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Bruce-Sanders

[11] **3,781,534**

[45] **Dec. 25, 1973**

[54] **LIQUID DELIVERY SYSTEMS**

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[21] Appl. No.: **256,788**

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May 27, 1971 Australia 5013

[52] **U.S. Cl.** ..... **235/151.34,** 235/92 FL, 222/76, 222/16

[51] **Int. Cl.** **G06f 15/20,** G06f 15/46, B67d 5/06

[58] **Field of Search** ..... 235/151.34, 92 FL; 222/76, 14, 16, 17

[56] **References Cited**

UNITED STATES PATENTS

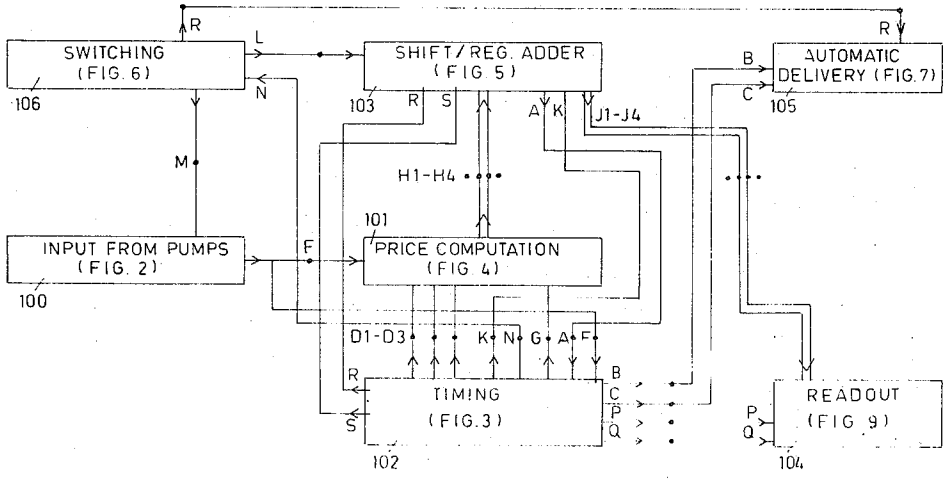
3,598,283	8/1971	Krutz	222/14
3,402,851	9/1968	Ciotti et al.	222/76 X
3,448,895	6/1969	Mesh	222/76 X
3,593,883	7/1971	Robbins	222/16
3,187,939	6/1965	Hayes	222/76 X
3,199,727	8/1965	Romanowski	235/151.34 X
3,666,928	5/1972	Burke et al.	235/151.34 X
3,633,000	1/1972	Bickford	234/151.34 X
3,612,393	10/1971	Jones	234/151.34 X

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Assistant Examiner—Edward J. Wise
Attorney—Donald D. Jeffery

[57] **ABSTRACT**

A liquid-delivery pump system includes a sensor providing a pulse for each fractional volume delivered, a pre-set digital circuit representing the price of said volume, means for passing signals representing said price to up-date a digital register each time said pulse is produced and a digital read-out for said register. A plurality of pumps may use a common register by time-division. Button-selected total value or total volume may be dispensed or the pump or pumps may be coin-operated.

7 Claims, 9 Drawing Figures



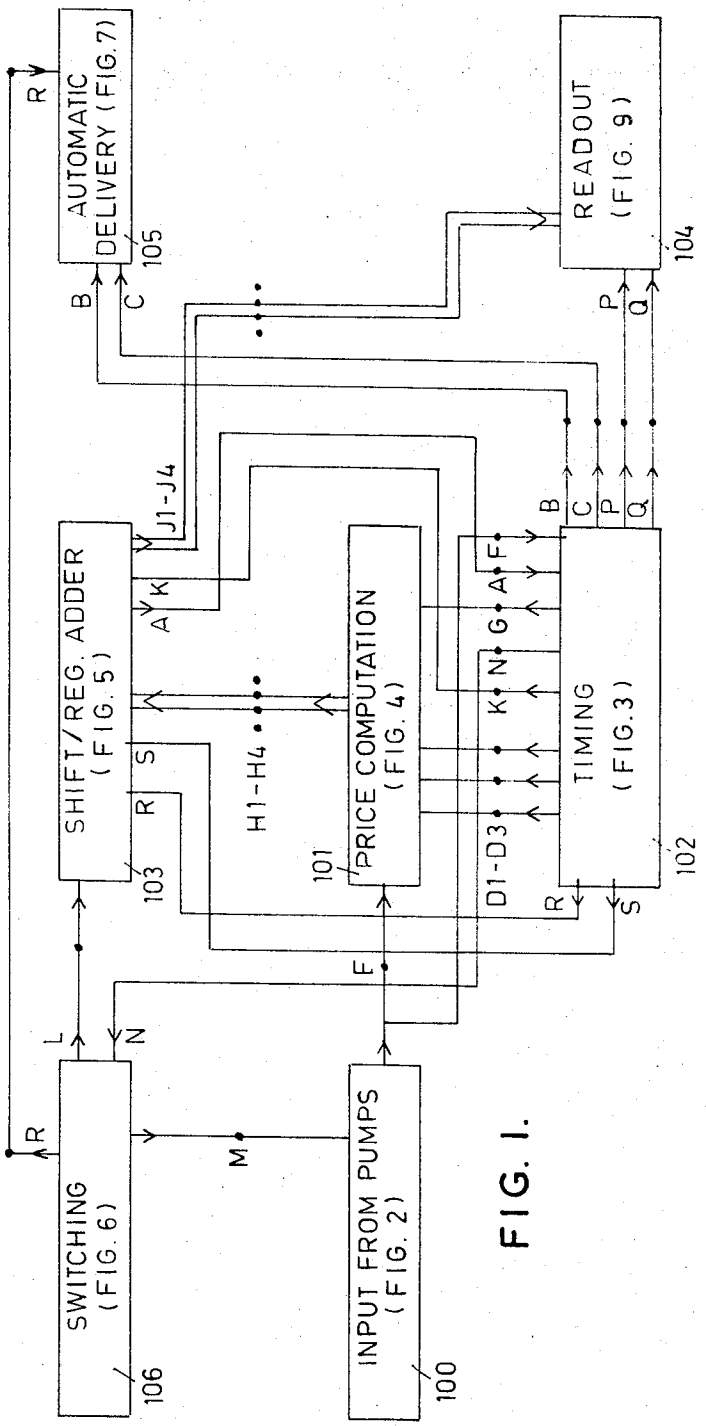

AUTOMATIC DELIVERY (FIG.7)
105
READOUT (FIG. 9)
104
SHIFT/REG. ADDER (FIG. 5)
103
PRICE COMPUTATION (FIG. 4)
101
TIMING (FIG.3)
102
SWITCHING (FIG. 6)
106
INPUT FROM PUMPS (FIG. 2)
100
J1-J4
H1-H4
D1-D3
R
S
A
K
B
C
P
Q
F
G
N
L
M

FIG. 1.

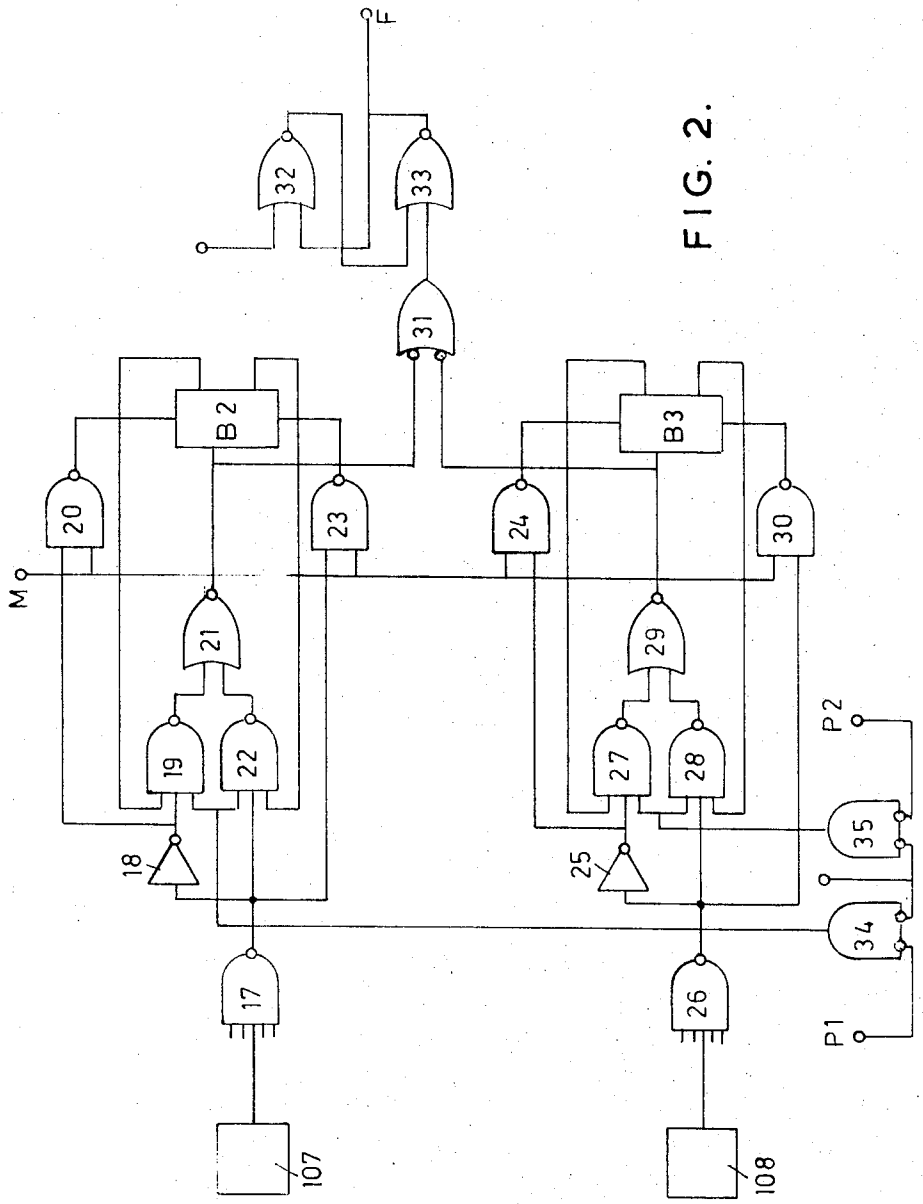
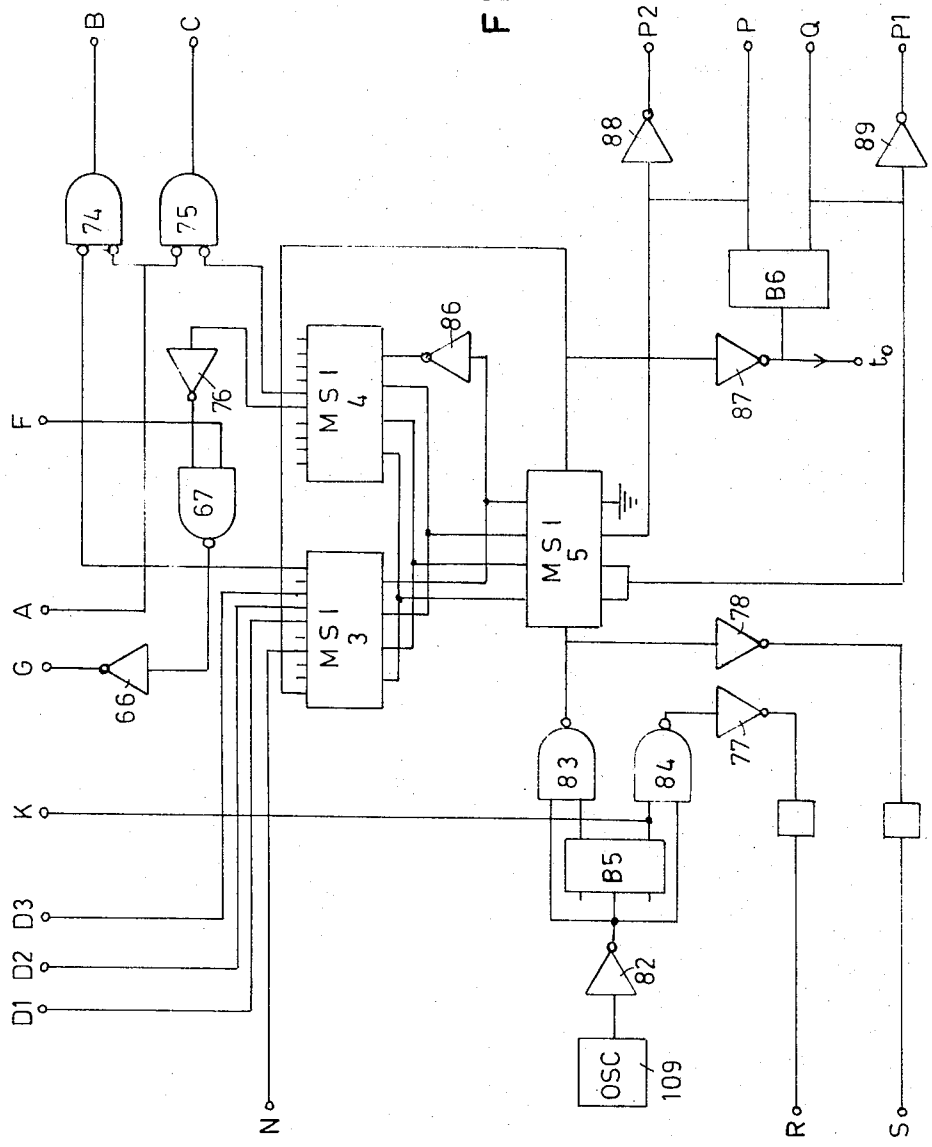

F
32
33
31
B2
B3
20
23
24
30
M
21
29
19
22
27
28
P2
35
18
25
34
17
26
P1
107
108

FIG. 2.

FIG. 3.


B
C
74
75
P2
P
Q
P1
88
89
B6
86
76
MSI 4
F
67
MSI 5
87
t_o
A
G
MSI 3
66
78
77
83
84
K
B5
D3
D2
D1
82
OSC
109
N
R
S

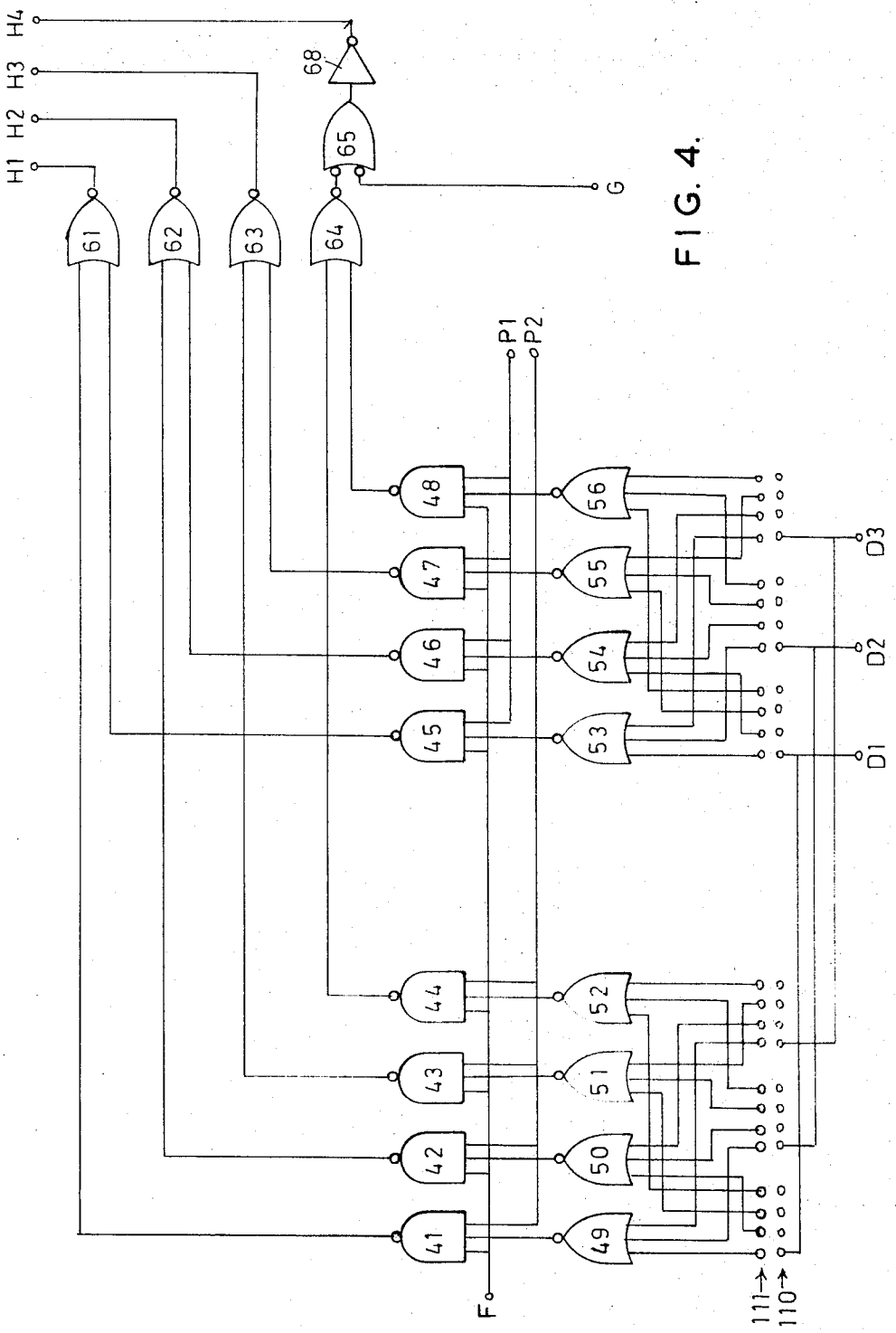

H4
H3
H2
H1
68
65
G
61
62
63
64
P1
P2
48
47
46
45
56
55
54
53
D3
D2
D1
44
43
42
41
52
51
50
49
F
111
110

FIG. 4.

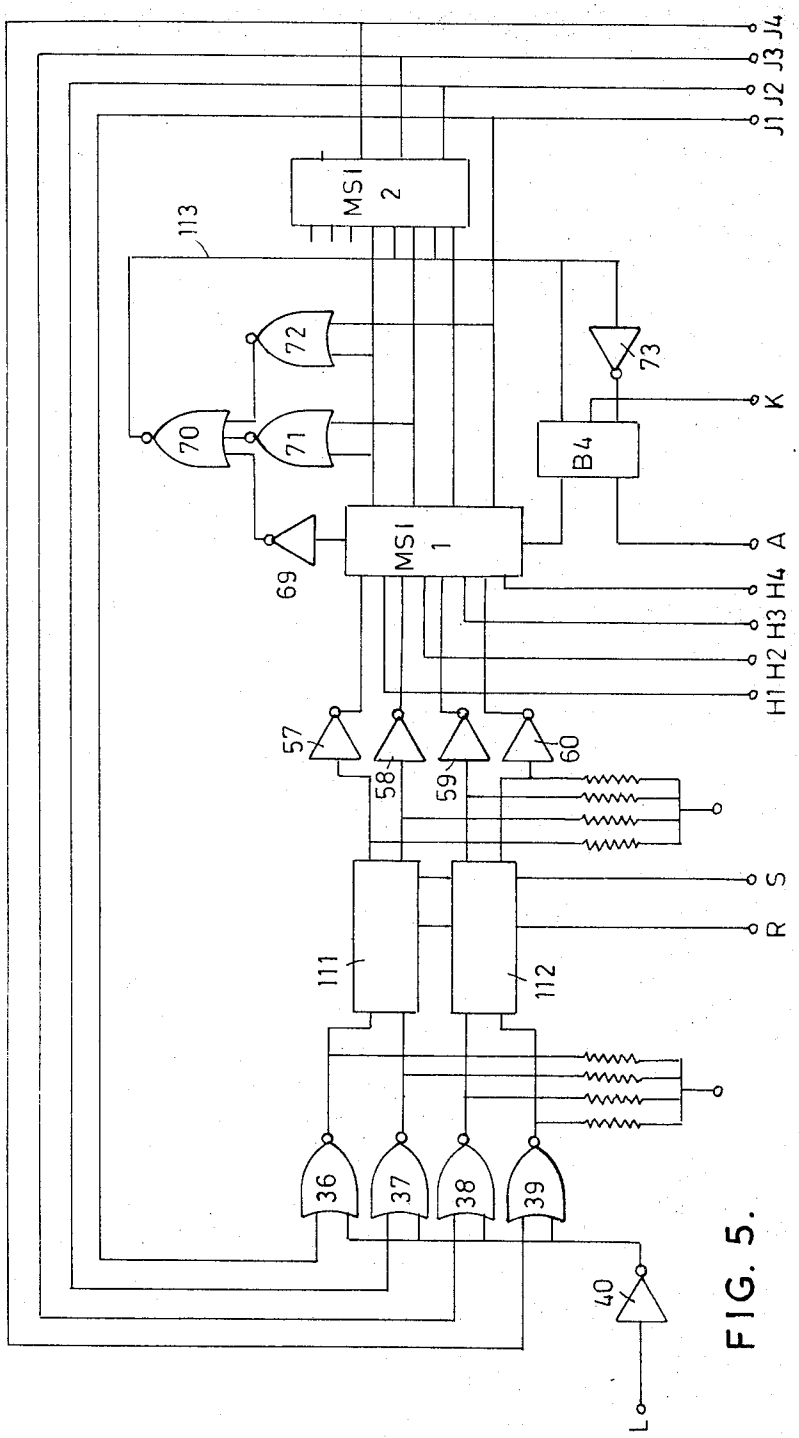
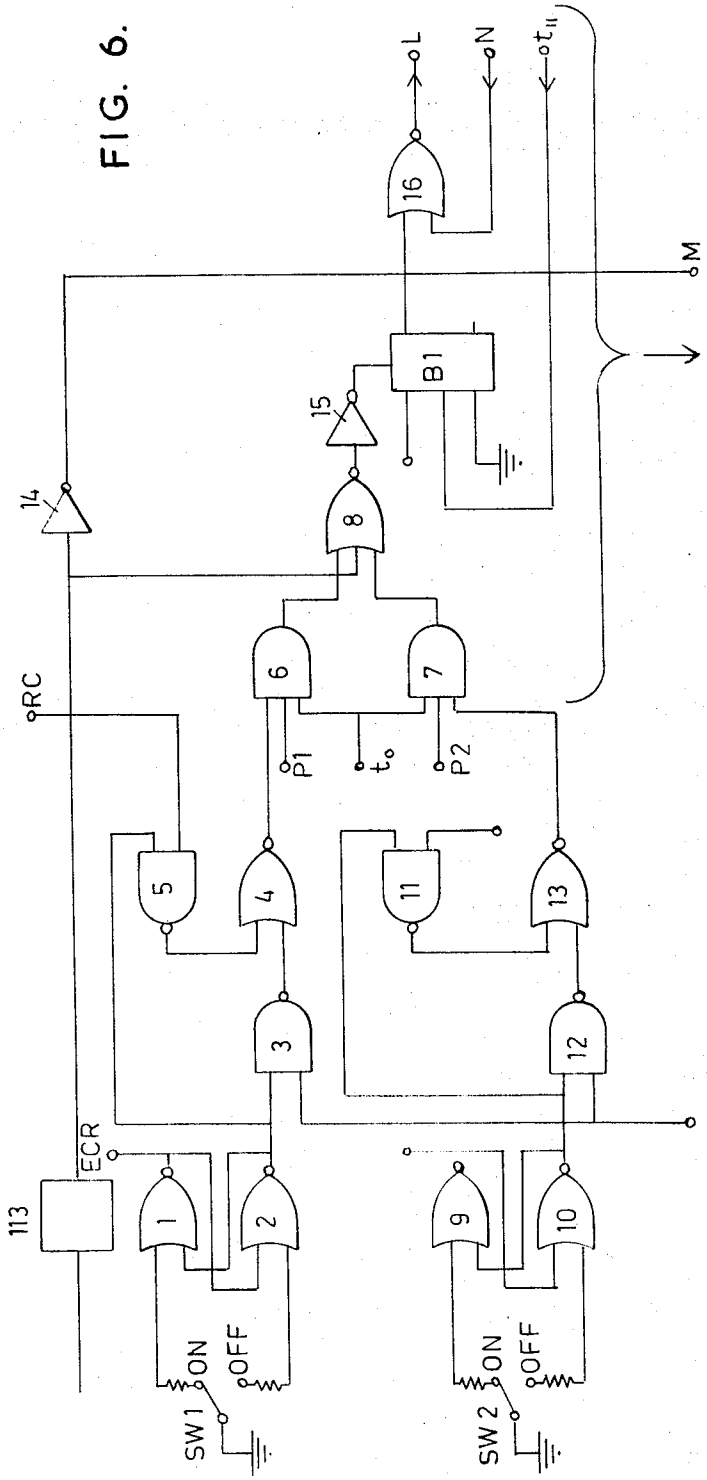

J1 J2 J3 J4
MSI 2
113
72
73
K
70
71
B4
MSI 1
69
A
H1 H2 H3 H4
57
58
59
60
R S
111
112
36
37
38
39
40
L

FIG. 5.

FIG. 6.


L
N
t_{11}
16
M
B1
15
14
8
6
7
RC
P1
t_0
P2
5
4
11
13
3
12
ECR
113
1
2
9
10
ON
OFF
SW1
SW2

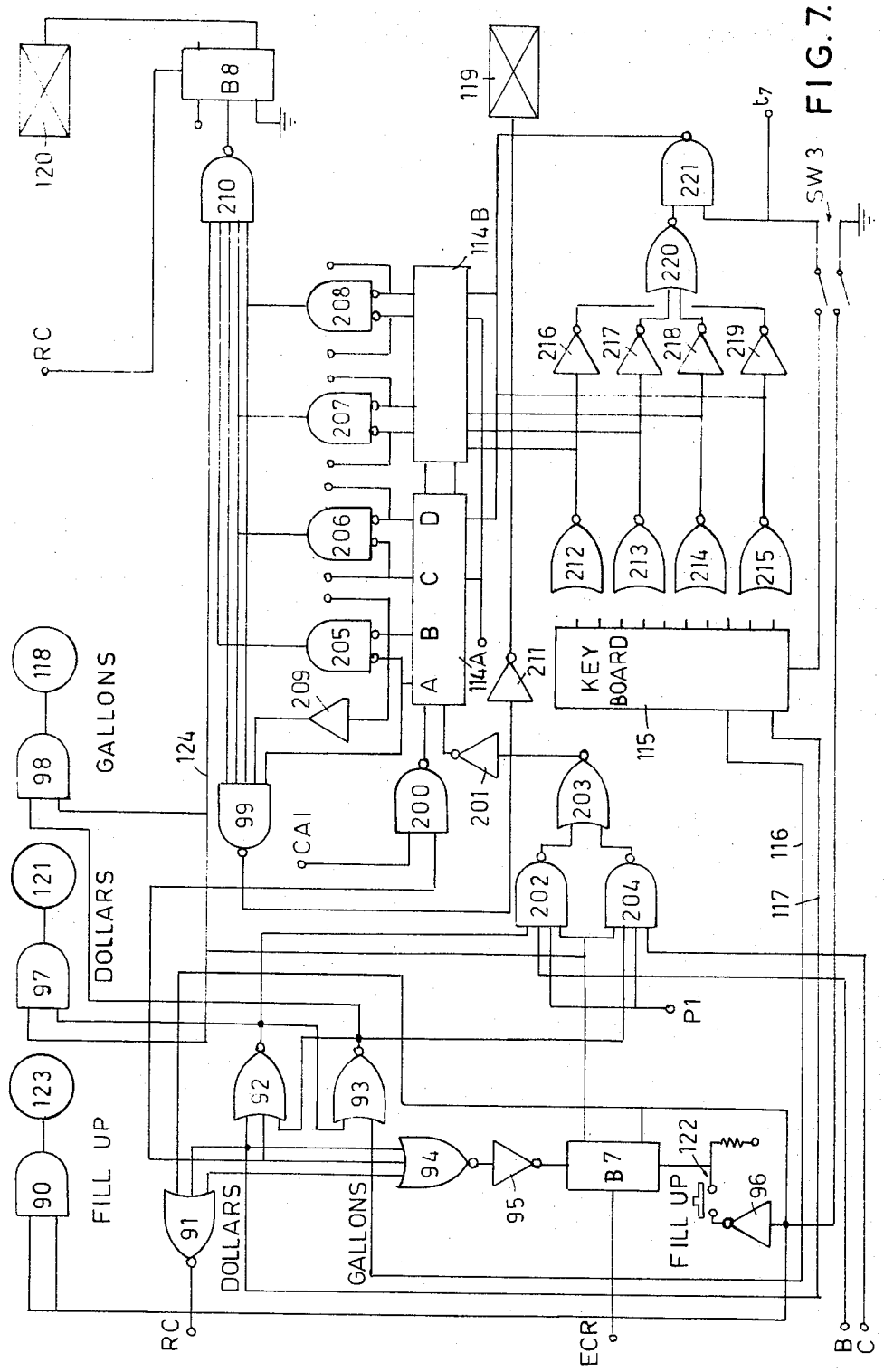
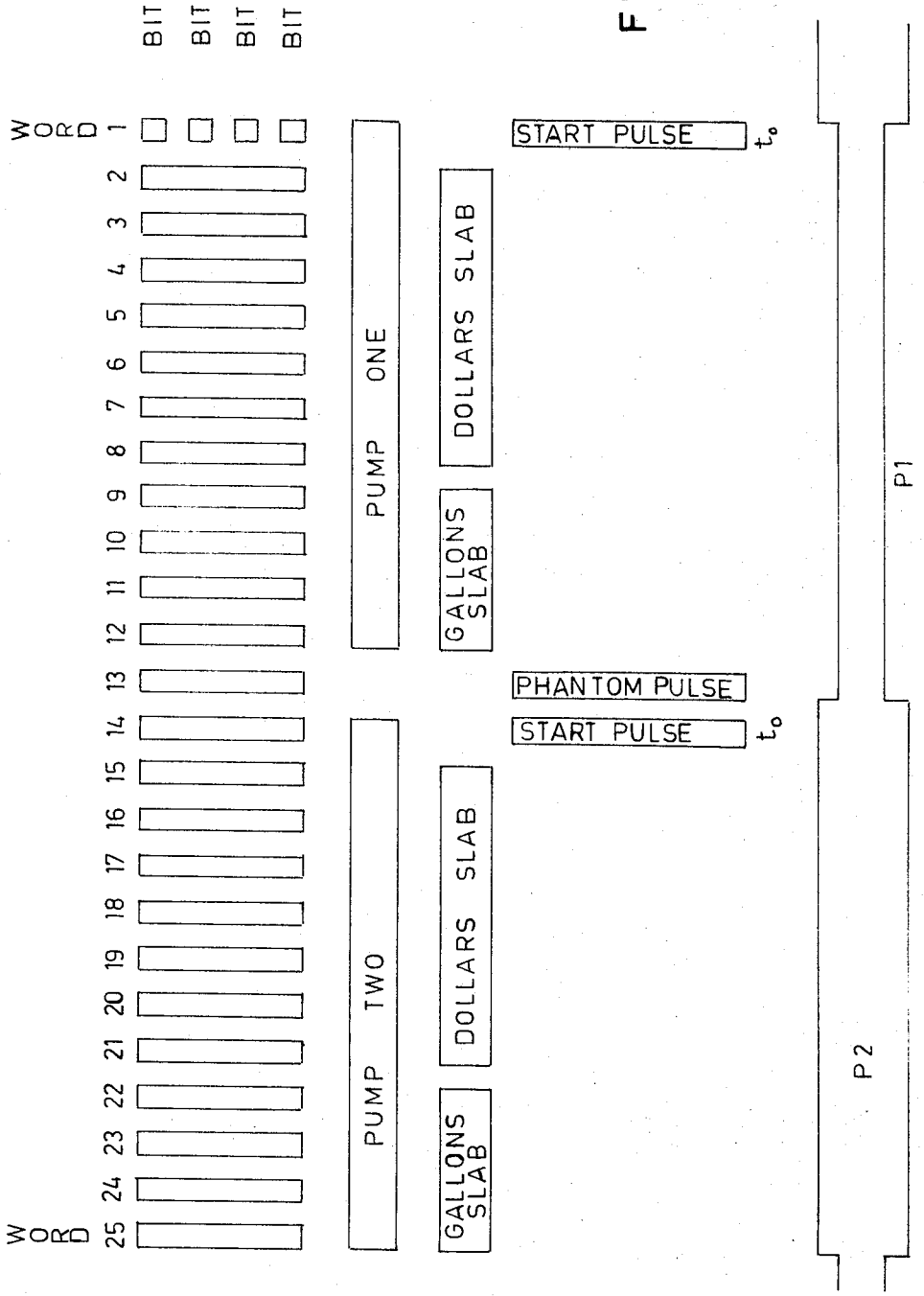

120
B8
210
RC
208
207
206
205
209
114B
A B C D
114A
211
119
221
220
216
217
218
219
212
213
214
215
KEY BOARD
115
SW 3
t7
118
98
GALLONS
121
97
DOLLARS
123
90
FILL UP
124
99
CAI
200
201
203
202
204
117
116
P1
92
93
94
95
B7
122
96
91
DOLLARS
GALLONS
FILL UP
RC
ECR
B
C

FIG. 7.

FIG. 8.


BIT 8
BIT 4
BIT 2
BIT 1
WORD
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
WORD
PUMP ONE
PUMP TWO
DOLLARS SLAB
GALLONS SLAB
DOLLARS SLAB
GALLONS SLAB
START PULSE
to
PHANTOM PULSE
START PULSE
to
P1
P2

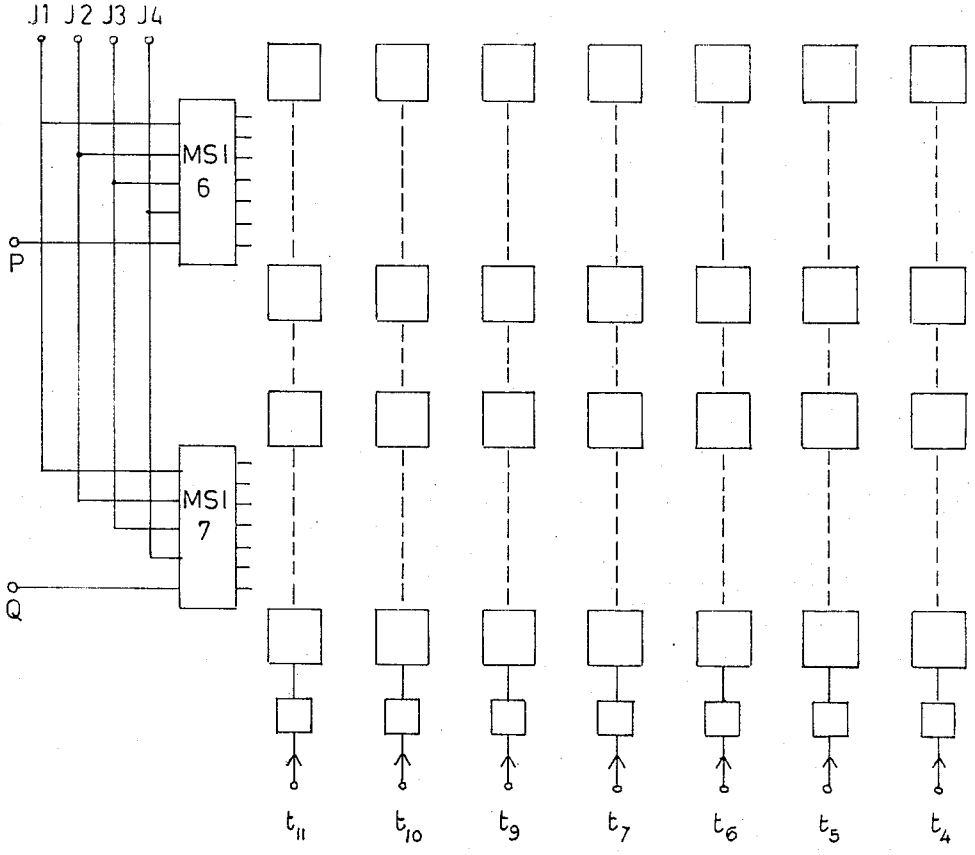


FIG. 9.

LIQUID DELIVERY SYSTEMS

This invention relates to gasoline and like pumps, in which liquid is delivered and the cost and volume is recorded on a visual display.

All such pumps include a metering and delivery section and a computation and display section.

The latter section converts revolutions of the metering pump shaft into gallons delivered and cost and feeds these quantities into the display.

Present systems are of three main types:

1. Types using gears of adjustable ratio between pump and computation unit and/or between the computation unit and the displays.

2. Types using mechanical or electronic systems to perform extra functions such as "coin-in-the-slot" delivery. These systems are built around existing computor heads, with a great deal of interconnection and interfaces which tend to be unreliable.

3. Types with which the customer serves himself, the total cost being presented on the display.

This invention relates to improved computing and display systems in such liquid pumps.

It is an object of the invention to provide purely electronic computing and display systems, easily mated with existing metering and delivery mechanisms.

It is a further object to provide such systems which are easily expanded to provide auxiliary automatic features of operation.

A further object of the invention is to economize on computing equipment by using time-sharing from several pumps to the one computor and thence to separate read-outs.

In general the invention comprises a liquid delivery pump system including;

a mechanical delivery pump;

a metering shaft on said pump;

a sensor on said shaft deriving a pulse for each predetermined incremental volume delivered; a digital multiple-gate circuit the outputs thereof being preset to represent the decimal price of each said incremental volume;

a digital adder;

a register up-dated from said adder;

a coupling circuit to pass a signal representing said price from the outputs of said digital circuit to said adder;

an input to said coupling circuit from said sensor whereby said price signal is passed to said adder on receipt of each said pulse;

and a digital visual read-out showing the total instantaneous price held in said register and the total instantaneous volume delivered.

In order that the invention may be better understood, a specific embodiment will be described in which two gasoline pumps share the major part of the computation circuitry.

The accompanying figures illustrate this embodiment.

FIG. 1 shows a block diagram of the system with interconnections,

FIG. 2 shows the inputs from two pumps,

FIG. 3 shows in detail the timing circuits,

FIG. 4 shows in detail the price computation circuits,

FIG. 5 shows the shift-register and adder circuits,

FIG. 6 shows the switching control circuits,

FIG. 7 shows the automatic delivery circuits,

FIG. 8 is a time diagram of some of the pulses used in the system, and

FIG. 9 shows diagrammatically the read-out circuits of the system.

Referring first to FIG. 1, the input unit **100** receives a train of pulses from each pump a single pulse of each train representing a hundredth gallon delivery from its pump.

Two interleaved signals on line F are passed to price computation unit **101** and timing unit **102.**

Timing unit **102** produces time-division pulse trains fed via line D1–D3 to unit **101.**

Unit **101** includes a plug-in unit producing a BCD three digit count representing the price of each (1/100) gallon in lines H1–H4 to the shift-register adder unit **103** whenever a pulse is received on line F.

Thus the total price is up-dated in unit **103** at each one-hundredth gallon dispensed.

The current total is fed via line J1–J4 to a visual read-out unit **104** for display of cost total and gallons total for each pump.

Unit **105** controls automatic dispensing functions whereby either:

a. A predetermined gallonage (set by push-buttons) may be dispensed;

b. A predetermined dollar value may be dispensed, also set by push-buttons;

c. The order "fill-up" can be executed; or

d. Coin-in-the-slot operation may be accomplished.

The switching unit **106** controls the on-off switching and function of the system.

Referring now to FIG. 2, **107** and **108** represent sensors for first and second pumps respectively. Each sensor may be a disc marked with alternate transparent and opaque sectors fixed to the metering shaft of the pump, a light source exciting a photo-electric detector during passage of each transparent sector.

The number of sectors are such that a pulse is produced for each (1/100) gallon dispensed.

If the metering shaft rotates 4 revolutions per gallon there will for example, be 25 transparent sectors.

Referring to sensor **107,** Schmitt trigger **17** squares the pulse, which is then applied direct to gate **22** and via inverter **18** to gate **19.** Gates **19, 22** thus receive opposite polarity signals. Both are strobed via gate **34** by a time pulse P1 during the time period allotted to the first pump. Signals from **19, 22** pass to gate **21** which drives flip-flop B2. The Q and $\overline{Q}$ outputs of B2 go back to inputs of **19, 22** respectively. By this means B2 controls the pulse produced and prevents drop-out of any pulse which may occur, say, as the timing signal P1 is coming on.

The circuit of sensor **108** is precisely similar with gates **27, 28, 29** and flip-flop B3, except that **27, 28** are strobed through **35** during the second pump time period by pulse P2.

The outputs of **21** and **29** drive gate **31** to set flip-flop **33, 32.** Lead F therefore presents alternate pulses in the P1 and P2 periods representing (1/100) gallon increments from the first and second pumps respectively.

Gates **20, 23** and **24, 30** are fed with a signal on line M on initial switch-on of the unit to clear the circuits.

Before considering the timing circuits of FIG. 3 and the price circuits of FIG. 4, reference is made to the time diagram of FIG. 8.

As will be explained below, a 25-bit four channel shift-register is used in computing.

Time is shared between pump one and pump two, each period having 12 four-bit words, representing digits. The gallons are represented by four digits (e.g. 13.42 gallons) and the dollar value by seven digits (e.g. $18.23456), the first digit in each P1 and P2 period being a "start pulse" (t_0) and a spare or " phantom" pulse occurring on word **13**, all as shown in FIG. **8**.

Referring to FIG. **3**, an oscillator **109** feeds a binary **B5** via inverter **82**. The Q and $\overline{Q}$ outputs of B5 feed gates **83, 84**, which each therefore produce half-frequency trains which are interleaved.

These are fed through **77, 78** respectively to produce pulses on lines R and S providing read-in and read-out signals to the shaft-register (FIG. **5**).

The signals from **83** pass to MSI-5, which is a divide-by-16 counter, and the output (the t_0 pulse) to the input of flip-flop **B6**. The Q and $\overline{Q}$ outputs of **B6** are fed back to MSI-5 to subtract 4 and 3 respectively from the 16 count.

The counter therefore counts **13** in the **P1** cycle and **12** in the **P2**, as indicated in FIG. **8**. The P1 and P2 pulses are taken out via gates **89, 88.**

The BCD count from MSI-5 goes to four-line to 10-line decoders MSI-3 and MSI-4, which give 16 pulses, with some outputs unused.

Outputs on lines **D1, D2** and **D3** give timing for words **2, 3** and **4** (FIG. **8**) in the **P1** cycle and words **15, 16** and **17** in the **P2** cycle, these being the decimal cents values.

Gate **74** is fed from MSI-3 with a pulse corresponding to the time of word **6** (FIG. **8**) which gives (1/10) dollar value. Gate **75** is similarly fed with word **10** pulse representing (1/10) gallon.

Both gates have input on line A from **B4** (FIG. **5**) indicating an up-date carry. A pulse occurs on line B for each (1/10) dollar increase in total and on Line C for each (1/10) gallon.

The pulse on N is the " phantom" pulse used in FIG. **6** for signalling the end of a period, while line G enters each (1/10) gallon up-date in the register through **67** which is enabled by pulse on Line F.

Turning to FIG. **4**, the lines **D1–D3** are applied in common to terminals **110** in groups of four. Between each group of terminals **110** and each group of terminals **111** a plug-in board or a thumb-wheel switch (not shown) sets in the decimal cents equivalent of (1/100) gallon (e.g. 424 if the price is 42.4 cents/gallon).

These BCD numbers are fed to gates **49–52** for pump two and to **53–56** for pump one and gates **49** through **56** provide one input to gates **41** through **48.**

Gates **41–44** are readied by the P2 pulse and gates **45–48** by the P1 pulse as shown.

The pulses F from the pump inputs are applied in common to all gates **41–48.**

The result is that each time a pulse F is received the price for (1/100) gallon is read-out via gates **61** through **64** to lines **H1** through **H4** to the shift-register adder (FIG. **5**).

The numbers for price on the plug-in boards or switches are also taken out to a visual read-out (not shown) on each pump giving the price per gallon.

It will be noted that any change in price can be entered merely by plugging in a different board, and that the two pumps may dispense different grades of petrol at different prices.

The line G (from FIG. **3**) reads in (1/10) gallons to the adder via **65, 68** and line **H4.**

FIG. **5** shows the shift-register and adder circuit. Two two-channel 25-bit shift-registers **111** and **112** operate together to give a capacity of 25 four-bit words circulating via MSI-1 MSI-2 the lines **J1–J4** and input gates **36–39.**

Incremental price inputs on lines **H1–H4** are fed into MSI-1 at the proper times in the cycles and add to the circulating four-bit words expressing the three least significant digits of the dollars total.

Up-dating can cause the two BCD numbers to become a binary number. To prevent this, gates **69** or **71–72** detect an "over 9" count and via **70** enter 6 in MSI-2. As is wellknown this converts the binary number back to BCD.

The carry signal on line **113** is passed to the input of binary **B4** and is transferred via the Q output to MSI-1 at the end of the add cycle for each word as indicated by a pulse on line K (from FIG. **3**) to add 1 to the next word.

Lines R and S (from FIG. **3**) act as shift signals in the register.

The added total is passed on lines **J1** through **J4** to the read-outs (FIG. **9**).

Signal on line L (from FIG. **6**) inactivates input gates **36–39** during either or both the **P1** and **P2** cycles if the corresponding pump is inoperative.

Referring to FIG. **6**, **SW1** and **SW2** are in the position shown when pump one or pump two is "ON" respectively (i.e. when the filler hose is taken off its hook on the bowser). Flip-flop **1, 2** reverses on change of switch **SW1** and via gates **3, 4, 6, 8** and **15** sets binary **B1** to produce a blocking pulse via gate **16** on line L during period **P1** if the pump is "OFF."

Similarly, switch **SW2** produces a pulse on line L during period **P2** when pump two is "OFF."

Unit **113** is activated by initial switch-on, say at the beginning of a day's trading, and sets gate **8,** and, via gate **14** passes a two second pulse signal on line M to gates **20, 23, 24, 30** (FIG. **2**) to clear the inputs and the register prior to the first delivery.

Pulse RC is generated by gate **91** (FIG. **7**) and automatically resets gates **5** and **4** on manual operation.

Signal on line N is the " phantom" pulse (FIG. **8**) and signals the end of a complete cycle.

FIG. **7** shows circuits for auxiliary functions of pump one. A similar circuit is provided for pump two.

Signals on lines B and C (from FIG. **3**) represent pulses for $ (1/10) and (1/10) gallon respectively. During period **P1,** these pulses are passed via **202** or **204** and **203, 201** to down-count counters **114A, 114B, 114A** represents cents and **10** cents and **114B** dollars or gallons.

Three functions are selectable from keyboard 115:

a. Dispensing of a selected number of gallons. Line **116** is activated by the "gallons" button and sets flip-flop **92, 93** to light gallons indicator **118** and enable gate **204.**

The "button selected" number of gallons is passed via gates **212–215** to set counter **114B** to this number. When delivery begins, counters **114A** and **114B** down-count in (1/10) gallon units.

Gates **205–208** detect non-zero numbers in the counter.

Gate **99** provides a signal when (1/10) gallon is reached which, via gate **211,** operates restrictor valve **119** to slow the delivery rate. Gate **210** detects " zero" gallons (i.e. when the selected number of gallons has

been delivered) and resets B8 and closes main valve 120 to stop the flow.

A signal on line RC (FIG. 6) is present on manual operation and when the "dollars" "gallons" or "fill-up" button is pressed, causes the register to be reset to zero prior to delivery.

b. Dispensing of a selected dollar value of gasoline. A signal on line 117 initiated by the "dollar" button on keyboard 115 resets flip-flop 92, 93, lights dollar indicator 121 and enables gate 202. Dollar value is set in counter 114B from keyboard 115 and the counters count down until restrictor valve 119 is actuated at $ (1/10) and main valve 120 at zero dollars as before.

c. Dispensing till "fill-up" of tank by pressing button 122. B7 is reset, disabling 202 and 204 lighting fill-up indicator 123 and directly controlling the main valve 120 via line 124 and gate 210. On conclusion of the "fill-up," a signal ECR from flip-flop 1, 2 (FIG. 6) returns B7 to its reverse state and switches off the main valve 120.

A fourth function (coin operation) is also available. Coin accept signals are applied from line CAI to gate 200 which sets the appropriate money amount in counter 114A and 114B. Count down to zero switches off as before. Switch SW3 (being open) latches out the keyboard and manual operation in coin-operated condition.

Gates 94, 95 reset B7 whenever dollars or gallons are ordered.

On "fill-up", a signal is applied to 3 and 12 (FIG. 6) to apply a continual reset via 36–39 to the register until either switch SW1 or SW2 is moved to "ON" position.

The read-outs, diagrammed in FIG. 9, consist of four banks of seven-segment decoders the upper two for the first pump and the lower two for the second.

Counter total on lines J1–J4 in BCD form are applied in parallel to MSI-6 and MSI-7 which are activated respectively during periods P1 and P2 by pulses P and Q (from FIG. 3).

The nixi tube anodes are energised in response to pulses applied as shown beneath each column so that they read in their correct timing.

The three left-hand digits read gallons (two digits) and tenths of gallons (one digit), for example 14.6 gallons. The four right-hand digits read dollars (two digits) and cents (two digits), for example $12.83.

The pulse regime repeats at some 80 times per second, so a flicker-free presentation occurs.

What I claim is:

1. A liquid-delivery pump system including:
a mechanical delivery pump;
a metering shaft on said pump;
a sensor on said shaft deriving a pulse for each predetermined incremental volume delivered;
a digital multiple-gate circuit, the outputs thereof being preset to represent the decimal price of each said incremental volume;
a digital adder;
a shift-register up-dated by said adder;
a coupling circuit to pass a signal representing said decimal price from the outputs of said digital circuit to said adder;
an input to said coupling circuit from said sensor whereby said price signal is passed to said adder on receipt of each said pulse; and
a digital visual read-out showing the total instantaneous price held in said register and the total instantaneous volume delivered.

2. A pump system as claimed in claim 1 including;
a manually-set selector selecting a required total value of liquid to be delivered;
a counter;
means controlled by said selector to set said required value into said counter;
a value pulse circuit actuated from said sensor pulses producing a pulse on delivery of liquid of value a predetermined fraction of said total value;
a connection between said pulse circuit and said counter to down-count said counter by said fractional value for each said pulse; a detector for detecting a zero value in said counter;
and means actuated by said detector for terminating liquid delivery when said zero value is detected.

3. A system as claimed in Claim 2 including;
a second detector for detecting a single said fractional value in said counter;
and means actuated by said second detector for reducing the rate of delivery from said pump on said single fractional value being detected.

4. A pump system as claimed in claim 1 including;
a manually-set selector selecting a required total volume of liquid to be delivered;
a counter;
means controlled by said selector to set said required volume into said counter;
a volume pulse circuit actuated from said sensor pulses producing a pulse on delivery of liquid of volume a predetermined fraction of said total volume;
a connection between said pulse circuit and said counter to down-count said counter by said fractional volume for each said pulse;
a detector for detecting a zero volume in said counter;
and means actuated by said detector for terminating liquid delivery when said zero volume is detected.

5. A system as claimed in claim 4 including;
a second detector for detecting a single said fractional volume in said counter;
and means actuated by said second detector for reducing the rate of delivery from said pump on said single fractional volume being detected.

6. A system as claimed in claim 1 including;
a manually-set "fill-up" selector;
and automatic means for terminating liquid delivery when "fill-up" is reached.

7. An assembly of a plurality of liquid-delivery pump systems, each system including:
a mechanical delivery pump;
a metering shaft on said pump;
a sensor on said shaft deriving a pulse for each predetermined incremental volume delivered;
a digital visual readout showing the total instantaneous price and the total instantaneous volume delivered;
a digital multiple-gate circuit, the outputs thereof being preset to represent the decimal price of each said incremental volume;
a digital adder;
a shift-register updated by said adder;

a coupling circuit to pass a signal representing said price from the respective outputs of said digital circuits to said adder;

an input to said coupling circuit from said sensor whereby said price signal is passed to said adder on receipt of each said pulse;

means for interleaving the sensor pulses of all said pumps to form a time-shared pulse train;

timing means for directing the sensor pulses of each said pump to said coupling means at appropriate times so that said register contains time-shared digital information of the instantaneous total delivery of each pump, and

control means on the separate read out of each pump actuated by said timing means to select and display the appropriate instantaneous total price and volume thereon.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,781,534 Dated December 25, 1973

Inventor(s) JAMES FREDERICK BRUCE-SANDERS

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent, on the front page, under item [30], delete the data of first foreign application mentioned, namely, "May 26, 1971 Australia .....5002" .

Signed and sealed this 16th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050,(10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334