Feb. 11, 1958 C. H. McCREARY 2,822,567

COUNTERBALANCE ASSEMBLY

Filed Feb. 23, 1955 2 Sheets-Sheet 1

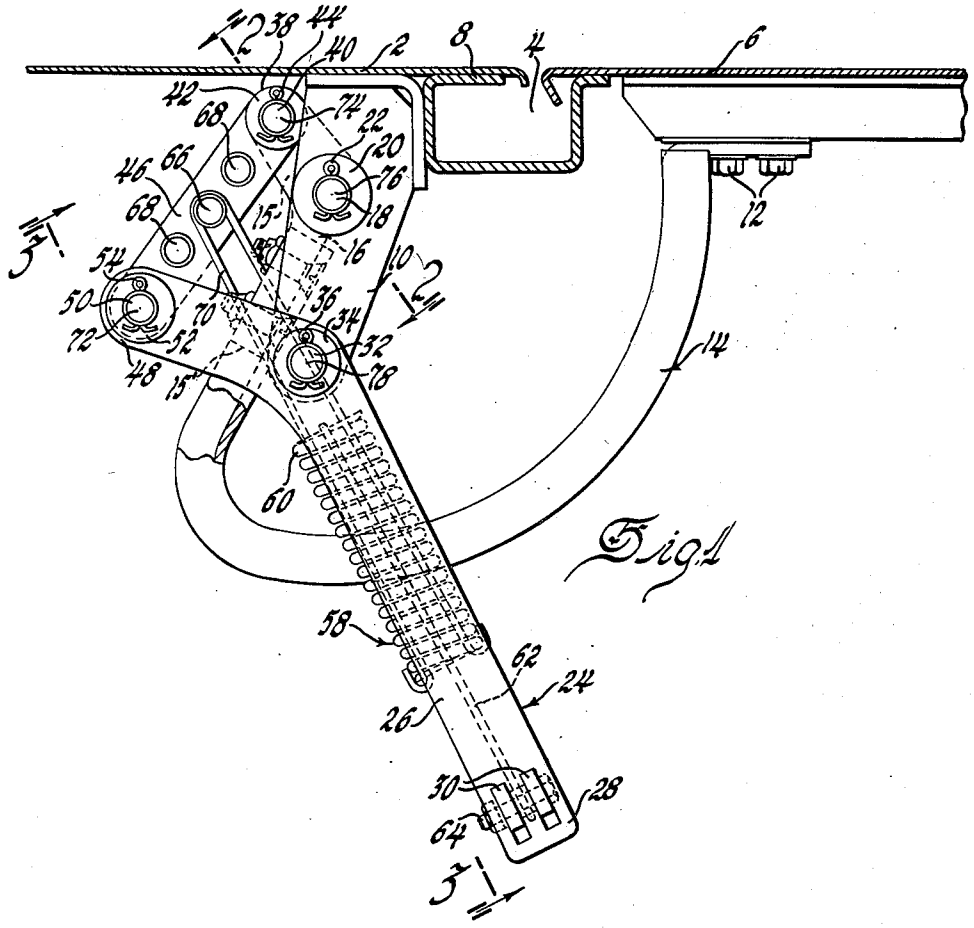


Fig. 1

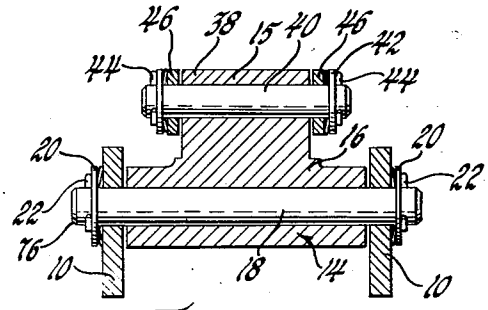


Fig. 2

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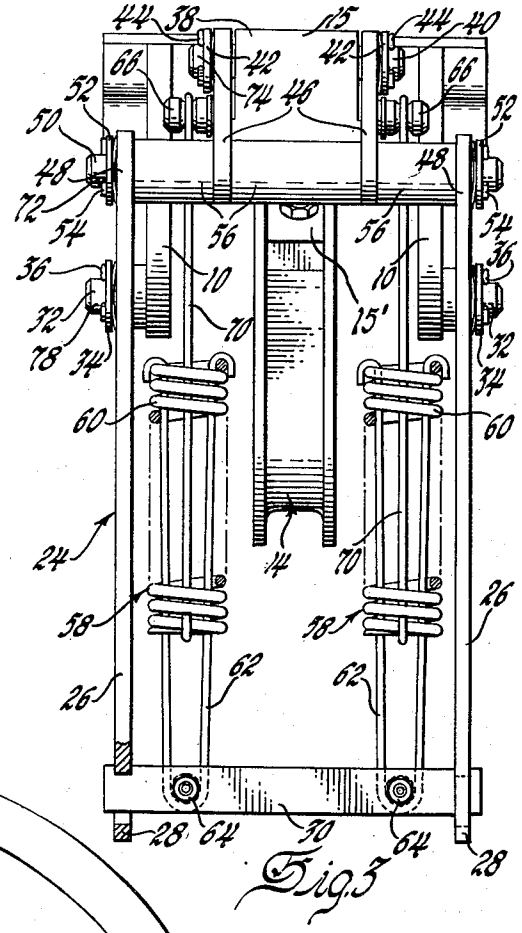


Fig. 3

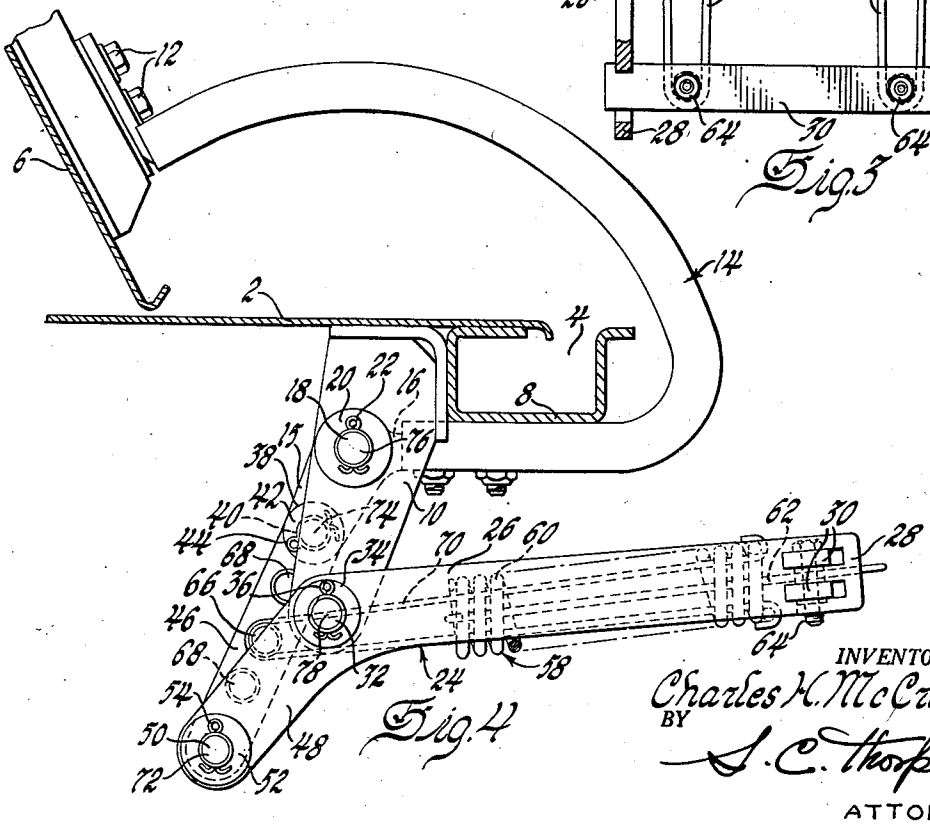


Fig. 4

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COUNTERBALANCE ASSEMBLY

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3 Claims. (Cl. 16—85)

This invention relates generally to hinges for closure members and more particularly to counterbalancing hinging means.

One of the objects of the invention is to provide an improved counterbalancing hinge in which the hinged member to be counterbalanced remains in whatever position it is placed.

Another object of the invention is to provide an improved counterbalancing hinge which is adjustable or may be readily calibrated for different weight members to be counterbalanced or members whose center of mass locations are different.

A more specific object of the invention is to provide a counterbalancing hinge in which, as the counterbalancing forces diminish due to the decrease in the deflection in the spring means used to obtain these counterbalancing forces, the lever arms to which the forces are applied are increased so as to obtain increased counterbalancing through a certain portion of decreasing deflective travel of the spring means.

In many instances in which it is desired to counterbalance a swing closure member the center of mass is located (when the member is closed) so as to initially increase the moment of the closure member about its hinge connection when the member is first raised. This is of course caused by the fact that the center of mass travels in a circle about the hinge connection so that if the center of mass is below the horizontal radius of this curve the center must not only move up but away from the hinge connection when raising the member thereby increasing the moment arm about the hinge connection and consequently the moment to be counterbalanced. In most counterbalancing hinge assemblies, however, the counterbalancing effect usually becomes gradually less as the closure member is raised. In the present invention the counterbalancing hinge assembly can be adapted to initially increase the counterbalancing effect of the assembly as the closure member is raised in a manner to be described in detail.

A further difficulty often found in counterbalancing hinge assemblies is that one assembly is usually suitable for only one closure member and as a result if it is desired to use a different closure member, i. e., one whose weight is different or whose center of mass may be differently located, it is necessary to devise a new counterbalancing hinge assembly for the new closure member. The present invention obviates this difficulty by providing a single counterbalancing hinge assembly which is quickly adjustable for different size closure members having different weights and whose centers of mass are differently located.

For a more complete understanding of this invention and the above and other objects thereof reference may be had to the accompanying detailed description and drawings, in which:

Fig. 1 is a fragmentary view partially in section of a compartment and a closure member including the novel counterbalancing hinge means swingingly securing the closure member to a wall of the compartment.

Fig. 2 is a view taken on the line 2—2 of Fig. 1 to illustrate that the gooseneck hinge used to secure the swinging closure member to a wall of the compartment has integrally formed thereon an arm which forms a bell crank with the hinge.

Fig. 3 is a view taken on the line 3—3 of Fig. 1 illustrating the yoke or frame for supporting the spring means of the hinge and connections between the various links, levers and arms.

Fig. 4 is a view similar to that of Fig. 1 except that the hinge assembly and the closure member are shown in the open position.

Referring now to the accompanying figures of the drawings a closure is partially shown having an upper wall 2 in this case formed by a flat metal plate. One end of the plate or wall 2 defines an opening 4 closable by the lowering of a closure member 6 into place therein. The wall 2 of the compartment has secured thereto a bracket 8 adjacent one peripheral edge of the opening 4 whose purpose will appear later in connection with the operation of the hinge assembly. Secured to the upper wall 2 of the compartment are a pair of spaced brackets 10 which extend downwardly away from the wall further into the interior of the compartment. The closure member 6 has rigidly secured thereto by means of studs 12 a large gooseneck hinge 14 which, as best illustrated in Fig. 1, when the closure member is properly lowered to close the opening 4 extends downwardly into the compartment. The hinge 14 is pivotally connected at its opposite end 16 to the brackets 10 intermediate the upper wall 2 and the lower ends of the brackets by means of a pin 18 extending through the end 16 and suitable holes provided in the brackets 10. The pin is maintained in place by means of suitable washers 20 and cotter keys 22.

As best observed in Figs. 1 and 2 the end 16 of the gooseneck hinge 14 is provided with an arm 15 which is integrally formed therewith and, when the hinge 14 is in a position to cause member 6 to properly close opening 4, extends generally away from the opening and upwardly toward the upper wall of the compartment. The arm 15 is a part of a member 15' which is rigidly secured to and forms a part of hinge 14.

Also pivotally secured to the brackets 10 but at the lower ends thereof is a spring yoke assembly indicated generally by a numeral 24. The yoke assembly 24 comprises a pair of oppositely disposed levers 26 rigidly secured together at their lower ends 28 by means of a pair of transverse members 30. The upper portions of the levers 26 adjacent the upper ends thereof are each secured to a lower end of one of the brackets 10 by means of trunnions 32 on the lower ends of these brackets which extend through suitable holes provided in the levers 26. The levers 26 are maintained on trunnions 32 by means of suitable washers 34 and cotter keys 36.

The free end 38 of the arm 15 has pivotally connected thereto by means of a pin 40, washers 42 and cotter keys 44, respectively, a pair of oppositely disposed links 46. The links 46 are secured at their opposite ends to the ends 48 of the levers 26 by means of a pin 50, washers 52, cotter keys 54 and suitable spacers 56. Extending between the lower end of the spring yoke 24 and the links 46 are a pair of oppositely disposed spring assemblies as indicated generally by numerals 58. Each spring assembly comprises a compression spring 60 having its upper ends anchored between the pair of transverse members 30 by means of a wire loop 62. The wire loop 62 which is secured between the members 30 by means of a nut and bolt assembly 64 extends upwardly through the spring and has its free ends hooked over the top helix of the spring 60. The lower ends of each spring 60 are anchored to studs 66 fixed in any one of a plurality of sets of holes 68 in the links by second wire loops 70. Each

loop 70 extends downwardly through its associated spring 60 and has its free ends hooked over the lowermost helix of the spring.

It will be observed from the profile of the hinge assembly shown in Fig. 1 that the axes of the various pivot points, which for convenience of description have been given the numbers 72, 74, 76 and 78, when connected together by means of imaginary lines in the brackets 10, the arm 15, the links 46 and the upper ends of the levers 26 form a movable quadrilateral linkage.

The spring assemblies 58, because of their connections to links 46 and levers 26, attempt to pull these members together about the axis 72. This action exerts a force at the pivotal connection between the links and the arm 15 (on axis 74) which tends to cause the arm and gooseneck hinge 14 to rotate about the axis 76. Because of the rather small angle subtended between the links 46 and arm 15 and the position of arm 15, however, the initial moment arm tending to rotate the arm 15 and gooseneck 14 about axis 76 is small even though the force exerted by the spring means in the position shown in Fig. 1 is at a maximum. As the links 46 and the levers 26 tend to be pivoted together about axis 72 the deflection of the spring means becomes less and the forces become less. However, the effective moment arm about the axis 76 rapidly becomes larger as does also the moment arm from the axis 72 to the axes of the spring assemblies and to axis 74. This results in a greater counteracting moment even though the deflection of the spring means, and consequently the force exerted thereby, is somewhat less. By picking proper lengths for the link 46, arm 15 and the upper portion of the lever 26 and properly apportioning the distance between the pivotal connections indicated by 76 and 78 effective counterbalancing of the closure member 6 may be accomplished regardless of its weight or the location of its center of mass.

The operation of the assembly is as follows: Assuming the hinge assembly and the closure member 6 to be in the position shown in Fig. 1, when the closure member is lifted the end 16 of the gooseneck hinge 14 will be caused to pivot in a counterclockwise direction about the axis 76. This counterclockwise movement will also cause the arm 15, which is integral therewith, to be moved in a counterclockwise direction. Because of the presence of the links 46, however, the lever 26, or alternatively the spring yoke 24, will be caused to also pivot in a counterclockwise direction about the axis 78. Since there is a tendency on the part of the links 46 and the levers 26 to be pulled together about the axis 72 because of the presence of the deflected spring assembly 58 lifting of the closure member 6 is easily accomplished throughout its range of swinging movement to the position shown in Fig. 4 at which time a straight portion of the gooseneck 14 abuts the bracket 8 acting as a limit stop. When the counterbalancing hinge is in the position shown in Fig. 4 the springs 58 are extended so that the minimum amount of force is exerted by them. It should be observed that if the ends of the springs 60 were anchored to some fixed support, as is commonly done, the axis 74 would move rapidly toward the fixed lower ends of the spring assemblies and the deflection would be quickly and materially reduced thereby cutting down the counterbalancing effect.

By anchoring the lower ends of the spring assemblies so that they move with the spring yoke 24 the lower ends of the spring assemblies tend to maintain their distance from the axis 74 as it is moved counterclockwise about the axis 76. In this way more deflection of the spring assemblies is maintained through a greater amount of movement of the gooseneck hinge 14 so that a greater counterbalancing effect is obtained through the range of movement of the closure member.

It should be appreciated that although a quadrilateral type linkage has been shown in order to examplify the invention the same desirable result could be achieved by

placing the levers and linkages in different combinations so as to obtain the same desirable operation.

A further feature worthy of mention is the ease with which the counterbalancing hinge assembly is adjusted so as to give the exact counterbalancing effect. As already mentioned, the links 46 are provided with a plurality of holes 68 into which the studs 66 may be secured. By providing a sufficient number of holes 68 these studs can be located in the links 46 so as to give the next deflection of the spring assemblies desired to achieve proper counterbalancing. In other words, in the instances shown in Fig. 1, if the studs 66 were placed in the holes 68 below the holes in which the studs are shown there would be less deflection of the spring assemblies and less of a tendency for the links and levers 26 to be pulled together about the axis 72. On the other hand, if studs 66 are placed in the holes 68 above the position in which they are shown there would be more deflection and larger moment arms tending to pull these two levers together about the axis 76, in which case the forces acting on the axis 74 would be materially increased and, of course, the counterbalancing forces for the closure member 6 would be greater. If the upper ends of the spring assemblies 58 were secured about the axis 72 there would, of course, be no forces exerted by the spring assemblies tending to pivot the links 46 and the levers 26 together about the axis 72.

From the foregoing it should be appreciated that the upper ends of the spring assemblies may be located anywhere on the links 46 in between the axes 72 and 74 in order to calibrate the hinge assembly for varying degrees of counterbalancing. This, then, enables the same hinge assembly to be readily adapted for various type closure assemblies having different weights and different centers of mass. The applications of this type of counterbalancing hinge assembly are manifold and only one example has been shown here. It will readily be appreciated that the various links, arms and levers may be rearranged in different combinations all within the scope of the present invention and it is intended to protect all such combinations with the claims appended hereto.

I claim:

1. A hinge assembly for a swinging closure member adapted to be raised and lowered to open and close an opening in a compartment comprising a fixed support within the compartment and connected to a wall thereof, a hinge fixed to the closure member, a first pivotal connection securing said hinge to said support, an arm fixed to said hinge operable therewith about said first pivotal connection, a lever, a second pivotal connection securing said lever to said fixed support for movement about an axis parallel to the axis of said first pivotal connection, a link extending between said arm and said lever and pivotally connected thereto at points removed from said first and second pivotal connections, and spring means secured to and acting between said link and said lever tending to move said link and said lever together about the point of pivotal connection therebetween.

2. A counterbalancing hinge assembly for a swinging member adapted to be raised and lowered comprising a rigidly fixable support, a hinge adapted to be fixed to the member, a first pivotal connection securing said hinge to said support, an arm fixed to said hinge operable therewith about said first pivotal connection, a lever, a second pivotal connection securing said lever to said fixed support for movement about an axis parallel to the axis of said first pivotal connection, a link extending between said arm and said lever and pivotally connected thereto at points removed from said first and second pivotal connections, said arm and lever and link forming a movable quadrilateral linkage with the portion of said support between said first and second pivotal connections, and spring means secured to and acting between said link and said lever tending to move said link and

said lever together about the point of pivotal connection therebetween.

3. An adjustable counterbalancing hinge assembly for swinging members having different weights and centers of masses comprising a rigidly fixable support, a hinge adapted to be fixed to the members, a first pivotal connection securing said hinge to said support, an arm fixed to said hinge operable therewith about said first pivotal connection, a lever, a second connection securing said lever to said fixed support for movement about an axis parallel to the axis of said first pivotal connection, a link extending between said arm and said lever and pivotally connected thereto at points removed from said first and second pivotal connections, spring means fixed to said lever, a plurality of fastening connections on said link corresponding to different members to be counterbalanced, said spring means being secured by one of said fastening connections to said link and acting between said link and said lever in a manner tending to move said link and said lever together about the point of pivotal connection therebetween.

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