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(54) Title: PORTABLE STRETCHING EQUIPMENT

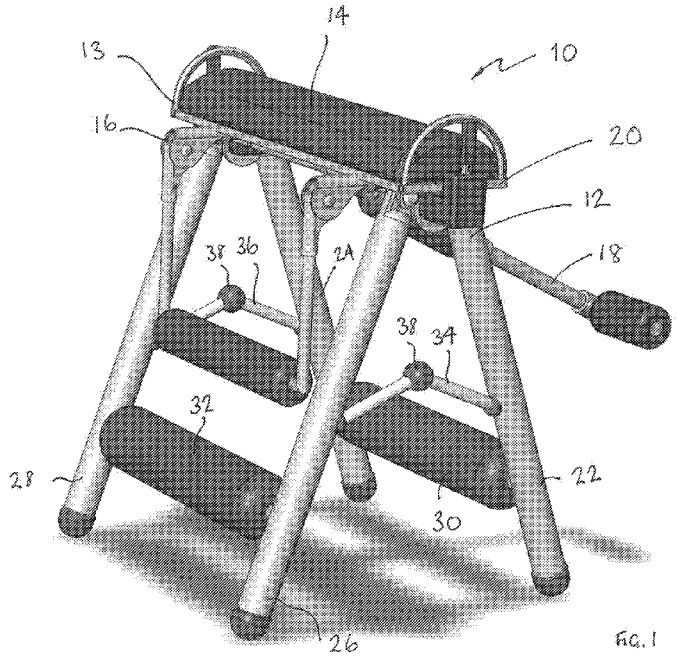


Fig. 1

(57) Abstract: A portable stretching apparatus (10) comprises a central support frame (12) the frame defining a top and legs (22, 24, 26, 28) extending from the top towards a relatively wider base, the legs forming part of the sides of the frame. The sides of the frame may preferably be folded towards each other, for transport or storage. A seat (14) is fixed on the top of the support frame and the seat is adapted to be used by a person sitting on the seat in an upright position. First and second support arms (16, 18) are pivotally mounted to opposite sides of the top of the central support frame. The first arm (16) is adapted to be fixed in a plurality of fixed angular orientations with respect to the frame. The angular position of the second arm (18) is substantially continuously variable about an arc. Hand grips (50,52) are provided on either side of the seat and may be grasped by a person using the stretching apparatus while in a seated position. At least one control means is provided for moving the angular position of the second arm by a user while seated or

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*[Continued on next page]*

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supine on the apparatus. The apparatus includes at least one means for restraining or locking a user's leg on one side, and preferably on both sides of the frame.

# "Portable stretching equipment"

## Cross-Reference to Related Applications

[0001] The present application claims priority from Australian Provisional Patent Application No 2016902126 filed on 2 June 2016, the content of which is incorporated herein by reference.

## Technical Field

[0002] This invention relates to a muscle stretching apparatus such as are used by athletes after training and gym users after a work-out, although other uses such as physiotherapy and use at home are envisaged.

## Background

[0003] It has long been recognised that it is very important to stretch and massage muscles after exercising/working out. Professional and serious athletes incorporate significant amounts of stretching, massage and recovery into their exercise routines. Most group gym classes will also conclude with a few minutes of stretching for the participants. Stretching is also important for flexibility, joint range, improved posture, recovery from injury or surgery, well-being, mobility and physiotherapy. There is an increasing focus on the importance of flexibility training. Many people are now using yoga and Pilates to gain an increased range of movement to address the lack of results from traditional stretching.

[0004] While it is possible to do some simple stretches without equipment, it is known to provide specialised stretching equipment for use when stretching whether after exercise or for therapy such as rehabilitation. For example, US 2014/0342886 discloses a muscle stretching apparatus for use in stretching an athlete's calves. WO2014/151721 discloses a therapeutic stretching apparatus for use in increasing knee extension, as well as maintaining knee stability after surgery. US 4,647,040 discloses a leg stretching apparatus which a person can use in a seated position. US 5,122,106 discloses a stretching apparatus for stretching a person's legs and lower back with the person in a supine position. A hamstring stretching apparatus is disclosed in US 2010/0279832, again to be used with the person stretching in a supine position. Similarly, US 2013/0225378 discloses a stretching apparatus which is limited to

stretching a person's legs with the person in a supine position. US 7,981,015 shows a yet further similar leg stretching device. Another leg stretching apparatus is shown in US 7,294,100 which relies on a track member and sliding platforms. Another device that provides only one area of stretching is shown in US 6,468,192 which stretches the spine only.

[0005] One problem with some existing stretching apparatus, such as those discussed above, is their lack of flexibility in that many stretching devices stretch only a few muscle groups. Ropes and restraints can be used for stretching, but these are also limited in their usefulness. There are a number of types of apparatus that can be used for multiple different types of stretching such as stretching frames which are typically large tubular metal structures, and stretching stations which allow for the stretching of multiple muscle groups. However a significant problem with such stretching apparatus, particularly stretching stations, is the size of the apparatus and this is a particular problem in locations where space for equipment may be limited, such as in gyms. Examples of large non-portable stretching machines include US 5,277,681 and US 7,563,207,

[0006] There are some smaller types of stretching apparatus, however even this smaller equipment can take up a significant amount of floor space, and the smaller apparatus tends to provide a more limited number of possible stretches. There are also a number of stretches that can be performed on weights and/or abdominal benches such as that shown in US 5,190,513, US 2007/0225135 and US 6,544,154 however the devices are not optimised for stretching and the number of stretches that can be done is severely limited. Other non portable devices include US 7,641,603 which can provide contralateral stretching, but again for limited muscles only and in a non portable device. Likewise US 20160354627 also provides limited contralateral stretching but only for the single combination of hamstrings and hip flexors but again is non-portable.

[0007] One significant drawback with many types of stretching apparatus, apart from the limited number of stretches that are possible, is that many require the user to lie in a prone position. This has a number of disadvantages. Firstly it compresses the users thoracic cavity and this tends to be uncomfortable, particularly for elderly users. Secondly the equipment can only target the users posterior chain and cannot be used for stretching the users anterior chain. Examples of earlier patents that can are designed for use by persons in a prone position include US 4753438, GB 2121304, WO 2011/059501, DE 202014100326 (although this

patent discloses an exercise device, not a stretching apparatus) and FR 2881949. Similarly US 7699763 relies on inversion for some exercises and compresses the thoracic cavity so is unsuitable for elderly persons.

[0008] Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present disclosure as it existed before the priority date of each claim of this application.

**Summary**

In a first broad aspect, there is provided a portable stretching apparatus comprising:

a central support frame, the frame typically defining a top and legs extending from the top towards a relatively wider base, the legs forming part of the sides of the frame, and wherein the sides of the frame may preferably be folded towards each other, for transport or storage of the apparatus;

a seat fixed on the top of the support frame which seat is arranged to be used by a person seated on the seat while seated in an upright position,

hand grips which are provided on either side of the seat which may be grasped by a person using the stretching apparatus while in a seated position;

first and second support arms pivotally mounted to opposite sides of the top of the central support frame; wherein

the first arm is adapted to be fixed in a plurality of angular orientations with respect to the top of the frame; and wherein

the angular position of the second arm with respect to the top of the frame is substantially continuously variable about an arc;

at least one control means for moving the angular position of the second arm while the person is seated or supine on the apparatus;

and including at least one restraint for restraining or locking the person's foot or leg on one, and preferably on both, sides of the frame.

[0009] Advantageously, the adjustability of the pivoted supports allows one to use the equipment in a number of different positions including seated facing forwards; seated facing sideways; laying down, both supine and prone. Many different stretching exercises can be performed depending on the orientation of the two adjustable supports. One support is predominantly used for raising and lowering limbs to be manipulated through the stretching actions. The other is predominantly used to support the user in the seated position, supine and prone positions. The supports can also be used to support one or both legs in a side split or front split movement.

[0010] In a preferred embodiment, the second arm defines a longitudinal axis and is telescopically adjustable in length along that longitudinal axis.

[0011] Typically, the second arm defines an end element in the form of a padded end restraint which extends to one side of the longitudinal axis of the arm in a direction which is perpendicular to the longitudinal axis of the second arm. The padded end restraint may be pivotally mounted to the end of the second arm and may be rotated about the pivot and fixed to either side of the second arm.

[0012] The apparatus may include a ratchet mechanism controlling the position of the second arm and wherein the control means for moving the position of the second arm is a lever positioned adjacent the grips at the top of the frame.

[0013] In a preferred embodiment the hand grips comprise arcuate rings and the lever is pivoted about the centre of one of the arcuate rings and its position relative to the ring serves as an indicator of the position of the second arm.

[0014] Preferably, the first support arm is pivotally mounted on a stub element which projects from the top of the apparatus. The first support arm may comprises two parallel elongate members, each parallel elongate members being pivotally mounted to a stud member

and linked by a padded crosspiece. Typically, the two parallel elongate members are telescopically extendible.

[0015] Typically, the foot restraint comprises a padded bar or brace fixed to a side of the frame. The position of the padded bars on the sides of the frame may be adjustable.

[0016] It is preferred that the frame has an inverted V-shaped in use and includes a foldable crosspiece bracing the frame. The apparatus may be folded with the adjustable supports generally parallel to the legs of the support frame when not in use so, that the apparatus occupies minimum space. In this position the compact apparatus is small enough to fit into a car boot or airline overhead locker and may be easily carried and transported or stored at home. In a gym several devices may be stacked one on top of another to reduce the floor space required for the apparatus.

[0017] In use, the supports of the apparatus are adjusted so that they are at the correct orientation for the desired stretching exercise. They can be used to support the torso or leg or legs of the body depending on the particular stretching exercise being undertaken.

[0018] The pivoted support arms may be used dynamically (moving) or fixed. Mechanisms may be provided to fix the supports in a particular position, using spring and ratchet system or a hydraulic cylinder or the like.

[0019] Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

**Brief Description of Drawings**

[0020] Specific embodiments of the present invention will now be described, by way of example only, and with reference to the accompanying drawings in which:-

Figure 1 is an isometric view from the front and one side of a first embodiment of a stretching apparatus;

Figure 2 is an isometric view from the rear and one side of the stretching apparatus of Figure 1;

Figure 3 is a partially exploded view of the stretching apparatus of Figure 1;

Figure 4 is shows the stretching apparatus configured to provide a lower back support;

Figures 5a to 5g show schematically a first series of stretches that can be carried out using stretching apparatus embodying the present invention;

Figures 6a to 6e show schematically a second series of stretches that can be carried out using stretching apparatus embodying the present invention;

Figures 7a to 7g show schematically a further series of stretches that can be carried out using stretching apparatus embodying the present invention.

Figure 8 shows a variant of the stretching apparatus shown in Figure 1 illustrating a ratchet system for moving a support arm of the apparatus; and

Figure 9 is shows detail of the ratchet system.

**Description of Embodiments**

[0021] Referring to the drawings, Figures 1 to 4 show a first embodiment of a stretching apparatus 10. The apparatus includes a central support frame 12 in the shape of an inverted V, and a cushioned seat 14 on the top 13 of the support frame. First and second support members/arms 16 and 18 respectively are mounted to the top of the frame 12 on opposite sides of the frame and extend generally away from the support frame.

[0022] The support frame includes a generally rectangular top portion/frame 20 on top of which the seat 14 is mounted. Two legs 22, 24 are pivotally mounted to one side of the top of the frame. A further pair of legs 26, 28 are pivotally mounted to the opposite side of the top of the frame. A first foot restraint 30 or support pad in the form of a bar covered in tubular padding extends between the legs 22 and 24, close to the feet of those legs. Similarly a second foot restraint 32 also in the form of a bar covered in tubular padding extends between

the legs 26 and 28, close to the feet of those legs. A bracing element 34 extends between legs 22 and 26 and a second bracing element 36 extends between legs 24 and 28. Each bracing element 34, 36 includes a central pivot 38 which allows the brace 34, 36 to be folded to allow the legs to be pivoted towards each other for storage or transport of the apparatus 10.

[0023] With reference to Figures 2 and 3, a semi-circular ring 50, 52 is defined at each side of the top of the support frame. These rings can be gripped by the hands of a person stretching on the apparatus, in use.

[0024] As is best seen in Figure 4, two short tubular stub members 60, 62 extend away from the top of the support frame. The first support member 16 is pivotally mounted to the distal ends of the stub members 60, 62. The first support member 16 comprises a first elongate tubular member 64 which is pivoted to the distal end of stub 60, a second elongate tubular member 66 which is pivoted to the distal end of stub 62 and a crosspiece 68 which extends between the distal ends of the tubular members and is covered in a padded tubular support 70. With reference to Figures 1 to 4 it can be seen that the first support member may be pivoted about the distal ends of the stub members into different fixed positions such as lowered when not required or for storage, as shown in Figure 1, oriented generally vertically as a lower back support as shown in Figure 4 or in angled or horizontal positions as shown in Figures 2 and 3. In a preferred embodiment, the tubular elements 64 and 66 are telescopic so that the length of the first support member and the distance of the crosspiece 68 from the stubs 60 and 62 may be adjusted.

[0025] A further elongate tubular element 70 which forms part of the second support arm/member 18 is pivotally mounted to the top of the frame as is best seen in Figure 3. The tubular element is telescopic and may be extended and retracted. Figure 3 shows that the tubular element 70 defines an outer tube 72 and an inner tube 74 which slides in the outer tube and which defines a series of apertures 76 for receiving a locking pin 78 to adjust the length of the tubular element 70. The outer tube 72 is enclosed by a cylindrical pad 80. At the distal end of the tubular element there is a side tube 82 which extends perpendicular to the longitudinal axis of the tubular element. A cylindrical pad 74 locates over the side tube 72. In a preferred embodiment, the side tube may be rotated in an arc about the longitudinal axis of the tubular element 70.

[0026] As is best seen in Figure 3, the seat 14 defines a cut out or aperture 90 which allows the second support arm 18 to rotate upward until it is nearly vertical. With reference also to Figures 8 and 9, the second support arm 18 is mounted to a movable arm 91 which is mounted about a pivot axis 93 and can be rotated by handle 100, which is located adjacent the ring/grip 52, via connecting rods 94, 96. When the handle 100 turns through a particular angle, the arms 91 and 18 move through the same angle.

[0027] A fixed toothed ratchet type wheel 92 is fixed to the frame A spring biased pawl or ratchet block 102 is mounted to the arm 91and prevents the support arm 18 from moving when engaged with the toothed wheel 92 as shown in Figure 9. On the reverse side of the toothed wheel to the connecting rods, and as shown in Figure 9, there is a pivoted lever 104 which when the handle is moved disengages the pawl 102 from the ratchet when 92 and allows the arms to move. The support arm 18 may thus be moved by simply moving the handle 100 while the stretching apparatus is in use. When the handle is released the pawl 102 re-engages in the ratchet wheel.

[0028] A person can use the apparatus in a number of different positions, as shown including seated facing forwards; seated facing sideways; lying down both prone and supine; standing; and suspended with the front of the thighs on the seat and the legs hooked under one moving arm, while doing a traction movement.

[0029] The equipment is designed to allow isometric (muscle not changing length) contractions throughout a number of positions throughout the range of motion and muscle lengths. This strengthens the muscle throughout the muscle length and importantly increases the strength of the muscle at the longest muscle length and end of motion. This greatly decreases the risk of muscle injury and increases the total amount of muscle force generated over the entire range of motion and muscle length

[0030] The apparatus also allows for prolonged static stretching without causing bending of the lumbar or thoracic vertebrae in the back. Static stretching has been shown through research to be less than effective if the stretch is held for only 15 to 20 seconds. The machine allows the user to hold stretches for extended periods which allows for muscle fibre and tenderness elongation. During traditional stretching to maintain tension on the muscle that will cause elongation requires the user to bend at the waist which causes improper strain on

the vertebrae in the back. Also this compressed position impacts on the stomach and lungs which causes discomfort. Further, during traditional stretching there is tension within the person's body, shoulders, arms etc. in creating a force sufficient to bring the lower limb muscles into stretch or tension positions. This discomfort often leads to inadequate time in the stretch position therefore ineffective stretching and poor results. Elderly people, people with larger waist measurements, and people with limited flexibility, find it difficult to place themselves into positions where they can gain effective stretching for a number of muscle groups around the pelvis, such as the Gluteal, Iliotibial band, Piriformis, hamstrings and quadriceps. The apparatus allows those stretches to be achieved easily by persons of limited flexibility, strength, mobility and by those with anthropometrically disadvantaged body shapes.

[0031] The may also enable the user to perform PNF stretching. This type of stretching is highly effective in requires the leg to be moved to, and halted at, a number of positions throughout the range of motion and muscle length. At each of these positions and isometric contractions will be performed against the support of the device. The apparatus allows for this PNF stretching to be performed on a large range of muscles in the body, including hamstrings, hip flexors, iliopsoas, gluteal, long adductors, short adductors, transverse adductors etc.

[0032] The apparatus also allows a user to perform eccentric stretching and strengthening which the user resists against the raising mechanism of the apparatus thereby contracting the muscles while they are lengthening.

[0033] The apparatus also allows the user to identify the differences in range of Motion from left to right side of the body. This is an important consideration as the differences are indicated to be prevalent in the development of back pain through the misalignment of the pelvis, and viscoelastic tension on the posture of the user. By identifying these differences, a plan can be put in pace that will correct these differences and in the long term assist in eh resolution of back pain and sciatica suffering.

[0034] The apparatus also allows for the identification of muscle imbalances. Various type of stretches that may be carried out are shown in Figures 5 to 7. In particular Figure 5b illustrates a gluteal stretch, Figure 5c a long adductors stretch, Figure 5d an short adductors

stretch, Figure 5e and inversion traction, Figure 5f advanced front splits and Figure 5g an assisted calf stretch (downward dog).

[0035] Figure 6a illustrates a standing soleus stretch, Figure 6b shows a hamstring gluteal stretch, Figure 6c shows assisted push ups Figure 6d shows a front deltoid pectoral stretch and Figure 6e shows a standing gluteal stretch.

[0036] Figure 7a shows s front or side splits, Figure 7b shows a standing quadriceps stretch, Figure 7c shows a hamstring hip flexor, Figure 7d shows a seated hamstring hip flexor, Figure 7e shows a standing hamstring hip flexor, Figure 7f shows an advanced long adductors stretch and Figure 7f shows a beginners long adductors stretch.

[0037] In summary, the apparatus embodying the invention may give the user the benefit of stretching a large number of muscle groups in a device that is portable, foldable and easily transportable. The device also allows the user to perform stretches without the need to flex their back to increase tension and induce stretch in the lower limbs.

[0038] The apparatus also allows the user to perform isometric contractions which both increase the strength of the muscles being targeted and decreased the impact of the stretch H reflex allowing deeper stretch with less discomfort. This function also realigns the myofascia of the muscles, which is currently addressed by either massage or the use of foam rollers.

[0039] The apparatus also, through the inventive positioning of foot restraints and the second swing arm, provides the user to perform contralateral stretches to the two separate muscle groups that are engaged in a person's stride. This is important in the rehabilitation of muscle strains and increases athletic performance through increases stride length and the increased muscle stretch at the end range of motion through the use of isometric contractions.

[0040] The apparatus also allows the user to change the position of the support arms without having to dismount from the apparatus. This allows for continuous use of the machine for numerous different muscle groups in a continuous operation.

[0041] Although the described embodiment provides for a lever and ratchet operated second arm, and a pivotable and lockable first arm mounted on a stub member, in a variant both the first and second support arms could be operated by the lever and ratchet mechanism as the

second support arm. In this case the lever on one side of the seat will move one arm and the lever on the opposite side of the seat will move the other arm.

[0042] It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the above-described embodiments, without departing from the broad general scope of the present disclosure. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS:

1. A portable stretching apparatus comprising:

a central support frame, the frame typically defining a top and legs extending from the top towards a relatively wider base, the legs forming part of the sides of the frame, and wherein the sides of the frame may preferably be folded towards each other, for transport or storage of the apparatus;

a seat fixed on the top of the support frame which seat is arranged to be used by a person seated on the seat while seated in an upright position,

hand grips which are provided on either side of the seat which may be grasped by a person using the stretching apparatus while in a seated position;

first and second support arms pivotally mounted to opposite sides of the top of the central support frame; wherein

the first arm is adapted to be fixed in a plurality of angular orientations with respect to the top of the frame; and wherein

the angular position of the second arm with respect to the top of the frame is substantially continuously variable about an arc;

at least one control means for moving the angular position of the second arm while the person is seated or supine on the apparatus;

and including at least one restraint for restraining or locking the person's foot or leg on one, and preferably on both, sides of the frame.

2. A stretching apparatus as claimed in claim 1 wherein the second arm defines a longitudinal axis and is telescopically adjustable in length along that longitudinal axis.

3. A stretching apparatus as claimed in claim 1 or claim 2 wherein the second arm defines an end element in the form of a padded end restraint which extends to one side of the longitudinal axis of the arm in a direction which is perpendicular to the longitudinal axis of the second arm.

4. A stretching apparatus as claimed in claim 3 wherein the padded end restraint is pivotally mounted to the end of the second arm and may be rotated about the pivot and fixed to either side of the second arm.

5. A stretching apparatus as claimed in any preceding claim including a ratchet mechanism controlling the position of the second arm and wherein the control means for moving the position of the second arm is a lever positioned adjacent the grips at the top of the frame.

6. A stretching apparatus as claimed in claim 5 wherein the hand grips comprise arcuate rings and the lever is pivoted about the centre of one of the arcuate rings and its position relative to the ring serves as an indicator of the position of the second arm.

7. A stretching apparatus as claimed in any preceding claim wherein the first support arm is pivotally mounted on a stub element which projects from the top of the apparatus.

8. A stretching apparatus as claimed in claim 7 wherein the first support arm comprises two parallel elongate members, each parallel elongate members being pivotally mounted to a stud member and linked by a padded crosspiece.

9. A stretching apparatus as claimed in claim 8 wherein the two parallel elongate members are telescopically extendible.

10. A stretching apparatus as claimed in any preceding claim wherein the foot restraint comprises a padded bar or brace fixed to a side of the frame.

11. A stretching apparatus as claimed in claim 10 wherein the position of the padded bars on the sides of the frame is adjustable.

12. A stretching apparatus as claimed in any preceding claim wherein the frame has an inverted V-shaped in use and includes a foldable crosspiece bracing the frame.

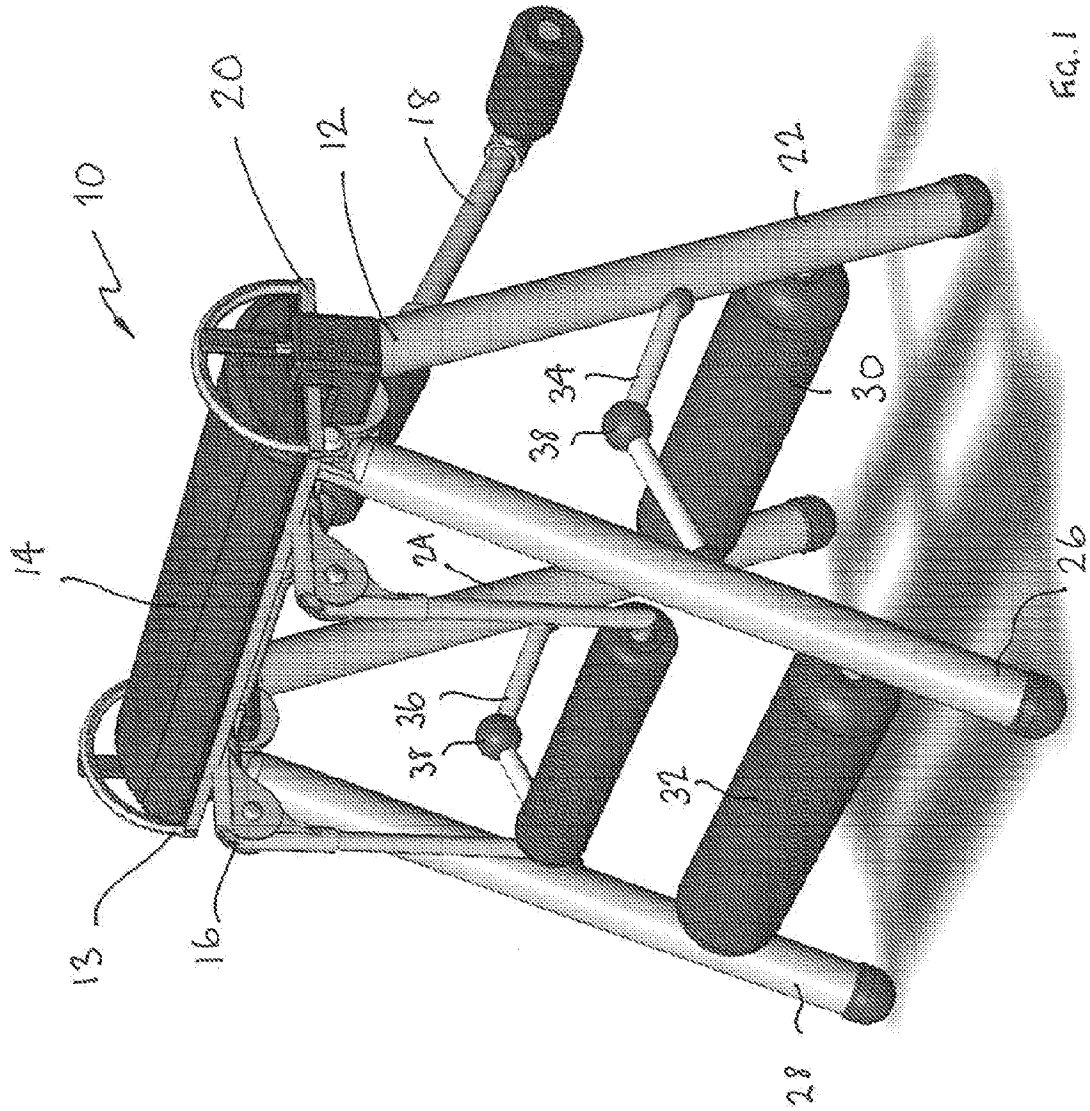


Fig. 1

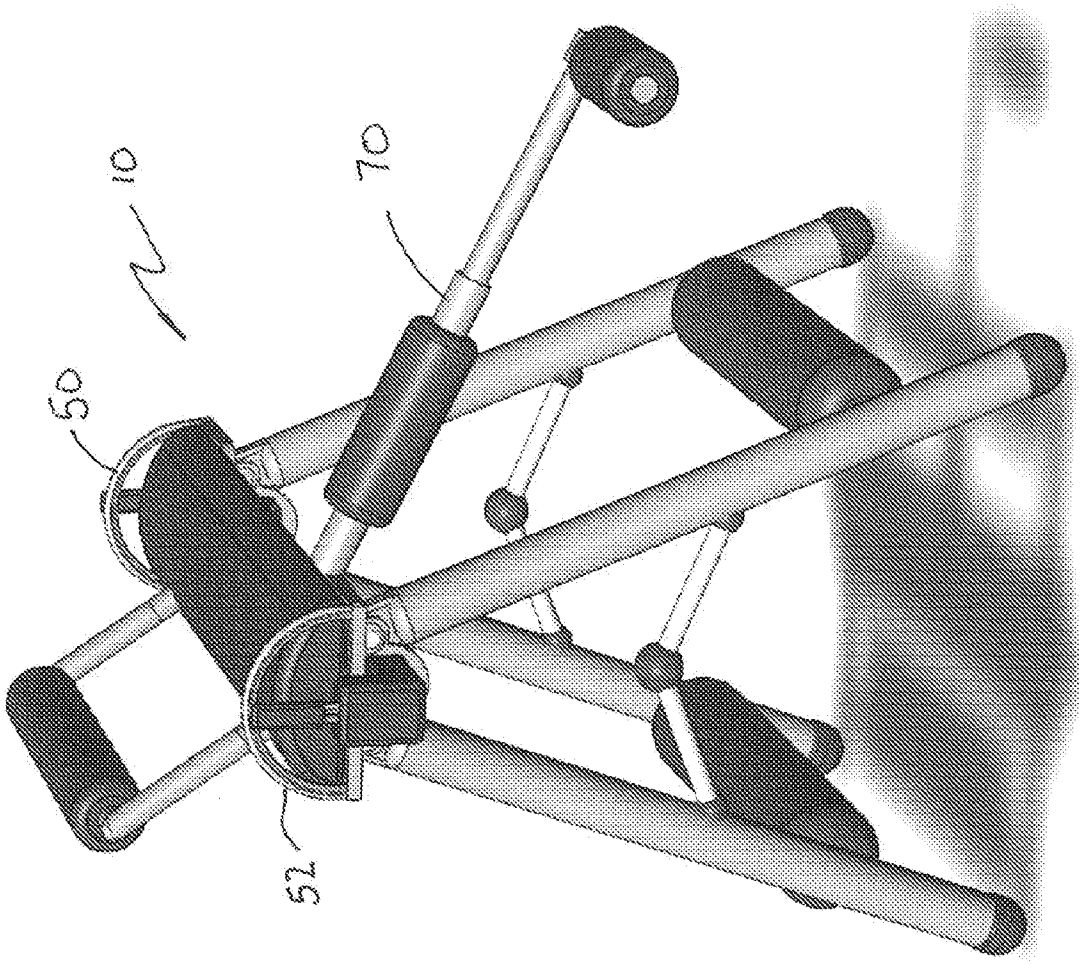


FIG. 2

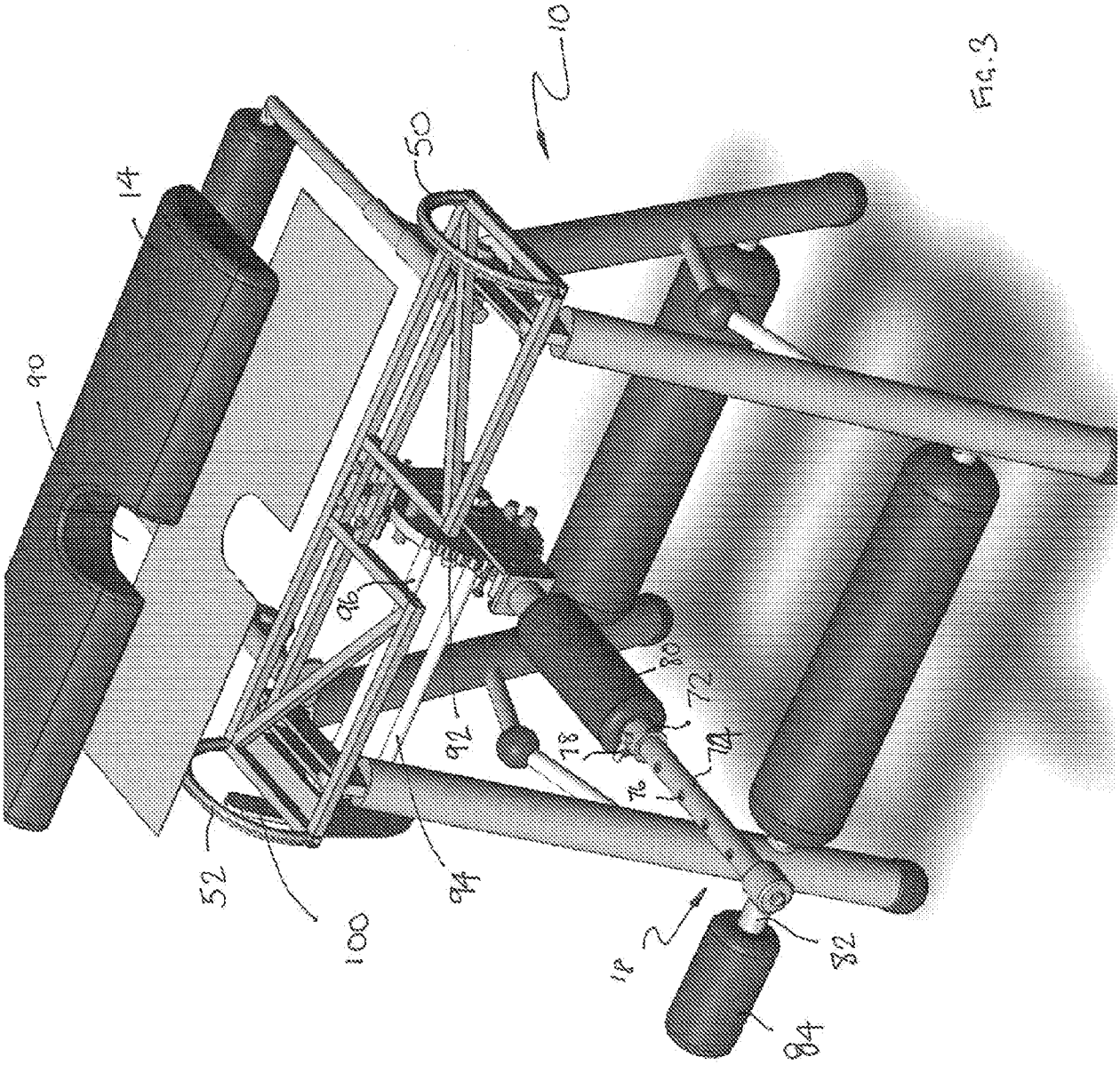


Fig. 3

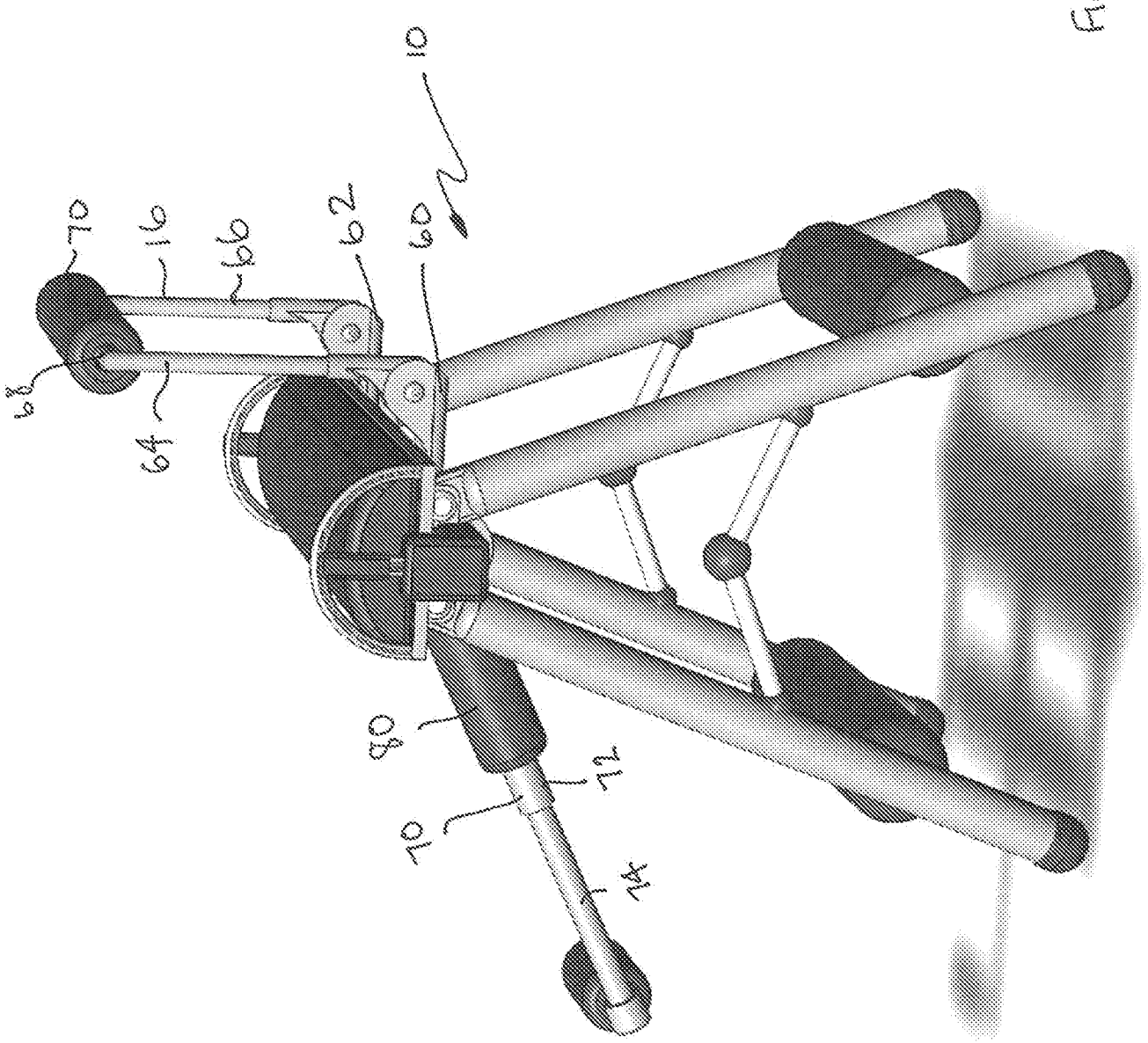


Fig. 4

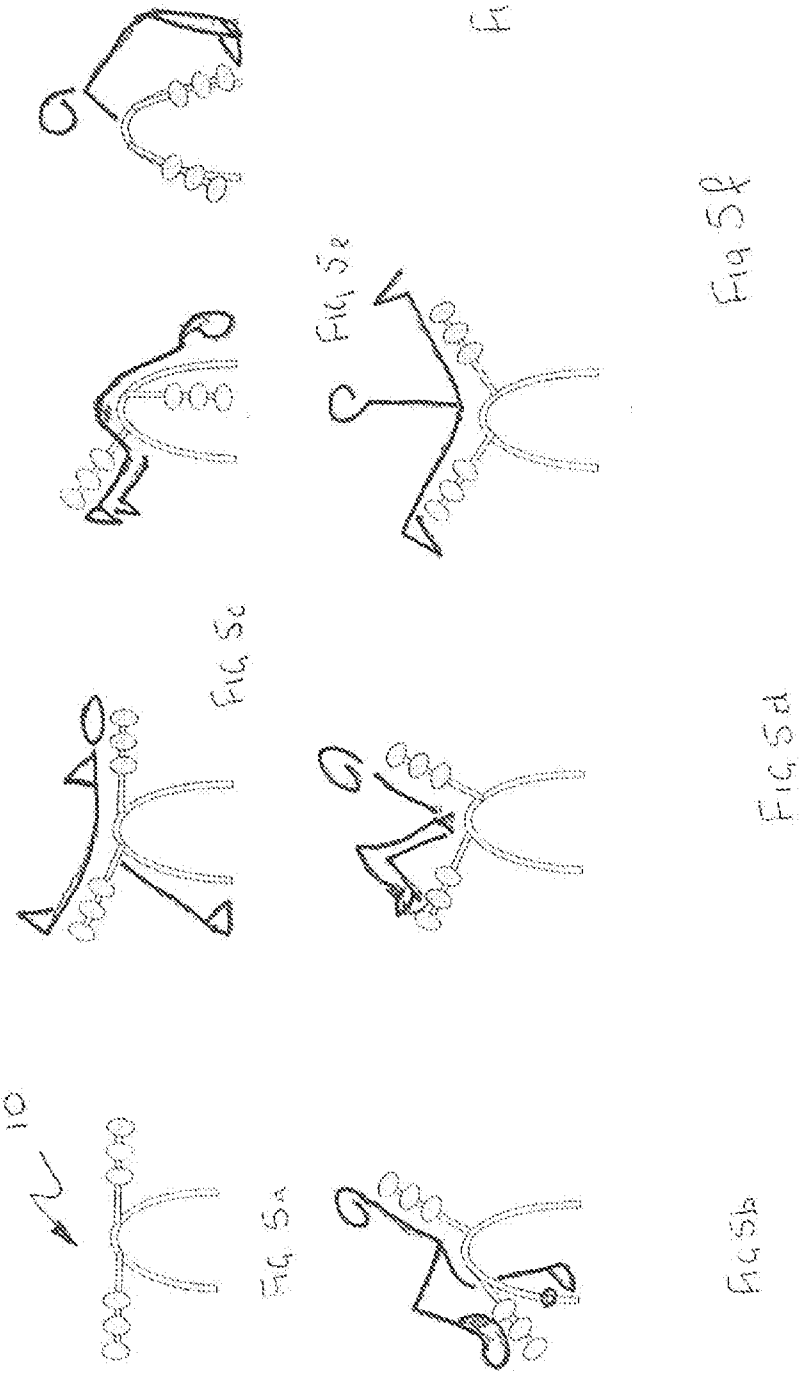
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Fig 5a
Fig 5b
Fig 5c
Fig 5d
Fig 5e
Fig 5f
Fig 5g

Fig 6c



Fig 6c



Fig 6d



Fig 6b

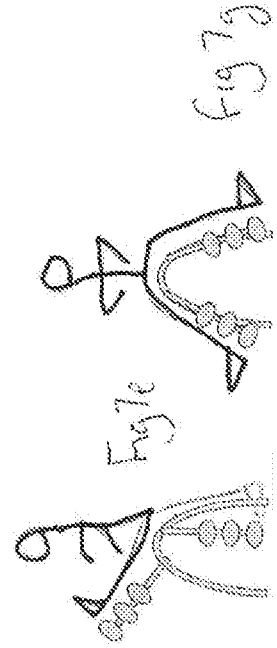

Fig 7a

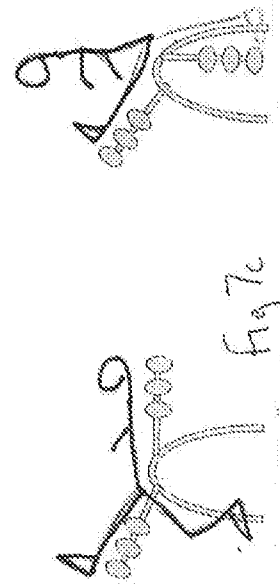

Fig 7b

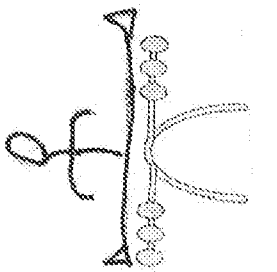

Fig 7c



Fig 7d



Fig 7e



Fig 7f

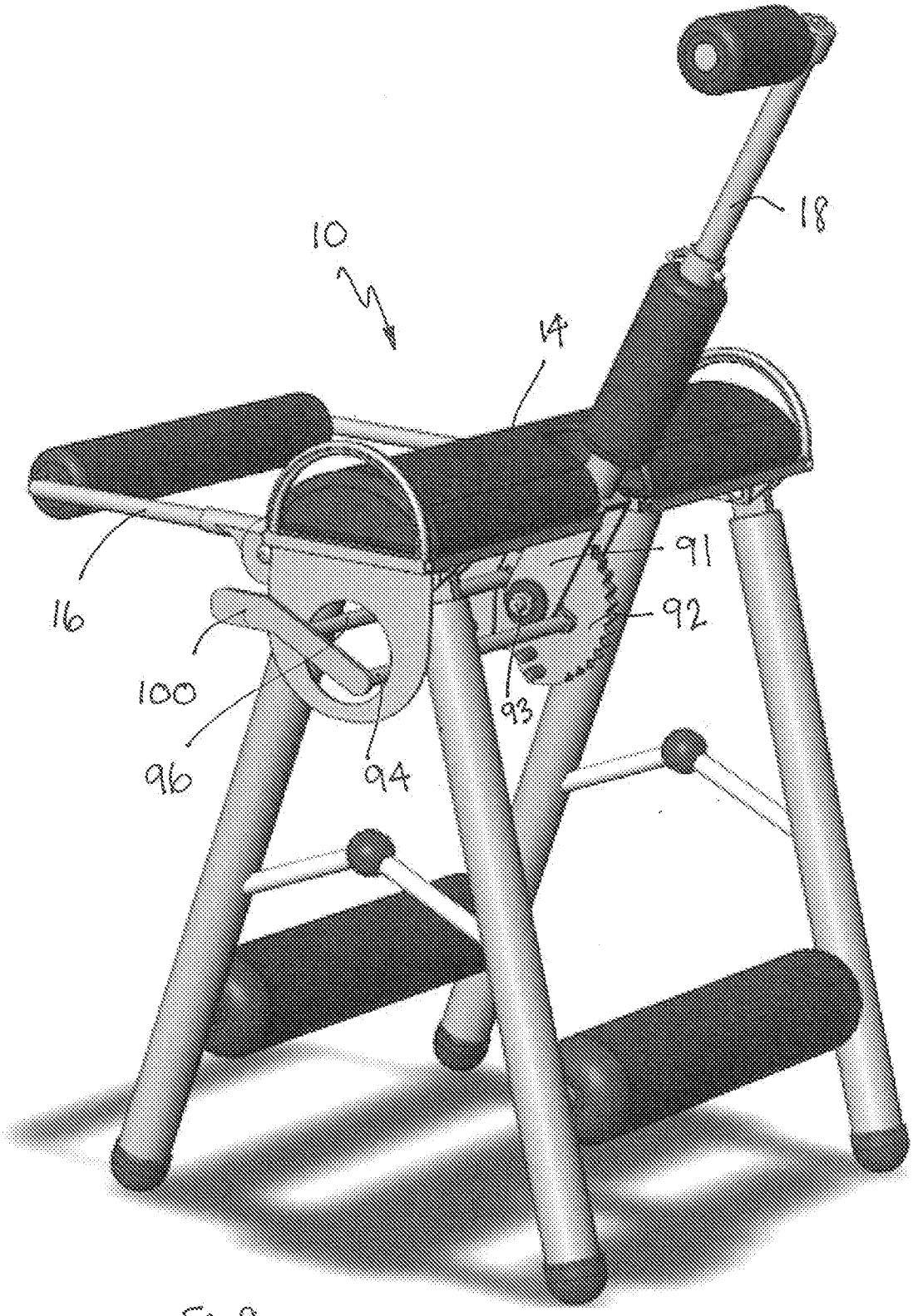


FIG. 8

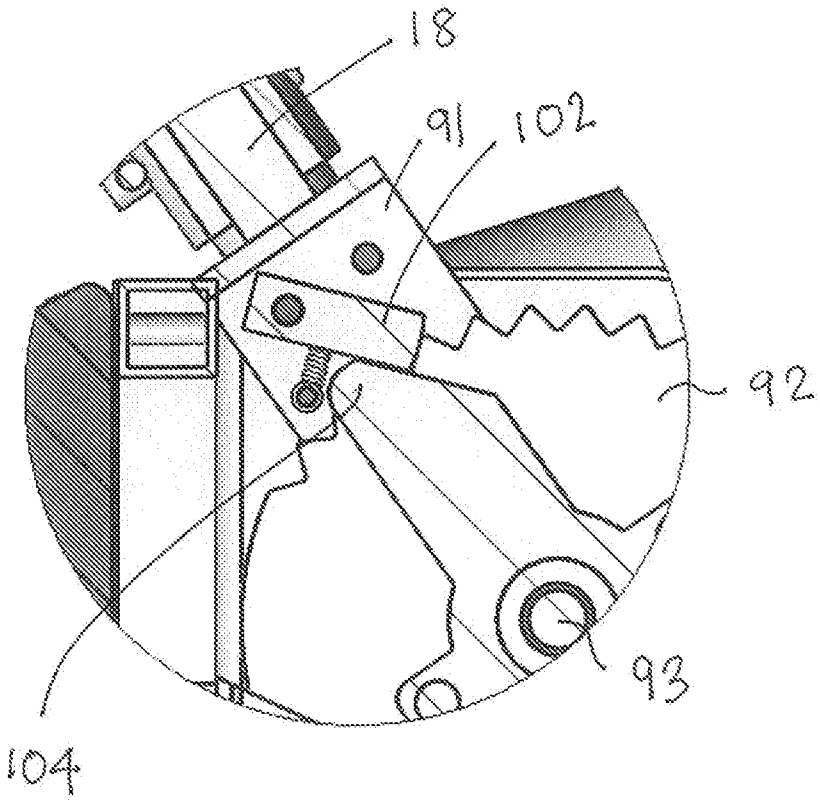


Fig. 9

**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/AU2017/050525**

A. CLASSIFICATION OF SUBJECT MATTER

***A61H 1/02 (2006.01)***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

PATENW: IPC: A63B21/068, A63B21/002. CPC: A63B21/00047/LOW, A63B2225/09/LOW, A63B21/068, A61H1/02/LOW, A63B2023/006, A63B21/002/LOW, A63B21/0023. Keywords: adjust, modify, alter, vary, multiple, angle, orientation, incline, support, extension, portion, arm, seat, fold, collapsible, demountable, portable, lever, or knob, handle, switch, grip, control, range, posture, exercise, stretch, ratchet, spring-loaded, and like terms.
GOOGLE, GOOGLE IMAGE: KEYWORDS: stretch, frame, exercise, bench, static, frame, and like terms.
GOOGLE PATENT: KEYWORDS: exercise, abs, roller, adjust, elastic, and like terms.
Applicant/Inventor names searched in PATENW and ESPACENET.
Applicant/Inventor names searched in internal databases provided by IP Australia

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| | Documents are listed in the continuation of Box C | |

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 7 August 2017 | 07 August 2017 |
| **Name and mailing address of the ISA/AU** | **Authorised officer** |
| AUSTRALIAN PATENT OFFICE<br>PO BOX 200, WODEN ACT 2606, AUSTRALIA<br>Email address: pct@ipaustralia.gov.au | Heather Abulafia<br>AUSTRALIAN PATENT OFFICE<br>(ISO 9001 Quality Certified Service)<br>Telephone No. +61262832360 |

| INTERNATIONAL SEARCH REPORT<br>C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | International application No.<br>**PCT/AU2017/050525** |
|---|---|---|
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| X | WO 2012/036332 A1 (KIM) 22 March 2012<br>Fig. 2-11; Para [0048]. | 1 - 3, 7 - 12 |
| X | US 2005/0003935 A1 (YAMAUCHI) 06 January 2005<br>Title; Fig. 1-23; Para [0030, 0036, 0039-0042, 0061]. | 1 - 12 |
| X | US 2013/0324383 A1 (ROGERS) 05 December 2013<br>Fig. 35-47; Para [0011, 0085]. | 1, 7, 10 |
| X | US 6213923 B1 (CAMERON et al.) 10 April 2001<br>Fig. 1-16; Col. 12, lines 1-26; Col. 15, lines 7-25. | 1, 2, 10 |

| INTERNATIONAL SEARCH REPORT<br>Information on patent family members | International application No.<br>**PCT/AU2017/050525** |
|---|---|

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| **Patent Document/s Cited in Search Report** | | **Patent Family Member/s** | |
|---|---|---|---|
| **Publication Number** | **Publication Date** | **Publication Number** | **Publication Date** |
| WO 2012/036332 A1 | 22 March 2012 | WO 2012036332 A1 | 22 Mar 2012 |
| | | KR 20120029821 A | 27 Mar 2012 |
| | | KR 101164166 B1 | 11 Jul 2012 |
| US 2005/0003935 A1 | 06 January 2005 | US 2005003935 A1 | 06 Jan 2005 |
| | | US 7014602 B2 | 21 Mar 2006 |
| US 2013/0324383 A1 | 05 December 2013 | US 2013324383 A1 | 05 Dec 2013 |
| | | US 9713745 B2 | 25 Jul 2017 |
| US 6213923 B1 | 10 April 2001 | US 6213923 B1 | 10 Apr 2001 |

**End of Annex**

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.