United States Patent [19]

Dilger

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[54] **METERING SYSTEM AND CONTROL THEREFOR**

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Jan. 12, 1971	United Kingdom	1454/71

[52] **U.S. Cl.** .... **222/26;** 73/194 E; 137/99; 222/76; 222/134; 222/249

[51] **Int. Cl.²** **B67D 5/18**

[58] **Field of Search** .... 222/14, 22, 23, 28, 76, 222/134, 135, 137, 25, 26, 27, 31, 32, 33, 36, 17, 37, 20, 249, 250; 235/92 FL, 151.34; 137/99, 99.5; 73/219, 232, 194 E

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Primary Examiner—Robert B. Reeves
Assistant Examiner—Joseph J. Rolla
Attorney, Agent, or Firm—Fleit & Jacobson

[57] **ABSTRACT**

Fluid Metering systems particularly but not exclusively for dispensing petroleum having a dispensing system, an indication means and a common controller which is arranged to control the dispensing system directly or indirectly and to directly control the indicating system. The controller includes a pulse generator selected trains of pulses from which cause operation of the dispensing system and operate the indicating device, the ratio of the numbers of pulses affecting each being adjustable to calibrate the system. The dispensing system comprises one or more displacement assemblies, for example piston and cylinder assemblies, each having a swept volume less than the permitted volumetric error spread for the minimum delivery of fluid to be dispensed. If the dispensing system is connected to more than one fluid source, the ratio of the number of pulses causing dispensing from one source relative to the number causing dispensing from another source can be adjusted to provide a selected blend.

17 Claims, 14 Drawing Figures

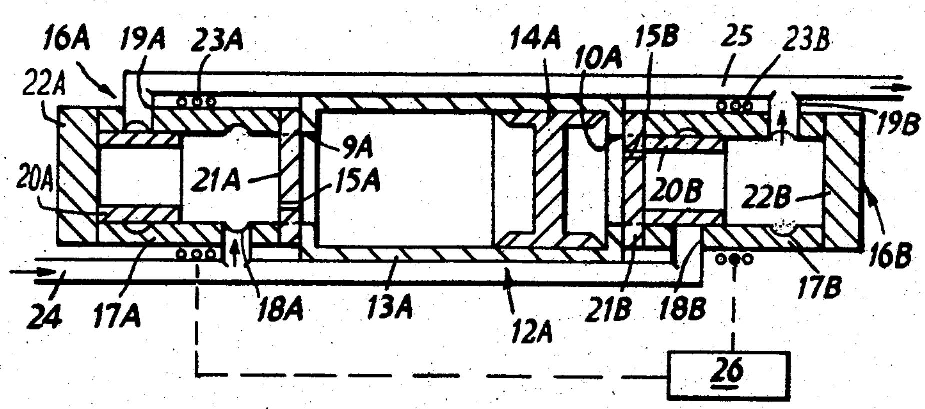
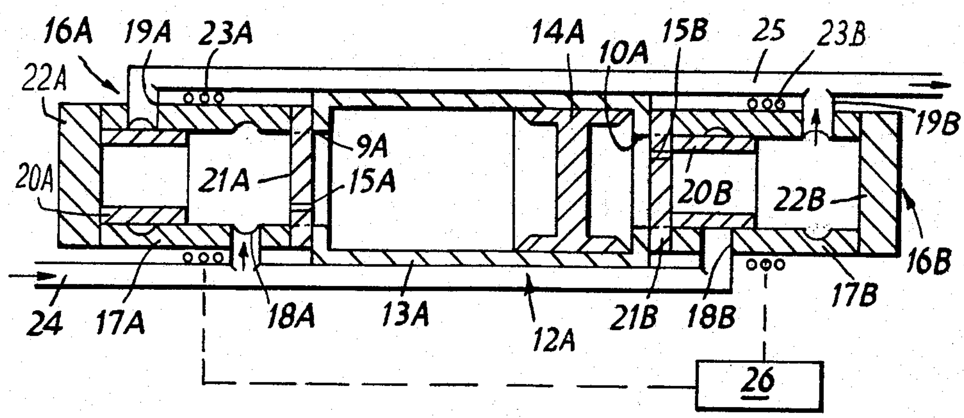


FIG. 1.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15B
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12A
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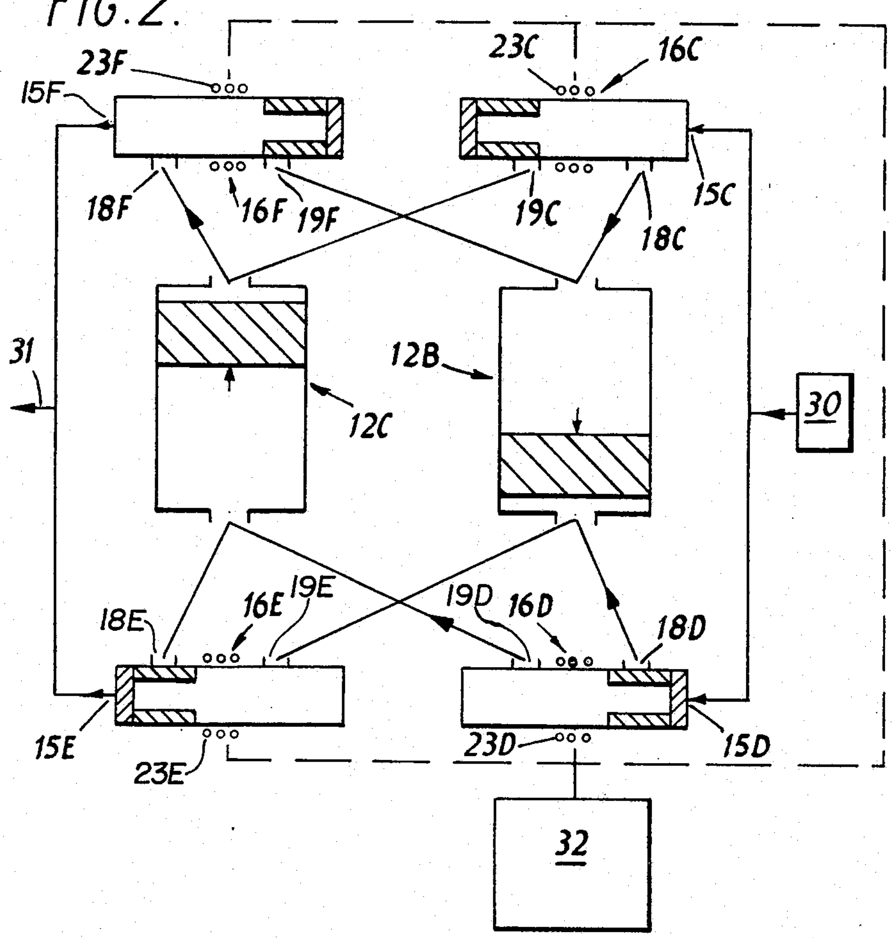
26

FIG. 2.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15F
18F
16F
19F
23C
16C
15C
19C
18C
31
12B
12C
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18E
16E
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19D
16D
18D
15E
23E
23D
15D
32

FIG. 3.

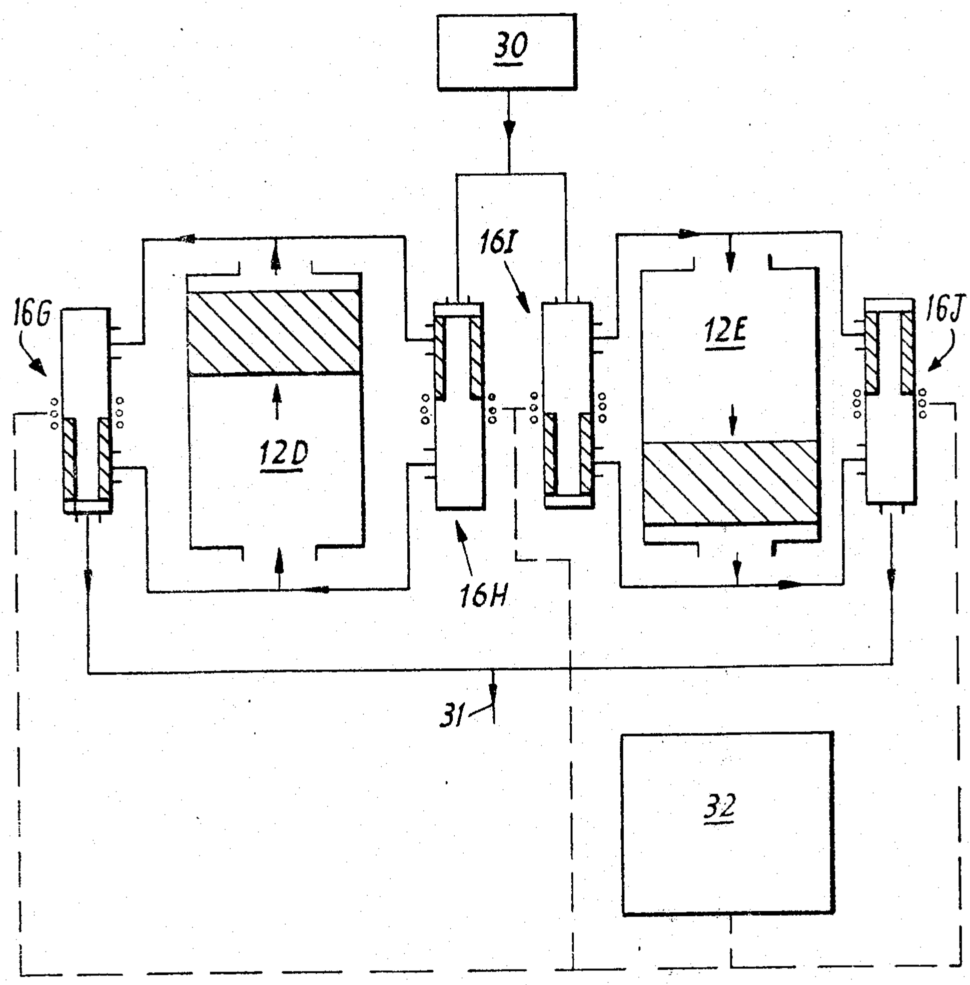


FIG. 4.

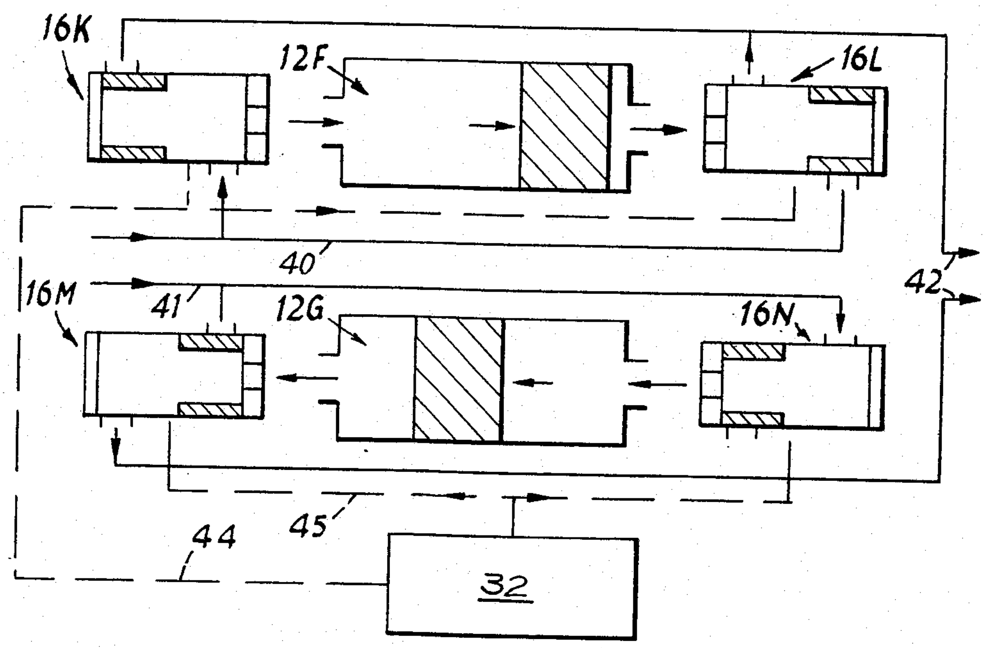
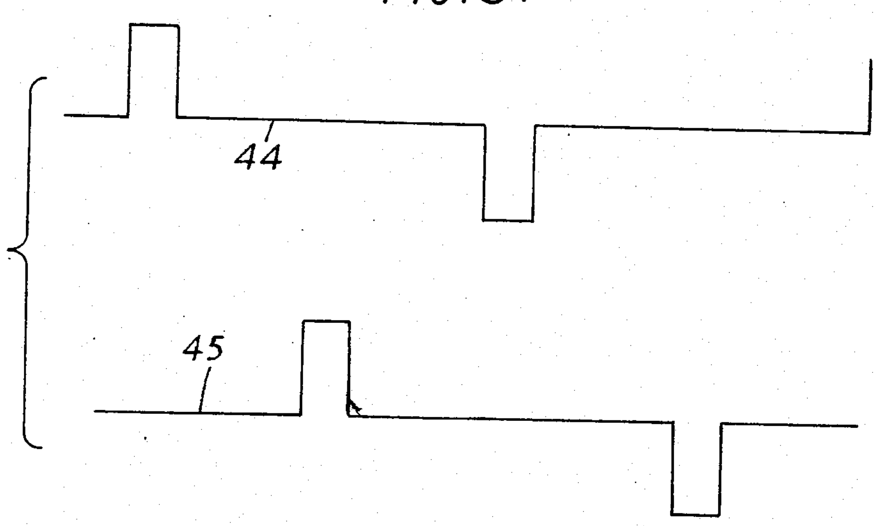


FIG. 5.



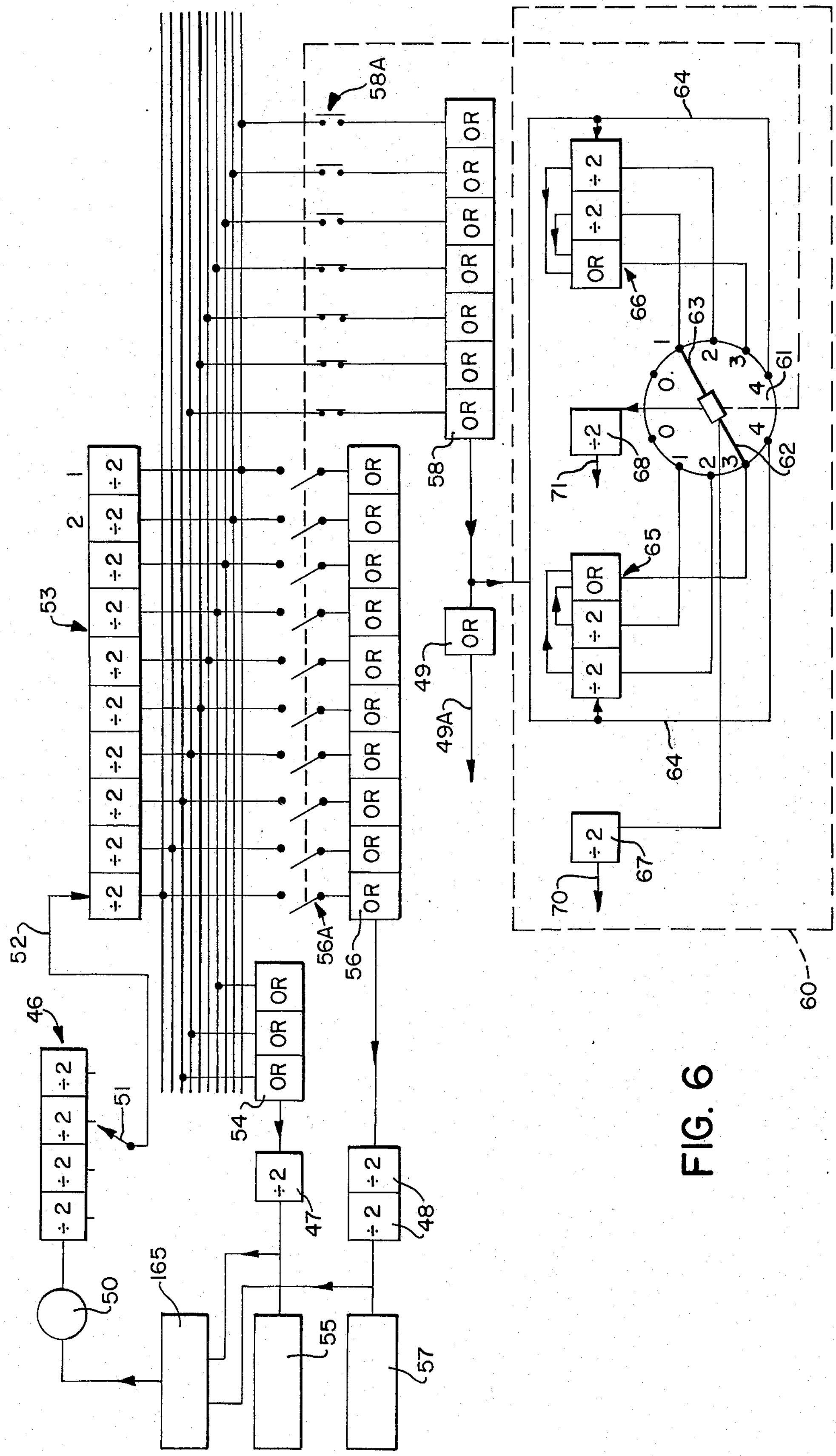
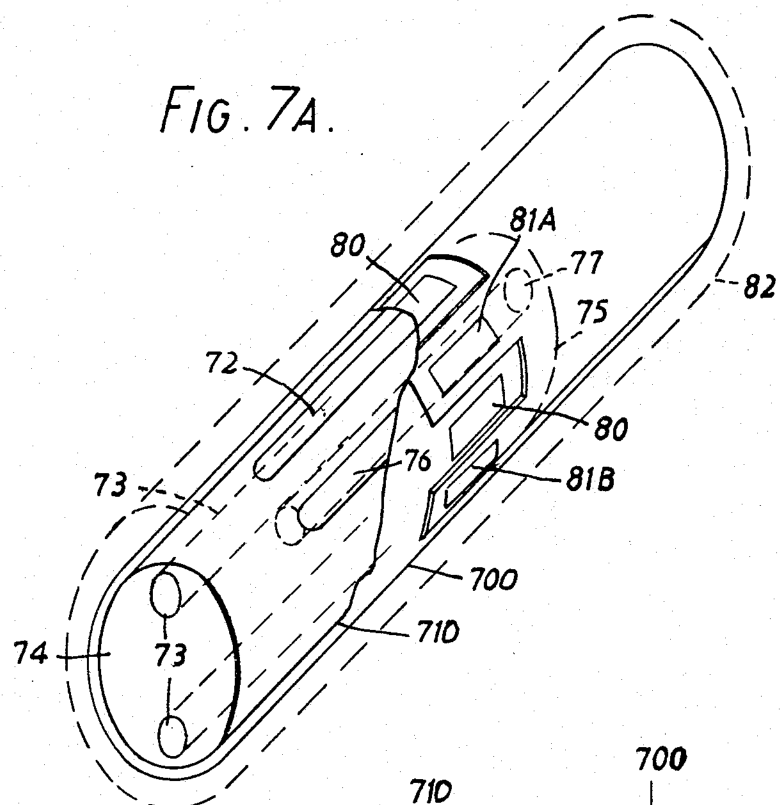

58A
OR
÷2
58
49
49A
53
56A
56
52
46
51
54
47
48
165
50
55
57
60
61
62
63
64
65
66
67
68
70
71

FIG. 6

FIG. 7A.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81A
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72
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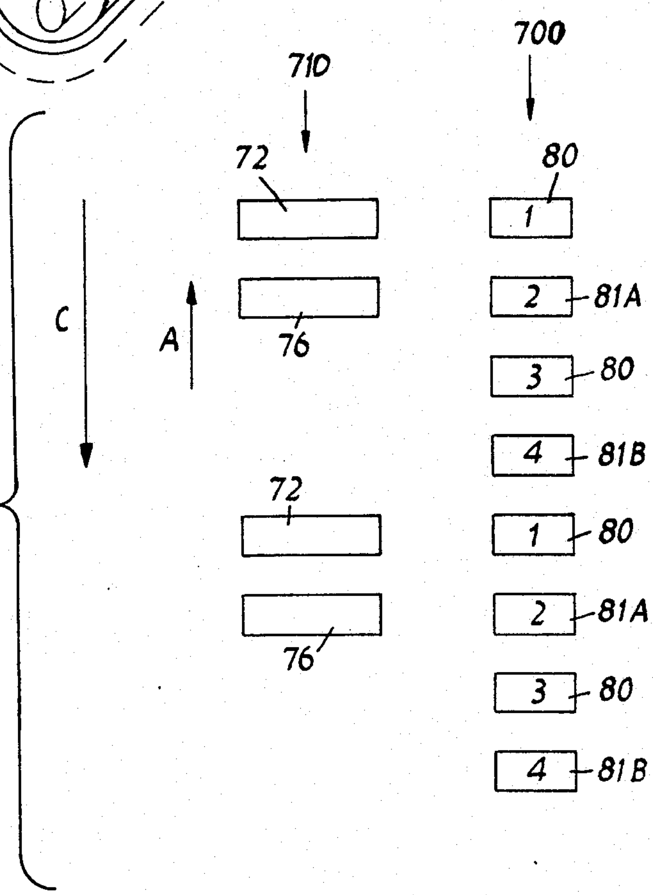
76
81B
73
700
710
74
73

FIG. 7B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76
3
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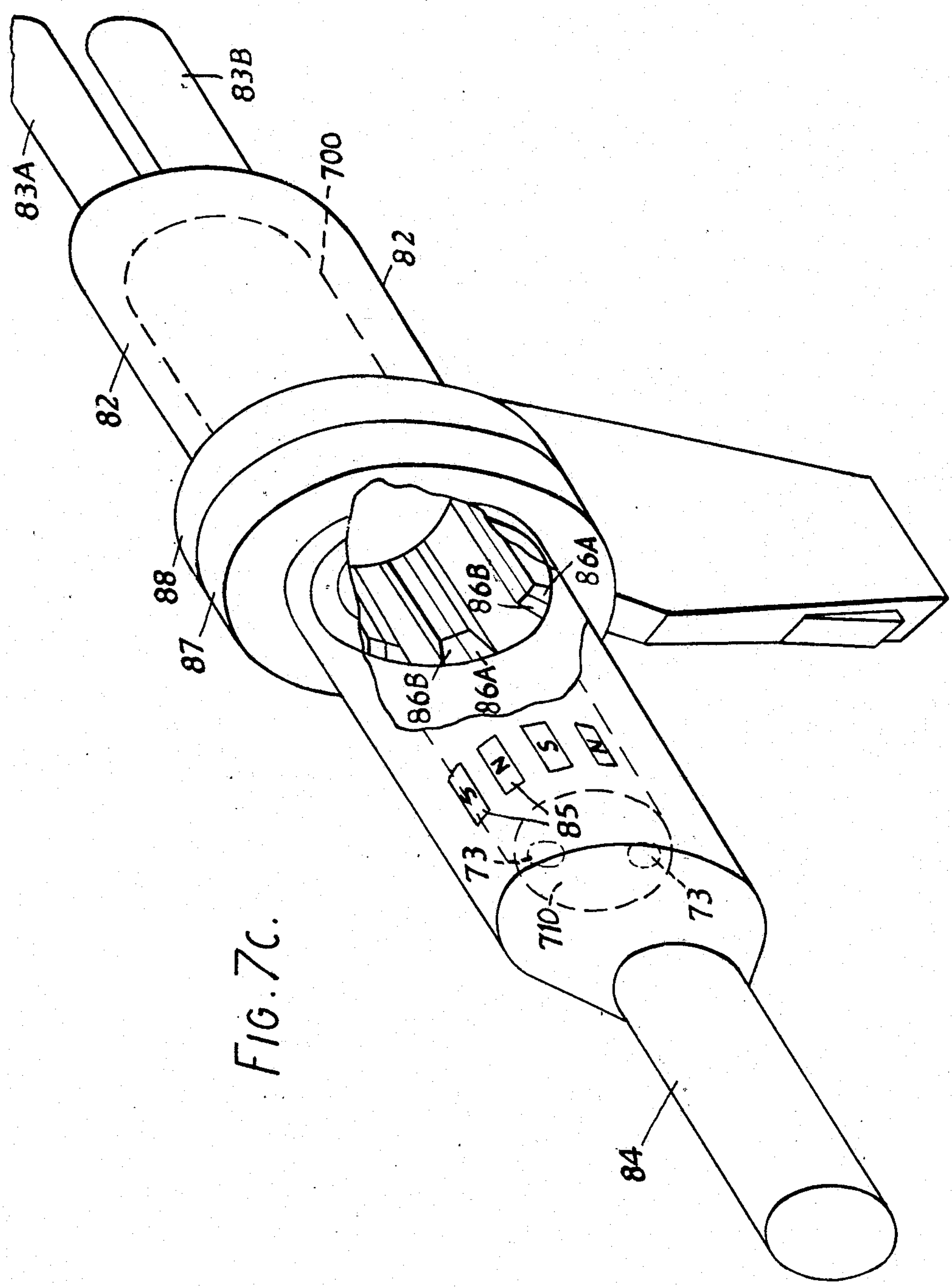
4
81B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86A
86B
86B
86A
86A
86B
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N
S
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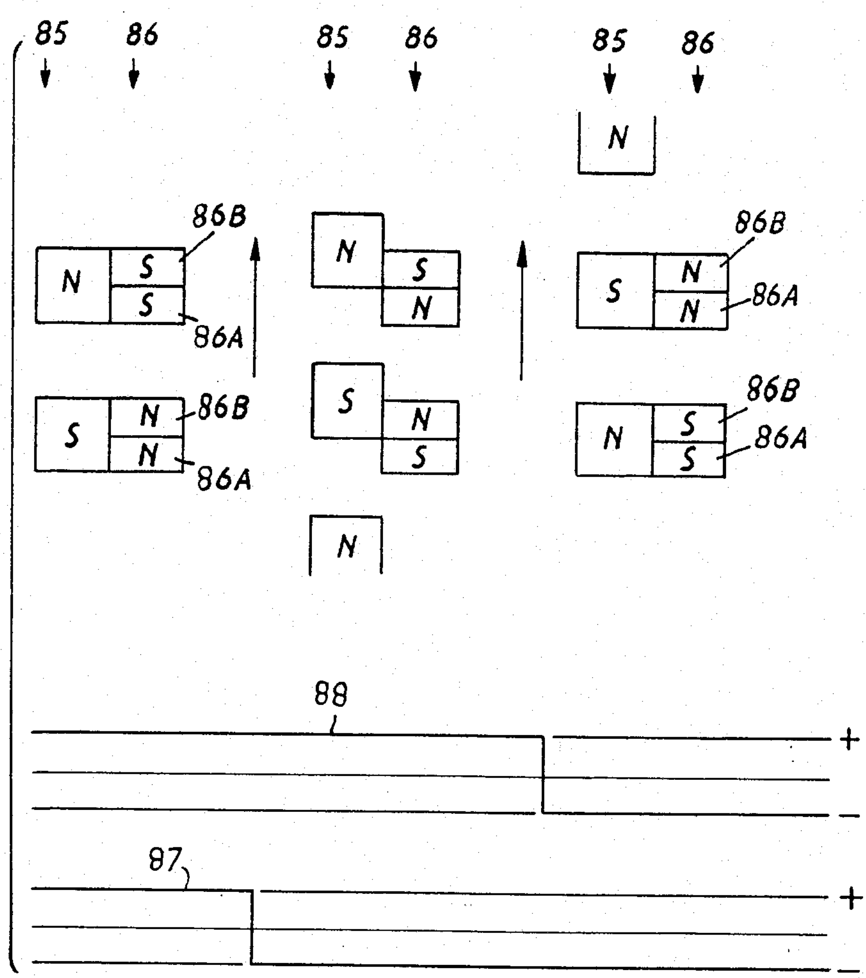
85
73
73
710
84

FIG. 7C.

FIG. 7D.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86A
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N
N
86B
86A
N
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86B
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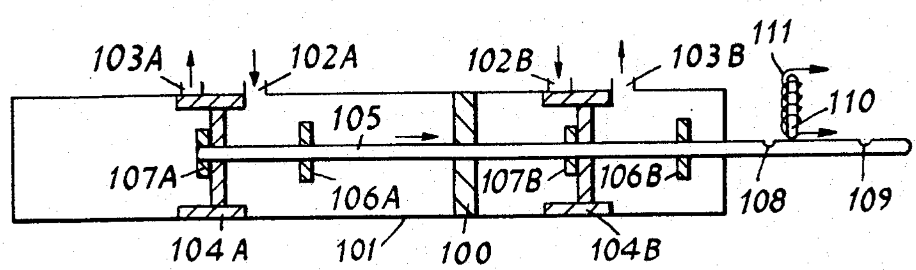
87
+
−

FIG. 8.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104A
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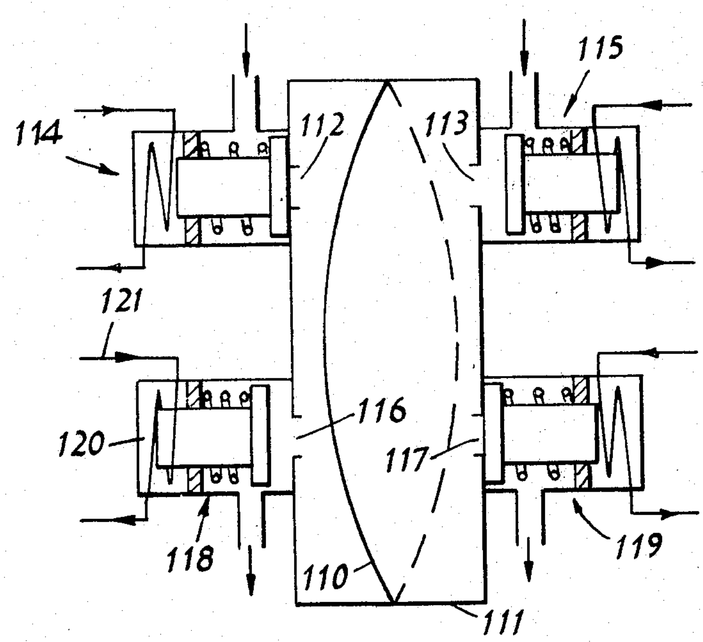
100
104B

FIG. 9.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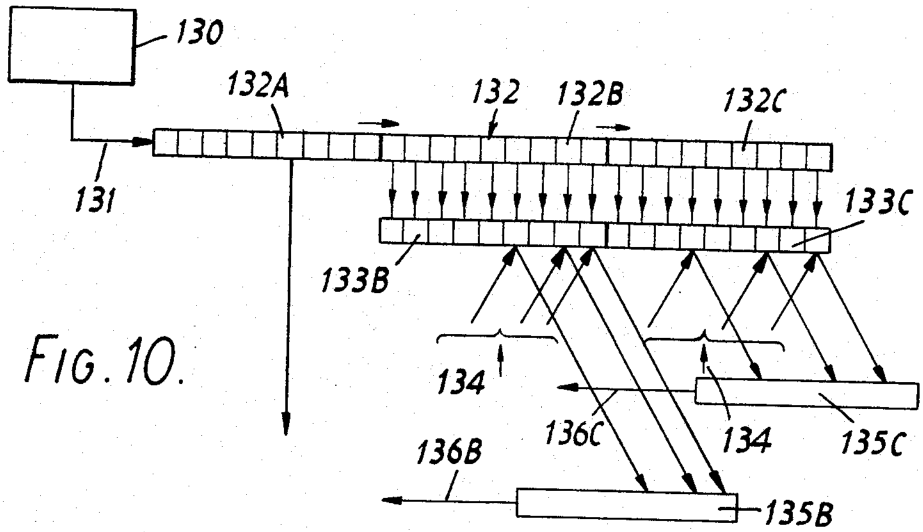
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132A
132
132B
132C
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133C
133B
134
134
135C
136C
136B
135B

FIG. 10.

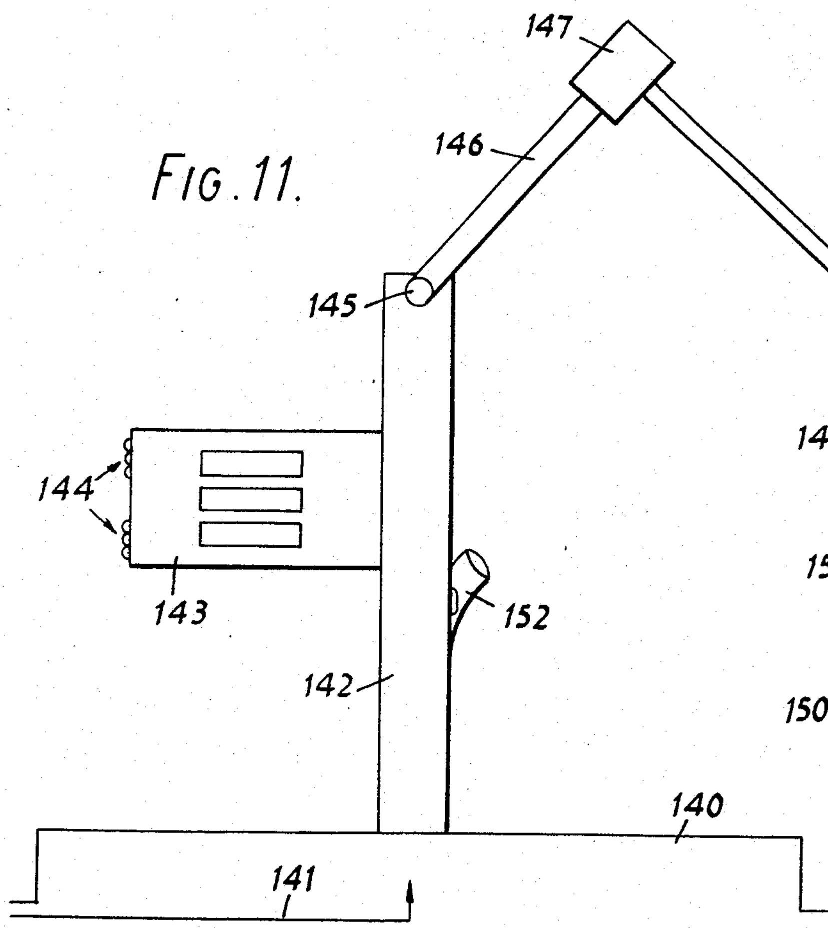
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FIG. 11.

METERING SYSTEM AND CONTROL THEREFOR

BACKGROUND OF THE INVENTION

This invention relates to a metering system for fluids particularly but not exclusively for dispensing liquids such as petroleum fuel for example for the retail sale of such fuel at kerbside pumps.

Such meters are normally of the posiitive displacement type in which a number of cylinders of accurately determined volume (for example, ¼ liter) are mechanically linked together and to an output shaft in such a manner that the relationship between the angular rotation of the output shaft and the volume of fluid displaced is substantially linear. The absolute volumes of the measuring cylinders are mechanically adjusted such that they are approximately equal to one another, and such that one rotation of the shaft (via gearing) corresponds to a suitable unit volume within the specifications laid down by various weights and measures authorities. The shaft is used directly or indirectly to drive a suitable indicating mechanism for indicating the quantity dispensed. The mechanical adjustment of the volume of the cylinders is time consuming and needs machining to a nearly accurate volume in the first place.

The Weights and Measures authorities in each country lay down specifications for both the maximum permitted errors for the dispensing meters and the minimum delivery allowed for dispensing liquids other than water. In the United Kingdom the permitted minimum quantity of petroleum which may be dispensed is ½ gallon and the permitted error at minimum delivery is 13 drams. The latest recommendation (International Recommendation No. 5) of the International Organisation of Legal Metrology, which the United Kingdom Government is planning to adopt, lays down a minimum delivery for petroleum of 2 liters and a maximum permitted error at initial verification on a complete meter installation of plus or minus 0.5%. However, the maximum permissible error at a minimum delivery is double the value specified above for the quantity corresponding to that delivery, and otherwise, whatever the measured quantity, the maximum permissible error is never less than that permitted for minimum delivery. This means that the permitted error between 2 and 4 liters is plus or minus 1% of 2 liters. In a complete meter installation some of the error occurs in the hoses etc. independently of the metering and indication system per se. The metering and indication system error should in practice not exceed 75% of the error allowed for the whole installation.

Thus under the International Recommendation in dispensing between 2 and 4 liters of petroleum fuel the permitted volume error in the whole installation is 40 milliliters which increases above 4 liters dispensed to plus or minus 0.5% of the quantity dispensed; the volumetric error in the meter and indicating systems per se should not be more than 30 milliliters between 2 and 4 liters. At present in the United Kingdom the volumetric error in the meter and indication system per se at minimum delivery should not be more than 13 × 0.75 drams. Clearly the volumetric error allowed in different countries and for different fluids is different but it is always clearly specified by the appropriate authority.

An object of the present invention is to provide a metering system which is accurate to the appropriate specification and is simple to calibrate and does not require its displacement assemblies to have accurate volumes.

A further object is to provide a system which is easily arranged to give a selected blend of fluids.

SUMMARY OF THE INVENTION

The present invention provides a fluid metering system comprising a dispensing system consisting of one or more small displacement assemblies and a valve system by which the displacement assemblies are selectively connectable to a source of fluid to be dispensed and to an outlet line for dispensed fluid, indicating means for indicating the volume of fluid dispensed and a common controller arranged to control the dispensing system and to directly control the indicating means.

With this arrangement the dispensing system does not need to have an output shaft driving the indicating system.

In a preferred form of the present invention the or each displacement assembly has a swept volume less than the permitted volumetric error spread for the minimum delivery of fluid to be dispensed. The swept volume of each displacement assembly will normally be less than 30 ml.

According to another feature of the invention the displacement assemblies do not have accurately machined volumes, but may for example be machined to within plus or minus 3% of their nominal value, and the calibration of the metering system is effected, not by the conventional method of adjusting the volume of the piston and cylinder assemblies to their nominal value, but by calibrating the controls to the indicating means and the dispensing means. This calibration is effected by passing a known quantity through the dispensing system. For example, assuming that the standard volume of each cylinder is meant to be 25 ml. and it is required to deliver 2 liters of fluid, nominally 80 volumes should be dispensed. However, during calibration with a known fluid flow it may be found that only 1.976 liters are dispensed for 80 volumes due to the measuring cylinder or cylinders being smaller than standard. One further quanta of fluid will, however, bring the delivery up to 2.001 liters, which is within the required tolerance. The control unit is then programmed to deliver 81 volumes for a 2 liter delivery.

The electronic controller preferably comprises a pulse generator for producing pulses, first selector means for selecting a required number of pulses to be supplied to the indicating means and second selector means for selecting independently a required number of pulses to be supplied to the dispensing system. Calibration is carried out by adjusting the ratio of the number of pulses supplied to the indicating means relative to the number of pulses supplied to the dispensing means. The rate of pulses delivered by the pulse generator can be varied to control the delivery rate of the fluid.

By means of appropriate circuitry the indicating means can indicate not only the volume dispensed, but additionally the monetary value of the fluid dispensed, and by comparing either of these with pre-set values it can be made to stop pulses controlling the valve system when the volume or value of fluid dispensed reaches the pre-set value, thus providing a means of delivering either a selected volume of fluid or a quantity of selected value.

The metering system as set out above is particularly adapted to provide an easy blend selector mechanism by which different blends or mixtures of fluids can be dispensed, for example blends of different octane rated fuels can be dispensed by the same meter installation. In such an installation the dispensing system is connectable selectively to at least two reservoirs and the valves are operated selectively by varying the ratio of the number of pulses driving the dispensing means to dispense from one reservoir and the number driving the dispensing means to dispense from the other reservoir.

The displacement assemblies are preferably piston and cylinder assemblies, more preferably of the free piston type driven by the pressure of the fluid to be dispensed and the valves are preferably electromagnetically controlled. However, the valves may be fluidic or may be directly controlled by other suitable means for example using magneto-striction or piezo-electric or electrostatic transducers. Alternatively they may be indirectly controlled for example by release of an inhibiting device. The displacement assemblies may equally take other forms such as diaphragms, bellows and bellofram. The displacement assemblies and valves may be incorporated in single units having a piston which rotates to produce the valving effect for example.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of metering systems and controllers will now be described by way of example only with reference to the accompanying drawings of which:

FIG. 1 is a sectional view of a fuel dispensing system;

FIG. 2 is a diagrammatical representation of an alternative arrangement of dispensing system using the same type of elements as those of FIG. 1;

FIG. 3 is a diagrammatic view of an alternative form of the dispensing system;

FIG. 4 shows diagrammatically yet another form of dispensing system;

FIG. 5 shows suitable trains of pulses to be emitted from an electronic controller;

FIG. 6 is a diagrammatic circuit of a controller for use with any one of the above dispensing systems;

FIG. 7A is a perspective view partly cut away of an alternative form of piston and cylinder assembly in which the piston is rotatable to achieve the valving;

FIG. 7B is a diagrammatic view showing the relationship of ports and apertures in the arrangement of FIG. 7A;

FIG. 7C is a further perspective view partly cut away of the dispensing system of FIG. 7A incorporated in a pistol grip dispenser and showing the means for rotating the piston;

FIG. 7D is a diagrammatic view showing the relationships of the magnetic operating means of FIG. 7C;

FIG. 8 is a diagrammatic sectional view through an alternative form of dispensing system in which the valving is automatically driven by the piston except when inhibited;

FIG. 9 is a diagrammatic sectional view through an alternative form of dispensing means using a flexible diaphragm;

FIG. 10 shows diagrammatically an alternative form of blending control; and

FIG. 11 is a diagrammatic view of a petrol dispensing system.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The metering systems of FIGS. 1 to 4 are built up from one or more displacement assemblies in the forms of piston and cylinder assemblies referred to collectively as assemblies 12 and two or more similar valves referred to collectively as valves 16. Individual assemblies or valves are given the suffixes A, B, C, . . . and similarly parts thereof are given appropriate suffixes A, B, C, etc; only one of each will be described in detail.

Referring first to FIG. 1, a piston and cylinder assembly 12A has a cylinder 13A with outlets 9A and 10A at opposite ends, and a free piston 14A which is free to slide between one end and the other. The swept volume of this piston and cylinder assembly in the example given is 16.16 ml; the piston having a stroke of approximately 3.2 cm. The dispensing system includes two similar electromagnetic valves 16A and 16B. The valve 16A has a cylindrical body portion 17A provided with two ports 18A and 19A at points spaced along its length, and a hollow valve member 20A movable axially of the body portion 17A between positions at which it closes one or the other of the ports 18A and 19A. The valve member 20A is of magnetisable material. At opposite ends of the valve 16A magnets 21A and 22A are arranged so that their poles face in opposite directions. A coil 23A is located around the centre of the outside of the body portion 17A, and can be energised by a current flow in either direction to selectively magnetise the valve member 20A. Current flow in one sense magnetises member 20A so that it is attracted to the magnet 21A and current flow in the other sense magnetises member 20A so that it is attracted to the magnet 22A and repulsed by the magnet 21A. It will thus be seen that the valve is bi-stable and can be pulsed from one position to the other. Valve 16A has an outlet 15A opening to one end through magnet 21A. The valve 16A is arranged coaxially with and abutting one end of the piston and cylinder assembly 12A, while valve 16B with a corresponding outlet 15B is arranged similarly at the other end of assembly 12A. The outlets 15A and 15B register respectively with outlets 9A and 10A. A supply line 24 for fluid, for example petroleum fuel at a pressure of about 1 kg. per sq. cm., connects to ports 18A and 18B of valves 16A, 16B, while an outlet line 25 for dispensed fluid connects to the ports 19A, 19B of the valves. In operation the two valves will be pulsed simultaneously but their magnets are arranged so that the port 18A of one valve will be open while the port 18B of the other valve is closed, and vice versa with the ports 19B and 19A. In the position shown in FIG. 1 fluid from line 24 enters the port 18A of valve 16A and flows through its outlet 15A and the port 9A of the piston and cylinder assembly to drive the piston 14A to the right, thus displacing 16.16 ml. of fluid through the valve 16B and into the outlet line 25. An electronic control system 26 is connected to coils 23A, 23B to provide the energising pulses. For example, if it is required to dispense 32 liters per minute and there are two displacement assemblies operating in tandem with interlaced pulsed trains, 64.6 ml. will be dispensed each cycle and the interval between pulses will be approximately 60 m. secs.

The system of FIG. 1 can be supplied as a unit measuring only 14 × 5 × 7 cms.

FIG. 2 shows a system in which two piston and cylinder assemblies 12 of the FIG. 1 type and referenced 12B and 12C are arranged in association with four valves 16 referenced 16C, 16D, 16E and 16F. A reservoir 30 of liquid to be dispensed is connected to the ports 15C and 15D of valves 16C and 16D. The ports 18C and 18D of each of the latter are connected to opposite ends of the piston and cylinder assembly 12B, and the ports 19C and 19D of each of those valves are connected to opposite ends of the piston and cylinder assembly 12C. The valves 16E and 16F have their ports 18E and 18F connected to opposite ends of the assembly 12C, and their ports 19E and 19F connected to opposite ends of the assembly 12B. The ports 15E and 15F of valves 16E and 16F are connected to an outlet line 31. A controller 32 is connected to the coils 23C, 23D, 23E and 23F four valves to provide a programmed sequence of pulses, so that each of assemblies 12A and 12B continuously dispenses fluid from its ends alternately.

FIG. 3 shows an alternative arrangement for connecting two assemblies, referenced 12D and 12E with four valves 16, referenced 16G, 16H, 16I and 16J. The connection of these valves to the assemblies 12 links a reservoir 30 of fluid to be dispensed to an outlet line 31 for dispensed fluid, and to a controller 32 shown in FIG. 3 and operated similarly to that of FIG. 2.

FIG. 4 shows another system for connecting two assemblies 12, referenced 12F and 12G, with four valves 16, referenced 16k. 16L, 16M and 16N. In this case valves 16K and 16L are connected to one supply line 40, while valves 16M and 16N are connected to a different supply line 41. The valves 16K, 16L, 16M, and 16N are connected to outlet lines 42 going to a common outlet. The valves 16K and 16L receive a first set of pulses, for example as indicated on line 44 in FIG. 5, while the valves 16M and 16N receive a separate set of pulses, for example as shown on line 45 in FIG. 5, from a controller 32. These pulses may, for example, be of 10 millisecs. duration at intervals of 62 millisecs. The pulses on the line 44 are preferably staggered relative to those on line 45. Assuming that supply lines 40 and 41 are connected to supplies of fuel having different octane ratings, by adjusting the relative frequencies of pulses on lines 44 and 45 a desired blend of fuel can be dispensed into the common outlet.

FIG. 6 shows diagrammatically one form of electronic controller which can be used with and calibrated to the particular dispensing system to which it is attached for forming a fluid metering system. A pulse generator 50 operating at a main clock repetition frequency is connected to a series 46 of binary divide units giving outputs in the ratios of 8:4:2:1, corresponding for example to delivery rates of, say, 32, 16, 8 and 4 liters per minute. The desired flow rate is selected by a switch 51. The pulse output selected by the switch 51 is fed through line 52 into a chain 53 of binary divide circuits giving outputs with pulse repetition rates of ½, ¼, ⅛, . . . of the main clock frequency. The propagation delay through these circuits is such that the whole pattern of pulses will interlace and output pulses from one circuit will not coincide in time with output pulses from any other circuit. Three patterns of pulses are derived by selection from this chain of binary circuits and are used in three different control functions. The first selector unit 54 comprising a group of OR gates connected to the outputs of the chain 53 by a series of selector switches 54A is arranged to drive a volume indicator 55, for example with an indication which records one liter for each 100 pulses received, the selector unit 54 is calibrated to receive pulses on lines respectively giving 128, 64 and 8 pulses in a given time and pass these to the indicator through a binary divide circuit 47. The second selector unit 56 comprising a group of OR gates connected to the outputs of the chain 53 by a series of selector switches 56A is a price selection unit and passes a further selected number of pulses in that same given time through two binary divide circuits 48 to the input of a price indicating means 57, for example it is arranged to supply 75 pulses per liter if the price were 7.5 pence per liter. The third selector unit 58 comprising a group of OR gates connected to the outputs of the chain 53 by a series of selector switches 58A is arranged to supply the appropriate number of pulses in that same given time to the dispensing system, for example to pulse the coils of valves 16; for example a nominal 120 pulses per liter for a metering system whose cylinders have a nominal displacement per stroke of 16.16 ml. is supplied through a binary divide circuit 49 to the coils of the valves 16 via line 49A. Where there are two or more displacement assemblies these must either be chosen to have approximately the same dispensing volume per stroke or the unit 58 duplicated and separately calibrated for each.

The zeros of the units 48 can be altered to read one or more instead of zero allowing a rounding up or down adjustment so that a whole number price will be displayed.

The zero of the unit 49 can also be altered to read one or more so as to make the dispensing system more accurate at higher volumes.

Where blending of different fluids is desired the output from unit 58 is alternatively supplied to a blending selector unit indicated generally at 60. A rotary wafer switch 61 has two oppositely extending contact arms 62, 63 each engageable with a respective set of five contacts numbered 0 to 4 inclusively. The arrangement is such that if one arm engages the associated contact 4 the other will engage its zero contact, the other combinations being 3-1, 2-2, 1-3, 0-4 so that five possible blend selections are available each giving the same total number of pulses. The output from unit 58 is supplied on lines 64 to the respective No. 4 contacts of the switch 61 and to a first binary divide circuit of each of two units 65, 66. Each of the units 65, 66 comprises two binary divide circuits and an OR gate and has respective contacts numbered 3, 2 and 1. The wafer contact arms 62, 63 are respectively connected through binary divide circuits 67, 68 to output lines 70, 71 driving the coils of valves 16 which are respectively controlling the dispensing from different sources such as high and low octane fuel reservoirs. The switch 61 is linked to the selector switch 56A so that the price indication is linked to the blend selected. Clearly other forms of selector unit for obtaining desired ratios of pulses on the lines 70, 71 can be devised, such as that described hereafter with reference to FIG. 10.

Pulses from either selector unit 54 or selector unit 56 can be continuously compared with values set up in a unit 165 such that at coincidence the pulse generator 50 is stopped, thus providing a pre-set dispensed quantity, either volume or value.

FIG. 7, parts A, B, C and D shows an alternative form of dispensing system in which the piston and cylinder assembly and valve means have been combined into a single unit in which the valving is carried out by rotation of the piston. Referring first to FIGS. 7A and 7B, the cylinder is shown at 700 with a free piston 710 arranged to sweep a volume of about 25 milliliters at each stroke. The piston is formed along its length opening to its cylindrical surface with four elongate apertures in the form of slots, a first two opposite ones of which slots 72 are connected via longitudinally extending channels 73 to one end face 74 of the piston. The other two opposite slots 76 are connected by respective channels 77 to the other end face 75 of the piston. The slots 76 are spaced at 45° from the respective slots 72. The cylinder 700 is formed substantially centrally of its length with eight equi-angularly spaced ports divided into four alternating sets 80 and 81. The set of ports 80 are arranged to be connected to an outlet for dispensed fluid; two opposite ones 81A of the set of ports 81 are arranged to be connected to one source such as a reservoir of high octane fuel and the other two opposite ones 81B of the set of ports 81 are arranged to be connected to another source such as a supply of low octane fuel.

It will be seen that in the position shown in FIG. 7A the source of high octane fuel is connected through the ports 81A, the apertures 76 and the channels 77 to the end face 75 of the piston 710 so that the pressure of this liquid has driven the piston fully to the left. The end face 74 of the piston is connected through the channels 73, the slots 72 and two of the ports 80 to the outlet so that fuel which was to the left of the piston has been dispensed through the outlet. Rotation of the piston through 45° in an anti-clockwise direction (as indicated by arrow A in the diagram FIG. 7B) will bring the apertures 72 into register with the ports 81B to connect the left hand end 74 of the piston to the supply of low octane fuel, the pressure of this fuel then serving to drive the piston to the right in the figure and displace the fuel previously on the right of the piston out through the channels 77, the slots 76 and other ports 80. At the end of this stroke the left hand side of the cylinder will be full of low octane fuel. Had the piston been rotated 45° clockwise (that is in the direction of the arrow C in diagram 7B) the apertures 72 would have been in register with the ports 81A and have received high octane fuel. It will be seen from any one dispensing position rotation through 45° in one direction connects the end of the piston to a low octane fuel supply and rotation in the other direction connects that end of the piston to a high octane fuel supply.

Referring now particularly to FIGS. 7C and 7D the piston and cylinder assembly of FIG. 7A is incorporated in a pistol type dispenser with the cylinder surrounded by a manifold 82 one end of which is connected to supply pipes 83A, 83B for example for high and low octane petroleum respectively and the other end of which is connected to an outlet nozzle 84, the nozzle and inlet lines being connected to the ports 80, 81 respectively by passages extending through the manifold.

The piston is rotated by a system of magnetic pole pieces and coils similar to the arrangement of a conventional stepping motor such system being shown diagrammatically in FIGS. 7C and 7D. The piston has embedded therein eight equi-angularly spaced magnets 85 alternate ones being north (N) and south (S) (as seen in FIG. 7C these are shown for ease of illustration adjacent one end of the piston, they will in fact be centrally of the piston between the slots). The manifold 82 has embedded therein eight pairs of magnetisable elements 86 the pairs being equi-angularly spaced and the elements 86A of each pair being magnetisable by a first coil 87, the other elements 86B of each pair being magnetisable by a second coil 88.

In one standing position of the piston, both elements of each pair 86 are magnetised in the same direction but alternate pairs are north and south as seen diagrammatically in the left hand portion of FIG. 7D. In order to rotate the piston the direction of the current through first one coil and then the other coil is changed this serving to first reverse the polarity of the element 86A of each pair and then reverse the polarity of the element 86B of each pair. If coil 87 is pulsed before coil 88 the piston will rotate in one direction and if coil 88 is pulsed before coil 87 the piston will rotate in the other direction. This is shown in FIG. 7D where first coil 87 is pulsed to change the direction of magnetisation of elements 86A as seen in the centre of the figure and then coil 2 is pulsed to change the direction of magnetisation of elements 86B causing the piston to rotate through 45° to the position shown at the right of the figure when it has aligned itself with the changed magnetic poles 86.

The ratio of pulses which turn the piston to connect it to one source and turn it to connect it to the other source will determine the blend of fuel.

If it is not required to blend several types of fuel but to dispense only one fuel, all the ports of the set 81 are connected to the same reservoir and the piston can be formed with eight apertures alternately opening to opposite end faces. Clearly other arrangements of apertures and ports can be envisaged.

Another form of dispensing assembly is shown in FIG. 8. In this arrangement the valves are moved in response to movement under the fluid pressure of the piston of the displacement assembly to change over as the piston reaches the end of its stroke. An interlock is provided to lock the piston in position at the end of each stroke and the pulses from the controller serve to release the interlock. Referring to FIG. 8 a piston 100 moves in a cylinder 101 in which there are two pairs of ports, an inlet port 102A and an outlet port 103A on one side of the piston and an inlet port 102B and an outlet port 103B on the other side of the piston. Valve members 104A and 104B are associated with the respective pairs of ports. A piston rod 105 integral with the piston 100 carries pairs of spaced stops, one pair 106A and 107A associated with the valve member 104A and the other pair 106B and 107B to operate the valve member 104B. The piston rod extends out of the cylinder and is formed with a pair of spaced grooves 108, 109 associated with an interlock detent 110 biassed towards the grooves but withdrawable away from the grooves on energisation of a coil 111 therearound. The coil is arranged to receive the pulses from a control system such as that of FIG. 6.

In operation in the position shown the piston is moving to the right in the FIG. 8 under action of pressurized fluid entering through the inlet port 102A and displacing fluid through the outlet port 103B. As the piston continues to move further to the right from the position shown the stops 107A, 107B will move the valve members 104A, 104B to the right to gradually close the inlet port 102A and the outlet port 103B until a position is reached at which these ports are just closed and the outlet port 103A and inlet port 102B will start to be opened by further movement of the piston to the right. This further movement is provided by the momentum of the piston and on this further movement the detent

110 drops into the recess 108 to prevent the piston returning to the left. On withdrawal of the detent 110 in response to a pulse through the coil 111 the pressure now exerted on the right hand side of the piston 100 as a result of pressurized fluid connection through the port 102B will start to drive the piston to the left until a postion is reached in which the ports 102A and 103B are again just opened and the detent 110 has located in the groove 109.

Another embodiment of dispensing system is shown in FIG. 9 in which instead of a piston and cylinder assembly a diaphragm arrangement connected to poppet valves is used. A flexible diaphragm 110 extending across a cylinder 111 is movable between the position shown in full line and the position shown in broken line. The cylinder 111 has two ports 112, 113 connected through poppet valves 114, 115 respectively to a supply of pressurised fluid to be dispensed and has two outlet ports 116, 117 connected respectively through poppet valves 118, 119 to a common outlet. The poppet valves are spring loaded to a closed position and can be moved to an open position by energisation of their respective coils 120 in response to pulses on respective lines 121. In the arrangement shown the inlet valve 115 on one side of the diaphragm is open and the outlet valve 118 on the other side of the diaphragm is also open, the other two valves being shut. Pulses will act to alternately open these two valves and close the other two and then reverse the system.

It will be appreciated that many types of valve system may be used for example slide valves, poppet valves, plate valves, rotary valves with electric or fluidic, direct or indirect control and that in each system control means can be provided by the controller to prevent a return stroke of the displacement member of the or each displacement assembly until its previous displacement stroke has been completed.

FIG. 10 shows an alternative blending unit for providing a substantially continuos incrementally varying blend ratio over a given range. In this arrangement the desired ratios of pulses designed to dispense a range of blends of high and low octane fuels are preprogrammed into a programme unit 130 which additionally contains information concerning the value of the programmed blend. Each time the blend to be dispensed is changed this unit feeds the programmed information via a line 131 to a shift register 132, part 132A of which then contains the information relating to the value, part 132B of which then contains the appropriate pulse pattern for the low grade fuel and part 132C of which then contains the appropriate pulse pattern for the high grade fuel. The output from part 132A is combined with the pulses selected to drive the indicating means so as to indicate the value of fluid dispensed. Parts 132B and 132C of the shift register have outputs connected to two sets of "and" gates, set 133B being associated with the low grade fuel and set 133C being associated with the high grade fuel. These sets of "and" gates each receive on line 134 the selected pulse train from the selector unit 58 of the controller. The outputs from the sets of "and" gates 133B and 133C are respectively supplied to sets of "or" gates 135B and 135C the outputs of which on lines 136B and 136C respectively are supplied to the dispensing system to cause the appropriate ratio of dispensing strokes of low and high grade fuel.

FIG. 11 shows a petroleum dispensing assembly incorporating a metering system. A pump island 140 has buried therein a supply line 141 from the source of pressurized fuel. This line extends through a hollow column 142 which supports a box 143 containing the control system and indicating means. Buttons indicated generally at 144 are provided for selecting the required blend and presetting the desired volume or value to be dispensed. The supply line and control system are connected through a knuckle joint 145 at the top of the column 142 to a pivoting arm 146 at the end of which is carried the dispensing system including the displacement assemblies and valve means all contained in a meter box 147. The hose pipe 148 extends from this system and at its end carries a pistol grip 150 having a switch lever 151 for initiating a dispensing operation (i.e. starting the pulse generator) and for controlling the flow rate. A holster 152 on the column 142 receives the pistol in its non-dispensing position and is fitted with an auto reset swtich operated on return of the pistol after a dispensing operation. For blended dispensing the dispensing system should either be at the pistol end of the hose have two separate channels. By removing the conventional pumping assembly from the conventional pump housing, a single narrow column 142 replaces the conventional pump housing of considerably larger cross-section. In addition neither a hose cock valve nor a pre-set valve is obligatory with this system and the initial and final pressure in the hose i.e. at the beginning and end of delivery are the same thus avoiding dilation problems and allowing use of a light-weight hose.

Although the embodiments described have particularly related to dispensing and blending of petroleum, the metering system is equally applicable to dispensing other liquids such as milk or to dispensing gases such as domestic gas supplies and to mixing totally different products such as petroleum and lubricating oil.

What is claimed is:

1. A fluid metering system comprising fluid supply means arranged to supply under pressure fluid to be metered, a fluid outlet line for metered fluid, a dispensing system having at least one displacement assembly including a chamber and a displaceable member dividing the chamber and movable therein under the influence of the pressure of said fluid to perform dispensing strokes and a valve system by which the parts of the chamber on each side of the displaceable member are connectable to said fluid supply means and to said outlet line for metered fluid, indicating means for indicating the volume of fluid dispensed and a common controller operable electrically to control said valve system to cause said displaceable member to execute complete dispensing strokes and to provide data derived independently of the dispensing strokes directly to the indicating means whereby the indicating means indicates the quantity of fluid metered to said outlet line.

2. A metering system according to claim 1 in which said displacement assembly has a swept volume less than the permitted volumetric error for the minimum delivery of fluid to be dispensed by the system.

3. A metering system according to claim 1 in which the swept volume of said displacement assembly is less than 30 milliliters.

4. A metering system according to claim 1 in which said displacement assembly is a piston and cylinder as-

sembly of the free piston type with the piston to be driven by the pressure of fluid to be dispensed.

5. A metering system according to claim **1** wherein the fluid is petroleum.

6. A fluid metering system comprising two sources of fluid under pressure, a dispensing system, operable to execute dispensing strokes under the influence of pressure fluid, valve means operable to selectively connect the dispensing system to either one of said two sources, an outlet line connected to said dispensing system, control means for supplying electrical pulses to control the valve means and actuate the dispensing system to dispense fluid from the connected source and blend selector means for adjusting the ratio of the number of pulses controling dispensing from one of said sources relative to the number of pulses controling dispensing from the other of said sources.

7. A fluid metering system comprisng fluid supply means arranged to supply under pressure fluid to be metered, a fluid outlet line for metered fluid, a dispensing system having at least one displacement assembly including a chamber and a displaceable member dividing the chamber and movable therein under the influence of the pressure of said fluid to perform dispensing strokes and a valve system by which the parts of the chamber on each side of the displaceable member are connectable to said fluid supply means and to said outlet line for metered fluid, indicating means for indicating the volume of fluid dispensed and a common controller operable electrically to control said valve system and to provide data directly to the indicating means, said controller including a pulse generator, first selector means operable to select the number of pulses to be supplied to the valve system to cause said displaceable member to execute complete dispensing strokes, and second selector means for independently selecting the number of pulses to be supplied to said indicating means whereby the indicating means indicates the quantity of fluid metered to said outlet line.

8. A metering system according to claim **7** in which the indicating means includes a first part for indicating the valve of fluid dispensed and a second part for indicating the volume of fluid dispensed each of the parts being driven by independently selectable numbers of the pulses.

9. A fluid metering system comprising fluid supply means arranged to supply under pressure fluid to be metered, a fluid outlet line for metered fluid, a dispensing system having at least one displacement assembly including a piston and cylinder assembly, and a valve system comprising a first set of apertures formed in the cylindrical surface of the piston and opening to one end face thereof and a second set of apertures formed in said cylindrical surface and opening to the other end face of the piston, at least one set of two ports formed in angularly spaced relationship in the wall of the cylinder with one port of the set connected to said outlet line and the other port of the set connected to said fluid supply means, and means for relatively rotating the piston and cylinder to connect the first and second sets of apertures alternately to the first and second ports of said set of ports, indicating means for indicating the volume of fluid dispensed and a common controller operable to control said valve system to cause said piston to execute complete dispensing strokes and to provide data directly to the indicating means whereby the indicating means indicates the quantity of fluid metered to said outlet line.

10. A metering system according to claim **8** including a second set of two ports formed in the wall of the cylinder in angular spaced relationship to each other and to the ports of the first set with one port of said second set connected to said outlet line, and the other port of said second set connected to a second fluid supply means whereby relative rotation between the piston and cylinder in one direction connects one end of the piston to one supply means and relative rotation in the other direction connects that end of the piston to said second supply means.

11. A metering system according to claim **8** in which one of the apertures and the ports are in the form of slots extending parallel to the length of the piston and cylinder assembly.

12. A metering system according to claim **8** in which the means for causing relative rotation of the piston and cylinder is electro-magnetic.

13. A fluid metering system comprising first and second fluid supply means each arranged to supply under pressure fluid to be metered, a fluid outlet line for metered fluid, first and second displacement assemblies each including a chamber and a displaceable member dividing the chamber and movable therein under the influence of fluid pressure to perform dispensing strokes, a first valve system by which the parts of the chamber of said first assembly on either side of the displaceable member thereof are connectable to said first fluid supply means and to said outlet line for metered fluid, a second valve system by which the parts of the chamber of said second assembly on either side of the displaceable member thereof are connectable to said second fluid supply means and to said outlet line for metered fluid, indicating means for indicating the volume of fluid dispensed, a common controller operable electrically to control said first and second valve systems and to provide data directly to the indicating means, and blend selector means electrically connecting said controller to said first and second valve systems, said controller including a pulse generator, first selector means operable to select the number of pulses to be supplied through said blend selector means to said first and second valve systems to cause the displaceable members of the first and second displacement assemblies to execute complete dispensing strokes, and second selector means for selecting independently the number of pulses to be supplied to said indicating means, whereby the indicating means indicates the quantity of fluid metered to said outlet line and said blend selector means being operable to select the proportion of the pulses selected by the first selector means for operation of the first valve system and the first displacement assembly and the proportion of the pulses selected by the first selector means for operation of the second valve system and the second displacement assembly.

14. A fluid metering system according to claim **12** in whch the blend selector means is operable incrementally to vary the ratio of said proportion of pulses selected for operation of the first valve system with respect to said proportion of pulses selected for operation of said second valve system.

15. A fluid metering system comprising fluid supply means arranged to supply under pressure fluid to be metered, a fluid outlet line for metered fluid, a dispensing system having at least one displacement assembly including a chamber and a displaceable member dividing the chamber into two parts and movable therein under the influence of the pressure of said fluid to perform dispensing strokes, and a valve system connected between the two chamber parts and the fluid supply and the outline line and operable in response to a first electrical signal to place one chamber part alternately in communication with said fluid supply means and said outlet line and simultaneously to place the other chamber part alternately in communication with said outlet line and said fluid supply means to cause the displaceable member to make complete dispensing strokes driving metered volumes of fluid through the outlet line, indicating means operable by a second electrical signal to indicate the volume of fluid dispensed, and a controller including means for deriving said first and second electrical signals independently of said dispensing strokes and supplying said first and second electrical signals independently to said valve system and said indicating means respectively.

16. A fluid metering system comprising fluid supply means arranged to supply under pressure fluid to be metered, a fluid outlet line for metered fluid, a dispensing system having at least one displacement assembly including a chamber and a displaceable member dividing the chamber and movable therein under the influence of the pressure of said fluid to perform dispensing strokes and a valve system by which the parts of the chamber on each side of the displaceable member are connectable to said fluid supply means and to said outlet line for metered fluid, indicating means for indicating the volume of fluid dispensed, a common controller operable electrically to control said valve system to cause said displaceable member to execute complete dispensing strokes and to provide data derived independently of the dispensing strokes directly to the indicating means whereby the indicating means indicates the quantity of fluid metered to said outlet line and means for adjusting the number of dispensing strokes performed by the displaceable member relative to the data provided directly to the indicating means whereby the metering system may be calibrated.

17. A fluid metering system comprising two sources of fluid under pressure, a dispensing system operable to execute dispensing strokes under the influence of pressure fluid, valve means operable selectively to connect the dispensing system to either one of said two sources, an outlet line connected to said dispensing system, indicating means for indicating the volume of fluid dispensed, a common controller operable electrically to activate the dispensing system to execute complete dispensing strokes under the influence of the fluid pressure of the connected source to dispense fluid from the connected source to said outlet line and to provide data derived independently of the dispensing strokes directly to the indicating means whereby the indicating means indicates the quantity of fluid dispensed to said outlet line and blend selector means operable to control said valve means to select the ratio of the number of dispensing strokes performed under the influence of the fluid pressure of one of said two fluid sources to the number of dispensing strokes performed under the influence of the fluid pressure of the other of said two fluid sources whereby a selected mixture of fluids is dispensed.

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