May 20, 1969 N. A. MacLEOD 3,444,631

APPARATUS FOR RESILIENT LOCOMOTION

Filed March 24, 1966

Fig. 1.

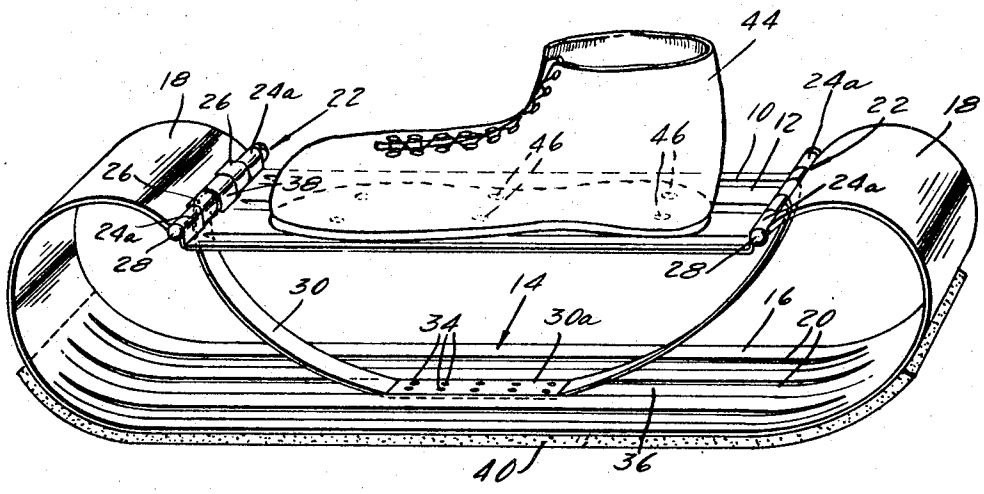


Fig. 2.

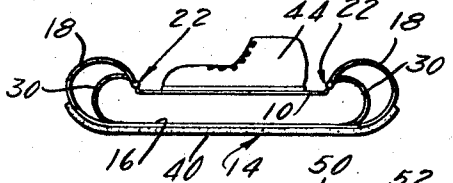
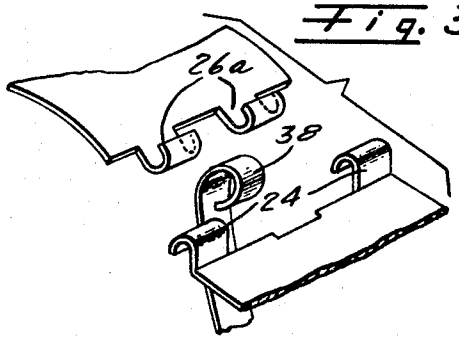


Fig. 3.



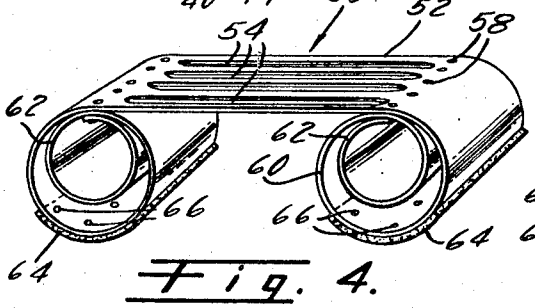


Fig. 4.

Fig. 5.

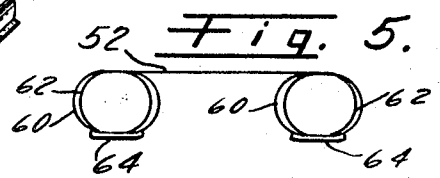


Fig. 6.

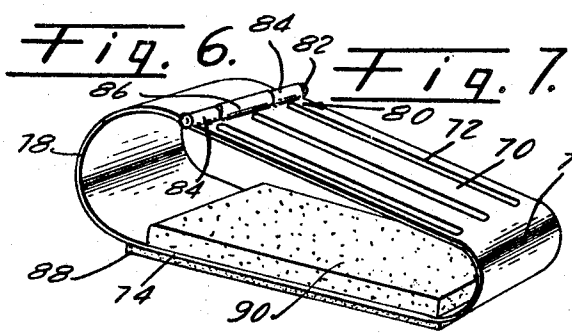
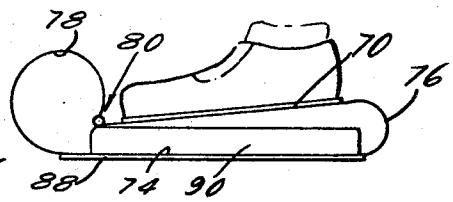


Fig. 7.



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APPARATUS FOR RESILIENT LOCOMOTION

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U.S. Cl. 36—7.8 10 Claims

ABSTRACT OF THE DISCLOSURE

A resilient reacting exercise device for use in walking, running, jumping and the like having a pair of oppositely preloaded arranged, resilient springs operably connected together, and a resilient restraining member retaining the springs preloaded but permitting movement of the springs under a force further loading same against their resistance, the restraining member then participating in resistance to the force.

This invention relates generally to exercising devices and relates more particularly to improvements in resiliently reacting devices which can be used in walking, running and jumping.

It is an object of the invention to provide a foot supporting device adapted to absorb momentum as the weight of the user is applied to it and which will give back most of this momentum as impulse when the weight of the user is taken away or relieved. Another object of the invention is to provide a device of this character having preloaded resilient means wherein the amount of preloading is a substantial part of the weight of the user.

It is still another object of the invention to use a preloaded resilient means of minimum weight for such preloading.

It is a further object of the invetnion to provide a lightweight foot piece which is capable of resilient movement vertically, but which has a minimum of horizontal movement, sideways or lengthwise.

It is a still further object of the invention to provide a light, flexible, resilient spring element to induce preloading on the resilient support, but which on loading will act as an auxiliary resilient supporting means.

Another object of the invention is to provide a device of this character in which the sole of the foot of the wearer comes very close to the ground during the resilient collapse of the foot piece.

The device can be used as an aid in running. Using the device in running, part of the energy normally given up by a foot touching the ground is returned to the foot as it leaves the ground on the next stride, giving significant reduction in muscular effort.

A further object is to provide a device of this character that is simple in construction, reliable in operation, light in weight, and that is easy and relatively inexpensive to manufacture.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings which represent certain embodiments. After considering these examples, skilled persons will understand that many variations may be made without departing from the principles disclosed and I contemplate the employment of any structures, arrangements or modes of operation that are properly within the scope of the appended claims.

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a perspective view of one arrangement;

FIG. 2 is a reduced schematic view showing the device of FIG. 1 partly compressed;

FIG. 3 is a fragmentary perspective view showing parts of one of the hinges;

FIG. 4 is a perspective view of an alternative arrangement;

FIG. 5 is a reduced schematic view of the device of FIG. 4 showing the springs or spring elements partly compressed.

FIG. 6 is a perspective view of another alternative arrangement; and

FIG. 7 is a reduced schematic side view of the arrangement of FIG. 6 with the spring compressed.

Referring more particularly to FIG. 1, there is shown a foot supporting device embodying the invention and comprising a platform **10** which may be of any suitable material such as, for example, sheet metal of suitable gage. It is desirable to have the platform **10** stiff or rigid and to stiffen said platform it is corrugated to provide longitudinally extending, laterally spaced ridges **12**.

Each end of the platform is hinged or pivoted to respective ends of a platform support, indicated generally at **14**, which has a central bottom plate or plate portion **16**. This bottom plate is shown as being integral with oppositely curved resilient ends or end parts **18** although these parts may be separate parts secured together to provide resilient elements at the ends of the bottom plate. The bottom plate is also made rigid by corrugations **20** which extend longitudinally of said plate **16** and are laterally spaced apart.

Resilient end parts **18** which are flat when unstressed toward each other and are hinged to the adjacent ends of the platform, the hinges being indicated generally at **22**. The free ends of the resilient end parts are provided with ears shown partly formed at **24** in FIG. 3. These ears are formed into bearings **24***a* there being such a bearing projecting longitudinally of the resilient parts **18** and at each corner, the openings through said bearings being in axial alignment with each other. It is to be noted that the ears forming the bearings **24** are colsed at the top, as best shown in FIG. 3. This arrangement strengthens the hinge connection and increases the weight supporting factor.

The adjacent ends of the paltform also have a pair of ears **26** which extend longitudinally of the platform and when fully formed form axially aligned bearings **26***a*, said bearings **26***a* being spaced inwardly from the respective sides and laterally apart relative to the platform.

A hinge pin **28** is disposed in the bearings between the respective ends of the platform and the adjacent ends of the resilient parts or means **18**.

The resilient end parts **18** are normally straight and are of resilient material such as spring steel for example. When the above described parts are assembled the resilient end parts are curved upwardly and inwardly, as shown in FIG. 1. There is restraint means provided limiting straightening of said parts beyond a predetermined position such as shown in FIG. 1, said restraint means comprising a metal strap **30** of suitable material such as spring steel.

The central portion **30***a* of the strap **30** is secured to the bottom plate **16** by rivets **34** or by spot welding or the like, said central portion **30***a* of the strap being disposed in the space **36** between corrugations adjacent the longitudinal center of the bottom plate.

End portions of the strap **30** are formed into bearings **38** which are disposed between the bearings **26***a* of the platform **10** and in which the respective hinge pins **28** are received.

The lightweight, flexible spring elements **30** induces preloading on the resilient support **14** and, on further loading in excess of the preloading stress acts as an auxiliary resilient supporting means.

It is to be noted that one of the resilient arcuate end parts **18** and the adjacent shorter end part of spring ele-

ment 30 forms a roughly crescent shaped resilient supporting means.

A sole 40 of any suitable material such as rubber, leather, plastic or the like is attached to the under side of the bottom plate 16 by means of rivets, not shown, a suitable adhesive, or other suitable means.

A special shoe 44 is attached to the platform 10 by means of rivets 46 or other suitable means. Alternatively straps or the like may be used to secure the ordinary shoe of a user to the platform.

It will be apparent that in the present invention, the construction of the resilient spring support involves the forced retention of the spring element in the form of arcuate shapes. It has been found that flat ribbon-like straight spring steel elements best give the desired results. By having the device approximately the width of the user's shoe or foot maximum stability is obtained so that tilting or wobbling laterally and/or longitudinally is reduced to a minimum or entirely eliminated.

For simplicity of manufacture, and lightness of weight, a single straight length of steel is used and corrugated longitudinally in the central portion to give a stiff, unbendable ground support, such as the part 16. The flat end portions 18 form the preloaded arcuate spring sections or means when brought into position under preloading stress.

With this arrangement the foot of the user, when the proper gauge of spring steel is used and there is the preloading of the spring, will come close to the ground and there is a maximum area of contact so that good stability and maximum efficiency of the spring can be obtained, and ankle-strain and balancing difficulty eliminated. Should the foot of the user be spaced some distance from the ground, as with a device having a preformed spring element, the likelihood of such angle-strain and balancing difficulty is a real problem.

The strength of the spring elements used will depend on the weight of the user and whether the spring shoes are to be used in walking or running. In walking the spring elements should be capable of being deflected under the weight of the walker so that the shoe piece makes firm contact with the ground piece.

It is therefore obvious that in the action of the spring shoe substantially complete collapse under a force approximating the maximum load is desired in order that a full return of the spring energy shall be made.

In the present arrangement having the preloaded springs the spring element chosen will not begin to deflect until a substantial part of the weight of the user is applied. For example, a walking spring shoe to be compressed through 2" for a 160-pound man, the preloading on the shoe can be 100 pounds and the spring element can be under maximum deflection at 140 pounds. Giving an average deflecting force of 120 pounds through 2" and the work done in such a deflection of 120 pounds x 2 inches or 20 foot/pounds, will be substantially returned as impulse when the foot leaves the ground on the next step. For use in running or leaping, a 100-pound boy may use the same spring shoes, and while under static load the shoe will not "give," the shoe will deflect to ground contact under the combination of static loading and the momentum of the weight of his descending body as his spring shoe makes contact with the ground in each stride or leap.

The action of the device is shown in FIG. 2 wherein the spring elements or parts 18 and the spring 30 are partly compressed.

It is obvious that within the requirement of substantially complete spring deflection and good ground contact, the user may use any range of spring preloading and of spring deflection resistance that he may desire, according to his weight and the principal use.

Referring again to FIG. 1, while the restraining spring element 30 is attached to the bottom plate 16 and shares the hinge structure 22 with the main arcuate spring element, so that both are further arced under load in the same direction, it is possible to use lateral restraining spring elements which will arc at right angles to the main spring element under load. With such a design one or more pairs of restraining springs could be used spaced in opposition and spaced along the sides of the foot.

Referring to the embodiment of FIG. 4, the device is shown as formed preferably of a single strip or sheet of metal such as spring steel, said strip or sheet being indicated generally at 50. A central portion 52 of this sheet or strip is corrugated to provide ribs 54 for a rigid platform.

The strip or sheet 50 is normally flat but the end portions, indicated generally at 56, are formed into a spiral and secured in this position by rivets 58 which act as restraining means and thus provide a plurality of preloaded generally cylindrical spring parts or springs 60 and 62, the springs 60 being of greater diameter than the springs 62, the latter being disposed within the springs 60. If desired spot welding may be used in place of the rivets 58.

Ground contact soles 64 are secured to the outer bottom part of the springs 60 by means of rivets 66 or the like.

In this arrangement the shoe may be attached to the platform either by rivets as shown in FIG. 1 or by straps or the like. When the weight of the user is applied the large spring elements 60 yields first and becomes elliptical, as shown in FIG. 5. Thereafter, with sufficient weight applied the lower parts of the inner spring elements 62 contact the inner sides of the larger spring elements 60 and become elliptical also. Energy stored up by compression of these spring elements is largely recovered as the foot is raised.

In the arrangement shown in FIGS. 6 and 7 the device is preferably formed of a single piece or sheet of material such as spring steel or the like which is normally flat or straight.

An end portion is provided with a rigid platform 70 having longitudinally extending, laterally spaced ribs 72 formed by corrugating the platform 70. Below the platform is a bottom plate 74 connected with one end of the platform by an arcuate or curved resilient part 76. The bottom plate should also be rigid and this may be effected by corrugating same.

The end part or end 78 of the device opposite the platform 70 is curved upwardly and toward the adjacent end of the platform to which it is operably connected by a hinge, indicated generally at 80. The hinge includes a hinge pin 82 received within axially aligned and spaced bearings 84 at the end of the platform and adjacent the sides thereof and a bearing 86 at the end of the resilient part 78.

A sole 88 is attached to the under side or bottom of the bottom plate by rivets, adhesive or any other suitable means and on the upper side of the bottom plate is secured a cushion 90 of sponge rubber or other suitable material which is attached to the bottom plate by an adhesive or other suitable means.

A shoe may be attached to the platform 70 of this arrangement by the same means as described in connection with the arrangement of FIGS. 1 and 2. The toe may be normally at the higher end. When the weight of the user is applied, the higher end of the platform 70 moves downwardly to substantially the position shown in FIG. 7, the spring 78 becoming substantially fully bowed, there being the hinging action between the hinged end of the platform 70 and the adjacent end of the spring part 78. Alternatively the heel may be at the higher end.

The cushion 90 will, of course, absorb shocks should there be a sudden downward movement of the platform.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form,

construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the arrangements hereinbefore described being merely by way of example, and I do not wish to be restricted to the specific form shown or uses mentioned except as defined in the accompanying claims, wherein various portions have been separated for clarity of reading and not for emphasis.

I claim:

1. In an exercising device:

(A) support engaging means;

(B) normally straight, flat spring means having arcuate end parts, said support engaging means having ends connected with adjacent ends of said arcuate parts;

(C) platform means having the ends thereof operably connected with the opposite ends of said arcuate parts from the ends connected with the support engaging means;

(D) and restraining means normally retaining said arcuate parts in a loaded condition, said restraining means permitting movement of said parts in a downward direction to further load said parts which then become still more arcuate, said restricting means then assuming a portion of the load, reducing loading thereof.

2. The invention defined by claim 1, wherein the support engaging means and the normally straight flat spring means are integral.

3. The invention defined by claim 2, wherein the support engaging means comprises a substantially rigid part.

4. The invention defined by claim 2, wherein the platform means is integral with the normally straight flat spring means.

5. The invention defined by claim 1, wherein the support engaging means is rigid; the platform is substantially rigid and the ends thereof are hinged to adjacent ends of

the arcuate parts; and wherein said restraining means is a normally substantially straight, flat restraining spring element having a central portion secured to the support engaging means intermediate the ends thereof, and the ends of said restraining spring element are hinged to the respective ends of the arcuate parts of said flat spring means hinged to the platform.

6. The invention defined by claim 4, wherein both end portions of said flat spring means are generally cylindrical; and means for securing said end portions in said cylindrical formation.

7. The invention defined by claim 4, wherein portions of both ends of said flat spring means are formed into a pair of substantially cylindrical parts, one cylindrical part at each end being smaller than the other and disposed within the larger cylindrical part.

8. The invention defined by claim 2, wherein one end of the platform is integral with one of the arcuate parts and the other end of said platform is hinged to the adjacent end of the other arcuate part.

9. The invention defined by claim 8, including a cushion secured to the top side of the support engaging means.

10. The invention defined by claim 1, including sole means secured to the under side of the support engaging means.

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