Title: BICYCLE WITH A CHANGEABLE RIDING POSITION

Abstract: A bicycle which has a frame, a rear fork and a front fork, and which frame has a main frame (12) which is articulated to the rear fork (15) with a first articulation (16), and a front frame (24) which is articulated to the main frame (12) with a second articulation (23), and the angle between the main frame (12) and the rear fork (15) and the one between the front frame (24) and the main frame (12) is changeable by means of articulations so that the axle spacing extends or shortens, the seat lowers down wards or rises upwards, the pedal crankset rises upwards or lowers downwards, and the steering angle becomes gentler or more upright.
BICYCLE WITH A CHANGEABLE RIDING POSITION

This invention relates to a bicycle of a changeable riding position.

From publication DE3837018A1 is known a bicycle which is changeable into a recumbent. In the bicycle according to the publication, when the seat moves backwards and downwards, at the same time, the pedals rise somewhat upwards. In order to gain as great as possible benefit from the low riding position, such as low air resistance, directionally-stable riding characteristics and efficient pedalling characteristics, the riding position should be so low that the person in this riding position would be in the saddle between the wheels and not on top of the wheels (rear wheel) as described in the publication. In addition, the pedal crankset should rise still considerably higher than described.

Additionally, the cyclist's centre of gravity moves in the low riding position close to the hub of the rear wheel, which causes that the front wheel of a bicycle tends to rise off the road when riding uphill, because a major part of the cyclist's total weight is in the extreme rear. Especially when riding to a steepish uphill, this characteristic is extremely undesired, because the bicycle then tends to, in a manner of speaking, fall backwards.

A desired characteristic of the bicycle is that it can be folded or modified into as small as possible space, when being transported, for example, in a car or in a public service vehicle. The bicycle according to the publication in question does not enable collapsing or modifying so that it could fit in a small space, for example, for transport or storage.

From publication DEG9015936.5 is known a recumbent which has a changeable riding-position height. In the publication, the change of the riding position is enabled by an articulation between the rear fork and the frame the angular change of which articulation rises and lowers the frame and then the seat and the pedal crankset. When the articulation between the rear fork and the frame rotates, the seat and the pedal crankset move in the same direction, that is, when the seat rises also the pedal crankset rises, because of which the riding position cannot rise to the upright riding position of a traditional bicycle. In the upright position, the pedals are too high up, and in the low position, they are too low.

With this invention, a fundamental improvement is achieved compared to the solution of the publication. In addition to the articulation between the rear fork and the main
frame, the front part of the main frame is articulated into a separate front frame, by means of which the height of the pedal crankset changes to the opposite direction when the height of the seat changes.

The aim of this invention is to eliminate above-mentioned disadvantages and to accomplish a bicycle which has good riding characteristics in all riding positions between the low and the high riding position, and which is possible to be modified for fitting into a small space for transport or storage. In addition, the bicycle should be collapsible so that when it is partially collapsed it forms an armchair in which the cyclist may have a rest, for example, during travel.

This object is achieved according to the invention so that the bicycle has an articulation with which the main frame is connected to the rear fork and the front frame, and these articulations may be adjusted independently from each other, whereby, by changing the angle between the main frame and the rear fork and the angle between the main frame and the front frame, one is able to steplessly form a desired riding position and desired riding characteristics. The pedal crankset is fastened to the main frame, and the pedal crankset rises or lowers based on how the geometry of the bicycle is changed. When setting the bicycle into the low riding position, that is, when enlarging the angle between the main frame and the rear fork, the pedal crankset rises upwards, and at the same time, the angle between the main frame and the front frame may be changed.

Furthermore, by changing the angle between the main frame and the rear fork and the one between the front frame and the main frame, the axle spacing, that is, the distance of the front wheel and the rear wheel from each other, either decreases or increases.

The backrest, the saddle and the handlebar are also articulated and further steplessly adjustable to a different position, whereby, when changing the geometry of the bicycle, they may be set as desired to the most suitable position for the cyclist. The main frame has a busbar, with which the seat frame slides, into which the saddle and the backrest are articulated. The seat frame being movable along the busbar, the distance of the saddle and the backrest from the pedal crankset is adjustable for cyclists of different heights.

The bicycle enables several different efficient and well-designed riding positions, and it is collapsible into a small space for transport. Because of the articulation, the geometry of the bicycle may be changed so that the riding position may be as
desired between the riding position of a nearly lying recumbent and a high riding position. The city-riding characteristics are achieved with an upright and high, short axle spacing, an upright steering angle and the centre of gravity thus being high. In road cycling, the air resistance is achieved low and the riding characteristics directionally-stable with different speeds by lowering the riding position, extending the axle spacing and flattening the steering angle. In addition, the frame articulation enables the collapsing of the bicycle into a small space, and it may be utilised as an adjustable armchair the backrest functioning as a support for the back and the saddle functioning as a seat.

The locking and the adjustment of the articulations is effected with locking beams and locking pins, screw adjusters, cable locking, pneumatic, hydraulic systems or equivalent structures.

To be precise, the bicycle according to the invention is characterised by what is stated in the appended claims and especially in the characterising part of claim 1.

In the following, the invention is described in detail by means of the accompanying drawings, wherein:

Figure 1  shows the bicycle and its components,

Figure 2  shows the different riding positions of the bicycle, an upright city-riding position, a gently-reclining cruising position and a low road-riding position, and the most significant measure changes of the frame caused by two main articulations,

Figure 3  shows the different articulations of the bicycle and the movements of the articulations,

Figure 4  shows the collapsing of the bicycle,

Figure 5  shows an alternative solution of a bicycle according to the invention.

Figure 1 shows the following main components of the bicycle:

1. handlebar,

2. handlebar-stem inner part,
3. handlebar-stem casing part,

4. handlebar-stem articulation,

5. stem bearings, between front fork and front frame,

6. front fork,

7. front hub,

8. front wheel,

9. pedal crankset,

10. pedal,

11. pedal crank,

12. main frame,

13. rear wheel,

14. rear hub,

15. rear fork,

16. main rear articulation (between rear fork and main frame),

17. backrest,

18. backrest articulation,

19. seat frame (fastened to main frame),

20. saddle articulation (saddle angle may be fine-adjusted),

21. saddle,
22. busbar in main frame with which busbar seat frame slides (with seat frame, the distance of saddle and backrest from pedal crankset may be adjusted suitable for cyclists of different sizes),

23. main front articulation (between front frame and main frame),

24. front frame,

25. front-frame folding articulation.

A handlebar 1 is fastened to a handlebar-stem inner part 2 which may move in the longitudinal direction inside a handlebar-stem casing part 3. The handlebar-stem casing part 3 is fastened with an articulation 4 to a front fork 6, and the front fork 6 is able to rotate around a front frame 24. The front frame 24 is fastened with an articulation 23 to a main frame 12 and is able to rotate because of the articulation 23 in regard to the main frame 12. A seat frame 19, into which a saddle 21 is fastened, is able to move along a busbar 22 in the main frame, and a backrest 17 is fastened to the seat frame 19 with an articulation 18. An articulation 16, which connects a rear fork 15 and the main frame 12, enables the rotation of the rear fork and the main frame in regard to each other. Forces are conveyed from a pedal crankset 9, which is fastened to the main frame 12, over the articulation 16 either with a drive chain, axle, belt or equivalent to a rear hub 14, and the drive chain or the axle or the belt may pass inside or outside of the main frame 12 and the rear fork 15, these being either tube-like, bar-like or equivalent casing-like or enclosed structures.

Figure 2 shows different riding positions of the bicycle, and the most significant measurement changes of the frame caused by the angular changes of the main rear articulation 16 and the main front articulation 23: the change of the pedal-crankset height (h1-h2), the change of the height of the saddle centre (H1-H2), the change of the axle spacing (L1-L2), and the change of the steering angle (Δ1 - Δ2). Changing the riding position from a high city-riding position to a low road-riding position occurs when the angle of the rear fork 15 in regard to the main frame 12 increases, and the angle of the front frame 24 in regard to the main frame 12 decreases. Then, the active measurements of the frame change: the saddle 21 lowers (H), the pedal crankset 9 and the pedals 10 rise upwards (h), the axle spacing (L) increases, and the steering angle (Δ) decreases. In the figure, H1 is the height of the saddle 21 from the ground, h1 the height of the pedal crankset from the ground, that is, from the surface defined by the wheels (H1 > h1), L1 is the axle spacing, that is, the distance of the front hub 7 and the rear hub 14, and Δ1 is the steering angle, that is, the angle
of the front fork 6 in regard to the ground in the city-riding position. In the figure, H2 is the height of the saddle from the ground, h2 the height of the pedal crankset 9 from the ground (H2 < h2), L2 is the axle spacing, and Δ2 the steering angle in the road-riding position. The figure also shows the joint maximum-height change X between the cyclist and the bicycle, which change essentially affects air resistance.

The backrest 17 rotates around the articulation 18, and the saddle 21 around an articulation 20. The handlebar-stem inner part 2 may be pulled out from the handlebar-stem casing part 3 and be rotated by means of the articulation 4, whereby the handlebar 1 may be set to a suitable place. The steering may be implemented with several different manners, and still, the change of the frame geometry enables the change of the riding position.

Figure 3 shows the articulations of the bicycle and the movements of the articulations. The backrest is fastened with articulation to the seat frame 19 into which also the saddle 21 is fastened with a saddle articulation. The handlebar-stem casing part 3 is fastened with the articulation 4 to the front fork 6, and the handlebar-stem inner part is able to move in the handlebar-stem casing part 3 enabling length adjustment. The rear fork 15 is able to rotate in regard to the main frame by means of the articulation 16, and correspondingly, the front frame 24 is articulated to the main frame with the articulation 23.

In figure 4, the frame of the bicycle folds into a small size by means of a main front articulation 23, a main rear articulation 16, a backrest articulation 18, a stem articulation 4 which enable changing of riding position, and further a folding articulation 25 folding the front frame 24 transversely in regard to the drive direction. The bicycle folds into a small size so that the front hub 7 and the rear hub 14 are side by side, which enables trailer-like pulling behind.

Figure 5 shows an alternative solution of a bicycle according to the invention, in which solution parallelogram-articulation is utilised.

Additional components of a parallelogram-articulated bicycle:

26. linkage articulation front frame,

27. linkage bar, links rear fork and front frame to each other so that the angles of both change in a proper relation with regard to main frame,
28. locking cylinder, adjusts and locks the angle of front frame with regard to main frame, and also the angle of rear fork through linkage bar,

29. linkage articulation rear fork,

30. drive chain, for power transmission from pedals to rear wheel,

31. gears for drive chain, on articulation 16 axle,

32. gears for drive chain, on pedal crankset axle.

The front frame 24 and the rear fork 15 are linked to each other with a linkage bar 27 which jointly with the main frame 12, the front frame 24 and the rear fork 15 forms a parallelogram. A change of one angle changes a second angle in a desired relation. The change of the angle of the front frame in regard to the main frame 12 changes the angle of the rear fork 15 in regard to the main frame 12, in a proper relation from the viewpoint of changing riding positions and riding characteristics.

The parallelogram solution decreases the number of separately adjustable settings in changing the riding position, when the articulations 23 and 16 are adjusted in a proper relation in regard to each other. The heights of the seat and the pedal crankset, the axle spacing and the steering angle change similar to the prior, broader solution, but only by adjusting the angle of one articulation.

It is well known by those skilled in the art that the different embodiments of the invention are not solely limited to the examples described above, and thus they may vary within the scope of the appended claims.
CLAIMS

1. A bicycle which has a frame, a rear fork and a front fork, characterised in that the frame has a main frame (12) which is articulated to the rear fork (15) with a first articulation (16), and a front frame (24) which is articulated to the main frame (12) with a second articulation (23), and that the angle between the main frame (12) and the rear fork (15) and the one between the front frame (24) and the main frame (12) is changeable by means of articulations so that the axle spacing extends or shortens, a seat lowers downwards or rises upwards, a pedal crankset rises upwards or lowers downwards, and the steering angle becomes gentler or more upright.

2. A bicycle according to claim 1, characterised in that the locking and the adjustment of the articulations is effected with locking beams and locking pins, screw adjusters, cable locking, pneumatic or hydraulic systems or other equivalent locking structures.

3. A bicycle according to claims 1-2, characterised in that the power transmission from a pedal crankset (9) to a rear hub (14) is effected with drive chains, axle, belt or other equivalent through an articulation (16).

4. A bicycle according to claims 1-3, characterised in that a seat frame (19) is movable in a busbar in the main frame (12), and that a seat and a backrest (17) is articulated to a seat frame (19).

5. A bicycle according to claims 1-4, characterised in that, by means of a main front articulation (23), a main rear articulation (16), and a front-frame folding articulation (25), the bicycle folds into a small size so that a front hub (7) and a rear hub (14) are side by side.

6. A bicycle according to claims 1-5, characterised in that a handlebar (1) is fastened to a handlebar-stem inner part (2), and that the handlebar-stem inner part (2) is movable in a handlebar-stem casing part (3) which is articulated with an articulation (4) to a front fork (6).

7. A bicycle according to claim 1, characterised in that the front frame (24) and the rear fork (15) are linked to each other with a linkage bar (27) which jointly with the main frame (12), the front frame (24) and the rear fork (15) forms a parallelogram, which enables the changing of the height of the seat.
and the pedal crankset, the axle spacing and the steering angle by adjusting only one angle of the parallelogram.

8. A bicycle according to claims 1-2, characterised in that, by means of articulations (16, 23), the angle between the main frame (12) and the rear fork (15), and the one between the front frame (24) and the main frame (12) are steplessly changeable.
**INTERNATIONAL SEARCH REPORT**

**INTERNATIONAL APPLICATION DATA**

| International application No. | PCT/FI2005/000196 |

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC7: B62K13/08, 3/02, 15/00

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)

IPC7: B62K

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

FI, DK, NO, SE

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

EPO-INTERNAL, WPI

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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</thead>
<tbody>
<tr>
<td>X Y</td>
<td>JP 2002-337780 A (YAMAHA MOTOR CO LTD) 27 November 2002 (27.11.2002) abstract; Fig. 1 - 3</td>
<td>1 2 - 6</td>
</tr>
<tr>
<td>X Y</td>
<td>JP 2003-175876 A (BRIDGESTONE CYCLE CO) 24 June 2003 (24.06.2003) abstract; Fig. 1 - 4</td>
<td>1, 7, 8 2 - 6</td>
</tr>
<tr>
<td>X Y</td>
<td>US 6530589 B1 (MA PEI-CHUAN) 11 March 2003 (11.03.2003) Fig. 1, 4, 12, 13, 14; column 1, lines 21 - 25</td>
<td>1, 7 2 - 6</td>
</tr>
<tr>
<td>Y</td>
<td>US 6595539 B1 (BELLI ALESSANDRO) 22 July 2003 (22.07.2003), Fig. 1, 2, 3</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>DE 20018160 U1 (HSU PI LIEN) 28 December 2000 (28.12.2000), abstract; Fig. 1, 2, 3, 4, 5</td>
<td>4</td>
</tr>
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* Further documents are listed in the continuation of Box C.

**Date of the actual completion of the international search**

20 July 2005 (20.07.2005)

**Date of mailing of the international search report**

20 July 2005 (20.07.2005)

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<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>DE 20310590 U1 (GIANT MFG CO) 11 December 2003 (11.12.2003), Fig. 1, 5, 6</td>
<td>4, 6</td>
</tr>
<tr>
<td>Y</td>
<td>JP 2000-198482 A (SHINOZUKA TSUTOMU) 18 July 2000 (18.07.2000), abstract; Fig. 1 - 6</td>
<td>5</td>
</tr>
<tr>
<td>A</td>
<td>DE 8909156 U1 (NATTEFORT) 17 January 1991 (17.01.1991), Fig. 1, 2, 4</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>DE 9015936 U1 (ABRAHAM) 21 March 1991 (21.03.1991), Fig. 1 - 4</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>EP 0770543 A2 (ITOCHU CORP et al.) 02 May 1997 (02.05.1997), abstract</td>
<td>1</td>
</tr>
<tr>
<td>Patent document cited in search report</td>
<td>Publication date</td>
<td>Patent family members(s)</td>
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<tr>
<td>JP 2002-337780 A</td>
<td>27/11/2002</td>
<td>None</td>
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<tr>
<td>JP 2003-175876 A</td>
<td>24/06/2003</td>
<td>None</td>
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<td>ES 2185318T T3</td>
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<td>WO 9938759 A1</td>
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<td>AU 2719699 A</td>
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<td>AT 225274T T</td>
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<td>IT MI980191 A1</td>
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<tr>
<td>DE 20018160 U1</td>
<td>28/12/2000</td>
<td>TW 507742Y Y</td>
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<tr>
<td>DE 20310590 U1</td>
<td>11/12/2003</td>
<td>NL 1023895C C2</td>
</tr>
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<td>JP 2000-198482 A</td>
<td>18/07/2000</td>
<td>None</td>
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<tr>
<td>DE 8909156 U1</td>
<td>17/01/1991</td>
<td>None</td>
</tr>
<tr>
<td>DE 9015936 U1</td>
<td>21/03/1991</td>
<td>None</td>
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<tr>
<td>EP 0770543 A2</td>
<td>02/05/1997</td>
<td>CN 1157243 A</td>
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<td>JP 9109972 A</td>
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