

[54] LIGHT PEN APPARATUS

[75] Inventors: Robert E. Radford, Nashua;  
Gary N. Stapleford, Londonderry,  
both of N.H.

[73] Assignee: Sanders Associates, Inc., S. Nashua,  
N.H.

[22] Filed: July 21, 1972

[21] Appl. No.: 273,889

[52] U.S. Cl. .... 250/217 CR, 250/239, 250/227

[51] Int. Cl. .... G06f 3/00

[58] Field of Search ..... 250/217 CR, 227,  
250/216, 229, 239; 178/DIG. 2, 5.4 E; 350/96  
R

[56]

References Cited

UNITED STATES PATENTS

3,334,236 8/1967 Bacon ..... 250/227 X

3,498,692 3/1970 Jewitt et al. .... 350/96 R  
3,509,353 4/1970 Sundblad et al. .... 250/227

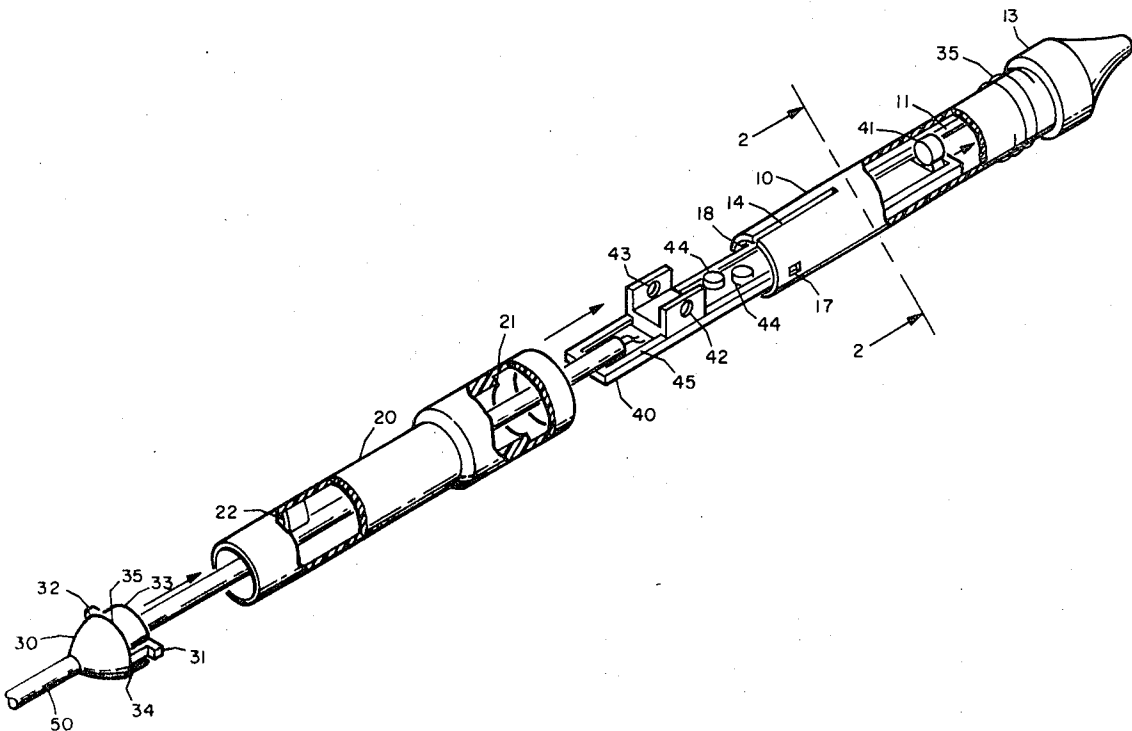
Primary Examiner—Walter Stolwein  
Attorney—Louis Etlinger

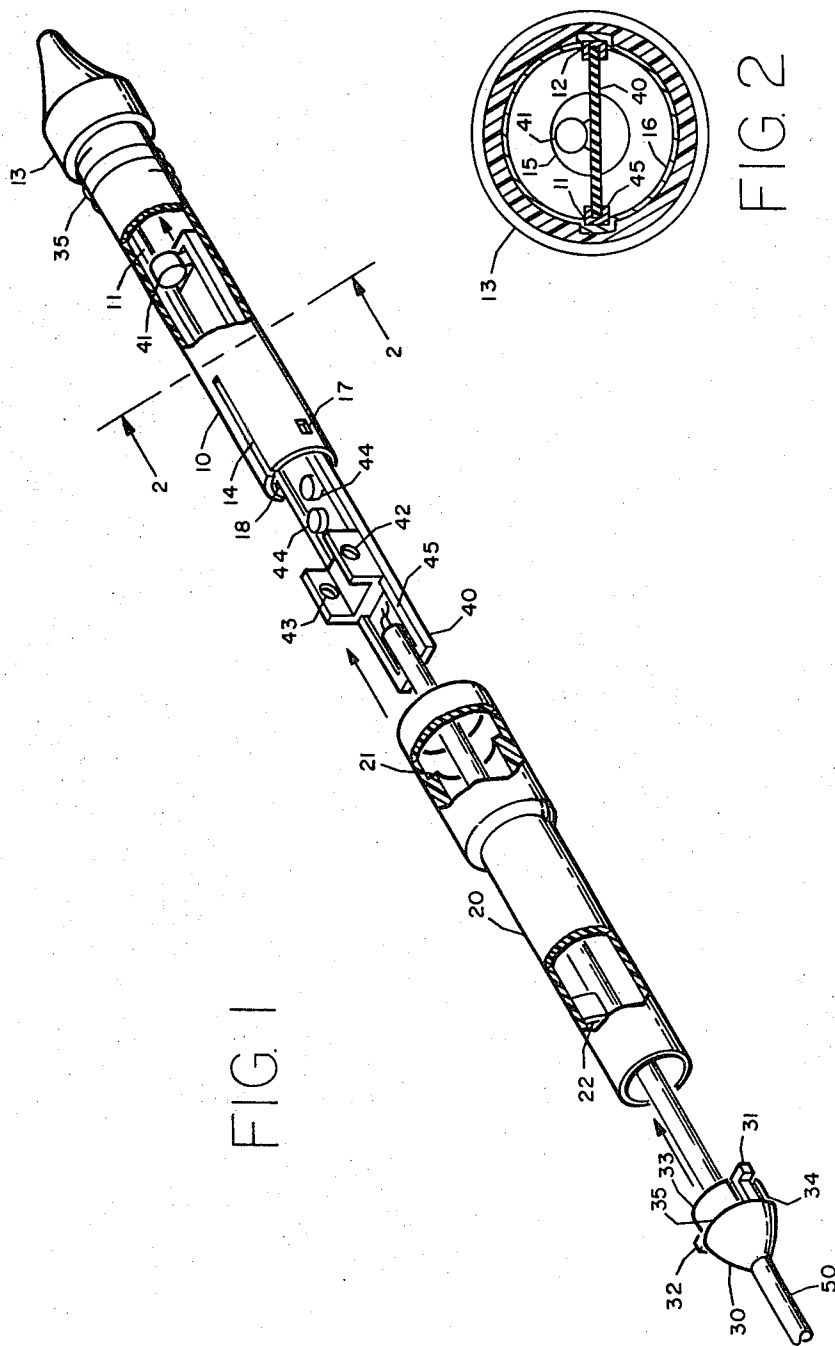
[57]

ABSTRACT

Light pen apparatus having a small number of parts. The light pen includes an inner barrel in which a printed circuit board is mounted. An outer barrel surrounds the inner barrel and is arranged for limited travel relative to the inner barrel in an axial direction. As the outer barrel and inner barrel are moved relative to one another a switch carried on the printed circuit board is actuated so as to allow the circuit mounted on the board to respond to light detected by a light responsive device also carried on the board.

7 Claims, 2 Drawing Figures





## LIGHT PEN APPARATUS

## BACKGROUND OF INVENTION

## 1. Field of Invention

This invention relates to novel and improved light responsive apparatus and in particular to a hand held light pen which is rather inexpensive to construct and yet reliable.

Light pens are useful, for example, in information display systems for operator selection of information items being visually displayed on a display screen such as the screen of a cathode ray tube. The operator selects a displayed information item by aiming the light pen at the item. The light pen responds to the light emitted by the selected item to produce electrical signals which are transmitted to associated apparatus within the information display system such as a computer.

## 2. Prior Art

Light pens generally include a switch operated circuit having a light responsive device mounted within an elongated pen like housing. In some prior art light pens, the switch, the light responsive device and the remainder of the circuit components have been mounted as separate units within the housing structure. This has resulted in a relatively complex housing structure which has been difficult to assemble as well as to service. In addition, the switch element employed in many prior art light pens has had a relatively short life thereby necessitating frequent service.

## BRIEF SUMMARY OF THE INVENTION

An object of the present invention is to provide a novel and improved light pen.

Another object is to provide a novel light pen which is characterized by simplicity of construction whereby it can be rapidly assembled and/or disassembled.

Still another object is to provide a novel light pen in which the switch mechanism is extremely reliable.

In brief, light pen apparatus embodying the present invention comprises three housing pieces, a printed circuit board assembly and a spring. The three housing pieces, which may preferably be injection molded thermoplastic pieces, include an inner tube an outer tube and an end cap. The printed circuit board assembly includes an elongated circuit board with the light responsive device mounted adjacent one end and the switch mounted adjacent the other end. The inner tube includes a means for holding the printed circuit board internally of itself with the light responsive device adjacent one end and the switch adjacent the other end. A first spring stop is located on the external surface of the inner tube. A slot is also located in the surface of the inner tube at the end adjacent the switch.

The outer tube which is arranged concentrically with the inner tube has a second spring stop on its internal surface and a switch actuating element on its internal circuit extending through the inner tube slot. The spring element is arranged concentrically with and between the inner and outer tubes and between and engaging the first and second stops.

The end cap includes a fastening element which is engaged with the inner tube and also an abutting edge which engages one end of the outer tube so as to normally maintain the spring in a first state of compression in which the switched actuating element is out of the actuation range of the switch. The inner and outer

tubes are slidable relative to one another so as to place the spring in a second state of compression in which the switch actuating element comes within the actuation range of the switch to thereby turn the switch and circuit on.

In the interest of reliability and long switch life, the actuating element is a shutter and the switch comprises a light source such as a light emitting diode which provides a beam of light incident upon a light responsive device such as a photo diode or photo transistor. So long as the light is incident upon the light responsive device (the shutter being out of the switch actuation range) the switch is turned off. When the shutter comes within the switch actuation range and interrupts the beam of light so that it is no longer incident upon the light responsive device, the switch is turned on.

## BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing like reference characters denote like elements of structure; and

FIG. 1 is a perspective view of light pen apparatus embodying the present invention; and

FIG. 2 is an enlarged cross sectional view taken along the line 2-2 of FIG. 1.

## DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to FIG. 1, light pen apparatus embodying the present invention is shown to include an inner tube or barrel 10, an outer tube or barrel 20, an end cap 30, a spring 35 and a printed circuit board 40. For the purpose of a clear illustration, all of these parts are shown in FIG. 1 as disassembled with accompanying arrows which indicate the respective location of the parts when in assembled form. The inner tube 10 includes a pair of slots 11 and 12 (best seen in FIG. 2) in its internal surface for receiving and holding in a secure manner the printed circuit board 40. The inner tube 10 further includes a first spring stop 13 on its external surface and a slot 14 at one end of the tube. The other end of the inner tube 10 is shown to be tapered with an aperture 15 (FIG. 2) for admitting light into the interior of the tube.

Mounted on the printed circuit board 40 at one end thereof is a light responsive device 41. When the printed circuit board 40 is inserted into the inner tube 10 along the grooves 11 and 12, the light responsive device 41 is in substantial alignment with the aperture 15 so as to respond to light admitted through the aperture. The light responsive device 41 may, for example, be a photo diode or a photo transistor. The light responsive device 41 is part of a circuit which also includes a light emitting diode 42, another light responsive device 43 and other circuit components 44 all of which are mounted upon the printed circuit board 40. The light emitting diode 42 and the light responsive device 43 are mounted in spaced apart relation at the other end of the board from the device 41. When the board 40 is fully inserted within the inner tube 10, the space between the light emitting diode 42 and the light responsive device 43 is in substantial alignment with the slot 14 of tube 10. In order to provide an adequate shield for the circuit, the printed circuit board 40 has its edge coated with a metallic material 45 and the inner tube 10 has its interior surface coated with a metallic material 16. Metallic material 16 and 45 may, for example, be copper.

The light emitting diode 42 and light responsive device 43 together form a switch which is off so long as light from diode 42 is incident upon light responsive device 43 and is on when the light is interrupted. The switch serves to turn the circuit on and off, i.e., make the circuit responsive and nonresponsive to light admitted by aperture 15. When the circuit is turned on, it responds to incident light upon light responsive device 41 to transmit a signal via an interface cable 50 attached to one end of printed circuit board 40. If the incident light is emitted by an information item on a display screen in an information display system, the cable 50 may be connected at its other end to other apparatus in the system such as a computer.

The outer tube 20 includes a second spring stop 21 and a switch actuating element or shutter 22. When assembled, the outer tube 20 is arranged concentrically with the inner tube with the shutter 22 extending through the inner tube slot 14.

The end cap 30 includes a pair of fastening elements 31 and 32 (snap locks in the illustrated embodiment), a pair of flange elements 33 and 34 and an abutting edge 35. The flange and fastening elements are positioned on the end cap 30 such that in assembled form they extend into the interior of the inner tube 10 where the fastening elements 31 and 32 snap or lock with apertures 17 and 18, respectively, in the inner tube 10. The abutting edge 35 of the 20 end cap 30 engages the end of the outer tube 20 such that the spring 35 is normally maintained in a first state of compression by the first and second spring stops 13 and 21. In this first compression state, the shutter element 22 is out of the actuation range of the switch elements 42 and 43. That is, the shutter element 22 does not interrupt the light emitted by diode 42 which is incident upon the light responsive device 43.

When it is desired to select an information item on the display screen, the outer barrel is held in the operator's hand and the tapered end of the assembled pen is aimed at the item and pressed against the screen. This causes the outer barrel and inner barrel to slide relative to one another so as to place the spring 35 in a second state of compression. In this second state of compression, the shutter 22 comes within the actuation range of the switch so as to interrupt the light beam from the diode 42 and hence turn the switch and circuit on. In addition, in the second state of compression the outer barrel 20 has travelled away from the abutting edge 35 of the end cap 30. When the operator removes the tapered end of the assembled light pen from the screen, the outer and inner barrels return to their initial or normal positions as the spring 35 returns to its first state of compression.

The inner tube 10, outer tube 20 and end cap 30 are preferably made of plastic material which may be either machined or molded into the desired shapes. From a cost point of view, it is extremely advantageous to employ thermoplastic material and injection molding for these parts.

Once the circuit components have been assembled on the printed circuit board 40, the entire light pen can be assembled very rapidly. First, the spring 35 is slipped over the external surface of the inner tube 10. The cable 50 is threaded through the end cap 30 and outer tube 20 and is then attached to the circuit board 40. The circuit board 40 is then inserted along the grooves 11 and 12 into the inner tube 10. The outer tube is then

slid along and over the inner tube 10. The end cap is then placed into position with its fastening elements 31 and 32 locking on to the inner tube 10. The light pen assembly can also be disassembled very rapidly with the aid of a pointed instrument (e.g., a pencil or pen) by depressing the fastening elements 31 and 32 so as to remove them from the apertures 17 and 18 of tube 10.

There has been described light pen apparatus embodying the invention which employs a relatively small number of parts. The switch in the illustrated embodiment has relatively long life since it does not rely upon a mechanical actuating element. However, in other embodiments the switch may take the form of mechanically actuated switches or field (magnetic or electric) actuated switches. In any case, the switch actuating element 22 would be mounted upon and carried by the outer tube 20. The actual shape of the tubes or barrels 10 and 20 and end cap 30 can vary from one design to another and the term tube or barrel as used herein is intended to mean not only cylindrical shapes but such other cross sections including, inter alia, square, triangular, polygonal, elliptical and other. Moreover, the light admitting end of the inner tube 10 need not be tapered. If it is desirable to employ a lens assembly to focus or magnify light emitted by an information item, such lens assembly may be mounted (by means not shown) over or in the aperture 15 of the inner tube 10.

What is claimed is:

1. A light pen comprising:

- a circuit including a light responsive device and a switch for turning the circuit on and off;
- an elongated printed circuit board with said light responsive device mounted adjacent one end, and said switch mounted adjacent the other end;
- an elongated inner tube having means for holding said board internally thereof with the light responsive device adjacent one light admitting end thereof and the switch adjacent the other end thereof;
- a first spring stop located on its external surface; and
- a slot in its surface at said other end;
- an outer tube arranged concentrically with said inner tube and having a second spring stop on its internal surface and a switch actuating element on its internal surface adjacent one end thereof and extending through said inner tube slot;
- a spring element arranged concentrically with and between said inner and outer tubes and arranged between and engaging said first and second stops; and
- an end cap which includes a fastening element adapted to be engaged with said inner tube and which further includes an abutting edge engaging said one end of the outer tube so as to normally maintain said spring element in a first state of compression in which said switch actuating element is out of the actuation range of the switch, said inner and outer tubes being slidable relative to one another to place said spring element in a second state of compression in which said switch actuating element comes within the actuation range of said switch to thereby turn said switch and circuit on.

2. A light pen as set forth in claim 1

wherein said switch includes a source of light and another light responsive device mounted in spaced

5

- apart relation adjacent the other end of said circuit board; and  
wherein said switch actuating element is a shutter which is arranged to interrupt the light beam from said source when the spring is in its second compression state. 5
3. A light pen as set forth in claim 2 wherein said first spring stop is located near said one end of the inner tube; and  
wherein said second spring stop is located near the other end of said outer tube. 10
4. A light pen as set forth in claim 3 wherein said fastening element is a snap lock which engages an aperture in said inner tube.
5. A light pen as set forth in claim 4 15

6

- wherein said inner and outer tubes and end caps are made of plastic material.
6. A light pen as set forth in claim 1 wherein the internal surface of said inner tube is coated with a metallic material; and  
wherein the edges of said printed circuit board are coated with metallic material and are in electrical contact with the metallic coating of said inner tube.
7. A light pen as set forth in claim 6 wherein said means for holding includes a pair of grooves in the internal surface of the inner tube each holding a different one of the two elongated edges of the printed circuit board.

\* \* \* \* \*

20

25

30

35

40

45

50

55

60

65