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(54) **ROLLING SPORTS EQUIPMENT**

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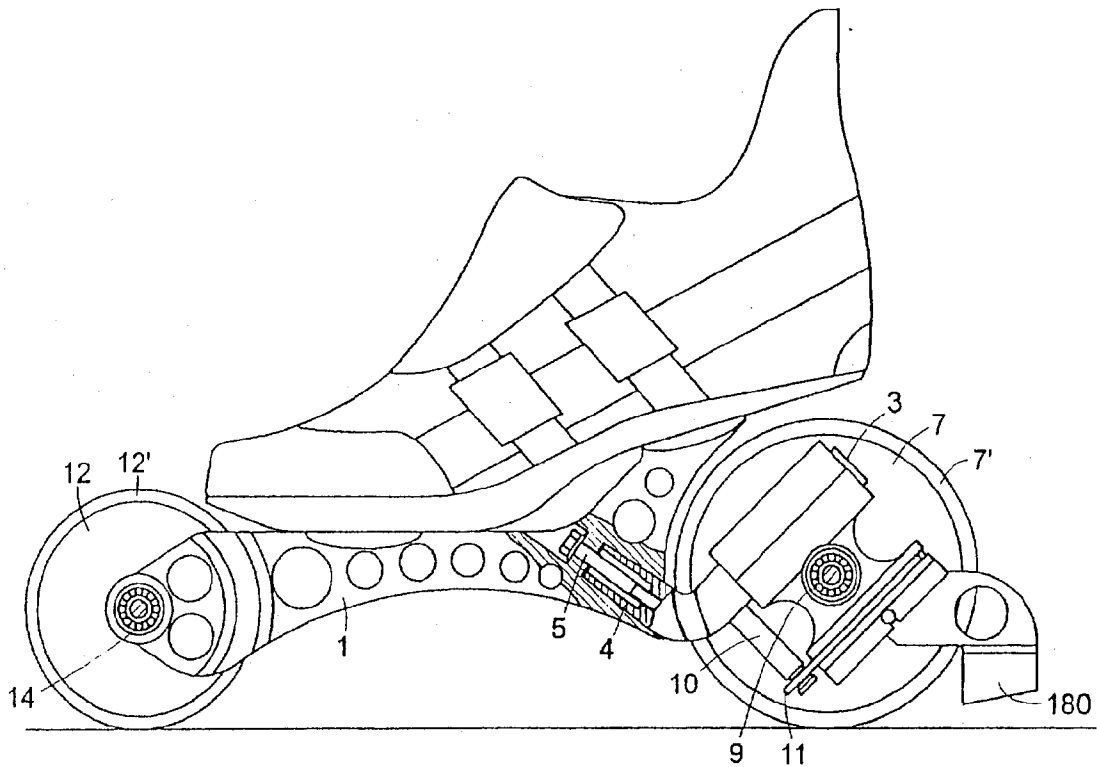
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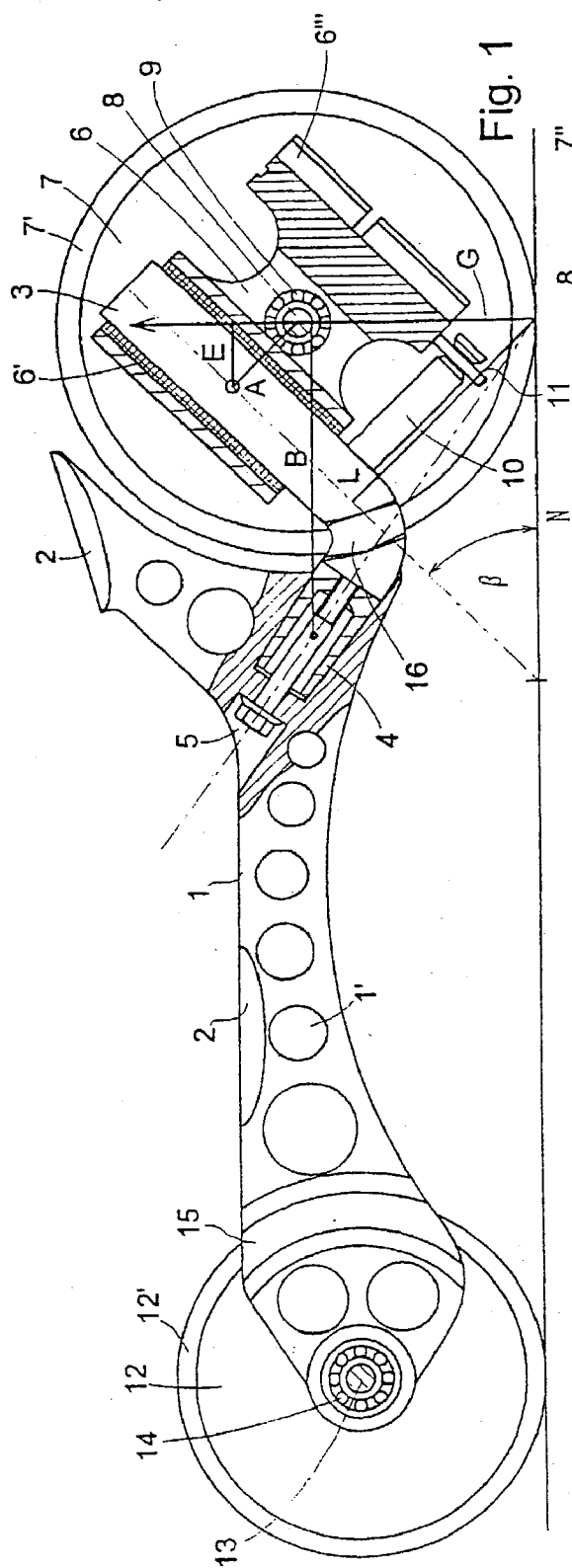
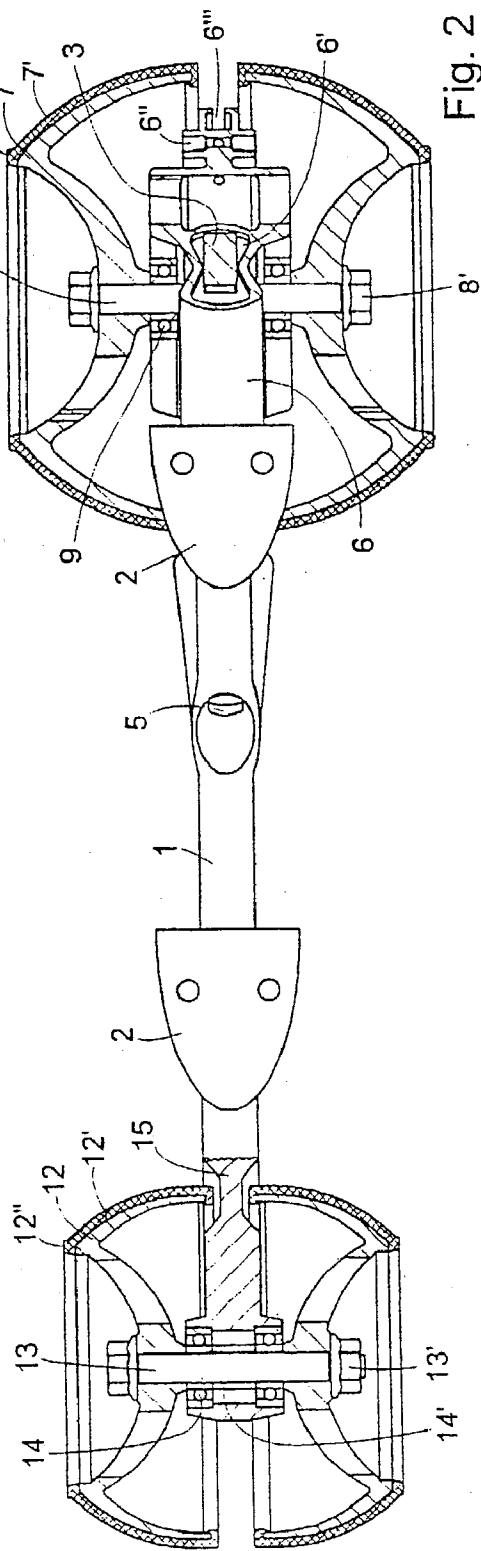
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ABSTRACT

In a roller sport device, particularly a single-track skateboard or a single-track roller skate, having two roller axles disposed one behind the other with single-track rollers which run one behind the other and which are disposed thereon, which axles are disposed on a board or on a supporting frame, the rearmost of the two roller axles (rear axle) can swivel about an axle (steering axle) which points obliquely downwards and forwards and which forms a trailing angle. The running faces of the rollers are curved transversely to the direction of travel and have a high coefficient of friction similar to that of rubber.





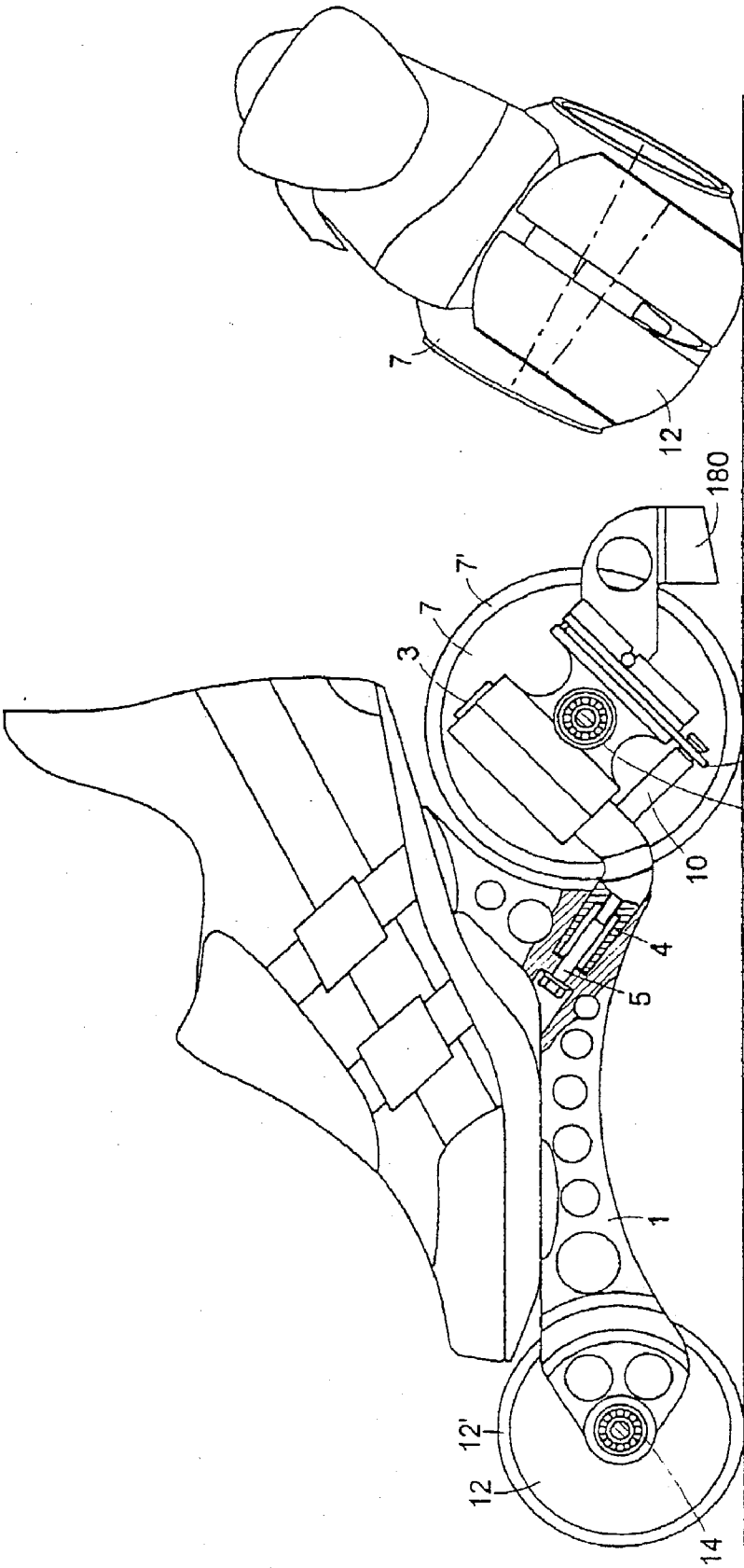


Fig.4

Fig.3

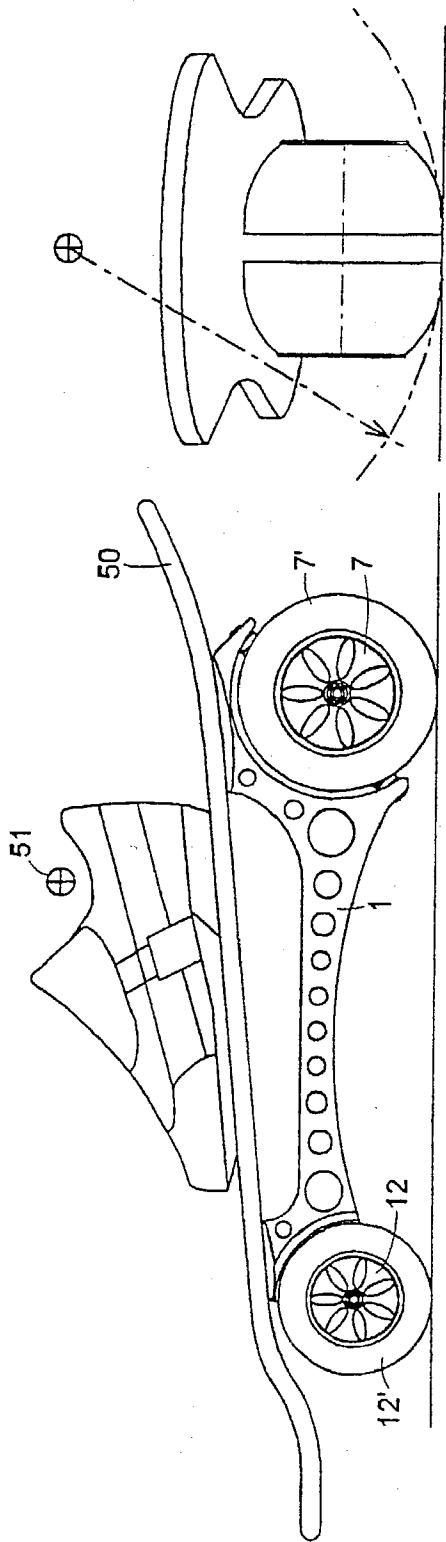


Fig. 5

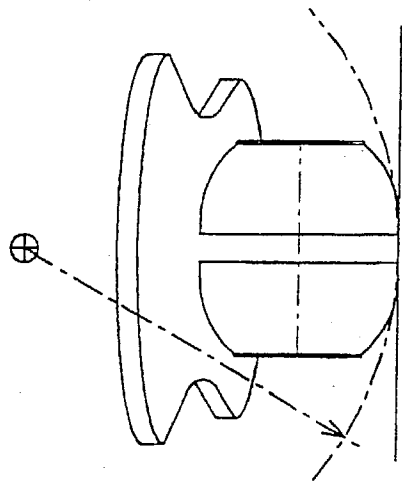


Fig. 7

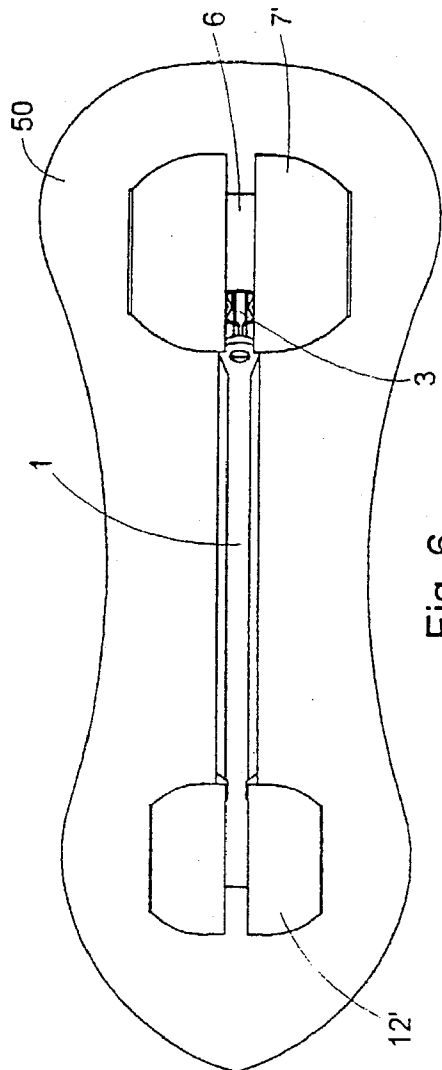


Fig. 6

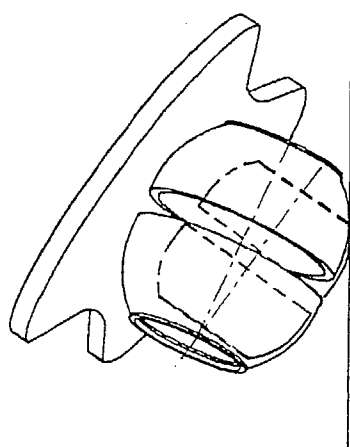
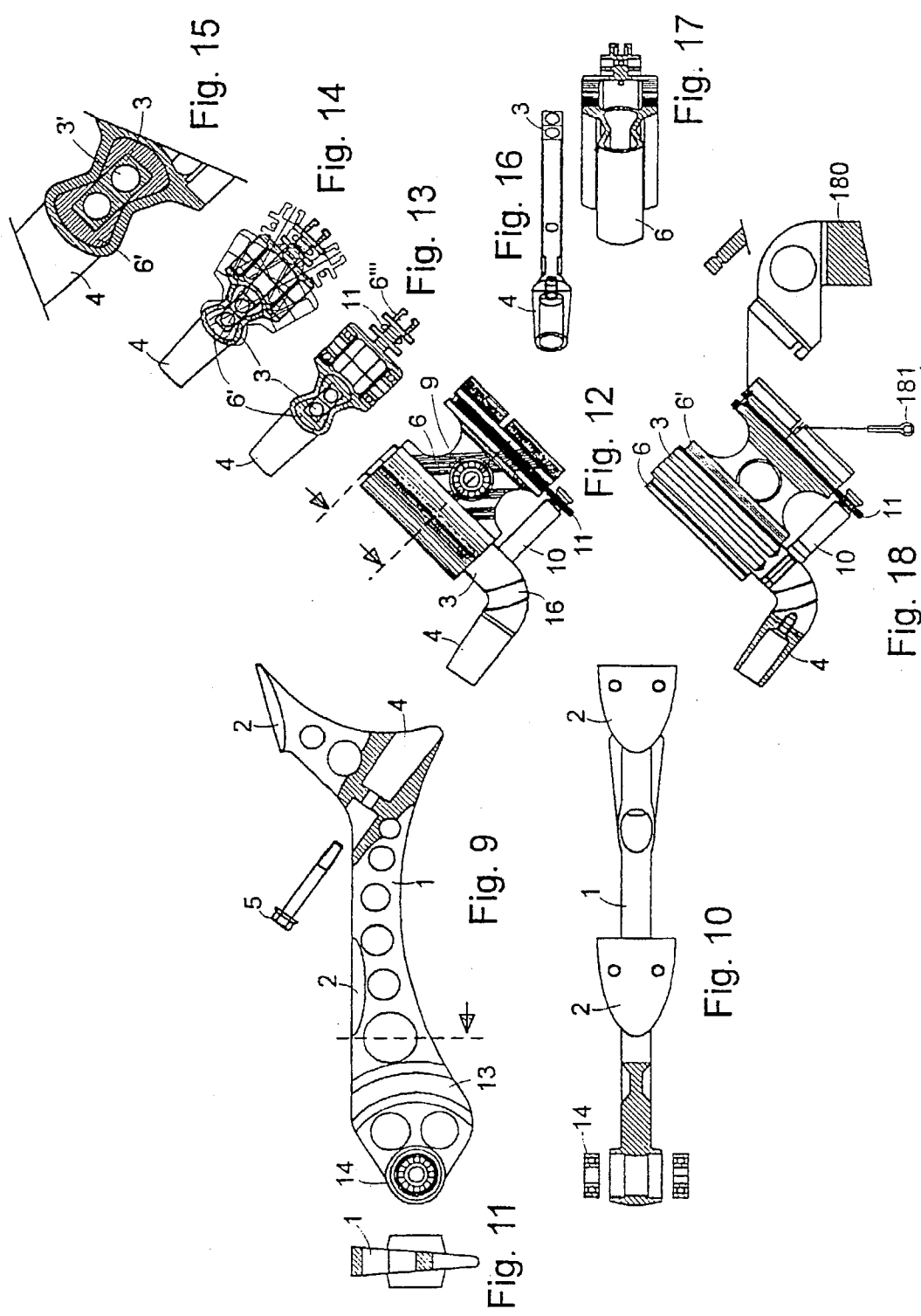
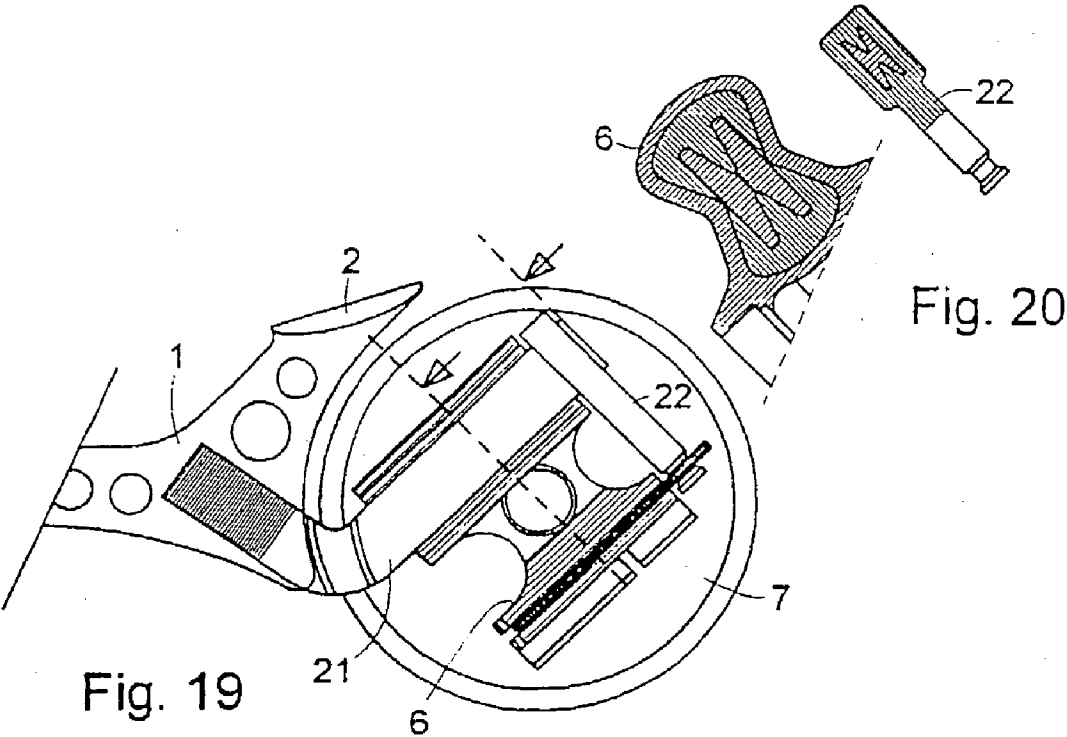
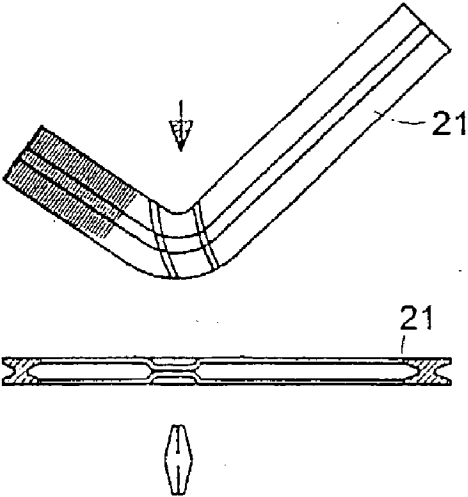


Fig. 8





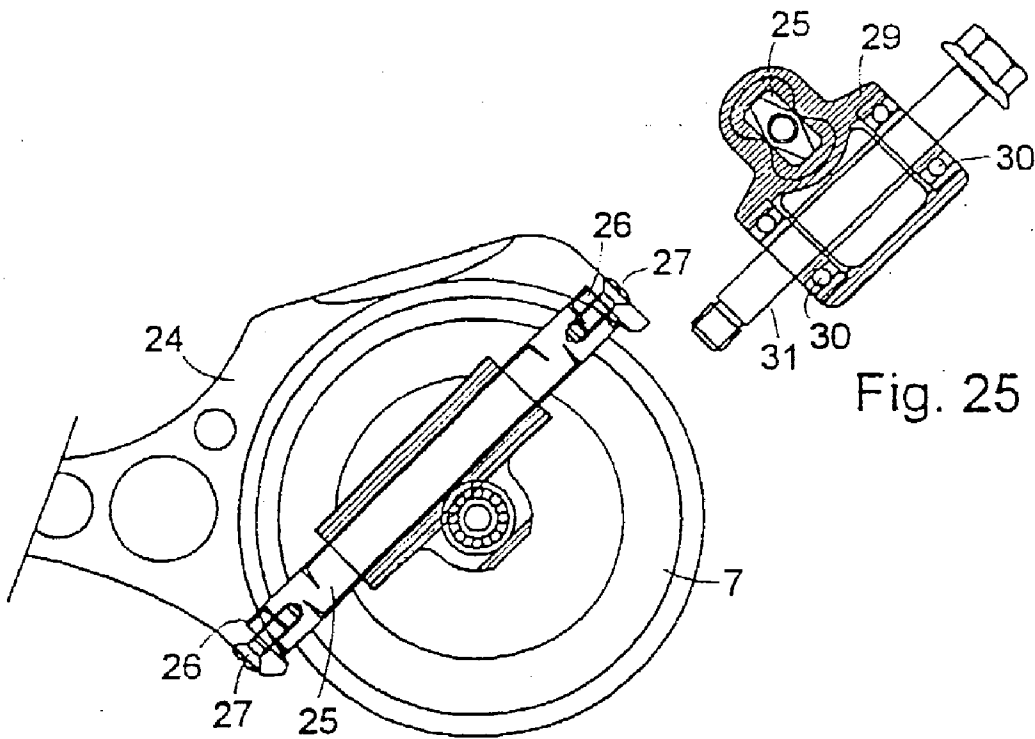


Fig. 22

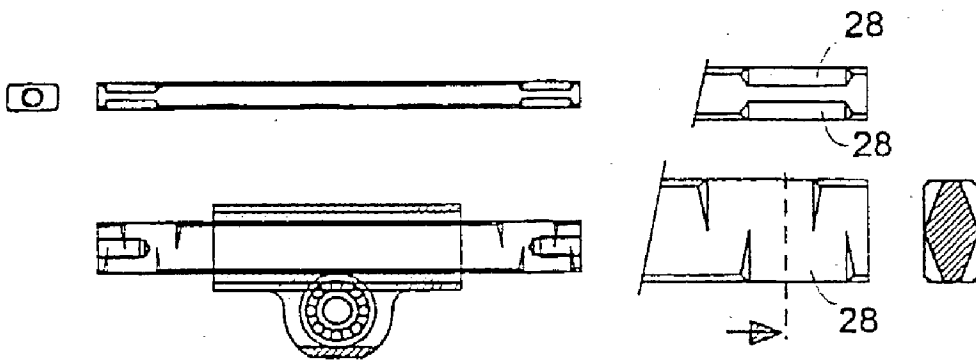


Fig. 23

Fig. 24

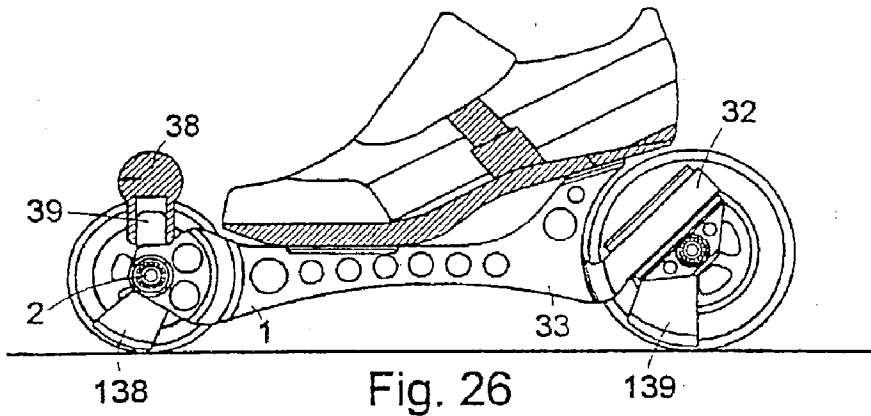


Fig. 26

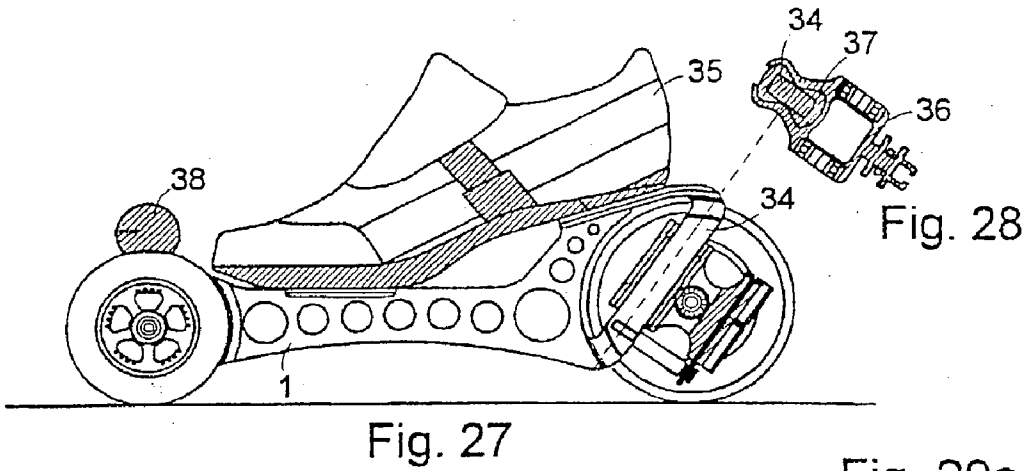


Fig. 27

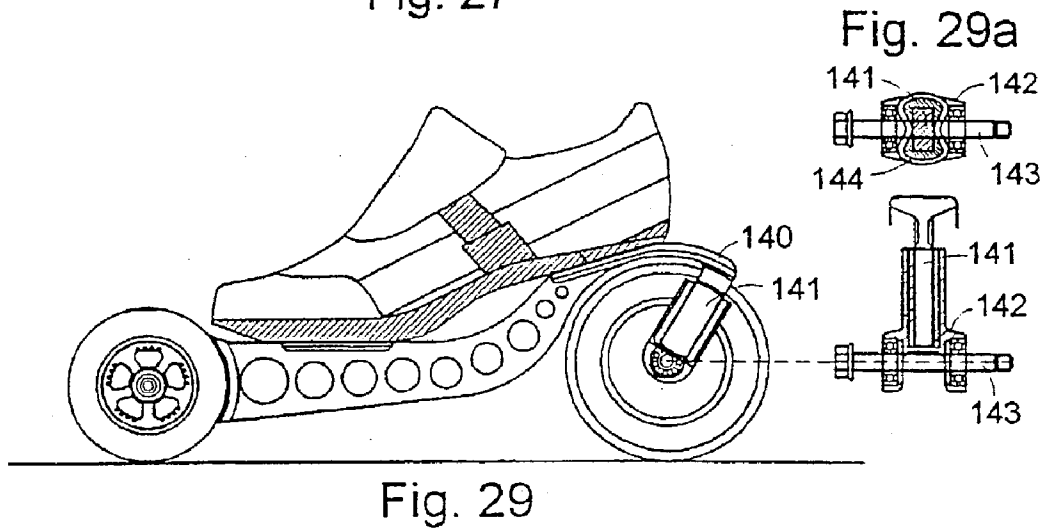
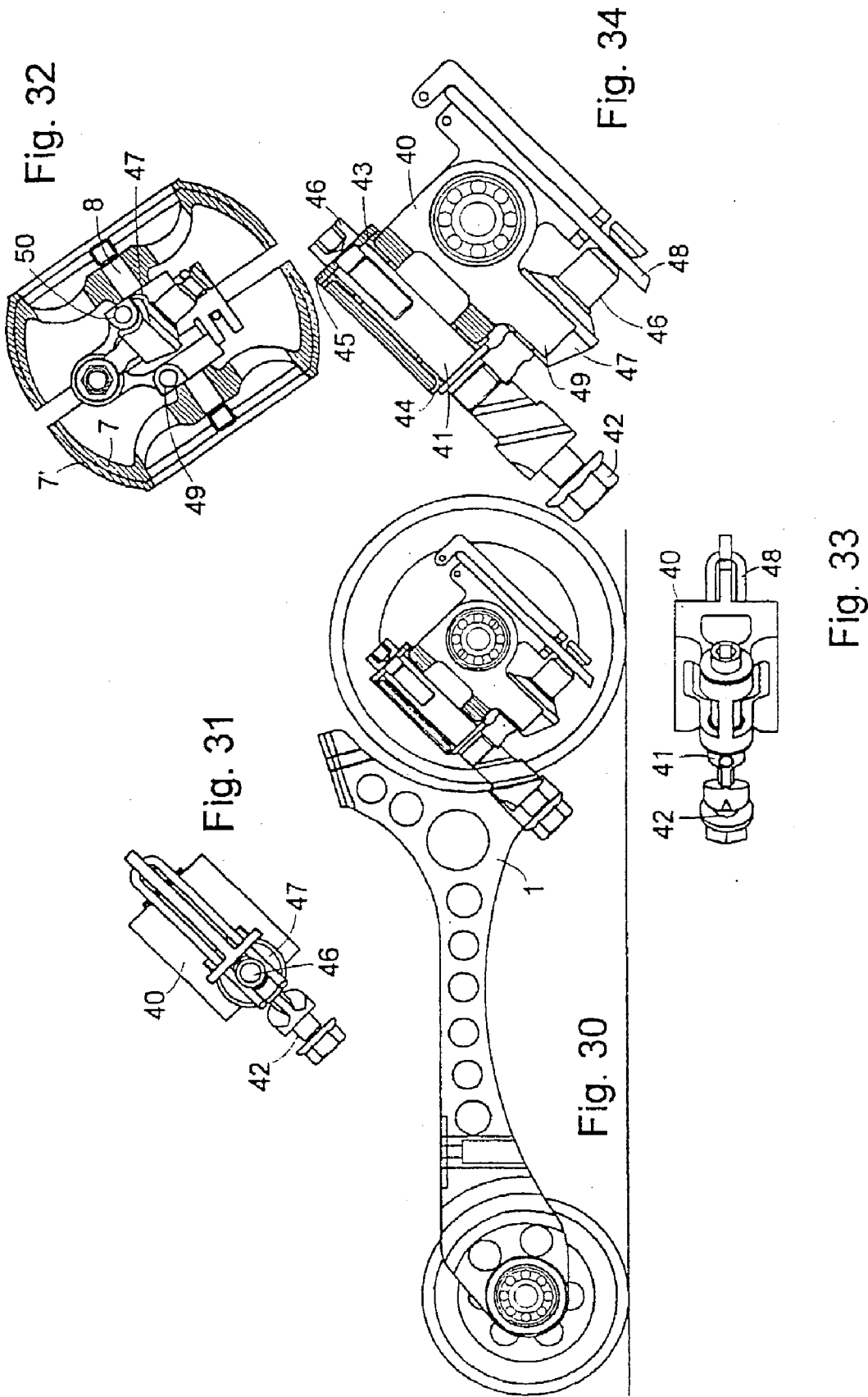


Fig. 29



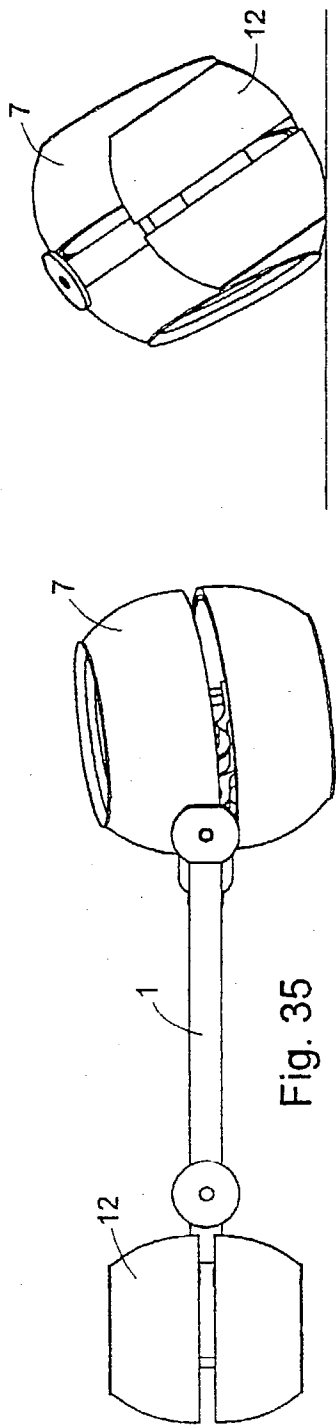


Fig. 36

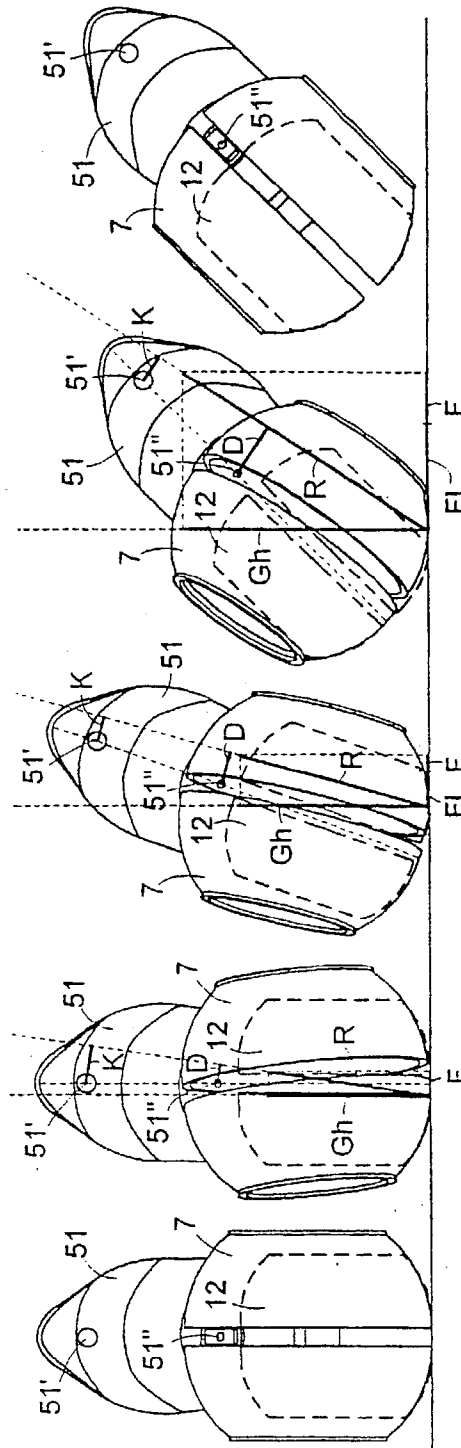


Fig. 40b

Fig. 40a

Fig. 39

Fig. 38

Fig. 37

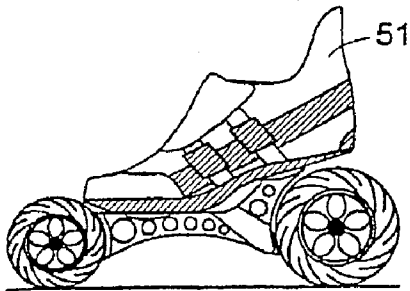


Fig. 41

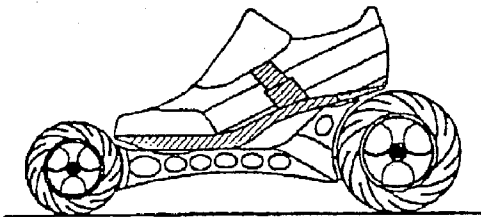


Fig. 42

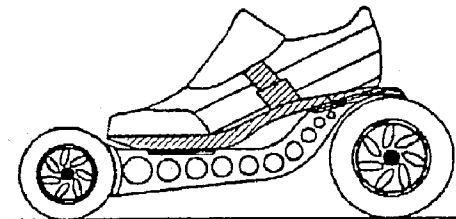


Fig. 43

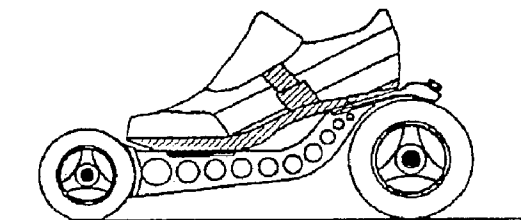


Fig. 44

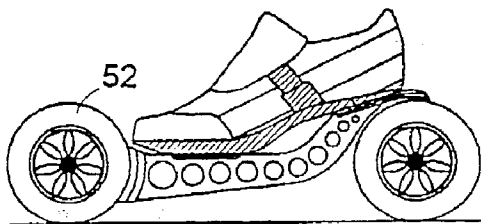


Fig. 45

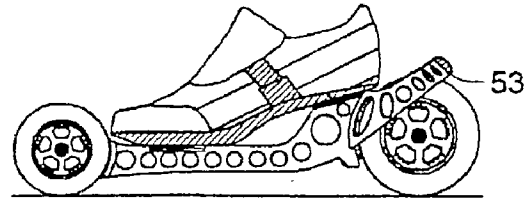


Fig. 46

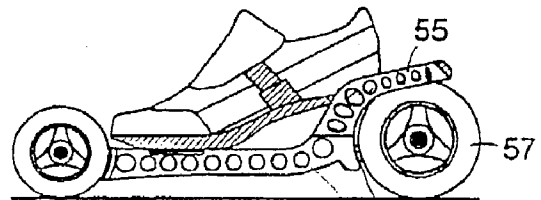


Fig. 47

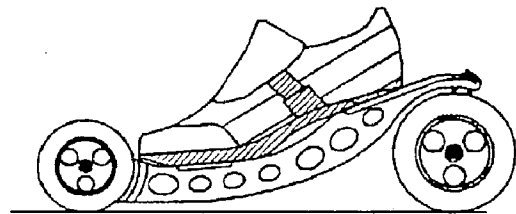


Fig. 48

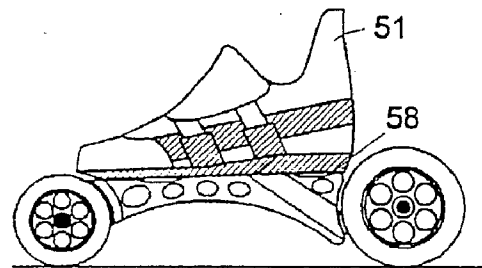


Fig. 49

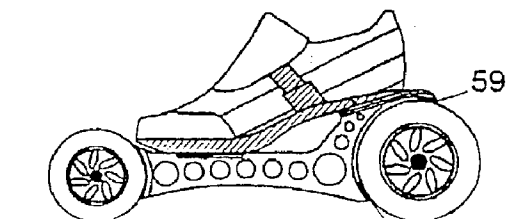


Fig. 50

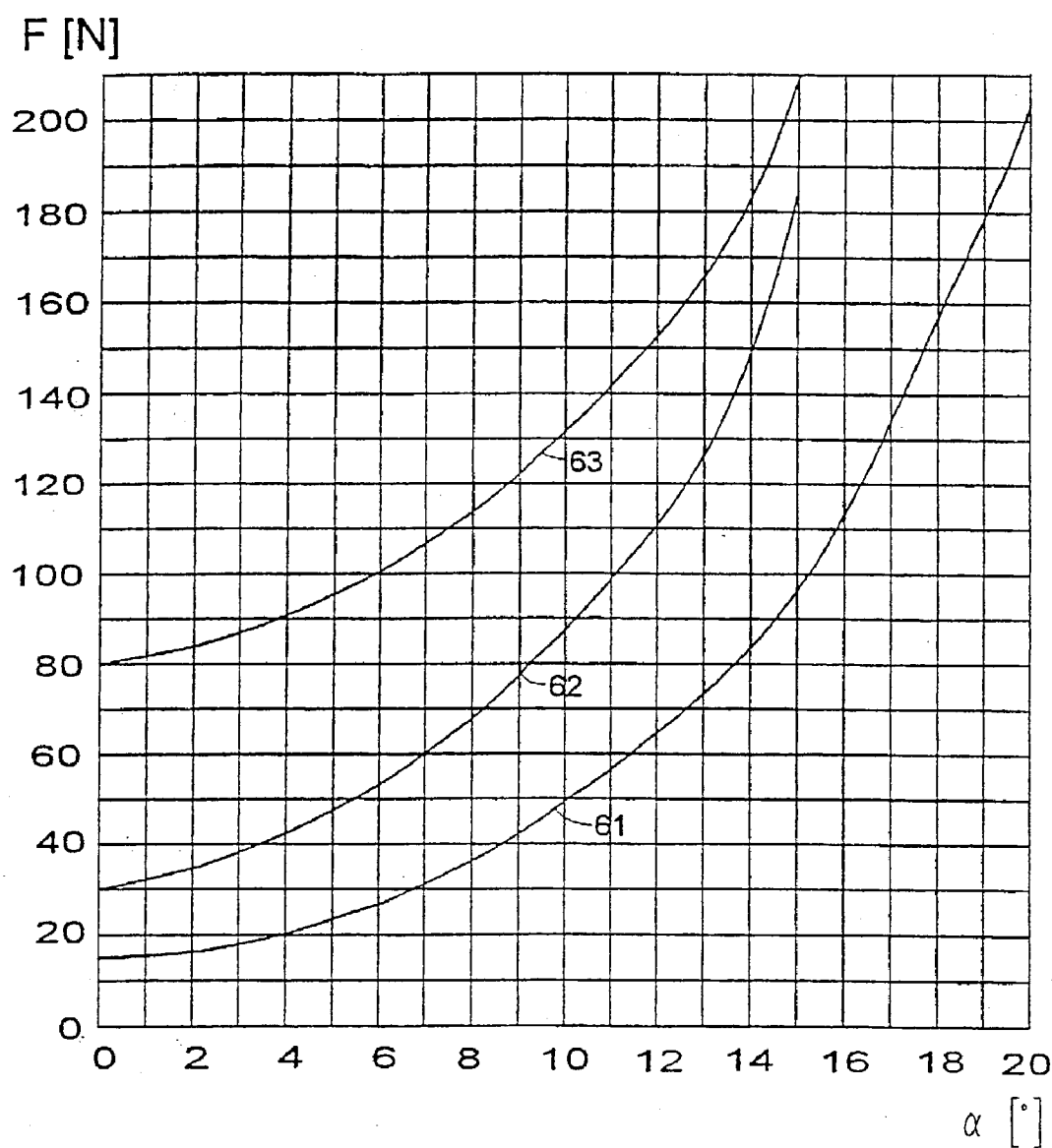


Fig. 51

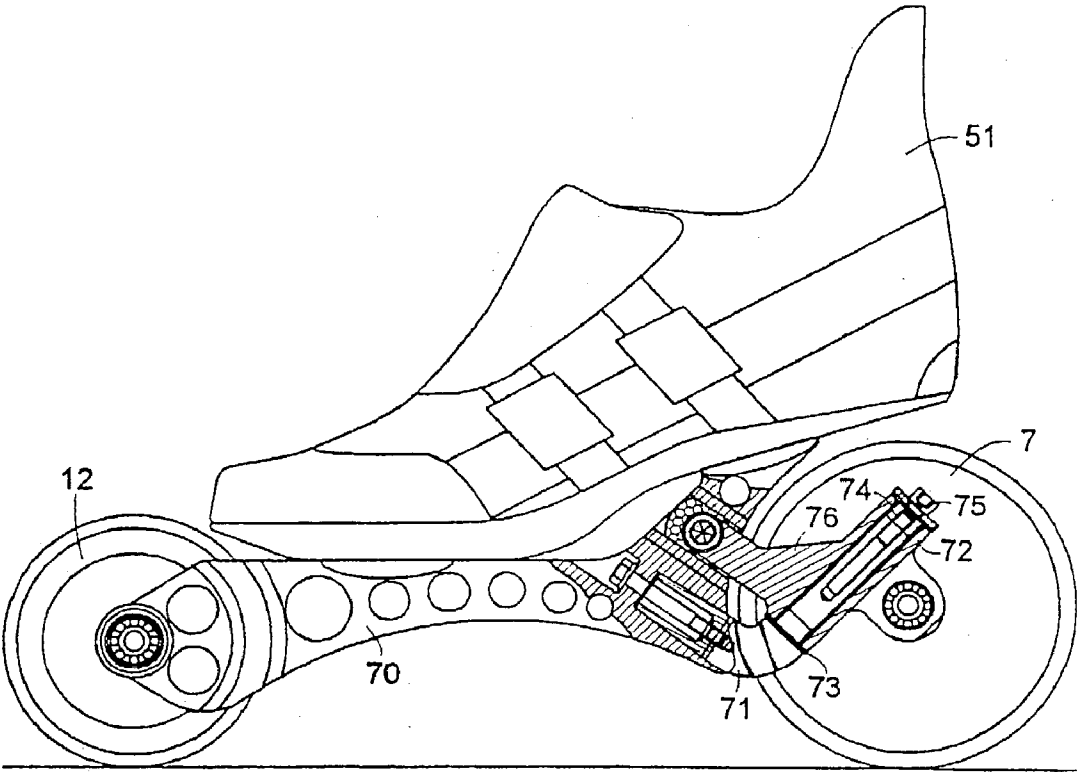


Fig. 52

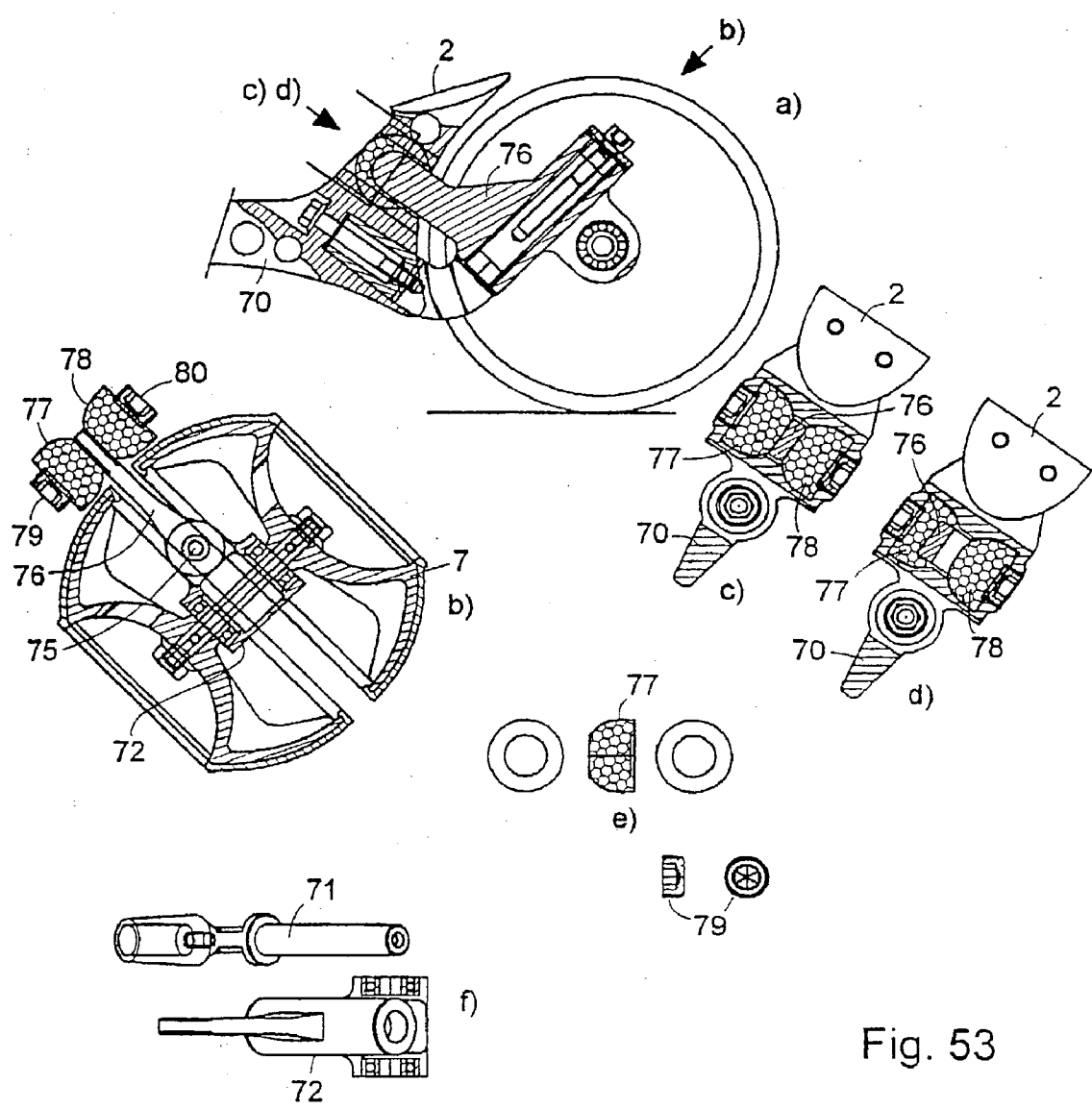


Fig. 53

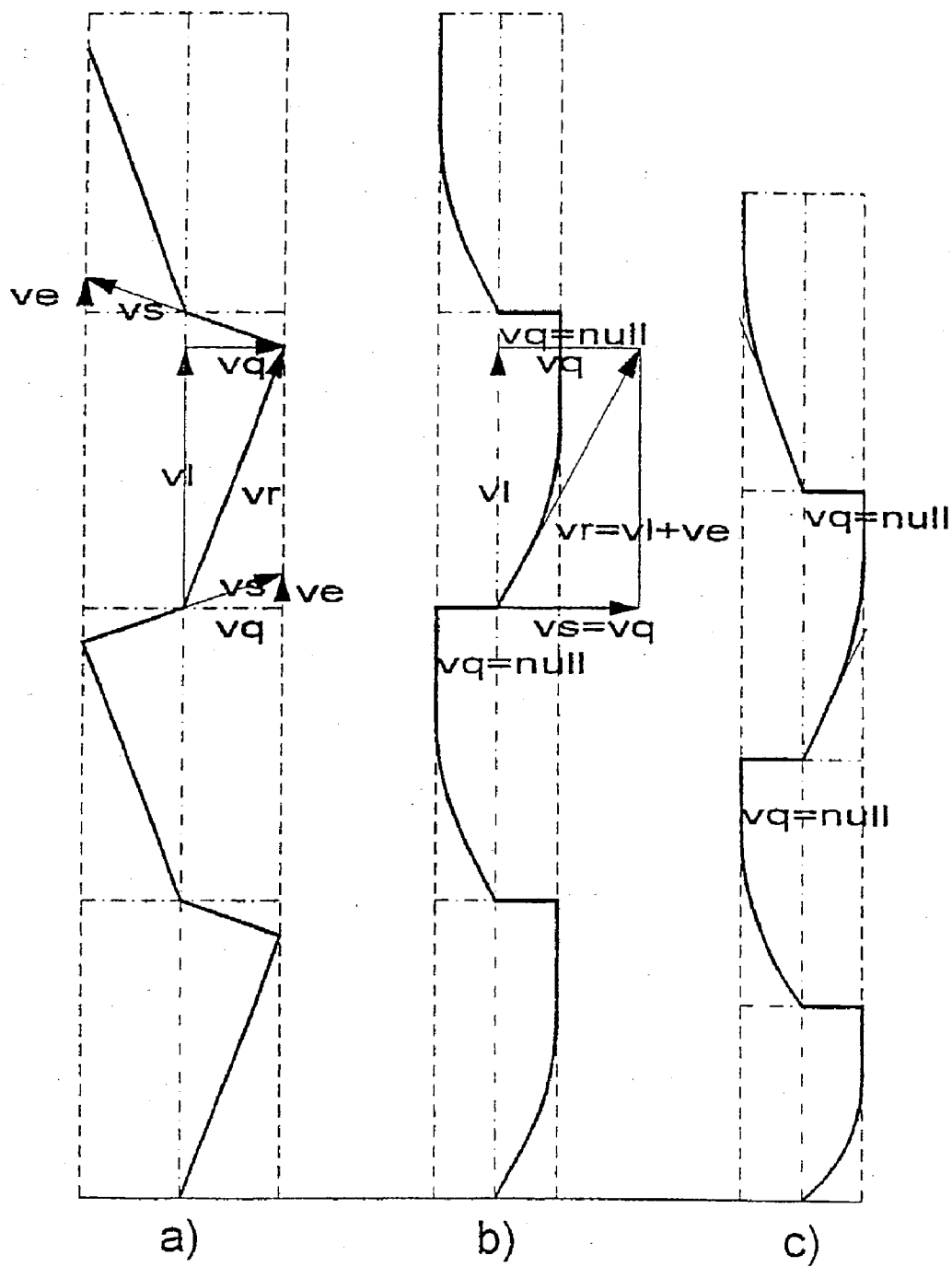


Fig.54

ROLLING SPORTS EQUIPMENT

[0001] This invention relates to a roller sport device, particularly a single-track skateboard or a single-track roller skate, having two roller axles disposed one behind the other with single-track rollers which run one behind the other which are disposed thereon, which axles are disposed on a board or on a supporting frame.

[0002] The invention relates in particular to a single-track roller skate consisting of a frame with a shoe fixed thereto or and with rollers are situated one behind another.

[0003] Roller skates of this type are subject to minimum requirements which relate to simple, efficient propulsion, balance, to the possibility of steering them and to their resistance to movement. The following properties are expected in addition: ease of running, i.e. a high speed for a low expenditure of energy, a use which is easy to learn, and good controllability. Factors which are particularly important are a dynamic, readily effected progression of movement and a definite perception of movement, which make travelling on roller skates interesting.

[0004] Two basic designs of roller skates as such are known:

[0005] as a twin-track device comprising four rollers on two axles, for which all four rollers are always in contact with the ground, and

[0006] as a single-track device comprising a plurality of disc-shaped rollers one behind another (in-line skater)

[0007] Most roller skates are propelled by a skating step, i.e. by alternately travelling on one roller skate on paths which are oriented obliquely away from the direction of travel and with the aid of which a transverse momentum of the body can be converted in part into a forwardly oriented momentum. In the course of this procedure, an outward pressure is exerted by the legs alternately, approximately perpendicularly to the average direction of travel. Propulsion is more efficient the more strongly the legs can swing out to the side and to the rear. With twin-track roller skates this freedom is limited because the foot always has to be approximately parallel to the ground.

[0008] With in-line skaters, the freedom of movement is considerably restricted by the ankle part of the shoe, which is usually high. The purpose of the ankle part is to relieve the ankle from the enormous tilting moments which occur due to the narrow, disc-shaped rollers which are used on single-track roller skates of this type, even at a slight tilt (inclined position) of the foot. Single-track roller skates comprising a shallow shoe can also be obtained for rapid travel, but the ankles are very severely stressed.

[0009] The skating step necessitates the prevention of lateral slippage, in order to make optimum use of the lateral force. For roller skates, a high coefficient of friction in relation to the roadway conflicts with the requirement for steerability, which is made easier by sliding in relation to the roadway.

[0010] The possibility of steering some twin-track roller skates is due to a kinematic coupling between the lateral tilting of the platform and the steering angle (tracking angle) of the two axles and thus of the four rollers. The angle of tilt

is very limited, so that the foot remains almost horizontal. If the body is inclined into a turn, the ankle has to be kinked. Executing turns in a pronouncedly slanting position is thereby made difficult or restricted. Regions of unevenness in the roadway react on the steering on account of the aforementioned coupling, and result in instabilities of balance.

[0011] Skateboards are also equipped with two pairs of rollers which can be steered kinematically in this manner, and sometimes suffer from the same problems, even though the coupling between the board and the wearer is not fixed in this manner, as it is for a roller skate. Steering is based on rotating the roller skate and/or turning it about a vertical axis against the forces of friction. If the roadway is rough (uneven), a roller skate can be turned more easily, since the individual rollers temporarily lose contact with ground. A low coefficient of friction of the rollers in relation to the roadway makes this easier and reduces the energy loss when executing turns. The rollers therefore generally consist of a relatively hard plastics material with low static friction. However, the execution of dynamic turns involving considerable centrifugal force is thereby restricted.

[0012] Swiss Patent No. CH 185 999 and French Patent No. FR 569 896, for example, propose two-wheeled, single-track roller skates comprising a fixed front wheel and a trailing rear wheel, the vertical axis of which is rotated by movements of the heels in order to effect control. The trailing wheels are fixed to a vertical steering axle via a horizontal fork and are centered by strong springs.

[0013] However, the steering effect of constructions of this type of is too slight to be able to execute tight turns. Moreover, if the pressure of the heel is inadvertently reduced there is a risk of the fork turning over and of the turn being executed on the wrong side of the rollers, which is accompanied by a considerable risk of accident or injury, particularly since this effect is self-intensifying. Here also, the tilting moments which have to be exerted by the ankle when executing turns are enormous, due to the flat rollers, and make shoes with high ankle parts necessary. The freedom of movement is thereby considerably restricted, however, just as it is with in-line skaters.

[0014] The object of the present invention is to provide a roller sport device of the type cited at the outset which can be accurately steered kinematically without significant loss of energy, with which rapid, tight turns involving a pronouncedly inclined position can also be executed, and which comprises a high degree of lateral guidance. In the form of a roller skate, the device should also be capable of being used by average sporting persons wearing shallow or half-height shoes, and should not result in excessively high stresses on the ankles when executing turns.

[0015] This object is achieved in that the rearmost of the two roller axles (rear axle) can swivel about an axle (steering axle) which points obliquely downwards and forwards and which forms a trailing angle, and is centered by means of elastic elements for straight running, that the running faces of the rollers are curved transversely to the direction of travel and that the running faces have a high coefficient of friction similar to that of rubber.

[0016] The steering of the device according to the invention is based on a course of movement or travelling tech-

nique which is known in skiing technology by the term heel thrust or heel pressure. In the form of a roller skate, this heel thrust can be exerted in a particularly simple manner with slightly bent knees (spring-ready posture). The low swing technique is preferred: a brief inward swing of the knee is followed by an outward pressure with subsequent stretching of the legs in the turn.

[0017] In order to steer inwards, a force directed towards the outside of the turn is exerted on the rear roller for this purpose by the heel of the foot which is on the outside of the turn (the left foot for a right turn). Said rear roller is thereby rotated towards the outside of the turn against the spring force of the steering bearing, and which, due to the steering axle which is inclined by the trailing angle, thereby changes both the track (i.e. the direction of rolling, twisting of the roller axle about a vertical axis) and the tilt (lateral inclination of the roller axle). A turn is initiated due to the track angle.

[0018] The weight of the body is subsequently shifted on to the foot on the outside of the turn, and the body is inclined towards the inside of the turn depending on the radius of the turn and the speed. The left ankle can remain in a straight position or can be slightly turned inwards. This procedure is assisted by kinking the waist towards the outside of the turn and rotating the upper body towards the outside of the turn to compensate for spin (skiing technique). The roller skate then travels into the turn and generates a centrifugal force in addition to the heel thrust. The steering effect is thereby increased. The steering kinematics according to the invention therefore result in a pronounced oversteer and can be stabilised and controlled by removing the heel thrust.

[0019] After the weight has been completely shifted on to the foot on the outside of the turn, the other roller skate can be raised slightly. To stabilise the execution of the turn, the knee can be supported in the bend of the knee on the outside of the turn. The steering deflection of the rear roller axle results from the equilibrium of the turning moments about the steering axle: heel thrust force, centrifugal force and a component of the weight which acts against the elastic force of reaction of the resilient mounting. It is therefore possible to make corrections to the path travelled by changing the heel thrust force, or the inclination of the roller skate, or the distribution of weight between the front and rear roller axles.

[0020] Advantageous embodiments and developments of the invention are given in the subsidiary claims.

[0021] Amongst other features, provision can be made for the trailing angle to range between 30° and 70°.

[0022] Provision can also be made for the running faces to be curved approximately spherically, with the roller radius as their radius of curvature, so that the distance from the point of contact of the respective roller to the center thereof does not substantially change over the entire range of oblique positions which can be covered. The device is thus very capable of being steered dynamically.

[0023] In order to facilitate a better capacity for centering and a more stable travelling position for straight running, the running faces can also be shaped transversely to the direction of running so that the distance from the roller center to the point of contact of the roller is a minimum when the roller axles are horizontal. This can also be achieved, for example, by making the running faces cylindrical over a narrow central region.

[0024] To prevent any overturning when the heel thrust is removed, the distance from the rear roller axle to the steering axle can be made less than the roller radius; the distance from the steering axle to the rear roller axle is preferably about $\frac{2}{10}$ to $\frac{6}{10}$ of the roller radius.

[0025] When the rear axle and the steering are suitably designed, it is also possible for the distance between the rear roller axle and the steering axle to be zero or even negative (roller axle in front of the steering axle).

[0026] One embodiment of the invention makes it possible to achieve a particularly simple construction in that the two rollers are each divided transversely to the roller axle into two half rollers which are at a distance from each other so that the parts which support the mounting can be passed through.

[0027] In another form of construction, the rear roller axle is attached to a steering body which can swivel about the steering axle by overcoming elastic restoring forces. A desired turn radius can thereby be accurately controlled and it is possible to make a progressive readjustment of the steering. Other advantages are: attenuation of travel noise, a variable steering characteristic and a flexible steering stop.

[0028] In this form of construction, the two half rollers of each roller can be separately rotatably mounted on the associated roller axle, wherein the front roller axle is fixed and the rear roller axle is fixedly attached to the steering body, or the two half rollers of each roller can be fixedly attached to each other by means of the associated roller axle, wherein the front roller axle is rotatably mounted in the frame and the rear roller axle is rotatably mounted in the swivelling steering body. A steering axle disposed at the rear results in the following advantages: executing turns without losses due to friction, steering by heel thrust, skiing techniques can be used, and a parallel swing technique can be used with a considerably inclined position.

[0029] In one advantageous embodiment of this form of construction, space for the steering body can be created by making the half rollers of at least the rear roller of shell-like construction so that they enclose a void. The internal steering which is thereby produced provides protection for the steering parts, and bearing forces and moments are minimised. With this attractive design, there is no risk of injury due to angular steering parts.

[0030] In another embodiment of the invention, the rollers consist of a supporting shell made of light metal or plastics and of an external covering made of a polymer with a high coefficient of friction (rubber, polyurethane, natural rubber) in relation to the road surface. Considerably inclined positions in turns and in dynamically changing turns are thereby made possible. The skating step which can thus be employed for propulsion is particularly effective. Furthermore, rolling noise is reduced and parallel swings can be employed for propulsion.

[0031] In one advantageous embodiment, the rear roller is larger than the front roller. The advantages of this embodiment are: space for steering kinematics in the rollers, the raised position of the foot is the optimum for making swings, maximum use can be made of the space under the heel, dynamic appearance and visual dominance of the roller.

[0032] Depending on the particular circumstances, provision can be made on the roller sport device according to the

invention for the spacing of each of the two half rollers of a roller in relation to each other to be adjustable, and/or for the rollers to be provided with a hard covering further inwards and with a soft covering further outwards.

[0033] Other advantageous developments and improvements of the invention are possible due to the measures listed in other subsidiary claims.

[0034] Amongst other features, the frame can be provided with openings in order to reduce weight. Light metal or composite materials can also contribute to minimising the weight.

[0035] Provision can be made for the steering stub to be integrally formed on the frame or to be anchored within the frame by a detachable friction cone joint. A detachable steering axle provides the facility of selecting the geometry and steering behaviour by changing the steering stub.

[0036] The rear roller axle can swivel about a steering axle which is at an angle β (trailing angle) to the horizontal. If the double roller swivels about an angle α , this causes a change in the tracking angle γ (direction of travel of the double roller) of $\delta\gamma = \alpha \cdot \sin \beta$ and a change in the tilt angle ϵ (lateral inclination of the double roller) of $\delta\epsilon = \alpha \cdot \cos \beta$. At a trailing angle of $\beta = 45^\circ$, $\sin \beta$ and $\cos \beta$ are approximately 0.71. If the trailing angle is greater, the steering effect (tracking angle) becomes greater and the tilting effect becomes less, and vice versa. At a trailing angle $\beta < 30^\circ$ the steering effect is too slight to be able to execute tight turns, and the tilting effect (i.e. the alignment of the double roller opposite to the inclination) can become so large that turns are executed on the wrong (outer) roller half.

[0037] The point of intersection of the line of alignment of the steering axle with the path travelled and the point of contact of the double roller define a trailing effect which has a stabilising effect (like that of a weathervane) on motion. The trailing effect is also in part determined by other variables such as the roller diameter and the spacing between the axles, i.e. the distance between the steering axle and the roller axle.

[0038] Large trailing angles reduce the trailing effect and decrease the ratio between the tracking angle (i.e. the radius of the turn) and the tilt angle. A (negative) tilt is desirable, however, so as to be able to cover strongly inclined positions without travelling on the outer edge of the considerably stressed (heel thrust plus centrifugal force) rear roller, instead of on the curved face.

[0039] Trailing angles $\beta > 70^\circ$ are therefore disadvantageous. The steering radius defines the lever on which lateral forces from the point of contact (heel thrust, etc.) act on the steering bearing. These forces (or moments) should be capable of counteracting an elastic opposing force on the steering bearing in order to make it possible to proportion the steering reaction (regulation of a desired turn radius). A large steering radius therefore necessitates high elastic opposing forces on the steering bearing and thus necessitates a heavy, costly construction. The same applies to the bending radius which defines the lever at which the weight due to the fixed introduction of force acts on the frame. The effective steering radius and the effective trailing effect depend on the inclination of the roller skate, since the point of contact shifts.

[0040] The eccentricity is the distance of the weight vector from the center of the rotationally elastic bearing. It defines a lever which exerts a moment of weight on the bearing in addition to the force due to the weight. The bending radius and the eccentricity should be as small as possible, for weight- and cost-saving reasons.

[0041] When the rear roller swivels about the steering axle, it is not only the tilt and tracking of said roller which change, but also its vertical and horizontal position. If the axle spacing is comparable with the roller dimensions, the lateral displacement becomes particularly important. When executing a turn, this means that the roller as a whole is displaced towards the inside of the turn. This is all the more advantageous.

[0042] If the roller skate is at a slant (inclined), a component of the weight acts at a steering radius and allows the roller to swing out in relation to the inclined position. At the same time, the roller also swivels upwards and consequently the heel becomes lower. If lateral pressure is then applied by the heel so as to bring the roller on to its inclined face in order to execute a turn corresponding to the slanting position (inclination), the turning moment exerted by the weight has to be overcome.

[0043] If the distance between the roller axle and the steering axle (hereinafter also called the axle spacing) is very large and the angle of swivel towards the wrong side is too large, a correction of the steering position is no longer possible since the requisite lateral force due to heel thrust becomes greater than the static friction of the roller on the roadway. Only a complicated course of movement is capable of correcting this fixed position: alignment of the roller skate, followed by heel pressure and then further angling of the roller skate for executing the turn.

[0044] In order to prevent this, the usable axle spacing has to be selected so that it is small enough for the steering axle to be situated inside the rear roller. If the angle of swivel α about the steering axle is limited to small values (by limit stops), the usable axle spacing can be greater. The requisite angle of swivel results from the smallest desired turn radius: $\text{turn radius} = \text{wheelbase} / \tan \alpha \cdot \sin \beta$. The turn radius is equal to half the turning circle diameter.

[0045] The axle spacing can also be selected to be zero. The effect of weight on the steering can then be practically eliminated, and it is only the horizontal transverse forces which are definitive for the steering behaviour. If the axle spacing is negative, the weight produces a steering deflection and consequently a turn in the direction of inclination, and is therefore correct with regard to the dynamics of movement. A trailing effect and a steering radius have to remain in every case, in order to make it possible to steer by means of transverse forces.

[0046] If the effect of weight on the steering is made to disappear (axle spacing zero), the option of correcting the steering by means of weight, i.e. by inclining the roller skate, is also lost.

[0047] The contour of the rollers is selected so that as far as possible the ankle is relieved from tilting moments. The optimum contour would be one corresponding to a circle about the effective axis of rotation of the ankle (complete relief from stress).

[0048] The roller width, however, should not be greater than the width of the foot. The tangent to the roller edge should correspond to the maximum desired inclined position (e.g. 45°). Therefore, the rollers are in practice narrower and more curved than is necessary for complete compensation for tilt. Depending on the particular requirements, the roller sport device according to the invention can also be provided with rollers which are of unsymmetrical construction.

[0049] In addition to the aforementioned kinematic relationships, what are purely geometric relationships play a part, such as the ground clearance of the frame and steering parts, which must be sufficiently large so that they do not get caught, or the distance of the foot from the ground, which should be as small as possible in order to exert only a slight tilting moment on the ankle. In addition, there are also purely relationships of form, in order to create an attractive, functional form.

[0050] Some advantageous features are given below in the form of a list, together with their advantageous effects:

[0051] Wide rollers:

- [0052] tilting moment on the ankle considerably reduced
- [0053] shallower shoe possible
- [0054] freely movable ankle possible
- [0055] soft, gripping rubber compound possible
- [0056] profiles which create an interesting form.

[0057] Large rollers:

- [0058] rolling resistance considerably reduced
- [0059] regions of unevenness can be travelled over easily
- [0060] travel shocks considerably reduced
- [0061] roller design visually emphasised.

[0062] Preadjustable, replaceable prestressed double springs:

- [0063] more stable straight running
- [0064] variable steering threshold.

[0065] Shallower shoe:

- [0066] ankle mobility
- [0067] wide, swinging ski step
- [0068] elegant and easy mode of travel (three effective joints).

[0069] Examples of embodiments of the invention are illustrated in the drawings, which comprise a plurality of Figures, and are explained in detail below. The drawings are as follows:

[0070] FIG. 1 is a view, shown partly in section, of a completely equipped frame of a roller skate according to the invention;

[0071] FIG. 2 is a plan view of the same frame, likewise shown partly in section;

[0072] FIG. 3 is a side view of a complete roller skate according to the invention;

[0073] FIG. 4 is a front view of the roller skate when executing a left turn;

[0074] FIGS. 5 to 7 are a side view, a rear view and a view from below of a skateboard according to the invention;

[0075] FIG. 8 is a rear view of the same skateboard when executing a right turn;

[0076] FIGS. 9 to 11 are a side view, a plan view and a cross-section through a frame of a roller skate according to the invention;

[0077] FIGS. 12 to 15 are a side view and sectional views of a steering apparatus comprising a steering body which is swivel-mounted on a steering stub;

[0078] FIG. 16 is a plan view of the steering stub and friction cone joint;

[0079] FIG. 17 shows the appropriate steering body;

[0080] FIG. 18 shows the possibility of fixing a brake block to the steering body;

[0081] FIGS. 19 and 20 are different views of another steering apparatus in its installed state;

[0082] FIG. 21 comprises different views of the steering sub which is used therewith;

[0083] FIG. 22 is a side view of a steering apparatus which is fixed on both sides;

[0084] FIG. 23 shows the steering axle which is used therefor;

[0085] FIG. 24 is a detailed view of the fixing end thereof;

[0086] FIG. 25 is a cross-section through the steering apparatus;

[0087] FIG. 26 shows a roller skate provided with a parking brake and comprising an integrally formed steering stub;

[0088] FIG. 27 shows a roller skate comprising an integrally formed steering axle which is fixed on both sides;

[0089] FIG. 28 is a cross-section through the steering apparatus thereof;

[0090] FIG. 29 shows a roller skate comprising a steering stub fixed thereto at the top and an axle spacing equal to zero;

[0091] FIGS. 30 to 36 are different detailed views of a completely equipped roller skate frame with a built-on, straight steering stub;

[0092] FIGS. 37 to 40 comprise studies of the movement and of the planes of forces of a roller skate according to the invention when executing a turn;

[0093] FIGS. 41 to 50 show different embodiments of roller skates according to the invention;

[0094] FIG. 51 is a graph showing the approximate values of the elastic properties of the steering for different major applications;

[0095] FIG. 52 shows another example of a roller skate according to the invention;

[0096] FIG. 53 shows parts of the roller skate illustrated in FIG. 52; and

[0097] FIG. 54 shows paths of the center of gravity of a known roller skate and of the roller skate according to the invention in order to explain the improved propulsion achieved by the roller skate according to the invention.

[0098] In the Figures, identical parts are denoted by identical reference numerals.

[0099] The frame 1 which is illustrated in FIG. 1 is employed for mounting a shoe which is not shown in this Figure. It is equipped with lightening holes 1', front bearings 14 for the front roller 12, two fixing plates 2 for a shoe, a non-positive friction cone joint 4, and the steering stub 3 which forms the steering axle and which comprises a conical fitting and a screw 5. A steering body 6, which comprises the bearing 9 for the rear roller 7, is joined to the steering axle 3 by an elastomer 6', e.g. vulcanised rubber. The rear roller 7 can thereby be swivelled about the obliquely extending steering axle 3 against the elastic force of the elastomer joint 6'.

[0100] The ends of a hairpin spring 11, which is held in the steering body 6, engage on both sides of a pin 10 which is fixedly attached to the steering axle 3. Prestressing said hairpin spring 11 results in a minimum force (minimum turning moment about the steering axle) for rotating the steering body 6.

[0101] The axis of the friction cone joint 4 points towards the point of contact of the rear roller 7, so that although bending moments act on this joint there is no turning moment about the axis (no loosening of the screw due to twisting). An extended screw 5 suffices for fixation, and facilitates replacement by a steering device with a different characteristic.

[0102] The steering axle 3 is set at a trailing angle β and defines a trailing effect (N) at the point of contact of the rear roller 7.

[0103] When it rotates about the steering axle 3 the roller 7 is subjected both to a change in its tracking angle (direction of rolling) and in its lateral inclination (tilt).

[0104] A shoe which is suitable for mounting on this frame has a stiff, solid sole and is screwed to the frame. The shoe should be made to fit the front of the foot and the heel and should not restrict the mobility of the ankle.

[0105] Some of the terms or definitions used for the geometry or kinematics are shown in FIG. 1: E is the eccentricity, B is the bending radius of the steering stub, G is the line of action of the weight on the rear axle 8, L is the steering radius and A is the axle spacing.

[0106] FIG. 2 is a plan view of the frame. The mounting for the front roller 12 consists of two ball bearings 14, a distance sleeve 14', a front axle 13 and two nuts 13'.

[0107] The steering body 6 is shown partially in section. It consists of a light metal extruded section and is joined to the steering axle 3 by means of the elastomer 6'. The steering body 6 bears two grooves 6'' for the hairpin spring 11 and a groove 6''' for fixing a brake block (not illustrated). In order to keep the gap between the halves of the rollers 7, 12 as small as possible, the frame and the steering stub are drawn in at 15 and 16, respectively. In order nevertheless to provide the frame 1 with sufficient strength, it is vertically reinforced in the region of the constriction 15.

[0108] The rollers 7, 12 each consist of two individual, identical half rollers. These in turn consist of a supporting inner shell made of light metal and of a non-slip external covering 7', 12', e.g. of vulcanised rubber which is similar to that used in motorcycle tyres. The external shape is fashioned so that at an inclined position of about 45° (FIG. 40) the outer edge of the front roller 12 contacts the ground. The outer edge of the rubber covering 7', 12' is reinforced by a rib 7'', 12''. The rollers 7, 12 are very wide so that in an inclined position the points of contact of the rollers are displaced as far as possible towards the tilting side in order to counteract the tilting moment. If tilting occurs accidentally, the ankle is thus relieved from stress, and a shoe with a shallow ankle part can be used.

[0109] The inner shells 7, 12 of the rollers are optimised for load-carrying capacity at the minimum weight. The shape of each half shell is approximately that of a hemisphere comprising a drawn-in spherical cap. In all inclined positions, the resulting vectors of force are substantially oriented towards the roller axes 8, 13, so that bending moments on the axes are minimised. The spherical shell has openings for lightening purposes (only illustrated in part; see FIGS. 41 et seq.). The half rollers can be produced by casting, die-casting or pressing methods, and can be internally ribbed.

[0110] In most of the embodiments illustrated, the rear roller 7 is of larger diameter and greater width than the front roller 12. This results in sufficient space for the installation of the entire steering apparatus 3, 6. The resulting ground clearance in front of the rear roller is sufficient for travelling on roads.

[0111] FIG. 3 shows the entire roller skate including a shoe. It fulfils the requirements of rollers which are as large as possible for the lowest possible position of the foot (balance, or moments acting on the ankle).

[0112] The front of the shoe is positioned somewhat behind and below the top of the front roller. The heel is raised by about 15°. Since the weight is distributed over both rollers, the effective roller diameter, which is one of the factors which determines the rolling friction, is approximately the average diameter of the front and rear rollers. Values of 70 mm to 100 mm are advantageous for the front roller, and values of 100 to 130 mm are advantageous for the rear roller.

[0113] The rubber-covered rollers can be provided with a spiral channel tread pattern. A profile such as this can improve the adhesion when executing turns in the wet, in dust or in sand, but results in flexing losses. A covering of harder rubber is advantageous in the middle of the roller (for straight travel), and a covering of soft rubber and/or one with a channelled profile is advantageous at the edge of the roller (for executing turns).

[0114] FIG. 4 is a front view of the roller skate when executing a left turn.

[0115] FIG. 5 shows a skateboard 50 which is mounted on a roller frame 1 according to the invention. The height of the ankle is marked (51).

[0116] FIG. 6 shows the skateboard from below, FIG. 7 shows the skateboard from behind, and FIG. 8 shows the skateboard from behind during a right turn. In order to vary

the steering behaviour and balancing capacity, provision can be made for the spacing of the half rollers from each other to be varied by distance pieces. FIGS. 9 to 18 show details.

[0117] FIG. 9 shows the frame 1, which can be made of die-cast light metal, for example, with the front axle bearings 14, the receiver for the steering axle 4 and the screw 5.

[0118] FIG. 10 is a plan view of the frame 1 and FIG. 11 shows the frame in cross-section. To prevent buckling, the side under compression is made wider than the side under tension.

[0119] FIGS. 12 and 13 are two views of the complete steering apparatus, which comprises the steering axle 3 (steel), the conical seating 4, and the countersunk region 16 at the roller periphery for reducing the spacing between the half rollers, and which also comprises the pressed-in pin 10 for the transmission of force into the hairpin spring 11. The steering body 6 consists of a machined light metal section.

[0120] FIG. 14 is an identical view to that of FIG. 13, and shows the position of the steering body 6 during straight running and when swivelling by $\pm 15^\circ$. One limb of the hairpin spring 11 is deformed in each direction of swivelling.

[0121] FIG. 15 illustrates, on an enlarged scale, the geometry of the elastic steering axle/steering body joint. The steering body comprises a butterfly-shaped internal bore, lead-in bores 3' of which receive the flat steering axle 3. On rotation, the elastomer 6' is deformed, whereupon the spring moment progressively increases as far as a strongly progressive stop. The steering body 6 can be rotated, but can only be displaced radially by a slight extent, since the bore is constricted in the middle. An axial displacement is likewise impossible due to the large effective length. In addition, the elastomer 6' acts to a certain extent as a shock absorber.

[0122] FIG. 16 is a plan view of the steering stub 3. FIG. 17 shows the steering body 6, which is preferably made of an extruded aluminium section.

[0123] FIG. 18 shows the installation of a brake block 180 by insertion in the groove 6" (FIG. 13) and the securing thereof by a split pin 181.

[0124] FIGS. 19 and 20 illustrate a considerably simplified design of the steering axle and steering apparatus, respectively. As shown in FIG. 21, the steering axle 21 is an X-shaped section, which is made of steel, for example, which is bent and which is compressed during bending so that an approximately rhomboidal cross-section is formed. In order to fix it to the frame, the steering axle is cast in or die-cast in directly (insertion technique), for which purpose the axle can be roughened at the appropriate location.

[0125] FIG. 20 is a cross-section on an enlarged scale. In this embodiment, the rod 22 for receiving the force of the hairpin spring is designed as a die-cast part and is pressed on to the end of the steering axle 21. This design is lighter and less costly, but prevents the steering apparatus from being replaced.

[0126] FIG. 22 shows another solution for the transmission of force into the steering axle. The frame 24 is forked around the rear roller so that both ends of a straight steering axle 25 can fit into the frame 24. The rectangular steering axle 25 is inserted in pockets 26 in the frame 24 from below

and is fastened with screws 27. Since there are practically no bending moments, the steering apparatus can be of relatively simple design.

[0127] FIG. 23 is an overall view of the parts of the steering apparatus. FIG. 24 shows a milled constriction 28 for reducing the roller spacing.

[0128] FIG. 5 is a cross-section through the steering body 29 with the rolling bearings 30 and the roller axle 31. A particularly small axle spacing is provided here (see the description of the steering geometry). The ease of replacement and low weight of this design are advantageous.

[0129] FIG. 26 shows a design which comprises a steering axle 32 which is cast on directly if the frame 33 is made of light metal or of a particularly strong plastics material (by a casting method). The bending forces at the base of the steering axle are very high, but can be controlled particularly easily and inexpensively using known Al casting materials. In addition, FIG. 26 shows stone guards 138 and 139 which close the gaps between the half rollers in the region of the points of contact, and which are fixed to the frame 1 and to the steering body, optionally by being integrally formed thereon.

[0130] FIG. 27 shows a support for the steering axle 34 at the top, so that the bending moment disappears at the lower lead-in thereof. The shoe 35 is somewhat higher for this purpose, however. This design is particularly light, inexpensive and stable.

[0131] The steering body 36 shown in FIG. 28 has a bore 37 with a butterfly-shaped cross-section, by means of which it is slid over the steering stub. In this design, the trailing angle can be increased without losing much ground clearance, because the lower lead-in can be of smaller dimensions.

[0132] The design shown in FIG. 29 allows other trailing angles to be employed. The lower lead-in is omitted. At the upper lead-in 140, the bending moment becomes less the larger is the trailing angle. The large extent of ground clearance despite the large trailing angle is advantageous.

[0133] The axle spacing is equal to zero here. If the cross-sectional profile of the roller is approximately circular, the line of action of the weight always passes through the steering axle. As a result of the shortened castor length and the short steering radius, only small turning moments act about the steering axle 141, so that the rotationally elastic mounting 141 is shorter. A large part of the weight is absorbed by a step bearing at the end of the steering axle 141. The axle spacing can also be made negative by placing the roller axle in front.

[0134] FIG. 29a comprises two views, on an enlarged scale, of the steering axle 141 with the steering body 142 and the roller axle 143.

[0135] In the embodiments illustrated in FIGS. 26 to 29, however, the steering apparatus cannot be replaced, in order to alter the leading angle, for example.

[0136] FIGS. 26 and 27 also show a locking device 38 for the front roller. This consists of a plastics component which acts like a wedge, which can be fitted to an extension 39 of the frame 1 and which can fix the front roller. This device can easily be identified from the outside and can be used on

locking faces for roller skates (escalators, stairs). The device can form an addition to the braking device shown in **FIG. 13**.

[0137] In contrast to **FIGS. 27 and 28**, the embodiments illustrated in **FIGS. 26 and 29** are shown without prestressing springs. It is also possible to use a prestressed spring there, however. This can improve the steering capacity.

[0138] **FIGS. 30 to 34** show an embodiment comprising separate functional units of the steering apparatus. **FIG. 30** is a side view, shown partially in section, of the roller skate, while **FIGS. 31 to 34** are different views of the roller and of the steering apparatus, some of which are shown on an enlarged scale. The steering axle **41** is screwed to the frame **1** by means of a screw **42**. The steering body **40** is mounted by means of two bearing bushes **43, 44** on the shank of the steering axle **41** and can swivel about the latter.

[0139] A conical rubber buffer **47** is situated on a rod **46** which is screwed or pressed into the steering axle **41**. Two extensions **49, 50** are integrally formed on the steering body **40** and constitute a fork; they are provided with a hole for weight-saving. Depending on the steering angle, at least one of the extensions **49, 50** presses on the buffer **47** and thus generates an elastic opposing force which opposes swivel. This force progressively increases with the extent of swivel.

[0140] The end of the rod **46** fits into a hairpin spring **48** which generates an additional opposing force. This spring is situated in a groove and is prestressed, and therefore presses on a support with a rest force. A minimum force is therefore necessary in order to swivel the steering body, i.e. a minimum turning moment is necessary for a steering deflection. Thus small accidental forces do not initiate a steering reaction. Longitudinal forces from the steering body **40** which act on the steering axle **41** are diverted into the steering axle **41** by the bearing bush **43** and a screw **46**.

[0141] **FIG. 35** shows the roller skate of **FIG. 30** at a swivelling angle of 10° in a right turn without tilting, while **FIG. 36** is a front view of the roller blade of **FIG. 30** inclined at 35° in a right turn.

[0142] If the steering bearing is disposed outside the rear roller, which is not illustrated as an example of an embodiment, and is provided with a fork for receiving the roller, the rollers can be made in one piece. The steering geometry is less favourable, however, but in certain situations this can be less important than the advantages which can be achieved thereby.

[0143] **FIGS. 37 to 40** illustrate the steering operation by means of a heel thrust, where the roller skate, with the front roller **12**, the rear roller **7** and a shoe **51**, is illustrated from behind in each case. The effective pivot **51'** of the ankle and the effective pivot **51''** of the steering axis are also illustrated. **FIG. 37** illustrates straight running. **FIGS. 38 to 40** also show the component of the weight G_h which acts on the rear axle, the resultant R from the component of weight G_h and the heel thrust F , together with the centrifugal force F_1 , the tilting moment K at the ankle and the turning moment D of the steering axle.

[0144] In the first phase of steering (**FIG. 38**) a heel thrust F is generated, i.e. a force directed towards the outside of the turn by the heel of the foot on the outside of the turn (the left foot for a right turn). The rear double roller rotates towards

the outside of the turn against the spring force of the steering bearing, and thus changes both the track (i.e. the direction) and the tilt. A trailing angle of 45° and a swivelling angle of the rear double roller of 8.5° about the steering axle result in the 6° which is shown for the tilt and tracking angles. Due to the tracking angle, a turn to the right is initiated (i.e. the rear double roller is directed outwards to the left).

[0145] In the second phase (**FIG. 39**) the weight is shifted on to the foot on the outside of the turn (left foot), and the skater inclines his body towards the inside of the turn according to the turn radius and his speed. The left ankle can remain in a straight position or can easily be turned inwards. This process is assisted by kinking the waist towards the outside of the turn and rotating the upper body towards the outside of this turn (skiing technique). The roller skate then moves into the turn and generates a centrifugal force F_1 in addition to the heel thrust F . The steering effect is thereby intensified. The steering kinematics therefore basically constitute an oversteer effect and can be stabilised and controlled by removing the heel thrust. An inclination (inclined position) of about 20° and a change in tracking and tilt of about 6° are shown. In the third phase (**FIG. 40**) there is a complete shift of weight on to the foot on the outside of the turn (to the left as shown in **FIG. 48**). The right roller skate (**FIG. 40b**) can easily be raised. The right knee can be supported in the bend of the left knee. Initiation of the steering of the rear double roller **7** is effected by the equilibrium of turning moments about the steering axle: heel thrust force F , centrifugal force F_1 and a component of weight G_h against the elastic forces of reaction of the elastomeric mounting or of an elastomeric or metal spring. Tracking corrections can therefore be made without varying the heel thrust force or the inclination of the roller skates or the distribution of weight between the front and rear double rollers **7, 12**.

[0146] An angle of swivel of 14° about the steering axle is illustrated; this corresponds to a tracking and tilt angle of 9.9° . In this example, the front double roller **12** travels at an inclination of 45° (as do the frame, shoe, etc). However, the rear roller travels at an inclination of only 35.1° , since the tilt of 9.9° is negative. More freedom as regards an inclined position is thereby imparted to the rear double roller **7**.

[0147] **FIGS. 41 to 50** show different embodiments of a roller skate according to the invention for different preferred applications.

[0148] The roller skate shown in **FIG. 41** has a relatively short wheelbase for tight turns and skilled movements. It is capable of being stressed. Since the steering axle shown in **FIGS. 12 to 19** is illustrated, the position of the foot is relatively high, which is why a higher ankle part of the shoe may be necessary.

[0149] On account of its longer wheelbase, the roller skate illustrated in **FIG. 42** is particularly suitable for more rapid travel. The position of the foot is somewhat lower. A shallower shoe therefore provides sufficient balance. The steering axle is likewise designed as shown in **FIGS. 12 to 19**.

[0150] The roller skate shown in **FIG. 43** has a similar geometry and similar uses. However, the frame and the steering axle are of one-piece construction, as shown in **FIG. 29**. The considerable ground clearance in front of the

rear roller makes it possible to travel over edges. However, the steering characteristic cannot be varied, since the steering unit is not replaceable.

[0151] In the roller skate shown in FIG. 44, the steering axle is screwed to the frame and can therefore be replaced.

[0152] FIG. 45 shows a roller skate comprising a large front roller 52 (the front and rear rollers are identical), due to which travel shocks are reduced when travelling over uneven surfaces, and then is a definite travel sensation when travelling over edges.

[0153] The roller skate shown in FIG. 46 comprises a particularly long wheelbase with a very low foot position for rapid travel and larger turn radii. The steering is designed corresponding to that shown in FIG. 22, and the frame 53 is forked at the rear.

[0154] FIG. 47 also shows a roller skate comprising a forked frame 54. In order to support the steering axle 56, only part of which is visible, the rear frame part 55 extends above the rear roller 57. This design can therefore be made narrower than that shown in FIG. 46.

[0155] The roller skate illustrated in FIG. 48 has a long wheelbase and a low foot position, and otherwise corresponds to that shown in FIG. 44.

[0156] In the roller skate shoe illustrated in FIG. 49, the shoe 51 is not raised at the heel 58.

[0157] FIG. 50 shows a roller skate in which the steering axle 59 is mounted on both sides.

[0158] FIG. 51 is a graph of approximate values of the elastic properties of the steering for various major applications. The restoring force F in Newtons at the point of contact of the rear roller is plotted against the angle of swivel α in degrees about the steering axle. Curve 61 can be employed for shoes which are provided for slow travel with tight turn radii and accurate controllability of the line of travel.

[0159] Curve 62 can be selected if wide turns are to be executed rapidly with an accurately controllable line of travel. Curve 63 is employed for a roller skate which can be employed for rapid straight running or wide turns. The smallest turn radius is given by the wheelbase divided by the tangent of the tracking angle.

[0160] The embodiment shown in FIG. 52 has a similar steering axle 71 to that of the embodiment shown in FIG. 3. In addition to the wheel bearings, the steering body 72, which is mounted on the steering axle 71 by means of two bearing bushes 73, 74 and which is fixed axially by means of a screw 75, has an extension 6 which protrudes outwards through the gap between the two half rollers 7. In its rear region, the frame 70 is widened into a box shape in order to provide space for two elastic bodies 77, 78 (FIG. 53). The extension 76 fits between the two elastic bodies. The elastic bodies 77, 78 can be prestressed, equally or unequally, by means of two screws 79, 80 (minimum turning moment for a steering effect).

[0161] FIG. 53(a) is an enlarged illustration of the rear region of the roller skate shown in FIG. 52, FIG. 53(b) is a section through the rear roller 7, the steering body 72 and the extension 76, and through the elastic bodies 77, 78 and

the screws 79, 80. FIGS. 53(c) and 53(d) are views of the rear part of the frame 70 for straight running (c)) and when executing a turn (d)).

[0162] FIG. 53(e) illustrates the component parts of the centring device, and comprises three views of an elastic body 77 and two views of a screw 79, while FIG. 53(f) comprises a view of the steering axle 71 and of the steering body 72.

[0163] FIG. 54 comprises graphs for explaining the propulsion during a skating step: in detail, FIG. 54(a) shows the movement of the center of gravity of the body for customary in-line skaters, FIG. 54(b) is the same plot for a roller skate according to the invention, and FIG. 54(c) is the same plot for a roller skate according to the invention during the starting phase. v denotes velocity, and the second letter in each case is a suffix, where q =transverse, l =longitudinal, r =resultant, e =additional and s =step.

[0164] The average propulsion momentum is $m \cdot (v_l + \frac{1}{2} v_e)$. It decreases due to the resistance to motion and is increased by $m \cdot v_e$ in each step. This increase is due to the skating step, in which by pushing back the foot which becomes free approximately transversely to the instantaneous direction of rolling a momentum $m \cdot v_s$ is generated which is directed obliquely forwards. This momentum has a component $m \cdot v_e$ which is added to the propulsion momentum and a transverse component $m \cdot v_q$ which is wasted. The center of gravity of the body executes a movement which is composed of an approximately constant travel in the average direction of movement and of a superimposed lateral swing. The lateral swing constitutes "lost momentum" of magnitude $2 m \cdot v_q$, where $v_q = (v_l + v_e) \cdot \tan(rw)$ and rw is the roll angle.

[0165] At a roll angle of 20° , for example, lost momentum of $2 m \cdot (v_l + v_e) \cdot 0.36$ is generated during each step. This means that 72% of the maximum propulsion momentum is wasted due to the unsatisfactory kinetics of the skating step. In this example it is assumed that $v_e = 0.13 v_l$, i.e. a loss in momentum of 13% v_l is compensated for in each step.

[0166] In physical terms, an impulse, i.e. force $\times$ time, is not energy, but physiologically the generation of a force for a given time is equivalent to energy conversion in a muscle.

[0167] With the roller skate according to the invention, the propulsion momentum is likewise increased by a skating step, but this is effected with an approximately transversely oriented momentum $m \cdot v_s = m \cdot v_q$. Due to this transverse momentum, the resultant momentum $m \cdot v_r$ is increased by $m \cdot v_e$. At the end of momentum generation, the resultant is deflected into the direction of travel. The velocity is given by $v_r = v_l + v_e = (v_l^2 + v_q^2)^{1/2}$. A transverse momentum of 52.6% v_l is required in order to add the same momentum of 13% of v_l . This results in a somewhat larger initial roll angle of 28° , which is insignificant, however. Compared with conventional in-line skaters, however, there is a saving in the force applied of about 20% under otherwise identical conditions. The advantage of the roller skate according to the invention is at the start, which can be important, particularly in competitions, and is particularly pronounced on a gradient, because the roll angle is then very large. As a result of steering into the average direction of travel, a path of travel which is less wide is required compared with known in-line skaters under otherwise identical conditions.

[0168] The purely physical energy usage during a skating step must be the same in both cases, since the same

resistance to motion, which has to be compensated for, is assumed. Nevertheless, a different amount of muscle work is necessary, since the methods of compensating for losses are different.

[0169] The velocity v_r of the center of gravity on the path has to be increased so that the usable component v_l is increased by v_e each time. The transverse component v_q has to be reduced to zero and built up again in the opposite direction. This results in twice the amount of physical muscle energy, since although a reduction in physical terms means energy recovery, it is actually a use of energy. The energy used (energy after the step minus energy before the step) in relation to the energy before the step is then $(v_l + v_e)^2 + v_l \cdot \tan^2(rw) + (v_l + v_e)^2 \cdot \tan^2(rw) / v_l^2 + v_l^2 \cdot \tan^2(rw)$. Normalising v_l to 1 and at the magnitudes indicated, this gives 1.4, i.e. 40% of the kinetic energy has to be added per step in order to effect constant travel on average. With the roller skate according to the invention, the transverse component disappears due to the deflection shortly before each new step. The energy used per step is then $[(v_l + v_e)^2 - v_l^2] / v_l^2$, which gives 1.283 and means that 28.3% of the kinetic energy is added per step in order to effect constant travel on average. This therefore results in a saving of physical energy of 11.7%.

1. A roller sport device, particularly a single-track skateboard or single-track roller skate, having two roller axles disposed one behind the other with single-track rollers which run one behind the other and which are disposed thereon, which axles are disposed on a board or on a supporting frame, characterised in that the rearmost of the two roller axles (rear axle) can swivel about an axle (3, 21, 25, 32, 34, 41, 71) (steering axle) which points obliquely downwards and forwards and which forms a trailing angle, that the running faces (7', 12') of the rollers (7, 12) are curved transversely to the direction of travel and that the running faces (7', 12') have a high coefficient of friction similar to that of rubber.

2. A roller sport device according to claim 1, characterised in that the rear axle is centered for straight running by means of elastic elements (6', 6'', 48, 77, 78, 144).

3. A roller sport device according to either one of claims 1 or 2, characterised in that the trailing angle ranges between 30° and 70°.

4. A roller sport device according to any one of the preceding claims, characterised in that the running faces (7', 12') are curved approximately spherically, with a radius of curvature which approximates to the roller radius, so that the distance from the point of contact of the respective roller (7, 12) to the center thereof does not substantially change over the entire range of oblique positions which can be covered.

5. A roller sport device according to any one of the preceding claims, characterised in that the running faces (7', 12') are formed transversely to the direction of running so that the distance from the roller center to the point of contact of the roller (7, 12) is a minimum when the roller axles are horizontal.

6. A roller sport device according to any one of the preceding claims, characterised in that the running faces are cylindrical over a narrow central region.

7. A roller sport device according to any one of the preceding claims, characterised in that the distance from the rear roller axle (8, 31) to the steering axle (3, 21, 25, 32, 34, 41, 71) is less than the roller radius.

8. A roller sport device according to any one of the preceding claims, characterised in that the distance of the steering axle (3, 21, 25, 32, 34, 41, 71) from the rear roller axle (8, 31) is about 2/10 to 9/10 of the roller radius.

9. A roller sport device according to any one of the preceding claims, characterised in that the distance between the rear roller axle and the steering axle is zero or negative.

10. A roller sport device according to any one of the preceding claims, characterised in that the two rollers (7, 12) are each divided transversely to the roller axle into two half rollers which are at a spacing from each other for the passage of parts which bear the mounting.

11. A roller sport device according to any one of the preceding claims, characterised in that the rear roller axle (8, 31) is attached to a steering body (6, 29, 36, 72) which can swivel about the steering axle (3, 21, 25, 32, 34, 41, 71) by overcoming elastic restoring forces.

12. A roller sport device according to claims 10 and 11, characterised in that the two half rollers of each roller are separately rotatably mounted on the associated roller axle, wherein the front roller axle is fixed and the rear roller axle is fixedly attached to the steering body.

13. A roller sport device according to claims 10 and 11, characterised in that the two half rollers of each roller (7, 12) are fixedly attached to each other by means of the associated roller axle (8, 31; 13), wherein the front roller axle (13) is rotatably mounted in the frame (1, 71) and the rear roller axle (8, 31) is rotatably mounted in the swivelling steering body (6, 29, 36, 72).

14. A roller sport device according to any one of claims 10 to 13, characterised in that the half rollers of at least the rear roller (7) are of shell-like construction so that they enclose a void.

15. A roller sport device according to any one of the preceding claims, characterised in that the rollers (7, 12) consist of a supporting shell made of light metal or plastics and of an external covering (7', 12') made of a polymer with a high coefficient of friction (vulcanised rubber, polyurethane, natural rubber) in relation to the road surface.

16. A roller sport device according to any one of the preceding claims, characterised in that the rear roller (7) is larger than the front roller (12).

17. A roller sport device according to any one of the preceding claims, characterised in that the spacing of each of the two half rollers of a roller (7, 12) in relation to each other is adjustable.

18. A roller sport device according to any one of the preceding claims, characterised in that the rollers (7, 12) are provided with a hard covering further inwards and with a soft covering further outwards.

19. A roller sport device according to any one of the preceding claims, characterised in that the roller axles are fixed to a frame (1, 71) which consists of a supporting beam and which is provided at the top with placement holders (2) for fixing a shoe, that the front end of the frame protrudes through the gap between the front half rollers (12) and bears the front roller axle (13), and at the rear the frame comprises a steering stub (3, 21, 25, 32, 34, 41, 71) which forms the steering axle and which is fixedly attached to the frame, and which protrudes between the rear half rollers (7) into the interior thereof, and that the steering body (6, 29, 36, 72) is disposed inside the rear roller (7).

20. A roller sport device according to claim 19, characterised in that the frame comprises means for the variable fixing of a shoe, particularly slots and wedges which can be placed underneath.

21. A roller sport device according to claim 20, characterised in that the shoe is fixed to the frame (**1**, **71**) with its heel raised, preferably at an angle of 10° to 17°.

22. A roller sport device according to any one of claims 19 to 21, characterised in that the steering stub (**32**, **34**) is integrally formed on the frame (**1**).

23. A roller sport device according to any one of claims 19 to 21, characterised in that the steering stub (**3**) is anchored in the frame (**1**) by a detachable friction cone joint (**4**).

24. A roller sport device according to any one of claims 19 to 21, characterised in that the steering stub (**21**) is undetachably pressed into the frame (**1**).

25. A roller sport device according to any one of claims 19 to 24, characterised in that the steering stub is provided with a bent-round end piece which protrudes obliquely forwards from below into the frame and is anchored there.

26. A roller sport device according to any one of the preceding claims, characterised in that the steering stub (**3**) is bent and is anchored by means of a screwed joint (**5**) so that the direction of action of the screwed joint (**5**) points towards the point of contact of the rear roller (**7**).

27. A roller sport device according to any one of claims 19 to 22, characterised in that the steering stub (**25**) is disposed between two extensions on the frame which protrude from the frame above and below the steering stub.

28. A roller sport device according to any one of claims of **19** to **27**, characterised in that the steering body (**6**) has a bore with which it is fitted over the steering stub (**3'**) in the manner of a sleeve, wherein the bore is wider than the steering stub (**3'**), and that the gap between the bore and the steering stub (**3**) is filled with an elastically resilient material (**6'**).

29. A roller sport device according to any one of claims 19 to 28, characterised in that the cross-section of the steering stub (**3**) has the shape of a rectangle standing on edge.

30. A roller sport device according to claim 29, characterised in that the cross-section of the bore has the shape of a rectangle standing on edge which is drawn in horizontally in the middle, the narrowest point of which is at half its height and corresponds approximately to the width of the steering stub (**3**) (butterfly shape).

31. A roller sport device according to any one of claims 10 to 27, characterised in that the steering body (**72**)

comprises a lever-like extension (**76**) which protrudes towards the frame between the two half rollers and the free end of which is held elastically in the frame (**70**).

32. A roller sport device according to claim 31, characterised in that the free end of the extension (**76**) is held in the frame between two elastic bodies (**77**, **78**).

33. A roller sport device according to any one of the preceding claims, characterised in that two restoring springs which are coupled to the steering body are prestressed in relation to each other and are secured by limit stops so that a threshold moment has to be overcome in order to rotate the steering body.

34. A roller sport device according to any one of claims 1 to 27, characterised in that the steering stub is formed as a torsion spring to which the steering body is fixed directly or on which the steering body is integrally formed.

35. A roller sport device according to any one of the preceding claims, characterised in that the restoring resistance of the steering and/or the threshold moment of the steering body are adjustable.

36. A roller sport device according to any one of claims 10 to 27, characterised in that the gap between the half rollers of the rear roller is closed by a stone guard (**139**) which is fixed to the steering body, and the gap between the half rollers of the front roller is closed by a stone guard (**138**) which is fixed to the frame at least in the region of the points of contact of the rollers.

37. A roller sport device according to any one of claims 19 to 36, characterised in that a brake block (**180**) made of an abrasive material, which projects backwards beyond the rear roller, is fixed to the steering body (**6**) so that when the entire frame (**1**) is slightly tilted said block contacts the ground at the back and produces a braking force.

38. A roller sport device according to any one of the preceding claims, characterised in that the rollers are of unsymmetrical design.

39. A roller sport device according to any one of the preceding claims, characterised in that a parking brake (**38**) is provided by means of which at least one of the rollers can be fixed, and that the parking brake (**38**) is formed by a pin/locking element which can be inserted in the rollers/roller axle or can be inserted via a polygonal formation on the roller, and which comprises a grip in the form of a protruding mark which is easily visible.

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