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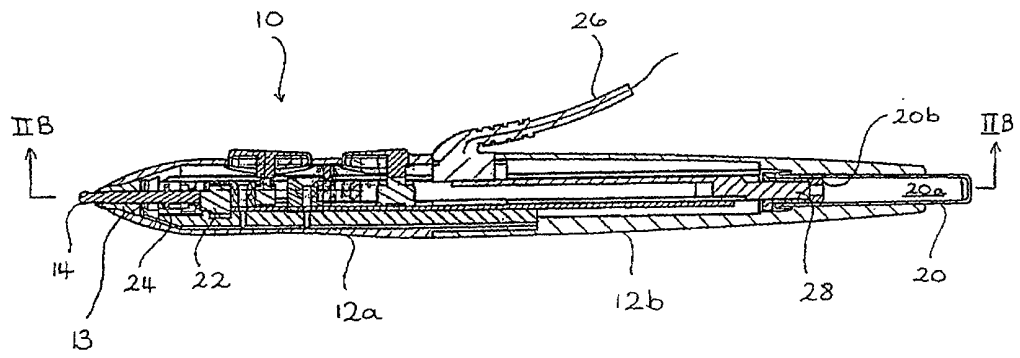
(54) **Title:** A METHOD AND APPARATUS FOR DETECTING DEPRESSION PRESSURE IN A STYLUS



(57) **Abstract:** An electronic stylus including: a forward end and a rear end; a tip located at said forward end; and first and second capactive electrodes in the stylus, tip resisting means for resisting the depression of the tip; wherein depression of the tip affects the capacitance between the electrodes, and further a capacitance measuring means that senses the depression of the tip. The measured depression of the tip can be used to sense force or pressure exerted by the user and can (for example) be used to affect the digitised line width.

WO 01/24157 A1

A METHOD AND APPARATUS FOR DETECTING DEPRESSION PRESSURE IN A STYLUS

The present invention relates to an electronic stylus, of the type used with computers for digitising drawings or entering text manually, and a method for detecting the depression of its tip.

Existing styluses are commonly employed with digitising tablets for digitising graphical material, or for allowing a user to enter hand written or drawn material into a computer. Similar styluses are also employed to digitise in three dimensions, for example, for translating a three dimensional prototype of an article of manufacture into a digital form for viewing and manipulation by computer.

Such styluses respond to pressure applied to their tip by emitting an electronic signal to their digitising tablet, computer or other electronic device. The position of the stylus may be determined by means of the capacitive coupling of the tip of the stylus and the tablet. Tip pressure may be detected by means of a mechanically activated switch or a force transducer (such a piezoelectric transducer).

It is an object of the present invention to provide a stylus that is sensitive to a range of tip pressures by means of capacitive coupling. It is another object of the present invention to provide a stylus that can operate in two modes, with either mechanical or capacitive coupling of the stylus tip, and thus perform a range of functions including those of a mouse.

Accordingly, the present invention provides an electronic stylus including:

a forward end and a rear end;

a tip depressible in response to rearward pressure applied to said tip, said tip located at said forward end and forming or being coupled to a first capacitive electrode;

a second capacitive electrode for capacitive coupling to said first electrode with a capacitance inversely proportional to the separation of said first capacitive electrode and said second capacitive electrode;

capacitance detecting means for detecting variations in said capacitance; and

tip resisting means for resiliently resisting the depression of said tip;

wherein said depression of said tip reduces the separation of said first capacitive electrode and said second electrode to vary said capacitance so that variations in said capacitance provide a measure of said separation of said first electrode and said second electrode, and said tip resisting means is locatable to resist said depression of said tip so that said variations in said capacitance provide a measure of said pressure.

Thus, the harder a user presses the stylus down, the higher is the pressure on the tip and hence the lower the distance between the first electrode (which may be the tip) and the second electrode. The resulting increase in capacitance between the first and second electrodes provides a measure of this pressure. A higher pressure may thereby be detected and used to indicate (for example) that the user wants a thicker trace at that point.

Preferably said capacitance is a first capacitance, and said stylus employs capacitive coupling for determining the position of said tip relative to a digitiser tablet from a second capacitance between said tip and said tablet, and said second capacitance, or variations in said second capacitance, are detectable by said capacitance detecting means.

Thus, the circuitry or electronics used to detect variations in the capacitance between the tip and a digitiser tablet is also used to detect the capacitance between the first and second electrodes.

Preferably said stylus includes pulse emitting means for transmitting an electrical pulse from said second electrode to said first electrode, wherein said pulse has a magnitude or amplitude indicative of said first capacitance.

Preferably said amplitude is proportional to said first capacitance.

In one preferred embodiment, the second electrode is located rearward of said tip. In another preferred embodiment, the tip includes an annular flange for engaging said tip resisting means, said second electrode includes an annular disc locatable about said tip rearward of said flange, and said flange forms said first capacitive electrode.

Thus, the second electrode may be located behind the tip, or actually surround a portion of said tip so that the tip is closer to the electrode (which may also be the pulse emitting means) and greater variations in the capacitance between the tip and

second electrode are caused by any change in the separation of the tip and second electrode.

Preferably said tip resisting means is locatable to engage said flange.

In addition, according to the invention there is provided an electronic stylus including:

a forward end and a rear end;

a depressible tip located at said forward end;

a switch for activation by said tip and for capacitatively coupling to said tip;

capacitance detecting means for detecting variations in the capacitance between said tip and said switch; and

tip resisting means for resiliently resisting the depression of said tip, and movable between a first position and a second position;

wherein when said tip resisting means is in said first position said switch may be activated by said depression of said tip through a mechanical coupling of said tip and said switch, and when said tip resisting means is in second position said tip resisting means is located to resiliently resist said depression of said tip so that said switch is mechanically decoupled from said switch and said depression is detectable owing to said capacitive coupling of said tip and said switch by means of said capacitance detecting means.

Thus, the tip resisting means can be used to switch between two modes, the first in which the tip is or may be mechanically coupled to the switch and the switch is activated by the tip, and the second in which the tip is capacitatively coupled to the

switch so that the depression of the tip is detected capacitatively.

Preferably said stylus includes signal processing electronics for receiving an input signal in response to said activation of said switch, and emitting an output signal in response to said activation of said switch, wherein, when said tip resisting means is in said second position, said second signal is indicative of the capacitance of said capacitive coupling and hence of the distance of depression of said tip.

Thus, when the tip resisting means is in the second position and the tip and switch are capacitatively coupled, the application of greater force to the tip by a user of the stylus alters the distance of the depression of the tip and hence the capacitance of the tip/switch coupling; this variation in the capacitance can be used to control the output signal of the stylus.

Preferably said capacitance is between said tip and said switch, so that as said tip is depressed towards said switch, said capacitance is varied.

Preferably said tip includes a projecting member for engaging said tip resisting means when said tip resisting means is in said second position.

Preferably said stylus is provided with a control member for moving said tip resisting means from said first position to said second position.

Preferably said control means projects from said rear end of said stylus, whereby said tip resisting means may be moved to said second position by driving said

control means towards said tip.

Preferably said stylus includes an elastic return means arranged to urge said tip resisting means from said second position to said first position.

Alternatively said control means is coupled to said tip resisting means, and said elastic return means is arranged to urge said control means along said stylus towards said rear end, and thereby to move said tip resisting means from said second position to said first position.

Thus, a user can switch between the mechanical and capacitive coupling modes with the control means.

Preferably said control means includes a retractable, reciprocating mechanism, for moving said tip resisting means between said first position and said second position.

Thus, the control means may be similar on operation to the retracting tip of a ball point pen.

Preferably said stylus is provided with output means for transmitting output signals from said stylus, said output means located at a point distant from both ends of said stylus by more than 10% of the length of said stylus.

More preferably said point is more than 35% of the length of said stylus from both ends of said stylus, and most preferably said point is approximately 40% of the

length of said stylus from a forward end of said stylus.

Preferably said output means includes or is connectable to an output wire or cable.

Thus, the output wire of the stylus connects nearer the mid-point of the stylus than in existing styluses, and most preferably close to that mid-point.

The invention thus further provides an electronic stylus including:

a forward end and a rear end;

a tip located at said forward end; and

output means for transmitting output signals from said stylus, said output means located at a point distant from both ends of said stylus by more than 10% of the length of said stylus.

Preferably said point is more than 35% of the length of said stylus from both ends of said stylus.

More preferably said point is approximately 40% of the length of said stylus from said forward end of said stylus.

Preferably said output means includes or is connectable to an output wire or cable.

In order that the invention may be more clearly ascertained, preferred embodiments will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a semi-transparent view of a electronic stylus according to a preferred embodiment of the present invention;

Figure 2A is a cross-sectional view in a vertical plane of the stylus through IIA-IIA in figure 1;

Figure 2B is a cross-sectional view in a horizontal plane of the stylus through IIB-IIB in figure 2A;

Figure 3A is a schematic view of the tip of the stylus and its mechanical coupling to the switch in the embodiment of figure 1;

Figure 3B is a schematic view of the tip of the stylus and its mechanically decoupling from and capacitive coupling to the switch in the embodiment of figure 1;

Figure 4A is a schematic view of the tip of the stylus of figure 1 illustrating the capacitive coupling of the tip and switch of the stylus of figure 1;

Figure 4B is a schematic view of the capacitive coupling of the tip and switch according to another preferred embodiment;

Figure 5A is a view of a forward portion of the casing of the stylus of figure 1;

Figure 5B is a cross-sectional view of the forward portion of the casing shown in figure 5A;

Figure 6 is a view of the chassis of the stylus of figure 1;

Figure 7A is a view of the rear portion of the casing of the stylus of figure 1;

Figure 7B is a cross-sectional view of the rear portion of the casing shown in figure 7A;

Figures 8A and 8B are views of the plunger of the stylus of figure 1;

Figures 9A and 9B are views of the tip of the stylus of figure 1;

Figure 10 is a view of a rubber ring for resisting the rearward movement of the tip of the stylus of figure 1;

Figure 11 is a view of the switch of the stylus of figure 1;

Figure 12A is a view a rear portion of the actuator of the stylus of figure 1;

Figure 12B is a cross-sectional view of the rear portion of figure 12A;

Figures 13 and 14 are respectively an end view and a perspective view of the rear portion of figure 12A;

Figure 15A is a forward portion of the actuator of the stylus of figure 1;

Figure 15B is a cross-sectional view of the forward portion of figure 15A;

Figures 16A and 16B are respectively an end view and a perspective view of the forward portion of figure 15A;

Figures 17A and 17B are respectively a perspective and a plan view of the output cable connection of the stylus of figure 1; and

Figure 18 is a view of the electronics PCB of the stylus of figure 1.

An electronic stylus according to a preferred embodiment of the present invention is shown generally at 10 in figure 1. The stylus includes an outer casing 12, a chassis 13 mounted within the casing 12, a tip 14 located at the forward end 16 of the stylus 10 and slidably mounted in chassis 13, and an actuator 20 slidably mounted in the rear end 18 of stylus 10.

These components are more easily viewed in figures 2A and 2B, which are cross-

sectional views of the stylus 10 through IIA-IIA in figure 1 and IIB-IIB in figure 2A respectively. From figures 2A and 2B it can be seen that casing 12 is in two parts, forward portion 12a and rear portion 12b, and that tip 14 is provided with an annular flange 24 and extends rearward towards switch 22. The stylus 10 also includes an output cable 26 located at a point approximately 40% the length of the stylus from the forwardmost point (i.e. the forward end of tip 14) of the stylus. Actuator 20 comprises rear part 20a projecting from the rear end 18 of stylus 10, and forward part 20b, which is received by the forward end of rear part 20a. A plunger 28 is located within chassis 13, extending between actuator 20 and a point forward of switch 22. Plunger 28 may be advanced and retracted by means of actuator 20.

Stylus 10 is switchable between two different modes of operation, illustrated in figures 3A and 3B.

In the first mode (see figure 3A), the tip 14 is mechanically coupled to the switch 22. In this mode, the tip 14 is urged towards switch 22 by spring 32, which applied a light force in direction 28 so that tip 14 remains close to or in contact with switch 22. When the user applies pressure to the stylus, the tip 14 is depressed into the body of the stylus in direction 28, and contacts and depresses switch 22. The switch 22 includes a spring (or another other suitable resilient means) to restore the switch 22 after depression to its pre-depression position. The tip 14 is connected to a pre-amplifier (not shown) and the other electronics of the stylus on PCB 30. The tip 14 is returned to its initial position by the inherent return force of the switch 22.

In the second mode of operation (see figure 3B), the tip 14 is prevented from

physically contacting switch 22 by rubber ring 36 located rearward of annular flange 24. Hence, tip 14 is mechanically decoupled from switch 22. Rather, the activation of switch 22 relies on the capacitive coupling of tip 14 and switch 22, the capacitance of which coupling varies according to the separation of tip 14 and switch 22. When a user applies pressure to tip 14, the ring 36 resists the rearward motion of the tip 14, but - owing to the compressibility of rubber ring 36 - the distance between tip 14 and switch 22 decreases, resulting in a change in this capacitance. The stylus 10 responds by transmitting a pulse from switch 22 of fixed amplitude. The amplitude of this pulse when received by tip 14, however, depends on the level of this changed capacitance, and hence on the distance of depression of tip 14 and therefore on the pressure applied to the stylus by the use. The output signal is thus indicative of the user's applied pressure. This signal is conducted from tip 14 by spring 32, and thereby to the amplifier circuitry on PCB 30.

Ring 36 is moved forward into position to resist annular flange 24 (and hence mechanically decouple tip 14 from switch 22) by means of plunger 28, which extends rearward in stylus 10 to engage actuator 20 (see figures 1 and 2). Actuator 20 (comprising rear part 20a and forward part 20b) is similar to actuators commonly found in ball-point pens that have retractable nibs. Forward part 20b is movable between a forward position and rearward position by means of rear actuator part 20a. The depression of rear actuator part 20a in a forward direction advances and rotates forward actuator part 20b which, in doing so, may be alternated between its forward and rearward positions. In its forward position, forward actuator part 20b engages and locates plunger 28 in a forward position, urging rubber ring 36 against annular flange 24, and thus switching the stylus from the mechanical to the

capacitive coupling of tip 14 and switch 22. When forward actuator part 20b is in its rearward position, plunger 28 is pulled or urged by any suitable means to its rearward position (spring or otherwise), allowing ring 36 to be moved rearward by tip 14, and hence permitting the mechanical coupling of tip 14 and switch 22.

The capacitive coupling described above is further illustrated in figure 4A. A signal pulse 40 is applied to the terminals 42 of switch 22. Switch 22 includes an actuating disc 44 to which terminals 42 are connected. The stylus includes an output lead 46 so that a signal received by tip 14 from switch 22 produces an output signal in lead 46. The stylus may include, or be used with, an amplifier 48 (preferably on PCB 30), an analogue to digital converter 50 and a micro-computer 52. The output pulse is transmitted by lead 46 to amplifier 48, and converted into a digital signal, with indicative of the amplitude of the output pulse, by ADC 50. This digital signal is then transmitted to computer 52.

The amplitude of the output pulse depends on the capacitance between the switch 22 and the tip 14 by an inverse square law. Thus, the more pressure that is applied to the stylus 10 (and hence by the digitiser tablet etc to tip 14), the closer are switch 22 and tip 14 and the higher is the capacitance between tip 14 and switch 22, and hence the amplitude of the output signal. The micro-computer 52 thus receives a digital pulse indicative of the pressure applied to the stylus 10 by the user, and can respond, for example, by designating a line traced by the user with a high applied pressure as thicker than one traced with a lower pressure.

It should be emphasized that this method of detecting the pressure applied to the tip

may be used with or without the dual mode feature described above.

Some existing stylus use capacitive coupling between the tip of the stylus and the digitiser tablet to determine the location of the tip relative to the tablet. The circuitry used to provide this feature can, according to the present invention, also be used for the detection of variations in the capacitance between the tip 14 and switch 22 (or disc 54 respectively).

An alternative embodiment of the capacitive coupling of tip 14 and switch 22 is shown in figure 4B. In this embodiment, the stylus 10 includes a metallic disc 54 located between plunger 28 and rubber ring 36. Disc 54 is capacitatively coupled and acts as the transmitter in place of switch 22. As disc 54 is closer to flange 24 than switch 22 is to tip 14, small changes in the position of the tip 14 produce large percentage changes in the separation of disc 54 and flange 24 and hence in the capacitance between them. This embodiment is thus more sensitive to subtle changes in the pressure applied by a user to the stylus 10.

Figures 5 to 18 more clearly illustrate the various components of stylus 10 described above.

Figures 5A and 5B are views of the front casing 12a of the stylus. The front casing 12a holds internal parts in position, and provides the form for a user to grip. It is sprayed finished with conductive paint followed by a final coloured paint layer. The conductive paint is connected to the electronics ground and serves to shield the internal circuitry from external electrical noise.

Figure 6 is a view of the chassis 13 of the stylus 10. Chassis 13 holds in place components such as the PCB 30, switch 22, tip 14, rubber ring 36 and spring 32, which are assembled onto the chassis 13.

Figures 7A and 7B are views of the rear casing 12b of the stylus. The rear casing 12b also holds internal parts in position and provides the form for a user to grip. It also has internal grooves and profiles that interact with actuators 20a and 20b, providing the two positions used to alternate between the two modes of operation. The rear casing 12b is also finished with conductive paint followed by a final coloured paint layer, to shield the internal circuitry from external electrical noise.

Figures 8A and 8B are views of plunger 28 for moving ring 36. Actuators 20a and 20b, together with the profiles on the inside of the rear casing 12b, interact to provide two rest positions for the plunger 28. The plunger 28 moves the rubber ring 36 forwards and backwards between its two operational positions, corresponding to the two modes of operation of the stylus 10.

Figures 9A and 9B are views of the tip 14. Rounded end 15a is so shaped to glide over a digitiser tablet surface, capacitatively picking up signals from that surface. The other end 15b activates the switch 22 when a user presses the stylus 10 onto the tablet surface. The flange 24 interacts with ring 36 when in the second operational mode (of capacitive rather than mechanical coupling), so that applied pressure is translated into displacement of the tip 14, and hence into a capacitance, and thereby into a signal indicative of that pressure, as described above.

Figure 10 is a view of rubber ring 36. Although shown an a simple annulus, ring 36 could be molded in a variety of shapes in order to vary the "feel" of the tip 14 and the pressure-to-signal characteristics of the stylus 10 (for example, to provide a logarithmic response function).

Figure 11 is a view of switch 22 which functions both as a conventional switch and also as an emitter of pulses, when employed in the second operational mode described above.

Figures 12A, 12B, 13 and 14 are views of rear part 20a of actuator 20, and figures 15A, 15B, 16A and 16B are views of forward part 20b of actuator 20. These parts 20a and 20b are similar to those of a retractable ball-point pen. Together with the groove profiles in the rear casing, they operate to provide two rest positions: rearward (in first or mechanical coupling mode) and forward (in second or capacitive coupling mode).

Figures 17A and 17B are views of the output cable connection 26 including connecting wire 27a and strain relieving housing 27b.

Figure 18 is a view of PCB 30 that contains or supports amplifier circuitry and other switches.

It should be noted that, although in existing styluses the output wire or cable is connected towards or at the rear end of the stylus, it is a preferred feature of the

present invention that it be located nearer the mid-point of the stylus, so that the stylus - in use - is more balanced and so that the cable does not tend to pull the end of the stylus undesirably. However, this feature could also be employed in existing styluses without the dual mode feature of the present invention to provide the stylus with these same advantages.

Modifications within the spirit and scope of the invention may readily be effected by person skilled in the art. It is to be understood, therefore, that this invention is not limited to the particular embodiments described by way of example hereinabove.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An electronic stylus including:

a forward end and a rear end;

a tip depressible in response to rearward pressure applied to said tip, said tip located at said forward end and forming or being coupled to a first capacitive electrode;

a second capacitive electrode for capacitive coupling to said first electrode with a capacitance inversely proportional to the separation of said first capacitive electrode and said second capacitive electrode;

capacitance detecting means for detecting variations in said capacitance; and

tip resisting means for resiliently resisting the depression of said tip;

wherein said depression of said tip reduces the separation of said first capacitive electrode and said second electrode to vary said capacitance so that variations in said capacitance provide a measure of said separation of said first electrode and said second electrode, and said tip resisting means is locatable to resist said depression of said tip so that said variations in said capacitance provide a measure of said pressure.

2. An electronic stylus as claimed in claim 1, wherein said capacitance between said first and second electrodes is a first capacitance, and said stylus employs capacitive coupling for determining the position of said tip relative to a digitiser tablet from a second capacitance between said tip and said tablet, and said second capacitance, or variations in said second capacitance, are detectable by said

capacitance detecting means.

3. An electronic stylus as claimed in either claim 1 or 2, wherein said stylus includes pulse emitting means for transmitting an electrical pulse from said second electrode to said first electrode, wherein said pulse has a magnitude or amplitude indicative of said capacitance between said first and second electrodes.

4. An electronic stylus as claimed in any one of the preceding claims, wherein said amplitude is proportional to said capacitance between said first and second electrodes.

5. An electronic stylus as claimed in any one of the preceding claims, wherein the second electrode is located rearward of said tip.

6. An electronic stylus as claimed in any one of claims 1 to 4, wherein the tip includes a flange for engaging said tip resisting means, said second electrode includes an annular disc locatable about said tip rearward of said flange, and said flange forms said first capacitive electrode.

7. An electronic stylus as claimed in claim 6, wherein said flange is substantially annular

8. An electronic stylus as claimed in either claim 6 or 7, wherein said tip resisting means is locatable to engage said flange.

9. An electronic stylus including:

a forward end and a rear end;

a depressible tip located at said forward end;

a switch for activation by said tip and for capacitatively coupling to said tip; capacitance detecting means for detecting variations in the capacitance between said tip and said switch; and

tip resisting means for resiliently resisting the depression of said tip, and movable between a first position and a second position;

wherein when said tip resisting means is in said first position said switch may be activated by said depression of said tip through a mechanical coupling of said tip and said switch, and when said tip resisting means is in second position said tip resisting means is located to resiliently resist said depression of said tip so that said switch is mechanically decoupled from said switch and said depression is detectable owing to said capacitive coupling of said tip and said switch by means of said capacitance detecting means.

10. An electronic stylus as claimed in claim 9, wherein said stylus includes signal processing electronics for receiving an input signal in response to said activation of said switch, and emitting an output signal in response to said activation of said switch, wherein, when said tip resisting means is in said second position, said second signal is indicative of the capacitance of said capacitive coupling and hence of the distance of depression of said tip.

11. An electronic stylus as claimed in either claim 9 or 10, wherein said capacitance is between said tip and said switch, so that as said tip is depressed

towards said switch, said capacitance is varied.

12. An electronic stylus as claimed in any one of claims 9 to 11, wherein said tip includes a projecting member for engaging said tip resisting means when said tip resisting means is in said second position.

13. An electronic stylus as claimed in any one of claims 9 to 12, wherein said stylus is provided with a control means for moving said tip resisting means from said first position to said second position.

14. An electronic stylus as claimed in claim 13, wherein said control means projects from said rear end of said stylus, whereby said tip resisting means may be moved to said second position by driving said control means towards said tip.

15. An electronic stylus as claimed in either claim 13 or 14, wherein said control means is coupled to said tip resisting means, and said elastic return means is arranged to urge said control means along said stylus towards said rear end, and thereby to move said tip resisting means from said second position to said first position.

16. An electronic stylus as claimed in any one of claims 9 to 14, wherein said stylus includes an elastic return means arranged to urge said tip resisting means from said second position to said first position.

17. An electronic stylus as claimed in any one of claims 13 to 15, wherein said control means includes a retractable, reciprocating mechanism, for moving said tip resisting means between said first position and said second position.

18. An electronic stylus as claimed in any one of claims 9 to 17, wherein said tip resisting means includes or consists of a rubber member for resisting said tip.

19. An electronic stylus as claimed in claim 18, wherein said tip resisting means includes or consists of a rubber ring locatable about said tip.

20. An electronic stylus as claimed in any one of claims 9 to 19, wherein said stylus is provided with output means for transmitting output signals from said stylus, said output means located at a point distant from both ends of said stylus by more than 10% of the length of said stylus.

21. An electronic stylus as claimed in claim 20, wherein said point is more than 35% of the length of said stylus from both ends of said stylus.

22. An electronic stylus as claimed in claim 21, wherein said point is approximately 40% of the length of said stylus from a forward end of said stylus.

23. An electronic stylus as claimed in any one of claims 20 to 22, wherein said output means includes or is connectable to an output wire or cable.

24. An electronic stylus including:

a forward end and a rear end;

a tip located at said forward end; and

output means for transmitting output signals from said stylus, said output means located at a point distant from both ends of said stylus by more than 10% of the length of said stylus.

25. An electronic stylus as claimed in claim 24, wherein said point is more than 35% of the length of said stylus from both ends of said stylus.

26. An electronic stylus as claimed in claim 25, wherein said point is approximately 40% of the length of said stylus from said forward end of said stylus.

27. An electronic stylus as claimed in any one of claims 24 to 26, wherein said output means includes or is connectable to an output wire or cable.

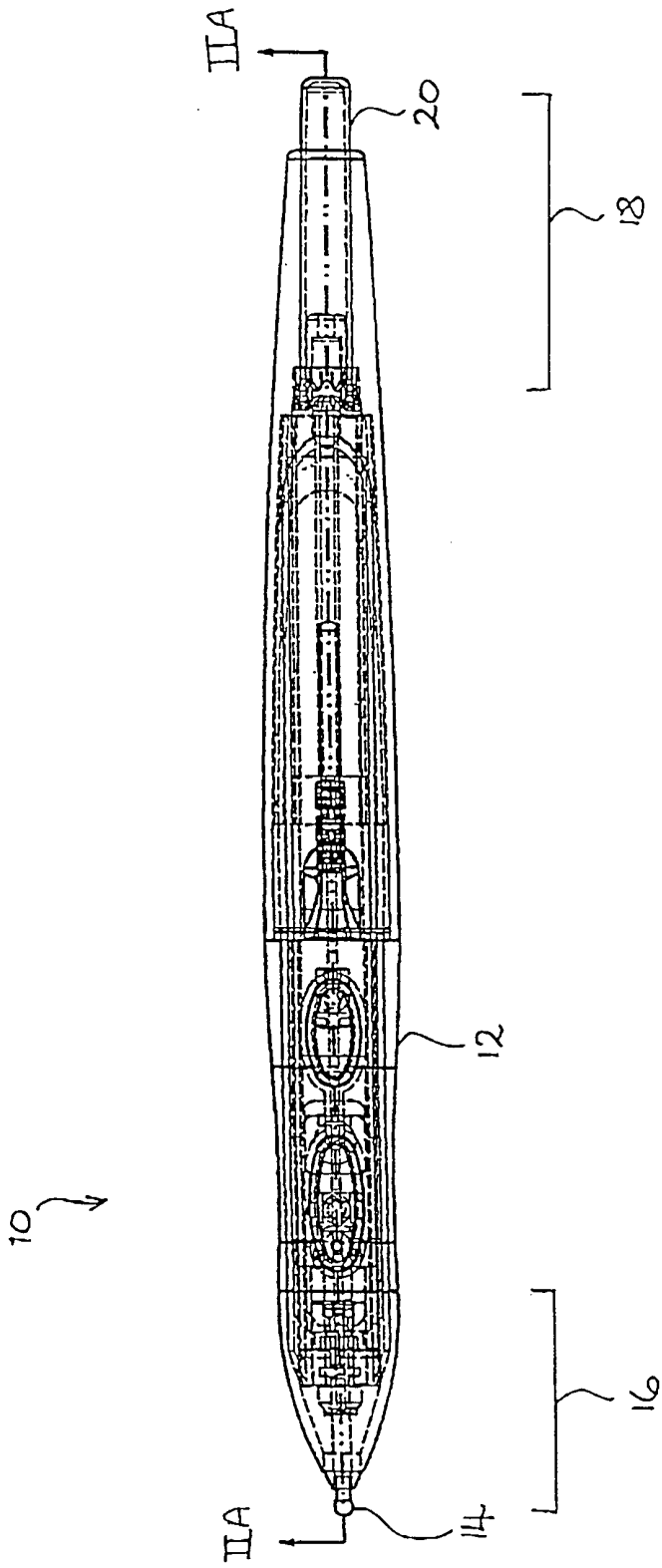


FIGURE 1

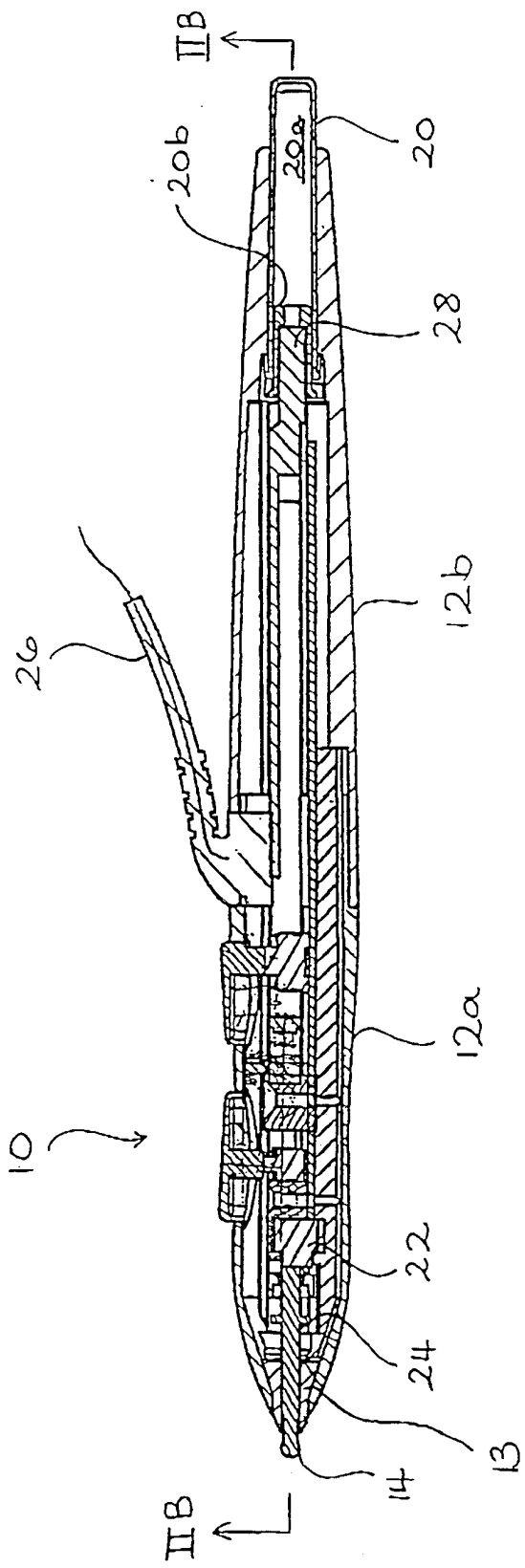


FIGURE 2A

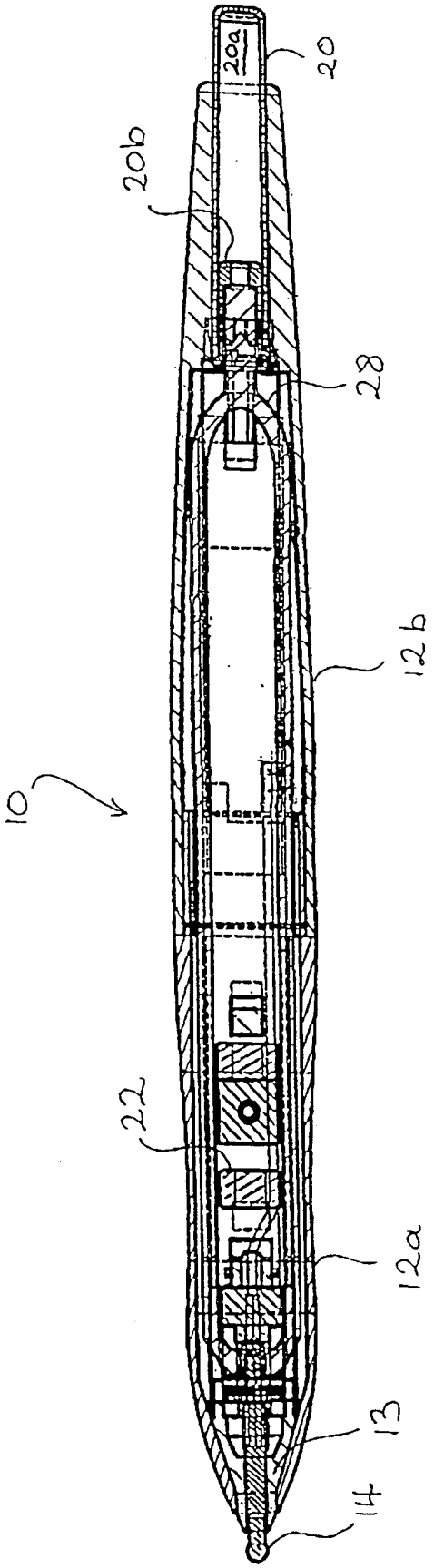


FIGURE 2B

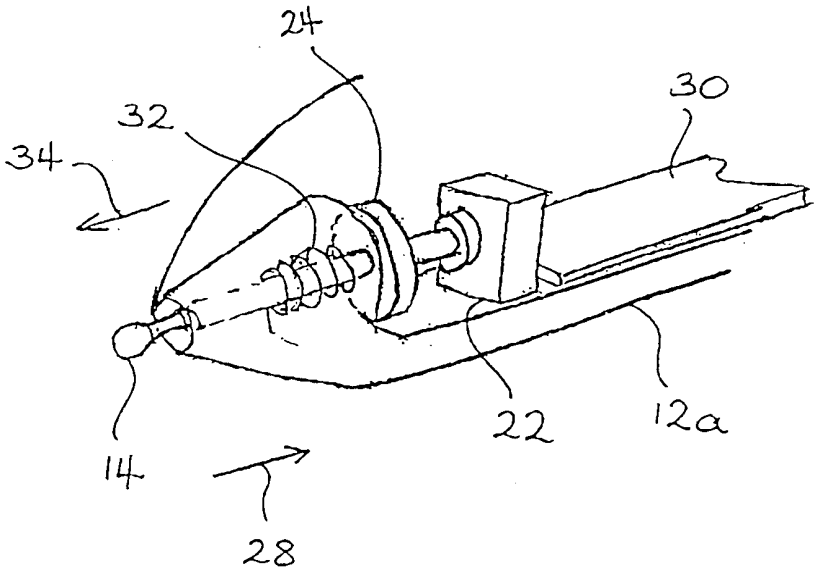


FIGURE 3A

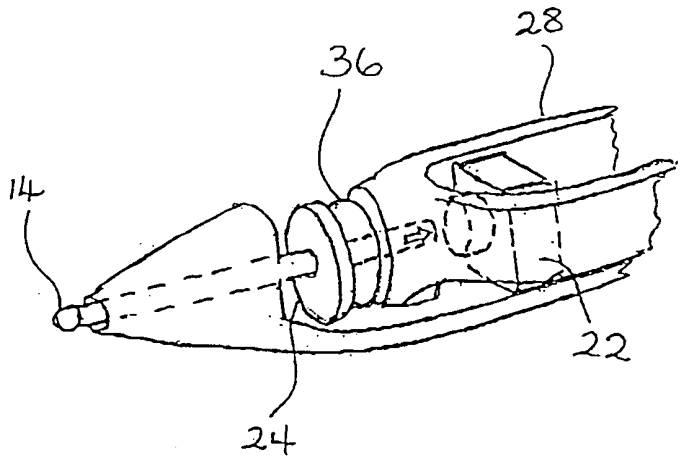


FIGURE 3B

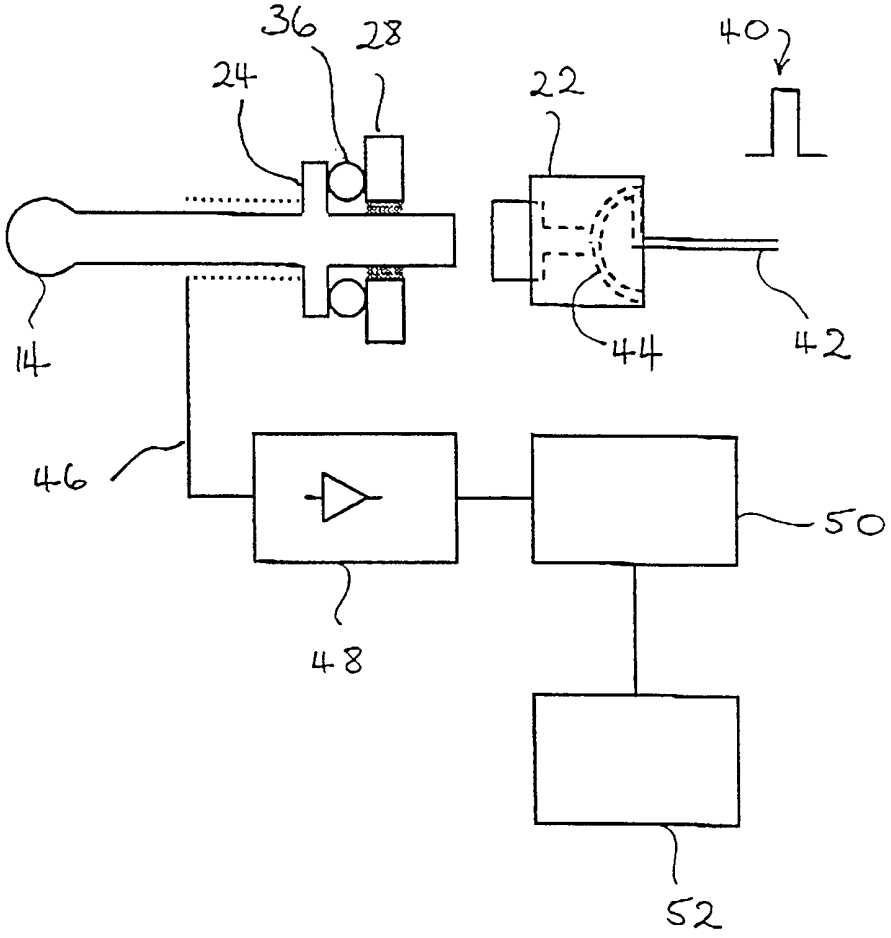


FIGURE 4A

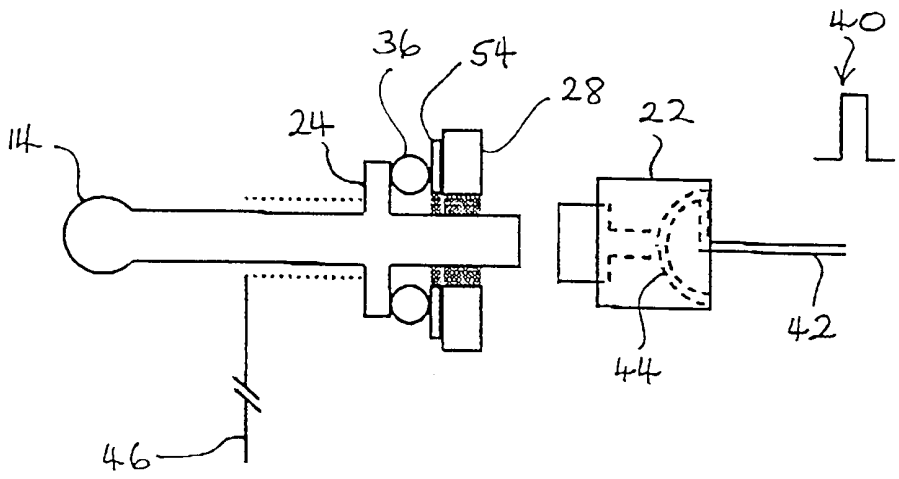


FIGURE 4B

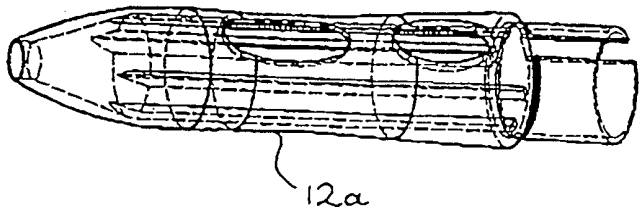


FIGURE 5A

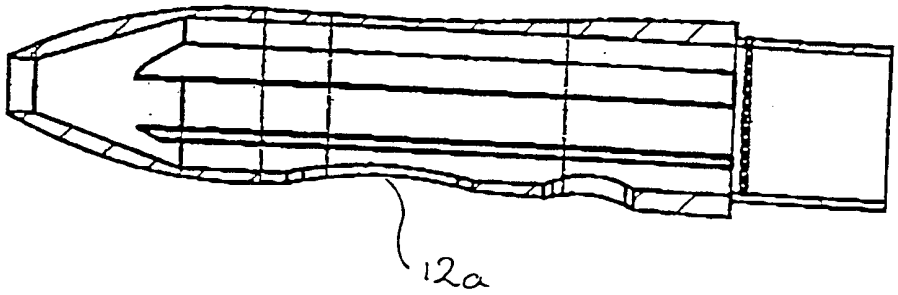


FIGURE 5B

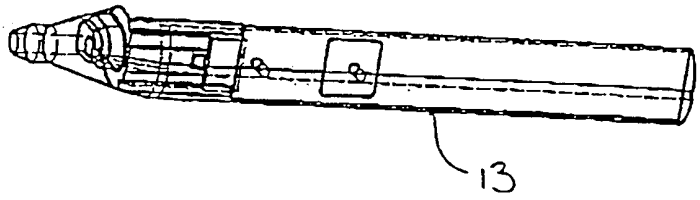


FIGURE 6

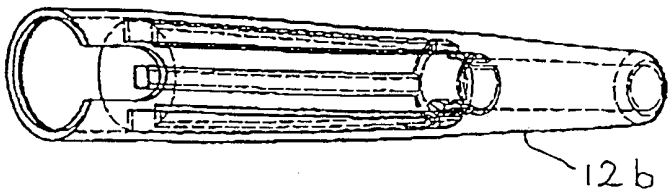


FIGURE 7A

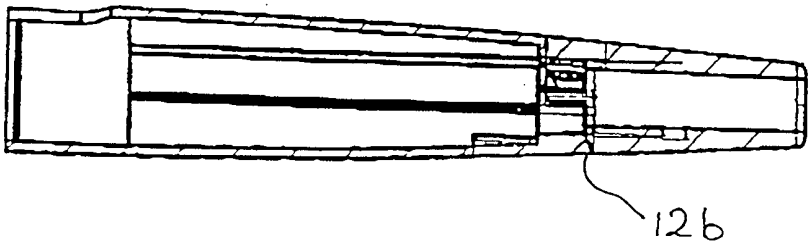


FIGURE 7B

FIGURE 8A

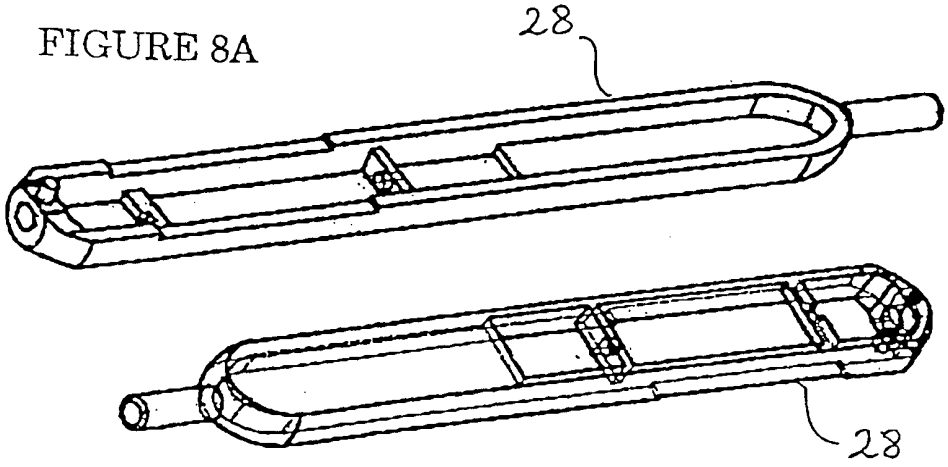


FIGURE 8B

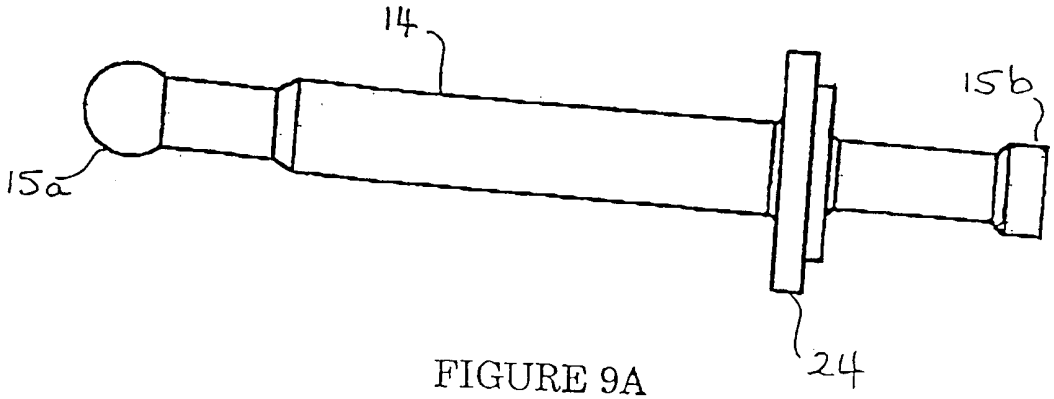


FIGURE 9A

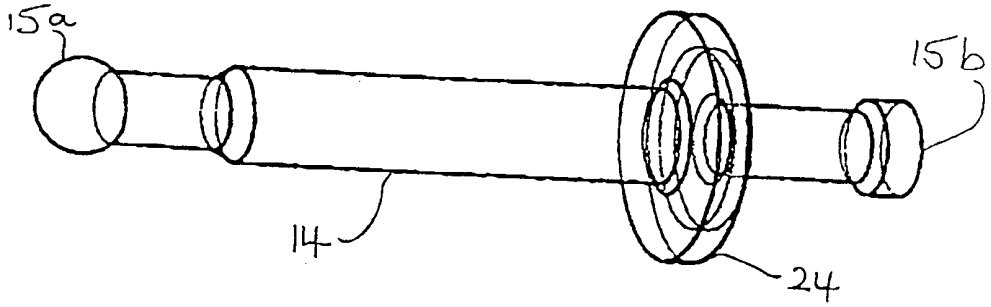


FIGURE 9B

FIGURE 10

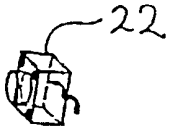


FIGURE 11

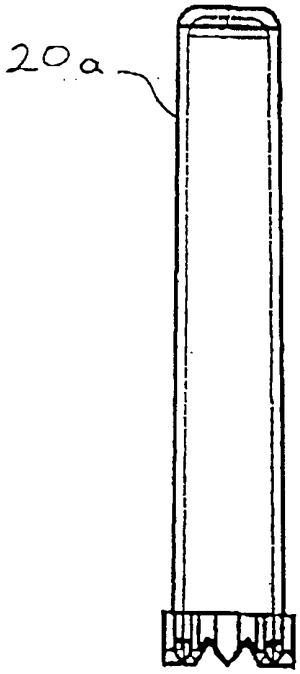


FIGURE 12A

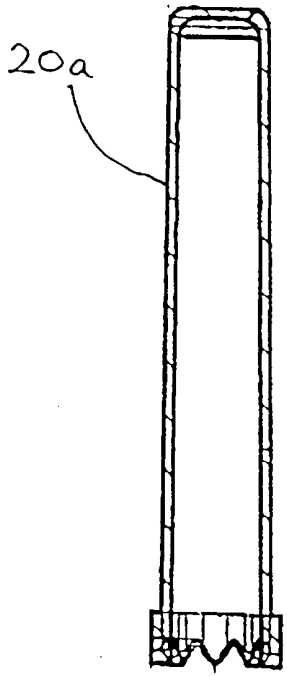


FIGURE 12B

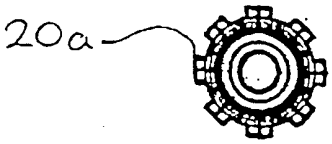


FIGURE 13

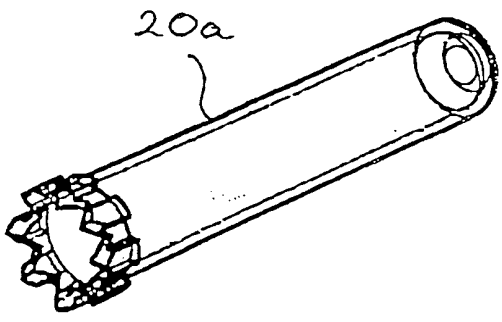


FIGURE 14

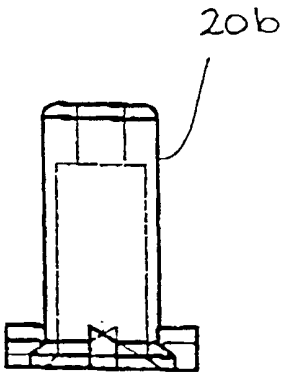


FIGURE 15A

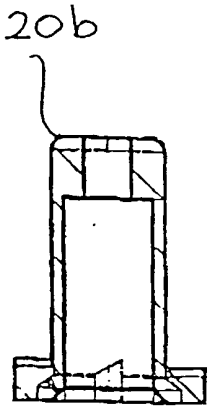


FIGURE 15B

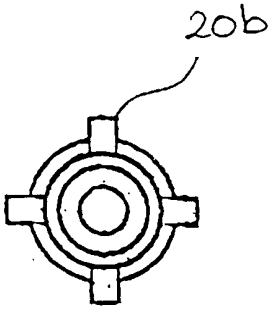


FIGURE 16A

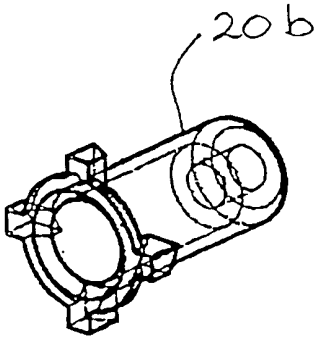


FIGURE 16B

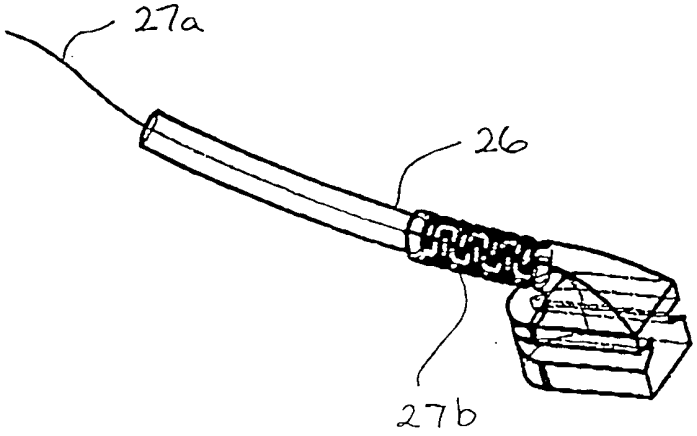


FIGURE 17A

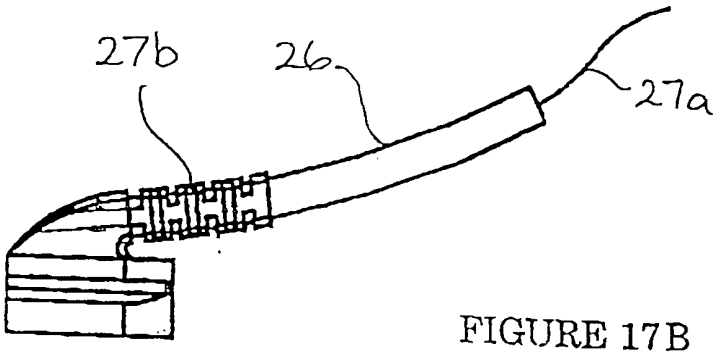


FIGURE 17B

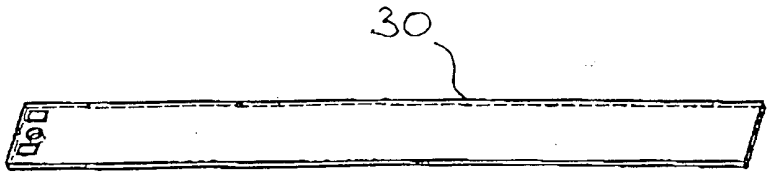


FIGURE 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG00/00149

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: G09G 5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

KEYWORDS

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPAT (stylus, capacitance, digiti+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 914 708 (LaGrange et al.) 22 June 1999 Whole document	24 1,3-5,9,11,20-23, 25-27
X	US 5 438 275 (IBM Corp.) 1 August 1995 Whole document	1,3-5,9,11
X	US 4 131 880 (Burroughs Corp.) 26 December 1978 Whole document	1,9

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
21 November 2000

Date of mailing of the international search report
30 NOV 2000

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG00/00149

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Derwent Abstract for JP 09016322 (NTT Corp.) 17 January 1997	20-27

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SG00/00149

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	5914708	AU	25749/97	WO	97/40488
US	5 438 275	NO	MEMBERS		
US	4 131 880	NO	MEMBERS		

END OF ANNEX