TRANSFLUXOR INTEGRATOR

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This invention relates to integrators in which information may be stored and read out at any time. Electro-mechanical devices have been used for integrating heretofore, but for aircraft applications the electro-mechanical devices are unsatisfactory because they are too heavy and bulky.

One object of this invention is to provide a reliable electric circuit which integrates electric signals and stores the result indefinitely and provides non-destructive readout.

Another object of the invention is to provide an integrating circuit which is compact, light weight, inexpensive to manufacture and has no functionally moving parts.

The invention contemplates an integrating circuit having memory and non-destructive readout comprising a transfluxor initially magnetized to a predetermined level and adapted to be connected to a source of alternating current for energizing the transfluxor and to a low-impedance source of pulsating signal voltage for changing the level of magnetization according to the instantaneous polarity of the signal voltage by an amount corresponding to the amplitude and duration of the signal voltage, the transfluxor providing an output corresponding to the level to which the transfluxor is magnetized, and means connected to the transfluxor for providing an output corresponding to the level of magnetization of the transfluxor from the predetermined level.

The foregoing and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawings wherein one embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawings are for illustration purposes only and are not to be construed as defining the limits of the invention.

In the drawings:
FIGURE 1 is a diagram of a novel integrator constructed according to the invention and shows waveforms of the input signal and integrated output signal; and
FIGURES 2 and 3 show the novel integrator used as a low pass filter and a high pass filter, respectively.

The novel integrator constructed according to the invention and shown in FIGURE 1 comprises a transfluxor 11 having a core 9 with a winding 8 thereon adapted to be connected to a source of direct current 10 for initially magnetizing the core for preconditioning the core by first raising the level of magnetization to completely block the core and then reducing the magnetization to a predetermined level preferably midway between completely blocked and completely unblocked to provide bidirectional operation of the core. For this purpose a pair of simultaneously operated three-position switches 12 are interposed between the winding 8 and source 10. The switches are moved to position 12" to connect winding 8 directly to source 10 to completely block the core of the transfluxor. The switches then are moved to position 12" to reverse the polarity of the source with respect to the winding and insert a resistor 14 in series with winding 8 to provide a current flow through the winding in an opposite direction and of lesser magnitude than heretofore to decrease the magnetization level preferably midway between completely blocked and completely unblocked as described above. Switch 12 is then moved to position 12' to disconnect winding 8 from source 10 and the transfluxor is ready to perform the integration. Resistor 14 determines the level of magnetization of the core and may be adjusted to provide any desired initial level of magnetization of the core.

A phase sensitive demodulator 1 is connected to a source of modulated carrier signals, not shown, and provides a direct current corresponding to the amplitude and phase of the modulated carrier signals. The direct current signal then passes through a diode gate circuit 3 which provides signal pulses with a repetition rate and duration as a function of one or more variable conditions or parameters such as Mach number, altitude, etc., and a voltage drive circuit 5 which provides a low impedance source. Drive circuit 5 is connected to a setting or control winding 7 on core 9 which incrementally increases or decreases the magnetization of the core, depending on the instantaneous polarity of the signal voltage applied to winding 7, by an amount corresponding to the amplitude and duration of each signal pulse applied; and the total increase or decrease in the magnetization of the core depends on the repetition rate of the pulses and the length of time the pulses are applied.

A primary or energizing winding 13 on core 9 is energized by a source of alternating current 15 and induces an output in a secondary winding 17 on core 9 which corresponds to the level of magnetization of core 9. The output from winding 17 is applied through a peak detector circuit 21 to a modulator 19 energized by an alternating current source 29. Peak detector circuit 21 supplies direct current to modulator 19 corresponding to the output of winding 17.

Since the transfluxor core is initially partially magnetized, as described above, to provide bidirectional operation, a voltage bucking circuit 23 at the output of modulator 19 provides an initial zero output. Circuit 23 comprises a source of alternating current voltage 25, 180° out-of-phase with source 20, connected across a primary winding 27 of a transformer 29, having its secondary winding 31 connected to modulator 19 and arranged to oppose the output from the modulator. Source 25 is adjusted to cancel the initial output from modulator 19 to zero the integrator.

Graph b—b' shows the integrated signal waveform corresponding to an input signal a—a' at the input of the circuit. It will be observed that the phase of the carrier in graph b—b' does not reverse until the integral of the signal goes to zero. The phase of the output current defines the sign of the integral and depends entirely on the amplitude of the transfluxor output with respect to the amplitude of source 25.

In FIGURE 2 the integrator circuit of FIGURE 1 is shown in use as a low pass filter. The input signal and filtered output are shown by graphs e and f, respectively.

FIGURE 3 shows the integrator circuit used as a high pass filter and graphs e and f show the input signals and filtered output, respectively.

The novel circuit disclosed provides an integrating device without moving parts capable of infinite memory and non-destructive readout and which is easily manufactured, compact and light weight.

Although but a single embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes may also be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. An integrating circuit having memory and non-destructive readout comprising a transfluxor having a core magnetized to a predetermined level and having a control
winding, a low impedance source of pulsating signal voltage connected to the control winding for changing the level of magnetization of the core according to the instantaneous polarity of the signal voltage and by an amount corresponding to the amplitude and duration of the signal, an energizing winding on the core adapted to be connected to a source of alternating current and an output winding on the core inductively coupled to the energizing winding by an amount corresponding to the level to which the core is magnetized, means connected to the output winding for detecting the peak voltage of the output and providing a sine wave of predetermined frequency modulated by the peak output voltage, and means connected to the last mentioned means for providing an output corresponding to the level of magnetization of the core from the predetermined level.

2. An integrating circuit having memory and non-destructive readout comprising a low impedance source including a gate circuit operated as a function of a variable parameter and adapted to be connected to a source of signal voltage to provide signal pulses with a repetition rate and duration as a function of a variable condition, a transfluxor having a core magnetized to a predetermined level, a control winding on the core connected to the gate circuit for changing the level of magnetization of the core according to the instantaneous polarity of the signal pulses and by an amount corresponding to the amplitude and duration of the signal pulses, an energizing winding on the core adapted to be connected to a source of alternating current, and an output winding on the core inductively coupled to the energizing winding and providing an output corresponding to the level to which the core is magnetized, means connected to the output winding for detecting the peak voltage of the output and providing a sine wave of predetermined frequency modulated by the peak output voltage, and means connected to the last mentioned means for opposing a predetermined portion of the sine wave output.

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