

**“Drum-type control device having multiple switching ways
and electronic appliance equipped with such devices”**

The present invention relates to a control device.

The invention relates, more particularly, to an electric
5 control device having multiple switching or commutation ways or
channels, especially of the tactile feedback or touch-working type.

The invention relates to a device by which distinct electrical
switching operations can be performed by means of a sole
actuating member for the purpose, for example, of controlling a
10 function of an electronic appliance ensuing from choices made by
selection from a menu or a display screen list.

Recent developments and the rapid evolution in
telecommunications means, such as mobile telephones, portable
computers and other devices by which play can be effected, for
15 example, by moving a cursor precisely on the screen demand the
provision of electromechanical components of smaller and smaller
dimensions and, especially in the aforementioned field, the facility
to scan menus, displace a symbol on a screen and, more
generally, combine several electrical switching functions within a
20 single component.

It is desirable to have a device employing a single control
member by which, on the one hand, electrical signals or pulses
repeated at high frequency and, on the other hand, unitary
signals, for example enabling signals, can be produced, and this
25 with an ergonomy for the user which is perfectly tailored to this
type of operation, that is to say which allows him to produce
repeated pulses quickly and easily, for example for the purpose of
performing a rapid scan of a menu or list and then producing
enabling signals.

30 Where the application is to a mobile telephone (for example
GSM), the dimensions of which are more and more compact and
which the user must be able to operate and control with just one
hand, it is especially desirable for a multiple switch of this kind to

be made operable with the thumb by being installed on the main front face of the telephone comprising, in particular, the keypad, either on one of the two main side edges of the housing of the telephone, or under the main face of the telephone.

5 The need for a compact control device of very small dimensions, by which a cursor can be displaced on a screen and/or menus can be scanned, also referred to as a "navigator", is becoming increasingly important on "mobile telephone" or "personal digital assistant" or said "MP3 devices" type appliances
10 offering an increasing number of functions and services based, especially, on choices proposed on one or more screens, analogously to the use of a portable computer.

It is further desirable to be able to have at least one enabling function on which the user presses to select a choice
15 corresponding to the position reached by the cursor on the screen by operation of a control member. Moreover, the anticipated growth in the size of the screens, in the order of 40 by 80 mm, dictates the need for a high-performance navigator by which displacement can be realized with both rapidity and precision.

20 These requirements are further intensified where the control device or navigator is used within the framework of a game.

Furthermore, the tactile sensation or feedback transmitted by the device to the user of the navigator is a very important parameter for his performances and his ergonomics.

25 The sensitivity of touch of the user is such that it allows him to perceive very fine, discrete or continuous variations, and that it is thus possible to transmit a very complex "message" to the finger or hand of the user.

The finger is thus an issuer of orders (or transmitter) for
30 displacing the cursor on the screen and/or for selecting a position of the cursor, and it is also a sensor (or receiver) which picks up "blind" tactile information returned through the actuator or control

member without the user, therefore, having to look at the screen, and/or in addition to his visual perceptions.

It is thus desirable to provide the user with tactile sensations produced directly in response to the movement of the
5 finger on the actuator, that is to say in its transmitter function.

In the case of a displacement or scanning, such messages or tactile sensations are, for example, pulses or mechanical "clicks" corresponding to each electrical signal or pulse produced by the navigator and destined for the electronic circuits for
10 processing signals or data of the appliance, or corresponding to series of pulses.

Other mechanical pulses or "clicks", generally different in nature and intensity from the preceding ones, correspond to the electrical pulses supplied to the electronic circuits in a manual
15 enabling or select action, for example when a target has been reached.

To this end, a control device has already been proposed, of the type comprising a plastics housing accommodating a revolving horizontal shaft which is capable of being rotated, in both
20 directions, by a manual driving drum supported or borne by the shaft to which it is rotationally linked, of the type in which the shaft is rotationally linked to at least one rotary member belonging to a generator of control signals or pulses for an electronic appliance, especially for controlling the displacements of a cursor
25 on a display screen of the appliance, and of the type in which the shaft is mounted such that it is vertically movable and tiltable in both directions about a transverse horizontal axis orthogonal to the longitudinal axis of the shaft so as to selectively provoke the triggering:

30 - of a first trigger member belonging to a first switching way when a first (enabling) force of vertical orientation is applied substantially to the center (half length) of the drum;

- of a second trigger member belonging to a second switching way when a second, distinct and of vertical orientation (selection) force is applied in the vicinity of one of the two longitudinal ends of the drum;

- 5 - of a third trigger member belonging to a third switching way when a third, distinct and of vertical orientation (selection) force is applied in the vicinity of the other of the two longitudinal ends of the drum.

Some design examples of such a device are described, for
10 example, in document FR-A-2.792.486 or in document US-A-6.555.768.

According to the different known designs, the control drum is mounted such that it revolves relative to an intermediate plate which is hinged-mounted relative to the housing or fixed support
15 and the movements of which are controlled by action upon the control drum.

US-B1-6.211.474 illustrates another design in which the drum rests vertically on a central member which bears upon the bottom of the housing and which, from a rest position, is
20 elastically deformable.

In addition to this complex design employing an intermediate plate, the different trigger members are individual and distinct, for example elastic domes which preclude a major miniaturization of the device.

25 The complexity resulting from the number of components and their assembly culminates in high costs, as well as in a very difficult command of certain parameters, especially the control precision for the different functions and the sensitivity of the tactile perceptions.

30 In order to overcome these drawbacks, the invention proposes a device of the aforementioned type, characterized in that said central member is a common conductive trigger, which belongs to the said

three switching ways, which bears upon the bottom of the housing and which, from said rest position, is selectively elastically deformable under the action of one of the said forces of vertical orientation.

5 According to other characteristics of the invention:

- each trigger member of the said common member is a trigger branch extending radially from a central portion bearing vertically upon the bottom of the housing;
- the second and third trigger members are a second and
5 third trigger branches, made of conductive material, which are diametrically opposed and longitudinally aligned, and each of which is selectively elastically deformable, from a stable and high rest position towards a low switching position, so as each to establish an electrical connection between two contacts of a pair
10 of associated fixed contacts arranged in the bottom of the housing and one of which is situated substantially in regard to the free end of the associated trigger branch;
- the peripheral surface of each of the opposite axial end sections of the drum rests vertically on the upper face of the free
15 end of one of the second and third trigger branches;
- the housing comprises guide means for guiding the opposite axial ends of the shaft in a vertical plane perpendicular to the bottom of the housing;
- the drum is returned elastically towards a high rest
20 position by the second and third trigger branches;
- the said first trigger member is a first trigger branch, made of conductive material, which extends radially from the said central portion in a transverse direction essentially orthogonal to the longitudinal direction of the second and third trigger branches
25 and which is elastically deformable, from a stable and high rest position towards a low switching position, so as to establish an electrical connection between two contacts of a pair of associated fixed contacts arranged in the bottom of the housing, one of which is situated substantially vertically in regard to the free end of this
30 first trigger branch;
- the said first trigger member comprises two first, diametrically opposed trigger branches, made of conductive material, which extend radially from the said central portion and

which are simultaneously elastically deformable, from a stable and high rest position towards a low switching position, so as each to establish an electrical connection between at least two fixed contacts of a pair of associated fixed contacts arranged in the bottom of the housing, one of which is situated substantially vertically in regard to the free end of the associated first trigger branch;

- the said first trigger member is comprised of the association said second and third trigger members, their switching being provoked simultaneously or substantially simultaneously when the said force having a vertical orientation is applied substantially to the center of the drum.

- each trigger branch suddenly changes of state, beyond a set trigger travel, in such a way as to transmit a tactile sensation of its triggering to the user of the device, through the drum;

- the said central portion from which the said trigger branches extend is a domed portion, the concavity of which is orientated upwards such that the central zone of its convex lower face bears vertically upon the bottom of the housing;

- each trigger branch extends radially outwards and upwards from the said domed central portion;

- the central zone of the domed central part comprises a portion in the form of a spherical or truncated, especially concave, cap, which bears vertically upon a complementary portion in the bottom of the housing such as to constitute a centering and/or articulation means for the said central portion;

- the said central portion is made of conductive material and is electrically connected to a common fixed electrical contact belonging to each pair of associated fixed contacts;

- the said rotary member is a toothed driving pinion, which is rotationally linked to the shaft and is arranged in the vicinity of one of the axial ends of the shaft, and between two consecutive teeth of the drum is received an upper section of a movable

contact rod such as to provoke the tilting of the contact rod in one or the other direction, when the shaft is rotated by the drum, in order to establish a fourth and/or a fifth switching way between the contact rod and a fixed fourth or fifth contact, and such as
5 then to provoke the automatic escape of the upper section from the space delimited by the two consecutive teeth beyond a set angle of rotation of the drive shaft;

- each longitudinal end section of the drive shaft bears a toothed driving pinion, which is rotationally linked to the shaft and
10 between two consecutive teeth of which is received an upper section of an associated movable contact rod such as to provoke the tilting of the contact rod in one or the other direction, when the shaft is rotated by the drum, in order to establish a fourth and/or a fifth switching way between the contact rod and a fixed
15 fourth or fifth contact, and such as then to provoke the automatic escape of the upper section from the space delimited by the two consecutive teeth beyond a set angle of rotation of the drive shaft;

- the movable contact rod extends essentially in an axial
20 vertical plane beneath the driving pinion;

- the movable contact rod extends essentially in an axial plane inclined by about 45° relative to the vertical;

- the movable contact rod comprises a lower vertical contact section movable in a transverse vertical plane extended
25 longitudinally by a horizontal section forming a return spring, the free end of which is immobilized and is in electrical contact with a fixed contact pad of the housing;

- the device comprises illuminating means for the drum, arranged in the bottom of the housing, and the drum is totally or
30 partially translucent or transparent in order to conduct the light transmitted by the illuminating means;

- the device comprises a ratchet wheel (236) rotationally linked to one lateral end of said driving drum and a fixed pawl

supported by the plastics housing to generate audio and/or tactile sensitive pulses when the drum is rotated;

- the pawl is elastic and, in cooperation with the indentations of the ratchet wheel, it provides the drum with an elastic upwards return effect after that the corresponding lateral end of the drum has been vertically displaced downwardly.

The invention also proposes an electronic appliance characterized in that it comprises a display screen and two devices in accordance with the teachings of the invention for controlling the displacements of a cursor on the screen along two perpendicular displacement axes (X, Y), and in that the two devices are disposed such that the rotational axes of the control members of the two devices are orthogonal and parallel to the said displacement axes, respectively.

According to other characteristics of the appliance:

- the second, third, fourth and fifth switching ways of each device are associated with the control of the displacements of the cursor along a same axis (X or Y);
- the second and third switching ways of a first of the two devices are associated with the control of the displacements of the cursor along one axis (X), and the fourth and fifth switching ways of the first device are associated with the control of the displacements of the cursor along the other axis (Y), and the second and third switching ways of the second of the two devices are associated with the control of the displacements of the cursor along the said other axis (Y), and the fourth and fifth switching ways of the second device are associated with the control of the displacements of the cursor along the said one axis (X).

Other characteristics and advantages of the invention will become apparent from a reading of the following detailed description, an understanding of which can be obtained by reference to the appended drawings, in which:

- figure 1 is an external perspective view, shown from above and three-quarters front right, representing a first embodiment of a control device in accordance with the teachings of the invention;

- figure 2 is an exploded, larger-scale perceptive view of
5 different components of the device of figure 1;

- figure 3 is an external perspective view, shown from above and from three-quarters front left, representing only the lower housing of the device of figure 1;

- figures 4 to 7 are views similar to that of figure 3,
10 illustrating different steps of installation of the components in the lower part of the housing;

- figure 8 is an underneath perspective view of the upper closing lid of the device;

- figure 9 is a large-scale top view of only the lower housing
15 of the device of figures 1 and 2;

- figure 10 is a large-scale top view of the common trigger member according to the invention;

- figure 11 is a side view of the common trigger member;

- figure 12 is a sectional view along the vertical and median
20 longitudinal plane 12-12 of figure 13;

- figures 13 to 15 are sectional views along the vertical and transverse planes of figure 12;

- figures 16 to 18 are views similar to those of figures 12, 14 and 15, representing only the lower housing;

25 - figures 19 to 21 are views analogous to those of figures 12 and 14, illustrating the device when a force F2 or F3 is applied to the drum;

- figures 22 and 23 are views analogous to those of figures 12 and 14, illustrating the device when a central force F1 is
30 applied to the drum;

- figure 24 is a view analogous to that of figure 12, illustrating an embodiment having a lower sealing film and figure 25 is a larger-scale view of the detail D25;

- figure 26 is an exploded perspective view of the sealing film and its holding frame and figure 27 is a larger-scale view of the detail D27;

- figure 28 is a perspective view of figure 24 and figure 29 is
5 a larger-scale view of the detail D29;

- figure 30 is a view analogous to those of figures 12 and 24, illustrating an embodiment of the rotary signals generator, and especially of its movable contact rod;

- figure 31 is a large-scale perspective view of the movable
10 contact rod of figure 30;

- figures 32 and 33 are views analogous to those of figures 5 and 12 or 24, illustrating another embodiment comprising illuminating means for a translucent drum;

- figure 34 is a simplified diagrammatic perspective view, on
15 a very large scale, of a second embodiment, illustrating the lower housing and the common trigger member in the course of installation in the housing;

- figure 35 is a top view of the components of figure 1, following the installation of the common trigger member;

20 - figures 36-37 and 38-39 are pairs of figures analogous to those of figures 34 and 35, illustrating the installation of the movable contact rods, then of the double-pinioned drum;

- figure 40 is a view similar to that of figure 38, illustrating the drum in position;

25 - figure 41 is a detailed sectional view along the line 41-41 of figure 37;

figure 42 is a large-scale view of the detail D42 of figure 37;

- figure 43 is a sectional view along the line 43-43 of figure
39;

30 - figure 44 is a perspective view, on the scale 2.5, of the complete device according to the second embodiment;

- figure 45 is a diagrammatic view illustrating an electronic appliance equipped with two control devices according to the invention;

5 - figure 46 is a perspective view of the translucent central core of a drum illuminated by diodes, as illustrated in figures 32 and 33;

 - figure 47 is a cross-sectional view of the device of figure 33;

10 - figure 48 is a view similar to the view of figure 1 showing another embodiment of a device according to the teachings of the invention;

 - figure 49 is a view of the device of figure 48 along another angle of view;

15 - figure 50 is an exploded view of the device of figure 48 similar to the view of figure 2;

 - figures 51 to 55 are views similar to the views of figures 5, 8, 9, 12 and 13;

 - figure 56 is an enlarged view of the detail D56 of figure 55;

20 - figure 57 is a perspective view of one of the two horizontal, transverse fixed contact rods;

 - figures 58 and 59 are views similar to those of figures 55 and 56 along another transversal cross sectional plane;

 - figures 60 and 61 are two views showing the details of the design of the movable contact rod;

25 - figures 62 to 64 are three external views showing the details of the design of the drum;

 - figure 64bis is a detailed perspective view along arrow F64 of figure 62;

30 - figures 65 and 66 are detailed views of some of the components of the drum;

 - figures 67 to 72 are views showing the integration of the device of figures 48 to 54 in the housing of equipment;

- figures 73 and 74 are two opposite perspective views showing the integration of the lid of the device in the housing of the equipment.

For the description of the invention, the orientations vertical,
5 longitudinal and transverse, according to the reference marking trihedron V, L, T indicated in Figure 1, shall be adopted on a non-limiting basis.

By convention, the terms lower, upper, front, rear, and left, right with reference to Figure 1 shall also be adopted.

10 In the following description, identical, similar or analogous elements belonging to the embodiments according to the invention shall be designated by the same numerical or alphanumeric references.

The device 20 comprises a lower housing 22 in the general
15 shape of a substantially parallelepipedal rectangle, the upper face 24 of which is upwardly open, and an upper closing lid 26 for the lower housing, which latter houses the principal components of the device 20.

These components comprise, in the first embodiment both
20 from the bottom up and in the bottom of the housing 22, two left T2 and right T3 horizontal, transverse fixed contact rods, two rear T4 and front T5 horizontal, longitudinal fixed contact rods and a fixed central contact ball 28, as well as a movable contact rod T6 belonging to a rotary signals generator associated with the
25 longitudinal rods T4 and T5.

Then, from the bottom up, a central trigger member 30 in the general shape of a star having four trigger branches Bi, a sole or single manual control member 32 of longitudinal and horizontal rotation axis Z-Z and a flat sealing joint 34.

30 The sole manual control member 32, which is here realized molded in a one single piece, is basically constituted by a rotary operating drum 36, the central section 38 of which is of reduced diameter, and of inwardly curved or concave profile, relative to its

two knurled longitudinal end sections, left 40 and right 42 (not represented), or is lined with a "soft"-feeling elastomer outer skin (not represented).

The drum 36 is designed to be rotated by its slender central
5 part 38, which, for this purpose, can comprise longitudinal ribs (not represented in this embodiment).

The control member 32 also comprises a central shaft, which is extended, beyond the longitudinal end side left and right faces 35, 37 of the drum 36, by two longitudinal end sections, left
10 44 and right 46, for the rotation-mounting and guiding-mounting of the member 32 in the lower housing 22, which, for this purpose, comprises two median vertical and longitudinal slots, left 48 and right 50, which emerge vertically in the upper face 24 and each of which receives, in rotational and vertically sliding arrangement,
15 the corresponding section 44, 46 respectively.

The slots 48 and 50 also provide for the longitudinal, play-free positioning of the control member 32 relative to the housing 22.

The control device or navigator 20 is here a device having
20 five switching ways, each of which can be used independently of the others through the application of a corresponding force F_i to the control member 32.

The first switching way is a so-called "SELECT" way, which is used by applying of a centered vertical force F_1 to the central
25 section 38 of the drum 36, by which, for example, a set position reached by a cursor on a flat screen of an electronic appliance (see, for example, Figure 45) equipped with the navigator 32 can be selected or enabled, each application of a vertical force F_1 allowing a selection signal or pulse to be produced or generated.

30 The second switching way is, for example, a so-called "LEFT" displacement way for displacement towards the left of the screen, which is used by applying a vertical force F_2 to the left section 40 of the drum 36, each application of a vertical force F_2

allowing a "LEFT" displacement signal or pulse to be produced (Figure 19).

In a symmetrical fashion, the third switching way is, for example, a so-called "RIGHT" displacement way for displacement
5 towards the right of the screen, which is used by applying a vertical force F_3 to the right section 42 of the drum 36, each application of a vertical force F_3 allowing a "RIGHT" displacement signal or pulse to be produced (Figure 20).

The circuits of the operated electronic appliance can provide
10 that, if the user keeps the drum "pressed" down according to F_2 or F_3 , the pulses are repeated in continuous trains of identical pulses ("Scrolling"), in the same way as for a computer keyboard on which the key or button is kept pressed.

The fourth switching way is, for example, a so-called
15 "DOWN" displacement way for displacement towards the bottom of the screen, which is used by applying to the central part 38 of the drum 36 a circular force F_4 tending to rotate it in a first direction or sense so as to generate a series of control signals or pulses by means of a signals generator 52 which will be described below.

20 In a symmetrical fashion, the fifth switching way is, for example, a so-called "UP" displacement way for displacement towards the top of the screen, which is used by applying to the drum 36 a circular force F_5 tending to rotate it in a second direction or sense so as to generate a series of control signals or
25 pulses by means of the signals generator.

The application of the forces F_2 or F_3 to the drum 36 might be facilitated by the presence of the knurls at its ends 40 and 42, which indicate to the user that they are zones on which it is necessary to press. However, as it will be seen later with respect
30 to the last embodiment, these zones might also be flush without knurls, the knurls being preferably arranged in the central portion for rotational driving.

The general concept of the device according to the invention with its single actuator or control member 32 does permit to have different values for the central SELECT force F1 and the lateral LEFT, or RIGHT force F2, or F3 in a ratio between 1,5 to 2. This is due to the possibility to dimension the drum and its various central and lateral 40, 42 actuating zones along the longitudinal axis, as well as the dimensions of the switching branches of the a central trigger member 30.

Also, the external shape or profile of the drum, in combination with the arrangement and dimensioning of the trigger member under the drum is thus that any vertical or substantially vertical effort applied to the central concave section or portion 38 of the drum member is inherently an effort of the F1 type which does provoke a switching of the first way. On the contrary, any effort applied on the lateral left or right section (40 or 42) is inherently an effort of the F2 or F3 type which does provoke a corresponding switching of the second or third way.

The navigator 20 has a general design symmetry relative to the median vertical and longitudinal plane PLM in which is situated the rotational axis X-X of the drum member 32, and a general symmetry relative to the median vertical and transverse plane PTM, with the exception of the means, constituting the signals generator 52, which are here gathered together in the right-hand part of the housing 22 and which have no symmetrical counterpart in the left-hand part of the housing.

In its center, corresponding to the intersection of the planes PLM and PTM, the flat horizontal bottom 56 of the housing 22 contains a receptacle 58, which receives the central metallic ball 28, the upper section of which, in the form of a convex spherical cap, projects vertically above the plane 56.

The ball 28 cooperates with a common, fixed, central contact pad P0, which is connected, by a strip conductor (or conducting strip) 60 (see Figure 9), to a connecting terminal in the

form of a pin or lug C0, which projects transversely forward in a receptacle 21 in the lower part of the front longitudinal face 23 of the housing 22.

Each fixed transverse contact rod T2, T3 is in the form of a pin and is mounted in the bottom of the housing, bearing upon two
5 left front 62 and rear 64 and right front 66 and rear 68 positioning and fixing side feet, containing vertical slots and raised in the bottom 56.

The front feet 62 and 66, respectively comprise a second P2
10 and a third P3 fixed conductor pad, each of which is electrically connected to the fixed contact rod T2, T3.

Each pad P2, P3 is connected, by a strip conductor 70, 72, to a connecting pin or lug C2, C3.

The bottom 56 also comprises two front 74 and rear 76
15 central feet, which, in the plane PTM, are aligned with the ball 28.

Each central foot constitutes a part of a first fixed conductor pad P1 and these parts are connected, here by a common strip conductor 78, to a common connecting pin or lug C1.

The common trigger member 30, which will now be
20 described in details, allows the first switching way between the pads P0 and P1, the second switching way between the pads P0 and P2 (through the fixed contact rod T2), or the third switching way between the pads P0 and P3 (through the fixed contact rod T3), to be selectively established, and this as a function of the
25 vertical force F1, F2 or F3 applied to the drum 36 by the user, i.e. as depending upon the force which is applied.

In accordance with the teachings of the invention, the common trigger member 30, here made of metal, integrates or gathers four trigger members, each of which is constituted by a
30 trigger branch Bi, of essentially radial orientation, which extends outwards from a central portion 80 of essentially domed shape and the concavity of which is orientated vertically upwards.

These four branches B_i are identical and are angularly distributed at 90° apart such that the member 30 has a design symmetry about its vertical central axis Y-Y, which, in position mounted in the housing, corresponds to the intersection of the planes PLM and PTM.

The bottom 84 of the central part 80 comprises a receptacle 82 in the form of a spherical cap, the concavity of which is orientated downwards and the radius of which is substantially equal to that of the ball 28 such as to rest on the latter (see Figure 12) and allow slight pivotal movements of the member 30 about the center of the ball 28.

By way of a variant (not represented), and in order to reduce frictions, the receptacle 82 can be truncated in such a way as to secure a circular contact with the ball 28.

The member 30 comprises two diametrically opposed longitudinal branches, left B₂ and right B₃, which will be referred to as the second trigger branch B₂ and third trigger branch B₃ and which belong to the second and third switching ways respectively.

The member 30 also comprises two first transverse trigger branches B₁, which are diametrically opposed and belong to the first switching way.

Each trigger branch B₁ extends slightly upwards and their free ends are substantially coplanar.

In mounted position of the member 30, each free end 86, 88 of the branch B₂, B₃ extends above and at a distance from the associated fixed transverse contact rod T₂, T₃.

In the same way, each free end 90 of the branch B₁ (front, rear) extends above and at a distance from a first fixed contact pad P₁.

As it can be seen, in particular from Figure 12, the drum 76 rests vertically on the upper faces of the free ends 86 and 88 of the longitudinal trigger branches B₂ and B₃. The latter are slightly

elastically pretensioned in the downward direction and thus permanently ensure an elastic return function of the drum 36 towards its high rest position illustrated in the figures, in which position the longitudinal end sections 44 and 46 bear upwards
5 against the lower face of mutually opposite portions 92 and 94 of the sealing joint 34, which "close" the slots or receptacle 48 and 50 in the upward direction.

When the drum or roller 36 is rotated, each upper face of a free end 86, 88 slides along a cylindrical annular path or track 41, 43, respectively, in the periphery of the drum, these being
10 adjacent to the knurled lateral end sections 40 and 42.

The design of the member 30 and of its branches Bi is such that, when the free end of a branch Bi is stressed by applying to it, from top to bottom, a substantially vertical force, the branch is
15 *elastically deformed, then suddenly changes of position, angling downwards*, this sudden change allowing the securement of a trigger function, for the purpose of establishing at least the corresponding switching way, and supplying, moreover, a click of tactile and/or auditory sensation indicating the sudden change of
20 position.

The use of the second, "LEFT" switching way, from the rest position illustrated in the figures, will now be described.

When the user applies the vertical force F2, that is to say when he presses on the left of the drum 36, he provokes a
25 lowering or descent of the corresponding left end 44 of the shaft, which tilts about a transverse horizontal axis (orthogonal to the axis X-X) passing substantially through the point of contact of the upper face of the right cylindrical end section 46 of the shaft with that portion 94 of the joint 34 which closes the slot 50.

30 Hence, the left longitudinal branch B2 becomes sufficiently deformed to change state in order for its free end to come into electrical contact with the rod T2, as illustrated in Figures 19 and 21.

This deformation of the considered B2 branch is combined with a rotational movement or tilting of the central trigger member 30 around the center of the ball 28.

To the deformation of the trigger branch B2 is thus added a
5 slight pivoting of the member 30 about the center of the ball 28, whereby the travel obtained for the free end 86 of the branch B2, with respect to the corresponding contact T2, can be augmented.

The second electrical switching way (28-P0, B2, 86, T2, P2) between the terminals C0 and C2 is thus established through the
10 common member 30, which is conductive and which, by its central part, is always in contact with the central fixed contact 28-P0, which is common to the first three switching ways.

In fact, in most of the cases and due to the concept and design of the star-shaped trigger member 30, all the branches
15 might simultaneously change state, but, in this case, the free end of the opposite lateral branch B3 does not come simultaneously in contact with the fixed corresponding contact T3. This free end might not come into contact or, if it comes into contact, it will be later so that an associated software for receiving and analyzing
20 the various switching signals or pulses will permit to discriminate between the two consecutive received signals.

In a similar manner, the downward travel of the free ends of the two opposed transverse branches B1 is inferior to the travel of the free end 86 of the branch B2.

25 In symmetrical fashion, the application of the force F3 by pressing on the right of the drum allows a signal or a pulse to be produced by virtue of the third, "RIGHT" switching way (28-P0, B3, 88, T3, P3) between the terminals C0 and C3, as illustrated in Figures 20 and 21.

30 For the use of the first, "SELECT" electrical switching way, the user applies the force F1 to the central concave portion 38 of the drum.

He thus provokes a lowering or total vertical descent of the control member 32 with the axis Z-Z, which remains essentially horizontal and parallel to himself, this movement being guided by the slots 48 and 50.

5 The tracks 41 and 43 of the drum 36 act simultaneously and symmetrically upon the free ends of the two longitudinal branches B2 and B3.

Owing to this "balanced" deformation force and through the design of the common trigger member, the four branches Bi
10 simultaneously change of state.

Insofar as there is virtually no pivoting of the member 30 relative to the ball 28, the free ends 86 and 88 of the two longitudinal branches B2 and B3 come into contact with neither the rod T2, nor with the rod T3.

15 On the other hand, the two branches B1 which are lowered each come into contact, by their free ends 90, 92, with an opposite fixed contact pad P1, thus establishing the first switching way, as illustrated in figures 22 and 23.

In the represented embodiment, the "doubling" of the
20 branches B1 and of the pads P1 is redundant insofar as the sudden change of state of the two branches is virtually simultaneous, but this redundancy provides a high level of working reliability.

In fact, especially in view of the very small dimensions of
25 the various components, an action of the F1 type might also provoke the switching between the free ends of the lateral branches B2 and B3 with the corresponding fixed contacts T2 and T3.

Again, the associated software will permit to analyze the
30 various received signals with a view to discriminating the quasi simultaneous switching of the second and third ways hereabove mentioned, from the consecutive switching of these two second

and third ways due to a consecutive and voluntary action on one and thereafter the other lateral end portion of the drum member.

In order to obtain the switching, it is necessary, for example, to apply a force F1 of value "N", whereas, for the second or the
5 third switching way, the value of the force F2 or F3 to be applied in order to obtain the corresponding switching is lower, for example between 0,5N and 0,7N, owing to the lever arm effect which is at play when the member 32 tilts in either direction.

This difference in the value of the forces to be applied
10 allows the achievement of discrimination between the functions.

According to another aspect of the invention, the first switching way when applying an F1 effort might not use the branches B1 and the associated fixed contacts, but only the quasi simultaneous formation of switching pulses or signals on the
15 *second and third ways, as described above, in combination with the corresponding analysis and discrimination by means of the associated software.*

Without changing the design and concept of the device, it is then possible to suppress at least one wire for connection with C1,
20 which is an advantage in the automotive field.

The signals generator 52 will now be described, the general design of which is that described and represented in document WO-A-02/075641 and in document FR-A-2.844.619 and in French patent application n°0306475 of 28 May 2003.

25 The generator 52 comprises a toothed spur-type driving pinion 100, which is rotationally linked to the shaft between the end section 46 and the opposite end face 37 of the drum 36. Between two consecutive teeth 102 of the twelve teeth of the pinion, an upper section 104 of the movable contact rod T6 in rest
30 position is received in such a way as to provoke the tilting of the movable contact rod T6 in either direction (F4, F5) when the shaft is rotated by the drum 36 in order to establish an electrical contact between the movable contact rod T6 and one or other of

the two fixed longitudinal contact rods T4, T5 and thus to generate a control signal, and such as then to provoke the automatic escape of the upper section 104 from the space delimited by the two consecutive teeth beyond a set angle of rotation of the associated drive shaft.

The movable contact rod T6 is a bent-wire element, which extends in a vertical plane and which, when the generator is at rest, lies in the plane PLM. Such a design of a movable rod has been described and represented in document WO-A-02/075641 (Figures 25 to 29).

It is basically composed of a vertical strand, comprising an upper section 106 and a lower section 108 connected by a horizontal intermediate section 110 constituting the horizontal general tilt axis of the movable contact rod T6.

For this purpose, the horizontal section is received in the bottom of a slot 112 formed in the upper face of a foot 114 adjacent to the right-hand inner side face 116 of the housing 22.

The vertical strand 106-108 is extended rightwards, from the lower end of the lower section 108, by a longitudinal horizontal strand 118 which is received in the bottom of a triangular recess 120 hollowed out in the bottom 56 and the free end 122 of which, bent back 180°, is clamped in a longitudinal vertical slot 124.

The bottom of this slot 124 comprises a conductor pad P6, which is connected, by a strip conductor 126, to an output terminal C6 to which the movable contact rod T6 is thus permanently electrically connected.

This design incorporating the horizontal strand 118 produces a high return motion stiffness, whilst the ohmic resistance of the wire section of the rod is very small between, on the one hand, the "crossed" point of contact between the lower section 108 and the fixed rod T4 (or T5) and, on the other hand, the contact pad P6.

The fixed longitudinal contact rods T4 and T5 are each squeezed by their left-hand longitudinal end 128, 130, bent back 180°, into a slot in a rear foot 132, front foot 134, and each extends longitudinally and horizontally in overhang above the
5 bottom of the recess 120.

Thus, each rod T4, T5 is deformable elastically and transversely outwards. This is therefore a case of an advantageous crosspoint contact with accompaniment, which avoids the phenomena of bounce, allows the force variations as a
10 function of production tolerances to be minimized and hence produces a high level of homogeneity in the forces to be applied to the drum.

The bottom of each slot comprises an associated conductor pad P4, P5, which is connected by a strip conductor 136, 138 to
15 an output terminal C4, C5 respectively.

When the signals generator 52 is at rest, the two rods T4 and T5 are parallel and the lower section 108 of the movable rod T6 is received between the two rods T4 and T5.

When the drum is rotated in one or the other direction, the
20 rod tilts about its horizontal axis 110, in the manner of a crankshaft, and its lower end proceeds to establish an electrical contact with the corresponding fixed rod T4 or T5.

The fourth switching way (C6, T6, T4, C4) or the fifth switching way (C6, T6, T5, C5) is thus established according to
25 the direction of rotation.

Insofar as the upper end 104 of the movable contact rod T6 is received between two consecutive teeth 102 and with a vertical play between its upper end and the bottom 140 of the interdental space, the vertical actuation of the drum 36 according to F1, F2 or
30 F3 produces no parasitic effect upon the signals generator, that is to say it generates no parasitic signal.

The lower horizontal section 118, clamped at its right-hand end, secures the elastic return of the movable rod T6 into its rest position.

The association of the rotary generator 52 with the multiple-
5 branched Bi trigger member 30 is particularly advantageous and allows the realization of a very compact assembly with a reduced number of components, yet the low total height of which offers access to a large portion of the drum emerging above the upper face of the lid 26.

10 For component symmetry reasons, the left longitudinal end 44 of the shaft also bears a left toothed pinion 144.

According to a variant (not represented), this second pinion can also belong to a second, dual-way rotary signals generator analogous to the generators 52, the components of which are in
15 this case arranged on the left-hand part of the housing 22 under the pinion 144. A second such generator may be necessary for the redundancy-based reliability of the device or as a function of a specific application inherent to the electronic appliance.

The pinions 144 and 100 are received with play in semi-
20 cylindrical receptacles 146 and 148 formed in the lower face 150 of the lid, which, with the upper face 24 of the housing 22, encloses the upper joint 34.

The components assembly is held in place by closure of the lid 26, which is fixed by hot crimping of the studs 152 of the
25 housing 22, which pass through holes 154 in the lid 26.

In this type of electromechanical component, it is particularly important to be able to ensure the best possible seal in order, especially, to protect the switching zones.

The first seal in the top part is secured by the joint 34 with
30 its cutout 93, which closely matches the profile of the drum 36 (35, 40, 41, 38, 43, 42, 37). By way of a variant (not represented), the joint can also, be realized by bi-injection molding with the lid.

In the low part, it is also possible to interpose a horizontal flexible joint in the form of essentially rectangular and horizontal film, which extends below the drum 36 and above the common trigger member 30.

5 As it can be seen from Figures 24 et seq., the film 170 is held in position by an upper peripheral frame 172, which rests on a peripheral inner shoulder 154 on which the periphery of the sealing joint can be glued.

10 The sealing film 170 thus extends vertically between the drum 36 and the common trigger member 30.

The drum in this case comprises two circular ribs or flanges 41 and 43, axially facing the upper faces of the ends 36 and 38 of the branches B2 and B3.

15 When the drum 36 rotates, each flange rubs on the part opposite the upper part of the film 170, which can be provided with a top coating (not represented) of low friction coefficient, for example "Teflon" (polytetra-fluoro-ethylene).

20 Where the device 20 comprises illuminating means for the drum, the film 170 can be totally or partially transparent or translucent.

25 As it can be seen, in particular, from Figures 24 and 28, 29, the film 170 provides a virtually total sealing of the lower part of the housing 22 with only a very small cut-out in its right-hand transverse edge having a transverse slot 174 for the passage and deflections of the movable contact rod T6, the upper control portion 104 of which extends above the film 170 so as to cooperate with the driving pinion 100.

30 In Figures 30 and 31, an embodiment of the movable contact rod analogous to that described in documents WO-A-02/075641 and FR-A-2.844.619 is described, according to which the rod T6 is connected to the last turn 158 of a helical spring 156 which secures its return into its angular position of rest and the axis Z-Z of which constitutes the pivot axis in both

directions of the movable contact rod and lies parallel to the rotational axis X-X of the drum.

The longitudinal cylindrical body of the spring 156 is received and guided in a complementary receptacle 166 in the housing 22. The length and the number of turns of the spring allow, in particular, the value of the elastic return force to be gauged. On the other hand, the ohmic resistance between the lower movable contact section 108 and the fixed pad P6 is greater than previously.

10 The housing 22, as in the case of the aforementioned "trackballs", can also comprise inner lighting diodes 176 for the drum 36, which can be totally or partially translucent.

Such illuminating means, represented diagram-matically in Figures 32 and 33, in association with the tactile sensations, allow the user to be supplied with luminous indications, especially for the purpose of guiding him in his use of the device, for example so as to indicate to him the type of force he must apply to the drum for the next executable function.

The drum 36 can comprise a translucent body 180 having molded-on opaque axial end sections 182, with the molding material extending longitudinally into the radial slots or notches 178 in the translucent body 180. Thus, on the surface of the central section of the drum, a series of angularly evenly distributed luminous windows are defined, which are equal in number, for example, to the number of teeth of the driving pinion.

It is possible to use different-coloured diodes 176 for each function and/or to make the drum out of a translucent material comprising differently coloured longitudinal sections, since the drum always revolves about the same axis, unlike the control ball of a trackball which revolves in "all directions".

It is also possible to use for the drum a known material, of the phosphorescent type, which permits to very quickly accumulate light from the external environment and to reconstitute

this light during several hours. This material might be in the form of an additive in an elastomeric soft-touch material.

Especially when the device is arranged in an area without permanent lightness (such as the inside of an automobile at night)
5 the drum might be permanently and slightly illuminated so as to facilitate its detection by the user in the same manner as an illuminated button or switch for equipment of the dashboard.

By way of a variant and as represented in Figure 45, in the case of the control of the Y-axis (vertical) displacements of a
10 cursor 202 on a screen 204 of an electronic appliance, the second (F2) and third (F3) switching ways can be used for "large-step" rapid displacements upwards and downwards, whereas the fourth (F4) and fifth (F5) switching ways retain their "fine-step" control function.

15 A first drum device 20-1 can in this case be used for X-axis displacements and a second device 20-2 to control the Y-axis displacements, the axes of both drums being perpendicular by virtue of a "T"-shaped (as in Figure 45) or "L"-shaped arrangement.

20 In such a hypothesis, the first device, arranged "horizontally" (parallel to the horizontal axis of the "X's" on the screen), can secure the control of all the "X-axis" displacements with displacements according to a large step (F2, F3) or according to a fine step (F4, F5) in both directions (leftwards or rightwards).
25 In the same way, the second device, arranged "vertically" (parallel to the vertical axis of the "Y's" on the screen), can secure the control of all the "Y-axis" displacements with displacements according to a large step (F2, F3) or according to a fine step (F4, F5) in both directions (leftwards or rightwards). Each of the
30 devices has, moreover, a supplementary enabling switching way (F1).

Still in this hypothesis combining two devices according to the invention, the first, "horizontally" arranged device can control

the "X-axis" displacements in large steps (F2, F3) and the "Y-axis" displacements (F4, F5) in fine steps, whereas the second, "vertically" arranged device controls the "Y-axis" displacements in large steps (F2, F3) and the "X-axis" displacements in fine steps (F4, F5).

The choice between one or other of these two combinations is realized as a function of their respective ergonomy and of the type of function to be controlled.

Moreover, for example as a function of the number of teeth on the driving pinions of the rotary signals generators, it is also possible to have different fine steps from one device to the other.

It is also possible to use a simplified device according to the invention, that is to say without a rotary signals generator.

The tracks connecting the pads Pi to the terminals Ci, an arrangement of which is represented diagrammatically in Figure 9, are advantageously realized in the form of pre-cut tracks, constituting inserts around which the plastics insulating body of the housing 22 is molded on.

The embodiment which has just been described is intended, for example, for an automotive application having an ergonomic drum of relatively large diameter in the order of 16 mm with overall dimensions LxTxV in the order of 36x27x18 mm, this "fat" drum or roller facilitating operation in a passenger compartment.

The second embodiment of the invention, illustrated in Figures 34 to 44, will now be described, which is a model of very small dimensions intended, for example, for integration in a mobile telephone, having an ergonomic drum of approximately 3.5 mm diameter, with overall dimensions LxTxV in the order of 12.9x10x4.5 mm.

In order to reduce, in particular, the total height of the component, it is possible "to incline" the movable contact rod relative to the vertical, here by about 45°, and hence to "split" the rotary signals generator into two symmetrical parts arranged on

either side of the two longitudinal ends of the drum and of the housing.

Thus, the device 20 according to the second embodiment has design symmetry about the central vertical axis corresponding to the interception of the aforementioned planes PLM and PTM.

The signals generator 52 is thus constituted by two identical generators 52 arranged on the left and on the right and each of which comprises a movable contact rod T6, the lower section 108 of which cooperates, by its free lower end 109, with a fixed pad P4 (on the right), P5 (on the left) arranged in the bottom 56, which bottom is constituted, for example, by a conductive inset.

As described and represented in documents WO-A-02/075641 and in FR-A-2.844.619, the rod T6 is connected to the last turn 158 of a helical spring 156 which secures its return into its angular position of rest and the axis Z-Z of which constitutes the pivot axis in both directions of the movable contact rod and lies parallel to the rotational axis X-X of the drum.

The two rectilinear sections 106 and 108 and the upper loop 104, bent back 180° (which is received between the teeth 102 of the pinion 100), extend in an axial plane which, in the angular position of rest of the rod T6, forms an angle relative to the vertical.

This orientation and the rotational immobilization of the first turn 160 of the body of the spring 156 are ensured by its vertical section 162, which is received in a hole 164 in the housing 22.

Thus the choice of inclination and of other dimensional parameters allows the overall height of the device 20 to be markedly reduced.

The longitudinal cylindrical body of the spring 156 is received and guided in a complementary receptacle 166 in the housing 22. The length and the number of turns of the spring allow, in particular, the value of the elastic return force to be gauged.

The double signals generator works as follows.

When the user drives the drum 36 by applying to it a force F4 (DOWN), the right-hand driving pinion 100 provokes the repeated formation of signals or pulses by repeated contacting of
5 the end 109 of the movable contact rod T6, which is essentially driven downwards so as to cooperate with the fixed contact pad P4. The user thus uses the fourth switching way.

The *equidirectional rotation of the left-hand pinion 100* provokes corresponding movements of the left-hand movable
10 contact rod T6, but its free end shifts essentially upwards without, however, entering into electrical contact with the lower, fixed contact pad P5.

The use of the fifth switching way through cooperation of the left-hand rod T6 with the fixed contact pad P5 is obtained by
15 rotating the drum 36 in the other direction F5.

A rotary signals generator 52 having a single switching way on each side of the housing eliminates the risk of generating parasitic pulses when the first three switching ways are actuated, since the descent of a pinion 100 provokes a tilting of the rod(s)
20 T6, but in a direction which tends to remove its lower contact end 109 from the associated conductor pad P4 or P5.

The teachings of French patent application n°0306475 of 28 May 2003 can, of course, be combined with those of the present invention.

25 The embodiment of the device illustrated in figures 48 and following will be now described by way of comparison with the embodiment of figures 1 to 25.

The upper closing lid 26 is extending longitudinally and transversely beyond the vertical planes of the lateral faces, such
30 as the front and rear longitudinal faces 23 and 25 and transversal faces 27, of the lower housing 22 thus defining a lower peripheral and horizontal edge surface 210.

Along the faces 23 and 25 and in the plane of the horizontal lower face 29, the housing 22 also comprises protruding horizontal ribs 212 defining a horizontal upper bearing surface 214.

5 The connecting terminals Ci made of conductive material and extending outside of the housing 22 are in the form of contacting blades which are elastically deformable, each of them extending upwardly in a corresponding receptacle 216 formed in the the lateral face 23. The receptacles 216 are separated by
10 isolating intermediary walls 220.

Each blade Ci defines a contacting outer face 218. Each blade Ci can be transversely depressed in the direction of the face 23.

Each left T2 and right T3 horizontal, transverse fixed
15 contact rod, such as the one T3 illustrated in details on figures 57 to 59, comprises a curved bent front end 222, 223 which is crimped in a corresponding shaft or well 224, 225 (in the form of a vertical and transversal slot which is open upwardly) equivalent to previous feet 62 and 66, each having in its bottom a conductive
20 pad P3, P2 respectively of L shaped cross section.

Each transverse rod T2, T3 is thus mounted in a cantilevered fashion such as a beam with its free rear end 226, 227 bearing, in an elastical pre-stressed state, against a horizontal lower bearing surface 228, 229.

25 This improvement provides for a more precise and trustable detection of the corresponding switching and is particularly advantageous when using the simultaneous or quasi-simultaneous switching of the second and third ways (in association with the corresponding software) to detect a central SELECT action of the
30 F1 type (as previously described in connection with the first embodiment).

Furthermore, it helps to prevent parasitic pulses or signals due to a vibrating environment.

Each rod, by means of its main central section, thus precisely defines a horizontal contact with which the lower face of the corresponding branch B2, B3 comes into contact, each rod T2, T3 being thereafter freely and elastically deformable downwardly under the action of the drum when either force F3 or F2 is applied.

As previously described, the mobile contact rod T6 is basically composed of a vertical strand, comprising an upper section 106 and a lower section 108 connected by a horizontal intermediate section 110 constituting the horizontal general tilt axis of the movable contact rod T6 which, for this purpose, is received in the bottom of a V shaped slot 112 formed in the upper face of a foot 114 adjacent to the right-hand inner side face 116 of the housing 22.

The vertical strand 106-108 is extended, from the lower end of the lower section 108, by a longitudinal horizontal strand 118 which is here suspended parallelly to the bottom of a recess 120 hollowed out in the bottom 56.

The free end 122 of the rod T6 which, bent back at 180° in the form of a horizontal hairpin, is clamped in a longitudinal vertical slot 124.

The bottom of the slot 124 comprises a conductor pad P6, which is connected, by a strip conductor 126, to the output terminal C6 to which the movable contact rod T6 is thus permanently electrically connected.

The clamping of the hairpin loop or end 122 of the rod T6 is ensured by means of a rib 230 formed in the upper strand 232 of the looped end 122 and which extends transversely in order to be force fitted in the facing internal longitudinal wall of the vertical slot 124.

The crimping or clamping is such that the lower strand 234 of the looped end 122 is permanently and elastically pre-stressed in electrical contact with the contacting pad P6.

It is also such that the looped end 122 does constitute an embedded end so that a kind of torque does permanently apply the intermediate section 110 in the V shaped slot 110.

The crimping might also be reinforced by hot welding of the upper part of the slot 164 so totally embed the end 122 in the loop.

In this embodiment, the two rear T4 and front T5 horizontal, longitudinal fixed contact rods have been replaced by conductive metallic pads P4(T4) and T6(P6) on which the lower housing is overmoulded.

As it can be seen on figures 54 to 56, the lower section 108 of the movable rod T6 is received with transversal play between the two pads P4 and P5.

When the drum is rotated in one or the other direction, the rod tilts about its horizontal axis 110, in the manner of a crankshaft, and its lower end 108 proceeds to establish an electrical contact with the corresponding fixed pad P4 or P5.

In order to provide a tactile and audio sensation to the user when the latter is turning the drum 32 along F4 or F5, the longitudinal left end side face 35 of the drum 36 is provided with a toothed wheel 236 here comprising eight hollow indentations 238 separated by eight V shaped convex teeth 240.

As well as the driving pinion 100 (having here only eight teeth), the wheel 236 is rotatably linked to the drum 36 so that an indentation 238 is downwardly oriented in a vertical plane when an interdental space 140 between two consecutive teeth 102 is also similarly oriented, i.e. when the upper portion of the mobile contact rod T6 is in rest position (see figures 62 to 64).

The wheel 236 is cooperating with an elastic indexing V shaped convex finger 242 which extends longitudinally and horizontally towards the right.

The wheel 236 in combination with the finger 242 does form a kind of ratchet wheel and pawl mechanism.

The indexing finger or pawl 242 belongs to an elastic indexing blade 244 which is supported by the lower housing 22 so as to provide a detent effect when cooperating successively with the indentations 238 and teeth 240 of the ratchet wheel 236.

5 In the rest position (see for instance figures 54 and 55) the finger 242 is received in a hollow or concave indentation 238 of the wheel 236.

As it can be seen on figures 62 to 64 bis, each indentation 238 is delimited by two lateral inclined (5° to 8°) opposed faces
10 237 and 239 so as to have a V shape opening radially towards the exterior.

In combination with the shape and dimensions of the pawl finger 242, when the left portion of the drum is descending vertically with respect to the finger 242, the V profile of the
15 indentation 238 does provide a return spring or elastic effect acting on the drum vertically and upwardly.

This returning effect comes in addition to the one exerted by the branches of the trigger element 30.

The arrangement of the pawl and ratchet mechanism does
20 provide the user with a tactile and/or audio sensation when the drum reaches a new angular rest position which also corresponds to a rest position of the pulse generator 100-T6. According to the first described embodiment the audio or tactile signal is generated when an electrical pulse is generated.

25 It is thus possible to design the wire mobile contact T in a less strong manner since it does no longer ensure any tactile or audio function an/or thus improve its life length.

In the embodiment illustrated in details on figures 54, 65 and 66, the drum 32 is made of several parts contrarily to the first
30 embodiment (fig. 24) where the drum 32 is a single molded piece.

The drum 36 is thus made of a main tubular and cylindrical molded body 180 having a central axial tubular hole which

receives a central shaft 252 which might be made of plastics or of metal and which is rotatably linked to the main body 180.

The two opposite ends of the central shaft 252 each comprises an axial open hole which receives an end rod
5 constituting two longitudinal end sections, left 44 and right 46, for the rotation-mounting and guiding-mounting of the member 32 in the lower housing 22, which, for this purpose, comprises two median vertical and longitudinal slots, left 48 and right 50, which emerge vertically in the upper face 24 and each of which receives,
10 in rotational and vertically sliding arrangement, the corresponding section 44, 46 respectively.

The driving pinion 100 and the wheel 236 are for instance metallic parts which are force fitted on the end rods 46 and 44.

The wheel 236 might also be made in a single piece with the
15 central shaft 252.

Alternatively, all the components 180, 252, 44, 46, 100 and 236 might be realized in the form of a single molded plastics piece, depending on the dimensions, efforts to be supported, life length, etc.

20 The central or mid portion of the drum 36 is here of concave shape and comprises series of axial knurls 264 to provide the user with additional tactile information and to improve its "gripping" of the drum for rotating it and also for applying the "enabling" effort F1 and the lateral end portions are here flush.

25 The knurls 264 might be realized directly by molding with the main body 180. However, the number of knurls is thus necessarily reduced due to the molding techniques.

The previously mentioned one piece molding of the drum easily permits to define an angular and precise orientation of the
30 knurls 264 with respect to the pinion 100 and the wheel 236 which already have a respective mutual angular orientation as previously mentioned.

If the number of the knurls is reduced and similar to the number of teeth 102 and indentations 238 which is generally comprised between six and twelve, and also depending on the overall external diameter of the drum, it is possible to orientate a
5 hollow between two indentations 264 upwardly in the vertical plane PLM and also an opposite lower one facing the branches B2 and B3, when the drum is in its angular rest position previously mentioned.

If a great number of knurls 264 is desired, and/or if a soft
10 touch material is to be used in this area comprising the knurls 264, they are preferably made in an independent sheath or tubular mantle 266 made by molding of an elastomeric material. This because it is then not possible to realize the knurls in the concave mid portion by molding techniques.

15 *The sheath 266 is extrusion molded independently and then the body is introduced therethrough elastically and temporarily deforming the sheath 266 illustrated in figure 66. The sheath is thus received in the external complementary groove 268 of the main body 180.*

20 *The sheath 266 can also be realized by bi-injection molding with the body 180.*

It has been represented on figures 68 and following a rectangular frame 280 which schematically represents a portion of a horizontal upper wall of an equipment (such as an electronic
25 appliance) equipped with a device according to figures 48 and 49.

The frame 280 delimitates a central opening 282 which is rectangular and complementary to the external shape of the upper lid 26. The lower peripheral and horizontal edge surface 210 of the lid 26 is bearing downwardly on a facing upper peripheral and
30 horizontal edge 284 of the opening 280 thus defining the vertical position of the lid with respect to the frame 280.

According to one aspect of this embodiment, the frame, or wall portion, 280 of the apparatus equipped with the multiway

switching device, comprises a number (four in the illustrated example) of elastic arms 286 which extend freely downwardly and each of them having a free lower end 288 which bears on the corresponding surface 214 of the lower body 22.

5 Each locking arm 286 is ramp shaped so as to automatically escape by elastical deformation when the device is vertically introduced for mounting in the opening 280, downwardly when considering figure 68. To this end, the internal ramp shaped face 290 of each arm 286 cooperates with the corresponding portion of
10 a facing rib 212.

In the position illustrated on figures 68, 69 and 72, the device 20 is fully locked and positioned with respect to the frame 280 (see also figure 54 on which the frame 280 has been represented).

15 In order to ensure the electrical connection of the device 20 with the corresponding circuits of the equipment or electronic appliance, the latter may comprise a hollow body, a portion 292 of which is illustrated on figures 71 and 72. The body 292 defines a rectangular parallelepipedal vertical hole 294 which opens in its
20 upper face 296 and which is adapted to receive the device 20.

The internal longitudinal face 298 of the central hole 294 comprises a series of conductive tracks 300, each of which being positioned and arranged to cooperate with a corresponding blade or terminal Ci-218 of the device 20 (see figure 72).

25 Each track 300 is preferably one face of a conductive metal strip 302 on which the plastic body 292 is overmoulded and which constitutes a fixed contact pin for electrical connection.

Finally, as illustrated in figures 73 and 74, the lid 26 might be made by molding as a single piece with the upper wall or frame
30 280, thus simplifying assembly and also permitting to suppress the elastic locking arms 286.

CLAIMS

1. Control device (20), of the type comprising a plastics housing (22) accommodating a revolving horizontal shaft (44,46) which is capable of being rotated, in both directions, by a manual driving drum (36) supported by the shaft to which it is rotationally linked,
- 5 - of the type in which the shaft is rotationally linked to at least one rotary member (100) belonging to a generator (52) of control signals or pulses for an electronic appliance, especially for controlling the displacements of a cursor on a display screen of the appliance,
- 10 - of the type in which the shaft is mounted such that it is vertically movable and tiltable in both directions about a transverse horizontal axis orthogonal to the longitudinal axis (X-X) of the shaft so as to selectively provoke the triggering:
- 15 - of a first trigger member belonging to a first switching way when a force (F1) of vertical orientation is applied substantially to the center (38) of the drum (36);
- of a second trigger member belonging to a second switching way when a force (F2) of vertical orientation is applied in the vicinity of one (40) of the two longitudinal ends of the drum (36);
- 20 - of a third trigger member belonging to a third switching way when a force (F3) vertical orientation is applied in the vicinity of the other (42) of the two longitudinal ends of the drum (36);
- 25 - and of the type in which the drum (36, 41, 43) rests vertically on a central member (30) which bears upon the bottom (56, 28) of the housing (22) and which, from a rest position, is elastically deformable,
- 30 characterized in that said central member (30, B1, B2, B3) is a common conductive trigger member, which belongs to the said three switching ways,

and which, from said rest position, is selectively elastically deformable under the action of one of the said forces (F1, F2, F3) of vertical orientation.

2. Device according to Claim 1, characterized in that each
- 5 trigger member of the said common member (30) is a trigger

branch (B1, B2, B3) extending radially from a central portion (80) bearing vertically upon the bottom (56, 58, 28) of the housing.

3. Device according to Claim 2, characterized in that the second and third trigger members are a second (B2) and third
5 (B3) trigger branches, made of conductive material, which are diametrically opposed and longitudinally aligned, and each of which is selectively elastically deformable, from a stable and high rest position towards a low switching position, so as each (B2, B3) to establish an electrical connection between two contacts of
10 a pair of associated fixed contacts ([P0,28], [T2,P2] - [P0,28], [T3,P3]) arranged in the bottom (56) of the housing (22), one of which ([T2,P2], [T3,P3]) is situated substantially vertically in regard to the free end (86, 88) of the associated trigger branch (B2, B3).

15 4. Device according to Claim 3, characterized in that the peripheral surface (41, 43) of each of the opposite axial end sections of the drum (36) rests vertically on the upper face of the free end of one of the second (B2) and third (B3) trigger branches.

20 5. Device according to the preceding claim, characterized in that the housing comprises guide means (48, 50) for guiding the opposite axial ends (44, 46) of the shaft in a vertical plane (PLM) perpendicular to the bottom (56) of the housing.

25 6. Device according to either of Claims 4 or 5, characterized in that the drum is returned elastically towards a high rest position by the second and third trigger branches.

7. Device according to any one of Claims 3 to 6, characterized in that the said first trigger member is a first trigger branch (B1), made of conductive material, which extends radially
30 from the said central portion (80) in a transverse direction (T) essentially orthogonal to the longitudinal direction (L) of the second and third trigger branches (B2, B3) and which is elastically deformable, from a stable and high rest position

towards a low switching position, so as to establish an electrical connection between two contacts of a pair of associated fixed contacts ([P0,28], P1) arranged in the bottom (56) of the housing (22) and one of which (P1) is situated substantially vertically in regard to the free end (90) of this first trigger branch (B1).

8. Device according to Claim 7, characterized in that the said first trigger member comprises two first, diametrically opposed trigger branches (B1), made of conductive material, which extend radially from the said central portion (80) and which are simultaneously elastically deformable, from a stable and high rest position towards a low switching position, so as each to establish an electrical connection between at least two fixed contacts of a pair of associated fixed contacts arranged in the bottom of the housing, one of which is situated substantially vertically in regard to the free end of the associated first trigger branch.

9. Device according to any one of Claims 3 to 6, characterized in that the said first trigger member is comprised of the association said second and third trigger members (B2, B3), their switching being provoked simultaneously or substantially simultaneously when the said force (F1) having a vertical orientation is applied substantially to the center (38) of the drum (36).

10. Device according to any one of Claims 3 to 9, characterized in that each trigger branch (Bi) suddenly changes of state, beyond a set trigger travel, in such a way as to transmit a tactile sensation of its triggering to the user of the device (20), through the drum (36).

11. Device according to any one of Claims 2 to 10, characterized in that the said central portion (80) from which the said trigger branches (Bi) extend is a domed portion, the concavity of which is orientated upwards such that the central

zone (84) of its convex lower face bears vertically upon the bottom (56, 28) of the housing.

12. Device according to the preceding claim, characterized in that each trigger branch (Bi) extends radially outwards and upwards from the said domed central portion (80).

13. Device according to either of Claims 11 or 12, characterized in that the central zone of the domed central part (80) comprises a portion in the form of a spherical or truncated, especially concave, cap (82), which bears vertically upon a complementary portion (28) in the bottom (56, 58) of the housing such as to constitute a centering and/or articulation means for the said central portion (80).

14. Device according to any one of Claims 3 to 10, characterized in that the said central portion (80) is made of conductive material and is electrically connected to a common fixed electrical contact (P0) belonging to each pair of associated fixed contacts ([P0,28], [T2,P2] - [P0,28], [T3,P3] - P0, P1).

15. Device according to any one of the preceding claims, characterized in that the said rotary member is a toothed driving pinion (100), which is rotationally linked to the shaft and is arranged in the vicinity of one (46) of the axial ends of the shaft, and between two consecutive teeth (102) of the drum is received an upper section (104) of a movable contact rod (T6) such as to provoke the tilting of the contact rod (T6) in one or the other direction, when the shaft is rotated by the drum (36), in order to establish (F4, F5) a fourth (P0, P4) and/or a fifth switching way (P5) between the movable contact rod (T6, 108) and a fixed fourth (T4) or fifth contact (T5), and such as then to provoke the automatic escape of the upper section (104) from the space delimited by the two consecutive teeth (102) beyond a set angle of rotation of the drive shaft.

16. Device according to the preceding claim, characterized in that each longitudinal end section of the drive shaft bears a

toothed driving pinion (100), which is rotationally linked to the shaft and between two consecutive teeth (102) of which is received an upper section (104) of an associated movable contact rod (T6) such as to provoke the tilting of the contact rod in one or the other direction, when the shaft is rotated by the drum (36), in order to establish (F4, F5) a fourth (P0, P4) and/or a fifth switching way (P0, P5) between the contact rod (T6, 108, 109) and a fixed fourth or fifth contact, and such as then to provoke the automatic escape of the upper section from the space delimited by the two consecutive teeth beyond a set angle of rotation of the drive shaft.

17. Device according to Claim 16, characterized in that the movable contact rod (T6) extends essentially in an axial vertical plane (PLM) beneath the driving pinion (100).

18. Control device according to Claim 15, characterized in that the movable contact rod (T6) extends essentially in an axial plane inclined by about 45° relative to the vertical.

19. Control device according to Claim 15, characterized in that the movable contact rod comprises a lower vertical contact section (108) movable in a transverse vertical plane extended longitudinally by a horizontal section (118) forming a return spring, the free end (122, 124) of which is immobilized and is in electrical contact with a fixed contact pad (P6) of the housing.

20. Device according to any one of the preceding claims, characterized in that it comprises illuminating means (176) for the drum, arranged in the bottom (56) of the housing (22), and in that the drum (36) is totally or partially translucent or transparent in order to conduct the light transmitted by the illuminating means (176).

21. Device according to anyone of the preceding claims, characterized in that it comprises a ratchet wheel (236) rotationally linked to one lateral end of said driving drum (36) and a fixed pawl (242, 244) supported by the plastics housing (22) to

generate audio and/or tactile sensitive pulses when the drum is rotated.

22. Device according to the preceding claims, characterized in that the pawl (242, 244) is elastic and in that, in cooperation
5 with the indentations (238) of the ratchet wheel (236), it provides the drum with an elastic upwards return effect after that the corresponding lateral end of the drum has been vertically displaced downwardly.

23. Electronic appliance (200), characterized in that it
10 comprises a display screen (204) and two control devices (20-1, 20-2), each in accordance with Claim 15, for controlling the displacements of a cursor (202) on the screen along two perpendicular displacement axes (X, Y), and in that the two
15 devices (20) are disposed such that the rotational axes of the control members (32, 36) of the two devices are orthogonal and parallel to the said displacement axes, respectively.

24. Electronic appliance according to the preceding claim, characterized in that the second, third, fourth and fifth switching
ways of each device (20-1, 20-2) are associated with the control
20 of the displacements of the cursor (202) along a same axis (X or Y).

25. Electronic appliance according to Claim 23, characterized in that the second and third switching ways of a first
(20-1) of the two devices are associated with the control of the
25 displacements of the cursor along one axis (X), and the fourth and fifth switching ways of the first device (20-1) are associated with the control of the displacements of the cursor along the other axis (Y), and in that the second and third switching ways of the second
(20-2) of the two devices are associated with the control of the
30 displacements of the cursor along the said other axis (Y), and the fourth and fifth switching ways of the second device (20-2) are associated with the control of the displacements of the cursor along the said one axis (X).

ABSTRACT**DRUM-TYPE CONTROL DEVICE HAVING MULTIPLE SWITCHING WAYS AND
ELECTRONIC APPLIANCE EQUIPPED WITH SUCH DEVICES**

The invention proposes a device (20) comprising a housing (22), a revolving shaft (44, 46) rotated by a drum (36), and a rotary signals generator (100, T6), of the type in which the shaft is mounted such that it is vertically movable and tilts in both directions so as selectively to provoke the triggering of a first switching way when a force is applied to the center (38) of the drum (36), or of a second and a third switching way when a force (F2, F3) is applied in the vicinity of one or other (40, 42) of the two ends of the drum (36), characterized in that the drum (36, 41, 43) rests vertically directly on a central member (30, 131, B2, 133) common to the three switching ways, which bears upon the bottom (56, 28) of the housing (22) and which, from a rest position, is selectively elastically deformable under the action of one of the vertical orientation forces (F1, F2, F3).

Figure 2