FIG. 7
ABSTRACT OF THE DISCLOSURE

An X-Y position indicator control for movement by the hand over any surface to move a cursor over the display on a cathode ray tube, the indicator control generating signals indicating its position to cause a cursor to be displayed on the tube at the corresponding position. The indicator control mechanism contains X and Y position wheels mounted perpendicular to each other, which rotate according to the X and Y movements of the mechanism, and which operate rheostats to send signals along a wire to a computer which controls the CRT display.

BACKGROUND OF THE INVENTION

This invention relates to visual display systems and, more particularly, to devices for altering the display at selected locations.

One of the potentially most promising means for delivering and receiving information to and from digital computers involves the display of computer outputs as visual representations on a cathode ray tube and the alteration of the display by a human operator in order to deliver instructions to the computer. In order for a human operator to readily change the displayed pattern, he must be provided with means for accurately indicating the exact position on the visual display at which he can make alterations. Devices are known which enable accurate position location on the tube display, such as a light pencil detector which is held against the tube while the entire tube is swept by the beam, the instant at which light is detected during the time required to sweep the entire face indicating the detector's position.

A disadvantage of the light pencil and other similar devices is that they generally require the human operator to hold the pencil against the CRT with one hand while changes are made. Consequently, the operator does not have both hands free to enter changes, as by typing them in, and cannot move to equipment only a step away from the CRT. Furthermore, the light pencil often covers part of the area of the CRT display where changes are to be entered, which interferes with the process.

SUMMARY OF THE INVENTION

One subject of the invention is to provide an X-Y position indicating control mechanism for controlling indications of positions on a cathode ray tube (CRT) display, by movement along a surface which can be other than the face of the CRT.

Another object of the invention is to provide a position indicator control which transmits signals defining its position on a surface, and which is connected by only a cable to the apparatus which acts upon such information.

Still another object of the invention is to provide a simple and improved X-Y position locating device.

The foregoing and other objects are realized by an X-Y position indicator control mechanism comprising a small housing adapted to be held in the hand and having two wheels and an idler ball bearing for contacting the surface on which it rests. The two wheels are mounted with their axes perpendicular to each other and each wheel is attached to a potentiometer or other means for indicating its rotation. The position indicator control is held by the hand and moved over any surface, such as a desk top or even by the foot. As the indicator control is moved, the two wheels rotate and the resistance of the potentiometer changes. Electrical leads connected to the potentiometers are wired to the indicator control and connect to a computer which continuously monitors the indicator control's position. The computer causes the CRT to display a symbol, or cursor, such as a short line on the CRT screen to define a position on the screen about which changes or the like may be made, the cursor position changing in accordance with movement of the X-Y position indicator control. Buttons are provided on the indicator control housing for closing switches to send pulses through additional wires trailing behind the indicator control to signal for a change in the displayed information. For example, one button on the indicator control may be used to cause the display of a small area directly above or following the cursor. New material may then be inserted in place of the material erased in accordance with the programming of the computer, as by typing in letters.

While a potentiometer may be connected to each of the two wheels on the indicator control, other devices can be used for generating signals indicating rotation of the wheels. One such device is a shaft position encoder which produces a digital output corresponding to the angular position of the wheel. While such an arrangement provides a direct digital output, instead of analog output which must be digitally converted to be used by the computer control in the CRT display, the output from a shaft encoder necessitates a 1:1 cable. Such encoder means for indicating position of a wheel is an incremental encoder and counter. An incremental encoder generates an up indicating pulse each time the shaft moves by a certain increment of rotation in one direction and generates a down indicating pulse when the shaft moves in the other direction. These pulses are transmitted to an up-down counter, which provides a digital output equal to the sum of the up inputs minus the sum of the down inputs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a pictorial illustration of a display system in accordance with the invention;

FIG. 2 is a sectional elevation view of the position indicating control mechanical mechanism of the invention;

FIG. 3 is a sectional plan view of the mechanism of FIG. 2;

FIG. 4 is a simplified schematic diagram of an electrical circuit for connection to a position indicating control mechanism of the invention;

FIG. 5 is a schematic diagram of another embodiment of an electrical circuit for use in the invention, wherein a shaft encoder is used;

FIG. 6 is still another embodiment of an electrical circuit for use in the invention, utilizing an incremental encoder; and

FIG. 7 is a schematic diagram of another circuit for use in the invention, which also employs an incremental encoder.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a display system constructed in accordance with the invention, comprising a cathode ray tube display 10 for creating visual patterns on the face 12 of a cathode ray tube, a computer system 14 including a typewriter input apparatus 16 and a display apparatus 18 that define the patterns displayed by the CRT display system, and an X-Y position indicator control 16. The position
indicators control 16 is positioned on the top of the cabinet 17 of the computer, although it can be positioned on any other surface. The indicator control 16 has wheels which support it on the cabinet and which register changes in the position thereof. A wire 18 connects the position indicator control to the computer 14 for transmitting signals indicating the position of the indicator control. The computer 14, which is mounted on the panes of the CRT face 12, generates signals causing the display of a line or other cursor 20 on the CRT. The position of the cursor 20 is governed by the position of the indicator control 16 determined by the computer 14 in accordance with the signals it receives from the indicator control over the wire 18.

Three buttons 22 are located on the indicator control 16 for operating switches within the indicator control to allow the setting of the conductors or position conductors of the wire 18. The switches may be used to cause changes in particular areas of the display, or for other purposes. For example, one button may be used to control the displays in the left-hand call of the display, while another may be used to control displays in the right-hand call of the display. A third button may be used to control the displays in the central call of the display.

When the position indicator control 16 is moved, the computer 14 is also moved. The computer 14, which is mounted on the panes of the CRT face 12, generates signals indicating the position of the indicator control 16 in accordance with the signals it receives from the indicator control over the wire 18. The computer 14 is connected to the CRT 12 for displaying the position indicator control 16 on the CRT face 12. The position indicator control 16 is mounted on the CRT face 12 in such a way that the position indicator control 16 is visible on the CRT face 12.

The position indicator control 16 is shown more clearly in FIG. 2 and is viewed from the side. In FIG. 2, the indicator control 16 is shown in a sectional view of FIG. 3. A housing 26 has a bottom wall 28 on which is attached a right angle bracket 30. One arm 32 of the bottom wall 28 is held in position by three pushbuttons 22, while the other arm 34 of the bottom wall 28 is connected to the cathode ray tube display. The pushbuttons 22 are side-mounted in the housing 26, for movement against the switches 32 and 34 to close them.

Each arm 32 and 34 of the bracket 30 holds a potentialmeter 38 and 40, respectively. An X position wheel 42 is fixed to a shaft 44 of the positional potentiometer 38, while an X position wheel 46 is fixed to a shaft 48 of the positional potentiometer 40. Each of the position wheels 42 and 46 project through slots 50 and 52, respectively, formed in the bottom wall 28. A ball bearing support 54 fixed to the underside of the bottom wall 28 serves as a third point of support, in addition to the two wheels 42 and 46, to stably support the indicator control on the cabinet 17 and the other surface.

When the position indicator control is moved over the cabinet 17, or any other surface, the X and Y position wheels rotate. Inasmuch as the X and Y position wheels 42 and 46 are mounted on axes that are perpendicular to each other, the X position wheel 42 rotates by an amount equal to the movement in one direction which may be defined as the X direction, while the Y position wheel 46 rotates an equal amount equal to the movement in a perpendicular or Y direction. As the wheels move, the shafts of their respective potentiometers rotate, and the resistance of the potentiometers enable continuous measurement of the resistance, and therefore of the X and Y positions of the indicator control 16. It may be noted that in most cases multi-turn potentiometers are used to enable monitoring of large movements of the indicator control, or conversely, to enable fine control.

The position indicator control may be utilized by first placing it on the cabinet 17 and moving it up and down to cause the corresponding movements of the cursor in the apparent position of the cursor 20, until the cursor lies in a desired position. The position indicator control remains stationary as long as it is left in place; therefore the cursor 20 remains fixed without any effort of the human operator. If it is desired to move the cursor 20, the position indicator control 16 is movable in directions corresponding to the desired movements of the cursor. The resistances of the rheostats, sensed through the conductors contained in the wire 18, are uniformly distributed about the full length of the indicator control and cause movement of the line cursor 20 accordingly.

FIG. 4 is a simplified schematic diagram of the electrical circuit by which the position of the indicator control 16 is monitored. Electrical conductors 62, 64, 66 and 68 represent separate pairs of wires which connect the indicator control to the computer. Voltage +V is connected at terminal 70 for sending currents through the two conductors, or position conductors, whose resistances are indicated at 38A and 40A. One side of each potentiometer is connected to lead 64, which is grounded. The wires 66 and 68 of the two conductors are connected to leads 68 and 66, respectively, which in turn are connected to terminals Y and X. By noting the voltage at X and Y, relative to ground potential, the resistances of the two potentiometers and therefore the X and Y positions of the indicator control are known.

The indications of X and Y position given by the voltages at terminals X and Y are presented in analog form. A digital computer requires digital inputs and therefore, an analog-to-digital converter must be used between the computer and the terminals X and Y. New computer inputs. Two types of digital output devices for use with the indicator control are shown in FIGS. 5, 6 and 7.

FIG. 5 shows a position indication circuit which provides a digital output. An encoding disc 80 is shown which is used to indicate the X position. The disc 80, which is shown in the exploded illustration of FIG. 5, is used in practice 1, is divided into four rings 82, 84, 86 and 88. The disc 80 is also divided into sixteen sectors, each divided by a number 80 through 85. Four electrical contacts connected to wires 92, 94, 96 and 98, provide readouts. Each of the sixteen sectors of each of the four rings 82 through 85 can be contacted with either a conductive material or insulative material. The contacts connected to the four output wires 92 through 98 remain closed while the indicator control is to the X position indicated by the disc 80. In order to indicate many positions, the disc 80 is, in practice divided into a large number of rings and sectors, so that a large number of positions can be indicated and small changes in position are registered. A similar scheme is used for the Y position. The advantage of the readout scheme of FIG. 6 is that a digital output is provided which completely defines the position of the indicator at every instant. A major disadvantage is that a large number of wires must be connected to the position indicator control so that a relatively thick cable trail behind it and limits the ease with which it can be moved.
of the AND gates. The outputs of two of the AND gates deliver pulses to the switch input ports of the down counter 170 while the outputs of two other AND gates are delivered to the down input port 172 of the counter. Therefore, the counters digital output signals defining the position of circuit 140.

While the position indicator control can be used merely to give the user position on the face of the pendulum, it can be used as a typical program control device. For example, the position indicator control can be placed on a drawing to be displayed on the CRT, and then the position indicator control can be moved to trace the lines of the drawing with the computer causing corresponding lines to be displayed on the CRT. For such uses, the wheels and electrical signal generators of the indicator control should cause cursor movements which very closely correspond to indicator control housing movements.

The particular mechanical construction shown in FIGS. 2 and 3 is especially well adapted for maintaining accuracy of output and ease of use. The use of only three points of contact, comprising the two wheels and the ball bearing support, help to assure that both wheels will constantly remain in contact with the surface on which the position indicator control rests. The location of the various buttons for indicating areas of the display to be operated on, or for other purposes, on the indicator which is moved by the hand allows a human operator to maintain control over both position of changes and the type of changes on the display. The location of any of an indicator control which rests firmly on a surface enables the operator to accurately maintain position with a minimum of muscle effort. Further, since the indicator control remains stationary unless some force is applied to it.

The use of relatively large position wheels having appreciable mass and frictional loss, reduces the effect of the indicator control and promotes smooth movement which is helpful in accurately positioning where the display area is small or where accurate tracing of a pattern is required.

While particular embodiments of the invention have been described, modifications and variations may be resorted to by those skilled in the art, and the scope of the invention is not limited by a just interpretation of the following claims.

I claim:

1. A display system controlled by a computer wherein the display is alterable in accordance with signals delivered to said computer which indicate positions on said display and changes desired to be made therein, the improvements in a position indicator control apparatus which is movable over a surface to provide position indications corresponding to positions on said display comprising:

a housing;

b a first position wheel rotatably mounted on said housing and having a rim portion extending past the boundaries defined by said housing for supporting said housing on said surface;

c a second position wheel rotatably mounted on said housing with its axis of rotation oriented perpendicular to the axis of said first wheel, said second position wheel having a rim portion extending past said housing for supporting said housing on said surface; and
d a transducer means connected to each of said first and second wheels, for generating digital position indicating signals indicating the degree of rotation of said wheels.

2. A flexible conductor means for connecting said transducer means to said computer, for conducting said position indicating signals to said computer while enabling unrestricted movement of said housing relative to said computer.
2. The improvement in a position indicating control apparatus as defined in claim 1 wherein:
said transducer means comprises an incremental encoder connected to said first position wheel and said flexible conductor means for generating first pulses at each predetermined increment of rotation of said first position wheel in a first direction and for generating second pulses at each increment of rotation of said first position wheel in the opposite direction;
and including:
counter means connected to said flexible conductor means, for generating a digital count indicating the net rotation of said first position wheel.
3. The improvement in a position indicating control apparatus as defined in claim 2 wherein said incremental encoder comprises:
a disc connected to said first position wheel having track means, said track means having a plurality of spaced conductor segments;
a control contact and a stepping contact disposed along said track means, said control and stepping contacts positioned for the electrical connection of only one of said contacts with said segments at first predetermined angular positions of said disc and for the simultaneous electrical connection of both of said contacts with said segments at second predetermined angular positions of said disc; and
logic means connected to said control and stepping contacts for generating said first pulses when said stepping contact makes a first direction of transition between electrical connection with one of said segments and lack of electrical connection with one of said segments at the same time that said control contact is in a first predetermined state of electrical connection with one of said segments and for generating said second pulses.
4. The improvement in a position indicating control apparatus as defined in claim 1 wherein:
said transducer means comprises a shaft position encoder having a plurality of outputs and said conductor means comprises a plurality of conductors connecting to said outputs of said encoder, whereby to constantly indicate the position of said position indicating apparatus.
5. In a display system controlled by a computer whereby the display is alterable in accordance with signals delivered to said computer which indicate positions on said display and changes desired to be made therein, the improvement in a position indicating control apparatus which is movable over a surface to provide position indications corresponding to positions on said display comprising:
a housing;
a first position wheel rotatably mounted on said housing and having a rim portion extending past the boundaries defined by said housing for supporting said housing on said surface;
a second position wheel rotatably mounted on said housing with its axis of rotation oriented perpendicular to the axis of said first wheel, said second position wheel having a rim portion extending past said housing for supporting said housing on said surface; and
transducer means connected to each of said first and second wheels, for generating digital position indicating signals indicating the degree of rotation of said wheels.
6. The improvement described in claim 5 including:
coupling means for substantially unrestrained coupling of said transducer means to said computer, to couple said position indicating signals to said computer while enabling substantially unrestrained movement of said housing relative to said computer.
7. The improvement described in claim 5 including:
a flexible conductor for connecting said transducer means to said computer, to carry position indicating signals to said computer while enabling substantially unrestrained movement of said housing relative to said computer.
8. A display system for presenting an alterable visual display comprising:
cathode ray tube means for providing a visual display; computer means connected to said cathode ray tube means for controlling inputs to said cathode ray tube means to define the visual display thereof, said computer means including means for generating signals defining a cursor for display at variable positions on said cathode ray tube means and means for altering inputs to said tube means to cause a change in the display about the position of said cursor;
a position indicator control connected to said computer means, said position indicator control having a housing which contains transducer means for delivering signals for causing movement of said cursor on said cathode ray tube means in response to movement of said housing over a surface; and
at least one cathode ray tube display control switch disposed on said position indicator control.

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