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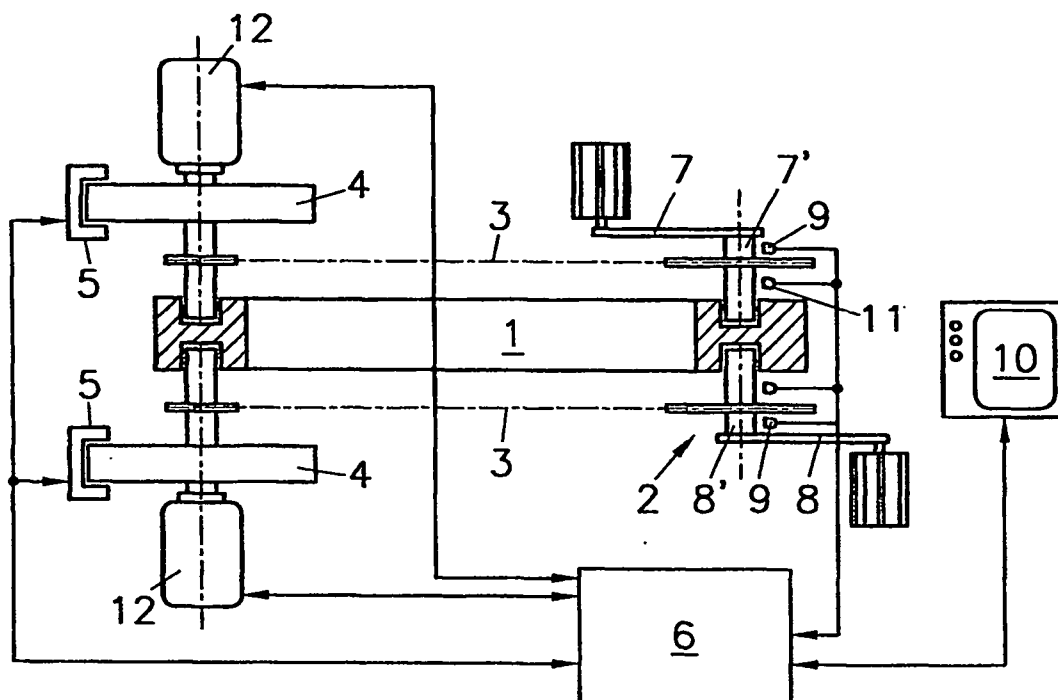
(19) **United States**(12) **Patent Application Publication****Vohryzka**(10) **Pub. No.: US 2005/0107221 A1**(43) **Pub. Date: May 19, 2005**(54) **ERGOMETER****Publication Classification**(76) Inventor: **Peter Vohryzka**, St. Poelten (AT)(51) **Int. Cl.⁷** **A63B 22/06**; A63B 69/16(52) **U.S. Cl.** **482/57**

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Dykema Gossett**Suite 300 West****1300 I Street NW****Washington, DC 20005-3306 (US)**(57) **ABSTRACT**(21) Appl. No.: **10/312,514**(22) PCT Filed: **Jun. 21, 2001**(86) PCT No.: **PCT/AT01/00198**(30) **Foreign Application Priority Data**

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The invention relates to an ergometer, preferably a bicycle ergometer, comprising a pedal arrangement (2) which is mounted in a frame (1); and an adjustable braking device (5) which optionally acts on a disk flywheel (4). The invention is characterised in that the two pedals (7, 8) of the pedal arrangement (2) are mounted independently of each other, excluding the transmission of force from one pedal to another.



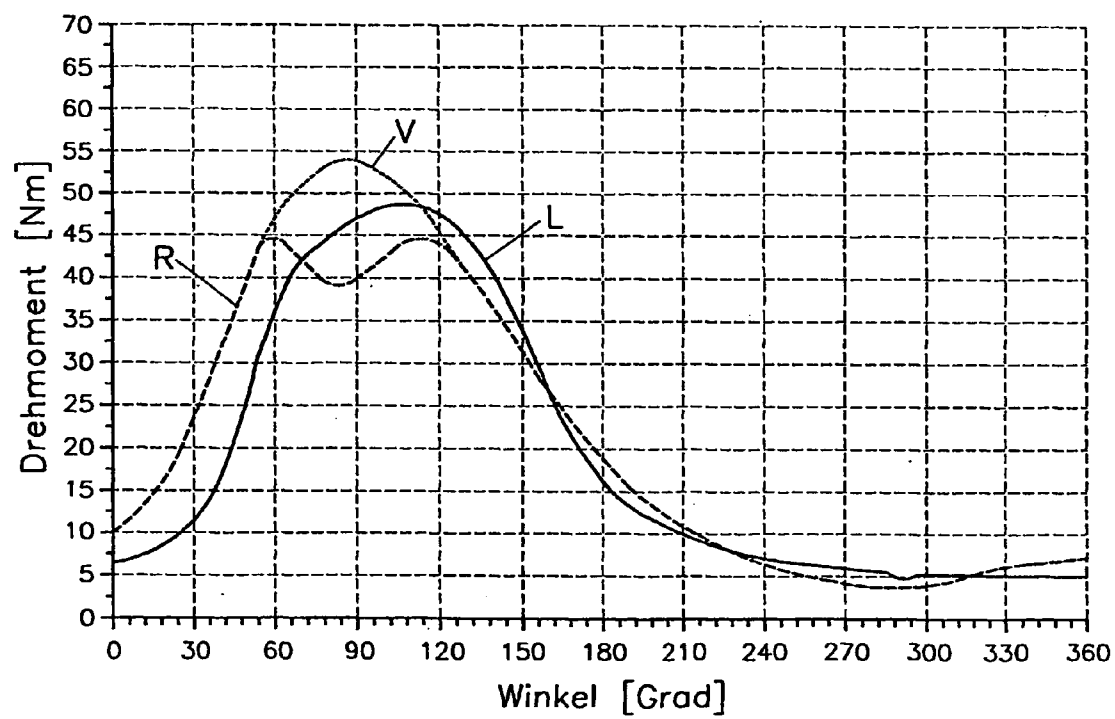
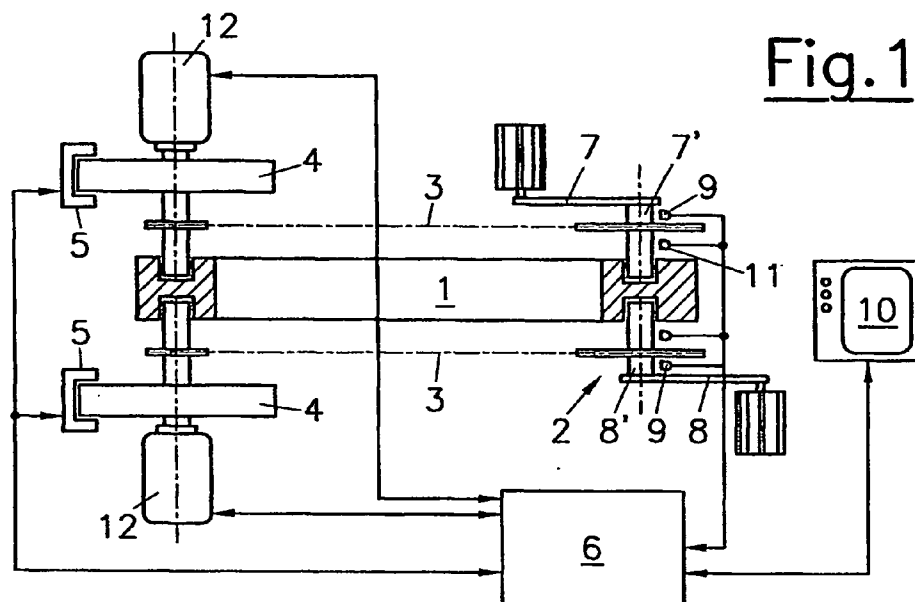


Fig.3

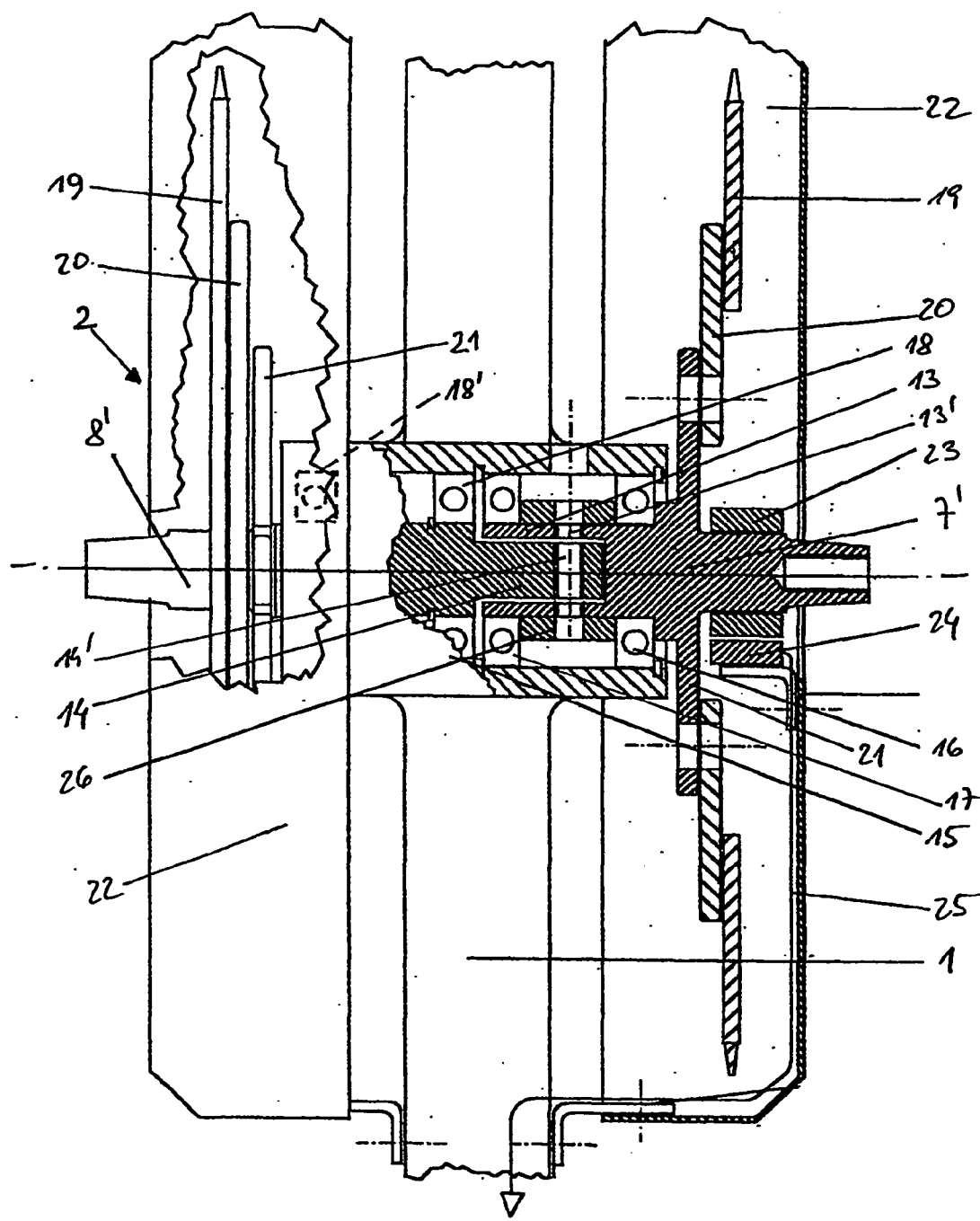


Fig. 2

ERGOMETER

[0001] The invention relates to an ergometer, preferably a bicycle ergometer, comprising a pedal arrangement which is mounted in a frame and an adjustable braking device which optionally acts on a disk flywheel.

[0002] Bicycle ergometers have recently found a wide field of applications. They are thus used, in addition to private use, both in medicine, especially in sports medicine for the purpose of performance diagnostics, as well as for checking the training progress in competitive sports. Further fields of application are in rehabilitation, e.g. for accident and stroke patients.

[0003] From DE 36 03 853 A1 a bicycle ergometer with a pedal arrangement has become known which comprises an adjustable braking device and a display instrument for the braking torque. In the zone of the handlebar grips there is a panel which comprises an indicator for the torque and speed. The user of the ergometer is thus provided with information about the torque required for overcoming the set braking force and the respectively achieved speed.

[0004] An ergometer is further known from DE 42 27 586 A1 which is used for finding and training the optimal sequence of movements. The device can be used to detect constructive and destructive force elements which are released by a cyclist on the pedals in real time and under real training conditions. For this purpose the elastic deformations relevant on the pedal lever as well as the deformations of handlebar and seat post are detected in a selective fashion and in a manner independent of each other by means of a suitable arrangement of wire resistance strain gauges. The obtained data allow determining and optimizing the complete sequence of movements of the cyclist, which means that the force components which are converted into the forward movement can be maximized and force components which cannot be converted into forward movement because they produce a static counter-force for example are minimized. It is disadvantageous that the apparatus is relatively complex because up to four possible elastic deformations (flexion in the direction of rotation, flexion perpendicular thereto, elongation in the longitudinal direction of the pedal lever, torsion about the longitudinal axis of the pedal lever) need to be detected and evaluated separately and independently from each other.

[0005] A further class of bicycle ergometers is used in medical diagnostics for the purpose of determining the aerobic/anaerobic threshold of a patient, with the performance being gradually increased and various data of the patient such as heart rate, O_2 and CO_2 content of the respiratory air, etc. being determined. Such ergometers have become known from U.S. Pat. No. 4,463,764 A and U.S. Pat. No. 5,782,772 A for example.

[0006] It is disadvantageous that the known apparatuses are incapable of determining differences in the pedaling behavior of the left and right leg of a test subject as uninfluenced as possible from any disturbances and with high resolution within a crank rotation.

[0007] It is the object of the present invention, based on an ergometer of the kind mentioned above, to provide improvements which allow detecting the torque progress of each crank or each leg separately with high resolution within a rotation of the crank.

[0008] This object is achieved in such a way that the two pedals of the pedal arrangement are mounted independently of each other, excluding the transmission of force from one pedal to another. Furthermore, a separate braking device is provided for each pedal whose braking force can be controlled independent from each other. Whereas in conventional ergometers both pedals are fastened to a continuous crank axle, it is possible as a result of the complete mechanical separation of the power flux of both pedals to detect their torque progress depending on the crank angle independent from each other and, after preparation in a computer unit, to transmit the same to a display device in the field of vision of the training person or the patient in rehabilitation.

[0009] For this purpose it is provided for in accordance with the invention that a torque sensor and/or a tachometer generator are situated on the crank axle of each pedal which is in connection with a computer unit plus display device, preferably a monitor. With the data of the sensors on the crank axles it is possible to display on the monitor a torque or force/angle curve of the respective leg. This feedback system can be used by the cyclist to directly or indirectly influence his or her turning behavior in order to reduce lateral differences and consciously work on his or her evenness on both sides.

[0010] The fields of application of the ergometer in accordance with the invention are mainly in two fields:

[0011] Sports medicine/performance diagnostics

[0012] As a result of the apparatus in accordance with the invention it is possible to achieve an improvement of the bio-mechanical efficiency by approx. 25% within a short period of time. One-sided strains that could lead to wear phenomena can be diagnosed at an early stage and can be remedied.

[0013] Rehabilitation

[0014] A successful application of the ergometer in accordance with the invention is given in all clinical pictures which lead to a force/co-ordination difference of two extremities, e.g. stroke, atrophies of different genesis, myopathies and many more. In this connection it is also possible to configure the two pedals as crank handles in order to return the co-ordination of the muscles of the affected arm after a stroke for example. In an embodiment as a rehabilitation apparatus it is also possible to hook up an auxiliary motor to each of the two pedals of the ergometer, with the output of the motor being controllable.

[0015] In accordance with the invention, each of the two auxiliary motors can comprise an anti-spasm control unit which can be activated automatically during the occurrence of a sudden change in resistance. When a patient uses an ergometer where pedaling is supported by an auxiliary motor it is advantageous when the motor cuts off during the occurrence of spasms (suddenly occurring, excessive muscular tone) or changes the direction of rotation. This helps prevent that the spastic limb is moved by the auxiliary motor by force.

[0016] The force separation in the crank drive of the ergometer can be produced according to an embodiment of the invention in such a way that one of the pedals comprises

a crank axle with a tubular projection and the other pedal a crank axle with a cylindrical projection, with the cylindrical projection being rotatably held in the tubular projection. For applications as a conventional bicycle ergometer the two projections may comprise mutually flush radial bores. By inserting a fixing screw into the radial bores, the pedal arrangement can be fixed in a 180° geometry.

[0017] The invention is now explained in closer detail by reference to the enclosed drawings, wherein:

[0018] FIG. 1 shows a schematic representation of the ergometer in accordance with the invention;

[0019] FIG. 2 shows the bottom bracket axle unit of the ergometer according to FIG. 1 in an axial sectional view, and

[0020] FIG. 3 shows a diagram of the torque progress depending on the crank angle.

[0021] The ergometer schematically shown in FIG. 1 comprises a pedal arrangement 1 mounted in a frame 1, which arrangement acts via a chain drive 3 on two separately mounted disk flywheels 4 with a braking device 5 whose braking force can be controlled independent from each other. The control of the braking force can occur in a manner not shown in closer detail either mechanically or controlled by the computer unit 6 in an electromechanical fashion, e.g. according to the principle of a eddy current brake. The two pedals 7 and 8 of the pedal arrangement 2 are held independent from each other in the frame 1 under exclusion of any transmission of forces from pedal 7 to pedal 8. A torque sensor 9 is situated on the crank axles 7', 8' of each pedal 7, 8, which sensor is in connection with a computer unit 6. The computer unit 6 is in connection with a display device 10, preferably a monitor, which is arranged in the field of vision of the user. The computer unit and the monitor can also be combined into a unit and be arranged in the zone of the handlebar-like handles of the ergometer. Furthermore, a tachometer generator 11 can be arranged on each crank axle 7', 8'. For certain applications in rehabilitation, e.g. after a stroke, it is also possible to hook up an auxiliary motor 12 to each of the two pedals 7 and 8 of the ergometer, with the output of the motor being controllable and the movement of the limb affected by the stroke being supported by the auxiliary motor 12.

[0022] FIG. 2 shows a possible embodiment of the bottom bracket axle unit of the ergometer, in which one of the pedals comprises a crank axle 7' with a tubular projection 13 and the other pedal comprises a crank axle 8' with a cylindrical projection 14, with the cylindrical projection 14 being rotatably held in the tubular projection 13. The crank axle 7' is held twice in the bearing housing 15 (see bearing 16, 17); the crank axle 8' is also held twice by the bearing 18 and the bearing 18' which is merely indicated by the broken line, thus allowing a compact design to be realized. A distance sleeve 26 is arranged between the two bearings 16 and 17. The two projections 13, 14 are provided with mutually flush radial bores 13', 14'. The pedal arrangement 2 can be fixed in a 180° geometry by inserting a fixing screw (not shown) into the radial bores.

[0023] The chain wheel 19 is fastened to a flange 21 on the crank axle 7' or 8' with the help of an adapter disk 20. The chain guard is designated on both sides with reference

numeral 22. The torque sensor consists for example of a torsion ring 23 which is fastened to the crank axles 7' or 8' and which co-operates with a data sensor 24 which is preferably fixed to the chain guard 22. The signal line starting from the data sensor 24 and leading to the computer unit 6 is designated with reference numeral 25.

[0024] FIG. 3 shows the curve of the torque depending on the crank angle, with the curve L being measured for the left leg L and the curve R (broken line) for the right leg R for example. The curve R for the right leg was displaced by 180° in order to ensure that the two maximums offer better comparison. For the patient in rehabilitation or for the sportsman undergoing training it is desirable that the two curves are arranged as evenly as possible. The recording on the screen can be used for feedback purposes. In the illustrated case it should be tried to influence the curve R by changing the rotational behavior in such a way that the torque drop in the region of the torque peak is prevented and a result according to curve V (dotted line) is achieved.

1. An ergometer, preferably a bicycle ergometer, comprising a pedal arrangement (2) which is mounted in a frame (1) and an adjustable braking device (5) which optionally acts on a disk flywheel (4), characterized in that the two pedals (7, 8) of the pedal arrangement (2) are mounted independently of each other, excluding the transmission of force from one pedal to another.

2. An ergometer as claimed in claim 1, characterized in that a separate braking device (5) is provided for each pedal (7, 8) whose braking force can be controlled independent from each other.

3. An ergometer as claimed in claim 1 or 2, characterized in that a torque sensor (9) and/or a tachometer generator (11) are situated on the crank axle (7', 8') of each pedal (7, 8), which sensor or generator is in connection with a computer unit (6) plus display device, preferably a monitor (10).

4. An ergometer as claimed in claim 1 to 3, characterized in that the two pedals (7, 8) are arranged as crank handles.

5. An ergometer as claimed in one of the claims 1 to 4, characterized in that an auxiliary motor (12) can be hooked up to each of the two pedals (7, 8), with the output of the motor (12) being controllable.

6. An ergometer as claimed in claim 5, characterized in that each of the two auxiliary motors (12) can comprise an anti-spasm control unit which can be activated automatically during the occurrence of a sudden change in resistance.

7. An ergometer as claimed in one of the claims 1 to 6, characterized in that one of the pedals (7) comprises a crank axle (7') with a tubular projection (13) and the other pedal (8) a crank axle (8') with a cylindrical projection (14), with the cylindrical projection (14) being rotatably held in the tubular projection (13).

8. An ergometer as claimed in claim 7, characterized in that the two projections (13, 14) are provided with mutually flush radial bores (13', 14'), with the pedal arrangement (2) being fixable in a 180° geometry by inserting a fixing screw into the radial bores.

9. An ergometer as claimed in one of the claims 3 to 8, characterized in that the torque sensor (9) consists of a torsion ring (23) which is fastened to the crank axles (7', 8') and co-operates with a data sensor (24) which is preferably fixed to the chain guard (22).

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