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Dalton

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[54] **ACTUATING DEVICE**

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[73] Assignee: **Westram Corporation,** Muskegon, Mich.

[22] Filed: **Aug. 24, 1971**

[21] Appl. No.: **174,453**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 4,883, Jan. 22, 1970, abandoned.

[52] **U.S. Cl.** **200/47,** 74/458, 74/424.7

[51] **Int. Cl.**.....**H01h 3/16**

[58] **Field of Search**.....74/458, 458.7, 458.8, 424.7; 200/47; 338/180, 148, DIG. 1

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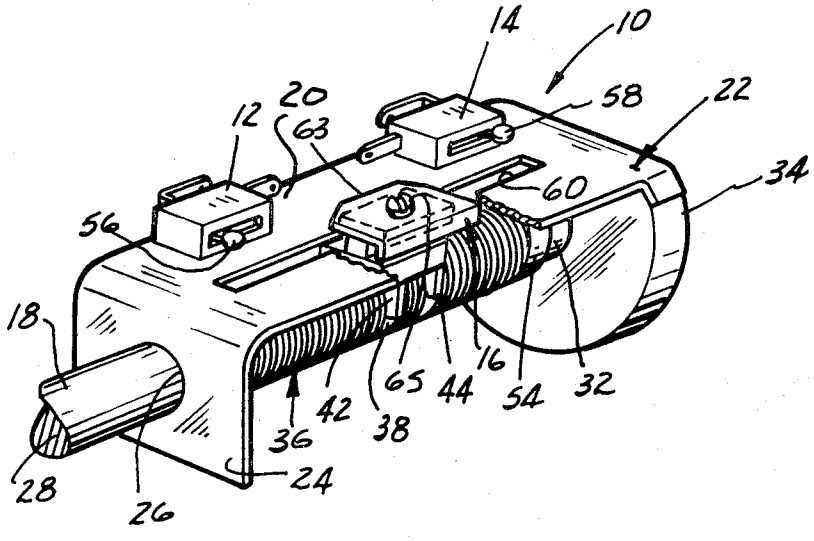
Primary Examiner—Herman J. Hohauser

Attorney—Robert C. Hauke et al.

[57] **ABSTRACT**

A device for actuating a pair of spaced limit switches in which an actuating member is reciprocably mounted for movement between the limit switches. The device comprises a rotatably mounted shaft having a wire wound around a selected length of the shaft and defining a helical path. The opposite ends of the wire are fixed to the shafts in such a manner that when a portion of the actuating member is disposed in the helical path, that is, between any two adjacent turns of the wire, the adjacent sides of each of the remaining successive turns of the wire are normally in abutment. As the shaft is rotated in opposite directions, the wire reciprocally drives the actuating member between the limit switches.

8 Claims, 8 Drawing Figures



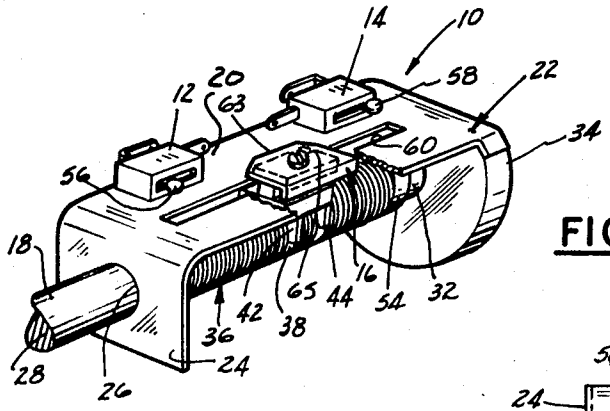


FIG-1

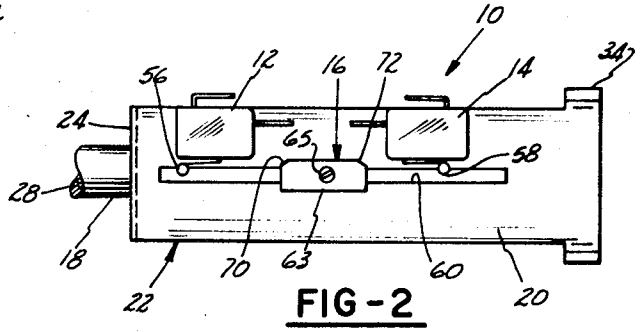


FIG-2

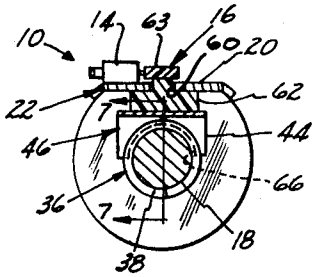


FIG-4

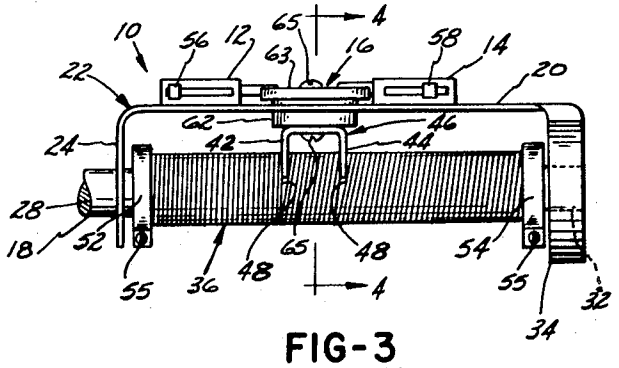


FIG-3

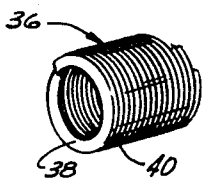


FIG-5

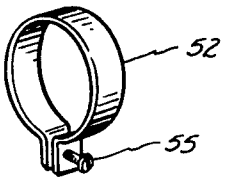


FIG-6

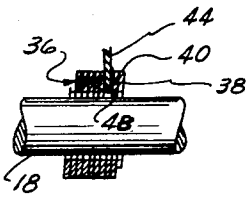


FIG-7

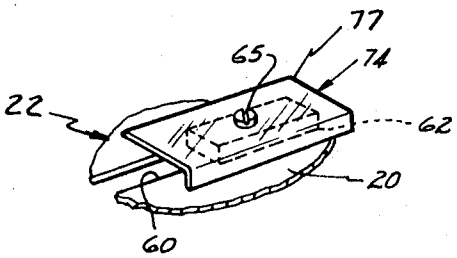


FIG-8

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ACTUATING DEVICE

CROSS REFERENCE TO RELATED APPLICATION

The present application is a continuation-in-part of co-pending U. S. Pat. application Ser. No. 4,883, filed Jan. 22, 1970, now abandoned.

BACKGROUND OF THE INVENTION

I. Field of the Invention

The present invention relates to actuating devices and is particularly applicable to such devices having a rotating shaft which reciprocally drives an actuating member to alternately actuate a pair of spaced limit switches.

II. Background of the Invention

Heretofore, such actuating devices have taken the form of a pair of electrical limit switches which are adapted to be actuated by means of an actuating member which is reciprocally mounted between the two switches. The actuating member usually comprises a nut disposed intermediate the limit switches and adapted to travel axially along a rotating threaded shaft. Although such limit switches have functioned in a satisfactory manner, they are characterized by certain disadvantages which the present invention overcomes. The threaded shaft of previous devices of course has a fixed number of turns per inch with the number depending upon the desired application. To modify the control requires in many cases replacement of the shaft. Such shafts are relatively expensive to manufacture as the grooves defined by each successive turn of the threads must be relatively deep to insure proper retention of the actuating member. If control of the actuating member within close tolerances is required, the shaft must have a greater number of threads per inch and this increases the cost of the manufacture of such shafts.

Such shafts also must be completely replaced in the event of any damage during operation and thus the cost of maintaining such devices represents another disadvantage in their use.

It is therefore desirable to provide an actuating device of the type hereinbefore described in which the actuating member is driven by a shaft selectively rotated in opposite directions, but which is of a simple and inexpensive construction.

SUMMARY OF THE PRESENT INVENTION

The present invention which will be described subsequently in greater detail comprises a rotatable shaft having a wire wound around a selected length of the shaft with adjacent sides of each successive turn of the wire being normally in abutment but being axially separable to define a helical path to receive an actuating member as the shaft is rotated to alternately engage and disengage a pair of spaced limit switches. In the preferred embodiment, the wire is substantially rectangular in cross section and has a radial depth which substantially exceeds its axial thickness. The wire is wound around the shaft on its narrow edges such that the depth of the wire defines the depth of the helical path. This not only insures that there will be sufficient depth formed by the wire to securely retain the actuating member, but it also provides a device in which because of the relatively large number of turns per inch a quite accurate actuating device can be inexpensively achieved. Suitable clamping means releasably attach the wire to the shaft to permit it to be readily installed on any shaft and to permit it to be easily replaced in the event of damage to the wire during use.

It is therefore an object of the present invention to provide an improved means for actuating limit switches which is extremely accurate, simple in construction and inexpensive to manufacture.

It is also an object of the present invention to provide an improved means for actuating limit switches in which the driving portion thereof may be easily and inexpensively replaced.

Other objects, advantages and applications of the present invention will become apparent to those skilled in the art when the accompanying description of an example of the best mode contemplated for practicing the invention is read.

BRIEF DESCRIPTION OF THE DRAWING

The description herein makes reference to the accompanying drawing wherein like reference numerals refer to like parts and in which:

FIG. **1** is perspective view of an actuating device constructed in accordance with the principles of the present invention;

FIG. **2** is a top plan view of the actuating device illustrated in FIG. **1**;

FIG. **3** is a side elevational view of the actuating device illustrated in FIG. **1**;

FIG. **4** is a transverse cross-sectional view of the actuating device taken along line **4—4** of FIG. **3**;

FIG. **5** is a fragmentary perspective view of one example of the present invention prior to its installation on a shaft;

FIG. **6** is a perspective view of the clamping means used in FIG. **1**;

FIG. **7** is a fragmentary cross-sectional view taken along line **7—7** of FIG. **4**; and

FIG. **8** is a fragmentary perspective view of a modification of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, there is illustrated an actuating device **10** of the rotary type having mounted thereon a pair of conventional limit switches **12** and **14** adapted to control an electrical device (not shown) when the limit switches **12** and **14** are actuated by an actuating member **16** which, in turn, is reciprocally driven by a rotating shaft **18**. The shaft **18** could, for instance, be the output shaft of an electric motor and the actuating device **10** and the limit switches **12** and **14** could be connected to the electric motor so that after rotation of the shaft **18** for a predetermined number of revolutions in one direction one of the limit switches would be engaged by the actuating member **16** to shut off the electric motor or to reverse the direction of rotation of the shaft for a predetermined number of revolutions.

The limit switches **12** and **14** are preferably attached to the upper surface of one leg **20** of a generally L-shaped member **22**. The other leg **24** of the L-shaped member **22** has an aperture **26** (FIG. **1**) through which shaft **18** extends. Aperture **26** is sized to permit relative

rotational movement between the shaft **18** and the leg **24**. One end **28** of the shaft **18** extends outwardly from the device **10** for connection to the rotary output of an electrical device, such as the aforementioned electric motor (not shown), whose operation it is desired to control and is adapted to rotate therewith, either directly or through suitable gearing means. The opposite end **32** of shaft **18** is rotatably supported by a suitable bearing **34** which, in turn, is fixedly mounted to the end of the leg **20** by any suitable means, such as by welding or the like.

A flat wire **36** is wound around the outer periphery of the shaft **18** for a portion of the length of the shaft **18** and, as can be seen in FIGS. **5** and **7**, the wire **36** is preferably rectangular in cross section having sides **38** with a radial depth substantially exceeding the axial thickness of the peripheral edge **40** of the wire **36**. The wire **36** is wound around the shaft **18** on its edges **40** such that the sides **38** of the wire **36** define the depth of the spacing between the successive turns of the wire **36**. As can be best seen in FIGS. **1**, **3**, **4** and **7**, the adjacent sides **38** of each successive turn of the wire **36** are normally in abutment, except for that portion engaged by a pair of flanges **42** and **44** of a U-shaped bracket **46** carried by the actuating member **16**. The spacing formed by the separation between turns of the wire **36** as the flanges **42** and **44** move along the shaft **18** defines a helical path **48** along the length of the shaft **18** and causes the actuating member **16** to be moved back and forth along the length of the shaft **18** as the shaft is rotated in opposite directions. The number of revolutions of the shaft **18** necessary to move the actuating member **16** any desired distance along the shaft **18** will depend upon the number of turns of wire per inch on the shaft **18** and the total length of the wire **36**. Thus, it can be seen that any selected control of the actuating member **16** may be obtained by using wires having various thicknesses of the edge **40** and various lengths so as to accommodate the particular application in which the limit switches are to be utilized.

The opposite ends of the wire **36** are attached to the shaft **18** by means of a pair of clamps **52** and **54** (FIG. **3**) made of any suitable material, such as spring steel, and which are adapted to snap onto the opposite ends of the wound wire **36** and to be fastened into place by screws **55** or the like so as to securely retain the wire **36** to the shaft **18**. Before tightening the clamps **52** and **54**, the flanges **42** and **44** are inserted between the appropriate pair of adjacent turns of the wire **36** and the clamps **52** and **54** are so positioned on the shaft **18** that the remaining adjacent sides **38** of each adjacent turn of the wire **36** are in abutment. The screws **55** are then tightened to securely mount the clamps **52**, **54** and the wire **36** to the shaft **18**. Since the clamps **52** and **54** and the wire **36** rotate with the shaft **18**, the flanges **42** and **44** and thus the actuating member **16** will be reciprocally driven longitudinally along the shaft **18**. As the shaft **18** is rotated, each adjacent side **38** of each successive turn of the wire **36** will be momentarily axially separated by the flanges **42** and **44** as the same follow the helical path **48**. In order to achieve this separation, each successive turn of the wire **36** moves axially a distance equal to the width of each flange **42** and **44**.

The clamps **52** and **54** permit easy removal and replacement of the wire **36** in the event it fails during use or if a different control is desired. The wire **36** is preferably made from a spring steel, however, other materials having specific desired characteristics, such as wear or corrosion resistant materials, may be used depending upon the particular application.

The limit switches **12** and **14**, respectively, have a pair of movable contacts **56** and **58**, each of which is adapted to make and/or break an electrical circuit in their respective limit switches **12** and **14** to generate an appropriate signal, which in turn controls the electrical device. The movable contacts **56** and **58** are positioned with respect to the upper surface of the leg **20** in such a manner that they extend over an elongated slot **60** in the leg **20**. The slot **60** is disposed along an axis parallel to the longitudinal axis of the shaft **18** and functions to guide the movement of the actuating member **16** in a manner to be described hereafter.

The actuating member **16** is comprised of three components: an inverted T-shaped member **62**, a rectangularly shaped member **63** carried at the top of the T-shaped member **62**, and the U-shaped bracket member **46**, all of which are coupled to each other by threaded screws **65**. The upper leg of the member **62** extends through the slot **60** and is guided thereby as the actuating member **16** travels between the movable contacts **56** and **58**. Each flange **42** and **44** of the U-shaped member **46** has a semi-circular portion, one of which is shown at **66** in FIG. **4**. The semi-circular portions **66** on each flange **42** and **44** are adapted to extend into, at axially spaced points, the helical path **48** defined by the axially separated sides **38** of the wire **36** and are moved axially by the wire **36** as the shaft **18** turns in the same manner as a nut would move along a rotating threaded screw. As the shaft **18** is rotated in a clockwise direction as viewed in FIG. **4**, the actuating member **16** will be driven by the wound wire **36** towards the movable contact **56**, that is, to the left as viewed in FIG. **3**. As the shaft **18** is rotated in the opposite direction, that is, counterclockwise as viewed in FIG. **4**, the actuating member **16** will be moved toward the movable contact **58**, that is, to the right as viewed in FIG. **3**.

Thus, the wound spring wire **36** provides a helical path similar to the spiral groove on the threaded shafts of the previously described devices and functions in a similar manner to drive the actuating member **16** in either direction between the pair of spaced limit switches **12** and **14** to alternately engage and actuate the limit switches.

In order to insure a smooth engagement of the actuating member **16** with each of the movable contacts **56** and **58**, the opposite ends of the rectangularly shaped member **63** are beveled to form cam surfaces **70** and **72** (FIG. **2**), which respectively engage the movable contacts **56** and **58** to displace the same. The limit switches **12** and **14** operate in a manner which is well known in the art and are adapted to complete an electric circuit when their associated movable contacts **56** and **58** are engaged by the actuating member **16** to generate an electrical signal which activates other electrical circuitry, also known in the art, to, for example, reverse the direction of rotation of the particular electrical device to be controlled, such as an electric motor.

Referring to FIG. **8**, there is illustrated a modified actuating member **74** having an L-shaped member **77** attached to the top of the leg of the T-shaped member **62**

by the screw **65**. By providing members **77** of various lengths, the amount of travel of the actuating member **16** between the limit switches **12** and **14** can be varied to suit any desired application.

In either embodiment of the invention, if the shaft **18** is the output shaft of an electric motor, for instance, the actuating device **10** can be used to control the direction and number of revolutions of such an output shaft. After the electric motor has been energized to rotate the shaft **18** a predetermined number of revolutions, the appropriate limit switch will be engaged by either member **63** or the member **77** to reverse the direction of the electric motor. The shaft **18** will then be rotated in a reverse direction until the opposite limit switch is engaged by either the member **63** or the member **77**, whereupon the direction of rotation of the electric motor is again reversed.

The present invention has particular application to electric motors in that a limit switch assembly can be provided for such devices by simply clamping the assembly of the present invention to the output shaft of the motor. Heretofore it would have been necessary to undertake expensive modifications of the output shaft or to provide another shaft coupled to the output shaft to provide a limit switch assembly for electric motors.

Having thus described the invention, what is claimed is as follows:

1. An actuating device comprising:

an actuating member mounted for movement toward at least one contact point;

a rotatably mounted shaft having at least one continuous helical path circumscribing said shaft along a selected length thereof, a portion of said actuating member extending into said helical path and movable along said selected length in response to the rotational movement of said shaft;

said helical path comprising spaces between successive turns of a wire wound around said shaft, the adjacent sides of each turn of said wire normally being abutment and being axially separable to accommodate said actuating member portion as said actuating member moves along said selected length.

2. The actuating device defined in claim **1** and in which said wire is rectangular in cross section and has a pair of edges of a smaller dimension than another pair of said edges, said wire being wound about said shaft on one of its shorter edges so that the longer edges define the depth of said helical path, the adjacent longer edges of said wire normally being in abutment.

3. The actuating device as defined in claim **1** including means for releasably attaching said wire to said shaft.

4. The actuating device as defined in claim **3** wherein said releasably attaching means comprises a pair of clamps attaching the opposite ends of said wire to said shaft.

5. The actuating device of claim **1** including at least one switch disposed in the path of said actuating member.

6. The actuating device as defined in claim **5** including a mounting bracket having a base and at least one flange extending at right angles thereto, said bracket being mounted to said shaft by said flange, said base having a slotted portion generally parallel to the axis of rotation of said shaft, said actuating member being mounted in said slotted portion, said switches being mounted on said base proximate one end of said slotted portion and adapted to be engaged by said actuating member as the same is driven along said slotted portion by said rotating shaft.

7. The actuating device as defined in claim **6** wherein said wire has a radial width which substantially exceeds its axial thickness, said wire being wound around said shaft on one of its edges such that the radial width of said wire defines the depth of said helical path.

8. The actuating device as defined in claim **7** including means for releasably attaching said wire to said shaft.

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