March 4, 1969 A. J. KRYSPIN 3,431,522

ADJUSTABLE SPRING TENSION MEANS

Filed April 14, 1967

FIG. 1

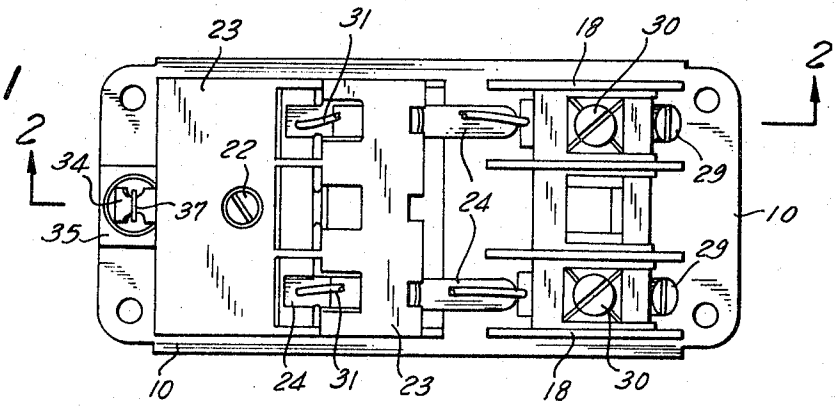


FIG. 2

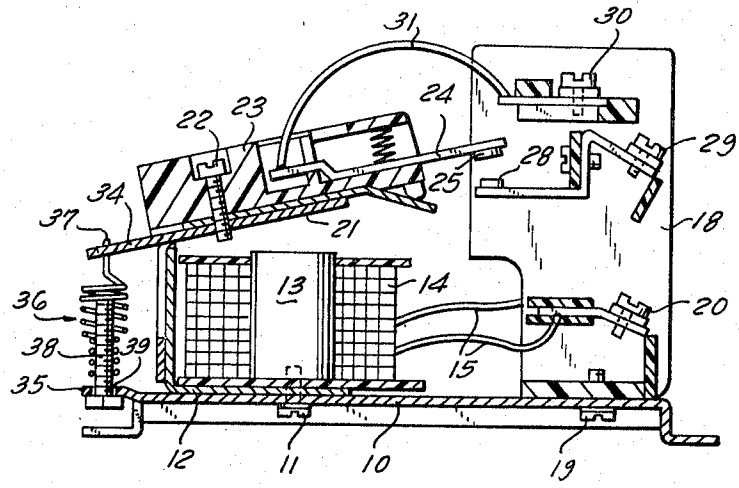


FIG. 3

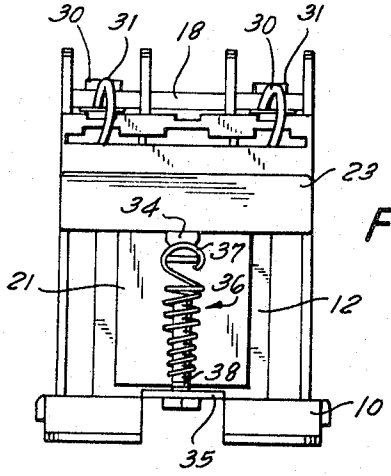
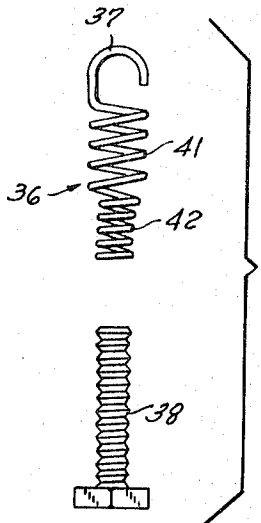


FIG. 4



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ADJUSTABLE SPRING TENSION MEANS

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ABSTRACT OF THE DISCLOSURE

Two relatively movable parts, e.g., the core and armature of an electrical relay, are held in a predetermined relationship by a coil tension spring. One end of the spring is non-rotatably joined to one of the parts. The other end terminates in coils of smaller diameter than the remainder of the spring coils, and is threadably engaged by a screw carried by the other part. By turning the screw, the spring can be stretched or relaxed to vary its tension.

This invention relates to resilient tensioning means, and more particularly to means for adjusting the tension of a coil spring.

It is an object of the invention to provide an adjustable coil spring tensioning means which is considerably less expensive than comparable conventional arrangements, because the coils of the spring are employed as one of the adjustment components.

It is another object of the invention to provide such a means admirably adapted to furnish the required tension between the relatively movable parts of electrical devices, such as relays and solenoid-operated equipment, e.g. valves.

In brief, the invention includes a coil spring secured at one end to one of two relatively movable parts. The securement is such that the spring is not permitted to rotate freely about its longitudinal axis. The other end of the spring terminates in a helical form, and is threadably engaged by a screw carried loosely by the other relatively movable part. Consequently, rotation of the screw causes the spring to stretch or relax, depending upon the direction of rotation, whereby the spring tension is varied.

Advantageously, the portion of the spring engaging the screw has a smaller diameter than the remainder of the spring, for reasons which are pointed out below in the detailed description of one embodiment of the invention.

In the drawings:

FIG. 1 is plan view of an electrical relay incorporating a spring means according to this invention;

FIG. 2 is a vertical cross-sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is an end view of the relay; and

FIG. 4 is an exploded view of a spring and adjustment screw with which it is cooperable.

The device chosen to illustrate this invention is an electrical relay, including a base plate **10** adapted to be mounted on some stationary support. The core of an electromagnet is mounted on the base plate by means of a screw **11**, the core comprising an L-shaped member **12**, and a post **13**, both of magnetic material. Wound around the post **13** is a solenoid, or coil, **14**, the ends **15** of which extend toward a terminal block **18** also mounted on the base plate **10** by means of a screw **19**.

The terminal block **18** is, of course, formed of insulation material, and carries a total of six terminals or binding posts. The ends **15** of the solenoid **14** are electrically connected to the two lowermost terminals **20** (only one being visible in FIG. 2). The terminals **20** are adapted to be connected to a suitable electrical control circuit

capable of energizing the solenoid when the relay is to be actuated.

Pivotally supported on the upper end of the vertical arm of L-shaped member **12** is an armature **21** of magnetic material. The armature has substantially an L shape, but its arms are arranged at an angle slightly greater than 90°. Mounted on the upper surface of the armature, by means of a screw **22** is a non-magnetic block **23** supporting a pair of spring biased, movable contact fingers **24**, each of which carries a contact button **25**. Arranged in the path of downward movement of the contacts **25** is a pair of fixed contacts **28** electrically connected to terminals **29** mounted in the terminal block **18**. The third pair of terminals **30** are electrically connected to the rear ends of contact fingers **24** by wires **31**.

When sufficient current is applied to the solenoid **14**, the armature **21** will be attracted to the post **13**, and hence the armature rotates in a clockwise direction in FIG. 2, to bring the movable contacts **25** into engagement with the fixed contacts **28**. When the solenoid **14** is deenergized, the spring tension means of the present invention, described below, rotates the armature back to the position of FIG. 2 and the contacts **25** and **28** are disengaged. Thus, external circuits connected to the terminals **29** and **30** will be controlled by operation of the relay.

The armature **21** is provided with an integral, rigid tab **34**, struck out of the vertical arm of the armature. The tab **34** extends from the pivot axis of the armature in a direction opposite to the direction of the horizontal arm of the armature. Directly below and spaced from the tab **34**, the base plate **10** is formed with an integral rigid tab **35**. A coil spring **36** is stretched between the tabs **34** and **35**. The upper end of the spring is formed as a hook **37** which extends over the top of the tab **34** and is accommodated by notches in the side edges of the tab **34**. This connection between spring and tab prevents any significant axial rotation of the spring, although some rotational "play" is permitted. The lower end of the spring terminates in a helical shape, and is connected to the tab **35** via an adjustment screw **38**. The threaded shank of the screw **38** fits loosely through a hole **39** in the tab **35**, and an enlarged head **40** on the screw limits its movement toward the tab **34**.

A special feature of the invention is the formation of the spring **36** with an effective region **41** of relatively large diameter coils, and a connection region **42** of smaller diameter coils. The coils **42** and adjustment screw **38** are so chosen that the screw is threadably accommodated within the coils. Consequently, when the screw **38** is rotated the coil region **42** of spring **36** moves axially along the shank of the screw. Thus, when the screw **38** is rotated in one direction, the region **42** of the spring moves down the screw toward the tab **35**, thereby stretching the effective region **41** of the spring and increasing the force on the armature **31** tending to keep it in the position shown in FIG. 2. As a result, the current level required in the solenoid to pivot the armature toward post **13** is increased. Rotation of the screw **38** in the opposite direction will have the opposite effect.

Several advantages accrue from the two diameter spring formation described above. As is known, for the same diameter wire, the larger the diameter of the coils of a spring, the lower the rate of increase in tension as the spring is stretched. Thus, it is desirable to employ relatively large coils so that fine adjustment of spring tension can be achieved; hence the coils **41** are relatively large. On the other hand, the cost of screws increase with their diameter. Therefore, by employing a connection region **41** of relatively small diameter coils, a cheaper adjustment screw can be employed.

More important, by making the internal diameter of

the spring region **41** larger than the adjustment screw diameter, the screw can be accommodated within the coils **41** without touching them. Thus, a relatively long screw **38** can be used, to permit a wide range of tension variation, but regardless of the adjustment, the number of coils in the effective region **41** of the spring remains the same. In contrast, if the spring **36** had a constant diameter throughout its length, each rotation of the adjustment screw tending to stretch the spring would withdraw another coil from the effective, force-producing region of the spring.

Furthermore, stretching the spring obviously reduces the number of its coils per unit length, whereas the number of threads per unit length of the screw remains constant. Hence, if the spring had a constant diameter, a point would be reached, upon tensioning of the spring, at which the spring coils and the screw would not be threadably engageable. With the spring of the present invention, however, all the stretching of the spring takes place in the region **41**, hence the screw **38** and spring region **42** remain threadably engageable throughout the range of spring adjustment.

It will be appreciated, therefore, that the present invention provides an adjustable spring tension means which is inexpensive to manufacture, assemble, and service, and which nevertheless offers a wide range of tension adjustment.

The invention has been shown and described in preferred form only, and by way of example, and many variations may be made in the invention which will still be comprised within its spirit. It is understood, therefore, that the invention is not limited to any specific form or embodiment except insofar as such limitations are included in the appended claims.

What is claimed is:

1. A device having first and second relatively movable parts, and adjustable spring tension means for movably maintaining said parts in a predetermined relationship, said means comprising a screw carried by said first part, said screw having a threaded portion and being freely rotatable and freely slidably in an axial direction with respect to said first part, means for limiting the axial movement of said screw toward said second part, and a coil spring non-rotatably joined to said second part, said spring having a region of relatively large diameter coils and a region of smaller diameter coils, all of said smaller coils being of the same diameter and at least some of said smaller diameter coils being located within the threads of said screw, whereby said smaller coils move longitudinally along the said screw as the latter is rotated so as to vary the tension in said larger coils, said screw being longer than the region of smaller diameter coils but the number of said larger diameter coils remaining the same regardless of the extent to which said screw is rotated to vary the tension in said larger coils.

2. A device as defined in claim **1** wherein said first part is provided with a hole through which said screw passes, the diameter of said hole being larger than the diameter of said screw, and said limiting means is a head on said screw having a dimension larger than the diameter of said hole so that said head will not pass through said hole.

3. A device as defined in claim **1** wherein one of said parts includes a solenoid, and the other of said parts includes an armature movable with respect to said solenoid and against the force of said spring when electric current is supplied to said solenoid.

4. A device as defined in claim **1** wherein said device is an electrical relay, said first part including a solenoid wound on a relatively stationary core, stationary contacts fixed with respect to said coil, said second part including an armature mounted for movement with respect to said core, and movable contacts carried by said second part adapted to engage said stationary contacts when said solenoid is energized and causes said armature to move against the force of said spring.

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U.S. Cl. X.R.

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