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54 **A limit switch and a method for manufacture of a rotary shaft for the limit switch.**

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## Description

The present invention relates to an improved limit switch and a method for manufacturing a rotary shaft for said limit switch.

As the sealed limit switch containing a switch element in a housing, there is known a device described in JP-U- 61-83229 (1986), for instance.

As illustrated in Fig. 5, the prior art limit switch has a rotary shaft a journaled within a housing and a roller lever is rigidly secured to one end of this rotary shaft a. Formed at the other end of the rotary shaft a is a cam portion b such that as the rotary shaft a is turned with the roller lever c, this cam portion b actuates a switch element d within said housing via a plunger (not shown). Furthermore, a bearing (not shown) supporting the rotary shaft a has a spiral channel on its inner surface so that the grease fed to the journal means spreads along said channel to the entire sliding surface of the rotary shaft a. In this prior art construction having a long spiral channel on the inner surface of the bearings, it takes time for the applied grease to diffuse onto the sliding surfaces and tends to cause abnormal wear and seizure due to local deficiencies in the grease. Furthermore, since the spiral channel is difficult to process, a large number of steps is required for the manufacture of the bearing, so that the overall manufacturing cost is inevitably increased.

The present invention overcomes the above disadvantages of the prior art limit switch and provides an improved limit switch which features a smooth rotation of the roller lever and a method of manufacturing the same.

The present invention relates, in one aspect, to a limit switch comprising a housing, a switch element contained in said housing, a rotary shaft, a journal means supporting said rotary shaft, a roller lever secured to one end of said rotary shaft for driving said shaft, a cam portion formed at the other end of said rotary shaft and a plunger and an auxiliary plunger through which said switch element is driven by said cam portion, said rotary shaft having a grease reservoir means axially extending at its periphery to lubricate sliding surfaces of said rotary shaft and journal means.

In a preferred embodiment, the present invention provides a limit switch which is generally the same as the above-mentioned switch except that said grease reservoir means consists of two axially intending grease reservoirs.

In still another aspect, the present invention relates to a method of manufacturing a limit switch rotary shaft which comprises die-casting a rotary shaft using a split die consisting of an upper segment and a lower segment, said segments being configured to form a couple of axially extending plane areas to serve as grease reservoirs along their parting line

and a multiplicity of minute hills and valleys for improved lubrication on the peripheral surface of the rotary shaft.

The above arrangements are advantageous over the prior art limit switch having a spiral channel on the inner surface of the journal means in that the grease may diffuse rapidly over the entire sliding surfaces to insure smooth rotation of the rotary shaft and prevent abnormal wear and seizure in prolonged operation.

The above method eliminates the need for machining the grease reservoir on the sliding surface of the rotary shaft and provides for effective diffusion of the grease by taking advantage of minute hills and valleys formed on the surface of the shaft in die casting.

In the drawings:

Fig. 1 is a sectional view showing a limit switch according to the invention;

Fig. 2 (a) is a perspective view of a rotary shaft embodying the principles of the invention;

Fig. 2 (b) is a perspective view showing another rotary shaft embodying to the invention;

Fig. 2 (c) is another perspective view of the same rotary shaft;

Fig. 3 is a front view of the rotary shaft shown in Fig. 2 (a);

Fig. 4 is a sectional view, on an exaggerated scale, of the part IV encircled in Fig. 3; and

Fig. 5 is a perspective view showing the prior art rotary shaft.

The preferred embodiments of the invention will now be described with reference to the accompanying drawings.

Referring to Fig. 1, the reference numeral 1 indicates a housing having a head unit 2 in which a journal means 3 is mounted. Rotatably supported by this journal means 3 is a rotary shaft 4. As shown in Figs. 2B and 2C, this rotary shaft 4 is formed with a reduced portion 4a having a spline at one end and the base of a roller lever 6 rotatably supporting a roller 5 is fitted into the other end of said reduced portion 4a. In addition, the rotary shaft 4 is provided with an annular groove 4b for installation of an O-ring in a position closer to said reduced portion 4a. Furthermore, the intermediate portion of the rotary shaft 4 is locally reduced in thickness to form an axially elongated flat surface for use as a grease reservoir means 4c. When the rotary shaft 4 is fitted into the journal means 3, a generally crescent space is formed between this flat surface and the inner surface of the journal 3 and this space is filled with grease at assembling.

In a preferred embodiment of the present invention, which is illustrated in Fig. 2A, this intermediate portion is provided with two grease reservoirs 4c which are formed in die casting as described in detail hereinafter.

Formed at the other end of the rotary shaft 4 is a

cam portion 4d which is offset from the axis of the shaft 4 and a plunger 8 accommodated in the head unit 2 of the housing 1 is abutted against the upper surface of said cam portion 4d.

The above-mentioned plunger 8 is biased against the cam portion 4d by a compression spring 9 so that as the rotary shaft 4 is driven by the roller lever 6, the cam portion 4d pushes up the plunger 8 to compress the compression spring 9. Another plunger 10 is abutted against the underside of the cam portion 4d. The aforesaid plunger 10 is abutted against the upper end of a vertically movable auxiliary plunger 11 within the housing 10 via a spring 11a and the lower part of the auxiliary plunger 11 is connected to an operable part of a switch element 12 housed within the housing 1. The reference numeral 13 indicates a seal cap disposed over the auxiliary plunger 11 for preventing entry of grease into the switch element 12 within the housing 1 from the rotary shaft region.

The rotary shaft 4 illustrated in Fig. 2A can be advantageously manufactured by die casting.

The die not shown consists of an upper segment and a lower segment, with the parting line thereof being complementary to said grease reservoirs 4c. Thus, when molten zinc or aluminum, for instance, is poured into such a die to manufacture a rotary shaft 4, a couple of flat areas 4c extending axially are formed in the cast shaft in the positions corresponding to the parting line or joint between the upper and lower die segments. If bars are produced, they will never be projecting beyond the sliding surface 4f, with the result that the finishing operation such as bar trimming may be omitted. Furthermore, as mentioned above, these flat areas serve as grease reservoirs.

When the rotary shaft 4 thus manufactured is assembled into a switch system, the flat areas 4c form clearances between the inner surface of the journal and the sliding surface 4f. These clearances are filled with grease for lubrication.

The die-cast sliding surface 4f reveals under magnification a multiplicity of hills and valleys distributed all over as illustrated in Fig. 4. Therefore, as the rotary shaft 4 is driven by the roller lever 6, the grease fed to said reservoirs finds its way into the valleys to lubricate the sliding surfaces, thus precluding chances of oil shortage.

This improvement in lubrication not only insures smooth rotation of the shaft but prevents abnormal wear and seizure, thus contributing to an increased switch life.

Furthermore, because the flat areas of the rotary shaft as cast are utilized as oil reservoirs, it is no longer necessary to provide such reservoirs by machining, thus contributing to reduced manufacturing cost.

While the flat parts 4c of the rotary shaft 4 as formed along the parting line of the casting die are utilized as grease reservoirs in the above embodiment, at least one portion of the peripheral surface of

the rotary shaft 4 may be chamfered in an axially elongated rectangular shape for use as said grease reservoir means as illustrated in Figs. 2B and 2C.

## Claims

1. A limit switch comprising a housing, a switch element (12) contained in said housing (1), a rotary shaft (4), a journal means (3) supporting said rotary shaft (4), a roller lever (6) secured to one end of said rotary shaft (4) for driving said shaft (4), a cam portion (4d) formed at the other end of said rotary shaft (4) and a plunger (10) and an auxiliary plunger (11) through which said switch element (12) is driven by said cam portion, characterized in that said rotary shaft (4) has a grease reservoir means (4c) axially disposed at its periphery to lubricate sliding surfaces of said rotary shaft (4) and journal means.
2. A limit switch according to claim 1 wherein said grease reservoir means (4c) consists of a couple of reservoirs extending along the length of said rotary shaft (4).
3. A method of manufacturing a limit switch rotary shaft (4) which comprises die-casting a rotary shaft (4) using a split die consisting of an upper segment and a lower segment, said segments being configured to form a couple of axially extending plane areas to serve as grease reservoirs (4c) along their parting line and a multiplicity of minute hills and valleys for improved lubrication on the peripheral surface of the rotary shaft (4).

## Patentansprüche

1. Endschalter, umfassend ein Gehäuse, ein im Gehäuse (1) enthaltenes Schalterelement (12), eine Drehwelle (4), ein die Drehwelle (4) tragendes Wellenlager (3), einen an einem Ende der Drehwelle (4) befestigten Rollen- bzw. Wälzhebel (6) zum Antrieb der Welle (4), einen am anderen Ende der Drehwelle (4) ausgebildeten Nockenabschnitt (4d), sowie einen Plunger bzw. Tauchkolben (10) und einen Hilfsplunger bzw. -tauchkolben (11), durch die das Schalterelement (12) vom Nockenabschnitt angetrieben wird, dadurch gekennzeichnet, daß die Drehwelle (4) ein axial an ihrer Peripherie angeordnetes Fettreservoir (4c) aufweist, um die Gleitflächen von Drehwelle (4) und Wellenlager zu schmieren.
2. Endschalter nach Anspruch 1, worin das Fettreservoir (4c) aus ein paar von sich entlang der

Länge der Drehwelle (4) erstreckenden Reservoirs besteht.

3. Verfahren zur Herstellung einer Endschaltdrehwelle (4), umfassend das Druckgießen einer Drehwelle (4) unter Verwendung einer geteilten Preßform bzw. Düse, die aus einem oberen und einem unteren Segment besteht, wobei die Segmente konfiguriert sind, um entlang ihrer Teilungslinie ein paar als Fettreservoirs (4c) dienende, axial verlaufende Flächenbereiche und eine Vielzahl von sehr kleinen Bergen und Tälern zur verbesserten Schmierung auf der peripheren Oberfläche der Drehwelle (4) auszubilden.

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### Revendications

1. Un interrupteur de fin de course comprenant un boîtier, un élément interrupteur (12) contenu dans ledit boîtier (1), un arbre rotatif (4), un moyen de fusée ou de tourrillon supportant ledit arbre rotatif (4), un levier à rouleaux (6) fixé à une extrémité de l'arbre rotatif (4) pour entraîner ledit arbre (4), une portion de came (4b) formée à l'autre extrémité dudit arbre rotatif (4) et un piston (10) et un piston auxiliaire (11), par l'intermédiaire desquels ledit élément interrupteur (12) est entraîné par ladite portion de came, caractérisé en ce que l'arbre rotatif (4) comprend des moyens de réservoir de graisse ou lubrifiant, axialement disposés à sa périphérie pour lubrifier les surfaces coulissantes de l'arbre rotatif (4) et des moyens de fusée.
2. Un interrupteur de fin de course selon la revendication 1, dans lequel les moyens de réservoir de graisse (4c) sont formés par un couple de réservoirs s'étendant le long de la longueur de l'arbre rotatif (4).
3. Un procédé de fabrication d'un arbre rotatif d'interrupteur de fin de course (4), qui implique la réalisation d'un arbre rotatif (4) par coulage sous pression en utilisant une filière fendue formée par un segment supérieur et un segment inférieur, lesdits segments étant configurés de façon à former un couple de zones planes s'étendant axialement pour servir de réservoirs de graisse (4c) le long de leur ligne de partage et une multiplicité de menues collines et vallées pour améliorer la lubrification sur la surface périphérique de l'arbre rotatif (4).

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FIG. 1

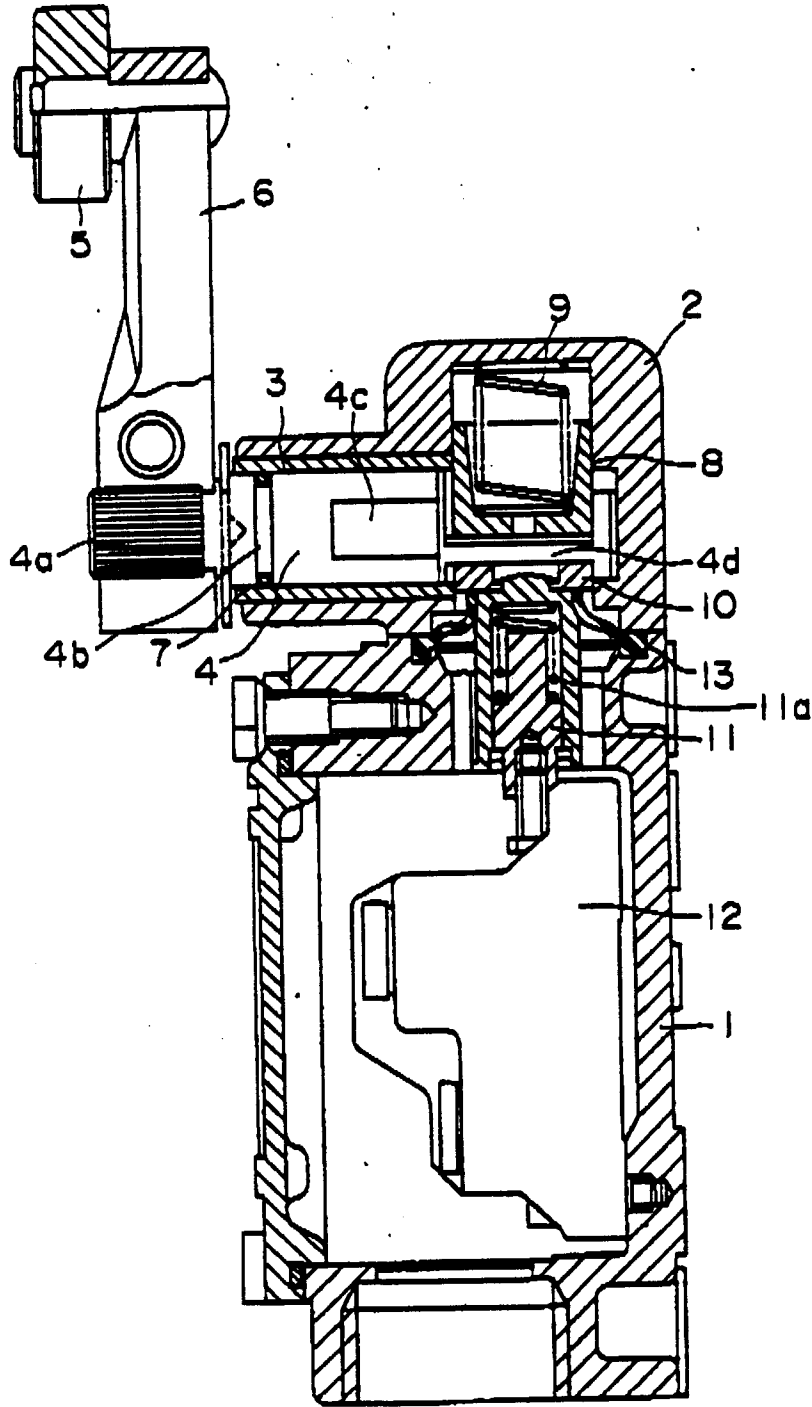


FIG. 2A

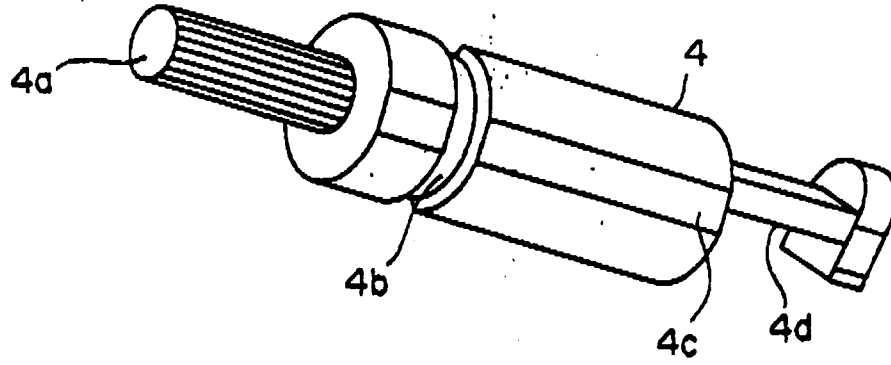


FIG. 2B

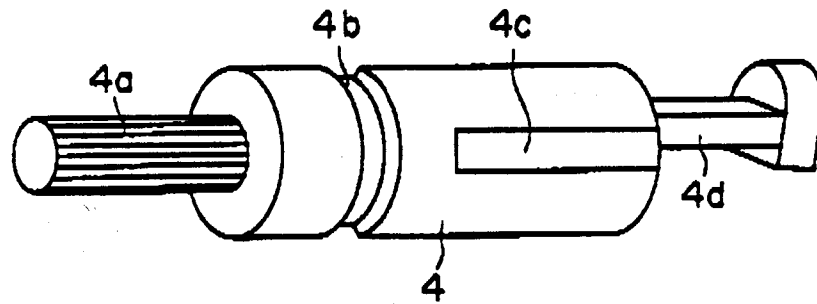


FIG. 2C

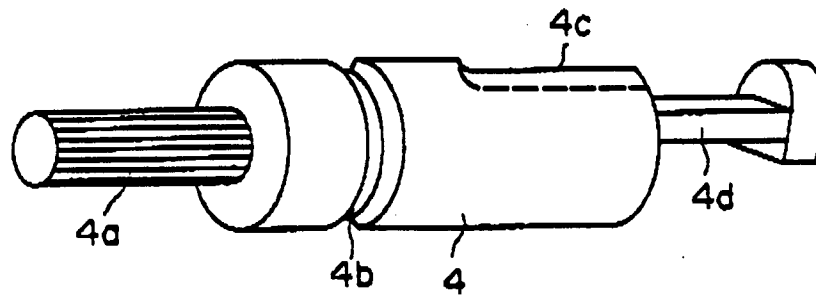


FIG. 3

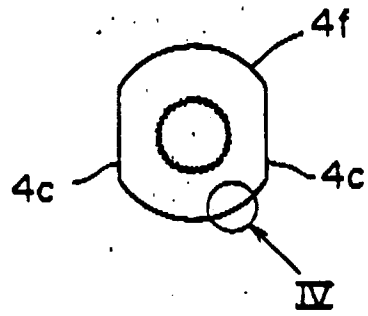


FIG. 4

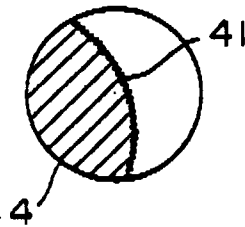


FIG. 5

