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APPLIANCE SWING-DOWN DOOR COUNTERBALANCE ARRANGEMENT

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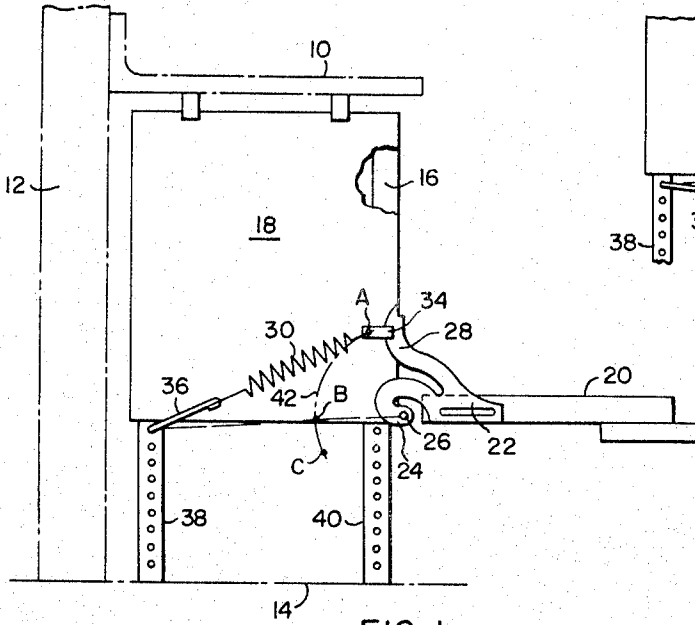


FIG. 1.

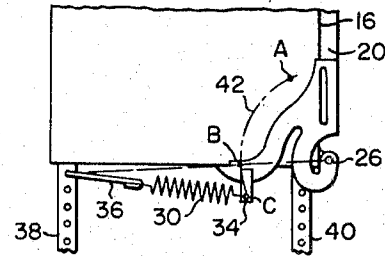


FIG. 3.

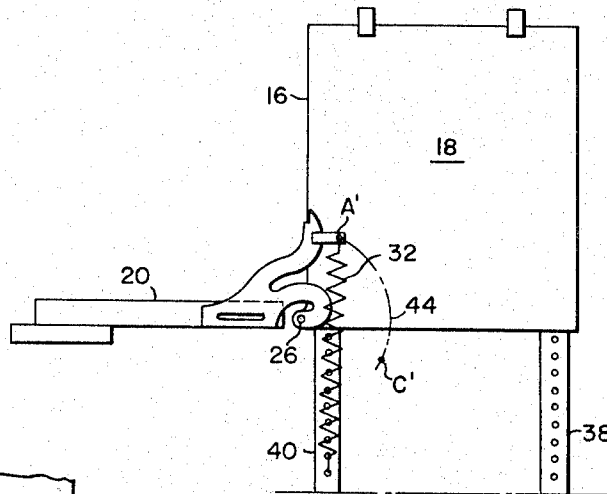


FIG. 2.

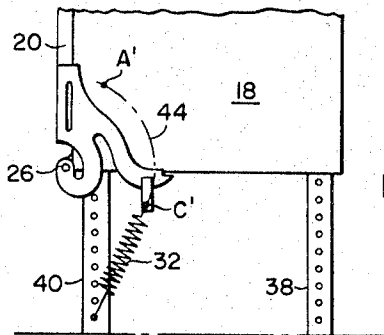


FIG. 4.

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APPLIANCE SWING-DOWN DOOR COUNTER-BALANCE ARRANGEMENT

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5 Claims

ABSTRACT OF THE DISCLOSURE

A swing-down door for an appliance such as a dishwasher counterbalanced by a pair of tension springs arranged with one spring exerting a closing torque upon the door throughout its range of movement, and the other spring exerting a decreasing closing torque upon the door throughout its movement from the fully open to a position closely approaching a closed position, and then exerting an increasing opening force as the door is moved to a fully closed position.

BACKGROUND OF THE INVENTION

Field of the invention

This invention pertains to the art of counterbalancing appliance doors of the swing-down type.

Description of the prior art

Since the invention is particularly applicable to domestic dishwashers with swing-down front opening doors, it will be described in that connection. The production dishwasher of applicant's assignee is an example of the prior art to which the invention may be applied. As such the swing-down door on the dishwasher has been provided with a pair of tension springs having one end connected to the hinge or lever arms of the door, and the other end connected to the base structure of the dishwasher at a location so that a closing torque is applied to the door throughout substantially all of its movement from an open to a closed position. The closing torque varies as both the lever arm and the spring force change as the door closes, with the spring force approaching zero as the door reaches its closed position. However, the combined spring torque and door momentum create an undesirable slamming of the door if it is substantially unrestrained as it is closed. This can lead to pinched thumbs or fingers as well as being obviously undesirable in other respects.

SUMMARY OF THE INVENTION

In accordance with my invention a superior counterbalancing arrangement is provided in which one of the springs is disposed to provide a braking torque as the door approaches the closed position, as well as providing a more nearly balanced condition of the door in its positions adjacent the closed position. This is accomplished by orienting the springs so that while one exerts a closing torque throughout the closing movement of the door, the other changes from a closing to an opening torque as the door approaches the closed position. Thus a substantially balanced condition exists in a position of the door adjacent the fully closed position such that slamming due to the relationship of the torque upon the door and door momentum is avoided.

DRAWING DESCRIPTION

FIGURE 1 is a partly broken elevational view of the right side of an undercounter dishwasher with the door open;

FIG. 2 is an elevational view of the left side of the dishwasher with the door open;

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FIG. 3 is a fragmentary elevational view of the right side of the dishwasher with the door closed; and

FIG. 4 is a fragmentary elevational view of the left side of the dishwasher with the door closed.

PREFERRED EMBODIMENT

The dishwasher of FIG. 1 is shown installed in a typical undercounter space defined by a kitchen counter top 10, building wall 12, and floor 14. The perimeter of the front face 16 of the dishwasher tube 18 defines the door opening which the door 20 closes when swung up to a vertical position from its horizontal position shown in FIGS. 1 and 2. The door is carried for its swinging movement by hinge arms which include a body portion 22 fixed to the door, a bent-under shaped leg 24 through the end of which a hinge pin 26 rotatably secures the hinge arms and door to the tub structure, and a leg-and-foot-shaped portion 28 to which the spring means of the invention are connected. The portions 26 and 28 will hereafter be called the hinge and spring portions, respectively, of the hinge arms.

The spring means for counterbalancing the weight of the door and for exerting torque to control positioning of the door comprises tension springs 30 and 32 shown on the right and left sides of the dishwasher, respectively, in FIGS. 1 and 2. In the case of both springs, the movable end of the spring is attached to a lug 34 which is in turn attached to the spring portion of the hinge arm, although it will be understood that the lugs 34 may be formed as an integral part of the hinge arms. The rear end of the spring 30 is connected by means of an extension link 36 to a location on the rear leg brace 38 of the base structure for the dishwasher well above the floor. The lower end of the tension spring 32 (FIGS. 2 and 4) is attached directly to a location near the bottom end of the leg brace 40.

The arc through which the movable end of the spring 30 travels as the door 20 is moved between its opposite positions is identified by the numeral 42 in FIGS. 1 and 3, while the arc through which the movable end of the tension spring 32 travels as the door is moved is identified by the numeral 44 in FIGS. 2 and 4. The torque exerted upon the hinge arms by the tension springs is of course a product of the lever arm (defined as the perpendicular distance between the line of action of the spring force and the hinge axis), and the spring force itself. Thus it will be appreciated that as the door 20 moves from its open position of FIG. 1 toward its closed position, the lever arm factor of the torque produced by tension spring 30 progressively decreases until it reaches zero at point B or dead center on arc 42. At point B the line of action of the spring is directed through the hinge axis 26. Then as the door is moved to the fully closed position (FIG. 3) the lever arm progressively increases as the arc is followed to point C. The force of spring 30 of course also decreases as the arc is followed from point A to point B along the arc, and then increases between points B and C.

Referring now to FIGS. 2 and 4, it will be seen that as the arc 44 of spring 32 is followed between point A' (door open) and point C' (door closed), the lever arm changes in a generally increasing direction while the spring provides a generally decreasing force. Thus it may be said that tension spring 32 provides a closing torque upon the door at all positions of the door. The difference in the magnitude and direction of the torque produced by the two springs 30 and 32 is a function of their orientation relative to the hinge axis.

It will be appreciated that the tension springs 30 and 32 are selected in accordance with the variable moment arising from the weight and swing of the particular door

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20. The moment of course decreases as the door is swung shut. Changes in trim and accessory features in the door will require changes in the tension springs or their connected locations to provide the proper force to balance the weight of the door.

The arrangement according to the invention is considered definitely superior to that of the prior art of applicant's assignee in which both tension springs are oriented generally as tension spring 32 is illustrated. With the new arrangement the door is substantially balanced in most positions in the latter half of its movement between an open and a closed position. Unless intentionally propelled, the door does not slam when it is moved toward a closed position in a substantially unrestrained way.

The arrangement is commercially advantageous in that it lends itself to incorporation in the established dishwasher structure of applicant's assignee and only requires the addition of the spring extension link 36.

What is claimed is:

1. In a dishwasher:

an access door rotatable about a hinge axis between a closed vertical position and an open substantially horizontal position;

lever arm means fixed to said door;

spring means for exerting counterbalancing forces upon said door;

said spring means including a first tension spring connected to said lever arm means to provide a closing torque upon said door throughout its movement from an open to a closed position, and a second tension spring connected to said lever arm means to provide a decreasing closing torque upon said door as said door moves from an open position approaching a closed position, and then an increasing opening torque as said door continues to a fully closed position, the relationship between the torque produced by said spring means and the movement of said door preventing said door from slamming shut under normal closing conditions.

2. In a dishwasher according to claim 1:

said first tension spring is oriented relative to its connection to said lever arm means so that the direction of its line of action of its torque producing force remains on one side of said hinge axis as said door is moved between its opposite positions, and

said second tension spring is oriented relative to its connection to said lever arm means so that the direction of its line of action of its torque producing

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force passes throughout said hinge axis as said door moves through the latter half of its movement to a closed position.

3. In a dishwasher according to claim 2:

said first and second tension springs are oriented so that both of said springs exert substantially the same torque in a door closing direction when said door is in a fully open position.

4. In a dishwasher according to claim 1:

said first and second tension springs are disposed so that said first spring exerts a closing torque which is substantially equal to the opening torque produced by said second spring when said door is in a substantially closed position.

5. In a dishwasher:

an access door rotatable about a hinge axis between a closed vertical position and an open substantially horizontal position;

counterbalancing spring means for said door;

said spring means including first spring means connected to exert a closing torque when said door is open, a decreasing closing torque as said door is moved toward a closed position, said closing torque decreasing to substantially zero as said door closely approaches a closed position, and an increasing opening torque as said door is moved from said position approaching an almost closed position to a fully closed position;

second spring means connected to exert a closing torque in all positions of said door as it is moving toward a closed position, said closing torque being of generally decreasing magnitude as said door is moved from an open to a closed position.

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45 KENNETH DOWNEY, *Primary Examiner.*

U.S. Cl. X.R.

16—72, 85; 126—191; 312—319