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VERTICALLY MOVING DOOR

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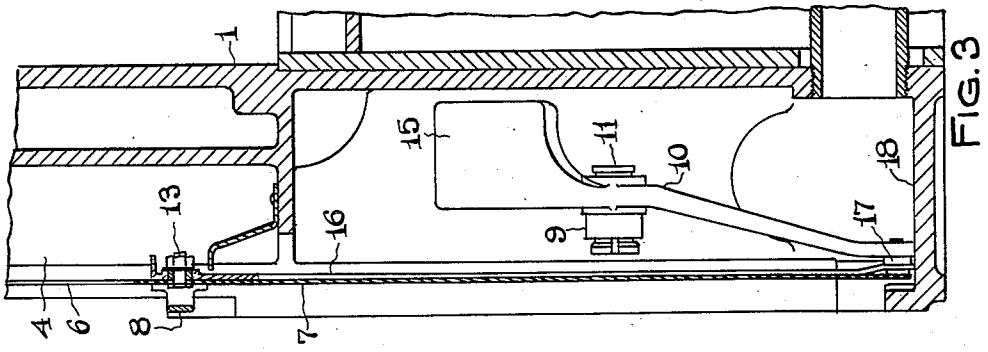


FIG. 3

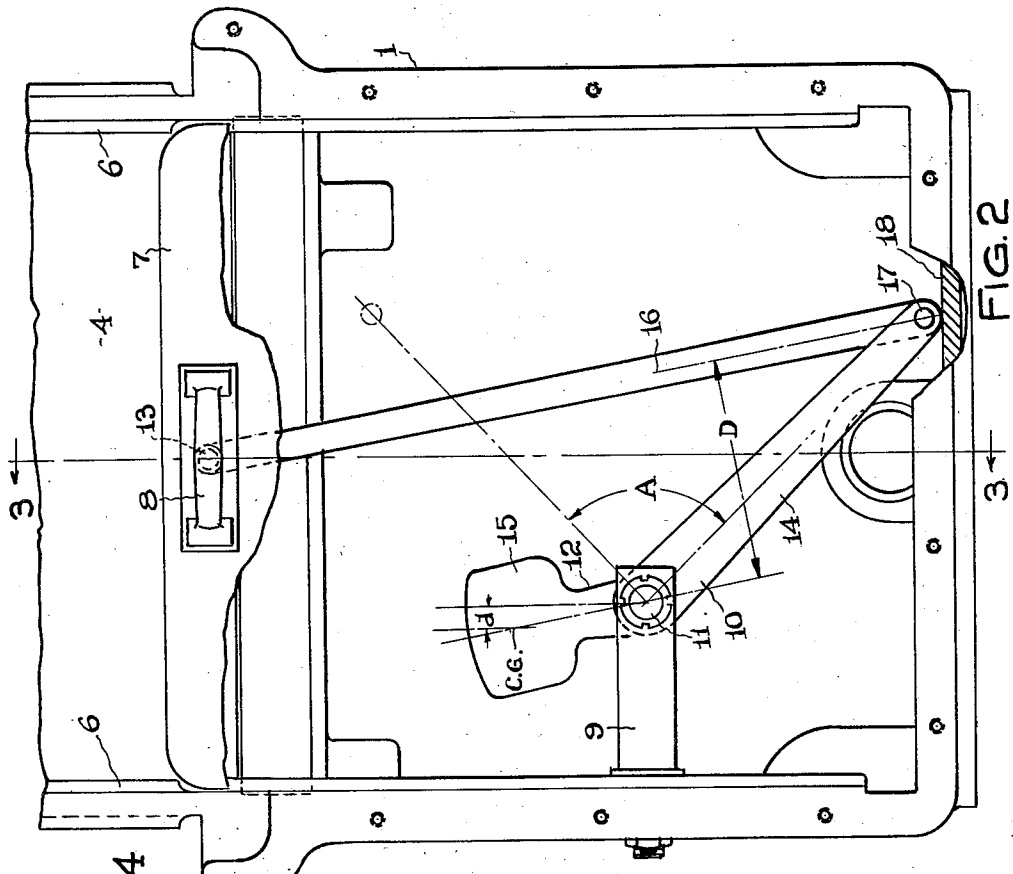


FIG. 2

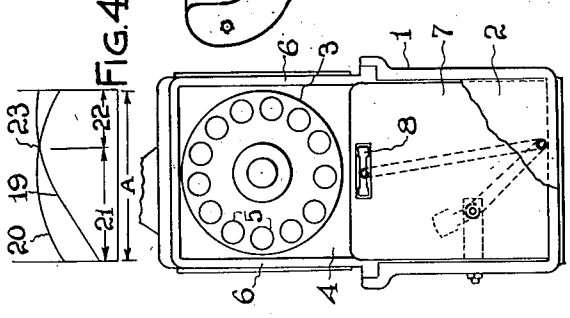


FIG. 1

FIG. 4

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VERTICALLY MOVING DOOR

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2 Claims. (Cl. 20—19)

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The present invention relates generally, as indicated, to balanced doors, and more especially to balanced sliding doors which are vertically shiftable to a plurality of positions relative to a supporting structure therefor, said doors usually having their opposite edges fitted in tracks or guideways formed in said supporting structure.

It is a primary object of this invention to provide a balanced door assemblage so constructed that the door, even though large and massive can be shifted with ease, said assemblage being further so formed that the door is automatically retained in a plurality of positions relative to its supporting structure without employment of springs, latches, or the like.

A further object is to provide a novel counterbalancing mechanism of a most elemental form for a vertically shiftable door and so formed that at the upper position of the door, the moment of the counter-weight of such mechanism exceeds that of the door; whereas at the lower position of the door, the moment of the door exceeds that of the counter-weight whereby the door will automatically be retained in one position until manually shifted to the other, such arrangement additionally rendering the door self-energizing upon manual shifting thereof beyond an intermediate position at which such moments are equal.

A still further object is to provide a counterbalancing mechanism in which the balancing force is applied centrally of the door adjacent its upper edge so as to assure free non-sticky action in the operation thereof.

Other objects and advantages will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail one illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

Fig. 1 is a front elevation view of a typical apparatus which includes a balanced door assemblage thereon, the door being illustrated in its lowermost position uncovering an opening in the upper portion of the apparatus;

Fig. 2 is an enlarged elevation view of the lower portion of the apparatus of Fig. 1 with the lower front panel removed and with the lower

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part of the door broken away to more clearly illustrate the novel counter-balancing mechanism associated therewith;

Fig. 3 is a vertical cross section view taken substantially along the line 3—3, Fig. 2; and

Fig. 4 is a diagrammatic representation of the variations in the moments of the door and of the counter-weight during movement of the door between its lowermost and uppermost positions.

Referring to the drawing and first more especially to Fig. 1 there is illustrated therein an exemplary apparatus with which the present balanced door assemblage may be conveniently used, said apparatus comprising a frame 1 having a cover plate 2 over the lower portion thereof and a wire drawing mechanism 3 or the like in its upper portion 4, which mechanism it is desired to enclose as during operation thereof and to expose so as to be readily accessible for adjustment and servicing prior to and after operation. Said mechanism 3 comprises, for example, a plurality of circularly arranged rotary capstans 5 around which wire or like elongated material is adapted to be wrapped and drawn thereby through dies (not shown) located between successive capstans with lubricant being constantly squirted into said dies and onto the wire during the drawing operation. By reason of the nature of said mechanism it is desirable to enclose the same when in operation in the interest of the safety of the operator and to prevent splashing of lubricant. Said mechanism is, of course, merely typical and has no bearing on the distinctive features of the present invention.

Said frame 1 is formed with tracks 6 along its opposite vertical edges for slidably receiving the corresponding edges of a door 7 which is vertically shiftable between positions covering and uncovering the mechanism 3 located in the upper portion 4 of said frame, a handle 8 being secured centrally adjacent the upper edge of said door for facilitating shifting thereof between such positions.

In order to reduce the effort required to shift the door 7 between the aforesaid positions, said frame 1 is provided with a bracket 9 extending inwardly from one side, the inner end of said bracket having pivotally connected thereto by the pivot pin 11 the intermediate portion of a two arm lever 10 of which one arm 12 is enlarged whereby to form a counter-weight 15 and the other arm 14 is pivotally connected to the door through the medium of a link 16 and pivots 17 and 13. The arms 12 and 14 of said lever

are so arranged that a line through the axes of pivots 11 and 17 and a line through the axis of pivot 11 and the center of gravity C. G. of the counter-weight 15 intersects at an angle other than a straight angle, as shown, for a purpose which will hereinafter appear. With reference to arm 14, it is preferred that the end thereof be adapted for engagement with the floor 18 of the frame as shown whereby to prevent damage to the lower edge of the door, as might otherwise occur by striking of such edge against the floor 18.

It is now apparent that the turning moments acting on lever 10 about the pin 11 by reason of the mass of the counterweight 15 acting through its moment arm *d* and of the mass of the door 7 acting through its moment arm D will be opposed to one another. Therefore, because the arms 12 and 14 of lever 10 intersect at an angle other than a straight angle, such opposed moments (where the maximums thereof are equal or nearly so) will vary as plotted in the graph of Fig. 4 during the movement of the lever 10 from the solid to the broken line positions of Fig. 2 and corresponding movement of the door 7 from its lower to its upper position, the line 19 in Fig. 4 representing the varying moment of the counter-weight 15 and the line 20 representing the varying moment of the door 7 during such movement. In Fig. 4 the abscissa is the angular displacement A of the lever 10 in shifting between the solid and broken line positions of Fig. 2 and the ordinate is the turning moment of the counter-weight 15 and of the door 7 during such shifting of said lever.

Now, because of the relative disposition of the counter-acting turning moments as aforesaid, the moment of the door 7 in the area designated by the line 21 will over-balance that of the counter-weight 15 and conversely the moment of the counter-weight 15 in the area designated by the line 22 will over-balance that of the door 7 whereby the door will be retained in its lower and upper positions by the differences in the respective moments in such areas 21 and 22, the force required to shift the door by its handle 8 in either case being relatively small so as to enable essentially effortless shifting. It is further apparent that once the door 7 has been shifted to either side beyond the intersection point 23 at which such moments are equal the door will continue its movement without application of force by the operator.

Another important feature of this invention is that because the counter-balancing forces are applied to the door 7 through the link 16 at a central point 13 adjacent the upper edge, the tendency of the door being cocked or jammed is thereby minimized.

Although the door 7 herein illustrated is imperforate, the principles of this invention are equally applicable to perforate doors such as for example those employed as machine and electrical equipment guards or the like. Likewise, the unit with which the door is associated may have the opening which is to be covered and uncovered at either its lower or upper portion.

Furthermore, while the present invention may have its greatest application in connection with vertically slidable doors, said doors may in some cases be otherwise disposed and may be guided other than by tracks or guideways disposed along opposite edges thereof. Considering the invention from still another aspect, it is obvious that link 16 and lever 10 along with bracket 9 may be arranged so as to be disposed above the lower position of the door 7 without detracting from any of the primary features of the specific embodiment herein disclosed.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. The combination with a vertically shiftable door and a supporting frame therefor, of a generally vertically disposed link having its upper end pivotally connected centrally adjacent the upper edge of said door, a lever having one end pivotally connected to the lower end of said link and the other end provided with a counterweight, and means on said supporting frame pivotally supporting said lever between its ends, said lever being so formed that a line through the pivot axis thereof and the pivot axis of the connection thereof with said link intersects a line through the pivot axis thereof and the center of gravity of said counterweight at an angle less than 180°.

2. The combination with a vertically shiftable door and a supporting frame therefor which is adapted to be mounted in front of a wire drawing mechanism whereby said door may be shifted downwardly to uncover such mechanism and to be shifted upwardly to cover such mechanism, of a generally vertically disposed link disposed behind said door and having its upper end pivotally connected centrally adjacent the upper edge of said door, a lever disposed behind said door when the latter is shifted downwardly and having one end pivotally connected to the lower end of said link and the other end provided with a counterweight, and means on said supporting frame pivotally supporting said lever between its ends, said lever being so formed that a line through the pivot axis thereof and the pivot axis of the connection thereof with said link intersects a line through the pivot axis thereof and the center of gravity of said counterweight at an angle less than 180° such that the force moments of said door and counterweight about the pivot axis of said lever are equal at an intermediate position of said door.

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