United States Patent [19]

Radu et al.

[11] **3,790,187**

[45] **Feb. 5, 1974**

[54] **WALKING SYSTEM FOR PARAPLEGICS**

[76] Inventors: **Gheorghe Radu,** Aleina Negreni 4; **Alexandru Aldea,** Str. Justinian nr. 18, Sector 2, both of Bucharest, Romania

[22] Filed: **Dec. 1, 1971**

[21] Appl. No.: **203,528**

[52] **U.S. Cl.** **280/11.2,** 280/11.21

[51] **Int. Cl.** **A63c 17/14**

[58] **Field of Search** 280/11.2, 11.21, 11.19

[56] **References Cited**

UNITED STATES PATENTS

323,405	8/1885	Elliot	280/11.27
1,517,352	12/1924	Foote	280/11.2
1,687,739	10/1928	Slusher	280/11.2
3,275,337	9/1966	Lau	280/47.34 X
2,350,062	5/1944	Mosier	280/87.01
2,672,351	3/1954	Kane	280/47.34 X

FOREIGN PATENTS OR APPLICATIONS

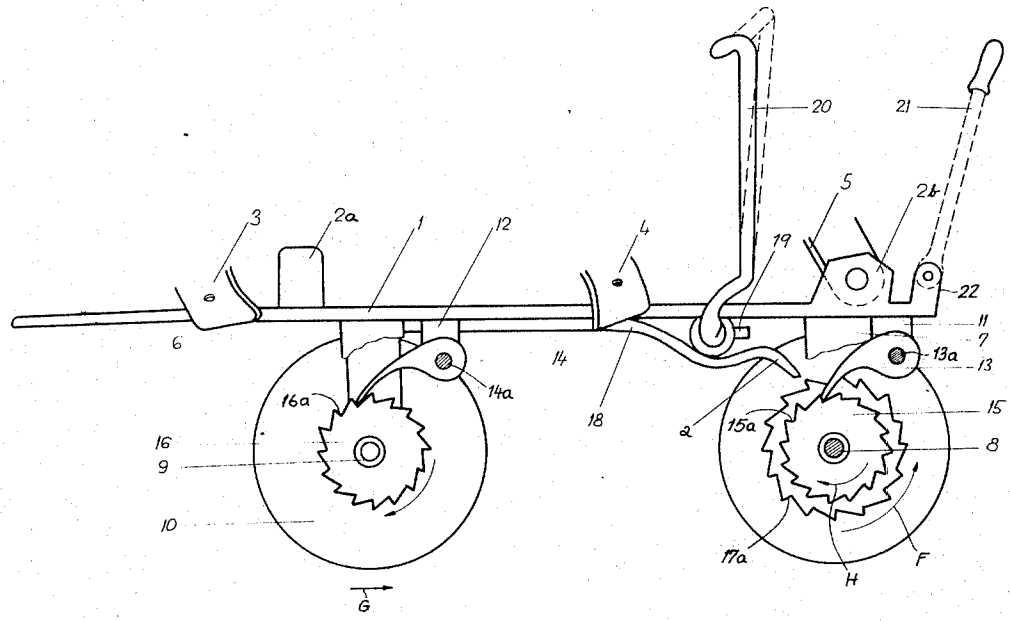
1,104,413	4/1954	France	280/11.2
791,911	6/1935	France	280/11.2
1,341,539	9/1963	France	280/11.2
609,453	9/1948	Great Britain	280/11.2
459,844	9/1968	Switzerland	280/11.21

Primary Examiner—Kenneth H. Betts
Assistant Examiner—David M. Mitchell
Attorney, Agent, or Firm—Karl F. Ross; Herbert Dubno

[57] **ABSTRACT**

A walking system for paraplegic and like patients incapable of use of the leg and foot muscles comprises a skate having a front and a rear pair of rollers with parallel axes inclined to the longitudinal axis of the skate and horizontally offset in the longitudinal direction. Pawl-and-ratchet arrangements prevent reverse rolling of the wheels of both pairs while a lever-operated pawl is designed to prevent rolling of at least one of the pairs of wheels in the forward direction upon deflection of a lever in response to the position of the patient's leg.

4 Claims, 2 Drawing Figures



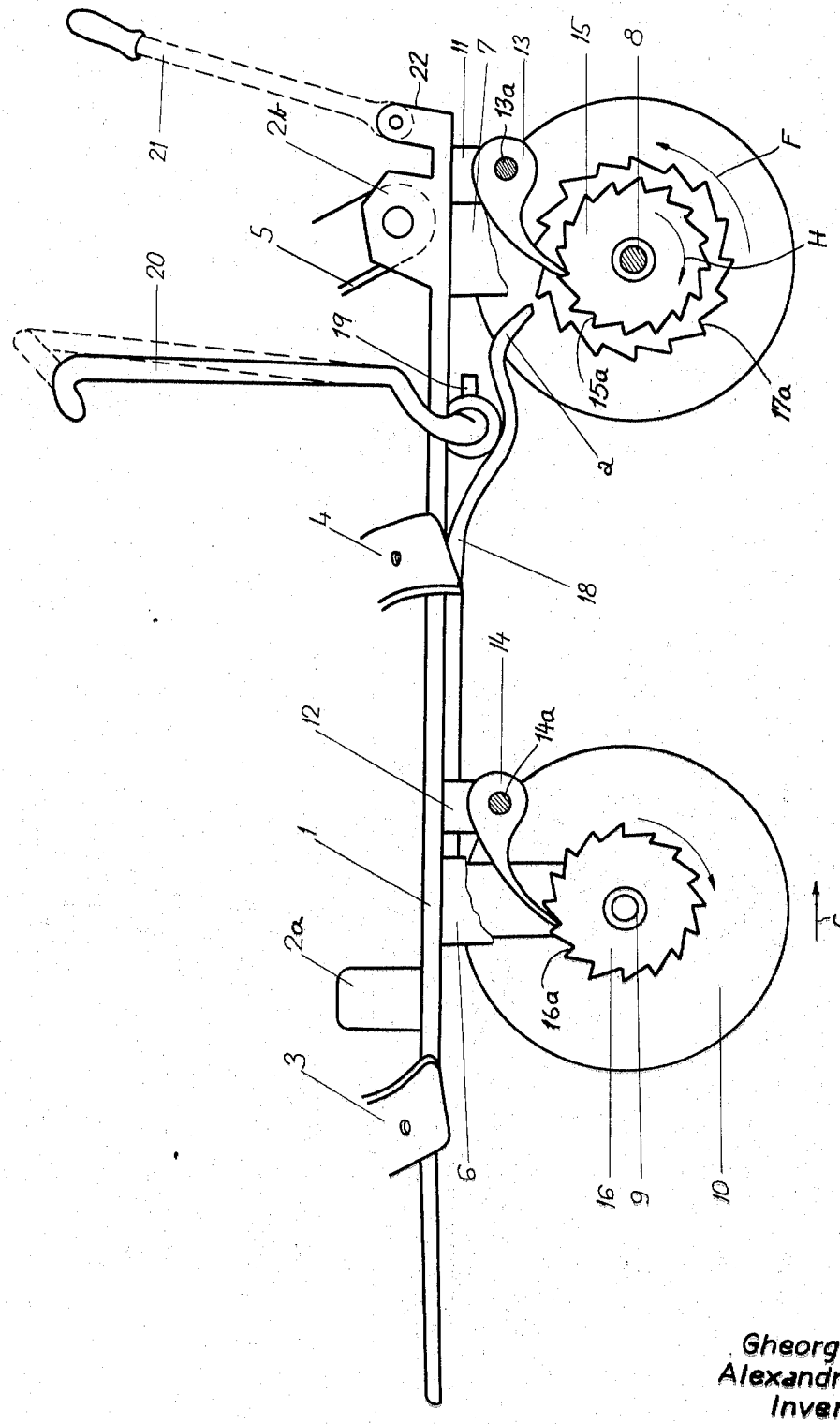


Fig. 1

Gheorghe Radu
Alexandru Aldea
Inventors,

By Karl G. Ross
Attorney

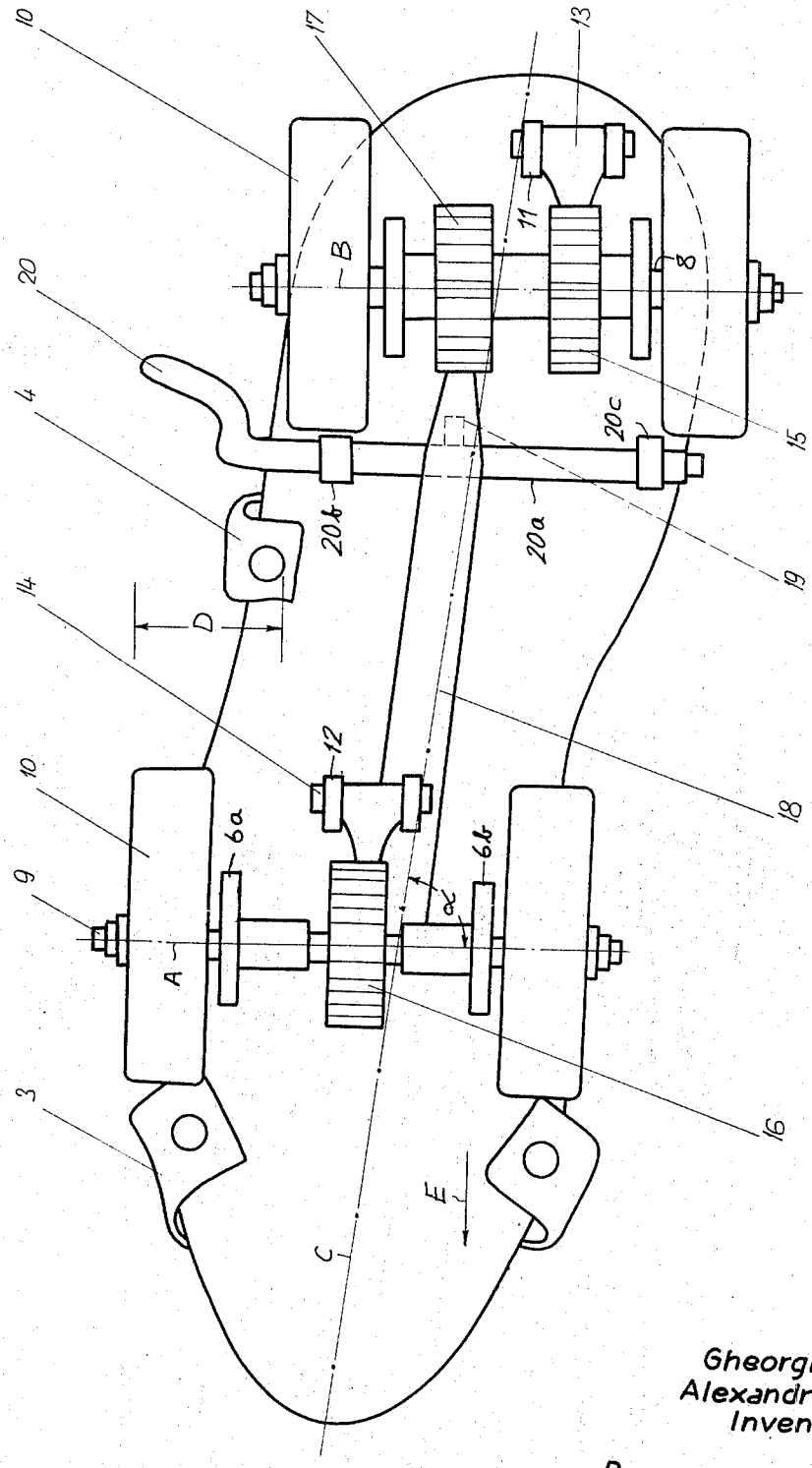


Fig. 2

Gheorghe Radu
Alexandru Aldea
Inventors.

By Karl G. Ross
Attorney

WALKING SYSTEM FOR PARAPLEGICS

FIELD OF THE INVENTION

The present invention relates to a walking system for paraplegics and patients with like leg-immobilizing infirmities and, more particularly, to a walking method for paraplegics using a rolling action as well as a prosthetic applicance for this purpose.

BACKGROUND OF THE INVENTION

Paraplegics and patients with leg infirmities, in which the leg may be swingable from the hip but is not under the control of the patient or is not fully controllable and foot-control motion is absent, frequently undergo training to establish a gait for walking movement in order to re-establish mobility or for other therapeutic purposes. It is common practice to provide such patients with a pelvio-cruro brace or harness which generally is affixed to a back brace or attached about the hips of the patient and extends along the thighs to the foot of the patient and is swingable at the hip. The patient, supported on crutches or a training cart or frame, can accomplish a walking movement by swinging the pelvis from side to side and thereby bring alternate legs forwardly. Conventional pelvio-cruro leg units and braces have been found to be disadvantageous because of the considerable effort required by the patient so that carriages and the like have been substituted therefor. Carriages have, however, the disadvantage that the patient is more or less immobile on the carriage and performs no therapeutic motion.

OBJECTS OF THE INVENTION

It is the principal object of the present invention to provide a walking system for paraplegics and patients with like leg infirmities which enables a walking movement to be carried out.

It is another object of the invention to provide an improved walking method for such patients.

Yet another object of the invention is the provision of an appliance enabling paraplegics and patients with like leg infirmities to produce a walking motion and power themselves along a surface.

SUMMARY OF THE INVENTION

These objects and others which will become apparent hereinafter are attained with an orthopedic appliance which may be attached to the bottom of a pelvio-cruro leg or brace, in which the leg is immobilized, and which comprises basically a skate bearing means for spreading the weight of the patient over the surfaces engaged by the skate and increasing the stability thereof with respect to normal skates having in-line pairs of rollers.

According to the present invention, the orthopedic skates are attached to the bottoms of the pelvio-cruro leg brace and are formed with a generally flat skate body having a sole plate and heel plate (which may be integral with one another) and having a longitudinal axis, a pair of front rollers and a pair of rear rollers journaled on the underside of the skate body and having mutually spaced rollers rotating about common axes which, although parallel to one another, are inclined to the longitudinal axis of the skate body. It is important to the present invention that the roller pairs be axially staggered in the direction of movement of the skate or transversely of this direction of movement to increase the number of points at which the skate bears upon the ground surface.

According to an essential feature of the invention, at least one, but preferably both roller pairs is provided with unidirectionally effective blocking means permitting rotation of the rollers in one direction, e.g. in the direction of forward movement, while a pawl-and-ratchet arrangement selectively engages the rollers in dependence upon the position of the brace and/or the orientation of the leg.

According to the present invention, therefore, the drawbacks of prior-art systems are eliminated when the patient is supported at his upper limb upon a pair of crutches or a mobile support frame and has his lower limbs immobilized in respective pelvio-cruro brace legs and attached to orthopedic devices rollingly supporting the patient upon the skates. The rolling means allows the patient's leg to swing forwardly and can be locked against rearward movement as the patient swings the other leg forwardly by a side-to-side motion of his hips. Means is provided to enable unidirectional rotation of the roller means for movement in the forward direction but for locking the roller means against displacement when the other leg is to be swung forwardly.

According to the method aspects of the present invention, therefore, the wheeled appliance is mounted upon the foot-wear of the patient who advances his foot in the forward direction while the rubber-tire or rubber-coated wheels engage the ground or floor and are rotated correspondingly in one sense. During this rotation, pawl-and-ratchet means lock the wheels against rotation in the opposite sense, corresponding to a rearward displacement of the skate. The orientation of the patient's leg, with respect to the sole plate of the sole plate of the appliance is detected by a lever extending above the sole plate and a second pawl-and-ratchet mechanism is engaged to lock the skate against further forward movement when the leg assumes a predetermined inclined orientation to the skate corresponding to a normal step of the patient. The other leg of the patient can now be shifted forwardly whereupon the lever-operated pawl is disengaged from its ratchet and the motion can be repeated.

In structural terms, the invention provides a sole or base plate (foot plate) which may be provided with lateral shoulders preventing shifting of the foot on the plate and with steps or securing the plate to the footwear of the patient. Along the underside of the skate, are provided pairs of journal members within which a pair of parallel but longitudinally spaced rotatable shafts or axles are carried. A pair of rubber wheels is mounted on each shaft for rotation therewith and each shaft is provided with a respective ratchet oriented so that its pawl locks the shaft against rotation in a sense corresponding to rearward movement of the skate. The wheels of the shafts are offset with respect to the longitudinal axis of the foot plate, the rear pair of wheels being offset inwardly and the front pair of wheels being offset outwardly. At least the rear shaft is provided with an oppositely directed ratchet wheel whose pawl is operated by the lever and has an S-shaped end which may be biased into engagement with its ratchet when the lever is tilted rearwardly to an extent corresponding to inclination of the leg in the manner indicated.

DESCRIPTION OF THE DRAWING

The above and other objects, features and advan-

tages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a side-elevational view of a skate for paraplegics and patients with like infirmities according to the present invention, partly broken away; and

FIG. 2 is a bottom view thereof.

SPECIFIC DESCRIPTION

In the drawing, we have shown a skate for a walking system for paraplegics and patients with like infirmities which may be mounted on the bottom of the pelvio-cruro leg brace or on the seat of the patient. It should be understood that the patient is normally supported at his upper limbs on crutches or other means enabling movement along the ground and is customarily provided with two skates as illustrated.

The skates each comprise a metallic bed plate **1** in the shape of a full-length show sole and illustrated as being of a single piece in the drawing. Conventional practices with respect to skates generally may be used to allow for adjustment of the length of the skate to the person's foot. The skate is provided with a pair of upstanding lugs **2***a* and **2***b* at the front and rear ends of the plate along the margins thereof to constitute supporting shoulders which limit lateral movement of the foot of the patient upon the sole plate **1.** Pairs of belts or straps, **3, 4** and **5,** are provided at the metatarsal, arch and heel regions of the sole plate, respectively, for attachment of the appliance to the footwear of the patient and to the brace structure immobilizing his leg.

On the underside of the sole plate **1,** there are provided supports **6***a* and **6***b* (generally designated at **6** in FIG. 1) constituting trunnions for an axle shaft **9** upon which rubber-tired ball bearing wheels **10** are mounted for rotation. A similar pair of wheels **10'** is mounted upon the shaft **8** held by the trunnions **7** below the heel portion of the appliance. The axis A and B of the shafts **8** and **9** lie parallel to one another but at an angle α to the longitudinal axis C of the skate. Furthermore, the wheels are offset laterally from one another by the distance D in the longitudinal direction to increase the stability of the skate. The axes A and B are thus also perpendicular to the direction of walking which is represented by the arrow E. The front pair of wheels is outwardly offset while the rear pair of wheels is inwardly offset with respect to the plane of movement of the patient.

The support plate **1** also carries at its bottom lugs **11** and **12** for the rear pair of wheels and the front pair of wheels respectively, the lugs being shown to constitute trunnions in which the rods **13***a* and **14***a* are received. The rods **13***a* and **14***a* carry tongues **13** and **14,** respectively, which are biased by inherent resiliency in the counterclockwise sense and engage a ratchet wheel **15** and a ratchet wheel **16** respectively adapted to the shaft **8** and the shaft **9** for joint rotation with the shafts and the rubber-tire wheels carried thereby. The ratchet wheels **15** and **16,** moreover, are so toothed that the steep flanks **15***a* and **16***a* face in the clockwise sense and permit only counterclockwise motion of the wheels. A counterclockwise rotation of the wheels (arrow F), of course, represents forward movement of the skate along the ground surface which provides a resistance represented by the arrow G.

The rear shaft is further provided with an oppositely oriented ratchet wheel **17,** i.e., a wheel whose teeth **17***a* face in the counterclockwise sense and which, when engaged by a pawl **18,** block rotation in the sense of arrow H, i.e., bars movement of the wheels in the rearward direction. The pawl **18** is an elongated tongue mounted above shaft **9** in FIG. **2,** to the underside of the sole plate **1.** The free end of the shaft has a sinuous or S-shaped configuration terminating in an end *a* adapted to engage the ratchet wheel **17.** Pawl **18** is operated by an eccentric portion **19** of a shaft **20***a* journaled in the bearings **20***b* and **20***c* and having an upwardly extending lever portion **20** actuated by the ankle. The shafts **8** and **9,** or one of them, may be driven by a miniature electric motor mounted directly on the skate body or may be provided with a lateral extension which can be coupled by a sheathed flexible shaft which in turn is driven by a motor. If greater movement then can be induced by the patient himself is desired, a rod **21** articulated to the tab **22** may be used to push the skate.

In operation, the skates are secured to the footwear and/or pelvio-cruro brace of the patient between shoulders **2***a* and **2***b* by the straps **3 – 5.** The lever **20** rests against the heel or rear leg portion of the patient. The patient is supported on crutches or by other means and, by shifting his weight, swings a leg forwardly whereby the pawls **13** and **14** slip freely over the respective ratchet teeth as the skate rolls forwardly. At the distance of a normal step, the leg of the patient is inclined somewhat rearwardly and deflects the lever **20** to engage the end a of tongue **18** in ratchet **17,** thereby blocking forward movement. The pawls **13** and **14,** of course, engage the respective ratchets to prevent rearward movement. If, during the walking motion, the heel is lifted from the ground, latch pawl **14** remains effective to prevent a rearward slip. Of course, the skates may be pushed by an attendant or other person via rods **21** or may be driven by a motor as indicated earlier. The system has the advantage that it allows a walking movement by patients with motor deficiencies of varying degrees and who cannot have a normal gait. There is almost a complete elimination of the physical effort for drawing the foot along the ground that has been required with crutches alone or other conventional appliances.

We claim:

1. An orthopedic roller skate for paraplegics and persons with like infirmities, comprising:

a sole plate adapted to be fixed to the foot of a person;

two pairs of wheels with rubber peripheries mounted on the underside of said plate and having parallel axes, each of said wheels being provided with a respective shaft;

respective ratchets on said shafts, and respective pawls engaging said ratchets for permitting only forward movement of said skate and corresponding rotation of said wheels in one sense;

a further ratchet mounted on one of said shafts;

a tongue engageable with said further ratchet and engageable with same to prevent rotation of the wheels of said one of said shafts in said one sense, said tongue having a generally S-shaped end proximal to said further ratchet; and

a lever engageable with a leg portion of the person above said plate and acting upon said tongue for enabling said tongue to engage said further ratchet upon the travel of said skate in a forward direction

corresponding to the completion of a step by said person, said lever being provided with a crankshaft along the underside of said plate and acting upon said S-shaped end.

2. The skate defined in claim **1** wherein said plate has a longitudinal axis, said pairs of wheels being laterally offset from one another and intersecting said longitudinal axis at angles thereto.

3. The skate defined in claim **2** wherein said plate has a configuration of a shoe sole with a front and a rear, the front pair of wheels being set outwardly and the rear pair of wheels being set inwardly with respect to said axis.

4. The skate defined in claim **3**, further comprising a rod articulated to a rear portion of said plate to enable displacement thereof by an attendant to said person.

* * * * *