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Patin

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[54] **THREE WHEELED VEHICLES HAVING STATIC AND DYNAMIC EQUILIBRIUM**

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Oct. 1, 1971 France 71.35441

[52] **U.S. Cl.** **280/62**, 280/111, 180/27

[51] **Int. Cl.** **B62d 61/06**

[58] **Field of Search** 180/27, 41; 280/62, 280/112, 111

[56] **References Cited**

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Assistant Examiner—Gene A. Church
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[57] **ABSTRACT**

A three-wheeled vehicle having a frame symmetrical relative to a median plane and carrying a forward guiding wheel mounted, in the said median plane, on a fork with positive castor, a rear framework comprising two wheels mounted on an axle on either side of the median plane of the frame, an organ for pivoting the frame relative to the rear framework, comprising a cylindrical bearing rigidly attached to the framework and having an axis which is substantially horizontal and positioned in the median plane, and on which pivots a coaxial, cylindrical part, connected to the frame, and a device for locking the pivoting organ comprising a drum rigidly connected to the framework and coaxial with the cylindrical bearing and an organ for locking on the drum by friction, operated by a pendulum oscillating on either side of the median plane under the effect of weight and centrifugal force, characterized by the fact that the friction locking organ consists of at least one pair of belts wound symmetrically, each in one direction, on the drum and attached at one end to the pendulum and at the other end to the frame, the anchorage points of the said belts on the frame being spaced on either side of the median plane. The pendulum may alternatively consist of the frame of the vehicle itself, the said frame being suspended from a yoke positioned inside the housing and mounted pivotably on the cylindrical bearing, by means of at least one pair of suspension arms, positioned symmetrically each on one side of the median plane and each hinged about two axes parallel to the median plane, at their lower portion to the bottom of the housing and at their upper portion to the yoke.

8 Claims, 10 Drawing Figures

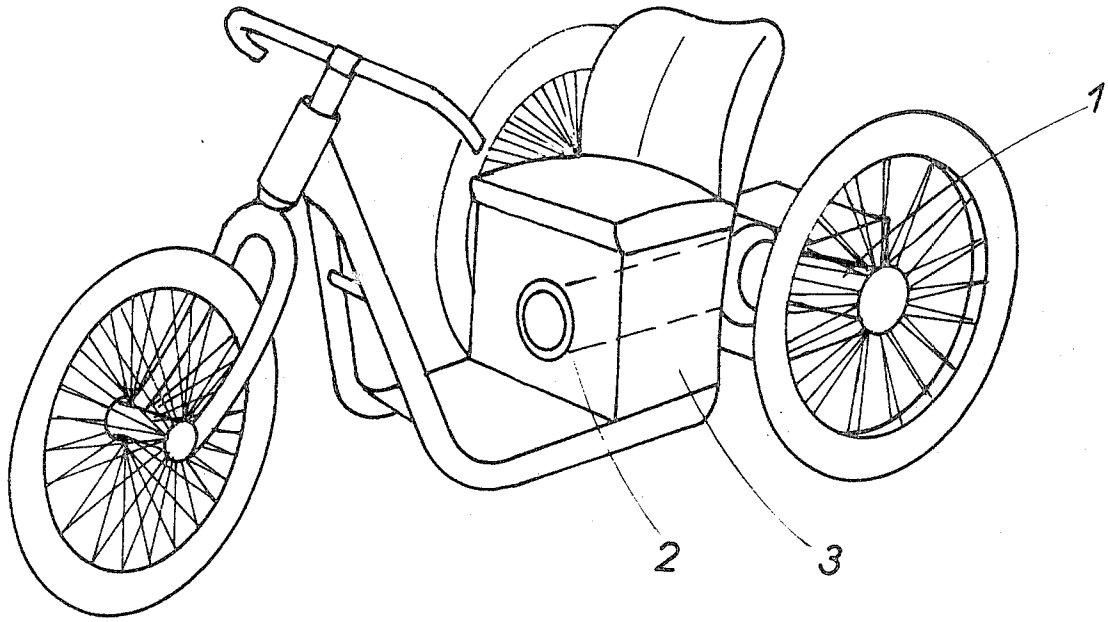


FIG. 1

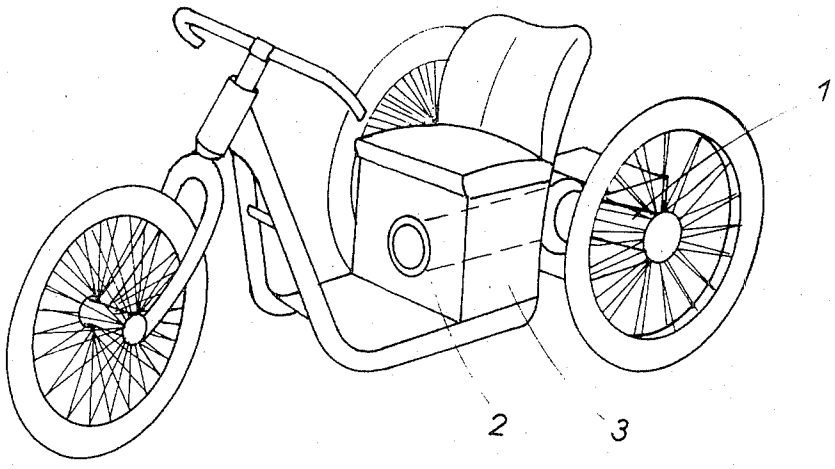


FIG. 3

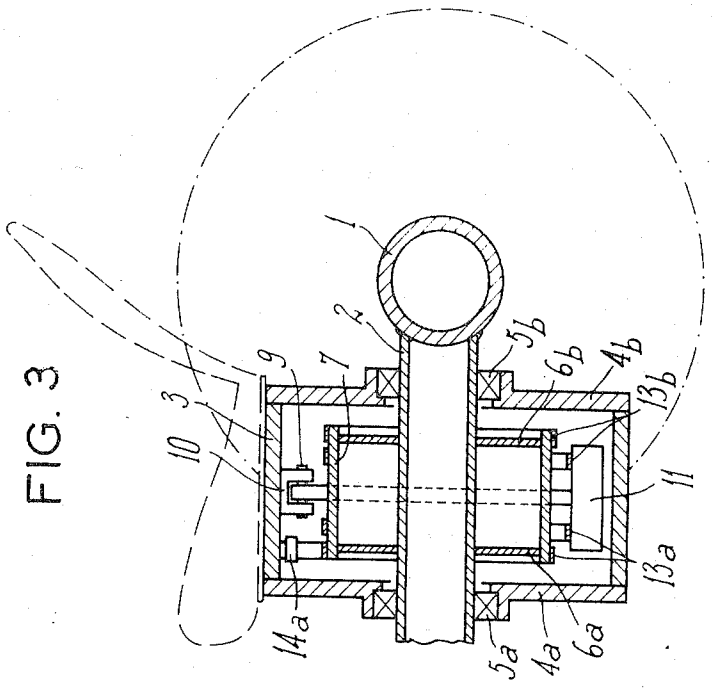

1
2
3
5b
6b
4b
13b
9
7
10
11
13a
14a
5a
4a
6a

FIG. 2

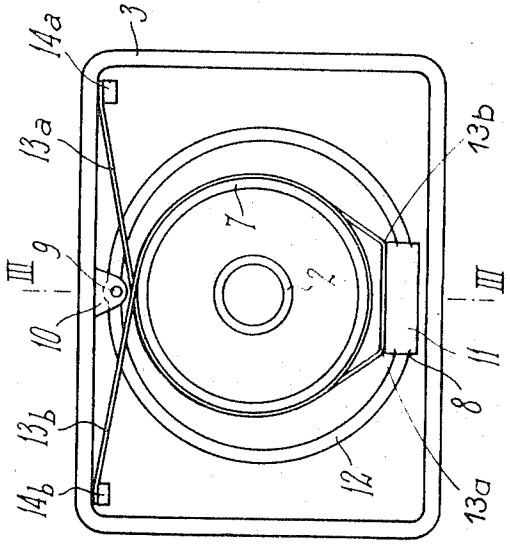

3
14a
13a
13b
7
9
III
2
10
11
III
8
13b
14b
12
13a

FIG. 4

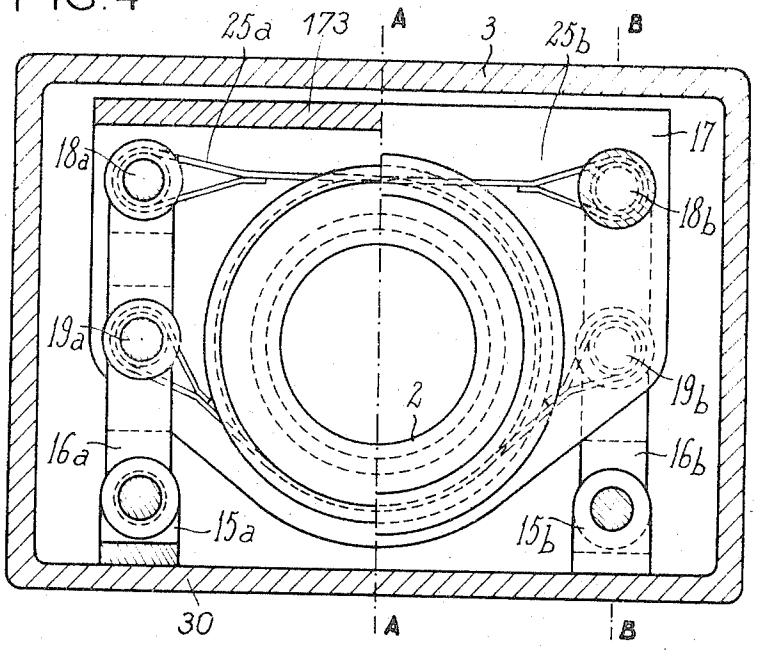


FIG. 5

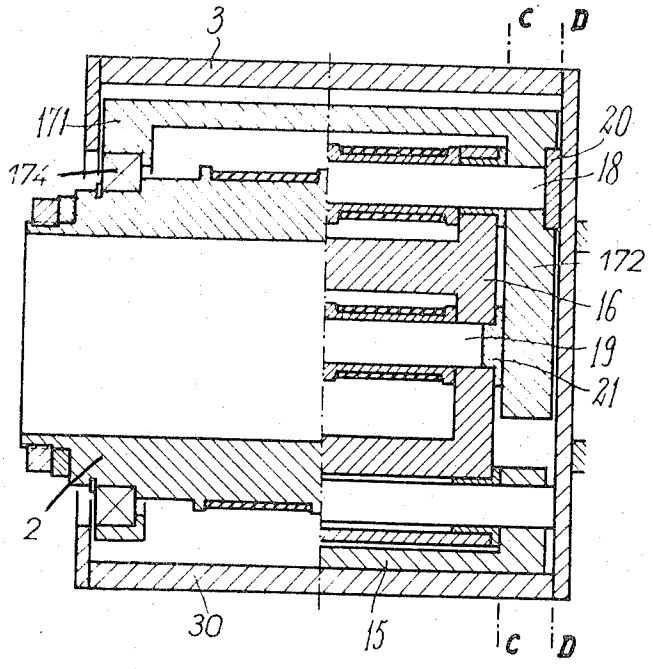
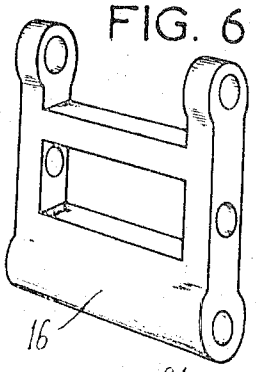


FIG. 6



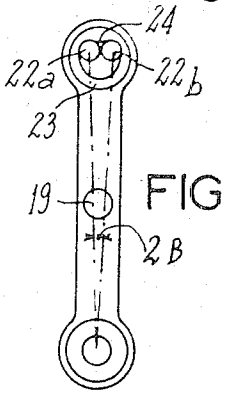


FIG. 7

FIG. 8

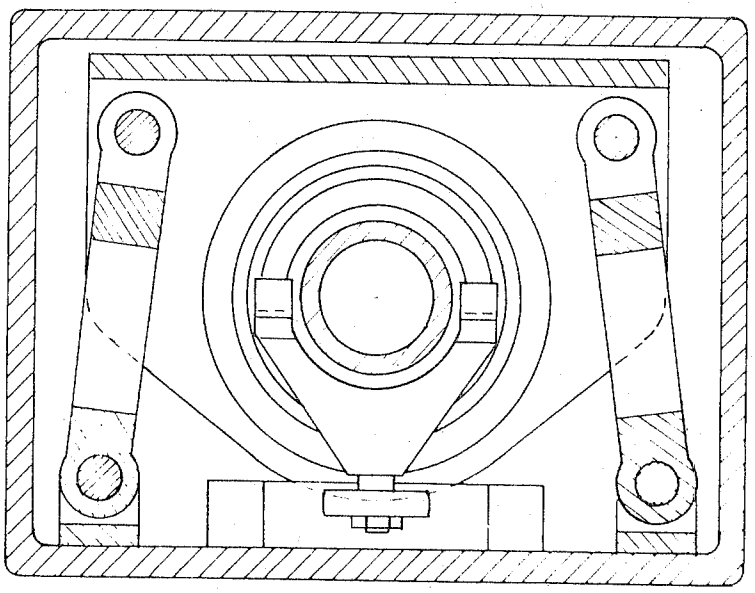


FIG. 8a

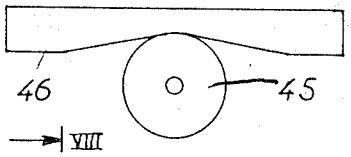
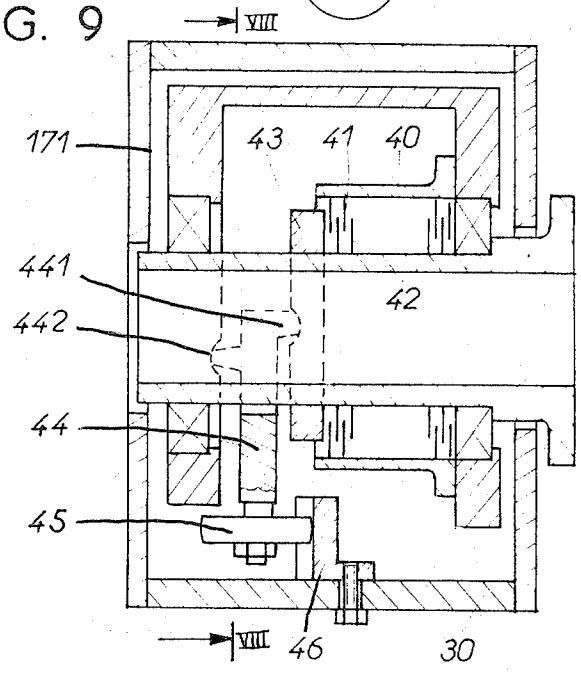


FIG. 9



THREE WHEELED VEHICLES HAVING STATIC AND DYNAMIC EQUILIBRIUM

The invention relates to new improvements to the stabilised, three-wheeled vehicle described in French Pat. No. 1,562,248 and its Certificate of Addition No. 2,031,813.

The three-wheeled vehicle described in this patent and its addition includes a frame which is symmetrical relative to a median plane and carries a forward guiding wheel mounted, in the said median plane, on a fork with positive castor, a rear framework including two wheels mounted on an axle, on either side of the median plane of the frame, and an organ for pivoting on the frame relative to the rear framework, comprising a cylindrical bearing rigidly connected to the framework, the axis of which is substantially horizontal and positioned in the median plane and on which pivots a cylindrical, coaxial part connected to the frame. In accordance with the invention described in French Pat. No. 1,562,248, the articulation is able to be locked in certain conditions, when the vehicle is stopped or when the median plane of the vehicle does not coincide with the apparent vertical which is the resultant of weight and centrifugal force.

French Pat. No. 1,562,248 and its addition describe a certain number of locking systems, some linked to the velocity of the vehicle and others to the apparent vertical. Different embodiments are described for the system of locking by moving the median plane away from the apparent vertical, but several of them present certain disadvantages, in particular that of not unlocking in certain conditions, for example when the vehicle starts off by turning in the direction in which it was inclined when stopped.

The present invention relates to new improvements describing several more advanced embodiments of apparent vertical locking systems not having the disadvantages mentioned.

The different embodiments which will be described below are of the same type as one of the locking devices described in French Pat. No. 1,562,248, this device comprising a drum rigidly connected to the framework and coaxial with the cylindrical bearing, and an organ for locking by friction on the drum, operated by a pendulum oscillating on either side of the median plane under the joint effect of weight and centrifugal force.

In the embodiment described in French Pat. No. 1,562,248, the drum rigidly connected to the framework is a brake-drum and the friction locking organ consists of two shoes separated by a cam rigidly connected to the pendulum and determining the spacing of the shoes when the median plane of the frame moves away from the apparent vertical.

In the different embodiments which form the object of the present invention, the operation of the friction locking organ is more efficient and more progressive.

In the first embodiment of the invention, the friction locking organ consists of at least one pair of belts wound symmetrically, each in one direction, on the drum and fixed at one end of the pendulum and at the other on the frame, the anchorage points on the frame being spaced on either side of the median plane.

In other embodiments, the pendulum consists of the vehicle frame itself, the said frame comprising a housing surrounding the pivot organ and suspended from a yoke mounted to pivot on the cylindrical part, by means of at least one pair of suspension arms, positioned symmetrically on either side of the median plane, the said arms each being hinged about two axes parallel to the median plane of the frame, at their lower portion on the bottom of the housing and their upper portion on the yoke.

In a modification of the latter embodiment, the fircction locking organ consists, as in the first embodiment, of at least one pair of belts wound symetrically on the drum, the ends of each belt being in this case attached to the yoke and to one of the suspension arms.

In another modification, the friction locking organ consists of a multi-disc clutch having a male element rigidly attached to the cylindrical bearing, a female element rigidly attached to the yoke and a plurality of clutch discs which are axially slidable and operated by a distributor ring, the said ring being subjected firstly to the action of an elastic organ for a separation of the discs and secondly to the antagonistic action of a lever for pressing together the discs pivoting about a fixed point positioned on the yoke and bearing firstly on the distributor ring and secondly on a ramp rigidly connected to the bottom of the housing, through a roller which runs on the said ramp.

Different embodiments, offered as non-limiting examples, and corresponding to various types of friction locking rogans and pendulumes will be described below with reference to the attached drawings:

FIG. 1 is an overall view of a balanced three-wheeled vehicle;

FIG. 2 is a diagrammatic cross section of a first embodiment of the improved locking organ of the invention;

FIG. 3 is a longitudinal partial section along III—III of FIG. 2;

FIG. 4 is a cross section of the second embodiment of the invention, the left part of which is shown in half section along C—C of FIG. 5 and the right half of which is shown in half-section along D—D of FIG. 5;

FIG. 5 is a longitudinal section of the second embodiment, showing in its left portion a half-section along A—A of FIG. 4 and in its right portion a half-section along B—B of FIG. 4;

FIG. 6 is a detailed perspective of a suspension link;

FIG. 7 is a side view of a modification of a suspension link;

FIG. 8 is a cross section of a third embodiment of the invention, FIG. 8*a* being a partial plan of a locking ramp, and

FIG. 9 is a longitudinal section of the third embodiment, along IX—IX of FIG. 8.

A first embodiment of the locking organ of the invention is shown in FIGS. 2 and 3.

On axle 1 of the vehicle is welded a pipe 2 which forms the cylindrical bearing defining the pivot axis. On this bearing 2 is mounted a box 3 rigidly attached to the frame of the vehicle. This box is closed by two covers 4*a* and 4*b*, with interposition of bearing 5*a* and 5*b* which enables box 3 to turn about pipe 2. To the latter are welded two wheel-discs 6*a* and 6*b* carrying a drum 7.

A pendulum 8 is pivoted about an axis 9 of clevis 10 carried by the upper portion of box 3. This pendulum 8 consists of a mass 11 rigidly connected to a ring 12 hinged about axis 9 and surrounding drum 7. To this

pendulum are symmetrically attached the ends of belts 13*a* and 13*b*.

These belts are also attached, by their other ends, to the upper portion of box 3, for example by bolted plates such as 14*a*, 14*b*. Belts 13*a*, 13*b* are mounted with slight play to allow free operation of the articulation when the plane of symmetry of box 3 coincides with the apparent vertical, i.e. with the position of the axis of pendulum 8.

If this condition is not satisfied, for example, if, while stopped, the vehicle is inclined to the right, belt 13*a* is tensioned, is applied to drum 7 and tends to lift pendulum 8 towards the left. This pendulum is then subject to a return force which gives to the belt a tension T_0. Because of the capstan effect, the other end of the belt is able to resist a tension $T_1 = T_0 e^{fa}$ much greater than the return force T_0, a being the winding angle and f the coefficient of friction of the belt on the drum; rotation of the box is thus stopped and the articulation locked. It will be noticed that, when the axis of the box and the apparent vertical coincide, whether the box is set upright by the action of the driver of the vehicle or the pendulum moves, for example under the effect of centrifugal force, the belt relaxes and the articulation progressively unlocks.

The system described above does however have characteristics which can be inconvenient in certain cases. Firstly, it requires: either a relatively large pendulum mass to cater for all load circumstances, or winding of the belt through a fairly large number of turns. Secondly, the pendulum risks being subjected to natural oscillations which are relatively undamped and fairly troublesome.

In other embodiments shown in FIGS. 4 to 8, the first of these disadvantages is eliminated by the use of the actual weight of the vehicle body as the mass of the pendulum.

In these examples of the embodiments, is still found pipe 2, welded to the axle, which forms the axis of articulation. This pipe itself forms the drum of the locking organ.

On the other hand, the frame is provided with an extension 30 passing under pipe 2 and which, in the embodiment shown, forms the bottom of a box 3 surrounding the whole of the pivot device. This extension 30 is provided with two clevices 15*a*, 15*b*, on which are hinged two links 16*a*, 16*b* which can be of the form shown in FIG. 6. Each link is provided with two arms hinged at their upper portions about axes 18*a*, 18*b*, on a yoke 17 mounted to pivot on pipe 2. Yoke 17 consists for example of two side plates 171, 172 spaced apart and rigidly connected by a metal plate 173, said side plates each having a circular orifice passing through them for passage of pipe 2, and ball bearings 174 being placed between the side plates and pipe 2.

In a first modification of this embodiment of the pendulum, shown in FIGS. 4 and 5, the locking organ comprises, as in the first-mentioned embodiment, two belts 25*a*, 25*b* wound symmetrically, each in one direction, on drum 2.

However, in this case, the belts are each attached at one end to one of the articulation axes 18*a*, 18*b* of the links, and at the other end to an axis 19*a*, 19*b* preferably attached to the median portion of the links; the belts thus make about two-thirds of a turn around the drum, their tensioned runs being fastened to the yoke and their relaxed runs to one of the links.

It will be seen immediately that any inclination of the body relative to the apparent vertical causes the rotation of the yoke and the tensioning of the relaxed run of one of the belts, which tensions, is applied to the drum and stops the rotation of the yoke and, consequently, of the articulation box and the body. As the return force is due to a component of the body's own weight, it is naturally proportional to the rotational force to be compensated.

To avoid oscillations of the pendulum system thus formed, a simple solution consists of providing, in any location in which relative motion of parts is produced during these oscillations, friction plates such as 20 and 21. However, the adjustment of this friction can be delicate. A more exact solution consists of a suspension with special links, such as the one illustrated in FIG. 7. In this modification, each of the links is hinged at its upper portion about not one, but two axes 22*a* and 22*b*, by means of a ring 23 having a heart-shaped opening. It will immediately be seen that such a link will only be rotated if the line of action of the resultant lies outside the angle 2β shown in the figure and formed by the straight lines joining the lower articulation axis to the two upper articulation axes.

In addition, it is possible to provide a system which prevents locking of the articulation when the velocity is sufficient to obtain dynamic equilibrium. As shown in French Pat. No. 1,562,248, which has been mentioned above, an electro-magnet could be used, controlled by a tachymetric dynamo and preventing oscillations of the pendulum system when the velocity is sufficient.

FIGS. 8 and 9 represent a further modification of the locking organ, but using the same pendulum suspension principal as that shown in FIGS. 4 and 5, the frame still being provided with an extension 30 suspended by two links from a yoke mounted to pivot on pipe 2.

In this latter modification, the friction locking organ consists of a multi-disc clutch, the male element of which consists of pipe 2, rigidly attached to the axle, the female element consisting of a sleeve 4 attached to one of the side plates of the yoke by screws which are not shown. Two sets of discs 41, 42 are rotated respectively by sleeve 40 and pipe 2, by means of longitudinal grooves along which the discs can slide. Axial sliding of the discs, which causes the progressive engagement of the clutch, is determined by displacement of a distributor ring 43 subjected to the action of a lever 44 which is in opposition to a spring (not shown) which tends to separate the discs.

As shown in FIG. 8, lever 44 comprises two arms forming a fork on either side of pipe 2 and each terminating in a bead 441, the two beads forming knife-edges aligned along a diameter of pipe 2 and bearing in corresponding grooves formed in the distributor ring 43.

On the other hand, the fixed point of lever 44 also consists of two beads 442 forming aligned knife-edges engaged in corresponding grooves formed in side plate 171 of the yoke. The lever is extended downwardly by an arm at the end of which is pivotably mounted a roller 45 running on a double ramp 46 attached to the bottom 30 of the articulation box 3.

The shape of ramp 46, which is shown in plan in FIG. 8*a*, consists of a hollow positioned in the axis of the articulation box 3 extended by two symmetrical ramps. In these conditions, it will easily be seen that when the le-

ver, rigidly attached to yoke 17, is situated in the axis of the articulation box 3, the roller is in the central hollow and the clutch is disengaged. Conversely, as the median plane of the frame moves to one side or the other of the plane of the apparent vertical, the lateral movement of box 3 relative to the yoke causes roller 45 to rise along one of the ramps 46, causing the rotation of the lever about its bearing point 442 and the progressive engagement of the multi-disc clutch which immobilises the yoke 17 on axis 2 until the driver brings the median plane of the frame back into the plane of apparent vertical.

It will be seen that in all of the embodiments described, locking and unlocking of the frame relative to the axle are absolutely progressive. As a result, if the vehicle starts by turning in the direction in which it was inclined whilst stopped, the weight locking organ disengages of its own accord allowing the driver to bring his vehicle to the upright position.

Of course, the invention is not limited to the embodiments described above and in particular embraces all their modifications. Thus, in particular, the suspension of the housing by means of two links from a support, which enables the frame itself to be used as a pendulum, could be adapted to any embodiments using a pendulum for locking a pivoting organ, and especially to the embodiment described in the previous patent to which reference has already been made, and in which the locking organ is a brake drum, the shoes of which are operated by a cam. In this case the pivoting of the cam could be controlled by a reduction system, for example using a rack attached to the bottom of the housing.

What is claimed is:

1. Improvements to three-wheeled vehicles having a frame symmetrical relative to a median plane and carrying a forward guiding wheel mounted, in the said median plane, on a fork with positive castor, a rear framework comprising two wheels mounted on an axle on either side of the median plane of the frame, an organ for pivoting the frame relative to the rear framework, comprising a cylindrical bearing rigidly attached to the framework and having an axis which is substantially horizontal and positioned in the median plane, and on which pivots a coaxial, cylindrical part, connected to the frame, and a device for locking the pivoting organ comprising a drum rigidly connected to the framework and coaxial with the cylindrical bearing and an organ for locking on the drum by friction, operated by a pendulum oscillating on either side of the median plane under the effect of weight and centrifugal force, characterized by the fact that the friction locking organ consists of at least one pair of belts wound symmetrically, each in one direction, on the drum and attached at one end to the pendulum and at the other end to the frame, the anchorage points of the said belts on the frame being spaced on either side of the median plane.

2. Improvements to three-wheeled vehicles as described in claim 1, characterized by the fact that the pendulum consists of a mass suspended by at least one arm passing around the drum from a pivot mounted on the frame in its median plane, and that the belts each makP several turns on the drum and are attached at their ends to the said mass.

3. Improvements to three-wheeled vehicles having a frame which is symmetrical relative to a median plane and carries a forward guiding wheel mounted, in the said median plane, on a fork with positive castor, a rear framework comprising two wheels mounted on an axle, on either side of the median plane of the frame, an organ for pivoting of the frame relative to the rear framework, positioned inside a portion of the frame forming a housing and comprising a cylindrical bearing rigidly attached to the framework and having a substantially horizontal axis positioned in the median plane, and on which pivots a coaxial, cylindrical part connected to the frame, and a device for locking the pivot organ, comprising a drum rigidly attached to the framework and coaxial with the cylindrical bearing and an organ for locking on the drum by friction, operated by a pendulum oscillating on either side of the median plane under the joint effect of weight and centrifugal force, characterized by the fact that the pendulum consists of the frame of the vehicle itself, and said frame being suspended from a yoke positioned inside the housing and mounted pivotably on the cylindrical bearing, by means of at least one pair of suspension arms, positioned symmetrically each on one side of the median plane and each hinged about two axes parallel to the median plane, at their lower portion to the bottom of the housing and at their upper portion to the yoke.

4. Improvements to three-wheeled vehicles as described in claim 3, characterized by the fact that the yoke consists of two rigidly connected side plates which are spaced apart and perpendicular to the pivot axis, the said side plates each having a circular orifice passing through them for passage of the cylindrical bearing, bearings being placed along the orifice between each side plate and the cylindrical bearing.

5. Improvements to three-wheeled vehicles as described in claim 3, characterized by the fact that the friction locking organ consists of at least one pair of belts wound symmetrically, each in one direction, on a drum, and each attached at its two ends to the yoke and to one of the suspension arms.

6. Improvements to three-wheeled vehicles as described in claim 5, characterized by the fact that the belts are each attached at one end to the articulation axis of one of the suspension arms on the yoke and at the other end to an anchorage point positioned on the same suspension arm and distant from the articulation axis.

7. Improvements to the three-wheeled vehicles as described in claim 6, characterized by the fact that the lever consists of a rod carrying at its lower end the roller bearing against the ramp and extended upwardly by two arms forming a fork provided at their ends with two knife-edges bearing in two corresponding grooves formed in the outer surface of the distributor ring and aligned along a diameter of the latter, the said lever bearing on the yoke along a knife-edge engaged in a groove formed in the surface of the yoke facing the distributor ring.

8. Improvements to three-wheeled vehicles as described in claim 3, characterized by the fact that locking organ consists of a multi-disc clutch having a male element rigidly attached to the cylindrical bearing, a female element consisting of a cylindrical sleeve rigidly attached to the yoke, a plurality of clutch discs which are axially slidable and fixed for rotation, some relative to the male element and the others relative to the female element, and a distributor ring able to cause the axial sliding of the discs, the said ring being subjected, firstly, to the action of an elastic organ for separating

the discs and, secondly, to the antagonistic action of a lever pivoting about a fixed point positioned on the yoke and bearing firstly on the distributor ring and secondly on a ramp rigidly attached to the bottom of the housing, by means of a roller running on the said ramp, the shape of the latter being such that spacing of the median plane of the frame on either side of the plane of the apparent vertical causes the rotation of the lever and the progressive engagement of the pivot locking clutch.

* * * * *