72 which is offset from the lower end 20 of the storage space 8. A slide 74 can slide horizontally between the bottom of the stack 10 and the top of the base plate 70. The slide 74 has an aperture 76, and is biased by a spring 78 to the left as seen in Figure 5 so that the aperture 76 overlies the aperture 72

in the base plate 70. To dispense a coin, a solenoid
 79 is energized in order to move the slide
 74 to the right so that the aperture 76 is underneath
 the stack 10 of coins. The lowermost coin in the stack
 5 enters the aperture 76, and projects slightly above the
 top of the aperture. The energy to the solenoid is
 released so that the slide shifts back toward the
 left, bringing the coin in the aperture 76 over the
 aperture 72 so that the coin can fall through both
 10 apertures in order for it to be dispensed. The second-
 lowermost coin in the stack 10 is prevented from being
 moved by the slider by its engagement with the lower
 end of a designator member 80 which is held against the
 lower end of the wall 26 by the spring 78. The
 15 designator member 80 is selected from a range of members
 in accordance with the thickness of the coins to be
 dispensed.

Although the assembly referred to herein has been
 described as being used with coins, it is of course
 20 possible to use it for other items of similar shapes
 and sizes to coins, for example tokens such as are
 commonly used in amusement machines, and the term "coin"
 is intended to cover such items.



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CLAIMS:

1. A coin storage assembly which comprises a container for storing a stack of coins and which has a sensor for detecting when the stack exceeds a predetermined level so that overfilling of the container and
5 jamming of the assembly can be prevented in response to said detection, wherein the container has a region into which coins are constrained to travel edge-first to reach the stack, so that a coin while in the region is in a predetermined orientation, and wherein the sensor is
10 arranged to detect a coin which is located in said region and supported by the stack.

2. An assembly as claimed in claim 1, wherein the sensor is able to detect the presence of the coin without
15 making physical contact therewith.

3. An assembly as claimed in claim 2, wherein the sensor is of the inductive type.

20 4. An assembly as claimed in any preceding claim, wherein the sensor is positioned so that it is in proximity to the face of a coin in said region.



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5. An assembly as claimed in any preceding claim, wherein said region is arranged so that a coin in the region is supported at an orientation substantially displaced from the horizontal.

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6. An assembly as claimed in claim 5, wherein said region is arranged so that the coin is supported with its centre of gravity located over the stack.

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7. An assembly as claimed in any preceding claim, wherein the container has at least one surface which is curved in such a manner that the engagement of a coin entering the container with the surface tends to cause the coin to twist about a generally horizontal axis.

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8. An assembly as claimed in any preceding claim, wherein the container has a surface which engages the surface of a support to which the container is mounted, at least one of said engaging surfaces extending substantially parallel to a coin in said region.

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9. An assembly as claimed in any preceding claim, comprising a plurality of said containers, each for receiving coins from a respective supply passage, and a plurality of gates each arranged to direct coins from a

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respective supply passage either to a stack in a respective container or to a respective secondary passage.

5 10. An assembly as claimed in claim 9, wherein the gates have a common actuator.

10 11. An assembly as claimed in claim 9 or claim 10, including a control for controlling said gates in such a manner that coins from a supply passage are directed to a stack unless the sensor of the respective container indicates that the stack has exceeded said predetermined level.

15 12. An assembly as claimed in claim 11, when appendent to claim 10, wherein the control is operable to control said common actuator so as to give priority to coins destined for secondary passages.

20 13. Apparatus as claimed in any one of claims 9 to 12, wherein the gates are all pivoted about an axis which is upstream of the coin deflecting surfaces of the gates.

25 14. A coin storage assembly substantially as herein described with reference to the accompanying drawings.
