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(54) Cam system and rotary filling head which includes the system.

(57) There is disclosed a cam 5 which has a first part 6 in the form of an arc of a circle and a second part 7 in the form of the remainder of the same circle, the first and second parts of the cam being pivotal with respect to each other at two places spaced apart along the same pivotal axis 8.

There is also provided a rotary filling head with a plurality of filling stations, each of which is associated with a reciprocal piston 1 having a piston rod 2 with a piston control roller 3 and a weight control roller 4, the filling head having: a weight control cam 33 which can limit the movement in one direction of the piston rods by rolling abutment between the weight control rollers 4 and the weight control cam 33; and a piston control cam 5.

By virtue of the cam and the filling head which incorporates the cam, the dosing system becomes fully adjustable. In fact, adjustment could even be made whilst the machine continues to run.

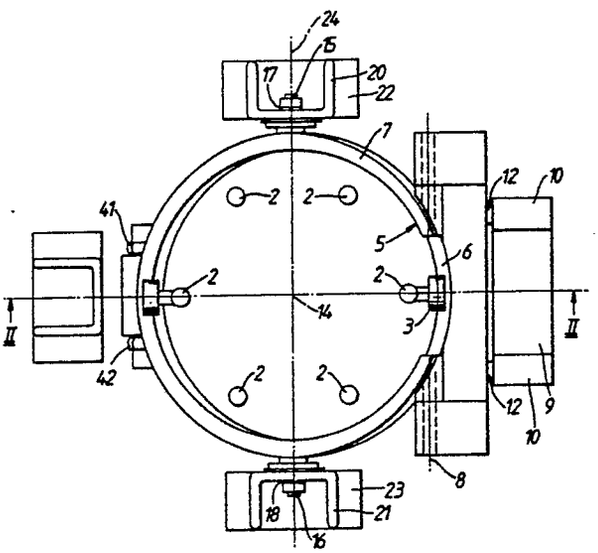

Fig.1.

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CAM SYSTEM AND ROTARY FILLING HEAD WHICH INCLUDES THE SYSTEM

This invention relates to a cam system and to a rotary filling head which incorporates the cam system.

Machines for dispensing fluid material into containers are well known, an example of such a machine being that disclosed in British Patent No. 1383506. In such a machine the containers which are to be filled with fluid material are fed tangentially to a rotary filler (or rotary filling head) and during the time that the containers are in the region of the head they are filled, after which the filled containers tangentially leave the region of the filling head.

The rotary filling head is provided with a plurality of filling stations which move around a circular path in conjunction with the same part-circular path followed by the containers being filled.

Each filling head includes a dispensing system which comprises a piston in a cylinder, movement of the piston in one direction, usually downwardly, allowing fluid material under pressure to be introduced into the piston chamber, and movement of the piston in the other direction, usually upwardly, causing expulsion of the fluid material from the chamber towards the container to be filled. In one known arrangement, each such piston normally has a piston rod which is provided with two rollers which are to follow respective cams. One such roller, usually the upper roller, is known as the piston control roller or top control roller and its function is, by following a piston control cam, to cause movement of the piston in the other (upward) direction so as to cause expulsion of the fluid material from the piston chamber.

The other roller is known as a weight control roller and, in conjunction with a weight control cam, determines the maximum amount of movement in the one (downward) direction, thereby determining the sweep of the piston and, when multiplied by the cross-sectional area of the cylinder, the volume being permitted to enter the piston chamber during the induction stroke.

Particularly with those pistons which are designed to operate with a diaphragm, which causes a seal between the piston chamber and the piston head (to prevent the accumulation of fluid material in the region of the chamber), it is desirable for the fluid material to remain in a condition of over-pressure (i.e. greater than super-atmospheric pressure) so as to cause the downward movement of the diaphragm and hence the piston - this prevents any "gap" occurring between the diaphragm and the head of the piston, as could happen if the piston where forced downwards by a cam. With this type of arrangement, when it is wished to vary the volume/weight being dispensed, it is necessary to move the weight control cam, i.e. the lower cam. So as to allow the piston control roller to be free to travel further downwards (assuming the weight control cam has been moved downwards), it is necessary either to have a sufficiently lower guide path on the piston control cam or to replace the piston control cam by one which has a suitably low portion so as to be compatible with the new position being adopted. This can obviously involve stopping the machine for a considerable time while the weight control cam is positioned and while any necessary adjustments are made to the piston control cam. It is possible, with certain types of piston control cam, for there to be a sufficient distance between the upper guide and the lower guide of the cam to accommodate a wide range of positions for the weight control cam, but this can have the effect, when small volumes are being dispensed, of meaning that the piston control roller contacts the lower guide of the piston control cam over only a short distance, and thus the filling only occurs over a short interval. For many technical and production reasons, it is best for the filling of the container to occur over as long a period as possible and also for the filling of the piston chamber from the source of material to occur over as long a period as possible.

With another known arrangement of cam system, there is no separate weight control cam and its associated roller. Instead, the sole cam controls both the upward and downward movement of the piston (without relying on the over-pressure of the fluid material to cause the downward movement of the piston). When it is wished to vary the volume/weight being dispensed with such an alternative arrangement, it is necessary to stop the machine and replace one particular cam dedicated to a particular volume by another particular cam dedicated to another particular volume.

Not only does the changing of cam take a considerable period, especially bearing in mind the relevant inaccessibility of the cam within the rest of the machine, but also, when one dedicated cam is replaced by another, it still means that only two different particular volumes can be dispensed, there being no provision for a variable weight/volume over a wide weight/volume range.

According to a first aspect of the present invention, there is provided a cam which has a first part in the form of an arc of a circle and a second part in the form of the remainder of the same circle, the first and second parts of the cam being pivotal with respect to each other at two places spaced apart along the same pivotal axis.

Preferably, the two end faces of the first part of the cam and the two end faces of the second part of the cam are planar and parallel to each other. The four end faces have a periphery at least a portion of which has the configuration of an arc of a circle, with the pivot axis lying at the centre of the circle; a consequence of this is that even when the second part of the cam pivots with respect to the first part of the cam there is, over part of the surfaces in the region of the joint, a continuous smoothness.

Following from the preferred feature mentioned in the immediately preceding paragraph is the preferred feature that the circular cam has, in a radial section, a peripheral region at least part of which takes the form of an ellipse. If the end faces of the first part and of the second part of the cam were, in the plane of those end faces, totally circular, the radial section through the circular cam would be totally elliptical.

According to a second aspect of the present invention, there is provided a rotary filling head with a plurality of filling stations, in which the fluid being dispensed is expelled from a piston chamber by movement of a piston in one direction, the movement of the piston in the one direction being in response to the interaction between a piston control roller associated with the piston and a piston control cam in accordance with the first-mentioned aspect of the present invention.

According to a third aspect of the present invention, there is provided a rotary filling head with a plurality of filling stations, each of which is associated with a reciprocal piston having a piston rod with a piston control roller and a weight control roller, the filling head having a weight control cam which can limit the movement in one direction of the piston rods by rolling abutment between the weight control rollers and the weight control cam; and a piston control cam in accordance with the first-mentioned aspect of the present invention.

In the filling head of the third aspect of the present invention, the piston control cam is preferably mounted so that with the first part of the arc lying in a horizontal plane and with the second part being inclined to the horizontal the centre of the cam lies on the same vertical line regardless of the angle of inclination of the second part of the cam. Preferably the first part of the piston control cam is mounted to permit horizontal translational movement of the first part of the piston control cam so as to allow variation in the horizontal distance between the first part of the piston control cam and the aforesaid vertical line, depending on the angle of inclination of the second part of the piston control cam.

To assist in this effect, the second part of the piston control cam is provided with two diametrically opposed pins which are located in vertically slotted brackets, in order to ensure that the centre of the piston control cam remains on the aforementioned vertical line.

In the filling head according to the third aspect of the present invention, preferably there is provision for the weight control cam to be moved upwardly and downwardly whilst the cam remains horizontal. Preferably this is achieved by the provision of vertical guides which allow the weight control cam to be moved vertically upwards and downwards, the vertical movement being controlled by rotatable screws which, on rotation, cause the upward or downward movement of the weight control cam. Preferably the screws used to cause the upward or downward movement of the weight control cam can through gearing be controlled by a single weight adjusting spindle.

Additionally, it is preferred for there to be a link between the weight control cam and the piston control cam such that upward or downward movement of the weight control cam (for example in the manner described above) causes respective upward or downward pivotal movement of the second part of the piston control cam with respect to the first part of that cam.

With such an arrangement for the filling head of the third aspect of the present invention, the dosing system becomes fully adjustable. In fact, adjustment could even be made whilst the machine continues to run, although this would not be desirable because different volumes would be introduced into adjacent containers. In practice, the machine would be stopped, the necessary adjustment effected by rotation of the weight adjusting spindle, and then the machine re-commenced to fill the containers with the new desired weight/volume.

It will be appreciated that, with an approximately constant spacing between the piston control roller (or top control roller) and the weight control roller on each piston rod, the upward and downward movement of the weight control cam permits a wide range of infinitely variable volumes to be dispensed. Moreover, and most importantly, the fact that the lowermost portion of the arc of the second part of the piston control cam is also generally following the upward or downward movement of the weight control cam means that the piston control roller can be in contact with the piston control cam over a large percentage of its travel around the circular path, thus avoiding the situation, mentioned above, in which the filling and expulsion of the fluid material into and from the piston chamber occurs only over a short portion of the circular path, thus wasting valuable filling and discharge time. It will also be readily appreciated that with the filling head in accordance with the third aspect of the invention, the adjustment of the single weight

adjusting spindle causes not only adjustment of the weight control cam but also appropriate adjustment of the piston control cam.

Regarding the rotation of the weight control spindle, this can be done manually or can be effected by means of a motor which can be linked to an automatic weight control system, if desired.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is a plane view of part of the dosing system of a rotary filling head in accordance with the present invention; and

Figure 2 is a vertical section taken along the line II - II shown in Figure 1.

In order deliberately to keep the drawings simple, well known components of the filling head are not shown. Also for simplicity, although in Figure 1 the head has six filling stations each with its own piston 1 (shown only in Figure 2) and associated piston rod 2, only some of the rollers associated with the rods 2 are shown. Similarly, in Figure 2, only two of the pistons 1 and rods 2 are shown, although more are obviously present.

Each piston 1 is located in a conventional cylinder (not shown) and each piston is mounted on a piston rod 2 which at an intermediate position is provided with a piston control roller 3 (also known as a top control roller, as it determines the top point reached by the piston during its upward travel). The piston rod 2 is also provided, near its lower end region, with a weight control roller 4.

A piston control cam 5 is in two parts, namely a first part 6 and a second part 7. When the second part 7 of the piston control cam 5 is horizontal the cam 5 assumes a perfectly circular configuration, as viewed from above. The first part 6 of the cam 5 represents a minor arc of a circle and the second part 7 of the cam 5 represents a major arc of the same circle. The two end faces of the first part 6 of the cam 5 are planar and parallel, as are also the two end faces of the second part 7 of the cam 5. These planes are vertical. A pivotal axis 8 passes through all four end faces of the first and second parts 6, 7 of the cam 5.

Each end face of the first and second parts 6, 7 of the cam 5, as viewed along the axis 8, has an upper peripheral portion which is circular. The whole of the end faces, as viewed along the pivot axis 8, could be circular but this is not of importance. In fact, generally, the end faces are rectangular apart from an upper, part-circular portion. It is the circularity of the upper portion which is of importance.

A consequence of the end faces having an upper portion which is part-circular is that the upper portion of the first and second parts, 6, 7 of the cam 5 have, as seen in radial cross-section, an elliptical configuration.

The pivot axis 8 is at a position such that it is at the centre of the circle partly followed by the upper portion of the end faces of the first and second parts 6, 7 of the cam 5. The consequence of this is that, even when the second part 7 of the cam 5 is pivoted with respect to the first part 6, the upper most portions of the cam 5 in the region of the joins between the first and second parts 6, 7 is smooth and continuous, thereby avoiding any "step" in the movement of the piston control rollers 3 which are to follow the uppermost portion of the piston control cam 5 over the majority of its circumference.

The filling head also includes a support 9 on which are provided two blocks 10 provided with two respective horizontal bores 11 in which are located respective rods 12, which are freely movable within the horizontal bores 11. Mounted on the rods 12 is a beam 13 extending beyond the two rods 12. The beam 13 supports the first part 6 of the piston control cam 5. The sliding relationship along a horizontal line of action between the rods 12 and the bores 11 permits the beam 13 and hence the first part 6 of the piston control cam 5 to move horizontally in towards, and out from, a vertical line 14 which is the vertical axis of the whole filling head and is the vertical line on which the centre of the piston control cam 5 is to lie.

Projecting outwardly along a diameter of the circle constituted by the first and second parts 6, 7 of the piston control cam 5, at points 90° remote around the circle from the centre of the first part 6, are two pins 15, 16 which are pivotally mounted in two respective blocks 17, 18 which, in turn, are located in two vertical slots, only one of which 19 is shown in Figure 2, the two vertical slots being provided in two uprights 20, 21 which project upwardly from two bases 22, 23. The arrangement is such that the pivotal axis 24 which passes through the centre of the pins 15, 16 remains in the same vertical plane which intersects the vertical line 14 regardless of the inclination of the second part 7 of the piston control cam 5.

As the first part 6 of the piston control cam 5 remains at the same, fixed vertical height, it will be appreciated that the axis 24 rises and falls depending on whether the second part 7 of the cam 5 has been pivoted upwardly or downwardly with respect to the first part 6 of the cam 5. The illustrated arrangement ensures that the axis 24 always bisects the vertical line 14.

Standing upright and opposite the support 9 is another support 25, both the supports 9, 25 being mounted on a main base 26. Provided on the support 9 is a guide 27 which cooperates, in sliding

relationship, with a guide 28 carried on a block 29. Similarly, the support 25 is provided with a guide 30 which cooperates, in sliding relationship, with a guide 31 carried on a block 32. The blocks 29 and 32 are located at diametrically opposed locations on the exterior of a circular weight control cam 33, and the blocks 29 and 32 are provided with internally threaded vertically disposed bores, in which bores the screwthreads engage with external screwthreads on two upright screws 34, 35. These screws 34,35 are mounted for rotation relative to the main base 26 and, through respective pairs of bevel gears 36, 37 and 38, 39, are linked to a control spindle 40. Pivotally mounted on the block 32 are two generally upright arms 41, 42 which are pivotally connected, at their upper end regions, to the second part 7 of the piston control cam 5 in regions remote from the first part 6 of that cam 5. The linkage system is such that, upon rotation of the control spindle 40 in one direction the screws 34, 35 are rotated in one direction so as to cause upward movement of the blocks 29, 32 and hence upward movement of the weight control cam 33 whilst keeping the same in a horizontal disposition. The upward movement of the block 32 causes, through the arms 41 and 42, corresponding upward pivotal movement of the second part 7 of the weight control cam 5.

In view of the linkage in the forms of the arms 41, 42 between the block 32 and that region of the second part 7 of the piston control cam 5 remote from the first part 6, the vertical spacing between that region of the second part 7 and the weight control cam 33 remains approximately the same, although there are slight variations in view of the fact that the arms 41, 42 become more inclined to the vertical the lower that the weight control 33 descends. The vertical spacing between the piston control roller 3 and weight control roller 4 on each piston rod 2 remains constant and, therefore, by virtue of the fact that the region of the second part 7 of the cam 5 descends with the weight control cam 33, it is possible to ensure that the piston control roller 3 is out of contact with the piston control cam 5 for only a small part of the generally circular path followed by the piston control roller 3.

At the right hand side of Figure 2 it can be seen that the piston 1 is in its uppermost position, as the piston control roller 3 is at the highest point of its travel, namely resting on the first part 6 of the piston control cam 5. As soon as the piston control roller moves off the first part 6, it moves on to the second part 7 of the piston control cam which, because it is downwardly inclined, allows the roller 3 to descend, being driven down by an overpressure of fluid material in the piston chamber acting on the piston 1. The piston 1 continues to descend in a controlled manner, as the piston control roller 3 follows a first zone of the second part 7 of the piston control cam 5. However, shortly before reaching the lowermost region of the second part 7, the weight control roller 4 comes into contact with the horizontal weight control cam 33 thus preventing any further downward movement of the piston rod 2 and piston 1.

The piston 1 and piston rod 2 shown in the left hand half of Figure 2 are at their lowermost position. Further movement of the piston rod 2 in a clockwise direction, as viewed from above in Figure 1, results in the roller 3 coming into contact again with the upwardly inclined second part 7 of the piston control cam with the result that the piston rod 2 and piston 1 are raised to cause expulsion of filling material from the piston chamber. Obviously, as soon as the roller 3 comes into contact with the upwardly inclined portion of the second part 7 of the piston control cam 5, the weight control roller 4 of the associated piston rod 2 is raised clear of the weight control cam 33.

When it is desired to alter the volume/weight of material being dispensed by the rotary filling head, rotation of the control spindle 40 is effected which, as indicated above, alters the height of the weight control cam 33 whilst causing an almost corresponding variation in the height of the lowermost portion of the second part 7 of the piston control cam 5. The degree of variation is fully adjustable. Although the height of the weight control cam 33 can be infinitely varied over a certain range, it will be appreciated that the maximum height of the piston 1 remains fixed, as the maximum height of the path of travel of the piston control roller 3 is associated with the top of the first 6 of the piston control cam 5, which remains at a fixed height.

Claims

1. A cam which has a first part in the form of an arc of a circle and a second part in the form of the remainder of the same circle, the first and second parts of the cam being pivotal with respect to each other at two places spaced apart along the same pivotal axis.

2. A cam according to claims 1, wherein the two end faces of the first part of the cam and the two end faces of the second part of the cam are planar and parallel to each other.

3. A cam according to claim 2, wherein the four end faces have a periphery at least a portion of which has the configuration of an arc of a circle, with the pivot axis lying at the centre of the circle.

4. A cam according to claim 3, wherein the circular cam has, in a radial section, a peripheral region at least part of which takes the form of an ellipse.

5. A rotary filling head with a plurality of filling stations, in which the fluid being dispensed is expelled from a piston chamber by movement of a piston in one direction, the movement of the piston in the one direction being in response to the interaction between a piston control roller associated with the piston and a piston control cam in accordance with any one of claims 1 to 4.

6. A rotary filling head with a plurality of filling stations, each of which is associated with a reciprocal piston having a piston rod with a piston control roller and a weight control roller, the filling head having: a weight control cam which can limit the movement in one direction of the piston rods by rolling abutment between the weight control rollers and the weight control cam; and a piston control cam in accordance with any one of claims 1 to 4 and for abutment by the piston control rollers.

7. A rotary filling head according to claim 6, wherein the piston control cam is mounted in such a way that with the first part of the arc lying in a horizontal plane and with the second part being inclined to the horizontal the centre of the cam lies on the same vertical line regardless of the angle of inclination of the second part of the cam.

8. A rotary filling head according to claim 7, wherein the first part of the piston control cam is mounted to permit horizontal translational movement of the first part of the piston control cam so as to allow variation in the horizontal distance between the first part of the piston control cam and the aforesaid vertical line, depending on the angle of inclination of the second part of the piston control cam, and wherein the second part of the piston control cam is provided with two diametrically opposed pins which are located in vertically slotted brackets, in order to ensure that the centre of the piston control cam remains on the aforementioned vertical line.

9. A rotary filling head according to any one of claims 6 to 8, which includes provision for the weight control cam to be moved upwardly and downwardly whilst the first part of the piston control cam remains horizontal.

10. A rotary filling head according to claim 9, wherein said provision for the weight control cam to be moved upwardly and downwardly comprises vertical guides which allow the weight control cam to be moved vertically upwards and downwards, the vertical movement being controlled by rotatable screws which, on rotation, cause the upward or downward movement of the weight control cam, the screws used to cause the upward or downward movement of the weight control cam preferably being, through gearing, controllable by a single weight adjusting spindle.

11. A rotary filling head according to claim 9 or 10, which includes a link between the weight control cam and the piston control cam such that upward or downward movement of the weight control cam causes respective upward or downward pivotal movement of the second part of the piston control cam with respect to the first part of that cam.

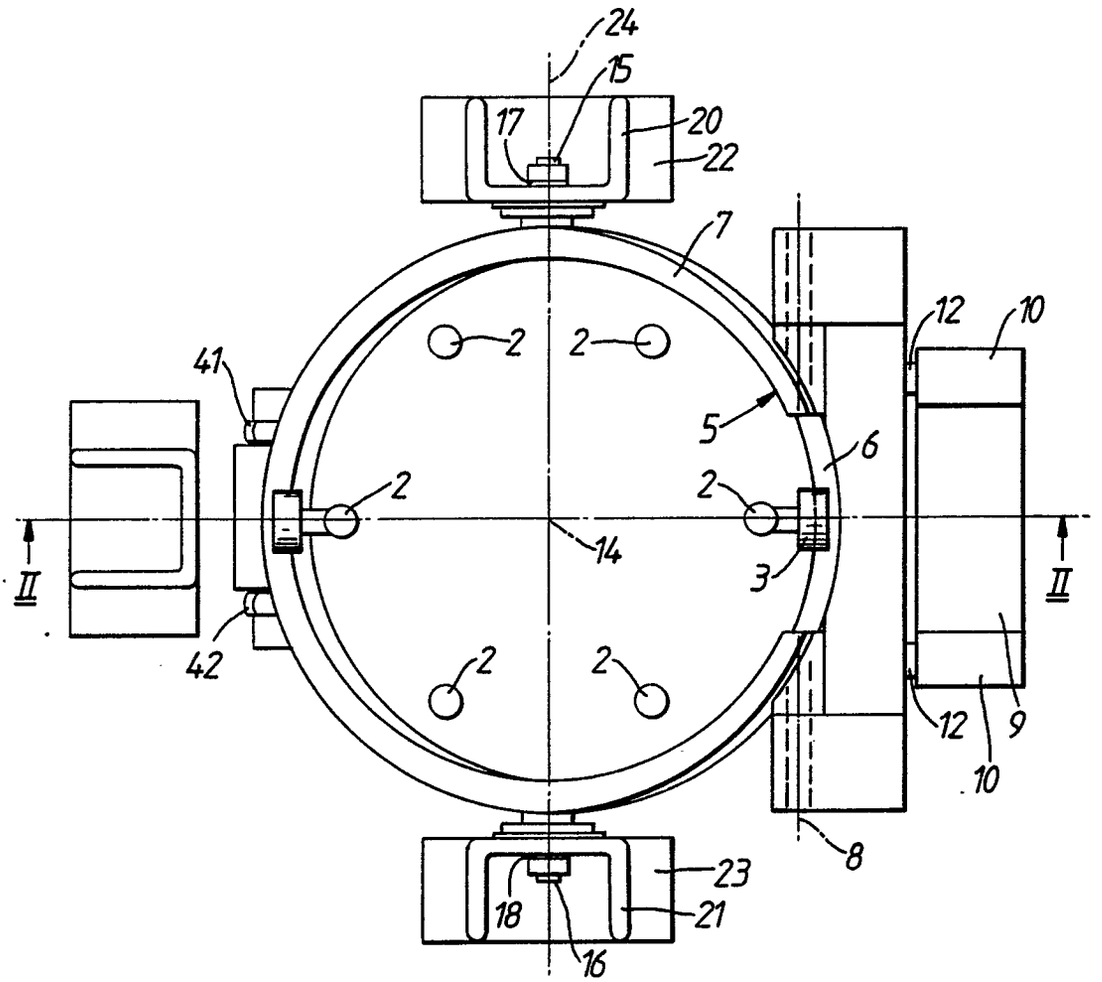

Fig.1.

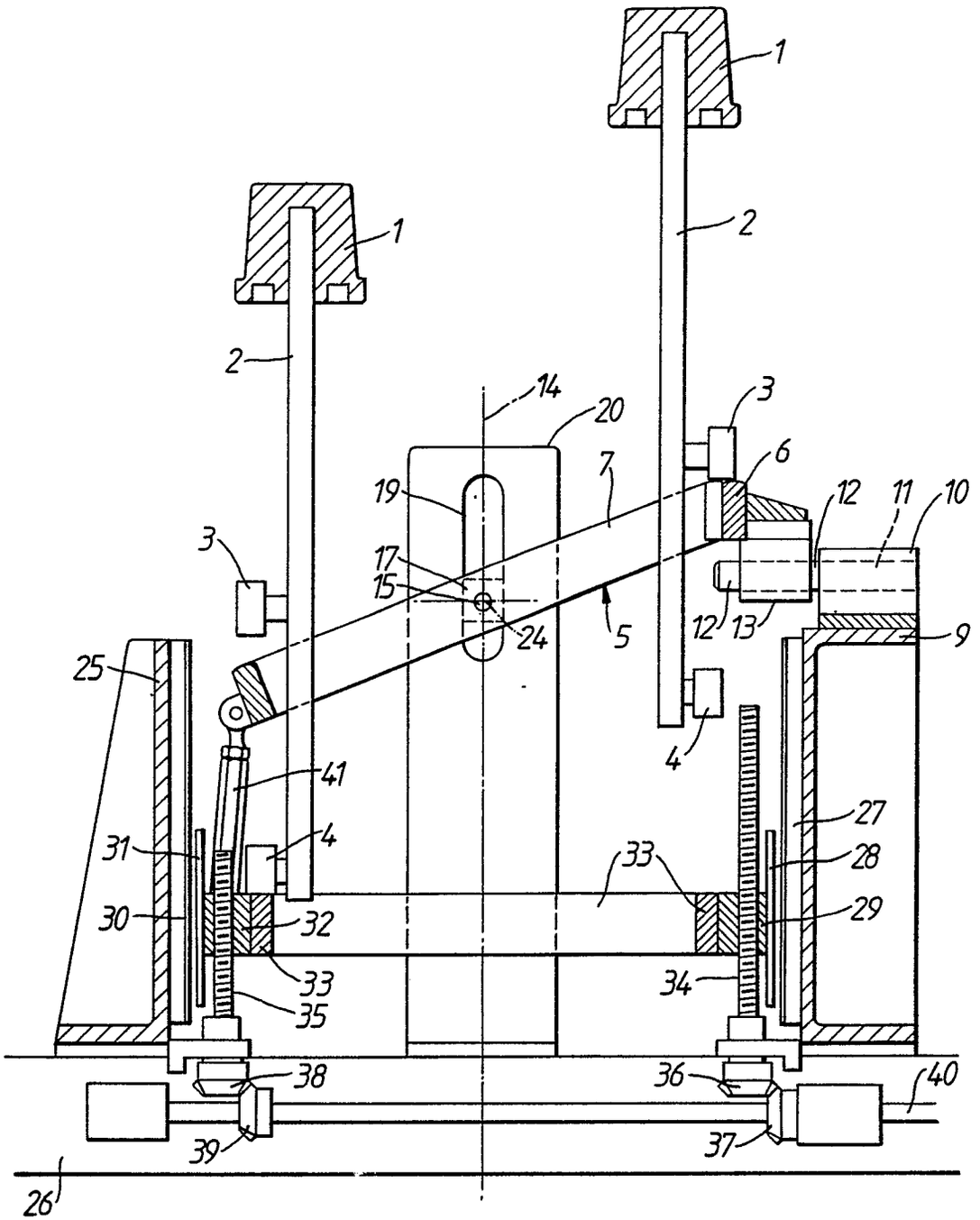

Fig.2.

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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 5630

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.4)
A	US-A-2 307 214 (GOLLMER) * Whole document * ---	1,5	B 65 B 43/60
A	US-A-1 506 851 (MARTIN) * Page 3, lines 18-68; figures 1,4,10 * ---	1,5	
A	US-A-3 400 739 (DARDAINE) * Column 5, line 70 - column 6, line 28; figures 1,5,6 * -----	1,2,5	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 65 B
B 67 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11-09-1989	CLAEYS H.C.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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