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 [33] **Great Britain**
 [31] **2526/66, 15368/66 and 28081/66**

[56]

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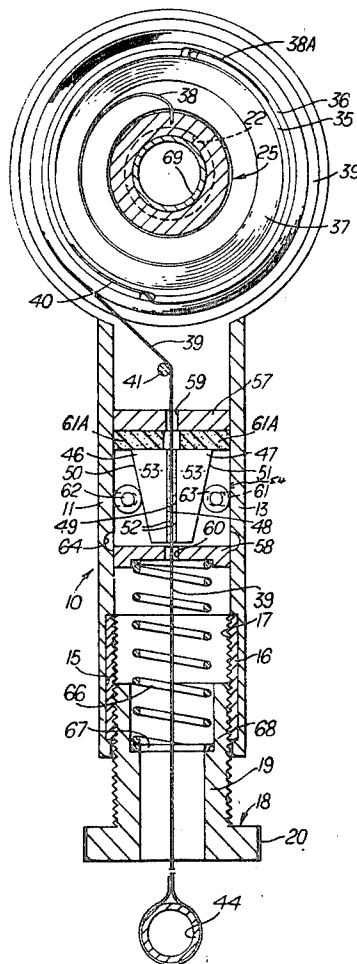
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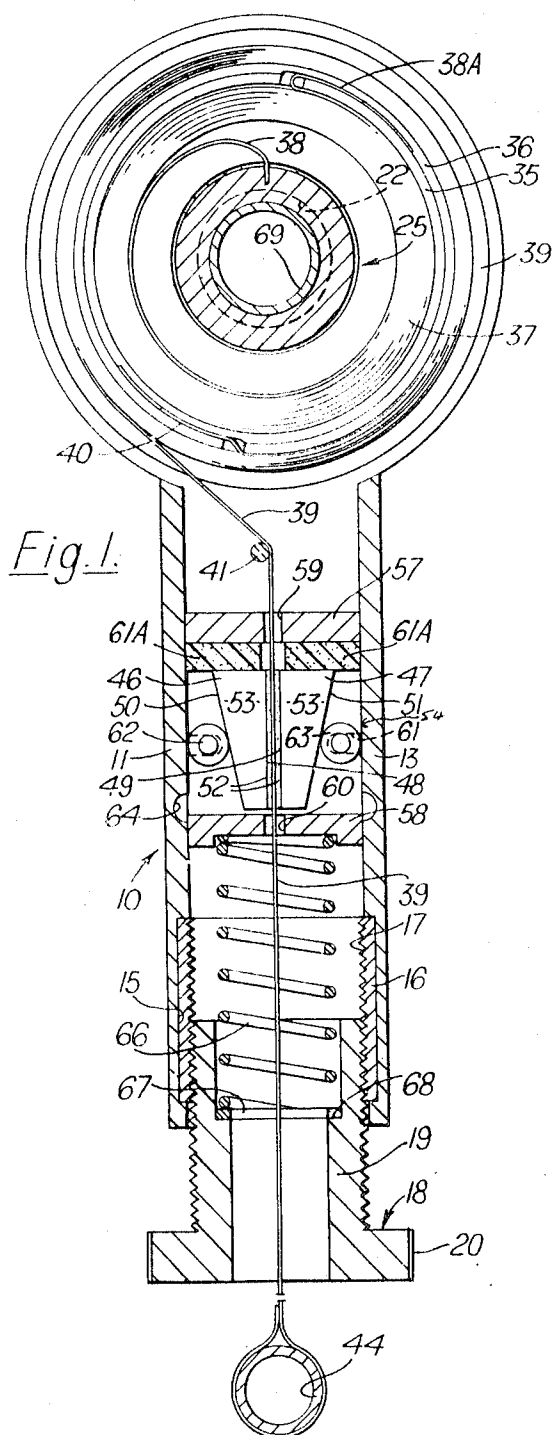
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[54] FRICTION EXERCISING APPARATUS 7 Claims, 8 Drawing Figs.

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 [51] Int. Cl. A63b 21/02
 [50] Field of Search 272/79, 83,
 80, 81, 82, 67, 68

ABSTRACT: An exercising device including an elongated flexible member for mounting within a frame. Attempted relative movement of the flexible member with respect to the frame in one direction is opposed by a force which gradually increases to a predetermined level, at which level it remains upon further movement of the flexible member in the said one direction. No significant force opposes relative movement of the flexible member in the opposite direction. Means are incorporated for regulating and adjusting the predetermined level of the opposing force.





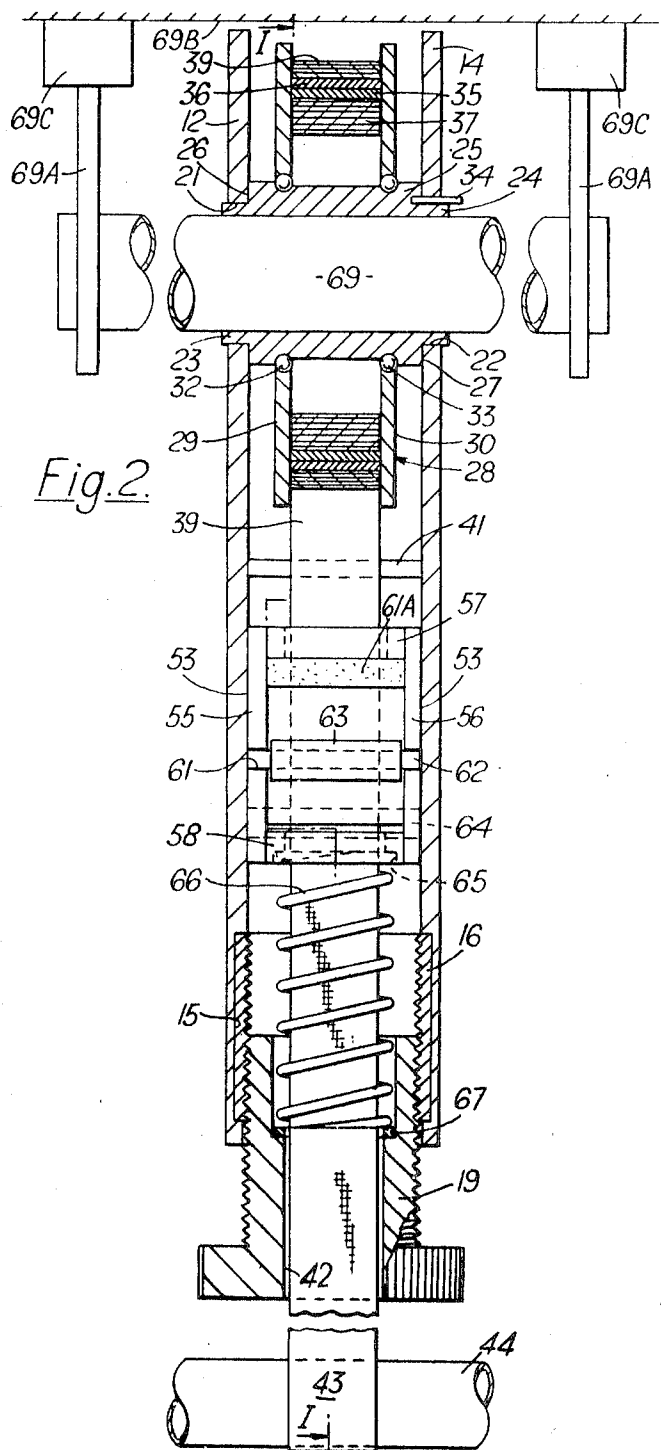


Fig. 3.

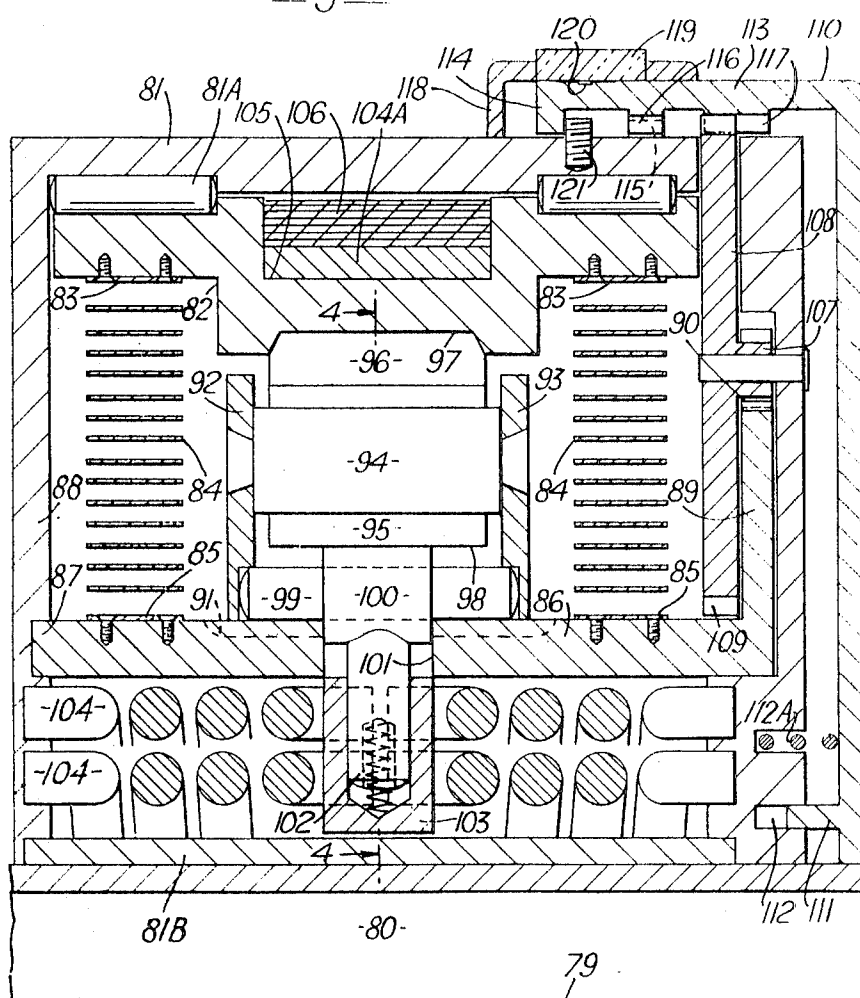


Fig. 4.

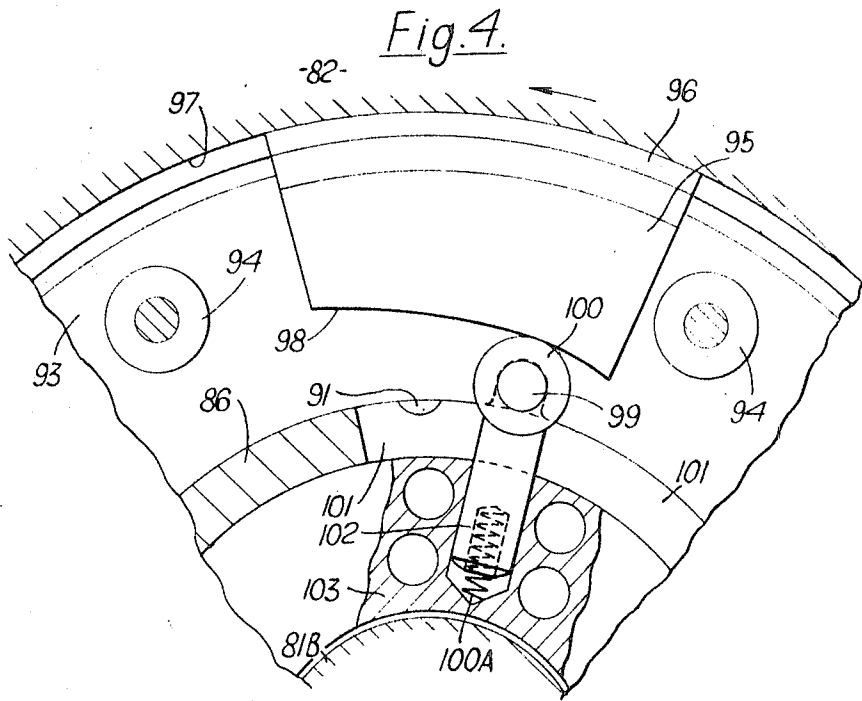
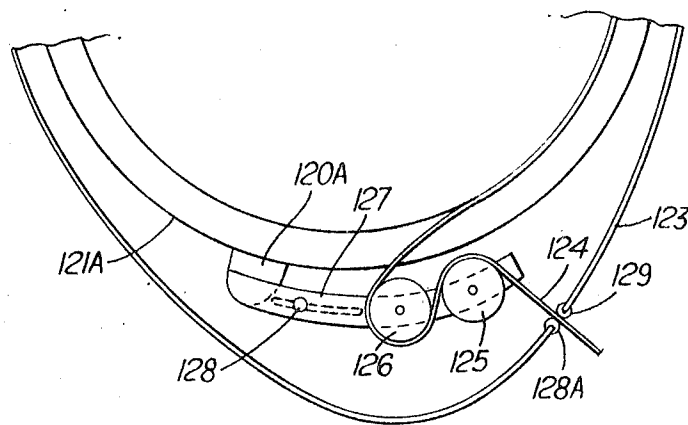
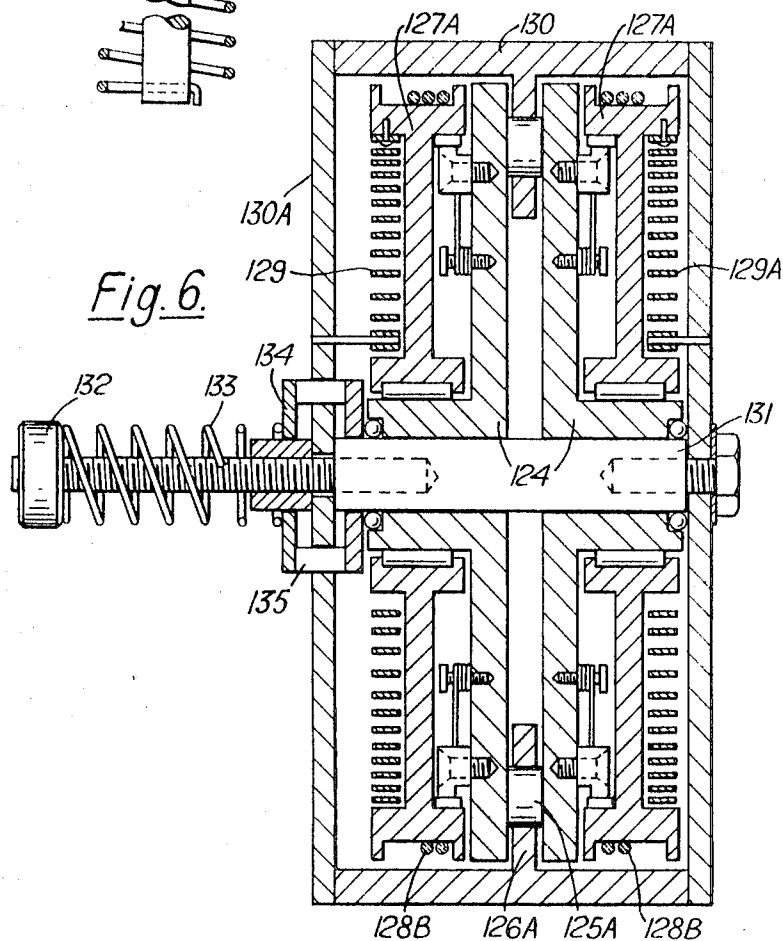
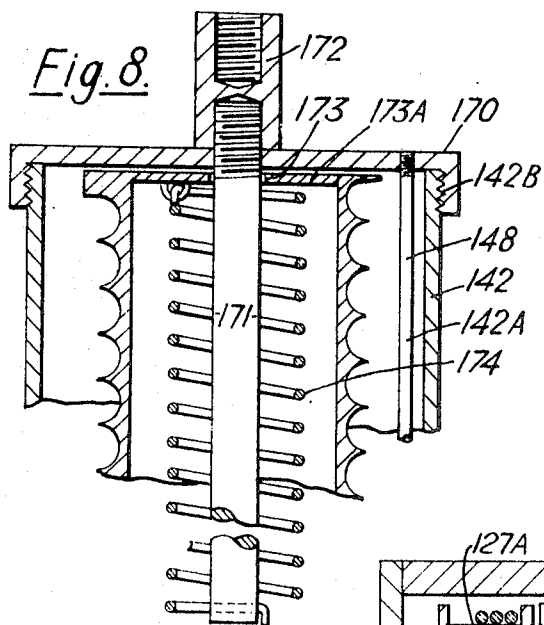


Fig. 5.





FRICION EXERCISING APPARATUS

This invention relates to exercising apparatus. According to the present invention there is provided an apparatus which provides a frictional resistance to movement in one direction of a flexible substantially inextensible elongated member, for example cord or webbing, but which provides substantially no resistance to movement in the reverse direction.

More specifically, the present invention frame, a flexible substantially inextensible elongated member some length of which is within the frame and which extends from the frame, means mounted in relation to the frame and adapted to frictionally oppose relative movement of the elongated member with respect to the frame in one direction but to present no significant opposition to relative movement in the opposite direction, and means for adjusting the amount of said frictional opposition.

Further features of the invention will be apparent from the following description of several embodiments of the invention, reference being made to the accompanying diagrammatic drawings in which:

FIG. 1 is a view of one embodiment looking in the direction of line 1-1 in FIG. 2;

FIG. 2 is a part axial section through the apparatus of FIG. 1, with some parts being shown in full;

FIG. 3 is a section containing the axis of part of a second embodiment;

FIG. 4 is a view in the direction of line 4-4 in FIG. 3 with certain parts being omitted and others in outline, to show the general arrangement of the parts;

FIG. 5 is a view showing the general arrangement of some parts of a third embodiment;

FIG. 6 is a view partly in section showing the general arrangement of a fourth embodiment;

FIG. 7 is a view showing the general arrangement of a fifth embodiment; and

FIG. 8 is a view showing a modification to the apparatus of FIG. 7.

The practice of exercising the body by the use of weights is growing. However, this practice involves the use of heavy awkward, pieces of equipment and there is a danger of injury to the user or damage to property should the weights be dropped unintentionally.

In lifting a weight from the floor, a person exerts a force against a constant opposing force, namely the weight. The various apparatus now to be described exert a substantially constant force against that used by a person to cause relative movement between a flexible substantially inextensible elongated member, such as cord, webbing or the like, and the apparatus, without the disadvantages associated with weights as mentioned above. These apparatus are intended for use in exercising the body.

The exercising apparatus shown in FIGS. 1 and 2 comprises a hollow steel frame 10 of rectangular cross section having four sides 11, 12, 13, 14. The sides 12, 14 at one end extend beyond the ends of the sides 11, 13. At their lower ends the sides are each recessed at 15, and welded into the recess is a hollow-boxlike member 16 open at its ends and formed with threads 17 in the central region of each of its sides. A hollow cylindrical member 18, which may be formed from a suitable plastics, for example Delrin, has an externally threaded shank 19, and a knurled head 20 at its lower end. The shank 19 is adapted to cooperate with the threads 17 and by manual rotation of the head 20 can be moved axially relatively to the frame 10.

The upper ends of the sides 12, 14 are respectively formed with aligned apertures 21, 22 which snugly but without play receive axial extensions 23, 24 of a hollow cylindrical member 25 formed for example from Tufnol and having annular shoulders 26, 27 respectively engaging the sides 12, 14.

A member 28 is formed from annular steel plates 29, 30 each having a central aperture therethrough and mounted respectively for rotation about the member 25 on bearings

diagrammatically shown at 32, 33. The bearings 32, 33 are centrally disposed in relation to the member 25 and are such as to resist relative movement between member 25 and member 28 along the axis of member 25. The members 25, 28 are coaxial.

A steel pin 34 passes through the plate 14 into the member 25 and is secured to these parts to prevent relative movement between them.

Two rigid cylindrical members 35, 36 formed from metal or rigid plastics surround the member 25. A spiral spring 37, formed of flat steel, has its inner end 38 passing through a slot in the periphery of the member 25 and is secured by suitable means such as screws or rivets to the member 25. The outer end 38a of the spring 37 is bent to lie between the members 35, 36 and is firmly held between them. The members 35, 36 are secured together, for example by adhesive.

A substantially inextensible length 39 of webbing has one end 40 secured between the members 35, 36. The webbing may for example be formed from nylon or terylene. The webbing 39 is wrapped several times round the outer surface of member 36 and then passes over a cylindrical steel rod 41 extending generally centrally across the frame 10 with its ends secured, for example by welding, to the sides 12, 14. The webbing extends through the lower part of the frame 10 and an internal bore 42 in the member 18, and its free end 43 is wrapped round a hand grip which in the arrangement shown is a hollow aluminum rod 44 which can be removed from the end 43.

A friction mechanism is contained within the lower part of the frame 10 which thus acts as a housing. This mechanism consists of two similar substantially incompressible wedge-shaped elements 46, 47 formed for example from steel or aluminum, having flat inner faces 48, 49 extending generally centrally along the axis of the frame 10. The outer faces 50, 51 are inclined inwardly as they extend away from the rod 41. Each of the inner faces 48, 49 has bonded to it a thin flat layer 52 of friction material, for example a known asbestos-based brake lining material. The webbing extends between the layers 52. The wedge elements have flat sides 53.

The wedge elements are contained in a rigid housing 54, formed for example from steel or aluminum, having flat sides 55, 56, and upper and lower walls 57, 58 formed with aligned elongated central apertures 59, 60 through which the webbing passes. The sides 53 can slide relative to the sides 55, 56 and the friction here is kept as low as possible.

Two foamed plastics cushions 61a are disposed between the upper wall 57 and the respective upper ends of the wedge elements. In the rest, upright, position shown in the drawings the lower ends of the wedge elements are spaced from the lower wall 58.

The sides 55, 56 are each formed with two similar, opposed, recesses 61. Two cylindrical steel rods 62 are supported by their ends in the two pairs of recesses.

A plastic hollow roller 63 is mounted on each rod 62. The roller 63 engages respectively the inner faces of the sides 11, 13. The rollers 63 may for example be made from nylon or polytetrafluoroethylene (P.T.F.E.). The rollers 63 engage respectively the inclined faces 50, 51.

The inner faces of the sides 11, 13 are each formed with an elongated recess 64, generally segmental in cross section referred to later.

The lower wall 58 has an annular recess 65 to receive one end of a compression spring 66 through which the webbing 39 freely extends. The other, lower, end of the spring 66 is seated into an annular ring 67 which normally engages an annular shoulder 68 formed in the axial bore 42.

A hollow cylindrical steel bar 69 extends snugly but removably through the member 25. The apparatus can pivot as a whole around the bar 69. As indicated, the apparatus is shown in an upright, unstressed condition.

The operation of the apparatus is as follows.

The bar 69 is firmly secured, e.g. by clamps 69A to a support which can stand a considerable strain, for example, a

bracket 69C fixed to a wall 69B. The user grips the bar 44 and pulls away from the frame 10 to try to draw the webbing from the frame. If the parts are not in the relative positions shown, a very slight initial force will bring them into that condition, the parts being arranged such that the frictional grip between faces 52 and webbing is greater than that between faces 50, 51 and rollers 63.

As the user pulls on the bar 44, the friction material 52 grips the webbing 39 to prevent relative movement between the webbing and the wedge elements, these elements exerting a lateral force on the rollers 63 which themselves engage the sides 11, 13. As the pull exerted increases, the wedge elements, housing 54 and rollers 63 move downwardly together against the opposition of the spring 66, and also the opposition of the spring 37. During this movement the rollers 63 roll on the sides 11, 13; the materials being chosen to keep the friction here as low as possible. However, the opposition of spring 37 is arranged to be small compared with that of spring 66 throughout most of the operating range of the apparatus. For example the maximum tension in spring 37 may be 5 pounds.

The force required to overcome the opposition of the spring 66 increases as the housing 54 moves downwardly and the spring 66 is further compressed. If the force exerted by the user increases to a sufficiently high value, the rollers 63 will come to a position in which they can begin to move outwardly into the recesses 64.

During these movements there is relative movement between the wedge elements and the rollers 63 which causes the pressure between the webbing and the faces 52 to be increased thus increasing the opposition.

When peripheries of rollers 63 first begin to enter the recesses 64, lateral movement of the wedge elements is prevented by the wedge elements sliding slightly further downwards, the relative frictional grips being as described above, but almost no extra force on the webbing is required to effect this. The lower ends of the wedge elements then come up against the lower wall 58, and then any further lateral separation of the wedge elements which might occur will cause the pressure on the webbing to be prevented from increasing further.

Thus when the rollers 63 begin to move further into the recesses 64 under the influence of an increased pull on the webbing and the user continues to pull with that increased pull, the webbing will be progressively drawn from the apparatus, at the same time winding up the spring 37.

In fact the peripheries of the rollers 63 will come to rest, assuming the user maintains a sufficient pull, on that part of the curve of the recess periphery as seen in cross section where the downward force on each wedge element caused by friction from the movement of the webbing as it is drawn between the elements is balanced by the upward forces of the springs 66 and 37. In this condition, once movement of the webbing has started, increasing the pull serves to increase the rate of movement of the webbing without changing the position of the wedge elements.

If the pull exerted is now released, the spring 37 will wind back, drawing the webbing back into the apparatus. The spring 66 returns to its unstressed condition, moving the housing 54 upwards. The friction material produces no or almost no opposition to this rewind of the webbing because the movement of the webbing tends to move the wedge elements so that there is little or no force between the rollers 63 and the wedge elements.

It will be appreciated that the force or pull which must be exerted to draw the webbing from the apparatus depends almost entirely on the extent to which the spring 66 must be compressed axially before the rollers 63 being to move into the recesses 64. This force depends therefore on the initial axial distance between the location of engagement between the rollers 63 and the sides 11, 13, and the upper edges of the recesses 64. This distance can be adjusted by rotating the head 20 to move the member 18 further into or out of the frame 10. In this way, by suitable dimensioning and selection of parts,

the pull required to draw the webbing from the frame can be arranged to be continuously adjustable within a desired range, say 5 to 800 lbs.

The force required can be indicated on a graduated scale, which could be on an unthreaded part of shank 19, cooperating with a suitable pointer.

The cushions 61A prevent the wedge elements from moving so far away from rollers 63 when the apparatus is upside down that they do not engage the webbing and thus cannot be drawn into the datum position; and hence the apparatus can be used in this upside down position.

It will be appreciated that alternative-shaped hand grips can be used and alternative means of mounting the apparatus relative to a main support can be used.

In using the apparatus, the user may pull the webbing 39 in any desired direction, the apparatus pivoting around the bar 69. If desired, a user may employ two exercising apparatus disposed at desired locations, and may pull on both hand grips together or alternatively or in any other desired manner. Alternatively the apparatus can be held in one hand whilst the user pulls on the webbing with the other.

FIGS. 3 and 4 show a second embodiment somewhat similar to that of FIGS. 1 and 2. This apparatus is symmetrical about a center line 79 and FIG. 3 therefore only shows the upper half of the section.

A central shaft 80, which can be secured in a bracket such as 69C, (FIG. 2) has a frame or housing 81 snugly but rotatably mounted on it. The housing 81 contains an annular member 82 mounted on needle bearings 81A for rotation in the housing. One end 83 of each of two flat spiral springs 84 is secured to the member 82 and the other ends 85 of the springs are secured to an inner annular member 86 which has one end 87 a sliding fit in a recess in one end 88 of the housing 81. The other end has a flange 89 which is formed with gear teeth 90. The member 86 is formed with two recesses 91 similar to the recesses 64 (FIG. 2).

Two rigid annular discs 92, 93 are mounted for rotation on the inner member 86. Four rollers 94 are riveted at their ends to the plates 92, 93 and act as stops for the movement of wedge elements 95. The outer surface of each element 95 has secured to it friction material 96 which friction material bears against a surface 97 on the member 82. Alternatively, the friction material could be on the member 82. The inner surface 98 of each element 95 is not concentric with the surface 97. A rigid e.g. steel roller 99 has its ends in recesses in the plates 92, 93 and is surrounded by a yoke 100 which bears against the surface 98 and which extends into a part annular recess 101 in the member 86. The roller 99 can rotate inside the yoke 100. A stud 102 is secured to the yoke 100 and forms a telescopic engagement with an annular member 103 which can rotate on the inner member 81B of the housing 81. Four coil springs 104 each have one end secured to the housing and the other secured to the member 103 and surround the inner member 81B. An annular asbestos member 104A is secured in a recess 105 in the member 82 and one end of the length of webbing 106 extends through the asbestos and is secured to the member 82. The webbing is wrapped around the asbestos and extends out from the housing to a hand grip. A gear 107 has teeth meshing with the teeth 90 and is integral with a gear 108 having teeth 109. An annular member 110 has an annular portion 111 which extends into an annular recess 112 in the housing 81. A spring 112A urges the member 110 axially outwardly from the housing 81. The member 110 has an axial portion 113 surrounding part of the housing 81 and formed with a flange end 114. A gear having teeth 115 is secured to the outer periphery of the housing 81. The portion 113 is formed with internal teeth 116, 117. The arrangement is such that when the teeth 116 mesh with the teeth 115 the member 110 cannot rotate nor the gears 108 and the member 86. When the member 110 is moved axially to the left in FIG. 3, the teeth 115 disengage but the teeth 117 do not and then on rotation of the member 110 the member 86 rotates to this vary the distance between the recess 91 and the roller 99 in the

datum position. This provides an adjustment to the force required to withdraw the webbing from the apparatus, in a similar manner to that described in FIGS. 1 and 2. An annular member 118 is slidably mounted on the periphery of the housing 81 and carries a lens 119 through which a scale 120 on the portion 113 can be viewed. The scale is circular and is graduated for example in pounds to show the force required to withdraw the webbing from the apparatus at any given position of adjustment of the member 110 and member 86. A screw 121 acts as a stop to prevent the member 110 leaving the housing 81. A spring 100A urges the yoke outwardly to allow the apparatus to be used in all positions relative to bar 80.

When the apparatus is used, the user pulls on the webbing 106 which causes the member 82 to try to move to rotate in the direction of the arrow in FIG. 4. This draws the wedges 95 with it, and then the wedges 95, rollers 99, plates 92, 93 move as a unit against the action of the springs 104 and 84, until the rollers 99 begin to enter into the recesses 91, at which time the webbing commences to be withdrawn from the apparatus in a manner similar to that described in relation to FIGS. 1 and 2. When the webbing is released, the springs 84 return the apparatus to its initial condition. As before, the maximum tension in the springs 84 may be for example 5 lbs.

FIG. 5 shows an alternative arrangement in which the friction material 120A engages a drum 121A which is mounted for rotation in a housing 123, the drum having a return spring, not shown, connected to it, such as the spring 37 in FIG. 1. The webbing extends around two rollers 125, 126 mounted at one end of a lever 127 pivoted to the housing at 128 and the webbing then extends out through a slot 128A in the housing. Rollers 129 are fitted at the edges of the slot to reduce friction. Pulling on the webbing urges the friction material into engagement with the drum. In an alternative the friction material is on the drum.

The pivot 128 is arranged to be adjustable as shown dotted to allow for adjustment of the frictional opposition to withdrawal of the webbing. The following table shows that, providing the frictional opposition to the withdrawal of the webbing is assisted by a substantially constant force, in this case the recoil spring, then the relative magnitude of the withdrawal force and the total force opposing the withdrawal, changes as a particular value of withdrawal force is exceeded, so that at any withdrawal force above that value the webbing will be withdrawn from the housing. This value is different for different lever ratios. Therefore by adjusting the lever ratio the force necessary to withdraw the webbing is also adjusted. The accuracy of such an adjustment setting will not be affected by wear between the friction surfaces 120A, 121A.

Withdrawal force, lbs.	Lever ratio	Coefficient of friction between 120A, and 121A	Recoil force, lbs.	Force opposing withdrawal, lbs.
40 X	1.8 X	0.5 +	5 =	41
50 X	1.8 X	0.5 +	5 =	50
60 X	1.8 X	0.5 +	5 =	59

The lever ratio times coefficient of friction must always be less than 1.0, otherwise withdrawal of the webbing will be impossible.

FIG. 6 shows a further alternative. This comprises a frame or housing 130 having a central shaft 131 fixed to it. Annular members 124 are mounted for rotation on the shaft and engage friction pads 125A contained in an internal flange 126A on the housing. Further annular members 127A are mounted for rotation on the annular members 124 and one end of each of two cords 128B are wound around and secured respectively to the annular members 127A. When the cords are pulled, all the annular members rotate against the action of springs 129A by virtue of the pawl and ratchet connections 130A between them. When the cords are released, the annular members alone are returned to the datum position by the springs, the

pawls travel freely over the ratchets, and the inner annular members 124 remain stationary relative to the friction pads. The cords extend out of the housing to hand grips. The force between the members 124 and the friction pads 125A can be adjusted by screwing in or out a nut 132 on the end of a threaded shaft 133 fixed in relation to the central 133A. Movement of the nut compresses or relieves a spring 133A which engages a member 134 which urges the annular members 124 towards the friction pads by means of pressure pins 135. The pull required to withdraw the cords or a cord from the housing can be indicated on an elongated scale alongside the spring.

FIG. 7 shows a further arrangement comprising a solid boss 140 which is threaded at 141 so that it may be secured to an anchor and prevented from rotating. A cylindrical housing 142 is secured at its upper threaded end to the boss. The lower end of the housing 142 has a helical thread 144 for receiving an internal helical thread 145 on a further cylindrical member 146. A spiral rewind spring 147 is secured at one end to the boss 140 and at the other end to a further cylinder 148 having an external helical thread 149. One end of a cord 150 is fixed to the cylinder 148 and the cord is then wrapped a number of times round the cylinder and extends downwardly through a hole in a disc 51 which itself has a thread 152 cooperating with the thread on the cylinder 148. Three rods 142A are secured to the boss and the cylinder 142 and pass through notches in disc 151. The cord extends through an aperture in the lower end of the cylinder and then is wrapped several times round a friction drum 160 which is mounted by a screw 167 to the lower end of the cylinder 146. The cord extends out through a slot in the lower end of the cylinder 146. A pawl 161 is mounted on the cylinder 146 and cooperates with a circular ratchet 162 secured to the friction drum 160. When the cord is pulled against the frictional resistance between the drum 160 and the cord, it eventually commences to be withdrawn and the disc 151 moves axially relative to cylinder 148 the cord being drawn off the cylinder 148 which rotates and energizes the return spring 147. During this time the pawl and ratchet prevent rotation of the drum 160. When the cord is released, the spring 147 returns the cord to the initial position and the drum 160 does not oppose this return since it is allowed to rotate by the pawl ratcheting over the ratchet. Adjustment of the force required to withdraw the cord is obtained by rotating the cylinder 146 relative to the cylinder 148 to vary the number of times the cord is wrapped round the friction drum. A lens 163 in the cylinder 146 enables a helical scale 163A on the cylinder 148 to be read to indicate the force which is required to withdraw the cord. Means (not shown) may be provided to lock the members 142, 146 so that relative movement is prevented during withdrawal of the cord.

An alternative recoil mechanism is illustrated in FIG. 8. Instead of a solid boss, an anchor cap 170 is secured to the thread 142b at the upper end of the cylinder 142 and a solid spindle 171, threaded at its upper end is locked into a mating thread in the center of the anchor cap 170. The thread can be extended outside the cap 170 to provide a convenient attachment for a socket 172 with which the apparatus may be anchored in various ways.

The closed upper end of the cylinder 148 has a central clearance hole 173 permitting the cylinder 148 to rotate. A helical coil spring 174 is secured at its upper end to the inside face of the upper closed end 173a of cylinder 148 and at its lower end is fixed to the lower end of spindle 171.

During withdrawal of the cord, the spring 174 is tensioned through the resultant rotation of cylinder 142, thus energizing the spring to rewind the cord on release, when the cylinder 142 will rotate in reverse direction coiling the cord onto its helical track.

FIG. 1 and 7 both comprises two functionally separate parts, namely a mechanism arranged to cause frictional opposition to the withdrawal of the webbing or cord and a mechanism arranged to draw back the webbing or cord when the withdrawal force is released. Both types may be con-

structed without this second mechanism.

In FIG. 1 this involves the section above 41 being replaced by a plate which closes the member 10. This plate contains an elongated central aperture, aligned with 59, 60 through which the upper end of the webbing passes.

Each device may have handles attached to the outer body. In FIG. 1 these may be coaxial tubes welded at one end to sides 12, 14 so that they extend at right angles to the frame. In FIG. 7 the handles may be coaxial tube welded at one end to diametrically opposed points on the cylinder 146 such that they extend at right angles to cylinder 146.

Each of the arrangements may then be mounted as follows. The lower end of the webbing or cord may be anchored at the feet of the user, e.g. by being firmly fastened to a board on which the user stands. The upper end of the webbing may be anchored above and close to the users head e.g. by a light clamp around the architrave of a door frame. The webbing may then be in light tension with the device at any point along its length.

In this position the user must overcome the selected frictional opposition when moving the device upwards along the webbing or cord, but he will experience little or no opposition when moving the apparatus downward to return to the starting position. A wide range of conventional repetitive exercises may thus be carried out without the need for the user to release his hold on the device.

We claim:

1. Apparatus for exercising the body comprising a frame, a flexible substantially inextensible elongated member some length of which is within the frame and which extends from the frame, opposition means, including frictional surfaces, for exerting opposition to attempted relative movement of the elongated member with respect to the frame in one direction but to present no significant opposition to relative movement in the opposite direction, such opposition means, being such that in operation, a pressure develops between the frictional surfaces to produce said opposition in response to the attempted relative movement of the elongated member, said opposition means presenting an opposition force which increases gradually to a predetermined level during initial movement of said elongated member in said one direction and remains generally at said predetermined level on further movement of said elongated member in said one direction, and means for regulating and adjusting the value of said predetermined level of said opposition force.

2. Apparatus as claimed in claim 1, in which said opposition means and a surface disposed to be frictionally cooperable therewith, and wherein the friction surface is carried by a lever and is urged towards said first rotatable member by the tension in the elongated member, which lever is mounted on an adjustable pivot by which the ratio of the lever can be varied, said apparatus further comprising a second member mounted for rotation about an axis fixed in relation to the

frame, one end of the elongated member being anchored to said second rotatable member, and recoil means, energized by the withdrawal from the frame of at least some further length of the elongated member when the elongated member is pulled, for drawing the elongated member back towards the frame after said some further length has been drawn from the frame and the elongated member released.

3. Apparatus as claimed in claim 1, in which the frictional surfaces are respectively on the elongated member and on the member disposed to engage the elongated member.

4. Apparatus as claimed in claim 1, in which said opposition means includes a first rotatable member and a surface disposed to be frictionally cooperable therewith, and wherein the adjusting means comprises means whereby when the frictional opposition between the surface and said first rotatable member has reached said predetermined level, it is prevented from increasing further, said apparatus further comprising a second member mounted for rotation about an axis fixed in relation to the frame, one end of the elongated member being anchored to said second rotatable member, and recoil means, energized by the withdrawal from the frame of at least some further length of the elongated member when the elongated member is pulled, for drawing the elongated member back towards the frame after said some further length has been drawn from the frame and the elongated member released.

5. Apparatus as claimed in claim 1, in which said opposition means includes a rotatable member, a plurality of elements each having a surface disposed to be frictionally cooperable with the rotatable member, and a plurality of parts disposed to engage an adjustable part and a respective element, each element and associated part being movable against spring means under the pull of the elongated member, each part being adapted upon relative movement with respect to the associated element to urge the surface on that element further towards the rotatable member to increase the pressure therebetween, and means operative when the opposition has reached the predetermined level and the spring means has a predetermined stress, to prevent any further relative movement between a part and the associated element from increasing said pressure, whereupon said relative movement in said one direction can occur.

6. Apparatus as claimed in claim 5, in which the element associated with said one part is a curved wedge which has a surface cooperable with a curved surface on the rotatable member, the smaller end of the curved wedge facing in the direction in which the rotatable member rotates when the elongated member is withdrawn, said one part engaging the curved wedge and comprising a curved surface engaging a fixed part, the means preventing relative movement from producing increased pressure comprising an appropriately shaped recess in the fixed part into which the curved surface on said one part can move.

7. Apparatus as claimed in claim 5, in which the parts are rollers.

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