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(54) **Method and apparatus for operating a door.**

(57) A power operated canopy type up-and-over garage door comprises an electric motor connected through a high ratio reduction drive and two torque transmitting shafts to the lower ends of the radius or mounting arms of the door. The motor unit applies torque directly between the door itself and the mounting arms whereby the door can be opened and closed under the control of the usual remote control actuating systems.

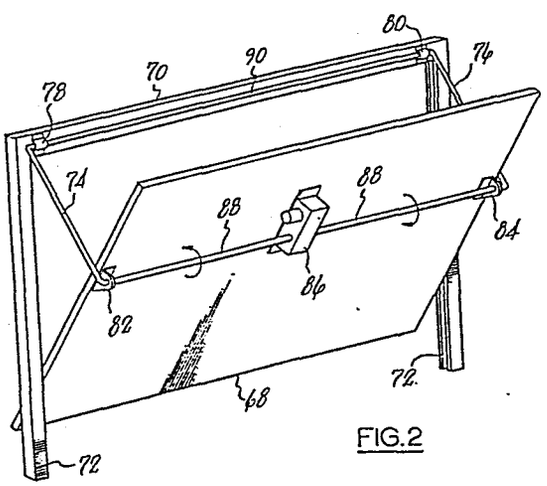

FIG.2

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METHOD AND APPARATUS FOR OPERATING A DOOR

This invention relates to a method and apparatus for operating a door. The invention is particularly but not exclusively applicable to so-called up-and-over doors such as garage doors.

Up-and-over type garage doors consist mainly of two general types. Firstly, there are the so-called "Canopy" doors which employ vertical tracks mounted at each side of the door on the door frame. Such doors comprise, in addition, a pair of mounting arms, or radius arms, which pivotally interconnect the door and the door support. Usually, the radius arms are connected between the top half of the door and the top member of the door frame.

Secondly, there are up-and-over garage doors of the kind comprising horizontal tracks at each side of the door extending rearwards, from the door into the garage, at or in the region of the top of the door. Such "horizontally tracked" doors likewise are provided with mounting arms which pivotally connect the door and its support. In this case, the mounting arms are usually pivotally connected to the door at or near the region of the bottom of the door. In the region of the other end of each mounting arm it is pivotally connected to the door support or frame at a position well up from ground level.

Both canopy doors and horizontally tracked doors usually have a counterbalance mechanism to support at least part

of the weight of the door and assist manual operation of the door. In the case of canopy doors, the counter-balance mechanism is often of the kind comprising a torsion spring operating a pair of drum-like winches which are connected by cables to the door guide members which run in the vertical tracks. In the case of horizontally tracked doors, counterbalancing is often provided by means of a coiled tension spring acting between the door frame at or near ground level and a short extension of each mounting arm.

There is a market requirement for up-and-over type garage doors which incorporate a door operating mechanism of the kind which may, if so desired, be operated by remote control. Such mechanisms enable a returning home owner to open the garage door from within the car by means of a radio or beam or pulse-transmitting control device which signals to the door operating mechanism to open.

Such power-actuated door operating mechanisms of various kinds are well-known, particularly in the United States. There are many mechanisms available for power operating the horizontally tracked type of door, but there are few available for canopy type doors. The basic reason for this arises from the differences in the geometry of the two door mechanisms. Moreover, in both cases, the currently available equipment for power operating such doors is large, comparatively complex and correspondingly expensive. For example, in the case of

horizontally tracked doors, the usual arrangement is to provide a motor mounted on the ceiling or roof of the garage at a point behind the rear end of the track of the door. The motor is connected to the door by a suitable linkage. Installation of such a system involves a significant time cost for the personnel involved, in addition to the original cost of the equipment.

The position is somewhat similar in the case of power operated canopy doors, though in this case the geometry of the door is such as to render power operation even more difficult.

There is thus a need for an improved and/or simplified operating mechanism for such doors. An aim of the present invention is to provide a method and apparatus for operating doors or like closure members which offers improvements in relation to one or more of the above-identified requirements.

According to the invention there is provided a method and apparatus for operating a door or like closure member as defined in the accompanying claims.

The invention also provides any novel method or apparatus step or feature or combination of steps or features as disclosed herein. In this connection it is to be noted that the invention may be provided in the form of a simple kit of parts which may consist of little more than a torque generating device such as a motor and one or more torque-transmitting members to connect the

motor to one or both of the door mounting arms.

In an embodiment of the invention described below a canopy-type up-and-over garage door is mounted on a pair of mounting arms which serve to support the door. The arms are inextensible. The arms are those which serve, with other components, to mount the door and enable it to be used as such without a power operating mechanism. In the embodiment, these mounting arms are connected to a torque-generating mechanism which serves to apply torque between the door and the mounting arms, so as to operate the door. In this way, the door can be power-operated in a very simple manner with a minimum of components since all that is required is to apply the necessary torque between the door and the existing mounting arms. The invention can thus be retro-fitted to existing garage doors in a very simple manner. No additional mounting arms are required. No special separate mounting for the motor is required. Nor is any special track or connection needed between the motor and the door itself.

Embodiments of the inventionwill now be described by way of example with reference to the accompanying drawings in which:

Fig 1 shows a perspective view of a canopy-type up-and-over single garage door of conventional construction;

Fig 2 shows a perspective view of a canopy-type up-and over double garage door incorporating a power operating mechanism according to the invention;

Fig 3 shows an elevation view of a counterbalance mechanism for incorporation in the door operating mechanism of Fig 2; and

Fig 4 shows a diagrammatic side elevation view of a horizontally tracked type up-and-over garage door.

As shown in Fig 1 a single canopy-type up-and-over garage door 10 is mounted on a pair of guides 12, 14 and on a pair of mounting arms 16, 18, also known as radius arms. Guides or tracks 12, 14 are secured to the side-facing surfaces of the timber frame (not shown) of the door. Mounting arms 16, 18 are pivotally connected at their upper ends to brackets 20, 22 fixed to the door frame or to the wall of the garage, on its inner side.

A pair of rollers 24, 26 are mounted, one at each side of door 10, for rotation about a common axis 28. The rollers are received in guides 12, 14 so that the door can freely run up and down the guides.

Likewise, mounting arms 16, 18 are freely pivotal in brackets 20, 22 at their upper ends, and in corresponding brackets 30, 32 on door 10.

In use, this conventional door can be manually moved from a closed position in which it lies between guides 12, 14 in a common vertical plane therewith, to an open position in which rollers 24, 26 are at the top of guides 12, 14 and mounting arms 16, 18 have risen almost to a horizontal position, the door itself being substantially horizontal.

Fig 3 shows a counterbalance mechanism 34 which may be provided in association with the door mechanisms of Figs 1 and 2. The counterbalance mechanism is secured by screws or bolts to the horizontal top frame member of the door frame. Mounting arms 36, 38, corresponding to mounting arms 16, 18, are freely pivotally mounted in brackets 40, 42 in the counterbalance mechanism. The other ends 44, 46 of the mounting arms are pivotally connected to the door as described above.

A torsion spring 48 is connected by shafts 50 at each end to a pair of winch drums 52, 54 of conical form on which cables 56, 58 are wound. Loops 60, 62 at the ends of the cables are engaged around the axles 64, 66 of rollers 24, 26 to apply a lifting force to the door.

In use, torsion spring 48 applies a turning force to winch drums 52, 54 whereby the weight of the door is significantly counterbalanced and raising of the door is assisted. As the door is lowered, energy is stored in the torsion spring for release the next time the door is opened.

Turning now to the embodiment of the invention shown in Fig 2, a double garage door 68 is mounted on a door frame 70 having guides 72 at each side corresponding to guides 12, 14. Rollers (not shown) are received in the guides in a similar manner to the rollers 24, 26 of Fig 1.

Mounting arms 74, 76 are likewise provided corresponding to the mounting arms 16, 18. The mounting arms are

pivotally connected to door frame 70 by means of brackets 78, 80. Likewise, corresponding brackets 82, 84 are provided on door 68 to pivotally connect the door to the other ends of the mounting arms.

Door 68 is provided with a counterbalancing mechanism (not shown) constructed and arranged substantially as described above with reference to Fig 3.

For power operation of door 68 there is provided a torque generating mechanism in the form of a motor and gearbox assembly 86 which is fixed to door 68 and connected by a torque transmitting member in the form of a torque shaft 88 to the ends of mounting arms 74, 76.

Torque shaft 88 is, in this embodiment, welded to the ends of mounting arm 74, 76 and coupled to motor and gearbox assembly 86 so that a torque can be applied between door 68 and the torque shaft. It is this torque which causes the door to be opened and closed.

In this embodiment, the upper ends of the mounting arms 74, 76 are likewise structurally interconnected by a shaft 90 so that the arms 74, 76 and the shafts 88, 90 form a stiff rectangular member. This arrangement has benefits in terms of structural integrity but is by no means essential.

The torque generating mechanism constituted by motor and gearbox assembly 86 comprises a conventional 12 volt electric motor in association with a gear train comprising four pairs of meshing gears providing a reduction ratio of

approximately 1000 to 1 between the motor and torque shaft 88.

In order to disconnect the drive between the motor and shaft 88, there is provided a key operated mechanism (not shown) which cooperates with one of the gears of the gear train. This particular gear is mounted to be axially shiftable to a position in which it is out of mesh with one of its associated gears so as to interrupt the drive. In this way, in the event of failure of the power operating mechanism, by means of a key operated device the mechanism can be freed so that the door can be manually raised or lowered. Otherwise, when the drive is fully connected, the door is effectively locked without the provision of a latch or the like. The high ratio drive provided between the torque shaft and the motor effectively has the result of locking the door in the position in which it stops, for example the closed position. Moreover, it is arranged that when the door stops in the closed position, it stops in a condition in which a small closing force is maintained on it so that it does not rattle.

In association with the motor and gearbox assembly of Fig 2 there is provided an electrical control system providing the following functions:

1 The provision of a low voltage supply to the motor;

2 The monitoring of the electrical power consumption

of the motor to provide an indication of such occurrences as the door reaching the end of its travel or engaging an obstruction;

3 The monitoring of the sequence of door movements so that at any given stage in door movement, the next movement is that which is appropriate to the circumstances.

The electrical control circuit comprises integrated circuits or the like to provide the necessary monitoring and control functions. A predetermined upper limit is set in relation to power consumption by the motor. This limit is exceeded at the ends of the door travel and when the door encounters an obstruction. In the case where an obstruction is encountered, the motor is signalled to stop. If the door is opening, then no further movement occurs for the time being. If the door is in the process of closing, after stopping the arrangement is such that the door begins to open again to release the obstruction. In the case of the door reaching the ends of its travel, limit switches provide signals to the control circuit to indicate that it is a limiting condition which has been reached and the door can remain in this position until it is next signalled by the user to open or close.

Any suitable system may be provided for actuating the door operating mechanism by remote control and no further disclosure of such means is believed to be necessary.

Among the advantages provided by the above-described embodiment of the invention are the following.

Firstly, the power operating mechanism of the door is simple, easily mounted on the door, and comprises very few components. Secondly, the power operating mechanism can be mounted on existing doors as a retro-fit in a simple manner - all that is required is to bolt the motor assembly to the door and connect it to the ends of the two mounting arms. After that, all that is needed is the electrical connection between the motor and its control circuit. As a result of the simplicity of the mechanism, it is correspondingly inexpensive to manufacture. Furthermore, no additional mounting arrangements are needed, such as additional mounting arms for the door, or the like.

Among modifications which could be made in the above described embodiment are the following:

1 Use of different types of torque generating mechanism. For example, other sources of power could be provided such as hydraulic, pneumatic, or even stored energy mechanical systems. Combinations of such systems may likewise be provided.

2 Variations in the arrangement of the mounting arms and the connection of the door to its supports.

3 Considerable variation in the structure and arrangement of the counterbalance system may be provided.

4 The torque generating device need not be connected to both mounting arms. It could be connected just to one of them, and in that case might be provided at one side of the door. In either case, the door itself

would need to be stiffened significantly.

Many variations may be provided in the method of connecting the motor assembly to the mounting arms for the transmission of torque.

Fig 4 shows, diagrammatically, a horizontally tracked door arrangement to which the invention may be applied. In Fig 4 there is shown a door 92 in three positions:

A: One third open

B: Two thirds open

C: Fully open

Door 92 comprises a pair of mounting arms 94, 96, one at each side of the door, pivotally connected at 98 to the door and at 100 to the door frame. The door is mounted by rollers (not shown) on a horizontal track 102 in a manner similar to that of Fig 1, but the rollers are provided at the top/rear end of the door. A tension spring 104 is provided for each mounting arm and connected between the inner end of the arm and the lower end of the door frame 106.

For power-operating purposes, a torque generating assembly substantially similar to motor and gearbox assembly 86 is provided (not shown) and connected by a torque shaft (not shown) to the ends of mounting arms 94, 96 in a very similar way to that of Fig 2. The motor assembly is secured to the door, near the bottom of the door and torque is transmitted to the mounting arms as in the Fig 2 embodiment and the whole assembly operates

in a substantially similar manner to that of the embodiment of Fig 2.

Further modifications which can be made in the above embodiments without departing from the scope of the invention include the following. Firstly, the invention may be applied to other types of up-and-over doors, such as doors which are not strictly 'canopy' doors where the guide rollers are located near the bottom of the door and there is little or no overhang in the raised position of the door. Secondly, other counterbalance systems may be employed including those using tension springs or weights connected by cables or pulleys to the door. Non-conical winch drums may be employed, driven by torsion springs. Thirdly, locking means for the doors may be provided in the form of brake means for the motor unit, or a movable stop to engage an abutment on one of the gears. Alternatively, a non-reversible drive such as a worm drive may be employed for the same purpose. Also, other signalling devices may be used in place of the limit switches to indicate when the door reaches the region of the ends of its travel.

CLAIMS:

1 An operating mechanism for a door or like closure member having a mounting arm pivotally interconnecting the door and a support therefor, characterised by a torque generating mechanism to be mounted on the door and connected to the mounting arm, the torque generating mechanism being actuatable to apply torque between the door and the mounting arm to operate the door.

2 A mechanism according to claim 1 characterised in that a mounting arm is provided at each side of the door, the mounting arms both pivotally interconnecting the door and a support therefor, the ends of the mounting arms which are connected to the door being interconnected by a torsion transmitting member extending across the width of the door, and the torque generating mechanism being connected to the torsion transmitting member.

3 A mechanism according to claim 2 characterised in that the axes of the pivotal connections between the mounting arms and the door are offset rearwards (when the door is in its vertical position) from the plane of the door.

4 A mechanism according to claim 3 characterised in that vertical guides or tracks are provided at the sides of the door and guide members on the door cooperate

with said guides or tracks, the guide members on the door being located below the pivotal connection of the mounting arms to the door, in the closed position of the door.

5 A mechanism according to claim 1 characterised in that said torque generating mechanism comprises an electric motor and a gear train, the gear train comprising at least two pairs of gears providing torque increase.

6 A mechanism according to claim 5 characterised in that at least one of the gears of said gear train is axially shiftable out of mesh by means of a key operated mechanism to release the drive provided by said torque generating mechanism.

7 A mechanism according to claim 1 characterised in that said torque generating mechanism comprises an electric motor, and an electrical control circuit is provided comprising power monitoring means for monitoring the electrical power consumption of the motor, and sequence monitoring means to monitor the progress of the door through its available sequence of movements, the control circuit being operable to stop the motor upon a predetermined power limit being exceeded and thereupon to respond in at least two different ways according to the stage in said sequence of movements which has been reached by the door.

8 A mechanism according to any one of the preceding claims characterised by the provision of counterbalance means to offset the weight of the door.

9 A method of operating a door or like closure member characterised by the step of actuating a torque generating mechanism mounted on the door to apply torque between the door and a mounting arm pivotally interconnecting the door and a support therefor.

10 A method according to claim 9 characterised in that said torque generating mechanism comprises an electric motor, the method further comprising the step of monitoring the electrical power consumption of the motor, monitoring the progress of the door through its available sequence of movements, and signalling to the motor to stop upon a predetermined power limit being exceeded and thereupon signalling to the motor to respond in either of at least two different ways according to the stage in said sequence of movements which has been reached by the door.

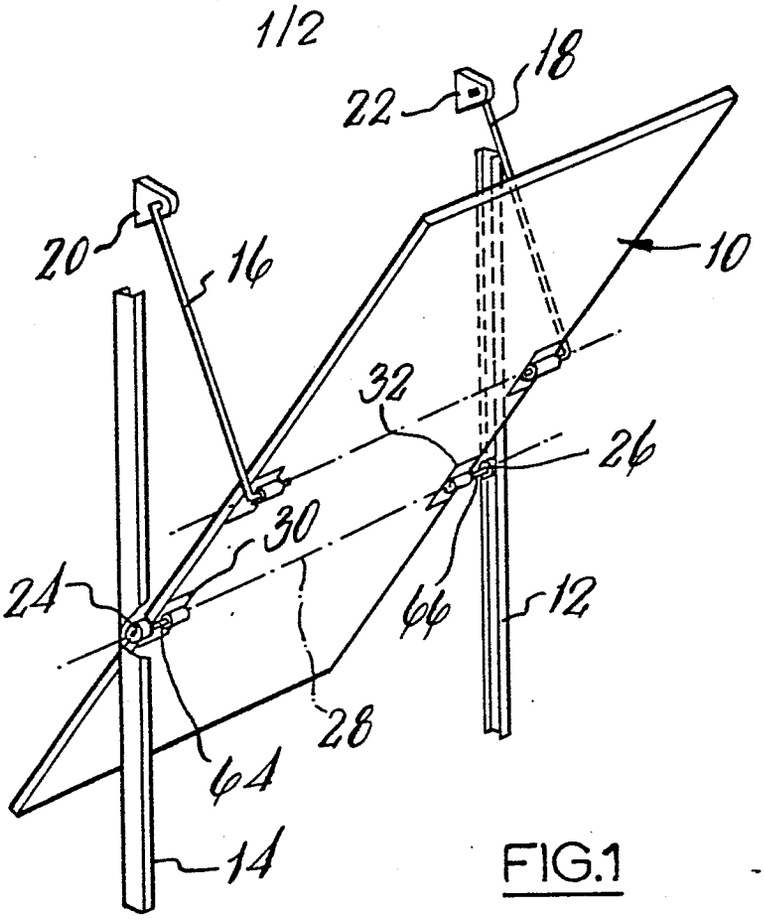

FIG.1

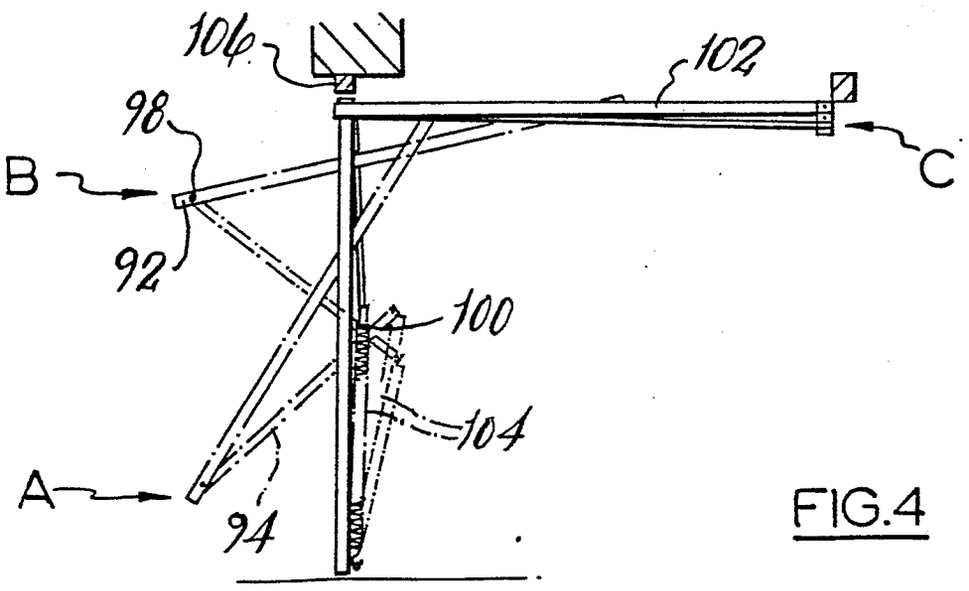

FIG.4

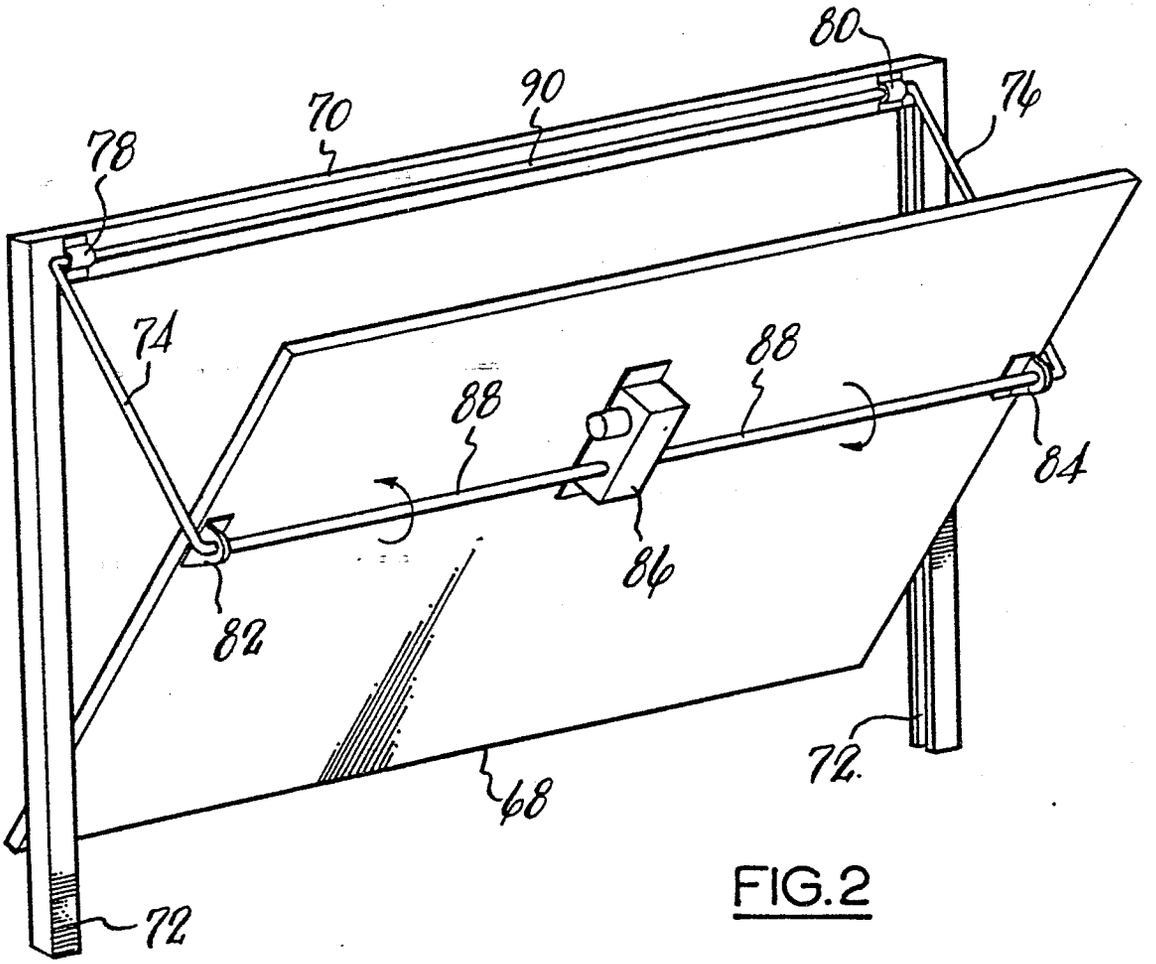
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FIG.2

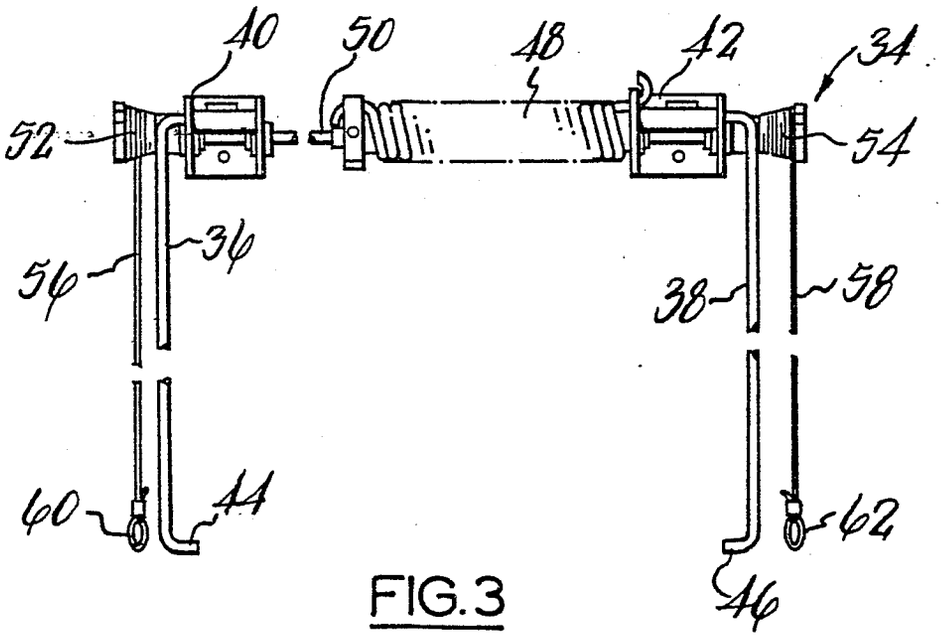
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FIG.3