

Feb. 2, 1971

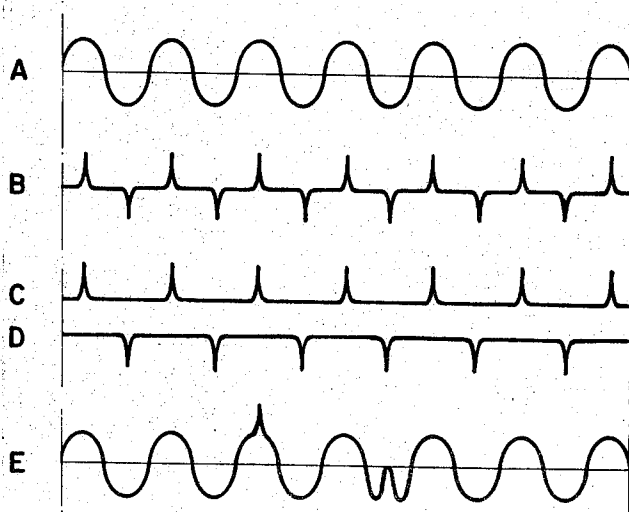
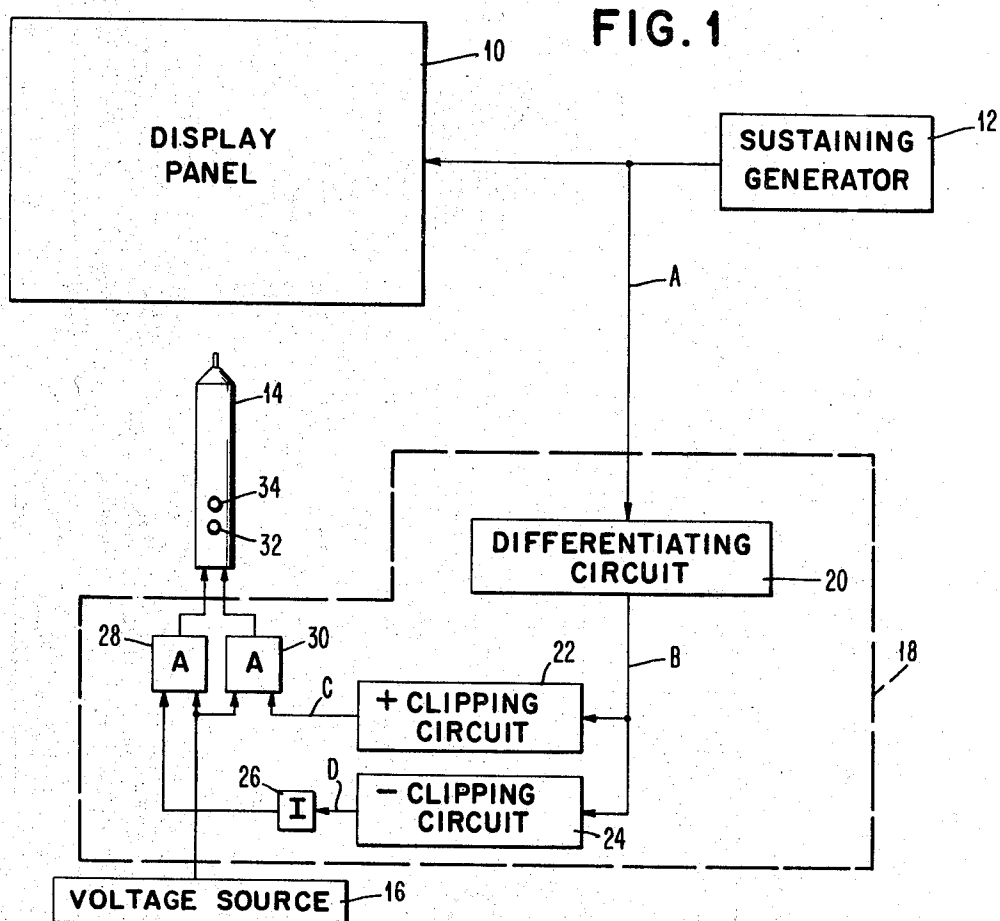
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3,559,307

STYLUS ACTUATED GAS DISCHARGE SYSTEM

Filed May 26, 1969

2 Sheets-Sheet 1



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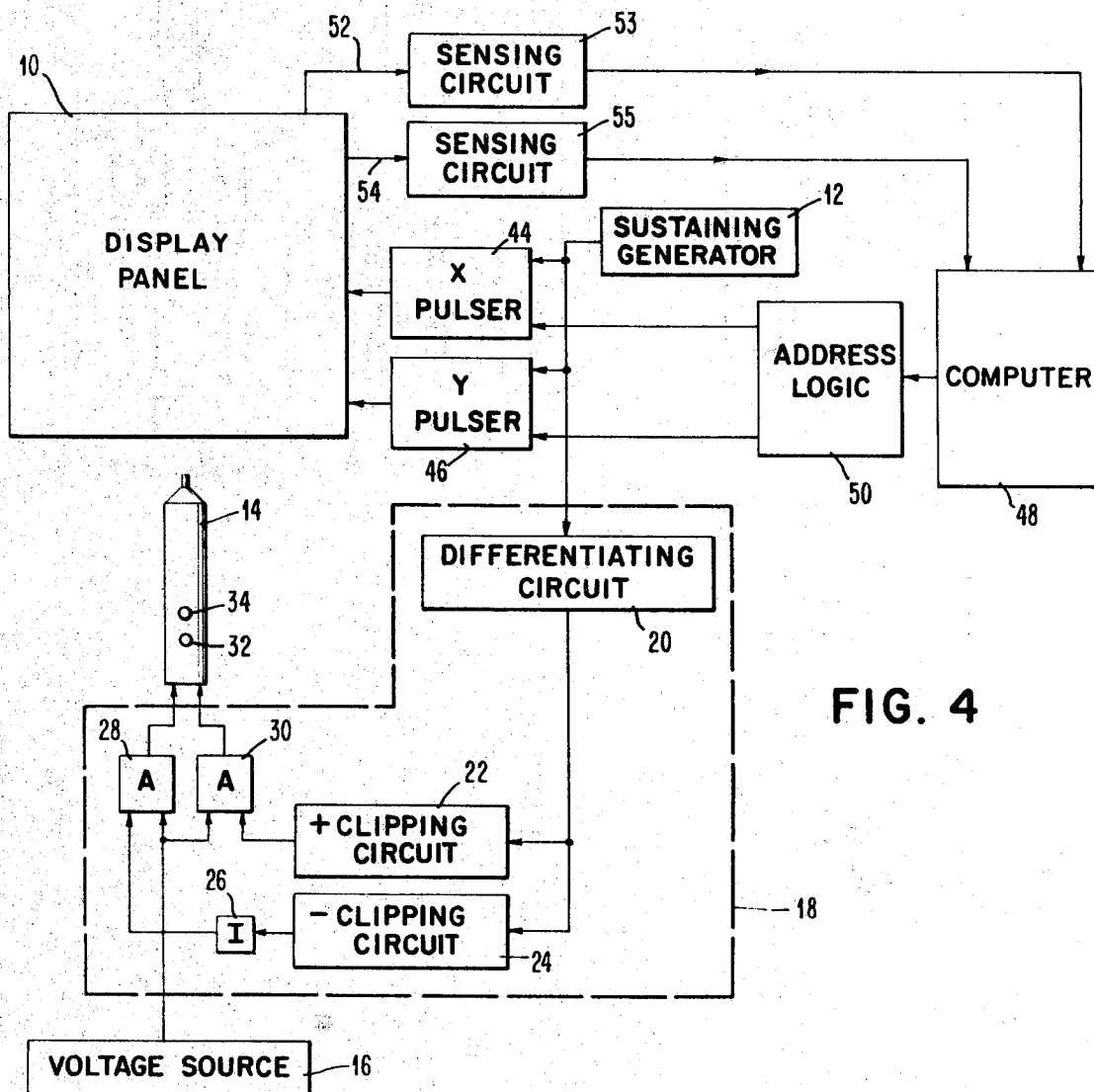
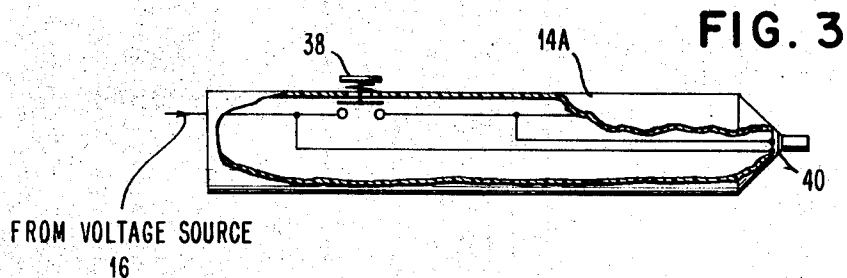
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1

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STYLUS ACTUATED GAS DISCHARGE SYSTEM
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Filed May 26, 1969, Ser. No. 827,598

Int. Cl. B43I 1/00

U.S. Cl. 35—61

9 Claims

ABSTRACT OF THE DISCLOSURE

A display system including a gas discharge display panel made up of an assembly of glass films enclosing a gas and including electrodes that define an array of discrete cells. A source of sustaining voltage is applied to the electrodes to maintain the gas slightly below a threshold value. A hand held stylus which produces a high voltage discharge is connected to the source of sustaining voltage and is employed to selectively excite the cells which then emit visible light until selectively extinguished.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention is in the field of gas discharge display panels.

Prior art

Gas discharge display panels of the type employed in the present invention are described in the article, "Plasma Display Panels Reviewed at WESCON," page 8, EDN Sept. 16, 1968, vol. 13, No. 18. The described panel is distinct from the present invention in that it is actuated by computer generated signals connected to the electrodes. The prior art displays do not have the feature of providing human interaction with a stylus.

SUMMARY OF THE INVENTION

Heretofore, display panels of the gas discharge type have been actuated by signals connected directly to the electrodes. They display includes a matrix of thousands of small separate cells. A logic system is required to convert a desired display or pattern into proper input signals to actuate the proper ones of the large number of cells.

An object of the present invention is to provide a system for generating patterns on a gas discharge display panel in real time without requiring logic circuits.

Another object of the present invention is to provide a system for generating patterns on a gas discharge display panel by a human operator using a stylus.

A further object of the present invention is to provide a system wherein a human operator and a computer can interact through a gas discharge display panel.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of the preferred embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a schematic block diagram of an embodiment of a gas discharge display panel system following the principles of the present invention.

FIG. 2 is an illustration of waveforms useful in explaining the embodiment of FIG. 1.

FIG. 3 is an illustration of another embodiment of a stylus which may be used in the present invention.

2

FIG. 4 is a schematic block diagram of an embodiment of the present invention employing a data processing system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a gas discharge display panel system is shown including a gas discharge display panel 10, a source of sustaining signal 12, a high voltage discharge stylus 14 with its associated voltage source 16 and connecting circuit 18 between stylus 14 and sustaining signal source 12.

Display panel 10 is a known device. It is described in the reference cited in the preceding "Prior Art" paragraph. The panel includes two glass plates, one containing a plurality of transparent conductors extending in the X direction and the other a plurality of conductors extending in the Y direction. In one type of display panel, the two glass plates form one large gas chamber with the X conductors on one side and the Y conductors on the other side forming a plurality of matrix intersection points. In another type of display panel, the two glass panels which form the plurality of matrix points are separated by an intermediate third glass panel having holes at the intersection points to form a plurality of separate cells which are filled with a gas, for example, neon or a helium-neon mixture. In either case, the region of gas excited into the visible state at an intersection point will be hereinafter referred to as a cell.

A sinusoidal sustaining voltage from generator 12 is applied to the X and Y conductors to excite the gas in the cells to a value below the threshold value at which discharge occurs. Thus, a potential is established across the gas in the intersection regions (i.e., in each of the cells) of the display device 10.

Stylus 14 contains an induction coil which produces a high voltage, low current, high frequency (R.F.) discharge. An example of a coil of this type is a Tesla coil which is described in the International Dictionary of Physics and Electronics, copyright 1956 by D. Van Nostrand Company, Inc., Princeton, N.J. Stylus 14 is placed on the desired location of display panel 10 and the voltage discharge produced by stylus 14 is sufficient to further excite the gas in the cell proximate to stylus 14 to produce visible light. When the gas is excited into the visible state, ions transfer across the intersection point from one conductor to the other to maintain the gas in the visible state when the voltage discharge produced by stylus 14 is removed. The gas will stay visible until an "erase" signal is provided by stylus 14.

More particularly, sustaining generator 12 produces a sinusoidal sustaining voltage as depicted as waveform A of FIG. 2. The sustaining signal is applied to a differentiating circuit 18 which differentiates the signal to produce a signal having a waveform shown as waveform B of FIG. 2. The positive and negative voltage spikes of waveform B occur simultaneously with the peaks of the sustaining signal applied to display panel 10.

The output signal from differentiating circuit 20 is applied to two clipping circuits 22 and 24. Clipping circuit 22 clips the waveform B signal of FIG. 2 to produce an output signal including only the positive spikes as shown as waveform C of FIG. 2. Clipping circuit 24 clips the waveform B signal to produce an output signal consisting only of the negative spikes as shown as waveform E of FIG. 2. The output signal from clipping circuit 24 is applied to an inverting circuit 26 which inverts the polarity of the negative spikes to produce an output signal consisting of positive spikes. Thus, the output signal from clipping circuit 22 is a series of positive voltage spikes concurrent in time with the positive peaks of the sustaining signal shown as waveform A. The output sig-

3

nal from inverting circuit 26 consists of a series of positive voltage spikes concurrent in time with the negative peaks of the sustaining signal. The supply voltage for stylus 14 from voltage source 16 is applied to an AND circuit 28 along with the output signal from inverting circuit 26 and also to an AND circuit 30 along with the output signal from clipping circuit 22. AND circuit 30, therefore, produces an output voltage signal concurrent in time with the positive peaks of the sustaining signal and an AND circuit 28 produces an output voltage signal concurrent with the negative peaks of the sustaining signal. The output signal from AND circuit 30 is applied to a gate circuit inside the stylus 14 which is controlled by button 32 and the output from AND circuit 28 is applied to another gate circuit inside stylus 14 which is controlled by button 34. Thus, when button 32 is depressed, stylus 14 will produce a high voltage discharge upon the next occurrence of a positive peak of the sustaining signal. When button 34 is depressed, stylus 14 will produce a high voltage discharge upon the next occurrence of a negative peak of the sustaining signal. Button 32 is depressed when it is desired to "write" on the display panel and button 34 is depressed when it is desired to "erase" the display panel. The write button 32 may be replaced by a pressure operated plunger in the tip of stylus 14 which is brought into contact with the face of display panel 10 when a write operation is desired. Alternatively, the erase button 34 may be replaced by the pressure operated plunger.

Referring to waveform E of FIG. 2, a signal is shown illustrating the cooperation of the output signal of stylus 14 and the sustaining signal from sustaining generator 12. Sometime after the occurrence of the second positive peak of the sustaining signal, the write button 32 of stylus 14 is depressed thereby opening the associated gate and permitting stylus 14 to operate. At the time of the next positive peak (the third peak) of the sustaining signal, a voltage discharge is produced by stylus 14 and directed to a desired cell of display panel 10. The voltage discharge from stylus 14 adds to the positive peak of the sustaining signal at the desired cell as shown in waveform E and is sufficient to exceed the threshold value required to excite the gas in the cell into the visible state. The cell will stay visible after the occurrence of the voltage discharge from stylus 14 and the release of button 32. Presuming that the erase button 34 is depressed after the occurrence of the third negative peak of the sustaining signal, a voltage discharge will be produced from stylus 14 upon the occurrence of the next or fourth negative peak of the sustaining signal. A positive voltage discharge from stylus 14 subtracts from the negative peak of the sustaining signal. The negative voltage is no longer sufficient to maintain the ion flow necessary to maintain the gas in the visible state and the gas returns to its original unexcited below threshold level and the gas in the cell is no longer visible.

What has been described is a gas discharge display panel wherein the gas in the individual cells can be made selectively visible under the control of an operator in real time by the use of a hand held stylus. As the operator moves the probe in desired patterns across the face of the display panel, a corresponding illuminated pattern will be produced on the face of the display panel.

FIG. 1 illustrated an embodiment of the invention wherein the probe 14 was synchronized with the sustaining signal. A stylus 14A is shown which may be employed with a different embodiment. The stylus is connected to voltage source 16. In between the high voltage coils (not shown) and voltage 16, a "write" button is connected which, when depressed, connects the voltage coils to the voltage source to produce a discharge which will make the gas visible upon the occurrence of the next positive peak of the sustaining signal. Button 38 must be released or stylus 14A moved prior to the negative peak of the sustaining signal or erasure will occur.

4

The tip of stylus 14A contains a photodiode 40 which provides almost infinite resistance when dark and almost zero resistance when illuminated. Photodiode 40 is shielded during the writing operation. When erasing is desired, the light from the display cell will cause photodiode to operate as a switch, thereby connecting voltage source 16 to the voltage coils. The stylus thus produces a discharge which will erase the lighted cell on the occurrence of the next negative peak of the sustaining signal.

If the sustaining signal has a relatively low frequency, for example, sixty cycles per second, a simple stylus having a single on-off button can be used.

It is also possible to provide a stylus which produces a positive write voltage discharge and a negative erase discharge, both of which operate on the positive peaks of the sustaining signal.

In another system embodiment, a stylus can be used with a display panel which is also connected to a computer. This type system has the advantage that the operator can interact with the computer. Referring to FIG. 4, a system is shown combining a computer operated display panel known in the prior art with a high voltage discharge stylus to provide interaction not obtainable with prior art systems. Elements of the system of FIG. 4 which are the same as elements of FIG. 1 are designated with the same reference numbers.

The system of FIG. 4 includes a gas discharge display panel 10 and a sustaining generator 12. Sustaining generator 12 is connected through circuit 18 to stylus 14. Buttons 32 and 34 of stylus 14 function identically as described relative to FIG. 1. Circuit 18 includes differentiating circuit 20, clipping circuits 22 and 24, inverting circuit 26 and AND circuits 28 and 30 which function identically to their counterparts in FIG. 1.

Rather than being connected directly to display panel 10, sustaining generator 12 is connected to X pulser 44 and Y pulser 46. A computer 48 containing the programmed information for the display panel 10 is connected to address logic circuit 50 which converts the computer information into X and Y input signal information. The output of the address logic circuit 50 is connected to X pulser 44 and Y pulser 46 which apply pulses on the sustaining signal from generator 12 in a manner illustrated in waveform E of FIG. 2 to provide write pulses and erase pulses. X pulser 44 and Y pulser 46 are connected individually to each of the X conductors and Y conductors of display panel 10 and, under control of computer 48 and address logic 50, apply either write pulses or erase pulses to the appropriate X and Y conductors of display panel 10 to effect a desired gas cell in the panel 10. As previously stated, this is how prior art gas display panels are operated.

The sustaining signal from generator 12 is also connected through differentiating circuit 20, clipping circuits 22 and 24, inverting circuit 26 and AND circuits 28 and 30 to stylus 15 along with the voltage from voltage source 16. The write button 32 and the erase button 34 of stylus 14 can therefore be actuated by an operator in a manner described relative to FIG. 1 to add to or erase from the display produced by computer 48. In order that computer 48 can obtain the information introduced by the operator, the X conductors and the Y conductors of display panel 10 are connected to sensing circuits 53 and 55 via cables 52 and 54 respectively. The outputs of sensing circuits 53 and 55 are connected to computer 48. When the operator either writes or erases a given gas cell of display panel 10, a corresponding change in voltage level occurs on the X conductor and Y conductor associated with the gas cell. This voltage level change is transmitted on the corresponding leads in cables 52 and 54 to the sensing circuits 53 and 54 which produce output signals in response to the voltage level change. The output signals from sensing circuit 53 and 55 are connected to a register or core storage in computer 48 to indicate that the operator has written or erased a gas cell.

Another form of operator-computer interaction action

5

which is desirable is selection. For example, in computer assisted instruction applications computer 48 may display a question and a number of possible answers. The operator then selects the one answer. Thus, to inform computer 48 of a selection, the operator positions stylus 14 next to the selected answer and depresses and holds down both buttons 32 and 34. This maintains the gates in stylus 14 open and generates a sequence of write and erase pulses which are directed at one gas cell. The fact that one cell is being continuously written and erased is manifested by alternate voltage level changes on the appropriate conductors in cables 52 and 54 which are applied to sensing circuits 53 and 55 which apply corresponding signals to computer 48.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A gas discharge display system comprising:

a display panel including first and second plates connected together to form a central chamber containing gas,

a first plurality of electrical conductors located on said first plate and a second plurality of electrical conductors located on said second plate to form intersection regions with said first plurality conductors,

a source of sustaining voltage signal connected to said first and second plurality of conductors to apply a voltage level to said gas in said intersection regions between said first and second plurality of conductors, and a discharge voltage source for producing a voltage discharge proximate to the gas in selected intersection regions of said display panel.

2. A gas discharge display system according to claim 1 wherein said discharge voltage source includes a voltage supply source and a stylus containing a voltage discharge coil connected to said voltage supply source for producing a voltage discharge proximate to an intersection region of said display panel.

3. A gas discharge display system according to claim 1 wherein said discharge voltage produced by said discharge voltage source excites the gas in said intersection region into the visible state.

4. A gas discharge display system according to claim 3 wherein said discharge voltage source produces a voltage discharge proximate to an intersection region of said display panel having gas in the visible state to render said gas in said intersection region nonvisible.

5. A gas discharge display system according to claim 1 further including means connected to said source of sustaining voltage signal and to each one of said first and second plurality of conductors for producing voltage pulses on selected ones of said first and second plurality of conductors for exciting the gas in the intersection regions associated with said conductors into the visible state.

6. A gas discharge display system according to claim 4 wherein said sustaining voltage signal is an alternating current signal and wherein said voltage alternates between first and second voltage peak levels,

and wherein said voltage discharge coil in said stylus produces a voltage discharge to excite said gas in said intersection regions into the visible state con-

6

current with said first peak voltage level of said sustaining signal and wherein said voltage discharge coil in said stylus produces a voltage discharge to render said gas in said intersection regions nonvisible concurrent with said second peak voltage level of said sustaining signal.

7. A gas discharge display system according to claim 6 including a differentiating circuit connected to said sustaining voltage signal source for producing voltage pulses on a first output lead in response to the occurrence of said first peak levels of said sustaining voltage and voltage pulses on a second output lead in response to the occurrence of said second peak levels of said sustaining voltage, first gating means connected to said stylus, said voltage supply source and said first output lead for gating said voltage supply voltage to said stylus upon the occurrences of the voltage pulses on said first output lead, second gating means connected to said stylus, said voltage supply source and said second output lead for gating said voltage supply voltage to said stylus upon the occurrences of the voltage pulses on said second supply lead,

the output of said first gating means being connected to a first switch in said stylus for selectively applying said gated voltage supply voltage to said voltage discharge coil of said stylus,

and the output of said second gating means being connected to a second switch in said stylus for selectively applying said gated voltage supply voltage to said voltage discharge coil of said stylus.

8. A gas discharge display system according to claim 7 wherein said second switch in said stylus is a light response switch located in the tip of said stylus.

9. A gas discharge display system according to claim 7 further including a data processing means connected to said sustaining voltage signal source and to each one of said first and second plurality of conductors for generating and applying voltage pulses on selected ones of said first and second plurality of conductors for exciting the gas in the intersection regions associated with said conductors into the visible state,

and means connecting each of said first and second plurality of conductors to said data processing means for transmitting signal changes to said data processing means, said signal changes resulting from gas in selected intersection regions being excited into the visible state and rendered nonvisible by said voltage discharge of said voltage discharge coil in said stylus.

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HARLAND S. SKOGQUIST, Primary Examiner

U.S. Cl. X.R.

40—28; 178—18; 340—324, 337

Disclaimer

3,559,307.—*Euval S. Barrekette*, New York, and *Herbert B. Baskin*, Mohegan Lake, N.Y. STYLUS ACTUATED GAS DISCHARGE SYSTEM. Patent dated Feb. 2, 1971. Disclaimer filed Dec. 17, 1973, by the assignee, *International Business Machine Corporation*.
Hereby enters this disclaimer to claims 1-9, inclusive, of said patent.
[*Official Gazette April 16, 1974.*]