

[54] GASOLINE DISPENSING SYSTEM

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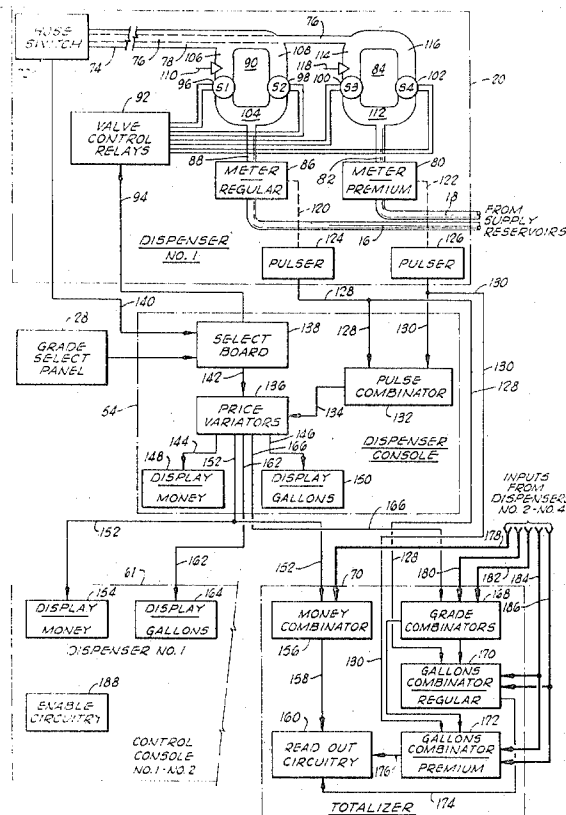
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[57] **ABSTRACT**

A system for dispensing of multiple grades of gasoline which utilizes electronic computational and control devices to meter selected grades of gasoline and accurately compute the money price of dispensed gasoline. The system utilizes meters controlling flow of regular and premium grade gasolines in such manner that controlled blending allows dispensing of any of a plurality of separate grades or octane ratings of gasoline, and computational equipment driven in response to such metering outputs accurately compute the gallonage delivered in ratio as well as the proportional unit price for the particular selected grade of gasolines dispensed. This equipment is utilized at a plurality of dispensing bays with all dispenser consoles under further control of a central console, and all quantities of premium gasoline, regular gasoline, selected grades of gasoline, and prices of dispensed gasoline are continually totaled at a central location to provide constant inventory readout for the particular station.

13 Claims, 10 Drawing Figures



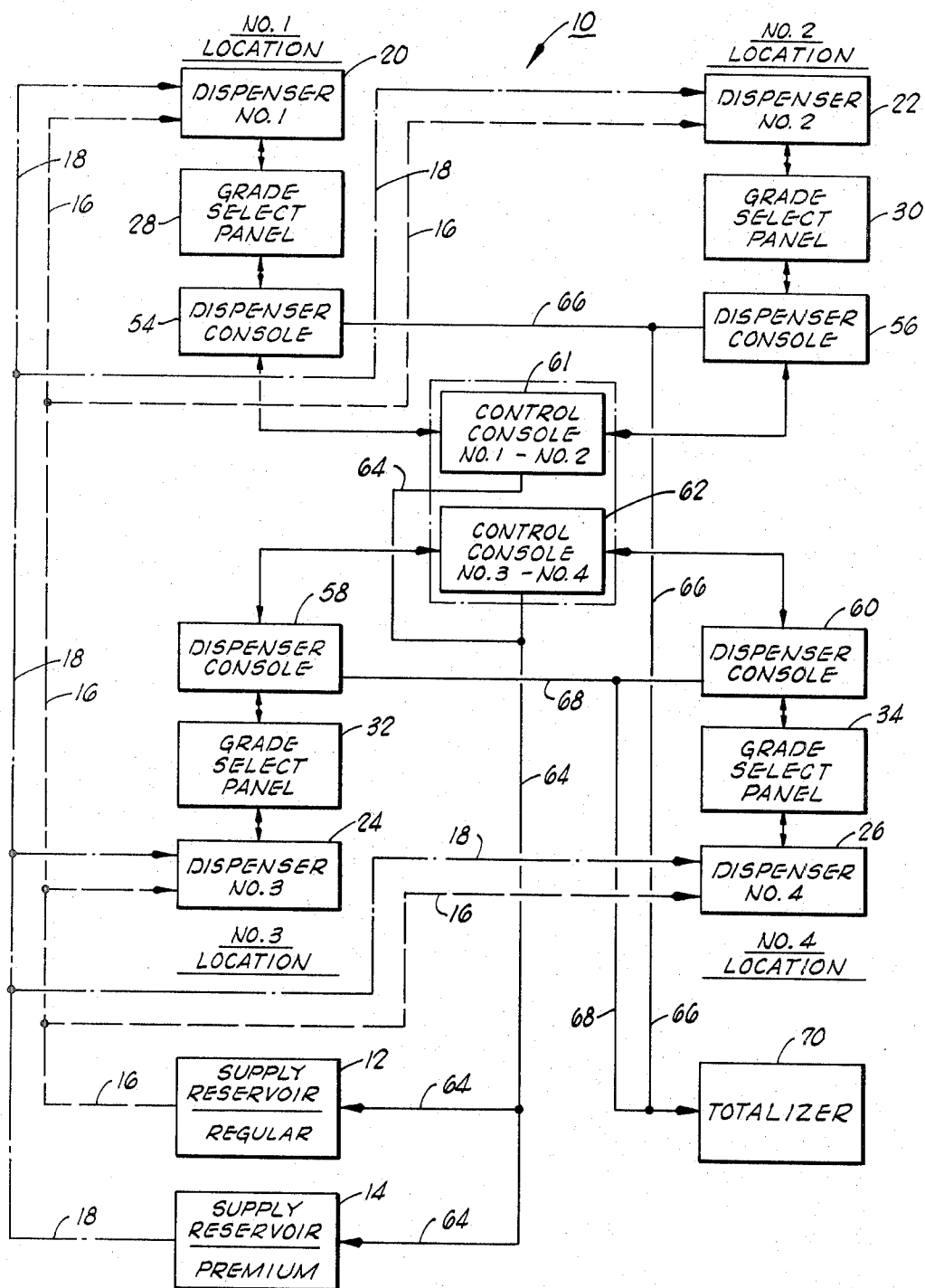
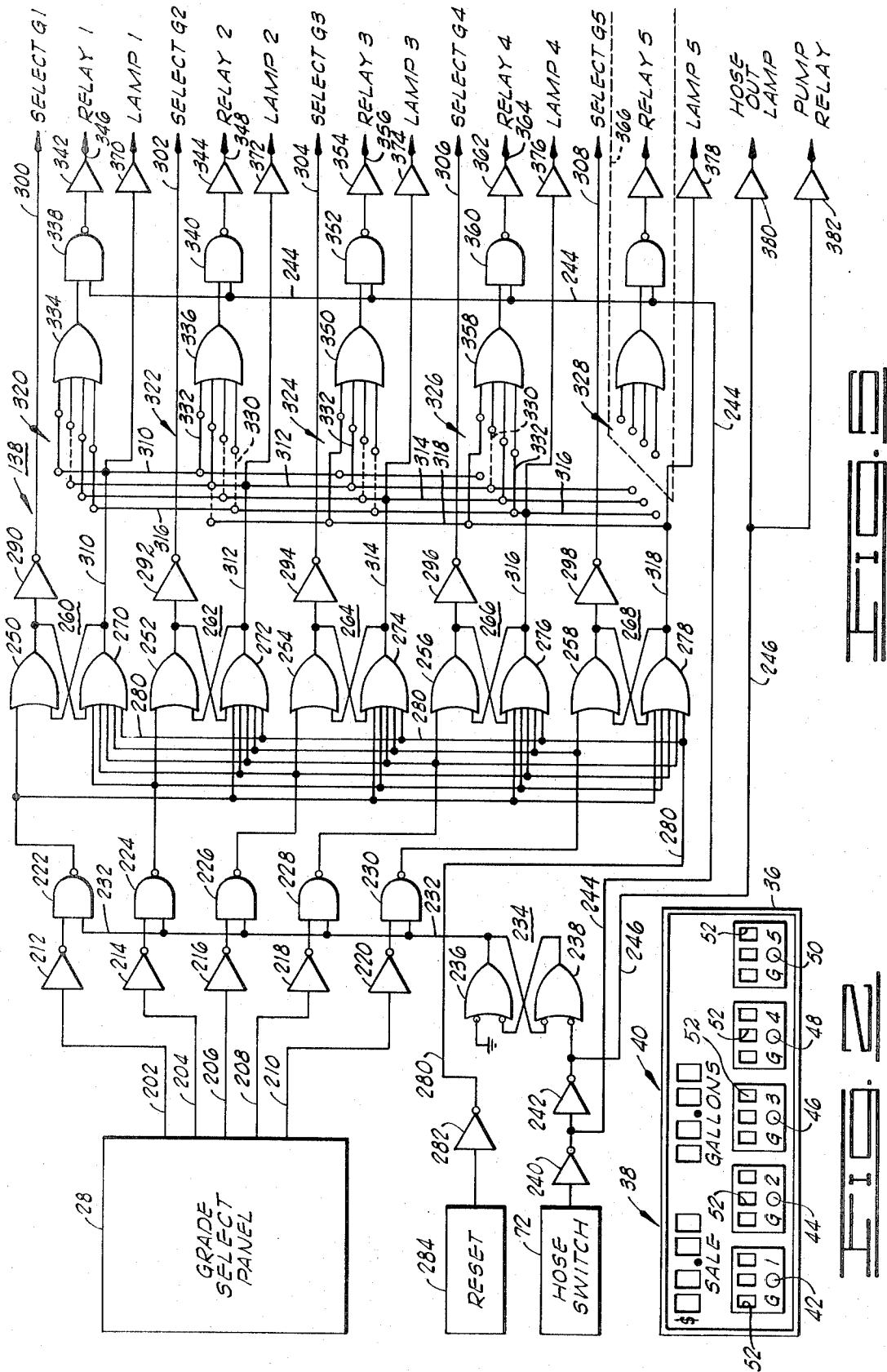
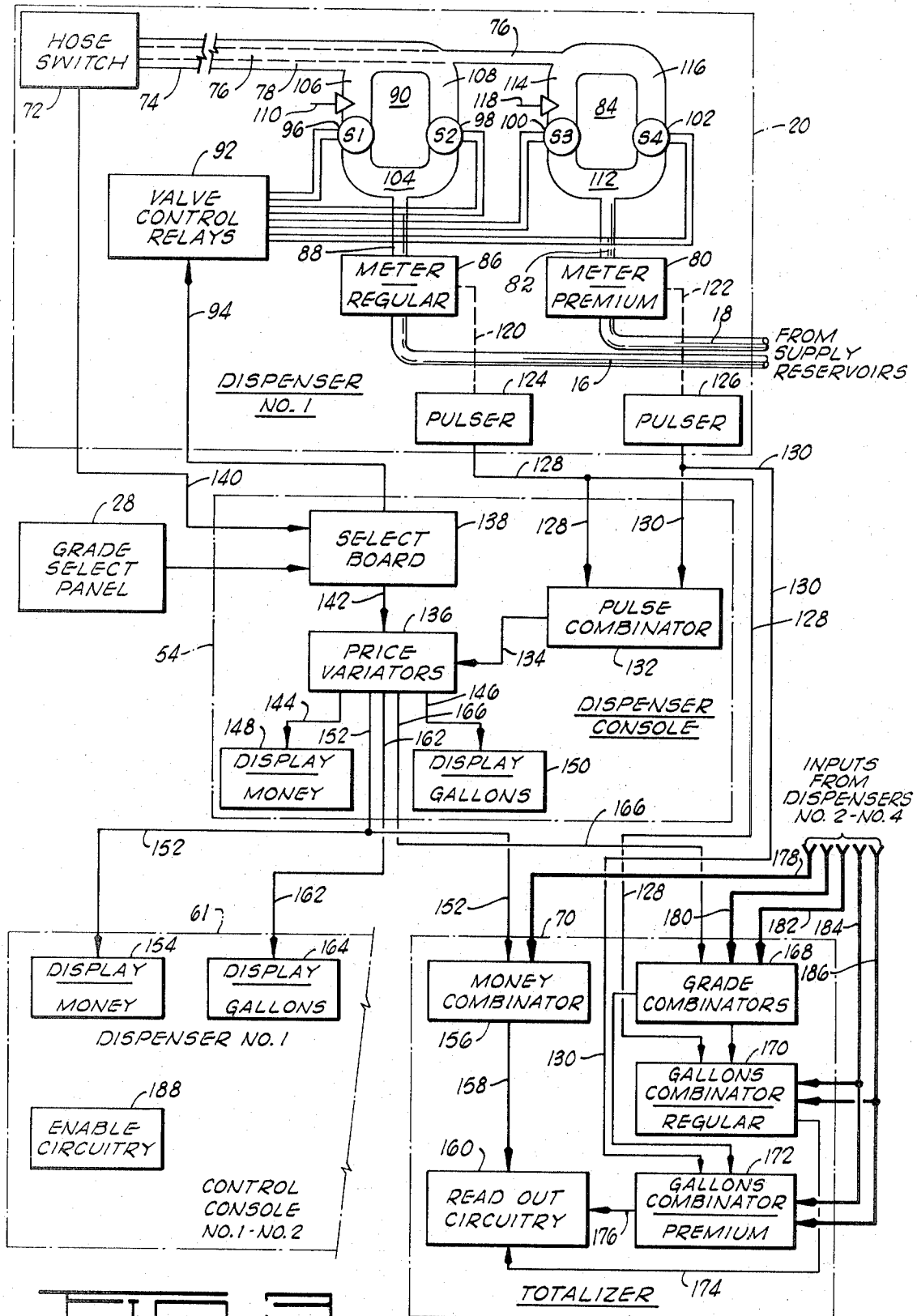
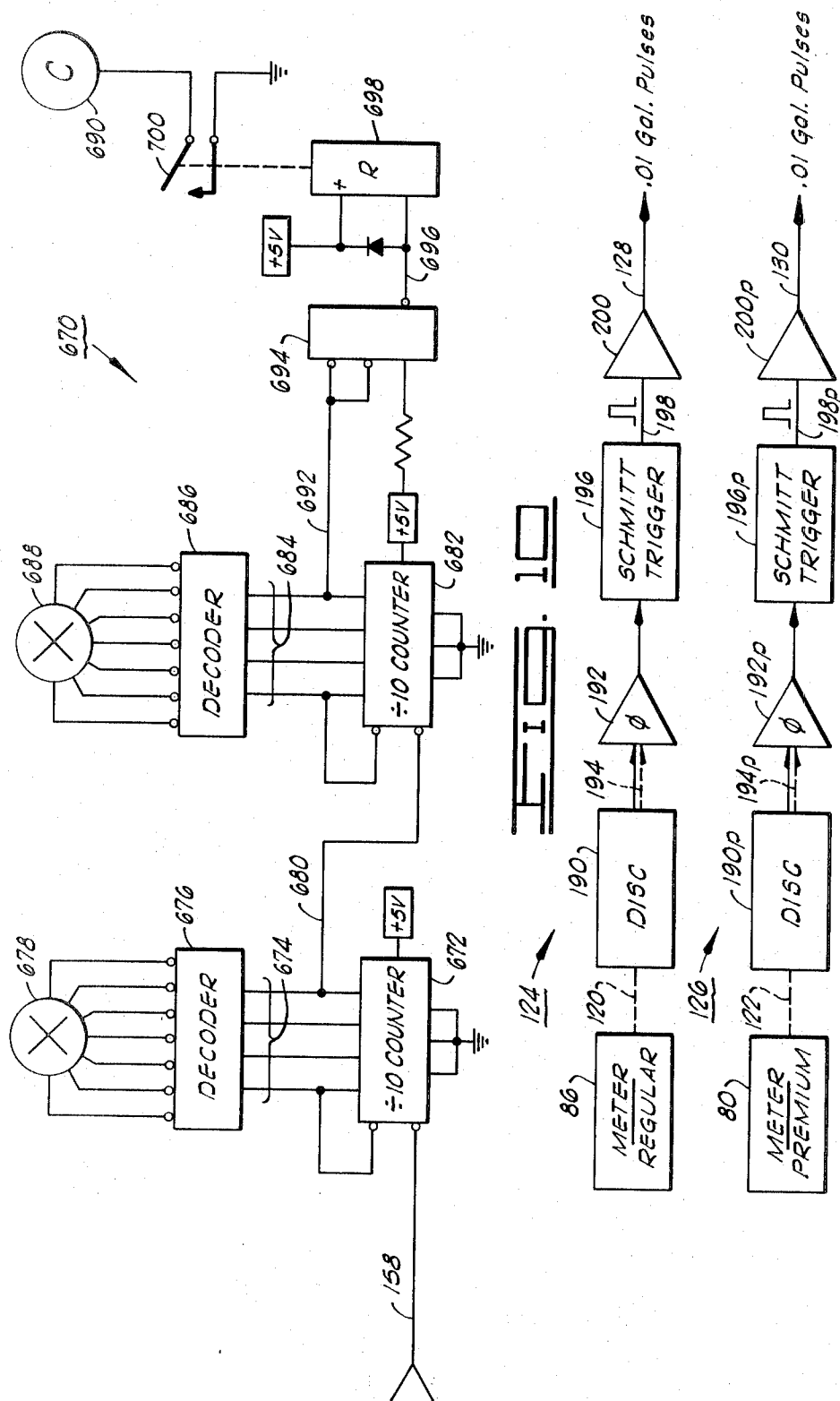
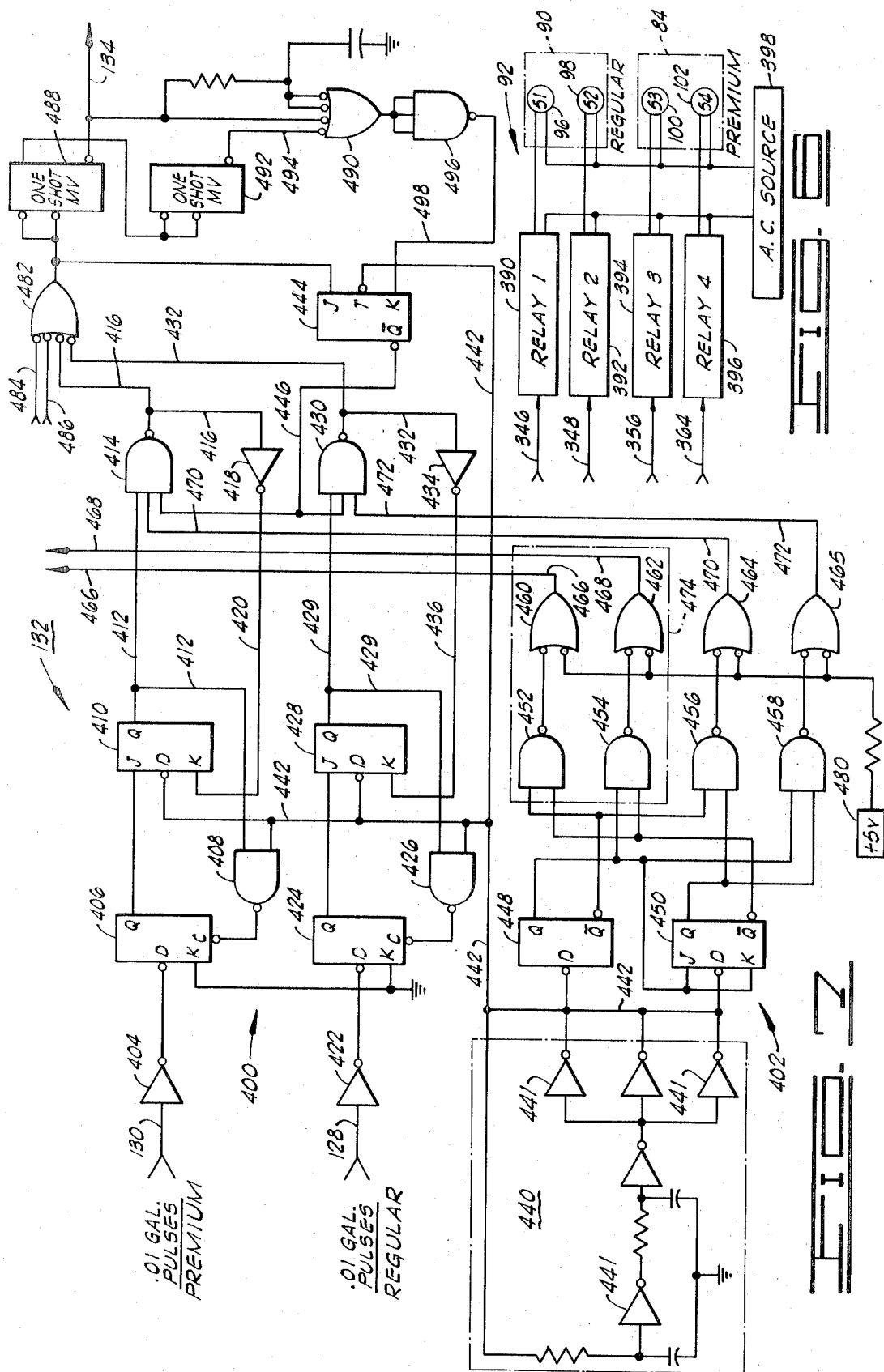


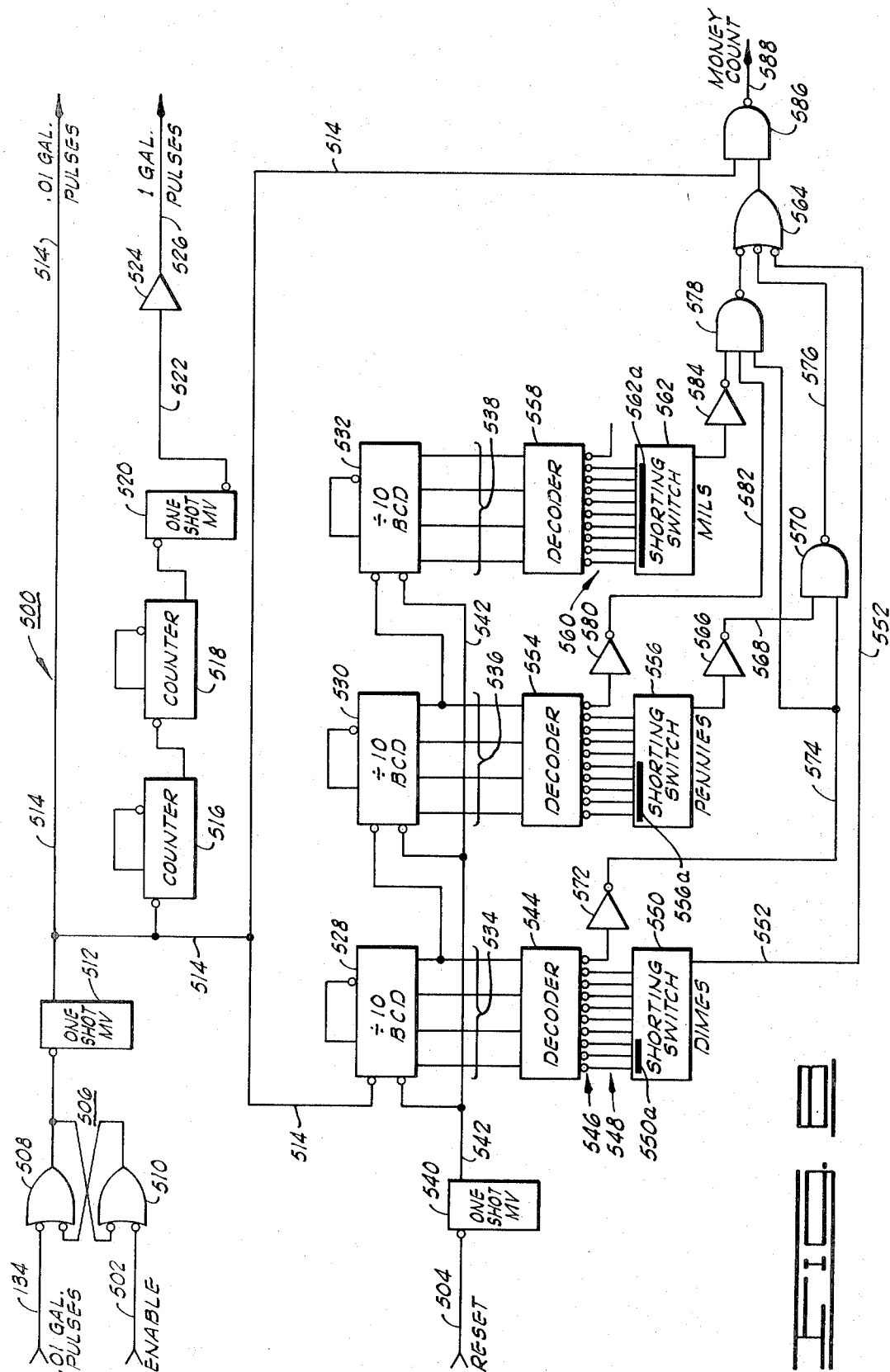
FIG. 1

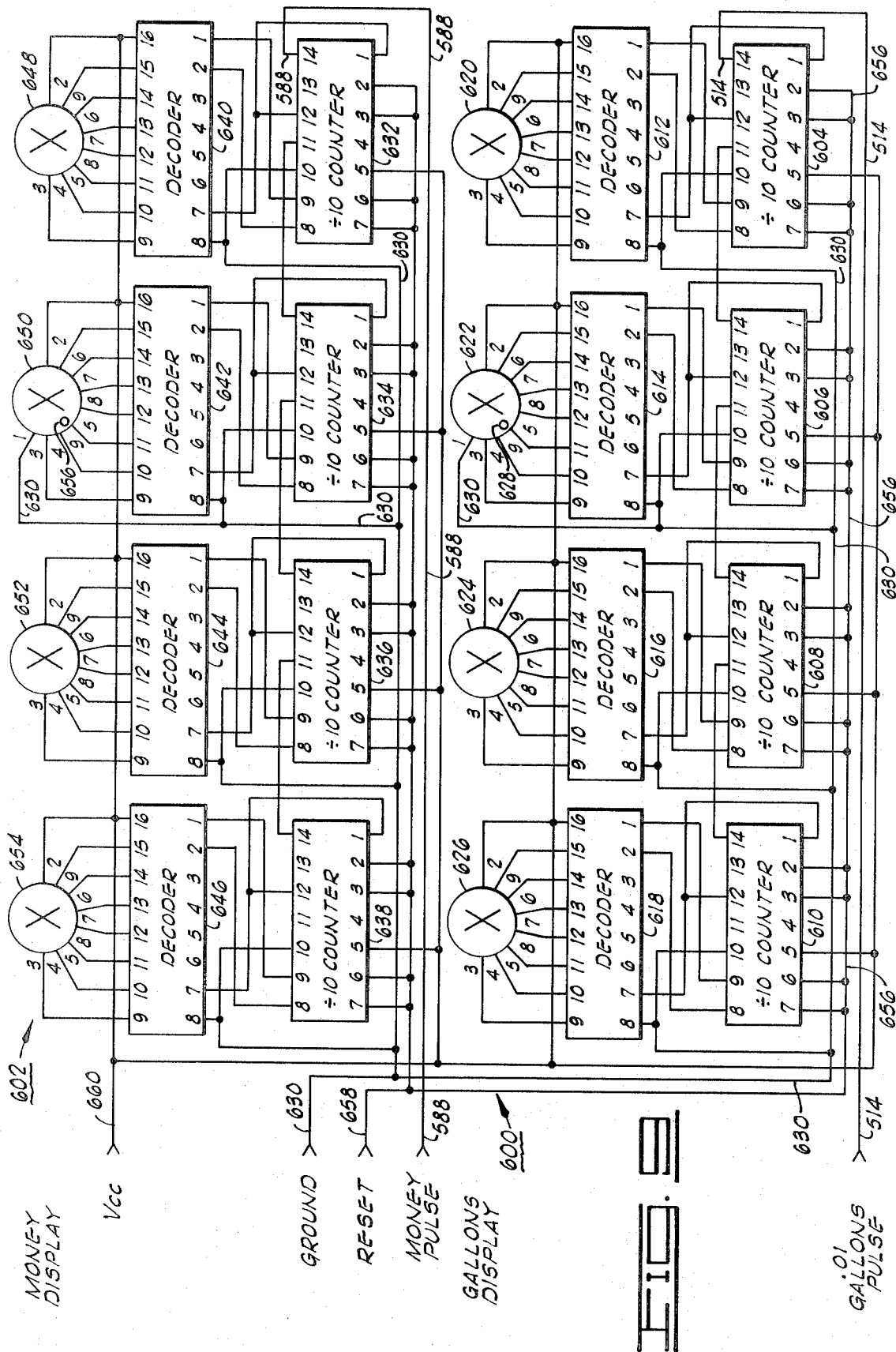












GASOLINE DISPENSING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to gasoline dispensing systems and, more particularly, but not by way of limitation, it relates to the improvements in dispensing metering and computational apparatus employed in the dispensing process.

2. Description of the Prior Art

The prior art has seen development of various forms of gasoline metering devices for use in commercial dispensing of gasoline products. Such prior art devices have been largely restricted to mechanical forms of metering and price computation, such counting devices being wellknown and utilized in nearly all present day gasoline stations throughout the world. The known devices have traditionally employed a well-known form of pump metering device coupled with mechanical linkage of gallonage delivery to a mechanical computer and counting device which, in turn, tallies fluid delivery as well as proportional pricing data as read from the display face of the pump installation. Until the recent advent of solid state electronics and low power requirement components, the choice of mechanical devices has been dictated by safety requirements which are inherent with exigencies surrounding gasoline handling and dispensing.

SUMMARY OF THE INVENTION

The present invention contemplates a gasoline dispensing system wherein an electronic computational device is utilized to yield increased accuracy in tallying and recording amounts of gas metered from a source reservoir. In a more limited aspect, the invention consists of a gasoline dispensing system for use at a dispensing station, such dispensing system being an integral device which maintains control of gasoline dispensing from a plurality of bays with gallonage and pricing date readout at each dispensing bay as well as at a station central console. Dispensed gasoline is metered through a regular meter and/or a premium meter through a common blending dispenser and electrical output therefrom provides count information to a pulse combinator which formulates further pulse output to price variator circuitry for determining the quantities of each gasoline metered as well as the money equivalent of dispensed gallonage. Output from the price variators then control display of money and gallons at each respective dispenser console as well as a central display at a control console. Money sales and gallons dispensed from all meters of all dispense stations are further tallied in a central totalizer to maintain continual inventory for the particular gasoline dispensing installation.

Therefore, it is an object of the present invention to provide a fully automated gasoline dispensing system.

It is also an object of the invention to provide a gasoline dispensing system which enables more accurate metering and calculation of dispensed product.

It is yet another object of the present invention to provide a gasoline dispensing system which enables continual complete inventory for a station installation.

It is another object of the present invention to provide an electronic computational device which provides count output for display of gallons and price for a multi-grade dispensing system.

Finally, it is an object of the present invention to provide an improved gasoline dispensing calculator which is more accurate and much less susceptible of failure in operation.

Other objects and advantages of the invention will be evident from the following detailed description when read in conjunction with the accompanying drawings, which illustrate the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of one form of gasoline dispensing station utilizing a dispensing system constructed in accordance with the invention;

FIG. 2 is a plan view of a display panel of a type which may be utilized at individual gasoline dispensers;

FIG. 3 is a partially schematic block diagram of a portion of the dispensing system in FIG. 1;

FIG. 4 is a block diagram of metering pulse count circuitry utilized in the invention;

FIG. 5 is a schematic diagram of grade select circuitry utilized in the system of the invention;

FIG. 6 is a block diagram of the meter relay circuitry;

FIG. 7 is a schematic logic diagram of pulse combinator circuitry as constructed in accordance with the present invention;

FIG. 8 is a logic diagram of variator circuitry utilized in the present invention;

FIG. 9 is a partially schematic block diagram of display circuitry of the present invention; and

FIG. 10 is a partially schematic block diagram of totalizer driver circuitry as used in the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The block diagram of FIG. 1 represents a gasoline dispensing system 10 such as might be used for control of a complete gasoline filling station having four auto bays or pump dispensers locations No. 1, No. 2, No. 3 and No. 4. Thus, regular and premium gasoline is supplied from a respective one of storage supply reservoirs 12 and 14 via conduits 16 and 18 to respective dispensers 20, 22, 24 and 26 at respective locations Nos. 1 through 4. The dispensers 20-26 would include the gasoline metering devices as well as the control relays therefor, as will be further described below.

Each dispenser location also includes grade select panels 28, 30, 32 and 34 in operative association with each of respective dispensers 20-26. Grade select panels 28-34 each consist of a money and gallonage display indicator and gasoline grade selection switches, and FIG. 2 illustrates one form of grade select panel of a type utilized at present installations. Thus, and referring to FIG. 2, a grade select panel 36 may be suitably mounted at the dispenser location to provide a money readout at a display position 38 while gallons readout is provided at a display position 40. Display panel 36 is a multi-grade panel allowing for selection of any of five different grades of gasoline, i.e. selection ranging from regular to premium and including three intermediate octane ratings. Thus, for each of the five gasoline grades there is a push button 42, 44, 46, 48 and 50 for

actuation to select the desired grade of gasoline for delivery, and pricing for each grade can be adjustably displayed within the associated escutcheon 52.

Referring again to FIG. 1, the grade select panels 28 through 34 are further interactively connected with dispenser consoles 54, 56, 58 and 60, respectively. Dispenser consoles 54-60 include the respective computer circuitry, as will be further described in detail, for control of gasoline and price calculation for each of respective auto bays or locations Nos. 1-4. Computed data from dispenser consoles 54 and 56 is transmitted to control console 61 at the central location while calculated data from dispenser consoles 58 and 60 is transmitted to control console 62. The control consoles 61 and 62 are suitably located at a central position for common control under an attendant or other overseeing authority. Gasoline delivery power to supply reservoirs 12 and 14 is also supplied from control consoles 61 and 62 as shown by line 64. Such gasoline delivery is effected in conventional manner utilizing submersible pumps and energization is effectuated from the control position.

FIG. 3 illustrates a portion of the dispenser system 10 in greater detail. Thus, equipment for a single auto bay or No. 1 location is shown, i.e., dispenser 20, grade select panel 28 and dispenser console 54, as connected for operation with control console 61 and totalizer 70. The dispenser 20 includes a hose switch 72 which is actuated "ON" upon removal of the hose nozzle assembly (not shown) from the nozzle holster. Gasoline is supplied to the hose nozzle through concentric tubing 74 which consists of an inner premium hose 76 and an outer regular hose 78, blending mixture for intermediate gasoline grades taking place at the nozzle assembly. Premium gasoline is supplied from supply reservoirs via conduit 18 to a meter 80 after which flow proceeds via conduit 82 to a "premium" digital valve 84 and further gasoline flow proceeds through hose conduit 76. Regular gasoline from conduit 16 proceeds through a meter 86 and conduit 88 to a "regular" digital valve 90 and, upon actuation, regular gasoline is supplied through hose outer conduit 78.

A plurality of valve control relays 92, as controlled via cable 94 from dispenser console 54, provide permutative control of solenoids 96, 98 of digital valve 90 and solenoid valves 100, 102 of digital valve 84. Actuation of one or more valves 96-102 will enable delivery of regular and/or premium gasoline at the nozzle in such proportion as to effect delivery of a selected single grade of the multiple grade gasoline choices. Digital valve 90 consists of a bifurcated conduit wherein gas input at a manifold 104 may be applied via a flow tube 106 and/or a flow tube 108, depending upon actuation of solenoids 96 and/or 98. A needle valve 110 provides orifice adjustment of flow through tube 106. Similarly, digital valve 84 includes a manifold 112 and flow tubes 114 and 116, the flow of flow tube 114 being restricted a pre-set amount by an orifice control needle valve 118. Needle valve 110 and 118 are adjusted for a relatively permanent setting allowing the proper flow rates which then enable multi-grade blending under digital monitoring and control.

Each of meters 86 and 80 provide rotational indication via respective mechanical linkages 120 and 122 to pulsers 124 and 126, respectively. The pulsers 124 and 126 transform mechanical rotation to electrical pulse output via leads 128 and 130, respectively, for use

throughout the system, as will be further described below. Meters 80 and 86 are a conventional form of gasoline metering device, and the type used in present installations is the Tokheim model AFC-1-DISP.

Regular and premium gasoline metering each indicative of 0.01 gallons pulses (to be described) are applied via respective leads 128 and 130 to a pulse combinator 132. Pulse combinator 132 then functions to calculate the total number of 0.01 gallon pulses for both regular and premium gasoline delivery. The pulse combinator 132 then functions to total all 0.01 gallon pulses to provide a total 0.01 gallon pulse output on lead 134 for input to price variators 136.

Price variators 136 consist of a plurality of identical circuits, as will be further described below, one for each grade of gasoline dispensed within the capabilities of the system. Thus, in the case of a five grade dispensing system, there will be five individual price variator circuits within price variators stage 136. A select board circuit 138 under control of push button switches 42-50 (FIG. 2) of grade select panel 28, provides enabling input via lead 142 to price variators 136. The select board circuitry 138 is further enabled by actuation of hose switch 72 to initiate operation via switch indication on lead 140. Thus, upon actuation of hose switch 72 and selection of desired gasoline grade at grade select panel 28, select board 138 functions to provide output via cable 94 to actuate valve relays 92 to actuate the selected ones of digital valve solenoid relays 96-102, and also to provide an enabling output via lead 142 to enable the proper one of the price variator circuits within price variator stage 136. After enabling of the correct grade price variator the total 0.01 gallon pulse input on lead 134 is tallied to provide output of both money and gallons delivery via lines 144 and 146, respectively, to provide visual readout through displays 148 and 150 at the dispenser console 54.

Money total output pulses are also applied via line 152 to a money display readout 154 at control console 61 as well as to a money combinator circuit 156 (to be further described) in totalizer 70. Money totals from the money combinator 156 can then be applied via 158 to readout circuitry 160 which provides continual readout of totals over a selected inventory. Pulse output on lead 162 indicative of 0.01 gallons per pulse is applied to a gallons display 164 at control console 61. Further output on lead 166 from price variator 136 provides 1 gallon pulses for application to grade combinator stage 168 in totalizer 70. Grade combinator 168 serve to maintain a running tally of total gasoline output for each one of the multiple grades of gasoline.

Output 0.01 gallon pulses from pulser 124 on line 128 are also applied to a "regular" gallons combinator 170 while premium gasoline 0.01 gallon pulses on line 130 are applied to a premium gallons combinator 172. Each of the gallons combinator 170 and 172 deliver readout by respective lines 174 and 176 to the readout circuitry 160 to provide a running account of gallons dispensed of both regular and premium gasoline. Five other input cables 178, 180, 182, 184 and 186 indicate the routes whereby the similar combining information comes in from the remaining dispensers or locations No. 2 through 4.

Enable circuitry 188 is shown generally as being located within control console 61. Enable circuitry 188 is under central control of the attendant or operator and provides master energization control of all station

equipment, i.e., the submersible gasoline pumps, lighting, main power to dispensing stations, etc. Further, the central operator at control console 61 maintains rest and visual control over usage of the individual ones of dispenser stations at locations Nos. 1 through 4. Thus, while the central operator also has the duty of collecting money paid for gasoline dispensed, such operator will maintain direct control over reset of each dispensing location after gallons and money readout, and payment from the consumer.

The 0.01 gallon pulses are derived from each of the regular and premium gasoline dispensing apparatus through utilization of photo-optical transducing circuitry such as shown in FIG. 4. Thus, the regular meter 86 provides mechanical linkage or output rotation via linkage 120 to a selected form of optical shutter disc 190 operating in conjunction with a photo-optical transducing circuit 192. The rotation through linkage 120 is such that shutter disc 190 delivers an optical response via line 194 upon delivery of each 0.01 gallons of regular gasoline. Such transmissive (or reflective) disc pulsing systems are well-known in the art; however, the particular transducer 192 employed in present systems is the RCA type CA3062 which is an integrated circuit system consisting of a photo-optical input transponder coupled with an operational amplifier. Periodic output from transducer stage 192 is then applied to a conventional form of Schmitt trigger circuit 196 which serves to provide a square wave pulse output on line 198 to a wave shaping amplifier 200. Pulse output of 100 pulses per gallon, 0.01 gallon pulses, is then provided on output lead 128.

The 0.01 gallon pulses for premium dispensing are derived in exactly the same manner utilizing a shutter disc 190 *p* as driven by mechanical linkage 122 from premium meter 80. Indication is transmitted via optical linkage 194 *p* for indication through transducer circuitry 192 *p* which generates operational amplifier output to a Schmitt trigger circuit 196 *p*. Pulse output from Schmitt trigger 196 *p* is then applied through wave shaping amplifier 200 *p* for output on lead 130 at the rate of 100 pulses per gallon of premium gasoline.

FIG. 5 illustrates the specific logic circuitry of select board 138 (FIG. 3). The components of select board 138 are comprised of transistor/transistor logic integrated circuits, the suppliers and specific type numbers to be stated as required through the description.

Selection of gasoline grade is made at grade select panel 28, as by actuation of one of push buttons 42 through 50, as shown in the display panel 36 of FIG. 2. The push button output is then present on each of leads 202, 204, 206, 208 and 210 to respective ones of inverter amplifiers 212, 214, 216, 218 and 220. Each of inverters 212-220 of a unit of Signetics type 5404 Hex Inverter integrated circuit.

Outputs from inverters 212-220 are then applied to an input of each of respective dual input NAND gates 222, 224, 226, 228 and 230. The remaining input of each of NAND gates 222-230 receives an enabling input from lead 232, the output from a latch circuit 234 consisting of NOR gates 236 and 238 connected in conventional latching gate configuration. Latching is initiated by activation of hose switch 72 (FIG. 3) which provides an impulse through series-connected inverters 240 and 242 to one input of NOR gate 238. Latching then occurs in conventional flip-flop type manner to maintain enabling output on lead 232 to NAND gates

222-230. Hose switch activation pulses of opposed polarity are also output on leads 244 and 246 for purposes as will be further described below. Inverters 240 and 242 each comprise a unit of a Signetics type 5404 Hex Inverter, NOR gates 236 and 238 are derived from a Signetics type 5400 quad array 2-input gate. Each of NAND gates 222-230 consist of similar type 5400 2-input gates.

Output pulses from NAND gates 22-230 are each applied to a respective input gate 250, 252, 254, 256 and 258 (Signetics type 5400 two-input gates) which form an integral part of latch circuits 260, 262, 264, 266 and 268. Complementary latching gates 270, 272, 274, 276 and 278 (Signetics type 5430 eight-input gate) each receive plural inputs from all of NAND gates 222-230 other than that input derived from its direct coupled component, i.e., the particular gate supplying input to the associated one of input gates 250-258. In addition, reset input is applied via lead 280 as derived through a standard amplifier 282 from a reset switch 284. The reset switch 284 is that which would be located proximate the control console for operation by the central attending authority.

In accordance with gasoline selection, respective ones of latching gates 260-268 will provide output through one of respective inverter circuits 290, 292, 294, 296, and 298 for output on leads 300, 302, 304, 306 and 308 to perform a select grade function. The select grade pulses on leads 300-308 are each supplied to the price variator circuitry 136 (FIG. 3). Thus, each pulse serves as an enabling pulse to one of a plurality of individual price variator circuits (to be described below) to perform price variation computation relative to the particular selected grade of gasoline.

Further output from latch circuits 260-268 are simultaneously derived on leads 310, 312, 314, 316 and 318, which outputs when selected serve to activate the gasoline pump relays and lamp indicator at the dispenser console. Each of latch output leads 310-318 is connected continuously with selected ones in contact arrays 320, 322, 324, 326, and 328. Each of the contact arrays 320-328 is formed in the printed circuit board for select board 138 so that selected connections can be made, and offered as required, to provide pump relay activation for any selected combination of grade or octane ratings to be made available within the multiple grades. Thus, the dash lines 330 illustrate remaining possible connections while the solid lines 332 illustrate the connections which actually may be made in a five grade multi-grade system ranging in octane rating from regular through premium. Thus, with solid line indications 332, as shown in FIG. 5, select grade G1 pulse output on lead 310 is connected for input to OR gate 334 and OR gate 336 (Signetics type 5420) which provide output through respective NAND gates 338 and 340 (Signetics type 5400). NAND gates 338 and 340 are enabled by pulse input on lead 244 from inverter 240 and hose switch 72. Output from NAND gates 338 and 340 is then applied through respective amplifiers 342 and 344 for outputs on 346 and 348 to activate respective relay 1 and relay 2, as will be further described.

Upon selection of grade G2, output from latch 262 on lead 312 is shorted to each of OR gate 336 and OR gate 350. OR gate 336 activates relay 2 as aforescribed and, in like manner, output from OR gate 350 is applied through a NAND gate 352 and amplifier 354

for output on lead 356 to activate relay 3. Selection of grade G3 places pulse output on lead 314 which is shorted for conduction through OR gate 334 and activation of relay 1, as well as through an OR gate 358, NAND gate 360 and amplifier 362 for output on lead 364 to activate relay 4. Selection of grade G4 with pulse output on lead 316 is supplied through OR gate 358 to relay 4 as well as OR gate 334 to relay 1. Finally, selection of the 5th or premium grade G5 provides output pulse on lead 318, and shorting contacts provide input to OR gate 358 (relay 4) and OR gate 350 (relay 3). The relay G5 circuitry and contact array 328, as shown in dashed lines 366, are left unused in a five grade system but are available for inclusion should a greater number of grades be desired.

Energization of respective ones of latch leads 310-318 are also applied through respective amplifiers 370, 372, 374, 376 and 378 to energize the respective lamps 1 through 5 at the dispenser console to verify the users selection through visual indication. Activation of hose switch 72 also provides indication via lead 246 to each of respective amplifiers 380 and 382 to transmit indication to the central console in the form of a hose-out lamp indication, and output from amplifier 382 provides activation of the main pump relay enabling delivery of gasoline from the supply reservoirs in conventional manner.

FIG. 6 illustrates the valve control relay circuitry 92 (FIG. 3) as controlled by output on relay leads 346, 348, 356 and 364 (FIG. 5) from select board 138 to activate, selectively, the solenoid valves 96, 98 of digital valve 90 and/or solenoid valves 100, 102 of digital valve 84. Thus, relay control inputs on leads 346-364 are applied to respective ones of control relays 390, 392, 394 and 396, relay 1 through relay 4 inclusive, which control application of power from standard AC voltage source 398. Upon activation, each of relays 1-4 applies AC power from 398 to activate its respective solenoid valve 96, 98, 100 or 102, the combinations of solenoid valve activation being in accordance with the leads 346, 348, 356 or 364 which are energized for a particular grade selection.

FIG. 7 represents a schematic logic diagram of pulse combinator circuitry 132. The pulse combinator 132 serves to receive input of 0.01 gallon pulses via leads 128 and 130 from each of regular gasoline pulser 124 and premium gasoline pulser 126 (See FIG. 3). Pulse combinator 132 receives such pulses and combines the total count of 0.01 gallon pulses, both regular and premium pulses, in such manner as not to miss a count, even in the event of exact coincidence of arrival, and to output a total 0.01 gallon pulse signal for application to the pre-selected variator circuit within price variators 136 (FIG. 3). Pulse combinator 132 consists of storage and counter circuitry 400 as operated in conjunction with the scanner circuit 402.

Premium gasoline 0.01 gallon pulses are applied in on lead 130 through an inverter 404 (Signetics type 5405), the output of which is applied to the D input of a J-K type flip-flop 406 (Signetics type 54107). Flip-flop 406 is periodically cleared through input to the C terminal from NAND gate 408 (Signetics type 5400), as will be further described. Q output from flip-flop 406 is applied to the J terminal of a J-K type flip-flop 410 (Signetics type 54107). Flip-flop 410 then provides Q output on a lead also being applied as input to NAND gate 408 to enable clearing of flip-flop 406. Flip-flop

410 is periodically enabled by output from NAND gate 414 via lead 416 and inverter 418, (Signetics type 5404) and lead 420 for input to the K terminal of flip-flop 410.

Regular gasoline 0.01 gallon pulses applied on lead 128 are applied to similar circuitry such as inverter 422 and the D terminal of a flip-flop 424. Flip-flop 424 is periodically cleared by an NAND gate 426, and Q output is applied to the J terminal of a J-K type flip-flop 428. The configuration of flip-flop 428 is similar to that of flip-flop 410 as the Q output is applied to NAND gate 430 with enablement as fed back via lead 432, inverter 434 and lead 436 to the K terminal of flip-flop 428. Q output from flip-flop 428 is also applied through NAND gate 426 to the clear terminal of the previous of D-type flip-flop 424.

Each series-connected pair of flip-flops 406, 410 and 424, 428 serve to actuate, upon receipt of an input 0.01 gallon pulse, and to briefly store such received pulses until sequenced out through respective NAND gates 414 and 430. Such sequencing takes place through control of scanner circuit 402 which serves to scan flip-flops 410 and 428, successively to continually clock out an existing pulse count. Scanner circuit 402 includes an oscillator 440, as shown in dashed-lines, which is comprised of a plurality of inverter stages 441, (Signetics type 5404), connected in conventional oscillator interconnection and providing a relatively high frequency output on lead 442. Oscillator 440 is presently operated to provide an output of one megahertz on lead 442; however, it is presently planned to utilize a conventional form of crystal controlled oscillator providing such as one megahertz output. A one megahertz frequency is selected in order to provide a very high order of scanning repetition relative to the highest possible frequency of .01 gallon pulse input which may be seen through inverters 404 and 422 to the storage and counting circuitry 400.

Output on lead 442 is applied to each of the remaining inputs of NAND gates 408 and 426, as well as to the D terminal inputs of J-K type flip-flops 448 and 450 (Signetics type 54107), and the high frequency pulse is also applied to the T terminal of a J-K type flip-flop 444 (Signetics type 54107), a timing flip-flop circuit providing Q output via lead 446 to each of NAND gates 414 and 430.

The clock frequency output on lead 442 is further applied to each of the D terminal inputs of flip-flops 448 and 450. Flip-flops 448 and 450 function at a rate controlled by oscillator 440 to control successive activations of NAND gates 452, 454, 456 and 458 (Signetics type 5400) which conduct through successive NOR gates 460, 462, 464, and 465 (Signetics type 5402) to provide successive enabling outputs on respective leads 466, 468, 470 and 471. Enabling pulses on leads 470 and 472 are then applied to inputs of NAND gates 414 and 430. The remaining enabling pulse leads 466 and 468, and actually the entire circuitry within dashed lines 474, are utilized in combinators of a type employed in the totalizer 70 (FIG. 3) circuitry wherein four channels of pulse processing, both money and gallons, are processed for totalization. Standardization of circuit boards allows the same type of combinator board to be used throughout the system.

Sequencing is achieved through alternative interconnection of flip-flops 448 and 450. That is, the J-K type flip-flop 448 provides Q output to an input of NAND

gate 454 and NAND gate 458 while also applying the same pulse level to the J and K terminals of the J-K type flip-flop 450. The Q output of J-K type flip-flop 448 is applied to the remaining NAND gates 452 and 456. The $\bar{Q}$ and Q outputs from J-K type flip-flop 450 are applied to NAND gates 456-458 and 452-454, respectively such that the repetitive flip-flop actuation provides sequencing of the respective NAND gates 452-458, and successive enabling output from NOR gates 460-465. A plus five volt source 480 is utilized to apply a high voltage input to the remaining inputs of NOR gates 460-465.

As previously stated, enabling outputs 466 and 468 are not utilized in the gallons pulse combinator 132 but only in the combinator arrays of totalizer 70, as will be further described below. However, successive enabling outputs on leads 470 and 472 enable respective NAND gates 414 and 430 which, if further enabled by $\bar{Q}$ output from timing flip-flop 444, will pass pulses present as $\bar{Q}$ output at either of flip-flops 410 and 428. Upon passage of such pulse output from NAND gates 414 and 430, further enabling takes place as feedback through respective inverters 418 and 434 to the K terminals of flip-flops 410 and 428 in preparation for a next succeeding 0.01 gallons pulse coming in on that respective input line. In like manner, Q output from either of flip-flops 410 and 428 will cause pulse indication to feedback to respective NAND gates 408 and 426 to the clear terminals of the input flip-flops 406 and 424 so that they are in readiness to accept the next following 0.01 gallon pulses incoming on their respective lines 130 and 128.

The 0.01 gallon pulses, both premium and regular pulses, when clocked through storage and counting circuitry 400 are passed through NAND gates 414 and 430 for output on respective leads 416 and 432 as input to NOR gate 482 (Signetics type 5420). Additional inputs 484 and 486 are shown but are included only for use with two remaining storage and count channels as used in the totalizer combinator applications, as previously described. NOR gate 482 conducts pulse output, for every pulse input, to energize a one shot multivibrator 488 (Signetics type 54121) and an output 0.01 gallons pulse is then present on lead 134 for conduction to price variators circuitry 136 (FIG. 3). A NOR gate 490 (Signetics type 5420) is conditioned to receive input from output 0.01 gallons pulses on lead 134 as well as output from a one shot multivibrator 492 (Signetics type 54121) which is responsive to actuation of one shot multivibrator 488 to provide an additional input on lead 494 to NOR gate 490. Pulse output from NOR gate 490 is then applied through a NAND gate 496 for application via lead 498 to the K terminal of the timing flip-flop 444. Thus, timing flip-flop 444 can only enable the NAND gates 414 and 430 to pass a pulse count after verification of a .01 gallons pulse output through actuation of one shot multivibrator 488.

The .01 gallons pulse output on lead 134 represents all .01 gallon pulses for both premium and regular gasoline dispensing, and these pulses are then applied as input to price variator circuitry 136 (FIG. 3). The price variator circuitry 136 includes five identical variator circuits 500 a-e, each as shown in FIG. 8, one for each grade of gasoline dispensed in the particular system. It should be understood however that there will be a variator circuit 500 for each grade of gasoline offered by the different multi-grade dispensing systems, i.e., three

grades, seven grades, etc. Similarly then, variator enabling pulses from select board 138 (shown generally by a line 142 of FIG. 3) will be applied to enable the proper grade variator in accordance with grade selection. Thus, each of five variator circuits 500 receives input of a .01 gallon pulse on lead 134 as well as the selected variator enabling pulse on a lead 502, i.e., a selected one of leads 300, 302, 304, 306 or 308 (FIG. 5) from select board circuit 138, as well as a reset pulse on a lead 504 as periodically generated under control of the central authority, e.g., at reset 284 (FIG. 5).

The .01 gallon pulses received in on lead 134 are applied through a latch circuit 506 consisting of input gate 508 in latching interconnection with an enabling gate 510 (Signetics type 5400). Pulse output from latch circuit 506 then triggers a one shot multivibrator 512 (Signetics type 74121) which is responsive to provide a .01 gallon pulse output via lead 514 (Similar to leads 146 and 152 of FIG. 3). The .01 gallon pulses on lead 514 are then variously processed to derive further information as to whole gallon and money count information, as will be further described below.

The .01 gallon pulses on lead 514 are applied as input to divide by ten counter 516 connected in series cascade with a divide by ten counter 518, thus to provide a single pulse output (for every 100 pulses on lead 514) to a one shot multivibrator 520 (Signetics type 74121). The one shot multivibrator 520 then provides output via lead 522 and pulse amplifier 524 to provide one gallon pulse output on lead 526. Counters 516 and 518 are conventional divide by ten counters, Signetics type 7490, which serve to provide a single output pulse in response to each ten input pulses. The one gallon pulses on lead 526, as derived for each individual variator circuit 500, when enabled, are applied via cable 166 (FIG. 3) to the grade combinator stage 168 in totalizer 70.

The .01 gallon pulses on lead 514 are also applied as input to money countdown circuitry consisting of series-connected counters 528, 530 and 532. Counters 528-532 are divide by ten counters providing binary coded decimal output via respective lead groups 534, 536 and 538. A signetics type 8280 pre-settable decade counter connected for binary coded decimal output may be utilized in the counter 528-532 stages. Reset to each of counters 528 through 532 is effected in response to an input reset pulse on lead 504 to trigger a one shot multivibrator 540 which, in turn, provides an output reset pulse on lead 542 to zero each of the divide by ten counters 528, 530 and 532.

The .01 gallon pulses applied as input to divide by 10 counter 528 provide binary coded decimal output on lead group 534 to a decoder 544. Decoder 544 is a conventional form of integrated circuit and may be comprised of such as the Signetics type 74145 binary/decimal counter circuit. Output from decoder 544 occurs successively on decimal output terminals 546 on respective leads 548 to a shorting switch 550. The shorting switch 550 may be any conventional form of consecutive shorting switch which is capable of providing a pre-settable variable shorting contact to selected, serial ones of the decade contacts. Thus, as shown for example, shorting switch 550 and shorting bar 550a serve to select the input pulses in a ratio of conducting each three out of ten inputs such that three-tenths of the received input pulses will be conducted as output on lead 552. Thus, shorting switch 550 acting upon a pulse for

each one of the .01 gallon input pulses on lead 514 serves as the "dimes" money counter, as will be further described.

The divide by ten counter 530, next in cascade, also provides one pulse output for each ten received through counter 528, and such output is provided on lead group 536 as binary coded decimal indication to a decoder 554. Decimal output from decoder 554 is then applied to each of the decade inputs of a shorting switch 556 which serves as the "pennies" counting switch. A schematically illustrated shorting bar 556A is shown to indicate that shorting switch 556 is set for five pennies per gallon on the "pennies" graduation. In again similar manner, the divide by ten counter 532 provides binary coded decimal output on lead group 538, one output per every one hundred .01 gallon pulses applied, and decoder 558 converts the BCD input to a decimal output on leads 560 to a shorting switch 562. Shorting switch 562 is the "mills" switch, and is here shown as including a shorting bar 562a set for nine-tenths of a cent per gallon. Thus, noting shorting switch shorting bars 550a, 556a, and 562a, the variator circuit shown is set for selected grade gallonage at 35.9 cents per gallon.

Output from dimes shorting switch 550 is provided by lead 552 to an NOR gate 564 (Signetics type 7410). In like manner, "pennies" output pulses from shorting switch 556 are applied through an inverter stage 566 and lead 568 to a NAND gate 570 (Signetics type 7400). The NAND gate 570 also received input from the cycle or ten count output of decoder 544 through an inverter 572 and input lead 574. NAND gate 570 functions to prohibit "pennies" count pulses from shorting switch 556 except upon coincidence with ten-count output from decoder 544. The output from NAND gate 570 is then also applied via lead 576 through NOR gate 564. The cycle output pulse on lead 574 is also applied as input to a NAND gate 578 (Signetics type 7410), as is also the cycle or ten-count output from tens decoder 554 through an inverter 580 and input lead 582. Thus, output from "mills" shorting switch 562 through an inverter 584 can only be conducted through NAND gate 578 upon coincidence of ten-count or cycle output on leads 582 and 574 from respective decoders 554 and 544.

All pulses present at the input of NOR gate 564 are conducted for input to an NAND gate 586, (Signetics type 7400), Which is enabled by .01 gallon pulses on lead 514 to pass money count output pulses on a lead 588 to a money tally circuitry. Thus, output on lead 588 is applied to the various money counting units as shown in FIG. 1, i.e., dispenser console money display, central console money display, and the totalizer 70.

Output from variator circuitry 500 of Fig. 8 in the form of .01 gallon pulses on lead 514 and money count pulses on lead 588 are applied as input to the respective gallons display 600 and money display 602 such as shown in FIG. 9. A gallon display 600 and money display 602 will be located at each dispenser station, such as money display 148 and gallon display 150 of dispenser console as shown in FIG. 3. The display 600 and 602 serve to provide visual indication to the customer as to the amount of gasoline dispensed in gallons and the cost of such gasoline in dollars and cents.

The .01 gallon pulses on lead 514 are applied to a cascade counter array which consists of an input divide by ten counter 604 connected in cascade to respective

divide by ten counters 606, 608 and 610. The divide by ten counters 604 through 610 may be any of various counter circuits, the particular integrated circuits shown being the Signetics type SN7490 decade counter as connected for divide by ten output and reset. Thus, counter 604 provides count output of 100ths while respectively cascaded counters 606, 608 and 610 provide count output of tenths, units and tens of gallons, respectively.

Count output from each of divide by ten counters 604, 606, 608 and 610 are connected to respective decoders 612, 614, 616 and 618 which, in turn, energize respective numerical indicators 620, 622, 624 and 626. Each of decoders 612 through 618 is comprised of an integrated circuit of the Motorola type CD2502E decade/decoder circuit, a seven segment decoder stage utilized for driving of lamp indicators. The Signetics type 8T01 decoder/driver has also been utilized to good advantage. Each of the decoders 612-618 are utilized to drive count indication of lamp indicators 620 through 626 which may be such as RCA type DR2000 and DR 2010 "Numitron" display devices. The lamp indicator 622 is a type DR2010, the only difference being that it includes an additional pin No. 1 for indication of decimal point 628. The pin one connection is maintained by connection through lead 630 to the system ground.

The money display circuitry 602 is essentially the same as gallons display 600. Thus, money pulse input on lead 588 is applied as input to a first divide by ten counter 632 which is connected in cascade array to additional divide by ten counters 634, 636 and 638. The divide by ten counters 632-638 may also be Signetics type 7490 decade counter integrated circuits. The respective divide by ten counters 632, 634, 636 and 638 each provide output of pennies count, dimes count, dollars count, and tens of dollars count, respectively, as applied to each of the respective decoders 640, 642, 644 and 646.

Decoders 640-646 each constitute a seven segment decade/decoder (e.g. Motorola type CD2502E) which provide counter outputs to respective lamp indicators 648, 650, 652 and 654. Again, the lamp indicators are "Numitron" display devices wherein lamp indicators 648, 652 and 654 are the RCA type DR2000 and the decimal indicator 650 is the RCA type DR2010, the No. 1 pin enabling decimal point 656 being grounded to ground lead 630. A reset pulse may be applied to all counter circuits via lead 658 to place both the gallons and money tally to zero. DC energizing voltage is applied via lead 660 to energize all counter, decoder and lamp display units of the gallons display 600 and money display 602.

Referring again to FIG. 3, the totalizer 70 is situated at a central location to provide continual tally information for all dispenser stations so that continual inventory and accounting information is available. Thus, relative to the partial system illustration of FIG. 3, money pulse output from price variators 136 are also applied via lead 152 to money combinator 156 in totalizer 70. Money combinator 156 also receives price variator outputs from remaining dispenser Nos. 2, 3, and 4 via cable input 178, and serves to order or count all pulses to provide a single pulse train of all pulses for all dispensers on a lead 158 to readout circuitry 160 which indicates a continual tally of money. In similar manner grade combinator 168 receive data from price varia-

tors 136 as to particular grades dispensed and grade combinator 168 serve to provide output of all pulses received in from all dispenser stations. In like manner, a gallons combinator 170 for regular gasoline and a gallons combinator 172 for premium gasoline receive pulse input as derived for all gasoline of each type metered through the dispensing stations. Thus, .01 gallon pulses for each of regular and premium for all dispensers Nos. 1 through 4 are combined to provide single outputs via lines 174 and 176 to the readout circuitry 160.

The readout circuitry may consist of suitable counter and indicating circuitry for indicating the continual tally or quantities combined in the money, grade and gallons combinator stages 156, 168, 170 and 172. For example, circuitry of FIG. 10 illustrates a suitable form of counter and tallying circuit 670 which is used to provide readout of the overall money count at the centralized totalizer 70. Thus, combined money pulses on lead 158 are applied as input to a divide by ten counter 672 (Signetics type 5490) which provides ten count BCD output via lead group 674 to seven segment decoder 676. (Signetics type 8T04) Decoder 676 is a seven segment decoder/lamp driver which provides seven individual outputs for indication of a numerical indicating lamp 678, e.g., the "Numitron" type DR2000.

A ten count output from divide by ten counter 672 is then present on a lead 680 to activate a next succeeding or cascaded divide by ten counter 682 (Signetics type 5490) which is connected in similar manner to provide BCD output via lead group 684 to a decoder 686 (e.g., Signetics type 8IO4 seven segment decoder/lamp driver) which, in turn, drives a numerical lamp indicator 688 to provide dimes count. Pennies and dimes count are continually provided by lamp indicator 678 and 688, and whole dollar count is continually tallied by means of a mechanical counter assembly 690 of well-known type.

Whole dollar count is available on lead 692 on every tenth dime count from divide by ten counter 682 to activate a one shot multivibrator 694 (Signetics type 54121) to provide output via lead 696 to activate a relay 698. Each activation of relay 698 closes control contacts 700 to advance the dollar count of counter assembly 690 by one count. Thus, tally circuit 670 receives penny pulses to provide dime and penny count, while providing a dollar count output to activate the mechanical counter assembly 690. In this manner, no matter how busy the group of individual dispenser stations may be, a momentary dollar count is always available to the attendant authority.

OPERATION

With reference to FIG. 3, the gasoline purchaser may buy gasoline by selection of a selected auto bay location and operation of the dispenser station at that bay. Each of a plurality of dispensing stations are enabled by well-known control and enable circuitry 188 operated by the attendant at the central location or control console 61. The purchaser then selects a grade of gasoline from grade select panel 28 (See also FIG. 2), that gasoline which will be best suited or recommended for his particular automobile engine. The system as disclosed herein makes provisions for delivery of five separate grades of gasoline ranging from 93 through 100 octane; however, it should be understood that the system may

be adapted for any number of gasoline grade deliveries or the two-grade regular and premium delivery, or single grade delivery, as will be further discussed below.

The purchaser actuates selected grades at grade select panel 28 which provides enabling through select board 138 for that grade of gasoline. The purchaser then removes the gasoline hose nozzle from its holster to activate hose switch 72, further enabling select board 138, so that select board provides activation of valve control relays 92 via line 94 in accordance with the selected grade of gasoline. That is, the proper combination of digital control valve S1 through S4 (designators 96-102) to deliver regular, premium, or a selected ratio blend of regular and premium.

For delivery of regular and/or premium the gasoline from the supply reservoirs via conduits 16 and 18 pass through regular meter 87 and premium meter 80, and each generates an electrical pulse output through pulsers 124 and 126 at the rate of 100 pulses per gallon. The .01 gallon pulses from each of pulsers 124 and 126 are then applied to a pulse combinator 132 which assures that all input pulses are counted and parallel added for output via lead 134 to price variators 136. Price variators circuitry 136 consists of a plurality of parallel arrayed variator circuits 500 (FIG. 8), each receiving combined .01 gallon pulse input on lead 134, and a selected one of said variator circuits 500 being enabled in accordance with output on lead 142 from select board 138, i.e., one of enable output leads 300-308 of FIG. 5.

Each of the price variator circuits 500 (FIG. 8), one for each grade of gasoline dispensed, has its consecutive shorting switches 550, 556 and 562 set to the particular price for that respective grade of gasoline which it controls so that its output money count on lead 588 will be proper per gallon of gasoline delivery. As shown in FIG. 8, the particular variator circuit 500 is set with shorting switch bars 550a, 556a, 562a indicating the price of 35.9 cents per gallon. This will vary for each grade variator circuit 500.

Output from price variators 136 then provide money and gallonage pulse output for display at the dispenser console 54 for indication to the purchaser as well as display to the attending authority at control console 61. Money pulse output on lead 144 is applied to the money display 148, a Numitron display, and money pulse output on lead 152 is applied to money display 154 at control console 61 as well as to a money combinator 156 within totalizer 70. Money combinator 156 receives money pulses from all dispensing stations to provide total tally parallel addition for output on lead 158 to inventory readout circuitry 160.

Price variators 136 provide .01 gallons pulses via line 146 to the dispenser console display 150, and .01 gallon pulses are applied via lead 162 to the control console display 164. Whole gallon pulses are also output via line 166 to grade combinator stages 168 within totalizer 70.

Dispensing ceases upon release of the nozzle actuator by the purchaser to stop flow of gasoline through concentric conduits 76 and/or 78. The stop of gasoline flow then stops meters 86 and 80 such that no more output pulses are provided from pulsers 124 and 126, thus ceasing all count activation through pulse combinator 132. The final readout of gallons dispensed and money costs will then be present at the dispenser and

control console money and gallons displays. The purchaser then replaces the hose nozzle in its holster to close hose switch 72, thus disabling select board 138, and the entire system is reset to zero by the attendant at control console 61 after verification, payment, etc. 5 The particular dispenser station of the system is then placed in readiness for the next customer.

It is still the practice of many gasoline retailing companies to provide two or three grades of gasoline in un-blended form, i.e., regular, premium and maybe a third 10 intermediate octane rating. In such a non-blending system where each grade is dispensed through its separate meter, the present system may be utilized in altered or substitutional form. Thus, with a single grade or straight regular/premium system the digital valve control relays 92 are much simplified and the necessity for pulse combinator 132 is obviated since metered .01 15 gallon pulses can be applied directly to a pricing counter for subsequent display at the dispenser and control stations.

The foregoing discloses a novel gasoline dispensing system which constitutes a very great improvement over existing mechanical-type systems as the system avoids the inherent problems encountered with respect to accuracy of metering and tally. The present system provides total meter reliability as to accuracy of gallonage delivery and cost per gallon while also affording the attendant advantage of electronic circuitry reliability. 25 The utilization of digital valve control and grade blending in the delivery line provides highly reliable and accurate blending while presenting minimal problem areas. The system of the present invention can be utilized in any number of gasoline station arrangements for delivery of any number or kinds of purchase delivery practice. In addition, the system leads well for utilization with coin or check acceptance devices which may soon serve to automate even further the practice of gasoline sales. 35

Changes may be made in the combination and arrangement of elements as heretofore set forth in the specification and shown in the drawings; it being understood that changes may be made in the embodiment disclosed without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. A gasoline dispensing system for delivery of regular, premium, and intermediate grades of gasoline from respective regular and premium supply reservoirs, comprising:

dispensing means including gasoline delivery hose; 50 regular metering means receiving gasoline flow from said regular supply reservoir to deliver flow to said dispensing means;

premium metering means receiving gasoline flow from said premium supply reservoir to deliver flow to said dispensing means; grade selector means providing selection ranging from regular to premium and including intermediate grades 55

first circuit means generating first electrical pulse output in proportion to the amount of gasoline flow through said regular metering means; 60

second circuit means generating second electrical pulse output in proportion to the amount of gasoline flow through said premium metering means; 65 pulse combinator means receiving as input each of said first and second electrical pulse outputs to provide a gallonage pulse output which is proportional

to the amount of gasoline flow through said regular and premium metering means;

variator circuit means receiving said gallonage pulse output and generating a gallons output pulse and a money output pulse;

first display circuit means receiving said gallons output pulse to provide visual indication of gallons of gasoline flow; and

second display circuit means receiving said money pulse output to provide visual indication of the cost of gasoline flow through said metering means.

2. A gasoline dispensing system as set forth in claim 1 wherein said dispensing means is further characterized to include:

regular digital valve means connected between said regular metering means and said gasoline delivery hose;

premium digital valve means connected between said premium metering means and said gasoline delivery hose; and

control relay means actuable to energize selected ones of said regular and digital valve means open to allow gasoline flow therethrough.

3. A gasoline dispensing system as set forth in claim 2 wherein said gasoline delivery hose comprises:

a concentric hose having a first conduit connected to said premium digital valve means and a second, concentric conduit connected to said regular digital valve means.

4. A gasoline dispensing system as set forth in claim 1 wherein said first and second circuit means comprise:

first and second pulse generator means connected for actuation, respectively, by said regular metering means and said premium metering means, and each providing a respective pulse output upon delivery of gallonage of regular and premium gasoline flow, respectively.

5. A gasoline dispensing system as set forth in claim 1 wherein said pulse combinator means comprises:

parallel adder circuitry receiving each of said first and second electrical pulse outputs to provide total gallonage pulse output.

6. A gasoline dispensing system as set forth in claim 3 which is further characterized in that:

said control relay means is actuable to energize both of said regular and premium digital valve means simultaneously to enable blending of gasoline flow delivery at an intermediate octane rating.

7. A gasoline dispensing system as set forth in claim 1 wherein said variator circuit means comprises:

first counting circuit means receiving said gallonage pulse output and generating a divided gallons output pulse indicative of .01 gallons flow delivery; and

second counting circuit means receiving said gallonage pulse output and generating a divided output pulse indicative of money equivalent of the gallons of flow delivery.

8. A gasoline dispensing system as set forth in claim 7 wherein said second counting means comprises:

first, second and third decade counter means connected in cascade and receiving as input said gallonage pulse output; and

first, second and third decoder means each connected to respective outputs of said first, second and third decade counter means to provide respec-

tive divide-by-ten electrical pulse outputs proportional to money value of gasoline flow through said regular and premium metering means.

9. A gasoline dispensing system as set forth in claim 8 wherein said first, second and third decoder means are further characterized to include:

first, second and third output switching means controlling outputs from said first, second and third decoder means such that output pulses therefrom are indicative of dimes, pennies and mils count, respectively, as pre-settable in accordance with the cost per gallon of the delivered gasoline.

10. A gasoline dispensing system as set forth in claim 1 wherein said dispensing means is further characterized to include:

first bifurcated conduit means connected between said regular metering means and said gasoline delivery hose;

second bifurcated conduit means connected between said premium metering means and said gasoline delivery hose;

first and second digital valve means connected to respective conduits of said first bifurcated conduit means and separately controllable to control flow through said bifurcated conduit means;

third and fourth digital valve means connected to respective conduits of said second bifurcated conduit

means and separately controllable to control flow through said bifurcated conduit means; and control relay means actuable to energize any selected combination of said first, second, third and/or fourth digital valve means to enable delivery flow of multiple grades of gasoline.

11. A gasoline dispensing system as set forth in claim 10 which is further characterized to include:

orifice control valve means connected to selected ones of said bifurcated conduits of said first and second bifurcated conduit means to enable pre-setting of gasoline delivery ratios.

12. A gasoline dispensing system as set forth in claim 11 which is further characterized to include:

select board circuit means actuable to select a gasoline grade for delivery while enabling a characteristic control output to said control relay means to energize selected ones of said first, second, third and fourth digital valve means.

13. A gasoline dispensing system as set forth in claim 12 which is further characterized to include:

logic circuit means providing an enabling output pulse to said variator circuit means to control said money output pulse in accordance with a selected grade of gasoline flow.

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