(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 119 712**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **84300810.3**

(22) Date of filing: **08.02.84**

(51) Int. Cl.³: **G 07 F 5/24**

(30) Priority: **08.02.83 GB 8303370**

(43) Date of publication of application: **26.09.84**
Bulletin 84/39

(84) Designated Contracting States: **AT BE CH DE FR GB IT LI LU NL SE**

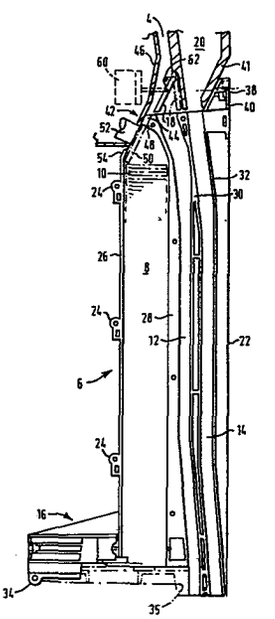
(71) Applicant: **MARS INCORPORATED, Westgate Park 1651 Old Meadow Road, McLean Virginia 22102 (US)**

(72) Inventor: **Thomas, Kim, 51 Thirkleby Close, Slough Berkshire (GB)**
Inventor: **Hutchinson, Derek, 7 Myrtle Close, Hillingdon Middlesex (GB)**
Inventor: **Stallwood, Peter Maurice, 7 Mountain Ash, Marlow Bottom Buckinghamshire (GB)**

(74) Representative: **Wright, Peter David John et al, R.G.C. Jenkins & Co. 12-15, Fetter Lane, London EC4A 1PL (GB)**

(54) **Coin storage assembly.**

(57) A coin storage assembly has several containers (6) each for storing a stack (10) of coins. A sensor (52) is located at the top of a container (6) near an entry (42) which is so designed that coins can only pass through the entry (42) if they are travelling edge-first. When the container (6) is nearly full, the next coin to arrive is supported on the top of the stack (10) in a predetermined position in the entry, so that it is reliably detected by the sensor (52).



EP 0 119 712 A1

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 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 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, 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.

Once the container is full, coins which are normally directed to the container are instead delivered to a cashbox. It is important that this be done reliably, in order to prevent overfilling of the container and jamming of the apparatus.

It has been proposed to use mechanical arrangements which are such that the last coin to enter a con-

tainer causes an alteration of the coin path so that subsequent coins are directed to a different destination (see, e.g., US-A-3948377, US-A-4095607 and GB-A-1328051). These arrangements, however, suffer from the disadvantage that they require accurate manufacturing techniques to be used, they cannot be used for a wide range of coin sizes, they are expensive and not particularly reliable, and their performance deteriorates rapidly with wear and tear.

It has also been proposed to use a sensor which provides an electrical signal when a stack of coins in the container exceeds a predetermined level so that a control system responds to the signal by directing further coins to an alternate destination. To avoid the problems of mechanical sensors, it is desirable to use a sensor which can detect the presence of a coin without making physical contact therewith.

Inductive sensors have been used for this purpose, because they are inexpensive. However, one difficulty 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 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 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 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 be used in place of the inductive sensor and which would be more liable to detect a coin in an incorrect orientation. However, optical sensors are more expensive, and less simple to mount the container, particularly because at least one light path through the container is needed. Further, even these sensors do not completely avoid the problem referred to above. US-A-4106610 describes an arrangement which uses an optical sensor, and in which there is in addition, in case the optical sensor is inadequate and there is a jam in the apparatus, a mechanical configuration such that the last coin to enter the container alters the coin path to cause further coins to be directed to an alternate destina-

tion, and an optical jam detector to detect extensive jamming of the apparatus.

According to 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 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 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 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.

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 to some extent 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 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;

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.

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 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 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 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 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

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.

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 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 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 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

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.

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 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 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.

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 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

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 coin will then fall directly face-down on the top of the stack.

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. 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 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 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 solenoid 60 is controlled in accordance with signals from the validator, which indicate the denomination of coins received thereby, and signals from the sensors 52. If a coin is of a denomination which is stored in one of the storage units 6, the solenoid 60 is energized so that the coin is deflected by the appropriate gate 18 to the associated storage space 8, unless the sensor 52 for that unit indicates that the unit is full, in which case it is ensured that the gate 18 is in the position shown in phantom in Figure 2 so that the coin enters the secondary passage 12.

Many of the coins delivered to the separator will be spaced apart sufficiently to allow the appropriate gate 18 in each case to be positioned correctly before arrival of the coin.

However, problems could arise, if no precautions are taken, if the coins are delivered to the separator in rapid succession, so that there is not enough time to alter the positions of the gates 18 in between arrival of respective coins. To avoid such problems without reducing the rate at which coins can be handled, the following provisions are made:

(A) The control system is arranged to give priority to one particular position of the gates 18. In the present embodiment, the "priority" position is that shown in phantom in Figure 2, in which coins are allowed to enter the secondary passages 12. Thus, if a first coin is sent to a secondary passage and very shortly afterwards a second coin arrives at one of the gates 18, the gates 18 remain in the position for sending the second coin to the secondary passage 12, irrespective of whether or not that coin would normally be sent to a storage space 8. On the other hand, if the control system decides to send the first coin to a storage space 8, and the second coin is in close proximity and is intended for a secondary passage 12, the gates 18 are controlled appropriately for the second coin, even if this interferes with the routing of the first coin. With this arrangement, coins might erroneously be delivered to secondary passages 12 instead of to storage spaces 8. However this is of no real disadvantage, and this type of arrangement ensures that over-filling of the storage spaces 8 cannot occur.

(B) Using provision (A), it is possible that a coin may arrive at a gate 18 while that gate

is in an intermediate position and moving towards its "priority" position. The gates 18 are so designed that jamming cannot occur in such a situation. This is achieved by arranging for the gates 18, when in their "priority" positions, to be out of the path of the coins, and also by arranging for the pivot axis of the gates to be upstream of their coin-deflecting surfaces.

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 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 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 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 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 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 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.

CLAIMS:

1. A coin storage assembly which comprises a container (6) for storing a stack (10) of coins and which has a sensor (52) for detecting when the stack (10) exceeds a predetermined level so that overfilling of the container (6) and jamming of the assembly can be prevented in response to said detection, wherein the container (6) has a region (42) into which coins are constrained to travel edge-first to reach the stack (10), so that a coin while in the region (42) is in a predetermined orientation, and wherein the sensor (52) is arranged to detect a coin which is located in said region (42) and supported by the stack (10).

2. An assembly as claimed in claim 1, wherein the sensor (52) is able to detect the presence of the coin without making physical contact therewith.

3. An assembly as claimed in claim 2, wherein the sensor (52) is of the inductive type.

4. An assembly as claimed in any preceding claim, wherein the sensor (52) is positioned so that it is in proximity to the face of a coin in said region (42).

5. An assembly as claimed in any preceding claim, wherein said region (42) is arranged so that a coin in the region (42) is supported at an orientation substantially displaced from the horizontal.

6. An assembly as claimed in claim 5, wherein said region (42) is arranged so that the coin is supported with its centre of gravity located over the stack (10).

7. An assembly as claimed in any preceding claim, wherein the container (6) has at least one surface (56) which is curved in such a manner that the engagement of a coin entering the container (6) with the surface (56) tends to cause the coin to twist about a generally horizontal axis.

8. An assembly as claimed in any preceding claim, wherein the container (6) has a surface which engages the surface of a support (41) to which the container (6) is mounted, at least one of said engaging surfaces extending substantially parallel to a coin in said region (42).

9. An assembly as claimed in any preceding claim, comprising a plurality of said containers (6), each for receiving coins from a respective supply passage (4), and a plurality of gates (18) each arranged to direct coins from a respective supply passage (4) either to a stack (10) in a respective container (6) or to a respective secondary passage (12).

10. An assembly as claimed in claim 9, wherein the gates (18) have a common actuator (60).

11. An assembly as claimed in claim 9 or claim 10, including a control for controlling said gates (18) in such a manner that coins from a supply passage (4) are directed to a stack (10) unless the sensor (52) of the respective container (6) indicates that the stack (10) has exceeded said predetermined level.

12. An assembly as claimed in claim 11, when appendent to claim 10, wherein the control is operable to control said common actuator (60) so as to give priority to coins destined for secondary passages (12).

13. Apparatus as claimed in any one of claims 9 to 12, wherein the gates (18) are all pivoted about an axis (62) which is upstream of the coin deflecting surfaces of the gates (18).

FIG. 1

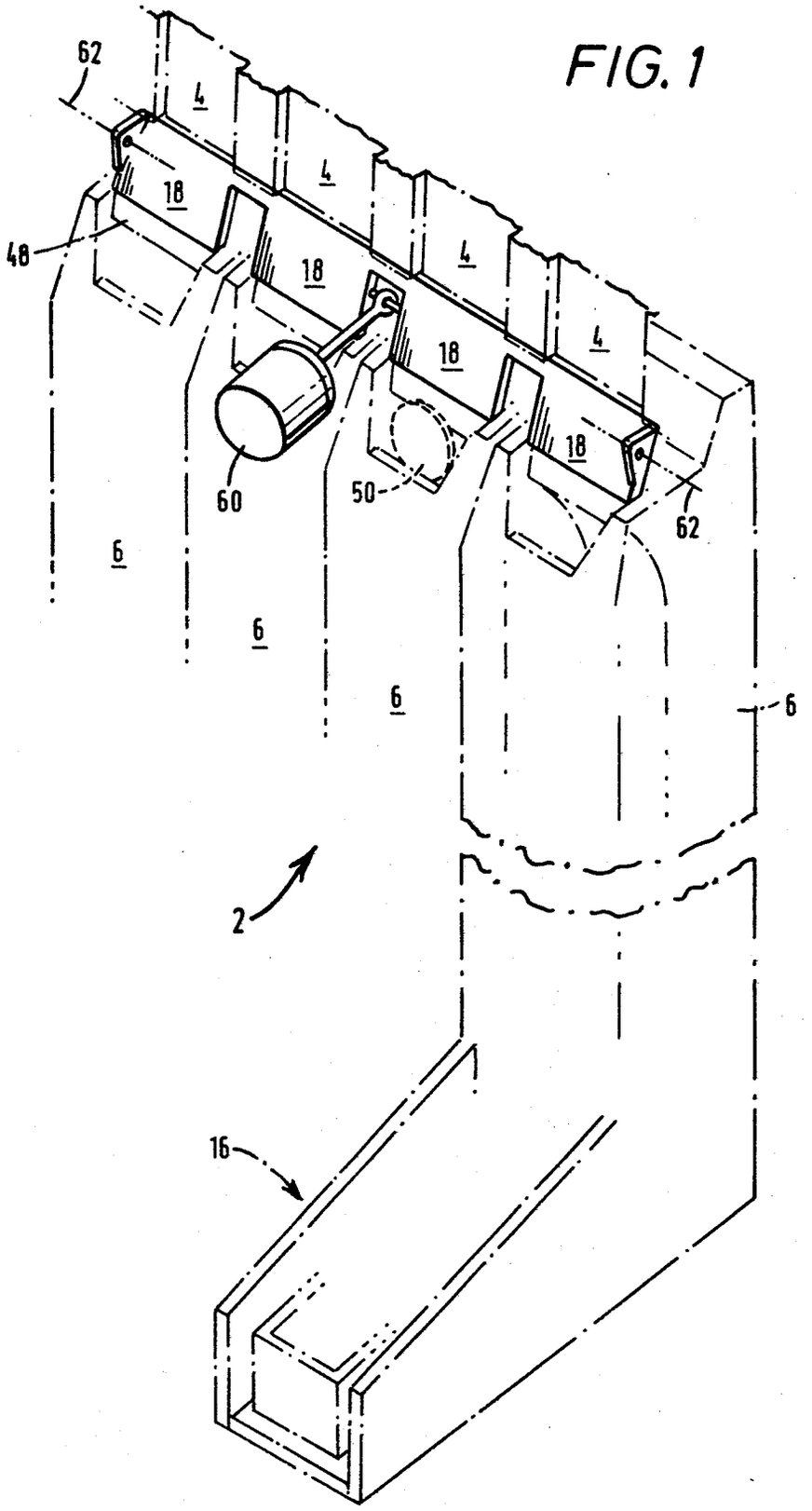


FIG. 2

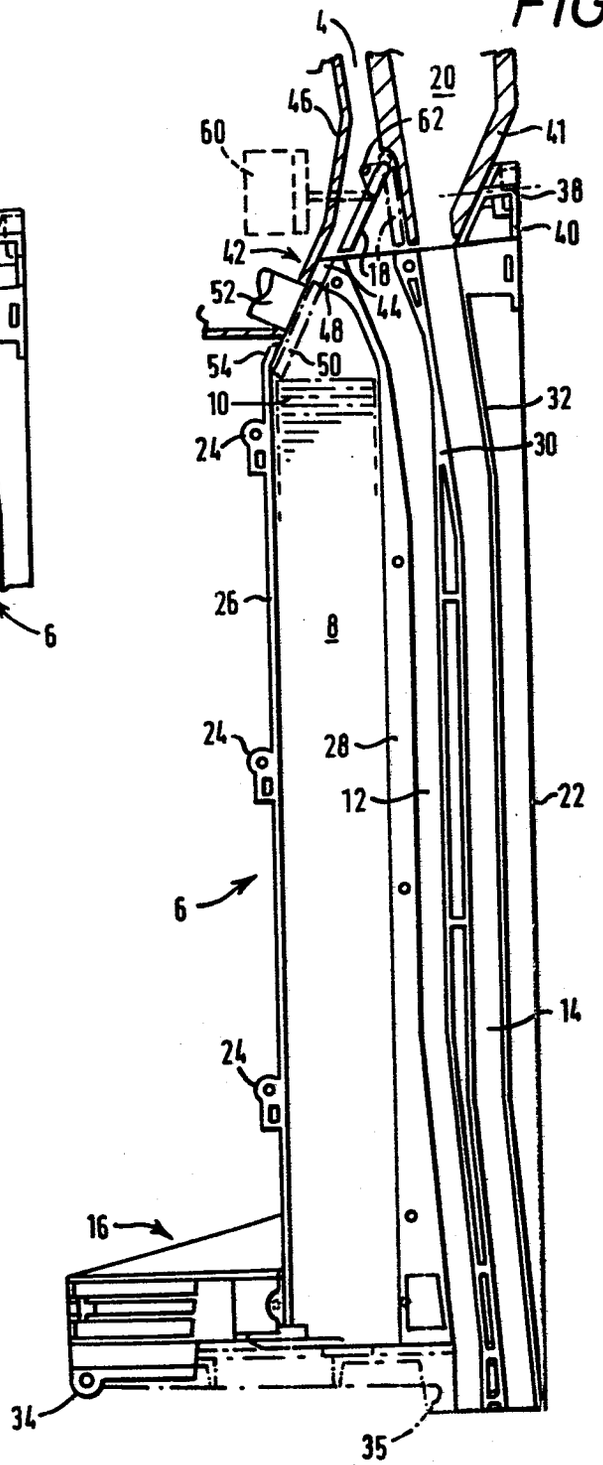

4
20
46
62
60
41
38
40
42
18
52
44
48
54
50
10
32
24
30
26
8
24
28
12
22
6
14
24
16
34
35

FIG. 3

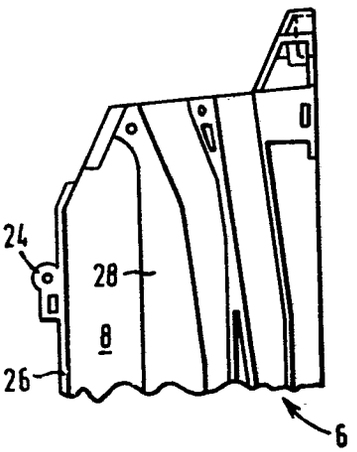

24
28
8
26
6

FIG. 4

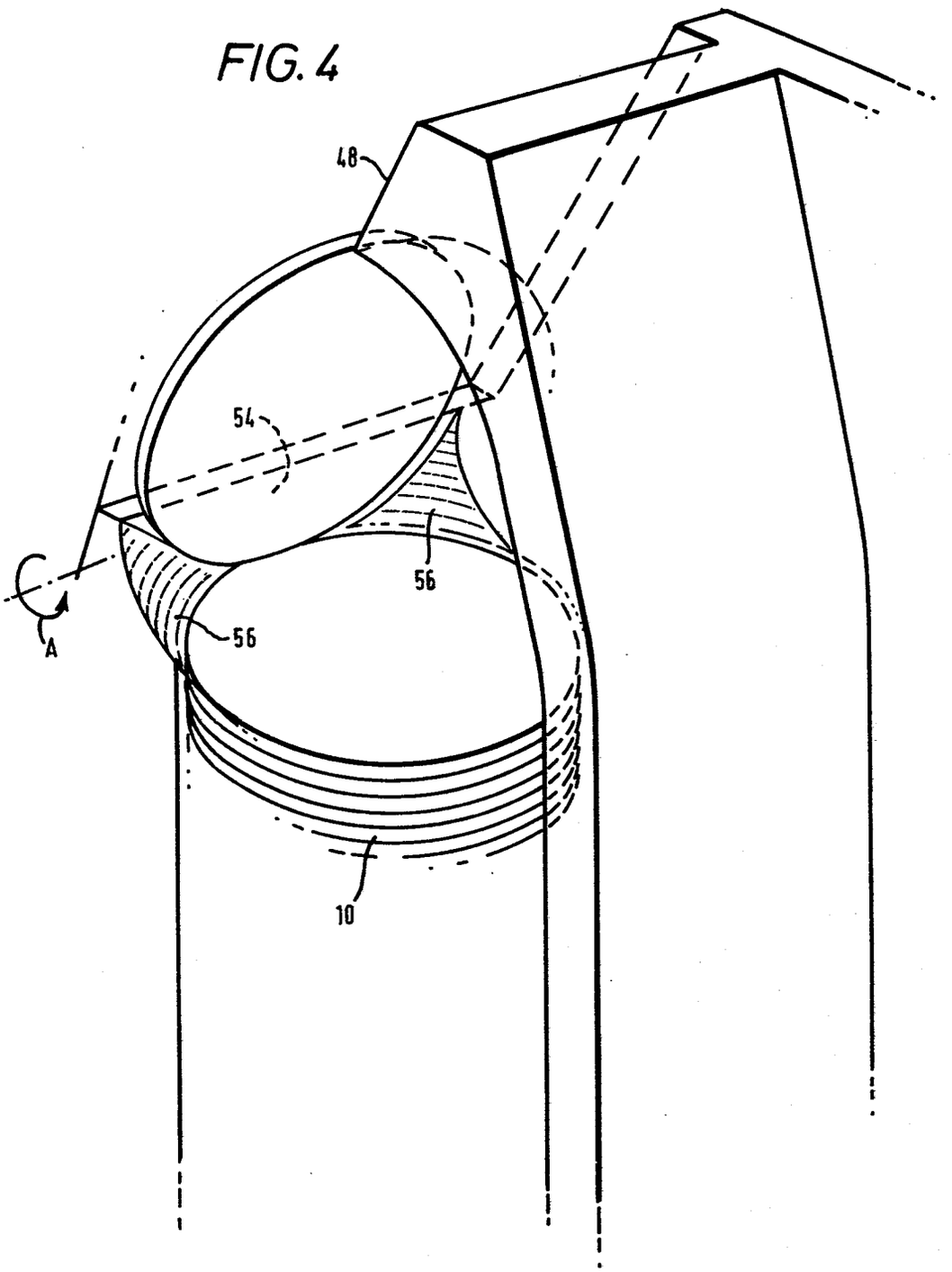
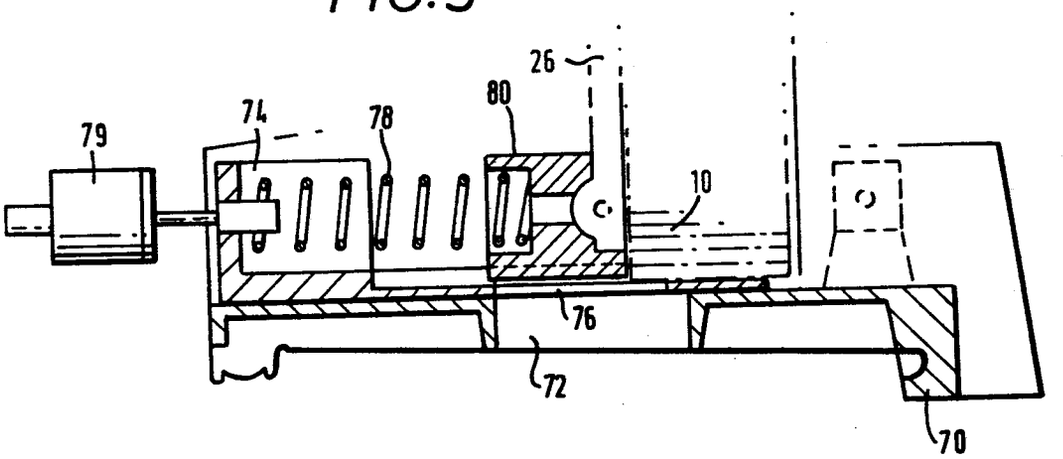


FIG.5



0119712

European Patent Office

Application number

EP 84 30 0810

EUROPEAN SEARCH REPORT

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. ³)
A,D	US-A-4 106 610 (HEIMAN) * Column 3, line 54 - column 4, line 62; figures *	1,2,5-9,11	G 07 F 5/24
A,D	GB-A-1 328 051 (THE VENDO CO.) * Page 1, line 72 - page 2, line 9; page 3, lines 94-113; figures 2-5 *	1,2,4-7,9	
A,D	US-A-3 948 377 (HAYASHI et al.) * Column 1, line 37 - column 2, line 56; column 23, line 2 - column 24, line 52; column 25, line 26 - column 26, line 17; figures 10-12,16a,16b *	1,2,4,7,9-12	
A	US-A-4 056 181 (IKEGUCHI et al.) * Column 1, line 15 - column 3, line 19; column 5, lines 11-32; figures 1,2A,2B *	1	TECHNICAL FIELDS SEARCHED (Int. Cl. ³) G 07 F G 07 D
A	US-A-4 286 703 (SCHULLER et al.) * Column 1, line 16 - column 2, line 11; column 2, line 62 - column 4, line 32; figures *	1-4	

-/-

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-05-1984	MEYL D.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 84 30 0810

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. ³)
A	DE-A-1 449 482 (ANKER) * Page 20, lines 1-20; figure 14 *	1	
A	US-A-3 204 648 (RUMER et al.) * Column 4, line 65 - column 5, line 44; figures *	1	
A	DE-A-1 926 499 (SIEMENS) * Page 2, lines 9-39; figures *	3,4	
A	GB-A-1 154 219 (CANADIAN PATENTS) * Claim 1; figures *	3	
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-05-1984	MEYL D.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82