

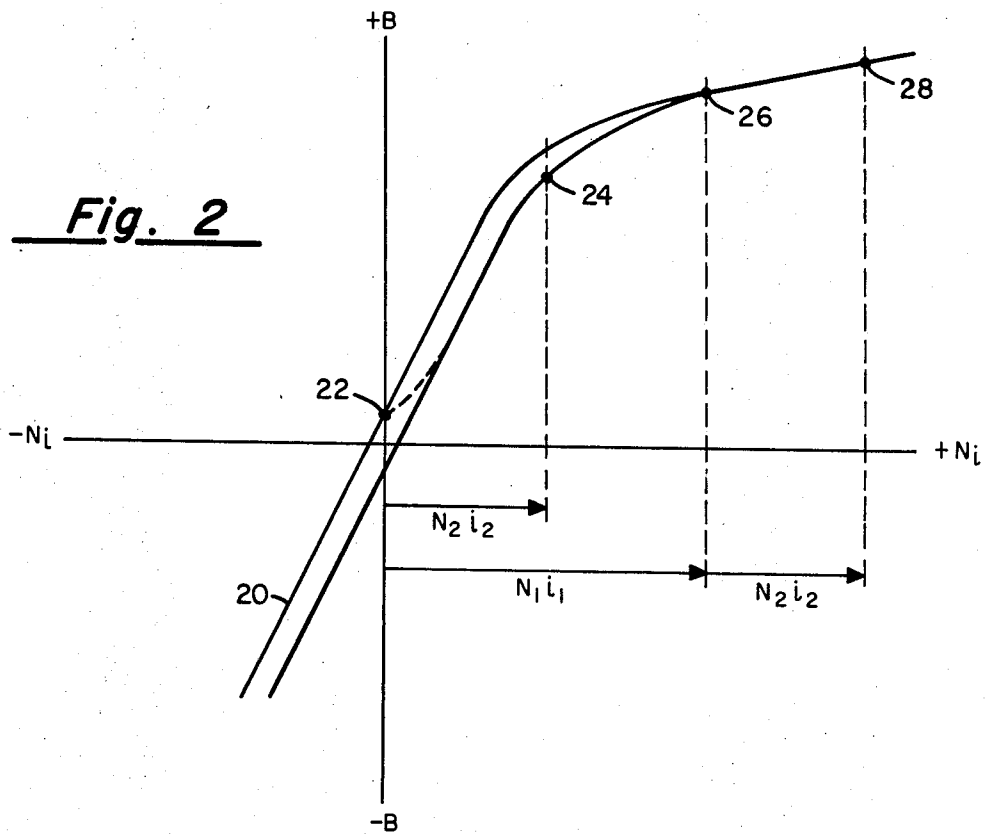
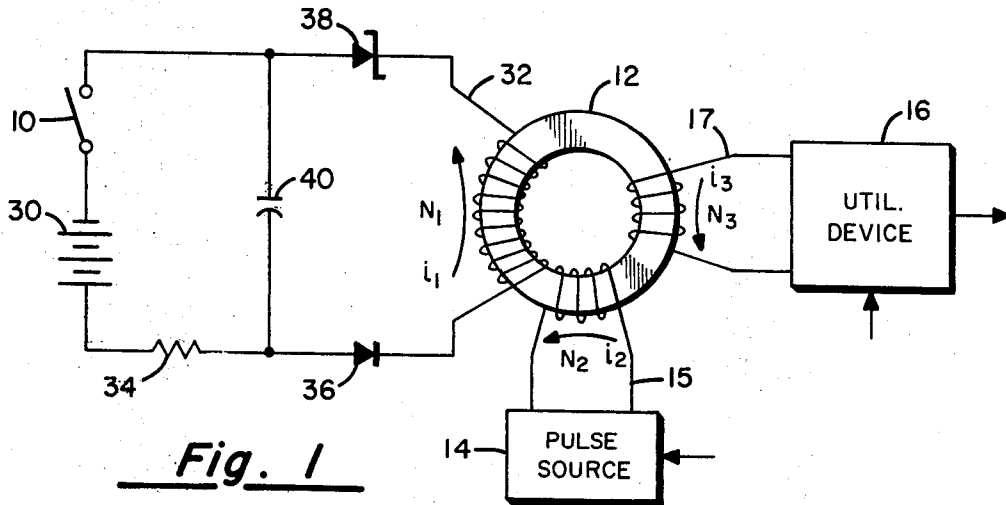
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REMOTE SWITCH STATUS SENSOR

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REMOTE SWITCH STATUS SENSOR

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ABSTRACT OF THE DISCLOSURE

A circuit for determining the status, i.e., whether opened or closed, of a remotely located switch; the switch may be representative of an ON, OFF electronic circuit such as a bistable multivibrator or a set of contacts on an electro-mechanical relay. The switch status initially establishes the magnetic state of a core of low residual magnetism in a low or, alternatively, in a high steady-state of magnetic flux density. A second signal source inductively coupled to the core induces a large or, alternatively, a small flux change in the core due to its low or high steady-state magnetic flux density, which flux change is detected by an inductively coupled utilization device as being indicative of the status of the switch.

BACKGROUND OF THE INVENTION

The present invention relates to a means for ascertaining the status, whether opened or closed, of a remotely located switch which switch may represent any type of opened, closed electrical device. The environment in which the present invention is located is an electronic data processing system having a plurality of remotely located control units coupled to a single central processor. The central processor samples certain interconnecting wires between it and the control units and responds appropriately to the condition of each of the interconnecting wires.

In the prior art configuration, the switch was comprised of a set of contacts in a press-to-set switch on the control panel of the remotely located control units. The pressing of the switch coupled an appropriate signal to the interconnecting wires which signal "set" a flip-flop stage of a register in the central processor. The central processor sampled the register and responded appropriately. In such configuration an electromechanical relay was used in place of the core of the present invention with relay contact bounce and cost, space requirements being eliminated, or reduced, by the use of the present invention.

SUMMARY OF THE INVENTION

The present invention relates to a circuit for setting the magnetic state of a core of low residual magnetization into a steady state of relatively low or, alternatively, relatively high flux density as being indicative of the status of an associated switch being opened or closed.

With the switch closed, a control signal is inductively coupled to the core through a serial circuit of a voltage source, a current limiting resistor, a diode, a control winding about the core and a Zener diode. Coupled in parallel circuit across the diode, the winding and the Zener diode is a capacitor for absorbing transient signals that are induced in the control winding while the Zener diode and the diode are conducting. The forward biased diode passes the control signal through the control winding and onto the Zener diode; the Zener diode is operated in its reversed biased condition providing a relatively constant voltage drop thereacross for a relatively wide range of reverse current changes therethrough. The control signal flowing through the control winding maintains the mag-

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netic state of the core at a substantially stable state of relatively high flux density. The subsequent inductive coupling of a strobe pulse to the core induces a relatively small output signal in an inductively coupled output winding which relatively small output signal is detected by the associated utilization device as being indicative of the switch being closed.

With the switch opened, no control signal is inductively coupled to the core so that it remains in its magnetic state of low residual magnetization. The subsequent inductive coupling of a strobe pulse to the core induces a relatively large output signal in the output winding, which relatively large output signal is detected by the utilization device as being indicative of the switch being opened.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustration of the preferred embodiment of the present invention.

FIG. 2 is an illustration of the hysteresis loop characteristic of the core of FIG. 1 in its operating conditions thereon.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With particular reference to FIG. 1 there is presented an illustration of the preferred embodiment of the present invention in which the status, opened or, alternatively, closed, of switch 10 established the magnetic state of core 12 of low residual magnetization in a relatively low or, alternatively in a relatively high steady state of magnetic flux density. Pulse source 14, through pulse winding 15, couples a pulse signal to core 12 thereby inducing a large or, alternatively, a small flux change in core 12 due to its low or high steady state of magnetic flux density. The flux change in core 12 is detected by utilization device 16, through output winding 17, as being indicative of the status of switch 10.

With particular reference to FIG. 2 there is presented an illustration of the hysteresis loop 20 characteristic of core 12 of FIG. 1. With no magnetomotive force coupled to core 12 the magnetic state of core 12 is along its B axis as in point 22. Point 22 may be considered to be the first initial magnetic stable state of core 12. Subsequently, with the coupling of a positive magnetomotive force, $+Ni$ to core 12 its magnetic state goes along loop 20 as through points 24, 26, 28 as a function of the intensity of the applied magnetomotive force. This well-known characteristic is utilized in the present invention to provide a relatively low or a relatively high output signal indicative of the status of switch 10 being opened or closed causing the magnetic state of core 12 to reside at point 22 or point 26.

With switch 10 opened, voltage source 30 is caused to couple no current signal to control winding 32 which winding is coupled in series circuit with resistor 34, diode 36, Zener diode 38 and switch 10. Accordingly, the magnetic state of core 12 is that of point 22 of FIG. 2. The subsequent inductive coupling of a strobe pulse to core 12 by pulse source 14, through its winding 15, generates a magnetomotive force $N\frac{1}{2}i_2$ (N being the number of turns of winding 15 about core 12, i_2 being the current signal flowing through winding 15 due to pulse source 14) in core 12 causing the magnetic state of core 12 to move along its hysteresis loop 20 from its first initial magnetic state represented by point 22 to a second magnetic state represented by point 24. This substantial change in flux density, ΔB_1 , in core 12 induces in winding 17 a substantial voltage causing the current signal i_3 to be coupled to utilization device 16. Utilization device 16 interprets this relatively large output signal as being indicative of switch 10 being opened, i.e., the magnetic

state of core 12 was at an initial state represented by point 22.

The magnetomotive force of $N_2 i_2$ in core 12 is also coupled to control winding 32. However, with diode 36 and Zener diode 38 nonconducting the induced signal in control winding 32 is isolated from the remainder of the control signal circuit and is not absorbed thereby. This isolation through Zener diode 38 is achieved by selecting a Zener diode having a breakdown voltage greater than the maximum amplitude of the voltage signal induced in control winding 32 due to the magnetomotive force of $N_2 i_2$ in core 12. This isolation of control winding 32 from the remainder of the control circuit with switch 10 opened permits a maximum current signal i_3 to be coupled to utilization device 16.

With switch 10 closed, voltage source 30 is coupled in series circuit with limiting resistor 34, diode 36, winding 32, Zener diode 38 and switch 10. The control signal from voltage source 30 passes through resistor 34 and forward biases diode 36. Zener diode 38 is then reversed biased, and it is caused to operate in the range that provides a nearly constant voltage drop thereacross wide range of negative current therethrough. Resistor 34 limits the magnitude of current signal i_1 in the series circuit ensuring a substantially constant steady state value for $N_1 i_1$, which is the magnetomotive force coupled to core 12 causing its magnetic state to assume a second initial magnetic stable state represented by point 26 on loop 20 of FIG. 2.

The subsequent inductive coupling of the strobe pulse to core 12 by pulse source 14 in its associated winding 15 generates a magnetomotive force of $N_2 i_2$ in core 12 causing the magnetic state of core 12 to move along its hysteresis loop 20 from its second initial magnetic stable state represented by point 26 to a second magnetic state represented by point 28. This insubstantial change in flux density, ΔB_2 , in core 12, induces in winding 17 a relatively small output signal which relatively small output signal is detected by utilization device 16 as being indicative of switch 10 being closed, i.e., core 12 was initially at a magnetic state represented by point 26 on hysteresis loop 20 of FIG. 2.

The magnetomotive force of $N_2 i_2$ in core 12 is also coupled to control winding 32. However, with diode 36 and Zener diode 38 conducting, the induced signal in control winding 32 is coupled to capacitor 40 which substantially absorbs the induced signal. Thus, with switch 10 closed, i.e., with diode 36 and Zener diode 38 conducting, the flux change in core 12 due to the coupling of the strobe pulse thereto is substantially absorbed by capacitor 40 rather than reflected into output winding 17 and, accordingly, utilization device 16.

In order to facilitate an understanding of the operation of this invention, the following group of actual values for the components of the illustrated embodiment are presented. It should be understood that the principles of operation of this circuit may be present in circuits having a wide range of individual specifications, so that the list of values here presented should not be construed as a limitation thereto.

Core 12 Supermalloy Tape-Wound Bobbin I.D. .095, O.D. .225, Ht. .175

Zener diode 38 IN753A 6.2 volt

Diode 36 IN4086

Capacitor 40 0.01 μ f. 100 v. ceramic

Resistor 34 1/4 watt 1800 ohms

Windings:

32, $N_1=110$ turns #40 enameled, confined to first half of core 12.

42, $N_2=12$ turns #38 enameled, wound on top of N_1 .

44, $N_3=12$ turns #38 enameled, wound on opposite, second, half of core 12.

It is apparent that applicant has disclosed herein an improved means for detecting the status of a remotely located switch.

What I claim is:

1. A circuit for determining the status of a switch, comprising:

a core of low residual magnetism;

first, second and third windings inductively coupled to said core;

a control signal source;

a limiting resistor;

a diode;

a Zener diode;

a switch;

a capacitor;

said control signal source, said limiting resistor, said diode, said first winding, said Zener diode and said switch coupled in series circuit;

said capacitor coupled in parallel circuit with said diode, said first winding and said Zener diode;

a pulse source coupled across said second winding; and a utilization device coupled across said third winding.

2. The circuit of claim 1 wherein with said switch closed, said control signal is coupled to said first winding for establishing the magnetization of said core in a substantially saturated magnetic stable-state along its hysteresis loop.

3. The circuit of claim 2 wherein said pulse source couples a pulse signal to said second winding for causing an insubstantial flux change in said core.

4. The circuit of claim 3 wherein said utilization device detects, through said third winding, said insubstantial flux change in said core as said switch being opened.

5. The circuit of claim 1 wherein with said switch opened, said control signal is not coupled to said first winding for establishing the magnetization of said core in its low residual magnetic stable-state along its hysteresis loop.

6. The circuit of claim 5 wherein said pulse source couples a pulse signal to said second winding for causing a substantial flux change in said core.

7. The circuit of claim 6 wherein said utilization device detects, through said third winding, said substantial flux change in said core as said switch being opened.

8. A circuit for determining the status of a switch, comprising:

a core of low residual magnetism coupled in series circuit:

a control signal source;

a limiting resistor;

a diode;

a first winding inductively coupled to said core;

a Zener diode;

a switch having an opened or a closed status;

a capacitor coupled in parallel circuit with said diode, said first winding and said Zener diode.

9. The circuit of claim 8 including means coupled to said core for determining the magnetic stable-state of said core along its hysteresis loop as a function of the status of said switch.

10. The circuit of claim 9 wherein said diode and said Zener diode are coupled oppositely poled to opposite ends of said first winding.

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