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(54) A movement and balancing mechanism for vertical sliding doors

(57) A movement and balancing mechanism for vertical sliding doors (2) has a return spring (38); to instantly counterbalance a variable force exerted by the spring, which is greater the more the spring is extended, a cable (36) cooperates with the spring and winds round a varying radius profile of an idle wheel (28), so that the moment exerted by the spring on the wheel is kept constant.

Preferably, the device includes an idle wheel (16) for winding the cable (12) of the door, coupled to the varying profile wheel (28) through a reduction ratio.

Use is particularly envisaged for furniture.

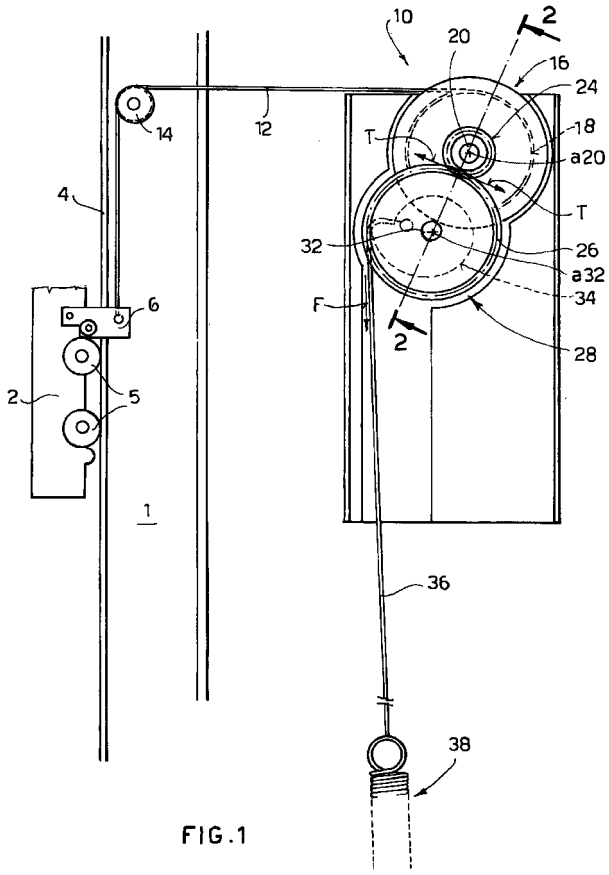

FIG.1

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Description

[0001] Vertically sliding door units are well known and widely used, particularly for wardrobes and furniture in general.

[0002] In vertically sliding door systems currently in use, a sliding door is supported at one end of at least one cable, which is wound on one or more idle pulleys and is fixed, with its other end, to a counterweight of equal weight to that of the door.

[0003] This system provides excellent balancing of the door in all its possible positions. A minus point is that the unit is very heavy and bulky and therefore unusable in many circumstances.

[0004] An aim of the present application is to produce a vertical sliding door unit of reduced weight and bulk, compared to said traditional systems, so that it may be used in furnishing applications and achieve more widespread use.

[0005] Such an aim has been achieved with a mechanism as contained in claim 1. Additional new and desirable characteristics are said in the dependent claims.

[0006] In other words, the new mechanism includes, for each vertically sliding door, at least one return or balancing spring means, an idle door cable winding wheel between the door and the spring means, a length of a door cable secured by one end to the door, with the other end being attached to the door cable wheel, a length of a spring cable secured to the spring and a to a spring cable winding wheel, a winding groove of varying radius being provided on the spring cable winding wheel. Preferably there should be two winding wheels, one for the door cable and the other for the spring cable, which are coupled by reduction gearing.

[0007] The new unit may use helical spring or gas systems as the balancing means for vertically sliding doors and therefore proves more compact and lighter compared to traditional vertical sliding door units.

[0008] The invention will be better described by referring to exemplary unrestrictive embodiments, shown in the annexed figures in which:

figure 1 is a broken-away elevational side view of a side unit of a vertical door movement mechanism, according to the invention, shown reduced;
figure 2 is a cross-sectional view along plane 2-2 in figure 1, shown enlarged with respect to said figure;
figure 3 shows in an enlarged scale with respect to the previous figures, a spring tension regulation device, at the base of a spring;
figure 4 shows a further embodiment of a side unit of a movement and balancing mechanism, in this case for a pair of opposite vertical sliding doors.

[0009] With reference first to figures 1, 2 and 3, a side unit for a movement and balancing mechanism for a vertical sliding door, carried on a fixed structure 1, is denoted, as a whole, by reference number 10. The door is referenced 2 and is guided through its vertical movement on fixed guides, referenced 4, on which it slides by means of, e.g., bearings or rollers 5. One end of a length of flexible cable 12, hereafter referred to as door cable, is fixed to a door bracket 6. This cable 12 winds round a stationary idle roller or pulley 14, on fixed structure 1, and is secured and winds round a peripheral grooved wheel 16, which is idle on the fixed structure 1. The peripheral groove of wheel 16 is referenced 18. As can be seen in figure 2, wheel 16 is idle supported on a pivot 20, having its axis a20 integral to structure 1, by a bearing 22. A small diameter crown wheel or toothing 24 is integral to the groove wheel 16 and meshes with a large diameter toothing 26 of a further wheel, or gear wheel, 28. The latter is supported idle, by a bearing 30, on a pivot 32, having axis a32, carried by structure 1. The axes a20 and a32 are parallel, in the example in the figures. Wheel 28 has a winding groove 34 for a cable, which groove has a varying radius around axis a32, as can be seen, for instance, in figure 1.

[0010] A second length of cable, or spring cable 36, has one end secured in groove 34, so as to wind round it, and the other end secured to a return spring 38, shown in a broken-away view in figure 1. The return spring 38, in the example shown, is a helical spring secured, in an adjustable way, to a stationary anchorage in structure 1, as shown in figure 3. The anchorage system of the spring could be any known anchorage system, for example, as in figure 3, a system comprising a cooperating screw 41 and nut screw 42, in which a lower end of spring 38 is locked to the nut screw by a pivot 43.

[0011] The system of the invention, through appropriate sizing of the variable radius groove 34 depending on spring 38, is able to provide for perfect balancing of door 2 in all positions thereof. The weight of door 2, applied to cable 12, is vertical in the vertical section of the cable 12 and horizontal in the horizontal section of the cable 12. The following condition must be satisfied for balance of wheel 16 around its axis a20:

$$P.\,r16 = T.\,r24$$

where P is the weight of the door (or of the door portion relating to side unit 10), r16 is the radius of the cable winding surface of wheel 16, T is the force exchanged by wheels 16 and 28 at toothings 24 and 26, and r24 is the pitch circle radius of toothing 24. For the equilibrium of wheel 28, the following condition must be satisfied:

$$T.\ r26 = F.\ r34$$

where F is the force exerted by spring 38, and r34 is the varying radius of the bottom of groove 34 (winding surface). Since the force exerted by spring 38 varies according to the drawing conditions of spring 38 (and is generally greater if the spring is extended), by properly

designing the varying radius of groove 34, F. r34 can be made constant. This ensures perfect balancing of door 2, at all moments and, in short, a smooth vertical door raising and lowering motion.

[0012] The mechanism has considerably reduced weight and limited bulk, with respect to a counterweight system, as could be seen for instance in figure 2, in which it can be appreciated that it may be enclosed in a box 50 of limited thickness.

[0013] A unit including the cable 12, the wheels 16 and 28 and the spring 38 may be centrally arranged with respect to door 2, or two such symmetrical units could be provided for with identical characteristics and positioned at the sides of door 2.

[0014] In figure 4, a modified embodiment of the unit is shown, for a pair of opposite vertically sliding doors. In figure 4 a movement and balancing unit for the upper door 2 has the same references as for figure 1 and will not be described in detail. In the lower part of the figure a further vertical door is shown and referenced 102. The details thereof and the movement and balancing unit thereof have the same references as for the upper door, increased by 100. In particular, therefore, a door cable 112 is coupled to door 102, by an arm 103, and winds round an idle snub pulley 114 and an additional idle snub pulley 115. Thus it winds around an idle wheel 116 supported on the stationary frame 1, said wheel having a peripheral groove 118. An end of the cable 112 is secured in said peripheral groove. The cable 112 is wound on wheel 116 is an opposite direction with respect to cable 12 on the wheel 16. Wheel 116 has an externally toothed portion 124, of reduced radius, that engages with a toothing 126 of a further wheel 128. Wheel 128 is idle round a pivot 132 supported on the frame 1. Wheel 128 has a varying radius groove 134 in which one end of a spring cable 136 is secured, the other end thereof being secured to a spring 138. The cam groove 134 has an identical but opposed configuration to that of cam groove 34.

[0015] The considerations on the equilibrium of the wheels referring to wheels 16 and 28 may be repeated for wheels 116 and 128. The unit comprising the wheels 16 and 28, 116, 128, relative idle snub wheels and cables, occupy a very restricted space, enclosed in a box of limited thickness. The unit is therefore of reduced weight and dimensions and is easy to assemble.

Claims

1. A movement and balancing mechanism for vertically sliding door characterised in that it includes:

a spring means (38) with one end thereof secured in a stationary position
a circular winding surface (18) on a wheel (16), said surface having a constant radius
a second winding surface (34) on a wheel (28), said surface having a varying radius
a first length of cable (12), or door cable, secured to the sliding door and windable on the constant radius surface,
a second cable (36) or spring cable, secured to the spring and windable on said varying radius surface (34)
so that a variable force exerted by the spring means according to its drawing conditions sets a constant moment round a rotation axis (a32) of the varying radius surface.

2. A mechanism according to claim 1, characterised in that the constant radius winding surface is a groove of a first idle wheel (16), the varying radius winding surface is a groove of a second idle wheel (28), a gearing engagement being provided between said wheels.

3. A mechanism according to claim 2 characterised in that the said wheels (16, 28) are interengaging by means of toothings, and a toothing (24) of said toothings is provided on a sprocket portion of the first wheel (16) and another toothing (26) of said toothings is provided on a portion of greater radius on the second wheel (28).

4. A mechanism according to claim 1 characterised in that it includes idle snub pulleys for at least the door cable.

5. A mechanism according to claim 1 characterised in that an end of the spring opposite the cable is secured to a position regulating device.

6. A mechanism according to claim 1 in which both said winding surfaces (18, 34) are provided on one wheel.

7. A vertical sliding door system including a number of vertical sliding doors characterised in that for each door it includes a mechanism according to any one of the previous claims.

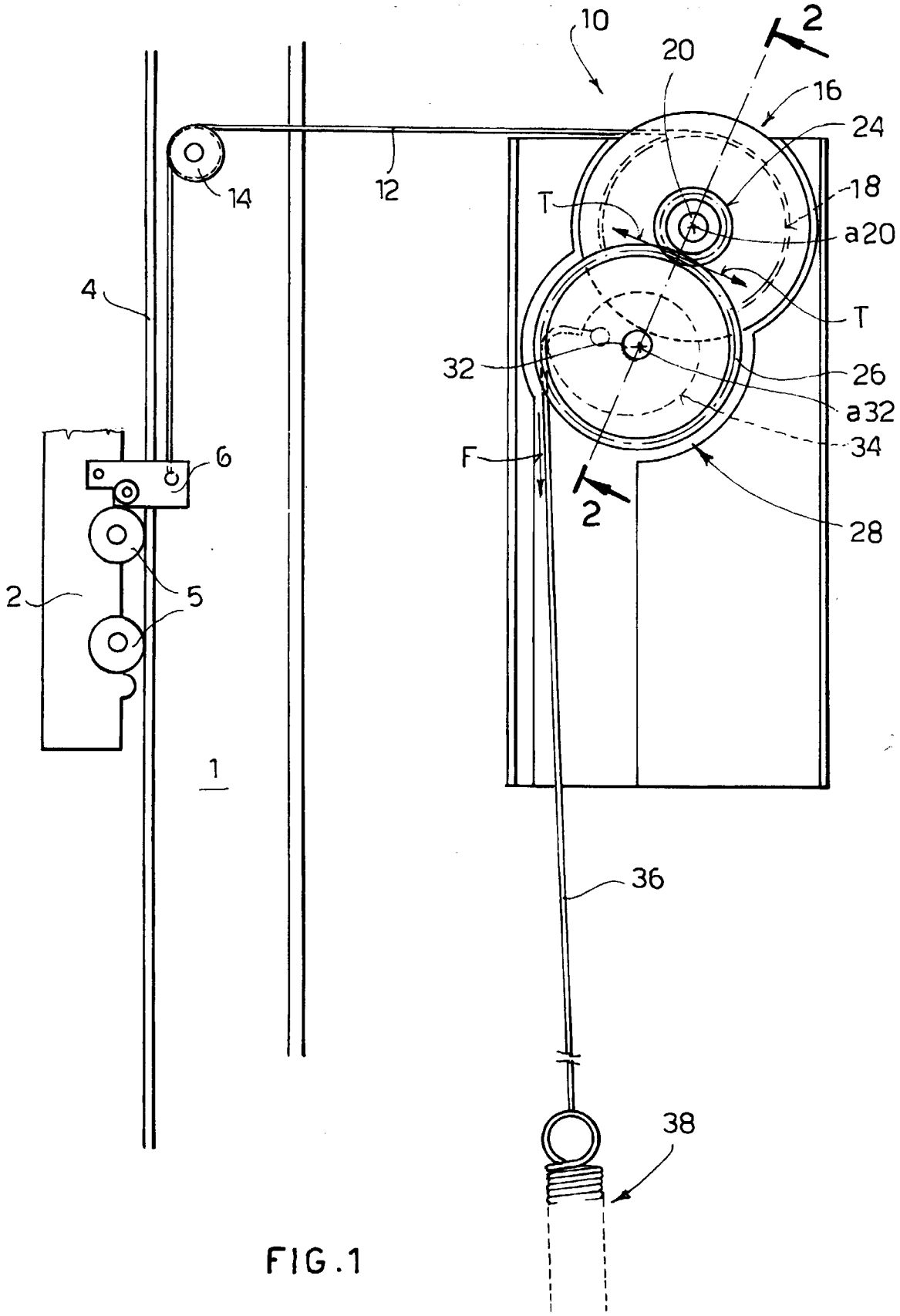


FIG.1

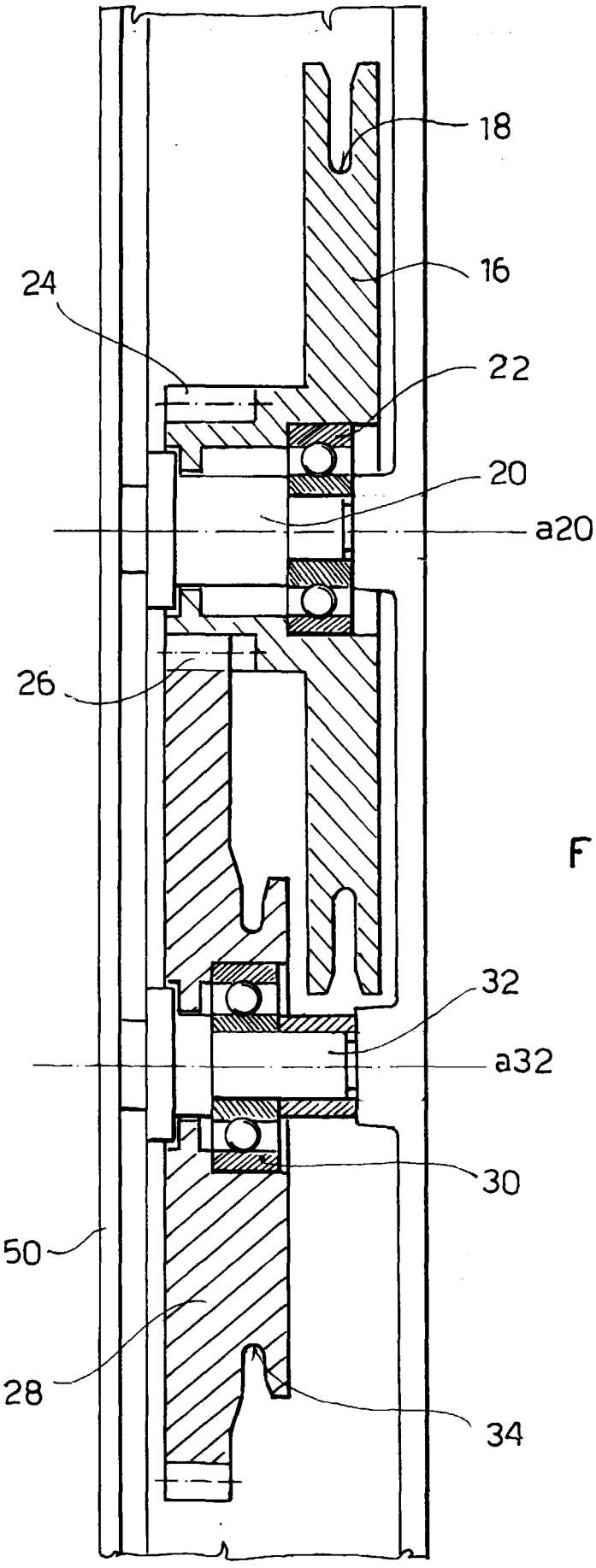
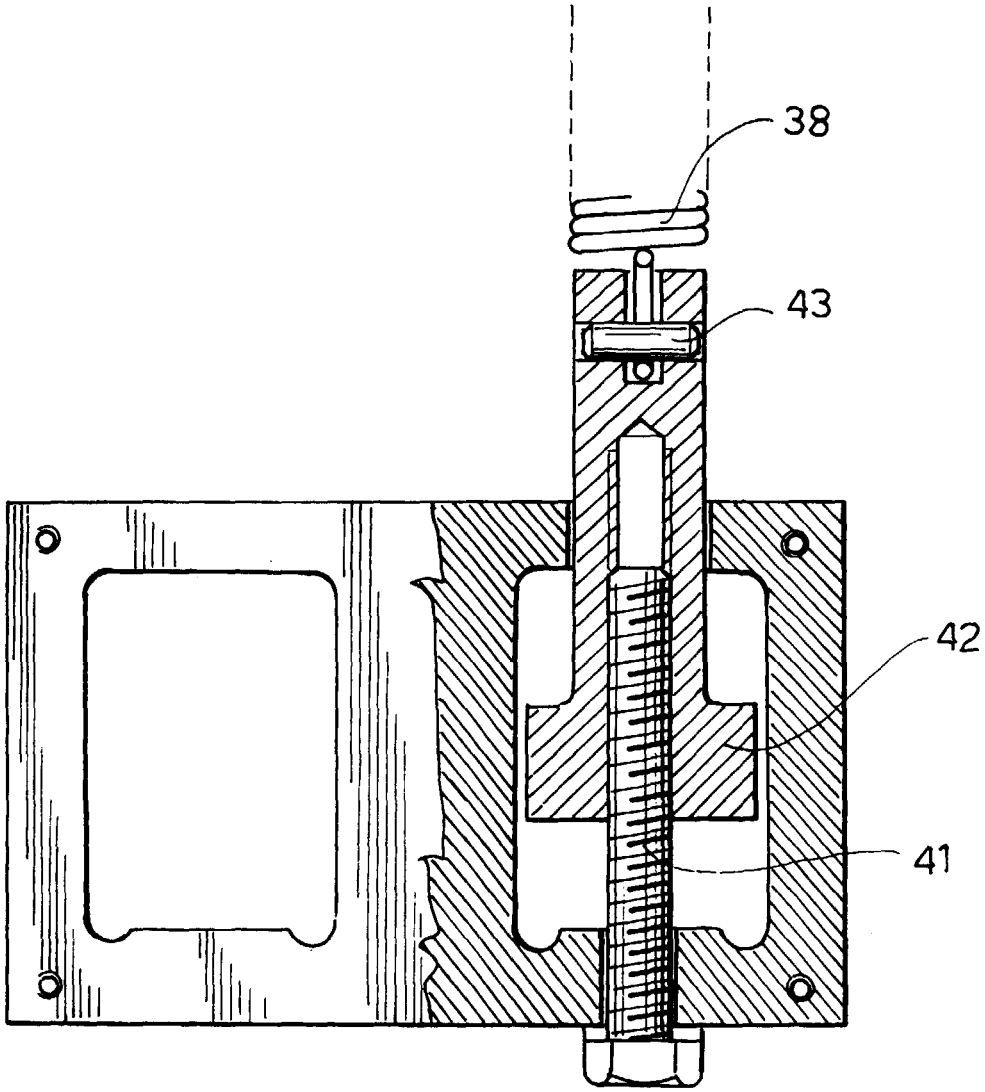
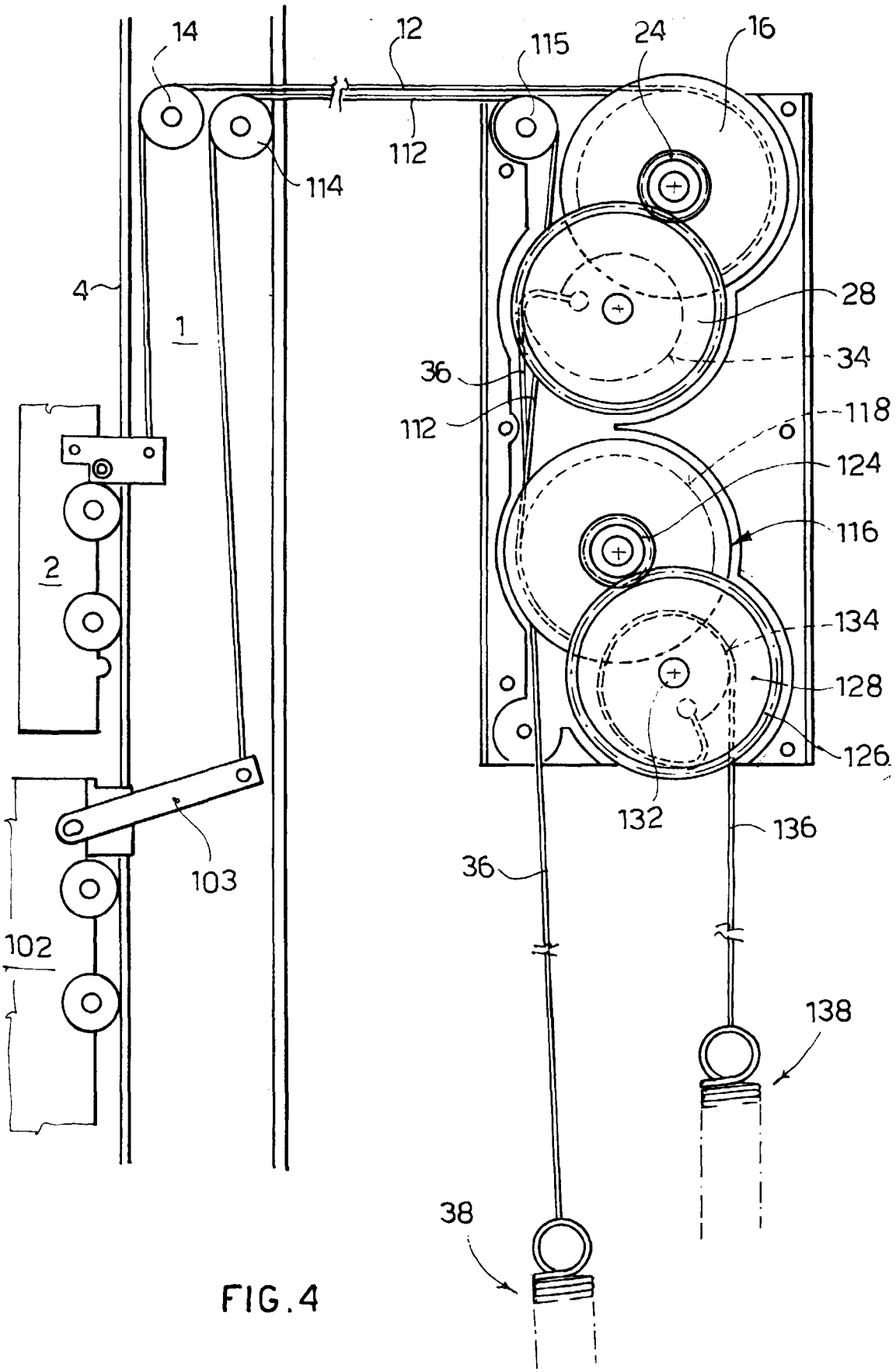


FIG. 2

FIG. 3

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38

FIG.4