United States Patent

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[54] **INFORMATION DISPLAY CIRCUIT INCLUDING MEANS FOR BLANKING THE DISPLAY DEVICE**
1 Claim, 2 Drawing Figs.

[52] U.S. Cl. 340/324, 340/343
[51] Int. Cl. G09f 9/46, H01j 17/48
[50] Field of Search 340/324, 334, 343; 315/84.5, 84.6

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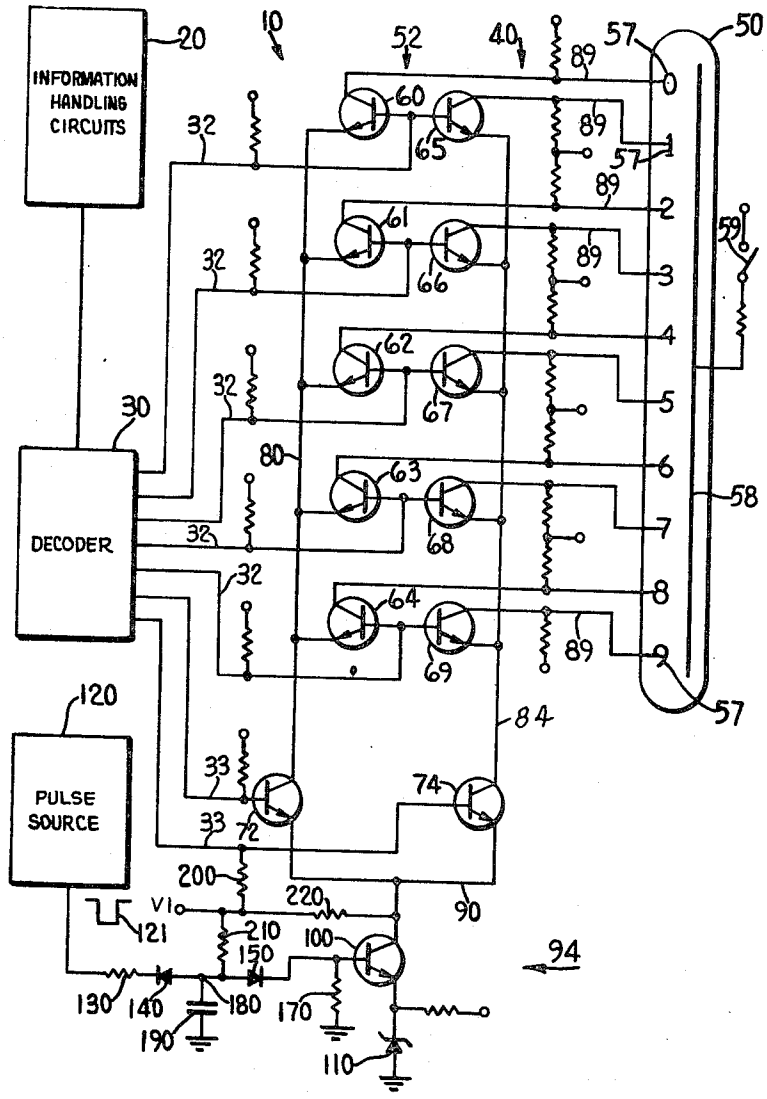
ABSTRACT: The disclosure is of a circuit which can be used in an information-handling and display system and includes a cathode glow display tube containing an anode and ten cathode electrodes which are coupled to a source of information signals in the system through a driving circuit. The driving circuit is a logic circuit which receives information signals from a decoder circuit and applies them to the cathode electrodes of the display tube, and the tube displays a number represented by the information signals when energizing potential is also applied to the tube anode. The driving circuit includes a control circuit which disables both the logic circuit and the display tube at desired times. The logic circuit includes five pairs of transistors connected in two groups with an auxiliary control transistor operating each group. The control circuit includes a transistor connected to the two control transistors for turning them off when desired to blank the display tube. A system is also disclosed for using the principles of the invention for controlling the timing of the application of information signals to the cathode electrodes and switching potentials to the anode electrodes of a series of display tubes in an information-handling instrument.



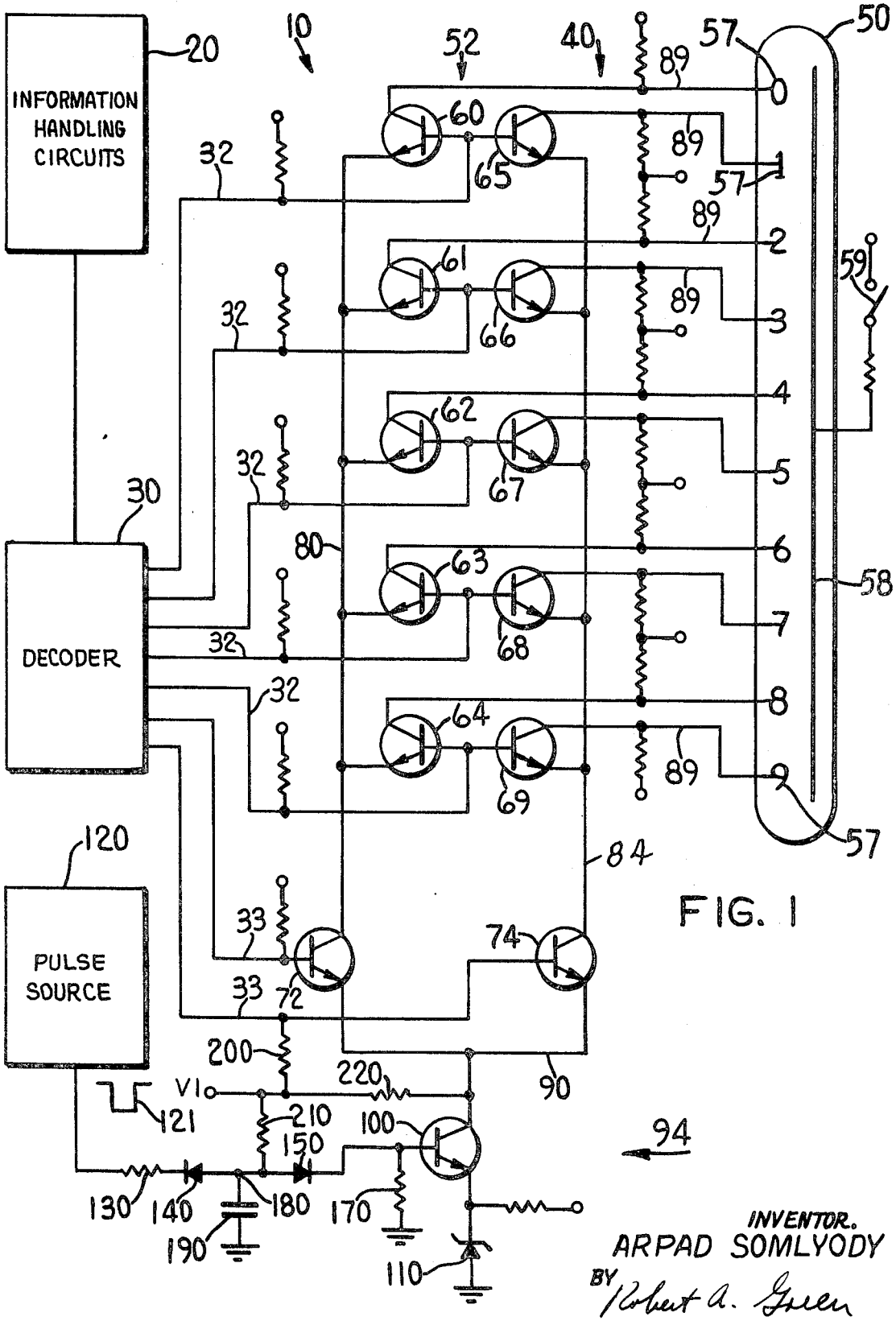


FIG. 1

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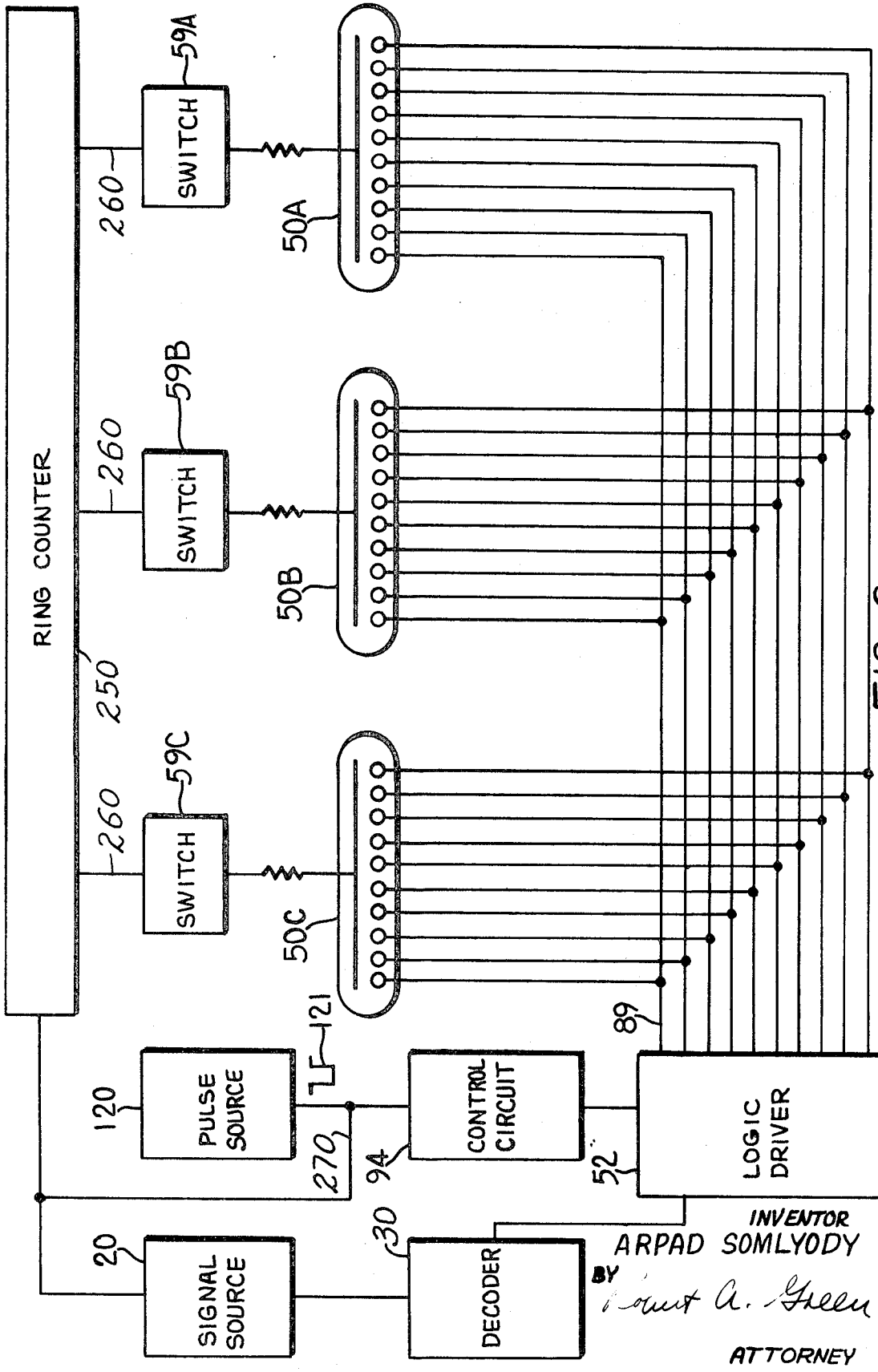

FIG. 2

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INFORMATION DISPLAY CIRCUIT INCLUDING MEANS FOR BLANKING THE DISPLAY DEVICE

BACKGROUND OF THE INVENTION

Indicator tubes of the type manufactured by Burroughs Corporation and known as NIXIE tubes have been widely used in information-handling systems such as computers, calculators, and the like. Under some circumstances, it is desirable to positively hold off or turn off the display tube while other parts of the system perform an operation or while information signals are collected for application to the logic driver circuit for the display tube. Various circuits have been proposed for turning off or blanking a display tube; however, these circuits are not completely satisfactory since they generally operate directly on the display tube itself, and not the associated logic circuitry. In addition, these circuits are not suitable for use in complex systems such as computers or calculators.

SUMMARY OF THE INVENTION

Briefly, a circuit embodying the invention includes one or more display tubes of the type described above and a separate logic circuit for applying informations signals to each display tube. The circuit also includes auxiliary circuit means for disabling the logic circuit (s) and the display tube(s) at a desired time in the information-receiving and displaying operation

DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a schematic representation of a circuit embodying the invention; and

FIG. 2 is a schematic representation of another system embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The principles of the invention are applicable to information-handling circuits and systems which display information in a display device such as a type 6844A numerical indicator tube. Thus, the invention may be used in a relatively simple circuit such as a decoder or in more complex systems such as computers, calculators, or the like. One type of circuit **10** (FIG. 1) which may utilize the invention includes various information-handling circuits represented by block **20** which feed into a decoder **30** and a display driver circuit **40**. The display driver circuit **40** includes a display tube **50** and a logic driver circuit **52** for applying thereto the output of the decoder **30** to cause a number to be displayed in tube **50**.

The indicator display tube **50** is a gas-filled tube and includes 10 glow cathodes **57** in the form of numerals zero to nine and an anode electrode **58**. When a positive potential of about 150 volts is applied between anode **58** and a cathode numeral **57**, the cathode exhibits cathode glow. A driver or switch **59**, which may be an electronic switch such as a transistor, is coupled to anode **58** to apply operating potential thereto at the same time that information potential is applied to a cathode numeral.

For purposes of illustration, the decoder **30** is shown as a type which has seven output lines which carry signal bits having a meaning in decimal code, that is, representing a decimal number. Five lines **32** comprise signal information lines, and two lines **33** comprise signal control lines.

The logic driver circuit **52** for coupling signals from the decoder **30** to tube **50** includes 10 signal-receiving and registering active devices **60** to **69**, which may be tubes, transistors, or the like. These transistors may be referred to as "glow" transistors since they are coupled to the respective glow cathodes. For purposes of illustration, three-electrode transistors are shown with the electrodes thereof represented in conventional fashion. As shown, the devices **60** to **69** are arranged in two groups of five and in pairs, with one member of a pair being in each group. Thus, one group includes devices **60** to **64**, and the other group includes devices **65** to **69**, with

the pairs being **60–65**, **62–67**, **63–68**, **64–69**. In addition, two auxiliary devices **72** and **74**, also transistors, are provided to control the operation of the two groups of five transistors.

The five transistors **60** to **64** have their emitter electrodes connected together to a bus **80** which is connected to the collector electrode of control transistor **72**, and the five transistors **65** to **69** have their emitter electrodes connected together to a bus **84** which is similarly connected to the collector of control transistor **74**. The collector electrodes of the transistors **60** to **69** are each connected by leads **89** to one of the cathode numerals in tube **50**. The emitter electrodes of the two control transistors **72** and **74** are connected together to a bus **90**.

According to the invention, an auxiliary control circuit **94** is provided including an auxiliary control transistor **100** which has its collector electrode connected to the emitter electrodes of the control transistors **72** and **74** and its emitter electrode connected through a Zener diode **110** to ground. Control circuit **94** also includes a source **120** of clock pulses or control pulses coupled through a resistor **130** and diodes **140** and **150** (oriented as shown) the base of control or blanking transistor **100**. The base of transistor **100** is also coupled through a resistor **170** to ground, and junction point **180** of the diodes **140** and **150** is connected through a capacitor **190** to ground. A positive DC power source V1 is connected through resistors **200** and **210** to line **33** and junction point **180**, respectively, and through resistor **220** to the collector of transistor **100**. Other connections are made to provide bias voltages for the various transistors as shown and need not be described in detail. In circuit **94**, capacitor **190** extends the time duration of pulses from source **120**, and the diodes **140** and **150** adjust voltage levels between source **120** and the base of transistor **100**. Under some circumstances, each diode **140** and **150** might require additional diodes to provide the desired balance, or, in some cases, no diodes may be needed.

In operation of the circuit **10**, signal information is processed through circuits **20** and **30**, and a group of signal bits appears on the seven lines **32** and **33**. Normally, transistors **60** to **69**, **72**, and **74** are held off by the bias voltages applied. Each group of seven signal bits has such polarities that the base electrodes of only one pair of transistors **60** to **69** receive a positive turn-on signal and only one of the control lines **33** receives a positive turn-on signal. The positive signal applied to the control line **33** turns on one of the control transistors, and this in turn applies a generally negative potential to one of the buses **80** or **84**, and this permits one transistor of the selected pair to turn on. When the selected transistor turns on, the cathode numeral in tube **50** to which it is connected glows and is visible when switch **59** is closed. As a specific example, if positive potential is applied to the bases of transistors **60** and **65** and to transistor **72**, then transistor **60** is turned on and numeral "O" glows.

Auxiliary control circuit **94** is used as follows. It has been found that, under some circumstances, particularly during the time when signal information on lines **32** and **33** is changing from one combination to another, improper operation of tube **50** may result and two cathodes may glow. This is prevented by the operation of the invention. In addition, the invention can be used to positively disable the circuit and the display tube **50**. This is accomplished, according to the invention, by a negative pulse **121** being coupled from source **120** through the resistor **130** and diodes **140** and **150**, to the base of auxiliary control or blanking transistor **100** which is normally on and is now turned off. This results in the application of positive potential to the emitter electrodes of the control transistors **72** and **74** which are also held off. Thus, a generally positive potential is applied through the buses **80** and **84** to the emitters of the five pairs of transistors **60** to **69** which are also held off. Because all of the driving transistors **60** to **69** are immobilized, the indicator tube **50** is blanked or held off and no cathodes can glow.

In the circuit, the resistor **130** and capacitor **190** provide a time constant which determines the time duration of the con-

trol pulse **121** and the length of time the circuit is disabled. In general, it is desirable for the pulse to be terminated just after a new group of signal bits appears on the lines **32** and **33** to the transistors **60** to **69** and **72, 74** so that the information can be displayed in tube **50** without spurious glow.

The principles of the invention may also be used in a somewhat more complex system **10'** of the type illustrated in FIG. **2** which represents a portion of a computer, calculator, or the like in which information is displayed on a plurality of display tubes **50A, 50B, 50C**, as is well known. In such a system, a single decoder **30** and logic driver circuit **52** are provided for all of the display tubes, and each of the 10 output lines **89** from circuit **52** is connected to the same cathode numeral in the display tubes **50**. Signal information is processed through the circuit and appears on lines **89** serially; that is, the first group of signals representing a decimal number is intended for entry in the first tube in the series **50A**, the second group of signals is intended for entry in the second tube **50B**, etc. In addition, an electronic switch means or driver **59A, 59B, 59C** is provided in the anode circuit of each tube **50**.

A ring counter **250** is coupled to and operates each of the anode drivers **59** by leads **260**, and it is assumed that the signal source represented by block **20** includes in its circuitry a sequential memory or register from which information signals are fed along toward the tubes **50**. Both the ring counter **260** and the memory or register in source **20** are coupled to the output of pulse source **120** by leads **270** for synchronizing the operation of switches **59A, 59B**, and **59C** and their associated display tubes with the operation of source **20** and of decoding and driving circuits **30**.

In operation of the system **10**, the first pulse **121** from source **120** operates ring counter **250** and causes the counter to apply operating potential to the anode of tube **59A**. At the same time, the memory or register in signal source **20** is energized by the first pulse **121** and caused to transmit the first group of information signals through the circuit in the direction of the indicator tubes. Again, at the same time, the first pulse **121** energizes control circuit **94**, and this circuit, as described above, disables logic driver circuit **52** and all of the indicator tubes for the length of time which is required for the information signals to reach lines **89**. At the end of this time period, again as described above, the pulse **121** is terminated and logic driver circuit **52** is permitted to operate and apply operating potential to one of the cathodes in tube **59A** determined by the first group of information signals. This selected cathode exhibits cathode glow, and the proper numeral representation appears. The next pulse **121** repeats this cycle of operation for tube **59B**, and the third repeats the cycle of operation for tube **59C**, etc.

The above-described operation occurs continuously and at such high repetition rate that all numbers corresponding to input information signals are visible in their tubes **50** at the same time.

According to the invention, control circuit **94** insures the proper coordination between the feeding of information to a series of display tubes and the operation of these tubes. In the circuits described, if control circuit **94** were not provided, spurious display might result. Such spurious display occurs when, for example, tube **59A** is on and displaying a numeral and another group of information signals appears on lines **89** before tube **59A** is turned off and the next tube **59B** in the series is switched on. When this happens, tube **59A** displays two numbers. This spurious display is prevented by the invention.

I claim:

1. In a decoding system for driving at least one multiple cathode display device for displaying information thereon, including a plurality of glow transistors coupled to different cathodes, said glow transistors being arranged in at least two groups, and a plurality of auxiliary transistors, one auxiliary transistor coupled to each group for rendering said groups of transistors conductive or nonconductive when said auxiliary transistors are conductive or nonconductive, respectively, the improvement of a blanking circuit comprising:

a blanking transistor,

said blanking transistor being connected to like electrodes of said auxiliary transistors for enabling said auxiliary transistors to be conductive or nonconductive when said blanking transistor is conductive or nonconductive, respectively, and

means operating independently of said information for selectively switching said blanking transistor between said conductive and nonconductive states,

said switching means being adapted to render said auxiliary transistors nonconductive during the time when a change occurs in said information.