United States Patent

Johnston

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[54] **DIGITAL MULTIPLIER USEFUL IN MULTIPLE PRODUCT DISPENSING APPARATUS**

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[52] **U.S. Cl.** .....**235/156,** 235/61.6 N, 235/92 DM, 235/61 M, 222/23, 235/160, 235/151.34

[51] **Int. Cl.**.....**G06f 7/56**

[58] **Field of Search** .....235/160, 159, 92 FL, 92 V, 235/92 DM, 156, 151.34, 61.6 N, 61 M; 250/219 DD; 222/23

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[57] **ABSTRACT**

A five product fuel dispensing system having an electronic cost counter, a rotary drum connected to be driven in accordance with the volume of fuel delivered having a plurality of light apertures arranged in a plurality of axially spaced circles and three photoelectric pickups operable by the light apertures for generating three electrical pulse trains for operating the cost counter in accordance with a three place unit volume price. A bank of fifteen coaxial masking rings encircling the drum provide five sets of price wheels for establishing the unit volume prices of the five available products respectively and the five sets of price wheels are adapted to be selectively conditioned by an axially shiftable selector for selecting the established unit volume price in accordance with the fuel product selected. The price wheels also function as price posting wheels for displaying the established unit volume prices of the available fuel products and the axially shiftable selector provides for framing the displayed price of the selected set of price wheels.

28 Claims, 7 Drawing Figures

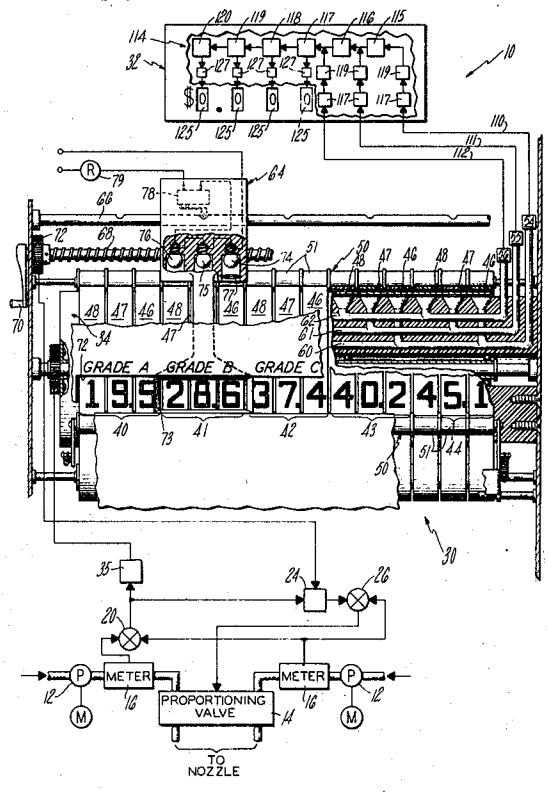
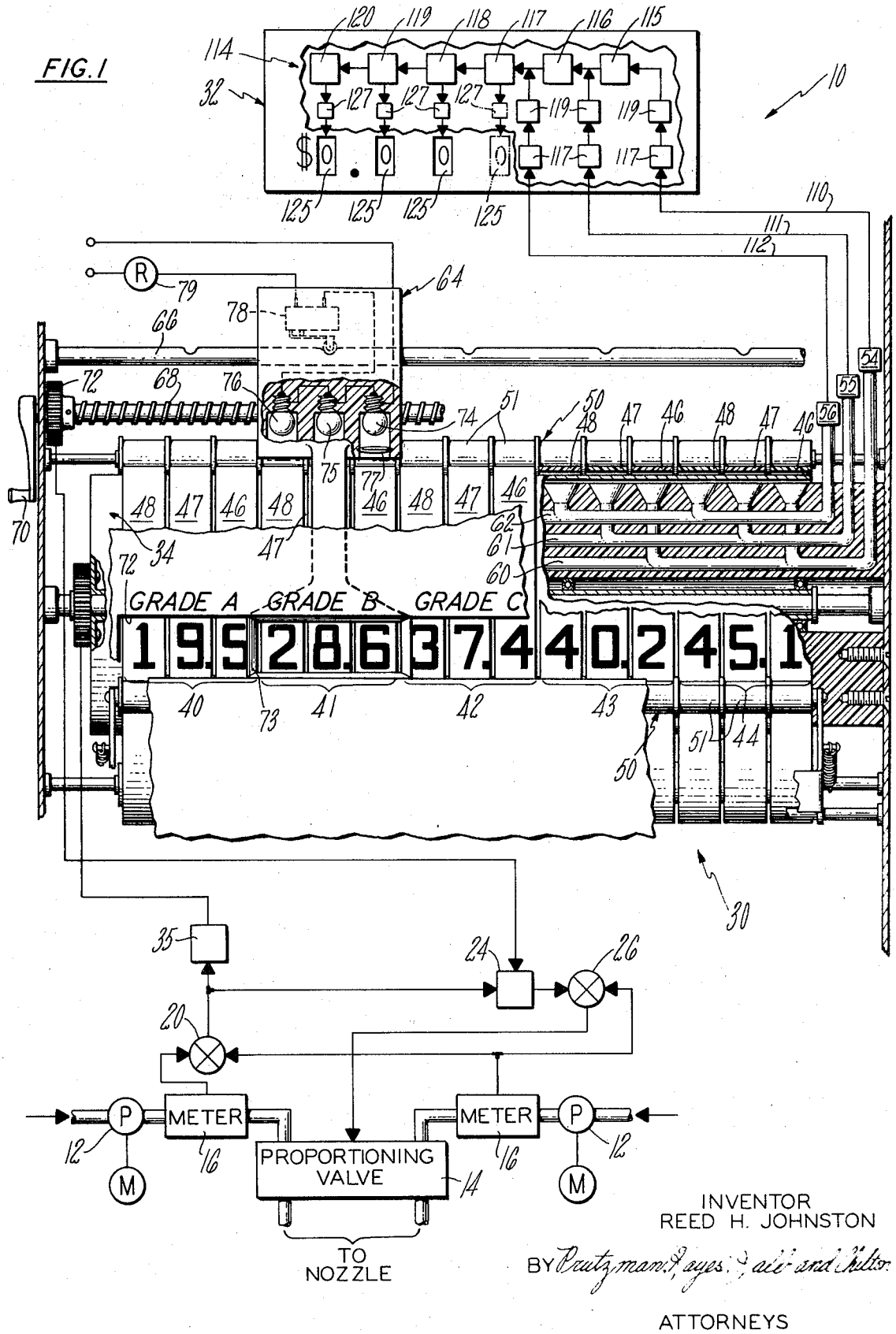


FIG. 1



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FIG. 7

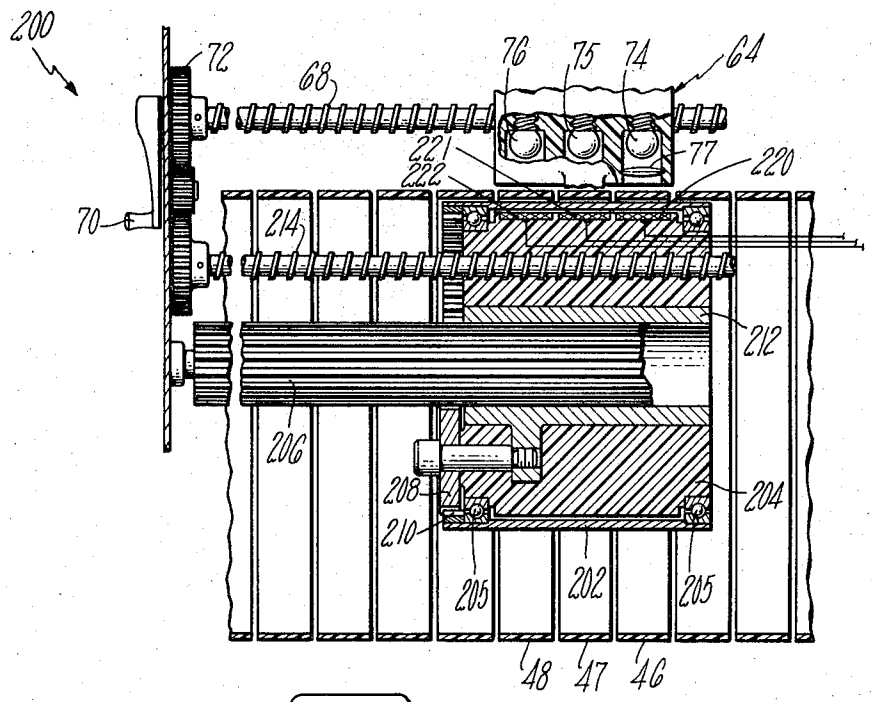

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FIG. 2

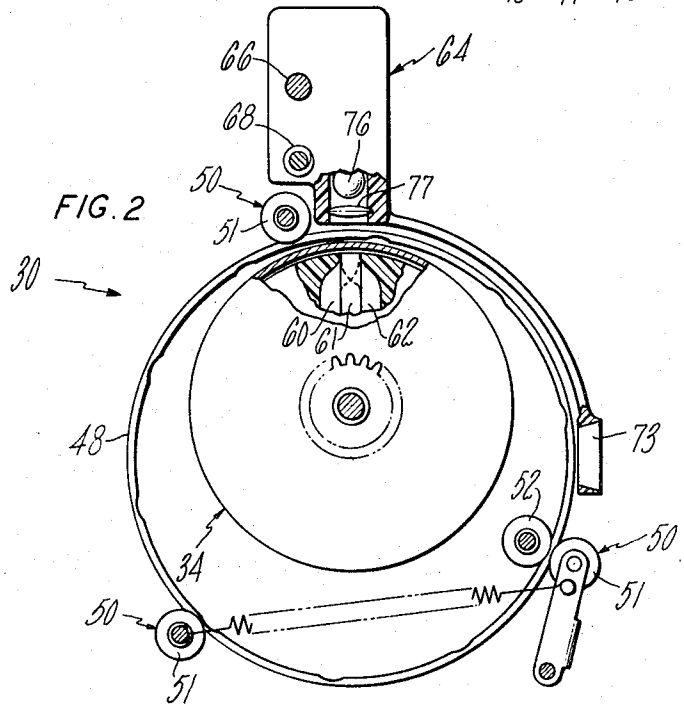

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FIG. 3

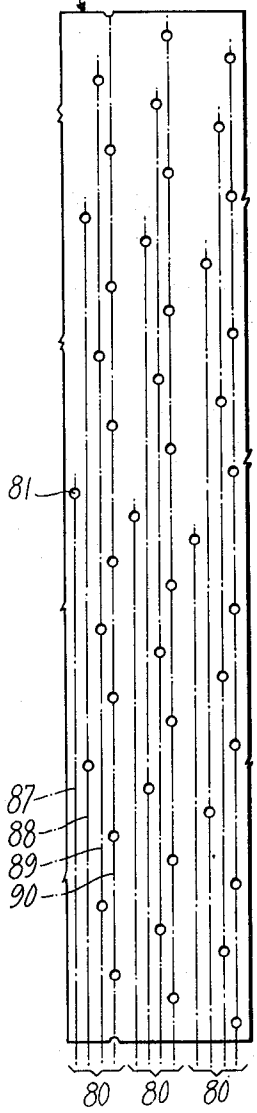


FIG. 5

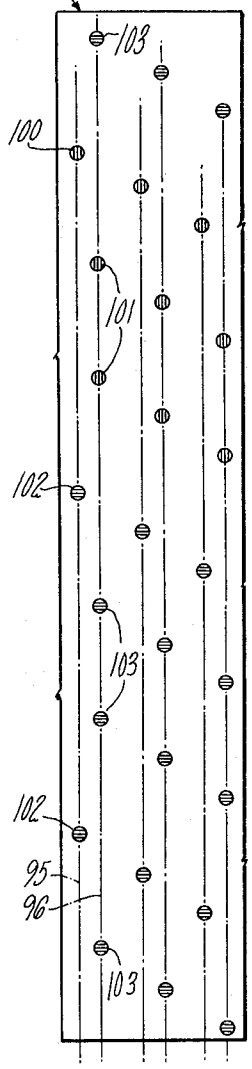
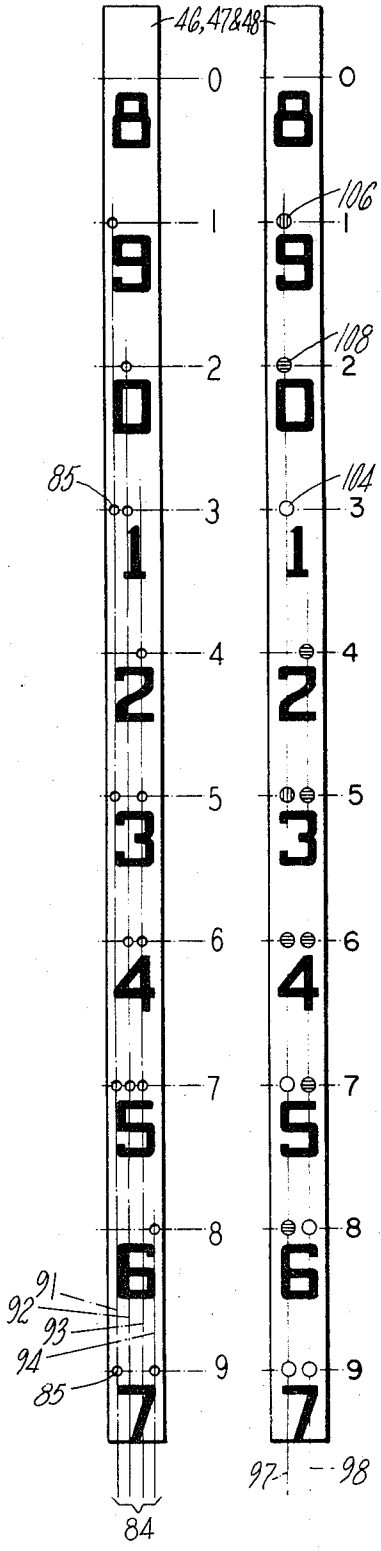


FIG. 4

FIG. 6



DIGITAL MULTIPLIER USEFUL IN MULTIPLE PRODUCT DISPENSING APPARATUS

BRIEF SUMMARY OF THE INVENTION

The present invention relates to computing devices having notable utility in multiple product fuel dispensing apparatus for computing the cost of each selected fuel product dispensed in accordance with the volumetric amount dispensed and the pre-established unit volume price of the selected fuel product.

It is a principal aim of the present invention to provide a cost computing device for fluid dispensing apparatus having a new and improved rotary pulse generator adapted to be driven in accordance with the volumetric amount of fluid dispensed and settable to establish the number of pulses generated for each unit volume of fluid dispensed for establishing the unit volume price of the fluid.

It is another aim of the present invention to provide a new and improved rotary pulse generator which is settable for generating a desired number of pulses for each predetermined rotation of the pulse generator.

It is a further aim of the present invention to provide a new and improved cost computing device for multiple product fluid dispensing apparatus which may be preset to establish the unit volume price of each of the available fluid products.

It is a further aim of the present invention to provide a new and improved computing device for multiple product fluid dispensing apparatus which provides a display of the established unit volume prices of the available products.

It is a still further aim of the present invention to provide a new and improved computing device providing reliable operation and having a compact and economical construction.

Other aims 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 generally schematic view, partly broken away and partly in section, of a multiple product fuel dispensing system employing an embodiment of a computing device in accordance with the present invention;

FIG. **2** is a transverse section view, partly broken away and partly in section, of a pulse drum and price wheel assembly of the computing device of FIG. **1**;

FIGS. **3** and **5** are developments, partly broken away, showing different embodiments of the pulse drum of the computing device of FIG. **1**;

FIGS. **4** and **6** are developments showing different embodiments of the price wheels of the computing device of FIG. **1**; and

FIG. **7** is a longitudinal section view, partly broken away and partly in section, of a rotary drum and price wheel assembly of another embodiment of a computing device in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings in detail wherein like numerals represent like parts, and referring in particular to FIGS. **1** and **2**, a multiple product fuel dispensing system incorporating an embodiment **10** of a computing device of the present invention is shown comprising a pair of motor driven pumps **12** for delivering two separate fuel grades or components to a dispensing nozzle (not shown) via a proportioning valve **14** and a pair of meters **16** adapted for metering the individual fuel grades. The meter outputs are combined by a summation differential **20** to drive settable blend gearing **24** in accordance with the total amount of fuel dispensed. The output of the blend gearing **24** and the output of one of the meters **16** are compared by a subtraction differential **26** to control the proportioning valve **14** and thereby establish the proportion of each fuel grade in accordance with the setting of the blend gearing **24**. The blend gearing **24** is for example selectively settable for establishing each of five different gear ratios and for thereby selectively establishing each of five different fuel products or blends of the two fuel components.

The computing device **10** comprises a variator **30** and a cost register **32** operable by the variator to register the cost of the fuel delivered in accordance with the selected unit volume price established by the variator setting—in the shown embodiment, a unit volume price within a three place unit volume price range of from 00.0 cents/gallon to 99.9 cents/gallon. The cost register is preferably resettable and is reset to zero in a suitable manner prior to the commencement of each fuel delivery.

The variator **30** comprises a rotary pulse drum **34** (driven by the meters **16** through the summation differential **20** and suitable gearing **35**) and a bank of coaxial price wheels or masking rings encircling the pulse drum. In the shown embodiment there are fifteen price wheels providing five price wheel sets **40–44** (i.e., one price wheel set for each available fuel product) each comprising three price wheels **46, 47, 48** for the three places respectively of the three place unit volume price range of the variator. The price wheels **46, 47, 48** are coaxially mounted for rotation about an axis parallel to but laterally offset from the axis of rotation of the pulse drum **34** such that the drum is mounted in close association with the price wheels at an axially extending pickup station. The price wheels are mounted on three angularly spaced roll supports **50** and separate rolls **51** are provided for each price wheel so that each wheel may be independently angularly set. Also a detent roll **52** is provided to cooperate with internal wheel recesses for retaining the wheel in its ten equiangularly spaced operative positions.

Three photoelectric pickups **54, 55, 56** are provided for the three places respectively of the three place unit volume price range of the variator and each pickup is adapted to be operated by the pulse drum **34** to generate a number of electrical pulses in accordance with the angular setting of the respective price wheel of the selected set of price wheels. For example, (as shown in FIG. **1**) the variator may be operated to condition the wheel set **41** for establishing the unit volume price, in which case the pickup **54** for the lowest order

place of the three place price range would be operated to generate a train of pulses in accordance with the setting of the price wheel **46** of the wheel set **41**, the pickup **55** would be operated to generate a train of pulses in accordance with the setting of the price wheel **47** of wheel set **41** and the pickup **56** would be operated to generate a train of pulses in accordance with the setting of the price wheel **48** of wheel set **41**.

In the embodiment of FIGS. **1** and **2** the photoelectric pickups **54, 55, 56** are connected via suitable light pipe systems **60, 61, 62** respectively to receive light pulses from each of the corresponding price wheels, and an axially shiftable light head **64** is provided for selectively conditioning each wheel set **40–44** for establishing the unit volume price. Thus, the light pipe to the lowest order pickup **54** is suitably connected to receive light pulses passing through each of the lowest order price wheels **46** and the shiftable light head **64** provides for activating only one of the price wheels **46**, as for example, the price wheel **46** of the wheel set **41** as shown in FIG. **1**. The remaining price wheels **46** remain inactive due to the absence of an activating light source and the number of pulses generated by the pickup **54** will be determined solely by the setting of the active price wheel **46** and the amount of rotation of the pulse drum **34**. The other pickups **55, 56** are similarly connected to the corresponding price wheels by the light pipe systems **61, 62** respectively to generate trains of pulses in accordance with the angular settings of the active price wheels **47, 48** respectively and the amount of rotation of the pulse drum **34**. delivered.

The light head **64** is mounted upon a rod **66** and screw **68** which extend parallel to the axes of the drum **34** and coaxial price wheels. The screw **68** has a suitable threaded engagement with the head **64** and is shown adapted to be manually rotated by an operating handle **70** such that, for example, by rotating the operating handle one complete revolution the light head **64** is shifted to select the adjacent price wheel set **40–44**. The handle **70** is also shown connected via a gear **72** for setting the blend gearing **24** to establish the fuel product to be delivered . Thus, for example, each complete rotation of the handle **70** would provide for setting the blend gearing **24** to establish the next fuel product and for setting the variator to compute the cost of the fuel delivered in accordance with a unit volume price established by the corresponding price wheel set.

The price wheels **46–48** also serve as number wheels for posting the established unit volume prices for the available fuel products, and for this reason the price wheels **46, 47, 48** of each wheel set bear the sequence of indicia 0–9 on the periphery thereof for displaying the three place unit volume price established by their angular setting. Preferably the variator **30** is mounted so that all of the fuel prices may be simultaneously displayed as, for example, through a single elongated window **72** as shown in FIG. **1**. Also, a frame indicator **73** is mounted on the shiftable light head **64** to frame the price numerals of the active price wheel set and thereby indicate both the fuel product being dispensed (which in the shown embodiment is displayed on the pump housing above the price of the corresponding price wheel set) and the unit volume price for the fuel product.

The light head **64** is shown having three series connected lamps **74–76**, one for each of the three active price wheels **46–48**, and a lens **77** for each lamp for establishing parallel light rays. The lamp circuit is also shown incorporating an interlock switch **78** and a suitable interlock relay **79**. The switch **78** is mounted within the light head **64** to cooperate with notches in the support rod **66** to complete the circuit to the lamps **74–76** and relay **79** when the light head **64** is properly positioned for cooperation with one of the price wheel sets **40–44**. The relay **79** is suitably connected for example in the pump motor circuit, to prevent delivery of fuel when the relay is de-energized.

Referring to FIGS. **3** and **4**, in one embodiment of the computing device, the drum **34** has 15 banks **80** of light apertures **81** (i.e., a bank **80** of light apertures **81** for each of the 15 price wheels) and each price wheel has a corresponding bank **84** of light apertures **85**. Each light aperture bank **80** on the drum **34** comprises four axially spaced aperture circles **87–90** with one, two, four, and eight apertures respectively adapted to generate one, two, four and eight light pulses respectively for each revolution of the drum. The light aperture bank **84** on each price wheel comprises four corresponding light aperture circles **91–94** which provide for selectively activating the corresponding light aperture circles of the pulse drum for selectively generating any number of pulses in the sequence of 0–9 for each revolution of the drum **34**. Thus, if a given price wheel is set at "1" a price wheel aperture **85** in the light aperture circle **91** would be provided at the pickup station for activating the corresponding pulse aperture circle **87** on the drum **34** (having one pulse actuator **81**) and the remaining pulse aperture circles **88–90** on the drum would remain inactive.

The pulse apertures **81** of each pulse actuator bank **80** are preferably positioned on the drum to have an equiangular spacing of 24°. Also, the three banks **80** of pulse apertures for each set of three price wheels are relatively angularly offset with respect to each other by 8° such that the pulse apertures **81** of all three banks **80** have an angular spacing of 8°. Accordingly, it can be seen that the light pulse trains (and therefore the electrical pulse trains produced by the pickups **54–56**) generated by the three active banks **80** of pulse apertures would have non-coincident pulses with a minimum pulse spacing of 8°.

In another embodiment shown in FIGS. **5** and **6** the drum **34** has a bank of two light aperture circles **95, 96** for each price wheel and each price wheel **46–48** has a corresponding bank of two light aperture circles **97, 98**. The drum aperture circle **95** has three light apertures with one aperture **100** polarized in one direction (shown transverse to the wheel axis) and the remaining two apertures **102** oppositely polarized (in a direction parallel to the wheel axis). Similarly, the drum aperture circle **96** has two light apertures **101** polarized transverse to the wheel axis and the remaining four light apertures **103** oppositely polarized parallel to the wheel axis. The light apertures on the price wheel comprise nonpolarized apertures **104** (to activate all of the drum apertures on the corresponding aperture circle) and apertures **106, 108** respectively polarized transversely and parallel to the wheel axis (to activate similarly polarized apertures on the corresponding drum pulse

aperture circle). Accordingly, it can be seen that any selected number of light pulses from 0–9 may be generated by the selective activation of the polarized drum apertures with the nonpolarized and polarized apertures of the price wheel.

In both price wheel embodiments shown in FIGS. **4** and **6** the numerals 0–9 on the price wheels are angularly offset by 90° from the corresponding set of light apertures inasmuch as the price display window is angularly offset from the pickup station by 90°. This angular offset between the numerals and the corresponding sets of light apertures is shown in FIGS. **4** and **6** wherein the effective value of each light aperture set is designated by corresponding numerals 0–9.

Output leads **110–112** from the three photoelectric pickups **54–56** respectively are connected to the cost register **32** for indexing the register and thereby record the total cost of the fuel delivered in accordance with the three place unit volume fuel price established by the selected price wheel set. For this purpose the register **32** is provided with a suitable counter **114** which in the shown embodiment comprises six decades **115–120** (of increasing order from right to left as viewed in FIG. **1**) suitably connected for generating transfers from adjacent lower to higher order decades. The output leads **110–112** are connected by parallel entry to the three lowest order decades **115–117** respectively and therefore in accordance with the relative values or weights of the corresponding places of the established multiple place price. Schmit triggers **117** and one shot multi-vibrators **119** are preferably provided in the input circuit to the decades **115–117** to form suitable electrical pulses for avoiding miscounting or overcounting in the operation of the counter **114**. In the described embodiment with the variator set at a unit volume price of 28.6 cents per gallon the "tenths" output train generated by the photoelectric pickup **54** will index the lowest order decade **115**, 600 steps for each unit volume of fuel dispensed; the "units" photoelectric pickup **55** will index the decade **116**, 800 steps for each unit volume of fuel dispensed; and the "tens" photoelectric pickup **56** will index the decade **117**, 200 steps for each unit volume of fuel dispensed. As a transfer step is generated to index each higher order decade for each 10 steps of the adjacent lower order decade after a gallon of fuel is delivered, decade counter sections **119**, **118**, and **117** would be stepped to their "2", "8", "6" positions (i.e., the unit volume price established by the variator setting) and the counter **114** would continuously provide a count of the total cost of the fuel delivered in accordance with the established unit volume price. The counter **114** is preferably an electronic counter in which case suitable indicators **125** and decoder driver circuits **127** may be provided to produce a visual readout of the three highest counter sections **118–120** for registering the total cost of fuel delivered. Also if desired a suitable indicator **125** and corresponding decoder driver circuit **127** could be provided as shown in broken lines in FIG. **1** for producing a suitable tenth cent indication.

Referring to FIG. **7** another embodiment **200** of a pulse generator or variator in accordance with the present invention comprises a rotary drum or sleeve **202** rotatably mounted on a nonrotatable but axially shiftable collar **204** as for example by a pair of axially spaced ball bearings **205**. The drum **202** is driven by an elongated input gear **206** (which is driven by the combined meter outputs as in the embodiment of FIG. **1**) via an idler gear **208** mounted on the collar **204** and an internal gear **210** secured within one end of the drum **202**. The collar **204** may be made of a suitable plastic and is provided with a suitable bushing **212** for supporting the collar on the drive gear **206**. The collar **204** is provided with a threaded opening for receiving a screw **214** like the screw **68** and which is geared to the screw **68** so that the entire drum assembly is adapted to be axially shifted with the light head **64**. Consequently the drum **202** has only three banks of light apertures (as in FIG. **3** or FIG. **5**) which cooperate with the selected set of price wheels. Accordingly the length and therefore the moment of inertia of the pulse drum is substantially reduced.

Photoelectric pickups **220–222** are shown mounted in the collar **204** in lieu of the light pipe systems employed in the embodiment of FIG. **1**. The three photoelectric pickups **220–222** are mounted to be associated with the three banks of light apertures respectively of the drum such that each photoelectric pickup **220–222** is adapted to generate a pulse train in accordance with the setting of the corresponding active price wheel.

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 computing the product of a multiplier and an amount proportional to a rotational input comprising a rotary pulsing device having a rotary input and a plurality of rotatable pulsers arranged in a plurality of coaxial pulser sets respectively, pulse generating means mounted for cooperation with the pulser sets and to be operated by each pulser of each pulser set cooperating therewith and for each revolution of the pulser as the pulsing device is rotated by the rotary input to generate a number of pulses corresponding to the number of times the pulsers operate the pulse generating means, a plurality of separate multiplier setting means each comprising at least one ringlike multiplier setting wheel encircling the pulsing device for cooperation with the pulsing device and angularly settable for selectively controlling the operation of the pulse generating means by the pulsers cooperating to thereby establish a multiplier, the multiplier wheels of the plurality of separate multiplier setting means being coaxially mounted and being spaced along the axis of the coaxial pulser sets, a counter connected to be operated by the pulses generated by the pulse generating means, and multiplier selector means for selectively conditioning each of the plurality of multiplier setting means for controlling the operation of the counter to count the product of the multiplier established by the selected multiplier setting means and an amount proportional to the rotation of the rotary input.

2. A computing device according to claim **1** wherein the pulsers are pulse light apertures, wherein the pulse generating means comprises photoelectric pickup means, and wherein the wheels have control light apertures for selectively controlling the operation of the photoelectric pickup means by the pulse apertures.

3. A computing device according to claim 2 wherein the pulse apertures and control apertures comprise polarized apertures.

4. A computing device according to claim 3 wherein each pulser set comprises polarized light apertures of opposite polarities and wherein each multiplier wheel comprises polarized control apertures of corresponding opposite polarities arranged in a coaxial control circle for permitting selective operation of the photoelectric pickup means by pulse apertures of corresponding polarity.

5. A computing device according to claim 1 wherein the multiplier wheels bear numerals for providing an in-line display of the multipliers established thereby.

6. A computing device according to claim 1 wherein the multiplier selector means comprises shifting means for axially shifting the pulsing device for selective cooperation with the multiplier setting wheels.

7. A computing device for computing the product of a multiplier and an amount proportional to a rotational input comprising a rotary pulse drum having a rotary input, pulse generating means operable for generating pulses and mounted for cooperation with the pulse drum for being operated thereby for generating pulses as the pulse drum is rotated by its rotary input, a plurality of separate multiplier setting means each comprising at least one ringlike multiplier setting wheel encircling the pulse drum and angularly settable for controlling the operation of the pulse generating means by the pulse drum and for thereby establishing a multiplier, the multiplier setting wheels of the plurality of separate multiplier setting means being coaxially mounted and being spaced along the drum axis, a counter connected to the pulse generating means to be operated by the pulses generated thereby, and multiplier selector means for selectively conditioning each of the plurality of multiplier setting means for controlling the operation of the counter to count the product of the multiplier established by the selected multiplier setting means and an amount proportional to the rotation of the rotary input.

8. A computing device according to claim 7 for computing the product of an amount proportional to a rotational input and a multiple place multiplier, wherein each multiplier setting means comprises a plurality of multiplier setting wheels for different places respectively of the multiple place multiplier.

9. A computing device according to claim 7 wherein the pulse drum is mounted for rotation about an axis laterally offset from the axis of the coaxial multiplier setting wheels.

10. A computing device according to claim 7 wherein the multiplier selector means comprises shiftable means mounted to be shifted parallel to the axis of the coaxial multiplier setting wheels for selectively conditioning the setting wheels for controlling the operation of the counter.

11. A computing device according to claim 10 wherein at least a portion of the pulse generating means is mounted on the shiftable means for selectively conditioning the setting wheels for controlling the operation of the counter.

12. A computing device according to claim 7 wherein the pulse drum and the coaxial multiplier setting wheels are mounted to be relatively axially shifted for selectively conditioning the multiplier setting wheels for controlling the operation of the counter, and wherein the multiplier selector means provides for relatively axially shifting the pulse drum and coaxial multiplier setting wheels.

13. A computing device according to claim 12 wherein the pulse drum is adapted to be axially shifted by the selector means within the coaxial multiplier setting wheels.

14. A computing device according to claim 7 wherein the pulse drum comprises a plurality of pulse light apertures arranged in a plurality of coaxial circles to form a plurality of coaxial pulse aperture sets respectively, wherein the pulse generating means comprises photoelectric pickup means operable by the pulse apertures, and wherein the multiplier setting wheels have control light apertures for selectively activating the pulse apertures for operating the photoelectric pickup means in accordance with the angular settings of the multiplier setting wheels.

15. A computing device according to clam 14 wherein each multiplier setting means comprises a set of a plurality of multiplier setting wheels, wherein the pulse drum and the coaxial wheels are mounted to be relatively axially shifted for selectively conditioning the wheel sets for controlling the operation of the counter and wherein the multiplier selector means provides for relatively axially shifting the pulse drum and coaxial wheels.

16. A computing device according to claim 15 wherein the selector means provides for shifting the pulse drum within the coaxial wheels.

17. A computing device according to claim 14 wherein each multiplier setting means comprises a set of a plurality of multiplier setting wheels, and wherein the drum has separate pulse aperture sets for each wheel set.

18. A computing device according to claim 17 wherein the multiplier selector means comprises shiftable means mounted to be shifted parallel to the axis of the coaxial wheels for selectively conditioning the wheel sets for controlling the operation of the counter.

19. A computing device according to claim 17 wherein the plurality of wheels of each wheel set provides for establishing different places respectively of a multiple place multiplier, wherein the pulse generating means comprises a separate photoelectric pickup for each place of the multiple place multiplier and a light pipe pickup system connecting each photoelectric pickup for receiving light pulses from each corresponding multiplier setting wheel.

20. A computing device for computing the product of a multiple place multiplier and an amount proportional to a rotational input comprising a pulsing device having a rotary input and a plurality of rotatable pulsers arranged in a plurality of pulser circles, each coaxial with its axis of rotation, to form a plurality of pulser sets respectively, pulse generating means mounted for cooperation with the pulser sets to be operated by each pulser of each pulser set cooperating therewith and for each revolution of the pulser as the pulsing device is rotated by the rotary input to generate a number of pulses corresponding to the number of times the pulsers operate the pulse generating means, a plurality of sets of angularly settable multiplier wheels angularly settable for selectively controlling the operation of the pulse

generating means by the pulsers cooperating therewith for establishing a multiple place multiplier, the multiplier setting wheels of the plurality of wheel sets being coaxially mounted and bearing numerals for providing an in-line display of the multiple place multipliers established thereby, multiplier selector means for selectively conditioning the wheel sets for setting the number of pulses generated by the pulse generating means, and a counter connected to the pulse generating means for being operated by the pulses generated thereby to count the product of the multiple place multiplier established by the selected wheel set and an amount proportional to the rotation of the rotary input.

21. A computing device according to claim 20 wherein the multiplier selector means comprises shiftable means shiftable parallel to the axis of the coaxial wheels for selectively conditioning the wheel sets for setting the number of pulses generated by the pulse generating means.

22. A computing device according to claim 21 wherein the shiftable means comprises an indicator for indicating the selected wheel set.

23. In a multiple product fluid dispensing system adapted for selectively dispensing each of a plurality of fluid products and having a cost register and a cost computing device driven in accordance with the volumetric amount of fluid dispensed and presettable for establishing the unit volume price of each of the plurality of products and connected for indexing the register in accordance with the preset unit volume price of the selected fluid product and the volumetric amount of fluid dispensed, the improvement wherein the computing device comprises pulse generating means connected to be operated in accordance with the volumetric amount of fluid dispensed and controllable to establish the unit volume pulse rate generated thereby, a plurality of price wheel sets for the plurality of fluid products respectively each comprising a plurality of angularly settable price setting wheel means, the price setting wheel means of each price wheel set and the pulse generating means being cooperable for controlling the pulse generating means for establishing the unit volume pulse rate and for thereby establishing the unit volume price of the respective fluid product in accordance with the angular setting of the price setting wheel means, the price setting wheel means of the plurality of price wheel sets being coaxially mounted and bearing numerals for providing an in-line display of the established unit volume prices of the plurality of fluid products, price selector means for selectively conditioning each price wheel set for controlling the pulse generating means, and means connecting the computing device and register for operating the register to count the cost of fluid dispensed in accordance with the unit volume price established by the selected price wheel set.

24. In a multiple product fluid dispensing system according to claim 23 wherein the price selector means comprises indicator means shiftable parallel to the axis of the coaxial price wheel means for indicating the unit volume price display of the selected fluid product.

25. In a computing device for computing the product of a multiplier and an amount proportional to a rotational input comprising a rotational input, presettable pulse generating means driven by the rotational input presettable for establishing the multiplier and operable to generate a number of pulses in accordance with the multiplier established by the setting of the pulse generating means and the rotation of the rotational input, and a counter connected to be operated by the pulses generated by the pulse generating means for counting the product of the established multiplier and an amount proportional to the rotation of the rotary input, the improvement wherein the pulse generating means comprises a rotary pulsing device connected to be rotated by the rotational input and having a plurality of rotatable pulse light apertures arranged in a circle to form a pulse aperture set, photoelectric pickup means mounted for cooperation with the pulse aperture set and adapted to be operated by each pulse aperture thereof for each revolution of the pulse aperture set as the pulse actuating device is rotated by the rotational input to generate pulses for operating the counter and having a number of pulses corresponding to the number of times the pulse apertures operate the pulse generating means, a control member having a plurality of control light apertures arranged to form a control aperture set for selectively controlling the operation of the photoelectric pickup means by the pulse apertures, the pulse aperture set and control aperture set each comprising polarized light apertures of opposite polarity such that the polarized control apertures provide for selectively activating the polarized pulse apertures of the same polarity for operating the photoelectric pickup means.

26. In a computing device according to claim 25 wherein the pulsing device comprises a second said pulse aperture set with one pulse aperture set having one aperture of one polarity and two apertures of the opposite polarity and the other pulse aperture set having two apertures of one polarity and four apertures of the opposite polarity, wherein the control member comprises a second said control aperture set, for said second pulse aperture set and wherein each of said control aperture sets has unpolarized control apertures and control apertures of opposite polarity for selectively activating the pulse apertures to provide with both of the control aperture sets any number of pulses in the sequence of 1–9 for each predetermined rotation of the pulsing device.

27. A computing device for computing the product of a multiplier and an amount proportional to a rotational input comprising a rotary pulse drum having a rotary input and a plurality of rotatable pulsers arranged in a plurality of coaxial pulser circles to form a plurality of coaxial pulser sets respectively, pulse generating means mounted for cooperation with the pulser sets and to be operated by each pulser of each pulser set cooperating therewith and for each revolution of the pulse drum as the pulse drum is rotated by the rotary input to generate a number of pulses corresponding to the number of times the pulsers operate the pulse generating means, a set of a plurality of multiplier setting wheels encircling the drum for cooperating with the pulser sets, the multiplier setting wheels being coaxially mounted and being spaced along the axis of the pulse drum and being angularly settable for selectively controlling the operation of the pulse generating means by the pulsers for establishing a multiplier and a counter connected to be operated by the

pulses generated by the pulse generating means for counting the product of the multiplier established by the wheel set and an amount proportional to the rotation of the rotary input.

28. A computing device for computing the product of a multiplier and an amount proportional to a rotational input comprising a rotary pulse drum having a rotary input and a plurality of rotatable pulsers arranged in a plurality of coaxial pulser circles to form a plurality of coaxial pulser sets respectively, pulse generating means mounted for cooperation with the pulse sets and to be operated by each pulser of each pulser set cooperating therewith and for each revolution of the pulse drum as it is rotated by the rotary input to generate a number of pulses corresponding to the number of times the pulsers operate the pulse generating means, a plurality of multiplier wheel sets each comprising a plurality of angularly settable multiplier wheels, the multiplier setting wheels of the plurality of multiplier wheel sets being mounted coaxially and being spaced along the drum axis and for cooperation with the pulser sets for controlling the operation of the pulse generating means by the pulsers cooperating therewith, a counter connected to the pulse generating means to be operated by the pulses generated thereby, and multiplier selector means for selectively conditioning the wheel sets for controlling the operation of the counter to count the product of a multiplier established by the setting of the selected wheel set and an amount proportional to the rotation of the rotary input, the selector means comprising means for relatively axially shifting the pulse drum and coaxial multiplier wheels for selectively conditioning the wheel sets for controlling the operation of the counter.

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