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(54) Detection apparatus of a training machine

(57) A detection apparatus of a training machine has a shifting device (25), four sensors (21-24) and a controller (30). The shifting device (25) is mounted on an exercise device along a circular motion trace (40) divided into four segments (41-44). The four sensors (21-24) are respectively mounted on the body and correspond to the four segments (41-44). The controller (30) determines

multiple exercise states, including the rotation speed, the rotational direction, the first rotation speed, the second rotation speed and the force exerted on the exercise device, according to detecting signals from the sensors at a same time. The structure of the detection apparatus is simplified for ease of use.

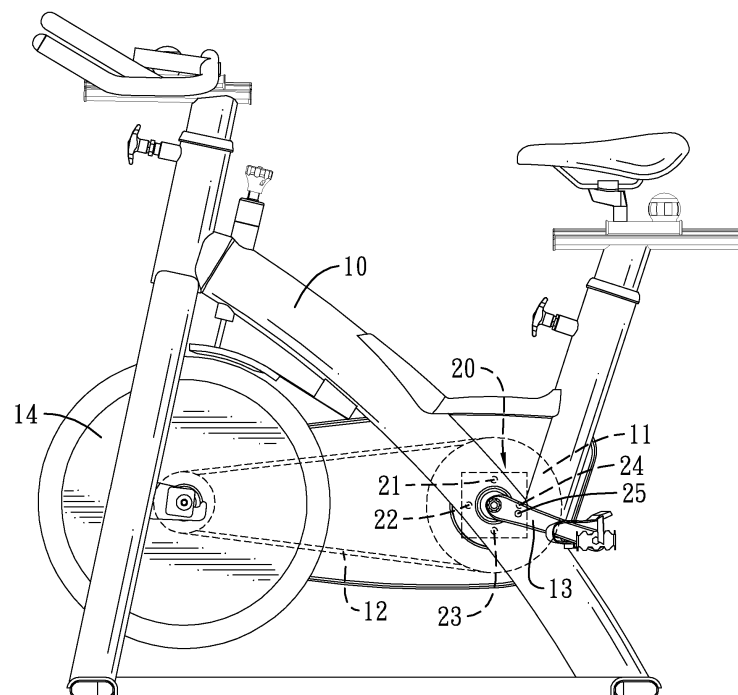


FIG. 1

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Description

1. Field of the Invention

[0001] The present invention relates to a detection apparatus, and more particularly to a detection apparatus of a training machine. The detection apparatus is adapted to detect an exercise state of a user.

2. Description of Related Art

[0002] The advantage of doing exercise is well known. Doing exercises not only strengthens the heart and lungs, but also improves blood circulation. In order to do exercise in a limited indoor space, most of the gyms are equipped with physical training machines, such as exercise bikes. A user can also purchase an exercise bike to do exercise at home.

[0003] A conventional training machine has a detector. The detector is electrically connected to a controller. The controller receives signals from the detector to determine the user's exercise state.

[0004] One detector can detect only one type of exercise state. For example, a rotation speed detector only detects a rotation speed. A rotational direction detector only detects a rotational direction. When the information of rotation speed and the rotational direction are both needed, the two detectors have to be mounted on the training machine. As more detectors occupy more space, the wire layout is more complicated.

[0005] An objective of the invention is to provide a detection apparatus of a training machine. The structure of the detection apparatus of the invention is simplified. The detection apparatus can detect multiple exercise states of a user at a same time.

[0006] The training machine has a body and an exercise device. The detection apparatus of the invention comprises a shifting device, four sensors and a controller.

[0007] The shifting device is mounted on the exercise device and movable along a circular motion trace. The circular motion trace is divided into a first segment, a second segment, a third segment and a fourth segment.

[0008] The four sensors are mounted on the body and respectively correspond to the four segments. Each sensor generates a detecting signal when the sensor detects the shifting device.

[0009] The controller is electrically connected to the sensors to receive the detecting signals, so as to calculate a first time duration (T1), a second time duration (T2), a third time duration (T3) and a fourth time duration (T4), to calculate a rotation speed (RPM), to determine a rotational direction of the exercise device according to a sequence of the detecting signals, to determine a first rotation speed (RPML) and a second rotation speed (RPMR), and to determine a force exerted on the exercise device by a user according to the time durations.

[0010] T1 is a duration of time for the shifting device to pass through the first segment. T2 is a duration of time

for the shifting device to pass through the second segment. T3 is a duration of time for the shifting device to pass through the third segment. T4 is a duration of time for the shifting device to pass through the fourth segment.

[0011] The rotation speed (RPM) is $60/T$, $T=T1+T2+T3+T4$. The first rotation speed (RPML) is $60/(T1+T2)$. The second rotation speed (RPMR) is $60/(T3+T4)$.

[0012] For example, the body of the training machine can be a bike frame and the exercise device can be a crank. When a user steps on the crank, the shifting device is moved along the circular motion trace. The sensors then correspondingly generate detecting signals. The controller determines the multiple exercise states, including the rotation speed, the rotational direction, the first rotation speed, the second rotation speed and the force exerted on the exercise device. Hence, the detection apparatus of the invention can determine multiple exercise states at a same time. The detection apparatus of the invention only has the shifting device, the sensors and the controller, such that the structure of the detection apparatus is simple and can simplify the wire layout.

IN THE DRAWINGS

[0013]

FIG. 1 is a plan view of the detection apparatus of the invention mounted on a training machine;

FIG. 2 is a circuit block diagram of the detection apparatus of the invention;

FIG. 3 is a first embodiment of the sensors, the shifting device and the circular motion trace; and

FIG. 4 is a second embodiment of the sensors, the shifting device and the circular motion trace.

[0014] With reference to FIGs. 1 and 2, the detection apparatus of the invention is mounted on a training machine. The training machine can be an exercise bike or an elliptical trainer. The training machine mainly comprises a body and an exercise device. The exercise device is mounted on the body and movable along a circular motion trace relative to the body.

[0015] For example, the training machine is an exercise bike. The body is a bike frame 10. The exercise device comprises a gear 11, a chain 12, two cranks 13 and a flywheel 14. The cranks 13 include a left crank and a right crank. When a user steps on the cranks 13, the cranks 13 rotate the flywheel 14 through the gear 11 and the chain 12.

[0016] The detection apparatus of the invention comprises a detection unit 20 and a controller 30. The detection unit 20 is mounted on a side of the bike frame 10. In this embodiment, the detection unit 20 is on the same side with the left crank. The detection unit 20 comprises multiple sensors 21-24 and a shifting device 25.

[0017] The shifting device 25 can be a magnet or an LED. In this embodiment, the shifting device 25 is a mag-

net as an example. The magnet is securely mounted on the cranks 13. With reference to FIG. 3, when a user steps on the cranks 13, the cranks 13 rotate around a fixed axis (A) relative to the bike frame 10, such that the shifting device 25 moves along a circular motion trace 40.

[0018] The sensors 21-24 can be Hall devices or optical sensors. In this embodiment, the sensors 21-24 are Hall devices as an example. Each sensor 21-24 is mounted on a circuit board mounted on the bike frame 10. The sensors 21-24 are mounted along the circular motion trace 40 and respectively generate a detecting signal (S) according to the magnetic field of the magnet. Therefore, when the user steps on the cranks 13, the shifting device 25 moves to sequentially pass through the sensors 21-24, such that the sensors 21-24 sequentially generate the detecting signals (S1)-(S4).

[0019] The shifting device 25 can be mounted on the gear 11 or the flywheel 14, such that the shifting device 25 moves with the rotating gear 11 or the rotating flywheel 14. The sensors 21-24 can be mounted on the bike frame 10 and correspond to the positions of the shifting device 25 on the circular motion trace 40. The controller 30 is electrically connected to the sensors 21-24 to receive the detecting signals. The controller 30 determines an exercise state of the training machine according to a timing of the detecting signals. With reference to FIG. 3, in this embodiment, the circular motion trace 40 is divided into a first segment 41, a second segment 42, a third segment 43 and a fourth segment 44, wherein the lengths of the four segments are equal to each other. The detection unit 20 has a first sensor 21, a second sensor 22, a third sensor 23 and a fourth sensor 24. The four sensors 21-24 are respectively mounted on the four segments 41-44. When the user steps on the crank 13, the shifting device 25 sequentially passes through the four sensors 21-24. When the shifting device 25 is moving through a complete revolution along the circular motion trace 40, the four sensors 21-24 respectively generate a first detecting signal (S1), a second detecting signal (S2), a third detecting signal (S3) and a fourth detecting signal (S4). The controller 30 defines a first time duration (T1), a second time duration (T2), a third time duration (T3) and a fourth time duration (T4). The first time duration (T1) stands for duration of time for the shifting device 25 to pass through the first segment 41. Similarly, the second time duration (T2), the third time duration (T3) and the fourth time duration (T4) respectively stand for durations of time for the shifting device 25 to pass through the second segment 42, the third segment 43 and the fourth segment 44.

[0020] When the controller 30 acquires the four time durations (T1)-(T4), the controller 30 calculates a total time (T) of the four time durations (T1)-(T4). The controller 30 calculates a rotation speed (RPM) of the cranks 13, wherein $RPM=60/T$ (second). Therefore, the invention uses only the detection unit 20 to determine the rotation speed of the cranks 13. The rotation speed stands for effort with which the user steps on the cranks 13.

[0021] The controller 30 can determine a rotational di-

rection of the cranks 13 according to a sequence of the detecting signals. For example, when the controller 30 sequentially receives the detecting signals of ...S_n, S₁, S₂, ... S_{n-1}, S_n, S₁, S₂...in a forward sequence, wherein n is a number of the sensors 21-24 and in this embodiment n=4, the controller 30 determines that the cranks 13 rotate along a first rotational direction, such as a clockwise direction. When the controller 30 sequentially receives the detecting signals of ...S₁, S_n, S_{n-1}, ..., S₂, S₁, S_n...in a backward sequence, the controller 30 determines the cranks 13 rotate along a second rotational direction, such as a counterclockwise direction.

[0022] Furthermore, the controller 30 can respectively determine the effort of the user's right foot and left foot according to the detecting signals. The detection unit 20 is mounted on the left side of the bike frame 10. In general, the user's left foot easily exerts force on the crank 13 in the first segment 41 and the second segment 42. The controller 30 calculates a left foot rotation speed (RPML),

wherein $RPML = \frac{60}{2TL}$ and $TL=T1+T2$. Similarly, the

user's right foot easily exerts force on the other crank 13 mounted on a right side of the bike frame 10 in the third segment 43 and the fourth segment 44. The controller 30 calculates a right foot rotation speed (RPMR), wherein

$RPMR = \frac{60}{2TR}$ and $TR=T3+T4$. Therefore, the con-

troller 30 determines the user's left foot effort and right foot effort according to the left foot rotation speed (RPML) and the right foot rotation speed (RPMR). When the rotation speed is faster, the effort is greater.

[0023] The controller 30 determines a force exerted on the crank 13 by the user's left foot and right foot according to the time durations (T1)-(T4) and determines if the user's feet slow down or stop exercising. In the first segment 41 and the second segment 42, when the second time duration T2 is longer than the first time duration T1 ($T2>T1$), the user's left foot slows down or stops exerting force on the crank 13 in the second segment 42. Similarly, when the fourth time duration (T4) is longer than the third time duration (T3) ($T4>T3$), the user's right foot slows down or stops exerting force on the crank 13 in the fourth segment 44.

[0024] In addition, with reference to FIG. 4, the detection apparatus of the invention can further comprise multiple sensors 26-29 mounted on the body. When the circular motion trace 40 comprises more sensors, the controller 30 can acquire more detection signals to precisely determine the exercise state in detail. The user can mount more sensors on a particular segment of interest. For example, with reference to FIG. 4, when a user wants to detect in detail the exercise state of the left foot in the first segment 41, the user can mount the sensors 26-29 in the first segment 41. Hence, the four segments 41-44

comprise different numbers of sensors, and among the segments, the first segment 41 has more sensors. The controller 30 can acquire more detecting signals in the first segment 41. The exercise state of the left foot determined by the controller 30 can be more detailed.

[0025] In conclusion, the structure of the invention is simplified for ease of use. The rotation speed determined by the controller 30 represents the effort of the user. Hence, the user knows the body condition and can adjust the exercising tempo and intensity.

Claims

1. A detection apparatus of a training machine having a body and an exercise device, the detection apparatus **characterized in that:**

a shifting device (25) mounted on the exercise device and movable along a circular motion trace (40), wherein the circular motion trace (40) is divided into a first segment (41), a second segment (42), a third segment (43) and a fourth segment (44);

four sensors (21-24) mounted on the body and respectively corresponding to the four segments (41-44), wherein each sensor (21-24) generates a detecting signal when the sensor (21-24) detects the shifting device (25); and

a controller (30) electrically connected to the sensors (21-24) to receive the detecting signals, so as to calculate a first time duration (T1), a second time duration (T2), a third time duration (T3) and a fourth time duration (T4), to calculate a rotation speed (RPM), to determine a rotational direction of the exercise device according to a sequence of the detecting signals, to determine a first rotation speed (RPML) and a second rotation speed (RPMR), and to determine a force exerted on the exercise by a user according to the time durations, wherein

T1 is a duration of time for the shifting device to pass through the first segment (41);

T2 is a duration of time for the shifting device to pass through the second segment (42);

T3 is a duration of time for the shifting device to pass through the third segment (43);

T4 is a duration of time for the shifting device to pass through the fourth segment (44);

the rotation speed (RPM) is $60/T$, $T=T1+T2+T3+T4$;

the first rotation speed (RPML) is $60/(T1+T2)$; and

the second rotation speed (RPMR) is $60/(T3+T4)$.

2. The detection apparatus as claimed in claim 1, wherein

when the controller (30) sequentially receives the detecting signals in a forward sequence, the controller (30) determines that the exercise device rotates along a first rotational direction; and

when the controller (30) sequentially receives the detecting signals in a backward sequence, the controller (30) determines that the exercise device rotates along a second rotational direction in reverse to the first rotational direction.

3. The detection apparatus as claimed in claim 1 further comprises multiple sensors (26-29) mounted on the body, such that the four segments (41-44) comprise different numbers of sensors.

4. The detection apparatus as claimed in claim 2 further comprises multiple sensors (26-29) mounted on the body, such that the four segments (41-44) comprise different numbers of sensors.

5. The detection apparatus as claimed in claim 2, wherein
the first rotational direction is a clockwise direction; and
the second rotational direction is a counterclockwise direction.

6. The detection apparatus as claimed in claim 5 further comprises multiple sensors (26-29) mounted on the body, such that the four segments (41-44) comprise different numbers of sensors.

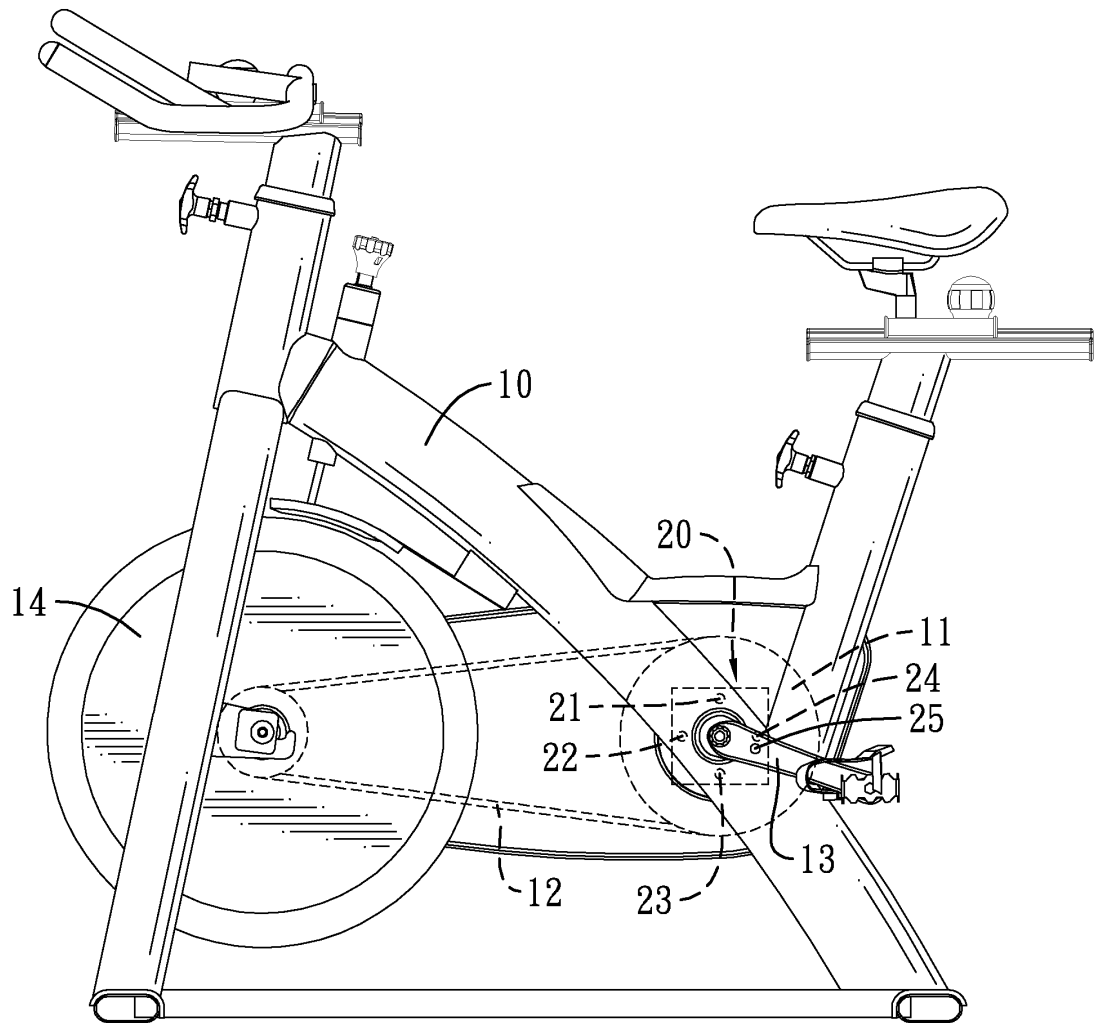


FIG. 1

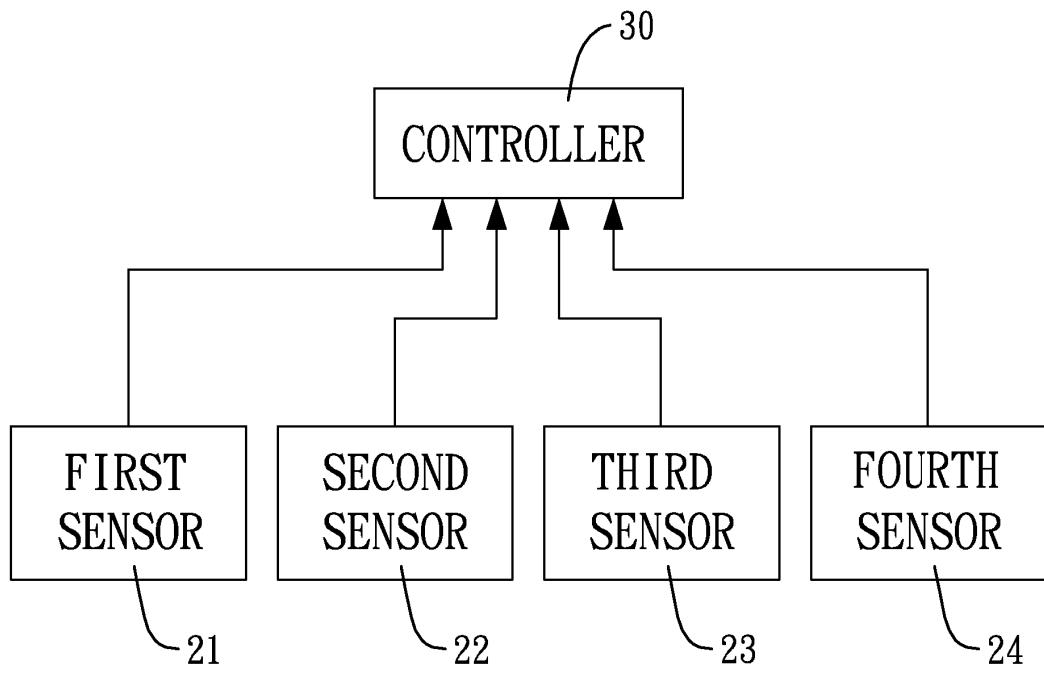


FIG. 2

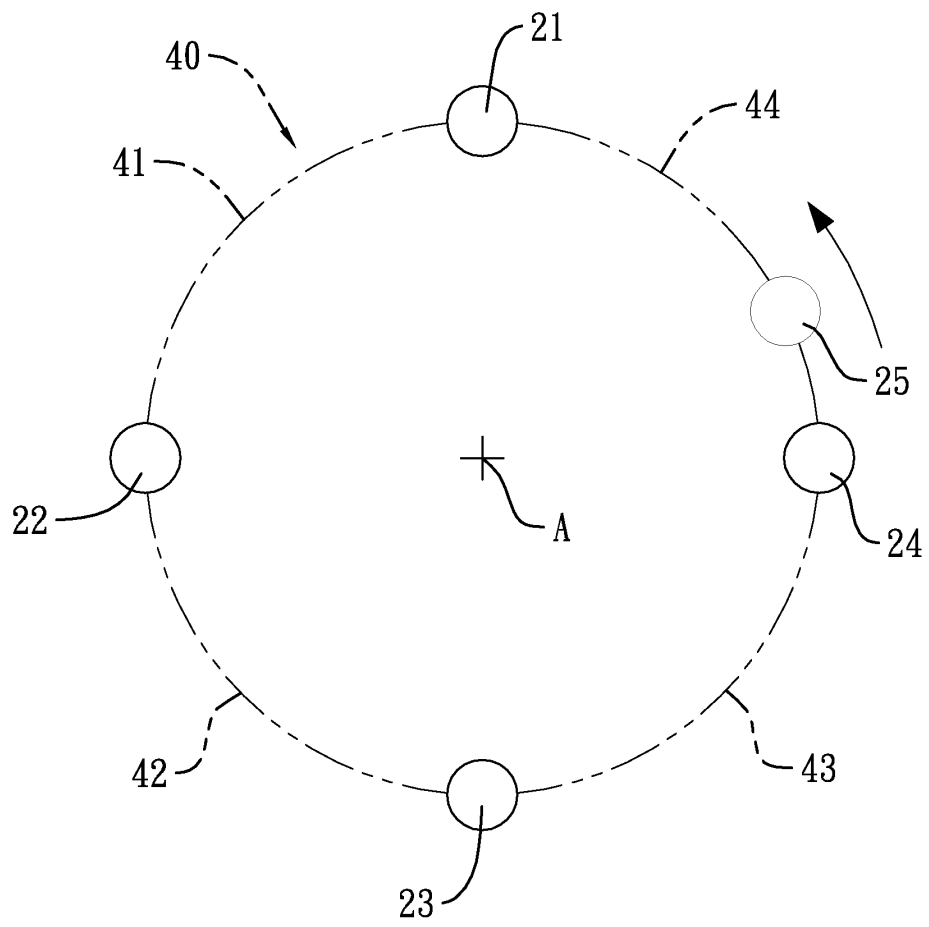


FIG. 3

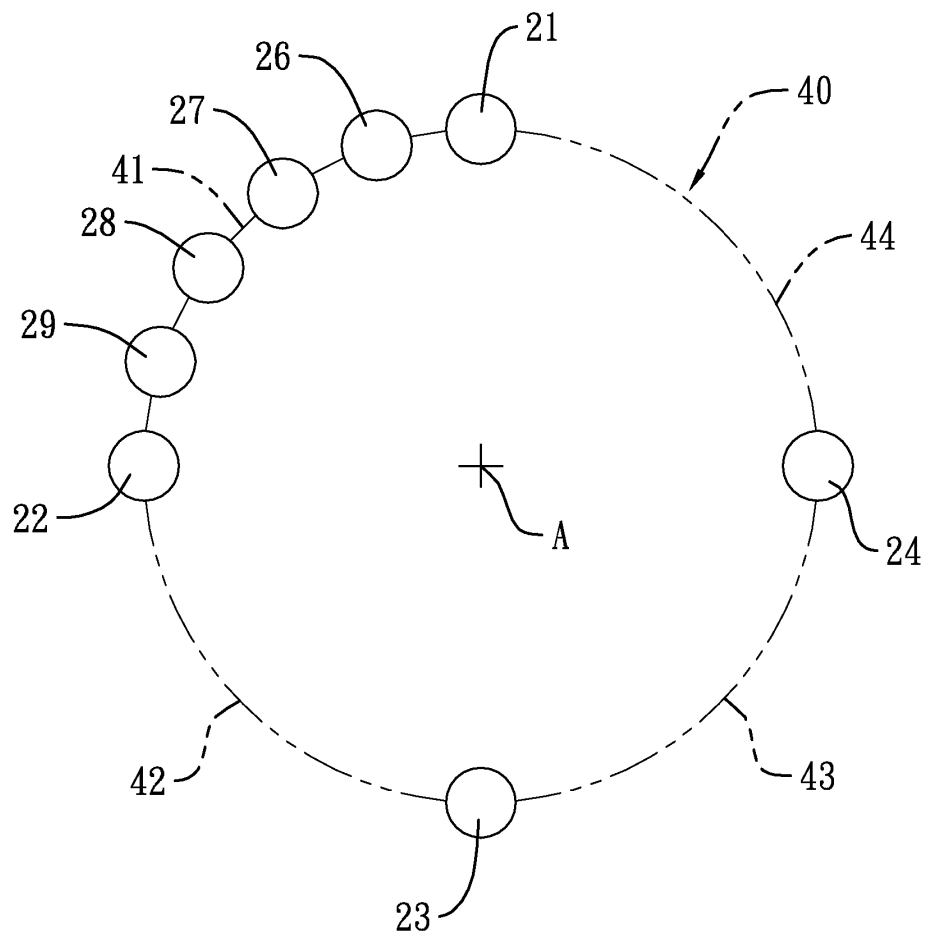


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 13 16 1478

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search Munich		Date of completion of the search 29 July 2013	Examiner Squeri, Michele
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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	

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EP 13 16 1478

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