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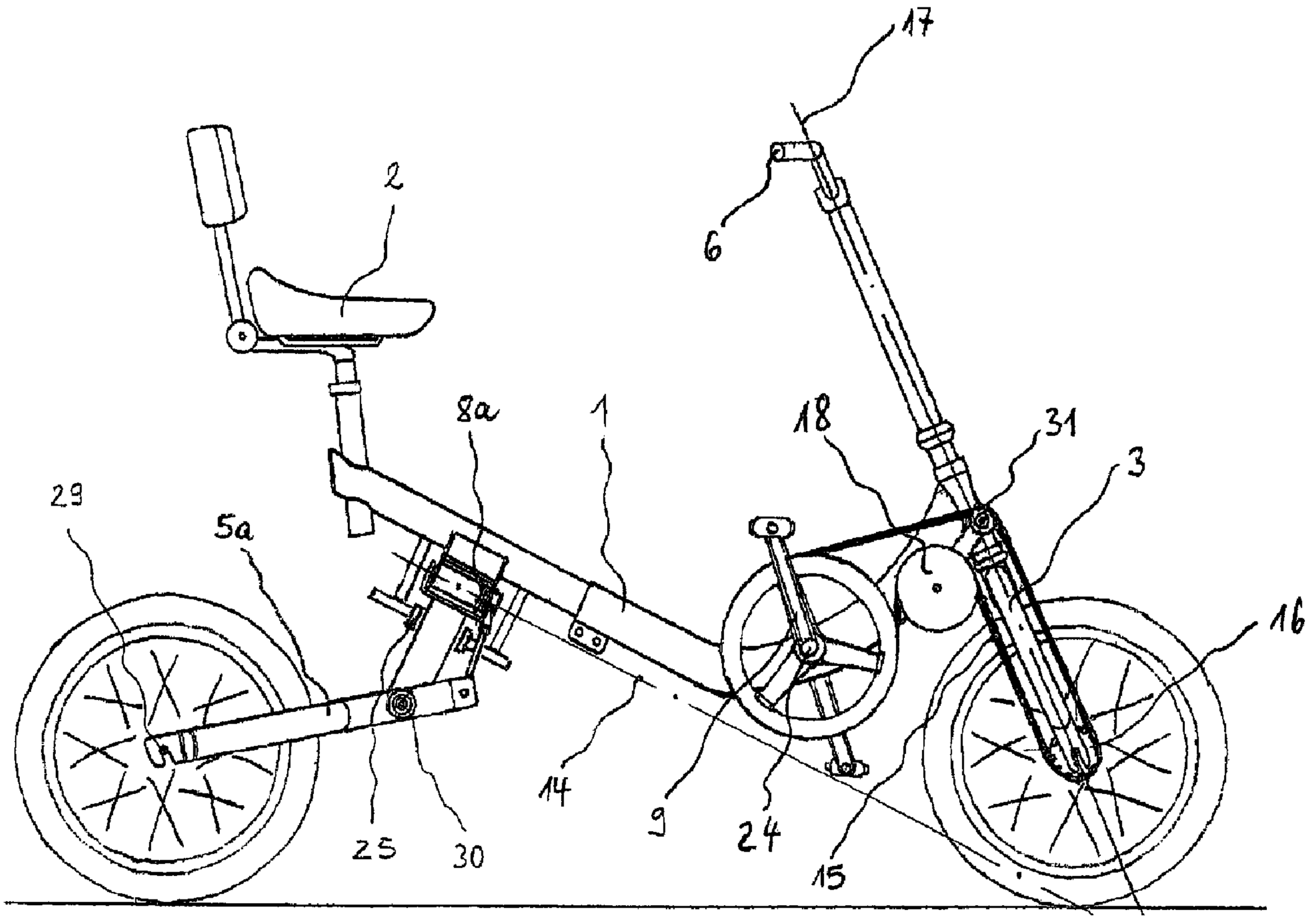
(54) Titre : VEHICULE A TROIS ROUES
(54) Title: VEHICLE WITH THREE WHEELS



(57) Abrégé/Abstract:
The invention relates to a vehicle capable of inclining in curves, preferably having a front wheel and two rear wheels, and a frame which is rotatably mounted to the steering head (7) underneath the driver seat. Rigid drivers are arranged in the area of the steering

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(57) Abrégé(suite)/Abstract(continued):
head (7) and couple the inclination of the vehicle frame (1) to the counter movements of the rear wheel rocker arms (5a, b), using control elements, in order to control the inclination of the vehicle and steer the rear wheels. To support the initial horizontal position of the three-wheeler, the steering head (7) has retaining springs which hold the rear wheel rocker arms (5a, b) in a balanced middle position. For application in slow vehicles suitable for rehabilitation purposes, the steering head (7) underneath the driver seat can be locked for vehicle start with a brake. For application in faster vehicles, the movement of the rear wheel rocker arms (5a, b) can be assisted by means of foot pedals or manually activated hydraulic cylinders.

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(81) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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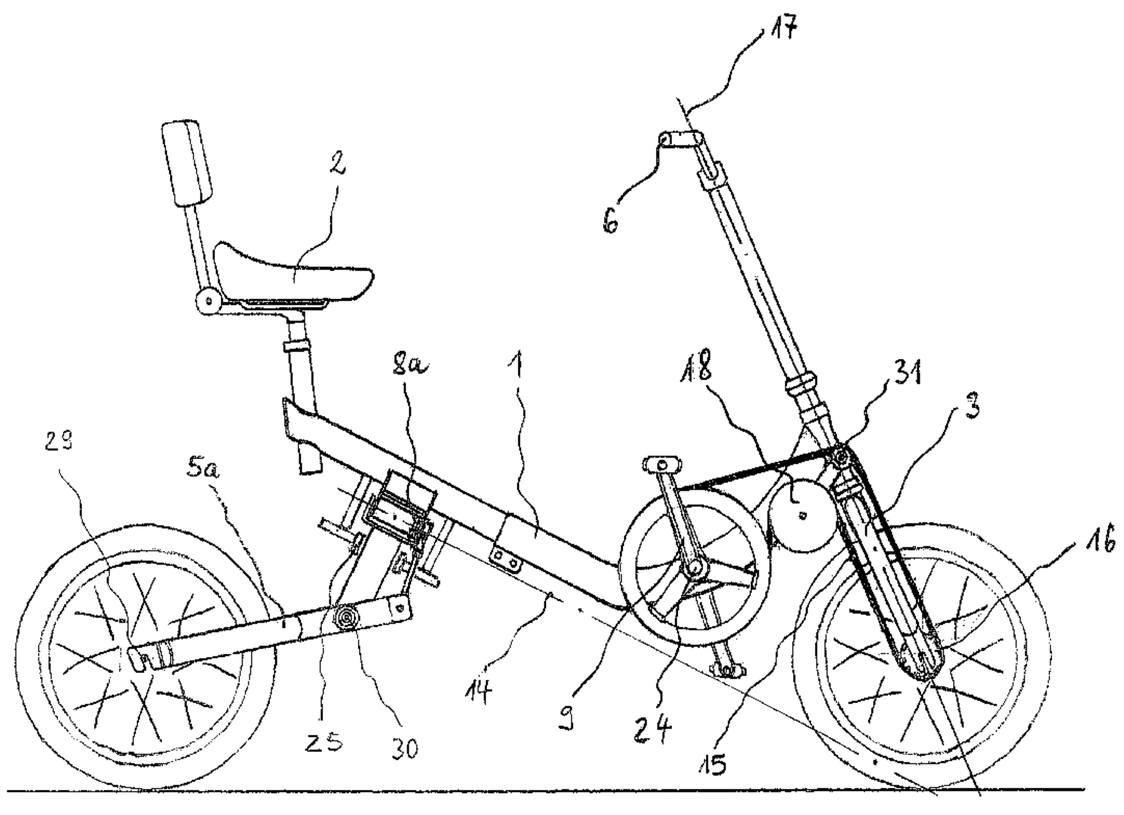
(54) Title: VEHICLE WITH THREE WHEELS

(54) Bezeichnung: FAHRZEUG MIT DREI RÄDERN



(57) Abstract: The invention relates to a vehicle capable of inclining in curves, preferably having a front wheel and two rear wheels, and a frame which is rotatably mounted to the steering head (7) underneath the driver seat. Rigid drivers are arranged in the area of the steering head (7) and couple the inclination of the vehicle frame (1) to the counter movements of the rear wheel rocker arms (5a, b), using control elements, in order to control the inclination of the vehicle and steer the rear wheels. To support the initial horizontal position of the three-wheeler, the steering head (7) has retaining springs which hold the rear wheel rocker arms (5a, b) in a balanced middle position. For application in slow vehicles suitable for rehabilitation purposes, the steering head (7) underneath the driver seat can be locked for vehicle start with a brake. For application in faster vehicles, the movement of the rear wheel rocker arms (5a, b) can be assisted by means of foot pedals or manually activated hydraulic cylinders.

(57) Zusammenfassung: Der Rahmen des kurvenneigbaren Fahrzeugs, das vorzugsweise ein Vorderrad und zwei Hinterräder aufweist, ist unterhalb des Fahrersitzes an einem Lenkkopf (7) drehbar gelagert. Im Bereich dieses Lenkkopfs (7) sind starre Mitnehmer angeordnet, die die Neigung des Fahrzeugrahmens (1) mit Steuerelementen an die gegenläufige Bewegung der Hinterradschwingen (5a, b) koppeln, um die Fahrzeugneigung zu steuern und eine Lenkung der Hinterräder

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GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Erklärung gemäß Regel 4.17:

— *Erfindererklärung (Regel 4.17 Ziffer iv)*

Veröffentlicht:

— *mit internationalem Recherchenbericht*

— *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eintreffen*

zu bewirken. Zur Unterstützung der horizontalen Ausgangslage des Dreirads sind am Lenkkopf (7) Rückholfedern vorgesehen, die die Hinterradschwingen (5a, b) in eine ausgeglichene Mittellage zwingen. An langsamen, für Reha- Zwecke geeigneten Fahrzeugen ist der Lenkkopf (7) unterhalb des Fahrersitzes zum Anfahren mit einer Bremse blockierbar. Bei schnelleren Fahrzeugen können die Hinterradschwingen (5a, b) mit Fußhebeln oder manuell betätigten Hydraulikzylindern unterstützend bewegt werden.

Description

Vehicle with three wheels

The invention relates to a vehicle with three wheels according to the preamble of claim 1.

US 3,237961 discloses a tricycle whose rear wheel swing arms, which are capable of moving in opposite directions, may be controlled by the driver, because their movement is coupled to the rotary movement of the handlebars by two control rods. However, the vehicle is designed as a tricycle for children. If a curve was taken at a high velocity, large forces would occur at the outer wheel, which would have to be compensated by the driver at the handlebars. For the driver to be able to exert corresponding leverage, the handlebar would have to be extremely wide or connected to a hydraulic steering assistance.

US 4,887,829 discloses a tricycle whose rear wheels are also coupled to rear wheel swing arms movable in opposite directions. The tricycle enters the curve like a single-track vehicle following a steering impulse at the handlebars. A rocker mounted to the vehicle frame and acting as balancing element allows the opposite movements of the rear wheel swing arms. In relation to the vehicle frame, the rear wheel swing arms are freely movable and tend to distribute the load equally among the two rear wheels, as if the vehicle did not have two wheels, but only a single, very broad rear wheel. Therefore, the driver can only oppose the centrifugal forces occurring in curves at increasing speed by leaning into the curve like on a single-track vehicle until reaching the inclination limit. If the driver leans abruptly into a tight curve, the balancing element, as it is freely movable, will immediately tilt towards the outer side of the curve, which causes the inner wheel to be lifted off the road even before the inclination limit is reached. If a mechanical stop limits the operation of the balancing element, a similarly unstable driving state occurs when the outer wheel looses ground contact while the vehicle is inclined even further with the help of the inner wheel. The increase in velocity in curves, which is per se desired and results from shifting the resultant of weight and centrifugal force toward the contact point of the outer wheel, is only practicable with acrobatic skills, because the rear wheel swing

arms cannot be controlled. Steering by shifting the body weight without a steering impulse is not possible either, because there is no co-steering of the rear wheels.

WO 2006/008569 A1 describes a recumbent tricycle wherein the initial neutral position of the vehicle is maintained not only by means of handholds or steering handles, but also by assisting torsion springs at the steering head. However, the vehicle is only of limited use in general road traffic because of the limited field of vision and the limited steerability.

In addition, various computerized hydraulic inclination systems for tricycles are known in prior art. Vehicles with the corresponding equipment allow shifting the resultant of weight and centrifugal force toward the contact point of the outer wheel until the vehicle drifts in an inclined position or tilts over outwards. However, due to their complexity, these systems are not suitable for light-weight, inexpensive vehicles driven by muscle force or electric motors.

It is therefore the object of the new invention to design a light-weight tricycle having a seat position allowing a clear view, an energy-saving propulsion system and a controllable inclination mechanism, and which also allows increasing the velocity in curves in an inclined position by shifting the body weight. It is supposed to be usable as a utility and sports vehicle and should automatically assume a neutral, horizontal basic position when standing or driving straight.

According to the invention, this object is achieved by the features of claims 1 to 4. The core of the invention is therefore the idea to arrange a steering head with rigid driving elements on the vehicle frame beneath the driver's seat, the steering head coupling the inclination of the vehicle frame to the opposite movements of the rear wheel swing arms by means of control elements in order to control the vehicle inclination and steer the rear wheels, and to arrange the rotation axis of the rear wheel swing arms between the receptacles of the control rods and the rear wheel mounts so that the lateral downward inclination of the vehicle frame results in an upward movement of the inner rear wheel, and to extend the rear wheel swing arms from the rotation axis of the rear wheel swing arms beyond the receptacles of the control rods by a foot lever to receive footrests which may assist in the control of the

upward and downward movements of the rear wheel swing arms, and to arrange an idler pulley on the vehicle frame in the area behind the vertical steering axis of the steerable front wheel carrier, the idler pulley redirecting the chain drive of a manually driven front wheel backwards relative to the direction of travel to obtain a low position of the pedal crank bearing.

Details of the invention will be explained in the following description of the preferred embodiments with reference to the drawings, in which:

Fig. 1 shows a side view of a tricycle having a manual front wheel drive;

Fig. 2 shows a top view of the rear wheel swing arms of a tricycle;

Fig. 3 shows a back view of a tricycle in an inclined position;

Fig. 4 shows a side view of a tricycle with weather protection;

Fig. 5 shows a side view of a tricycle adapted to have tracks and skids;

Fig. 6 shows a side view of a children's tricycle having a pedal crank in the front wheel;

Fig. 7 shows a top view of a children's tricycle having a pedal crank in the front wheel;

Fig. 8 shows a side view of a tricycle with full suspension and an electric drive;

Fig. 9 shows a side view of a tricycle with hydraulic pedal control;

Fig. 10 shows a side view of a tricycle with hydraulic handlebar control;

Fig. 11 shows an isometric side view of a tricycle having a rigid front wheel carrier;

Fig. 12 shows an isometric back view of a tricycle having a rigid front wheel carrier;

Fig. 13 shows a side view of a tricycle with full casing;

Fig. 14 shows a side view of a tricycle having rigid foot levers;

Fig. 15 shows a side view of a tricycle having foot levers provided with springs; and

Fig. 16 shows a side view of a tandem vehicle having a stepper.

The tricycle comprises a front wheel and two wheels on rear wheel swing arms (5a, b) movable in opposite directions, as well as a driver's seat (2) mounted to the vehicle frame (1) and handlebars (6). It may be designed as sports equipment having a rigid front wheel carrier (4) being part of the vehicle frame (1). With a steerable front wheel carrier (3), which may, for example, be implemented as a front wheel fork, it may also be used as a conventional road vehicle, wherein the curve radius and the vehicle inclination may be controlled independent of each other.

The special feature of the new vehicle is that the vehicle frame (1) is rotatably mounted to a steering head (7) beneath the driver's seat (2) and the rear wheels change direction as soon as the vehicle inclines sideways. In addition, driving elements (8a, b) are arranged in the area of the steering head (7) with control rods (11a, b) attached thereto, the control rods coupling the rotary movement of the vehicle frame (1) to the opposite movements of the rear wheel swing arms (5a, b). The rotation axis (30) of the rear wheel swing arms (5a, b) is arranged between the receptacles (28a, b) of the control rods (11a, b) and the rear wheel mounts (29a, b). For this reason, the right rear wheel, for example, will move upward when the right control rod (11a) moves downward.

Since the driver's seat (2) is arranged above the steering head (7), it forms a lever together with the vehicle frame (1) which the driver controls by changing the horizontal position of the driver's seat (2) and consequently also the vehicle frame (1) with the help of his or her body weight. As long as this lever is maintained in a position oriented towards the inner side, as shown in Fig. 3, the rigid driving elements (8a, b) prevent that the rear wheel swing arms (5a, b) continue to move in opposite

directions. Thus the vehicle cannot raise itself from the inclined position, nor can the wheels tilt outwards. As a consequence, the resultant of weight and centrifugal force "FR" runs through the contact point of the outer rear wheel when the velocity in the curve increases. Since the inclination mechanism is designed to have suitable stops so that the vehicle frame (1) with the front wheel cannot be inclined sideways more than 45°, the vehicle will understeer in an extreme case, although the rear wheels are inclined less than the front wheel.

The higher the velocity in the curve, the more force the driver must expend to hold the handlebars (6) and the more he must shift his body inward on the driver's seat (2) to force the vehicle frame (1) in this direction and to prevent the opposite movements of the rear wheel swing arms (5a, b). However, he may ultimately only exert a weight force similar to that of a passenger in a sidecar on the vehicle frame (1). To achieve a higher velocity in the curve for fast electric vehicles constructed without pedal cranks (9) or for hybrid vehicles having both pedal cranks (9) and electric hub motors (25), the control of the rear wheel swing arms (5a, b) may be assisted by mechanical foot levers, as illustrated in Figs. 14 and 15. For this purpose, the rear wheel swing arms (5a, b) are extended beyond the receptacles (28a, b) of the control rods (11a, b) by a foot lever (33a, b) at the end of which there are arranged footrests (32a, b). Instead of maintaining the vehicle frame (1) in the desired position with the help of the body weight only, the driver may now also hold on to the handlebars (6) and push the foot lever (33a, b) powerfully downward on the inner side. As long as the driver maintains the tension between handlebars (2) and footrests (32a, b), the rear wheel swing arms (5a, b) cannot move in opposite directions, even if the driver's body weight is disadvantageously shifted. Depending on the preferred driving style, the foot levers (33a, b) may also be designed to have a double joint, wherein two gear-wheels intermesh so that their direction of movement is reversed and the driver exerts downward pressure on the outer side. Shock-like loads, such as they occur in uneven terrain, may be absorbed by springs (34a, b) on the foot levers (33a, b). This is particularly useful for sports vehicles where the driver rises from the driver's seat (2) while driving through a curve to be able to exert more pressure on the footrests (32a, b).

In principle, additional pressure may also be exerted on the rear wheel swing arms (5a, b) by hydraulic reduction at the foot pedals (10) or the steering levers (12), as shown in Figs. 9 and 10. This does not necessarily require hydraulic systems, because hydraulic cylinders (13) having different diameters are sufficient in many cases. Electrical actuators are also conceivable instead of hydraulic elements.

With manual chain drive, the new tricycle is suited well for rehabilitation purposes. For balance training, the steering head (7) arranged beneath the driver's seat (2) is blocked by a brake (25), which may, for example, be implemented as a hydraulic caliper brake. In the blocked state, the vehicle behaves like a rigid tricycle. After the critical starting phase, when the accelerating vehicle is stabilized by the gyroscopic forces of the wheels, the driver may release the brake lever. Although the initial horizontal position is still supported by the return springs (18), the driving experience during the subsequent straight ride resembles that on a conventional bike.

Vehicles used for sports purposes only, which have a rigid front wheel carrier (4), offer the driver a very dynamic curve behavior, which may be referred to as "swing", due to the forced control of steering and inclination. The angle between the steering axis (14) of the steering head (7) arranged beneath the driver's seat and the road is preferably 25° to 45°. In vehicles having a steerable front wheel carrier (3), 3° to 25° degrees are sufficient, depending on the achievable maximum speed, because the curve radius may be corrected with the help of the steerable front wheel carrier (3) independent of the vehicle inclination.

Primarily in slower vehicles having a manual chain drive, rear wheel steering is very important, because, in order to save costs, it is necessary to drive the front wheel instead of the two rear wheels. In order to reduce the negative effect that the torque of the drive chain has on the steering, the loaded chain run (15) should be directed from the front wheel hub (16) to a point on the vehicle frame (1) that is as close as possible to the vertical steering axis (17) of the steerable front wheel carrier (3). Since, when steering, the chain and the tire will quickly touch each other, steering is quite restricted in known bicycles with front-wheel drive. In the new tricycle, however, a tight turning circle is achieved by the co-steering of the rear wheels.

The redirection of the chain drive is also very important. In the case of a manual front-wheel drive, the driver normally has to assume a more or less recumbent sitting position to reach the pedals, because the pedal crank bearing is arranged above the front wheel. In order to allow a sitting position on the new tricycle while maintaining sufficient traction of the front wheel and a minimal overturning tendency when braking with the front-wheel brake, an idler pulley (18) is provided on the vehicle frame (1) in the area behind the vertical steering axis (17) of the steerable front wheel carrier (3). With the help of an advantageously arranged chain tensioner (31), the loaded chain run (15) may be directed from the front wheel hub (16) upward to the vehicle frame (1) in parallel to the vertical steering axis (17) of the steerable front wheel carrier (3) and from there downward to the chain wheel of the pedal crank (9) in a low, ergonomically advantageous position and back again without significant load effects on the steering.

For the vehicle to automatically assume an initial horizontal position, return springs (18a, b) may be arranged between the steering head (7) arranged beneath the driver's seat (2) and the rear wheel swing arms (5a, b). They exert the same amount of pressure on both rear wheel swing arms (5a, b) and tend to force them into a balanced position. The same is achieved if a torsion spring or a torsion bar is integrated in the steering head (7).

The spring mechanism for the rear wheel swing arms (5a, b) movable in opposite directions may be realized by a central strut (19). For this purpose, the steering head (7) is also movably mounted to a swivel joint (20) arranged in a transverse direction relative to the direction of travel, and is connected to the central strut (19), which may, for example, be equipped with a tension spring.

Due to the simple mechanical control of the inclination mechanism, even children's vehicles may be provided therewith, as illustrated in Figs. 6 and 7. Similarly, city vehicles driven by hub motors (25) and provided with a weather protection element (21), as illustrated in Fig. 4, or vehicles completely enclosed by a hardtop (26) and a lateral sliding door (27), as illustrated in Fig. 13, may, for example, be provided therewith. Such vehicles may even be provided with an additional seat arranged behind or in front of the driver's seat.

The presented tricycle may also be used for winter sports, if the wheels are replaced by snow tracks (22) or skids (23), as illustrated in Fig. 5.

In addition, tandem vehicles usable for sports purposes are conceivable, wherein the passenger holds on to a bar (37) mounted to the driver's seat (2) and drives the rear wheels by means of a stepper, as shown in Fig. 16. In this case, footboards (35a, b) provided with return springs (38a, b) are movably mounted to the outer or inner side of each rear wheel swing arm (5a, b), wherein the passenger pushes the left and right footboards alternately downward with his feet. As a consequence, a spiral-shaped chain wheel (36a, b), which is provided with a freewheel mechanism and flanged to the hub of one of the two rear wheels, is rotated via a chain hoist (31a, b) with an idler pulley (39a, b). After the respective footboard (35a, b) has been pulled into the initial position by the return spring (38a, b), the spiral-shaped chain wheel (36a, b), too, is again in the initial position. In this way, the passenger may drive the rear wheels with the stepper, while the driver drives the front wheel with the pedal crank (9).

In principle, the inclination joint may also be used in the front portion, as shown in Fig. 17, wherein a steel cable (40) may be used as a steering damper.

Claims

1. A three-wheeled vehicle comprising a vehicle frame (1) and a driver's seat (2) and two rear wheel swing arms (5a, b) movable in opposite directions, characterized in that a steering head (7) having rigid driving elements (8a, b) is arranged on the vehicle frame (1) beneath the driver's seat (2), the steering head coupling the inclination of the vehicle frame (1) to the opposite movements of the rear wheel swing arms (5a, b) by means of control elements to control the vehicle inclination and steer the rear wheels.

2. The three-wheeled vehicle comprising a vehicle frame (1) and a driver's seat (2) and two rear wheel swing arms (5a, b) movable in opposite directions, characterized in that the rotation axis (30) of the rear wheel swing arms (5a, b) is arranged between the receptacles (28a, b) of the control rods (11a, b) and the rear wheel mounts (29a, b) so that lateral inclination of the vehicle frame (1) results in an upward movement of the inner rear wheel.

3. The three-wheeled vehicle comprising a vehicle frame (1) and a driver's seat (2) and two rear wheel swing arms (5a, b) movable in opposite directions, characterized in that the rear wheel swing arms (5a, b) are extended from their rotation axis (30) beyond the receptacles (28a, b) of the control rods (11a, b) by a foot lever (33a, b) to receive footrests (32a, b) which may assist in the control of the upward and downward movements of the rear wheel swing arms (5a, b).

4. The three-wheeled vehicle comprising a vehicle frame (1) and a driver's seat (2) and two rear wheel swing arms (5a, b) movable in opposite directions, characterized in that an idler pulley (18) is arranged on the vehicle frame (1) in the area behind the vertical steering axis (17) of the steerable front wheel carrier (3), the idler pulley redirecting the chain drive of a manually driven front wheel backwards relative to the direction of travel to obtain a low position of the pedal crank bearing (24).

5. The vehicle of claims 1 to 4,
characterized in that footboards (35a, b) with return springs (38a, b) are arranged on the rear wheel swing arms (5a, b), the footboards driving the rear wheels by means of chain hoists (31a, b) and spiral-shaped chain wheels (36a, b).

6. The vehicle of claims 1 to 5,
characterized in that return springs (18a, b) are arranged at the steering head (7) arranged beneath the driver's seat (2), the return springs stabilizing the horizontal position of the vehicle by forcing the rear wheel swing arms (5a, b) into a balanced mid-position.

7. The vehicle of claims 1 to 6,
characterized in that a central strut (19) is articulated between the steering head (7) arranged beneath the driver's seat (2) and the vehicle frame (1).

8. The vehicle of claims 1 to 7,
characterized in that hydraulic cylinders (13) are provided at the steering head (7) arranged beneath the driver's seat (1), the hydraulic cylinders allowing additional control of the opposite movements of the rear wheel swing arms (5a, b).

9. The vehicle of claims 1 to 8,
characterized in that a brake (25) is provided at the steering head (7) arranged beneath the driver's seat (2), with which its rotary movement may be blocked.

10. The vehicle of claims 1 to 4,
characterized in that receiving bores are provided on the rear wheel swing arms (5a, b) movable in opposite directions and on the front wheel carrier, where snow tracks (22) or skids (23) may be mounted.

11. The vehicle of claims 1 to 10,
characterized in that a roof-like weather protection element (21) is arranged on the vehicle frame (1).

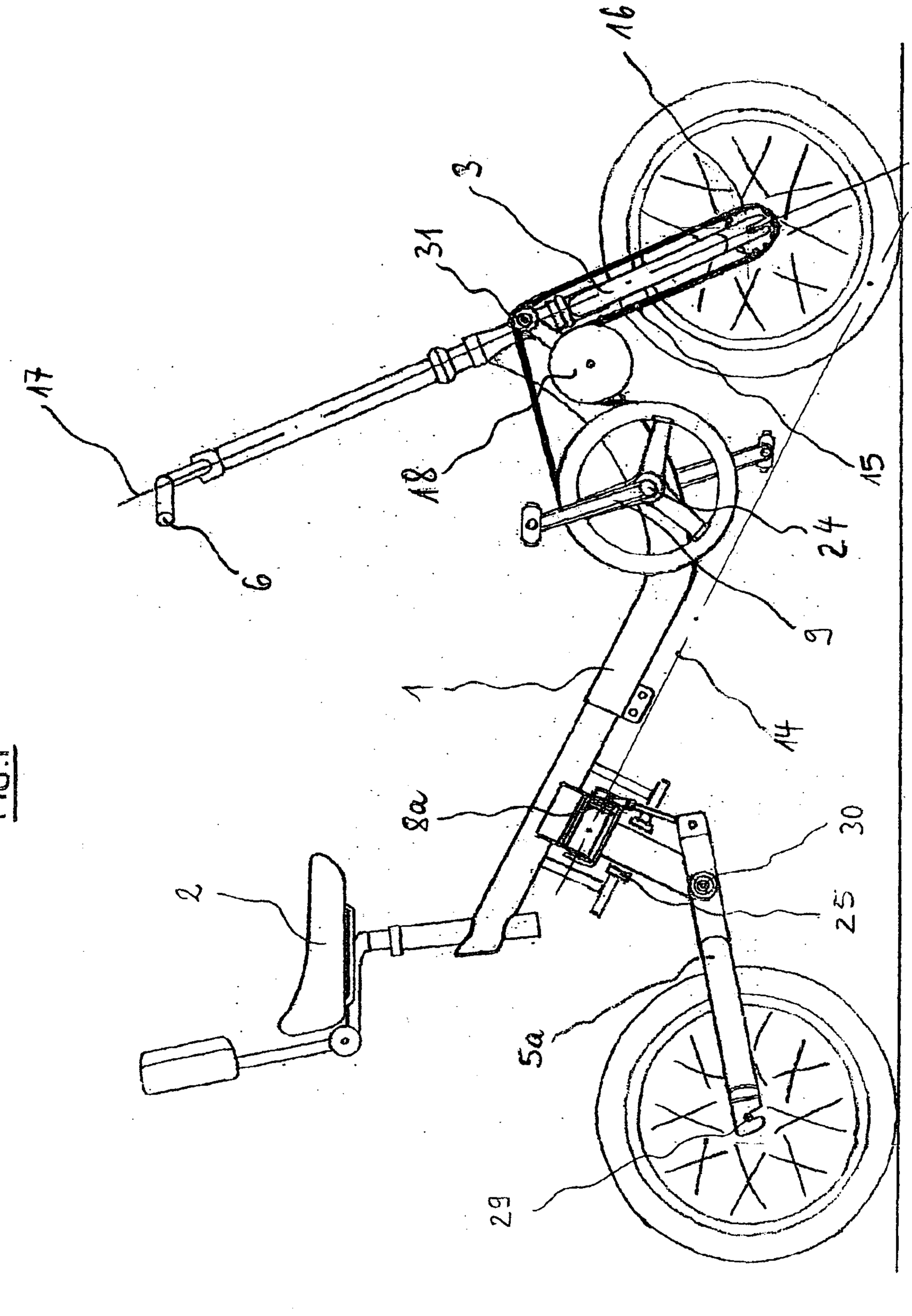


FIG.1

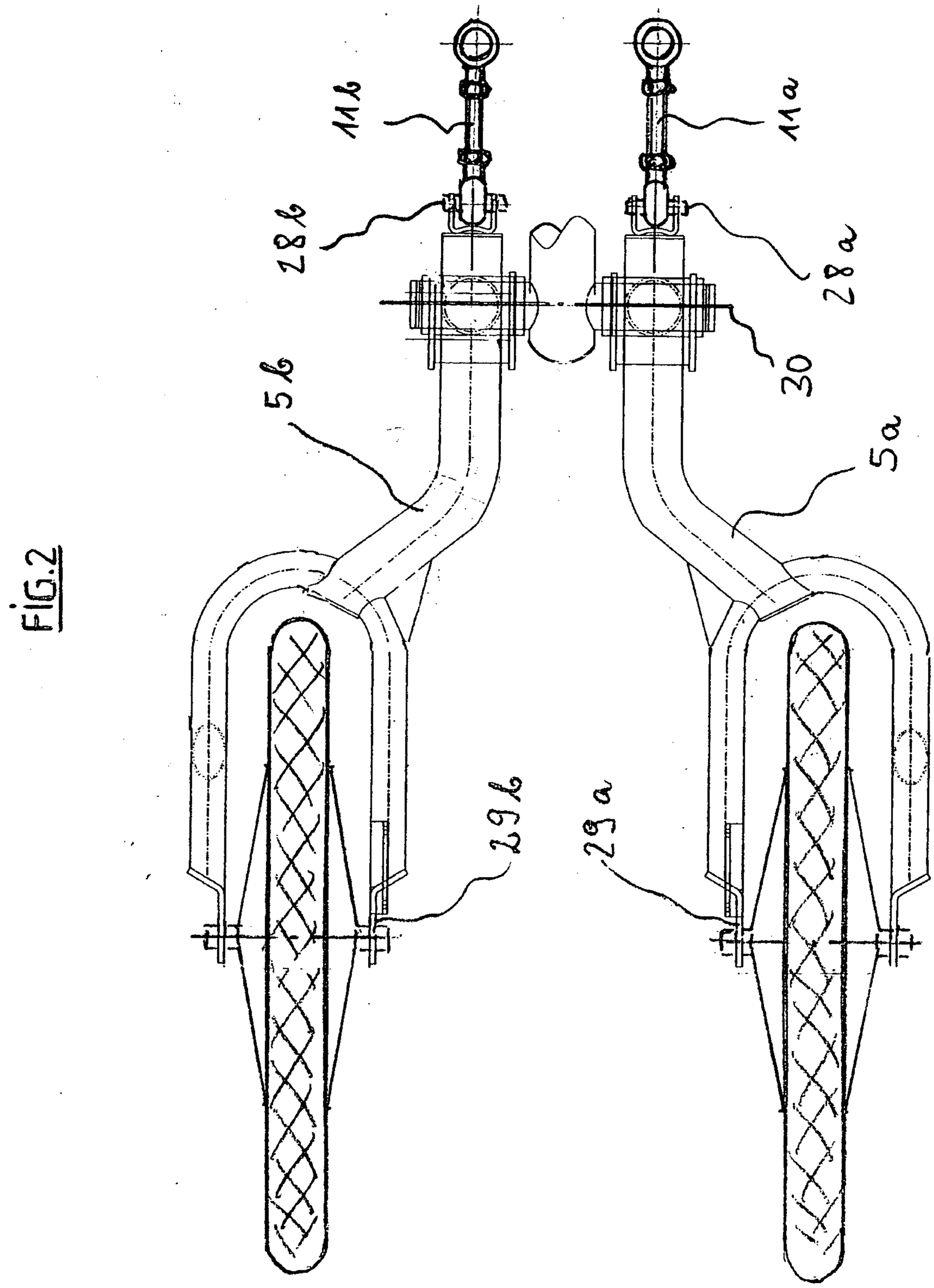


FIG.2

FIG.3

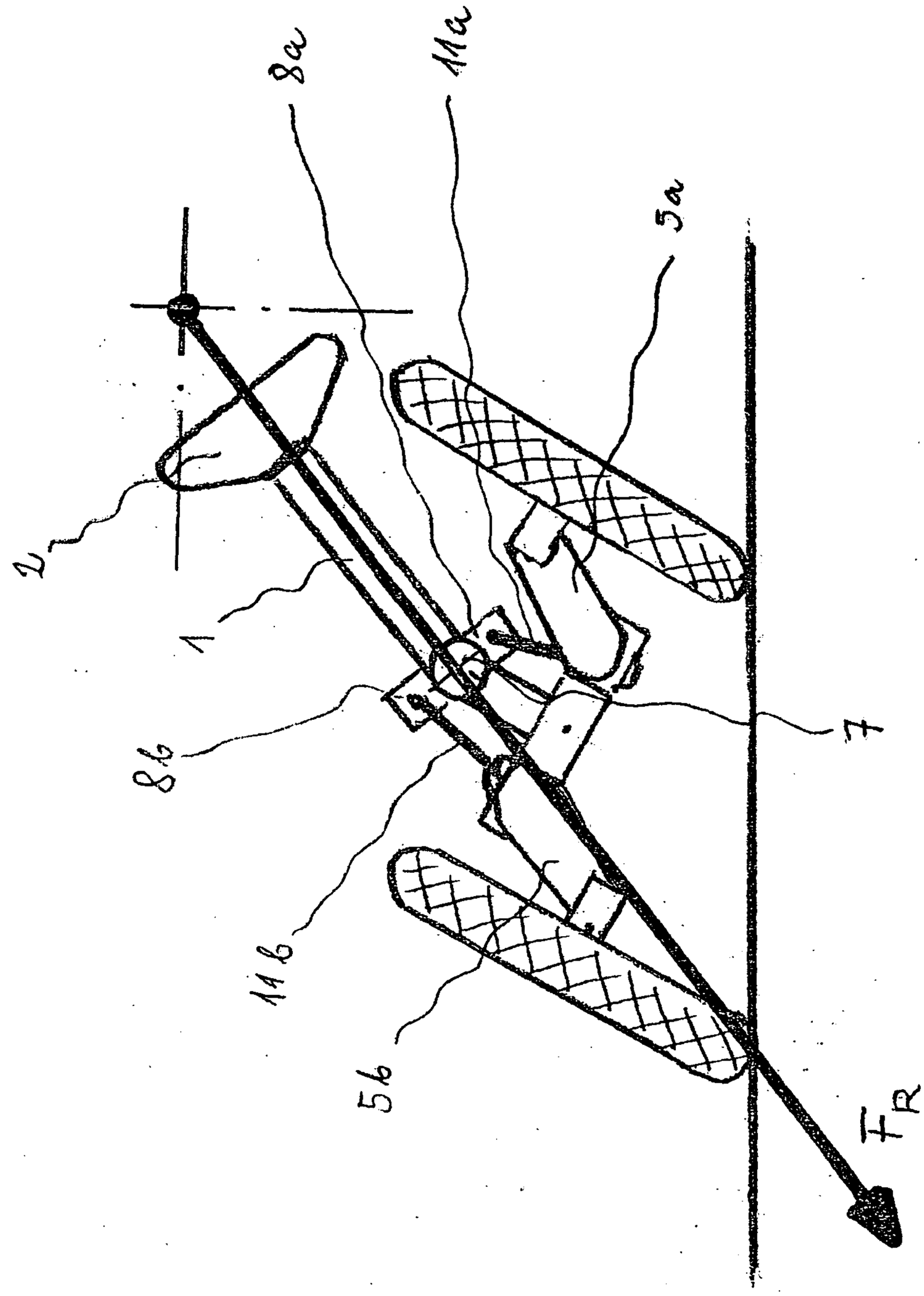


FIG.4

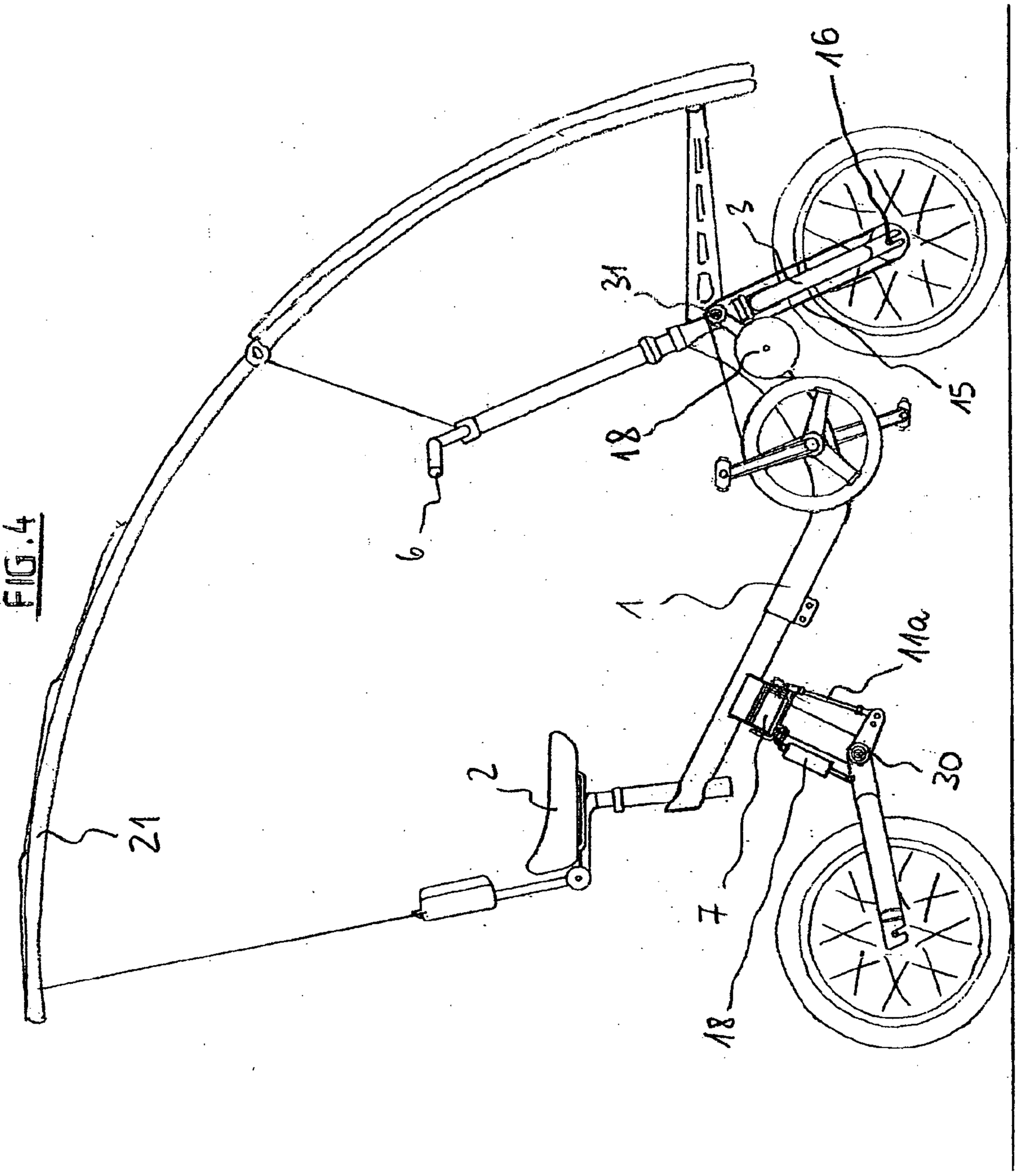
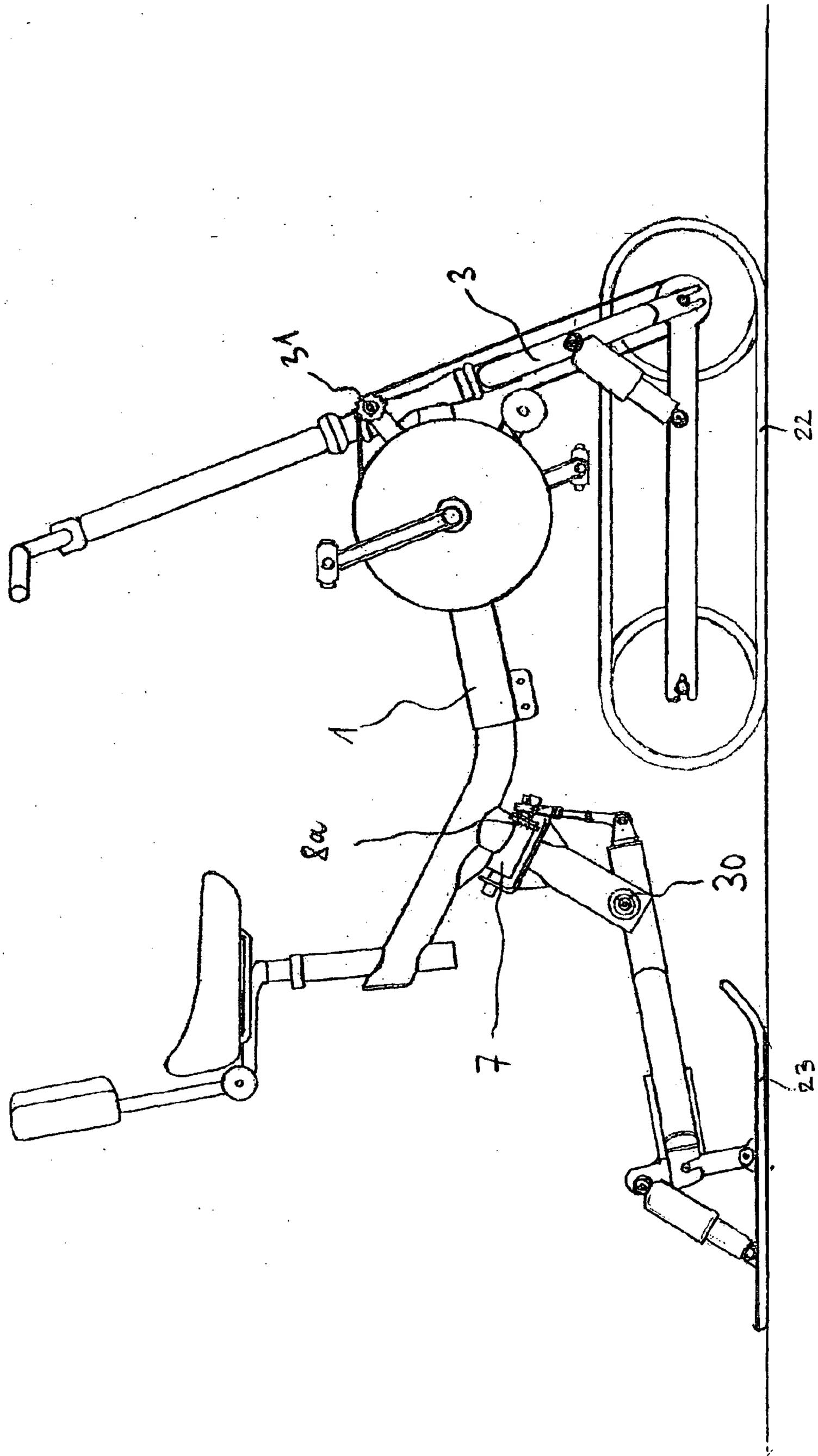


FIG. 5



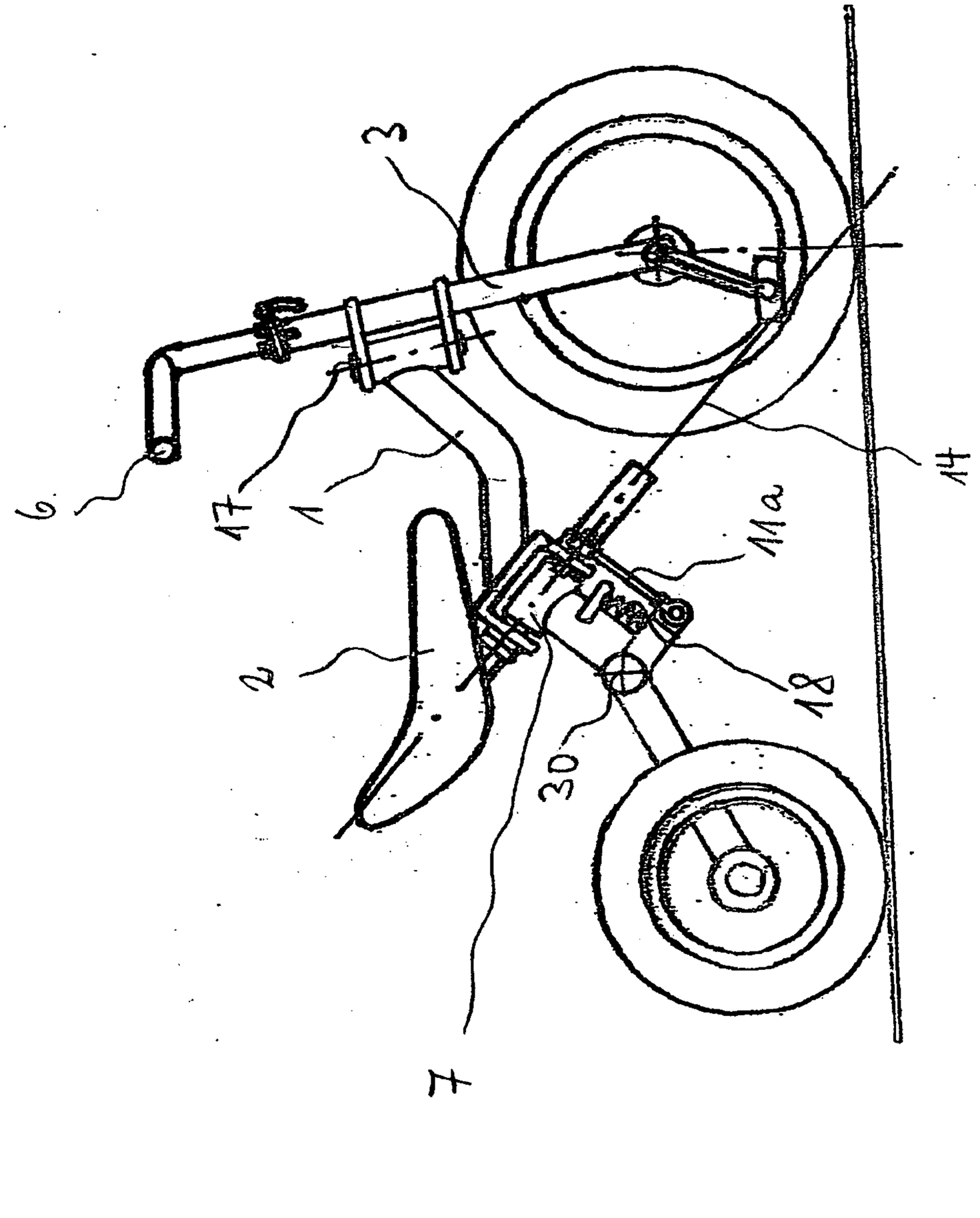


FIG.6

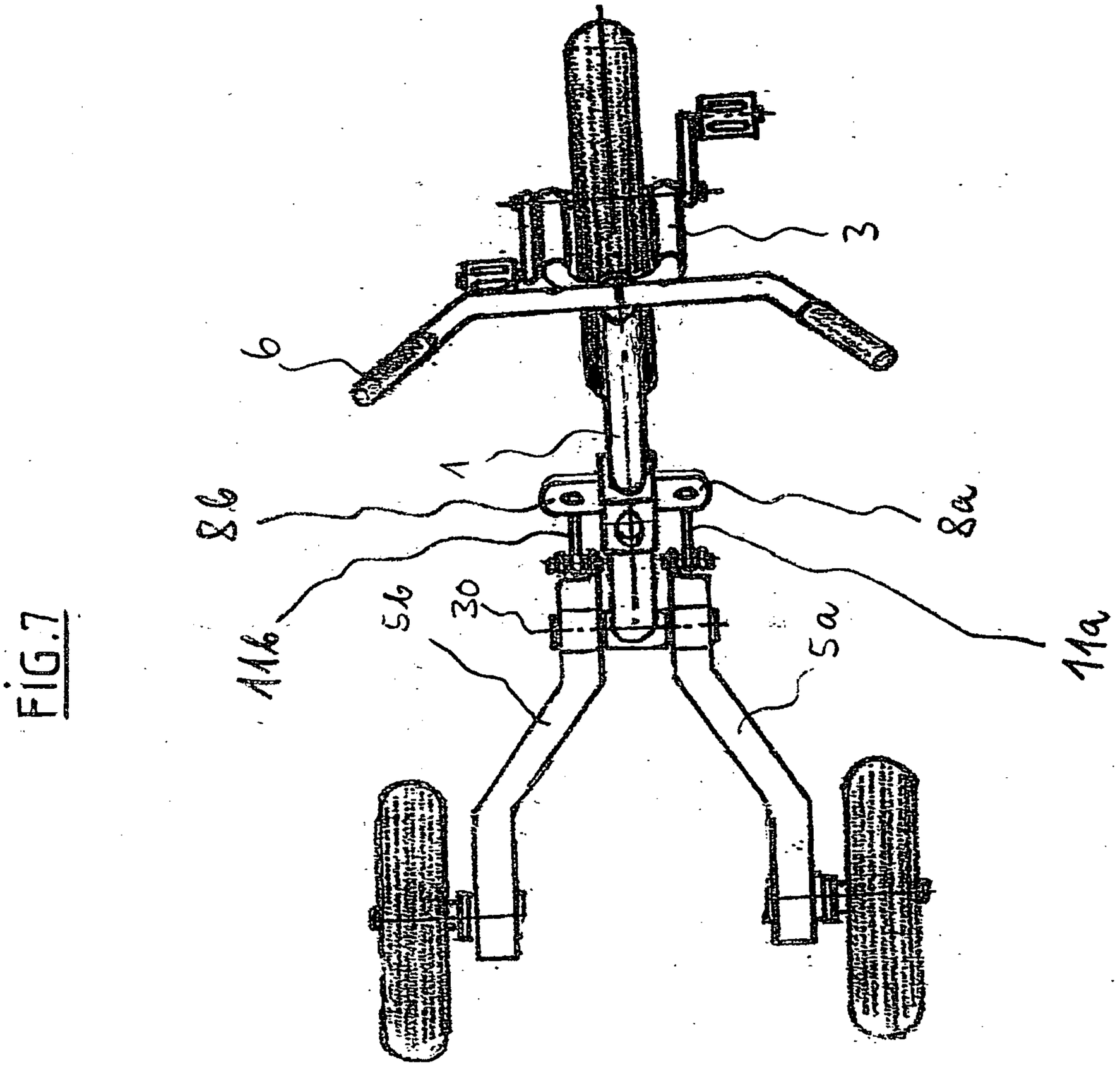


FIG.7

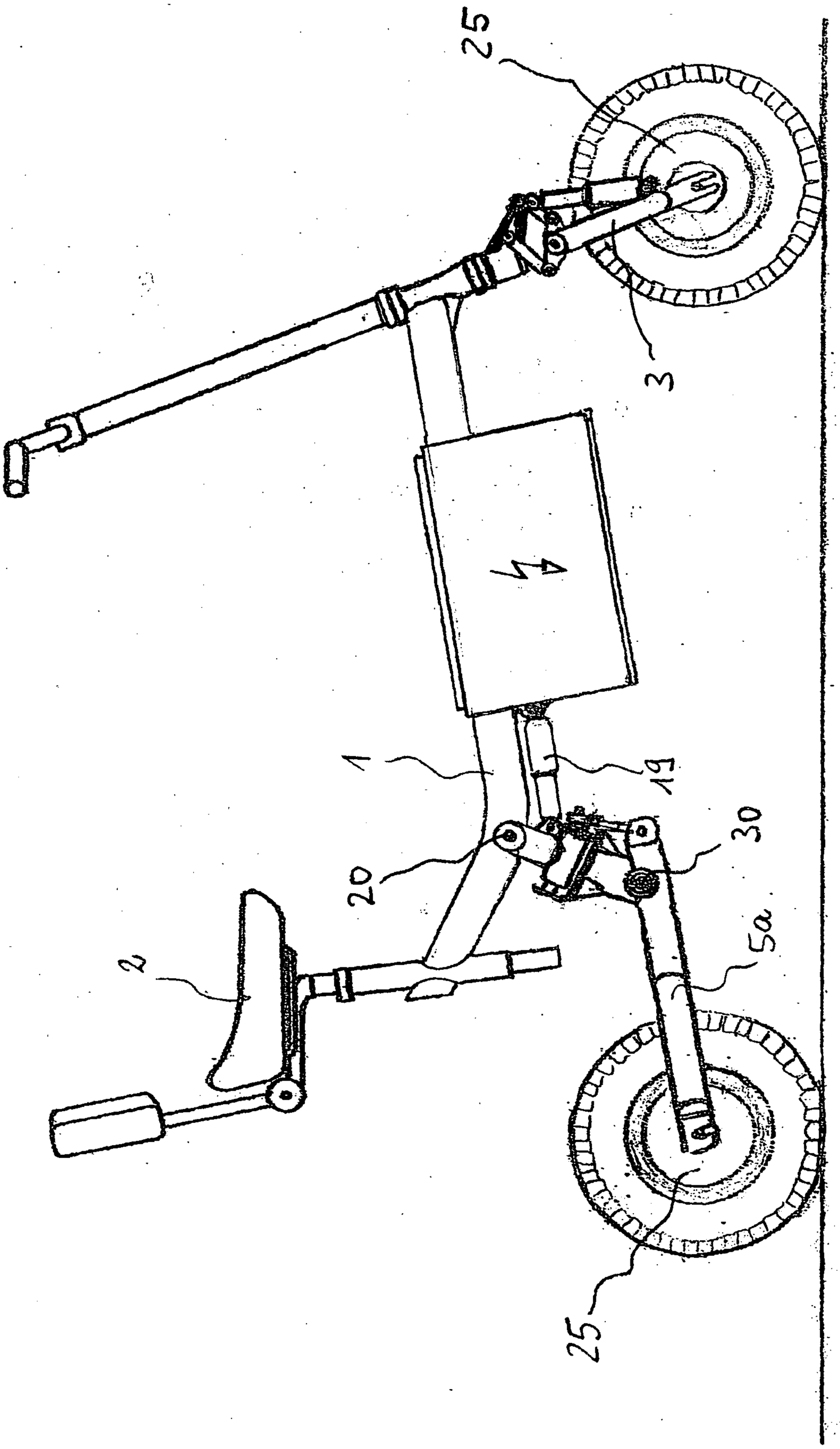


FIG.8

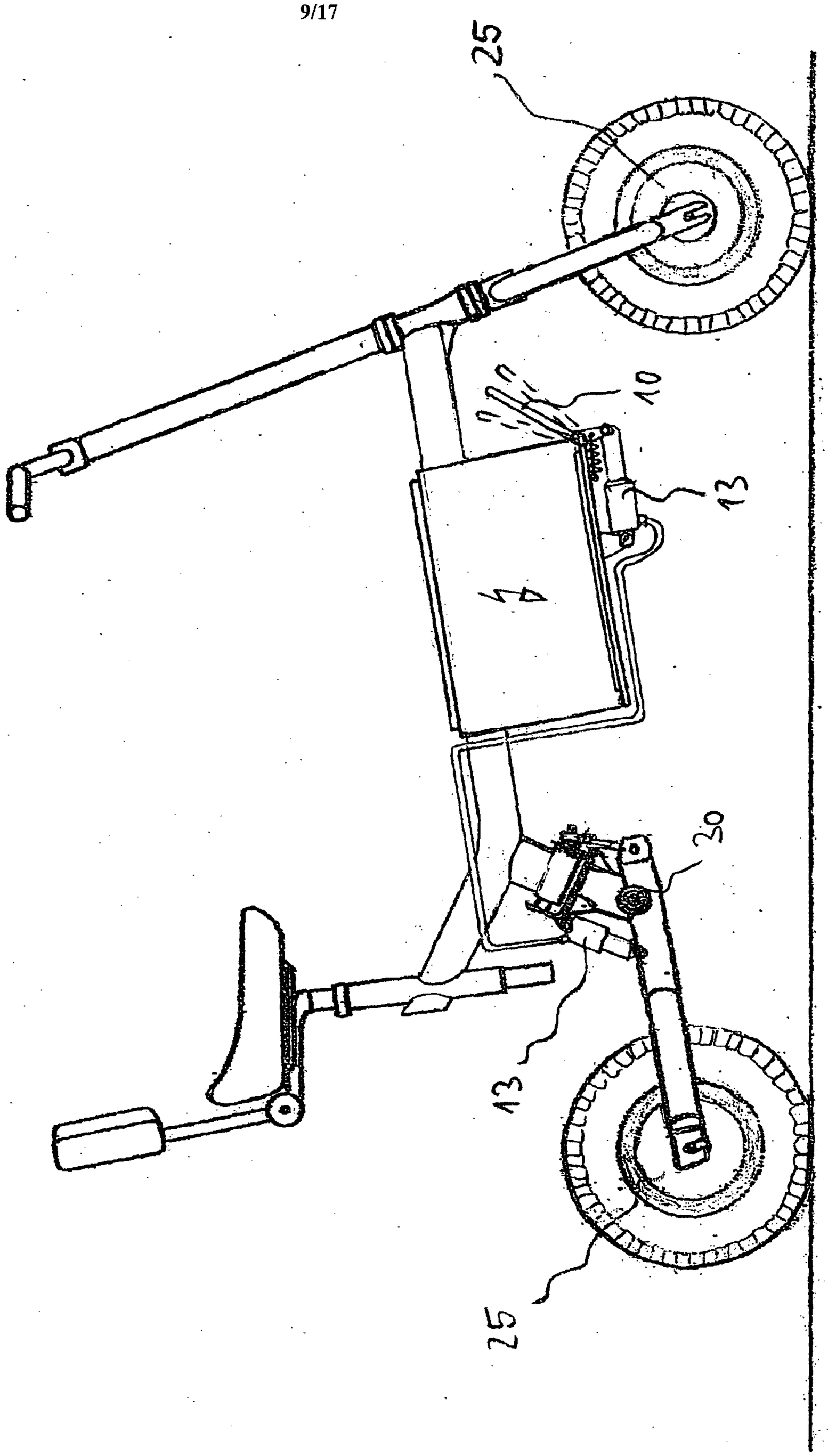


FIG.9

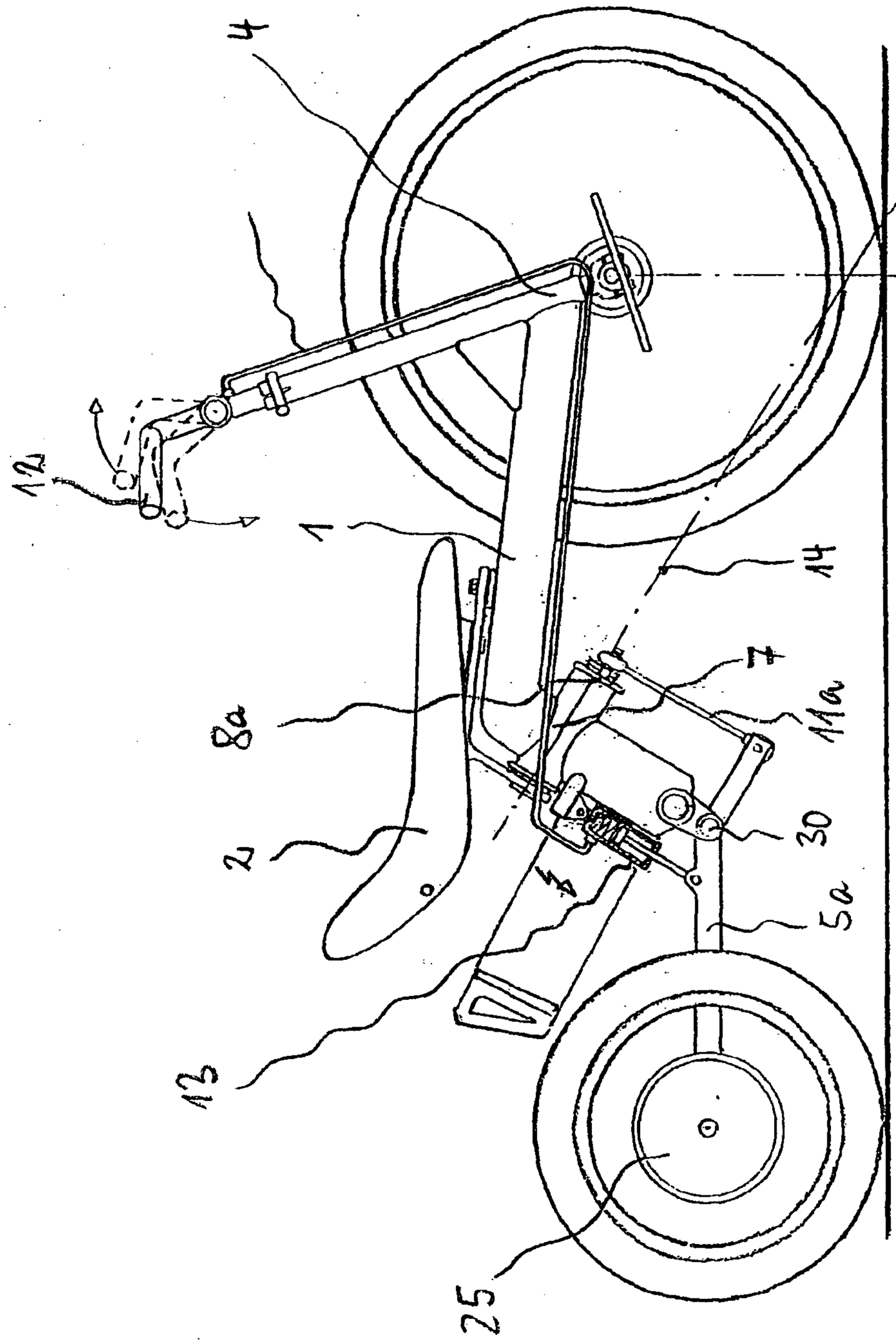


FIG.10

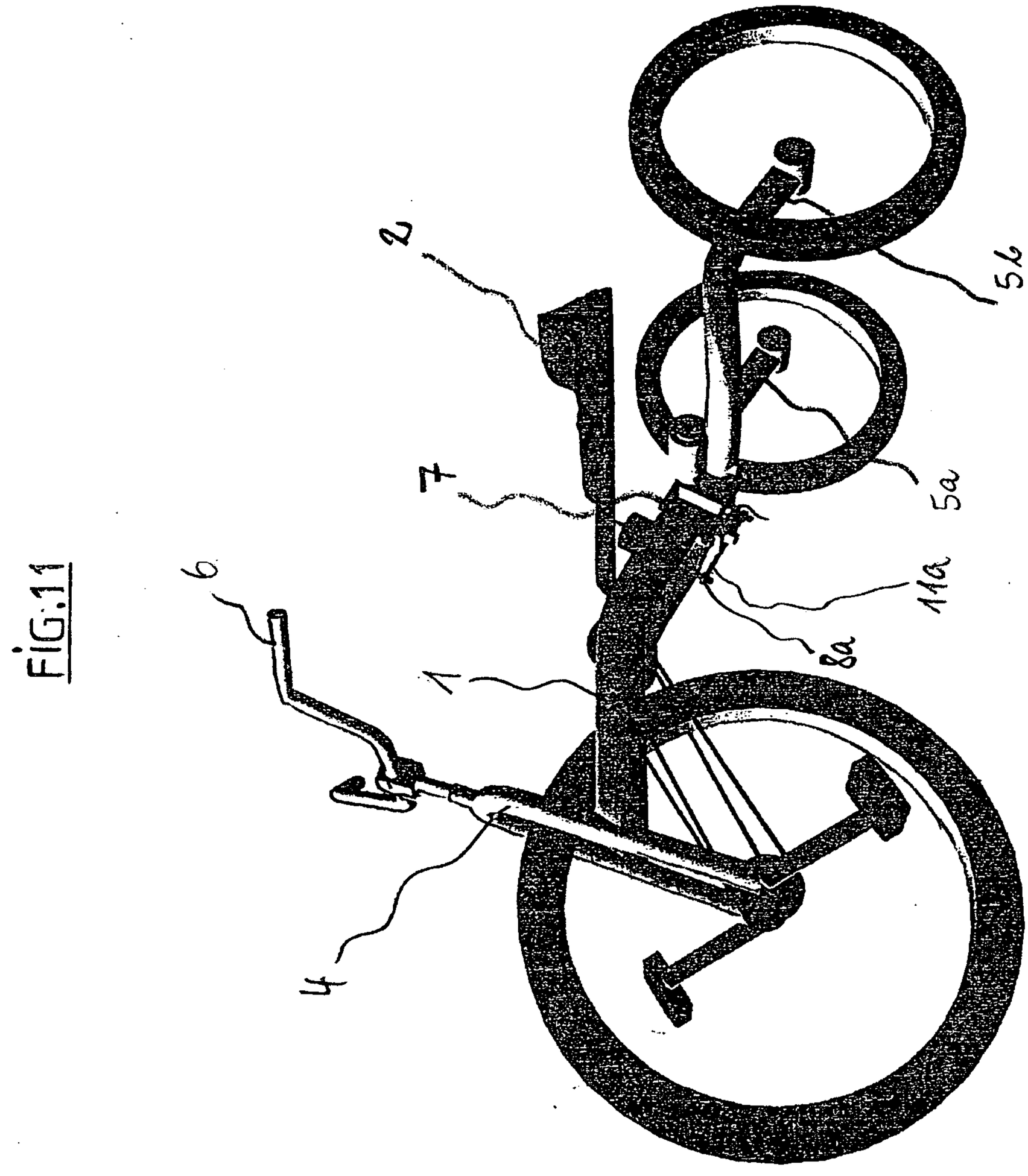
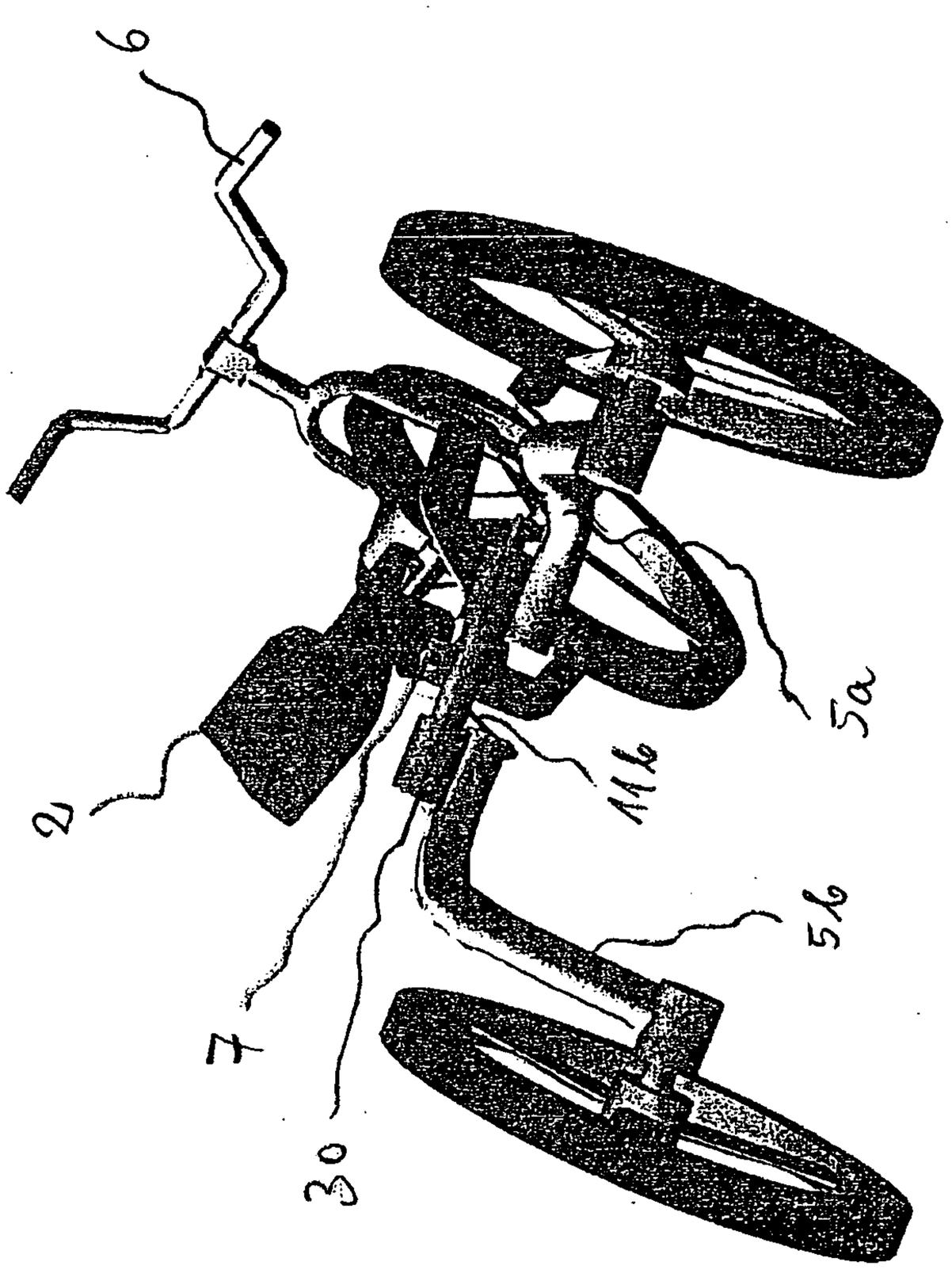


FIG.11

FIG.12



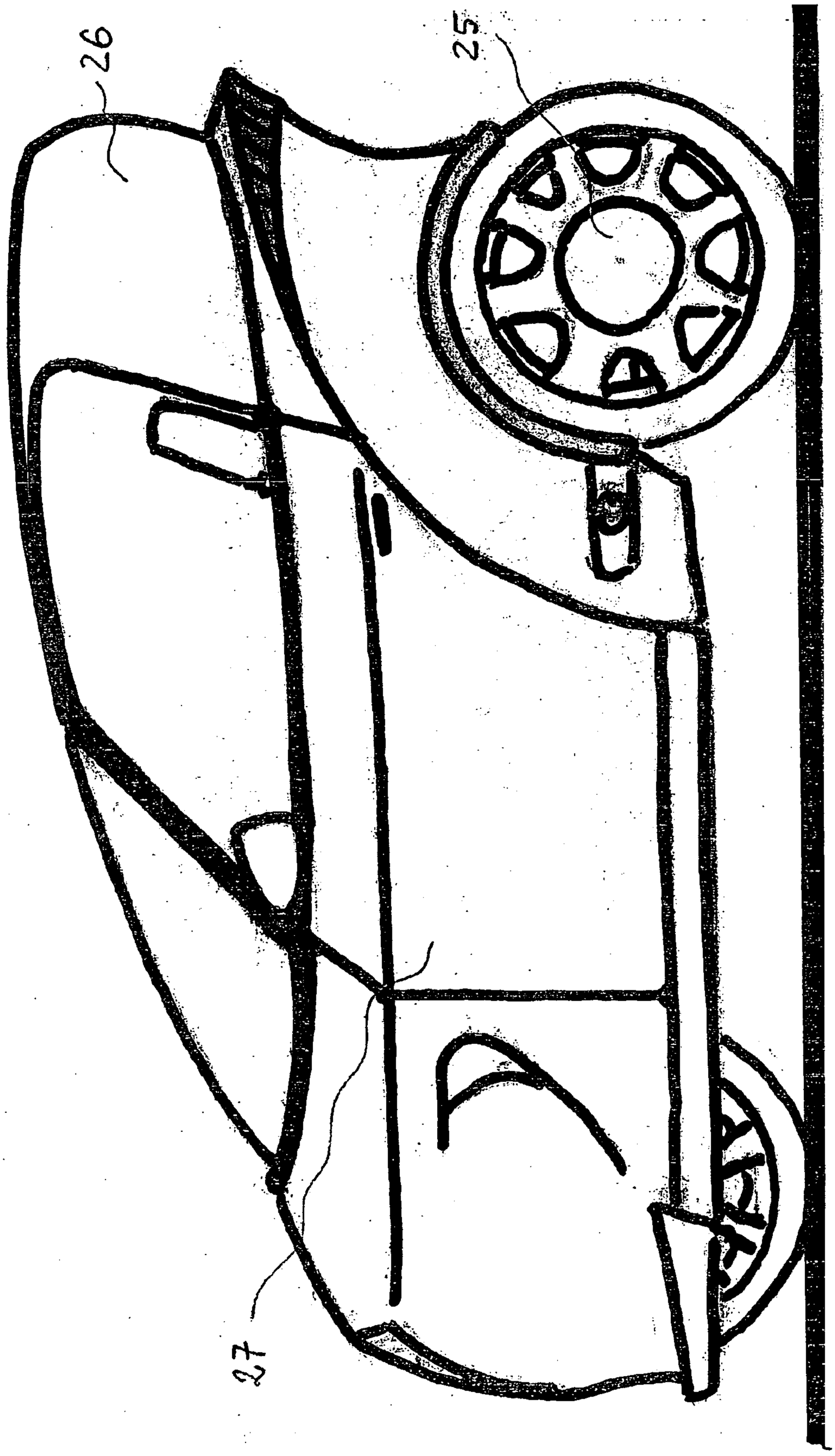


FIG.13

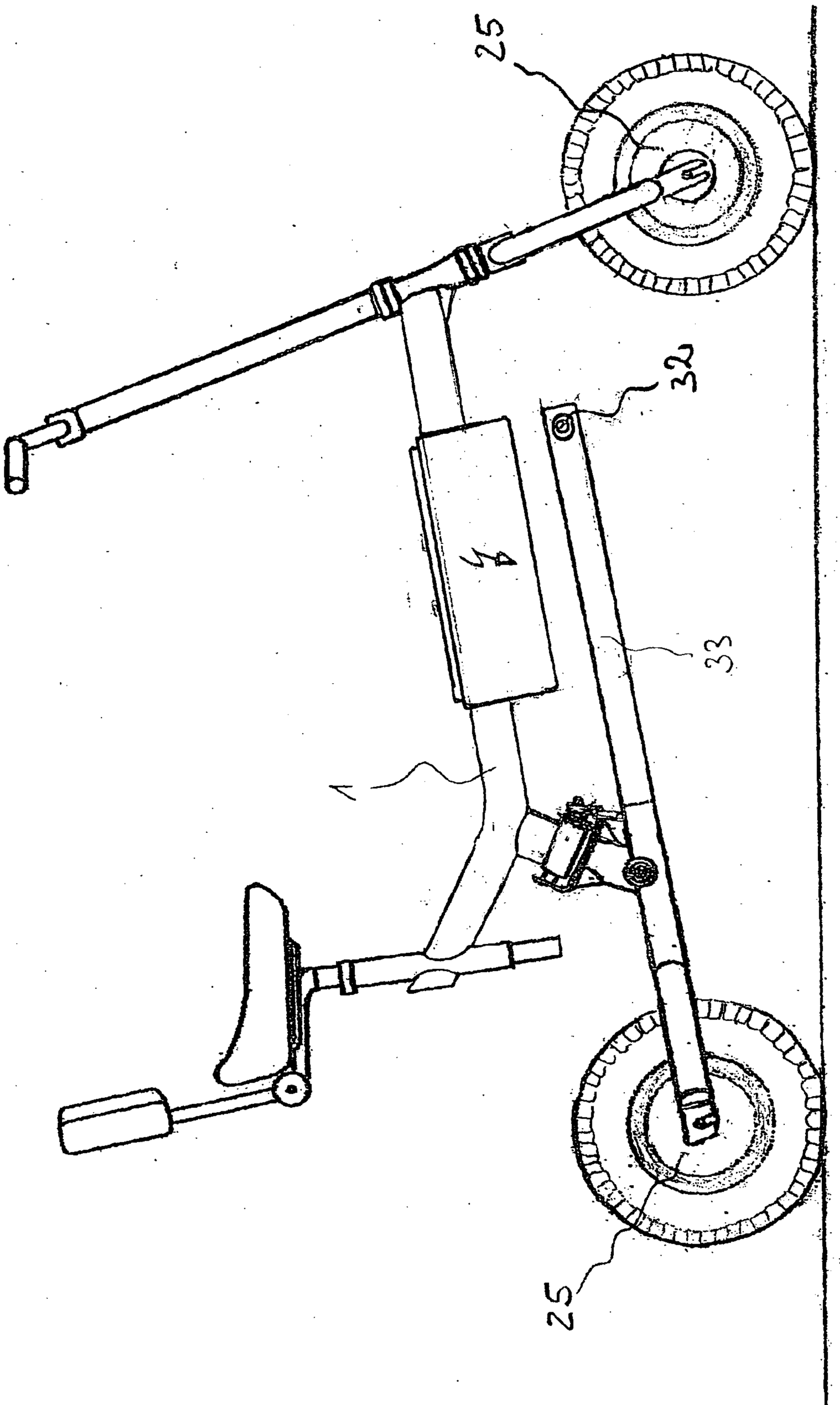


FIG.14

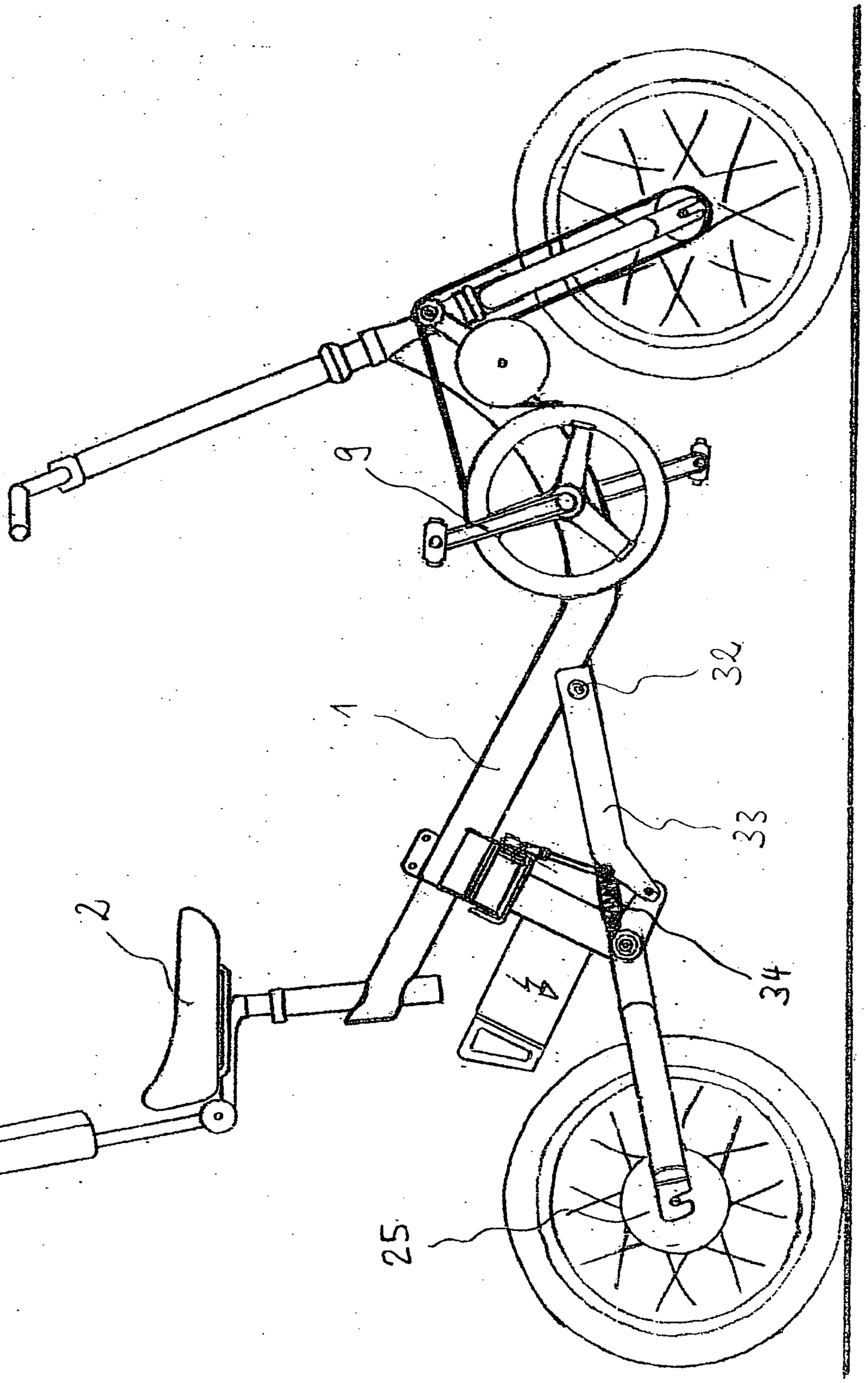


FIG.15

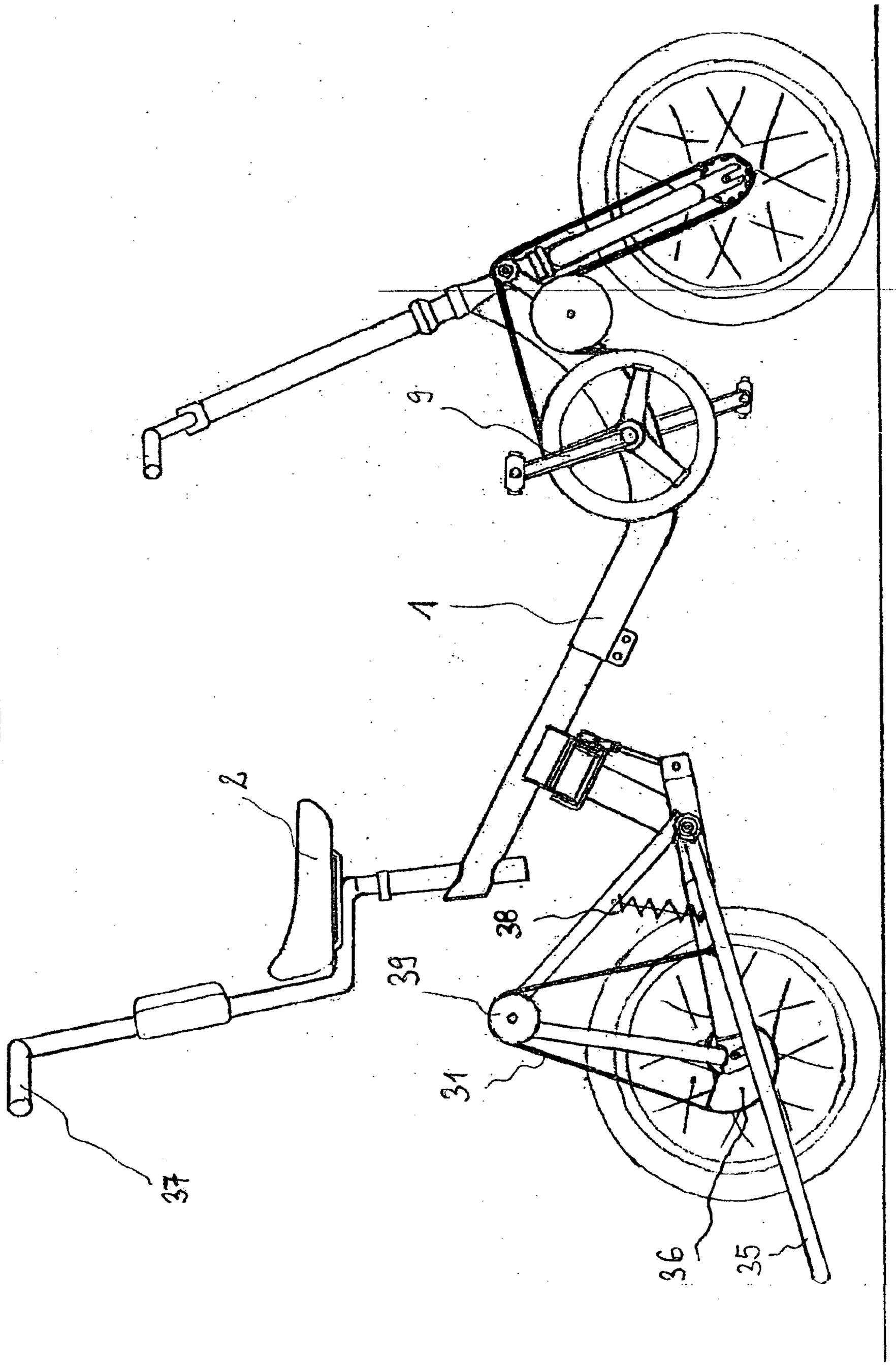


FIG.16

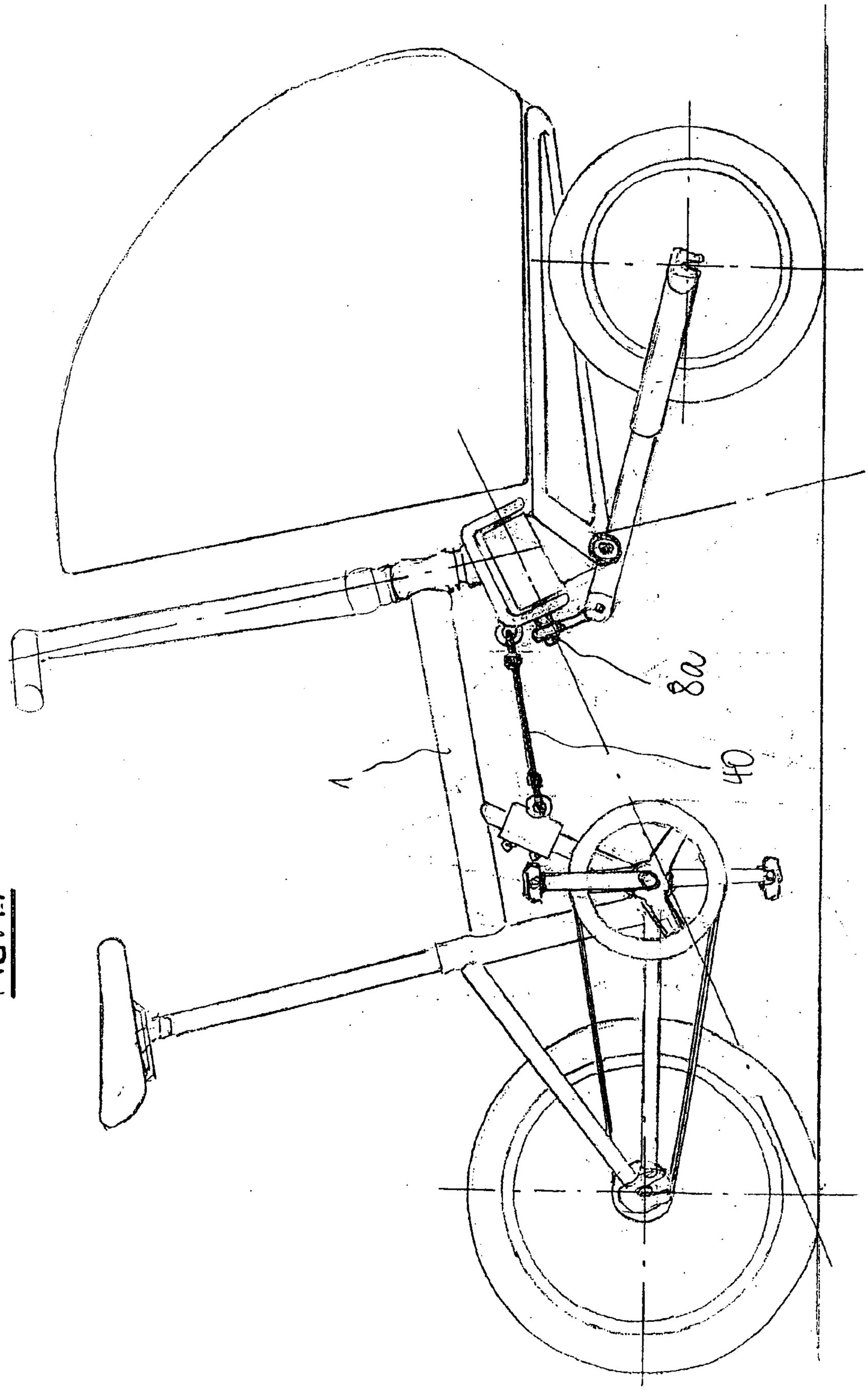
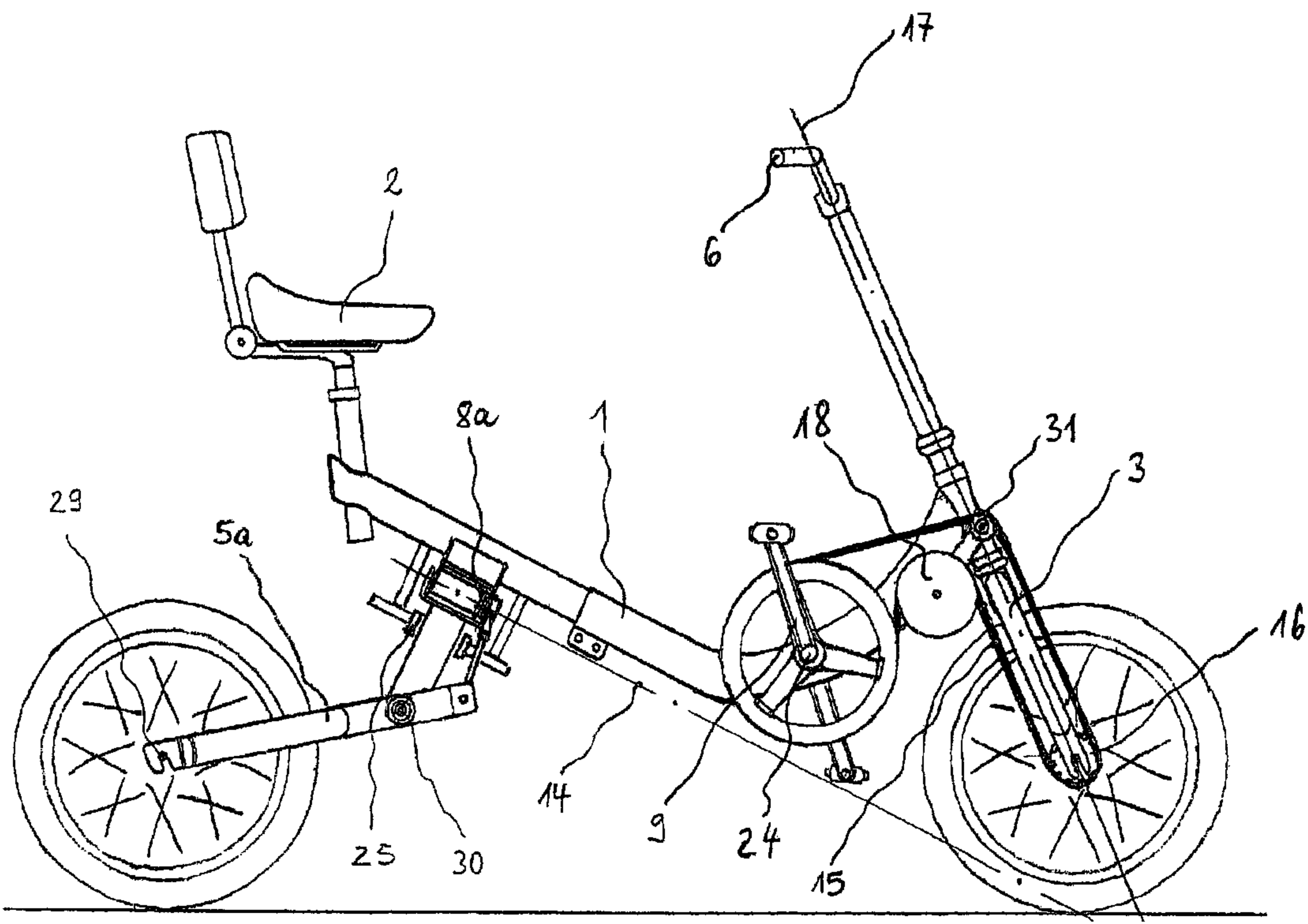


FIG.17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