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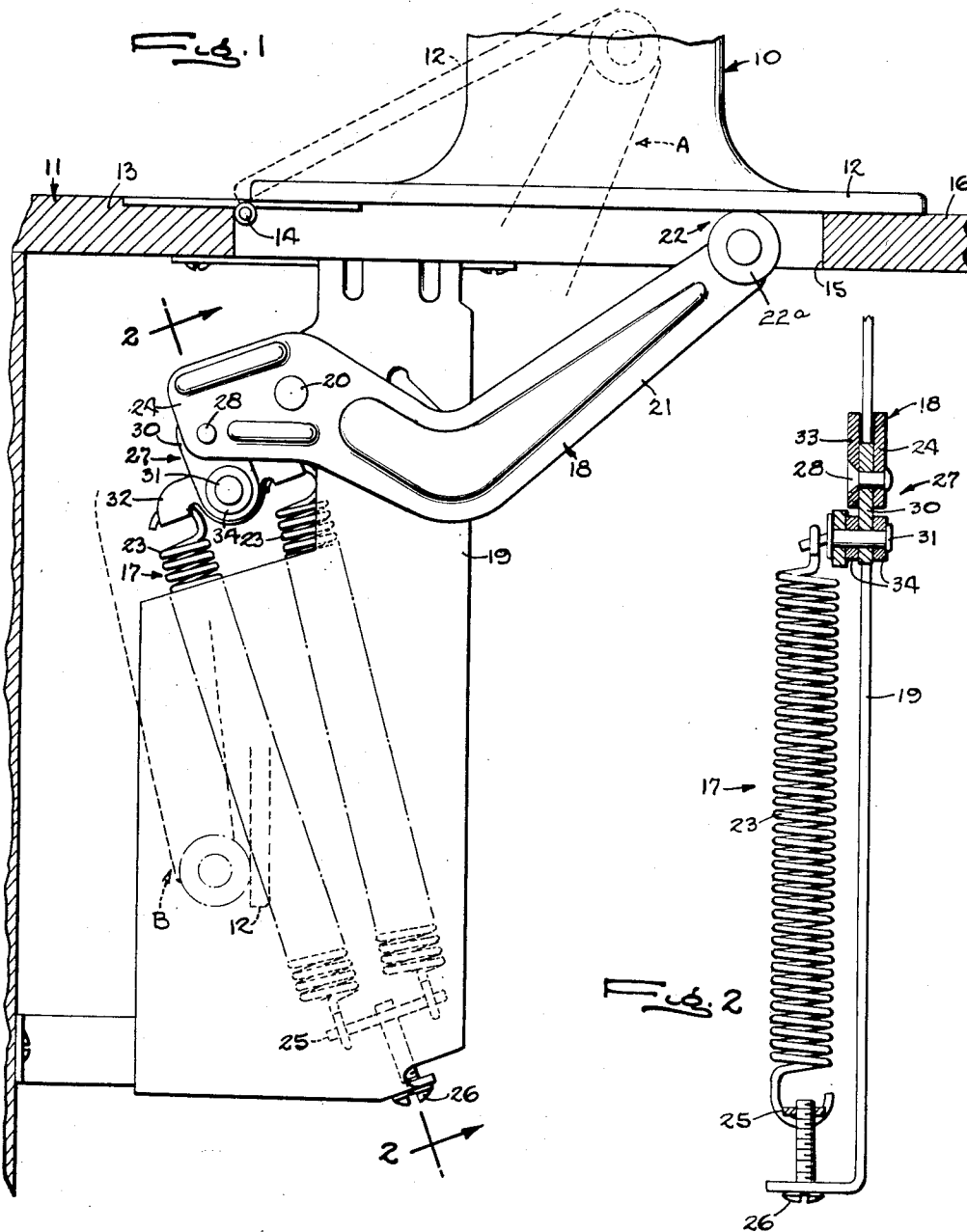
A. W. AHLGREN ET AL

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BALANCING MECHANISM

Filed July 2, 1956

2 Sheets-Sheet 1



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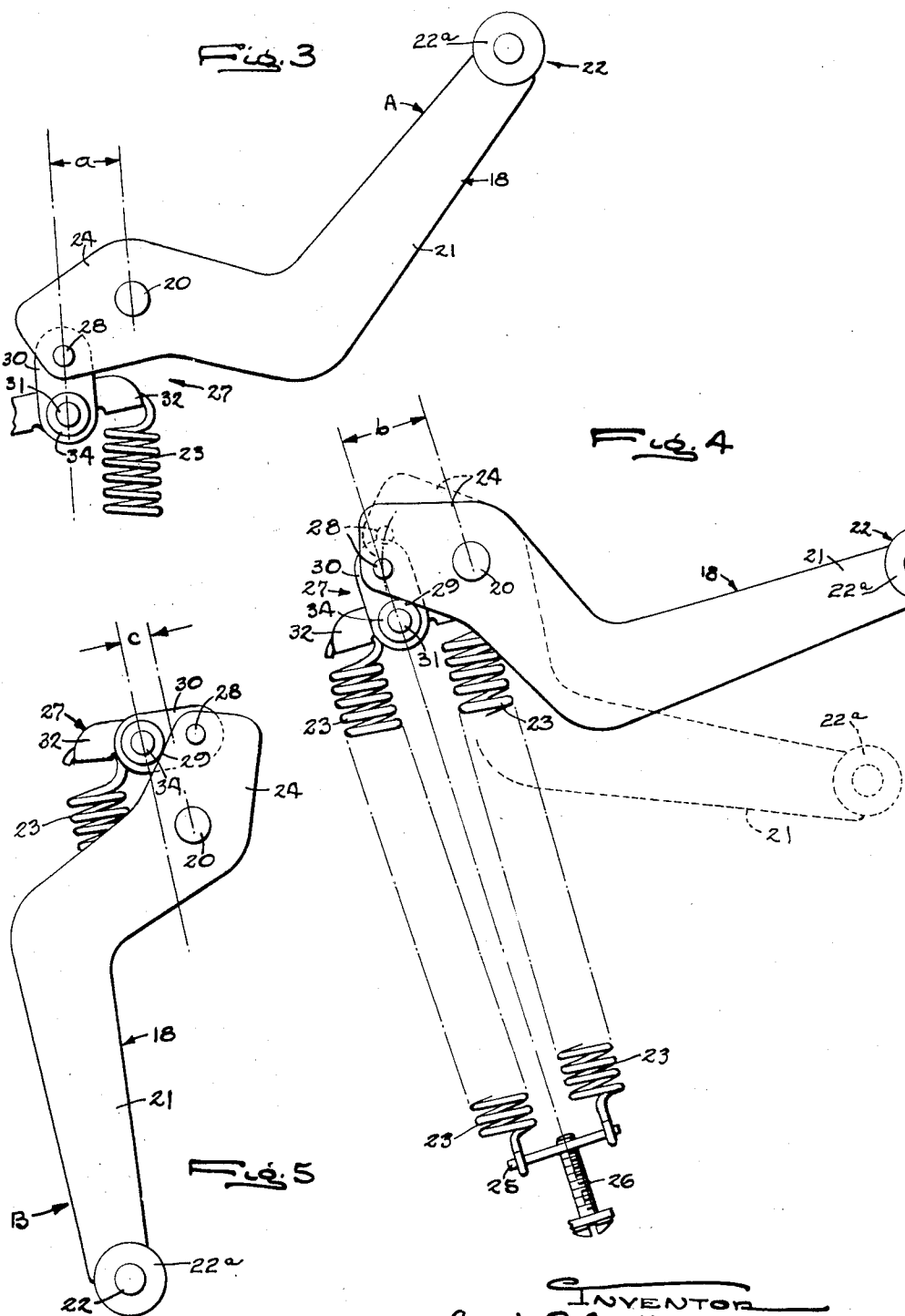
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BALANCING MECHANISM

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5 Claims. (Cl. 74—99)

This invention relates to mechanisms for balancing objects movable between two positions such as a sewing machine which is movable between a stored position within a cabinet and an operative position on top of the cabinet. More particularly, the invention relates to a mechanism of this type in which a lever is fulcrumed in the cabinet with one arm connected to the object being balanced and the other end to a spring, the latter exerting the force for counterbalancing the weight of the object.

The general object of the invention is to provide a new and improved mechanism of the above character in which the effective lever arm of the spring is at or near its maximum length throughout a greater range of lever movement as compared to prior devices of this type.

A more detailed object is to achieve the foregoing object by interposing a novel connection between the lever and the spring with the connection being operable first to join the spring to the lever at one point until the effective lever arm begins to decrease and then to transfer the connection to another point so that the lever arm continues to increase in length.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figure 1 is a fragmentary vertical section of a sewing machine incorporating the novel balancing mechanism of the present invention.

Fig. 2 is a fragmentary sectional view taken along the line 2—2 in Fig. 1.

Figs. 3, 4 and 5 are views similar to Fig. 1 but show the parts in different positions.

While the invention may be used to balance a variety of objects which move back and forth between two positions, it is shown in the drawings for purposes of illustration as used to balance a sewing machine 10 which is pivotally mounted on a frame 11. Herein, the frame is a cabinet or housing for storing the sewing machine and is arranged so that the machine rests on top of the cabinet when in use.

The base 12 of the sewing machine is joined along its rear edge to a top portion 13 of the cabinet 11 by a hinge 14 to swing up and down about the horizontal axis of the hinge. The base spans an opening 15 in the cabinet top and the front edge of the base rests on a second top portion 16. The latter is, by a means not shown, hinged to swing up and down to open the cabinet top and permit the sewing machine to be inserted into the cabinet.

To store the machine 10, the latter first is swung up to the position shown in broken lines in Fig. 1 and then the top cabinet portion 16 is lifted to open the upper end of the cabinet. Next, the machine is swung into the interior of the cabinet and the cabinet top is closed.

In order to make it easier to raise and lower the sewing machine, the machine is counterbalanced by a spring mechanism 17. This mechanism includes a lever 18 ful-

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crumed intermediate its ends, but nearer one end, on a bracket 19 which is bolted to the cabinet on the inside thereof. The lever is fulcrumed by means of a pin 20 to swing about a horizontal axis generally below the axis of the hinge 14 and the longer arm 21 of the lever is coupled to the underside of the base 12 of the sewing machine as indicated at 22. In this instance, the coupling 22 includes a roller 22a which abuts against the underside of the base 12 and rolls back and forth across the base as the machine and lever are swung up and down.

One or more contractile springs 23, in this case two, are connected at one end to the shorter arm 24 of the lever 18. The springs are vertically disposed and are anchored at their lower ends to the bracket 19 by means of a plate 25 and a screw 26. The springs tend to turn the lever counterclockwise as viewed in Fig. 1, that is, in the direction to raise the sewing machine. Thus, when the machine is swung down into the cabinet, the springs are extended and exert a force which partially balances the weight of the machine.

In such a balancing mechanism, the magnitude of the balancing force depends on the effective lever arm of the springs 23, that is, the distance between the fulcrum 20 and the point at which the springs are connected, this distance being measured along a line perpendicular to the longitudinal axes of the springs. With prior mechanisms of this type, the effective lever arm follows generally along a sine curve and, usually, the length of the arm decreases rapidly as the object being balanced approaches its lowermost position, the time when the greatest balancing force is desired.

To enlarge the range in which the effective lever arm is at or near its maximum, the present invention contemplates interposing a novel connection 27 between the lever 18 and the springs 23 so that the arm is of appreciable length during a major portion of the movement of the lever. For these purposes, the connection 27 is constructed and arranged so that it first joins the springs to the lever at a point 28 near the outer end of the arm 24 and then, when the effective lever arm is at or near the maximum, it transfers the connection to a point 29 (Fig. 4) which is spaced inwardly from and beneath the point 28. The result of the transfer is that the lever arm continues to increase upon further turning of the lever 18.

In the present instance, the connection 27 includes a short link 30 which is pivotally connected to the shorter arm 24 at the point 28. Joined to the other end of the link by a pivot 31 is a bracket 32 to which the upper ends of the springs 23 are anchored. As shown in Figs. 1 and 2, the lever 18 is disposed on one side of the housing bracket 19 and the springs 23 on the other and a flat plate 33 similar in size and shape to the short arm 24 is disposed on the same side as the springs and is connected to the fulcrum 20. The outer end of the plate is connected to the pivot 28, that is, the plate and the short arm straddle the link 30, whereby the plate is, in effect, a part of the lever 18. With this arrangement and with the parts in the position shown in Fig. 1, the springs 23 act on the lever 18 at the pivot 28.

In order to transfer the connection between the springs 23 and the lever 18 from the pivot 28 to the point 29, washers 34 are mounted on the pivot pin 31 on opposite sides of the link 30 so that they are in the planes of the short arm 24 and the plate 33 as illustrated in Fig. 2. Thus, when the lever 18 turns to the position shown in full lines in Fig. 4, the washers abut against the undersides of the short arm and the plate at the point 29. At this time, therefore, the springs are connected to the lever at the point 29 and the force of the springs now acts on the pivot 31 instead of the pivot 28.

With the construction described above, the lever 18

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turns from an upper position A (shown in broken lines in Fig. 1) to a lowermost position B. As illustrated in Fig. 3, the link 30 projects down from the pivot 31 and the washers 34 do not engage the short arm 24 and the plate 33. The effective length of the lever arm for the springs 23, therefore, is the perpendicular distance between the pivots 28 and the fulcrum 20, that is, the distance a in Fig. 3. This distance is less than the actual distance between the pivot and the fulcrum. As the sewing machine 10 is swung down into the cabinet 11, the lever arm increases until it equals the actual distance between the pivot and the fulcrum. At about this time, the washers 34 abut against the short arm 24 and the plate 33.

With the washers 34 engaging the arm 24 and the plate 33 as shown in Fig. 4, the pivot pin 31 is, for practical purposes, rigid with the lever 18. Now, therefore, the effective lever arm is the perpendicular distance between this pin and the fulcrum, the distance b in Fig. 4. It will be seen that the pin is below the fulcrum so that the new lever arm has not as yet reached its maximum. As the machine 10 is swung down further, therefore, the lever arm increases in length until the lever 18 reaches the position shown in broken lines in Fig. 4. It is not until this time that the effective lever arm begins to decrease. Even when the lever reaches the lowermost position B, the lever arm is of substantial length (the distance c in Fig. 5). Without the novel connection 27, there would be no balancing force in the position B since the pivot 28 has passed over the line of action of the springs 23.

It will be observed that the range in which the effective lever arm of the springs 23 is at or near the maximum is greatly increased by interposing the novel connection 27. Moreover, the lever arm remains of substantial length through a greater arc of lever movement than with conventional mechanisms and this permits the object being balanced to move further while still obtaining a balancing force.

We claim as our invention:

1. A balancing mechanism for a device which is movable up and down between first and second positions, said mechanism comprising a frame, an elongated lever fulcrumed intermediate its ends on said frame to turn about a horizontal axis, means for coupling one end of said lever to said device, a generally upright link, a pivot joining the upper end of said link to the other end of said lever, an element pivotally mounted on the other end of said link, an anchor mounted on said frame and disposed below said link, a contractile spring connected to said anchor and said element and operable to urge said lever to turn in one direction about its fulcrum, and an abutment mounted on said link beneath said pivot to engage the lower edge surface of said lever as the latter turns against the action of said spring, said abutment being located to engage said surface when said fulcrum and said pivot are in a line generally perpendicular to the line of action of said spring whereby the spring thereafter acts on the lever through the abutment.

2. A balancing mechanism comprising a frame, a member for supporting the device to be balanced and mounted on said frame to swing up and down about a horizontal axis, an elongated generally horizontal lever fulcrumed intermediate its ends on said frame to swing about a second horizontal axis spaced below said first axis, a generally upright link, a pivot joining the upper end of said link to the other end of said lever, an element piv-

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otally mounted on the other end of said link, an anchor mounted on said frame and disposed below said link, a contractile spring connected to said anchor and said element and operable to urge said lever to turn in one direction about its fulcrum, and an abutment mounted on said link beneath said pivot to engage the lower edge surface of said lever as the latter turns against the action of said spring, said abutment being located to engage said surface when said fulcrum and said pivot are in a line generally perpendicular to the line of action of said spring whereby the spring thereafter acts on the lever through the abutment.

3. A balancing mechanism for a device which is movable between first and second positions, said mechanism comprising a frame, an elongated lever fulcrumed intermediate its ends and said frame, means for coupling one end of said lever to said device, a link, a pivot joining one end of said link to the other end of said lever, an element pivotally mounted on the other end of said link, a contractile spring connected at one end to said element and at the other end to said frame and operable to urge said lever to turn in one direction about its fulcrum, and an abutment mounted on said link and spaced from said pivot to engage an edge surface of the lever as the latter turns against the action of said spring, said abutment being located to engage said surface when said fulcrum and said pivot are in a line generally perpendicular to the line of action of said spring whereby the spring then acts on the lever through the abutment.

4. A balancing mechanism for a device which is movable between first and second positions, said mechanism comprising a frame, an elongated lever fulcrumed intermediate its ends on said frame, means for coupling one end of said lever to said device whereby the lever swings in one direction as the device moves to said first position and in the opposite direction when the lever moves to said second position, a member, a spring acting between said member and said frame, and a connection for selectively joining said member to said lever at one of two angularly spaced points with a first one of said points leading the second point as the lever swings in said one direction, said connection being operable as the lever turns against the action of said spring to join the member first to said first point on the lever and then, when the fulcrum of the lever and said first point are in a line generally perpendicular to the line of action of the spring, to join the member to the lever at said second point.

5. A balancing mechanism for a device which is movable between first and second positions, said mechanism comprising a frame, an elongated lever fulcrumed intermediate its ends on said frame, means for coupling one end of said lever to said device, a link, a pivot joining one end of said link to the other end of said lever, a spring acting between the other end of said link and said frame to be stressed as said lever turns in one direction about said fulcrum, said spring tending to turn the lever in the other direction about the fulcrum, and an abutment on said link trailing behind said lever as the latter turns in one said direction and engageable with the lever as said fulcrum and said pivot form a line perpendicular to the line of action of said spring whereby the spring thereafter acts on the lever through said abutment.

No references cited.