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(54) **Title**: AN ECOLOGICAL VEHICLE FOR TRANSPORTATION OF PERSONS

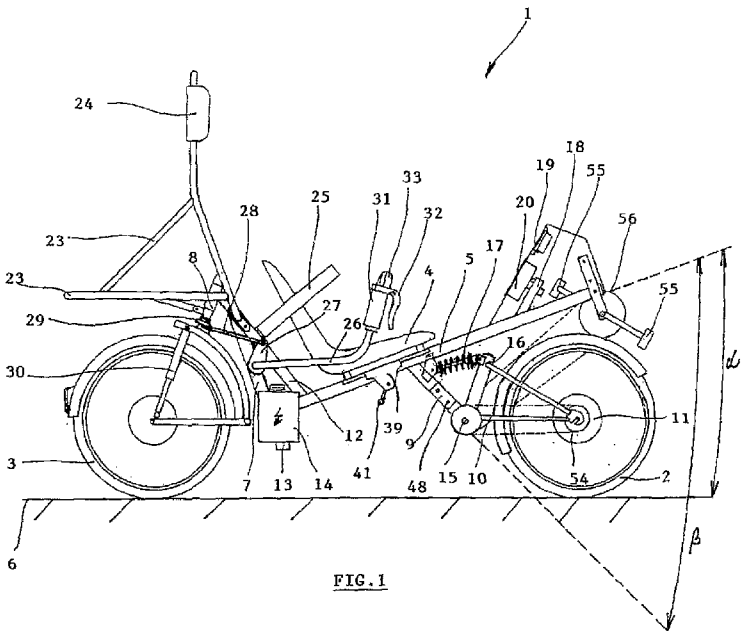

FIG.1

(57) **Abstract**: An vehicle comprising one support frame with a raised higher front part, which is provided with at least two wheels (2, 3) and at least one seat (4), a control means connected with at least one steerable wheel (3) and a drive means connected to at least one driven wheel (2). The support frame forms a diagonally arranged elongated straight beam (5) forming an angle a of between 15° and 30° with the horizontal plane (6) and arranged with its rear end before the rear steerable wheel (3) and with its front end above the front driven wheel (2). Simultaneously, to the rear end of the beam (5) there is fixed an upwardly extending rear support arm (7) carrying the mounting (8) of the rear steerable wheel (3) and in the central part of the beam (5) there is fixed a downwardly extending front support arm (9) carrying the swinging fork (10) for mounting the front driven wheel (2). On the beam (5) there is further arranged a sliding mounted seat (4) with the possibility of locking a selected position of the seat (4) on the beam (5).

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AN ECOLOGICAL VEHICLE FOR TRANSPORTATION OF PERSONS

Field of the invention

The invention relates to an ecological and economical vehicle for the transportation of persons, including their hand baggage, suitable mainly in urban and suburban traffic, for recreation, for sport, and for other purposes.

Background of the invention

Currently known vehicles for the individual transportation of persons, in particular passenger cars, motorcycles, motorized scooters, electric bicycles, bicycles, and scooters usually consist of a self-supporting frame or tubular construction on which is mounted a drive unit and a front and rear axle, wherein the front wheels or possibly rear wheels, are guided to the desired direction of travel by a steering wheel or handlebars.

The disadvantages of existing vehicles are, for passenger cars and motorcycles, especially their large mass, high fuel consumption, harmful emissions and poor utilization of energy consumed due to a low average occupancy. They also place high demands on garage and parking space. The quantity of vehicles with internal combustion engines manufactured in the world is constantly growing, and the associated production of pollutants from their operation far exceeds the atmosphere's possibility to clean itself. The situation is not resolved by the effort on the part of car manufacturers to produce classic cars with electric or hybrid drive, because the total weight of such a car continues to increase due to the need to install the appropriate batteries capable of powering electric drives for a heavy vehicle for sufficiently long enough.

One certain solution seems to be the use of bicycles. Under the power of his own propulsion, the rider, possibly with assistive drive using a small electric motor with an appropriate battery capacity, is a progressive step especially in urban and suburban areas. The use of electric scooters is a similar case. Compared to passenger cars, however, bicycles and scooters have disadvantages, particularly the high center of gravity of the machine's assembly/rider, little or no protection against the weather, and almost no protection in the event of an accident. A

drive using the power of the rider brings the additional risk of health problems caused by the need to use the narrow seats on bicycles without a backrest. The rider sits in an unnatural position with his back bent, his head twisted, and his viscera compressed. His arms pushing into the handlebars transfer the vibrations from the front wheel into the muscles and nerves of the entire body. In the same way, the blood vessels supplying the sex organs also suffer, leading to their subsequent dysfunction.

A particular danger is presented by the handlebars. The eventual fall over the handlebars during a frontal collision usually occurs in fractures of the limbs and severe injuries of the abdomen and spine, and especially the head. The differing load on the front and rear wheels also acts negatively on slippery terrain. Using the front wheel to steer results in insufficient illumination of the corner towards which the vehicle is traveling when turning a corner at night, because permanently mounted spotlights illuminate only in a straight line. Solutions that eliminate this effect are expensive and unreliable.

The disadvantage of a high center of gravity and incorrect ergonomic position are partially redressed with the "recumbent bicycle", the basis of which is a frame with a seat on which the rider is in a semi-reclining position leaning back, and the pedals with derailleur are at the front end of the frame. The rear wheel is driven mounted in the suspension fork, while the front wheel is steerable using lower handlebars, as is described in patent application DE 3345831 A1 or using upper handlebars, as is described e.g. in document CN 2287596 Y. An alternative with a steerable rear wheel is described in patent CZ 252 644. The disadvantage of this design is in the difficulty of maintaining driving stability, especially when starting and stopping, and in the unprotected position of the feet, which are exposed to the possibility of injury during a frontal impact. The "recumbent tricycle" is also known, with two wheels on the steerable front axle and with a rear drive wheel in a fixed rear fork. An alternative design with two steerable rear wheels is described e.g. in patent applications DE 196 096 28 A1, DE 197 28 150 A1, DE 198 24 576 A1, and NL 103 5799. Patent application DE 102 39 357 A1 describes a folding tricycle with two front wheels steerable by using a handlebar and with the rear wheel driven by pedals. A similar concept is also described in the utility model CZ 9 779 U1. Also known are tricycles fitted with electric drive and pedals, with a fixed rear axle with two driven wheels and with a front wheel steerable by the handlebar, wherein the concept of the frame substantially coincides with the classical children's tricycle. The center of gravity of the rider

sitting on the seat is in this case high again, and the risk of rider injury on impact is not eliminated.

Also known is the tricycle with a very low center of gravity, with a tubular frame bearing a seat for the rider whose legs are propped in fixed footrests on the fork of the front wheel. The tricycle drive is resolved by a manual crank mechanism, and the front wheel is also powered and steerable. The tricycle powered by hands is particularly suitable for the disabled or for athletes strengthening their arm muscles, but not for normal traffic, since the arm-powered drive is physically very demanding.

The disadvantages of known constructions of light single- and multi-track vehicles with reduced weight and with a low center of gravity are mainly that they do not resolve the optimal distribution of forces during a frontal impact. The frame of these vehicles is mostly spinal and substantially horizontal, which in a frontal collision leads to its considerable deformation and to severe injuries, since all the impact energy is absorbed in the direction of the rider. It is therefore necessary to re-dimension the solidity of the entire frame construction to achieve at least a basic level of safety. This leads to high production costs. Some vehicles have the front part of the frame raised, but in such a way that the construction does not allow for a change in the seat position of the rider relative to the pedals, and in general is a single-purpose construction which does not allow for the necessary versatility with respect to the rider, types of power drive, and types of undercarriages. At the same time, most known vehicles of this type are not suitable for the elderly or for persons with reduced mobility. None of the known constructions resolve the problem of luggage space and a closable body. The invention aims to eliminate the above insufficiencies.

Summary of the invention

The subject of the submitted invention is an ecological vehicle for transporting people and/or luggage, comprising at least one supporting frame with elevated front part, having at least two wheels and at least one seat, a control means connected with at least one steerable wheel, and a drive means connected to at least one driven wheel.

The essence of the invention consists in a supporting frame construction which forms an obliquely arranged elongated straight beam forming an angle α in the range from 15° to 30° with the horizontal plane, and arranged with its rear end before the rear steerable wheel and its front end above the front driven wheel. To the rear end of the beam there is fixed an upwardly extending rear support arm bearing the mounting of the rear steerable wheels and in the central portion of the beam there is attached a downwardly extending front support arm carrying a swinging fork for mounting the front driven wheel. On the beam there is further arranged a adjustable mounted seat with the possibility of locking the selected seat position on the beam.

In a preferred embodiment of the invention, the rear support arm forms an angle of optimally 90° with the beam and is connected to it by an obliquely arranged reinforcement, wherein the seat is arranged on the beam in the region between the reinforcement and the front support arm. Depending on the construction of the rear part of the frame and the wheel size, an angle larger than 90° can be selected.

The construction of the obliquely arranged longitudinal beam, together with the mounting of the rear wheel, of the front wheel, and of the seat, forms a compact unit with high strength and in particular with optimal distribution of forces during a frontal impact with regard to the position of the seat and center of gravity of the rider. The rider sits lower with regard to the front part of the beam and the front wheel, rests on the seat, and the impact force is spread in the oblique beam onto the oblique reactive components, which together with the overall lower center of gravity prevents the vehicle from rolling over upon a frontal impact.

Seeing as how one possible alternative drive means of the vehicle is an electric motor, it is preferred that in the rear end of the beam there is attached a downwardly extending rear bracket holding a receptacle for the battery, the mass of which at this site helps to lower center of gravity of the vehicle.

It is further preferred that the front support arm forms an acute angle ß with the beam and is, at its end, provided with a pin for the rotatable mounting of the swinging fork bearing the front driven wheel. The swinging fork has a swingarm which is pivotally attached at one end on a pin and on its other end is attached via a spring with a shock absorber to the upper part of the front support arm.

In another preferred embodiment of the invention, on the upper side of the beam before the seat there is mounted a bracket bearing an instrument panel with airbag for enhancing the passive protection of the rider.

In another preferred embodiment of the invention, on the front end of the beam there is mounted a front bracket with footrests for support and for protecting the feet of the rider from impact for the design with the electromotor drive or with a combustion engine. For optimal safety and distribution of impact forces it is advantageous if the front bracket forms an angle of 90° with the beam.

Another preferred embodiment of the invention consists in the construction of a luggage compartment in conjunction with other safety features, where in the area that the rear bracket connects with the reinforcement, the frame of the luggage compartment is fixed with a headrest and a seat belt catch.

The steering means for controlling the rotation of the rear steerable wheel is preferably formed by at least one operating lever arranged on the side of the seat and connected with a control arm pivotally mounted on the rear support arm, which is connected through a rod with the control arm for rotating the rear suspension fork in a swivel mounting.

The steering means preferably comprises two control levers which are arranged on both sides of the seat and are coupled for synchronized movement, wherein at the ends of at least one control lever is a handle with brake lever and with a control element, e.g. direction light indicators, lights, etc.

In terms of structural strength of the vehicle and optimization of production costs, another preferred embodiment of the invention is important in which the longitudinal beam is formed by a direct closed profile the height of which is greater than its width, and which has adequate rigidity in the vertical direction. The material of the beam may be metallic, composite, or plastic. The upper side of the beam, on which the seat is fitted, is preferably provided with a system of locking openings into which a locking pin engages in a slide arranged on the underside of the seat. The slide is connected to the lateral guiding profiles adjustably adjacent to the sidewalls of the beam. The lateral guiding profiles are connected to the sidewalls, in

which is pivotally mounted a pressure eccentric with wheel flanges engaging the underside of the beam. The eccentric is provided with a locking lever for tightening and loosening the seat, which can be positioned on the longitudinal beam so that it optimally suits the rider's body proportions. When the eccentric is loosened, the rear part of the seat can be lifted with the slide and locking pin, and the entire seat assembly can be slid to the desired position and locked again with the pressure eccentric. To prevent loosening the pressure eccentric due to excessive vibrations, the pin of the pressure eccentric can be replaced with a bolt with nut, for example a wing nut, which after setting to the desired position can be tightened.

In another preferred embodiment, the vehicle, according to the invention, is provided with a further safety element, specifically a adjustably mounted chassis which is provided in the front part with a reversibly deformable member, e.g. an air bag with a specially modified inlet and outlet valve which operates at atmospheric pressure. The preloaded spring arranged in the area between the front bracket and the chassis serves for the sliding movement of the chassis rearward upon impact and for returning it to its original position after impact. The preloaded spring keeps the chassis in a front unstable position. On impact, the chassis moves backwards, whereby the preloaded spring holds it in the rear unstable position. Pushing on the chassis from behind returns the chassis to the front unstable position. To facilitate the displacement, the rear part of the chassis is mounted on rollers arranged in the frame of the luggage compartment.

The vehicle according to the invention is characterized by its high variability of motor and foot drives that can be mounted on the same general construction and can be mutually combined.

In one preferred embodiment, the drive means comprises an electric motor and/or other motor driving the front driven wheel, e.g. a combustion, compressed-air, or flywheel motor, or another electric motor. The electric motor can be stored in the hub of the front driven wheel. If another engine is used simultaneously, it is preferably attached to the front support arm on its fork attachment with fastening pins and can be connected to a generator for charging the battery in the box.

In another preferred embodiment, the drive means comprises rotatable pedals on a crank with a converter, arranged in the front part of the beam, wherein the converter, using at least one

chain, drives the toothed pinion of the front driven wheel when the rider pedals the pedals. The problem of the connection of the pedal drive with the wheel in the swinging fork with variable position is preferably resolved in that the pin for the rotatable mounting of the swinging fork is formed by a roller-shaft mounted in the fork attachment fastened to the front support arm. The shafts are connected to idle sprockets, one of which is connected by a chain with pedal convertor and the second is connected by a chain with a toothed pinion of the front driven wheel.

Alternatively, in another preferred embodiment of the pedal drive according to the present invention, the drive means comprises two pedal levers with rotating pedals mounted on a common axis in the front part of the beam with the possibility of a rocking motion of the pedal levers at the sides of the beam and of the front driven wheel. The legs of the rider do not move about a circle while pedaling, but along an arc whose radius is given by the distance of the pedals from the common axis of both levers. The advantage of the pedal levers is better transmission of power during pedaling, which has a more continuous waveform unlike pedaling along a circle. Additionally, one pair of ends of the pedal levers are attached to return springs whose other ends are anchored to the beam. The springs serve for accumulating energy of the synchronized movement of the pedal levers, wherein the return force of one spring facilitates pedaling on the second pedal lever and vice versa. The pedal levers are provided with a means for transferring the force of pedaling on the pinion of the front driven wheel, which consists of chains fixed to the lower ends of the pedal levers, wherein the chains engage with the idling sprockets connected with the shaft forming the pin. This is pivotally mounted in the fork attachment fastened to the front support arm. The ends of the chains are mutually connected behind the sprockets by a cable guided over a rotatable pulley mounted on the beam. The shaft forming the pin is connected to another idling sprocket, connected by a chain with the geared pinion of the front driven wheel.

The synchronizing motion of the pedal levers is preferably resolved so that the center of the axis of the common axis of the pedal levers is pivotally mounted in a sleeve connected with the beam, and each pedal lever is connected to one bevel gear pivotally mounted on an axis, wherein the bevel gears are engaged with a common inserted bevel gear arranged perpendicularly to the axis. The action of the return springs during pedaling is transmitted via the gears from one pedal lever to the other. The preload of the return springs can be adjusted, thus adjusting their storage according to the strength requirements and physical condition of

the rider. The greater the force of the return springs, the more resistance the rider must overcome when pedaling. The regulation of the preload is preferably designed such that the second ends of the return springs are mounted to a carrier movably connected to the beam by means of an adjustable means for setting the preload of the return springs.

In yet another preferred embodiment of the invention, the drive means comprises a motor mounted to the front support arm, which directly drives the front driven wheel via freewheel sprockets, one of which is connected by a chain with the drive gear of the internal combustion engine and the second is connected by a chain with the driven pinion of the front driven wheel.

The ecological vehicle according to the invention has a number of undercarriage variants. In one preferred embodiment, it is constructed as a single-track vehicle with a single steerable rear wheel and with one front driven wheel on a common straight longitudinal beam. In another preferred embodiment, it is constructed as a three-track vehicle with two steered rear wheels and with one front driven wheel on a common straight longitudinal beam. In yet another preferred embodiment, the vehicle is constructed as a two-track vehicle with two steerable rear wheels and with two front wheels, of which at least one is driven, whereby the vehicle frame comprises at least two longitudinal straight beams interconnected by at least one crossbeam. The vehicle can be single-seated as well as multi-seated with seats behind or next to each other.

The advantages of the vehicle and for passenger and hand luggage transport according to the invention lies mainly in its increased safety due to the compact angled frame with the bottom oblique mounting of the front swinging fork, with increased variability of the position of the driver or rider, and possibilities of combinations of different types of drives using a single or only very slightly different undercarriage design. The construction of the vehicle allows for a reduction in production costs, particularly in view of the fact that strength-wise, only the middle part of the frame is the most stressed by the occupied seat. The other parts of the frame need not be of high quality or expensive strength profiles. Finally, the construction of the invention allows for the minimization of vehicle dimensions and its convenient usability for both sport and recreation as well as for entrepreneurs in the service sector, for craftsmen, for seniors and persons with reduced mobility.

Description of the illustrations

The invention is illustrated in more detail by illustrations which show the following:

Fig. 1 a side view of a single-track, single-seat vehicle powered by pedaling the pedals on a crank and with assistive electric drive in the hub of the front wheel;

Fig. 2 plan view of the vehicle according to Fig. 1;

Fig. 3 a side view of a single-seat three-track vehicle with one front driven wheel and with two steerable rear wheels, driven by pedaling on the pedal levers and with assistive electric drive in the hub of the front wheel;

Fig. 4 plan view of the vehicle according to Fig. 1;

Fig. 5 a side view of a two-seat two-track vehicle formed by joining two longitudinal straight beams by connecting rods, powered by an internal combustion engine driving the front wheels, with assistive electric drive in the hub of the front wheels, and with a floor and protective frame;

Fig. 6 a plan view of the vehicle according to Fig. 5;

Fig. 7 a side view of a single-track vehicle with electric drive and with a sliding chassis mounted on a deforming return member,

Fig. 8 detail of the mounting of the front swinging fork on the shaft provided with a set of freewheel sprockets;

Fig. 9 detail of the mounting of the seat assembly on the beam in side view;

Fig. 10 detail of the lower mounting of the seat assembly on the beam in front view;

Fig. 11 plan view of the placement of the seat assembly on the beam;

Fig. 12 detail of the upper mounting of the seat assembly on the beam in cross-section;

Fig. 13 examples of the beam profile design in cross-section;

Fig. 14 a side view of the pedal lever mechanism;

Fig. 15 a bottom view of the pedal lever mechanism;

Fig. 16 a plan view of the pedal lever mechanism;

Fig. 17 detail of the mounting of the pedal levers in partial cross-section;

Fig. 18 to Fig. 19 a schematic representation of the position of the rider's legs and the force while pedaling on common pedals on the crank;

Fig. 20 to Fig. 21 a schematic representation of the position of the rider's feet and the force while pedaling on the pedal levers;

Fig. 22 cross-section of the positionable mounting of the pedal levers with adjustable spring preload;

Fig. 23 a plan view of the positionable mounting of the pedal levers according to Fig. 22;

Fig. 24 special design of a single-seat three-track vehicle for riding on snow or sand, with the drive belt in front and with skis or wheels in the back.

Examples of the preferred embodiments of the invention

It is understood that the hereinafter described and illustrated specific examples of the realization of the invention are presented for illustrative purposes and not as a limitation of the examples of the realization of the invention to the cases shown herein. Experts who are familiar with the state of technology shall find, or using routine experimentation will be able to determine, a greater or lesser number of equivalents to the specific realizations of the invention which are specifically described here. These equivalents shall also be included into the scope of the claims.

In the first example of the embodiment, Fig. 1 and Fig. 2 show a single-track single-seat vehicle with a pedal drive. The basis of the vehicle **1** comprises a supporting frame rising towards the front part of the vehicle **1**. The supporting frame is an obliquely arranged straight longitudinal beam **5** consisting of a closed metal profile whose height is greater than its width. The material of the beam **5** can also be composite or plastic, as can as other components connected to the beam **5**. Examples of possible variants of shapes of the beam **5** are shown in Fig. 13. The upper or lower side of the beam **5** can be provided with a bead produced during the welding of the profile of the beam **5**; this bead can be used as a guide for mounting the seat **4**. In other embodiments, not shown, plastic or composite material may also be used. For eliminating and distributing the horizontal component of the force acting on the vehicle **1** during a frontal impact, it is preferable if the beam **5** forms, with the horizontal plane **6**, an angle α in the range of 15° to 30°. In the example of the embodiment shown in Fig. 1, $\alpha = 20°$. To the rear end of the beam **5**, at an angle of 90°, is welded a rear support arm **7**, also comprising a closed metal profile, the same as the reinforcement **12** welded obliquely between the upper end of the rear support arm **7** and the beam **5**. The connection of the rear end of the beam **5**, the rear support arm **7**, and the reinforcement **12** forms an area which is the main strength element of the supporting frame, but in particular is important for the dispersion of forces acting upon impact with the elimination of the component acting in the direction of the roll of the vehicle **1** and with its transformation into the vertical component acting towards

the ground, i.e. leading to the maintenance of the stability of the vehicle 1, with a low center of gravity and the distribution of impact forces to the beam 5 and the rear support arm 7. The rear support arm 7 with reinforcement 12 also bear the rotatable mounting 8 of the rear steerable wheel 3, placed behind the rear end of the beam 5, above which is the self-supporting tubular frame 23 of the luggage space with headrest bracket 24 and a catch for the seat belt 25. In the area of the rear end of the beam 5 there is welded a downwardly projecting rear bracket 13 on which is mounted a box 14 for a battery powering the electric assistive motor 11 placed in the example of the embodiment according to Fig. 1 in the hub of the front driven wheel 2 of the vehicle 1. In the box 14 may be placed other objects such as a fuel tank, tools, etc.

The front part of the beam 5 extends above the front driven wheel 2, which is suspended on the front support arm 9, also formed by a closed metal profile welded to the beam 5 in its central part and forming, with the beam 5, an acute angle ß. In the embodiment in Fig. 1, the angle ß = 60°.

The front driven wheel 2 is mounted in a swinging fork 10, with a swingarm 16 mounted in the front support arm 9, respectively in the fork extension 47 on the pin 15. The upper end of the swingarm 16 rests through a spring with shock absorber 17 on the front support arm 9 and absorbs the shocks of the front driven wheel 2.

On the upper side of the beam 5 in the area between the reinforcement 12 and the fastening point of the front support arm 9 is an adjustable and lockable mounted seat 4 for the rider 71 (shown in Fig. 7) made of a suitable material, e.g. plastic or fiberglass. In the upper side of the beam 5 there are drilled, at regular pitches, locking holes 34 into which fits the locking pin 35 attached by means of a locking screw 38 as shown in Figs. 9 to 12. The seat 4 can be moved along the beam 5 and locked in a selected position suitable for the rider 71 with a locking pin 35 which fits into the appropriate locking hole 34. The seat 4 lifts as it moves. The seat 4 has, on its lower side, a slide 36, consisting of metal profiles arranged transversely to the beam 5. Inside the profile there is arranged a locking pin 35 which protrudes out of the profile. So that the guiding of the seat 4 is sufficiently rigid in the lateral direction, there are welded to the slide 36 lateral guide rails 37, 37', also formed by closed metal profiles. The lateral guide rails 37, 37' can be moved along the beam 5. On the outer sides of the lateral guide rails 37, 37' are fixed sidewalls 39, 39', into which are pivotally mounted a pressure eccentric 40 with side

flanges 77 fitting into the bottom side of the beam 5 and provided with a locking lever 41. When loosening the pressure eccentric 40, the seat 4 can be moved along the beam 5 and locked in the selected position with the locking pins 35, while tightening the pressure eccentric 40 results in a firm connection between seat 4 and the beam 5 with sufficient longitudinal and transverse stiffness also sufficient for the case of an impact.

On both sides of the seat 4 there are arranged control levers 26, 26' for steering the steerable rear wheel 3 and for controlling the brakes and other functions of the vehicle 1. The control levers 26, 26' are connected with the control arms 27, 27' pivotally mounted on the rear support arm 7, and connected by linkage 28, 28' with the steering arms 29, 29' which rotate the rear suspension fork 30 which bears the rear steerable wheel 3 in the rotatable mounting 8 with bearings. In the case that the vehicle 1 is a three-track, as shown in Fig. 3, both rear wheels 3 are controlled using the control levers 26, 26'. In the case that the vehicle 1 is two-seated with two seats 4 side by side (Figs. 5, 6) only one control lever 26 between the seats 4 can be used.

At the end of the control levers 26, 26' are handles 31, 31' with brake levers 32, 32' for braking the wheels 2, 3, and with control elements 33, 33' for switching directional lights (not shown) or for controlling other functions of the vehicle 1.

On the upper side of the beam 5 is mounted, in front of the seat 4, a handle 18 carrying the instrument panel 19 with the airbag 20.

The vehicle 1 shown in Fig. 1 and Fig. 2 has, as an auxiliary drive means, an assistive electric motor 11 built into the hub of the front driven wheel 2 and powered from a battery stored in a box 14. The electric motor 11 may be stored elsewhere than in the front wheel 2. The main drive means of the vehicle 1 according to the first example of the embodiment in Fig. 1 and Fig. 2 are the pedals 55 on a crank with a convertor 56 mounted on the front end of the beam 5 and driving a pinion 54 of the front driven wheel 2 via a pin 15 for the mounting of the swinging fork 10. As shown in Fig. 8, the pin 15 is, in this embodiment, replaced by shafts mounted in the fork extension 47 fastened by screws 48 to the front support arm 9. The screws 48 also form the fixing pins 52, 53 for attaching another engine. On the shaft is an assembly of freewheel sprockets 49, 50, wherein one freewheel sprocket 50 is connected by a chain to the convertor 56 of the pedals and transmits the drive to the shaft through pedaling.

The second freewheel sprocket 49 is connected with the pinion gear 54 and transmits the drive through pedaling from the shaft on the front driven wheel 2. The chain transfer may be designed as direct, or with an inserted derailleur, not shown in the drawing. The embodiment of the vehicle 1 with pedals 55 on a crank according to Figs. 1 and 2 can be used for sporting purposes, similarly like a bicycle, wherein it is possible to take advantage of the assistive electric motor 11.

In the second example of the embodiment of the invention, shown in Fig. 3, Fig. 4 and Figs. 14 to 17, 20, and 21, the three-track single-seated vehicle 1 may alternatively be equipped with a different kind of pedaling power. As shown in Figs. 18 and 19, the pedaling force on the pedals 55 on crank circumscribing a circular path is not ideal and has an abrupt course with low utilized efficiency of the pedaling power. The vehicle 1 according to Fig. 3 and Fig. 4 uses, instead of the pedals 55 on a crank, pedal levers 59, 59' with rotatable pedals 61 moving about an arc trajectory. The pedal levers 59, 59' are mounted on a common axis 58 situated above the front part of the beam 5. The force of pedaling on the pedal levers 59, 59' is fluent, as shown in Fig. 20. An even better course of the pedaling force is achieved according to Fig. 21 with the use of return springs 65, 65' which pull the pedal levers 59, 59' towards the rider. When moving one pedal lever 59, energy thus accumulates to facilitate pedaling the other pedal lever 59', given the fact that the levers 59, 59' are, on the axis 58, pivotally mounted in a sleeve 66 provided with bevel gears 67, 67', which are joined together in continuous synchronized engagement via an enclosed bevel gear 68. The transmission of force from the pedal levers 59, 59' to the pinion 54 of the driven wheel 2 is resolved such that to the lower ends of the pedal levers 59, 59' there are secured chains 60, 60'. The chain 60 of the first pedal lever 59 is guided over the freewheel sprocket 62 mounted on the shaft forming the pin 15 according to Fig. 8. The chain 60' of the second pedal lever 59' is guided through the freewheel sprocket 57 mounted on the shaft forming the pin 15 according to Fig. 8. The ends of the chains 60, 60' are, behind the sprockets 57, 62, mutually connected by a cable 63 guided over a rotatable pulley 64 mounted on the beam 5. Pedaling on the levers 59 59' is transmitted to the sprockets 57, 62 and from there to the rotating shaft forming the pin 15 and through the freewheel sprocket 49 onwards to the pinion 54 of the front driven wheel 2.

In the preferred embodiment according to Fig. 22 and Fig. 23, the return springs 65, 65' are provided with an adjustable positioning means 70 for adjusting their preload, which can be regulated through the force of pedaling. The ends of the return springs 65, 65' are attached to

the carrier 69 which is movable relative to the beam 5. The positioning means 70 is, in the embodiment according to Fig. 22 and Fig. 23, formed by a threaded rod passing through the threads in the nut of the carrier 69 and by a rotatable sleeve which can be manually rotated by a threaded rod.

The vehicle 1 in the embodiment according to Fig. 3 and Fig. 4 has two steerable rear wheels 3 connected with two control levers 26, 26', and one front drive wheel 2, equipped with an assistive electric motor 11 in the front wheel 2.

Fig. 5 and Fig. 6 show a third example of the embodiment of the invention, wherein the vehicle 1 is two-seated vehicle and two-track, and is substantially formed through an assemblage of two single-track and single-seated vehicles 1 according to the first example of the embodiment. For connecting the beams 5 , there serves the rear cross member 73 in the rear part and the front bracket 21 with footrests 22 welded to the front ends of the beams 5. The brackets 21 are connected by a common floor and protective frame 72, which serves as a foot support and protection, or possibly for storing luggage. The frame 72 is not used in the pedal propulsion. The direction of travel of the vehicle 1 is controlled by coupled control levers 26, 26' as in the previous examples of the embodiment. It is possible to remove the outer lever 26 and steer the vehicle 1 using only one control lever 26' arranged between the seats 4. This design can also be used in other embodiments of the vehicle 1. The drive means for the vehicle 1 according to Fig. 5 and Fig. 6 is formed by a combustion engine 51 (a compressed-air or flywheel motor may be used, or other electric motor) mounted to the front support arm 9 by means of fastening pins 52, 53. For transmitting the drive to the pinion 54 of the front driven wheel 2 the shaft forming the pin 15 is again used, for pivotally mounting the swinging fork 10 in the fork extension 47, with the freewheel sprockets 49, 50, one of which is connected with the chain with a drive gear of the internal combustion engine 51 and the second with the pinion 54 of the front wheel 2.

For all the above examples of the embodiment, it is possible to mutually combine the individual motor and pedal drive means, wherein the means for fastening the motor is generally the front support arm 9, and the means for transmitting force are the freewheel sprockets 49, 50, 57, 62 on the shaft forming the pin 15 of the swinging fork 10. For chain drives, it is possible to simultaneously or alternatively use a classic converter and derailleur with tensioners, which can be retrofitted.

Fig. 7 shows another example of the embodiment of the vehicle **1** according to the invention with safety elements. The rider **71** is seated in the vehicle **1** in the seat **4** with a secured position on the beam **5** and is secured with a safety belt **25**. Of fundamental importance for safety is primarily an adherence to speed limits and the position of the system of the rider **71** and the vehicle **1**. Fig. 7 shows the position of the body of the rider **71** during a calm ride with upright torso, and the position of the rider **71** during a sudden stop, when the body of the rider **71** swings forward by inertial force and is retained by the safety belt **25** and cabin air bag **20**. Fig. 7 shows further safety elements which can be applied to all the alternatives of the undercarriage and drive of the vehicle **1**. The vehicle **1** is provided with a adjustably mounted chassis **43** which is provided in the front part with a reversibly deformable member **44**. The reversibly deformable member **44** is a special air bag with a valve for balancing internal and external pressure for absorbing the energy of a frontal impact, with the extreme positions marked by cross-hatching. The rear part of the chassis **43** is mounted on rollers **46** in the frame **23** of the luggage space. For the automatic movement of the chassis **43** rearwards upon impact, there serves a preloaded spring **45**, which, upon impact, moves to the rear unstable position **45'**, together with the chassis **43**. Upon impact to the reversibly deformable member **44**, part of the impact energy is first absorbed in this member **44** and afterwards the chassis **43** is moved rearwards.

Fig. 8 shows a partial cross-section and a side and front view of the assembly of the freewheel sprockets **49**, **50**, **57**, **62** on a common shaft forming the pin **15** of the swinging fork **10**. The shaft is, in the part passing through the freewheel sprockets, provided with grooves with springs that fit into grooves of the bushings of the freewheel sprockets **49**, **50**, **57**, **62**. Both ends of the shaft are protected against loosening of the slipped-on freewheel sprockets **49**, **50**, **57**, **62** by washers with bolts. The shaft, in its central part, passes through the bearings of the swinging fork **10** and subsequently symmetrically on both sides of the bearings of the side carriers. The gaps between the bearings are filled by washers for the required length. The carriers are mounted on the front support arm **9**.

Fig. 18 to Fig. 21 explain the advantages of not pedaling on the pedals along the circumference, as is commonly the case with existing bicycles, of pedaling along a circular arc of the given radius of the pedal levers **59**, **59'**. Fig. 18 shows the physiologically most suitable direction of force. Fig. 19 shows the actual profile of the force exerted on the pedals moving along a circular path of the crank radii (as is usual in the current design of bicycles).

The disadvantage is the small part of the path used for applying the force to rotate the sprocket. Fig. 20 shows an ideal state of movement across the entire part of the circular arc of a given radius of the pedal lever **59**, **59'**. The result is a steady increase of force, but the origin of the pressure is limited, according to the picture, by the angle of opening of the shin - thigh. Fig. 21 explains the use of springs **45**, **45'** which insert the excess power in the final stage of compression into the storage capacity of the springs **45**, **45** 'and subsequently this excess energy is used at the commencement of the activity of compressing the second lever **59**, **59'**. The use of this feature can be achieved only with the mutual synchronization of both levers **59**, **59'**.

Fig. 24 shows the last example of the embodiment of the vehicle **1** according to the invention, wherein instead of wheels **3**, **2** technically equivalent means are used, namely a driven belt **74** with suspension units **76** in front, and two skis **75** in the back. A combustion engine **51**, or any other motor **51** is used for propulsion. The skis **75** may be replaced with pneumatic wheels with a wide profile. The vehicle **1** in Fig. 24 is designed for driving in snow or on sand dunes and beaches.

Industrial applicability

The ecological vehicle according to the invention can be used for the transport of passengers and hand luggage, is particularly suitable for urban and suburban traffic and for recreational and sport activities, and possibly a special modification of the vehicle can also be used for medical purposes. The vehicle is also suitable for driving on desert dunes or along coastal beaches. In these cases, where it is advantageous to use photovoltaic devices which form the roof for on-board battery charging, a roof with photovoltaics can simultaneously serve as an sun shade for the crew.

Overview of the reference symbols used in the drawings

1	vehicle
2	front driven wheel
3	rear driven wheel
4	seat
5	beam
6	horizontal plane
7	rear support arm
8	mounting of rear steerable wheel
9	front support arm
10	swinging fork
11	electric motor
12	reinforcement
13	rear bracket
14	box
15	pin
16	swingarm
17	spring with shock absorber
18	bracket
19	instrument panel
20	airbag
21	front bracket
22	footrests
23	frame of luggage area
24	headrest
25	safety belt
26	control lever
26′	control lever
27	control arm
27′	control arm
28	rod
28′	rod
29	steering arm

29′ steering arm
30 rear suspension fork
31 handle
31′ handle
32 brake lever
32′ brake lever
33 control element
33′ control element
34 locking hole
35 locking pin
36 slide
37 lateral guide profile
37′ lateral guide profile
38 locking screw
39 sidewall
39′ sidewall
40 pressure eccentric
41 locking lever for pressure eccentric
42 pin for pressure eccentric
43 chassis
44 reversibly deformable member
45 preloaded spring
45′ rear position of preloaded spring
46 roller
47 fork extension
48 screw
49 freewheel sprocket
50 freewheel sprocket
51 motor
52 fixing pin
53 fixing pin
54 pinion
55 pedal on the crank
56 converter

57 freewheel sprocket
58 axle of pedal levers
59 first pedal lever
59′ second pedal lever
60 chain of first pedal lever
60′ chain of second pedal lever
61 rotatable pedal
62 freewheel sprocket
63 cable
64 swivel pulley
65 return spring
65′ return spring
66 sleeve
67 bevel gear
67′ bevel gear
68 inserted bevel gear
69 carrier
70 adjustable positionable means
71 rider
72 floor and protective frame
73 crossbeam
74 drive belt
75 ski
76 suspension unit
77 flange of pressure eccentric

CLAIMS

1. An ecological vehicle (1) for transporting persons and/or luggage, comprising at least one support frame with a raised front part, having at least two wheels (2, 3) and at least one seat (4), a steering means connected with at least one steerable wheel (3) and a drive means connected with at least one driven wheel (2), **characterized in that** the support frame forms a diagonally arranged elongated straight beam (5) forming an angle α in the range of 15° to 30° with the horizontal plane (6) and arranged with its rear end before the rear steerable wheel (3) and with its front end above the front driven wheel (2), wherein to the rear end of the beam (5) there is fixed an upwardly extending rear support arm (7) carrying the mounting (8) of the rear steerable wheel (3) and in the central part of the beam (5) there is fixed a downwardly extending front support arm (9) carrying the swinging fork (10) for mounting the front driven wheel (2), and on beam (5) there is further arranged an adjustable mounted seat (4) with the possibility of locking the selected position of the seat (4) on the beam (5).

2. An ecological vehicle according to claim 1, **characterized in that** the rear support arm (7) forms, with the beam (5), an angle of 90° and is connected to it by an obliquely arranged reinforcement (12), wherein the seat (4) is arranged on the beam (5) in the area between the reinforcement (12) and the front support arm (9).

3. An ecological vehicle according to claim 1 or 2, **characterized in that** in the area of the rear end of the beam (5) there is fastened a downwardly extending rear bracket (13) carrying the box (14) for the battery.

4. An ecological vehicle according to at least one of claims 1 to 3, **characterized in that** the front support arm (9) forms, with the beam (5), an acute angle ß and is, at its end, provided with a pin (15) for pivotally mounting the swinging fork (10).

5. An ecological vehicle according to claim 4, **characterized in that** the swinging fork (10) has a swingarm (16) of which one end is pivoted on a pin (15) and its other end is, through a spring with a shock absorber (17), mounted to the top part of the front support arm (9).

6. An ecological vehicle according to at least one of claims 1 to 5, **characterized in that** on the upper side of the beam (5) there is, before the front seat (4), fixed a bracket (18) carrying the instrument panel (19) with the airbag (20).

7. An ecological vehicle according to at least one of claims 1 to 6, **characterized in that** on the front end of the beam (5) there is fixed a front bracket (21) with footrests (22).

8. An ecological vehicle according to claim 7, **characterized in that** the front bracket (21) forms, with the beam (5), an angle of 90°.

9. An ecological vehicle according to at least one of claims 2 to 8, **characterized in that** in the area of the connection of the rear bracket (13) with the reinforcement (12) there is fastened the frame (23) of the luggage space with the headrest (24) and seat belt catch (25).

10. An ecological vehicle according to at least one of claims 2 to 9, **characterized in that** the driving means comprise at least one control lever (26, 26') arranged on the side of the seat (4) and connected with the control arm (27, 27'), mounted pivotally on the rear support arm (7), which is connected via rods (28, 28') connected with the control arm (29, 29') for rotating the rear suspended forks (30) in the swivel mounting (8).

11. An ecological vehicle according to claim 10, **characterized in that** the two control levers (26, 26') are arranged on both sides of the seat (4) and are coupled for synchronized movement, wherein on the ends of at least one control lever (26, 26') is a handle (31, 31') with a brake lever (32, 32') and with a control element (33, 33').

12. An ecological vehicle according to at least one of claims 1 to 11, **characterized in that** the beam (5) is composed of a closed profile whose height is greater than its width.

13. An ecological vehicle according to claim 12, **characterized in that** the upper side of the beam (5) is provided with an assembly of locking holes (34) into which fits the locking pin (35) arranged in the slide (36) on the underside of the seat (4), and with the slide (36) there are connected the lateral guiding profiles (37, 37') movably adjacent to

the sidewalls of the beam (5), and with the side guiding profiles (37, 37') there are connected the sidewall (39, 39') in which there is pivotally mounted the pressure eccentric (40) with flanges (77), abutting the underside of the beam (5) and provided with a locking lever (41).

14. An ecological vehicle according to at least one of claims 1 to 13, **characterized in that** it is provided with a movably mounted chassis (43) which, in its front part, is provided with a reversibly deformable member (44).

15. An ecological vehicle according to claims 7 to 14, **characterized in that** between the front bracket (21) and the chassis (43) there is fastened at least one preloaded spring (45) for holding the chassis (43) in a front unstable position, with the possibility of moving the chassis (43) to the rear unstable position (45') upon impact and of returning it back to the front unstable position.

16. An ecological vehicle according to claims 9 to 14, **characterized in that** the rear part of the chassis (43) is mounted on rollers (46) in the frame (23) of the luggage space.

17. An ecological vehicle according to at least one of claims 1 to 16, **characterized in that** the drive means comprises an electric motor (11) and/or another motor (51) driving the front driven wheel (2).

18. An ecological vehicle according to claim 17, **characterized in that** the electric motor (11) is mounted in the hub of the front driven wheel (2).

19. An ecological vehicle according to claim 17 or 18, **characterized in that** to the front support arm (9) is mounted, by means of fastening pins (52, 53), another motor (51) with a generator for recharging the battery in the box (14).

20. An ecological vehicle according to at least one of claims 1 to 19, **characterized in that** the drive means comprises rotary pedals (55) on a crank with a converter (56), arranged in the front part of the beam (5), wherein the converter (56) drives, with at least one chain, a pinion (54) of the front driven wheel (2).

21. An ecological vehicle according to claims 5 and 20, **characterized in that** the pin (15) for pivotally mounting the swinging fork (10) comprises a shaft mounted rollably in the fork extension (47) fastened to the front support arm (9), and connected to the shaft are freewheel sprockets (49, 50), one of which is connected by a chain with the converter (56) of the pedals (55), and the second is connected by the chain with the pinion (54) of the front driven wheel (2).

22. An ecological vehicle according to at least one of claims 1 to 19, **characterized in that** the drive means comprises two pedal levers (59, 59') with rotatable pedals (61), mounted on a common axis (58) in the front part of the beam (5) and with the possibility of rocking motion of the pedal levers (59, 59') on the sides of the beam (5) and of the front driven wheel (2), wherein the pedal levers (59, 59') are provided with a means for transferring the force of the pedaling to the pinion (54) of the front driven wheel (2), and to the pedal levers (59, 59') there are connected one end of a return spring (65, 65') whose other ends are anchored to the beam (5).

23. An ecological vehicle according to claims 5 and 22, **characterized in that** the means for transmitting the force is formed by chains (60, 60') fastened to the lower ends of the pedal levers (59, 59'), wherein the chains (60, 60') engage with freewheel sprockets (57, 62) connected with the shaft forming the pin (15), pivotally mounted in the fork extension (47) which is fastened to the front support arm (9), and the ends of the chains (60, 60') are, behind the sprockets (57, 62), mutually connected by a cable (63) guided over a roller (64) mounted on the support (5), wherein with the shaft forming the pin (15) there is connected another chain freewheel (49) connected by a chain with a toothed pinion (54) of the front driven wheel (2).

24. An ecological vehicle according to claim 22 or 23, **characterized in that** the center of the axis (58) is pivotally mounted in a sleeve (66) connected with the beam (5), and each pedal lever (59, 59') is connected with one beveled sprocket (67, 67') pivotally mounted on an axis (58), wherein the bevel sprockets (67, 67') are engaged with a common inserted bevel sprocket (68) arranged perpendicularly to the axis (58).

25. An ecological vehicle according to at least one of claims 22 to 24, **characterized in that** the second ends of the return springs (65, 65') are secured to the carrier (69) movably connected with the beam (5) by an adjustable positionable means (70) for setting the preload of the return springs (65, 65').

26. An ecological vehicle according to claims 5 and 17, **characterized in that** the drive means comprises a motor (51) fixed to the front support arm (9) by means of fastening pins (52, 53), wherein the pin (15) for pivotally mounting the swinging fork (10) comprises a shaft mounted rollably in the fork extension (47) which is fastened to the front support arm (9), and with the shaft there are connected freewheel sprockets (49, 50), one of which is connected by a chain to the drive gear of the motor (51) and the second chain is connected by a chain with the driven pinion (54) of the front driven wheel (2).

27. An ecological vehicle according to at least one of claims 1 to 26, **characterized in that** it is made as a single-track vehicle with one steerable rear wheel (3) and with one front driven wheel (2) on a common straight longitudinal beam (5).

28. An ecological vehicle according to at least one of claims 1 to 26, **characterized in that** it is made as a three-track vehicle with two steerable rear wheels (3) and with one front driven wheel (2) on a common straight longitudinal beam (5).

29. An ecological vehicle according to at least one of claims 1 to 26, **characterized in that** it is made as a two-track vehicle with two steerable rear wheels (3) and with two front wheels (2) of which at least one is driven, whereby the frame of the vehicle is comprised of at least two longitudinal straight beams (5) interconnected by at least one crosspiece (73).

30. An ecological vehicle according to at least one of claims 1 to 29, **characterized in that** it is formed as multi-seated and includes at least two seats (4).

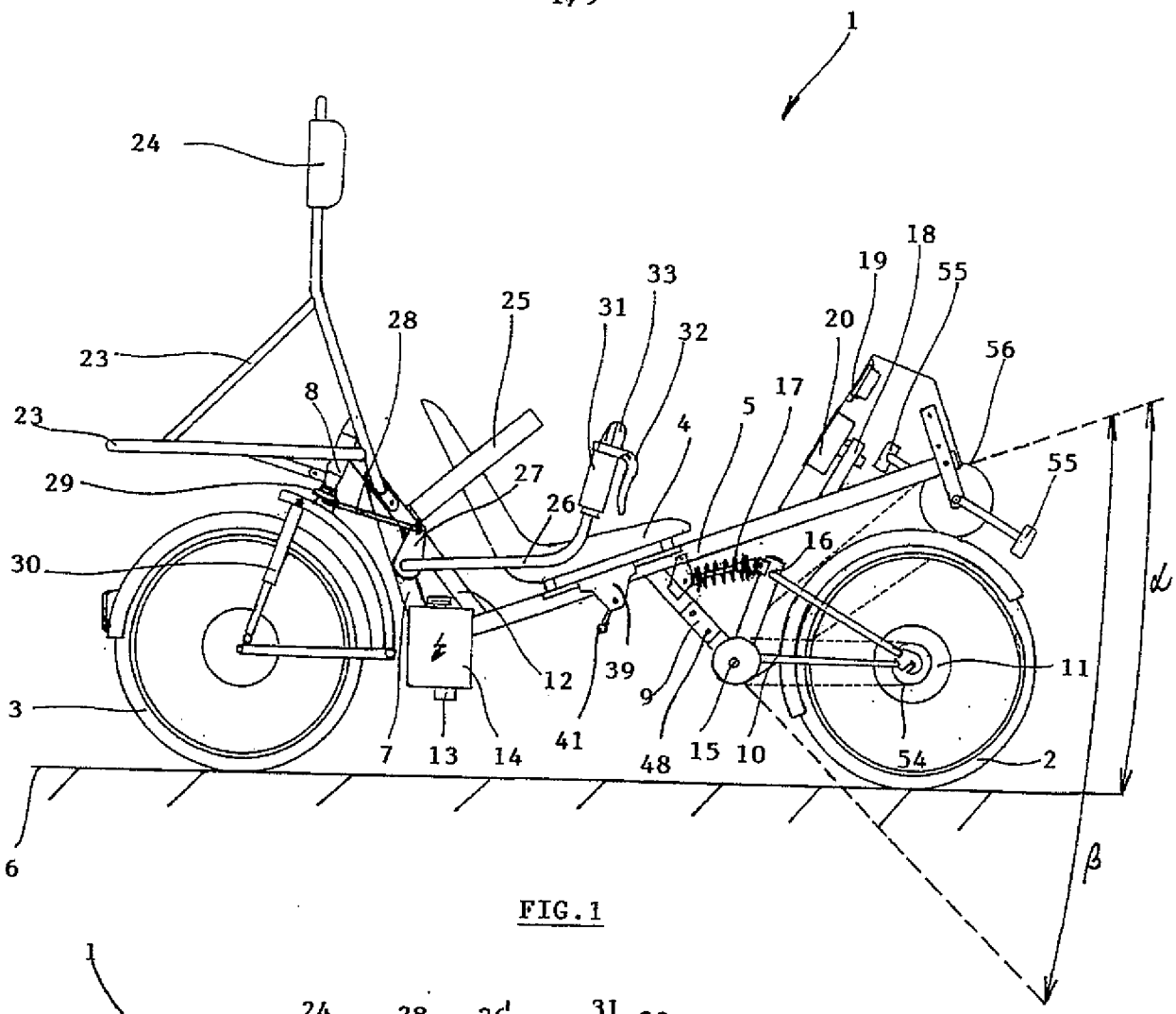

1
24
23
23
29
30
3
6
28
25
8
31
33
32
4
5
17
18
19
55
20
56
55
27
26
16
12
39
9
41
48
15
10
7
13
14
54
2
11
α
β

FIG.1

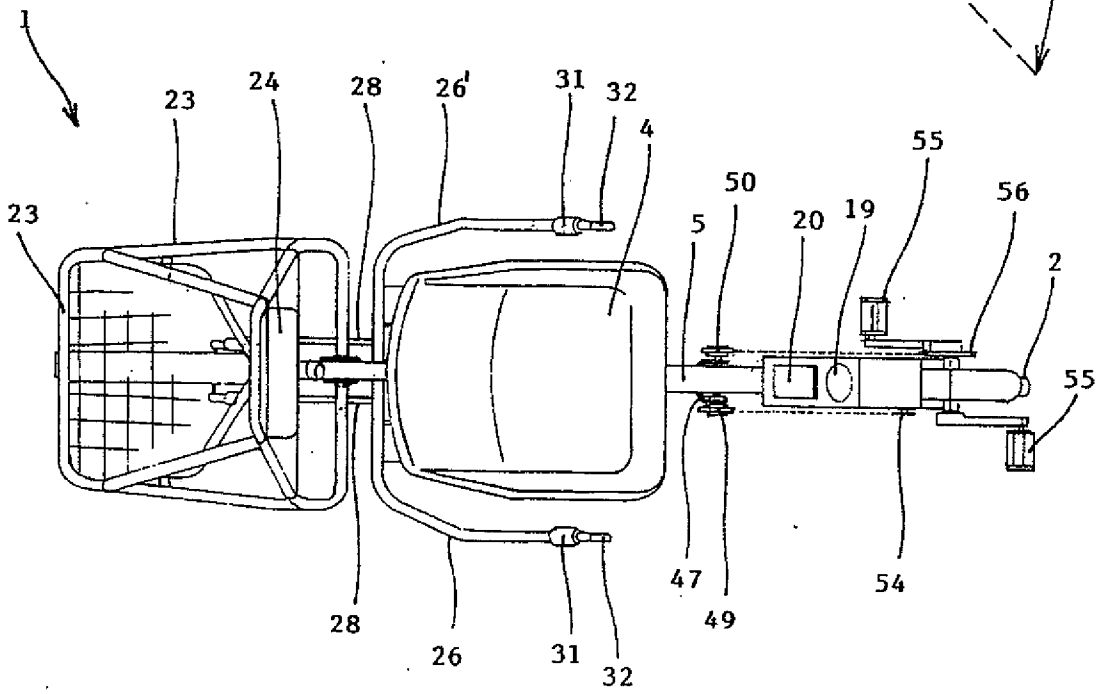

1
23
24
28
26'
31
32
4
23
50
5
20
19
55
56
2
55
28
26
31
32
47
49
54

FIG.2

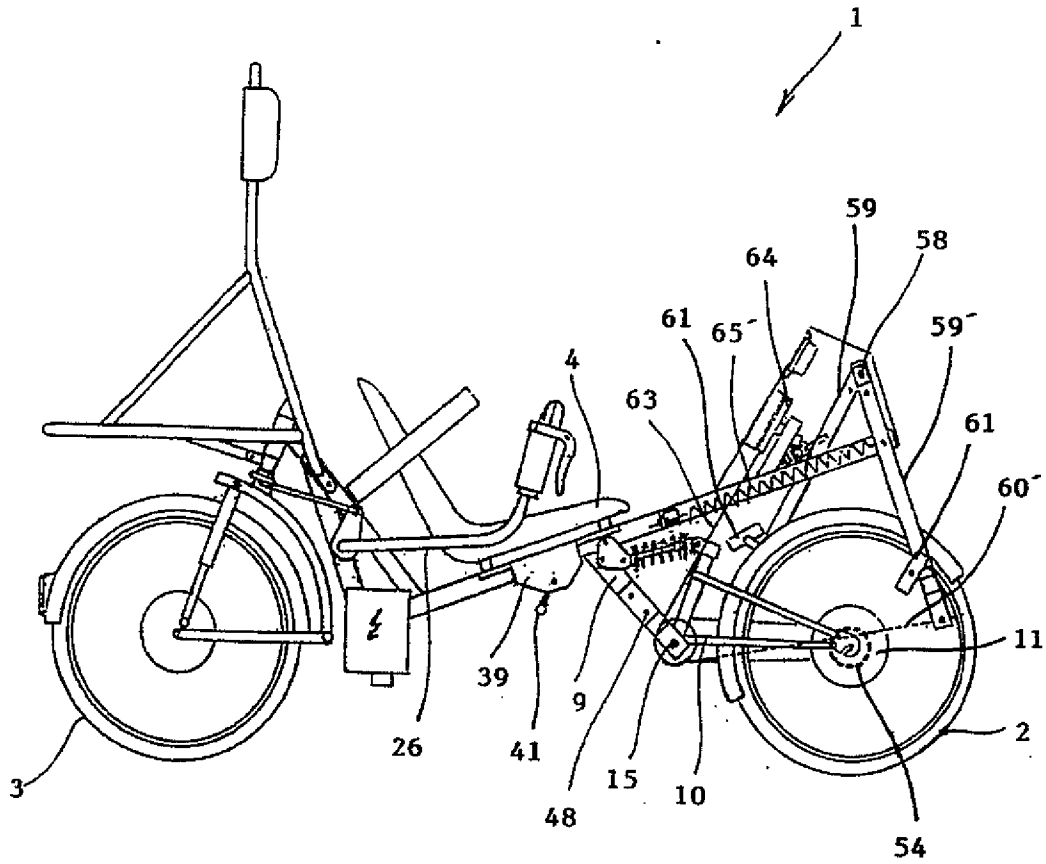

1
59
58
64
61
65´
59´
4
63
61
60´
11
2
3
26
41
39
9
15
10
48
54

FIG.3

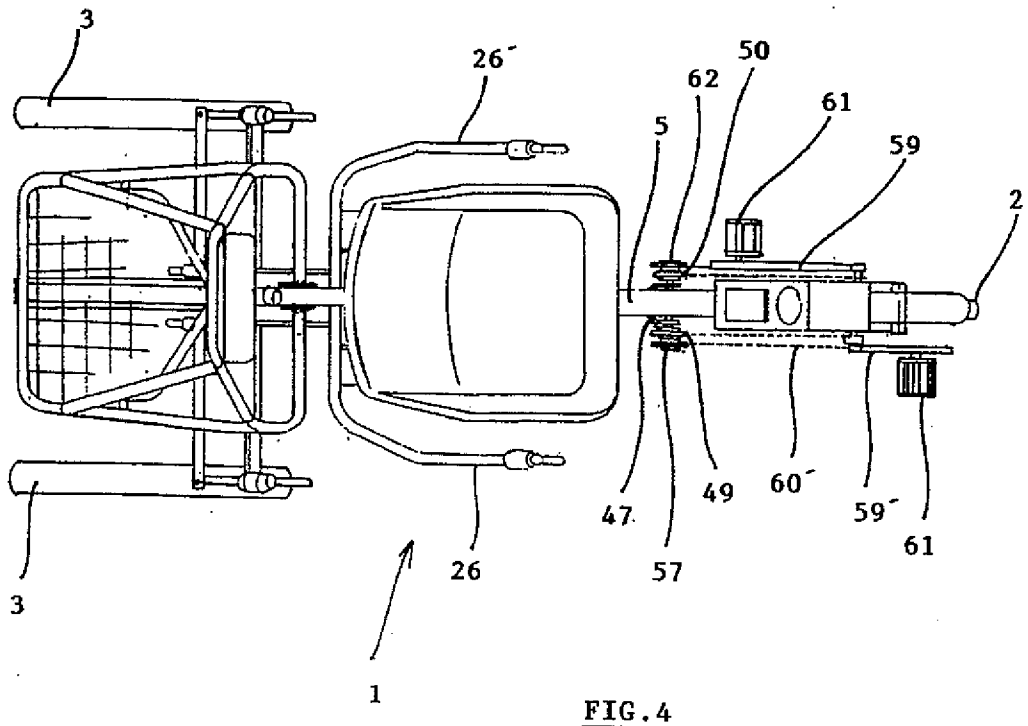
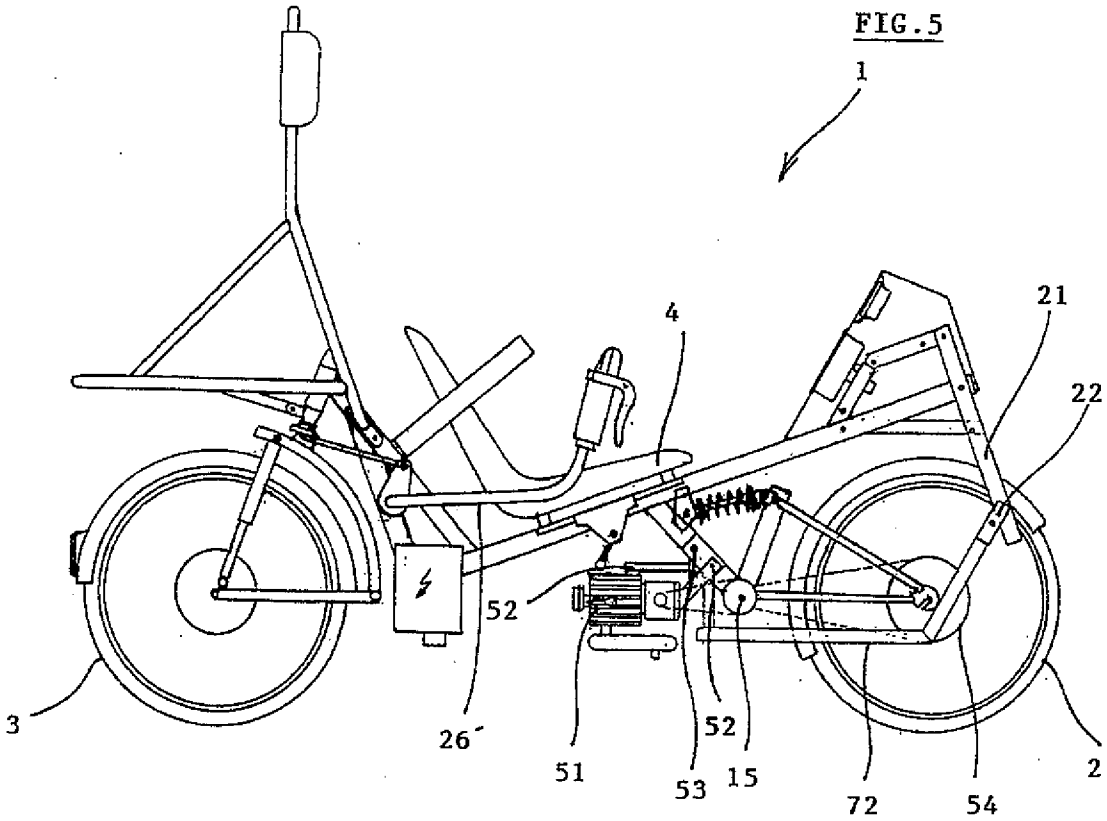

3
26´
50
62
61
59
5
2
47
49
60´
59´
61
57
26
3
1

FIG.4

FIG.5



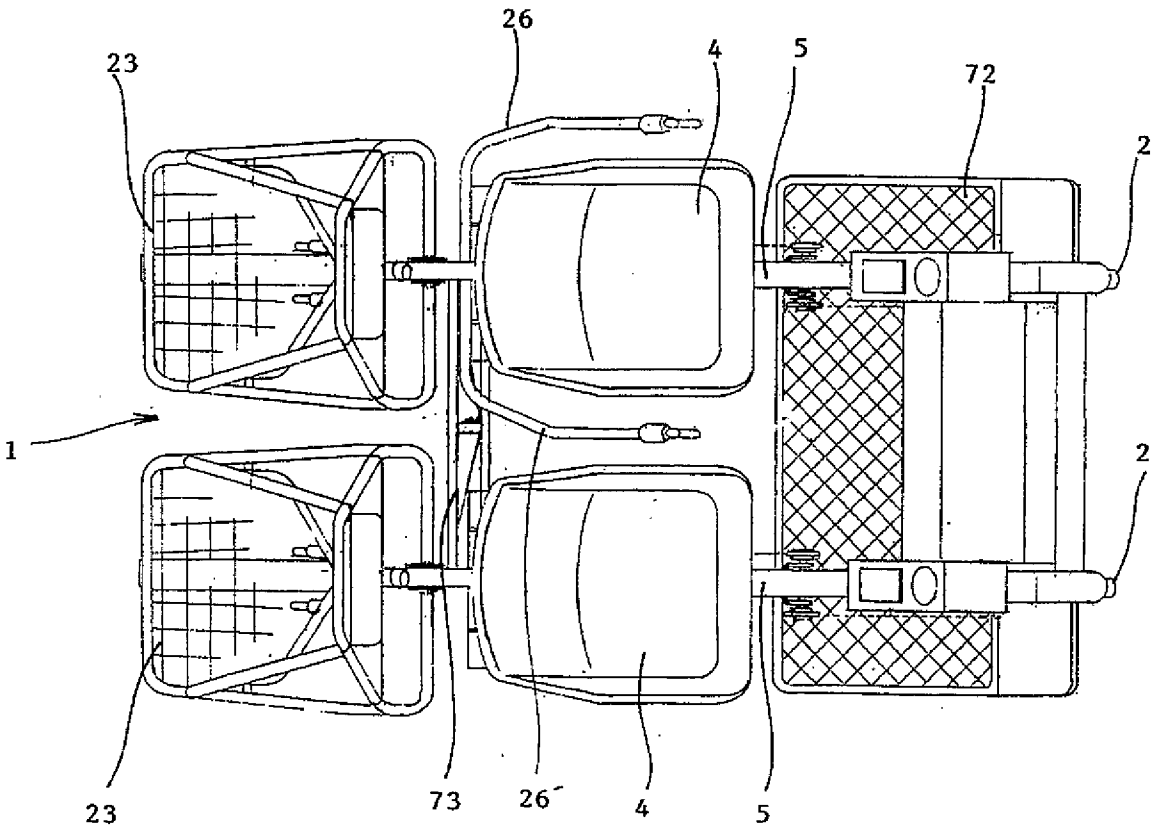


FIG.6

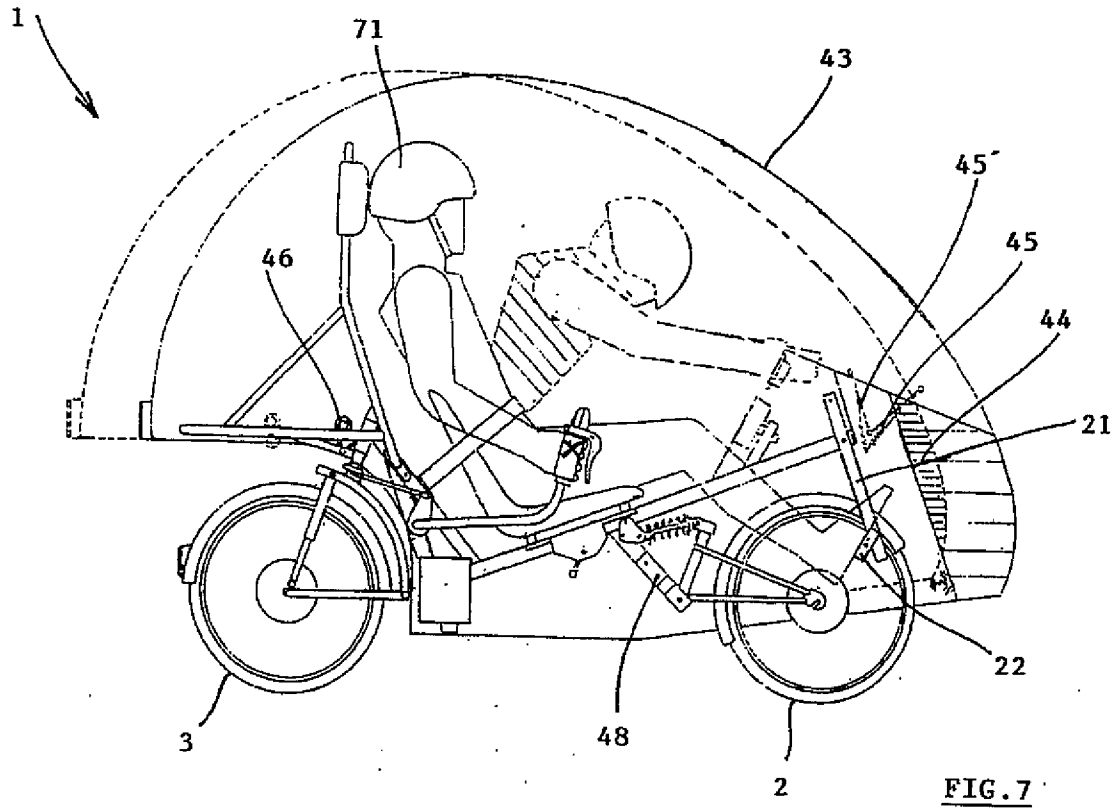


FIG.7

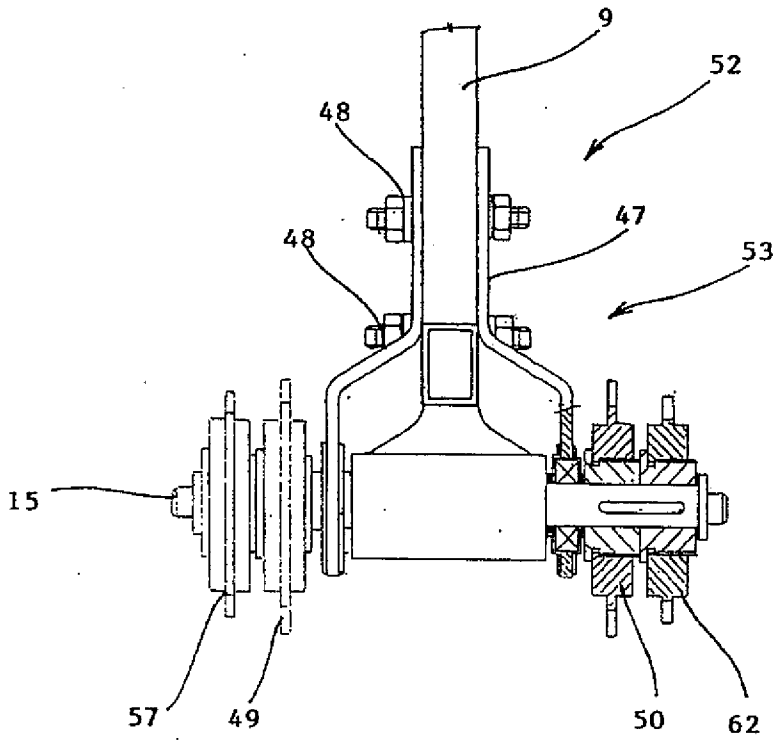


FIG.8

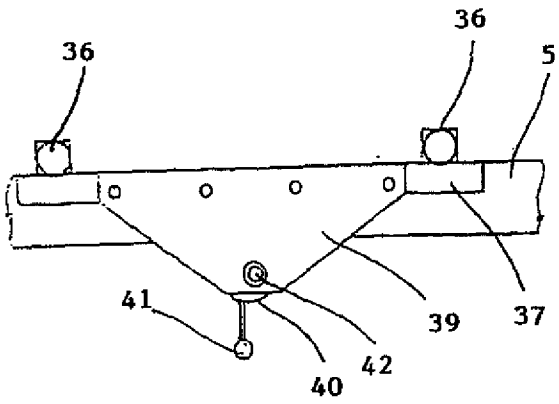


FIG.9

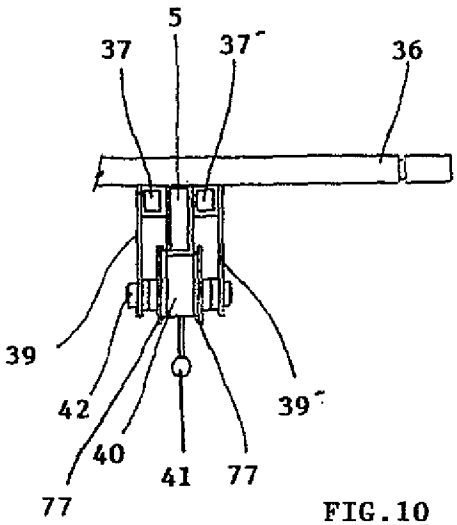


FIG.10

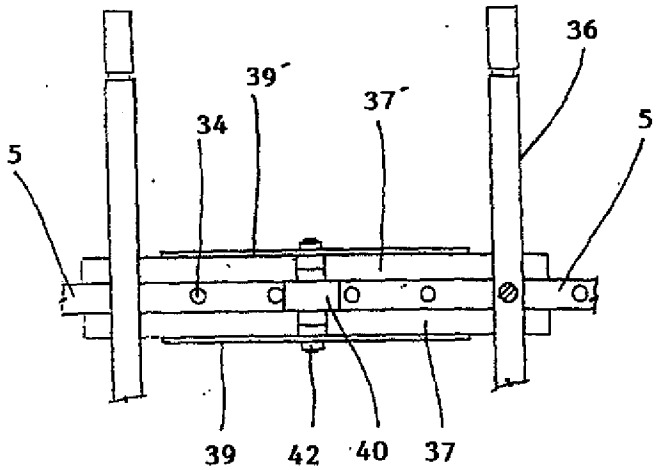


FIG.11

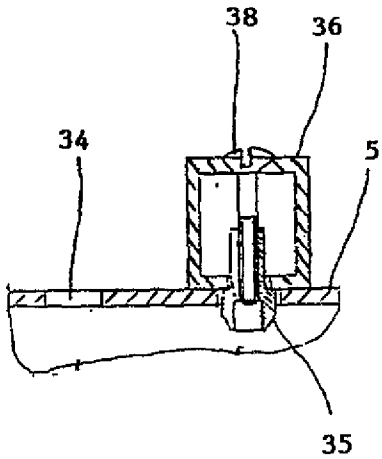


FIG.12

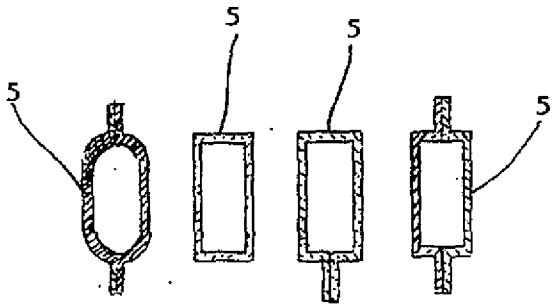


FIG.13

FIG.14

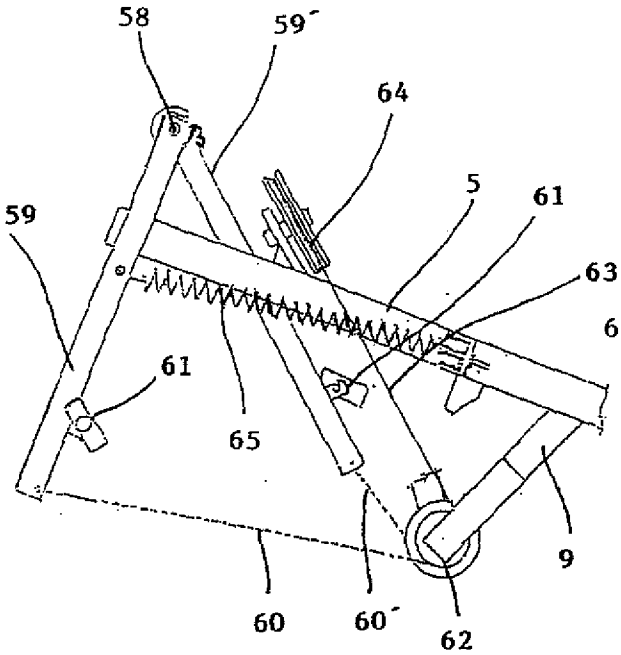
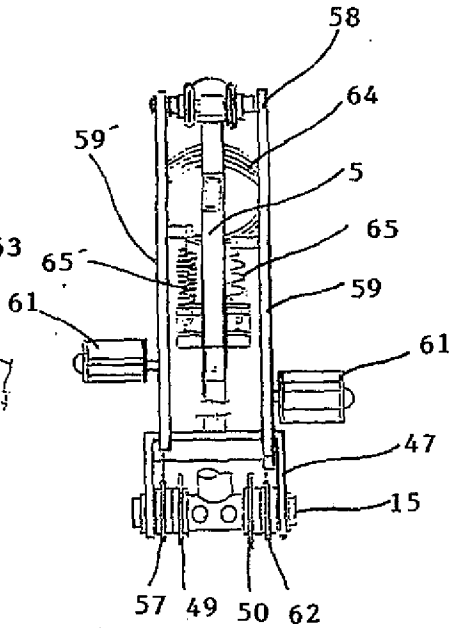


FIG.15



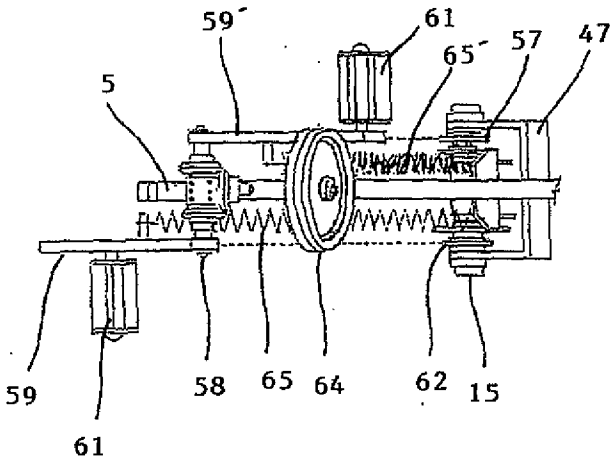


FIG.16

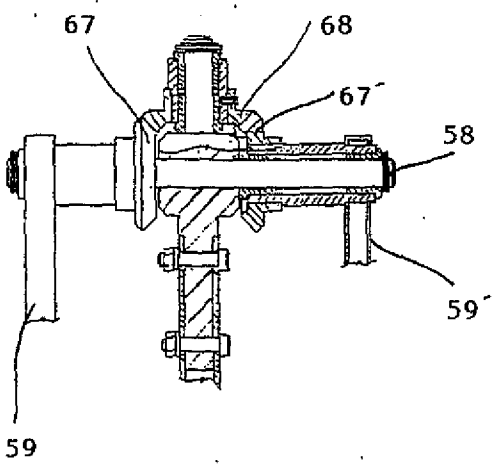


FIG.17

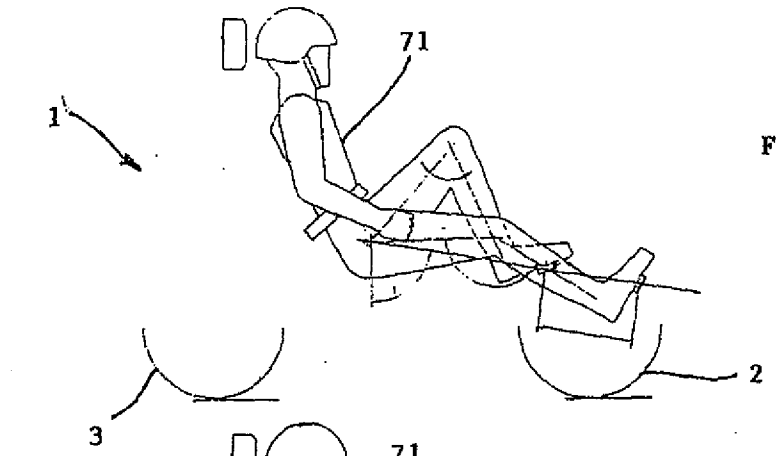
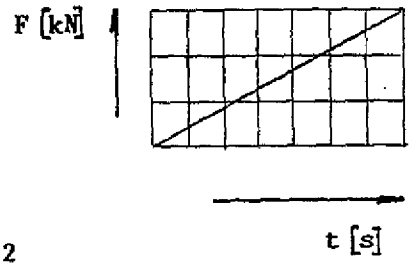


FIG.18



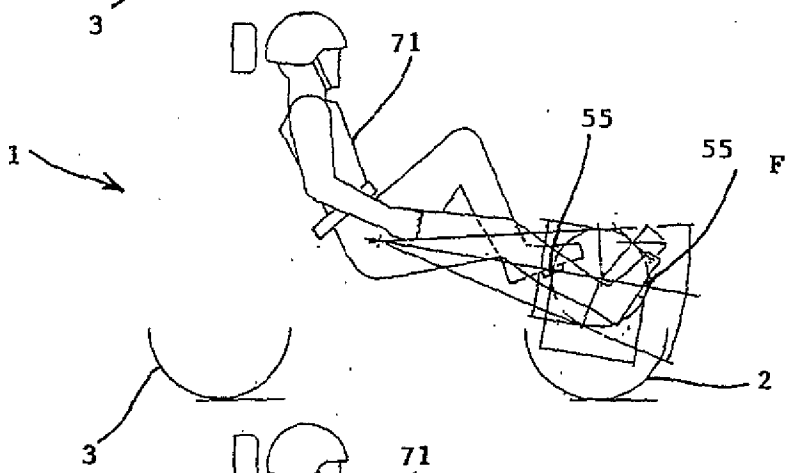
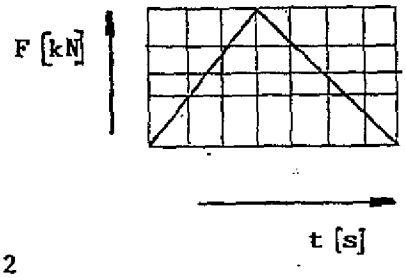


FIG.19



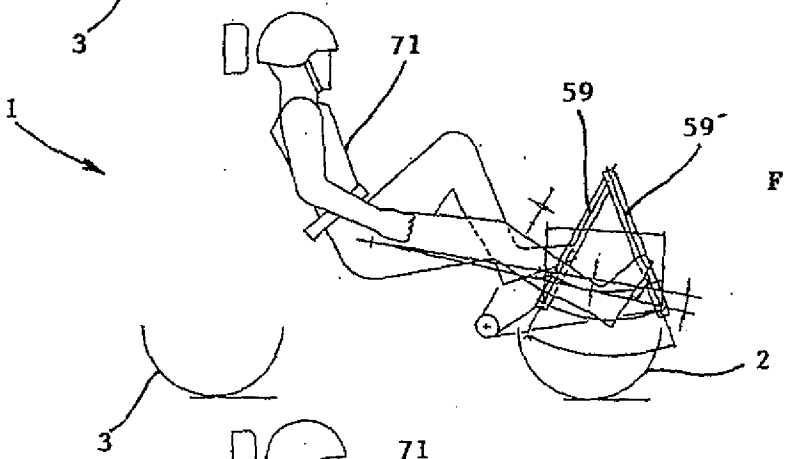
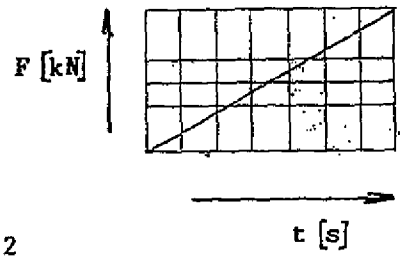


FIG.20



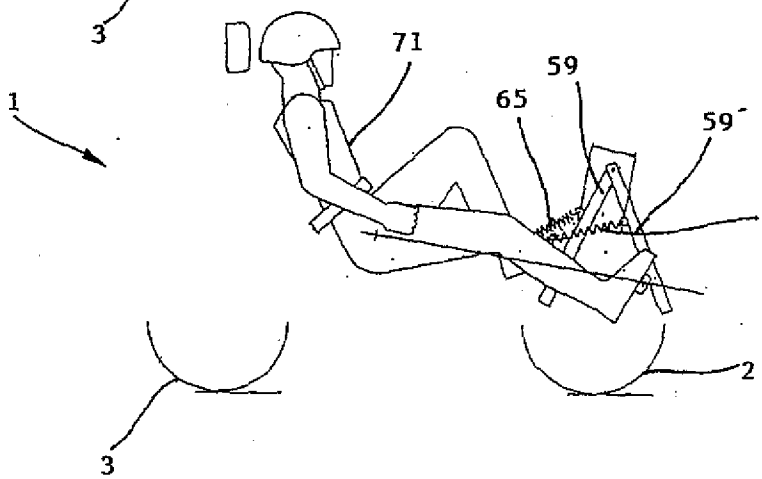


FIG.21

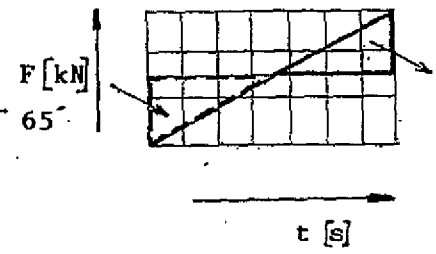


FIG.22

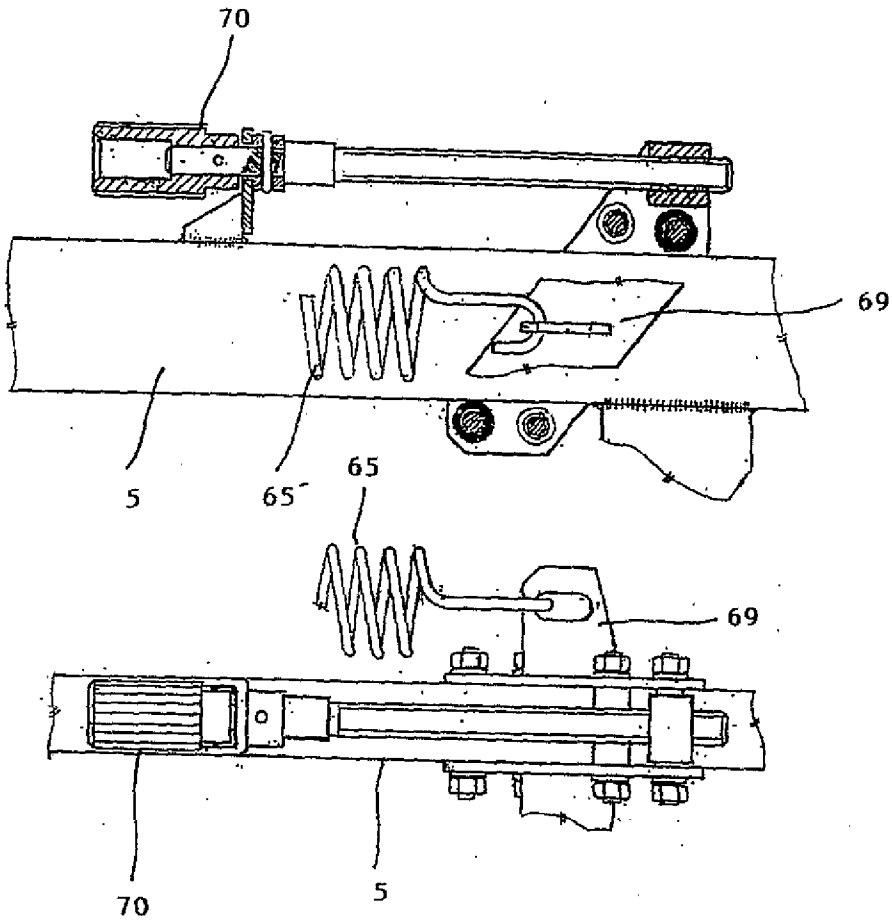


FIG.23

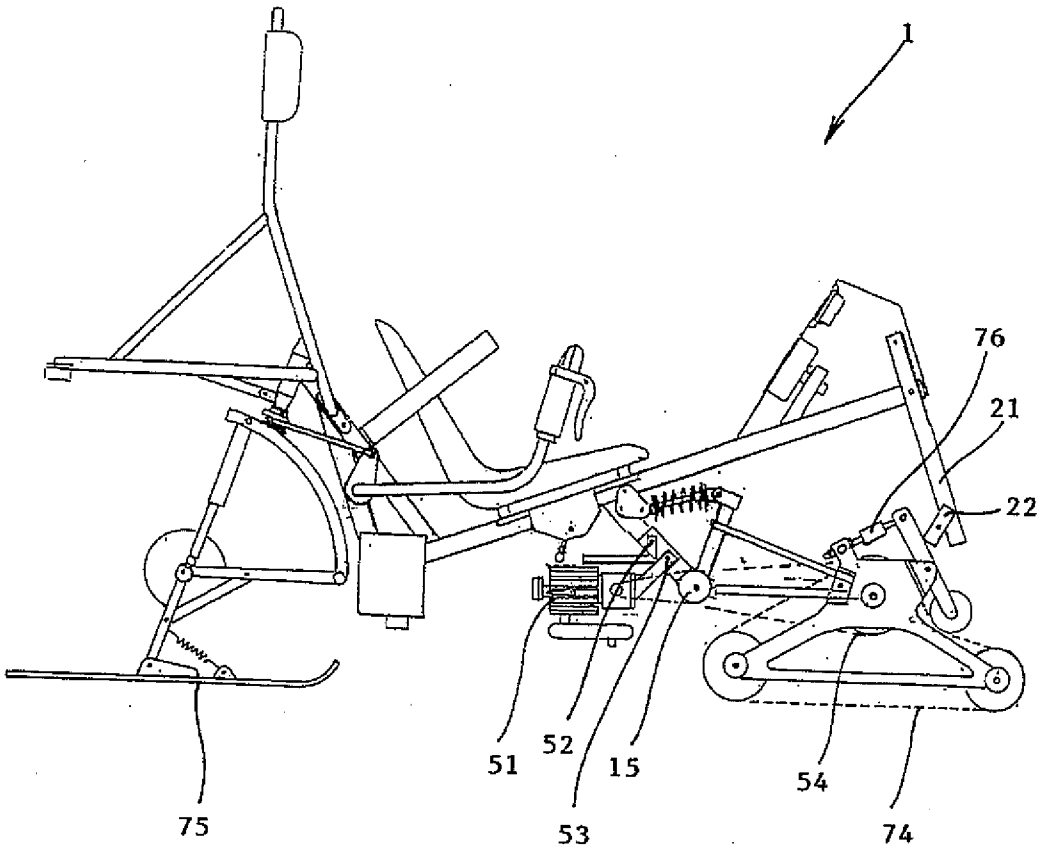


FIG.24

INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2015/000036

A. CLASSIFICATION OF SUBJECT MATTER
INV. B62K3/00 B62K3/10
ADD.

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)
B62K

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10 2007 007783 A1 (STRAUCH FALKO [DE]; ZEIDLER GREGOR [DE]) 23 August 2007 (2007-08-23) paragraph [0043] - paragraph [0043]; figure 2	1,5,12, 13,20
A	DE 195 11 629 A1 (JOACHIMSTHALER GUENTHER [DE]) 2 October 1996 (1996-10-02) column 6, line 29 - column 9, line 38; figure 1	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 July 2015	23/07/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Feber, Laurent

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/CZ2015/000036

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102007007783 A1	23-08-2007	NONE	
DE 19511629 A1	02-10-1996	NONE	