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(54) **Title:** CENTRIFUGAL CLUTCH ARRANGEMENT

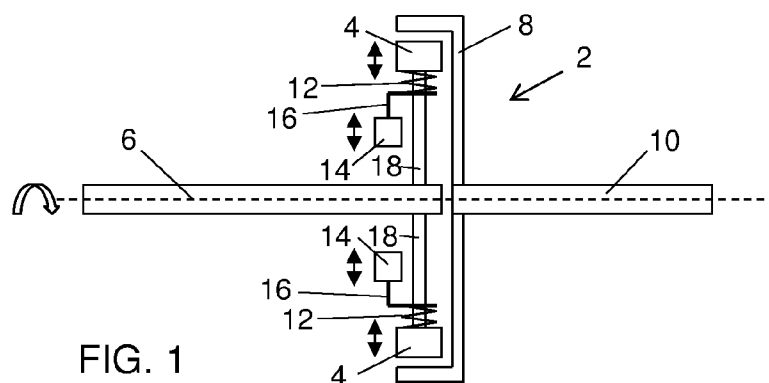


FIG. 1

(57) **Abstract:** A centrifugal clutch arrangement (2) comprising at least one friction element (4) arranged at, and adapted to rotate together with, a drive shaft (6), a drum-shaped member (8) arranged at, and adapted to rotate together with, a second shaft (10), whereby the friction element (4) is adapted to be displaced between a disengaged condition and an engaged condition. The centrifugal clutch arrangement (2) comprises a torque-limiting means (12) arranged such that the friction element (4), when in its engaged condition, is adapted to be displaced in a radial direction with respect to the drive shaft (6) if the torque between the friction element (4) and the inner surface of the drum-shaped member (8) exceeds a predetermined threshold value of torque, and that the clutch in this case slips. The centrifugal clutch arrangement (2) comprises at least one mass element (14) that is arranged such that it can be displaced and that is adapted to transfer through a transfer arrangement (16) motion from the mass element (14) to the said friction element (4) through the said torque-limiting means (12) such that the said friction element (4) is displaced in the radial direction, depending on the rate of rotation of the drive shaft (6), with respect to the drive shaft (6) for engagement and disengagement of the clutch.



Title

Centrifugal clutch arrangement

Technical area

- 5 The present invention concerns a centrifugal clutch arrangement according to the introduction of the independent claim.

Background to the invention

A centrifugal clutch is a type of clutch that is controlled by centrifugal force.

- 10 According to some applications, the clutch is connected to a drive shaft from a combustion engine. When the rate of revolution of the engine is at idling, the clutch is in its neutral condition; when the engine is operated at a rate of revolution that exceeds a certain rate of revolution the clutch starts to drive in what is known as its engaged condition. If the engine is operated at a rate of revolution that is
- 15 higher, the clutch becomes completely engaged. This is controlled by, for example, weights on the lamellae of the clutch.

One advantage of centrifugal clutches is that they do not require any external control.

- 20 The following patent documents concern centrifugal clutches in which, among other things, springs with weights are used to control the engagement and disengagement of the clutch.

US-2012/0018269 concerns a centrifugal clutch with a separate sliding clutch unit.

- 25 The clutch is engaged when the rate of rotation of the driving shaft is higher than a threshold value, and it is disengaged when the rate of rotation exceeds a second threshold value.

US-6575282 concerns a mechanical clutch between two non-driving wheel shafts,

- 30 in which one variant concerns connected shafts that comprise centrifugal clutches that transfer torque in a manner that is proportional to the speed of the vehicle and the difference in speed between the wheels on the shafts.

EP-0816705 concerns a spring-loaded centrifugal clutch provided with weights that influence a friction element.

- 5 US-3747731 reveals a centrifugal clutch intended to maintain a constant speed.

Another type of clutch is that known as a "sliding clutch", which is used avoid sudden changes in torque at the drive shaft having a negative influence on the unit that is to be driven through the clutch. Through a sliding clutch, torques that
10 are too high, which may occur during change of, for example, the rate of revolution, are not permitted to pass, since the clutch will slip if the torque becomes too high.

The purpose of the invention is to achieve an improved centrifugal clutch
15 arrangement that demonstrates the advantages of both centrifugal clutches and sliding clutches.

To be more specific, the purpose is not only to achieve slipping of the clutch when the torque exceeds a predetermined maximal torque, but also that the
20 engagement takes place at a specific lower rate of revolution, and that the disengagement takes place at a second specific higher rate of revolution.

Summary of the invention

The purposes stated above are achieved with the invention defined by the
25 independent patent claim.

Preferred embodiments are defined by the non-independent claims.

Through the invention, a clutch is achieved that is adapted to control three
30 important functions when driving through a coupling.

These three functions are:

- to achieve the functionality of a sliding clutch through slipping occurring if the torque exceeds a threshold value of torque
- that the clutch is engaged at a first, lower rate of revolution
- that the clutch is disengaged at a second, higher rate of revolution.

5

One application of the centrifugal clutch arrangement is to use it for the engagement of an AC system for a vehicle, where the AC system has a normal working range of 1000-3500 revolutions per minute (rpm).

Such a system demonstrates resonance frequencies at low frequencies that arise during the start of the engine. At the rate of revolution of idling, which is often in the interval 500-800 rpm, it is desirable that the AC system is not engaged.

According to the invention, the arrangement demonstrates a lower interval for the rate of rotation of the drive shaft when the AC system is not engaged.

At high rates of revolution of the engine, preferably greater than approximately 3500 rpm, it is desirable to disengage operation of the AC system. Through the invention, operation of the AC system at too high a rate of revolution is avoided. It is, furthermore, sometimes desirable to start and stop the AC system during operation. Extremely high values of torque, known as "load spikes", arise during such an engagement, and it is preferable that these be avoided. Through the slipping that the arrangement achieves through the spring-loaded friction element, it is avoided that these load spikes are transferred to the AC system.

Brief description of drawings

Figure 1 shows a schematic longitudinal section of a centrifugal clutch arrangement according to the invention in a disengaged condition.

Figure 2 shows a schematic longitudinal section of a centrifugal clutch arrangement according to the invention in an engaged condition.

Figures 3a-3c show schematic cross-sections of an embodiment of the centrifugal clutch arrangement according to the invention in various conditions of engagement.

Figures 4a-4c show schematic cross-sections of another embodiment of the centrifugal clutch arrangement according to the invention in various conditions of engagement.

5 Detailed description of preferred embodiments of the invention

The centrifugal clutch arrangement according to the invention is preferably adapted to be used for driving an air conditioning system (AC system) of a vehicle, such as a bus or a lorry.

Also other areas of application are, of course, possible, for example on vessels
10 and in industry, as is also the use of the arrangement to drive other systems.

The invention will be described in detail below with reference to the drawings.

Figures 1 and 2 show schematic longitudinal sections of the centrifugal clutch
15 arrangement according to the invention in a disengaged condition and in an engaged condition, respectively.

The centrifugal clutch arrangement 2 comprises at least one friction element 4 arranged at, and adapted to rotate together with, a drive shaft 6, a drum-shaped
20 member 8 arranged at, and adapted to rotate together with, a second shaft 10.

The drive shaft 6 is connected to, for example, a combustion engine, and the second shaft is connected to and intended to drive, for example, an AC system. Two friction elements 4 arranged one on each side of the drive shaft 6 are shown in the drawings. Within the scope of the innovative concept of the invention, the
25 number of friction elements may be three, four or more, which friction elements are symmetrically distributed around the drive shaft. The invention will be described below with reference to one friction element. It shall, however, be understood that the means and elements that are described in association with the friction element are arranged for each of the friction elements in the
30 arrangement.

The friction element 4 is adapted to be displaced between a disengaged condition and an engaged condition, which is illustrated in Figure 1 by double-directed arrows. In the engaged condition (see Figure 2), the friction element 4 is in contact with the inner surface of the drum-shaped member 8 in order to achieve a connection between the friction element 4 and the drum-shaped member 8 in order in this way to transfer rotation from the drive shaft 6 to the second shaft 10.

The centrifugal clutch arrangement 2 comprises a torque-limiting means 12 arranged such that the friction element 4, when in its engaged condition (see Figure 2), is adapted to move in a radial direction with respect to the drive shaft 6 if the torque between the friction element 4 and the inner surface of the drum-shaped member 8 exceeds a predetermined threshold value of torque, and that the clutch in this case slips.

The centrifugal clutch arrangement 2 comprises further at least one mass element 14 that is arranged to be displaceable and that is adapted to transfer through a transfer arrangement 16 motion from the mass element 14 to the said friction element 4 through the torque-limiting means 12 such that the said friction element 4 is displaced in the radial direction with respect to the drive shaft 6 for engagement and disengagement of the clutch. The mass element 14 is arranged such that it can be displaced in an essentially radial direction with respect to the drive shaft 6 and that the motion of the mass element 14 depends on the rate of rotation of the drive shaft 6.

According to one embodiment, the torque-limiting means 12 is constituted by a spiral spring arranged to absorb radially directed forces. The torque-limiting means may be constituted also by an elastic material, in the form of, for example a cylinder, that has been dimensioned such that the desired properties are achieved. The elastic material may be a rubber material.

The torque-limiting means 12 must be able to withstand sufficient large radially directed forces such that the friction element 4, in its engaged condition, can

transfer the rotation to the drum-shaped member without slipping, when the torque lies below the predetermined threshold value of torque.

In more detail, the mass element 14 and the transfer arrangement 16 are adapted
5 to influence the friction element such that when the rate of rotation is in a first interval of rate the clutch is disengaged, when the rate of rotation is in a second interval of rate, in which the rates of rotation exceed the rates in the first interval of rate, the clutch is engaged, and when the rate of rotation is in a third interval of rate, in which the rates of rotation exceed the rates in the second interval of rate,
10 the clutch is disengaged.

The first interval of rate covers rates of rotation from 0 up to a first predetermined threshold value that preferably lies in the interval 300-1000 rpm.

The second interval of rate covers rates of rotation from the first threshold value to
15 a second predetermined threshold value that preferably lies in the interval 2500-4000 rpm.

The third interval of rate covers rates of rotation that exceed the second threshold value.

For applications for AC systems, an example of an appropriate region of
20 engagement (the second interval of rate) is 600-3500 rpm.

According to one embodiment, the centrifugal clutch arrangement 2 comprises at least one extended support 18 fixed to the said drive shaft 6 and has an essentially radial extension. The friction element 4 is arranged such that it can be
25 displaced in connection with the outer end 20 of the said support 18.

The transfer arrangement 16 can be brought to reality in a number of different ways, and two variants will now be described in more detail.

30 One embodiment of the transfer arrangement is shown in Figures 3a-3c.
According to this embodiment, the transfer arrangement 16 comprises a link arm system 22 that is fixed at one end 23 at the said support 18. The link arm system

22 is adapted to transfer motion from the mass element 14 to the said friction element 4 through the torque-limiting means 12.

A spring-loaded unit 25 is arranged between the mass element 14 and the support 18. The spring-loaded unit 25, which is constituted by, for example, a spiral spring, is adapted to exert a radially inwardly directed force at the mass element that depends on the distance of the mass element from the drive shaft. The radially inwardly directed force is to balance the centrifugal force to which the mass element is exposed when the drive shaft rotates.

The link arm system comprises a number of rigid link arms joined to each other through joints that are depicted in the drawings by filled circles. One joint is arranged in association with the torque-limiting means 12. One joint is arranged in association with the mass element 14 and one joint is arranged at the support 18 close to the drive shaft 6. Link arms from these joints are subsequently connected to a uniting joint 27.

The centrifugal clutch arrangement is shown in Figure 3a when the rate of rotation of the drive shaft 6 is in the first interval of rate.

The spring-loaded unit 25 is arranged to hold the mass element under spring tension in such a condition that the clutch is disengaged. This occurs through the link arm system holding the friction element in its disengaged condition.

The centrifugal clutch arrangement is shown in Figure 3b when the rate of rotation of the drive shaft 6 is in the second interval of rate. In this case, centrifugal force influences the mass element such that it has been displaced outwards such that the link arm system now influences the friction element such that the clutch is in its engaged condition.

The centrifugal clutch arrangement is shown in Figure 3c when the rate of rotation of the drive shaft 6 is in the third interval of rate. In this case, centrifugal force influences the mass element such that it has been displaced a further distance outwards from the condition that is shown in Figure 3b. The link arm system in this

way influences the friction element such that the clutch is in its disengaged condition.

A second embodiment of the transfer arrangement is shown in Figures 4a-4c.

5 According to this embodiment, the transfer arrangement 16 comprises an eccentric system 24 that is fixed in a manner that allows rotation at the support 18 and adapted to transfer motion from the mass element 14 to the friction element 4 through the torque-limiting means 12.

An outer part of the eccentric system 24 is in contact with the torque-limiting means 12. A spring-loaded unit 25' is arranged between the mass element 14 and
10 the support 18. The spring-loaded unit 25', which is constituted by, for example, a spiral spring, is adapted to exert an essentially radially inwardly directed force at the mass element that depends on the distance of the mass element from the drive shaft. The radially inwardly directed force is to balance the centrifugal force
15 to which the mass element is exposed when the drive shaft rotates.

The centrifugal clutch arrangement is shown in Figure 4a when the rate of rotation of the drive shaft 6 is in the first interval of rate.

The spring-loaded unit 25' is arranged to hold the mass element under spring tension in such a condition that the clutch is disengaged. This occurs through the
20 eccentric system holding the friction element in its disengaged condition.

The centrifugal clutch arrangement is shown in Figure 4b when the rate of rotation of the drive shaft 6 is in the second interval of rate. In this case, centrifugal force influences the mass element such that it has been displaced outwards such that
25 the eccentric system now influences the friction element such that the clutch is in its engaged condition.

The centrifugal clutch arrangement is shown in Figure 4c when the rate of rotation of the drive shaft 6 is in the third interval of rate. In this case, centrifugal force
30 influences the mass element such that it has been displaced a further distance outwards from the condition that is shown in Figure 4b. The eccentric system in

this way influences the friction element such that the clutch is in its disengaged condition.

The present invention is not limited to the preferred embodiments described
5 above. Various alternatives, modifications and equivalents can be used. The
embodiments above are, therefore, not to be considered as limiting the protective
scope of the invention, which is defined by the attached patent claims.

Claims

1. A centrifugal clutch arrangement (2) comprising at least one friction element (4) arranged at, and adapted to rotate together with, a drive shaft (6), a drum-shaped member (8) arranged at, and adapted to rotate together with, a
5 second shaft (10), whereby the friction element (4) is adapted to be displaced between a disengaged condition and an engaged condition, in the engaged condition the friction element (4) is in contact with the inner surface of the drum-shaped member (8) in order to achieve a coupling between the friction element (4) and the drum-shaped member (8) in order in this way to transfer rotation from the
10 drive shaft (6) to the second shaft (10),
characterised in that the centrifugal clutch arrangement (2) comprises a torque-limiting means (12) arranged such that the friction element (4), in its engaged condition, is adapted to move in a radial direction with respect to the drive shaft (6) if the torque between the friction element (4) and the inner surface of the
15 drum-shaped member (8) exceeds a predetermined threshold value of torque and that the clutch in this case slips, and that the centrifugal clutch arrangement (2) comprises at least one mass element (14) arranged such that it can be displaced and that is adapted to transfer motion through a transfer arrangement (16) from the mass element (14) to the said friction element (4) through the said torque-
20 limiting means (12) such that the said friction element (4) is displaced in the radial direction with respect to the drive shaft (6) for engagement and disengagement of the clutch, whereby the mass element (14) is arranged such that it can be displaced in an essentially radial direction with respect to the drive shaft (6), and whereby the motion of the mass element (14) depends on the rate of rotation of
25 the drive shaft (6).
2. The centrifugal clutch arrangement (2) according to claim 1, whereby the said torque-limiting means (12) is constituted by a spiral spring arranged to absorb radially directed forces.
- 30 3. The centrifugal clutch arrangement (2) according to claim 1 or 2, whereby the mass element (14) and the transfer arrangement (16) are adapted to

influence the friction element such that when the rate of rotation is in a first interval of rate the clutch is disengaged, when the rate of rotation is in a second interval of rate, in which the rates of rotation exceed the rates in the first interval of rate, the clutch is engaged, and when the rate of rotation is in a third interval of rate, in which the rates of rotation exceed the rates in the second interval of rate, the clutch is disengaged.

4. The centrifugal clutch arrangement (2) according to any one of claims 1-3, comprising at least one extended support (18) fixed at the said drive shaft (6) and with an essentially radial extension, whereby the said friction element (4) is arranged such that it can be displaced in association with an outer end (20) of the said support (18).

5. The centrifugal clutch arrangement (2) according to claim 4, whereby the transfer arrangement (16) comprises a link arm system (22) that is fixed at one end (23) at the said support (18) and that is adapted to transfer motion from the said mass element (14) to the said friction element (4) through the torque-limiting means (12).

6. The centrifugal clutch arrangement (2) according to claim 4, whereby the transfer arrangement (16) comprises an eccentric system (24) that is fixed such that it can rotate at the said support (18) and that is adapted to transfer motion from the said mass element (14) to the said friction element (4) through the torque-limiting means (12).

7. The centrifugal clutch arrangement (2) according to any one of the preceding claims, whereby the centrifugal clutch arrangement is adapted for the driving of an air conditioning system (AC system) for a vehicle.

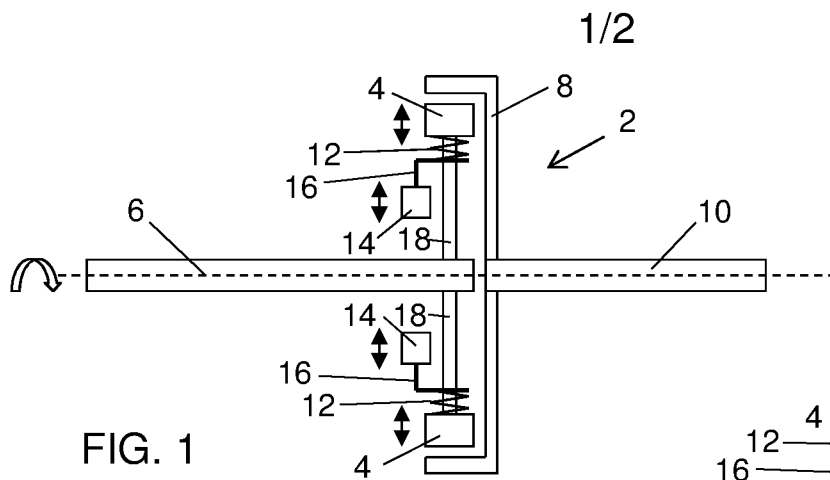


FIG. 1

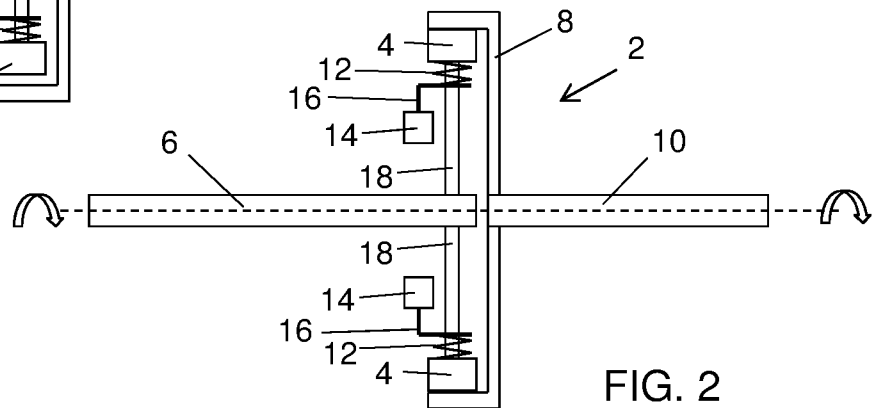


FIG. 2

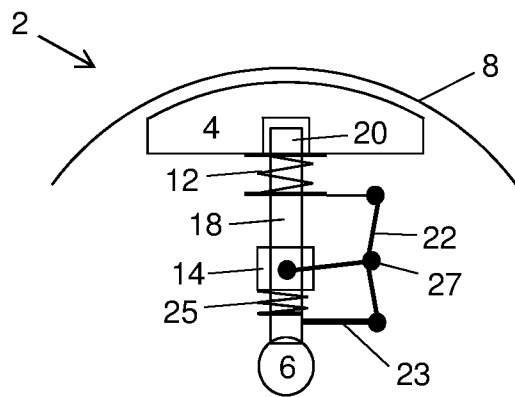


FIG. 3a

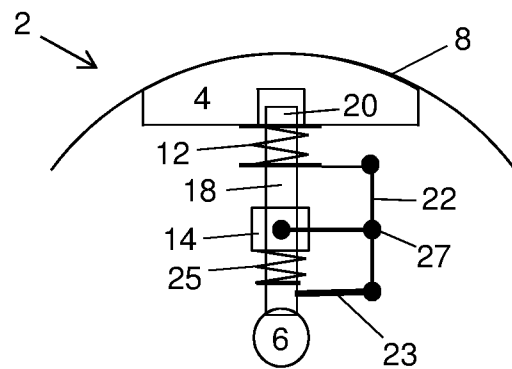


FIG. 3b

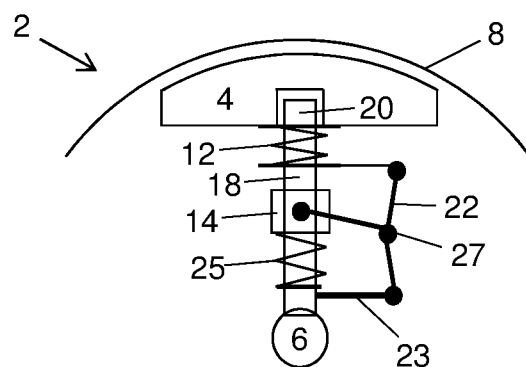


FIG. 3c

2/2

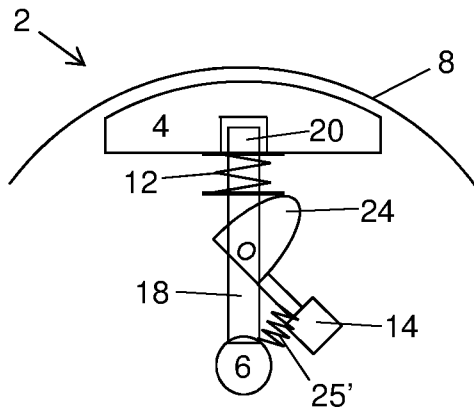


FIG. 4a

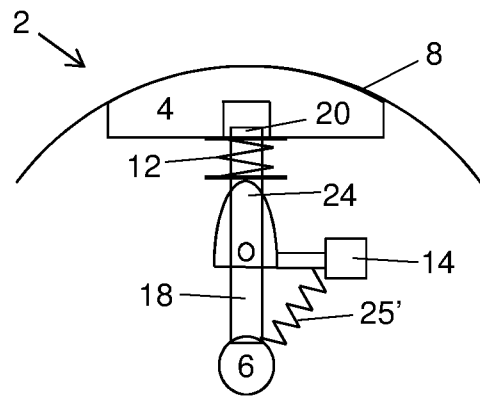


FIG. 4b

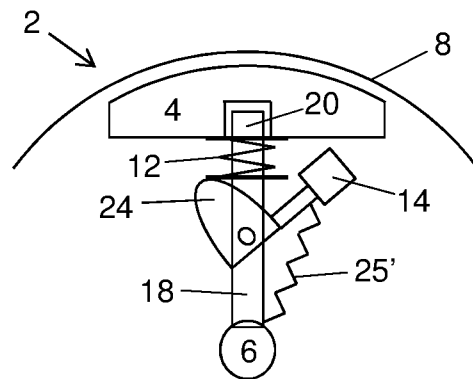


FIG. 4c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2014/050633

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 109945 A (CLARKE CHAPMAN LTD ET AL), 4 October 1917 (1917-10-04); page 3, line 57 - page 4, line 7; figures 1,2	1, 2, 4-7
Y	--	3
X	US 4117918 A (SILBERSCHLAG RUSSELL EARL), 3 October 1978 (1978-10-03); abstract; column 3, line 43 - column 4, line 47; figures	1, 2, 4-7
Y	--	3

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2014/050633

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	--	1, 2, 4-7
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Continuation of: second sheet**International Patent Classification (IPC)*****F16D 43/22*** (2006.01)***F16D 43/14*** (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2014/050633

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