EUROPEAN QUALIFYING EXAMINATION 1996

PAPER A
ELECTRICITY / MECHANICS

This paper comprises:

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INSTRUCTIONS TO CANDIDATES

You are to assume that you have received the annexed letter from your client including a description of an invention for which he wishes you to obtain a European patent together with references to the most pertinent prior art known to your client.

You should accept the facts given in the paper and base your answers upon such facts. Whether and to what extent these facts are used is your responsibility.

You should not use any special knowledge you may have of the subject-matter of the invention, but are to assume that the prior art given is in fact exhaustive.

Your task is to draft an independent claim (or claims) offering the applicant the broadest protection possible while at the same time having a good chance of succeeding before the EPO. In drafting your claim(s) you should bear in mind the need for inventive step over the prior art indicated, the requirements of the Convention, in particular as to the form of claims, and the recommendations made in the Guidelines for Examination in the EPO. Dependent claims should also be drafted so as to enable you to fall back upon them should the independent claim(s) fail and should be kept to a reasonable number.

You are also expected to draft an introduction, i.e. that part of the description which precedes the examples or the explanation of the drawings. The introduction should be sufficient to provide support for the independent claim(s). In particular, you should consider the advisability of mentioning advantages of the invention in the introduction.

You are expected to draft claims and an introduction for one European patent application only. This application should meet the requirements of the Convention as to unity. If you would in practise seek to protect further inventions by filing one or more separate applications, you should, in a note, clearly identify the subject-matter of the independent claim of such separate application(s). However, it is not necessary to draft the wording of the independent claim for the or each separate application.

In addition to your chosen solution, you may - but this is not mandatory - give, in a note, the reasons for your choice of solution, for example, why you selected a particular form of claim, a particular feature for an independent claim, a particular piece of prior art as starting point or why you rejected or preferred some piece of prior art. Any such note should however be brief.

It is assumed that you have studied the examination paper in the language in which you have given your answer. If this is not so, please indicate on the front page of your answer in which language you have studied the examination paper. This always applies to candidates who - after having filed such a request when enrolling for the examination - give their answer in a language other than German, English or French.

CLIENT'S LETTER

Our firm produces cursor control devices for use with personal computers (PCs) commonly refe to as "mouse" or "trackball" devices. Currently we are selling computer systems wherein software options can be executed by selecting corresponding graphic representations displayed on the screen of a monitor. Such graphic representations are generally called "icons". A particular software option represents a task or program which can be executed by the computer system. By selecting one or several of the software options, the computer system can be operated in a desired manner.

A particular software option can be selected by moving a cursor displayed on the screen such that it indicates the corresponding icon. By providing an execution command, the selected software option will be executed by the computer system. The cursor generally takes the form of a short line, a patch or an arrow displayed on the screen.

For displacing the cursor on the screen an operator may use the four "arrow" keys provided on a conventional computer keyboard, that is, two keys for moving the cursor up and down, and two keys for moving the cursor to the left and right. The "enter" key of the keyboard may be used for providing the execution command.

However, the use of such keys has proven not to be efficient in cases wherein a user has to choose repetitively software options. For this purpose, cursor control devices in the form of mouse and trackball devices have been developed.

A typical computer mouse comprises a freely rotatable ball which rotates as the mouse is moved over a support surface, e.g. a desktop surface or table. The ball is associated with first and second potentiometers which produce electrical signals which control the position of the cursor on the screen. The ball and the potentiometers are contained in a housing which has an opening through which the ball partly projects.

By moving the mouse in a desired direction, the ball is caused to roll on the support surface, which changes the electrical signals from the potentiometers. These electrical signals are converted into a corresponding position of the cursor on the screen. Accordingly, the cursor can be displaced on

the screen by a corresponding displacement of the mouse over the support surface. By [illegible] a button mounted on the housing of the mouse, the user can command the computer to [illegible] software option which corresponds to the icon indicated by the cursor.

Trackball devices have a somewhat similar construction to a mouse. However, instead of the housing being moved by the user, the ball is rotated directly by the user while the housing remains stationary, for example, fixedly attached to the computer housing.

For your information, Document I attached to this letter discloses a cursor control device in the form of a mouse for which we received a patent in several countries and which has been in our sales assortment for quite some time now. However, we have now discovered certain shortcomings of this device. Therefore, we decided to develop an improved cursor control device, which is technically superior to the known device.

Hereafter you will find a description of our new cursor control device with reference to the appended drawings. In our view this device is patentable and we ask you to prepare a European patent application. In particular, we feel that the features of the device which avoid the problems of limited reach in the device of Document I ought to be protected.

In the accompanying drawings:

Fig. 1 is a perspective view of a computer system including a cursor control device in the form of a mouse in accordance with the present invention;

Fig. 2 is a schematic view illustrative of the principle of operation of the cursor control device of the present invention;

Fig. 3 is a perspective view of the mouse of Fig. 1 with the cover raised;

Fig. 4 is a top view of part of the internal structure of the mouse of Fig. 3, with the cover removed;

Fig. 5 is a schematic illustration, on an enlarged scale, of part of a transducer used in the mouse of Fig. 3;

Fig. 6 is a schematic illustration of part of an alternative form of transducer which may be used in the mouse of Fig. 3;

Fig. 7 is a top view of a trackball device according to the present invention, with the cover thereof removed;

Fig. 8 is a view in vertical section of the trackball device of Fig. 7 taken along the line VIII-VIII, with the cover in place; and

Fig. 9 is a diagram showing signals produced by the transducer of either Fig. 5 or Fig. 6.

In the drawings, corresponding parts are indicated by the same reference numeral.

The computer system 1 illustrated in Fig. 1 comprises a processor 2 and a screen 3, both mounted in a housing 4 positioned on a table 5. The computer system 1 includes a keyboard 6 and a cursor control device according to the present invention in the form of a mouse 7. The keyboard 6 and the mouse 7 are connected to control inputs of the processor 2 via cables 8,9, respectively.

In operation, the mouse 7 is operated by a user on a support surface 10 placed on the table 5. The movement of a cursor 11 in the form of an arrow on the screen 3 is governed by the movement of the mouse 7. That is to say, the mouse 7 generates electrical signals controlling the movement of the cursor 11 in such a manner that the displacement of the cursor 11 on the screen 3 corresponds to the displacement of the mouse 7 in a desired direction over the support surface 10.

During use, the processor 2 generates signals that define graphic representations or icons 12 corresponding to particular software options to be executed by the computer system 1. Such software options occur during the execution of, for example, a file management program, a printer control program or a word processing program. By positioning the cursor 11 on a particular icon 12 on the

screen 3, the corresponding software option can be executed by actuating a button 13 in the housing 14 of the mouse 7.

The principle of operation of the cursor control device of the invention will be described with reference to Fig. 2.

A ball 15 is biassed against first and second rollers 16,17 by a biassing roller 18. The first and second rollers 16,17 are supported for rotation about first and second axes 19,20 respectively which are schematically illustrated by dash-dot lines. The axes 19,20 extend perpendicularly to each other and the first and second rollers 16,17 are in contact with the surface of the ball 15. Rotation of the ball 15 causes a corresponding rotation of one or both of the rollers 16,17.

The biassing roller 18 is located on a straight line 21 passing through a point P where the axes 19,20 intersect and the centre O of the ball 15 for biassing the ball 15 against the first and second rollers 16,17 under equal forces. The biassing roller 18 is rotatably supported by a holder 22 biassed by a spring 23 supported by the housing 14 for resiliently biassing the ball 15 against the first and second rollers 16,17.

The first and second rollers 16,17 have shafts 24,25 on which first and second transducers 26,27 are mounted, respectively. When the ball rotates, the first and second transducers 26,27 translate the angles through which the shafts 24,25 rotate into corresponding electrical signals. These signals are indicative of the x- and y- components of the movement of the mouse in a Cartesian coordinate system.

Figs. 3 and 4 show in more detail the mouse 7 of Fig. 1. The housing 14 of the mouse has a cover 28 and a base 29 upon which the elements shown in Fig. 2 are disposed.

A frame 30 is provided which includes a dome 31 containing the ball 15 and having three apertures 32,33,34. The planes of the apertures 32,33 are disposed at 90 degrees with respect to one another, and aperture 34 is oriented symmetrically opposite the other apertures 32,33, following the line 21 of Fig. 2.

The frame 30 is mounted on a printed circuit board 35 carrying electrical compone[illegible]e mouse. The connection cable 9 is connected with the printed circuit board through an [illegible] connector 37.

As illustrated in Fig. 4, two pairs of photo-emitters 40a,40b are mounted on the frame 30. Similarly, two pairs of photo-detectors 41a,41b are mounted on the frame 30, opposite the photo-emitters 40a,40b such that the photo-emitters 40a face the photo-detectors 41a and the photo-emitters 40b face the photo-detectors 41b.

Between the photo-emitters 40a,40b and photo-detectors 41a,41b, encoder discs 42,43 are provided, axially coupled to shafts 24, 25, respectively. Each encoder disc 42,43 is provided with a plurality of radially disposed slots 44, such that a light beam generated by a photo-emitter 40a,40b and directed to the corresponding photo-detector 41a,41b is passed or interrupted when the corresponding encoder disc 42,43 rotates. The shafts 24,25 are coupled to the first and second rollers 16,17, respectively. The first roller 16 is positioned in front of the aperture 32 and the second roller 17 is positioned in front of the aperture 33, such that part of the circumferential surface of the first and second rollers 16,17 extends within the interior of the dome 31. The facing photo-emitters 40a,40b and photo-detectors 41a,41b and the encoder discs 42,43 form the transducers 26,27 of Fig. 2.

The ball 15 is disposed within the dome 31 of the frame 30. The ball 15 is maintained in contact with both the first and second rollers 16, 17 through the biassing roller 18.

Different from the arrangement shown in Fig. 2, the biassing roller 18 is mounted on a flexible shaft 50 and extends through the aperture 34 into the interior of the dome 31 to make contact with the ball 15. The flexible shaft 50 is supported by bosses 48,49 and provides a biassing effect on the ball 15.

As shown in Fig. 3, the button 13 extends through the cover 28 of the housing 14 opposite a switch 51. The switch 51 can be actuated by pushing the button 13.

Each encoder disc 42,43 interrupts two light-beams respectively from the photo-emitters 40a,40b.

When, as illustrated in Fig. 5, the light-beam from the photo-emitter 40a is fully transm[illegible]h a slot 44 of an encoder disc 42,43, the light-beam from the photo-emitter 40b is partially blo[illegible] the preferred embodiment, the photo-emitters and detectors operate in the infrared region. Howe[illegible] it will be appreciated that any suitable light wavelength may be used.

The light-beam interruptions from the rotation of an encoder disc are detected by the photo-detectors 41a,41b which produce signals in the form of pulses. The form of these pulses is shown in Fig. 9 which shows the voltage of the signals plotted against time. A first signal 70 is produced by the photo-detector 41a. A second signal 71 is produced by the photo-detector 41b. At the instant 72, the signal 70 is at its maximum intensity, corresponding to the light beam being fully transmitted as illustrated in Fig. 5, whilst the second signal 71 lags behind the first signal, the light beam being only partially transmitted. The number of pulses, i.e. the number of times the light beam is transmitted or interrupted, is a measure of the amount of rotation of the encoder disc and hence the distance which the mouse is displaced over the support surface. From the order in which the light-beams of the photo-emitters associated with a particular encoder disc are interrupted, the direction of rotation of the encoder disc may also be determined. It will be appreciated that this effect could not be obtained if the arrangement was such that the pulses were either simultaneous or equally spaced from one another.

It may further be noted that it would be possible to arrange a single photo-emitter such that the photo-detectors 41a,41b receive the light beams from the single photo-emitter.

From Fig. 5 it will be appreciated that during a clockwise rotation of the encoder disc 42 the light-beam of photo-emitter 40a will be interrupted a short time before the light beam of photo-emitter 40b, so that the photo-detectors 41a,41b produce the signals 70,71 as illustrated in Fig. 9. During an anti-clockwise rotation, the light beam of photo-emitter 40b will be interrupted a short time before the light beam of photo-emitter 40a, so that signal 71 precedes signal 70. Thus, the signals provided by the photo-detectors may be decoded such that, in addition to the distance of displacement of the mouse, the direction of motion of the mouse may be determined.

To decode the signals provided by the photo-detectors, appropriate circuitry is provided either in the mouse 7 or in the processor 2.

It will thus be appreciated that, in contrast to the device of Document I, the device of the invention does not require the use of potentiometers, which are generally not to be preferred due their inherent inaccuracy, which becomes even worse over time due to the penetration of dust and wear. Further, the device of Document I has a limited reach, i.e. when the device is moved such that the wiper of a potentiometer reaches an end position, the cursor cannot be moved further in that particular direction.

Instead of a photo-emitter/detector combination, an inductive transducer may be used, as shown in Fig. 6. A pair of inductive detectors 55a,55b is positioned adjacent to the circumference of a toothed encoder disc 54 of magnetic material. Each inductive detector is composed of a permanent magnet 56 and a coil 57 wound around the permanent magnet 56. One end of the permanent magnet 56 is disposed in close proximity to the periphery of the encoder disc 54.

As the teeth 58 of the encoder disc 54 pass through the magnetic field of a permanent magnet 56 with the rotation of the encoder disc 54, a pulsed variation takes place in the leakage flux of the permanent magnet 56 so that a pulsed electromotive force is induced in its coil 57. By positioning the inductive detectors such that unequally large portions of teeth 58 pass at the same time through the magnetic fields of the detectors, staggered pulsed signals are generated, the order of the signals depending on the direction of rotation of the encoder disc 54. Accordingly, the amount and direction of rotation of the encoder disc 54 may be decoded from the generated signals.

Both the optical and the inductive detectors operate in a contactless manner, which means that the rotation of the encoder discs 42,43,54 is not impeded, providing a high accuracy and less wear over time.

Fig. 7 shows an embodiment of the cursor control device according to the present invention, in the form of a trackball device 60. The device includes a ball 15, first and second rollers 16,17 and a biassing roller 18, arranged as shown in Fig. 2. Encoder discs 42,43 coupled with the first and

second rollers 16,17 and photo-emitter/detector combinations 40,41 form the transduce[illegible]e several parts are mounted in a housing 62 having a bottom part 63 and a cover 64 (as s[illegible] Fig. 8).

As can be seen from the vertical section of Fig. 8, beneath the shaft 61 of the biassing roller 18, the housing 62 is provided with a cylindrical bore 65 which extends substantially perpendicularly to the shaft 61 and receives therein a helical spring 66. The helical spring 66 imposes a biassing force on the ball 15 via the roller 18, to urge the ball 15 into contact with the first and second rollers 16,17.

In operation, the trackball device 60 is positioned as shown in Fig. 8.

List of reference numerals used

1	computer system	30	frame
2	processor	31	dome
3	screen	32,33,34	apertures
4	housing	35	printed circuit board
5	table	36	electrical components
6	keyboard	37	electrical connector
7	mouse	40,40a,40b	photo-emitters
8,9	cables	41,41a,41b	photo-detectors
10	support surface	42,43	encoder discs
11	cursor	48,49	bosses
12	icons	50	flexible shaft
13	button	51	switch
14	housing of the mouse	54	toothed encoder disc
15	ball	55a,55b	inductive detectors
16	first roller	56	permanent magnet
17	second roller	57	coil
18	biassing roller	58	teeth
19	first axis	60	trackball device
20	second axis	61	shaft
21	straight line	62	housing of trackball
22	holder	63	bottom part
23	spring	64	cover
24	first shaft	65	cylindrical bore
25	second shaft	66	helical spring
26	first transducer	70	first signal
27	second transducer	71	second signal
28	cover	72	instant
29	base		

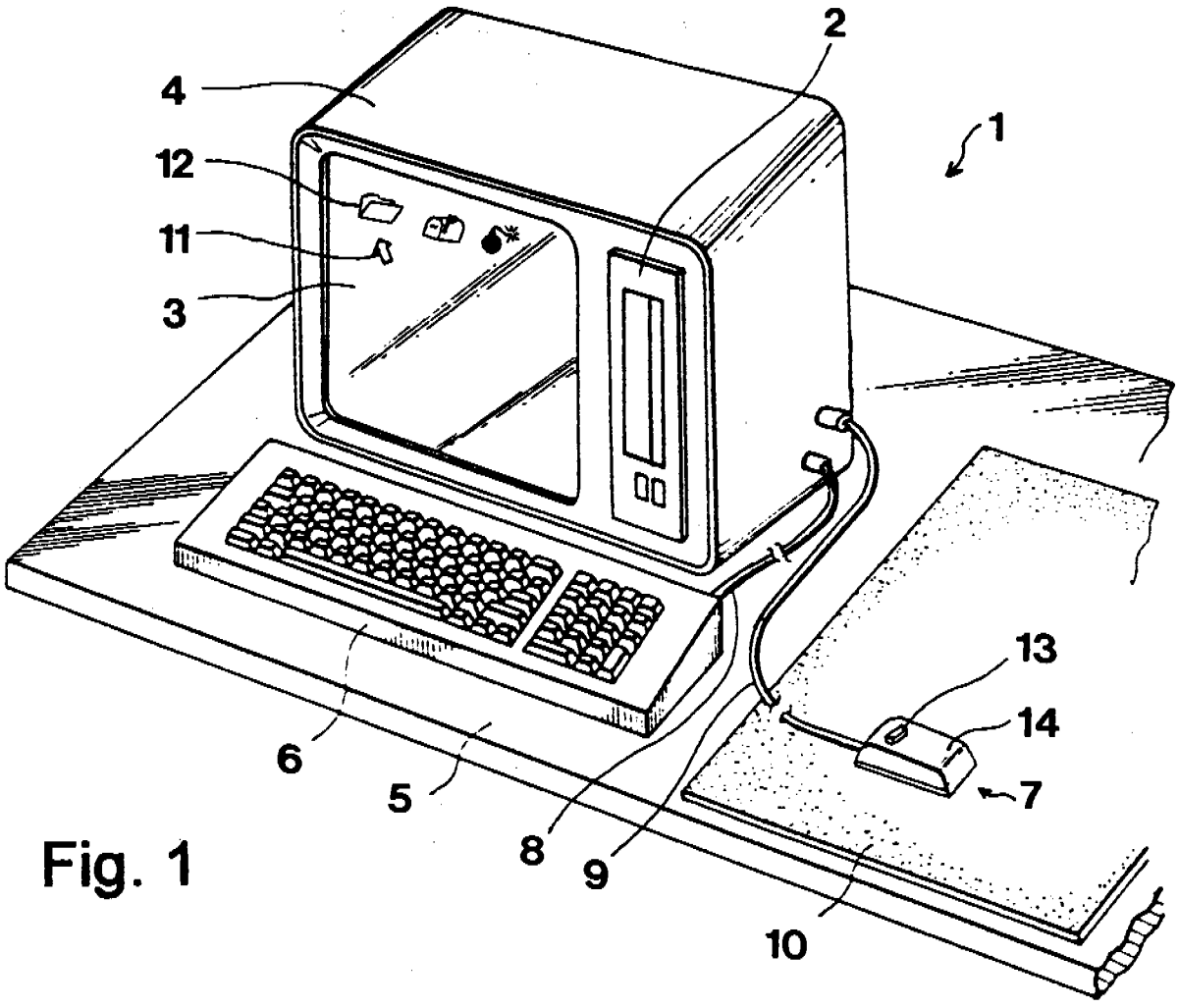


Fig. 1

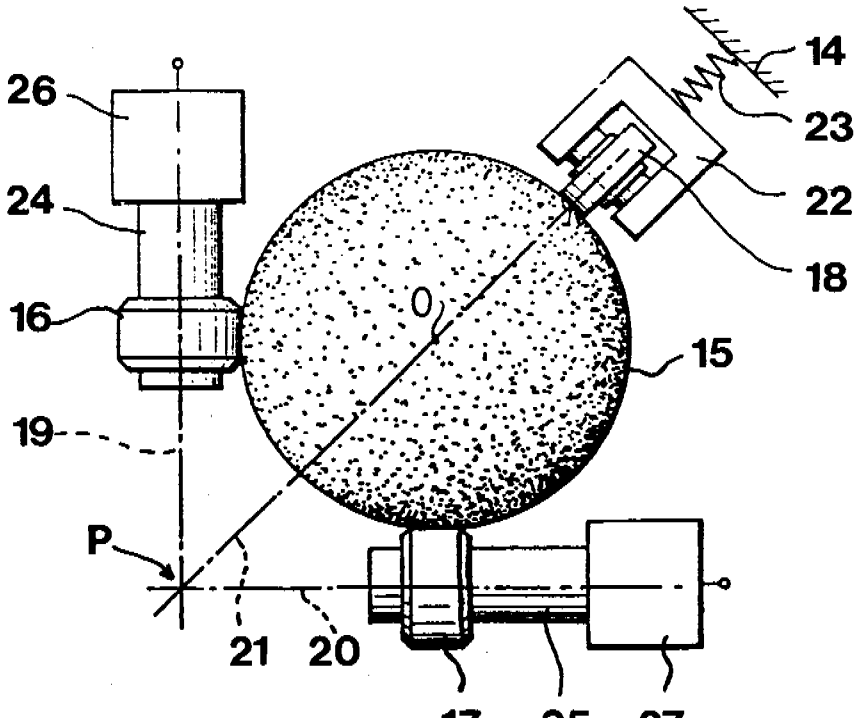


Fig. 2

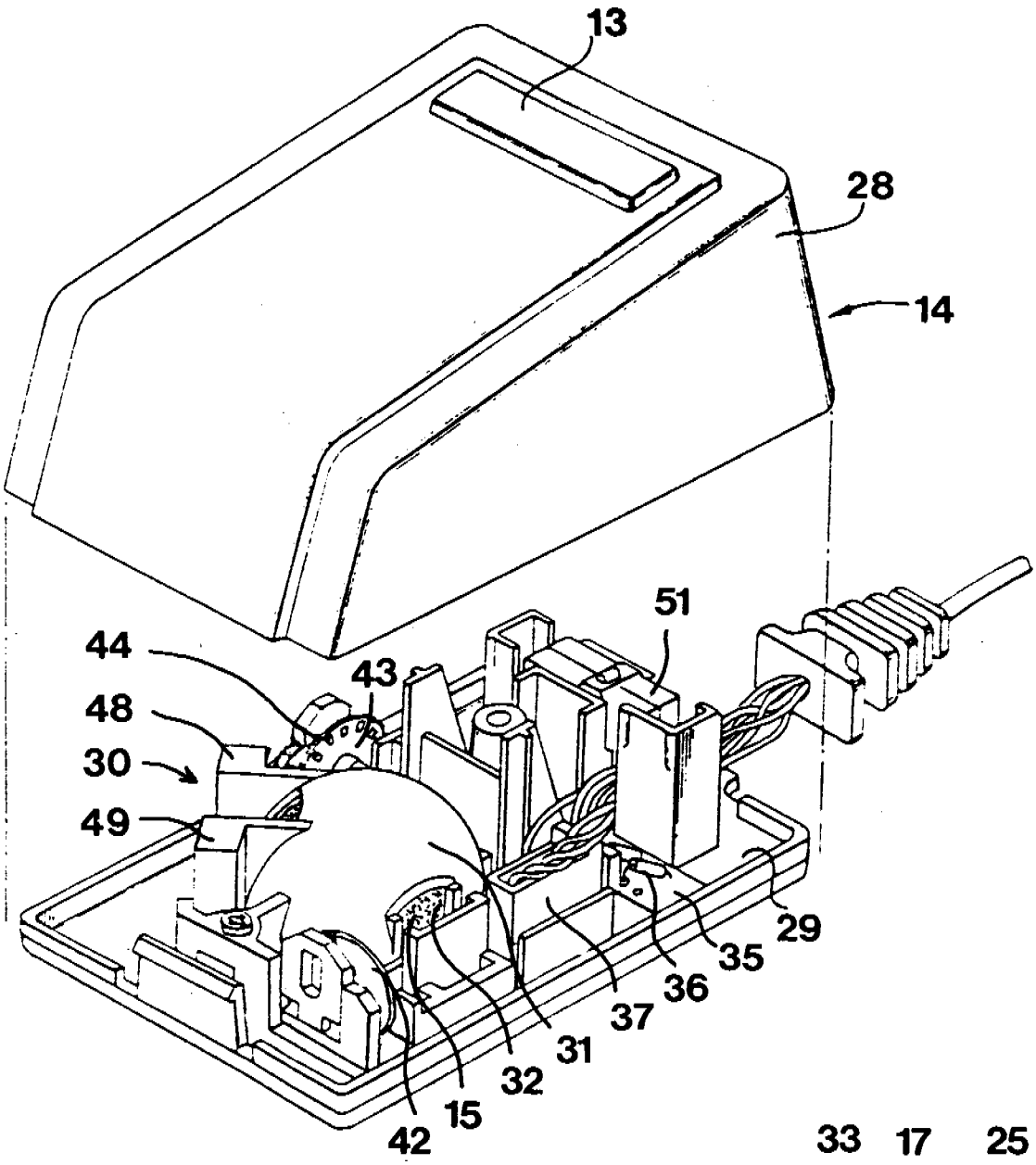


Fig. 3

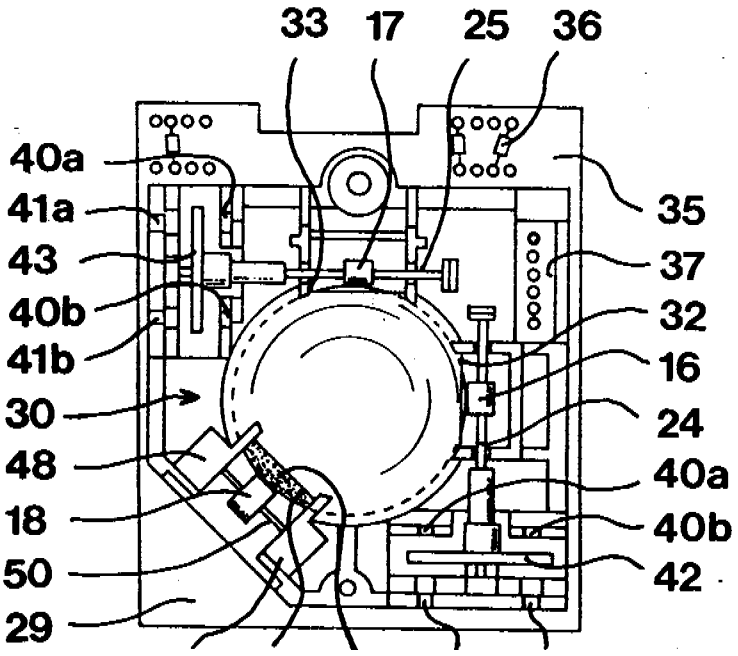


Fig. 4

Fig. 5

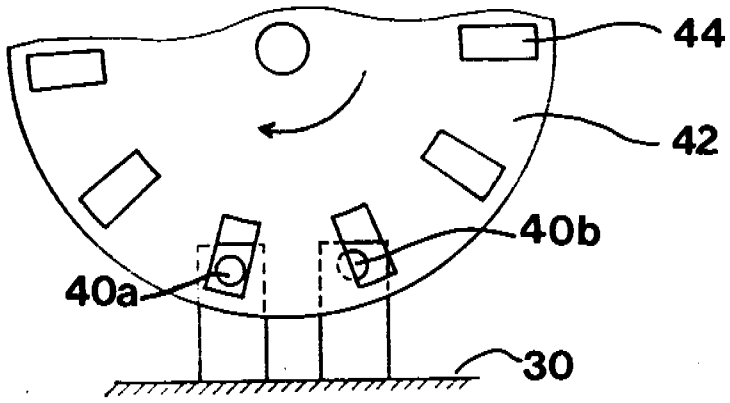
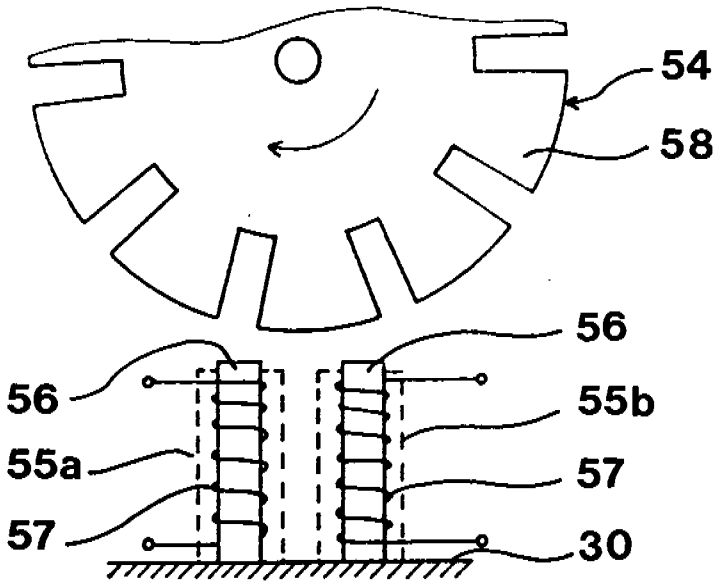


Fig. 6



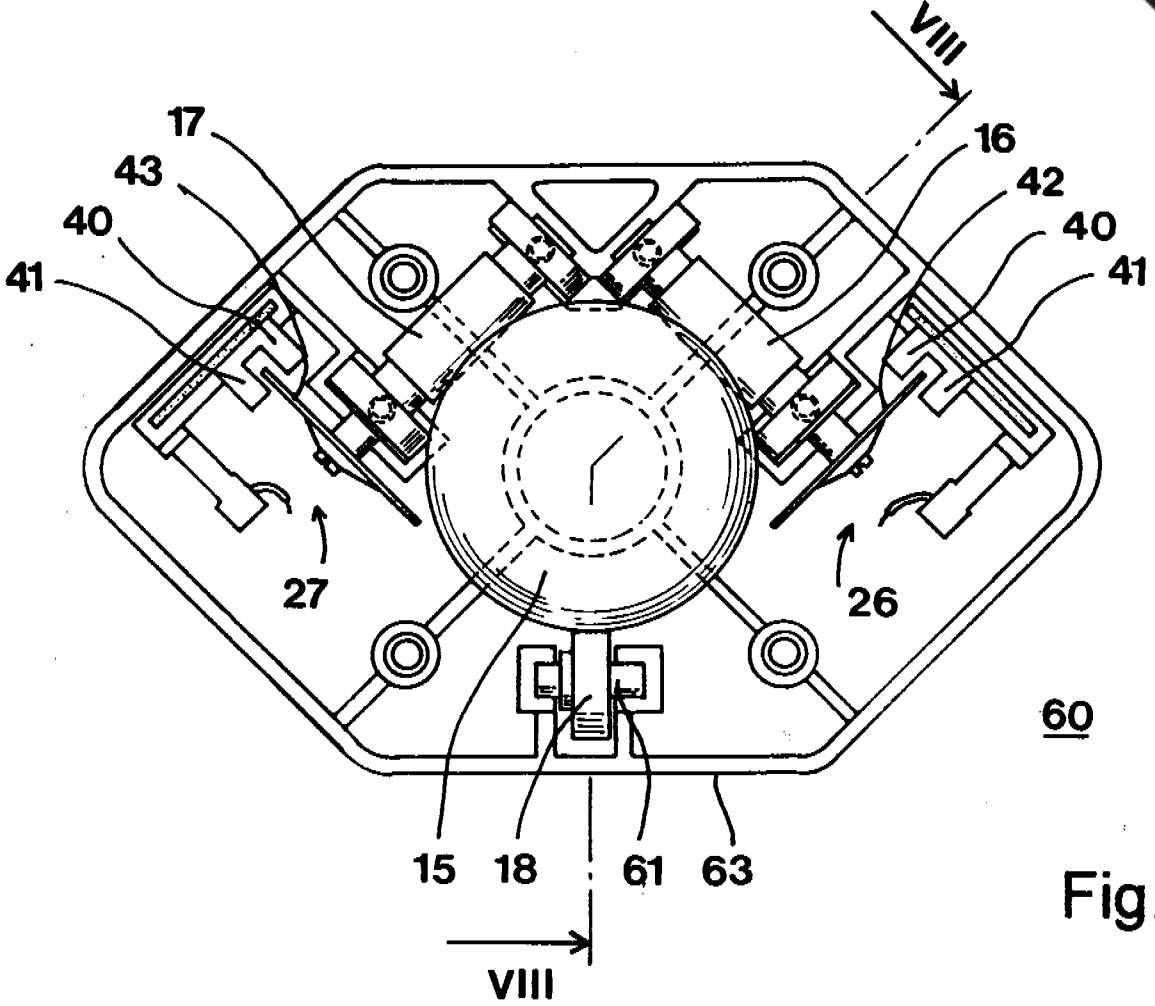


Fig.7

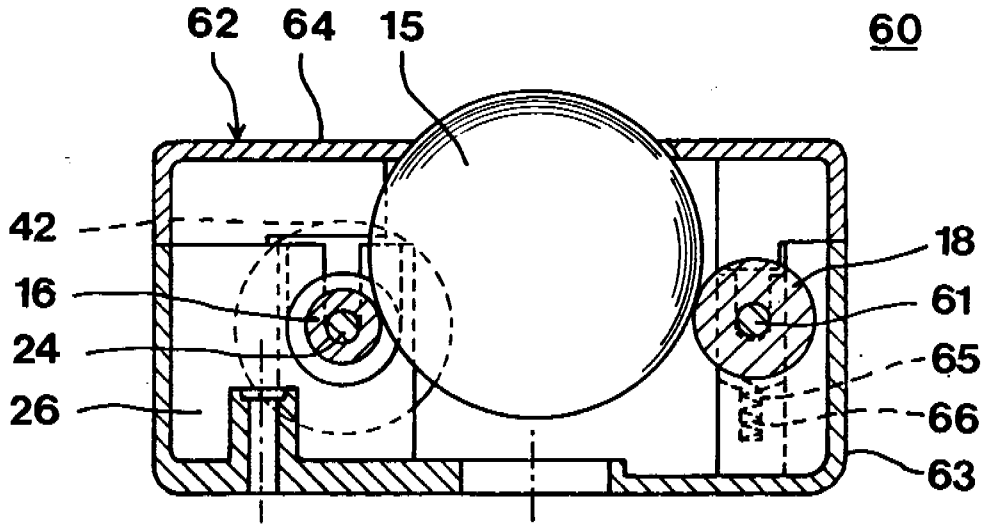


Fig. 8

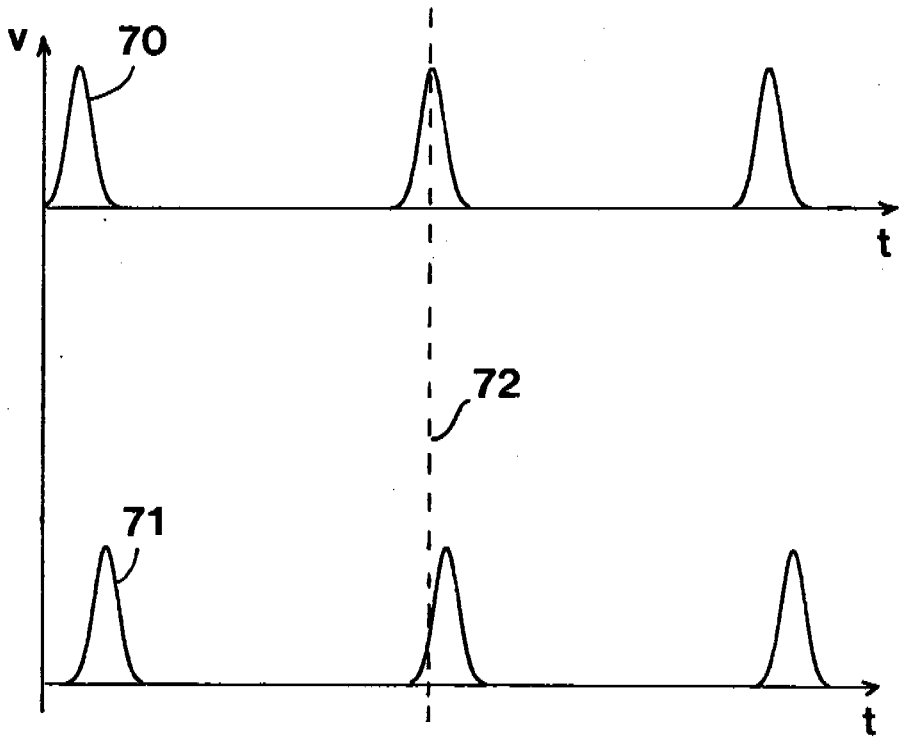


Fig. 9

DOCUMENT I (State of the Art)

The invention relates to display systems and, more particularly, to a position indicator device controlling a cursor on a visual display, e.g. a monitor.

The invention will be better understood from the following description in conjunction with the accompanying drawings.

Fig. 1 is an elevation partly in section of the position indicator device according to the present invention.

Fig. 2 is a top view partly in section of the position indicator device of Fig. 1.

Fig. 3 shows an electrical circuit forming part of the position indicator device of Figs. 1 and 2.

Referring to Fig. 1, the position indicator device 1 comprises a housing 2 which partly encloses a ball 5. The housing has a dome-shaped cover part 3 which connects to a flat bottom part 4. A portion of the ball 5 extends through an aperture 6 in the bottom part 4. In use, this portion of the ball 5 is in contact with a support surface such a desk top (not shown).

A bearing 8 mounted on one side of a plate 9 embedded in the housing 2 restricts the movement of the ball 5 in the upward direction viewed in the plane of Fig. 1. The ball 5 is constrained horizontally by wheels 10-13, which are rotatably mounted on respective housing flanges 14-17. Bearings 18-21 are disposed on the bottom part 4 of the housing 2 to prevent any undesired contact of the housing with the support surface.

A switch 22 is mounted on the other side of the plate 9 which can be actuated by a push button 23 slidably mounted in the cover part 3. The switch 22 may be used to command a processing device (not shown) to execute a software option corresponding to a position of the cursor.

As shown in Fig. 2, the wheels 10,13 are each connected to a respective potentiometer 24,25, that is, a variable resistance as explained in more detail below, via rotatably mounted shafts 26,29. As

can be seen from Fig. 2, the shafts 26,29 are perpendicular to each other. The wheels [illegible] supports for the ball 5 and rotate about shafts 27,28, respectively. The shafts 26-29 are s[illegible] by the respective housing flanges 14-17. The ball 5 and the wheels 10-13 may be of any mat[illegible] which ensures stable dimensions and avoids slippage between the wheels 10,13 and the ball 5.

The wheels 10,13 are position wheels, the position of which represents Cartesian x and y coordinates. As the position wheels 10,13 rotate upon a rotation of the ball 5 as a consequence of a movement of the position indicator device 1 over the support surface, the shafts 26,29 rotate, thus varying the resistances of the respective potentiometers 24,25.

As can be seen from Fig. 3, a voltage +V is connected via a supply terminal 30 to a first end terminal of each of the two potentiometers 24,25. A second end terminal of each potentiometer 24,25 is connected to a ground terminal 31. The wipers 36,37 of the potentiometers 24,25 are connected to output terminals 32,33, which provide x and y control signals respectively for controlling the position of the cursor in the x-y directions on the display, according to the movement of the position indicator device 1. The resistances of the potentiometers 24,25 measured between the wipers 36,37 and the second end terminals are indicated with reference numerals 34,35, respectively.

The wipers 36,37 are coupled to the shafts 26,29 of the potentiometers 24,25, respectively. Rotation of the shafts 26,29 causes the wipers 36,37 to move between a first end position, at which the wipers 36,37 connect directly to the supply terminal 30, and a second end position at which the wipers 36,37 connect directly to the ground terminal 31. The voltages at the output terminals 32,33 measured relative to the ground terminal 31 vary between +V and ground potential, and are dependent on the actual positions of the wipers 36,37. These voltages thus depend on the actual values of the resistances 34,35 of the potentiometers 24,25, respectively, and hence on the position of the position indicator device 1 on the support surface.

It should be noted that the user could also rotate the ball 5 by a finger or the thumb of the hand, so as to control the movement of the cursor on the display.

DRAWINGS OF DOCUMENT I (State of the Art)

Fig. 1

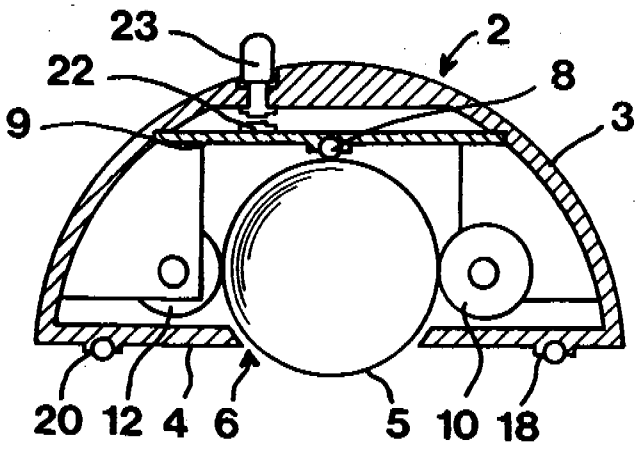


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Fig. 2

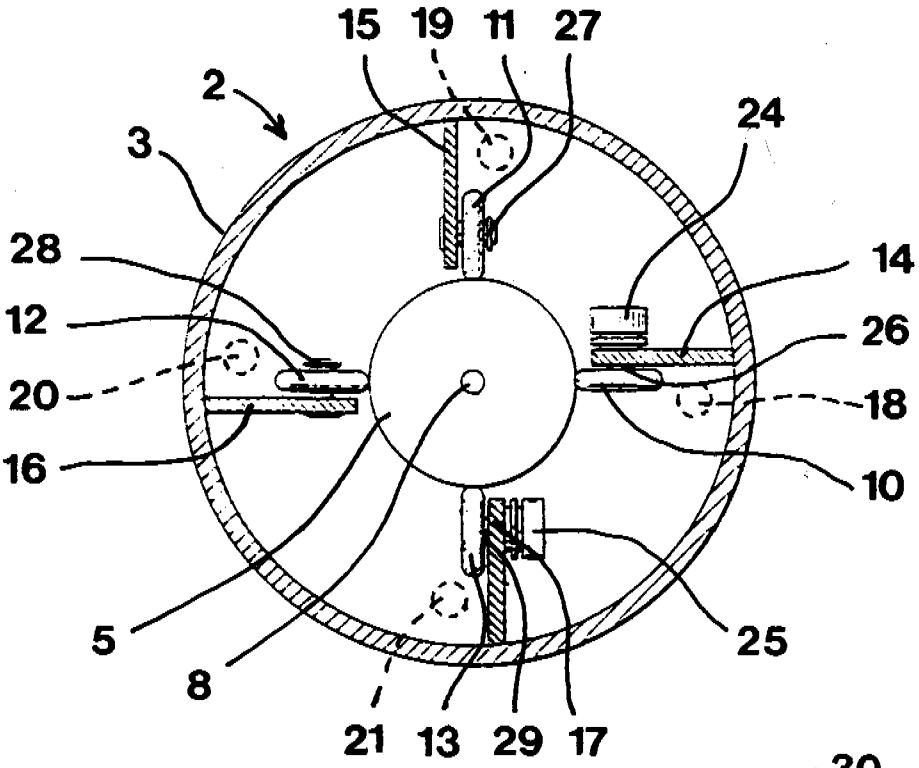

Fig. 3