June 25, 1935. J. E. BANCROFT 2,006,082

DOOR OPERATING MECHANISM

Filed Aug. 17, 1934 2 Sheets-Sheet 1

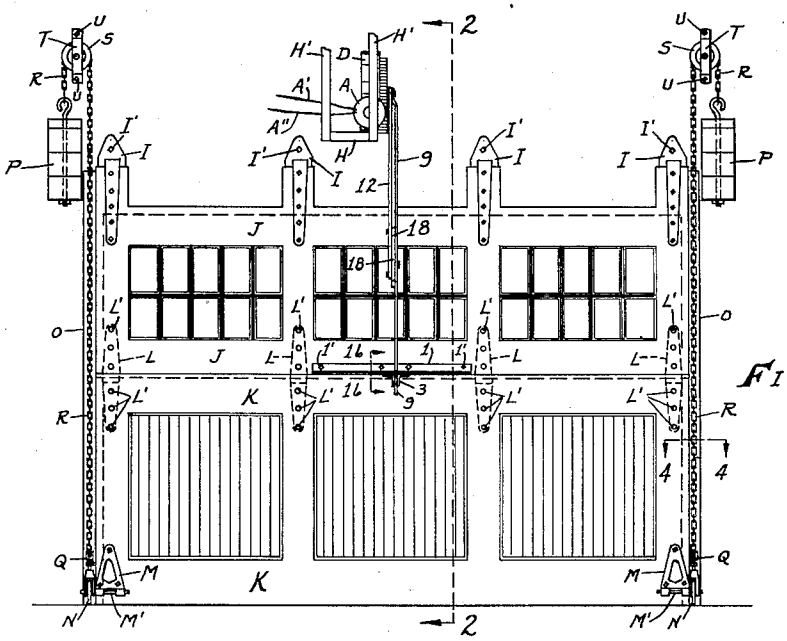


FIG. 1.

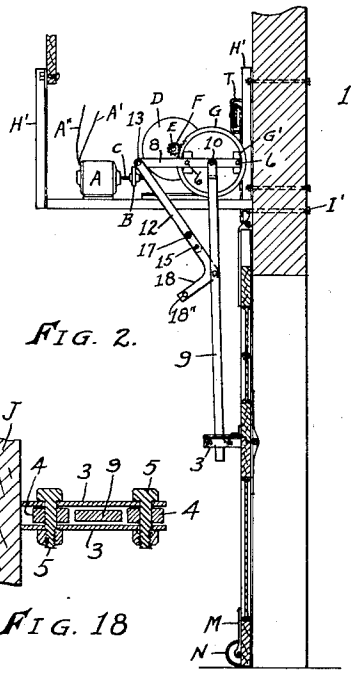


FIG. 2.

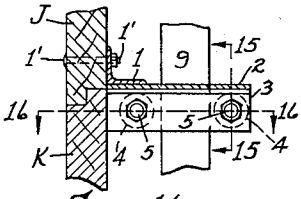


FIG. 16.

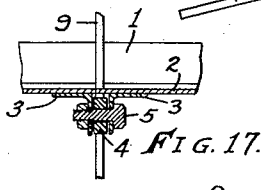


FIG. 17.

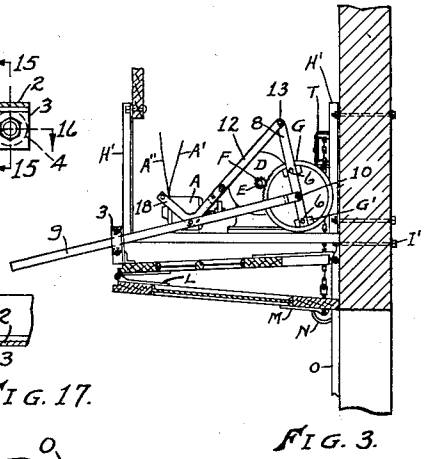


FIG. 3.

FIG. 18

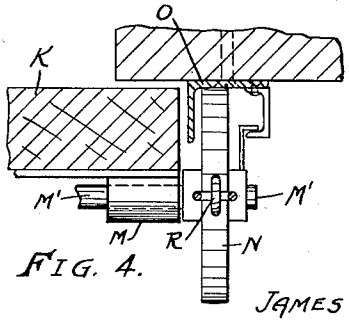


FIG. 4.

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DOOR OPERATING MECHANISM

Filed Aug. 17, 1934 2 Sheets-Sheet 2

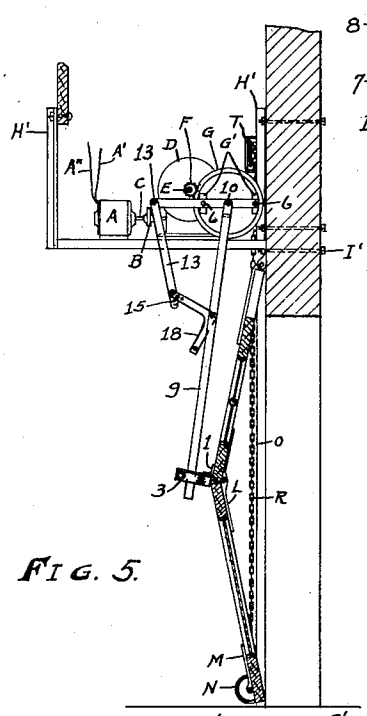


FIG. 5.

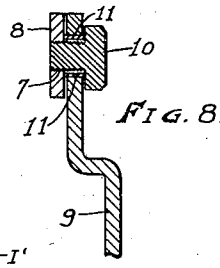


FIG. 8.

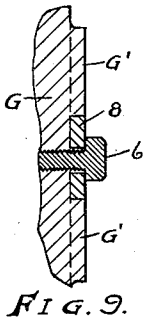


FIG. 9.

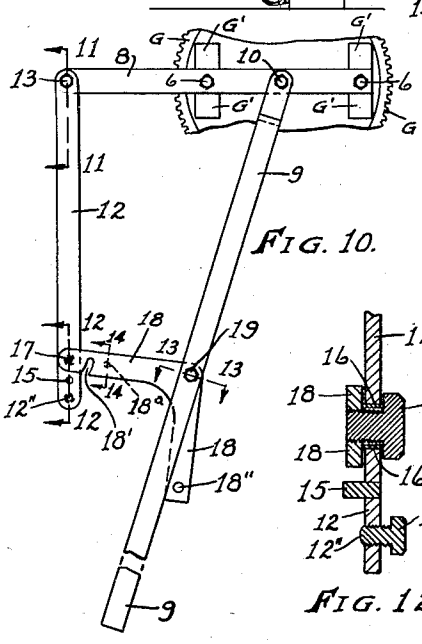


FIG. 10.

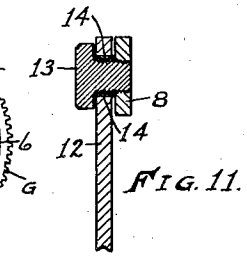


FIG. 11.

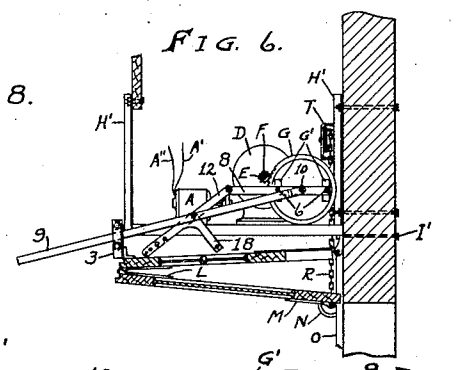


FIG. 6.

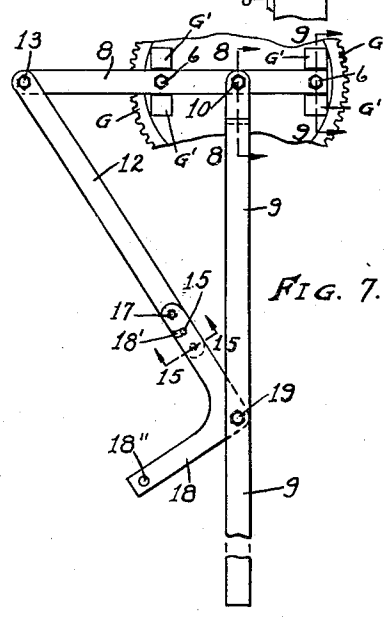


FIG. 7.

FIG. 12.

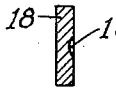


FIG. 14.

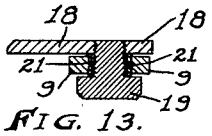


FIG. 13.

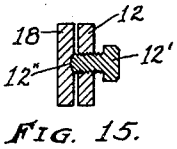


FIG. 15.

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Patented June 25, 1935 2,006,082

UNITED STATES PATENT OFFICE

2,006,082

DOOR OPERATING MECHANISM

James E. Bancroft, Richmond, Ind., assignor, by mesne assignments, to The Richmond Fireproof Door Company, Richmond, Ind., a corporation of Indiana

Application August 17, 1934, Serial No. 740,207

6 Claims. (Cl. 268—74)

One of the objects of my invention is the provision of a door operating mechanism which is applicable to doors of the upwardly folding type, the same constituting an electric motor driving unit in combination with a gear reduction unit together with means for connecting to a door of the type indicated.

Another object of my invention is the provision of an operating unit which will automatically break the door to which it is connected, when the power is applied thereto to open the door, and also automatically lock the door in closed position and rigidly maintain the door in the locked position until it is desired to open the same.

Another object of my invention is to provide an operating unit which transmits a smooth and positive motion to the door, also a unit which is constructed of a minimum number of parts, is economical to manufacture, and efficient to operate.

Still another object of my invention is the provision of an operating unit which may be rendered inoperable with relation to the door without disconnecting any of the parts thereof when it is necessary to operate the door manually through the failure or interruption of electric current or other causes.

Other objects and advantages of my invention will suggest themselves in the course of the following description, and that which is new will be correlated in the appended claims.

The most satisfactory manner of carrying out the principles of my invention in a practical, economical, comprehensive and efficient manner is shown in the accompanying two sheets of drawings, in which—

Figure 1 is an elevation of a door having my invention shown in connection therewith.

Figure 2 is a vertical section through the door and opening taken on the line 2—2 of Figure 1, and showing a side elevation of my invention.

Figure 3 is a partial vertical section through the door, and is similar to Figure 2 except that the door is shown in open position.

Figure 4 is a detail cross section through one of the door jambs taken on the line 4—4 of Figure 1.

Figure 5 is a vertical section through the door and opening showing the door in position for manual operation after being released from the power supply.

Figure 6 is a partial vertical section through the opening and showing the door in full open position after being manually opened.

Figure 7 is a detail elevation of my invention per se.

Figures 8, 9 and 15 are detail sections taken on the lines 8—8, 9—9 and 15—15 respectively of Figure 7.

Figure 10 is a detail elevation of my invention showing a position which the members thereof assume when released for manual operation.

Figures 11, 12, 13 and 14 are detail sections taken on the lines 11—11, 12—12, 13—13 and 14—14 respectively of Figure 10.

Figure 16 is a detail section taken on the line 16—16 of Figure 1.

Figures 17 and 18 are detail sections taken on the lines 17—17 and 18—18 respectively of Figure 16.

Similar indices denote like parts throughout the several views.

In order that the construction, the operation, and the advantages of my invention may be more fully understood and appreciated, I will now take up a detailed description thereof, in which I will set forth the same as fully and as comprehensively as I may.

In the drawings, the letter A denotes an electric motor to which the electric wires A′ and A″ are connected in the usual manner, the motor A being connected to the flanged coupling B by means of the shaft C, said flanged coupling B being connected by a second shaft to the reduction unit D, the shaft extending into the reduction unit housing and is secured to a worm gear located therein, the worm gear being in mesh with a worm wheel also located therein and secured to the central portion of the shaft E. Secured to one end of the shaft E is the pinion gear F which is adapted to mesh with its companion gear G, the gear G having the lugs G′ formed integral therewith, between which the main arm member of my invention is secured.

The operating unit is supported by the platform H which is suspended by the brackets H′.

The door per se is supported by the hangers I which are secured to the wall by the through bolts I′. The door being comprised of the upper section J and the lower section K which are hingedly secured together by means of the center hinges L, which are secured thereto by means of the through bolts L′. Secured near each lower corner of the door section K are the hangers M, the same being adapted to carry the wheels N by means of their respective shafts M′. The wheels N are adapted to operate upwardly and downwardly, on the surface of their respective track members O, when the door is opened and

closed. The door is counterweighted by means of the counterweights P, the same being indirectly attached to the adjustable fasteners Q by means of the chains R running over the sheaves S, which are rotatably secured in their respective housings T and which are secured to the wall by means of the through bolts U.

My invention is adapted to mechanically open and close a door of the bifold, or jackknife type, and is held in slidable connection therewith by means of the angular-shaped bracket 1 which is secured to the lower portion of the upper section of the door, said bracket 1 being secured thereto by means of the through bolts 1' extending through the vertical leg thereof and through the door. Secured to the outwardly extending leg of the bracket 1 is the plate 2, to which the angular-shaped and spaced-apart members 3 are secured. Between the angular-shaped members 3 are the rollers 4, the same being held therebetween by their respective bolts 5 which extend through the downwardly extending legs of each of the angular-shaped members 3.

Formed integrally with the outer face of the gear wheel G are the lug members G', there being threaded apertures formed in the gear wheel G, and each of which is located centrally between a pair of the lug members and through which the main bar member 8 is rigidly secured by means of the cap screws 6. Located in the main bar member 8, and midway between the cap screws 6, is a threaded aperture 7 into which one end of the radius rod 9 is pivotally secured by means of the cap screw 10, the aperture through which the cap screw 10 extends being of sufficient diameter for the reception of the spacer bushing 11. The spacer bushing 11 being of such length to allow the radius rod 9 to turn or pivot freely between the main bar member 8 and the head of the cap screw 10. Located near the outer end of the main bar member 8 is a threaded aperture where one end of the connecting bar 12 is secured by means of the cap screw 13, the aperture through which the cap screw extends being of sufficient diameter to accommodate the spacer bushing 14, said spacer bushing 14 being of sufficient length to allow the connecting bar 12 to pivot freely between the head of the cap screw 13 and the main bar member 8. Located near the opposite end of the connecting bar 12 and rigidly secured therein is the pin 15, one end of which projects outwardly from the face of the connecting bar and the opposite end thereof being substantially flush with the opposite side of the connecting bar, as shown in Figure 12. Located near the lower end of the connecting bar 12 is the cap screw 12' which is threaded thereinto and projecting outwardly a short distance therebeyond. Said cap screw 12' having its projecting end formed to a convex surface, the purpose of which will be hereinafter set forth.

Located between the pin 15 and the cap screw 13 is an aperture formed through the connecting bar 12, the same being formed nearer the pin 15 than the cap screw 13, and is of sufficient diameter to accommodate the spacer bushing 16. Extending through the spacer bushing 16 is the cap screw 17 which is threaded into the angular-shaped lever 18, as shown in Figure 12, the lever 18 having a threaded aperture formed therethrough for the reception of the cap screw 17. The spacer bushing 16 being of sufficient length to allow the angular-shaped lever 18 to pivot freely between the connecting bar 12 and the head of the cap screw 17.

The angular-shaped lever 18 has the slotted aperture 18' formed therein, the same being adapted to register with the pin 15 of the member 12. Near the vertex of the lever 18 a threaded aperture is formed therethrough and into which the cap screw 19 is secured, said cap screw 19 extending through an aperture which is formed through the radius rod 9, and in which the spacer bushing 20 is located, the length of the spacer bushing 20 being sufficient to allow the radius rod 9 to turn or pivot freely between the lever 18 and the head of the cap screw 19. Located near the lower end of the lever 18 is the aperture 18'', the purpose of which is to provide a place in which to hook a rod or the like to break the joint between the connecting bar 12 and the lever 18 in case the lever 18 is too high to be conveniently reached by hand. Formed in the lever 18, between the aperture 18' and the cap screw 19, is the concave aperture 18^a, the purpose of which will be hereinafter set forth.

The operation of my mechanism is substantially as follows—It is to be understood that there is to be a reversing switch used in connection with the motor unit, said reversing switch being of the conventional type and which is not shown in the drawings, also the reversing switch having in connection therewith "Open" and "Close" push buttons.

When it is desired to open the door by means of the power mechanism, the "Open" button is pressed, and thereby closing the electric circuit to the motor A. The electric motor becomes energized and rotates, and in turn transmits motion to the large gear wheel G through the members B, C, D, E and F. As the main bar member 8 is rigidly secured to the gear wheel G by means of the cap screws 6, it is carried therewith in the rotation thereof. The connecting bar 12 being secured at one of its ends to the main bar member 8 by means of the cap screw 13, and at its opposite end to the lever 18 by means of the cap screw 17, exerts a pull on the lever 18. The lever 18 being secured, at its vertex, to the radius rod 9 by means of the cap screw 19, exerts the pull on the radius rod 9. As the pull is exerted through the connecting bar 12 and the lever 18 to the radius rod 9, the pull is transmitted against one of the rollers 4, which being connected to the door by means of the bracket members 3, 2 and 1 respectively, causes the central portion of the door to be pulled away from the wall, after which the continued motion of the gear wheel G causes the door to open to the position as shown in Figure 3. It will be noted that during the travel of the door in opening, the radius rod 9 slides between the rollers 4, due to the difference between the center of the gear wheel G and the bracket 4 in the closed and open positions of the door. When the gear wheel G has assumed the position as shown in Figure 3, the power is automatically cut off through the means of a limit switch (not shown). Throughout the movement of the door, after being pulled away from the wall by the radius rod 9, the counterweights P carry the weight of the lower portion of the door, and thereby preventing any undue strain on the operating mechanism, the same being designed only to control the motions of the door.

When it is desired to close the door by means of the power mechanism, the "Close" button is pressed, thereby causing the motor to rotate in the reverse direction from that in opening.

As the door closes against the wall the power is automatically cut off through the means of the

limit switch (not shown). When the door is in closed position, the radius rod 9 is forced against one of the rollers 4 and thereby holds the door tightly against the wall, and the irreversible gearing in the reduction unit D prevents any movement of the door away from the wall through the members 8, 12 and 18. The locking of the door against the wall is one of the important features of my mechanism, as this feature prevents any persons from opening the door from the outside, or opposite side of the door.

In case of failure of electric current or other causes, I have provided means of opening the door without disconnecting any of the parts of the mechanism. The manual operation of the door is accomplished by a downward pull on the lower portion of the lever 18, thereby causing the knuckle or break-joint between the connecting bar 12 and the lever 18 to be broken, after which the bottom of the door may be manually lifted to the position as shown in Figure 6. When the door is to be closed manually, it is only necessary to pull downwardly on the lower portion of the door until it is in closed position, and then restore the lever to its original position as shown in Figures 2 and 7. Should the door be opened at some time by manual operation and it should be desired to close it by power operation, it is only necessary to push the "Open" button which will operate the gear wheel G and the main bar member 8 to the position as shown in Figure 3. As the main bar member 8 assumes the position as shown in Figure 3, the connecting bar 12 and the lever 18 will be brought into rigid relation to each other as shown in Figure 3, after which the "Close" button is pressed, and the door closed in the usual manner.

It will be noted that the convex end 12'' of the cap screw 12' and the concave aperture 18a of the lever form a knuckle, or break joint between the two members 12 and 18. The tension, or pressure between the two members 12 and 18 being sufficient to prevent the joint from breaking while the door is under power operation, yet the pressure is not great enough to prevent the joint from being broken by a pull on the lower end of the lever 18.

I desire that it be understood that minor changes may be made in the several details, and in the arrangement of the parts herein shown and described, without departing from the spirit of my invention or sacrificing any of the advantages thereof which are new and useful, and which involve invention.

Having now fully shown and described my invention, what I claim and desire to secure by Letters Patent of the United States, is—

1. In a door operating mechanism, the combination of a motor driven speed reducer having a gear wheel actuated thereby, a main bar member rigidly secured to said gear wheel, a radius rod pivotally secured at its upper end to the main bar member and in alignment with the center of said gear wheel, with a connecting bar having one end thereof pivotally secured to one end of the main bar member, a lever member having an aperture formed through the vertex thereof and adapted to be held in pivoted relation to the radius rod through said aperture, a break joint formed by the lever member and the connecting bar, said break joint providing means for releasing a door from its power operating unit without disconnecting any of the pivoted joints.

2. In combination with a bifold door, an operating mechanism comprising in combination, an electric motor operating in connection with an irreversible gear reduction unit having a pinion gear secured to the projecting shaft thereof, said pinion gear being adapted to mesh with a comparatively large gear wheel; a main bar member rigidly secured to the large gear wheel, a radius rod having one end thereof pivotally secured to said main bar member with the connecting point thereof being in substantial alignment with the center of the large gear wheel, said radius rod extending downwardly therefrom and secured in slidable connection with the central portion of the door, a connecting bar having its upper end pivotally secured to the outer end of the main bar member, an angular-shaped lever member pivotally secured at its central portion, to the central portion of the radius rod, said lever member having one of its ends pivotally secured to the lower end of said connecting bar, and a break joint formed between the connecting bar and the lever member.

3. In combination with an upwardly opening folding door, an operating unit comprising in combination, a radius rod having one end thereof slidably secured to the central portion of the door, a main bar member pivotally secured to one end of said radius rod, a connecting bar having one end thereof adapted to be pivotally secured to one end of said main bar member and having its opposite end adapted to be pivotally secured to a lever member, said connecting bar having a projecting pin rigidly secured thereto, an angular-shaped lever member having one end thereof adapted to be secured to the connecting bar and having a slotted aperture formed therein, said slotted aperture being adapted to normally register with the projecting pin of the connecting bar, said lever member having an aperture formed in the vertex thereof and adapted to be held in pivoted relation to the radius rod therethrough.

4. In combination with a jack-knife door, an operating mechanism comprising an electric motor, an irreversible gear reduction unit having a pinion gear secured on one end of a projecting shaft, said pinion gear adapted to mesh with a larger gear wheel; a main bar member rigidly secured to and rotatable with the large gear wheel, a radius rod having one of its ends pivotally secured to the main bar member and the opposite end adapted to be slidably connected to the central portion of the door, a connecting bar having its upper end pivotally secured to a projecting end of the main bar member, an angular-shaped lever member pivotally secured at its vertex to the radius rod and having one of its ends pivotally secured to the lower portion of the connecting bar, means for forming a break joint between the lever member and the connecting bar, an automatic and positive door locking device provided by all of the members when the door is in closed position and the several members are in their normal positions in relation thereto, and an automatic door breaking device provided by all of the members in combination with each other, all substantially as shown and described.

5. In combination with a foldable door comprising a plurality of sections held in hinged relation to each other and an operating mechanism therefor; an angular-shaped bracket having one of its sides secured to one of said door sections and having its other side extending outwardly therefrom, spaced-apart angular members positioned in parallel relation with each other and

each being secured at one end thereof to the underside of said bracket and extending outwardly therefrom, a plurality of rollers revolvably positioned between said spaced-apart angular members and adapted to receive a radius rod slidably located therebetween, said bracket providing means for holding the door in closed position and providing means whereby the motion of the operating unit is transmitted to the door, all substantially as shown and described.

6. In a door operating mechanism comprising in combination, a motor controlled speed reducer having a shaft projecting therefrom, a gear wheel rigidly secured on said projecting shaft, a main bar member rigidly secured to the gear wheel, a radius rod pivotally secured at its upper end to said main bar member and having its lower end held in slidable connection with a door, a connecting bar pivotally secured to a projecting end of said main bar member, a lever member pivotally secured to the radius rod and having one of its ends pivotally secured to the lower portion of said connecting rod and forming a break joint therebetween.

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