May 19, 1953 C. B. ULRICH 2,639,053

SPRING COUNTERBALANCING MEANS FOR THE COVERS OF CABINETS

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Fig. 1.

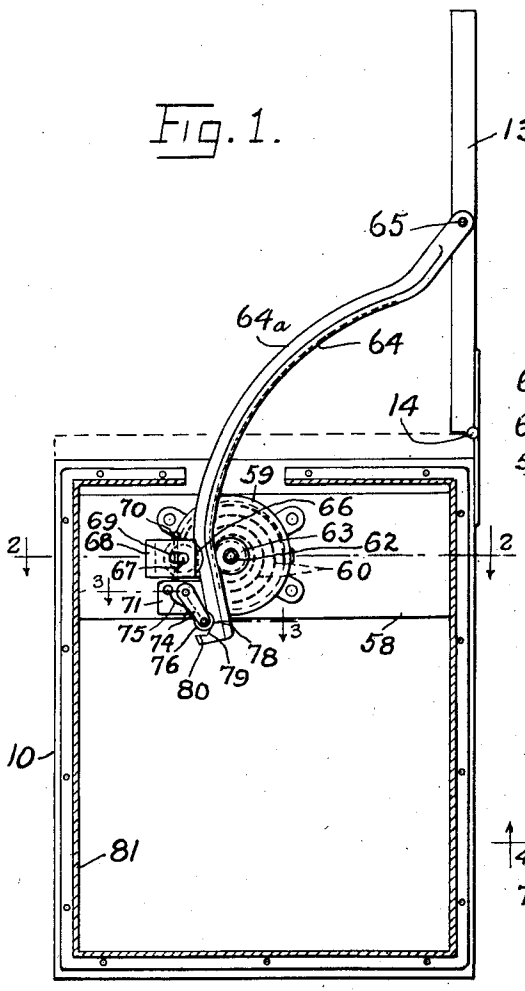


Fig. 2.

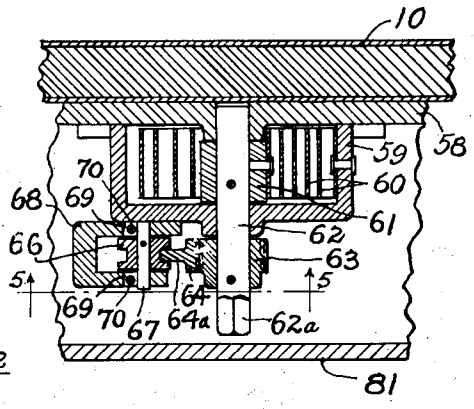


Fig. 3.

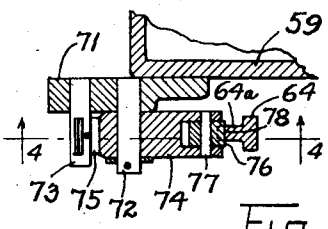


Fig. 4.

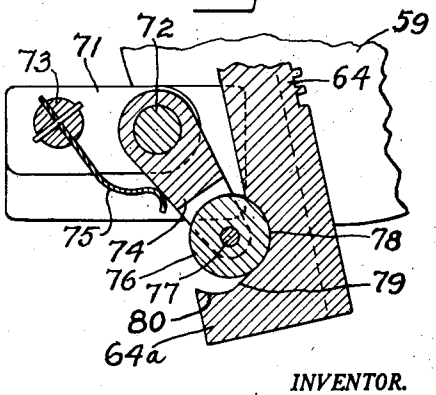
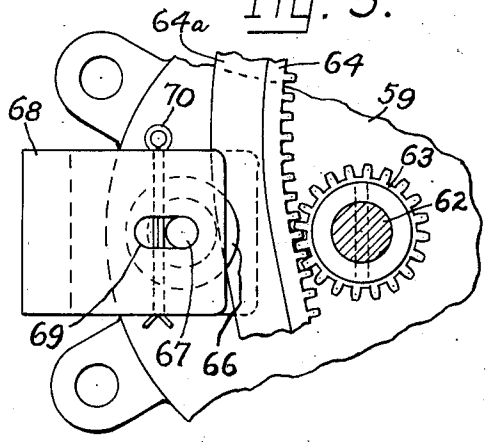


Fig. 5.



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SPRING COUNTERBALANCING MEANS FOR THE COVERS OF CABINETS

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4 Claims. (Cl. 217—60)

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The invention pertains to counterbalancing means for the hinged covers of vertical planfiles and the like, which covers are so large and heavy as to be difficult to operate unless a considerable part of their weight is counterbalanced in one way or another.

In the past, it has been proposed to effect such counterbalancing by means of counterbalancing weights, but this practice, although operative, was objectionable for two reasons: first, the weight to be effective, necessarily was required to have sufficient mass to develop by the action of gravity, the maximum counterbalancing force required, and said mass was a constant quantity always producing by gravity the same weight, although the gravity moment of the cover to be counterbalanced varied from zero to a maximum value determined by the weight of the cover in any particular case, and considerable complication resulted from attempting to give the counterbalancing moment a varying value similar to the varying value of the gravity moment of the cover; second, the weight of the counterbalancing mass being constant, it was necessary to construct the supporting means for the counterbalancing mechanism not only strong enough to safely withstand the counterbalancing forces, but in addition, strong enough to at all times safely support the counterbalancing weight, and this added substantially to the weight of the cabinet having the counterbalanced cover.

It is an object of this invention to eliminate the difficulties incident to the use of weights for counterbalancing hinged covers of the class referred to, by using spring counterbalancing means for that purpose; it is a further object of the invention to produce a counterbalancing means for such hinged covers, in which the counterbalancing forces are produced by springs having small weight in comparison with said forces; it is a further object of the invention to produce spring counterbalancing means for such covers, in which the stresses developed in the counterbalancing springs vary and have different values for different positions of a cover during its opening movement; it is a further object of the invention to produce spring counterbalancing means of the kind referred to, in which the variation in spring counterbalancing moment, is substantially proportional to the corresponding variations in the gravity moment of a cover during its opening and closing movements; and it is a further object of the invention to limit cover opening movement by the structure of the spring counterbalancing means.

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The invention will be best understood by reference to the accompanying drawings illustrating preferred embodiments thereof, in which

Fig. 1 shows in side elevation a vertical planfile with its hinged cover in open position, and with spring counterbalancing mechanism of the invention, supported by the side wall of the cabinet of the planfile,

Figs. 2 and 3 are horizontal, sectional views to an enlarged scale of parts of the structure shown in Fig. 1 taken respectively along the lines 2—2 and 3—3 in Fig. 1,

Fig. 4 is a sectional view to a further enlarged scale, of the structure shown in Fig. 3, taken along the line 4—4 in Fig. 3, and

Fig. 5 is a sectional view of the structure shown in Fig. 2 taken along the line 5—5 in Fig. 2, this view being to substantially the same scale as Fig. 4.

Similar numerals refer to similar parts throughout the several views.

As shown in Fig. 1, the cabinet 10 has mounted on the outer surface of one of its side walls, a mounting plate 58 to which a cylindrical casing 59 is rigidly secured. Said casing contains a spiral spring 60 having its outer end secured to said casing, and having its inner end secured to a cylindrical hub 61 supported by a shaft 62 extending through the outer side wall of said casing (see Fig. 2). Outside of the casing 59, the shaft 62 carries and has rigidly secured thereto a pinion gear 63, said shaft extending beyond said gear and having a squared end 62a to facilitate spring adjustment. The hub 61 and gear 63 are rigidly secured to the shaft 62 in any convenient manner, for example by pins as indicated in Fig. 2.

As shown in Fig. 1, the gear 63 is in mesh with a curved rack bar or link 64 pivotally connected at its upper end at 65 with an end surface of the cover 13 hinged to the cabinet at 14. The rack bar 64 extends a substantial distance below the gear 63 for a purpose below described. To impart the required stiffness and strength to the rack bar 64 to carry the cover load that it may be required to support, said rack bar is provided with a longitudinal web 64a opposite its toothed surface, the outer edge of said web being parallel with the pitch line of the teeth of said rack bar, for engagement with a grooved roller 66, (Fig. 2), which roller is supported on a bearing rod 67 having end bearing surfaces supported for rotation in the side legs of a U-shaped mounting member 68 secured to and rigidly supported by the spring casing 59. The rod 67 is rigidly secured to the roller 66 in any convenient manner,

for example, by a pin as indicated in Fig. 2, and the ends of said rod are mounted in horizontal slots 69 in the side legs of the mounting member 68, said slots being in substantially horizontal alignment with the shaft 62 and being so positioned that when the rod 67 is held in the right hand ends of said slots, the roller 66 will hold the teeth of the rack bar 64 positively in mesh with the teeth of the gear 63 and prevent disengagement of the rack bar from the gear; however, as shown in Fig. 5, the teeth of the rack bar 64 and of the gear 63 are of substantial size to carry the load upon them which may be large for large covers, and said teeth are preferably made with a substantial radial clearance when in their properly meshed or load-carrying relation, and, furthermore, said teeth are constructed with a substantial angular clearance or backlash, to the end that the rack bar may be operative for substantial changes in its angle of inclination to the gear, which may result from the curvature of different portions of the rack bar, and that binding of the teeth will not occur throughout the range of said angle of inclination.

The rod 67 is held in the right hand ends of the slots 69 during the operation of the counterbalancing structure, by pins 70 extending across said slots; when the pins 70 are removed, the length of the slots 69 permits movement of the roller 66 and rack bar 64 away from the gear 63 sufficiently to disengage the rack bar from the gear, thereby permitting adjustment of the strength of the spring 60 by means of a wrench or lever on the squared shaft end 62*a* without movement of the rack bar, which is desirable in effecting adjustment of the spring in the factory; when the spring is given the desired adjustment, and before releasing it, the rack bar is moved into mesh with the gear, the bearing rod 67 is moved to the right hand ends of the slots 69, thus moving the roller 66 to its operative position adjacent the web 64*a*, the pins 70 are inserted to hold the rod 67 in place, the spring is released, and the cabinet is ready for use.

The roller 66 has a length substantially equal to the spacing of the side legs of the member 68 from each other, which serves to retain the rack bar 64 laterally in alignment with the gear 63.

Adjacent to and below the mounting member 68, the spring casing 59 has rigidly secured thereto, a small mounting plate 71 rigidly supporting stud rods 72 and 73 extending from said plate parallel with the rod 67, which stud rods serve respectively as a pivotal support for the upper end portion of a detent arm 74, and as a fixed support for one end portion of a flat spring 75 pressing at its opposite end portion against said detent arm (see Figs. 1, 3 and 4). The detent arm 74 may be held in place on the rod 72 in any convenient manner, for example, by a washer and by a pin extending through said rod 72, as shown in Fig. 3, and the spring 75 may be secured to the rod 73 by extending through it and being held in place by a pin as indicated in Fig. 4. The lower end portion of the detent arm 74 is forked to receive with a free turning fit, a plain roller 76 supported in said forked end by a bearing rod 77 secured to said detent arm (Figs. 3 and 4). As shown in Fig. 3, the roller 76 is held in lateral alignment with the web 64*a* by the supporting structure described, and is pressed against the outer edge surface of said web with substantial pressure by the spring 75 as indicated in Fig. 4.

As shown in Fig. 4, the lower end portion of the web 64*a* is cut out in the form of an arcuate recess or seat 78 of substantial depth receiving and loosely fitting the roller 76 when the cover 13 is in its fully opened or substantially vertical position as shown in Fig. 1, at which time little or no downward thrust is exerted on the rack bar 64 by the gravity moment of the cover 13 around its hinges 14. As shown in Fig. 4, the seat 78 is continued downwardly by a tangent and oblique cam surface 79 for a desired distance, which cam surface at its lower end terminates in an arcuate hook-shaped stop surface 80 extending sufficiently around the roller 76 when the latter is in engagement with it, to positively prevent upward movement of the rack bar 64 relatively to the roller.

As a result of the construction just described, when the cover 13 is raised from its closed position, the roller 76 rolls on the edge surface of the web 64*a* without opposing said opening movement to an appreciable extent, although the pressure of the roller on the web is substantial; this condition continues until the cover reaches its vertical position, at which time the roller is forced by the spring 75 into engagement with the detent recess 78 in the web, which detent recess is of substantially less depth than the radius of the roller 76, thereby permitting movement of the cover in either direction to disengage the roller from the detent recess, by the application of a corresponding force to the cover, which force is determined in amount largely by the strength of the spring 75, which strength should be substantial to insure substantial detent action by the roller 76.

When the cover 13 is carefully opened by the operator, the detent action described limits said opening movement by engagement of the roller 76 with the detent recess 78 as described, and closing movement of the cover will require the application of an initial force which although appreciable, is not large enough to be objectionable; in some cases, however, by careless operation, the cover may be opened too rapidly, developing considerable inertia of movement when the detent position of the cover is reached, and in any such case the rack bar may be moved beyond its detent position, thereby raising the roller on the cam surface 79 with progressively increasing spring resistance and cushioning action depending on the length and inclination of the cam surface, thus counteracting or substantially reducing the inertia of movement of the cover by the time the roller engages the stop surface 80 on the rack bar, and thereby reducing the shock of engagement of the roller with the stop surface. The cam surface 79 should have such inclination to the roller 76, and the spring 75 should be of sufficient strength for the stopping position of the rack bar, to move the cover and rack bar from their stopping position, forwardly to their detent position so that closing movement of the cover may then proceed in a normal manner.

The counterbalancing structure described in connection with Figs. 1 to 5 inclusive is preferably enclosed by a removable casing 81, which, when in place on the cabinet, prevents access to the shaft end 62*a* and to the pins 70, thereby preventing the unauthorized adjustment of the spring 60. The casing may be secured to the cabinet in any convenient manner, for example by suitable screws.

The counterbalancing structure described in connection with Figs. 1 to 5 inclusive may, if preferred, be mounted in the side walls of the cabinet, where said walls are of sufficient thickness

to permit so doing, and where complete heat insulation of the cabinet is not required, in which case it is desirable to provide said side walls with doors affording access to the shafts **62** and to the pins **70** for the spring adjusting purposes described.

The counterbalancing structure described in connection with Figs. 1 to 5 inclusive, is preferably duplicated on the other side wall of the cabinet **13**, the only difference being that the parts have an opposite hand relation when viewed from said other side.

The metal parts of the above counterbalancing structure shown and described as having fixed connection with each other, may be secured together in any convenient manner, for example, by screws, bolts, or by welding.

The spiral spring **60** may be replaced by a similar and equivalent spring developing an increasing stress therein by the closing movement of the cover, accompanied by a decrease in the number of turns of said spring, by reversing the direction of the spiral of said spring indicated in Fig. 1, and constructing said spring to be relatively closely wound for its condition of minimum stress.

It will be understood that for cabinets of the kind described, the counterbalancing structures should be of substantial construction, since, for example, the covers of planfiles of large size weigh 300 pounds or more.

It is desirable with the counterbalancing structure shown, that one of said structures be employed in or on each of the opposite side walls of the cabinet, and that the two said structures shall be of substantially the same construction and have equal counterbalancing effects in any case; this arrangement has two advantages, first, it eliminates the possibility of twisting and racking the cover and producing unbalanced forces on the hinges, and second, in the event of breakage in one of the counterbalancing structures, the other of said structures avoids the danger of serious accident.

It should, however, be noted, that the invention is operative where only one of said counterbalancing structures is used with a hinged cover, which arrangement may be satisfactory for many cabinets and particularly for those having hinged covers of relatively small size and weight, by proportioning the single counterbalancing structure to counterbalance to a desired degree the entire gravity moment of the cover around its hinges.

The weight of the cover **13**, which is large for cabinets of large size and requires some form of counterbalancing to permit it to be easily moved from its closed to its open position, exerts a turning moment by gravity around the hinges **14** during its opening movement, which opposes said opening movement and which is a cosine function of said opening movement; and the spring **60** exerts a thrust on the link or rack bar **64**, in opposition to the thrust exerted on said rack bar by said gravity moment, and develops a stress in the spring which increases for closing movement of the cover and which decreases for opening movement of the cover, the change in stress in the spring being proportional to the deflection of the spring from one position of the cover to another, said deflection being the change produced in the number to turns or convolutions of the spring by movement of the cover from one position to the other.

The result of the expressed relations to each other of the cover **13**, rack bar **64** and spring **60**, is that the counterbalancing thrust exerted upwardly on the rack bar **64** by the spring **60** during cover movement in either direction, parallels and is similar in degree to the downward thrust on the rack bar **64** exerted by the gravity moment of said cover around its hinges during its said movement, thereby providing for any desired differential between said upward and downward thrusts on the rack bar **64** by correspondingly proportioning and adjusting the spring **60**.

The lifting thrust exerted on the rack bar **64** by the spring **60** should be somewhat less than the downward thrust exerted on the rack bar by the gravity moment of the cover for any position of the cover, for otherwise the cover will not tend to move to its closed position nor to stay in that position; the uncounterbalanced portion of the gravity moment of the cover must, of course, be overcome by the operator of the cabinet, but this manual effort can readily be reduced by the counterbalancing devices described so that it is not burdensome.

In the claims, the term "deflection" of a recited spring, is used to include a change in the number of turns with corresponding change in stress of said spring of the spiral type.

While I have shown my invention in the particular embodiment above described, I do not limit myself thereto as I may employ equivalents thereof without departing from the scope of the appended claims.

What I claim is:

1. Means for counterbalancing the hinged covers of cabinets, including a cabinet having enclosing side walls and an open upper end, a cover hinged at one edge to one of said walls and movable to open and close said upper end, a link pivotally connected at its upper end with said cover and extending downwardly therefrom adjacent one of said side walls, spring means connected with the lower portion of said link and stressed by closing movement of said cover, said link having rack teeth in one of its surfaces, and said spring means including a spiral spring held at one end by a fixed support, and a gear secured to the other end of said spring and meshing with said rack teeth, the toothed surface of said link having a longitudinal curvature, a roller engaging a surface of said link opposed to said toothed surface and holding said rack teeth in mesh with said gear, said roller having a bearing rod projecting from its ends, a U-shaped bearing member with slots in its side legs supporting the ends of said bearing rod, said slots extending away from said link and having a length substantially greater than the diameter of said bearing rod, and movable means holding said bearing rod in a position in said slots effecting a meshing engagement of said rack teeth with said gear, whereby moving said movable means to rod-releasing position permits moving said rack teeth from engagement with said gear for spring adjusting purposes.

2. Means for counterbalancing the hinged covers of cabinets, including a cabinet having enclosing side walls and an open upper end, a cover hinged at one edge to one of said walls and movable to open and close said upper end, a link pivotally connected at its upper end with said cover and extending downwardly therefrom adjacent one of said side walls, spring means connected with the lower portion of said link and stressed by closing movement of said cover, and a spring actuated detent having fixed support and engaging said link, said link having a recess yield-

ingly engaging said detent for the open position of said cover, whereby said cover in its open position is yieldingly held against movement, said link having a projecting cam surface extending from its said recess for engagement by said detent and also a stop surface, whereby cover opening movement from its detent-held position is resisted by engagement of said detent with said cam surface and stopped by engagement of said detent with said stop surface.

3. Means for counterbalancing the hinged covers of cabinets, including a cabinet having enclosing side walls and an open upper end, a cover hinged at one edge to one of said walls and movable to open and close said upper end, a link pivotally connected at its upper end with said cover and extending downwardly therefrom adjacent one of said side walls, spring means connected with the lower portion of said link and stressed by closing movement of said cover, said link having rack teeth in one of its surfaces, and said spring means including a spiral spring held at one end by a fixed support, and a gear secured to the other end of said spring and meshing with said rack teeth, said spring having a relation to said gear increasing the deflection of said spring for closing movement of said cover, and a spring actuated detent having fixed support and engaging said link, said link having a recess yieldingly engaging said detent for the open position of said cover, whereby said cover in its open position is yieldingly held against movement.

4. Means for counterbalancing the hinged covers of cabinets, including a cabinet having enclosing side walls and an open upper end, a cover hinged at one edge to one of said walls and movable to open and close said upper end, a link pivotally connected at its upper end with said

cover and extending downwardly therefrom adjacent one of said side walls, spring means connected with the lower portion of said link and stressed by closing movement of said cover, said link having rack teeth in one of its surfaces, and said spring means including a spiral spring held at one end by a fixed support, and a gear secured to the other end of said spring and meshing with said rack teeth, said spring having a relation to said gear increasing the deflection of said spring for closing movement of said cover, and a spring actuated detent having fixed support and engaging said link, said link having a recess yieldingly engaging said detent for the open position of said cover, whereby said cover in its open position is yieldingly held against movement, said link having a projecting cam surface extending from its said recess for engagement by said detent and also a stop surface, whereby cover opening movement from its detent-held position is resisted by engagement of said detent with said cam surface and stopped by engagement of said detent with said stop surface.

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