United States Patent [19]

Young

[11] **3,727,796**

[45] **Apr. 17, 1973**

[54] **MOTOR FUEL DISPENSING APPARATUS**

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[73] Assignee: **Sun Oil Company of Pennsylvania,** Philadelphia, Pa.

[22] Filed: **Mar. 17, 1972**

[21] Appl. No.: **235,702**

Related U.S. Application Data

[62] Division of Ser. No. 85,612, Oct. 30, 1970, Pat. No. 3,705,596, which is a division of Ser. No. 850,901, Aug. 18, 1969, Pat. No. 3,587,337.

[52] **U.S. Cl.** **222/26**

[51] **Int. Cl.** **G01f 1/04**

[58] **Field of Search** 222/20, 17, 14, 25, 222/26, 135, 144.5

[56] **References Cited**

UNITED STATES PATENTS

3,087,651 4/1963 Bliss et al. ..... 222/17 X

Primary Examiner—Stanley H. Tollberg
Attorney—George L. Church et al.

[57] **ABSTRACT**

An apparatus for dispensing a selected grade of motor fuel (each grade having a different octane rating) has an array of operating pushbuttons a selected one of which may be actuated (the selection being made according to the grade of fuel desired) to start the dispensing operation. Upon the actuation of a pushbutton, certain instrumentalities in the apparatus are energized or released to (among other things) select gearing in the apparatus appropriate to the grade selected, reset the counter or register to zero, set a control valve to a predetermined position, and start up the pump to cause the dispensing of fuel to begin. All of these functions are performed automatically, i.e., without any further human intervention, once the pushbutton has been actuated. Upon the termination of the actual dispensing, electrical instrumentalities are automatically activated to carry out certain resetting operations, prior to the next dispensing operation. The dispensing apparatus is particularly suitable for a self-service type of operation.

5 Claims, 17 Drawing Figures

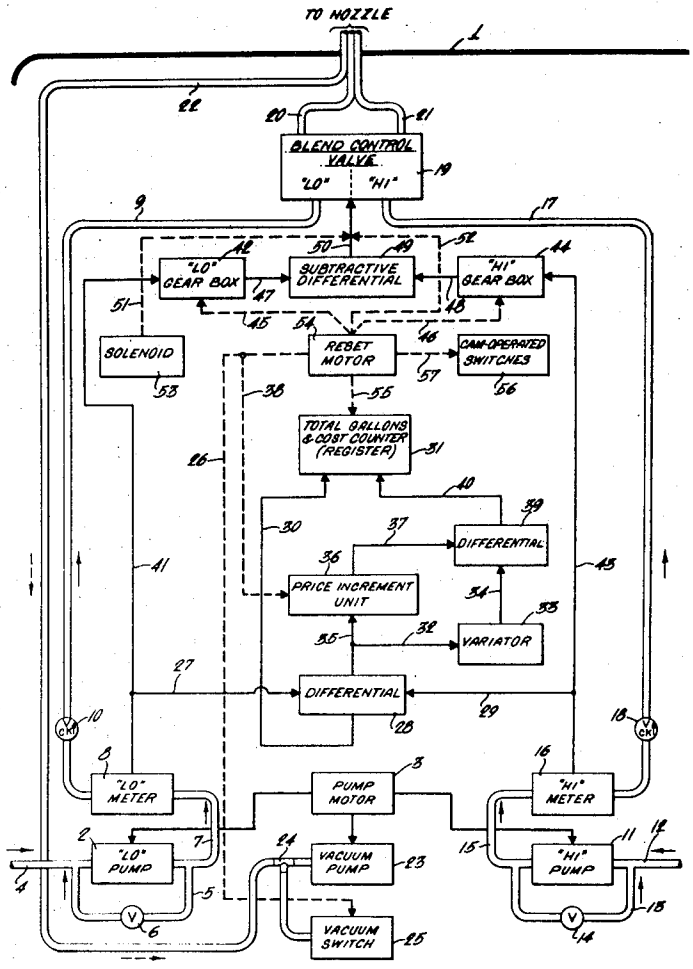


FIG. 1.

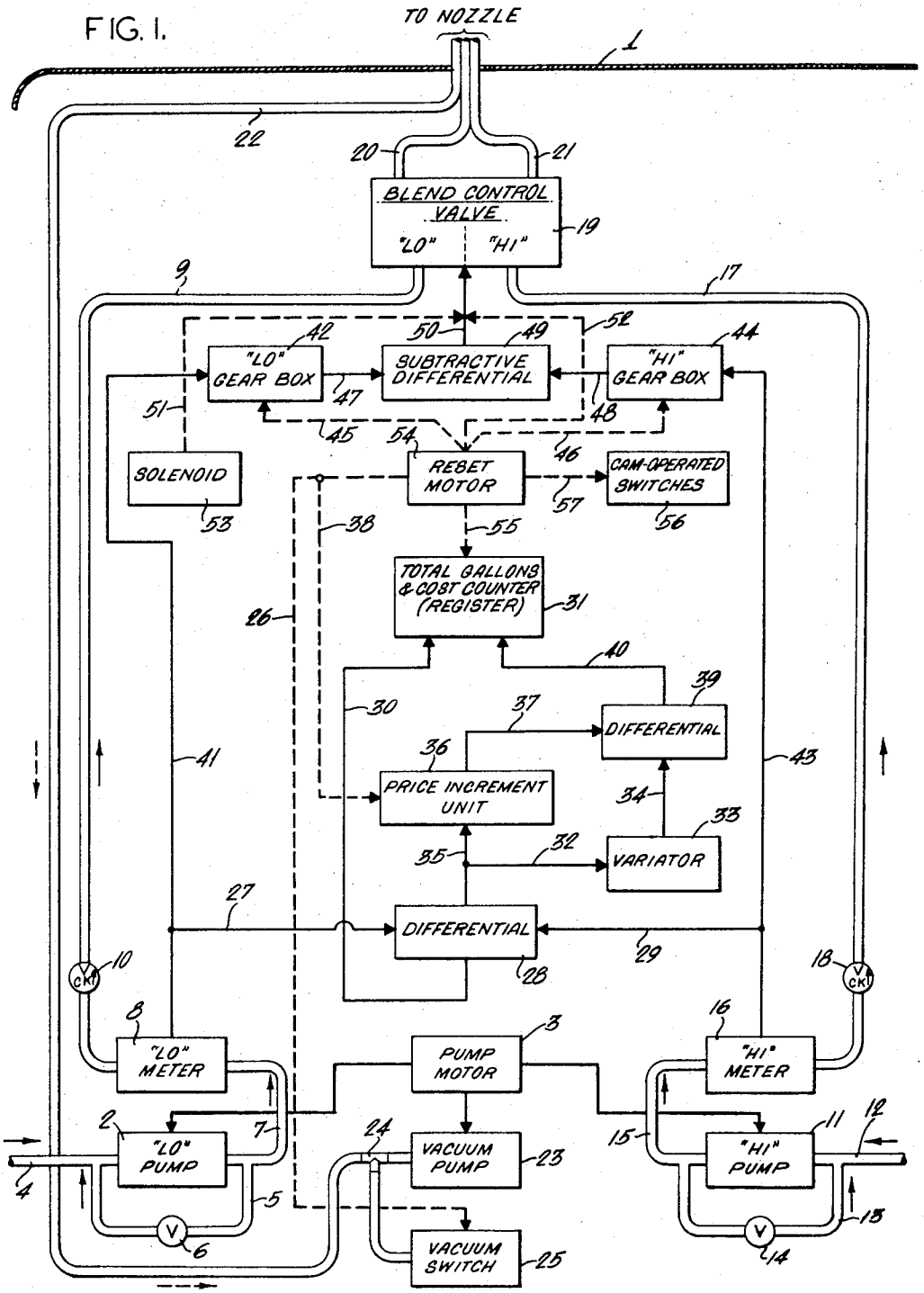

TO NOZZLE
1
22
20
21
BLEND CONTROL VALVE
"LO"
"HI"
19
9
17
"LO" GEAR BOX
42
SUBTRACTIVE DIFFERENTIAL
50
49
52
"HI" GEAR BOX
44
47
48
51
45
54
46
SOLENOID
53
REBET MOTOR
CAM-OPERATED SWITCHES
57
56
38
55
TOTAL GALLONS & COST COUNTER (REGISTER)
31
26
40
39
30
37
DIFFERENTIAL
41
43
36
PRICE INCREMENT UNIT
34
33
VARIATOR
35
32
27
DIFFERENTIAL
29
28
10
CK
18
CK
8
"LO" METER
PUMP MOTOR
3
16
"HI" METER
2
7
24
VACUUM PUMP
23
15
11
12
"LO" PUMP
"HI" PUMP
4
5
6
13
14
VACUUM SWITCH
25

FIG. 10.

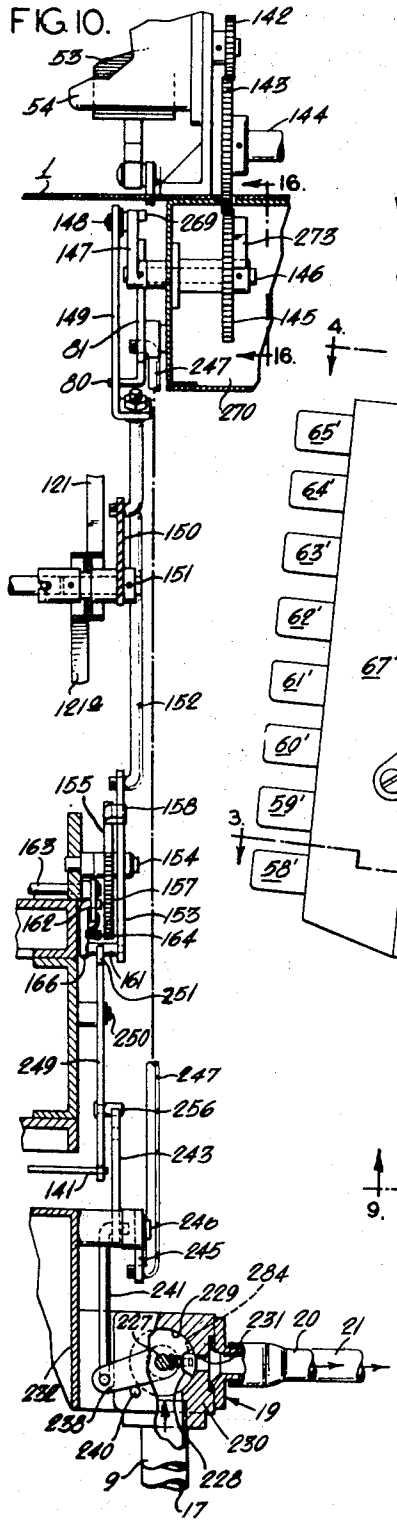


FIG. 2.

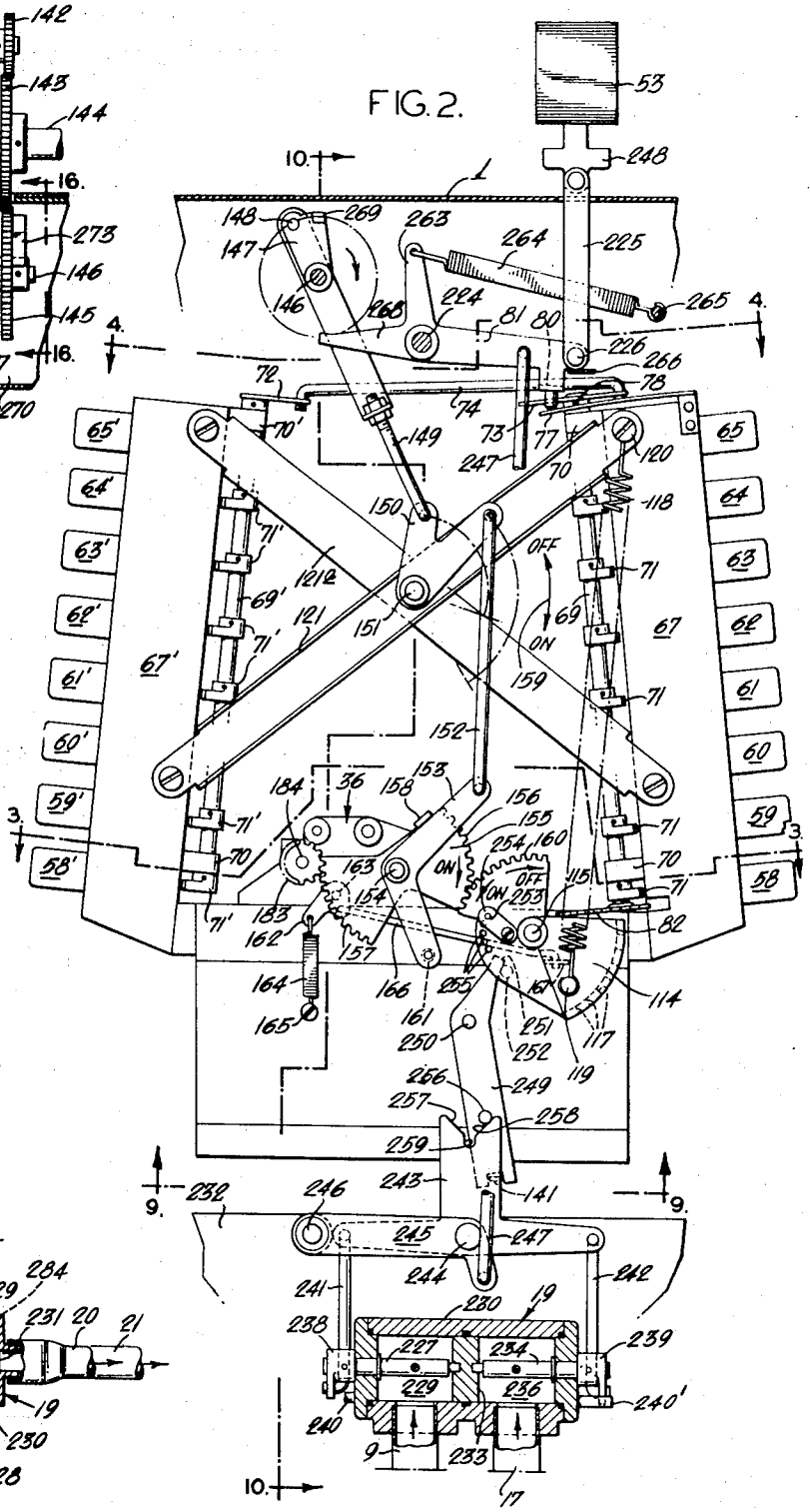


FIG. 3.

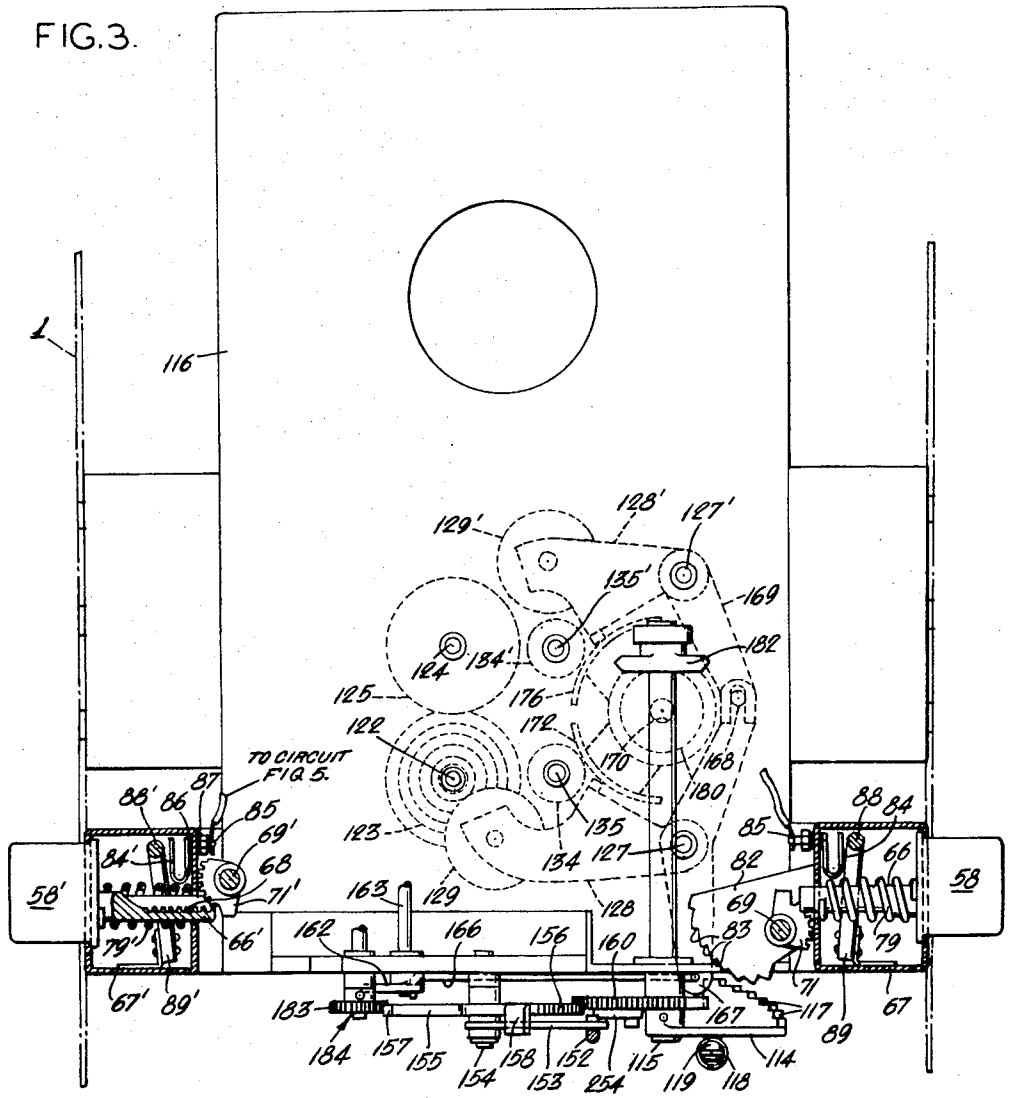

1
116
129'
128'
127'
135'
169
182
124
134'
125
176
172
122
170
168
180
TO CIRCUIT FIG 5.
88'
86
87
85
69'
68
71'
84'
58'
123
135
134
127
82
88
84
66
58
69
83
79
71
163
129
128
162
166
156
160
66'
79'
67'
89'
183
184
157
155
154
158
153
152
254
115
119
118
167
117
114
89
67

FIG. 4.

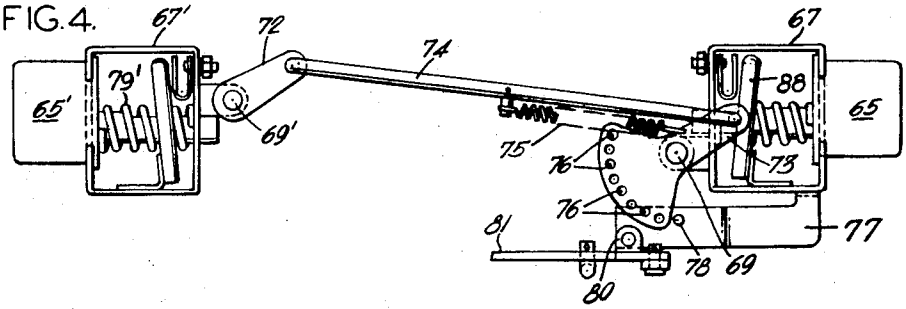

67'
72
74
67
79'
88
65'
65
69'
75
76
73
76
77
81
78
69
80

FIG. 5.

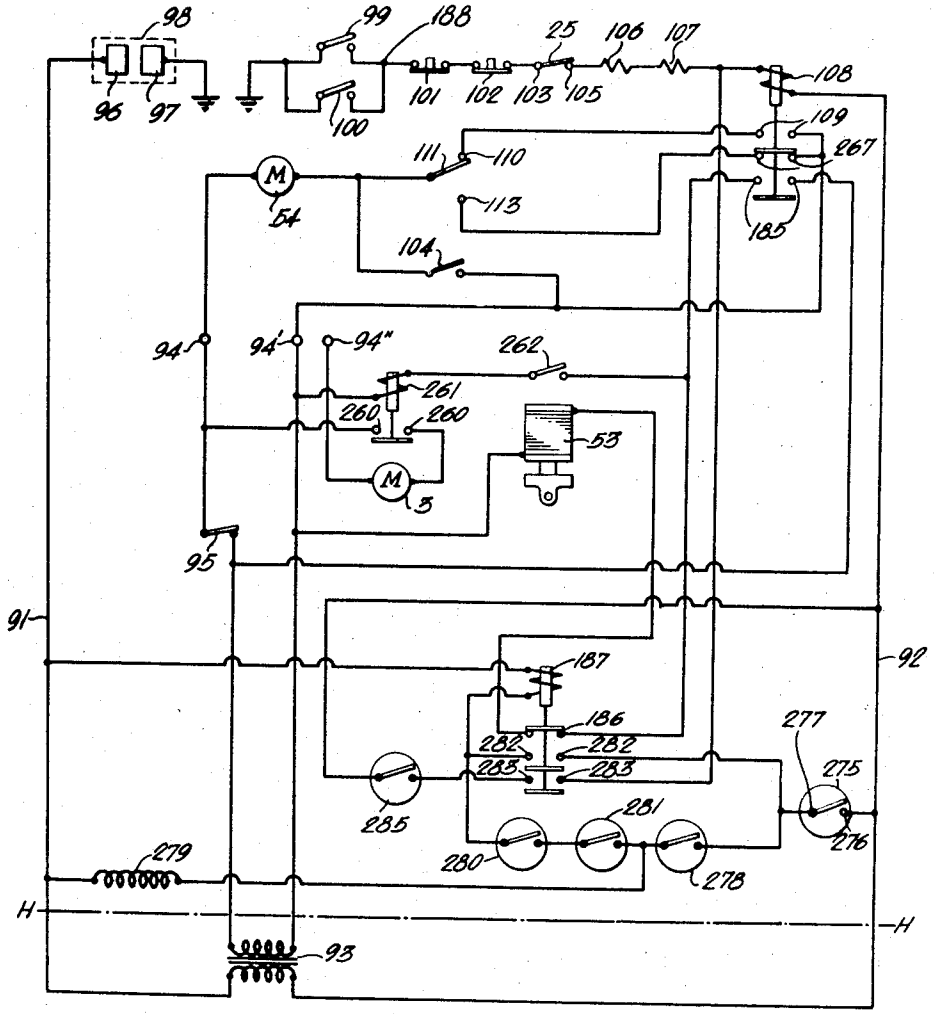

98
99
188
25
106
107
108
95
97
100
101
102
103
105
109
111
110
267
M
54
113
185
104
94
94'
94"
262
261
260
260
53
M
3
95
91
92
187
186
277
282
282
283
283
275
285
281
280
278
276
279
H
H
93

FIG. 17.

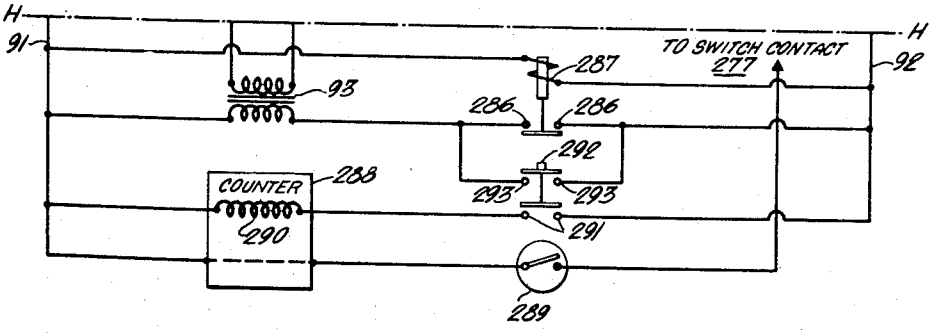

H
91
H
92
TO SWITCH CONTACT 277
93
287
286
286
292
COUNTER
288
290
293
293
291
289

FIG. 7.

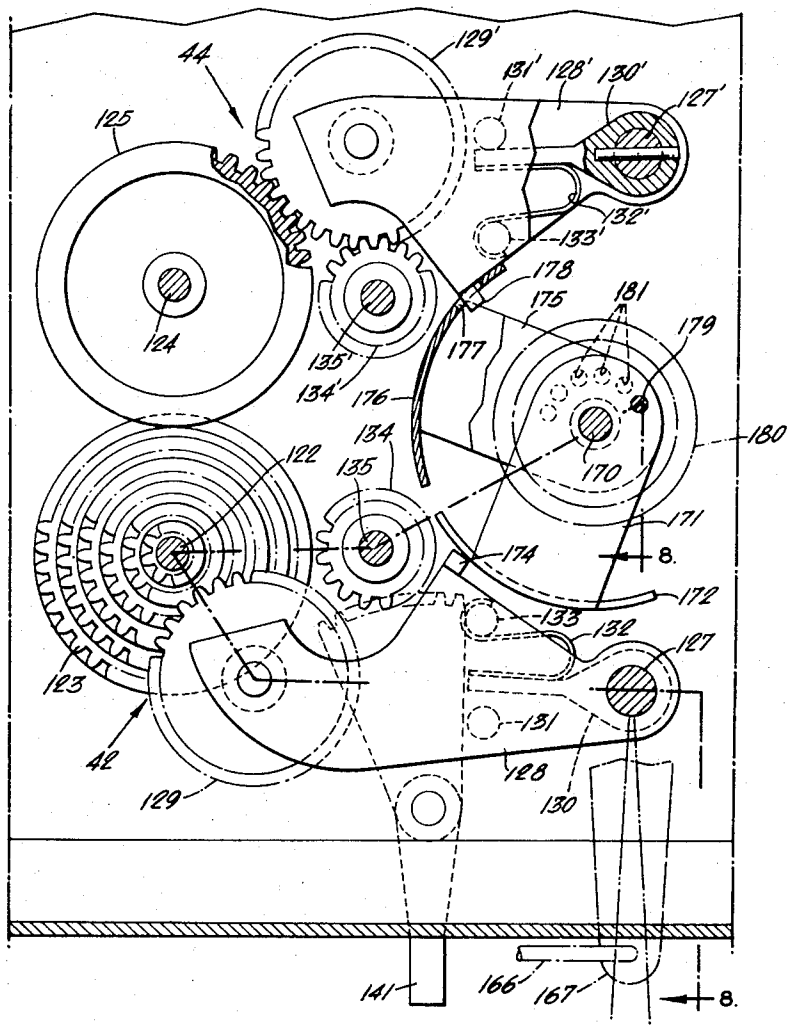
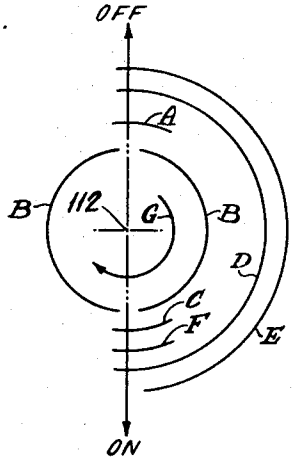

44
129'
131'
128'
130'
127'
125
132'
133'
178
175
181
179
124
135'
134'
177
176
180
134
122
135
170
171
174
8.
172
133
132
127
123
131
42
128
129
130
141
166
167
8.

FIG. 6.


OFF
A
B
112
G
B
D
C
F
E
ON

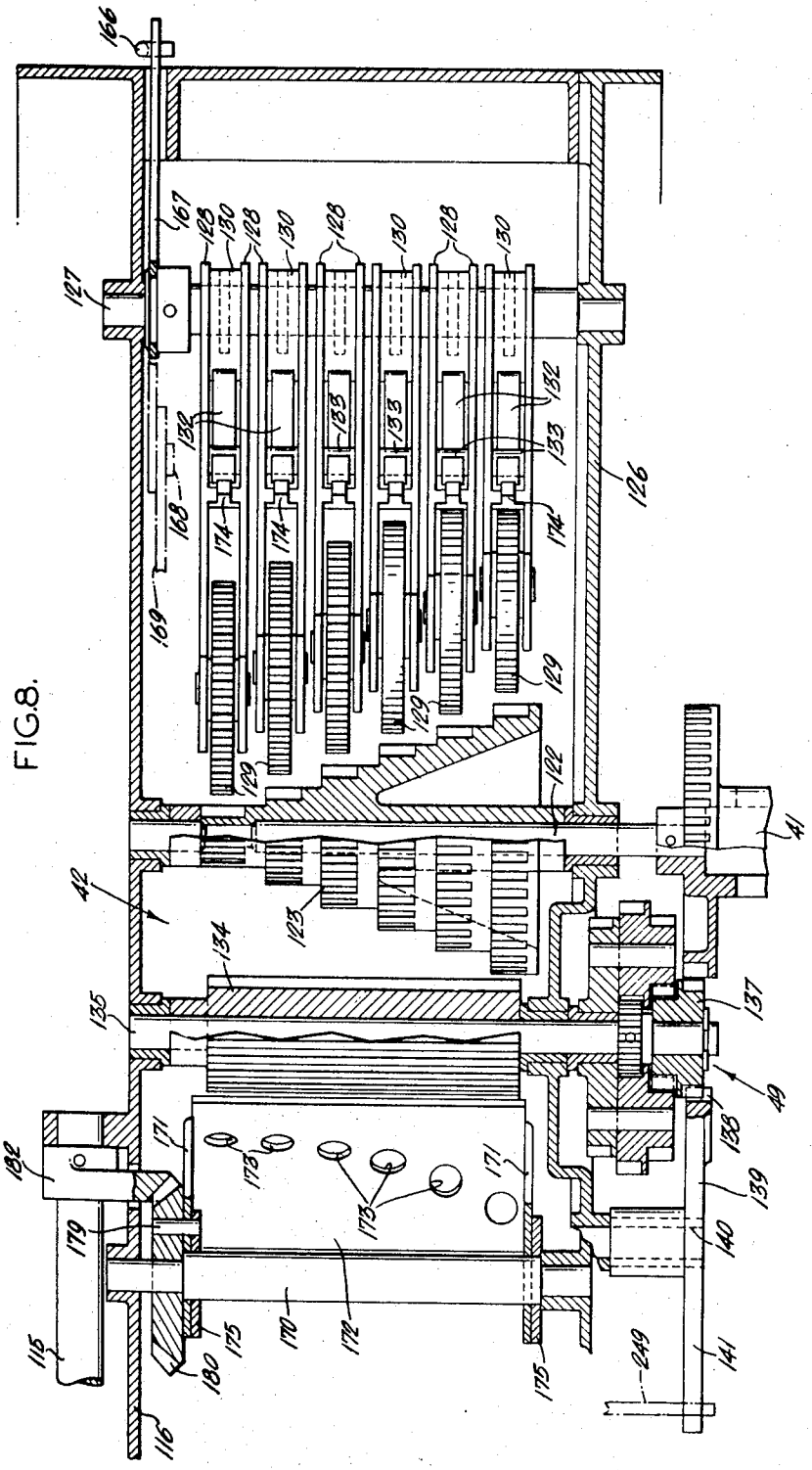

166
167
128
130
127
132
133
168
174
169
129
126
122
41
42
134
123
135
137
49
171
173
175
138
139
182
179
140
115
170
172
180
116
249
141

FIG.8.

FIG.9.

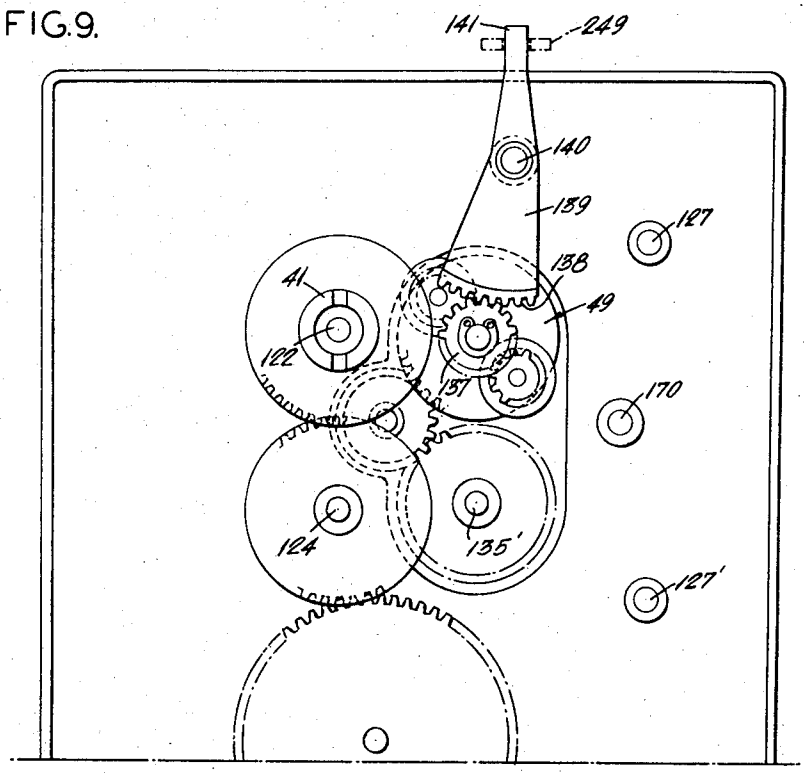

141
249
140
139
127
138
41
49
122
137
170
124
135'
127'

FIG.16.

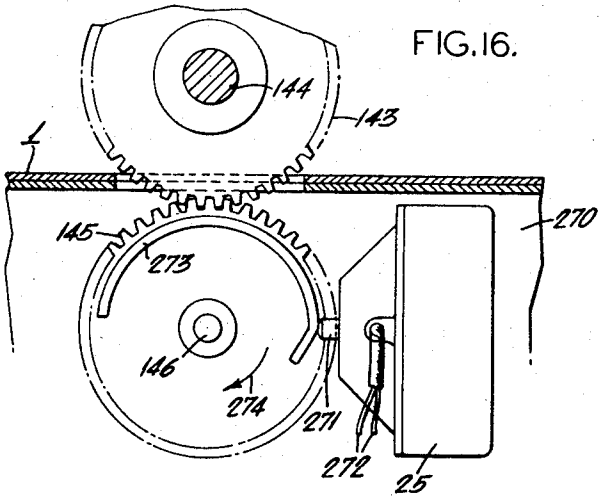

144
143
145
273
270
146
274
271
272
25

FIG. 11.

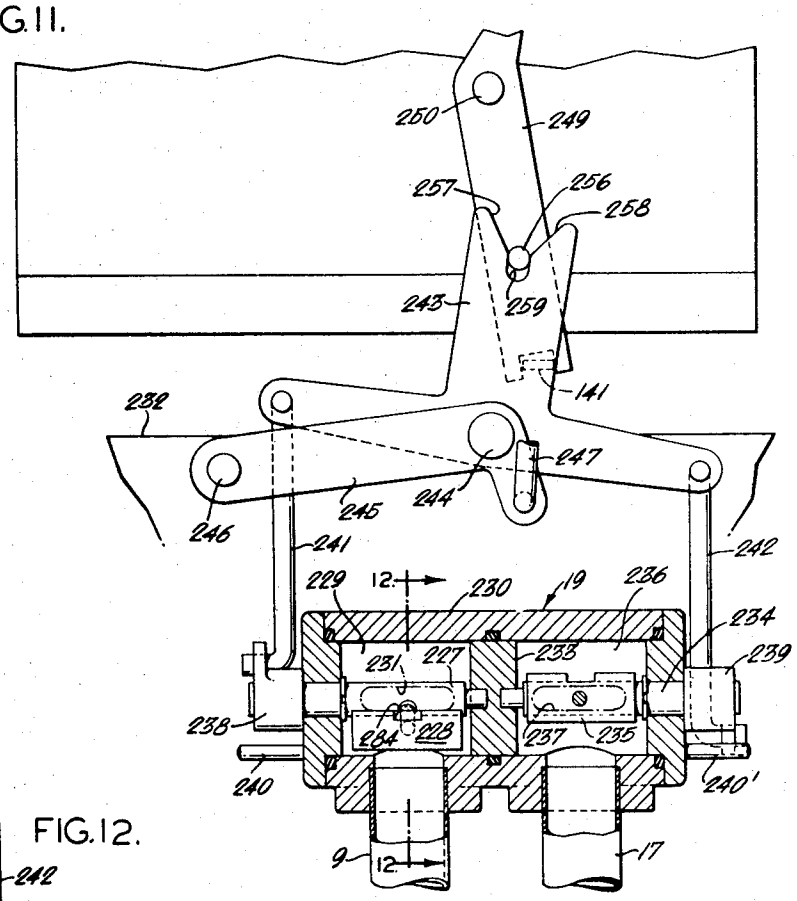
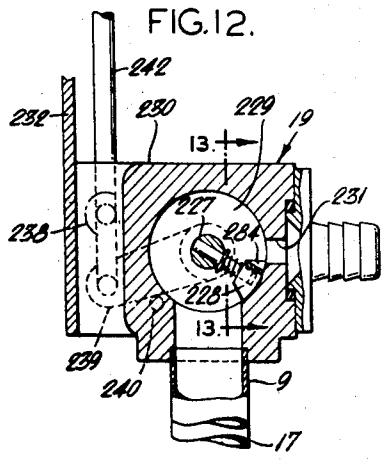


FIG. 12.



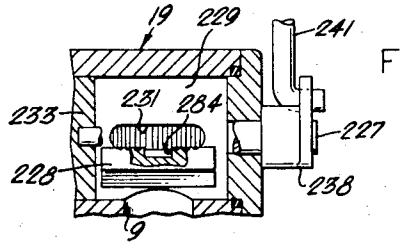


FIG. 13.

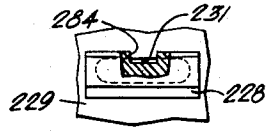


FIG. 14.

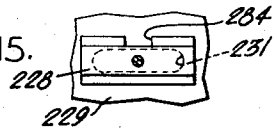


FIG. 15.

MOTOR FUEL DISPENSING APPARATUS

This application is a division of application Ser. No. 85,612, filed Oct. 30, 1970, now U.S. Pat. No. 3,705,596, which is in turn a division of U.S. Pat. No. 3,587,337, filed Aug. 18, 1969 as Ser. No. 850,901.

This application relates to motor fuel dispensing apparatus, and more particularly to dispensing apparatus of the so-called "multigrade" type, wherein a plurality of different grades of fuel (each having a different octane rating) are selectively dispensed by a single apparatus. These various grades are provided by various blends of two fuel components of different octane ratings, and in addition by solely one component and solely the other component. Thus, the number of "grades" usually is two greater than the number of "blends."

A typical example of a "multigrade" motor fuel dispensing apparatus according to the prior art is described in my U.S. Pat. No. 2,880,908, referred to hereinafter as the '908 patent. Dispensing apparatus built according to the teachings of the '908 patent is now being used to a considerable extent in gasoline marketing operations, in service stations. However, such apparatus, while easily manipulatable for the dispensing of motor fuel by a trained service station attendant, is too complicated for a self-service or unattended type of dispensing operation, that is, for an operation wherein the customer operates the dispensing apparatus himself, for his own motor vehicle. To particularize, in the prior dispensing apparatus all of the control operations, such as fuel grade selection, resetting of the counter or register to zero, and turning the pump motor or motors on and off, must be performed manually through the actuation of various knobs or handles, some of which require considerable physical force to actuate. For fuel grade selection, one handle must be actuated and held in this actuated position while a separate knob is rotated, all while watching an indicator. A separate control lever must be actuated to effect a resetting of the counter or register, while still another handle, which calls for considerable physical force to actuate, must be rotated in one direction to turn the pump motor or motors on and in the opposite direction to turn the pump motor or motors off. In addition, the prior dispensing apparatus includes a manually-operated nozzle valve which must be opened in order to begin the actual dispensing.

The rather complicated control operations which are required for the prior dispensing apparatus render it unsuitable for a self-service type of operation. Therefore, a fuel dispensing apparatus which is much simpler to operate would be very desirable, since there is now a trend toward self-service in the industry. In addition to its use for self-service, such a simplified apparatus would be highly beneficial even for attended operation.

An object of this invention is to provide a novel motor fuel dispensing apparatus.

Another object is to provide a novel motor fuel dispensing apparatus of the "multigrade" type.

A further object is to provide a "multigrade" motor fuel dispensing apparatus which is simple and convenient to manipulate.

A still further object is to provide a "multigrade" motor fuel dispensing apparatus wherein an electric motor is employed to carry out certain resetting and

adjustment actions required for each dispensing operation, thereby reducing to a substantial extent the manual, physical manipulative force utilized as compared to that utilized with prior apparatus.

Still another object is to provide an automated "multigrade" motor fuel dispensing apparatus which operates to carry out the dispensing completely automatically, once a single (combined) grade selection and "start" manipulation has been performed.

The objects of this invention are accomplished, briefly, in the following manner: An array of pushbuttons is provided on each side of the housing of a "multigrade" motor fuel dispensing apparatus, one pushbutton for each "grade" to be dispensed. These pushbuttons carry individual gearing for mechanically positioning a shaft, and also actuating means which causes closure of a pair of electrical contacts when any one of the pushbuttons is actuated. If the dispensing nozzle has been properly positioned in the fillpipe of the motor vehicle fuel tank, the closure of the contacts results in the energization of a reset motor and also of a solenoid which are included in the dispensing apparatus. These two electrical instrumentalities, when energized, effect an adjustment of selective gearing in the apparatus appropriate to the grade of motor fuel selected for dispensing, in accordance with the position of the pushbutton-operated shaft, as well as an adjustment of a blend control valve in the apparatus to an appropriate position, and cause the pushbutton which has been actuated to be mechanically locked in, and reset the counter or register to zero. After the adjustments and resetting have been completed, the motor brings about energization of a relay which energizes the pump motor and starts the dispensing of the selected grade of motor fuel, and then shuts itself off.

When the dispensing operation is finished, the pump motor relay is almost immediately deenergized (terminating the dispensing), and the reset motor is automatically reenergized and the solenoid is deenergized, thereby to operate the blend control valve to an "OFF" position, and then to reset the various mechanically-adjustable items to their initial positions.

A detailed description of the invention follows, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a block diagram illustrating the liquid and mechanical connection involved in a preferred form of dispensing apparatus according to the present invention;

FIG. 2 is a side elevation, partly in section and with certain parts broken away, of the dispensing apparatus of the invention;

FIG. 3 is a sectional plan view of the apparatus, as viewed along line 3—3 in FIG. 2;

FIG. 4 is a view similar to FIG. 3, but taken along line 4—4 in FIG. 2;

FIG. 5 is a diagram illustrating electrical circuitry employed in the apparatus;

FIG. 6 is a diagrammatic illustration of the operation of certain cam-operated switches;

FIG. 7 is a horizontal section, somewhat schematic, through the blend control portion of the apparatus;

FIG. 8 is a cross-section through a portion of the dispensing apparatus, taken along line 8—8 of FIG. 7;

FIG. 9 is a bottom view of the blend control portion of the apparatus, as viewed along line 9—9 of FIG. 2;

FIG. 10 is a vertical section of the apparatus, taken along line 10—10 of FIG. 2;

FIG. 11 is a side elevation, partly in section, of the lower portion of the apparatus shown in FIG. 2, but illustrating another position of the mechanism;

FIG. 12 is a sectional view taken along line 12—12 of FIG. 11;

FIG. 13 is a vertical section taken on line 13—13 of FIG. 12;

FIG. 14 is a fragmentary section, showing certain of the parts of FIG. 13 in a different position;

FIG. 15 is a view similar to FIG. 14, but illustrating still another position;

FIG. 16 is a section of a portion of the apparatus taken on line 16—16 of FIG. 10, and drawn on an enlarged scale; and

FIG. 17 is a diagram illustrating remote circuitry which can be used with the apparatus of the invention.

A brief description of the overall operation of the dispensing apparatus will first be given, referring to FIG. 1. In this figure, liquid connections between various elements are indicated by double lines (as pipes), mechanical connections utilized during the resetting and adjustment cycles are indicated by single dotted lines, while mechanical connection utilized during the actual dispensing operation are indicated by single solid lines. In this connection, it is noted that throughout the present description, the various resetting and adjustment operations that take place immediately prior to an actual dispensing operation will be referred to as constituting an "ON" cycle, while those resetting operations that take place after the conclusion of a dispensing operation (and prior to the start of a following "ON" cycle) will be referred to as constituting an "OFF" cycle.

In FIG. 1, the apparatus housing indicated as 1 may be more or less conventional, locked against unauthorized access, and provided with windows and various operating devices (such as pushbuttons) accessible from the outside of the housing, as will hereafter appear. Where an apparatus generally is referred to hereinafter, it will be understood that it is this housing and the parts contained therein and associated therewith, though in some cases (as will hereinafter appear) there may be a remote unit associated with the apparatus. Included in the dispensing apparatus is a "lo" gasoline pump 2 driven during dispensing by a pump motor 3 (for example, by means of a belt drive) and provided with an inlet connection 4 from a supply (storage) tank containing a "lo" or relatively low-octane gasoline (fuel) component. As usual, a bypass 5 is provided containing a relief valve 6 to bypass the pump in the event that a blend control valve is closed. The "lo" gasoline to be dispensed flows through connection 7 and a conventional "lo" meter 8 and thence through the pipe connection 9 incorporating a check valve 10.

A pump 11 for the "hi" gasoline draws its supply of "hi" gasoline (a high-octane fuel or gasoline component) from a storage tank through pipe connection 12. This pump 11 may be of the same type as the "lo" pump 2 and is preferably driven by the same motor 3. Associated with it is a bypass 13 incorporating a relief valve 14.

The "hi" gasoline pump 11 delivers the "hi" gasoline through line 15 to the "hi" meter 16 which may be of the type serving to meter the "lo" gasoline. Delivery from the meter 16 takes place through piping 17 which includes the check valve 18.

The "lo" and "hi" gasolines delivered, respectively, through lines 9 and 17, are respectively controlled by the "lo" and "hi" sections of a blend control valve 19, to be further described hereinafter. The "lo" and "hi" gasolines, as controlled by the "lo" and "hi" sections of the valve 19, are delivered through conduits 20 and 21, which are connected to passages through a hose to a nozzle, such as the nozzle disclosed in FIGS. 7 and 8 of my U.S. Pat. No. 3,590,890, referred to hereinafter as the '890 patent. The hose passages are maintained separate, communicating with each other closely adjacent to the nozzle itself, so that admixture of the two components cannot taken place to any substantial degree so as to markedly change the composition dispensed. As disclosed in my '890 patent, if, but only if, the nozzle is properly inserted into the fillpipe of a motor vehicle fuel tank, electrical continuity is provided by the fillpipe between a pair of spaced electrodes mounted on the nozzle, thus completing a conducting path between such electrodes, one of which is grounded. This conducting path will be further referred to hereinafter.

As disclosed in my '890 patent, a triple-conduit hose combination connects housing 1 to the nozzle mentioned. The third conduit 22 of this combination (being in addition to the conduits 20 and 21) is utilized, during dispensing, for abstracting air and vapor from the fuel tank into which the nozzle is inserted. The housing end of the vapor conduit or hose 22 is connected to a vacuum pump 23 by way of a tee fitting 24. The vacuum pump 23 is driven (as by way of a belt drive) during the actual dispensing by the pump motor 3, along with pumps 2 and 11. A vacuum switch 25 is also connected to the tee 24, so as to be responsive to the pressure in conduit 22. This vacuum switch, as disclosed in my '890 patent, includes a pair of electrical contacts which are opened in response to a "full" condition of the motor vehicle fuel tank. These contacts will be further referred to subsequently. These contacts are mechanically held closed during a portion of the "ON" resetting and adjustment cycle, until the actual dispensing gets well under way, by means of a cam arrangement schematically indicated at 26 and described in detail hereinafter. This cam arrangement is also referred to in my '890 patent. It has been stated previously that the vacuum pump 23 is used to abstract air and vapor from the fuel tank. (This pump also in a sense forms a portion of the automatic shutoff for a "full" fuel tank, since it establishes the pressure in conduit 22, to which vacuum switch 25 is responsive.) The air and vapor (which together may be thought of as tank vapors) discharged from vacuum pump 23 is preferably conducted (by means of one or more pipes, not shown) back to the underground storage tanks (from which tanks connections are made at 4 and 12, respectively, to pumps 2 and 11).

The "lo" meter 8 provides one input 27 to a differential 28, the other input to which is provided at 29 from the "hi" meter 16. The output of the summing-type differential 28 at 30 represents the sum of the two quantities delivered by the two meters 8 and 16, and operates the total gallons portion of the gallons and

cost counter or register **31**. This said portion of the counter **31** is arranged to indicate the total gallons dispensed during an operation, through a suitable window arrangement in the apparatus housing **1**.

A second output from the differential **28**, also corresponding to total gallons, is delivered at **32** to a variator **33** in which is set the price per gallon ascribed to the "lo" gasoline. The setting of this variator may be changed by a manual operation from time to time, whenever the price of the "lo" gasoline changes; this setting is changed only by an authorized person, upon proper access to the interior of housing **1**. This price setting is automatically exhibited through a window in the housing **1**. The output **34** of variator **33** represents the total gallons of both "lo" and "hi" gasolines multiplied by the price of the "lo" gasoline.

A third output from the differential **28**, also corresponding to total gallons, is provided at **35** to a price increment unit (termed "selective gearing" in my '908 patent) indicted at **36**, from which there is provided an output **37**. The price increment unit **36** just mentioned is reset (i.e., adjusted) during each "ON" resetting and adjustment cycle concurrently with, and in dependence upon, the adjustment for control of the grade of fuel to be dispensed. The mechanical arrangement whereby this resetting is effected is indicated schematically at **38**, and will be further referred to hereinafter. As described in detail in my '908 patent, the price increment unit **36** effects the multiplication of the total gallons dispensed (at **35**) by an amount according to the excess (or increment) of the price per gallon of a grade being dispensed over the price per gallon ascribed to the "lo" gasoline. The output from the price increment unit delivered at **37** provides an input to a summing-type differential **39**, the other input to which is **34**, the differential providing its output at **40** to the total cost portion of the gallons and cost register **31**. This portion of the register **31** is arraNged to exhibit through a window in the apparatus housing **1** the total cost of the gasoline dispensed.

Another output at **41** from the "lo" meter **8** provides an input to a "lo" gear box **42**, while a corresponding output at **43** from the "hi" meter **16** provides an input to a "hi" gear box **44**. The gear boxes **42** and **44** are reset (i.e., adjusted) during each "ON" resetting and adjustment cycle to adjust the control of the grade of fuel to be dispensed. The mechanical arrangement whereby the "lo" gear box **42** is adjusted is indicated schematically at **45**, while the mechanical arrangement whereby the "hi" gear box **44** is adjusted is indicated schematically at **46**. The "lo" and "hi" gear boxes may together be thought of as comprising a blend control unit.

The outputs of the "lo" and "hi" gear boxes at **47** and **48** drive a subtractive differential **49**, the output of which at **50** controls concurrently the relative positions of the "lo" and "hi" sections of the blend control valve **19**. For example, this control may be effected by means of a pair of shafts which are operated simultaneously to control valve shoes in the "**10**" and "hi" sections of valve **19**, as will be described hereinafter. In brief, with particular settings of the "**10**" gear box **42** and the "hi" gear box **44**, if the meters **8** and **16** indicate a proper ratio of deliveries of "lo" and "hi" gasolines, the output at **50** is zero and does not affect the settings of the valve shoes in the two portions of valve **19**. On the other hand, if this correspondence does not exist, an output at **50** adjusts the valve shoes to control the composition of the delivered blend. At this juncture, it is desired to be pointed out that for the dispensing of solely the "lo" gasoline or solely the "hi" gasoline, the gear boxes **42** and **44** and the differential **49** are in effect rendered inoperative and thus out of the picture. For the dispensing of the "lo" or "hi" components separately, the blend control valve **19** is mechanically placed in a predetermined corresponding position and is positively maintained in such position during the dispensing operation. This will all be described in somewhat more detail hereinafter.

Also operating on the shoes of valve **19** are two mechanical arrangements indicated schematically at **51** and **52**. The arrangement **51** is operated by a solenoid **53** and functions to bring the valve **19** to an open position at the beginning of a dispensing cycle and to bring this valve to a closed position at the end of the actual dispensing operation; this arrangement will be described more in detail hereinafter. The arrangement **52** is controlled by a reset motor **54** during the "ON" and "OFF" resetting cycles and functions to bring the valve **19** to certain predetermined positions; this arrangement will also be described in detail hereinafter.

The reset motor **54** also controls the mechanical arrangements **26**, **38**, **45**, and **46** previously referred to, and also operates to reset the number wheels of the register **31** to zero during the "ON" resetting cycle, through a mechanical arrangement indicated schematically at **55**. In addition, the motor **54** operates a group of cam-operated switches **56** through a mechanical arrangement indicated schematically at **57**. All of these mechanical arrangements will be described in detail hereinafter.

Refer now to FIGS. **2–4**. A vertically-extending array or column of operating or grade selecting pushbuttons **58–65**, which for convenience may be termed "start" buttons, is provided at one side of the apparatus housing, in the upper portion thereof, these buttons extending through respective holes in a suitable escutcheon plate (not shown) and thus being accessible for operation from the exterior of the housing. A duplicate array of pushbuttons **58′–65′** is provided at the opposite side of the housing, so that the dispensing apparatus may be operated or started from either side. The last-mentioned pushbuttons are located directly opposite (across the housing) to the respective "start" buttons **58–65**. The apparatus housing is generally frusto-pyramidal in configuration, so the arrays of pushbuttons **58–65** and **58′–65′**, viewed from the side thereof as in FIG. **2**, slope inwardly from bottom to top, as shown.

The "start" buttons **58-65** and **58′–65′**, being arranged for grade selection, each correspond in number to the number of grades of motor fuel which the dispensing apparatus is capable of dispensing, there being one button (on each side of the housing) for each respective grade of fuel. Assume, for purposes of illustration, that the dispensing apparatus is capable of dispensing any one of eight grades of motor fuel; thus, there are eight "start" buttons **58–65** on one side of the hosing, and eight "start" buttons **58′–65′** on the opposite side of the housing. Each of these buttons car-

ries, on its outer end, individual indicia (such as an arbitrarily-assigned number) corresponding to a respective grade of motor fuel. By way of example only, these numbers may be respectively as follows, beginning with button **58** and proceeding in order to button **65**: **190**, **200**, **210**, **220**, **230**, **240**, **250**, and **260**. Button **58** may correspond to solely "lo" gasoline, and button **65** to solely "hi" gasoline, the remaining buttons corresponding to blends of "lo" and "hi" gasolines.

Each of the "start" buttons **58–65** is mounted for individual sliding movement in a direction inwardly and outwardly of the apparatus housing, by means of an individual shank such as **66** (FIG. 3) secured to each respective pushbutton. The inner end of each shank is slidably mounted in a respective aperture provided in the base of a channel-shaped support **67** secured to the apparatus housing and extending somewhat vertically, parallel to the array of pushbuttons. Each "start" button is biased outwardly by a separate coiled spring such as **79** which surrounds the respective shank **66**, one end of the spring bearing against the base of support **67** and the other end thereof bearing against the inner end of the respective pushbutton.

The shank of each of the pushbuttons **58–65** carries linear or rack-like gear teeth such as illustrated at **68** (FIG. 3). Each of these pushbutton shanks has a different number of teeth, as follows: pushbutton **58**, eight teeth; pushbutton **59**, seven teeth; pushbutton **60**, six teeth; pushbutton **61**, five teeth; pushbutton **62**, four teeth; pushbutton **63**, three teeth; pushbutton **64**, two teeth; pushbutton **65**, one tooth.

It is again pointed out that all of the structure so far described (at one side of the housing) is duplicated at the opposite side of the housing. There is a pushbutton (in the array **58'–65'** at the opposite side of the housing) exactly corresponding to each respective one of the pushbuttons **58–65**, and the former carry rack-like teeth corresponding to those carried by the latter, the least number of teeth being carried by the upper most pushbutton **65'** and the greatest number of teeth being carried by the lowermost pushbutton **58'**. The duplicated structure at the opposite side of the housing is denoted by the housing same reference numerals but carrying prime designations.

A shaft **69**, the axis of which extends more or less vertically and parallel to the support **67**, is journaled for rotation in a pair of fixed bearings **70** secured to the base of support **67**. Fixedly secured to shaft **69** are eight sector gears **71** (one for each of the pushbuttons **58–65**) which are all exactly alike (they may each have ten teeth, for example) and which are adapted to mesh with the rack-like gear teeth carried by the respective pushbuttons. Each of the sector gears **71** is so located as to mesh with a corresponding one of the pushbutton-carried rack gears, when such pushbutton is pushed inwardly. To make this possible, the axis of shaft **69** is laterally offset from the centerlines of the pushbutton shanks (see FIG. 3) Since the number of teeth carried by each of the pushbuttons is different, when a certain one of the buttons **58–65** is depressed, the shaft **69** will be gear-driven through an angle depending upon and uniquely determined by which one of these buttons is so depressed or actuated.

A similar shaft **69'** is journaled for rotation at the opposite side of the housing, in bearings **70'**. This latter shaft carries eight sector gears **71'** which are exactly like gears **71** and which are adapted to mesh with the rack-like gear teeth carried by the respective pushbuttons **58'–65'** at this opposite side of the housing. When a certain one of the "start" buttons **58'–65'** is depressed, the shaft **69'** will be gear-driven through an angle depending upon and uniquely determined by which one of these latter buttons is so depressed or actuated. The gear ratios between the shaft **69'** and the array of "start" pushbuttons **58'–65'** at the corresponding side of the housing are exactly similar to those between the shaft **69** and the array of "start" buttons **58–65**. Thus, when a particular one of the "start" buttons **58'–65'** is depressed, the shaft **69'** will be rotated through a certain angle which is exactly the same as the angle through which shaft **69** is rotated when the matching pushbutton on the first-mentioned side of the housing is depressed.

In order to lock the shafts **69** and **69'** together, a crank plate **72** (see FIG. **4**) is pinned at one end to the upper end of shaft **69'**, and a crank plate **73** is pinned centrally to the upper end of shaft **69**. A rigid link member **74** is pivotally secured at one end to the other end of crank **72**, and is pivotally secured at its other end to one of the ends of crank **73**. It may be seen that the link and crank arrangement just described positively locks the two shafts **69** and **6'** together. A coiled spring **75**, one end of which is attached to link **74** and the other end of which is attached to crank **73**, tends to return the crank **73** to the "OFF" position illustrated in FIG. **4**.

The end of crank **73** opposite to link **74** has therein a plurality of holes **76** equal in number to the number of grades of motor fuel to be dispensed (in accordance with what has been previously stated, eight holes are illustrated), these holes being equally spaced along the circumference of a circle centered on the axis of shaft **69**. A thin locking plate **77**, slightly flexible in the direction of its thickness, which carries an upstanding pin **78** at one end thereof, is secured at its opposite end to the side of support **67**, in such a position that the pin **78** can enter any one of the holes **76**. Plate **77** is positioned below crank **73** and is arranged so that in its released position the pin **78** will enter one of the holes **76** (if such hole has been rotated into vertical alignment with this pin). Plate **77** is normally (which is to say, in the "OFF" position, between dispensing operations) held downwardly (in such a position that the crank **73** can rotate freely thereabove, without interference by pin **78**) by a downwardly-depending pin attached to one end extension **80** of a somewhat T-shaped pivoted arm **81** which will be further referred to hereinafter. Arm **81** is rotatably mounted on a fixed pivot pin **224**.

As previously described, when one of the "start" buttons **58–65** is actuated, the shaft **69** (and also, incidentally, the shaft **69'**, through link **74**) will be rotated to an angular position which depends on the particular button actuated. Of course, if one of the buttons **58'–65'** is actuated, shaft **69** is caused to rotate through the operation of shaft **69'** and link **74**. As shaft **69** rotates, the crank **73** pinned thereto also rotates (in the counterclockwise direction in FIG. **4**), bringing one of the holes **76** into vertical alignment with pin **78**. The particular hole **76** which is brought into alignment with

pin 78 will depend on the amount of angular rotation of shaft 69. When the pushbutton being actuated has reached the limit of its travel (bringing shaft 69 to the appropriate angular position), the solenoid 53 (see FIG. 2) is energized, as will be subsequently described. Solenoid 53 is mounted above the apparatus housing 1 in a suitable manner, and the plunger of this solenoid is pivotally attached to the upper end of a rigid link member 225 which extends through an aperture into the housing, the lower end of link 225 being pivotally attached at 226 to the end of arm 81 adjacent extension 80. When solenoid 53 is energized, link member 225 moves vertically upwardly from the position shown. This causes the end extension 80 of arm 81 to move upwardly, away from plate 77. This action releases plate 77 so that its pin 78 enters the particular one of holes 76 which is then vertically aligned therewith. Since the plate 77 is rigid in the direction of its length, this provides a locking effect, which mechanically locks the shaft 69 in its rotated or adjusted ("ON") angular position. Therefore, that one of the sector gears 71 (or 71') which is then in mesh with the rack teeth of the actuated pushbutton holds such pushbutton in the depressed or actuated position during the dispensing operation, even though this pushbutton has been manually released after being manually actuated. This arrangement provides a mechanical lock, which locks "in" the particular pushbutton which has been actuated, during the dispensing operation which occurs upon its actuation.

At the conclusion of the dispensing operation, as will be described, solenoid 53 is deenergized, which allows the end extension 80 of arm 81 to be pulled downwardly by a spring (hereafter described), along with the link 225, causing plate 77 to be pushed downwardly and its pin 78 to be pushed out of the hole 76 into which it had previously entered. Crank 73 and shafts 69 and 69' then return to the "OFF" position illustrated in FIG. 4 under the urging of spring 75, and the actuated pushbutton is released for return to its outward or unactuated position, under the urging of its respective spring 79.

A stop plate 82, seen in face view in FIG. 3, is fixedly secured to the lower end of shaft 69, so as to rotate therewith. Plate 82 has a plurality of stepped projections 83 on its outer periphery, equal in number to the number of grades of motor fuel to be dispensed (in our example, this would be eight), providing eight abutments on the periphery of this plate which are located at different radial distances from the axis of shaft 69, these radial distances constituting a stepped or orderly progression (in a clockwise direction in FIG. 3) from the minimum radial distance (corresponding to "start" button 65) to the maximum radial distance (corresponding to "start" button 58). In this connection, it may be noted that buttons 65 and 65' stand for solely the "hi" gasoline, buttons 58 and 58' stand for solely the "lo" gasoline, while the intermediate buttons stand for different blends of the "lo" and "hi" gasolines or gasoline components. The array of pushbuttons is orderly, with buttons 64 and 64' denoting the highest-octane one of the six blends, and buttons 59 and 59' the the lowest-octane one of the six blends. Since buttons 58 and 58' carry eight teeth, while buttons 65 and 65' carry one tooth, it may be noted that the actuation of one of the former causes a maximum angular rotation of shaft 69 and of stop plate 82, from the position illustrated in FIG. 3, while the actuation of one of the latter causes a minimum angular rotation of stop plate 82, from this same position. The rotation of shaft 69 (or shaft 69') to an angular position determined by the particular pushbutton which is depressed, brings stop plate 82 to a corresponding angular position, such that a particular one of the projections 83 is brought to a position wherein it can control or govern the amount of angular rotation of a cooperating member 114 which will be described hereinafter.

A resilient, U-shaped contact member 84, insulated from "ground" or the metallic elements such as support 67, and a similar insulated contact member 84' are each insulatingly mounted within a respective one of the channel-shaped supports 67 and 67', as by means of a bolt 85 which extends through the member 84, through a washer 86 of electrical insulating material, through an enlarged hole in the support, and through another washer 87 of electrical insulating material on the outside of the support. A common electrical connection is made to the bolts 85, the two bolts 85 being directly connected together. The contact member 84, and the duplicate contact member 84' on the opposite side of the housing, are positioned within the respective supports 67 and 67' as illustrated in FIG. 3, and are arranged to be engaged respectively by grounded U-shaped bars 88 or 88'. Each of these bars extends for most of the length of supports 67 and 67', so that they will cooperate with all pushbuttons in the respective supports. That is to say, when any one of the pushbuttons is depressed the grounded bar on that side is caused to come into contact with the insulated contact member on the same side of the housing. This will result in the grounding of the corresponding insulated contact member. Each foot 89 and 89' of the U-shaped bar 88 or 88' is flexibly attached as by a bolted hinge-like strap to the respective support such as 67'. As the pushbutton is depressed or actuated, its base comes into engagement with the bar 88 or 88' and swings this bar inwardly to bring it into contact with the appropriate insulated contact member 84 or 84', thus grounding this insulated contact. The arrangement is such that the contact between members 88 or 88' and 84 or 84' is made subsequently to the actuation of shaft 69 or 69' by the actuated pushbutton, and just prior to the reaching of the extreme limit of travel (inwardly) by the pushbutton. Thus, each time a pushbutton is actuated, one or the other of the two insulated contacts 84 or 84' (one of which contacts is at each respective side of the apparatus housing) is grounded.

Refer now to the circuit diagram of FIG. 5. A low-voltage alternating current (25 volts, for example) is supplied to a pair of buses 91 and 92 by means of a stepdown transformer 93 whose primary is connected to the a.c. supply terminals 94 and 94' (these terminals comprising one 115-volt side of a three-wire a.c. supply, terminal 94 being one "line" terminal, terminal 94' being a "neutral" terminal, and terminal 94'' being the other "line" terminal) through a cam-operated switch 95 which is closed prior to the start of each dispensing operation, and is so illustrated. It may be noted here that the cam operator for switch 95 is driven mechanically by the reset motor 54.

The nozzle associated with the dispensing apparatus (and to which the hose or conduits **20–22**, FIG. **1**, are connected) carries a pair of spaced electrodes **96** and **97**, as disclosed in my '890 patent. As described in my '890 patent, one of these electrodes is insulated from ground; this electrode **96** is connected to bus **91**. The other electrode **97** is grounded, and when the nozzle is properly inserted into the fillpipe of a motor vehicle fuel tank, the metal fillpipe schematically illustrated at **98** forms a conducting path between the electrodes **96** and **97**, all as described in my '890 patent. It will be assumed that the nozzle has been properly positioned in the fillpipe prior to the actuation of one of the "start" buttons, so that electrode **96** is connected electrically to the grounded electrode **97**.

The contact **99** represents bar **88** on one side of the apparatus housing, while the contact **100** represents bar **88'** on the opposite side of the housing. As previously described, when any one of the buttons is actuated, either the insulated contact **84** or the insulated contact **84'** is grounded. These insulated contacts (by way of bolts **85**) are connected together as at **188** and through the closed contacts of a pair of "emergency stop" switches ("panic buttons") **101** and **102** (push-button, spring-biased, normally closed, push to open, these two switches being on respective opposite sides of the apparatus housing and being accessible from the outside of the housing) to one contact **103** of a vacuum-operated single-pole, single-throw switch **25**. This latter switch may be constructed, for example, as disclosed in my '890 patent, and is mechanically caused to close by a cam (as will be described subsequently) prior to the beginning of each dispensing operation. It is therefore shown as closed in FIG. **5**. It may be noted here that the cam just mentioned is driven mechanically by the reset motor **54**.

The other contact **105** of switch **25** is connected through a pair of resistors **106** and **107** and then through the operating winding of a relay **108** to the bus **92**.

When one of the "start" buttons is actuated, it may be seen that a circuit is completed between buses **91** and **92** through the winding of relay **108** (provided, of course, that the dispensing nozzle has been properly positioned in the fillpipe). This energizes relay **108**. The a.c. supply terminal **94** is connected directly to the reset motor **54**. When relay **108** is energized, a pair of relay contacts **109** are closed to connect the a.c. terminal **94'** to one of the movable contacts **110** of a single-pole, double-throw cam-operated switch **111**. The cam operator for switch **111** is also driven mechanically by the reset motor **54**, and the movable arm of this switch is closed on contact **110**, as illustrated, prior to the beginning of each dispensing operation. Thus, when relay **108** is energized (in response to actuation of one of the "start" buttons), a circuit is completed from the a.c. supply terminals **94** and **94'** to reset motor **54**, energizing this motor.

The reset motor **54** is one of the electrical instrumentalities employed to bring about the "ON" resetting and adjustment cycle of the dispensing apparatus. Refer now to FIG. **6**, which diagrammatically illustrates the mode of operation of various cam-operated switches (some in the group **56**, FIG. **1**) operated by the reset motor **54**. The cams which operate these switches are mounted on a shaft driven by motor **54** through suitable gearing indicated at **57** in FIG. **1**. The various arcs illustrated in FIG. **6**, with respect to the center **112**, represent the angles through which the cams actuate the switches, referred to the vertical line extending upwardly from center **112**, which line represents the beginning of the "ON" resetting and adjustment cycle. This line is denoted by "OFF," since it represents conditions at the end of the "OFF" cycle, as well as at the very beginning of the "ON" cycle. The entire figure represents one complete or 360° rotation of the shaft on which the cams are mounted.

The arc indicated by A represents the operation of the switch **111**. This switch is closed on its contact **110** (by a previous rotation of the camshaft) slightly prior to the reaching of the "OFF" position or upwardly-extending vertical line, and remains closed on this contact for about 25° more of the camshaft rotation; throughout the remainder of the 360° of camshaft rotation this switch is closed on its other contact **113**. Thus, after about 25° of camshaft rotation from "OFF" (during the "ON" cycle) the contact **110** is opened and the motor energization circuit previously described is opened.

However, the motor **54** is maintained energized for substantially 180° of camshaft rotation (from "OFF") by means of a cam-operated switch **104** whose single-pole, single-throw contacts are connected directly in a series circuit with motor **54** across the a.c. supply terminals **94** and **94'**. The arc indicated by B represents the operation of switch **104**. Switch **104** is closed by its cam at about 8° after the beginning of the "ON" cycle (the "ON" cycle beginning at the upwardly-extending vertical line in FIG. **6**, and proceeding in the direction of the clockwise arrow denoted by G), and remains closed throughout substantially all of the remainder of the 180° of the "ON" cycle, that is, substantially until the downwardly-extending vertical line designated "ON" in FIG. **6** is reached. This last-mentioned line represents the completion of the "ON" cycle, which coincides in camshaft position, but not in time, with the beginning of the following "OFF" cycle. Thus, the reset motor **54** is maintained energized (by switch **104**) until the substantial completion of the "ON" cycle, even though the original energization circuit for this motor (through contact **110**) is opened at about 25° of camshaft rotation following the beginning of the "ON" cycle. It may be mentioned here, in passing, that the arc B indicates that switch **104** is also closed throughout substantially all of the following "OFF" cycle; this will be further referred to later.

The arc denoted by D represents the operation of switch **95**. Switch **95** is closed by its cam (by a previous rotation of the camshaft)slightly prior to the reaching of the "OFF" position, and remains closed throughout the "ON" cycle, and also for a few degrees of rotation in the following "OFF" cycle.

The arc denoted by E represents the operation of the cam which mechanically causes the contacts **103** and **105** of vacuum switch **25** to close. The contacts of this vacuum switch are mechanically caused to close (by a previous rotation of the camshaft) slightly prior to the reaching of the "OFF" position, and are mechanically released just prior to the termination of the "ON" cycle. The operation of other cam-operated switches depicted in FIG. **6** will be described hereinafter.

From the above, it may be seen that the reset motor **54**, upon energization thereof in response to actuation of one of the "start" buttons **58–65** or **58'–65'** is maintained energized until it has caused rotation of the camshaft through substantially 180°, then it is shut off or deenergized by the opening of switch **104** (see arc B in FIG. **6**). This motor is provided with a brake which causes its output shaft to stop rotating immediately upon deenergization of the motor. Thus, the motor is made to stop exactly when the camshaft has reached the position represented by the downwardly-extending vertical line designated "ON" in FIG. **6**. This line denotes the completion of the "ON" cycle.

A positioning and adjusting member **114**, which is somewhat disc-shaped when seen in end view as in FIG. **2**, is pinned to the outer end of a shaft **115** which is suitably journaled for rotation in a fixed supporting plate **116** (FIG. **8**). Along a portion of the edge thereof, and extending over say 80° of its circumference, member **114** has a plurality of stepped projections **117**, equal in number to the number of grades of motor fuel to be dispensed (in the example, this would be eight), providing eight abutments along the periphery of member **114** which are located at different axial distances (measured parallel to the axis of shaft **115**) from a reference plane transverse to the axis of shaft **115**. That is to say, this portion of the edge of member **114** may be thought of as forming a stepped cylindrical wall. If it be assumed that the reference plane previously mentioned coincides with the extreme outer end of member **114** in FIG. **3**, the axial distances of the stepped projections **117** from this reference plane constitute an orderly progression from the minimum axial distance (corresponding to solely the "lo" gasoline component) to the maximum axial distance (corresponding to solely the "hi" gasoline component).

The axes of shafts **115** and **69** lie at substantially 90° to each other, and the projections **117** provided on member **114** are arranged to cooperate with the projections on stop plate **82** in such a manner that, when member **114** is free to rotate in the counterclockwise or "ON" direction in FIG. **2**, it will rotate to an angular position uniquely determined by the angular position to which stop plate **82** has been rotated by shaft **69**. That is to say, member **114**, when it is free to rotate in the counterclockwise direction in FIG. **2**, will be caused to stop at a selected one of eight angular positions, the selection being made in dependence upon the particular one of the "start" buttons **58–65** or **58'–65'** which has been actuated (and the consequent angular position of stop plate **82**). A coiled tension spring **118**, which is rather strong, provides the motive force for driving member **114** in the counterclockwise or "ON" direction in FIG. **2**. One end of this spring is attached to an outstanding eccentric pin **119** secured to member **114**, and the other end is attached to a pin **120** which also secures one end of a diagonally-extending brace **121** to the support **67**. The other end of brace **121** is secured to support **67**. A similar diagonally-extending brace **121*a*** is secured at its ends respectively to supports **67** and **67'**. The braces **121** and **121*a*** together form an X-shaped configuration. Spring **118** acts to urge the member **114** to rotate in the counterclockwise or "ON" direction in FIG. **2**, to move the projections **117** toward the stop plate **82**.

Refer now to FIGS. **7–9**, which illustrate the "lo" and "hi" gear boxes **42** and **44**, respectively, together with mechanical connections such as **45** and **46** for resetting the same, that is, for adjusting the same to various selected positions. These gear boxes constitute an essential part of the blend control unit or portion of the dispensing apparatus. The shaft coupling **41** (FIGS. **1** and **8**) is driven through suitable gearing from the output of "lo" meter **8** and corresponds to gallons of "lo" gasoline. A shaft **122**, which may be integral with the shaft coupling **41**, has secured thereto a cone gear **123**. Similarly, the shaft coupling **43** (FIG. **1**) is driven through suitable gearing from the output of "hi" meter **16** and corresponds to gallons of "hi" gasoline. A shaft **124** (FIG. **7**), which may be integral with the shaft coupling **43**, has secured thereto a cone gear **125**. Since the "lo" gear box **42** and the "hi" gear box **44** are essentially similar, only the " lo" gear box will be described in detail, in connection with FIG. **8**, reference being made to elements of the "hi" gear box, when necessary, to complete the disclosure.

Each of the cone gears **123** and **125** comprises six spur gears arranged each in a separate level, for a total of six levels. The two cone gears **123** and **125** are identical, but they are disposed oppositely, that is, they are disposed in parallel but inverted relation with respect to each other. They are so disposed that the levels of the two gears are respectively aligned with each other, reference being made here to a horizontal alignment. By way of example, the numbers of teeth in the various levels of gear **123** are, reading from top to bottom in FIG. **8**, as follows: eight teeth, 16 teeth, 24 teeth, 32 teeth, 40 teeth, and 48 teeth.

The shafts **122** and **124** are journaled for rotation by bearings provided in the supporting plate **116** and in a lower supporting plate **126**. A rocker shaft **127** is journaled for rotation at its upper and lower ends, respectively, in plates **116** and **126**. Rotatably carried by shaft **127** are six vertically-arranged pairs of mounting plates **128** (one pair of plates for each of the levels of cone gear **123**), of more or less triangular shape seen in plan as in FIG. **7**, these plates being carried by shaft **127** adjacent one of the three vertices of the triangle. Each pair of plates **128** carries, adjacent another of its three vertices, a respective idler gear **129**, one such gear for each of the levels of cone gear **123**. Each of the idler gears is journaled for rotation in suitable bearings provided in the two individual plates of its respective pair of plates **128**. All of the idler gears **129** are identical, and each is adapted to be swung into and out of mesh with its corresponding spur gear (or level) of cone gear **123**.

A separate banjo-shaped member **130** is positioned between each respective pair of plates **128**, the large end of each of these members **130** being pinned to shaft **127**. A fixed pin **131**, whose two ends are fixed in the respective plates **128**, is mounted between each respective pair of plates **128**, in such a location as to be engaged by one side of the straight or "neck" portion of the respective banjo member **130**. A wishbone-shaped spring **132** is positioned between each respective pair of plates **128**, one end portion of this spring engaging the "neck" of the banjo member **130**, on the opposite side thereof from pin **131**, and the other end portion of this spring being wrapped around a respective fixed pin

133 (similar to pin 131) whose two ends are fixed in the respective plates 128. Pin 131 is located near one side of its (somewhat triangular) respective plates 128, while pin 133 is located near another side of its respective plates 128.

In the "hi" gear box, the elements 127–133 previously described are duplicated, being denoted in this latter gear box by the same reference numerals but carrying prime designations. Each of the idler gears 129' in the "hi" gear box is adapted to mesh with a corresponding spur gear (or level) of cone gear 125.

The elements 127–128 and 130–133 together comprise a "gear throw-out," by operation of which the idler gears 129 may be brought into and out of mesh with cone gear 123 and pinion gear 134. Elements 127'–128' and 130'–133' comprise a similar "gear throw-out" for the "hi" gear box, by operation of which the idler gears 129' may be brought into and out of mesh with cone gear 125 and pinion gear 134'. For convenience of illustration only, in FIG. 7 a "lo" idler gear 129 is shown out of mesh with cone gear 123 and pinion gear 134, while a "hi" idler gear 129' is shown in mesh with cone gear 125 and pinion gear 134'; it is desired to be pointed out, however, that these conditions will never occur in actual practice during dispensing, which is to say that in actual practice, either both, or neither, of (a selected one of) the idler gears 129 and 129' will be in mesh with the respective cone and pinion gears, during dispensing.

Each idler gear 129 in the "lo" gear box, in addition to meshing with its corresponding one of the individual gears in cone gear 123, is adapted to mesh with an elongated pinion gear 134 (having a vertical length about equal to the combined vertical lengths of the six levels of cone gear 123) which is pinned to a shaft 135 journaled for rotation in plates 116 and 126. Each idler gear 129' in the "hi" gear box, in addition to meshing with its corresponding one of the individual gears in cone gear 125, is adapted to mesh with a similar pinion gear 134' which is pinned to a shaft 135'.

The shafts 135 and 135' constitute the mechanical connections 47 and 48, respectively (FIG. 1), which couple the outputs of gear boxes 42 and 44, respectively, to the subtractive differential 49. This subtractive differential is preferably constructed and arranged as disclosed in my U.S. patent No. 2,977,970, referred to hereinafter as the '970 patent. This subtractive differential will not be described in detail herein, since it is fully and completely disclosed in my '970 patent. The principle of operation, however, may be described as follows. The "lo" gear box 42 may be thought of as including cone gear 123, a selected one of the idler gears 129, and pinion 134, while the "hi" gear box 44 may be thought of as including cone gear 125, a selected one of the idler gears 129', and pinion 134'. The settings of the gear boxes 42 and 44 (i.e., the particular levels of the gear cones with which the corresponding idler gears are in mesh) determine the relative flows which would be required to maintain at zero the output 50 of differential 49 to hold the two sections of valve 19 in fixed relative position. If the rate of flow of "hi" gasoline relative to "lo" gasoline (assuming that a mixture or blend of liquids is being dispensed) exceeds the predetermined ratio, the differential 49 will have an output of such direction as to move the valve shoe in the "hi" section of valve 19 toward closed position and the valve shoe in the "lo" section of valve 19 toward open position. The result is readjustment of the individual flows to a ratio predetermined by the gear box settings and resulting in zero output from differential 49. If the "lo" flow is in excess, a reverse output from the differential 49 occurs, resulting in correction of the ratio of the flows.

The output 50 of the subtractive differential 49 is provided in an output gear 137 which meshes with a sector gear 138 carried by one end of a rigid lever 138 pivotally mounted at 140 to the frame and having a dog configuration 141 at the other end of the lever. The dog 141, moving back and forth (about pivot 140) as the output of differential 49 varies from zero, effects a mechanical control adjustment of the blend control valve 19, as will appear hereinafter.

It is here noted that all of the foregoing description of the operation of differential 49 has assumed that a mixture of liquids is being dispensed, which means that a selected one of the idler gears 129 is in mesh with a corresponding spur gear (in a particular level) of the cone gear 123, and a selected one of the idler gears 129' is in mesh with a corresponding spur gear (in the same level) of the cone gear 125. For the dispensing of either "hi" or "lo" gasoline, alone, the differential 49 is in effect inoperative, as will hereinafter appear.

Referring now to FIGS. 2 and 10, reset motor 54 (illustrated schematically in FIG. 10) is mounted on top of the apparatus housing 1. This motor, when energized in the manner previously described, drives, through a small gear 142 pinned to its output shaft, a larger gear 143 which is secured to a camshaft 144 to be later described. Gear 143, in turn, drives a gear 145 (having the same number of teeth as gear 143) which is located inside the apparatus housing. Gear 145 is pinned to one end of a stub shaft 146 which may be thought of as a motor-driven shaft. The hub end of a crank 147 is pinned to the other end of the motor-driven shaft 146, and a crank pin 148 at the radially-outer or eccentric end of crank 147 is pivotally connected to one end of a rigid link member 149 which extends in a generally downward direction and whose opposite or lower end is pivotally connected to one outer end of a bifurcated plate 150. At its base, the plate 150 is attached to a stub shaft 151 which is pinned to a counter reset shaft (referred to hereinafter). The stub shaft 151 may be thought of hereinafter as itself comprising the counter reset shaft. Shaft 151 is journaled for rotation in the cross braces 121 and 121*a*, at the point of intersection or overlap of these two braces. Shaft 146 operates at the same speed as camshaft 144.

One end of a rigid link member 152 is pivotally connected to the other outer end of plate 150, and the other end of this link member is pivotally attached to one end of an L-shaped lever 153 which is rotatably supported at its base by means of a fixed pin 154. Also rotatably supported on pin 154 is a wing plate 155, which carries at one side a sector gear 156 and at its other side (more or less diametrically opposite to gear 156) another sector gear 157. The wind plate 155 has thereon an integral outwardly-extending leg 158 which is adapted to engage the side edge of that leg of lever 153 to which link 152 is coupled.

During the "ON" cycle (180° of rotation of shaft **146**), the reset motor **54**, through the various linkages described, drives the plate **150** in the direction indicated by the "ON" arrowhead on arc **159**, and the arrangement is such that during this cycle the center of the lower end of link **152** (that is, the end of this link which is coupled to lever **153**) travels through an arc of 90° about the center of pin **154**.

The sector gear **156** meshes with a sector gear **160** which is formed integrally on member **114**, approximately diametrically opposite the projections **117**. Thus, when member **114** rotates in the "ON" direction (counterclockwise in FIG. **2**), it can drive plate **155** (by way of the gearing **156**, **160**) in the "ON" direction (clockwise in FIG. **2**). As previously stated, member **114** is caused to rotate in the "ON" direction by the force exerted on it by spring **118**. The various elements are illustrated in the "OFF" position in FIG. **2**.

A rearwardly-extending pin **161** is secured to that end of lever **153** which is opposite to link **152**. A crank **162**, secured to the outer end of a price increment unit locking shaft **163** and adapted to rotate about the axis of such shaft, has a radially-outwardly extending portion which lies in the path of pin **161**, as lever **153** is rotated by the reset motor. A tension spring **164**, one end of which is tied to a fixed pin **165** and the other end of which is tied to the previously-mentioned portion of crank **162**, tends to maintain the crank **162** in the "OFF" position illustrated in FIG. **2**. When the lever **153** is rotated by the reset motor **154** in the "ON" direction (which is clockwise in FIG. **2**), pin **161** will engage crank **162** and rotate it in the clockwise direction, about its pivot point **163**, in opposition to the bias of spring **164**.

One end of a rigid link member **166** is pivotally connected to crank **162** at an eccentric location, and the opposite end of this link is pivotally connected to one end of a lever **167** (see FIG. **3**) which is pinned at its central point to the upper end of the "lo" gear box rocker shaft **127** (see also FIG. **8**). At its other end, arm **167** carries a pin **168** which fits between the two arms provided by the bifurcated end of an arm **169** pinned to the upper end of the "hi" gear box rocker shaft **127'**.

The arrangement is such that, during the "ON" cycle, when pin **161** engages crank **162** and causes it to rotate in the clockwise direction in FIG. **2**, the link **166** rotates lever **167** to cause a rotation of shaft **127** in the clockwise direction in FIG. **7**, and a rotation of lever **169** (by way of pin **168**) to cause a rotation of shaft **127'** in the counterclockwise direction in FIG. **7**.

The spring **164** ordinarily (which is to say during the interval between successive dispensing operations) maintains the crank **162** in such a position that both of the rocker shafts **127** and **127'** are brought to the position exemplified by the shaft **127** in FIG. **7**, that is, to a position wherein all of the idler gears **129** and **129'** are out of mesh with the respective cone gears **123** and **125** and also out of mesh with the respective pinions **134** and **134'**. Also, during the "OFF" resetting and adjustment cycle (which takes place following the completion of an actual dispensing operation, as will later become apparent) the spring **164** rotates crank **162** in such a direction as to cause rotation of rocker shaft **127** in the counterclockwise direction in FIG. **7** and to cause rotation of rocker shaft **127'** in the clockwise direction in FIG. **7**. The "ON" position for shaft **127'** being illustrated in the upper portion of FIG. **7** (wherein the illustrated one of the idler gears **129'** is in mesh with cone gear **125** and with pinion **134'**), the rotation of rocker shaft **127'** in the clockwise direction (during the "OFF" cycle) causes all of the banjo members **130'** to engage their fixed pins **131'** to swing all of the mounting plates **128'** clockwise from the position illustrated, moving all of the idler gears **129'** out of mesh with the cone gear **125** and with the pinion **134'**. No net force is exerted at this time by wishbone spring **132'**, since one of its ends is attached to the pin **133'** (attached to and moving with plate **128'**), and the other of its ends bears against banjo member **130'**, which is in firm engagement with the pin **131'** (also attached to and moving with plate **128'**).

Similar action takes place during the "OFF" cycle for the "lo" gear box, when rocker shaft **127** is rotated in the counterclockwise direction in FIG. **7**. Summarizing the operation so far described of the gear throw-out arrangement for the "lo" and "hi" gear boxes, it may be seen that all of the idler gears **129** and **129'** are moved out of mesh with their corresponding cone gears **123** and **125** and pinions **134** and **134'** during the "OFF" cycle, by the force of spring **164** acting through the crank **162** and linkage **166**, etc., and are maintained out of mesh, until the next "ON" cycle, by this same spring. It remains to be explained how a selected one of the gears **129** and a selected one of the gears **129'** (or alternatively, none of these gears) are brought into mesh with the cone gears and pinions during the "ON" cycle.

Refer again to FIGS. **7** and **8**. A vertically-extending supporting shaft **170** is mounted between the fixed supporting plates **116** and **126**. Journaled on the shaft **170** are two spaced stirrup members **171** between which is mounted an arcuate plate **172** (for the "lo" gear box) provided with six helically-arranged apertures **173**, one such aperture for each of the levels of cone gear **123**. One of the two individual plates of each pair of mounting plates **128** (it will be remembered that there are a total of six pairs of such plates, each pair carrying an idler gear **129**) is provided with a projecting tab **174** which is adapted to enter a corresponding one of the apertures **173**, and can enter such aperture if the plate **172** has been rotated to a position wherein the aperture **173** is in alignment with the tab. That is to say, a selected one of the six tabs **174** can enter its aperture **173**, the selection depending upon the angular position to which arcuate plate **172** has been rotated.

Also journaled on the shaft **170** are two spaced stirrup members **175** between which is mounted an arcuate plate **176** (for the "hi" gear box) similar to plate **172** and also provided with six helically-arranged apertures **177**, one such aperture for each of the levels of cone gear **125**. One of the two individual plates of each pair of mounting plates **128'** (it will be remembered that there are a total of six pairs of such plates, each pair carrying a separate idler gear **129'**) is provided with a projecting tab **178** which is adapted to enter a corresponding one of the apertures **177** as illustrated in FIG. **7**, and will enter such aperture if the arcuate plate **176** has been rotated to a position wherein the aperture **177** is in alignment with the tab. The particular one of the six tabs **178** which enters its aperture depends upon

the angular position to which arcuate plate 176 has been rotated.

When one of the tabs 178 enters its aperture 177 (as illustrated in the upper portion of FIG. 7), the idler gear 129' associated with that particular tab (that is, the idler gear which is carried by that particular plate 128') is brought into mesh with the cone gear 125 and with the pinion 134'. The same is true for one of the tabs such as 174 in the "lo" gear box. If, on the other hand, the apertures in arcuate plates 172 and 176 are not in alignment with the tabs (which condition is in effect illustrated in the lower portion of FIG. 7), the idler gears associated with all of these latter tabs are prevented from meshing with the cone gears 123 and 125 and the pinions 134 and 134'. For each of the six blends, the arcuate plate 176 will be brought to a position wherein one of its apertures 177 is in alignment with a corresponding tab 178, and the arcuate plate 172 will be brought to a position wherein one of its apertures 173 (generally on the same horizontal level as the aligned aperture in plate 176) is in alignment with a corresponding tab 174; the idler gears 129 and 129' on this particular level will come into mesh with their cone gears 123 and 125 and pinions 134 and 134'. All the other idler gears (to wit, five idler gears in the group 129 and five idler gears in the group 129') will be prevented from meshing with the cone gears and pinions.

For each of the two additional grades of gasoline to be dispensed (to wit, the "lo" gasoline component alone and the "hi" gasoline component alone), no corresponding holes are provided in arcuate plates 172 and 176. This means that for each of these two latter grades, all of the idler gears 129 and 129' will be prevented from meshing with the cone gears and pinion gears (as illustrated in the lower portion of FIG. 7). In each of these cases, the subtractive differential 49 is in effect rendered inoperative to adjust the blend control valve 19, the cone gear 123 rotating idly during the dispensing of solely the "lo" gasoline and the cone gear 125 rotating idly during the dispensing of solely the "hi" gasoline.

It has been previously stated that during the "ON" resetting and adjustment cycle, the motor-driven pin 161 engages and rotates crank 162, resulting in a rotation of shaft 127 in the clockwise direction in FIG. 7, from the "OFF" position illustrated, and also a rotation of shaft 127' in the counterclockwise direction from its "OFF" position (not illustrated, but corresponding to the "OFF" position illustrated for shaft 127). When shaft 127 rotates in the clockwise direction, each banjo member 130 tends to push against its respective wishbone spring 132, tending to compress the latter somewhat, and whichever one of the six tabs 174 is aligned with an aperture 173 in arcuate plate 172 is pushed into such aperture by the respective spring 132, pushing resiliently against the fixed pin 133 in the corresponding mounting plate 128. The spring 132 corresponding to the tab 174 which so moves into its aperture 173 is compressed somewhat, and exerts a force on pin 133 which tends to maintain this tab in its aperture 173 (and the corresponding idler gear 129 in mesh with cone gear 123 and pinion 134) during the rotation of such gears (which rotation takes place during the actual dispensing operation).

Similar action takes place during the "ON" cycle for the "hi" gear box, when rocker shaft 127' is rotated in the counterclockwise direction in FIG. 7.

The arcuate plates 172 and 176 are fastened together, so as to be rotated simultaneously, by means of a vertically-extending pin 179 which passes through aligned holes in the two upper stirrup members 171 and 175 (the upper one of stirrup members 171 directly overlying the upper one of stirrup members 175) and also through a hole provided in a bevel gear wheel 180, at an eccentric location on such wheel. Gear wheel 180 is journaled on shaft 170. A plurality of holes 181, equally spaced on a base circle which is centered on the axis of shaft 170, are provided in the "hi" stirrup member 175. This provides for an adjustment or variation of the included angle between the longitudinal center lines of arcuate plates 172 and 176 (by insertion of pin 179 through an appropriate one of the holes 181). This possibility of variation of the angular relation between the arcuate plates permits effectuation of a change in the number of grades of gasoline which are capable of being dispensed by the dispensing apparatus of this invention (for example, reduction in the number of grades from eight to some other number). The variation of the angular relation between the plates 172 and 176, from the relation illustrated, will cause the idler gear 129 which is in mesh with the cone gear 123 (during a dispensing operation) to be in a level different from the idler gear 129' which is in mesh with the cone gear 125 during the same operation.

The arcuate plates 172 and 176 are rotated to a selected position (for positioning no holes in alignment with the tabs 174 and 178, or for positioning a pair of holes 173 and 177 in alignment with the appropriate ones of tabs 174 and 178, respectively) by means of a sector bevel gear 182 pinned to shaft 115 and meshing with the bevel gear 180. The latter drives the arcuate plates 172 and 176 by means of pin 179.

Refer again to FIG. 2. As previously indicated, in the "OFF" position, prior to the beginning of an "ON" cycle, the spring 164 maintains the idler gears 129 and 129' "thrown out," that is, out of mesh with the cone gears 123 and 125 and pinions 134 and 134', as exemplified in the bottom portion of FIG. 7. In this position, the tabs 174 and 178 are all withdrawn from the holes in the arcuate plates 172 and 176, and these latter are free to rotate.

When the reset motor 54 is energized to begin the "ON" cycle (as a result of actuation of one of the "start" pushbuttons 58–65 or 58'–65'), it causes lever 153 to begin rotating in the clockwise direction. As soon as this lever begins to rotate, lug 158 is freed from engagement with lever 153, so that member 114 can rotate in the "ON" or counterclockwise direction, being driven in this direction by spring 118. (Prior to this freeing of lug 158, of course, the member 114 is prevented from rotating due to the meshed gearing 156, 160). The member 114 rotates to a final angular position of stop plate 82, the position of the latter being determined by the particular one of the "start" buttons which has been actuated.

As member 114 rotates, it rotates shaft 115 (to which it is pinned), and the rotation of this shaft, through 182, 180, etc., causes rotation of arcuate plates 172 and 176 to an angular position determined

by the final angular position of member **114** (and appropriate to the particular grade of gasoline selected by the actuated "start" button). The arrangement is such that the arcuate plates reach their (selected) angular positions before the motor-driven pin **161** comes into engagement with crank **162** (it will be remembered that the tabs **174** and **178** are free of the plates **172** and **176** during this time, so that the latter are free to rotate). When the pin **161** engages and rotates crank **162**, the rocker shafts **127** and **127'** are rotated (through link **166**, etc.) to "throw in" or bring into mesh the one selected (as determined by the angular positions of the arcuate plates **172** and **176**) idler gear in each group **129** and **129'**, or, alternatively, to keep all idler gears out of mesh (again as determined by the angular positions of the arcuate plates).

It is pointed out that during the "ON" cycle, the wing plate **155** rotates in the clockwise direction as member **114** rotates, being driven through the gearing **156, 160** from this latter member.

As wing plate **155** rotates, the sector gear **157** carried thereby meshes with a gear **183** pinned to the cam-carrying shaft **184** of a price increment unit denoted generally by the numeral **36**. This price increment unit is preferably of the type disclosed in FIGS. **8** et seq. of my '908 patent. In the '908 patent, the price increment unit is termed "selective gearing." The diametral relation of gears **183** and **157** is such that the shaft **184** is rotatable in 40° steps, whereas the wing plate **155** and the member **114** rotate in 10° steps (the individual projections **117** on member **114** being in 10° steps). That is to say, the successive possible stop positions of member **114** and of wing plate **155** are separated by 10°, whereas the successive possible stop positions of camshaft **184** are separated by 40°.

The camshaft **184** corresponds to camshaft **302** of my '908 patent, and operates by means of cams to select gearing (for inclusion between the couplings **35** and **37**, FIG. **1**) individual to each possible stop in the angular rotation of camshaft **184**. The particular gearing selected by the operation of camshaft **184** depends upon the final angular position to which this shaft is brought during the "ON" cycle, and this in turn depends upon the final angular position of wing plate **155** (the latter being governed, as previously described, by the final angular position of member **114**, which in turn depends upon the particular grade of gasoline selected for dispensing by means of the "start" pushbuttons **58–65** or **58'–65'**). For further details regarding this gearing selection, reference should be made to my '908 patent, wherein the same is more fully and completely described. It is here noted that the rotation of camshaft **184** to its final angular position is completed before the motor-driven pin **161** comes into engagement with crank **162**.

The price increment unit **36** is provided with a locking arrangement for locking the price selection gears out of mesh, this locking arrangement preferably being similar to that illustrated at **338, 340, 342**, etc., in FIG. **11** of my '908 patent. The locking arrangement just referred to includes a rockable lever operated by a locking shaft **163**. As previously described, shaft **163** is secured to crank **162**. In the "OFF" position illustrated in FIG. **2**, the locking shaft **163** is in its "locked" position, wherein the gears are held out of mesh. The spring **164**, acting on crank **162**, tends to maintain shaft **163** in this "locked" position. During the "ON" cycle, as previously described, the motor-driven pin **161** engages crank **162** and causes this crank to rotate in the clockwise direction. This happens after camshaft **184** has reached its final angular position, and results in the rotation of shaft **163** to its "unlocked" position, wherein the proper gear is allowed to go into mesh, as urged by the cam and spring. It remains in mesh during the actual dispensing operation, which follows the "ON" resetting and adjustment cycle.

Refer again to FIG. **5**. Relay **108**, shown in its unenergized position, has a pair of normally-open contacts **185** which are connected in a series circuit extending from the a.c. supply terminal **94** (the cam-operated switch **95** being closed) to the a.c. supply terminal **94'**, by way of a pair of normally-closed (reed switch) contacts **186** of a reed-switch-actuating relay **187** and the operating winding of the solenoid **53**. Thus, when relay **108** is energized as above described (e.g., as a result of the operation of one of the "start" contacts denoted as **99** and **100** in FIG. **5**), its contacts **185** close to energize the winding of solenoid **53**. The solenoid **53** is thus energized simultaneously with the energization of reset motor **54**, at the beginning of the "ON" cycle. This solenoid remains energized after the end of the "ON" resetting and adjustment cycle, and throughout most if not all of the actual dispensing operation which follows such "ON" cycle.

Refer now to FIGS. **2, 10**, and **11**. The blend control valve **19** is generally somewhat similar in construction to the "combined proportioning and shut-off valve **36**" described in my U.S. Pat. No. 3,073,484. In the "lo" section of this valve, a shaft **227** serves to mount a spring-engaged valve shoe **228**, which is provided with a cylindrical surface engaging the interior wall of a chamber **229** in the valve housing or body **230**. The shoe **228** cooperates with an outlet port **231** in the valve body for the control of flow of the "lo" fuel component, the valve or housing end of the "lo" hose **20** being coupled to receive liquid flowing through this outlet port. The valve housing **230** is suitably secured to a fixed support or frame **232** (see FIG. **10**) provided inside the apparatus housing **1**. The "lo" gasoline enters the chamber **229** by way of the connection or coupling **9**. It may be seen that by rotation of shaft **227**, the shoe **228** may be made to selectively cover or uncover the outlet port **231**, and thus to control the flow of "lo" gasoline into the hose **20**.

The "hi" section of the valve **19** is sealed off from the "lo" section thereof by means of a sealing partition **233**. In the "hi" section of the valve, a shaft **234** serves to mount a spring-engaged valve shoe **235**, which is provided with a cylindrical surface engaging the interior wall of a chamber **236** in the valve housing or body. Preferably, the two chambers **229** and **236** are cylindrical and have a common longitudinal axis which extends horizontally. The shoe **235** cooperates with an outlet port **237** in the valve body for the control of flow of the "hi" fuel component, the valve or housing end of the "hi" hose **21** (see FIG. **1**) being coupled to receive liquid flowing through this outlet port. The "hi" gasoline enters the chamber **236** by way of the connection or coupling **17**. It may be seen that by rotation of shaft **234**, the shoe **235** may be made to selectively cover or

uncover the outlet port 237, and thus to control the flow of "hi" gasoline into the hose 21.

The shafts 227 and 234 preferably have a common longitudinal axis, and extend outwardly from opposite sides of the housing 230. The inner ends of these two shafts are mounted for rotation in respective opposite sides of the partition 233. One end of an arm 238 is fixedly secured (pinned) to the outer end of shaft 227, and one end of a similar arm 239 is fixedly secured to the outer end of shaft 234. In FIGS. 2 and 10, the valve 19 is illustrated in the closed position, both sections of the valve being closed (valve shoes 228 and 235 completely closing their respective outlet ports 231 and 237). This closed position is the position reached just after the start of an "OFF" cycle, and is the position which is maintained between successive dispensing operations. As will be later detailed, at the end of an "OFF" cycle the reset motor 54 and the solenoid 53 are both deenergized, and the "start" buttons 58–65 and 58'–65' are all in their outward or unactuated positions. A fixed pin 240, which extends outwardly from housing 230 into the path of rotation of arm 238, provides a limiting abutment or stop which limits the rotation of this arm in the valve closing direction (counterclockwise in FIG. 10), and thus fixes the amount of rotation of the arm in this direction. A similar fixed pin 240' is provided for arm 239, to limit the rotation of this arm in the valve closing direction.

One end of a rigid link member 241 is pivotally connected to the other end of arm or crank 238, and one end of a similar link member 242 is pivotally connected to the other end of arm or crank 239. The other ends of links 241 and 242 are pivotally connected to the respective ends of the crossarm portion of a T-shaped arm 243 which is rotatably mounted on a "floating" pin 244 located at the center of the crossarm portion. Pin 244 is in turn rigidly secured to an intermediate point on a somewhat L-shaped arm 245 which is pivotally mounted at one end thereof on a pivot pin 246 secured to the fixed support 232.

The pin 244 is caused to move along an arc (centered at the center of pin 246) by means of a rigid elongated link member 247 the lower end of which is pivotally attached to the end of arm 245 opposite pin 246 and the upper end of which is pivotally secured to the pivoted arm 81, at a location on the latter adjacent the attachment 226 and the end extension 80. When the solenoid 53 is energized at the beginning of the "ON" cycle, in the manner previously described, the plunger-attached link 225 moves upwardly, causing arm 81 to rotate in the counterclockwise direction in FIG. 2, about its fixed pivot 224. This moves the link 247 upwardly from the "OFF" position illustrated, the amount of rotation of arm 81 (and hence the amount of upward movement of link 247) being determined in a positive manner by the engagement of the upwardly-moving solenoid armature 248 with the fixed solenoid core. The lower end of the link 247, obviously, moves upwardly the same distance as the upper end of this link, and the link 247, acting on arm 245, moves pin 244 through a predetermined arc, about the fixed pivot 246.

An arm 249 which is bifurcated or slotted at its lower end, is mounted for rotation about a fixed pivot pin 250. The end of dog 141, which as previously described provides output from the subtractive differential 49, and which moves horizontally in FIG. 2 as the differential output varies from zero, fits within the slot at the lower end of arm 249, and by engaging the sides of such slot, causes arm 249 to rotate back and forth as the differential output varies from zero. The differential 49 is operative during the dispensing of the six blends of the total of eight grades of gasoline, but is in effect inoperative during the dispensing of either solely "hi" gasoline or solely "lo" gasoline (as previously described).

Member 249 is provided at its upper end with an integral lug 251 which an engage one or the other of two rigid pins 252 or 253 mounted on the positioning and adjusting member 114, during the "ON" cycle, thereby to bring the arm 249 to one or the other of two corresponding predetermined angular positions; it should be pointed out that one of these two positions (determined by pin 252) represents solely "lo" gasoline, and the other (determined by pin 253) represents solely "hi" gasoline.

The pins 252 and 253 are centered on a base circle whose center is at the center of shaft 115, and they extend in such a direction from member 114 that they can come into engagement with the sides of lug 251. The location of pin 252 is fixed on member 114, but the pin 253 is carried by an arm 254 which can be swung to various adjusted positions and then tightened in position on member 114, thereby to position the pin 253 in any selected one of various holes 255 spaced on the base circle just mentioned. The adjustment provided for the location of pin 253 on member 114 enables the dispensing apparatus of the invention to be adjusted to dispense either eight grades of gasoline (with pin 253 in the particular one of holes 255 in which it is shown in FIG. 2) or, in the alternative, some number of grades less than eight (with pin 253 in some other one of the holes 255).

If solely "lo" gasoline is selected for dispensing, the member 114 will rotate (as previously described) during the "ON" cycle in the counterclockwise direction through only a very small angle from the "OFF" position illustrated in FIG. 2, and arm 249 will be allowed to rotate clockwise through only a very small angle, and will be held in this latter position by pin 252 during dispensing, as will become apparent hereinafter. If solely "hi" gasoline is selected for dispensing, the member 114 will rotate during the "ON" cycle in the counterclockwise direction through a maximum angle from the "OFF" position, and arm 249, being engaged by pin 253 as member 114 rotates, will be rotated clockwise through a maximum angle, and will be held in this latter position, during dispensing, by pin 253.

If an intermediate grade of gasoline, which is to say a "blend," is selected for dispensing, the member 114 will rotate during the "ON" cycle in the counterclockwise direction to an intermediate position wherein neither pin 252 nor pin 253 will interfere during dispensing with the movement of arm 249, and in these cases the rocking of arm 249 will be controlled from the subtractive differential 49, through dog 141 which acts on the lower end of this arm.

Near its lower end, arm 249 carries an outwardly-extending fixed pin 256 which is arranged to cooperate with the upper end of the upwardly-extending straight

leg of T-shaped arm **243**. The upper end of the straight leg of arm **243** is beveled inwardly from both sides to provide two surfaces **257** and **258** which together form a V, the intersection of these two surfaces (at the center of the width of this straight leg) being cut out to form a U-shaped notch **259** having substantially the same radius of curvature as pin **256**, so that pin **256** can enter into and seat in notch **259**.

The operation of the linkage which adjusts the position of the blend control valve **19** during the "ON" cycle, will now be described. As previously stated, FIG. **2** illustrates the various members (including the blend control valve **19**) in their "OFF" positions, which means prior to the beginning of an "ON" adjustment and resetting cycle; it will be recalled that in the "OFF" position of the blend control valve, both sections of the valve are closed. In the "OFF" position, the pin **256** rests in engagement with the inclined or beveled surface **258** at the upper end of arm **243**; this relation is a result of the previous "OFF" cycle, as will later appear.

Assume, first, that a selection of solely the "lo" gasoline has been made, by actuation of either of the "start" buttons **58** or **58'**. Assuming that the nozzle has been properly inserted into the fillpipe, the closure of an electrical circuit by the actuated pushbutton (at or near the end of its mechanical travel) begins the "ON" cycle and causes the relay **108** (FIG. **5**) to be energized, resulting in the simultaneous energization of reset motor **54** and of solenoid **53**. Immediately after the solenoid **53** is energized, the solenoid-actuated link **225** is pulled upwardly, to the end of its travel in the upward direction. Due to various factors, such as mechanical inertia in the motor **54**, the gear ratio between the motor output shaft and shaft **146**, the fact that the motor-driven lever **153** must release the wing plate **155** at **158** before the spring-actuated member **114** can rotate, etc., the solenoid link **225** completes its travel before the member **114** has rotated to any substantial degree.

At this juncture, it is pointed out that when the link **225** pulls upwardly on the end of the pivoted arm **81**, the end extension **80** thereof moves away from locking plate **77**, which permits pin **78** to enter the appropriate one of the holes **76** and mechanically "lock in" the pushbutton which has been actuated.

The upward movement of link **247**, produced as a result of the solenoid link **225** acting on arm **81**, moves the "floating" pin **244** upwardly through an arcuate path about the pivot pin **246**. As pin **244** moves in the upward direction, carrying with it the arm **243**, the reaction of pin **256** against the inclined surface **258** (which is on arm **243**) causes the arm **243** to tilt or rotate in the clockwise direction about pin **244**, as illustrated in FIG. **11**, to a final position which is reached when pin **256** enters the U-shaped notch **259**. In this connection, it may be noted that during this rotation of arm **243**, pin **256** remains essentially stationary because the lug end **251** of arm **249** is in engagement with pin **252** on member **114**. For this grade of gasoline, the member **114** rotates through only a very small angle from its "OFF" position, so that when this latter member does rotate somewhat later during the "ON" cycle, the arm **249** rotates only slightly, lug **251** remaining in engagement with pin **252**.

The above-described tilting of the T-shaped arm **243** tends to pull link **241** upwardly, and to push link **242** downwardly. However, the lower edge of arm **239** (to which the lower end of link **242** is attached) is at this time in engagement with its stop **240'**, so that link **242** is prevented from moving downwardly; therefore, shaft **234** does not rotate, so the "hi" valve shoe **235** remains in its closed position, covering and sealing the "hi" outlet port **237**.

The movement of link **241** upwardly (in response to the tilting of arm **243**) rotates arm **238** in the upward direction, rotating the valve shaft **227** to move the "lo" valve shoe **228** away from its outlet port **231**. By the time the tilting of arm **243** ceases, the "lo" outlet port **231** is completely uncovered, so that "lo" gasoline can flow substantially unimpeded through the connection or coupling **9**, through the valve chamber **229**, and through the "lo" outlet port **231** to the "lo" hose **20**, and thence to the nozzle.

FIGS. **11** and **12** show the positions of the various parts of the linkage, and of the blend control valve **19**, at the end of the "ON" cycle in accordance with the action just described, when solely "lo" gasoline has been selected. The "lo" section of the blend control valve **19** is fully open, and the "hi" section is completely closed. The subtractive differential **49** being inoperative for any control purpose under these conditions, dog **141** is ineffective, and the blend control valve **19** remains in the position illustrated in FIGS. **11** and **12** throughout the dispensing of solely the "lo" gasoline.

Now assume that a selection of solely "hi" gasoline has been made, by actuation of either of the "start" buttons **65** or **65'**. The relay **108** is again energized to begin the "ON" cycle, resulting in the simultaneous energization of motor **54** and of solenoid **53**. The solenoid-actuated link **225** is again pulled upwardly by the solenoid, producing an upward movement of link **247** from the "OFF" position illustrated in FIG. **2**. Again, the "floating" pin **244** is caused to move upwardly through an arcuate path. Also, the arm **243** is caused to tilt or rotate in the clockwise direction about pin **244**, as the notch **259** is caused to move upwardly, to bring pin **256** thereinto. (Lug end **251** of arm **249** remains essentially in engagement with pin **252** during this portion of the operation). This results in bringing the blend control valve **19**, during this initial part of the "ON" cycle, to the position illustrated in FIG. **11–12**, just as before.

However, somewhat later during the "ON" cycle, member **114** rotates to a position (which is reached prior to the end of its angular rotation) such that pin **253** comes into engagement with lug **251**, and, as member **114** continues to rotate in the counterclockwise or "ON" direction, arm **249** is forced to rotate clockwise about its pivot **250**. This rotation of arm **249** causes (by the action of pin **256** against one side of the U-shaped notch **259**) the arm **243** to tilt or rotate in the counterclockwise direction about pin **244**, away from the position illustrated in FIG. **11**. The final tilted position of arm **243** is reached, in this case, when member **114** reaches its final angular position and ceases rotating arm **249**. The tilting of arm **243** in the manner just mentioned (in the counterclockwise direction, away from the position illustrated in FIG. **11**) causes link **241** to move downwardly, and link **242** to move upwardly.

The movement of link 241 downwardly rotates arm 238 in the downward direction, until it comes into engagement with its stop 240. This rotation of arm 238 rotates the valve shaft 227 in such a direction as to move the "lo" valve shoe 228 back over its port 231, until it reaches the closed position illustrated in FIGS. 2 and 10 (which position it reaches when the lower edge of arm 238 comes into engagement with stop 240). The "lo" valve shoe then covers and seals the "lo" outlet port 231.

The movement of link 242 upwardly rotates arm 239 in the upward direction, rotating the valve shaft 234 to move the "hi" valve shoe 235 away from its outlet port 237. By the time the member 114 has reached its final angular position and has stopped rotating (thus stopping the rotation of arm 249) the "hi" outlet port 237 is completely uncovered, so that "hi" gasoline can flow substantially unimpeded through the coupling or connection 17, through the valve chamber 236, and through the "hi" outlet port 237 to the "hi" hose 21, and thence to the nozzle. During the actual dispensing which follows the "ON" adjustment operations described, no further motion of the blend control valve 19 occurs (the subtractive differential 49 being inoperative for any control purpose under these conditions), and such valve remains in the condition last described, that is, with its "lo" section completely closed and with its "hi" section fully open.

Next assume that an intermediate grade of gasoline is desired, that is, a "blend." The selection is made by actuation of one of the "start" buttons 59–64 or one of the buttons 59'–64'. The relay 108 is again energized to begin the "ON" cycle, resulting in the simultaneous energization of motor 54 and of solenoid 53. The solenoid-actuated link 225 is again pulled upwardly by the solenoid, producing an upward movement of link 247. The "floating" pin 244 is caused to move upwardly through an arcuate path. Lug end 251 of arm 249 remains essentially in engagement with pin 252, causing the arm 243 to tilt or rotate in the clockwise direction about pin 244, as notch 259 moves upwardly, to bring pin 256 thereinto. This results in bringing the blend control valve 19, during this initial part of the "ON" cycle, to the position illustrated in FIGS. 11–12, as before. In this position, the "lo" section of the valve is fully open, and the "hi" section is completely closed.

The valve 19 tends to remain in this position as member 114 rotates (somewhat later during the "ON" cycle) to its final angular position, even though pin 252 may move away from the lug end 251 of arm 249, since in this case there is nothing to positively cause a movement of arm 249, and there is a certain amount of friction which acts to keep the valve in the position illustrated in FIGS. 11–12 (to which it has been brought).

When the member 114 has reached its final angular position, the pin 252 has moved sufficiently counterclockwise (from the position illustrated in FIG. 2) to prevent any interference thereby with movements of the lug end of arm 249, and the member 114 has not rotated enough to bring pin 253 sufficiently close to lug 151 to cause any interference thereby with movements of this same lug end.

For the actual dispensing of a blend, the output dog 141 of the subtractive differential 49 moves back and forth (horizontally) automatically, as called for by any change in conditions (this including the initial and rapid automatic setting of the valve 19, at the very beginning of the actual dispensing of a blend, from the "lo" valve open, "hi" valve closed initial position of FIGS. 11–12 to another position, for a blend, wherein the ports 231 and 237 are both partially closed, or both partially open, depending on the way one looks at it). Considering, by way of example, this first initial and rapid automatic setting, when the "lo" flow is in excess of what it should be (as would be the case when the valve is in the solely "lo" position illustrated in FIGS. 11–12, whereas a blend of "hi" to "lo" has been selected by the "start" button), an output from the subtractive differential 49 occurs, such as to cause dog 141 to move horizontally to the left in FIG. 11. When dog 141 moves to the left, arm 249 pivots to move pin 256 to the left also. When pin 256 moves to the left, it causes a counterclockwise tilting or rocking of arm 243 about its pivot 244 (due to the pin 256 engaging the respective side of notch 259). This counterclockwise tilting of arm 243 causes link 241 to move downwardly and link 242 to move upwardly, resulting in the moving of "lo" valve shoe 228 in a direction to partially cover its port 231, and in the moving of "hi" valve shoe 235 in a direction to partially uncover its port 237.

Conversely, when the "hi" flow is in excess of what it should be, dog 141 moves to the right, pin 256 moves to the right, and the arm 243 tilts or rocks in the clockwise direction about pin 244, resulting in the moving of link 241 upwardly and link 242 downwardly. This opens the "lo" shoe 228 and closes the "hi" shoe 235.

Now referring to FIGS. 10 and 16, a subsidiary housing 270, which is secured in the main apparatus housing on the underside of the top wall thereof, provides a mounting support for the vacuum switch 25, this switch being mounted on a side wall of the subsidiary housing. The vacuum switch 25 preferably is of the construction disclosed in FIG. 10 of my '890 patent, and includes a movable plunger 271 which extends outwardly from the casing of the switch, as well as a pair of wires 272 which are connected individually to respective contacts inside the switch casing and which may be electrically connected to external circuitry. The two wires 272 are connected to circuitry as diagrammatically illustrated in FIG. 5, wherein the two contacts 103 and 105 represent the pair of contacts inside the vacuum switch casing. As described in my '890 patent, the plunger 271 may be mechanically pushed inwardly with respect to the switch casing for a predetermined distance, in order to cause closure of the two electrical switch contacts inside the casing.

The vacuum switch 25 is so located that its plunger 271 may be acted upon by a camming surface 273 integrally formed on the same wheel which carries gear 145. This latter wheel, as previously stated, is pinned to shaft 146 and is driven by reset motor 54 through the gearing 142, 143. The camming surface 273 rotates in the direction indicated by the arrow 274 in FIG. 16, and the motor-driven shaft 146 rotates at the same speed as camshaft 144.

Refer again to FIG. 6. It may be seen that the configuration of the cam 273 corresponds to that illustrated by arc E, with the "OFF" position line extending horizontally to the right from the center of shaft 146 in FIG. 16 and the "ON" position line extending horizon-

tally to the left from this same center, the arrow **274** indicating a clockwise direction of rotation, as does the arrow G; the "OFF" position of the cam **273** is illustrated in FIG. **16**.

In the "OFF" position, the cam **273** pushes the plunger **271** of vacuum switch **25** inwardly, causing its contacts to be mechanically closed. These contacts are held closed by cam **273** throughout most of the "ON" cycle, and are mechanically released (by the left-hand end of cam **273** in FIG. **16** passing the plunger **271**) just prior to the termination of the "ON" cycle.

During the "OFF" cycle, just before reaching the "OFF" position, the cam **273** again comes into engagement with the switch plunger **271**, mechanically closing the contacts of the vacuum switch in preparation for the next "ON" cycle.

Recapitulating the operations so far described, actuation of one of the "start" pushbuttons **58–65** or **58'–65'** (the selection being made according to the grade of gasoline desired) mechanically rotates the shaft **69** and the stop plate **82** to a corresponding angular position. After this has occurred, the actuated pushbutton causes the closure of electrical contacts, which (assuming that the nozzle has been properly positioned in the fillpipe) results in the energization of relay **108** (FIG. **5**). The closure of the contacts of this relay simultaneously energizes the solenoid **53** and the reset motor **54**. The solenoid remains energized throughout the actual dispensing operation (contacts **186** and the contacts **185** of relay **108** normally remaining closed during such actual dispensing). Relay **108** normally remains energized throughout the actual dispensing, since the mechanical "locking in" of the actuated pushbutton, which occurs as previously described, causes one or the other of contacts **99** or **100** in FIG. **5** to remain closed throughout such actual dispensing. Motor **54**, as previously described, locks itself on by means of the cam-operated switch **104**, which maintains the motor energized until shaft **146** has rotated through 180° from the "OFF" position, at which time switch **104** opens to deenergize the motor and thus stop the rotation of shaft **146**.

Solenoid **53**, which operates almost instantaneously upon the closure of the pushbutton contacts, lifts one end of arm **81** to cause (by means of **77**, **78**, etc.) a mechanical "locking in" of the particular pushbutton which has been actuated, and also to cause (by means of **247**, **244**, etc.) the adjustment of blend control valve **19** to a position different from the "OFF" position (for example, to the position illustrated in FIGS. **11–12**).

Reset motor **54** (by means of **147**, **149**, **150**, etc.) causes rotation of the counter reset shaft **151** through a predetermined angle. This rotation causes the resetting of the counter **31** to zero, prior to the beginning of the actual dispensing. Motor **54** also (by means of **152**, etc.) rotates the lever **153**, releasing wind plate **155** and allowing this latter to be driven from member **114**. Member **114**, as it is rotated in the counterclockwise direction by spring **118** to a selected angular position established by stop plate **82**, causes (in conjunction with the throwout mechanism **161**, **162**, **166**, etc.) an appropriate selection of gears to be made in the blend control unit **42**, **44**. Also, it may cause a further adjustment of the blend control valve **19** to be made, if solely "hi" gasoline has been selected, by means of **253**, **249**, etc.

The wing plate **155**, as it is driven in the "ON" direction by member **114**, causes (in conjunction with the throwout mechanism **161**, **162**, **163**) an appropriate selection of gears to be made in the price increment unit **36**.

Again referring to FIG. **5**, the pump motor **3** is connected in series with the normally-open contacts **260** of a relay **261** across the 230-volt a.c. supply terminals **94'**, **94''**. One end of the operating winding of relay **261** is connected to the a.c. supply terminal **94'**, and the other end of this winding is connected through the contacts of a single-pole, single-throw cam-operated switch **262** and the contacts **185** of relay **108** to the supply terminal **94**, through the normally-closed switch **95**. In FIG. **6**, the arc dented by C represents the operation of switch **262**. Switch **262** is closed by its cam prior to the reaching of the "ON" position, and prior to the termination of arc E (which latter represents the operation of the cam which operates on the contacts **103** and **105** of vacuum switch **25**). Thus, switch **262** is closed prior to the mechanical releasing of the vacuum switch contacts **103** and **105**.

The cam arrangement provided for switch **262** is so designed that the closing of this switch by such cam always occurs after the completion of all of the previously-described mechanical resetting and adjustment operations. When, at the time indicated by the commencement of arc C in FIG. **6** (this commencement being referred to the clockwise direction of arrow G), switch **262** closes, an energization circuit is completed from the a.c. supply terminals through the operating winding of relay **261** (switch **95** and contacts **185** then being closed). Relay **261** then closes its contacts **260**, energizing the pump motor **3**. This motor drives the "lo" pump **2** and the "hi" pump **11**, thus causing the actual dispensing of gasoline to begin. The dispensing takes place in the manner previously described and is of course controlled by the blend control valve **19**. When solely "hi" gasoline or solely "lo" gasoline is being dispensed, the blend control valve **19** is set to and maintained at a corresponding fixed position, but when a "blend" is being dispensed, the gear boxes **42** and **44** (which have been adjusted for that blend during the "ON" cycle), acting through the subtractive differential **49**, provide a continuous control of the position of the blend control valve.

As previously mentioned, the contacts **103** and **105** of vacuum switch **25** are held closed by a cam when pump motor **3** is energized to begin the actual dispensing. Motor **3** drives the vacuum pump **23**, as well as the gasoline pumps **2** and **11**. As indicated in FIG. **6** by the termination of arc E, the contacts of vacuum switch **25** are mechanically released by its cam shortly after the vacuum pump **23** is started (by the energization of its driving motor **3**). If, at the time of this mechanical release, a suitable vacuum has been developed in the vapor hose **22**, the contacts of the vacuum switch **25** will be maintained closed in response to such vacuum, as described in my '890 patent. If, on the other hand, there is not present at this time a suitable vacuum in hose **22**, the vacuum switch contacts **103**, **105** will open (also as described in my '890 patent). The opening of contacts **103**, **105** will result in the commencement of an "OFF" cycle of the dispensing apparatus and the termination of the dispensing, as will subsequently be explained.

It may be observed that the following items are all connected in series in the energization circuit (between buses 91 and 92) for the operating winding of relay 108: (1) the electrical path provided by the fillpipe 98 between the nozzle electrodes 96 and 97; (2) the pushbutton contacts 99 or 100, one or the other of which has been actuated to start the operation; (3) the emergency stop switches 101 and 102; and (4) the contacts of vacuum switch 25. The breaking of the series circuit to the winding of relay 108 by any of items (1) through (4) will result in the deenergization of relay 108 and, as will subsequently be explained, such deenergization causes the commencement of an "OFF" cycle and the termination of the actual dispensing of gasoline. Items (1), (2), and (3) provide emergency-type or safety-type action, whereas item (4) provides a more normal type of termination, resulting from the filling of the motor vehicle fuel tank; filling of the customer's fuel tank is what is desired, in many instances.

When the nozzle accidentally drops out of the fillpipe 98 during dispensing, the necessary electrical continuity is broken at 96–98, and relay 108 is deenergized; this provides a safety feature by automatically terminating the dispensing.

If the closed one of pushbutton switches 99 or 100 opens accidentally for any reason, relay 108 is deenergized, again automatically terminating the dispensing.

If either of the emergency stop switches or panic buttons 101 or 102 is pressed, such switch will be opened, deenergizing relay 108 and automatically terminating the dispensing.

If the contacts of vacuum switch 25 open when the cam mechanically releases such contacts, just before the end of the "ON" cycle (rather than being held closed by the vacuum developed), relay 108 is deenergized, automatically terminating the dispensing.

Now, a somewhat more normal (and typical) type of operation will be considered in detail, to explain what takes place when relay 108 is deenergized. A typical nozzle arrangement which can be employed with the dispensing apparatus of this invention is disclosed in my '890 patent. A nozzle arrangement of the type mentioned operates on vacuum switch 25 to open its contacts 103,105 in response to a "full" condition of the motor vehicle fuel tank into which gasoline is being dispensed by way of the nozzle. This action is explained in detail in my '890 patent. When the contacts 103, 105 of switch 25 thus open, in response to the fuel tank becoming full of gasoline, relay 108 is deenergized, opening its contacts 109 and 185 and returning it to the position illustrated in FIG. 5.

The opening of relay contacts 185 deenergizes the solenoid 53. Since the contacts 185 are connected in series with the operating winding of relay 261, the opening of these contacts deenergizes this relay, opening its contacts 260 and turning off the pump motor 3. This stops the pumping of gasoline and terminates the actual dispensing operation. However, there is provided a more rapid and more positive cutoff of the actual gasoline flow through the hoses 20 and 21 at This time, by the operation of the blend control valve 19; this will now be explained.

The arm 81 has an integral lateral (upwardly-projecting) extension 263, to the free end of which is attached one end of a coiled tension spring 264. The other end of spring 264 is attached to a fixed pin 265 secured to the framework. The spring 264 normally acts to rotate arm 81 in the clockwise direction (in FIG. 2) about its fixed pivot 224, that is, to urge the solenoid pin 226 end of this arm in the downward direction. When solenoid 53 is energized at the beginning of the "ON" resetting and adjustment cycle, it pulls this end of arm 81 upwardly, against the bias of spring 264. When solenoid 53 is deenergized at the beginning of the "OFF" cycle, the arm 81 is released for rotation by spring 264, to move the links 225 and 247 downwardly. A fixed stop 266, secured to the framework, is provided in such a position as to engage the lower end of link 225 and limit the rotation of arm 81 in the clockwise direction.

When the arm 81 rotates in the clockwise direction from its "ON" position to the position illustrated in FIG. 2, the end portion 80 of this arm pushes locking plate 77 downwardly, removing the pin 78 from that one of the holes 76 into which it had previously entered. This unlocks or releases (by releasing shafts 69 and 69 for rotation) the particular "start" button (in the groups 58–65 or 58'–65) which had previously been actuated to start the operation, and allows it to be pushed outwardly to its unactuated position by means of its individual spring 79.

When the link 247 is moved downwardly as a result of the rotation of arm 81, the "floating" pin 244 is moved in a clockwise direction in FIG. 2, about its pivot 246. This pushes the T-shaped arm 243 in a generally downward direction, which causes both of the links 241 and 242 (if unimpeded) to move downwardly.

When the pin 244 is moved in a generally downward direction as previously described, both of the valve shoes in blend control valve 19 are moved to their closed or shut-off positions, no matter in what positions they had been previously. For example, if solely "lo" gasoline were being dispensed, the blend control valve 19 would have been in the position illustrated in FIGS. 11 and 12, during the actual dispensing operation. In this case, when pin 244 is moved downwardly (since the valve shoe 235 is closed and the "hi" arm 239 is already against its stop) the link 242 does not move downwardly and the arm 243 in effect pivots about its right-hand end, moving the link 241 downwardly, which results in moving the arm 238 upwardly and the "lo" valve shoe 228 to its closed position covering the outlet port 231. The converse occurs in the case of the dispensing of solely "hi" gasoline; now, when pin 244 is moved downwardly, the link 241 does not move downwardly and the arm 243 in effect pivots about its left-hand end, moving the link 242 downwardly and closing the "hi" valve shoe 235.

In the case of the dispensing of a "blend" (wherein both of the ports 231 and 237 are partially uncovered by their respective valve shoes), when pin 244 is moved downwardly the links 241 and 242 move downwardly together, moving both valve shoes 228 and 235 toward their closed positions until one or the other of the arms 238 or 239 engages its respective stop, following which the single unimpeded link continues to move downwardly until its corresponding arm 238 or 239 engages its stop. When this occurs, both of the valve shoes 228 and 235 are completely closed.

The operation of the blend control valve **19** just described (which takes place upon deenergization of solenoid **53**) occurs very rapidly upon deenergization of the solenoid, and, since such operation results in both valve shoes **228** and **235** being brought to their completely closed positions, a positive cutoff of the gasoline from hoses **20** and **21** is provided.

It may be noted, from a comparison of FIGS. **10** and **12**, that the valve shoes **228** and **235** move to only one side of their respective ports **231** and **237** during any operation of the valve, from closed to open and back to closed.

When pin **244** is moved downwardly in the manner previously described, the arm **243** moves in a generally downward direction. This moves the notch **259** down to a position wherein the pin **256** is freed for lateral movement on the surfaces **257** or **258**, without contacting the sides of the U-shaped notch **259**.

Referring again to FIG. **5**, the relay **108** carries a pair of normally-closed contacts **267** which are connected in series with the cam-operated switch **111** and its contact **113**, and with reset motor **54**, across the a.c. supply terminals **94**, **94'**. It will be recalled that switch **111** is closed on its contact **113** during the "ON" cycle, at the termination of arc A in FIG. **6**. Therefore, when relay **108** is deenergized in response to the opening of the contacts of vacuum switch **25** upon "fill" (or in response to the removal of the nozzle from the fillpipe, the pressing of one of the switches **101** or **102**, etc., as previously described), an energization circuit is completed for reset motor **54**. Shortly after motor **54** begins to rotate at the beginning of the "OFF" cycle, it causes the cam-operated switch **104** (whose cam is driven from this motor) to close, as illustrated by the left-hand portion of arc B in FIG. **6** (the cam operation continuing in the direction G). This closes a "lock-in" circuit for the motor, maintaining the motor energized for as long as switch **104** is closed. Switch **104** remains closed throughout substantially all of the remainder of the "OFF" cycle, that is, substantially until the upwardly-extending vertical line designated "OFF" in FIG. **6** is reached. This last-mentioned line represents completion of the "OFF" cycle, which coincides in camshaft position, but not in time, with the beginning of the following "ON" cycle.

From the above, it may be seen that the reset motor **54**, upon energization thereof in response to deenergization of relay **108** (normally at the end of an actual dispensing operation, is maintained energized until it has caused rotation of the camshaft **144** (and also of the shaft **146**) through substantially 180° from the "ON" line in FIG. **6**; then it is shut off or deenergized by the opening of switch **104** (see the left-hand portion of arc B in FIG. **6**). The line designated "OFF" in FIG. **6** denotes the completion of the "OFF" cycle.

During the "OFF" cycle (180° of rotation of shaft **146** in a clockwise direction in FIG. **2**, beginning with a position 180° clockwise from the position illustrated), the reset motor **54**, through the various linkages previously described, including the crank **147**, drives the plate **150** in the direction indicated by the "OFF" arrowhead on arc **159**.

The arm **81** is somewhat T-shaped, having an integral extension **268** which extends to the left of the pivot **224** in FIG. **2**, approximately in alignment with the center of the pivotal attachment **226** and with the center of the aperture through which the upper end of link **247** extends. This extension **268** is adapted to at times (as will be explained hereinafter) come into engagement with an outwardly-extending lug **269** formed on and carried by crank **147**, as the extension **268** is moved upwardly by spring **264**, when the solenoid **53** is deenergized. However, in the present case (a "fill" operation, wherein the solenoid **53** is deenergized simultaneously with the energization of motor **54**), the lug **269** has been moved (by motor **54**, rotating crank **147**) out of the way of extension **268**, by the time this extension has moved upwardly to a point where such engagement might otherwise occur. Therefore, the lug **269** does not interfere in this case with the rotation of arm **81**, and complete shutoff of valve **19** (in the manner previously described) is effected very rapidly.

During the "OFF" cycle, when plate **150** rotates in the counterclockwise direction, the counter reset shaft **151** pinned thereto rotates in the counterclockwise direction, effecting the first step in a counter resetting operation. This will be further referred to hereinafter.

During the "OFF" resetting and adjustment cycle, as the crank **147** rotates clockwise from its "ON" position, the link member **152** moves generally upwardly, rotating the L-shaped lever **153** in the counterclockwise or "OFF" direction, from its "ON" position.

When the pin **161** (carried by lever **153**) rotates away from its previous engagement with crank **162**, spring **164** rotates the latter to the "OFF" position illustrated in FIG. **2**. This rotation of crank **162**, by means of the linkage **166**, **167**, etc., "throws out" all of the gears in the "lo" gear box **42** and in the "hi" gear box **44**, which is to say that all of the idler gears **129** and **129'** are brought to a position wherein they are out of mesh with the respective cone gears **123** and **125**, and also out of mesh with the respective pinions **134** and **134'**. Also, the rotation of crank **162** to its "OFF" position by spring **164** returns the shaft **163** to its "locked" position, wherein the gears are held out of mesh, in unit **36**.

As lever **153** continues to rotate in the counterclockwise direction (being driven in this direction by the motor **54**), a location is reached wherein one of its arms "picks up" or comes into engagement with the lug **158** of wing plate **155**. Then, as lever **153** continues to rotate in this "OFF" or counterclockwise direction, it rotates wing plate **155** along with it.

The rotation of wing plate **155** in the counterclockwise direction, through gearing **157**, **183**, causes rotation of the camshaft **184** of the price increment unit **36** to its "OFF" or "reference" position.

The wing plate **155**, as it rotates in the counterclockwise direction, drives the positioning and adjusting member **114** through the gearing **156**, **160**, the rotation of the latter member being in the clockwise direction in FIG. **2**, which is the "OFF" direction of rotation for such latter member. The rotation of member **114** in this "OFF" direction tensions or stretches spring **118**.

The rotation of member **114** in the "OFF" direction rotates shaft **115**, which causes rotation of arcuate plates **172** and **176** in the "lo" and "hi" gear boxes **42** and **44**, respectively, to an "OFF" or reference position.

The member 114 itself rotates in the clockwise direction, under the positive control offered by the gearing 156, 160, to the "OFF" or reference position illustrated in FIG. 2, wherein its projections 117 have a certain predetermined relation to the projections 83 on stop plate 82.

As the member 114 nears the end of its rotation in the clockwise or "OFF" direction, the pin 252 carried thereby comes into engagement with the lug 251 of arm 249, rotating this arm in the counterclockwise direction about its pivot 250 to bring the pin 256 to the predetermined "OFF" position illustrated in FIG. 2.

Refer again to FIGS. 5 and 6. In FIG. 6, the arc denoted by C represents the operation of the cam-operated switch 262. It has been described previously how this switch is closed by its cam (driven by camshaft 144) near the end of the "ON" cycle, thereby to energize the pump motor relay 261 (relay 108 being energized at this time, and its contacts 185 closed) and turn on the motor 3. As indicated by arc C, the switch 262 is opened by reset motor 54 shortly after the beginning of the "OFF" cycle, thus making absolutely certain that the pump motor relay 261 will not be again energized during the "OFF" cycle (even though, of course, this relay has been previously deenergized by the opening of contacts 185 of relay 108 at the very beginning of the "OFF" cycle).

The arc denoted by D in FIG. 6 represents the operation of the cam-operated switch 95. As indicated by this arc, the switch 95 is opened by reset motor 54 shortly after the beginning of the "OFF" cycle. The opening of this switch removes the voltage from buses 91 and 92, thus making certain that the "OFF" cycle will proceed in the desired manner regardless of any changes that might take place in any of the circuit elements connected to these buses (such as, for example, the closing of one of the pushbutton switches 99 or 100, which might otherwise cause relay 108 to again become energized). The opening of switch 95 also effects another break in the energization circuit of solenoid 53, preventing this solenoid from accidentally becoming energized during the "OFF" cycle, as well as effecting an additional break in the energization circuit of the pump motor relay 261.

Just prior to the end of the "OFF" cycle, the reset motor 54 causes the closing of the cam-operated switch 111 on its contact 110 (see arc A in FIG. 6). Also, at or about this same time the cam-operated switch 95 is closed (see arc D), and the cam 273 acts to close the contacts of the vacuum switch 25 (see arc E). Thus, the various items are reset for the following "ON" cycle, which can be begun by actuation of one of the "start" buttons 58–65 or 58'–65', as before.

Although not illustrated in the drawings, all of the electrical contacts at which sparking might be produced are enclosed in an explosion-proof housing located, for example, on top of the apparatus housing. Inside this explosion-proof housing are mounted the relays 108 and 261 (together, of course, with their contacts), and the cam-operated switches 11, 104, 262, and 95, as well as another cam-operated switch 275, yet to be described. In this housing, also, is mounted a switch for turning on a lamp (not shown) which provides illumination for the dispensing apparatus. The cams which operate the cam-operated switches are rotated by means of the camshaft 144, which is sealed through a wall of the explosion-proof housing. This camshaft rotates at the same speed as does shaft 146. In order to avoid undue complication of the drawings, the configurations of the cams which operate the switches 111, 104, etc. are not shown in detail; from a study of FIG. 6, the actual cam configurations should be apparent to those skilled in the art.

The foregoing has described the termination of the actual dispensing operation, and the beginning of the "OFF" resetting and adjustment cycle which follows, as resulting from a "full" condition of the motor vehicle fuel tank. The dispensing apparatus of this invention also includes an arrangement for terminating the dispensing operation upon the dispensing of a preset number of dollars' worth of gasoline, and this latter arrangement will now be described.

The register 31 which is included in the overall dispensing apparatus may generally be of the type disclosed in Bliss U.S. Pat. No. 2,814,444, insofar as the actual registering of total gallons or quantity and total cost is concerned. This register ordinarily includes a set of gallons or quantity wheels, which are driven by the total gallons (mechanical) output 30 of summing differential 28, and a set of cost or money wheels, which are driven by the total cost (mechanical) output 40 of summing differential 39 (FIG. 1). The money wheels comprise dollars, tens of cents, and cents wheels coupled together in decade transfer relationship, in accordance with the teachings of the aforementioned Bliss patent.

Refer again to FIGS. 5 and 6. A single-pole, single-throw reed switch 275, one contact 276 of which is connected directly to bus 92, serves as a power control switch for the "money cutoff" network now to be described. Switch 275 is controlled by a rod-type permanent magnet mounted on the gear wheel 145, which is driven by reset motor 54 (and which also carries the camming surface 273). In FIG. 6, the arc denoted by F represents the operation of switch 275. Switch 275 is operated substantially simultaneously with switch 262 (see arc C), which is to say that switch 275 is caused to close toward but before the end of the "ON" resetting and adjustment cycle, remains closed during the actual dispensing operation which follows, and is opened shortly after the beginning of the "OFF" cycle; switch 275 is open at all other times. It will be assumed in what follows that an actual dispensing operation is taking place; switch 275 is then closed.

In FIG. 5, switches (including the switch 275, previously referred to) surrounded by circles represent so-called reed switches, which are operated or actuated by bringing permanent magnets in proximity to the fixedly-mounted switches. Generally, these reed switches are of the single-pole, single-throw type. A reed switch 278 has one contact connected to the other contact 277 of switch 275 and its other contact connected to one end of a stepper winding 279, the other end of winding 279 being connected to bus 91. Switch 275 being closed, each time that switch 278 closes, a pulse of current will flow through stepper winding 279.

The reed switch 278 is arranged to be actuated (i.e., closed) by a rod-type permanent magnet which is attached to the tens cents money wheel of the gallons and cost register 31, at a location such that switch 278 is

closed simultaneously with each appearance of the "9" digit on this wheel in the viewing window of the register, which would occur each time 90 cents, plus some dollar value from zero upward, worth of gasoline has been dispensed.

The energization circuit for stepper **279** closes each time that switch **278** closes. Stepper **279** comprises part of a manually-settable counter which can be set to some desired whole number of dollars, prior to the "-start" of the dispensing operation. Each time that the stepper **279** operates, it mechanically sets this counter back one step, in the direction toward zero. Thus, it may be set back once when 90 cents worth of gasoline has been dispensed, again when $1.90 worth has been dispensed, and so on. When the counter has reached the "1 dollar" step (either from having been stepped backward to this step by means of successive operations of the stepper **279**, or from originally having been set to only the "1 dollar" step), the next following operation of the stepper **279** causes a reed-type "reset switch" **280** to close. Switch **280** is actuated (i.e., closed) by a rod-type permanent magnet attached to the shaft of the manually-settable counter (which shaft is mechanically stepped in the reverse direction by stepper **279**).

The contacts of a reed switch **281** are connected in series with the contacts of switches **278** and **280**, and with the operating winding of the reed-switch-actuating relay **187**, between contact **277** of switch **275** (this latter contact being connected to bus **92** by closed switch **275**) and bus **91**. The reed switch **281** is arranged to be actuated (i.e., closed) by a rod-type permanent magnet which is attached to the cents money wheel of the gallons and cost register **31**, at a location such that switch **281** is closed simultaneously with each appearance of the "8" digit on this wheel in the viewing window of the register. Thus, when 98 cents of the final dollar's worth of gasoline ordered has been dispensed, reed switches **278**, **281**, and **280** are all closed, resulting in the energization of relay **187**. Relay **187** is preferably a reed-switch-actuating relay, carrying magnets which operate reed switch contacts.

When relay **187** is energized, its normally-closed reed switch contacts **186** are opened and its two normally-open pairs of reed switch contacts **282** and **283** are both closed. Contacts **282** are connected between switch contact **277** and one end of the winding of relay **187**, and thus across the series combination of reed switches **278**, **281**, and **280**; the closing of contacts **282** thus "locks in" the relay **187**. In this connection, it may be here noted that relay **187** is reset (i.e., deenergized) at a later time (to wit, shortly after the beginning of the "OFF" resetting and adjustment cycle, which follows the termination of the actual dispensing operation by the opening of the cam-operated switch **95**, which removes the voltage from buses **91** and **92**.

The opening of contacts **186** of relay **187** opens the energization circuit of solenoid **53**, deenergizing this solenoid. Thus, this solenoid is deenergized upon the dispensing of 98 cents of the final dollar's worth of gasoline ordered.

Refer now to FIGS. **2** and **13–15**. Each of the valve shoes **228** and **235** in the blend control valve **19** has therein a centrally-located cutout or notch, on the side of the shoe which is closest to its respective outlet port when the shoe is in its open position. The notch **284** in the "lo" valve shoe **228** is illustrated in FIGS. **13–15** (and also in FIGS. **10** and **12**); the "hi" valve shoe **235** has a similar notch therein. Each notch allows a restricted flow to take place through the respective outlet port when the valve shoe is moved to a "partial shutoff" position.

FIG. **13** illustrates the fully open position of the "lo" valve shoe **228**; in this position an unrestricted flow can taken place through the outlet port **231**. (Of course, if a "blend" of "lo" and "hi" gasolines is being dispensed, the "lo" valve shoe would not be in this fully open position, but would be in some intermediate position wherein the outlet port **231** is partially covered.)

FIG. **14** illustrates the "partial shutoff" position of the "lo" valve shoe **228**, wherein this shoe has been moved upwardly, from the position illustrated in FIGS. **13** and **12**, to cover all but the upper central portion of the outlet port **231**; a very restricted flow then takes place through the outlet port, by way of the notch **284**.

FIG. **15** illustrates (like FIG. **10**) the fully closed position of the "lo" valve shoe **228**, wherein the lower edge of the notch **284** has moved upwardly beyond the outlet port **231**, completely closing this port and completely cutting of the flow therethrough.

Summarizing the above, it may be seen that a "partial shutoff" position of the valve shoe **228** (wherein a very restricted flow takes place through the outlet port **231**) results from moving the shoe upwardly (with respect to the outlet port) from the FIG. **13** position to the FIG. **14** position, followed by complete shutoff when the valve shoe moves to the FIG. **15** position.

The foregoing description, in connection with FIGS. **13–15**, is also applicable to the "hi" valve shoe **235**, which has a notch cooperating in exactly the same way with its outlet port **237**, to provide a partial shutoff when this valve shoe moves upwardly (with respect to its outlet port) for a certain distance, from a previous fully open (or partially open) position. Further movement upwardly of this "hi" valve shoe provides a complete shutoff.

The lug **269** carried by crank **147** extends outwardly (i.e., to the right of the plane of crank **147** in FIG. **10**) a sufficient distance to intersect the plane of the main portion of arm **81**. In the "ON" position of crank **147**, the lug **269** has been rotated 180° clockwise, around to the dotted-line position indicated at **269'**; in this latter position, it can come into engagement with the end extension **268** of arm **81**, and thus limit the upward movement of this end of the arm.

As previously described, when solenoid **53** is deenergized the arm **81** is rotated by spring **264** in the clockwise direction in FIG. **2**, moving the end extension **268** upwardly, and (in the case of automatic money cutoff) the solenoid is deenergized upon the dispensing of 98 cents of the final dollar's worth of gasoline ordered.

As described hereinabove, when arm **81** is rotated clockwise upon deenergization of solenoid **53**, link **247** moves downwardly, to move both of the valve shoes **228** and **235** toward their closed positions. However, in the present case (motor **54** having not yet been energized, and lug **269** therefore remaining in the path of rotation of extension **268** of arm **81**), the valve shoes will be prevented from moving to their fully closed

positions, and will instead move only to the "partial shutoff" position illustrated in FIG. 14. In this latter position, only a very restricted flow takes place through one or both of the valve outlet ports, by way of the notches such as 284.

Summarizing the foregoing, it may be seen that upon the dispensing of 98 cents of the final dollar's worth of gasoline ordered, the solenoid 53 is deenergized, thereby to cause operation of the blend control valve 19 to the "partial shutoff" position illustrated in FIG. 14. The reduced or restricted flow of "partial shutoff" is then effective throughout the remainder of the actual dispensing operation.

Under the reduced flow conditions which continue, the reed switch 281 will open, but this has no effect since relay 187 remains locked in or energized by means of its contacts 282.

The contacts 283 of relay 187 are connected in series with the contacts of a reed switch 285, across the winding of relay 108. In this connection, it will be recalled that the relay contacts 283 close when relay 187 is energized, and remain closed as long as this relay remains energized. The reed switch 285 is arranged to be actuated (i.e., closed) by a rod-type permanent magnet which is attached to the tens cents money wheel of the gallons and cost register 31, at a location such that switch 285 is closed simultaneously with each appearance of the "zero" or "0" digit on this wheel in the viewing window of the register.

Under the partial shutoff or restricted flow condition which comes into effect upon the dispensing of 98 cents of the final dollar's worth of gasoline ordered, the cost wheels of the register continue to rotate, though of course at a much slower rate, and upon the dispensing of the full amount of the final dollar's worth of gasoline ordered, the "zero" on the tens cents wheel comes into view, and switch 285 closes. When switch 285 closes, the winding of relay 108 is short-circuited through contacts 283 and switch 285, so that this relay becomes deenergized and releases.

The deenergization of relay 108, as before, causes the energization of reset motor 54, which rapidly rotates the crank lug 269 out of the path of extension 268 of arm 81, permitting this arm to continue its clockwise rotation to bring it against its stop 266. This moves link 247 further downwardly, to bring both of the shoes in blend control valve 19 to their fully shutoff positions illustrated in FIG. 15, and also in FIGS. 2 and 10.

The "OFF" resetting and adjustment cycle begins, as before, with the deenergization of relay 108 and the resultant energization of reset motor 54. The "OFF" cycle then proceeds in the manner previously described, this cycle including the deenergization of the pump motor relay 61 (thereby turning off the pump motor 3) by the cam-operated switch 262.

Again summarizing, full and complete shutoff of the gasoline flow occurs automatically upon the dispensing of the exact number of dolars's worth of gasoline which has been ordered or present into the mechanism (by manual operation of the counter associated with stepper 279). The "OFF" resetting and adjustment cycle again takes place upon the completion of the actual dispensing operation.

Refer now to FIG. 17. This figure diagrammatically illustrates circuitry which may be added to the circuitry of FIG. 5, below the line H—H, when remote indication of the cost of the gasoline dispensed is desired.

When the remote circuitry of FIG. 17 is added to that of FIG. 5, the supply of voltage to the buses 91 and 92 from the secondary of the stepdown transformer 93 is by way of the contacts 286 of a relay 287 whose operating winding is connected across the busses 91 and 92. For the sake of consistency, the relay 287 is illustrated in its unenergized condition; however, it is pointed out that during each dispensing operation this relay is actually energized and its contacts 286 closed, which causes the low voltage to be fed to buses 91 and 92, for operation, as required (the cam-operated switch 95, FIG. 5, being closed during dispensing, as previously described).

The operating winding of a remote counter 288 is connected in series with a reed switch 289, between bus 91 and the contact 277 of switch 275 (contact 277 being connected to bus 92 during the actual dispensing operation, since cam-operated switch 275 is closed during such operation). The reed switch 289 is located in the apparatus housing, not at a remote point, and is arranged to be repetitively actuated (i.e., closed) by rod-type permanent magnets which are attached to the cents money wheel of the gallons and cost register 31, at respective locations such that switch 289 is closed simultaneously with the appearance of each of the digits on this wheel in the viewing window of the register, which is to say that each closure of switch 289 represents the dispensing of 1 cent worth of gasoline. During the actual dispensing, then, the operating winding of the remote counter 288 is provided with "cents" pulses which step the counter 288 around in steps of one cent for each pulse. Thus, the cost of the gasoline dispensed is indicated remotely by counter 288.

Incorporated in the remote counter 288 is a reset winding 290, which is connected in series with one pair of normally-open contacts 291 of a pushbutton (manually-operable) reset switch 292, across the buses 91 and 92. When the reset switch 292 is actuated following the termination of a dispensing operation, its contacts 291 are closed, which supplies current to the counter reset winding 290, for resetting the counter 288 to zero.

As previously stated, the cam-operated switch 95 is opened during the "OFF" resetting and adjustment cycle; this removes the voltage from buses 91 and 92 and thus deenergizes the relay 287, opening its contacts 286. Just before the end of the "OFF" cycle, switch 95 is reclosed, which reconnects the primary of transformer 93 to the a.c. supply terminals. The other pair of normally-open contacts 293 of reset switch 292 are connected across relay contacts 286. When reset switch 292 is actuated, its contacts 293 are closed, which applies voltage from the secondary of transformer 93 to buses 91 and 92. This energizes the operating winding of relay 287, which then closes its contacts 286 to maintain the necessary operating voltage on buses 91 and 92.

All of the electrical items of FIG. 5 which were not previously described as being enclosed in an explosion-proof housing, are considered to be "intrinsically safe," since they all operate on low voltage and since a goodly number of them comprise reed switches.

The total gallons and cost counter or register **31** has not been illustrated in the drawings, in order not to complicate them unduly. This counter, except for its resetting mechanism, may be quite conventional, and is preferably of the type disclosed in the aforementioned Bliss patent. The resetting mechanism for this counter has been only briefly referred to hereinabove, in connection with the counter reset shaft **151** (which is rotated back and forth during the "ON" and "OFF" cycles by means of the bifurcated plate **150**, to which it is attached). A useful counter resetting mechanism is disclosed in my U.S. Pat. No. 3,616,996.

The invention claimed is:

1. In apparatus for the simultaneous delivery of two liquids in any one of a plurality of preestablished ratios, metering means providing a first output corresponding to the total delivery of said liquids, a variator receiving said output and adjustable to provide a second output corresponding to the amount of said total delivery multiplied by a base price per unit, a settable gear mechanism also receiving said first output and providing a third output corresponding to the amount of said total delivery multiplied by an incremental price per unit which depends upon the particular one of said preestablished ratios selected for delivery, means adding said second and third outputs to provide an indication of total price of said total delivery, a plurality of manually-operable pushbuttons one for each of said preestablished ratios, means operating automatically, in response to the operation of a selected one of said pushbuttons, for setting said gear mechanism to a position depending upon which particular pushbutton has been operated, valve means controlling the delivery of said liquids, and controlling means for said valve means to effect delivery of said liquids in substantially a predetermined ratio.

2. In apparatus for the simultaneous delivery of two liquids in any one of a plurality of preestablished ratios, metering means providing individual outputs corresponding to the delivery of said first and second liquids and also providing a first output corresponding to the total delivery of said liquids, a variator receiving said first output and adjustable to provide a second output corresponding to the amount of said total delivery multiplied by a base price per unit, a settable gear mechanism also receiving said first output and providing a third output corresponding to the amount of said total delivery multiplied by an incremental price per unit which depends upon the particular one of said preestablished ratios selected for delivery, means adding said second and third outputs to provide an indication of total price of said total delivery, a plurality of manually-operable pushbuttons one for each of said preestablished ratios, first means operating automatically, in response to the operation of a selected one of said pushbuttons, for setting said gear mechanism to a position depending upon which particular pushbutton has been operated, valves individually controlling the deliveries of said liquids, adjustable means operated by said metering means and simultaneously controlling said valves to effect the delivery of said liquids in substantially a predetermined ratio, and second means operating automatically, in response to the operation of said one selected pushbutton, for adjusting said adjustable means to a position depending upon which particular pushbutton has been operated.

3. In apparatus for the simultaneous delivery of first and second liquids in any selected one of a plurality of preestablished ratios ranging from a zero ratio of the first to the second to an infinite ratio of the first to the second, metering means providing individual outputs corresponding to the deliveries of said first and second liquids and also providing a first output corresponding to the total delivery of said liquids a variator receiving said first output and adjustable to provide a second output corresponding to the amount of said total delivery multiplied by a base price per unit, a settable gear mechanism also receiving said first output and providing a third output corresponding to the amount of said total delivery multiplied by an incremental price per unit which depends upon the particular one of said preestablished ratios selected for delivery, means adding said second and third outputs to provide an indication of total price of said total delivery, a plurality of manually-operable pushbuttons one for each of said preestablished ratios, first means operating automatically, in response to the operation of a selected one of said pushbuttons, for setting said gear mechanism to a position depending upon which particular pushbutton has been operated, valves individually controlling the deliveries of said liquids, adjustable means operated by said metering means and simultaneously controlling said valves to effect the delivery of said liquids in substantially a predetermined ratio, second means operating automatically, in response to the operation of said one selected pushbutton, for adjusting said adjustable means to a position depending upon which particular pushbutton has been operated, and third means operating automatically, in response to the operation of said one selected pushbutton, for causing the presetting of said valves to one or the other of two predetermined positions depending upon which particular pushbutton has been operated, said third means having certain elements in common with said second means.

4. Apparatus set forth in claim **3**, wherein the valves are preset to one of said predetermined positions for all of said plurality of preestablished ratios of liquids except an infinite ratio of the first liquid to the second liquid, and are preset to the other of said predetermined positions for an infinite ratio of the first liquid to the second liquid.

5. Apparatus recited in claim **3**, wherein said pushbuttons are resiliently urged toward their unoperated positions, said apparatus including also means acting in response to the operation of any one of said pushbuttons for mechanically locking the same in its operated position.

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