

12 **EUROPEAN PATENT APPLICATION**

21 Application number: 86300529.4

51 Int. Cl.4: E05F 15/10

22 Date of filing: 27.01.86

30 Priority: 01.02.85 GB 8502659

43 Date of publication of application:  
06.08.86 Bulletin 86/32

84 Designated Contracting States:  
AT BE CH DE FR GB IT LI LU NL SE

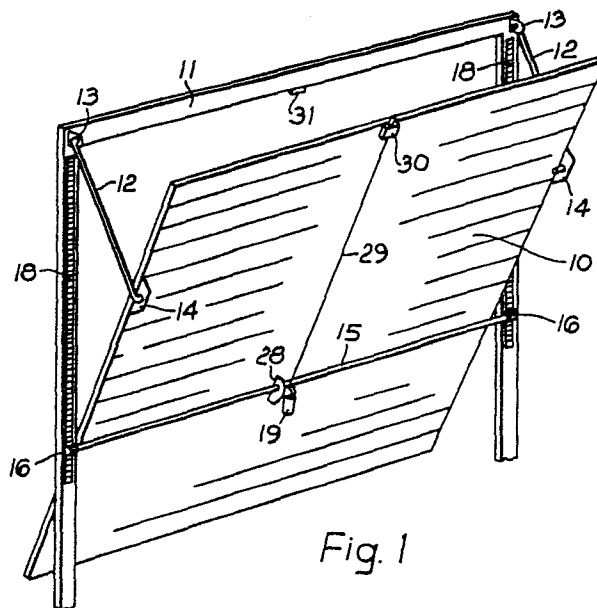
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54 **Operating mechanism for an up-and-over door.**

57 An operating mechanism for an up-and-over door comprises a rotary guide member (16) pivotally mounted at or upon a side of the door (10), a linear trackway (18) positively engaging the rotary guide member (16), and drive means (19) mounted upon the door (10) to rotate the rotary guide member (16) and thereby move it along the trackway (18). In an illustrated embodiment, two rotary guide members in the form of pinions (16) are located at opposite ends of a shaft (15) rotated by an electric motor (19) on the door and engage two linear racks (18).



EP 0 190 025 A2

## OPERATING MECHANISM FOR AN UP-AND-OVER DOOR

The invention is an operating mechanism for a door of the type known as an up-and-over door. Such doors are widely used for domestic garages and in a range of industrial settings.

Up-and-over doors are doors which, in opening, move from a normal closed vertical position upwards and rearwards into a generally horizontal open position. Such movement from one position to the other entails two components of movement, namely a pivoting movement of the door about a pivot point on the side of the door and a linear movement of the pivot point along a vertical or horizontal path.

Thus the so-called "retractable" doors usually feature rollers mounted at the sides of the door at a point near the door top, which rollers are guided in horizontal tracks extending rearwardly from near the top of the door opening. The door then pivots about the rollers as the rollers move along the track. The other popular type of up-and-over door is the so-called "canopy" door, which word refers to the short projecting over-hang of the door forwards of the doorway when the door is in its open position. Canopy doors are usually guided by rollers running in vertical tracks, located at the sides of the doorway, the rollers usually being disposed in the lower half of the door sides (relative to the closed position of the door). The canopy door pivots about the rollers as they move up and down along the vertical track.

Up-and-over doors are usually counter-balanced in some way to make manual operation of the doors less strenuous. More recently, there has been a growing demand for automatically opening doors. Such automatic doors may, for example, be operated by motor-driven mechanisms linked to the door. However the practical problem of transmitting the drive to the moving door in this manner has led to the development of a variety of complicated operating systems.

It is therefore an object of the present invention to provide an operating mechanism for up-and-over doors which is more simple than most prior such mechanisms and which is directly mounted upon the door, thus enabling a reduction in the torque required to operate the door as compared with many prior mechanisms.

The operating mechanism according to the present invention comprises at least one rotary guide member pivotally mounted at or upon a side of the door, a linear trackway positively engaging the rotary guide member, and drive means mounted upon the door to rotate said guide member and thereby effect linear movement of said guide member along said trackway.

Because the mechanism according to the present invention operates by means of a rotary member engaging a linear track, it is readily applied to up-and-over doors of both the retractable and canopy types. Indeed it can be applied to existing such doors by appropriate modification of the conventional roller and trackway systems. Because the drive is mounted upon the door, the problems of complicated transmission mechanisms are avoided. And also as a direct consequence of providing the drive at the point about which the pivotal component of movement of the door takes place, the effort required to move the door from its open to its closed position and vice versa is minimised.

The invention includes operating mechanisms having only one rotary guide member, or two such members only one of which is driven, but it is strongly preferred that the mechanism should comprise two rotary guide members, one at each side of the door, and two associated linear track-

ways, and that both of the rotary guide members should be driven by the drive means. For convenience, references hereinafter to the rotary guide member will be in the plural but as indicated, the invention is not to be limited thereby.

The rotary guide members may be wheels or rollers and must positively engage the associated trackways, that is it is not sufficient for them to be merely guided by them. Thus either the rotary guide members or the trackways or both may have friction-enhancing surfaces so that rotation of the guide members advances the guide members along the trackways. However, it is strongly preferred that a more positive engagement be achieved and this is best attained by providing ribs or teeth on the rotary guide members, to engage corresponding features of the trackways. For example, the guide members may be in the form of pinions or ribbed rollers and the trackways may be linear racks engaged thereby; or the guide members may be sprocket wheels engaging trackways in the form of chains; or in yet another form, the trackways may be lengths of toothed belting engaging appropriately profiled rotary guide members.

The drive means to rotate the rotary guide members may conveniently take the form of an electric motor, which may drive the rotary members directly but preferably works through a suitable reduction gearing. However because the drive is applied to the door at the point about which the door pivots, the effort required to operate the door is less than conventionally required and therefore relatively modest reduction ratios, for example of the order of 50 to 1, are all that are necessary. The drive may be transmitted to the rotary guide members by rotating a common spindle upon which both guide members are mounted at its opposite ends. Alternatively, especially when the operating mechanism is produced by modifying an existing door-and-rollers installation, a flexible drive may link the motor to the guide members.

If the door is supported upon arms in the manner conventionally used for up-and-over doors for domestic garages, for example, then the geometry of the system comprising the door and its support arms may be such that the door, when closed, is slightly biased towards its closed position. If the door is intended to be opened automatically by means of an operating mechanism according to the present invention, it is preferred that the geometry of the system be modified so as to avoid that bias of the conventional system. This modifying may simply entail extending the bracket by means of which the support arms are pivotally attached to the door, with the result that the points of pivotal attachment are displaced a short distance away from the door. If, on the other hand, it is wished to avoid modifying the geometry of the door support system in such a way, then it is necessary to rotate the door through a small angle before the drive transmitted by the rotary guide members can take effect, in the opening direction of door movement. This small rotation may be effected, for example, by a compression spring so located as to push the upper or lower edge of the door when a door-retaining latch is released. A preferred arrangement achieves this same result by means of the drive system.

In this preferred arrangement, the rotary guide members are mounted at the opposite ends of a drive shaft which passes rectilinearly across the door and is driven by a motor mounted directly upon the door. Guideways or cams are then provided upon the door, with corresponding followers upon the doorway frame, such that linear movement of the door along the trackways (that is, lifting of the

door) is initially prevented. When the motor is energised but the door is initially unable to move, a reactive force in the drive shaft causes the door to rotate sufficiently to clear the followers and the lifting of the door by the cooperation of the guide members and trackways can proceed normally. Alternatively, the guideways or cams may be mounted upon the doorway frame, to cooperate with followers projecting from the door.

When the door is in its closed position, for security reasons it will usually be secured by a suitable latch. If the door operating mechanism is to be truly automatic, as opposed to simply affording powered assistance to a manual operation, then the mechanism will also incorporate some form of delatching system. For example, activating the drive means may operate a solenoid which thereby releases the latch. However the delatching may also be achieved by a modification of the preferred drive arrangement described above. In this modification, the drive motor is mounted upon the door in such a way as to allow a limited pivoting of the motor about the drive shaft. Then when the motor is initially energised, the motor pivots through a small angle and this action may bring about the delatching via a rigid or flexible link connecting the motor to a spring-loaded latch.

The drive motor may be activated manually, for example by a push-button on the door or doorway frame or in some secure position remote therefrom, or by a remote control system, for example an infra-red or radio-frequency control system such as may be carried by the user. Whichever such system is used, a manual over-ride arrangement to disconnect the electrical drive is preferably provided, so that if the door mechanism is rendered inoperable by mechanical or power failure, the door can still be opened manually. Such disconnecting arrangement may be automatically reversible so that the drive is reconnected when the disconnecting force is removed, or may be automatically reversed by restoration of the power supply, or provision may be made for reconnecting the drive manually.

It should be noted that, because in many embodiments of the present invention the door is operated by an electric motor via a worm drive, there is a built-in resistance to opening of the door when power is not being applied. Thus the mechanism inherently affords additional security against unauthorised opening of the door. From this standpoint, it is preferred that any arrangement for manually disconnecting the drive be located in a secure position, for example inside the garage if the garage has an alternative entrance.

The invention will now be further described by reference to the accompanying drawings, wherein:

Fig. 1 is a perspective view of a canopy type of up-and-over garage door, fitted with an operating mechanism according to the present invention;

Fig. 2 is a front elevation in enlarged detail of a rotary guide member and trackway of the operating mechanism of Fig. 1; and

Fig. 3 is a perspective view in enlarged detail of the drive motor and mounting therefor of the operating mechanism of Fig. 1.

Referring firstly to Fig. 1 of the drawings, a canopy door 10 is mounted within a doorway frame 11 upon support arms 12, 12 pivotally attached to support brackets 13, 13 on the frame 11 and to the door 10 at 14, 14. The pivot points 14, 14 are slightly displaced rearwardly away

from the plane of the door. The door 10 carries a transverse shaft 15 having pinions 16, 16 fixedly secured at its two ends. The door is free to pivot about the shaft 15 as it opens and closes.

Additional support for the door, to afford some counterbalance to its weight and make its operation easier, is provided in the form of cables 17 (one of which is visible in Fig. 2), which encircle the shaft 15 adjacent to the pinion 16 and are tensioned by an elongated coil spring (not shown) extending along the top of the doorway frame 11.

Extending vertically down an upper length of the sides of the frame 11 are racks 18, 18 engaged by the pinions 16, 16. In the illustrated preferred embodiment the racks and pinions are both made of nylon. However, if desired, either or both of these components may be made of metal, for example aluminium.

The shaft 15 is driven by an electric motor 19 through gearing (not shown) giving a reduction ratio of 55:1. The motor 19 is mounted upon the rear of the door 10 in a manner described in more detail hereinafter. As will be apparent from Fig. 1, rotation of the shaft 15 by the motor 19 causes the pinions 16, 16 to move along the respective racks 18, 18 and either open or close the door 10, depending upon the direction of rotation of the shaft.

The operation of one pinion 16 is shown in more detail in Fig. 2 of the drawings. The shaft 15 is guided by a bush 20 carried by a bracket 21 secured to the door 10. The free end of the shaft 15 carries a freely-rotating roller 22, retained behind a flange 23 of a channel section 24 mounted on the doorway frame 11 parallel to the rack 18. Thus the roller 22 assists in keeping the pinion 16 in engagement with the rack 18. Lateral swing of the door 10 during operation is restricted by a shoulder or lip 25 on the pinion, thereby preventing the disproportionate wear across the width of the pinion which could otherwise arise.

Referring now to Fig. 3, the method of mounting the motor 19 is shown, somewhat schematically. The motor is mounted directly upon a generally circular gearbox casing 26, which in turn is pivotally mounted at 27 upon a motor mounting bracket 28 secured to the rear of the door 10. Pivotal movement of the casing 26 and motor 19 is limited to a small angle (of the order of 30 degrees) by a pin projecting into an arcuate slot. A flexible cable 29 links the motor to a spring-loaded latch 30 (Fig. 1) engaging a bracket 31 on the frame 11.

The operation of the door mechanism is as follows. When a suitable control switch such as a push-button is operated to energise the motor 19, the motor attempts to rotate the shaft 15 but is initially unable to do so because of the natural resistance arising from the weight of the door. Reaction in the motor therefore causes the motor to pivot through a small angle about the pivot point 27 and thus to pull on the cable 29 and release the latch 30.

Following the de-latching, further rotation of the shaft 15 moves the pinion 16 along the racks 18 and opens the door as desired.

The overall operation of the door may be controlled by means of a microcomputer or other form of logic control. In particular, limit switches, mechanical positional switches, or light-controlled proximity switches may be provided to detect the arrival of the door at its fully-open or fully-closed position and switch off the motor drive. The micro-computer may also incorporate an alarm facility, which may be switched on when required and may then detect any movement of the door relative to the limit switches or the like.

As already indicated, the mechanism may incorporate a provision for disconnection of the motor drive in the event of power failure. A preferred such arrangement may take the form of a lay shaft in the gear train which may be disengaged if the electric supply fails. The disengagement may be wholly automatic but is preferably under manual control. For example, if the lay shaft is retained in position against spring pressure by a pin or similar keep, operation of the key-controlled garage door handle may remove the keep and allow the shaft to disengage. This disengagement may be made easier if, under microcomputer control, the drive motor is reversed momentarily each time it comes to a halt, thereby removing the drive pressure from the gear train. Provision is preferably made for reengagement of the drive, for example by manual means, when the power supply is restored.

### Claims

1. An operating mechanism for an up-and-over-door characterised in that said mechanism comprises at least one rotary guide member pivotally mounted at or upon a side of the door, a linear trackway positively engaging the rotary guide member, and drive means mounted upon the door to rotate said guide member and thereby effect linear movement of said guide member along said trackway.
2. A door operating mechanism according to claim 1, characterised by two said rotary guide members, one at or upon each side of the door, each rotary guide member engaging one of two said linear trackways and both of said rotary guide members being rotatable by said drive means.
3. A door operating mechanism according to claim 1 or claim 2, characterised in that each rotary guide member is a wheel or roller and in that said wheel or roller has ribs or teeth thereon engaging corresponding features on said linear trackway.
4. A door operating mechanism according to claim 3, characterised in that each rotary guide member is a pinion or a ribbed roller and in that said trackway is a linear track.
5. A door operating mechanism according to claim 3, characterised in that each rotary guide member is a sprocket wheel and in that said trackway is a chain.
6. A door operating mechanism according to any of the preceding claims, characterised in that said drive means is an electric motor mounted upon the door.
7. A door operating mechanism according to claim 6, characterised in that said electric motor drives a spindle, mounted upon the door and having two rotary guide members at its opposite ends.
8. A door operating mechanism according to any of the preceding claims, characterised in that the door is supported by support arms, pivotally linked at their opposite ends to the door and to a door frame respectively, and in that the points of pivotal attachment of said support arms to said door are displaced rearwardly from the plane of the door by a short distance.
9. A door operating mechanism according to any of the preceding claims, characterised by means to rotate the door through a small angle about the rotary guide member before movement of said guide member along said linear trackway in the opening direction of the door.
10. A door operating mechanism according to claim 9, characterised in that said means to rotate the door through a small angle comprises at least one cam and cam follower associated with the door and with a door frame.
11. A door operating mechanism according to any of the preceding claims, characterised by a latch to retain the door closed, said latch being operable to release the door in response to activation of the drive means.
12. A door operating mechanism according to claim 11, characterised in that the drive means is mounted for limited pivotal movement relative to the door so as to operate the latch and release the door when said drive means is activated.
13. A door operating mechanism according to any of the preceding claims, characterised by manual means for disconnecting the drive means from the rotating guide member.

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