PATENT SPECIFICATION 1,134,704

DRAWINGS ATTACHED.

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1,134,704

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COMPLETE SPECIFICATION.

A Circuit for a Touch Keyboard.

We, INTERNATIONAL BUSINESS MACHINES CORPORATION, a Corporation organized and existing under the laws of the State of New York in the United States of America, of Armonk, New York, 10504, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a circuit for a touch keyboard. These keyboards make use of the capacitance introduced when the operator touches a selected key or terminal. The great advantage of touch keyboards is that there are no moving parts and the risk of failure is slight.

A circuit for a touch keyboard according to the invention comprises two signal paths including a common capacitor, means for supplying fluctuating signals to the paths so that the effect on the common capacitor of signals along one path is nullified by the effect of signals along the other path, one of the paths including a terminal which when touched by a human operator introduces a further capacitance to unbalance the circuit and cause the common capacitor to become charged.

The common capacitor may also form part of a control circuit of a voltage responsive indicating device, the arrangement being such that when the circuit is unbalanced and the common capacitor becomes charged the voltage developed across the capacitor increases until the minimum value required to trigger the device is reached.

In order that the invention may be fully understood preferred embodiments thereof will now be described with reference to the accompanying drawings.

In the drawings:—

Figure 1 shows a circuit according to the invention connected to operate in a touch keyboard;

Figure 2 shows voltage waveforms at various points in the circuit shown in Figure 1.

Figure 3 shows a modification of the circuit shown in Figure 1.

Referring first to Figure 1, a circuit embodying the invention is shown within the dotted rectangle indicated by the reference numeral 1. The circuit in this particular embodiment is shown connected to a cold-cathode trigger tube 2. The 'key' associated with this particular circuit although not actually shown would be provided as a terminal or other device which may or may not be coated with a dielectric to which the operator can make contact, at point 3. The capacitance introduced by the operator touching the circuit at this point is shown as a dotted connection and referenced 4. The circuit is required to produce an output voltage at point 14 when the operator touches terminal 3 which switches on tube 2 which in turn illuminates the key indicating that it has been touched.

The circuit is seen to consist of two signal paths connected between an input terminal 5 and one plate of a load capacitor 6. One path consists of a resistor 7 and a diode 8 connected to pass positive signals from the input 5 to the capacitor 6. The other path contains a resistor 9 and a diode 10 connected to pass positive signals from the capacitor 6 to the input 5.

A square wave as shown in Figure 2*a* is supplied to the input terminal 5. The wave has a mark/space ratio of unity and has a period τ. Resistors 7 and 9 have the same

[*P*

value and the time constant of capacitor 6 and one of the resistances 7 or 9 is long compared to the τ of the input signal. During the positive half cycle τ_1 of the input signal a current will flow along the path through resistor 7 and diode 8 and capacitor 6 will receive a small charge. No current will flow along the other path since diode 10 in this path is reverse biassed. During the next half cycle τ_2 when the signal is negative the reverse takes place, the capacitor 6 discharges through diode 10 and resistor 9 whilst diode 8 is reverse biased. Thus the charge on capacitor 6 does not build up and since the bias voltage is chosen so that it is too low to trigger the tube 2 this device remains off.

Now the effect of an operator touching the key at point 3, is to block the discharge path of capacitor 6 at least temporarily so that the potential across the capacitor rises sufficiently to trigger tube 2. During the positive half cycle of the input signal, that is during time τ_1, (Figure 2*a*) the capacitor 6 charges as before. This time there is also a flow of current through resistor 9 or as shown in Figure 1 the resistor 9 diode 11 combination to charge up the schematic capacitor 4 provided by the operator touching the terminal 3. The charging time constant of capacitor 4 is small and so the voltage across it rises to almost V bias +V with the result that a reverse bias voltage is developed across diode 10. Now, during the negative half cycle of the input signal, that is during time τ_2 (Figure 2*a*) the capacitor 6 cannot start to discharge until diode 10 becomes forward biassed once again. This does not occur until capacitor 4 has been discharged sufficiently through resistor 9, diode 11 being reverse biassed. Thus, the effect of the operator touching point 3 is to reduce the time during which capacitor 6 can discharge. The voltage across this capacitor thus rises until the charge it acquires during the time τ_1 is exactly balanced by the charge it loses during time τ_2. The waveforms of voltage V across the schematic capacitor 4 and the load capacitor 6 when equilibrium is reached are shown in Figure 2*b* and 2*c* respectively. V_t is the average voltage across the output capacitor 6 and is above the voltage necessary to trigger the tube 2.

Figure 3 shows a modification of the circuit shown in Figure 1 which also embodies the invention. The only difference between the two circuits is that there are two separate input terminals 12 and 13 to the two signal paths in Figure 3 replacing the single input terminal 5 in Figure 1 and diode 11 is omitted. The form of input signals applied to the input terminals 12 and 13 are shown in the drawing. It is seen that these signals fluctuate between two voltage levels V_1 and V_2 and as one input signal rises the other falls. Therefore, the voltage across the capacitor 6, that is the voltage V_t at point 14, does not change. The input signals can of course be shifted in time relative one to the other with the result that the capacitor charges as the signal to terminal 12 goes positive and discharges as the signal to terminal 13 goes negative. In either case the effect of the input signals on the capacitor 6 along one signal path is nullified or cancelled by the effect of the input signals along the other path.

The introduction of the effective capacitor 4 by the operator touching terminal 3 either directly or through a dielectric, serves once again to block one of the signal paths. Capacitor 4 is charged when the input signal to terminal 13 is at its upper level V_1. Thus, the capacitor 6 which is charged by input signal to terminal 12 rising to V_1, cannot discharge until the capacitor 4 has been discharged sufficiently. Thus, the charge gained by capacitor 6 exceeds the charge lost with the result that the voltage across capacitor 6 increases until the tube 2 is triggered.

WHAT WE CLAIM IS:—

1. A circuit for a touch keyboard comprising two signal paths including a common capacitor, means for supplying fluctuating signals to the paths so that the effect on the common capacitor of signals along one path is nullified by the effect of signals along the other path, one of the paths including a terminal which when touched by a human operator introduces a further capacitance to unbalance the circuit and cause the common capacitor to become charged.

2. A circuit as claimed in claim 1, in which each signal path includes a unidirectional device connected so that signals of one polarity are supplied to charge the common capacitor along one path and signals of opposite polarity are supplied to discharge the common capacitor along the other path.

3. A circuit as claimed in claim 2, in which the terminal is included in the discharge path and is connected between the unidirectional device in that path and the means for supplying fluctuating signals to the path.

4. A circuit as claimed in claim 2 or claim 3, in which the unidirectional devices are diodes and the fluctuating signals alternate between two predetermined fixed values, the values being such that each diode is forward biassed when the fluctuating signal applied thereto has one fixed value and reverse biassed when the signal has the other fixed value.

5. A circuit as claimed in any one of the preceding claims, in which the fluctuating signals are in the form of constant amplitude rectangular pulses.

6. A circuit as claimed in claim 5, in which the mark/space ratio of the fluctuating signals is unity.

7. A circuit as claimed in any one of the preceding claims, in which the means for supplying fluctuating signals is a single source and is common to both signal paths.

8. A circuit as claimed in claim 7, in which the fluctuating signal is a constant amplitude alternating signal having a mark/space ratio of unity, such that the common capacitor becomes partially charged due to current flow along one of the signal paths during one half cycle of the fluctuating signal and thereafter becomes discharged due to current flow along the other signal path during the other half cycle of the fluctuating signal.

9. A circuit as claimed in any one of claims 1 to 6, in which the two signal paths present the same impedance to the fluctuating signals supplied thereto and the fluctuating signal applied to one path is the inverse of the fluctuating signal supplied to the other path.

10. A circuit as claimed in any one of the preceding claims, in which the common capacitor also forms part of a control circuit of a voltage responsive indicating device, the arrangement being such that when the circuit is unbalanced and the common capacitor becomes charged the voltage developed across the capacitor increases until the minimum value required to trigger the device is reached.

11. A circuit as claimed in claim 10, in which the indicating device is a cold-cathode discharge tube.

12. A circuit for a touch keyboard substantially as hereinbefore described with reference to, and as illustrated in, Figure 1 of the accompanying drawings.

13. A circuit for a touch keyboard substantially as hereinbefore described with reference to, and as illustrated in, Figure 3 of the accompanying drawings.

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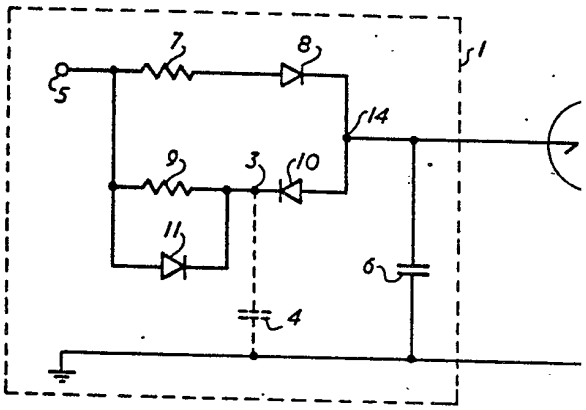

FIG. 1

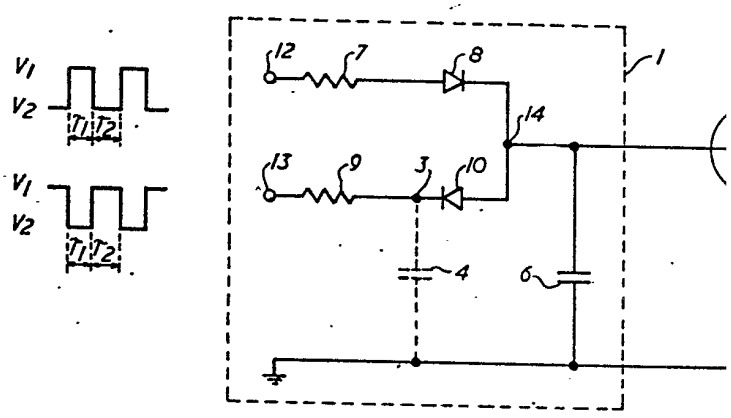

FIG. 3

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 1 & 2

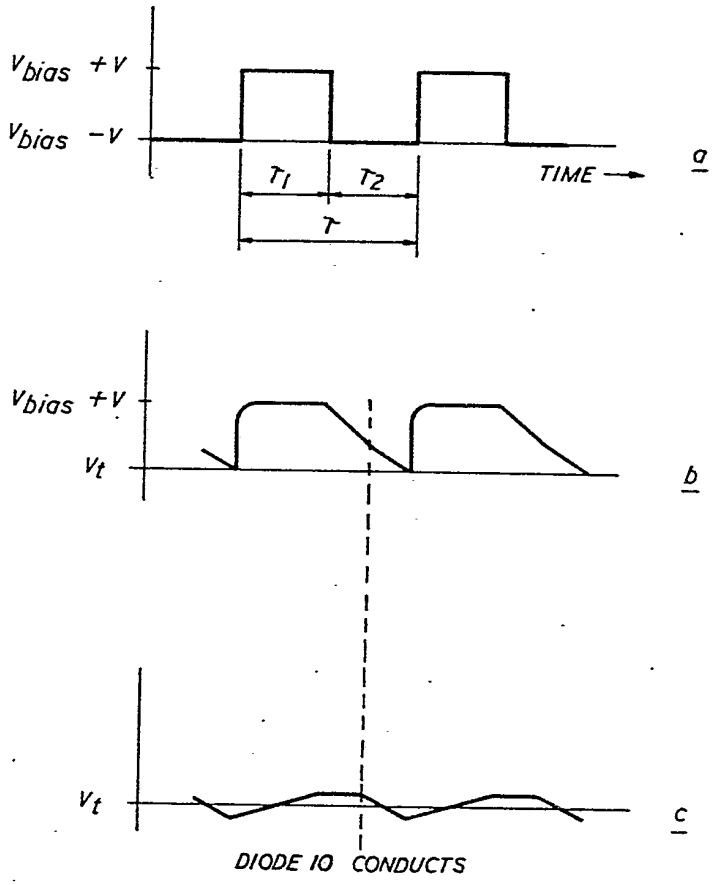

FIG. 2

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 1 & 2

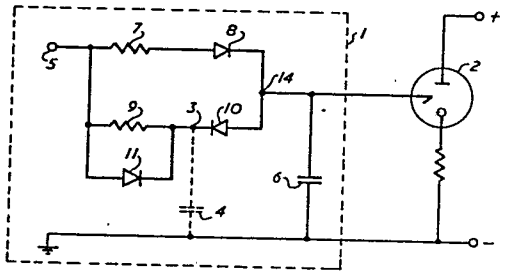

FIG. 1

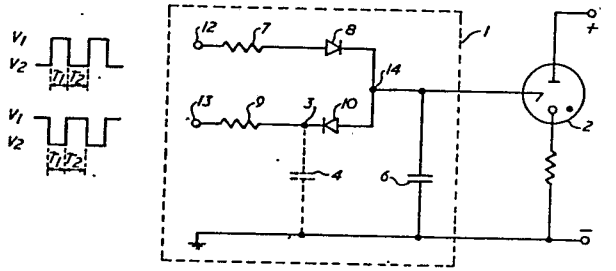

FIG. 3

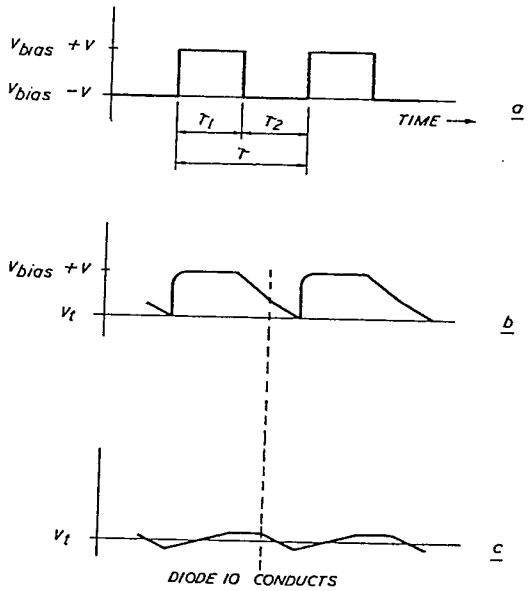

FIG 2