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54 A linkage system.

57 The invention relates to a linkage system to automatically open and close a foldable door. The foldable door is pivotally attached in a door opening (3) with the aid of hinge means (4). A motor (8) opens and closes the door with the aid of a driving arm (7) pivotally connected with one end of a connecting rod (6). The characteristic feature of the invention is that the point of action of the linkage system has been moved out from the hinge means (4) to a door bracket (22) mounted at the top

portion of the outer door section (1). A link (24) is at one end thereof pivotally connected to the door bracket (22) and is at its opposite end pivotally connected to one end of a lever (25) which at its other end is pivotally connected to a wall bracket (26) mounted at the wall above the door opening (3). A leg portion (19) is rigidly attached at one end thereof to the lever (25) and is at its other end pivotally connected to the opposite end of the connecting rod (6).

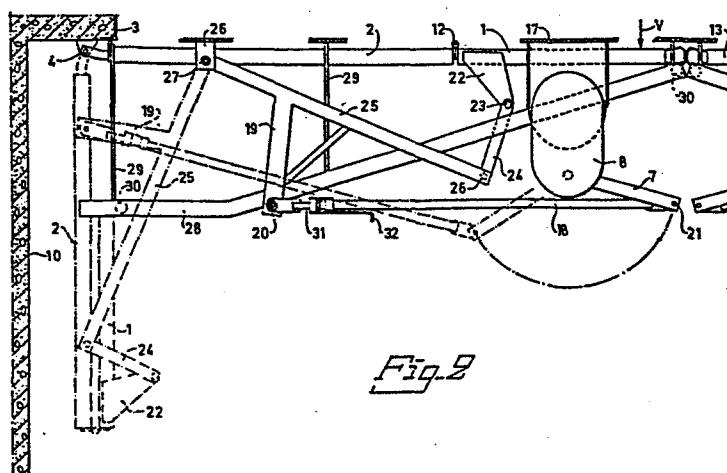


Fig. 2

A LINKAGE SYSTEM

The present invention relates to a linkage system in an apparatus for automatically opening and closing at least one folding door of the kind having two door sections, arranged foldable against each other, one door section hereinafter referred to as the inner section being pivotably attached to a wall inside of the door opening with the aid of hinge means, the linkage system including a motor provided with an arm on the motor drive shaft and firmly mounted on the inside of the wall above the door opening, one end of the arm being pivotably connected to one end of a connecting rod.

Linkage systems of the kind referred to above are known and include a link pivotably connected at one end to the arm on the motor drive shaft, its other end being pivotably connected to a bracket fixed to the inner door section and projecting out at right angles from it. The known system is burdened with at least two disadvantages, of which the foremost is that the bracket encroaches on the space behind the inner door section when the folding door is in its open position, i.e. when the door opening is fully exposed. The bracket projecting from the opened folding door must have a free path, this limiting the width of the door opening, or alternatively requires the provision of openings in the side walls of the room where the door is installed. Another disadvantage is that the torque caused by the wind load against the door leaves exerts unfavourable loads on the door frame hinges and door leaves when the lateral space behind the inner section bracket is small. This results in a third disadvantage appearing as a swaying and jerky motion of the door, this being accompanied with peak loads acting on the hinges and door attachments.

The lever arm from the door frame hinges to the pivoting

point on the bracket mounted on the door leaf is decisive for dimensioning hinges and leaf in relation to wind loading and the size of the door opening and also for dimensioning the required space behind the inner door leaf.

5 The present invention has the object of providing a linkage system of the kind described in the introduction, which avoids the disadvantages of the known configuration and does not have any details encroaching on the space behind the inner door section in the open position of the folding door,
10 and wherein the force from the connecting rod is applied at the outer door section via a linkage system.

The invention will now be described in detail below in conjunction with the accompanying drawings, on which

15 Fig. 1 is a plan view seen from above of a known structure for automatically opening and closing a folding door,

Fig. 2 is a plan view from above of a structure for automatically opening and closing a folding door in accordance with the present invention and

Fig. 3 is a side view of the structure shown in Fig. 2.

20 Fig. 1 illustrates a known structure for automatically opening and closing a folding door of the kind having two door sections 1, 2 which are foldable against each other. The section 1 is designated "outer section" and section 2 "inner section" or door frame section. The folding door is
25 suspended in the door opening 3 with the aid of hinge means 4. A bracket 5 is attached to the upper portion of the inner door section 2. The bracket has the form of a rectangular bar, the outer end of which is pivotably attached to a connecting rod 6, the opposite end of which is in turn
30 pivotably connected to an arm 7 rotated by the output shaft

of a motor 8, which is mounted on the wall above the door opening 3. On actuation of the motor 8 in one direction, the arm 7 is turned in the direction indicated by the arrow 9, the connecting rod 6 moving the inner door leaf 2 from the position illustrated by full lines in Fig. 1 to the open position illustrated by chain-dotted lines. A guide roller, not shown, is mounted on the upper portion of the outer door section 1, and a guide rail, not shown, is mounted on the wall above the door opening 3 and cooperates with the guide roller to guide the outer door leaf during the opening movement from the closed position illustrated in Fig. 1 by full lines to the open position illustrated by chain-dotted lines.

It will be seen from Fig. 1 that the bracket 5 encroaches on the space behind the door blade in the open position of the door, which is a disadvantage, particularly if it is necessary to cut a hole or an opening (illustrated by dashed lines in Fig. 1) in the side wall 10 of the room to which the door opens. It is sometimes impossible to carry out such cutting and it will then be necessary to mount the hinges 4 so far out from the side wall 10 that the available door opening width is reduced.

Although not previously mentioned, there is a hinge means 12 joining door sections 1 and 2 to each other. If the door opening is wide, two folding doors can be arranged in line as indicated in Fig. 1, where only the corresponding outer door section 13 for the additional folding door has been indicated. It will be further noted that the additional section can be operated by the same motor 8, which is used for operating the door sections described in the introduction, an additional arm 14 on the motor drive shaft being pivotably connected to an additional connecting rod 15, which is in turn pivotably connected to a bracket, not shown, mounted at the top section of the inner door leaf,

not shown, of the additional folding door.

Fig. 2 illustrates a new linkage system in accordance with the present invention. Details in Fig. 2 and 3 corresponding to those in Fig. 1 are denoted by the same reference characters. A motor 8 is mounted on the wall 16 about the door opening 3 on a motor bracket 17. The motor has a driving arm 7, which is pivotably connected at its outer end to a connecting rod 6, the other end of which is pivotably connected to the substantially perpendicular leg 19 of a T-shaped lever 25. The pivoting point between members 6 and 19 is denoted by 20. The pivoting point between members 7 and 6 is denoted by 21. A bracket 22 is attached to the upper edge of the outer door section 1, and has a triangular configuration (see Fig. 2) with a pivoting point 23 at its apex, to which one end of a link 24 is pivotably connected. The other end of this link is pivotably connected at a pivoting point 26' to the lever 25. The other end of the lever 25 is pivotably connected to a wall bracket 26 which, similarly to the motor bracket 17 is attached to the wall 16 above the door opening 3. The leg 19 is rigidly attached, e.g. welded, to the lever 25. The pivoting point between the wall bracket 26 and the lever 25 is denoted by 27. Distinguishing from the previously known structure the action of the connecting rod 6 is translated via the leg 19 (pivoting point 20) and lever 25 (pivoting point or fulcrum 27) to the door bracket 22. The point of action is thus moved further away from the hinge 4 to the region of the outer section 1. This considerably increases the lever arm to the hinging point 4, which results in a more favorable force distribution to door frame hinges and door leaf.

By the mentioned disposition of the door bracket 22 there is also afforded the possibility of not encroaching the space behind the opened folding door, i.e. the space between the side wall 10 and the inner door section 2 when the latter is

in the position illustrated by chain-dotted lines in Fig. 2. It will be understood that the length of the leg 19 must not be made so great that its end thrusts out past the opened door leaf 2 if the feature with the free space behind the door blade 2 is to be retained.

In the illustrated example the combined width of the door levers 1 and 2 is 1.95 m, the distance between the hinging point 4 and the pivoting point 27 is 0.4 m and the lever arm between the pivoting points 27 and 20 is 0.52. It will be understood that said extended lever arm between the door hinging point 4 and the door bracket 22 is dependent on the combined width of the door leafes. The greater this combined width is, the farther away the door bracket 22 must be moved from the hinging point.

In Fig. 2 the positions of the door sections 1 and 2 are illustrated by chain-dotted lines when the folding door is open. During the movement of the door from the closed to the opened position the lever 25 moves through an arc round its fulcrum 27 while the inner door section 2 moves in an arc round the hinging point 4. The link 24 pivots about 220° clockwise from the position illustrated in Fig. 1 and the driving arm 7 moves thorough an angle of about 180° clockwise from the position illustrated by full lines in Fig. 1. During the opening movement the pivoting point 23 first describes a cycloidal movement from the position illustrated in Fig. 1 by full lines, and during the last third of the opening movement this point moves substantially at right angles to the side wall 10, i.e. substantially parallel to the door opening. The link 24 takes up the relative motion between the arcuate movement of pivoting point 26' and the motion of the pivoting point 23. A conventional guide rail 28, mounted in the wall portion 16 above the door opening with the aid of a plurality of stays 29 guides the front edge of the outer door section, assisted by a conventional

guiding roller 30 arranged in the configuration with the mentioned front edge.

5 The length of the connection rod 6 is conventionally adjustable with the aid of a bar 31 telescopically inserted in the rod 6, and the position of the bar can be locked with the aid of a conventional emergency opener 32, which can be used if there is a current failure to the motor or if the motor fails for some other reasons, and it is desired to open or close the door. The length of the connecting rod 6
10 is dependent on the positioning of the motor 8 relative to the central opening of the door, which is denoted by the chain-dotted line C_L .

If so desired, the motor 8 can be provided with an additional driving arm 7 which, in a way corresponding to
15 the structure according to Fig. 1, is caused to operate the other folding door half in the case where it is desired to have both folding door halves operated simultaneously.

The embodiment of the invention described above can be varied in many ways and modified within the scope of the
20 inventive concept.

CLAIMS

1. A linkage system in a folding door of the kind which has outer (1) and inner (2) door sections which are foldable against each other, and of which the inner (2) is pivotably attached to a wall inside of the door opening (3) with the aid of hinge means (4), said linkage system being intended for installation between the folding door and a wall-mounted motor (8) for opening and closing the folding door, said system including a connecting rod (6) having one end pivotably mounted on an arm (7) on the motor drive shaft and its other end pivotably connected at a first pivoting point (20) on a lever (25), said lever at one end having its fulcrum at a point (27) situated above the door opening and at a distance from the hinge means (4) and at its other end being in force translating connection with the folding door, characterized in that the force translating connection comprises a link (24) with one end pivotably connected at a second pivoting point (26') to the other end of the link (25) and at its other end being pivotably connected at a third pivoting point (23) to a door bracket (22) mounted on the outer door section (1).

2. A linkage system as claimed in claim 1, characterized in that the connecting rod (6) is connected to the lever (25) at a leg portion (19) rigidly attached to the lever (25) and projecting out from it.

