United States Patent

[11] **3,576,975**

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[54] **REVERSIBLE COUNTER WITH READOUT**
2 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **235/92,** 310/49, 318/138
[51] **Int. Cl.** **G06m 3/14**
[50] **Field of Search** ..... 235/92, 9, 1, 66 (B); 340/378, 379, 319; 335/220, 239; 310/49, 168; 318/138

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ABSTRACT: The invention describes apparatus for counting a sequence of events and for displaying the final count of that sequence. A number of magnetic cores are energized and deenergized sequentially to produce a changing magnetic field. Ferromagnetic plates on a rotatable cylinder are arranged such that the changing magnetic field exerts a force on the plates which results in rotation of the cylinder to place any of a series of characters imprinted on the periphery of the cylinder at a viewing panel. The cylinder may be rotated in either direction of changing the order of energization of the cores to correspond to either addition or subtraction.

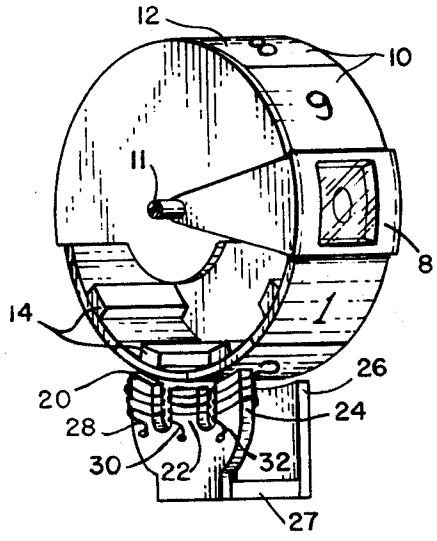


FIG. 1

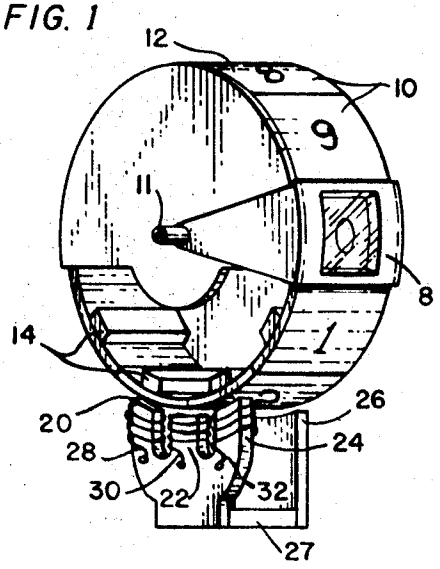


FIG. 2a

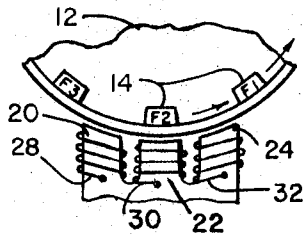


FIG. 2b

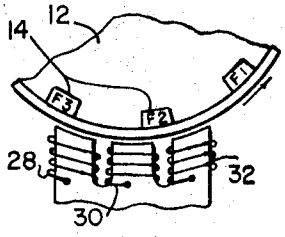


FIG. 2c

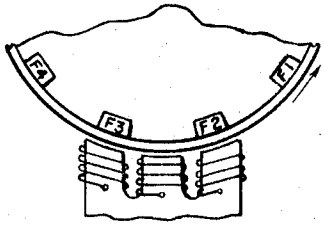


FIG. 2d

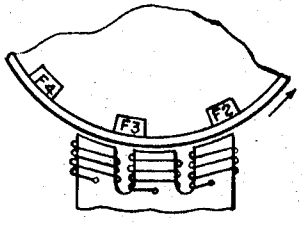


FIG. 2e

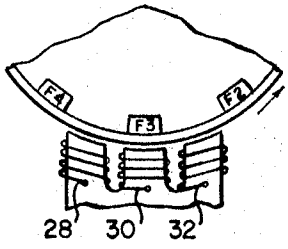
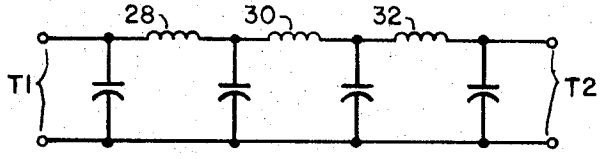


FIG. 3



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REVERSIBLE COUNTER WITH READOUT

The invention described herein may be manufactured, used, and licensed by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to counting devices and more particularly to electromechanical counters having storage and readout facilities.

In the field of information display, it has been the general practice to employ external logic circuitry to accomplish the actual counting operation, with a separate display device for readout. The display devices are usually phosphorescent, luminescent, glow discharge or incandescent lamps having characteristically low visibility under ambient light conditions. A further disadvantage of the present art entails the loss of the stored symbol in the event of a power failure.

The general purpose of this invention is to provide a digital counter mechanism capable of counting a sequence of events, displaying that count and storing the final count indefinitely.

An object of the present invention is to provide means for totaling a sequence of digital data.

Another object is to provide direct readout of the totaled count of the data.

A further object of the invention is the provision of an indefinite storage facility of the totaled count.

Still another object is to allow for reversible operation and, consequently, a combination of subtraction and addition of sequential data.

A still further object of this invention is to provide a system wherein the memory is preserved in the event of a power failure.

Other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the annexed drawings which illustrate a preferred embodiment and wherein:

FIG. 1 shows a perspective view of the mechanical indicator mechanism with a portion broken away to show internal parts of the apparatus.

FIGS. 2*a* to 2*e* show cutaway sections of the device of the FIG. 1.

FIG. 3 depicts a delay network having a ladder structure composed of series inductances and shunt capacitances.

Briefly stated, the apparatus operates in the following manner. Four magnetic pole pieces are arranged in conjunction with a source of magnetic flux such that three distinct fields are formed among them. A first pole piece of one polarity is positioned to form a field with each of the three remaining pole pieces having a polarity opposite to that of the first. A cylinder centered about an axle is placed such that ferromagnetic plates on the periphery thereof may be moved in and out of the fields formed by said magnetic pole pieces. Current-carrying coils wound on the three pole pieces of like polarity are utilized to inhibit the flux between any one of the three like polarity pole pieces and the opposite pole piece.

Referring to FIG. 1 there is shown the cylinder **12** centered about the axle support **11**, numbered windows **10** displaced on the outer periphery of cylinder **12**, the viewing panel **8** framing the numbered window on display, the ferromagnetic plates **14**, displaced on the inner periphery of cylinder **12**, the permanent magnet **27** having three magnetic pole pieces of a first polarity on one end thereof, the magnetic pole piece **20**, the magnetic pole piece **22** and the magnetic pole piece **24** and one pole piece of a second polarity on the other end thereof, magnetic pole piece **26**, slightly displaced form and disposed parallel to the curvature of the cylinder **12**, the coil **28** wound about magnetic pole piece **20**, the coil **30** wound around magnetic pole piece **22** and the coil **32** wound around magnetic pole piece **24**.

With reference to FIG. **1**, the apparatus is shown in the position wherein the numeral "zero" is displayed at viewing panel **8**. For purposes of illustration, the means for positioning the numeral **1** at viewing panel **8** will be explained with the understanding that the same means are used to position all other characters on cylinder **12** at viewing panel **8**.

FIG. **2** illustrates five sequential steps in repositioning cylinder **12** such that one character is completely replaced by another. Only four of the ferromagnetic plates **14** are shown in FIG. **2** and are labeled F1, F2, F3 and F4 for purposes of illustration. The repositioning is accomplished as a first, ferromagnetic plate F3, completely replaced a second ferromagnetic plate F2 in the position between magnetic pole piece **22** and magnetic pole piece **26**. With no current applied to the coils, there are three distinct paths of flux, one between each of the pole pieces of a first polarity and the fourth pole piece of a second polarity. In the initial position, with ferromagnetic plate F2 centered between magnetic pole piece **22** and magnetic pole piece **26**, none of the coils, coil **28**, coil **30** or coil **32**, are energized, the fields being balanced, ferromagnetic plate F2 remains stationary. In order to move cylinder **12** in a counterclockwise direction, current is applied to coil **28** in such a direction as to inhibit the magnetic flux between magnetic pole piece **20** and magnetic pole piece **26**. The fields are unbalanced with respect to the position of F2, and, as a consequence, ferromagnetic plate F2 is drawn to a position between magnetic pole piece **22** and magnetic pole piece **24**, resulting in the situation illustrated in FIG. 2(*b*). Current-carrying coil, coil **30** then is energized while coil **28** is simultaneously deenergized. The result of this is an inhibition of the magnetic flux between magnetic pole piece **22** and magnetic pole piece **26**. Ferromagnetic plates F2 and F3 are thus drawn to positions directly within the fields formed by magnetic pole pieces **20** and **24** and magnetic pole piece **26**, as indicated in FIG. 2(*c*). Similarly, application of current to coil **32** and removal of current from coil **30** inhibits the flux between magnetic pole piece **24** and magnetic pole piece **26** resulting in F3's being attracted to the center of the field formed by magnetic pole piece **20** and magnetic pole piece **26**, and magnetic pole piece **22** and magnetic pole piece **26**. (See FIG. 2(*d*). Finally, removal of current from coil **32** reestablishes the initial state wherein all three flux fields exist among the four magnetic pole pieces. FIG. **3** is then attracted to the center of the fields and a full replacement of one ferromagnetic plate for another has taken place. (See FIG. 2(*e*).

The method employed in the preferred embodiment entails the connection of the three current-carrying coils into a delay line having a series arrangement of the three coils and shunt capacitors. A pulse generator may be connected to either end of the delay line to apply current to the coils in forward or reverse consecutive order depending on which terminals are excited. FIG. **3** illustrates such an arrangement. Thus, the current-carrying coils, coil **28**, coil **30** and coil **32** may be connected in series from left to right between terminals T1 and terminals T2. A pulse from terminals T1 travels along the transmission line and energizes first coil **28** then coil **30** and finally coil **32** causing rotation of cylinder **12** in the counterclockwise direction by one character. A pulse from terminals T2 energizes first coil **32**, coil **30** and coil **28** in that order causing a clockwise rotation of cylinder **12** by an amount sufficient to replace one character with another in viewing panel **8**. Thus, a signal from one or the other pair of terminals results in an addition or subtraction depending on which pair of terminals was excited. Consecutive pulses from first one and then another results in a combined operation of addition and subtraction.

Methods other than the transmission line shown in FIG. **3** can be used to provide sequential energization of the current-carrying coils. Any delay circuitry known to the art, for example, can be used to sequentially feed pulses from the energized terminals to the windings in sequence.

It should be understood that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

I claim:

1. Apparatus comprising a two-pole permanent magnet, having first and second projecting members of magnetic

material, said first projecting member being trident-shaped and being fixed to the first pole of said two-pole permanent magnet, said second projecting member being fixed to the second pole of said permanent magnet and spatially displaced from said first projecting member, so that a magnetic field is established in the space intermediate said projecting members, three current-carrying coils wound on the prongs of said trident-shaped member, one of said coils wound on each of said prongs, a supporting axle, a hollow circular cylinder having characters on the perimeter thereof rotatably attached to said supporting axle, said cylinder having ferromagnetic plaques spatially disposed on the inner periphery of said cylinder, said cylinder being positioned adjacent said space intermediate said first and second projecting members such that said plaques will be rotated through said magnetic field, a series inductance-shunt capacitance transmission line having three inductance elements and three capacitance elements, said current-carrying coils forming the inductance elements thereof, said transmission line being responsive to an energizing signal originating from either end thereof.

2. Apparatus for counting electrical signals comprising a plurality of magnetic pole pieces, said pole pieces forming a magnetic field, said one of said pole pieces having a magnetic polarity opposite to the polarity of said pole pieces having said current-carrying coils wound thereon indicia-bearing rotatable means having a plurality of magnets mounted thereon, means for disposing said rotatable means in said magnetic field, delay means including a series inductance-shunt capacitance transmission line, each said current-carrying coil connected in series and forming the series inductance elements of said transmission line, and means for applying input pulses to either end of said transmission line, whereby said coils are energized and deenergized sequentially by said pulses to produce a changing magnetic field which exerts a force on at least one of said magnets mounted on said rotatable means which in turn is rotated through a predetermined angle.