

[54] **FLUID DISPENSING APPARATUS
COMPUTING AND/OR PRESELECTING
SYSTEM**

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[22] Filed: **Jan. 20, 1972**

[21] Appl. No.: **219,340**

[52] U.S. Cl. **235/151.34**, 222/25, 235/92 DM,
235/92 FL, 235/160, 307/88 MP

[51] Int. Cl. **G06f 15/56**, G06f 7/39

[58] Field of Search 235/150.3, 151.34,
235/160, 92 FL, 92 DM, 61 M, 92 MC;
307/255-226, 88 MP; 328/38, 48, 65; 222/25,
28; 340/174 VB, 174 MC, 174 SP, 359

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Primary Examiner—Eugene G. Botz
Assistant Examiner—Jerry Smith
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[57] **ABSTRACT**

A multiple product gasoline dispensing system having a cost counter for accumulating the cost of gasoline dispensed; a bank of three magnetic domain wire pulse multiplier switches for each product angularly settable for generating from 0 to 9 output pulses for each input pulse for establishing the amounts of the three places respectively of a three-plate unit volume price; a pulse generator for generating three pulse trains for operating the three multiplier switches of a selected switch bank having members of pulses in accordance with a geometric progression having a common ratio of 10; and a product selector at a fuel dispensing nozzle comprising a valve for establishing the product and a magnetic domain wire pulse multiplier switch for generating a pulse train having a number of pulses in accordance with the selected product for selectively activating the multiplier switch banks. Each pulse multiplier switch comprises a generally circular magnetic domain wire with a nucleation coil at one end, a pickup coil with separate angularly spaced coils and a settable rotor with a permanent magnet establishing the number of pulses generated by the pickup coil upon each operation of the nucleation coil.

3 Claims, 3 Drawing Figures

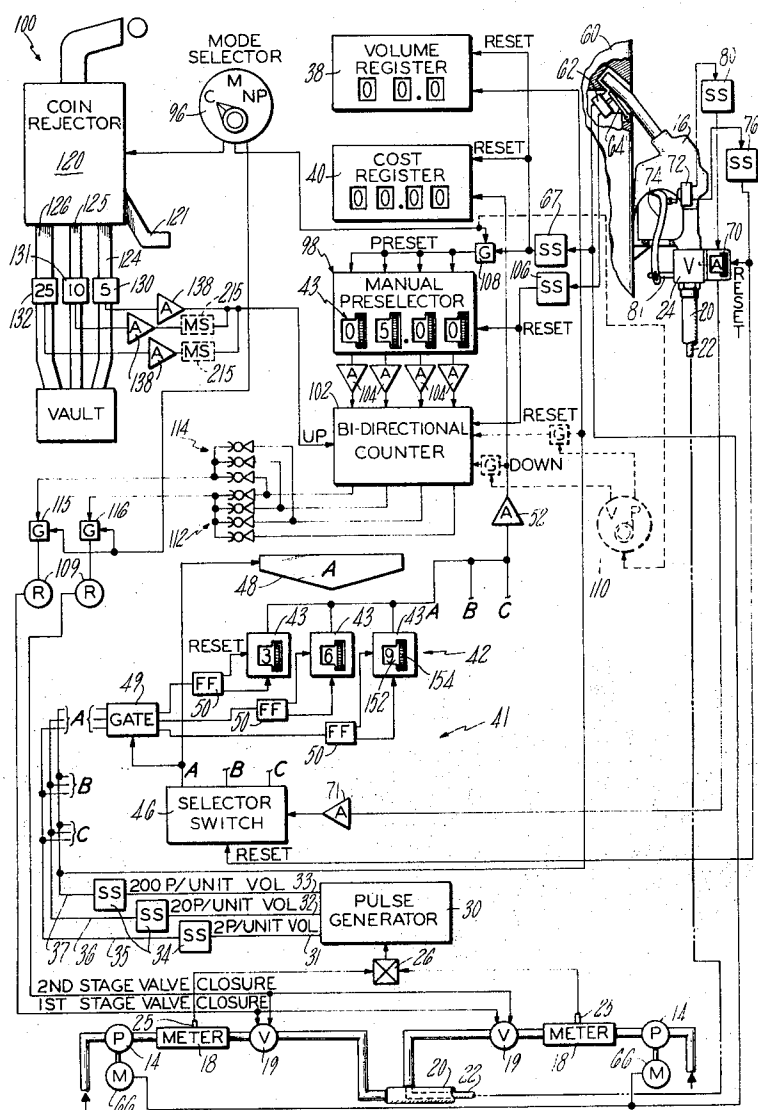


FIG. 1

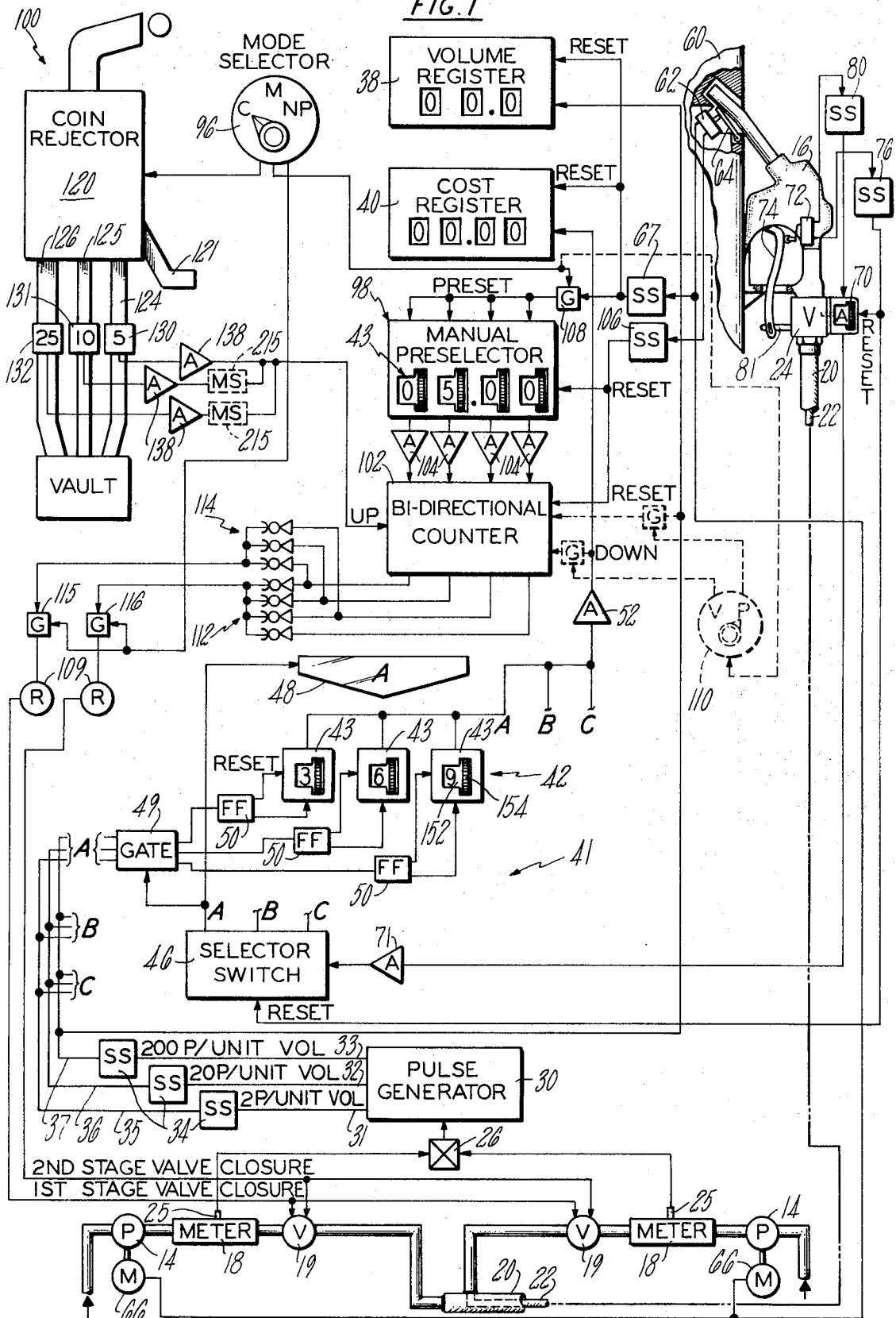
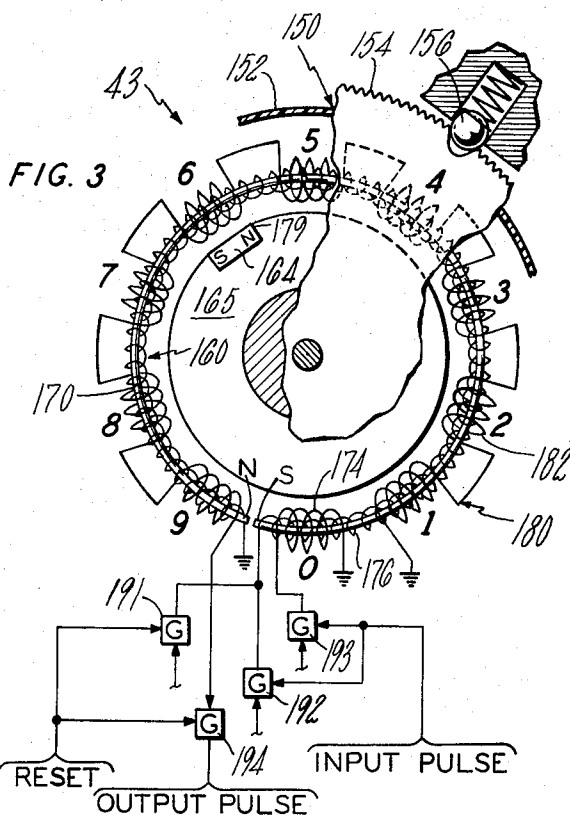
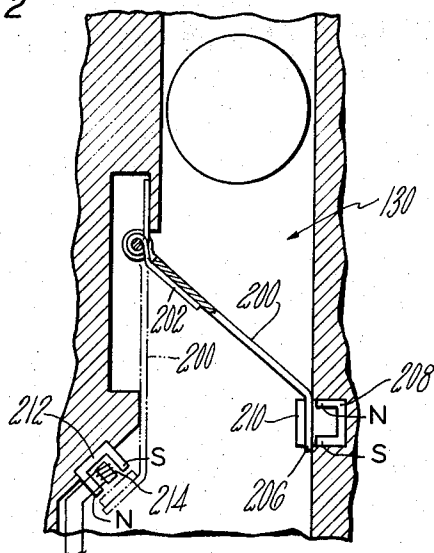


FIG. 2



FLUID DISPENSING APPARATUS COMPUTING AND/OR PRESELECTING SYSTEM

BRIEF SUMMARY OF THE INVENTION

The present invention relates generally to fluid dispensing apparatus and more particularly to a new and improved system for computing the cost of fluid delivered and/or for preselecting the amount of fluid to be delivered and automatically terminating the delivery after the preselected amount is dispensed.

It is a primary aim of the present invention to provide a new and improved computing system for a multiple product fluid dispensing apparatus for presetting the unit volume price of each of the available fluid products and for computing the cost of the fluid dispensed in accordance with the selected product and the corresponding unit volume price.

It is another aim of the present invention to provide a new and improved preset system for fluid dispensing apparatus for presetting the amount of fluid to be delivered.

It is another aim of the present invention to provide a new and improved control system for multiple product fluid dispensing apparatus for selecting the fluid product at the fluid dispensing nozzle.

It is a further aim of the present invention to provide a new and improved control system for multiple product fluid dispensing apparatus for automatically activating the apparatus for delivering fluid upon the removal of the fluid dispensing nozzle from its storage receptacle and for deactivating the apparatus upon returning the nozzle to its storage receptacle.

It is a still further aim of the present invention to provide a new and improved electronic computing device for computing the product of a pre-established multiple place multiplier and a second amount proportional to the rotation of a rotary input.

It is another aim of the present invention to provide a new and improved pulse multiplier switch operable by an input pulse for generating a train of output pulses having a settable number of pulses.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

A better understanding of the invention will be obtained from the following detailed description and the accompanying drawings of illustrative applications of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a diagrammatic representation of a fuel dispensing system incorporating an embodiment of the present invention.

FIG. 2 is a diagrammatic representation of a coin chute and coin operated switch employed in the fuel dispensing system; and

FIG. 3 is a diagrammatic representation of a pulse multiplier switch employed in the fuel dispensing system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to the drawings, a multiple product gasoline dispensing system incorporating an embodiment of the present invention is shown comprising a pair of motor driven pumps 14 for delivering two separate grades of gasoline to a dispensing nozzle 16 via a pair of fuel meters 18, two-stage shut-off valves

19, a pair of coaxial conduits 20, 22 and a product control valve 24 mounted at the input end of the nozzle 16. The output shafts 25 of the meters 18 are connected to a summation differential 26 for driving a pulse generator 30. The pulse generator has three separate output leads 31-33 connected to suitable single shot multi-vibrators 34. The pulse generator is operable so that three separate pulse trains of non-coincident pulses are generated in the single shot multi-vibrator output leads 35-37 and having different numbers of pulses for each pre-established unit volume of gasoline delivered in accordance with a geometric progression having a common ratio of 10. For example, the pulse generator 30 provides for generating (a) two approximately equally spaced pulses in the "units" lead 35 for each such pre-established unit volume of gasoline delivered, (b) 20 substantially equally spaced pulses in the "tens" lead 36 for each such unit volume of gasoline delivered and (c) 200 substantially equally spaced pulses in the "hundreds" lead 37 for each such unit volume of gasoline delivered—a total of 222 pulses for each such unit volume of gasoline delivered.

A suitable resettable electronic volume register 38 is provided for accumulating and registering the volume of gasoline dispensed, and the "hundreds" output lead 37 is connected for indexing the volume register 38. A suitable resettable electronic cost register 40 is operated by a computing device 41 for accumulating and registering the cost of gasoline dispensed in accordance with the total volume dispensed and a multiple place unit volume price (within a three-place price range in the shown embodiment). The computing device 41 is operated by the pulse trains in the output leads 35-37 and is presettable for establishing each place of the unit volume price of each of the available fuel products.

More particularly, the computing device 41 comprises a bank 42 of three settable pulse multiplier switches 43 (i.e. units, tens and hundreds multiplier switches 43) for each of the available fuel products and the switch banks 42 (of which there is only one shown in FIG. 1) are individually activated in accordance with the selected fuel product by a selector switch 46. The selector switch 46 is also connected to operate a corresponding product indicator 48. For example, when product "A" is selected a corresponding price gate 49 is operated by the selector switch 46 to connect the leads 35-37 to the corresponding price multiplier switches 43 via flip-flop circuits 50. Each multiplier switch is operated by every second pulse in the pulse train to the respective flip-flop circuit 50 to generate a pulse train of zero to nine pulses in accordance with the setting of the multiplier switch. The alternate pulses in the respective pulse train operate the flip-flop circuit 50 to reset the multiplier switch 43 for conditioning the multiplier switch for being operated by the succeeding pulse.

The pulse trains of non-coincident pulses from the multiplier switches are connected via a suitable amplifier 52 for indexing the cost register 40. Thus, for example, if the price for product "A" is 36.9 cents per gallon as shown in FIG. 1 and the pulse generator 30 is operable for generating the pulse trains in accordance with a unit volume of one hundredth of a gallon; (a) the units multiplier switch 43 would be pulsed 100 times to generate 900 pulses for each gallon of fuel delivered; (b) the tens multiplier switch 43 would be pulsed 1,000 times to generate 6,000 pulses for each

gallon of fuel delivered; and (c) the hundred's multiplier switch 43 would be pulsed 10,000 times to generate 30,000 pulses for each gallon of fuel delivered—a total of 36,900 pulses. The cost register 40 would be suitably designed to be operated by the pulses generated by the multiplier switches 43 to properly and continuously register the cost of fuel delivered, for example, to the nearest 1 cent.

Each bank 42 of pulse multiplier switches 43 provides for displaying the pre-established price of the corresponding fuel product, and the corresponding indicator 48 is energized by the selector switch 46 to indicate the product selected and the product price upon which the cost computation is based.

The fuel nozzle 16 is shown provided in a conventional manner with a storage receptacle 60 for storing the nozzle 16 between fuel deliveries. A control switch 62 operated by the nozzle 16 via a switch operating lever 64 is actuated at the beginning of fuel delivery upon the removal of the nozzle 16 from its storage receptacle 60 and is actuated again at the completion of a fuel delivery upon replacing the dispensing nozzle 16 in its storage receptacle. The switch 62 is suitably connected to the pump motors 66 for maintaining the pump motors energized while the nozzle is removed from its storage receptacle and for deenergizing the pump motors when the nozzle is replaced in its storage receptacle. Also, the switch 62 is connected via a suitable single shot multi-vibrator 67 for resetting the volume register 38 and cost register 40 to zero when the nozzle is removed from its storage receptacle.

The product selector valve 24 comprises a suitable rotary valve which is angularly settable for selecting the fuel product to be delivered. For example, the rotary valve may have three angular settings for establishing three different fuel products consisting of each of the two available fuel grades and a pre-established blend (e.g. 50% of each grade) of the two fuel grades. A rotary product switch 70 (which functions like the rotary multiplier switches 43 as hereinafter explained) is connected to the valve 24 to be manually set with the valve 24 and the product switch 70 provides for operating the selector switch 46 via a suitable amplifier 71 in accordance with the product established by the manual setting of the product control valve 24.

A switch 72 is connected to be operated by the usual nozzle operating lever 74. The switch 72 is connected via a suitable single shot multi-vibrator 76 for resetting the selector switch 46 and the product switch 70 (as hereinafter explained) when the nozzle lever 74 is released. Also, when the nozzle lever 74 is depressed to dispense fuel, the switch 72 is actuated to operate another suitable single shot multi-vibrator 80 to operate the product switch 70 for generating one or more pulses (depending on the position of the product switch 70 and product control valve 24) for indexing and thereby setting the selector switch 46 in accordance with the setting of the product control valve 24. The selector switch 46 will thereupon activate the corresponding bank 42 of price multiplier switches 43 to compute the cost of the fuel delivered in accordance with the selected product. (The nozzle operating lever 74 is suitably interlocked with the product control valve 24 as by the linkage 81 to prevent resetting the valve 24 when the nozzle operating lever 74 is depressed.) Thus, the fuel product can be selected (and reselected at any time the nozzle lever 74 is released)

and the computing device 41 provides for computing the cost in accordance with the selected product and the pre-established price of the selected product.

The dispensing system includes a preset system comprising a mode selector 96 having coin preset ("C"), manual preset ("M") and non-preset ("NP") positions; a manual preselector 98, a coin operated preselector 100, and a suitable bi-directional decade counter 102 selectively operable by the manual preselector 98 or coin preselector 100 depending upon the position of the mode selector 96. The manual preselector 98 comprises four pulse multiplier switches 43 which are individually connected via suitable amplifiers 104 to respective decades (not shown) of the bi-directional counter 102 for presetting the counter at a count according to the setting of the preselector multiplier switches 43.

The nozzle operated switch 62 is connected via a suitable single shot multi-vibrator 106 for resetting the manual preselector multiplier switches 43 and the bi-directional counter when the nozzle 16 is replaced in its storage receptacle. With the mode selector in its manual preset or "M" position, a gate 108 is operated so that the nozzle operated switch 62 is operable via the single shot multi-vibrator 67 to pulse the manual preselector multiplier switches 43 and thereby load the bi-directional counter 102 with the amount manually preset in the manual preselector 98 when the nozzle is removed from its storage receptacle. During the subsequent delivery, the bi-directional counter 102 is stepped in the subtracting direction from its preset or loaded count to zero whereupon the delivery of fuel is automatically terminated with the two-stage valves 19 (as hereinafter explained). The counter 102 is shown in bold lines connected to be indexed by the output pulse train from the selected price switch bank 42 and therefore in accordance with the cost amount of fuel delivered (in which event the manual preselector 98 would be adapted to preset the cost amount of fuel to be delivered). If desired, as shown in broken lines, a volume/price manual selector 110 could be connected for connecting the counter 102 to be indexed along with the volume register 38 (when the selector 110 is in the volume ("V") position and the mode selector 96 is in the manual ("M") position) in which event the manual preselector 98 would be adapted to preset the volumetric amount of fuel to be delivered.

The counter 102 is connected for operating the two-stage shutoff valves 19 for (a) closing the first valve stage for reducing the fuel flow rate shortly before the end of the preset delivery and (b) closing the second valve stage to terminate the delivery when the counter 102 reaches zero. Suitable relays 109 are operated by the counter 102 via suitable collector OR'ing circuits 112, 114 respectively for closing the first valve stage when the counter 102 reaches a pre-determined count of, for example, 9 and for closing the second valve stage for terminating the fuel delivery when the counter reaches zero. Suitable gates 115, 116 operated by the mode selector 96 when the mode selector 96 is in its non-preset ("NP") position are provided for maintaining the valves 19 open during a non-preset delivery.

With the mode selector 96 in its coin preset ("C") position, the coin preselector 100 is operable to index the bi-directional counter 102 to load the counter in accordance with the total value of coins deposited in a coin rejector 120. In a conventional manner, the coin

rejector 120 provides for returning unacceptable coins via a return chute 121 and for separating the accepted coins into corresponding coin chutes 124—126 (indicated for 5, 10 and 25 cent pieces). The coin rejector is preferably connected to the mode selector 96 such that all deposited coins are returned via the coin return chute 121 when the mode selector is not in its "C" position. Each accepted coin is adapted to operate a respective switch 130—132 in the corresponding coin chute 124—126 respectively. The 5 switch 130 is connected via an amplifier 138 to index the counter 102 five counts in the additive direction, and the 10 and 25 switches 131, 132 are connected via amplifiers 138 to index the counter 102 10 counts and 25 counts respectively.

Referring to FIG. 3, a ten position pulse multiplier switch 43 is shown comprising a ten position rotor 150 having an outer rim or shell 152, a knob 154 for manually setting the rotor 150, a suitable detent 156 for accurately locating the rotor in its set position, and a circular magnetic domain wire assembly 160 coaxial with the rotor 150 and encircling a contiguous generally circumferentially extending permanent magnet 164 mounted on a hub 165 of the rotor.

The magnetic domain wire assembly 160 comprises an inner circular magnetic domain wire 170 extending substantially 360° around the hub 165 and having a slight air gap between its ends. The magnetic domain wire 170 is pre-magnetized in one axial direction, for example with a South magnetic pole at its clockwise end and a North magnetic pole at its counterclockwise end and such that the pre-established magnetic field of the magnetic domain wire 170 is compatible with the magnetic field of the rotor permanent magnet 164 (whereby the domain wire 170 and permanent magnet 164 are magnetically attracted to each other).

A suitable nucleation coil 174 is mounted on one end of the magnetic domain wire 170, and a suitable propagation coil 176 is mounted to extend substantially the full length of the magnetic domain wire. The nucleation coil is operated with sufficient power to generate a magnetic field of sufficient intensity to nucleate a reverse magnetic domain at the end of the wire, and the propagation coil is operated with sufficient power to generate a magnetic field of sufficient intensity (which is substantially less than the required field intensity of the nucleation coil) to propagate the reverse magnetic domain along the wire. The relative strengths of the magnetic fields produced by the permanent magnet 164 and propagation coil 176 are established so that the permanent magnet 164 is effective to block propagation of the reverse magnetic domain at a point approximately opposite the leading edge 179 of the permanent magnet.

A readout coil 180 having nine equiangularly spaced pick-up coils 182 (shown having a 36° coil pitch) is mounted on the magnetic domain wire 170 for generating a pulse as the reverse magnetic domain is propagated along the magnetic domain wire 170 through each pick-up coil 182. Thus, with the rotor 150 positioned as shown in FIG. 3 in its "5" position, a reverse magnetic domain would be propagated up to but not including the "6" position and such that the reverse magnetic domain would be propagated through five of the individual pickup coils 182 to generate five substantially equally spaced electrical pulses. The magnetic domain wire 170 is thereafter magnetically reset

by reversing the magnetic field of the propagating coil to return the magnetic domain wire to its original condition.

The multiplier switch circuit employs suitable gates 191—194 so that (a) the nucleation and propagation coils are adapted to be operated by a suitable input pulse to generate output pulses with the readout coil 180 and (b) the propagation coil is adapted to be operated by a suitable reset pulse to magnetically reset the magnetic domain wire 170. Thus, the pulse multiplier switch 43 would be operable by each input pulse to generate from zero to nine output pulses for indexing the cost register 40 depending on the angular setting of the multiplier switch rotor 150. The rotor shell 152 bears a sequence of equiangularly spaced indicia of 0 to 9 which are properly located to indicate the pulse multiplier effect produced by the switch 43.

The magnetic domain wire 170 may be advantageously formed to provide separate portions of relatively high and low coercivity respectively and relatively high and low retentivity respectively and with both portions having generally axial magnetic anisotropy, and such that (a) the magnetism of that portion having the relatively high coercivity and high retentivity is not reversed by the nucleation and propagation coils and (b) the nucleation and propagation coils provide for generating and propagating a reverse magnetic domain only in that portion having the relatively low coercivity and low retentivity. For example, the magnetic domain wire 170 might consist of a composite of two wires having the desired relative magnetic characteristics, for example like the composite structure described in U. S. Pat. No. 3,067,408 of William A. Barrett, Jr., entitled Magnetic Memory Circuits and dated Dec. 4, 1962, and wherein both wires of the composite structure exhibit generally axial magnetic anisotropy. Alternatively, the magnetic domain wire 170 might comprise a composite structure having a core portion of relatively low magnetic retentivity and coercivity and a shell portion of relatively high magnetic retentivity and coercivity, for example like the composite structure described in U. S. Pat. No. 3,134,096 of Edward A. Bartkus, et al. entitled Magnetic Memory and dated May 19, 1964, and wherein both portions of the composite structure exhibit generally axial magnetic anisotropy. Where the magnetic domain wire 170 is so formed with separate portions of the desired relative magnetic characteristics, the portion with the relatively high retentivity and coercivity would be effective to reset the other portion when the nucleation and propagation coils are deenergized, in which event the multiplier switch 43 would be self-resetting and a separate reset pulse would be unnecessary. However, it may still be preferable to "reset" the multiplier switch even when the magnetic domain wire 170 is self-resetting to provide for ensuring complete restoration of the magnetic domain wire 170 to its original magnetic condition with the wire portion of relatively high coercivity and retentivity fully magnetized.

The product switch 70 operates like the pulse multiplier switch 43 and could be identical to the pulse multiplier switch 43 excepting that the product switch 70 would have a number of positions corresponding to the number of available products (i.e., three in the described embodiment) and such that for example the product switch 70 would generate one output pulse for product A, two output pulses for product B and three

output pulses for product C, for appropriately indexing the selector switch 46.

Referring to FIG. 2, the 5 switch 130 is shown comprising a pivotal lever 200 normally held in an upper extended position shown in full lines in FIG. 2 by a torsion spring 202 and adapted to be pivoted, in the clockwise direction as shown in FIG. 2, to a withdrawn position shown in broken lines in FIG. 2, by a 5 coin as it passes through the coin chute 124. The lever 200 is shown with a depending end portion 206 lying adjacent a U-shaped permanent magnet 208, and a straight magnetic domain wire segment 210 is mounted on the depending portion 206 to be pre-magnetized in one axial direction by the permanent magnet 208. When the lever 200 is actuated to its withdrawn position by a coin the magnetic domain wire segment 210 is moved to a readout position where its magnetism is reversed by a second permanent magnet 212. A suitable pick-up coil 214 is mounted adjacent the permanent magnet 212 so as to sense the magnetic field change accompanying the magnetic reversal in the magnetic domain wire segment 210 and produce a corresponding output pulse for indexing the bi-directional counter 102. The 5 cent switch 130 may as shown have only one magnetic domain wire segment 210 whereas the 10 cent and 25 cent switches 131, 132 would have two and five magnetic domain wire segments 210 respectively. Alternatively, all three coin operated switches 130-132 could employ only one magnetic domain wire segment 210, in which event suitable multiple shot multi-vibrators 215 (shown in broken lines in FIG. 1) would be employed in the 10 cent and 25 cent circuits for generating two and five pulses respectively for each switch generated pulse.

The magnetic domain wire segments 210 are preferably formed with separate portions of relatively high and low coercivity respectively and relatively high and low retentivity respectively and with generally axial magnetic anisotropy as previously described with respect to the magnetic domain wire 170 and such that (a) the permanent magnet 212 would create a reverse magnetic domain only in that portion of the wire segment 210 having the relatively low coercivity and low retentivity and (b) the wire portion having the relatively high coercivity and high retentivity would provide for resetting the magnetic domain wire segment 210 when the coin operated lever 200 returns to its normal position. However, it is still preferable to provide a permanent magnet 208 for fully resetting the magnetic domain wire segment 210 for ensuring generating a sharp output pulse with the pickup 214.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. A computing device for accumulating the product of a first amount proportional to the displacement of a first input and a pre-established multiple place multiplier comprising a plurality of settable magnetic domain wire multiplier switch means for the multiple

places respectively of the multiple place multiplier, each settable magnetic domain wire multiplier switch means having a manually shiftable element manually shiftable to each of ten settings representative of the numerals 0 through 9 respectively for establishing a corresponding amount for the respective place of the multiple place multiplier, and each settable magnetic domain wire multiplier switch means being operable by an electrical input pulse for generating a burst of domain wire output pulses in accordance with the amount established by its manual setting, a first displaceable input, electrical pulse generating means connected to be operated by the first input to generate input pulses for operating the plurality of multiplier switch means in proportion to the displacement of the rotary input, and a product accumulator connected to be operated by the domain wire output pulses for accumulating the product of a first amount proportioned to the displacement of the first input and the multiple place multiplier established by the settings of the plurality of magnetic domain wire multiplier switch means.

2. A computing device according to claim 1 wherein the pulse generating means is operative to generate a plurality of pulse trains of input pulses for operating the plurality of multiplier switch means respectively and having fixed relative numbers of pulses in accordance with a geometric progression having a common ratio of 10.

3. In a fluid dispensing system computing device for a fluid dispensing system having a cost accumulator operable for accumulating the cost of fluid dispensed, pulse generating means for generating pulses in accordance with the volume of fluid dispensed and settable varying means connected for being operated by the generated pulses and for operating the cost accumulator to accumulate a count in accordance with the volume of fluid dispensed and a multiple place unit volume price established by the setting of the varying means, the improvement wherein the settable varying means comprises a plurality of settable magnetic domain wire multiplier switch means for the multiple places respectively of the multiple place unit volume price, each magnetic domain wire multiplier switch means having a manually shiftable element manually shiftable to each of ten settings representative of the numerals 0 through 9 respectively for establishing a corresponding amount for the respective place of the multiple place price, and each magnetic domain wire switch means being operative by the input pulses generated by the pulse generating means for being repetitively pulsed in accordance with the volume of fluid dispensed and for repetitively producing a burst of magnetic domain wire output pulses for operating the cost accumulator, having a number of pulses in accordance with the setting of the switch means, for repetitively adding such amount established by the multiplier switch means to the cost accumulator in accordance with the relative weight of such amount and the volume of fluid dispensed.

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