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A. DE VRIES ET AL
EXTENSIBLE SPRING BALANCE

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Fig. 1.

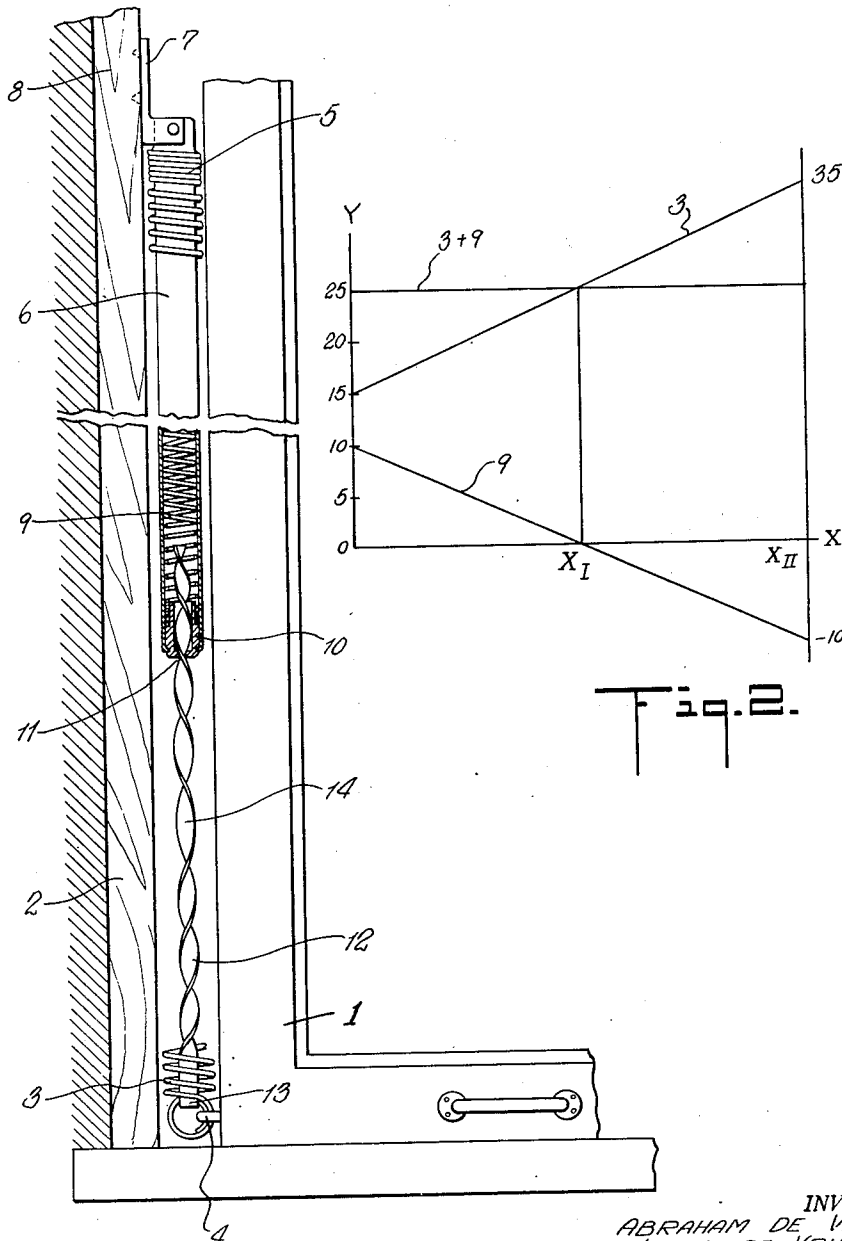


Fig. 2.

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EXTENSIBLE SPRING BALANCE

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The present invention relates to an improvement in an extensible spring balance that is particularly useful for balancing window sash.

It has been known for some time to balance window sash and the like with spring balances instead of the earlier sash cord and weight. Spring balances of this type generally include a spiral strip member having a gradually increasing pitch that is enclosed by a pair of coil springs, one of the springs acting as a torsion spring which exerts its reactive force on the spiral strip, and the other acting as a tension or compression spring that is extended or compressed as the sash is raised or lowered.

Although spring balances of this type have been constructed wherein the net effective force exerted by the balance remains substantially constant in all positions, the amount of space made available in window frames for the reception of sash balances is so small as to require a selection of springs that are incapable of balancing heavier sash.

It has now been found that by using a spiral member having a reverse twist, the range of reaction forces exerted by a torsion spring and an extensible spring, such as a tension or compression spring, can be effectively doubled, thus making it possible to increase greatly the load capacity without increasing the dimensions of the balance.

One advantage of the balance of this invention, therefore, is that it is capable of balancing objects such as window sash of greater weight than was hitherto possible with balances of equal dimensions.

This and other advantages, as well as the principles of the present invention will become more apparent from the following detailed description made with reference to the accompanying drawing, it being understood, however, that the invention is not limited to the particular construction illustrated or to the application thereof to the balancing of window sash.

In the drawing:

Figure 1 is a view in sectional elevation of a preferred embodiment of the invention as applied to a window sash; and

Figure 2 is a graphic representation showing the variation of forces exerted by the spring within the balance while the balance is extended from its fully contracted position to its fully extended position.

In the embodiment illustrated by way of example in Figure 1, a window sash 1 is mounted slidably in a window frame 2. In a space between the sash 1 and the frame 2 there is posi-

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tioned a tension spring 3, one end of which is attached to the sash by any suitable means at 4. The other end of the spring 3 is fixedly secured at 5 to a tube 6 which is in turn attached by means of a fastening member 7 to the frame at 8.

A torsion spring 9 within the tube 6 is fixedly connected to the tube at its upper end. The lower end of the spring 9 is secured to a spiral engaging member which may be in the form of a nut or, as shown, in the form of a slotted nipple 10 mounted for rotation in the tube 6. The nipple 10, at point 11, engages with a spiral member which may be in the form of a screw threaded bar or, as shown, in the form of a spiral strip 12. The spiral strip 12 is secured to the spring 3 at 13 and reverses its pitch at 14.

The operation of the spring balance illustrated in Figure 1 in counterbalancing window sash will now be explained with reference to Figure 2, wherein the ordinate axis $o-y$ indicates force in kilograms exerted in an upwardly direction, the abscissa $o-x$ represents the amount of movement of the sash in a downwardly direction, the positively sloping line represents the upward reaction force of the tension spring 3 and the negatively sloping line represents the upward reaction force of the torsion spring 9.

Assuming, for the purpose of illustration, that the window sash 1 weighs 25 kilograms and that only one spring balance is to be employed to counterbalance it, the tension spring, in its contracted position, i. e., when the sash is in its extreme raised position may be biased to exert an upward reaction force of 15 kilograms on the sash at 4. At this point the nipple 10 engages the spiral strip 12 near its lower end, at which the strip has its minimum positive pitch. The torsion spring 9 is biased to exert a torque or rotational force on the nipple, i. e., it tends to unwind in a clockwise direction when viewed from above. The pitch of the spiral strip 12 at its lower end and the bias of the torsion spring 9 is such that the vertical component of the reaction force exerted by the nipple 10 on the spiral strip and, therefore, the sash 1, is 10 kilograms in an upwardly direction. The total effective force exerted by the springs 3 and 9 is therefore 25 kilograms, the weight of the sash.

As the sash is lowered toward its half-way position, represented in Figure 2 by X_1 , the tension spring 3 is stretched and therefore exerts a gradually increasing force in the upwardly direction until it becomes 25 kilograms at X_1 . At the same time, the spiral strip 12 moves outwardly

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of the tube 6 and the torsion spring 9 is wound up. Due to the gradual increase in pitch of the spiral, the vertical component of the reaction force exerted by the nipple on the spiral strip 12 gradually diminishes notwithstanding the fact that the torsion spring 9 is wound up until it becomes zero when the nipple engages the strip at point 14 since the pitch at that point is 90°. Here again the total effective force exerted by the springs 3 and 9 is, therefore, 25 kilograms.

When the sash is further lowered to its lowermost position, as illustrated in Figure 1, the tension spring 3 is further stretched until it exerts a maximum force, in an upwardly direction, of 35 kilograms. At the same time, the spiral strip 12 moves outwardly of tube 6 and the torsion spring 9 is unwound. Due to the gradually decreasing negative pitch of the spiral engaged by the nipple 10, the torsion spring 9, through the medium of the nipple exerts a gradually increasing force, notwithstanding the fact that the torsion spring is unwound further all the time, in a downwardly direction on the spiral strip until it becomes 10 kilograms at position XII. Thus the algebraic sum of reaction forces of the spring balance is again 25 kilograms in an upwardly direction.

From the foregoing description, it is evident that the total effective force exerted in an upwardly direction by the spring balance remains substantially constant at all positions of the sash. Furthermore, the effective ranges of reaction forces exerted by the springs are, due to the reverse twist in the spiral strip 12, twice as great as they would be if the spiral strip were twisted in only one direction.

It is to be understood that the tension spring 3 may be replaced by a compression spring and that innumerable other changes and modification, which will become apparent to those skilled in the art upon reading the foregoing description, may be made without departing from the principles of this invention as defined in the appended claims.

We claim:

1. An extensible spring balance comprising a reversely twisted spiral member securable at one end against rotation, an extensible spring member having a first and second end and surrounding said spiral member, the first end of said spring member being movable with the securable end of said spiral member and the second end of said spring member being movable relative to said first end, a spiral engaging member within said extensible spring member and rotatable on said spiral member upon movement along the length thereof, and a torsion spring member within said extensible spring member, one end of said torsion spring member being secured within and immovable relative to said second end of the extensible spring member and the other end of said torsion spring member being fixed to said spiral engaging member, said spiral member, spiral engaging member, extensible spring member and torsion spring member cooperating to exert a substantially uniform force between the securable end of the spiral member and the second end of said extensible spring member while said extensible spring member is in various degrees of extension.

2. An extensible spring balance comprising a reversely twisted spiral member securable at one end against rotation, a tension spring member having a first and second end and surrounding said spiral member, the first end of said spring member being movable with the securable end of

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said spiral member and the second end of said spring member being movable toward and away from said first end, a nipple within said tension spring member, said nipple engaging with said spiral member and being rotatable thereon upon movement along the length thereof, and a torsion spring member within said tension spring member, one end of said torsion spring member being secured within and immovable relative to said second end of the tension spring member and the other end of said torsion spring member being fixed to said nipple, said spiral member, nipple, tension spring member and torsion spring member cooperating to exert a substantially uniform force between the securable end of the spiral member and said second end of said tension spring member while said tension spring member is in various degrees of extension.

3. An extensible spring balance comprising a spiral member securable at one end against rotation, said spiral member being twisted in one direction between its midpoint and one end and in the opposite direction between its midpoint and the other end, an extensible spring member having a first and second end and surrounding said spiral member, the first end of said spring member being movable with the securable end of said spiral member and the second end of said spring member being movable relative to said first end, a nipple within said extensible spring member, said nipple engaging with said spiral member and being rotatable thereon upon movement along the length thereof, and a torsion spring member within said extensible spring member, one end of said torsion spring member being secured within and immovable relative to said second end of the extensible spring member and the other end of said torsion spring member being fixed to said nipple, said spiral member, nipple, extensible spring member and torsion spring member cooperating to exert a substantially uniform force between the securable end of the spiral member and said second end of said extensible spring member while said extensible spring member is in various degrees of extension.

4. An extensible spring balance comprising a spiral member securable at one end against rotation, said spiral member being twisted in one direction between its midpoint and one end and in the opposite direction between its midpoint and the other end to form convolutions having gradually decreasing pitches as they approach the ends of the spiral members, an extensible spring member having a first and second end and surrounding said spiral member, the first end of said spring member being movable with the securable end of said spiral member and the second end of said spring member being movable relative to said first end, a nipple within said extensible spring member, said nipple engaging with said spiral member and being rotatable thereon upon movement along the length thereof, and a torsion spring member within said extensible spring member, one end of said torsion spring member being secured within and immovable relative to said second end of the extensible spring member and the other end of said torsion spring member being fixed to said nipple, said spiral member, nipple, extensible spring member and torsion spring member cooperating to exert a substantially uniform force between the securable end of the spiral member and said second end of said extensible spring member while said extensible spring member is in various degrees of extension.

5. A sash balance for a window comprising an

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extensible spring member, one end of said spring member being secured to the window sash and the other end being secured to the window frame, a reversely twisted spiral member within said spring member, one end of said spiral member being secured against rotation to one end of said spring member, a spiral engaging member within said extensible spring member and rotatable on said spiral member upon movement along the length thereof, and a torsion spring member within said extensible spring member, one end of said torsion spring member being secured within and immovable relative to the end of the extensible spring member remote from the end to which the spiral member is secured and the other end of said torsion spring member being fixed to said spiral engaging member, said spiral member, spiral engaging member, extensible spring member and torsion spring member cooperating to exert a substantially uniform force to counterbalance the weight of the window sash in all positions thereof relative to the window frame.

6. In an extensible spring balance having a spiral member and a coil spring cooperatively engaged to exert a substantially uniform force while the balance is in various degrees of extension, one portion of said spiral member being twisted in clockwise direction and another portion thereof being twisted in counterclockwise direction.

7. In an extensible spring balance having a

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spiral member and a coil spring cooperatively engaged to exert a substantially uniform force while the balance is in various degrees of extension, said spiral member comprising an elongated strip having parallel sides, said strip having a twist in one direction from the mid-point thereof to one end and a twist in the opposite direction from the mid-point to the other end.

8. In an extensible spring balance having a spiral member and a coil spring cooperatively engaged to exert a substantially uniform force while the balance is in various degrees of extension, said spiral member comprising an elongated strip having parallel sides, said strip having a twist in one direction from the mid-point thereof to one end and a twist in the opposite direction from the mid-point to the other end, the number of turns per unit length of said strip increasing gradually toward both ends.

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