(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 043 809**
**A2**

# (12) EUROPEAN PATENT APPLICATION

(21) Application number: **81850121.5**

(51) Int. Cl.³: **G 05 G 9/04**

(22) Date of filing: **02.07.81**

(30) Priority: **04.07.80 SE 8004971**

(43) Date of publication of application: **13.01.82**
**Bulletin 82/2**

(84) Designated Contracting States: **AT BE CH DE FR GB IT LI NL**

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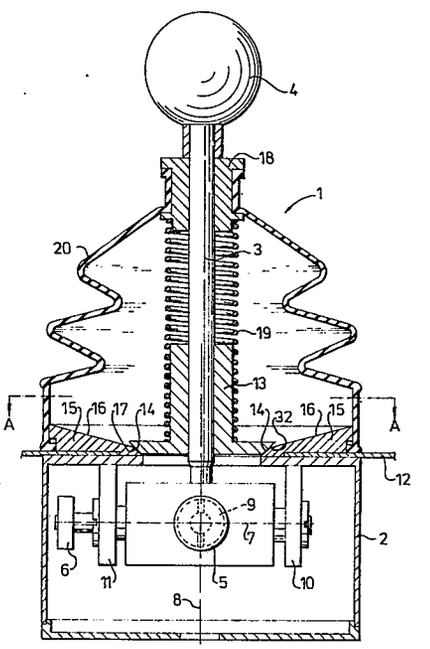
## (54) Device at multi-way lever.

(57) A device at a multi-way lever, so-called «joy-stick», comprised for example in a manipulator, comprising a housing (2) and projecting therefrom a control lever (3), which at its end located in the housing is hinged. According to the invention, a sleeve (13) is mounted concentrically about the lever (3), which sleeve (13) at one end is provided with a conic surface (14) intended by action of a spring force on the sleeve (13) to abut a plate (15) with a slide surface (16). The slide surface (16) includes a portion (17) with a conic surface so formed that the conic surface (14) of the sleeve upon abutment to the conic surface of the slide surface (16) is centered with respect to the slide surface to a non-operative position. By the invention a sturdy and simple device is obtained, which simply can be modified with respect to the force required for moving the lever (3) from its non-operative position. Modifications of the cross-sectional profile of the slide surface (16) yield different characteristics with respekt to said force required.

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Device at multi-way lever

This invention relates to a multi-way lever, a so-called "joy-stick" which, for example, is comprised in a manipulator.

Multi-way levers of this kind can in normal cases be moved from a central non-operative position in any directions. Multi-way levers of the kind here referred to often are used at machines and the like where several valves are desired to be controlled by one and the same operating lever.

Multi-way levers of this kind normally are supported at their lower end by two spring-loaded electric potentiometers, which are arranged perpendicularly to each other and capable each to emit an electric signal, so that the two signals together deliver information on the direction, in which the lever has been moved from the non-operative position, and on the distance of the lever movement from said position.

At a usual construction, the springs at the potentiometers together tend to maintain the lever in vertical non-operative position. The joint members, in which the lever is suspended, generally are yokes, on which the potentiometers and springs are mounted.

This construction, at which the springs are helical ones, does not permit the force, which is required for moving the lever from non-operative position, to be so varied as often is desired. Said force should be variable in such a manner, for example, that a much greater force is required when the lever has been moved through a certain distance from the non-operative position. At known constructions, furthermore, the force required for initiating the lever movement out of non-operative position is very small. As a result thereof, the person operating the lever must strain the arm in order to prevent the lever from being moved through too great a distance out of non-operative position when the deflection desired is only a small one.

A further disadvantage of known multi-way levers is their

structural height which, from the upper surface of an instrument inward to the panel, is great, due to the space required for said yokes and springs.

An essential desire, which cannot be satisfied by the present state of art, is a multi-way lever so designed that for moving the lever in some selected directions the force required is smaller than in the remaining directions.

The present invention eliminates entirely the aforesaid disadvantages and permits a multi-way lever to be designed so as to satisfy the said desire.

The present invention, thus, relates to a device at a multi-way lever, a so-called "joy-stick" which, for example, is comprised in a manipulator, comprising a housing and projecting therefrom a control lever, which is hinged at its end located in the housing,and characterized, in that a sleeve is mounted concentrically about the lever, which sleeve at one end is provided with a conic surface intended by action of spring force on the sleeve to abut a plate with a slide surface, which includes a central portion with a conic surface and outside said portion a portion concave to the sleeve, which conic surface is formed so that the conic surface of the sleeve upon abutment to the conic surface of the slide surface is centered with respect to the slide surface.

The invention is described in greater detail in the following, with reference to the accompanying drawings, in which

Fig. 1 is a section through a multi-way lever, to which the invention is applied,

Fig. 2 is a downward directed view along the line A-A in Fig. 1,

Fig. 3 shows a modified embodiment of the invention, one detail shown in the same view as in Fig.2,

Figs. 4, 5 show rolled-out circular sections of the detail in Fig. 3, and

Figs. 6,7 show two modified embodiments.

In Fig. 1 a multi-way lever 1 is shown, to which the invention is applied.

The multi-way lever 1, for example, is comprised in a manipulator and comprises a housing 2 and projecting therefrom a control lever 3. At the upper end of the lever 3 a ball 4 or corresponding member is located, which is held gripped when the lever is operated. To the lower end of the lever 3 two potentiometers 5,6 located perpendicularly to each other are attached. The fulcrum of the lever 3 is located at the lower end thereof on the same level as the intersecting point between the two lines 7,8. The lever 3 is attached to its fulcrum in a first joint member 9 so that the lever 3 can be moved in the plane of the drawing in Fig. 1. Said first joint member is hingedly attached to a second joint member 10,11, so that the lever 3 can be moved in a direction perpendicular to the plane of the drawing in Fig. 1. Said two joint members 9,10,11, thus, together render it possible to move the lever 3 in any direction out of its non-operative position shown in Fig. 1.

The numeral 12 designates the upper surface of an instrument panel or corresponding means. The aforedescribed attachment of the lever 3 to the joint members 9,10,11 and the location and design of the potentiometers 5,6 are not per se part of the present invention, but can be formed in a way other than shown in Fig. 1.

According to the invention, a sleeve 13 is located concentrically about the lever 3. The sleeve 13 is provided at one end with a conic surface 14, amd the entire sleeve 13 preferably is axial-symmetric. At least, however, the conic surface 14 preferably is axial-symmetric.

A plate 15 further is provided, which has a slide surface 16, against which the sleeve is intended to slide. Said slide surface 16 of the plate 15 includes a portion 17 with a conic surface so formed, that the conic surface 14 of the sleeve 13 upon abutment to the conic surface of the slide surface 16 is centered with respect to the slide surface, as shown in Fig. 1.

The sleeve 13 is located about the lever 3 between the free end thereof and said plate 15. A compression spring 19 of helical type is located between the sleeve 13 and a seat

18 at the free end of the lever and, thus, presses the sleeve 13 down against the slide surface 16. When the conic surface 14 of the sleeve 13 abuts the conic portion 17 of the slide surface 16, the lever 3 is centered automatically by action of the spring force to the non-operative position shown in Fig. 1.

As appears from Fig. 1, the sleeve 13 is moved to the free end of the lever 3 when the lever is moved in any direction from the non-operative position.

The slide surface 16 is inclined radially and has its lowermost point at the conic portion 17. As a result thereof, the lever automatically returns to non-operative position by action of the spring force of the spring 19, irrespective of in which direction and how far from the non-operative position the lever has been moved.

The portion of the device located above the instrument panel 12 preferably is protected by a rubber sleeve 20.

In Fig. 3 a modified embodiment of the invention is shown, at which the plate 15 has been given a modified design. Said plate 15 is designed in Fig. 3 by the numeral 21. Like the plate 15, the plate 21 has a conic portion 17.

According to this embodiment, the plate has different heights in different radial directions. In Fig. 4 the outer periphery 22 of the plate 21 is shown rolled-out, and in Fig. 5 a circular section at 23 is shown. Said circular section is an axial cross-section through the plate along the upper edge 32 of the conic portion 17. The conic portion 17 is axial-symmetric with the same form as shown in Fig. 1. The height of the plate 21 radially outside the conic portion varies so, that the plate is highest along four radii 24,27, which form $90^{\circ}$ relative to each other, and that the plate 21 is lower along radii 28-31, which are offset $45^{\circ}$ in relation to the radii 24-27.

The position of the radii is indicated by said numerals in Figs. 3 and 4. Between its higher and, respectively, lower portions, the plate 21 assumes sinus shape as shown in Fig. 4.

The amplitude of the sinus shape successively decreases for circular concentric sections through the plate 21 and is completely abolished at said inner periphery 23, see Fig. 5. According to this embodiment of the invention, the greatest diameter of the sleeve 13 is smaller than at the embodiment shown in Figs. 1 and 2, in order that the lower portion of the sleeve shall abut not only the higher portions 24-27 of the plate 21.

Owing to this design of the plate 21, relatively little force is required for moving the lever 3 radially out from its non-operative position in four mutually perpendicular radial directions. After having been moved radially along such a direction, the lever 3 can be moved perpendicularly to the radial direction, i.e. so that the sleeve 13 passes over a higher portion of the plate 21. For this, however, a substantially greater force is required.

An operator, thus, easily will sense four mutually perpendicular directions, which is of great importance for manipulators at certain machines.

The plate 21, of course, can be designed according to the principle described with reference to Figs. 3 and 4, but instead in such a manner, for example, that the plate 21 is formed with radially directed lower portions in one, two or three directions instead of in four.

The amplitude of the sinus shape, furthermore, can be levelled from the periphery 22 of the plate to the conic portion 17 in a manner other than successively or linear.

Such modifications are regarded comprised in the invention.

In Figs. 6 and 7 additional embodiments of the plate 15 are shown, which in Fig. 6 is designated by 33 and in Fig. 7 by 34. The plates 33 and, respectively, 34 are shown in a section corresponding to the section B-B in Fig. 2. The plates 33,34 in Figs. 6 and 7 are axial-symmetric.

In Fig. 6 the plate 33 is designed so that its height increases successively with the distance from its centre. The

height increases substantially close to the periphery 35 of the plate 33, resulting in that the force required for moving the lever from its non-operative position increases with increasing deflection of the lever 3 and increases substantially when the sleeve 13 approaches the periphery 35 of the plate 33, i.e. at a great deflection of the lever 3.

In Fig. 7 a plate 34 is shown, which is designed so as to have a substantially plane portion 36, whereafter in radial direction the height of the plate increases substantially close to its periphery 37. Owing to this design, the force required for moving the lever 3 from its non-operative position increases substantially first when the sleeve 13 approaches the periphery 17 of the plate 34.

The features mentioned in the introductory portion as characteristic of the invention, thus, result in a simple and sturdy structural design, which besides renders it possible to form the characteristics of the force required for moving the lever in such a manner, that the characteristics is adapted to different purposes. A further advantage of the invention is, that the structural height from the instrument panel 12 and downward of a manipulator is reduced substantially compared with known manipulators, because the spring arrangement is located above the instrument panel.

Different modifications of the invention have been mentioned above. The device according to the invention can be modified additionally without abandoning the invention idea.

The invention, thus, must not be regarded restricted to the embodiments referred to above, but can be varied within the scope of the attached claims.

Claims

1. A device at multi-way lever, so-called "joy-stick", comprised for example in a manipulator, comprising a housing and projecting therefrom a control lever, which at its end located in the housing is hinged, c h a r a c t e r i z e d i n that a sleeve (13) is mounted concentrically about the lever (3), which sleeve (13) at one end is provided with a conic surface (14) intended by action of a spring force on the sleeve (13) to abut a plate (15) with a slide surface (16), which slide surface includes a central portion (17) with a conic surface and outside thereof a concave portion to the sleeve, which conic surface is designed so that the conic surface (14) of the sleeve (13) upon abutment to to the conic surface of the slide surface (16) is centered with repsct to the slide surface (16).

2. A device as defined in claim 1, c h a r a c t e r i z e d i n that the sleeve is located about the lever (3) between the free end of the lever and said plate (15), and that the slide surface (16) of the plate (15) is directed to the free end of the lever (3).

3. A device as defined in claim 1 or 2, c h a r a c t e r - i z e d i n that the height of the plate (15,21) varies with the radial distance from the conic portion (17) and outward, at the same time as its height varies in circumferential direction, preferably according to a sinus shape, so that the variation in height in circumferential direction is greatest at the outer periphery (22) of the plate (21) and smallest or insignificant at the transition of the conic portion (17) to the portion of the slide surface (16) which is located outside.

4. A device as defined in claim 3, c h a r a c t e r i z e d i n that said variation in height is such, that the height of the plate (21) in radial direction is highest in four mutually perpendicular directions (24-27) and lowest in four perpendicular directions (28-31), which lastmentioned directions (28-31) are offset $45^{\circ}$ in circumferential direction relative to said firstmentioned directions (24-27).

5. A device as defined in claim 1 or 2, c h a r a c t e r - i z e d i n that the plate (15) is axial-symmetric, and the height of the plate (15) varies with the radial distance from the conic portion (17) and outward, so that the height increases substantially in said direction close to the periphery of the plate (15,33,34).

Fig_1

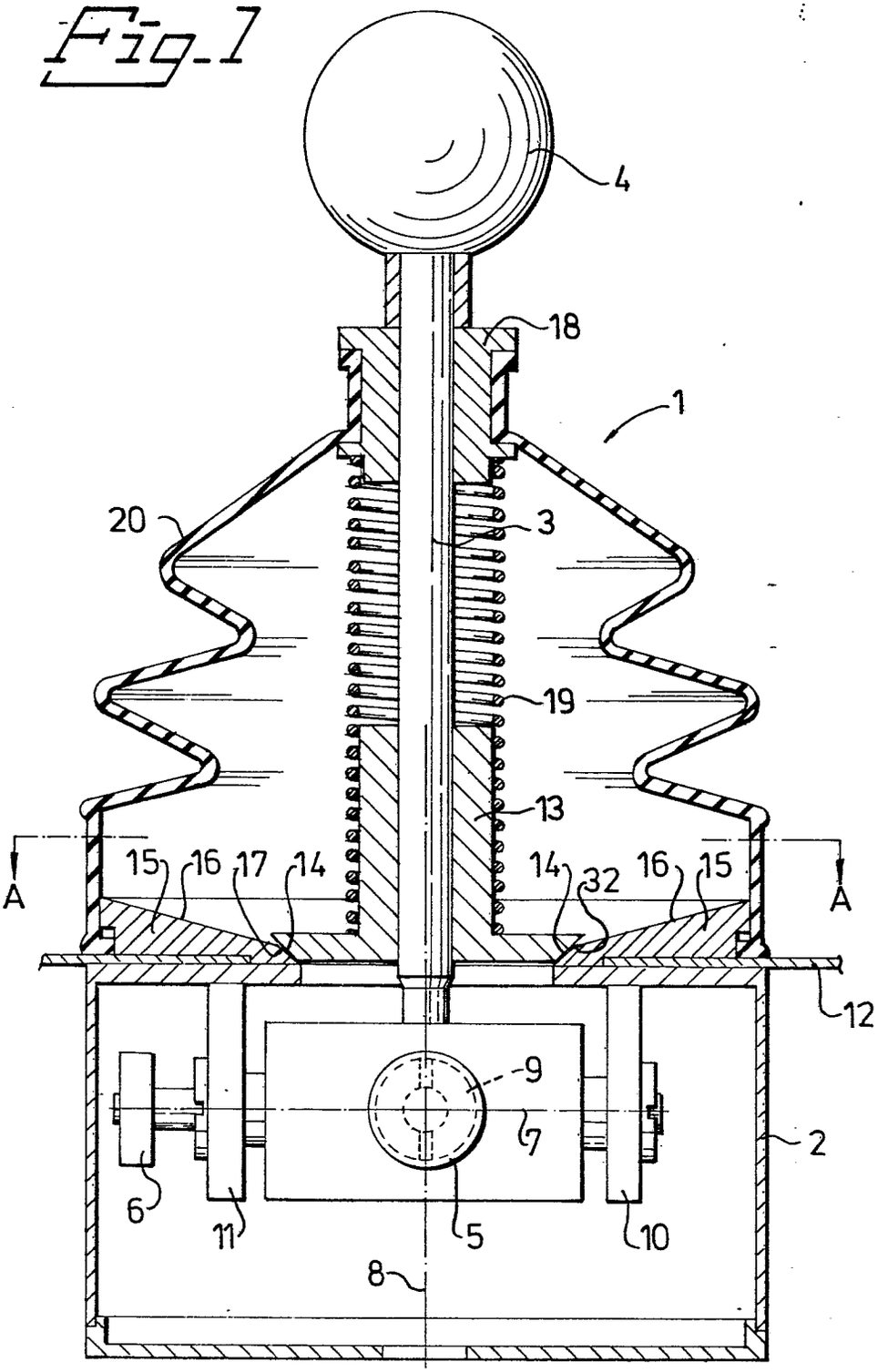

Fig. 2

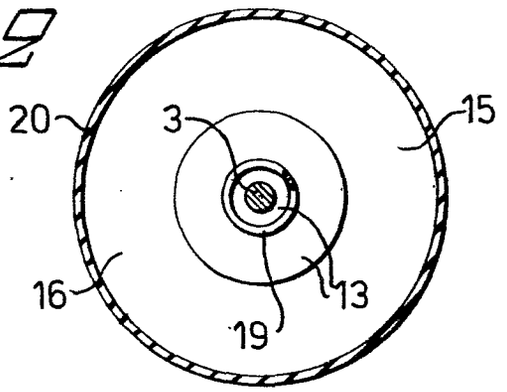


Fig. 3

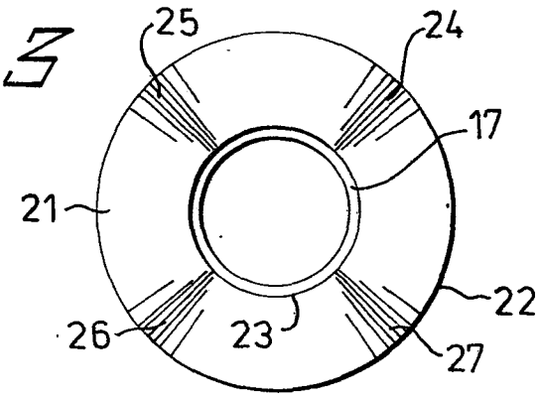


Fig. 4

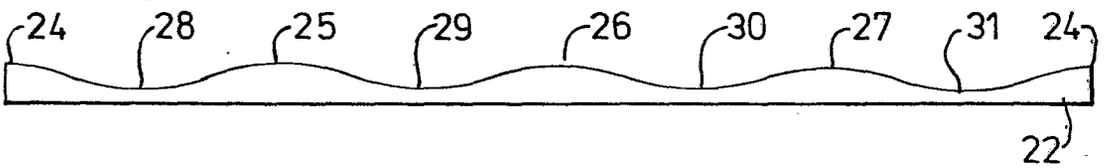


Fig. 5


Fig. 6

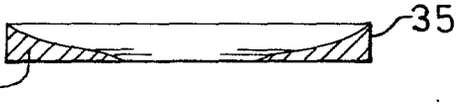


Fig. 7