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(54) Compact actuator

(57) An actuator (1) for moving an object from one position to a second position and vice versa, and if desired, any position therebetween. The actuator (1) comprises a motor (62) that powers directly or indirectly a spindle drive (27). A chain (12) with one end connected to the spindle drive (27) and the other end being intended for connection to a window element. A movable exit guide (70) is provided with a chain guide surface (71), said chain guide being movable between a retracted position and an extended position in which it extends from said actuator.

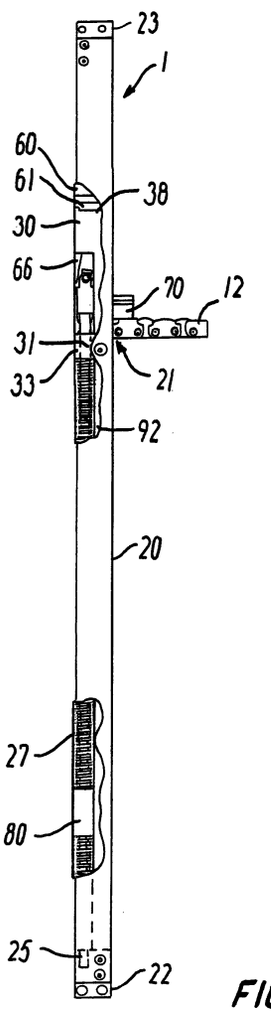

FIG.3

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Description

[0001] The present invention relates to an actuator for moving an object from one position to a second position and vice versa and if desired any position therebetween. Typically, such actuators are used to control the position of a window sash such as in bottom-hung, tophung or side-hung windows, sky lights and of doors such as ventilation doors.

BACKGROUND ART

[0002] Conventional actuators of this type as known from e.g. AU B1-51 808/79 use a chain, i.e. a chain storable within a housing and with the chain being extended from and retracted into the housing by means of a rotatable drive sprocket having a toothed relation with the chain.

[0003] EP-B-0 708 218 discloses a chain actuator with a spindle drive. The housing of the actuator is provided with separate guide channels for the nut of the spindle and for the chain. The two channels are separated by a wall provided with a longitudinal slit through which a foot of the nut protrudes to engage the inner end of the chain.

[0004] In these known actuators, the cross-sectional area of the housing is about ten times the cross-sectional area of chain.

[0005] Both above mentioned actuator designs claim though to be compact. They are however too bulky to fit into a hollow profile of industrially available window frames without machining a part of the window frame to create space for the actuator.

[0006] Consequently, these actuators are either mounted on top of the master window frame or window sash, or alternatively, they are build in the master window frame or window sash after a space has been machined in either of these window parts. By machining such a space, the stiffness/stability of the profile in question, and consequently, the stability of the window frame as such is sometimes significantly reduced.

[0007] A window sash or a window frame usually consists of an inner frame build up of extruded profiles and an outer frame build up of extruded profiles. The inner frame and the outer frame are separated by an insulation frame. Machining a space for the prior art actuators usually results in removing locally the insulation frame, thus creating a thermal break between the inner and outer frames reducing the insulation capacity of the overall window significantly.

[0008] A problem in providing compact actuators has been though the aspect that the actuator must be able to deliver a substantial driving force. Thus, the elements of the actuator have to have sufficiently large dimensions to obtain the required strength and stability of the actuator, e.g. simply reducing the cross-sectional area of the chain is not a viable alternative.

DISCLOSURE OF THE INVENTION

[0009] On this background, it is an object of the present invention to provide an actuator of the kind referred to initially, that has a minimal cross-sectional area whilst being able to provide a high driving force. This object is achieved in accordance with claim 1 by an actuator comprising a longitudinal housing provided with a chain exit aperture, a linear drive means arranged in the longitudinal housing, a chain driven by the linear drive means, the chain extending at least partially in the longitudinal housing and being guided by at least one guide in the longitudinal housing towards the chain exit aperture, and a movable exit guide provided with a chain guide surface extending in the exit direction of the chain, wherein the exit guide is arranged adjacent the chain exit aperture.

[0010] By employing linear drive mains for driving the chain, and by providing a movable chain guide, the actuator can be constructed more compact, whilst maintaining the same performance.

[0011] The linear drive means may comprise a spindle with a nut in threaded engagement.

[0012] Preferably, a motor driving directly or indirectly the spindle, is arranged in the longitudinal housing.

[0013] One end of the chain may be connected to the nut and the other end being intended for connection of an object to be moved.

[0014] The linear drive means may comprise an hydraulic or pneumatic cylinder. Alternatively, the linear drive means may comprise a belt drive.

[0015] The exit guide may extend substantially perpendicular to the longitudinal axis of the housing.

[0016] Preferably, the exit guide is movable between a retracted position in which it is at least partially located inside the elongated housing and an extended position in which it extends from the elongated housing to guide.

[0017] The actuator comprises preferably means for urging the exit guide to the extended position.

[0018] The chain guide may be pivotally connected to the longitudinal housing.

[0019] In order to improve the guidance of the exit guide, it may be provided on the side opposite to the chain guide surface with a substantially rail that engages a corresponding shaped groove in a frame in the longitudinal housing for guiding the exit guide in its translative movement between the retracted position and the extended position.

[0020] The exit guide may be movable between a retracted position in which it is substantially completely located inside the actuator and an extended position in which it extends from the actuator.

[0021] The actuator may comprise a frame which has a cross-section substantially corresponding to the inner cross-section of the longitudinal housing, the curved guide preferably being an integral part of the frame, the frame further defining a transverse guide channel for the chain guide and/or defining a cylindrical recess for re-

ceiving an extremity of the spindle.

[0022] Preferably, the longitudinal housing is formed by a tube with a substantially rectangular cross-section, preferably a substantially squared cross-section.

[0023] The chain is preferably bendable in one plane and the chain being arranged in the housing beside the spindle viewed in a direction parallel to the one plane.

[0024] The chain is preferably guided by at least one guide rail extending parallel to the longitudinal axis and protruding into the chain.

[0025] Also the nut is preferably guided by at least one guide rail extending parallel to the longitudinal axis and protruding into a groove in the nut. The chain and the nut are preferably guided by one and the same guide rail.

[0026] The actuator preferably comprises a first substantially planar guide surface extending parallel with the longitudinal axis and extending substantially perpendicular to the exit direction of the chain, a second substantially planar guide surface extending parallel to the first guide surface, the chain and the nut being arranged between the first guide surface and the second guide surface and the distance between the first guide surface and the second guide surface being substantially equal to the width of the chain and preferably the distance between two parallel side surfaces of the nut being substantially equal to the chain width.

[0027] Preferably, the first and second guide surfaces are formed by two strips of low friction material, preferable low friction plastic material such as nylon, that are inserted in the longitudinal housing.

[0028] The guide rail may be formed by a longitudinally extending protrusion on the first or second guide surface.

[0029] Preferably, the output shaft of the motor is substantially parallel with the longitudinal axis.

[0030] The actuator preferably comprises a reduction gearing which is connected to the output shaft of the motor, the reduction gearing, preferably a planetary gearing, having an output shaft that is substantially parallel with the longitudinal axis.

[0031] The output shaft of the reduction gearing and the spindle are preferably not concentric, whereby the spindle and the output shaft are mechanically connected by a flexible shaft, or by a straight gearing or a by double universal joint.

[0032] On the above background, it is a further object of the present invention to provide an actuator of the kind referred to initially, that has a minimal cross-sectional area whilst being able to provide a high driving force. This object is achieved in accordance with claim 25 by an actuator comprising a longitudinal housing provided with a chain exit aperture, a spindle extending in the longitudinal housing, a motor driving directly or indirectly the spindle, a nut in threaded engagement with the spindle, the chain being connected to the nut, the chain extending at least partially in the longitudinal housing and being guided by a guide surface in the longitudinal housing towards the chain exit, the chain being bendable in one plane and the chain being arranged in the housing beside the spindle viewed in a direction parallel to the one plane.

[0033] Preferably, one end of the chain is connected to the nut and the other end is intended for connection to an object to be moved.

[0034] The guide surface may be curved to facilitate a change in direction of the chain.

[0035] The nut may be guided by at least one guide rail extending parallel to the longitudinal axis and protruding into a groove in the nut.

[0036] Preferably, the chain and the nut are guided by one and the same guide rail.

[0037] The actuator may comprise a first substantially planar guide surface extending parallel with the longitudinal axis and extending substantially perpendicular to the exit direction of the chain, a second substantially planar guide surface extending parallel to the first guide surface, the chain and the nut being arranged between the first guide surface and the second guide surface and the distance between the first guide surface and the second guide surface being substantially equal to the width of the chain, and preferably, the distance between two parallel side surfaces of the nut is substantially equal to the chain width.

[0038] The first and second guide surfaces may be formed by two strips of low friction material, preferable low friction plastic material such as nylon, that are inserted in the longitudinal housing.

[0039] Preferably, the guide rail is formed by a longitudinally extending protrusion on the first or second guide surface.

[0040] The output shaft of the motor is preferably substantially parallel with the longitudinal axis.

The actuator is preferably comprising a reduction gearing is connected to the output shaft of the motor, the reduction gearing, preferably a planetary gearing, having an output shaft that is substantially parallel with the longitudinal axis.

[0041] The reduction gearing and the spindle are preferably not concentric, whereby the spindle and the output shaft are mechanically connected by a flexible shaft, or by a straight gearing or a by double universal joint.

[0042] Further objects, features, advantages and properties of the actuator according to the invention will become apparent from the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] In the following detailed portion of the present description, the invention will be explained in more detail with reference to the exemplary embodiments shown in the drawings, in which

Fig. 1a is a diagrammatic cross-sectional view of a main frame and a sash of a window of in which an actuator according to a preferred embodiment of

the invention is mounted,
Fig. 1b and 1c illustrate the movement of the sash to an open position,
Fig. 2 is a perspective opened up view of a first preferred embodiment of the actuator according to the invention,
Fig. 2a is an enlarged detail of Fig. 2,
Fig. 3 is a diagrammatic partially opened up side view of of the first preferred embodiment of the actuator according the invention,
Fig. 4 is a perspective diagrammatic view of a detail of the first preferred embodiment of the actuator according to the invention,
Fig. 5 is another perspective diagrammatic view of a detail of the first preferred embodiment of the actuator according to the invention,
Fig. 6 is a diagrammatic partially opened up side view of a detail of the first preferred embodiment of the actuator according the invention,
Fig.7 is a perspective opened up view of a second preferred embodiment of the actuator according to the invention,
Fig. 8 is a diagrammatic partially opened up side view in detail of the second preferred embodiment of the actuator according the invention,
Fig. 9 is another side view of the second preferred embodiment of the actuator according to the invention with the exit guide in the retracted position,
Fig. 10 is the same side view as Fig. 9 with the exit guide in the extended position,
Fig. 11, is a perspective diagrammatic view in detail of the second preferred embodiment of the actuator with the exit guide in the retracted position, and
Fig. 12 is the same perspective diagrammatic view in detail as Fig. 11 actuator with the exit guide in the extended position.

DETAILED DESCRIPTION

[0044] In the following detailed description, the invention will be described by the preferred embodiments. With reference to Fig. 1, the actuator 1 is shown mounted inside the extruded profile 10 that forms one side of a window main frame 8. The main frame 8 holds a bottom hung sash 9 with a top profile 11 opposite the pivots. The extremity of the chain 12 extending from the actuator 1 is fastened to the top profile 11 of the sash 9 by means of a bracket 14. Fig. 1b and 1c illustrate the movement of the sash 9 to an open position.

[0045] As shown in more detail in Figs. 2 to 6, the actuator 1 comprises a longitudinal housing 20 formed by a tube with a substantially squared cross-section. The housing is provided on one of its sides with a chain exit aperture 21 through which the chain extends from the inside of the housing 20 to the window sash 9. The extremities of the housing 20 are sealed by end caps 22,23. End cap 22 is provided with a cylindrical aperture 25 receiving the extremity of a spindle 27 extending longitudinally inside the housing 20. The spindle 27 is provided with a thread. The opposite extremity of the spindle 27 is received in a cylindrical aperture 31 in a first extremity 33 of a frame 30 located inside the housing 20.

[0046] The cross-section of the frame 30 is substantially equal to the inside of the housing 20, so that the frame 30 is retained in the housing 20 in a stable manner. The frame 30 is a machined part, preferably made of aluminum, and defines an outer curved guide 34 with a guide surface in the form of an arc that extends over an angle of 90° for guiding the chain 12 towards the chain exit aperture 21. The frame 30 is further provided with a transversely extending guide channel 36 for an exit guide 70. The frame 30 further comprises a bridge 37 spanning between the first extremity 33 and a second extremity 38 of the frame 30. Between the opposite ends of the bridge 37, two parallel slits 43,44 facing one another are provided for receiving a print board 50 with the electric control of the actuator 1. The second extremity 38 is provided with a cylindrical aperture 39 for receiving an output shaft 61 of a planetary reduction gear 60. The reduction gear 60 is driven by a DC motor 62. The DC motor 62 and its output shaft (not shown) are concentrically located inside the housing 20. The planetary reduction gear 60, and its output 61 shaft are also concentrically located within the housing 20. The spindle 27 is however not located concentrically in the housing 20. The output 61 shaft is therefore connected to the spindle 27 by a double universal joint 66 extending between the opposite extremities 33,38 of the frame 30.

[0047] A movable exit guide 70 is provided in the transversely extending guide channel 36 adjacent the chain exit aperture 21. The exit guide 70 is provided with a chain guide surface 71 extending substantially perpendicular to the longitudinal axis of the housing 20 for ensuring that the chain 12 leaves the housing 20 as a substantially straight and rigid member. The chain guide 70 is movable between a retracted position in which it is substantially completely located inside the housing 20 and an extended position in which it extends from the housing 20 to guide the chain 12. A coil spring 72 is placed behind the exit guide 70 for urging the exit guide 70 to the extended position. When the chain 12 is retracting the sash 9 abuts with the exit guide 70 and forces it into the housing 20 until the sash 9 abuts with the master window frame 30. The exit guide 70 is provided on the side opposite to the outer curved guide 34 with a substantially T-shaped rail 73 that engages a corresponding shaped groove 74 in the frame 30. The T-shaped rail 73 guides the exit guide 70 in its translative movement between the retracted position and the extended position. This additional transverse guidance is advantageous because the extend of the transversely extending guide channel 36 at the side facing the outer curved guide 34 is relatively short.

[0048] A box shaped nut 80 is in treaded engagement with the thread of the spindle 27. The nut 80 has a rectangular cross-section (in a plane perpendicular to the

spindle 27 axis), with a lesser extension and a larger extension. The larger extension is somewhat smaller that the corresponding inside width of the housing 20. The spindle bore in the nut 80 is located such that nut 80 extends asymmetrically in one direction from the spindle 27. As best shown in Fig. 2a, the asymmetrically extending part of the nut 80 is provided with a recess 81 for receiving the extremity of the chain 12. An anchor pin 82 extends over the recess 81 through the proximal link 83 of the chain 12 to secure it to the nut 80. The nut 80 is further provided with a groove 84 extending in the longitudinal direction of the housing 20. The chain 12 extends from the proximal link 83 in the longitudinal direction of the housing 20 adjacent the spindle 27 until it meets the curved outer guide 34.

[0049] The chain 12 and the nut 80 are guided inside the housing 20 by a first guide surface 90 and a second guide surface 91. The first and second guide surfaces 90,91 are formed by two respective strips 92,93 of nylon or other low friction material with approximately the same width as the inner dimension of the housing 20. The strips 92,93 rest with their rear surfaces on the inner surface of the housing 20. The thickness of the strips 92,93 is such that the distance between the first- and second guide surfaces 90,91 is substantially equal to the chain width, which is in turn substantially equal to the lesser extension of the nut 80. The chain 12 and the nut 80 are thus laterally supported in a first direction in the full range positions of the chain 12 to provide lateral stability for the spindle 27, nut 80 and chain 12.

[0050] The first guide strip 92 extends from the end cap 22 up to the chain exit aperture 21. The first guide surface 90 curves smoothly over a 90° angle towards the chain exit aperture 21 to form an inner curved guide 94. As best shown in Figs. 2 and 2a, the first guide strip 92 is further provided with longitudinally extending guide rail 96 protruding from the first guide surface 90. The guide rail 96 protrudes into the U-shaped links 85,86 of the chain 12, thus, giving it lateral support in a second direction. The guide rail 96 also protrudes into the groove 84 in the nut 80 and gives the nut 80 and consequently, also the spindle 27, lateral support in the second direction.

[0051] The chain 12 is build up of outer links 85 and inner links 86 which are interconnected by rivets 87. The outer and inner links 85,86 being U-shaped in cross-section and so made and arranged, that the chain 12 may be bended in one direction in a plane perpendicular to the rivets 87, for example, around the curved inner guide 94, but in the opposite direction, it cannot be bended beyond an arrangement in which the links are in a substantially straight line.

[0052] By arranging the chain 12 adjacent the spindle 27 seen in the plane in which the chain 12 can be bend, i.e. a plane extending perpendicular to the rivets 87, both the chain 12 and the spindle 27 can be located in a single guide channel, thus, rendering the actuator 1 extremely compact.

[0053] With reference to Figs. 7 to 12 a second preferred embodiment of the actuator 1 is shown. The actuator is basically build up the same way with as the actuator according to the first embodiment described above. The linear drive means in this embodiment comprises a worm 90, i.e. a revolving threaded screw. The worm 90 is driven by the DC motor 62 via the reduction gear 60 and the double universal joint 66. An extremity of the worm extends through a cylindrical aperture 31 in frame 30 and is connected to the double joint 66.

[0054] The chain 12 is provided with teeth 91 formed by extensions of the rivets 86. As best seen in Fig 8 the teeth 91 mesh with the thread on the worm 90. An elongated block 93 extends from the end cap 22 to the worm 90. The elongated block serves as a guide for the chain 12 and is provided at its end that faces the worm 90 with a cylindrical aperture 97 in which an extremity of the worm 90 is received.

[0055] The frame 30 is provided with a slot 94 for receiving a movable exit guide 70'. A pivot pin 95 extends across the slot 94 and through a bore in the moveable exit guide 70'. The movable exit guide 70' is movable by rotation about the pivot pin 95 between a retracted position in which it is substantially completely located in the housing 20 (cf. Figs. 9 and 11) and an extended position in which it extends from the housing 20 (cf. Figs. 10 and 12) to support the chain 12. The movable chain guide 7' is urged by a spring 72' to the extended position in which a guide surface 71' ensures that the chain 12 leaves the housing 20 as a substantially straight rigid member.

[0056] Alternatively, the linear drive means may be formed by a hydraulic or pneumatic cylinder (not shown). It is also possible to use a tooth belt (not shown) provided with teeth on both sides of the belt. The belt extends along a part of the length of the chain, whereby the teeth on the outer side of the belt are in engagement with the chain.

[0057] The invention as described here allows the construction of an actuator with a ratio between cross-sectional surface of the chain and the cross-sectional surface of the housing which is improved by about a factor two. The actuator according to the invention is therefore substantially more compact than any of the prior art actuators, and can consequently, be mounted inside window profiles without machined additional space into such a window profile.

[0058] Although the present invention has been described in detail for purpose of illustration, it is understood that such detail is solely for that purpose, and variations can be made therein by those skilled in the art without departing from the scope of the invention.

[0059] Merely as an example, a non-exclusive list of possible variations to the preferred embodiment is listed here:

- the spindle 27 may be provided with a normal thread, or with a spiral groove for recirculating ball

engagement with the nut 80,

- the housing 20 does not have to be squared in cross-section, it may also be rectangular, hexagonal, octagonal, round, or any other suitble shape, in this case the cross-sectional shape of the nut 80, the frame 30 and of the guide strips 92,93 is simply adjusted to the cross-sectional shape of the housing 20,
- the housing does not have to be tubular, it may also be produced as a box shaped housing, by assembling two or more housing-halves, made by metal casting, plastics moulding, or assembly of strip material,
- the chain 12 does not have to be build up of U-shaped links 85,86, the links may just as well be formed by two opposite plates, or alike metal or moulded plastic links,
- the DC-motor 62 may be replaced by an AC motor, a pneumatic motor or any other suitable source of rotational power,
  the planetary gearing 60 may be replaced by any other type of reduction gear, i.e. any gearboxes with striate gears, or helical gears that fit in the housing 20, the teeth 91 on the chain 12 do not have to be formed as extensions of the rivets 85,86, the teeth could also be formed by e.g. protrusions of the links,
- the connection between the output shaft 61 of the reduction gearing 60 and the spindle 27 does not have to be formed by a double joint 66, it may be replaced by a straight gearing or a flexible shaft.

[0060] Thus, while the preferred embodiments of the devices and methods have been described in reference to the environment in which they were developed, they are merely illustrative of the principles of the invention. Other embodiments and configurations may be devised without departing from the scope of the appended claims.

Claims

1. An actuator comprising a longitudinal housing provided with a chain exit aperture, a linear drive means arranged in said longitudinal housing, a chain driven by said linear drive means, said chain extending at least partially in said longitudinal housing and being guided by at least one guide in said longitudinal housing towards said chain exit aperture, and a movable exit guide provided with a chain guide surface extending in the exit direction of said chain, wherein said exit guide is arranged adjacent said chain exit aperture.

2. An actuator according to claim 1, wherein said linear drive means comprises a spindle with a nut in threaded engagement.

3. An actuator according to claim 2, wherein a motor driving directly or indirectly said spindle, is arranged in said longitudinal housing.

4. An actuator according to claim 2 or 3, wherein one end of said chain is connected to said nut and the other end being intended for connection of an object to be moved.

5. An actuator according to claim 1, wherein said linear drive means comprises a hydraulic or pneumatic cylinder.

6. An actuator according to claim 1, wherein said linear drive means comprise a belt drive.

7. An actuator according to any of claims 1 to 6, wherein said exit guide extends substantially perpendicular to the longitudinal axis of said housing.

8. An actuator according to any of claims 1 to 7, wherein said exit guide is movable between a retracted position in which it is at least partially located inside said elongated housing and an extended position in which it extends from said elongated housing to guide said chain.

9. An actuator according to any of claims 1 to 8, further comprising means for urging said exit guide to said extended position.

10. An actuator according to any of claims 1 to 9, wherein said chain guide is pivotally connected to said longitudinal housing.

11. An actuator according to any of claims 1 to 9, wherein said exit guide is provided on the side opposite to said chain guide surface with a substantially rail that engages a corresponding shaped groove in a frame in said longitudinal housing for guiding the exit guide in its translative movement between the retracted position and the extended position.

12. An actuator according to any of claims 1 to 11, wherein said at least one guide is a curved guide.

13. An actuator according to any of claims 1 to 12, further comprising a frame which has a cross-section substantially corresponding to the inner cross-section of said longitudinal housing, said curved guide preferably being an integral part of said frame, said frame further defining a transverse guide channel for said chain guide and/or defining a cylindrical recess for receiving an extremity of said spindle.

14. An actuator according to any of claims 1 to 13, in which said longitudinal housing is formed by a tube with a substantially rectangular cross-section, pref-

erably a substantially squared cross-section.

15. An actuator according to any of claims 1 to 14, wherein said chain is bendable in one plane and said chain being arranged in said housing beside said spindle viewed in a direction parallel to said one plane.

16. An actuator according to any of claims 1 to 15, wherein said chain is guided by at least one guide rail extending parallel to said longitudinal axis and protruding into said chain.

17. An actuator according to claim 16, wherein said nut is guided by at least one guide rail extending parallel to said longitudinal axis and protruding into a groove in said nut.

18. An actuator according to claim 17, wherein said chain and said nut are guided by one and the same guide rail.

19. An actuator according to any of claims 1 to 18, further comprising a first substantially planar guide surface extending parallel with said longitudinal axis and extending substantially perpendicular to the exit direction of said chain, a second substantially planar guide surface extending parallel to said first guide surface, said chain and said nut being arranged between said first guide surface and said second guide surface and the distance between said first guide surface and said second guide surface being substantially equal to the width of said chain and preferably the distance between two parallel side surfaces of said nut is substantially equal to the chain width.

20. An actuator according to claim 19, in which said first and second guide surfaces are formed by two strips of low friction material, preferable low friction plastic material such as nylon, that are inserted in said longitudinal housing.

21. An actuator according to claim 19 or 20, wherein said guide rail is formed by a longitudinally extending protrusion on said first or second guide surface.

22. An actuator according to any of claims 1 to 21, in which the output shaft of said motor is substantially parallel with said longitudinal axis.

23. An actuator according to claim 22, in which a reduction gearing is connected to the output shaft of said motor, said reduction gearing, preferably a planetary gearing, having an output shaft that is substantially parallel with said longitudinal axis.

24. An actuator according to claim 23, in which said output shaft of said reduction gearing and said spindle are not concentric, whereby said spindle and said output shaft are mechanically connected by either a flexible shaft, a straight gearing or a double universal joint.

25. An actuator comprising a longitudinal housing provided with a chain exit aperture, a spindle extending in said longitudinal housing, a motor driving directly or indirectly said spindle, a nut in threaded engagement with said spindle, said chain being connected to said nut, said chain extending at least partially in said longitudinal housing and being guided by a guide surface in said longitudinal housing towards said chain exit, said chain being bendable in one plane and said chain being arranged in said housing beside said spindle viewed in a direction parallel to said one plane.

26. An actuator according to claim 25, wherein one end of said chain is connected to said nut and the other end is intended for connection to an object to be moved.

27. An actuator according to claim 25 or 26, wherein said guide surface is curved.

28. An actuator according to any of claims 25 to 27, wherein said chain is guided by at least one guide rail extending parallel to said longitudinal axis and protruding into said chain.

29. An actuator according to claim 28, wherein said nut is guided by at least one guide rail extending parallel to said longitudinal axis and protruding into a groove in said nut.

30. An actuator according to claim 29, wherein said chain and said nut are guided by one and the same guide rail.

31. An actuator according to any of claims 25 to 30, further comprising a first substantially planar guide surface extending parallel with said longitudinal axis and extending substantially perpendicular to the exit direction of said chain, a second substantially planar guide surface extending parallel to said first guide surface, said chain and said nut being arranged between said first guide surface and said second guide surface and the distance between said first guide surface and said second guide surface being substantially equal to the width of said chain and preferably the distance between two parallel side surfaces of said nut is substantially equal to the chain width.

32. An actuator according to claim 31, in which said first and second guide surfaces are formed by two strips

of low friction material, preferable low friction plastic material such as nylon, that are inserted in said longitudinal housing.

33. An actuator according to claim 31 or 32, wherein said guide rail is formed by a longitudinally extending protrusion on said first or second guide surface.

34. An actuator according to any of claims 25 to 33, in which the output shaft of said motor is substantially parallel with said longitudinal axis.

35. An actuator according to claim 34, in which a reduction gearing is connected to the output shaft of said motor, said reduction gearing, preferably a planetary gearing, having an output shaft that is substantially parallel with said longitudinal axis.

36. An actuator according to claim 35, in which said output shaft of said reduction gearing and said spindle are not concentric, whereby said spindle and said output shaft are mechanically connected by either a flexible shaft, a straight gearing or a double universal joint.

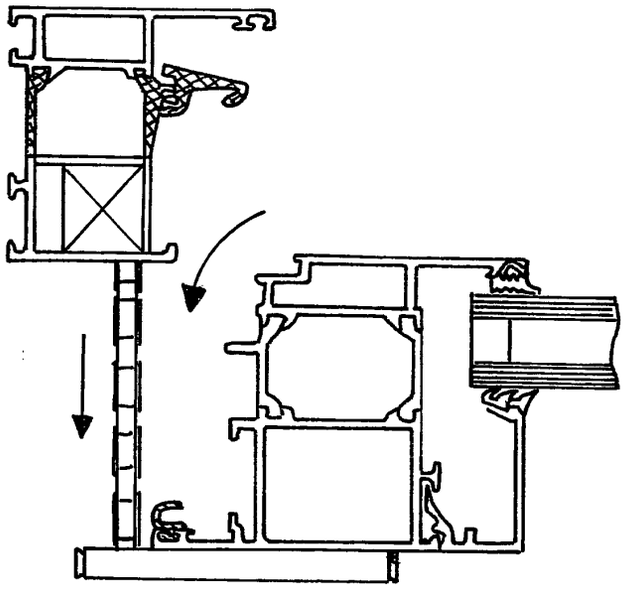


FIG. 1c

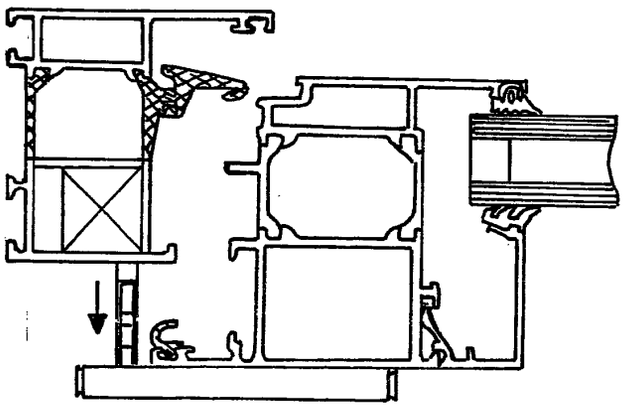


FIG. 1b

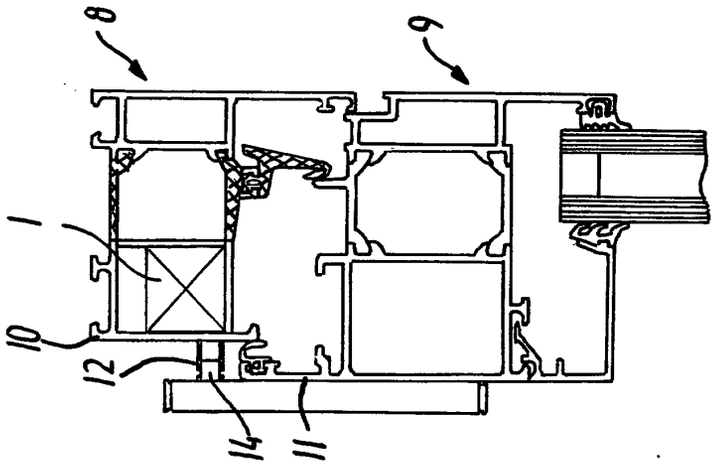
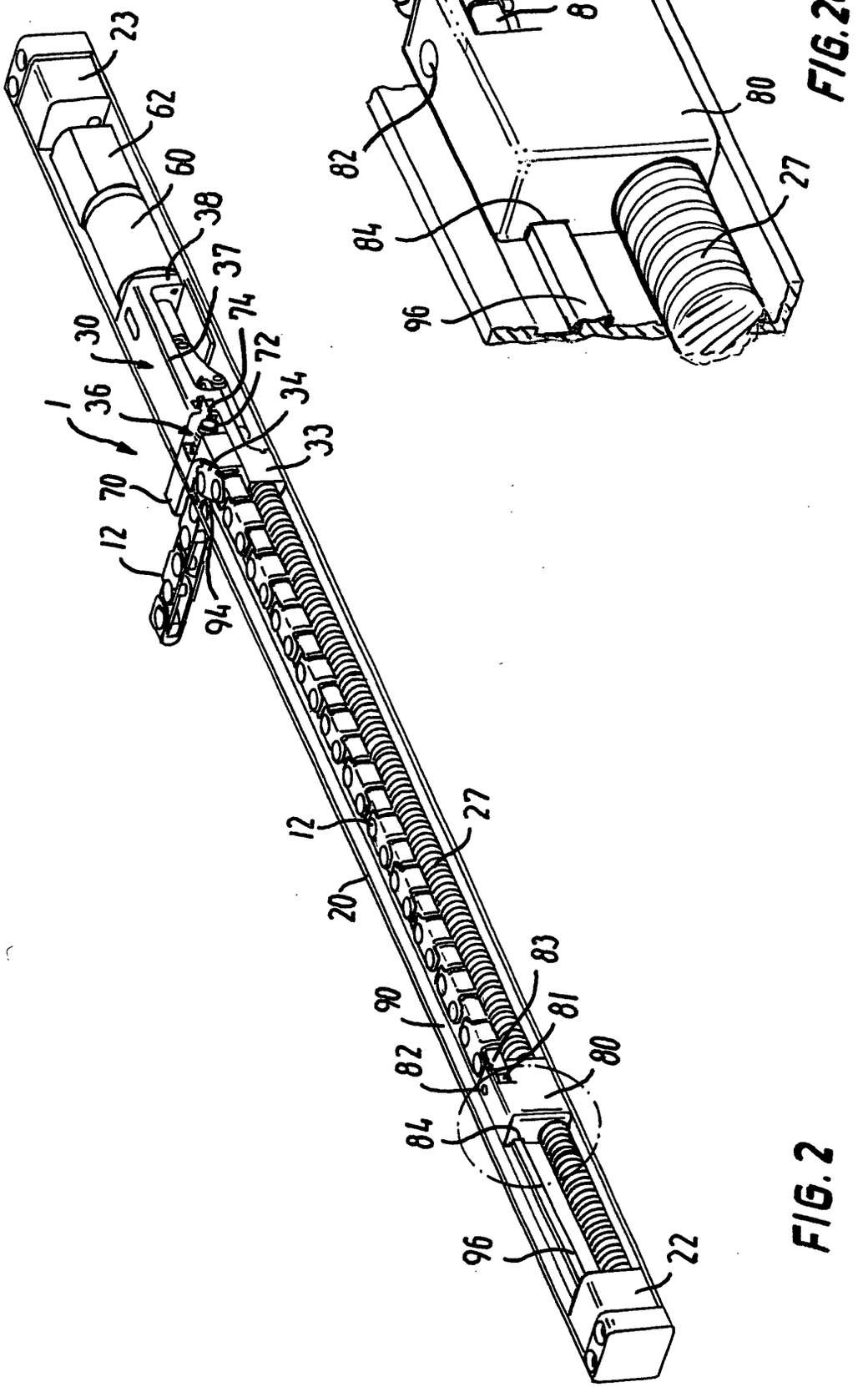


FIG. 1a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84
96
22

FIG.2

81
80
82
27
84
96

FIG.2a

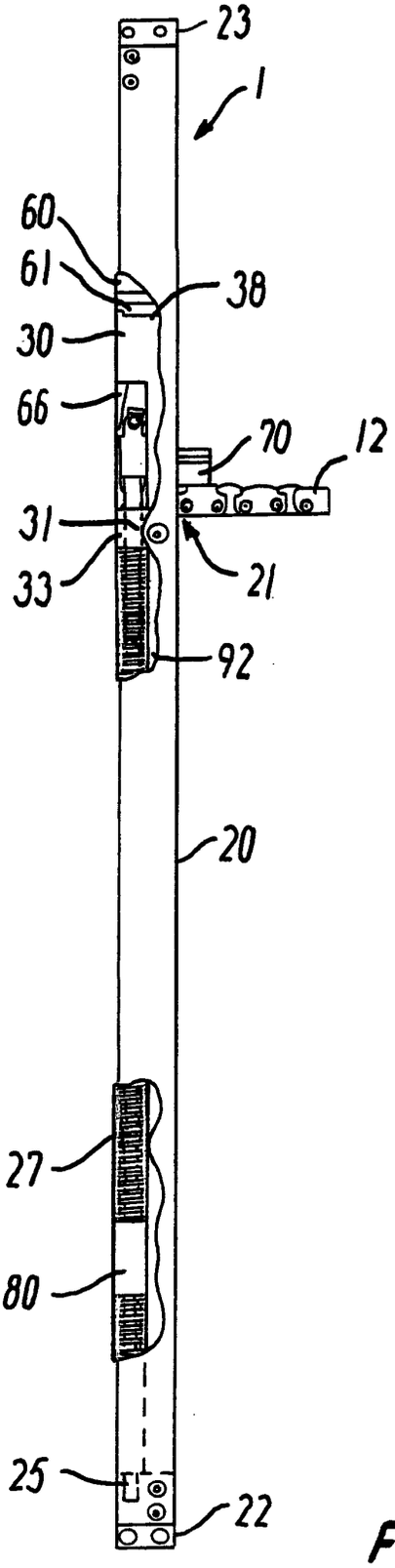

FIG. 3

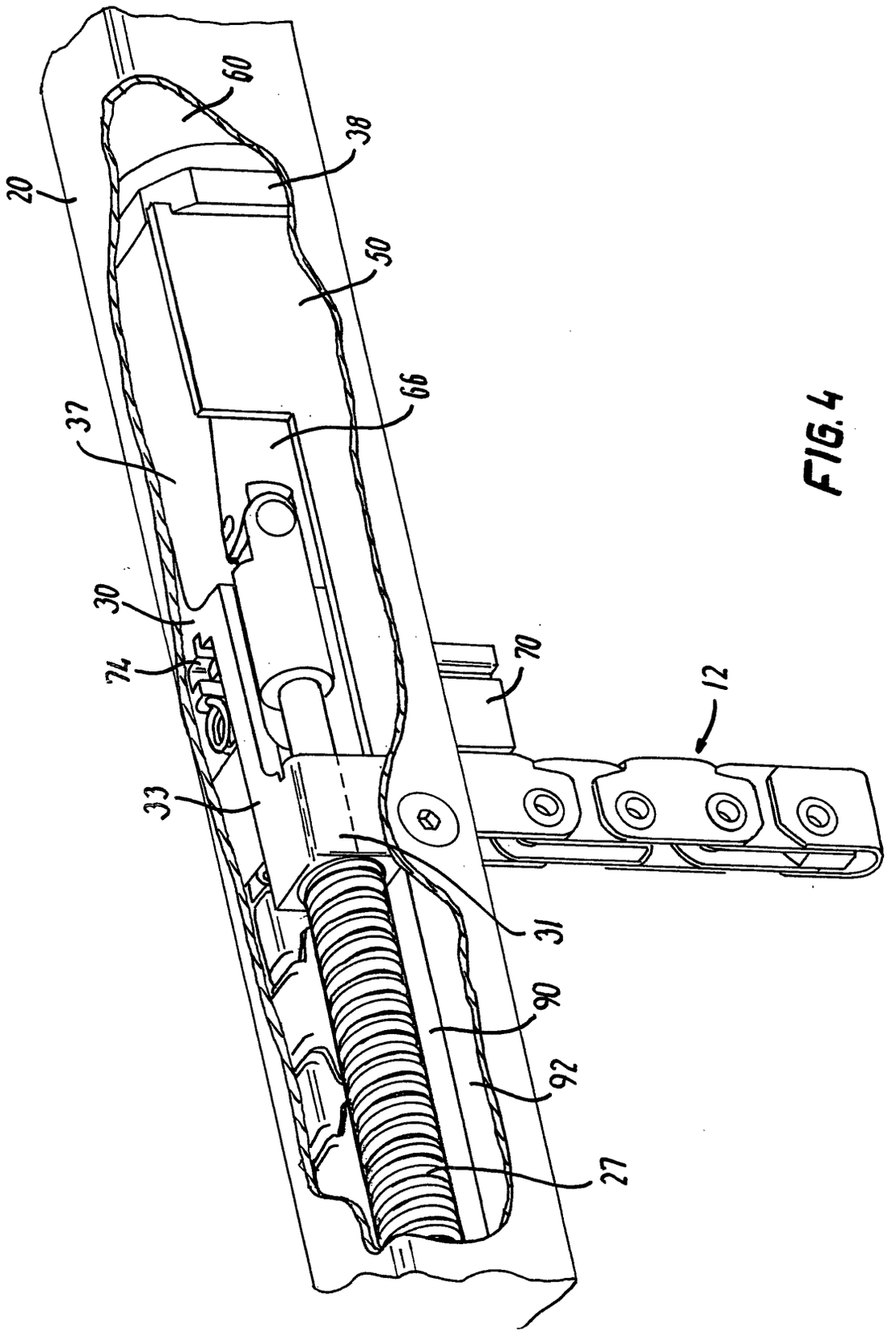

FIG. 4

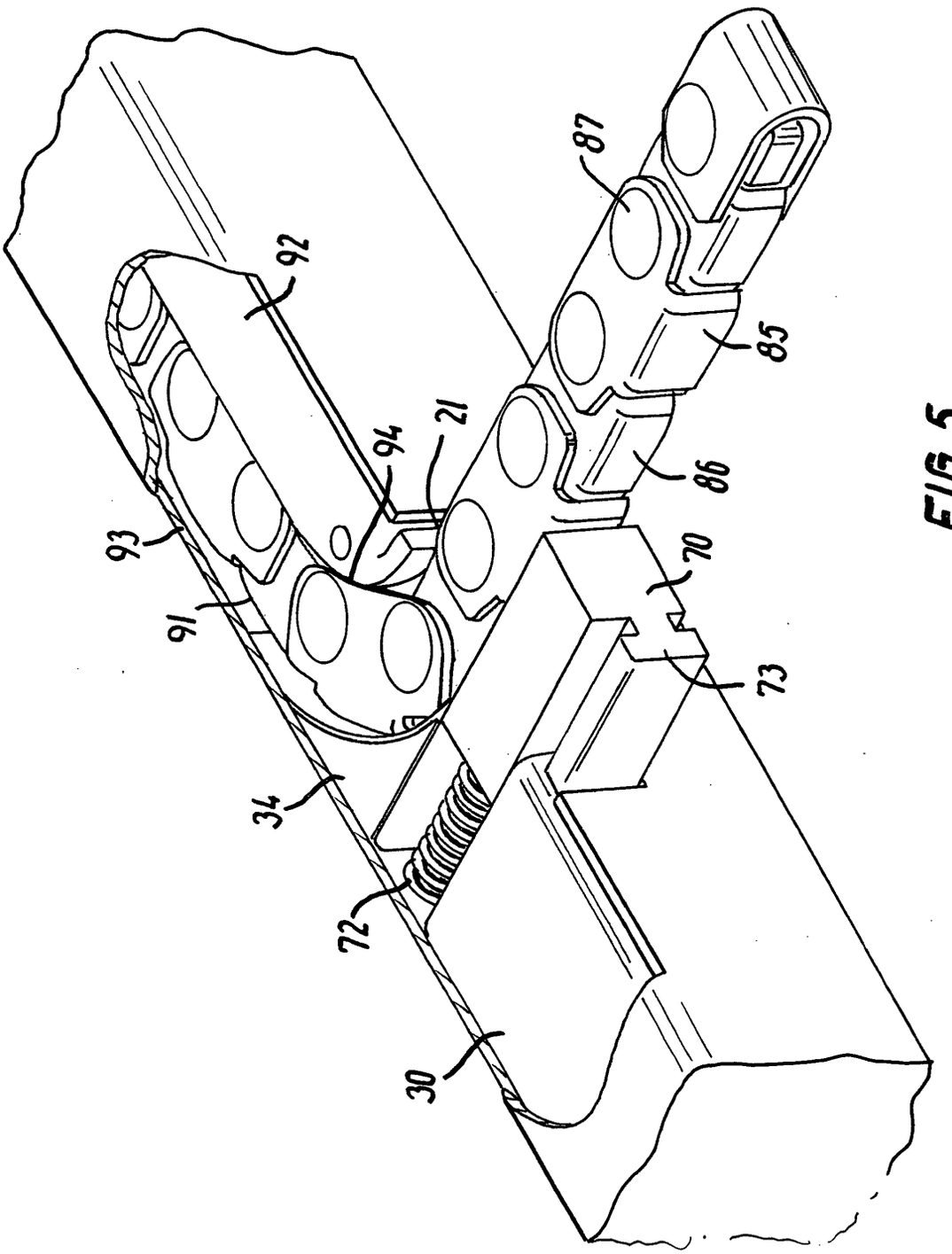

FIG.5

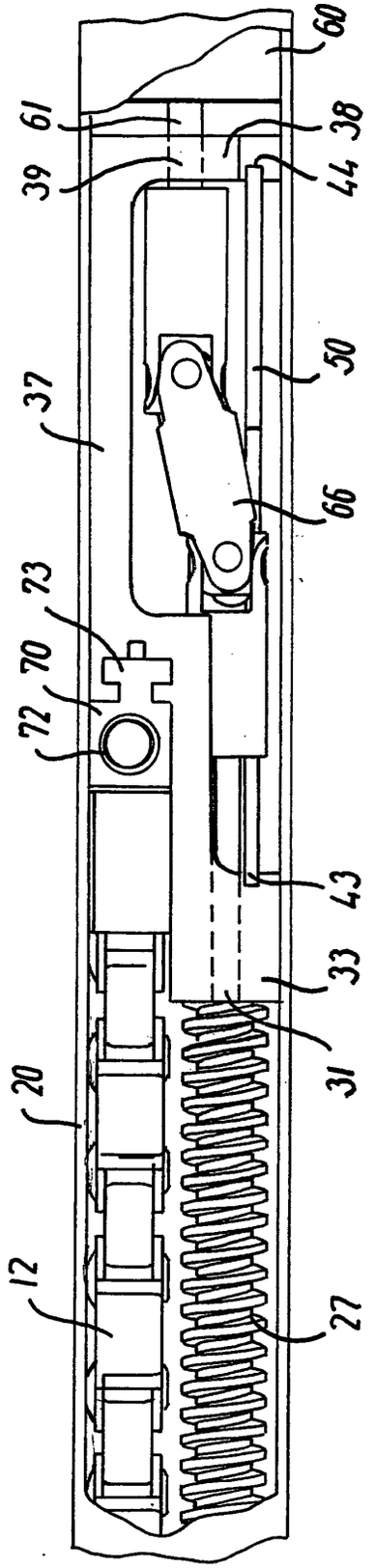

FIG. 6

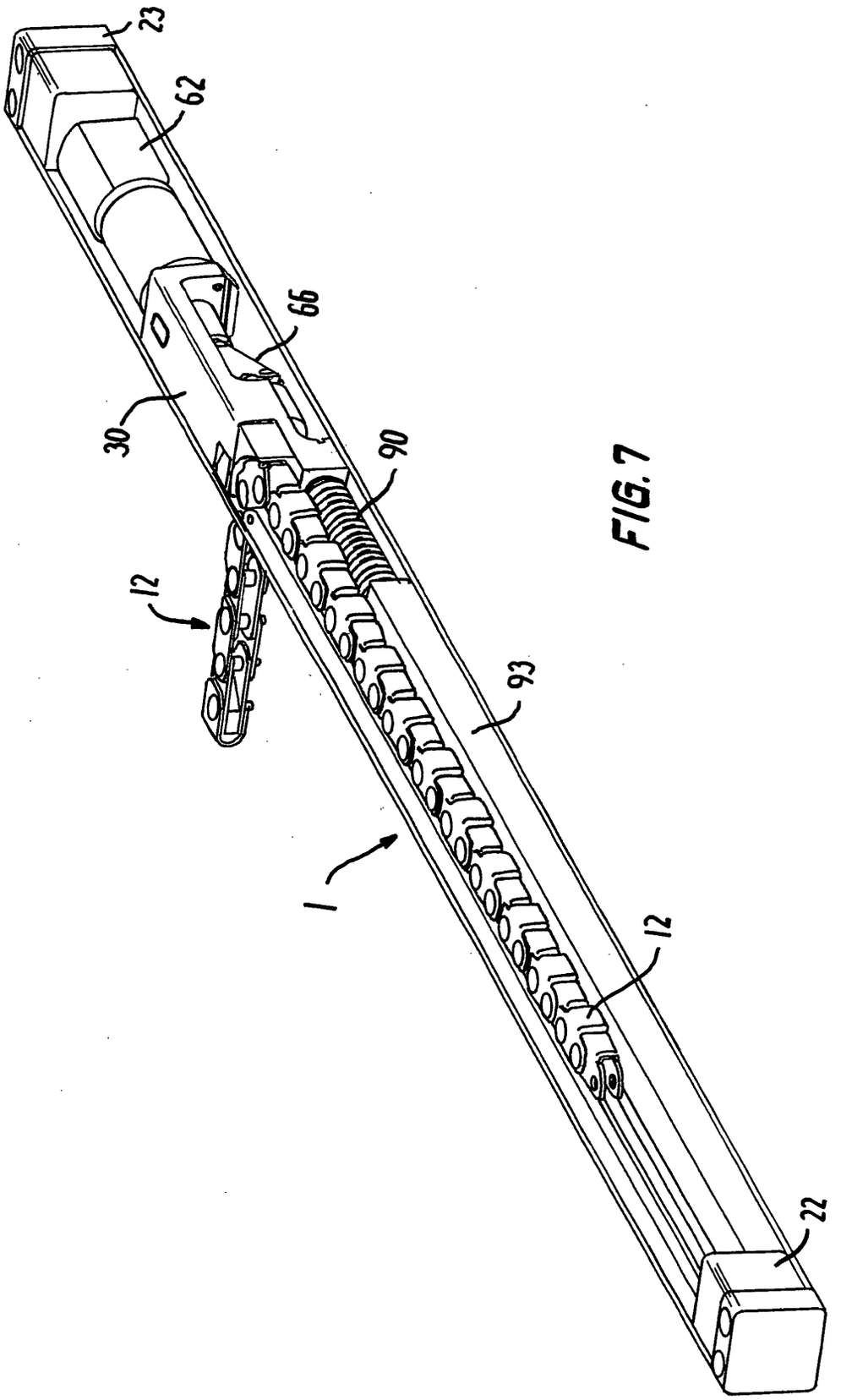

FIG.7

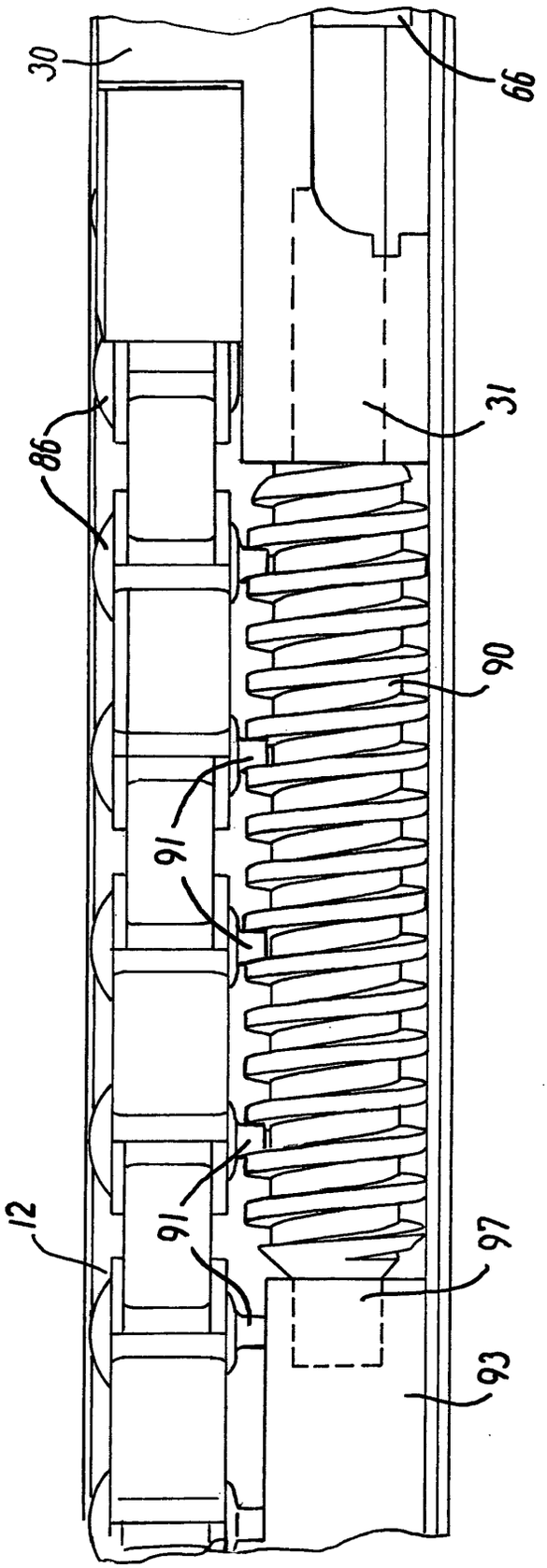

FIG. 8

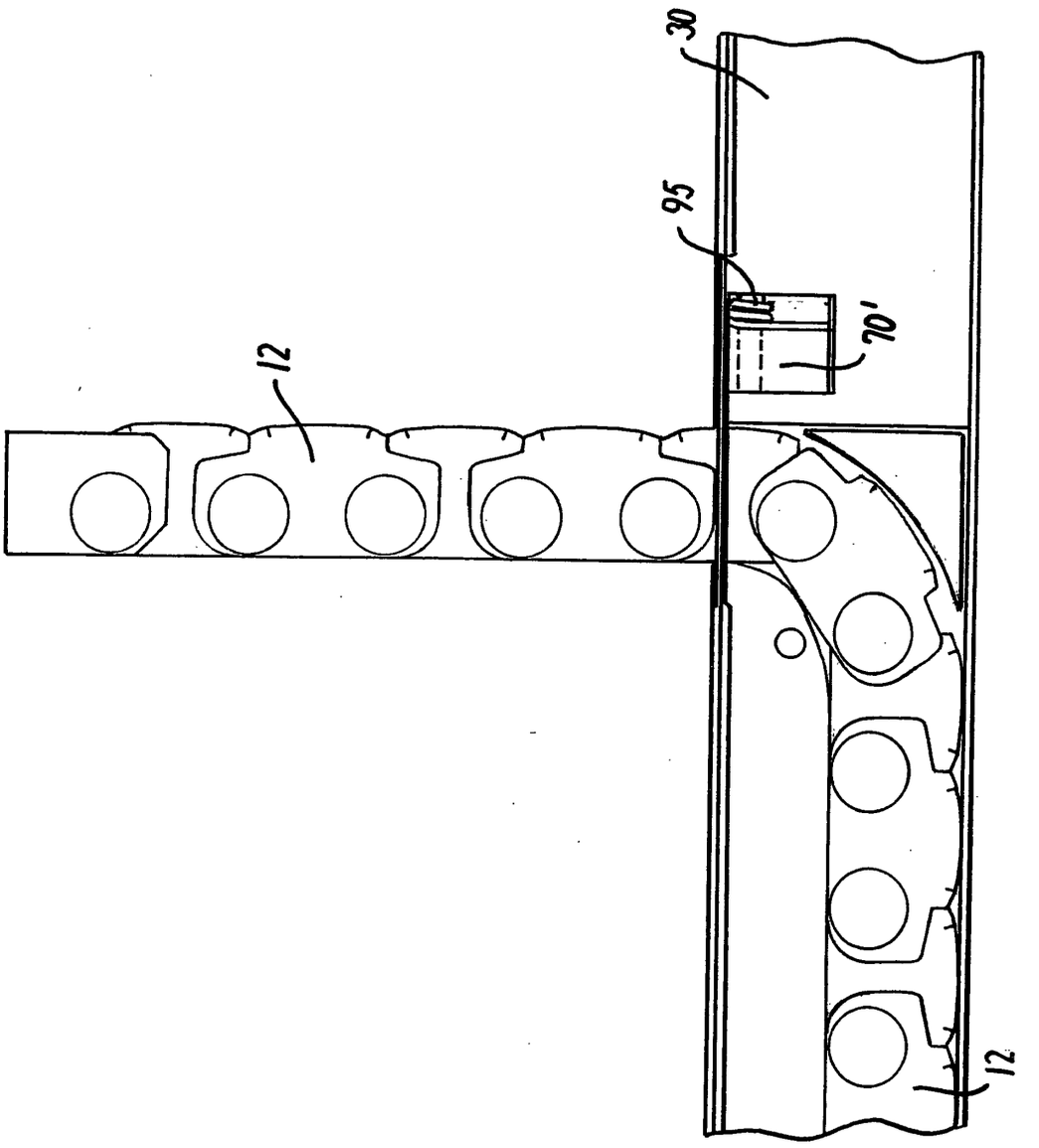

FIG. 9

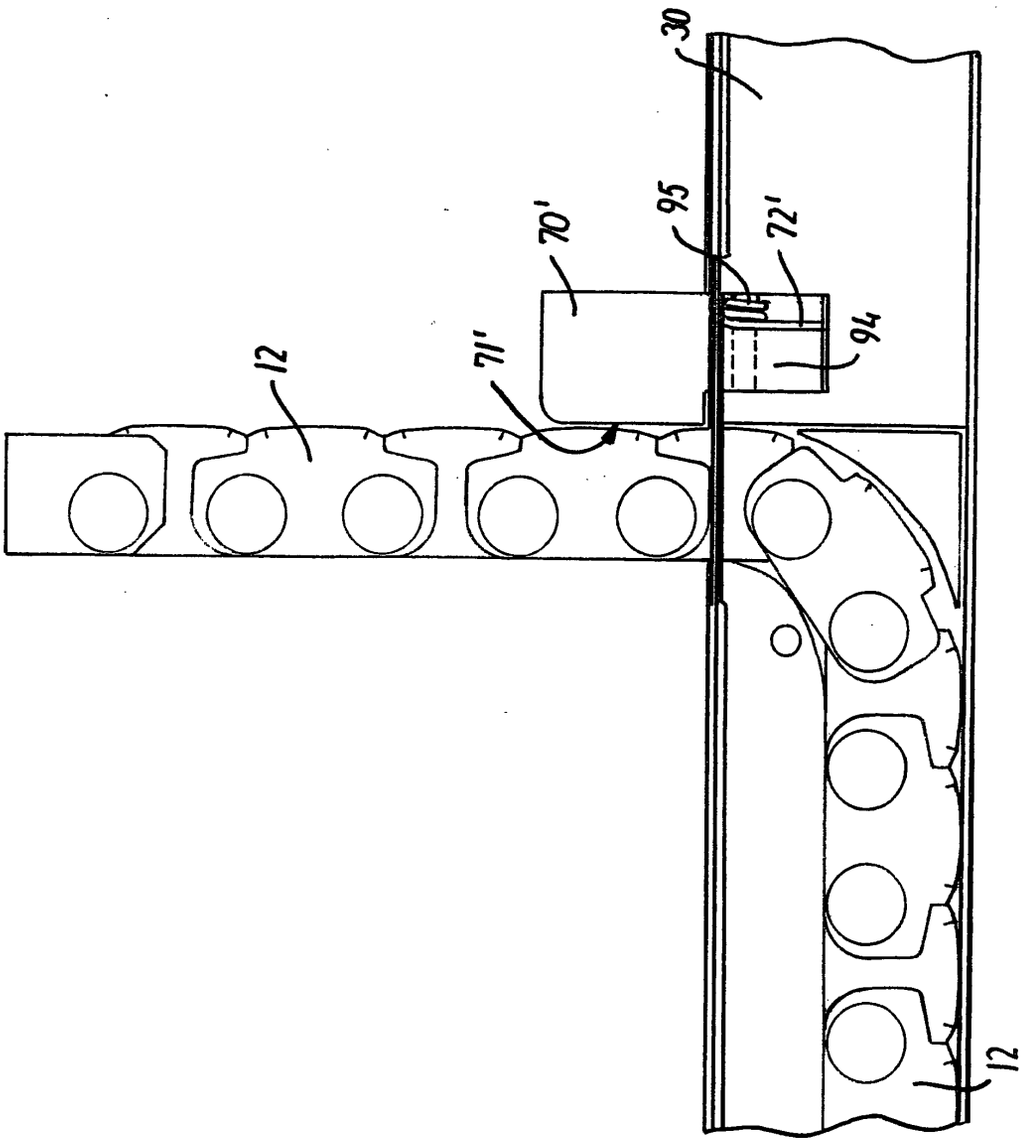

FIG.10

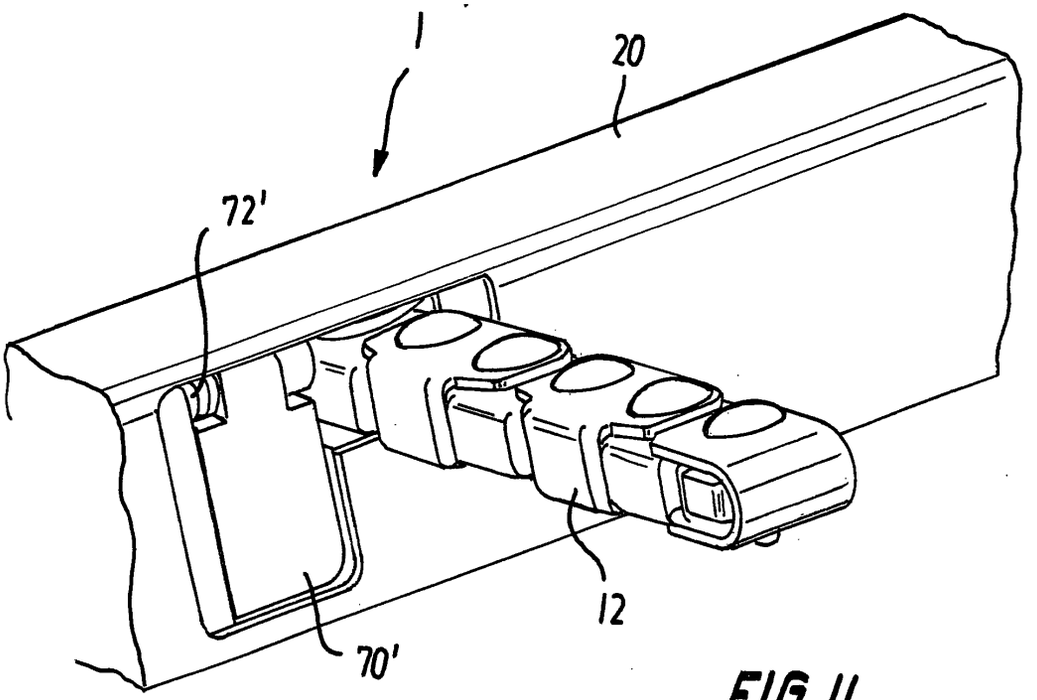

FIG. 11

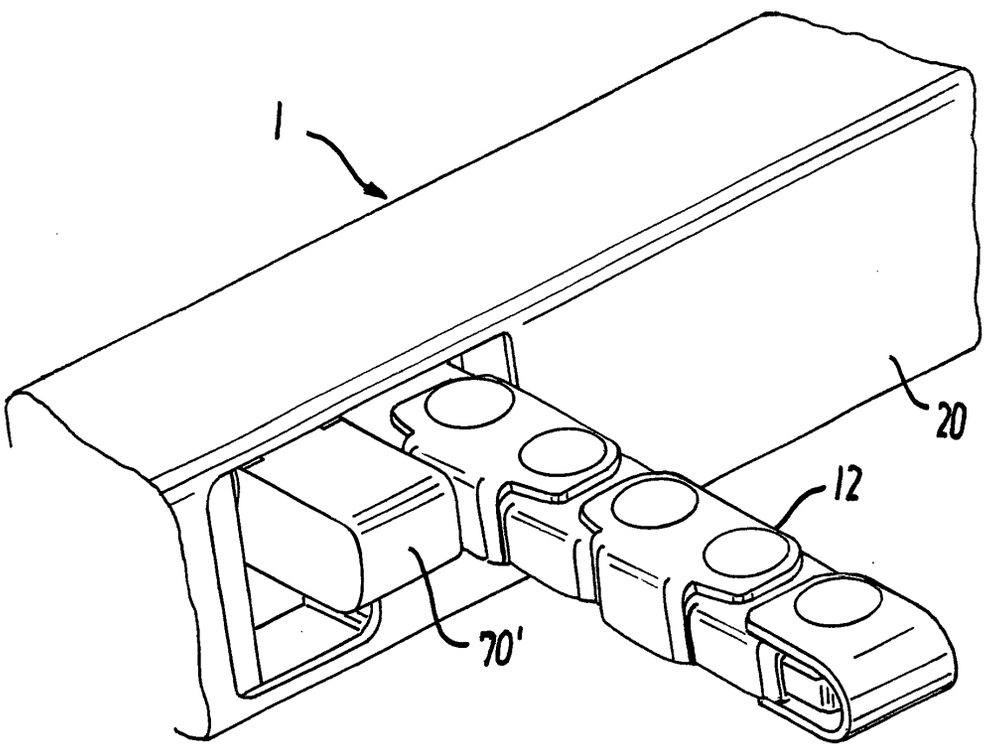

FIG. 12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 00 7883

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 September 2002	Bitton, A

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