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United States Patent [19]

Oyen et al.

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[45] **Date of Patent:** **Nov. 19, 1996**

[54] **SHOCK ABSORBENT IN-LINE ROLLER SKATE**

[76] Inventors: **Gerald O. S. Oyen**, #480 - 601 W. Cordova Street, Vancouver, British Columbia, Canada, V6B 1G1; **Francois E. Charron**, P.O. Box 169 Suite 101 - 1184 Denman St., Vancouver, British Columbia, Canada, V6G 2M9

[21] Appl. No.: **261,037**

[22] Filed: **Jun. 14, 1994**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 50,819, Mar. 22, 1993, Pat. No. 5,330,208.

[51] **Int. Cl.**^{6} **A63C 17/04**

[52] **U.S. Cl.** **280/11.22**; 280/11.2; 280/11.27; 280/11.28

[58] **Field of Search** 280/11.22, 11.23, 280/11.2, 11.27, 11.28, 11.115, 87.042

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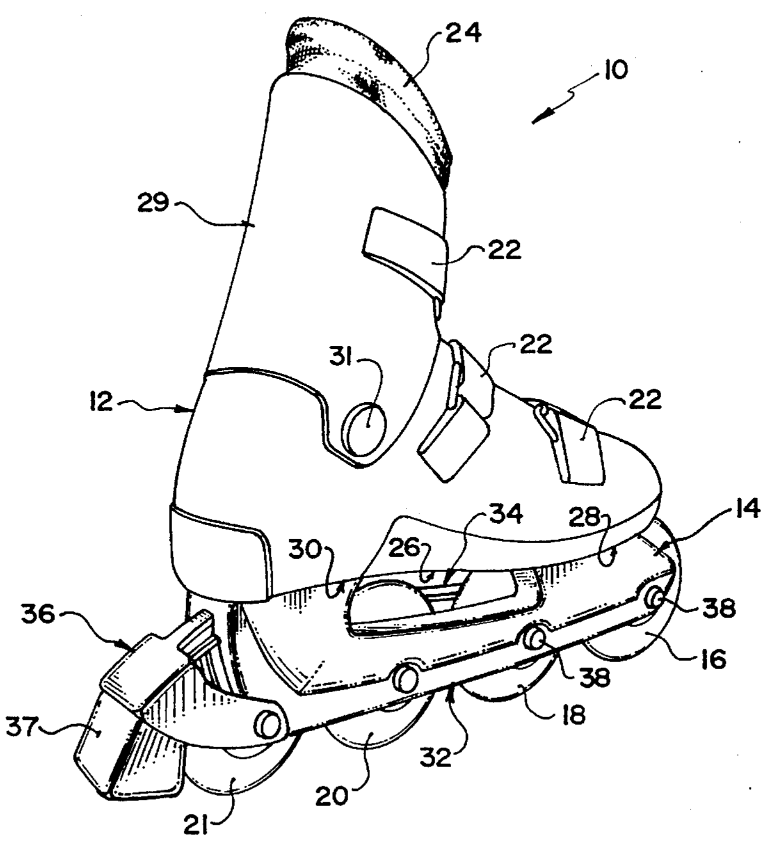
Primary Examiner—Richard M. Camby

Attorney, Agent, or Firm—Oyen Wiggs Green & Mutala

[57] **ABSTRACT**

This invention is directed to in-line roller skates. More particularly, this invention pertains to shock absorbent in-line roller skates wherein the wheels are resilient mounted to navigate over rough, bumpy surfaces. An in-line roller skate comprising: (a) a boot with a heel and toe adapted to receive a foot of a skater; (b) a first wheel supporting rail means secured to an underside of the boot and extending from the heel to the toe; (c) a second wheel supporting rail means secured to an underside of the boot, and extending from the heel to the toe adjacent and generally parallel to the first rail means; (d) a plurality of wheel means mounted in tandem in a line between the first and second rail means, the wheel means being respectively connected to the first and second rail means by respective axle means and bearing means; and (e) a plurality of resilient shock absorbing means located between the respective axle means and bearing means and the rail means to enable the respective wheel means to move under force individually upwardly or downwardly relative to the first and second rail means.

14 Claims, 13 Drawing Sheets



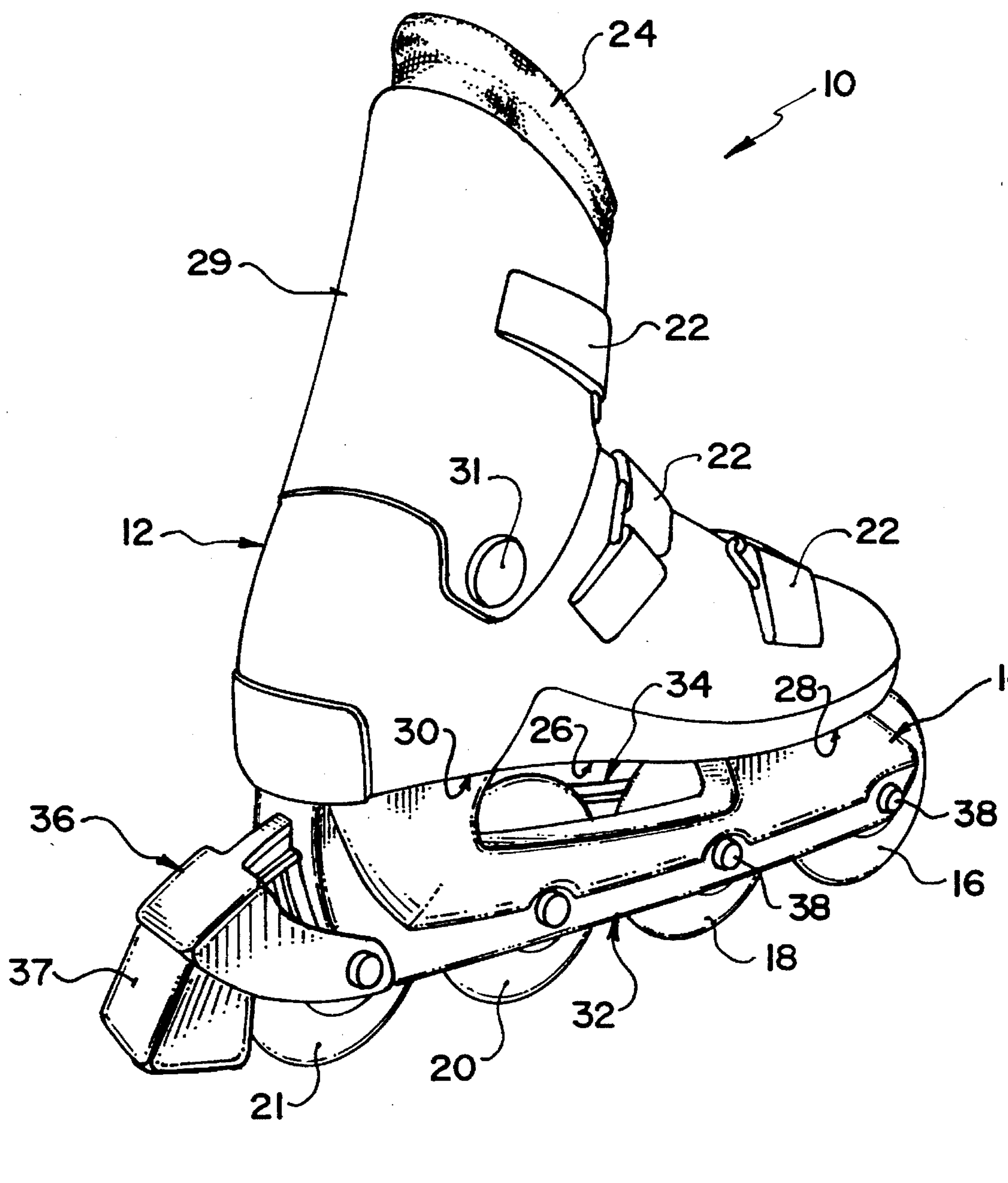


FIG. 1

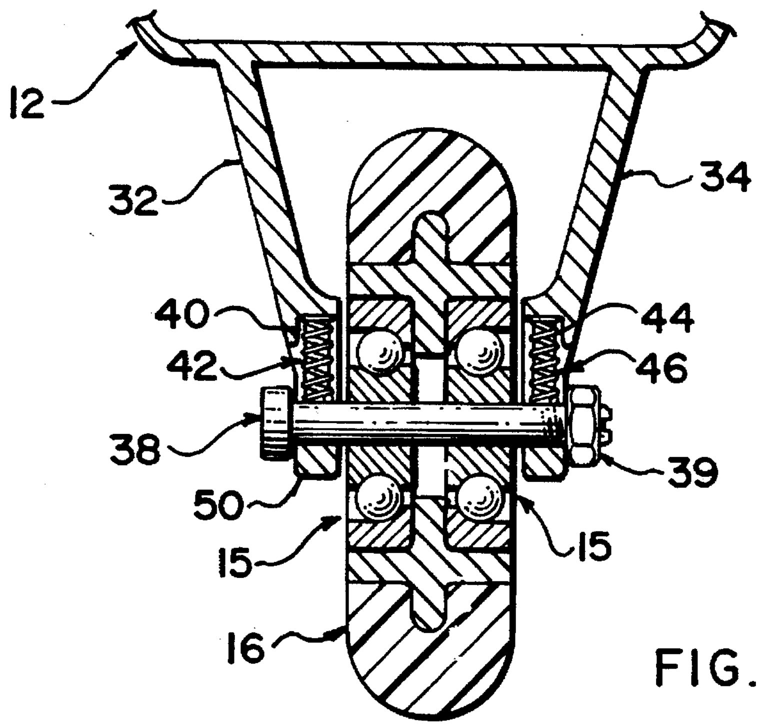


FIG. 2

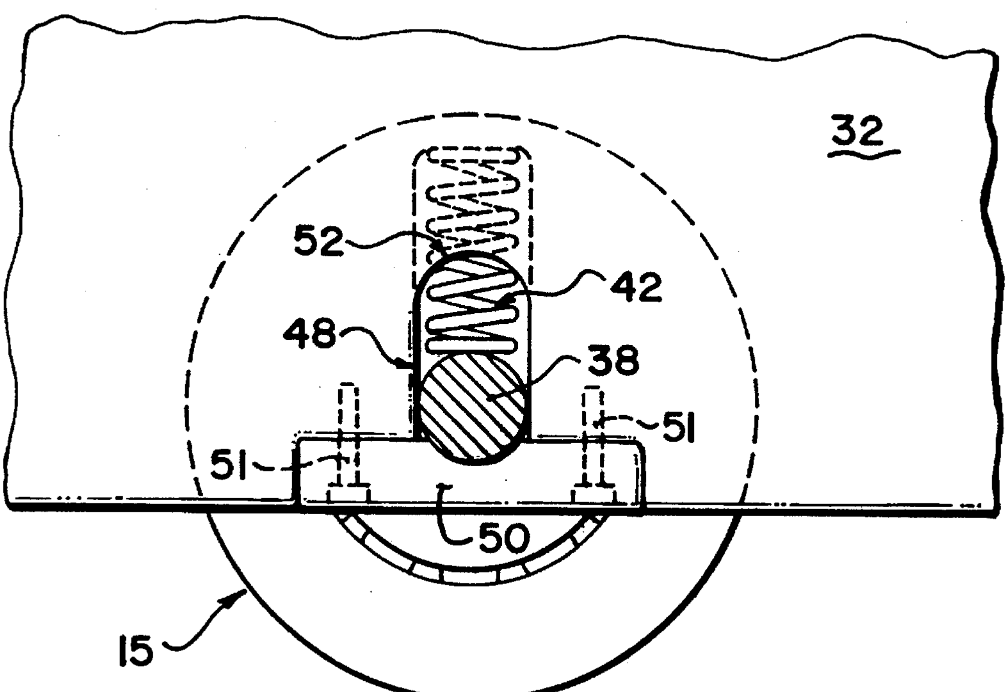


FIG. 3

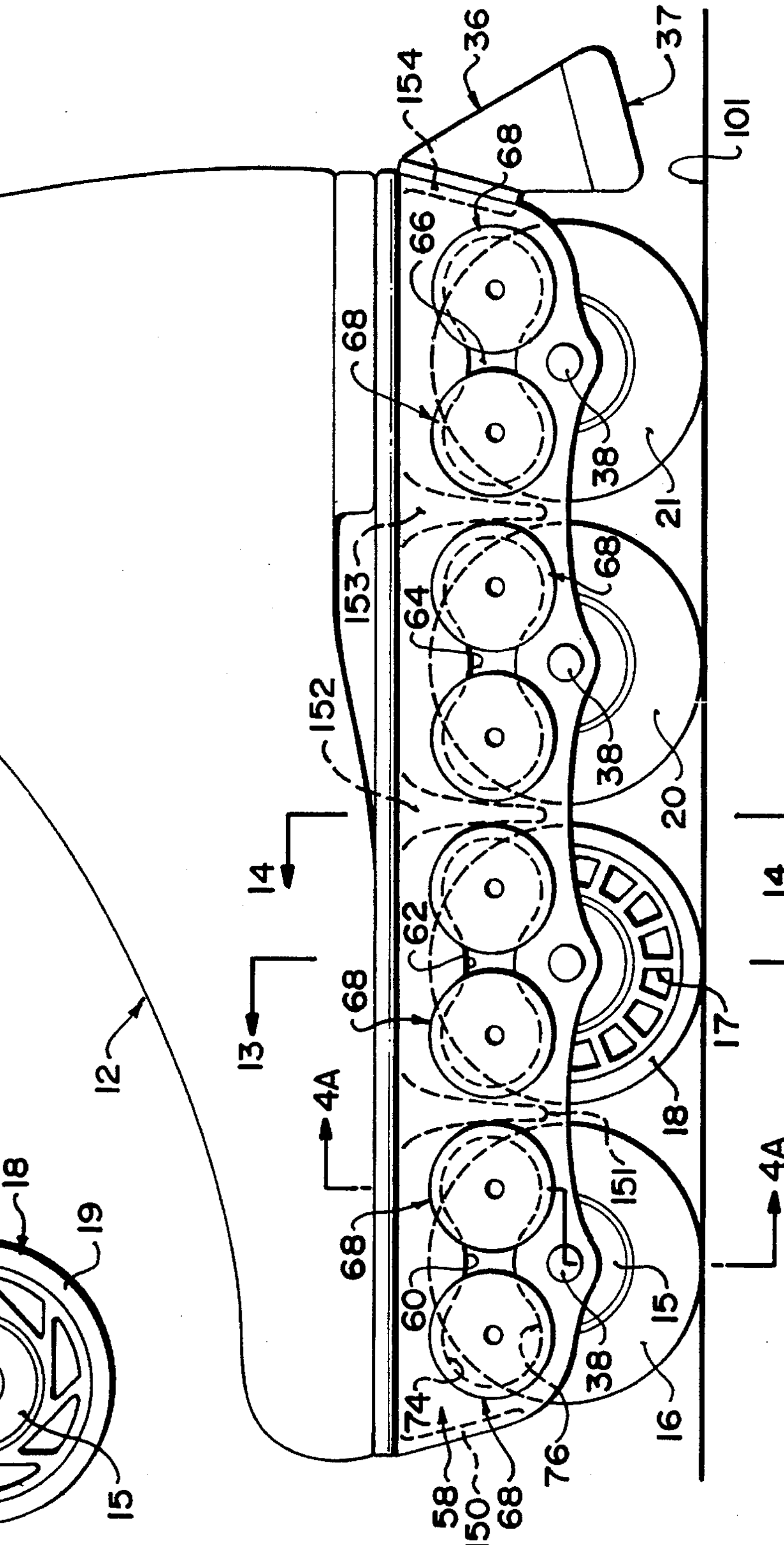

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FIG. 4

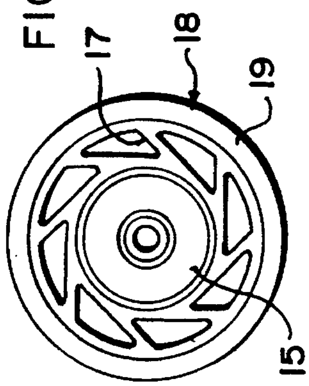
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FIG. 18

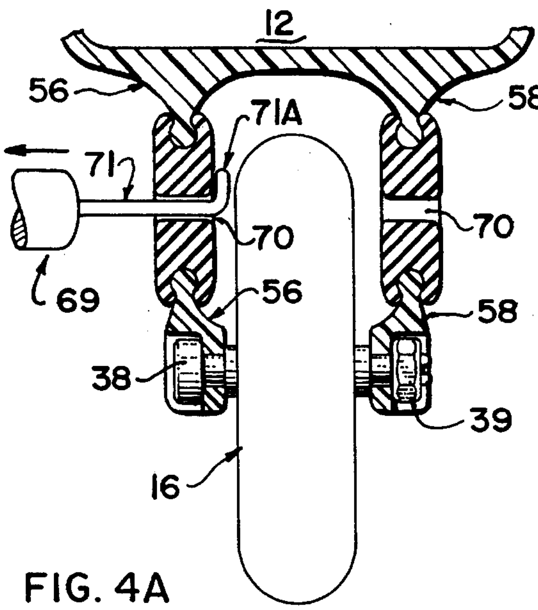


FIG. 4A

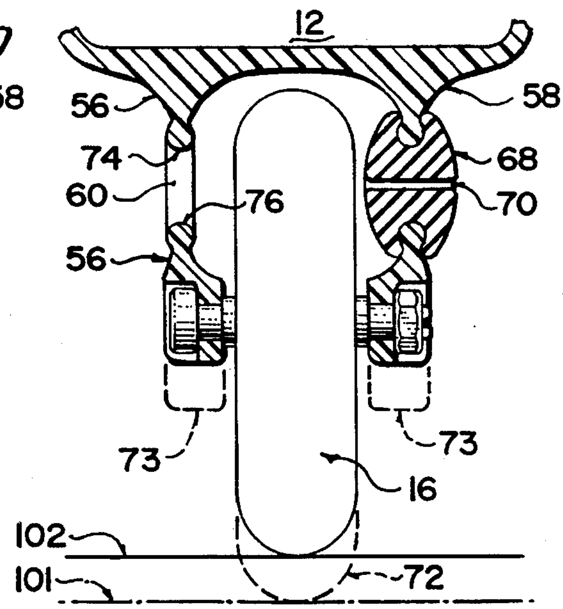


FIG. 4B

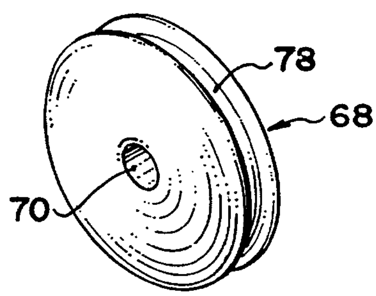


FIG. 4F

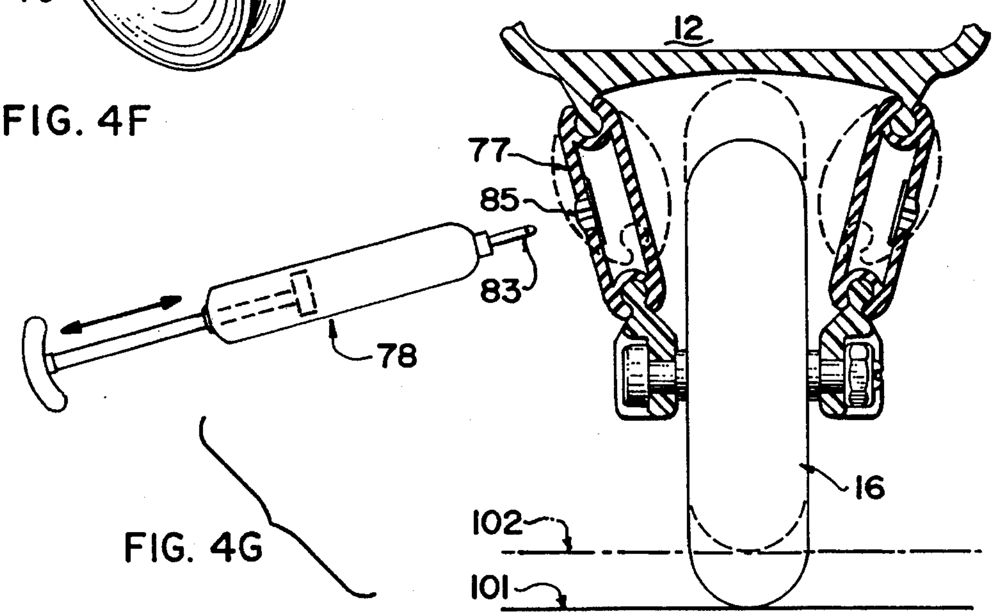


FIG. 4G

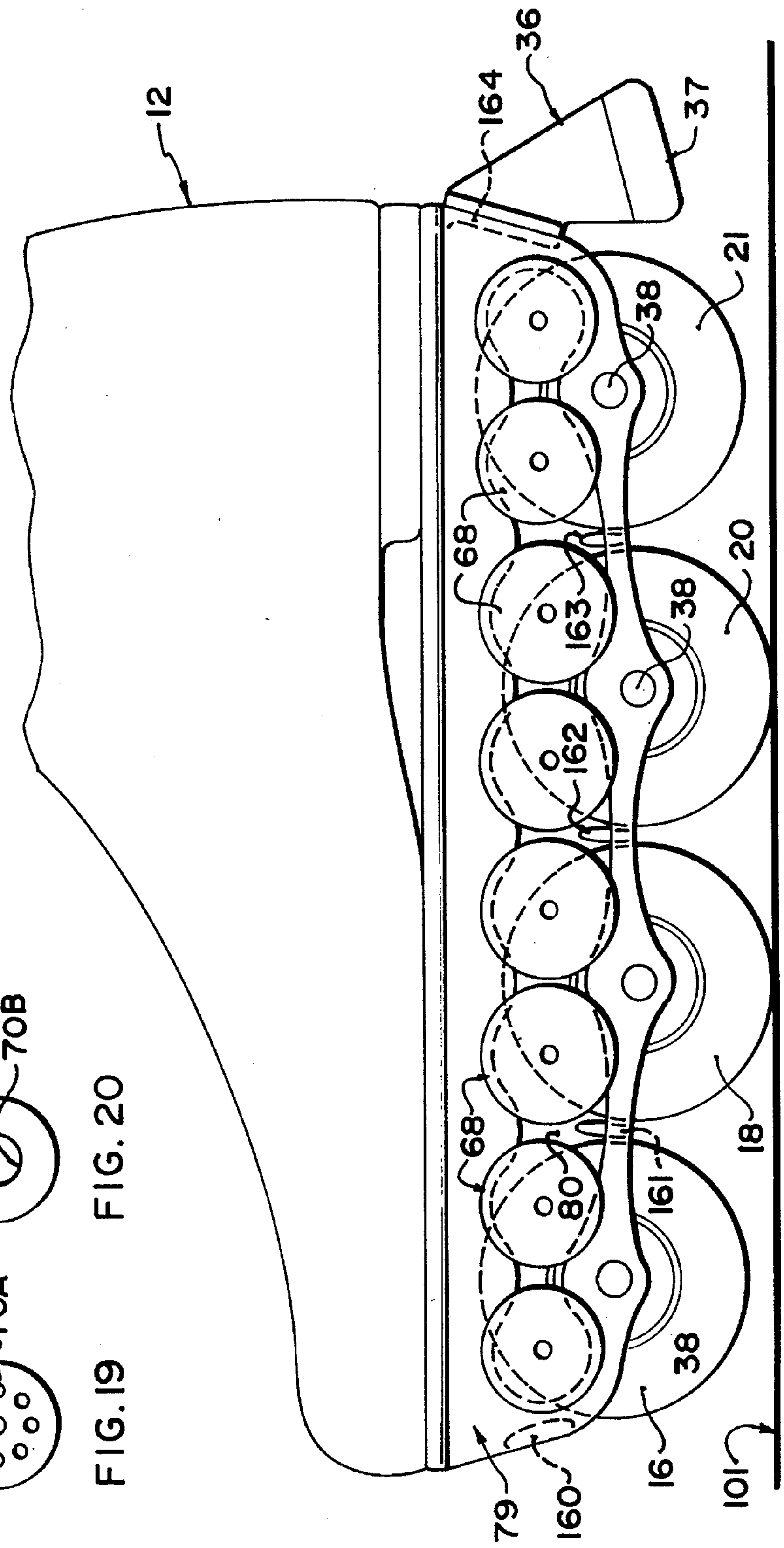


FIG. 4C

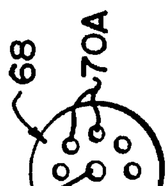


FIG. 19

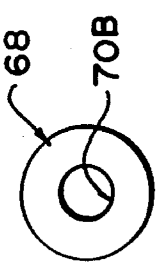


FIG. 20

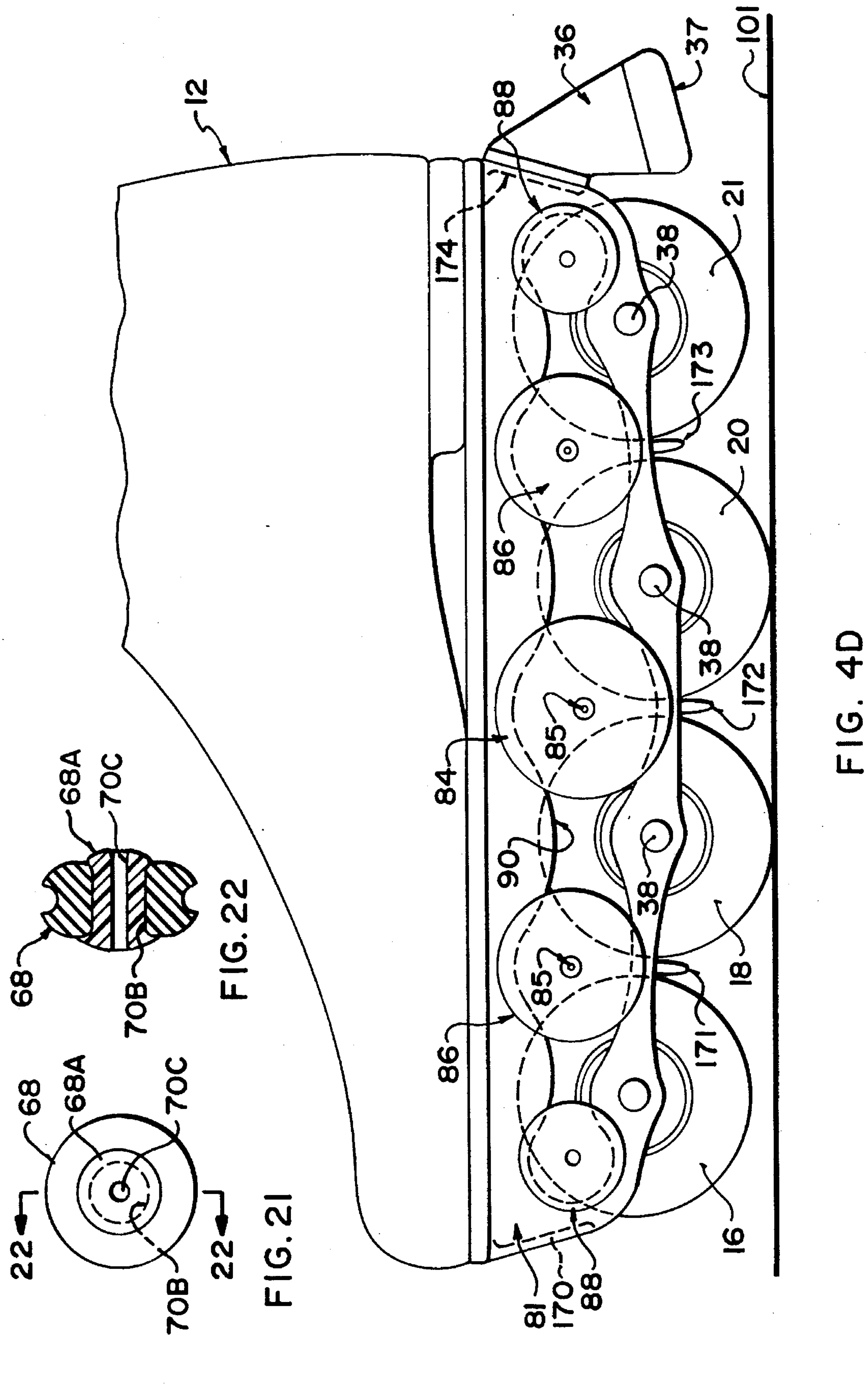
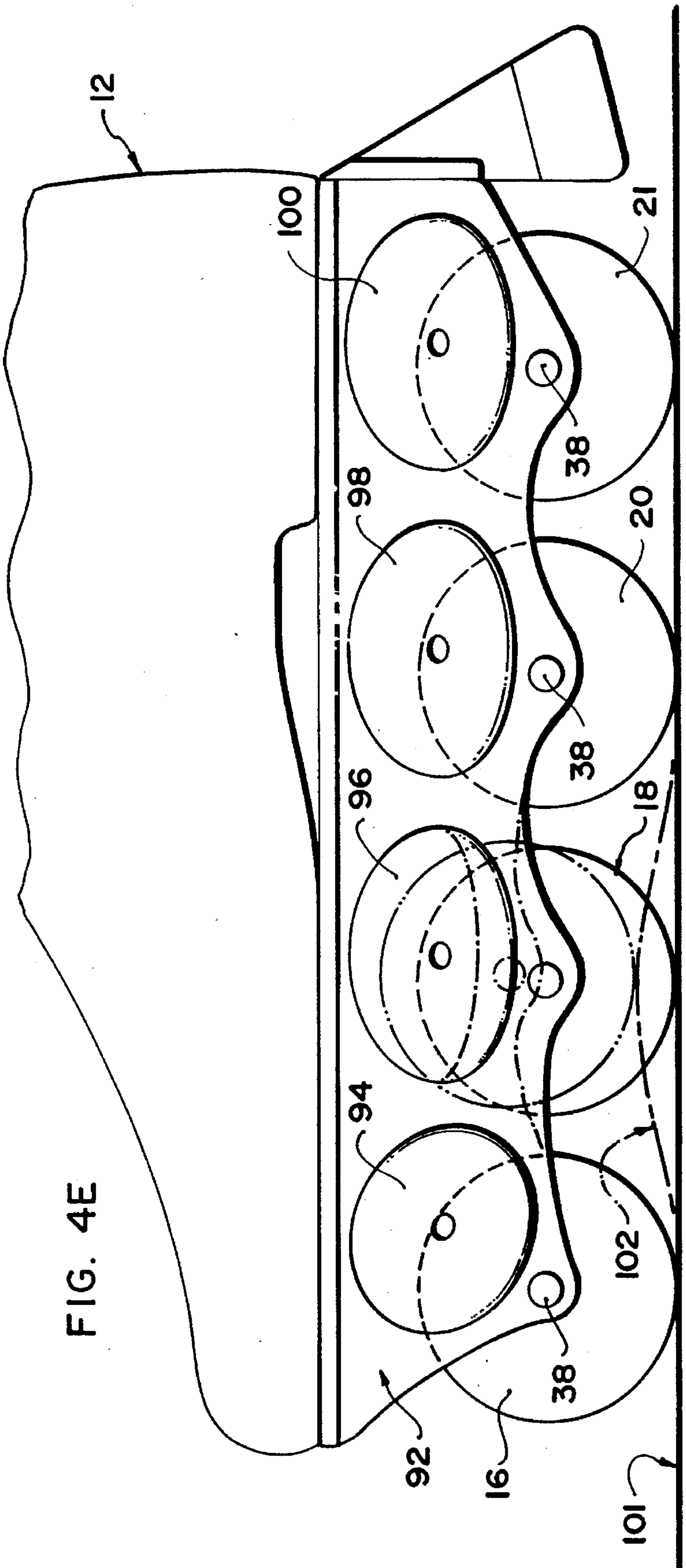


FIG. 4D

FIG. 22

FIG. 21



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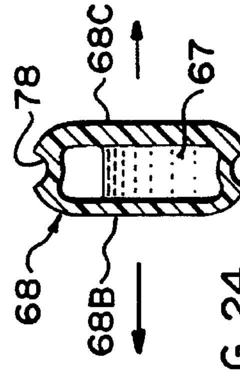

FIG. 24

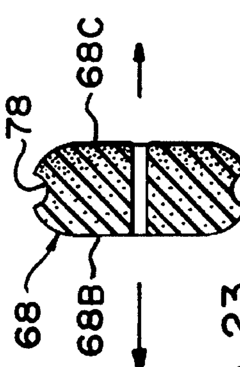

FIG. 23

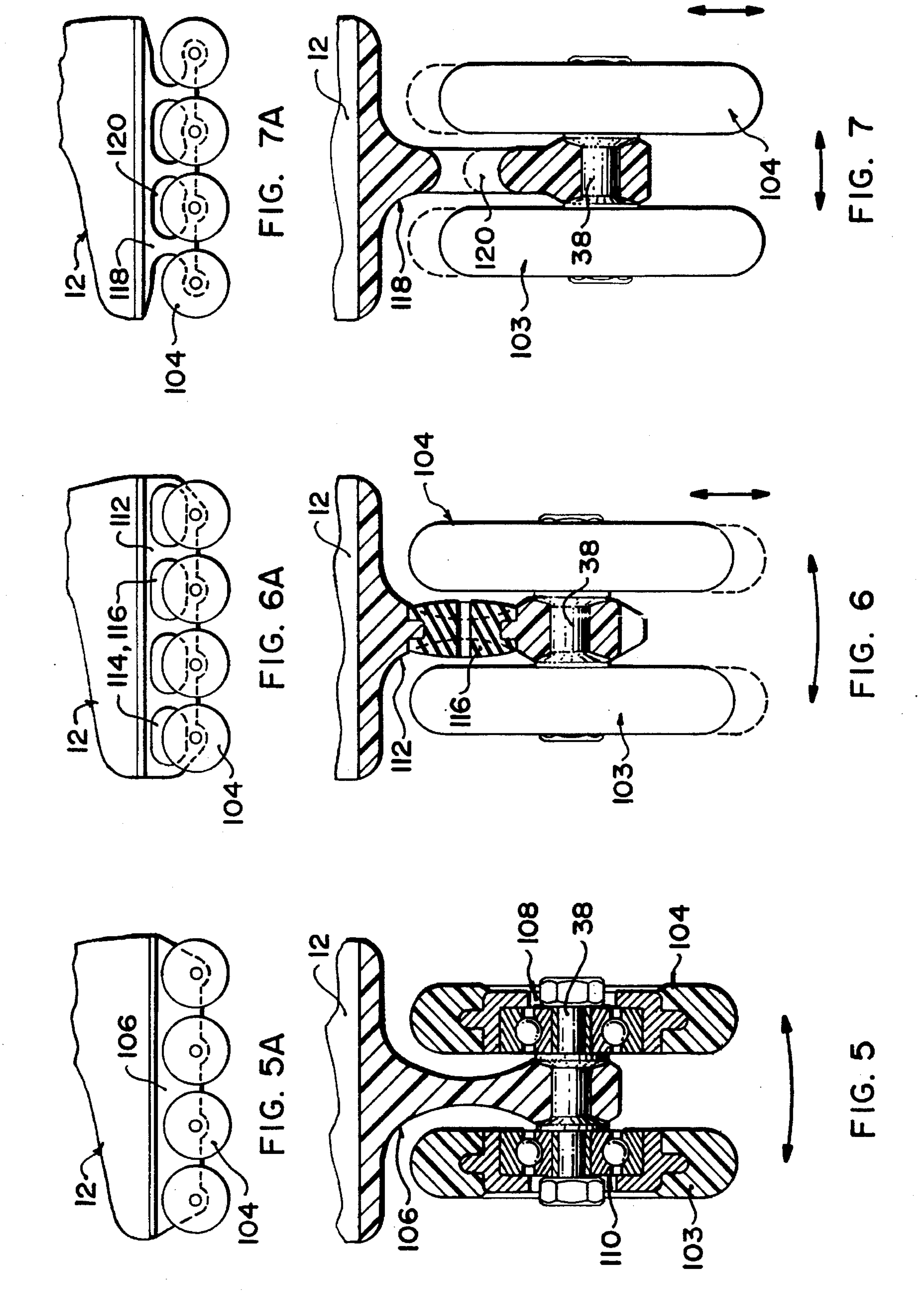
FIG. 7A
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FIG. 7
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FIG. 6A
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FIG. 6
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FIG. 5A
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FIG. 5
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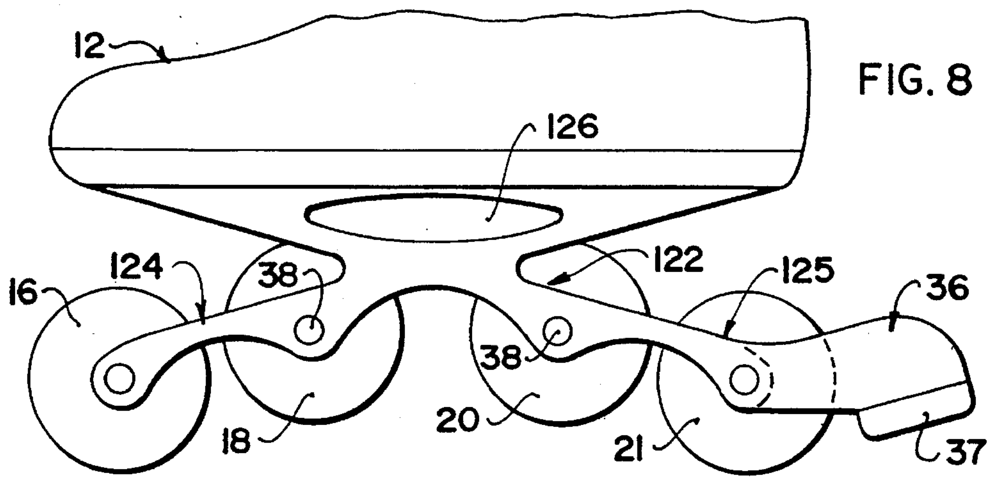

FIG. 8

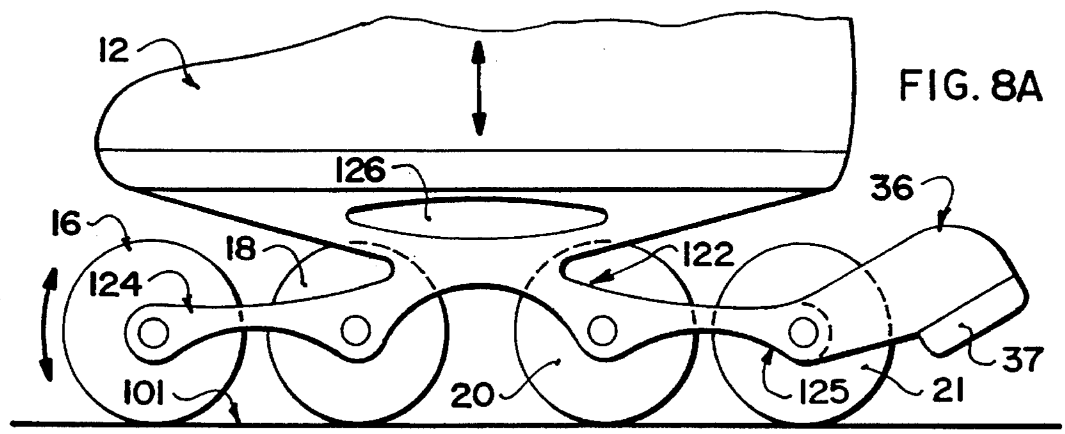

FIG. 8A

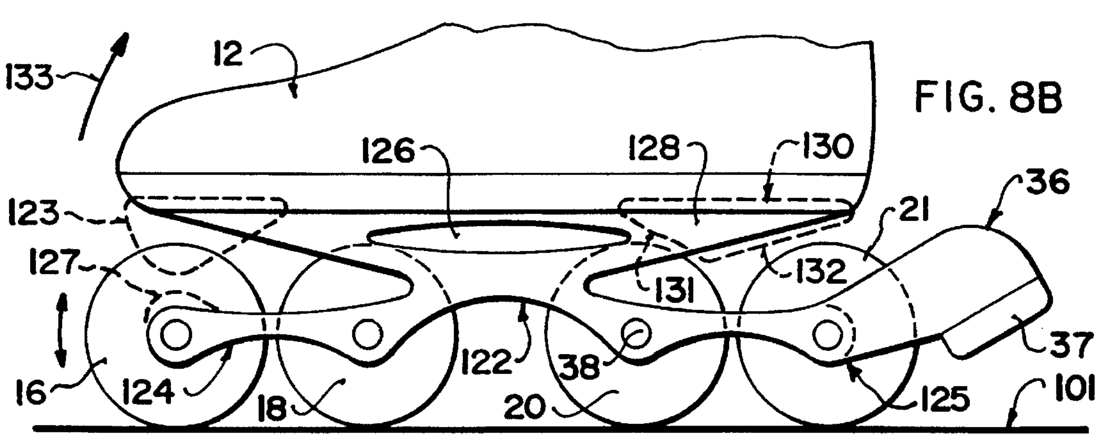

FIG. 8B

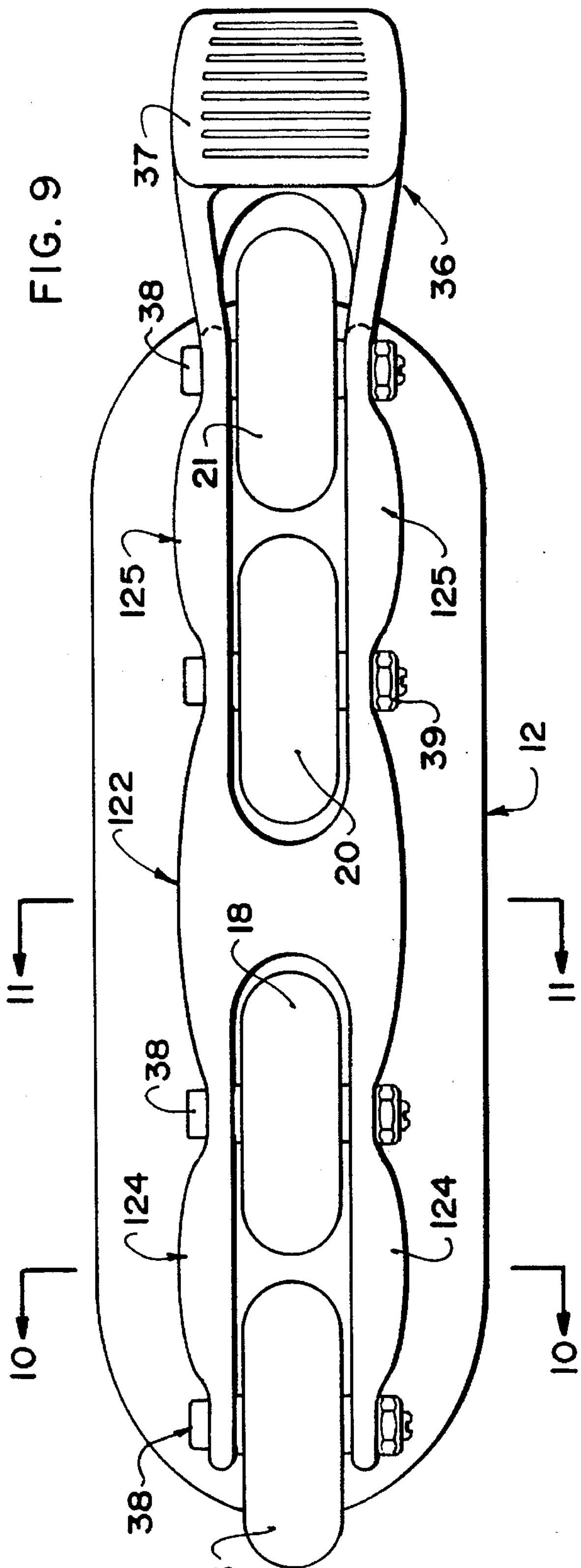

FIG. 9

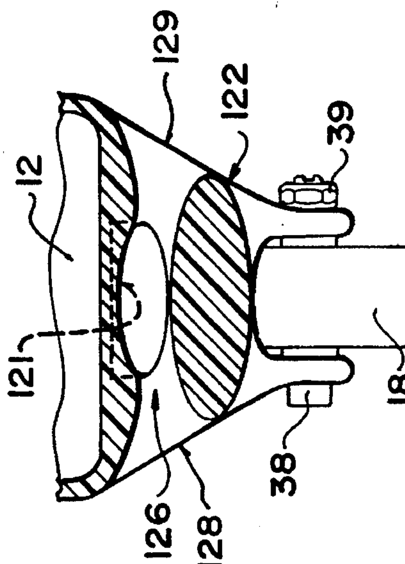

FIG. 11

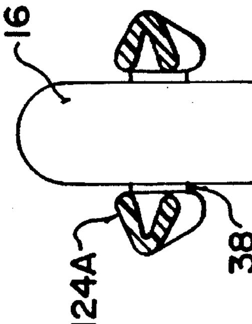

FIG. 12

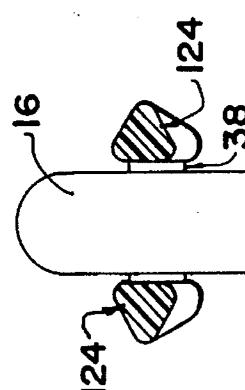

FIG. 10

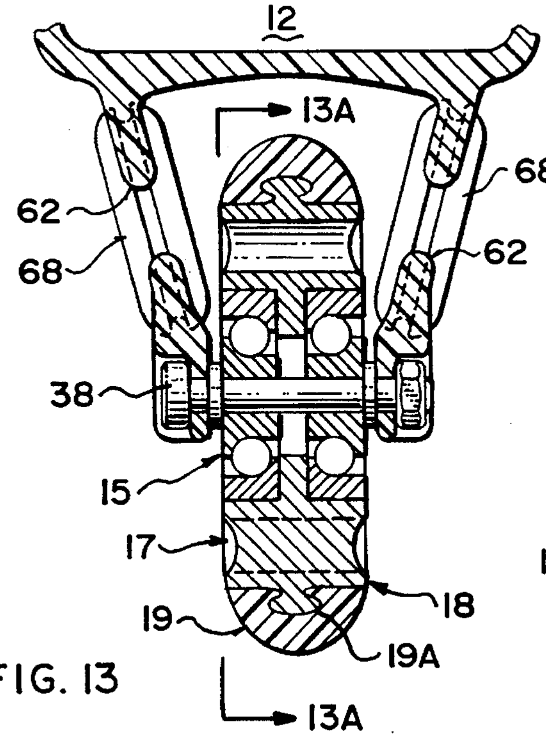

FIG. 13

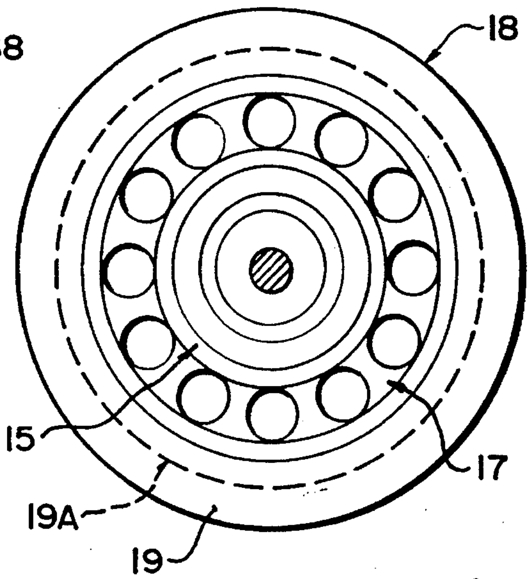

FIG. 13A

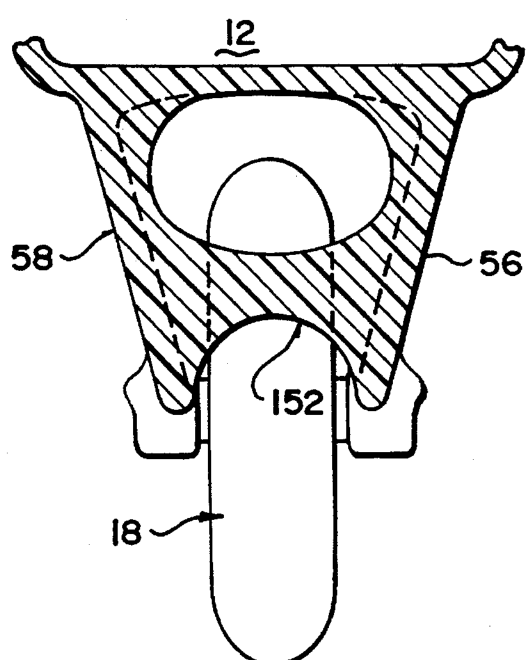

FIG. 14

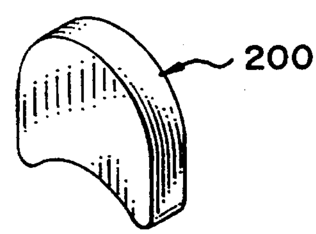

FIG. 15A

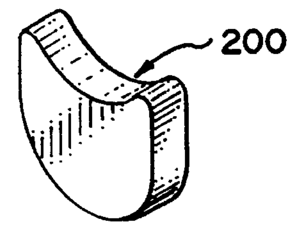

FIG. 15B

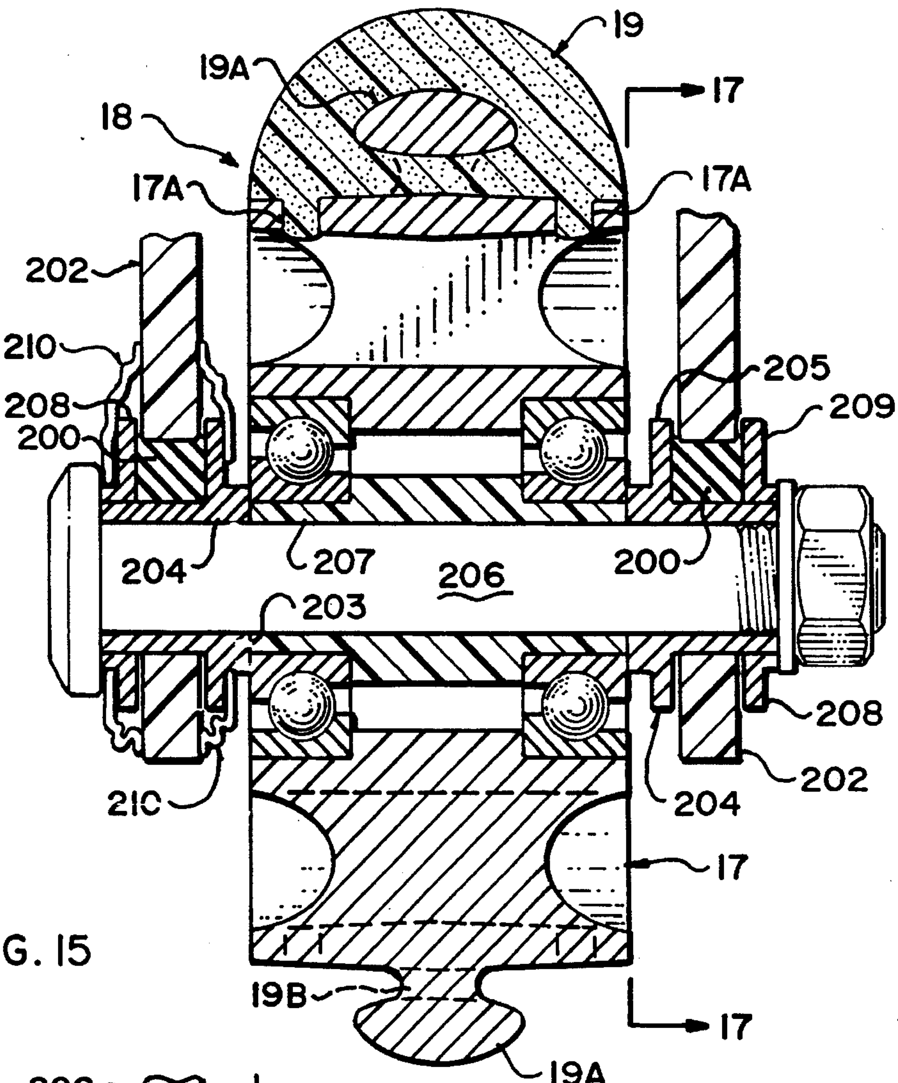

FIG. 15

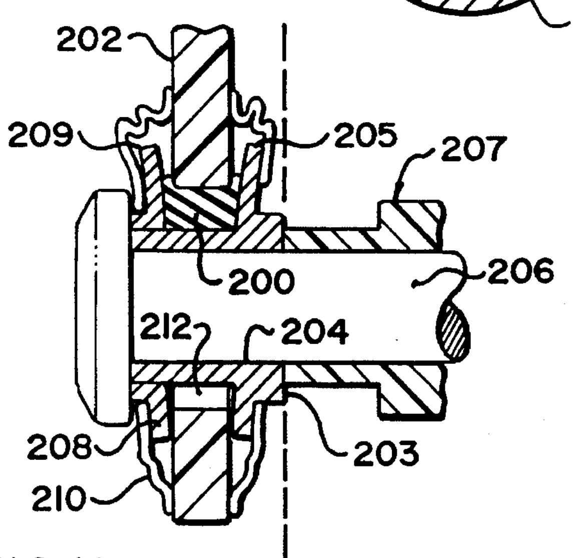

FIG. 16

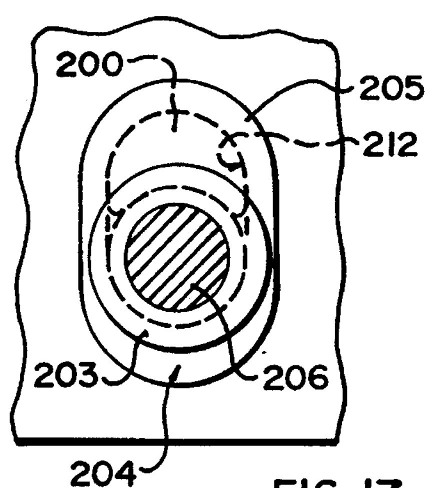

FIG. 17

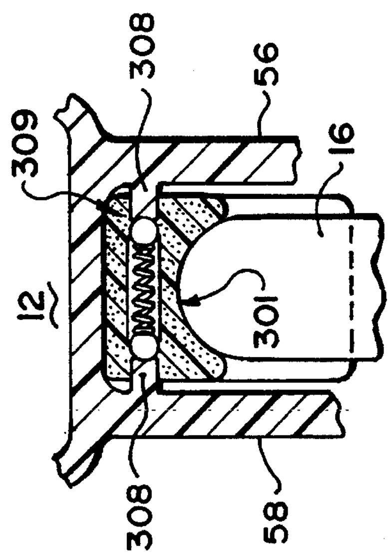

FIG. 27

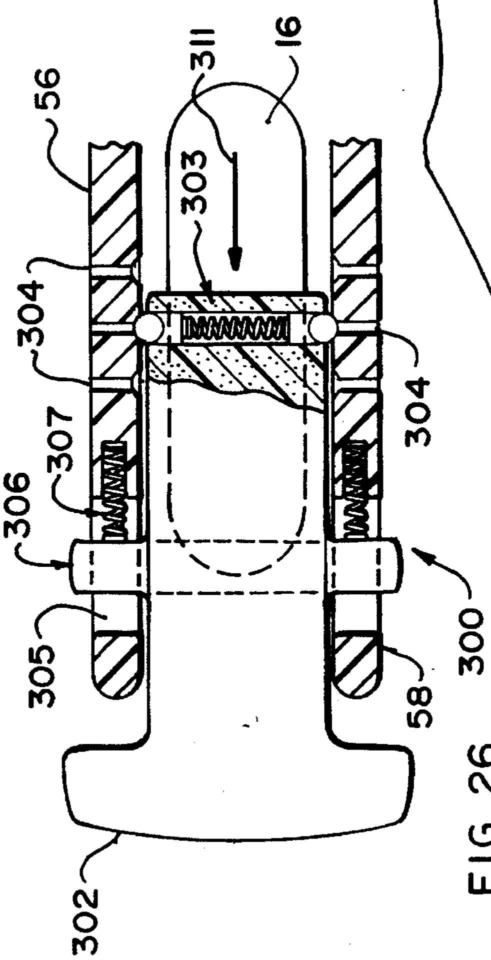

FIG. 26

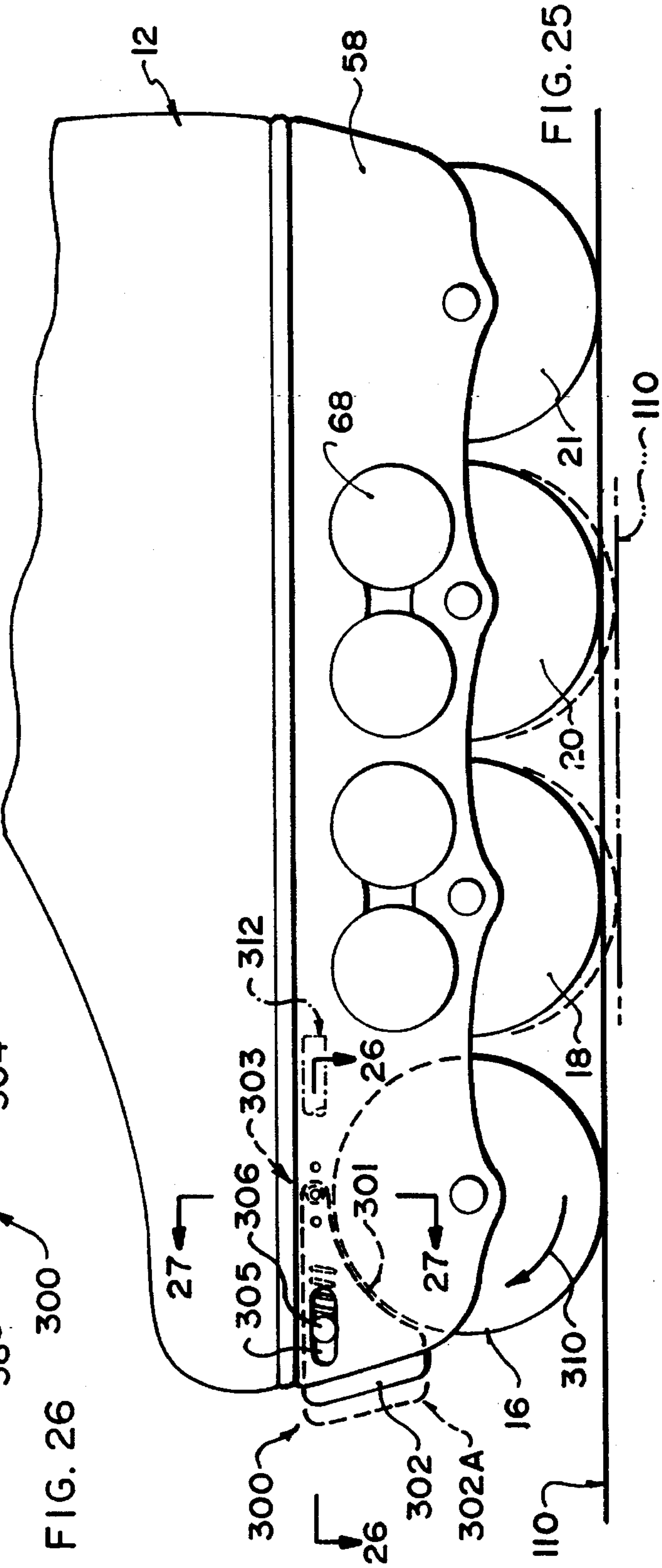

FIG. 25

SHOCK ABSORBENT IN-LINE ROLLER SKATE

This application is a continuation-in-part of application Ser. No. 08/050,819, filed Mar. 22, 1993 U.S. Pat. No. 5,330,208.

FIELD OF THE INVENTION

This invention is directed to in-line roller skates. More particularly, this invention pertains to shock absorbent in-line roller skates wherein the wheels are resilient mounted to navigate over rough, bumpy surfaces. The invention also relates to a wheel stopping mechanism which can be activated to retard wheel rotation.

BACKGROUND OR THE INVENTION

In-line roller skates have become very popular with the public in the past few years. However, the in-line roller skates that are available on the market have a number of inherent limitations. For one thing, the wheels and axles are rigidly mounted to the frame member under the boot and there is minimal shock absorbing capacity built into the wheels. Accordingly, it is difficult for a person wearing conventional in-line roller skates to skate over uneven or bumpy surfaces. This is particularly important during long downhill runs at high speeds. Transmission of excessive high frequency low amplitude vibration due to road surface irregularities may blister a skaters foot as well as cause fatigue. Impacts of high amplitude at any frequency may cause a loss of balance and a serious fall.

Existing in-line skates offer limited shock absorption through the use of a slightly soft tire compound which compensates for only minor bumps. Such tires require frequent replacement due to wear and tear. Use of a relatively soft tire compound, while lending more shock absorbing capacity, increases rolling friction and detrimental heat buildup. This may soften the tire, degrade bearings and overall, require greater skating effort, particularly in high ambient temperatures.

Existing in-line skates usually have three to five tandem wheels in relatively rigid horizontal and vertical alignment. In a three wheel skate, when a skater encounters a bump, in forward motion, the initial upward wheel impact forces the toe upward. Impact with the following middle wheel raises the toe still further leaving ground contact substantially with the final wheel. This action tends to destabilize the skater by removing toe contact which normally supplies the best control.

Allowing independent wheel deflection vertically while maintaining lateral rigidity would enable greater control and stability over relatively rough terrain. Transferring the resilient action away from the tire also would allow the use of harder tire compounds

Another problem is braking. Most in-line skates have a rear brake pad on one skate. It would be helpful if a wheel rotation stopping mechanism could be used. This would avoid unwanted wheel rotation.

U.S. Pat. No. 4,915,399, Merandel, granted Apr. 10, 1990 discloses a front and rear wheel roller skate design which has a suspension system on the front and rear wheels. The roller skate is equipped at the level of the front and rear pivoting axles, with a suspension system for damping shocks resulting from unevenness of a skating surface. The front and rear pivoting axles are each provided with a suspension system which is fixed at one end on the central part of the pivoting axle, and at the other end being guided by a centring barrel located inside a base of the skate. The pivoting axles are also each equipped with a pivoting system secured at one end to the base by a pivoting device while the other end is secured to an arm of the central part by resilient washers. Marandel does not disclose in-line roller skates. He discloses conventional roller skates with a pair of wheels on a front axle and a pair of wheels on a rear axle.

U.S. Pat. No. 5,092,614, Malewicz, assigned to Rollerblade, Inc., granted Mar. 3, 1992, discloses a lightweight in-line roller skate frame and frame mounting system. The in-line roller skate has a frame including a pair of side rails, each side rail having front and rear mounting brackets for attachment of the frame to the boot of the in-line roller skate. Each frame side rail includes a curved portion and a planar portion. The planar portion carries a plurality of axle apertures through which an axle for a wheel may be inserted. Preferably, the axle apertures are configured to receive an axle aperture plug, have an eccentrically disposed axle bore and are situated on the frame side rails such that the wheels may be mounted at multiple relative heights to each other. Malewicz does not disclose any shock absorbing mechanism for the in-line wheels, or any ability for the wheels to move upwardly or downwardly in order to recede when the wheels impact a bump or obstruction.

SUMMARY OF THE INVENTION

The invention is directed to an in-line roller skate comprising: (a) a boot with a heel and toe adapted to receive a foot of a skater; (b) a first wheel supporting rail means secured to an underside of the boot and extending from the heel to the toe; (c) a second wheel supporting rail means secured to an underside of the boot, and extending from the heel to the toe adjacent and generally parallel to the first rail means; (d) a plurality of wheel means mounted in tandem in a line between the first and second rail means, the wheel means being respectively connected to the first and second rail means by respective axle means and bearing means; and (e) a plurality of resilient shock absorbing means located between the respective axle means and bearing means and the rail means to enable the respective wheel means to move under force individually upwardly or downwardly relative to the first and second rail means.

There are variable choices in the degree and placement of the resilient elements concomitant with greater control and enhanced wear characteristics of the ground engaging wheels.

As an alternative embodiment, the resilient shock absorbing means can be absent and the wheels can have resilient spokes which enable the circumferences of the respective wheels to move upwardly or downwardly relative to the first and second rail means. There can be at least three wheel means and the first rail means and the second rail means can include at least three respective resilient means and the at least three wheel means can be rotationally mounted in the respective resilient means.

A pair of respective resilient shock absorbing means can be used for each wheel, axle and bearing means and the resilient shock absorbing means can be mounted in respective cavities formed in the first and second rail means. The respective resilient shock absorbing means can be resilient members which fit in cavities in the first and second rail means.

At least three spring cavity means can be formed in the first rail means and at least three cavity means can be formed in the second rail means, the cavity means coinciding with the positions of the three wheel means respectively, each cavity means being adapted to receive respective removable resilient shock absorbing means.

The resilient shock absorbing means can be removable and invertible resilient plugs which can be positioned in the respective cavity means in the first rail means and the second rail means, the resilient plugs impinging on the axle and bearing means for each respective wheel means, and absorbing compression force when the respective wheel means moves upwardly, and dispensing compression force when the respective wheel means moves downwardly.

The first and second rail means can have formed therein, in association with the respective cavity means, axle wells which permit the axles to move upwardly or downwardly in relation to the first and second rail means. The invertible resilient plugs can be held in place in relation to the axle means and the rail means by spacer sleeve means. The resilient means can also be held in place by washer means.

The resilient means can have protective covers thereon. Each resilient means can have a crescent shape and can fit in respective vertical elongated cavities in the first rail and second rail means, the axle fitting in the concave curve of the crescent.

The axles can be positioned at a first elevation when the concave side of the crescent faces upwardly and can be positioned at a second lower elevation when the concave side of the crescent faces downwardly.

The respective resilient means can be held in place by respective removable washer means which fit about the respective axle means. The respective resilient means can be held in place by respective spacer sleeves which fit about the respective axle means on a side of the resilient means opposite to the washer means. At least one reinforcing web can be located between the first and second rail means to lend stability.

The invention is also directed to an in-line dual wheel roller skate comprising: (a) a boot adapted to receive a foot of a skater; (b) a resilient wheel supporting means secured to the underside of the boot; (c) at least three pairs of wheels mounted in tandem linear relationship on the wheel support means in dual pair relationship with one another, the dual wheels being individually moveable relative to the boot when a force is exerted on the wheels thereby flexing the wheel supporting means.

The dual wheels can be rotationally mounted on either side of the wheel supporting means by a laterally extending axle, the axle being adapted to pivot upwardly or downwardly in relation to the boot by compressing the wheel supporting means. The wheel supporting means can have positioned therein, at least one resilient spring disc which enables the wheels to move upwardly or downwardly relative to the boot. The wheel supporting means can have one or more compressible cavities thereon.

The wheel support means can have formed therein a cavity which can be adapted to receive a coil spring, the coil spring impinging upon the axle means and enabling the axle means to move upwardly or downwardly in relation to a force exerted upwardly or downwardly on the dual wheels and the axle.

The invention is also directed to an in-line roller skate comprising: (a) a boot adapted to receive a foot of a skater; (b) a resilient yoke-like wheel supporting means secured to an underside of the boot, the supporting means having forward extending and rearward extending fork-like arms; and (c) a plurality of wheels rotatably arranged within the fork-like arms of the wheel support means;

A pair of wheels can be arranged in line between the forward fork-like arm, and a pair of wheels can be arranged between the rearward fork-like arm, and the wheels and arms can move upwardly when the wheels are placed on the ground, to absorb compression forces.

The invention is also directed to an in-line roller skate comprising: (a) a boot adapted to receive a foot of a skater; (b) a resilient wheel mounting means secured to the underside of the boot, longitudinal with the boot, and having an elongated longitudinal wheel receiving cavity therein; with at least one opening formed in the wheel mounting means; (c) a plurality of wheels rotatably mounted in series within the wheel receiving cavity; and (d) a removable resilient compression force absorbing means fitted in the opening in the wheel mounting means.

Alternatively, an opening can be formed in each wall of the wheel mounting means on either side of the wheel receiving cavity, the openings being adapted to receive a plurality of detachable resilient compression force absorbing means. The detachable resilient compression force absorbing means can be formed in the shape of discs which can have a peripheral groove around the circumference thereof, the peripheral groove being adapted to fit with the edges of the opening, the discs receiving axles of the wheel means.

Each wall of the wheel mounting means can have formed therein a plurality of openings, each opening receiving a pair of resilient disc-like compression force absorbing means. The disc-like resilient compression force absorbing means can have compressible openings therein. The disc-like resilient compression force absorbing means can be hollow.

The wheels can have rotatable bearings therein and can be mounted on axles which are secured to the side walls of the wheel supporting means. A pair of disc-like resilient compression absorbing means can be detachably fitted to the wheel mounting means for every axle.

A releasable toe wheel lock for hill or stair climbing may be installed. This wheel lock may be applied to one wheel per boot or simultaneously to two or more if desirable. The wheel lock may operate in a ganged manner.

The invention is also directed to an in-line roller skate comprising: (a) a boot adapted to receive a foot of a skater; (b) a wheel mounting means secured to the underside of the boot, longitudinal with the boot, and having an elongated longitudinal wheel receiving cavity therein; (c) a plurality of wheels rotatably mounted in series within the wheel receiving cavity in longitudinal alignment with one another; and (d) a releasable wheel rotation stop means located between the underside of a toe of the boot and above a forward wheel of the plurality of wheels.

The wheel stop means can move between a first position wherein the stop means can be free of the forward wheel and permits the forward wheel to rotate and a second position wherein the stop means abuts the forward wheel and prevents rotation of the forward wheel. The wheel stop means can have releasable lock means which enables the stop means to be locked in a first or second position.

The wheel stop means can be located between the underside of a heel of the boot and above a rear wheel of the plurality of wheels.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings which represent specific embodiments of the invention but which should not be regarded as restricting the spirit or scope of the invention in any way:

FIG. 1 illustrates a perspective view of a conventional in-line roller skate with four in-line wheels and a rail frame securing the wheels to a boot.

FIG. 2 illustrates a front partial section view of an in-line roller wheel, spring-mounted to a wheel carrying frame attaching the wheel and axle to the boot.

FIG. 3 illustrates a side view of a wheel bearing and axle, spring-mounted to a frame of an in-line roller skate.

FIG. 4 illustrates a side view of a second embodiment of shock absorbent in-line roller skate and boot design comprising elastic shock absorbing rails with variable density shock absorbing discs in receptacles.

FIG. 4A illustrates a section view taken along section line 4A—4A of FIG. 4.

FIG. 4B illustrates a variation of a section view taken along section line 4A—4A of FIG. 4 when the roller wheel is reacting to upward compression, and a disc is on one side only.

FIG. 4C illustrates a side view of a third embodiment of shock-absorbent in-line roller skate.

FIG. 4D illustrates a side view of a fourth embodiment of shock-absorbent in-line roller skate.

FIG. 4E illustrates a side view of a fifth embodiment of shock-absorbent in-line roller skate.

FIG. 4F, which appears on the same sheet as FIGS. 4A and 4B, illustrates an isometric view of a resilient shock absorbent spring plug.

FIG. 4G, which appears on the same sheet as FIGS. 4A and 4B, illustrates an end partial section view of a sixth embodiment of the invention with air-filled resilient discs.

FIG. 5 illustrates an end section view of a first embodiment of a lateral dual wheel in-line roller skate.

FIG. 5A illustrates a side view of the dual wheel in-line roller skate illustrated in FIG. 5.

FIG. 6 illustrates an end-section view of a second embodiment of a lateral dual wheel in-line roller skate.

FIG. 6A illustrates a side view of the dual wheel in-line roller skate illustrated in FIG. 6.

FIG. 7 illustrates a end-section view of a third embodiment of a lateral dual wheel in-line roller skate.

FIG. 7A illustrates a side view of the dual wheel in-line roller skate illustrated in FIG. 7.

FIG. 8 illustrates a side view of an in-line roller skate with spring yoke wheel suspension.

FIG. 8A illustrates a side view, of an in-line roller skate with spring yoke wheel suspension, when contacted with the ground and under a limited load.

FIG. 8B illustrates a side view of an in-line roller skate with spring yoke wheel suspension, when subjected to further ground compression action, compared to the configuration illustrated in FIG. 8A.

FIG. 9 illustrates a bottom view of an in-line roller skate with spring yoke wheel suspension.

FIG. 10 illustrates a section view taken along section line 10—10 of FIG. 9.

FIG. 11 illustrates a section view taken along section line 11—11 of FIG. 9.

FIG. 12 illustrates a section view taken along section line 10—10 of FIG. 9 of an alternative embodiment of hollowed-out lightweight yoke supports.

FIG. 13 illustrates a section view taken along section line 13—13 of FIG. 4, showing a lightweight wheel assembly with a low profile tire.

FIG. 13A illustrates a view of the wheel of FIG. 13 taken along section line 13A—13A of FIG. 13.

FIG. 14 illustrates a section view taken along section line 14—14 of FIG. 4, showing a lateral stabilizer web in the wheel support rail.

FIG. 15 illustrates an enlarged section view of an in-line roller skate wheel and support with a pair of axle-mounted resilient shock absorbing axle plugs and tire mounting means.

FIG. 15A, which appears on the same sheet of drawings as FIGS. 13 and 14, illustrates an isometric view of a resilient shock absorbing axle plug.

FIG. 15B, which appears on the same sheet of drawings as FIGS. 13 and 14, illustrates an isometric view of an inverted shock absorbing axle plug.

FIG. 16 illustrates a section view of a detail of the axle and resilient shock absorbing axle plug of FIG. 15 under compression.

FIG. 17 illustrates a section view taken along section line 17—17 of FIG. 15.

FIG. 18, which appears on the same sheet of drawings as FIG. 4, illustrates a spring action angled spoke shock absorbing wheel.

FIG. 19, which appears on the same sheet of drawings as FIG. 4C, illustrates a means of varying disc density.

FIG. 20 illustrates a further means of varying disc density.

FIG. 21, which appears on the same sheet of drawings as FIG. 4D, illustrates a means of adjusting the density of the disc of FIG. 20.

FIG. 22 illustrates a section view taken along section line 22—22 of FIG. 21.

FIG. 23, which appears on the same sheet of drawings as FIG. 4E, illustrates a graded density disc.

FIG. 24 illustrates an asymmetrically resilient fluid filled disc.

FIG. 25 illustrates a side view of a partially shock-absorbent in line skate with a releasable toe wheel lock.

FIG. 26 illustrates a section view taken along section line 26—26 of FIG. 25.

FIG. 27 illustrates a section view taken along section line 27—27 of FIG. 25.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS OF THE INVENTION

FIG. 1 illustrates in perspective view a conventional in-line roller skate **10**. The skate **10** includes a boot **12** and a rigid wheel frame **14** attached on the underside thereof. Frame **14** rotatably supports four in-line wheels which are identified from front to rear respectively as wheels **16**, **18**, **20** and **21**. Frame **14** is attached to the under-sole **26** of boot **12** at a front sole attachment **28** and a rear sole attachment **30**. Frame **14** includes parallel first and second side rails **32** and **34** respectively. Side rail **34** is partly visible in FIG. **1**. The side rails **32** and **34** are used for mounting the axles of the wheels **16**, **18**, **20** and **21**. Frame **14** may include at the rear a brake assembly **36** having a braking pad **37** which a skater may use to assist in stopping forward or reward motion, by pressing the pad against the ground.

Boot **12** includes an ankle cuff **29** which is pivotally attached to boot **12** by a cuff pivot point **31**. Boot **12** further includes a plurality of boot closure means **22** for closely conforming the boot **12** to a skater's foot. As shown in FIG. **1**, closure means **22** are individual buckle type closures, which are conventional. Other known means of tightening a boot onto a foot, such as laces and eyelets, or hook and pile fastener straps are also feasible and are within the scope of the present invention. Boot **12** may include a soft absorbent liner **24** which may be removable if desired.

FIG. **2** illustrates a front partial section view of a wheel **16**, which is rotatable on an axle **38**. The axle **38** rotates in a pair of ball bearings **15** in the wheel **16**, which is conventional. The bearings **15** reduce friction and minimize heat development when the wheels **16**, **18**, **20** and **21** (see FIG. **1**) rotate while the skater is skating. The axle **38** is held in place by nut **39**. The first side rail **32** is constructed to include therein a vertical cavity **40** which can receive a coil spring **42**. The top end of the coil spring **42** bears against the top of the cavity **40**, which is slightly notched. At its lower end, the spring **42** bears against the top side of axle **38**. The wheel **16** rotates by bearings **15** on the axle **38** which is basically stationary. The second side rail **34** is constructed to have therein a similar second spring cavity **44** and a second coil spring **46**. This construction with dual springs **42** and **46**, one on each side of the wheel **16**, enables wheel **16** to move upwardly or downwardly (depending upon the degree of softness of the springs **42** and **46**) against the pair of springs **42** and **46** respectively when the wheel **16** contacts an obstruction or bump in the ground surface over which the skate is traversing. The construction also permits a slight amount of lateral tilting of the wheel **16**, which can be controlled by the degree of stiffness of the coil springs **42** and **46**.

The other three wheels illustrated in FIG. **1**, namely, wheels **18**, **20** and **21**, are similarly equipped with corresponding coil springs and cavities in the side rails **32** and **34** in order to enable those wheels to also yield upwardly against the springs when bumps or obstructions are encountered on the ground surface. The springs **42** and **46**, and the other springs, are selected to have sufficient compression force to carry the weight of the skater. The springs can be removed and replaced with springs of other compressive force to proportionately accommodate the weight of lighter or heavier skaters. Spring systems other than coil springs, for instance, resilient rubber blocks, or leaf springs may be used.

FIG. **3** illustrates a side view of the axle **38**, wheel bearing **15** and spring construction illustrated in FIG. **2**. The wheel **16** is not shown. In FIG. **3**, it can be seen that side rail **32** has formed therein a vertical longitudinal axle well **48**, in which axle **38** and wheel **16** can move upwardly or downwardly within fixed limits. Forward or rearward movement of the axle and wheel a restricted. The downward movement of axle **38** and wheel **14** is restricted by cross bar **50**. Bar **50** is held in place against rail **32** by a pair of counter sunk screws **51**. Likewise, the upward movement of axle **38** and bearing is limited by the top **52** of well **48**. As seen in FIG. **3**, wheel **16**, which rotates about axle **38** by means of the ball bearings **15**, is free to move upwardly against the downward force exerted by coil spring **42**, whenever the bottom of wheel **16** hits an obstruction in the ground surface over which the skater is skating. The distance of axle travel between bar **50** and the top **52** of well **48** is sufficient to enable the spring **42** to absorb the shock caused by most bumps encountered by the skater. While spring **42** is visible in FIG. **3**, as depicted, side rail **32** can be designed and formed (such as by injection molding) to provide a cover for spring **42**, and well **48**, so that they are not visible. This may be desirable for cosmetic or design reasons or retard inclusion of foreign particles.

As used in this disclosure the term "resilient material" means a material which is elastic, recoils. rebounds and resumes shape and size after being stretched or compressed under a force, which is subsequently removed.

FIG. **4** illustrates a side view of a second embodiment of shock absorbent in-line roller skate and boot design. As with the previous design, the boot **12** (shown schematically) has four wheels **16**, **18**, **20** and **21** on the underside thereof, and a brake assembly **36** and pad **37** at the rear end thereof. However, in the second embodiment illustrated in FIG. **4**, the pair of parallel side rails **56** and **58** (side rail **58** is visible in FIG. **4**) have a different construction. The side rail **58** is typically constructed of a resilient strong material such as extruded high density polyethylene, polypropylene, or some other suitable material, (which can, if desired, be reinforced with glass or graphite fibres) which provides both rigidity, strength and a certain amount of flexibility. The material should be relatively rigid in the linear alignment direction and reasonably flexible in the vertical direction to prevent linear wobble of the wheels, but allow some vertical movement of the wheels. The side rail **58** is extruded to have formed therein a series of four dumbbell shaped openings, **60**, **62**, **64** and **66**. The centre of each dumbbell opening **60**, **62**, **64** and **66** is positioned above the axle **38** of the underlying wheel. The regions between the adjacent ends of each dumbbell opening **60** can be reinforced, if desired, to increase strength and rigidity.

FIG. **4** also illustrates in dotted lines a series of lateral stabilizing webs **150**, **151**, **152**, **153** and **154** which lend additional lateral stability to the side rails **56** and **58**. These webs assist in preventing the wheels from wobbling laterally out of tandem alignment.

Fitted in the large opening at each end of the dumbbell **60** are a series of spring plugs or discs **68** which are formed of a suitable compressible material, such as a polyurethane elastomer, or the like. These spring plugs or discs **68** act like compression springs and provide shock absorbing capacity to the wheels when the wheels contact bumps or uneven terrain. The spring discs **68** can be exchanged with either softer or firmer versions in order to provide the desired amount of shock absorbing or spring action to the dumbbell **60** and spring disc **68** combination. The elasticity of each disc can be individually selected to customize the bump absorbing action or some or all of the discs may be removed to produce desired shock absorbing action. The degree of elasticity may be chosen with regard skater weight and ability for various road conditions and skating styles. The discs may be colour coded for density e.g. clear or translucent for lighter elements, grading to dark for less resilient discs. Alternatively, the discs may be patterned and coloured for coding or for decorative purposes.

FIG. **4**, as an alternative embodiment, illustrates second forward wheel **18** having an enlarged hub, spoke and rim assembly **17**. Prior art wheels have large relatively soft tires to absorb a very limited amount of shock. These tires fail to dissipate heat adequately and thereby increase bearing stresses. These factors generate increasing rolling friction both in the bearing and tire compound. The soft tire compound and bearings of the prior art thus tend to wear more quickly and require more effort to increase speeds. The hub, spoke and rim assembly **17** serves to provide better cooling while the low profile tire inherent with the assembly **17** may be of a harder wear resistant nature. While only one wheel **18** is shown, it will be understood that all four wheels may be of the spoked design.

As an alternative embodiment, the spoked wheel **18** may be constructed of different materials to provide shock absorbing action or reduction in weight.

FIG. 4A illustrates a section view taken along section-line 4A—4A of FIG. 4. In FIG. 4A, spring discs **68** are shown at each side. For purposes of illustration, a plug remover **69** and hooked rod **71** are shown removing the disc **68** in the opening **60**. The discs may be press fitted for installation, with or without a tool. The first side rail **56** extends downwardly from the boot **12** at the left side of the figure, while the parallel side rail **58** extends downwardly the right side of the figure. The dual side rail combination **56**, **58** can be injection molded as a unit, and fibre reinforced, which is evident in FIG. 4A. The axle **38** extends through the base regions of the side rail combination **56**, **58**, and is secured with nut **39** on the opposite side. The axle **38**, and nut **39** combination holds the wheel **16** in the interior opening provided by the parallel spaced side rails **56** and **58**.

FIG. 4B illustrates, in section view, upper lip **74** and lower lip **76** which are formed in the upper and lower regions of the dumbbell opening **60**. The upper lip **74** and lower lip **76** are designed to engage snugly with the groove **78** which is formed around the periphery of the spring disc **68**. In FIG. 4B, the upper lip **74** and lower lip **76** are shown having a rounded form, and the groove **78** in the spring disc **68** also has a congruent rounded form. However, the respective configurations can have different designs, for instance, square, triangular, dove-tail, and the like, if greater interaction between the groove **78** and the respective lips **74** and **76** is required. In FIG. 4B, no disc **68** is shown in the left side opening **60**. This can be by design. As a rule, however, discs **68** are normally installed on both sides.

As seen in FIG. 4A, the spring disc **68** is in a non-compressed configuration. However, when the wheel **16** encounters a bump or an obstruction of some sort (level **102**), the wheel **16** is forced upwardly, as illustrated in FIG. 4B, which illustrates a section view taken along section line 4A—4A of FIG. 4, except in the depiction illustrated in FIG. 4B the roller wheel **16** is under upward compression. The initial position of wheel **16** is indicated by dashed lines **72**. The upward movement of the wheel **16** forces the axle **38**, nut **39** to move upwardly as indicated by dashed lines **73**. As is evident in FIG. 4B, this upward action compresses dumbbell opening **60**, and spring disc **68**. Spring disc **68** absorbs the upward compressive force by contracting vertically and expanding laterally. A similar action would take place in a companion spring disc **68** if it were fitted in left dumbbell opening **60**. The spring disc **68** has an opening **70** through the centre thereof. The size of this opening **70** can be varied in order to provide increased control over compressibility of the spring disc **68**. As a general rule, the larger the spool opening **70**, the more resilient is the spring disc **68**. However, compressibility is also governed by the degree of elasticity of the elastomeric material from which spring disc **68** is formed. The opening is also used to enable the disc **68** to be installed or removed by disc remover **69** as shown in FIG. 4. Further embodiments of wheel discs are discussed below and illustrated in FIGS. **19** to **24**.

FIG. 4C illustrates a side view of a third embodiment of shock-absorbent in-line roller skate. As seen in FIG. 4C, the four wheels **16**, **18**, **20** and **21** are arranged in an arc configuration so, in the embodiment shown in FIG. 4C, only the two centre wheels **18** and **20** touch the ground **101**. In certain instances, for example, increased maneuverability, may be desirable to have the forward wheel **16** and the rear wheel **21** raised above the two middle wheels **18** and **20**. The forward wheel **16** and the rear wheel **28** would then only contact the ground under certain conditions. The side rail position linking the axles **38** can be designed to have a vertical bowing action, and a relatively rigid linear configuration. This region of the rail **79** can be post-tensioned or pre-tensioned, as required, in order to accommodate the elasticity of the discs **68**.

As seen in FIG. 4C, the side rail **79**, rather than having formed therein a series of four dumbbell openings, has formed therein a single continuous undulating "string of beads" type opening, in which the spring discs **68** are fitted. The discs **68** can have uniform or varying degrees of elasticity as required to provide the proper shock absorbency action. The central discs can be of a larger diameter than the end discs. As with the design illustrated previously in FIG. 4, there is a pair of spring discs **68** for every wheel and axle combination. Again, the side rails **58** and **56** (not visible) are formed of appropriate resilient material to provide a certain amount of flexibility, so that the dimensions of the continuous undulating opening **80** will compress upwardly to a certain extent, when the wheels **16**, **18**, **20** and **21** impact the ground. The compression action of the opening **80**, however, is controlled both by the degree of resiliency of pre or post-tensioning of the linking area between the axles **38** and by the degree of compressibility provided by the spring discs **68**. FIG. 4C also illustrates in dotted lines lateral stabilizer webs **160**, **161**, **162**, **163** and **164**, which give lateral stability to the rails **79**.

FIG. 4D illustrates a side view of a fourth embodiment of shock-absorbent in-line roller skate. The design illustrated in FIG. 4D is similar to a certain extent to that illustrated in FIG. 4C, except that the undulating opening **90**, is formed (or deformed by pre- or post-tensioning) so that it accommodates significantly different sizes of spring discs. Also, the middle three discs **86** as seen in FIG. 4D have air valves so that the internal air pressure can be adjusted. As seen in FIG. 4D, there are five spring discs, arranged so that they fit on the outsides and the interiors of the four axles of the four wheels **16**, **18**, **20** and **21**. A single large size hollow air filled spring disc **84** is fitted into the central portion of the opening **90**, between the middle wheels **18** and **20**. A pair of medium size air filled spring discs **86**, are fitted between the two forward wheels **16** and **18**, and the latter two wheels **20** and **21**. A pair of small exterior spring discs **88**, are fitted in the two ends of the opening **90**. The action provided by the embodiment illustrated in FIG. 4D is similar to that provided by the previous embodiments, but represents a alternative means of achieving the shock absorbent, compressible wheel design provided by the invention. As illustrated, spring disc **85** and discs **86** are oversized to lower the centre wheels **18** and **20** relative to wheels **16** and **20**, to provide a convex curved ground contacting wheel bottom profile, but may be replaced with smaller discs to allow all wheels to contact the ground simultaneously. FIG. 4D also illustrates lateral stabilizer webs **170**, **171**, **172**, **173** and **174**.

FIG. 4E illustrates a side view of a fifth embodiment of shock-absorbent in-line roller skate. As seen in FIG. 4E, four discs, **94**, **96**, **98** and **100**, are fitted in oval openings formed in side rail **92**. The four discs, **94**, **96**, **98** and **100** are positioned above and slightly to the rear of the respective axles **38** of the respective wheel **16**, **18**, **20** and **21**. However, to provide the shock absorbing capacity along the force line that would be generated by wheel **16** impacting a bump, or the like, the front spool **94** is positioned slightly farther behind axle **38** of front wheel **16**, than with the other three discs.

FIG. 4E illustrated by means of dashed lines **102**, the manner in which wheel **18** reacts when it impacts a bump indicated by dashed line **102**. The wheel **18** moves upwardly, thereby compressing disc **96**, into a more oval shape configuration. A resiliency of the disc **96** absorbs the upward compressive force, and thereby enables wheel **18** to negotiate the bump **102** readily. The wheels **16**, **18**, **20** and **21** provide independent suspension because they all act independently as the bump **102** moves under each wheel.

FIG. **4**F illustrates an isometric view of resilient shock absorbent spring disc **68**. The spring disc **68** has a general disc-like configuration, with a peripheral groove **78** around its circumference. Disc opening **70** is also indicated in the central area of the spring disc **68**, and penetrates through the interior of the spring disc **68**. This opening **70** can vary in size in order to regulate the degree of elasticity of the disc **68**. It can also be used to receive plug remover **69** for installation or removal on the skate rail.

FIG. **4**G illustrates a partial section view of an embodiment of the invention with air-filled discs. The discs **77** are at an angle to avoid any interference with wheel movement under severe compression. The discs **77** are hollow so that they can be air filled via valves **85**. The air can be pumped in by pump **78** and needle **83**. The manner in which the discs compress when wheel **16** contacts a bump **102** is indicated in dashed lines. The pump **78** can be of small size and clamped to or incorporated in boot **12**.

FIG. **5** illustrates an end section view of a dual wheel in-line roller skate. The boot **12** as seen in FIG. **5** has on the underside thereof two parallel rows of wheels **102** and **104** mounted by axle **38** to a central mount **106**. This dual wheel in-line roller skate design is also adapted to absorb shocks and bumps as will be explained below.

In the end section view illustrated in FIG. **5**, the first wheel **102** is paired with a second wheel **104**, both of which are rotatably mounted on a common axle **38**, and are rotatable about respective ball bearings **108** and **110**. The pair of wheels **102** and **104** are fixedly mounted on a central dual wheel mount **106**, which is secured to the undersigned of the boot **12**. The central dual wheel mount **106** is constructed, such as by extrusion molding, from a strong semi-rigid material which has a certain amount of lateral "give" to it. The degree of stiffness of the material from which the wheel mount **106** is constructed can be varied as required. Reinforcing with glass or graphite fibres may be advisable. FIG. **5**A illustrates a side view of the dual wheel construction with four pair of wheels **102** mounted in spaced relation rotatably on central dual wheel mount **106**, which is secured to the underside of boot **12**.

As indicated by the double ended arrow in FIG. **5**, the pair of wheels **102** and **104** can move laterally due to the semi-flexibility of the central dual wheel mount **106**. This action enables each wheel **102** and **104** to negotiate individually a bump or an obstruction. The result is that the four pair of wheels on the skate (see FIG. **5**A) are adapted to yield to obstructions on the surface over which the skater is travelling.

FIG. **6** illustrates and end section view of the second embodiment of the dual wheel in-line roller skate. FIG. **6**A illustrates a side view of the dual wheel in-line roller skate illustrated in FIG. **6**. The dual wheel design illustrated in FIGS. **6** and **6**A vary from that illustrated in FIGS. **5** and **5**A in that the central mount **112** has formed therein a plurality of openings **114**, into which can be fitted resilient spring discs **116**. The action provided by this combination is similar to that described previously for the openings and the spring disc combinations described for the single in-line roller skate designs illustrated in FIGS. **4**, **4**A, **4**B, **4**C, **4**D, **4**E, **4**F and **4**G.

The configuration illustrated in FIG. **6** and **6**A enables lateral movement and vertical wheel movement to be achieved, as indicated by the pair of double headed arrows.

FIG. **7** illustrates an end section view of a third embodiment of a dual wheel in-line roller skate. FIG. **7**A illustrates a side view of the roller skate design illustrated in FIG. **7**. In this design, the central wheel mount **118** has an "open-ended" design, with two central openings **120**. This design also has lateral and vertical dual wheel movement, as indicated by the pair of double headed arrows in FIG. **7**. The material from which central mount **118** is constructed can be selected to provide the requisite amount of flexibility and shock absorbing capacity. A semi-rigid resilient plastic material such as density polyethylene, high density polypropylene, suitable reinforced with fibreglass or graphite filaments, or the like, can be utilized.

The three embodiments of dual wheel in-line roller skate design illustrated in FIGS. **5**, **5**A, **6**, **6**A, **7** and **7**A show the wheels mounted in pairs. In each case, the pair of wheels can move upwardly or downwardly by compressing the openings or in a lateral direction about the central dual wheel mount which is constructed of a suitable resilient material.

Most bumps and obstructions encountered by a skater as he or she skates over the ground are not very large and accordingly it is unlikely that each of the dual wheels will encounter the same bumps simultaneously. Thus, when one of the dual wheel pairs encounters a bump, it is able to move upwardly relative to the other dual wheel, and thereby absorb at least a portion of the impact caused by the bump. The pair of wheels are also able to move laterally. This pivotal dual wheel configuration provides a more smooth operating and shock absorbing in-line skate design, than the conventional in-line roller skate design where the wheels are rigidly mounted to the frame.

With the dual wheel mounting, one or both of the wheels are free to move upwardly against the compression force exerted by the central mound, with or without spring discs, when one or both wheels encounter a bump or obstruction the ground surface over which the skater is skating. This construction provides a very smooth operating dual wheel in-line roller skate. Furthermore, when the skater negotiates a turn, and "leans" into the turn, the wheel mounting flexes somewhat and enables the inner wheel to yield more than the outer wheel, as the case may be, thereby enabling all wheels to remain in contact with the ground surface, even though the skater is leaning into the turn.

FIG. **8** illustrates a side view of an in-line roller skate with spring yoke wheel suspension, shown in an unstressed condition. In this design, the four wheels **16**, **18**, **20** and **21**, are mounted on a yoke-like wheel suspension **122**, which is secured to the underside of the boot **12**. FIG. **8** illustrates the arrangement the wheels and the yoke **122**, which is constructed of a semi-ridge spring-line resilient material, such as flexible metal alloys, graphite fibre, or similar material, used in bicycle forks and frames, tennis rackets, or similar sports equipment constructions. The front pair of wheels **16** and **18** are mounted on the forward portion **124** of the yoke. Wheels **20** and **21** are rotatably mounted on the rear portion of the yoke **122**.

When the skater wearing the boot **12**, contacts the ground, the forward and rear arms **124** and **125** of the yoke **122** yield upwardly as illustrated in side view perspective in FIG. **8**A. This action is illustrated by the vertical double headed arrow on boot **12**. As the skater applies more weight, the yoke **122**, by means of the compression action provided by elongated oval opening **126**, provides further shock absorbing and compression force absorbing action as seen in FIG. **8**B. FIG. **8**B illustrates in dotted lines an optional set of upper and lower front bumpers **123** and **127** which prevent the forward wheel **16** from bumping and stalling against the underside of boot **12**, when wheel **16** encounters a large bump. As shown in FIG. **11**, the upper front graded bumper **123** can be inserted into a socket **121** formed between side rails **128** and **129** and below boot **12**.

FIG. **8B** also illustrates in dotted lines a wedge-like graded braking pad **130** which may be inserted into a rear socket under the heel of the boot **12** similar to socket **121**. As viewed in FIG. **8B**, the graded braking mechanism acts as follows: When the toe of the boot **12** is rotated upwardly, as shown by upward arrow **133**, initial braking commences when third wheel **20** contacts surface **131** of the pad **130**. This begins to apply a mild braking action to wheel **20** while still allowing contact of front toe wheel **16** and second wheel **18** with the ground surface. Further upward rotation of the toe of the boot **12** increases the braking action applied to wheel **20** and initiates braking action between under surface **132** of pad **130** and wheel **21**. Meanwhile, toe wheel **16** remains in ground contact permitting continued directional control. Continued upward toe rotation, in the direction of arrow **133**, finally engages brake pad **37** with the ground surface **101**. This also applies progressively more braking force to wheels **20** and **21** and in combination increases overall braking effectiveness. Bumper **123** and brake pad **130** can be removably replaced with similar shaped elements of varying physical characteristics of elasticity and wear. The in-line roller skate design illustrated in FIG. **8**, **8**A and **8**B by selecting the appropriate constructing material for the yoke **122**, can provide a cushioning-type action to the skate.

FIG. **9** illustrates a bottom view of an in-line roller skate with spring yoke wheel suspension, as illustrated FIGS. **8**, **8**A and **8B**. The forward arm **124** of the yoke and the rear arm **125** of the yoke **122** are forked, thereby providing openings in the interior in which the wheels **16**, **18**, **20** and **21** can be rotatably mounted respectively by axles **38**.

FIG. **10** illustrates a section view taken along section **10—10** of FIG. **9**. The wheel **16** is shown rotatably mounted on axle **38**, which is held by forward yoke arm **124**. FIG. **11** illustrates a section view taken along section **11—11** of FIG. **9**. Wheel **18** is rotatably mounted on axle **38**, nut **39** combination, which is mounted in yoke **122**. The opening **126** is also indicated. The yoke **122** is secured to the underside of the boot **12**.

FIG. **12** illustrates a section view taken along section line **10—10** of FIG. **9** with an alternative embodiment of hollowed-out lightweight yoke supports. The yoke supports **124**A are constructed of strong, lightweight, resilient material and are hollowed out to reduce weight while maintaining lateral rigidity and allowing resilient vertical movement to carry axle **38** and wheel **16**.

FIG. **13** illustrates a section view taken along section line **13—13** of FIG. 4. The section line **13—13** passes through the narrowest part of the dumbbell shaped disc receiving cavity **62**. This central portion of the opening **62** serves as a bumper preventing wheel contact with the sole plate of the boot **12** thereby avoiding inadvertent braking of the wheels in extreme situations. FIG. **13** shows inter alia a lightweight composite wheel **18**, including a metal or plastic bearing housing hub, spoke and rim element **17** mounting a ground engaging tire **19** of low profile with good wear characteristics. The spokes serve to lighten the weight of the wheels. They also serve to conduct unwanted heat away from the circumference of the wheels, axles and bearings by allowing circulating air between the radial spoke members. The tire is mounted on the rim element **17** which may include a tire engaging annular ring **19**A. As the shock absorption in taken within the rail members, and/or the elements **17**, if constructed of resilient material, the tires **19** may be constructed of generally firm material such as hard rubber or plastic such as polyurethane, neoprene, or polybutadiene. In extreme situations the tire compound may even include imbedded hard particulates or grit for grip on slippery surfaces such as ice. The particulates may be coarse or fine and of metal, sand or other suitable friction enhancing materials.

FIG. 13A illustrates a side view of a wheel **18** with the vented spokes in the element **17** mounting the bearings **15** and tire **19**. The position of the annular tire anchoring ring **19**A is shown in dotted lines. The ring **19**A aids in bonding the tire **19** to the rim of wheel element **17**. Adhesive may be used. Referring to FIG. **15**, bonding may be further enhanced through boring of a plurality of radial spaced apart holes **17**A, in the rim of element **17** and spaced apart annular holes **19B**, in tire anchor **19**A.

FIG. **14** illustrates a section view taken along section line **14—14** of FIG. **4**, showing a lateral stabilizer web **152**. These stabilizer webs **150**, **151**, **152**, **153**, and **154** can be hollow, semi-hollow or of a lattice structure to reduce weight, and lend lateral stability to the side rails and prevent wander, wiggling or wobbling of the in-line wheels.

FIG. **15** illustrates a section view of an in-line roller skate wheel and support with axle-mounted resilient shock absorbing axle plug. As seen in FIG. **15**, a pair of resilient shock absorbing plugs **200** are positioned between the wheel supporting rails **202** and a pair of respective spacer sleeves **204** which fit over the axle **206** at each end. The plugs **200** are confined at the opposite side by respective washers **208**. The sleeves **204** and washers **208** have extended vertical flanges **205** and **209** respectively which contain the plug member **200** and can be constructed of a suitable lightweight plastic such as polyethylene or metal such as aluminum. This construction enables the axle **206** to yield upwardly to bumps and obstructions to which the wheel may be subjected when the skater is traversing over uneven terrain.

FIG. **15A**, which appears on the same sheet of drawings as FIGS. **13** and **14**, illustrates an isometric view of a resilient shock absorbing axle plug **200**. The plug **200** has a basic crescent shape and is constructed of suitable resilient material. The degree of resilience can be selected to accommodate the degree of shock absorbing ability desired.

FIG. **15B**, which appears on the same sheet of drawings as FIGS. **13** and **14**, illustrates an isometric view of the axle shock absorbing plug **200** in inverted configuration. In certain situations, it may be desirable to raise the elevation of the axle **206** and this can be done by inverting the two plugs **200** and placing them beneath the axle **206**.

FIG. **16** illustrates a section view detail of the axle and resilient shock absorbing plug of FIG. **15** under compression. In this view, the vertical movement of the axle **206** in the vertical slot **212** is evident. The plug **200** is compressed and thus permits the axle **206** to yield upwardly. Alignment of plug enclosing flanges **205** and **209**, and of spacer **204** and washer **208** respectively, may be accomplished by using a splined bore in washer **208** thereby interfacing matching splines on spacer **204**. End face **203** may have splines (not shown) which mate with matching splines (not shown) at the interface with bearing spacer **204**. Axle **206** may be shaped to prevent rotation within the axle slot **212**. An optional protective dust cover **210** can be installed.

FIG. **17** illustrates a section view taken along section line **17—17** of FIG. **15**. This view reveals an end elevation of the spacer **204** with its vertical plug containment flange **205**. During impact with a bump, axle **206** and spacer sleeve **204** move upwardly, within slot **212**, thereby compressing plug **200** and absorbing shock.

FIG. **18**, which appears on the same sheet of drawings as FIG. **4**, illustrates a second embodiment of shock absorbing wheel. In this view, the wheel **18** has angled resilient spokes **17**, which yield under force and enable the wheel **18** to absorb compression forces. The spokes **17** can be formed of a resilient elastic shock absorbing material such as rubber or plastic, while the wheel circumference can be formed of a wear resistant ground gripping material such as polyurethane.

FIG. **19**, which appears on the same sheet as FIG. **4C**, illustrates a means of controlling the resiliency of disc **68** by adjusting density using a plurality of holes **70**A in addition to central hole **70**. Although not shown these holes may be retroactively filled with a suitable filler to increase density.

FIG. **20** illustrates a further means of varying resiliency by using a larger diameter cavity **70B** in the disc **68**.

FIGS. **21** and **22**, which appear on the same sheet as FIG. **4D**, illustrate in front and section view a means of adjusting the resiliency of the disc **68** in FIG. **20** by retrofitting a further plug **68**A of some determined density into bore **70B**. The plug **68**A may be press fitted into bore **70B** or be removed using a tool **69**, as described earlier. Disc **68** may subsequently be removed by using a finger which is inserted into bore **70B** and then is used to pry out the disc.

FIG. **23**, which appears on the same sheet as FIG. **4E**, illustrates a disc member **68** of graded density where side **68B** is more resilient than side **68C**. This causes the softer side **68B** to bulge out more than the stiffer side **68C** under compressive forces. Side **68B** can be orientated to the outside of the skate whereas side **68C** can face the inside adjacent the wheels. Side **68C** can thus be designed to avoid abrasive contact with the wheels.

FIG. **24** illustrates a further embodiment where the disc **68** may be filled with a fluid **67**. The side walls **68B** and **68C** are dimensioned to avoid abrasive wheel contact.

FIG. **25** illustrates a further embodiment of a shock-absorbent in-line roller skate where only the centre wheels have resilient members over their respective axles. In this embodiment, the initial shock encountered by the first wheel **16** (in forward motion) encountering a bump is dampened by the foot of the skater as the toe pivots upward about the ankle of the skater over the bump. The second and third wheels, **18** and **20**, absorb the shock of the bump in turn by displacing or compressing their respective resilient members **68**. This allows the toe wheel **16** to recontact the surface **110** thereby allowing the toe wheel **16** to be used for directional control, while the following wheels negotiate the bump in turn and absorb shock. The rear wheel **21** absorbs the shock of the bump generally by the action of the skater's knee. FIG. **25** further shows the ability of the embodiment to adjust relative wheel height. Insertion of larger or stiffer members **68** over the axles of the middle wheels **18** and **20** will tend to downwardly extend the wheels along the dashed lines shown below the wheels **18** and **20** thereby allowing for alternative skating styles as is known in the in-line skating art.

FIG. **25** also illustrates a removable and replaceable to forward wheel lock mechanism **300** which can be used to lock the wheel **16** in a wedging manner, between the wheel and the bottom of the sole plate of the boot **12**. This locking action can be used to facilitate climbing a slope or negotiating stairs and the like. In operation, the inverted concave saddle shaped surface **301** of the mechanism **300** is tapped rearwardly into frictional engagement with the toe wheel **16** by striking the head **302** of the mechanism against the ground, or against some suitable vertical abutment, prior to initiating a climb up a set of stairs or a slope. The rearward position of the mechanism **300** prevents the wheel **16** from rotating in a clockwise direction, as indicated by arrow **310** in FIG. **25**. This allows the skater to use the stationary wheel **16** to gain a purchase in climbing. It is not therefore necessary to revert to the common method of sidestepping uphill or upstairs which is awkward, slow and becomes particularly precarious when negotiating stairs. Increasing clockwise force on the wheel **16** due to the climb will be resisted by automatically increasing wedging action.

Briefly, returning to FIG. **8B**, it will be understood that the bumper **123** illustrated in FIG. **8B** may be replaced with a similar saddle shaped wedge member slidably fitted into the socket **121** to lock the front wheel of that embodiment for climbing purposes.

Returning to FIG. **25**, the lock mechanism **300** includes a detent keeper **303** which releasably engages detent holes **304** in the rail **58** in a sequential manner. The keeper **303** ensures that the lock **300** remains engaged as the clockwise force **310** is removed as each foot is successively raised in the climbing action. Alternative conventional lock mechanisms can be used, for example, a swing lever which applies a locking force to the lock mechanism **300** when rotated to a locked position.

When the climb is completed, and the skater wishes to free the wedge lock mechanism **300**, the skater simply manually grasps the head **302** and pulls it forward to a disengaged detent position as indicated by dashed line **302A** in FIG. **25**. Advantageously, the skater may also more readily free the front wheel **16** by striking the wheel **16** forwardly along the ground in a counterclockwise direction, opposite to the arrow **310** in FIG. **25**.

This action may best be seen in FIG. **26** where the counterclockwise force is designated by arrow **311**. The wedge **300** is forced out of the locking detent forwardly of the skate **12** with the pair of biasing springs **307** acting on the ends of the pair of retaining guide pins **306** in slots **305** which are formed in rails **56** and **58**. This serves to space the under surface **301** away from the circumference of the wheel **16**, and permit free rotation once again. Number **312**, in FIG. **25**, designates an alternative position for a single biasing spring located between the rails **56** and **58** about arrow **311**, as shown in FIG. **26**. The pin **306** and the detent keeper **303** also prevent the wedge **300** mechanism from resting on the wheel **16** when disengaged.

FIG. **27** shows an alternative means of preventing wedge face **301** from riding on the wheel **16** using support flanges **308** which slidably fit in slots in the sides of the wedge member **300**. In this case, a click stop detent **309** may engage recesses (not shown) on the inner faces of the flanges **308**.

The wheel lock **300** may further be used as a brake while skating backwards, simply by applying the head **302** onto the ground the ground surface **110** with the wheel **16** still in touch with the ground. Progressively greater pressure applied to the head **302** will eventually act to slow the wheel **16** thereby adding to overall braking effectiveness.

Preferably each skate will have a toe wheel brake lock mechanism and, although not shown in FIG. **25**, may also have a rear brake **36** as seen in previous figures.

Additionally, more than one wheel may be locked simultaneously or sequentially with a series of ganged wedge lock mechanisms. The toe lock wedge may be adapted to any of the foregoing disclosed shock-absorbing in-line skates or shaped to fit most existing conventional in-line skates.

Although the overall weight appears to increase with some combinations of resilient disc densities, and this may be of concern, this factor may be offset by the incorporation of lighter ground wheels. Resilient shock-absorbing in-line skates are of great benefit in long downhill runs where comfort is desirable and lack of control of paramount concern. On relatively slow level surfaces, lighter replaceable resilient elements may be used or the replaceable elements removed entirely dependent according to skater weight and boot rail resiliency ratios. At some ratios, the removal of a number of the resilient discs may result in the rails sagging and the wheels of the skate contacting the bottom of the boot sole plate, particularly where wheel travel limit stops are not provided. This situation can be of advantage, however, in that it would allow the skater to walk if so desired. Spare resilient members may be carried by the skater to alter the behavioral characteristics of the skate in response to varying road conditions. These shock-absorbing in-line skates may be designed for country road or limited cross country applications.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

What is claimed is:

1. An in-line roller skate comprising:

(a) a boot with a heel and toe adapted to receive a foot of a skater;

(b) a first wheel supporting rail means secured to an underside of the boot and extending from the heel to the toe;

(c) a second wheel supporting rail means secured to an underside of the boot and extending from the heel to the toe adjacent and generally parallel to the first rail means;

(d) a plurality of wheel means mounted in tandem in a line between the first and second rail means, the wheel means being respectively connected to the first and second rail means by respective axle means and bearing means; and

(e) a plurality of resilient shock absorbing means located between the respective axle means and bearing means and the rail means to enable the respective wheel means to move under force individually upwardly or downwardly relative to the first and second rail means, said resilient shock absorbing means being arranged in pairs for each wheel, axle and bearing means, and the resilient shock absorbing means being mounted in respective vertical elongated cavities in the first and second rail means, each resilient means having a crescent shape, the axle means fitting in the concave curves of the crescents whereby the axles are positioned at a first elevation when the concave sides of the crescents face upwardly and are positioned at a second lower elevation when the concave sides of the crescents face downwardly.

2. A roller skate as claimed in claim **1** wherein there are at least three wheel means and the first rail means and the second rail means include at least three respective resilient means and the at least three wheel means are rotationally mounted in the respective resilient means.

3. A roller skate as claimed in claim **1** wherein the resilient shock absorbing means are removable and invertible resilient plugs which are positioned in the respective cavity means in the first rail means and the second rail means, the resilient plugs impinging on the axle and bearing means for each respective wheel means, and absorbing compression force when the respective wheel means moves upwardly, and dispensing compression force when the respective wheel means moves downwardly.

4. A roller skate as claimed in claim **3** wherein the first rail means and the second rail means have formed therein, in association with the respective cavity means, axle wells, which permit the axles to move upwardly or downwardly in relation to the first and second rail means.

5. A roller skate as claimed in claim **1** wherein the respective resilient means are held in place by respective removable washer means which fit about the respective axle means.

6. A roller skate as claimed in claim **5** wherein the respective resilient means are held in place by respective spacer sleeves which fit about the respective axle means on a side of the resilient means opposite to the washer means.

7. A roller skate as claimed in claim **1** wherein at least one reinforcing web is located between the first and second rail means.

8. A roller skate as claimed in claim **1** including a releasable wheel stop located between the underside of a toe of the boot and the top of a front wheel of the plurality of wheels.

9. An in-line roller skate comprising:

(a) a boot adapted to receive a foot of a skater;

(b) a wheel mounting means secured to the underside of the boot, longitudinal with the boot, and having an elongated longitudinal wheel receiving Cavity therein;

(c) a plurality of wheels rotatably mounted in series within the wheel receiving cavity and longitudinal alignment with one another;

(d) a releasable wheel rotation stop means located between the underside of a toe of the boot and above a forward wheel of the plurality of wheels, said wheel rotation stop means being movable so that it can impinge against a wheel to retard rotation of the wheel.

10. A roller skate as claimed in claim **9** wherein the wheel stop means is movable between a first position wherein the stop means is free of the forward wheel and permits the forward wheel to rotate and a second position wherein the stop means abuts the forward wheel and prevents rotation of the forward wheel.

11. A roller skate as claimed in claim **10** wherein the wheel stop means has releasable lock means which enables the stop means to be locked in a first or second position.

12. A roller skate as claimed in claim **9** wherein the wheel rotation stop means is slidably mounted on the underside of the toe and is movable horizontally between a first forward position whereby the wheel rotation stop means does not impinge on a front wheel, and a second rear position whereby the wheel rotation stop means impinges on the front wheel and thereby stops rotation of the front wheel.

13. A roller skate as claimed in claim **12** wherein the wheel rotation stop means has a protrusion on each lateral side thereof, said protrusions slideably moving in respective horizontal slots on each lateral side of the wheel mounting means.

14. A roller skate as claimed in claim **12** wherein the wheel rotation stop means has a releasable lock means which enables the stop means to be releasably locked in a forward wheel-free position or releasably locked in a second rear position whereby the front wheel is prevented from rotating.

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