

[54] **REMOTE CONTROL AND DISPLAY FOR A LIQUID DISPENSING SYSTEM**

[75] Inventors: **Elmer C. Anderson**, Colonia; **John Dow, Jr.**, Atlantic; **William B. Gutman**, Scotch Plains; **William A. Oetting**, Green Brook, all of N.J.

[73] Assignee: **Lockheed Electronics Company, Inc.**, Plainfield, N.J.

[22] Filed: **Nov. 9, 1972**

[21] Appl. No.: **305,109**

[52] U.S. Cl. **235/92 FL, 235/92 R, 235/92 EA**

[51] Int. Cl. **G06m 3/08**

[58] Field of Search **235/92 FL**

[56] **References Cited**

UNITED STATES PATENTS

2,977,046	3/1961	Dobner	235/92 FL
3,169,185	2/1965	Nines	235/92 FL
3,211,332	10/1965	Thielen	235/92 FL
3,400,255	9/1968	Vroom	235/92 FL
3,662,157	5/1972	Somers	235/92 FL

Primary Examiner—Paul J. Henon

Assistant Examiner—Robert F. Gnuse

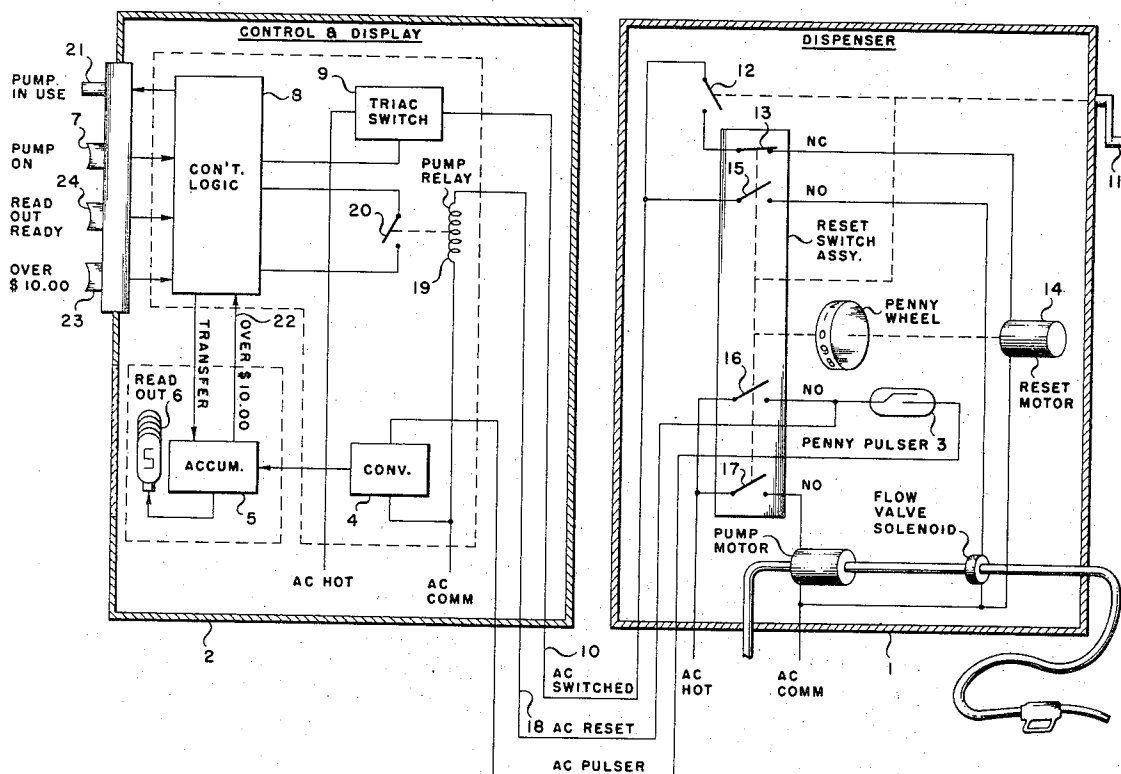
Attorney, Agent, or Firm—Billy G. Corber; Albert K. Geer

[57]

ABSTRACT

An electronic calculator and control system for a gasoline dispenser or the like for remotely controlling the dispenser and displaying the accumulated sale and/or volume. A pulse generator is actuated as the fuel is dispensed and the count is stored in a decade counter. A plurality of flip-flops (latches) and control logic provide control functions such as applying power to the dispenser, lighting proper indicators on a control panel, transferring the accumulated count to readout devices, preserving a count for at least one readout, resetting the counters, turning off the dispenser in the event the sale exceeds a certain amount, and an override if it is desirable to exceed this amount. Provision is made for operating a plurality of dispensers utilizing the same readout devices. The pulse generator is preferably an A.C. to D.C. converter utilizing an optical coupler.

5 Claims, 5 Drawing Figures



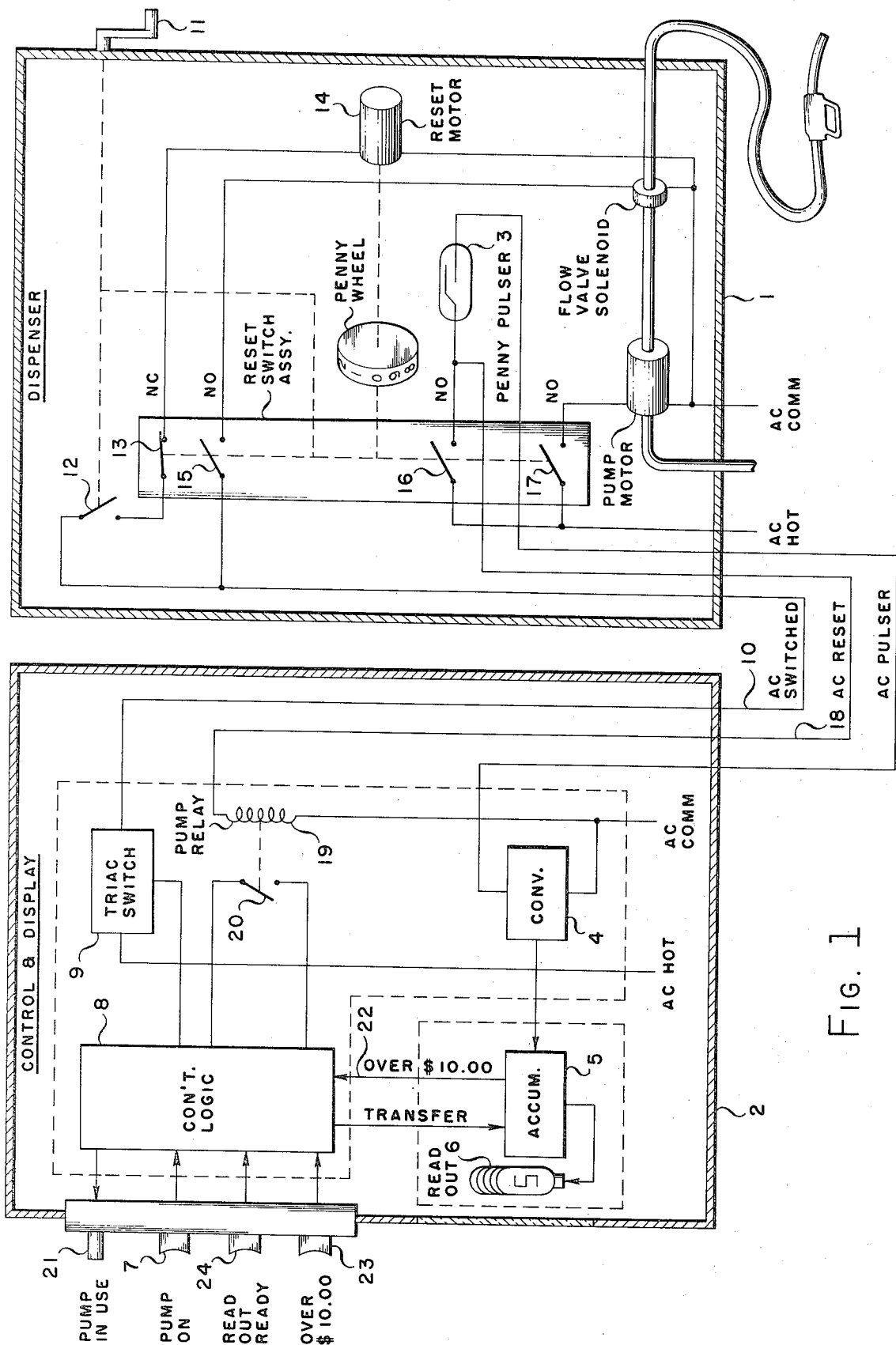


FIG. 1

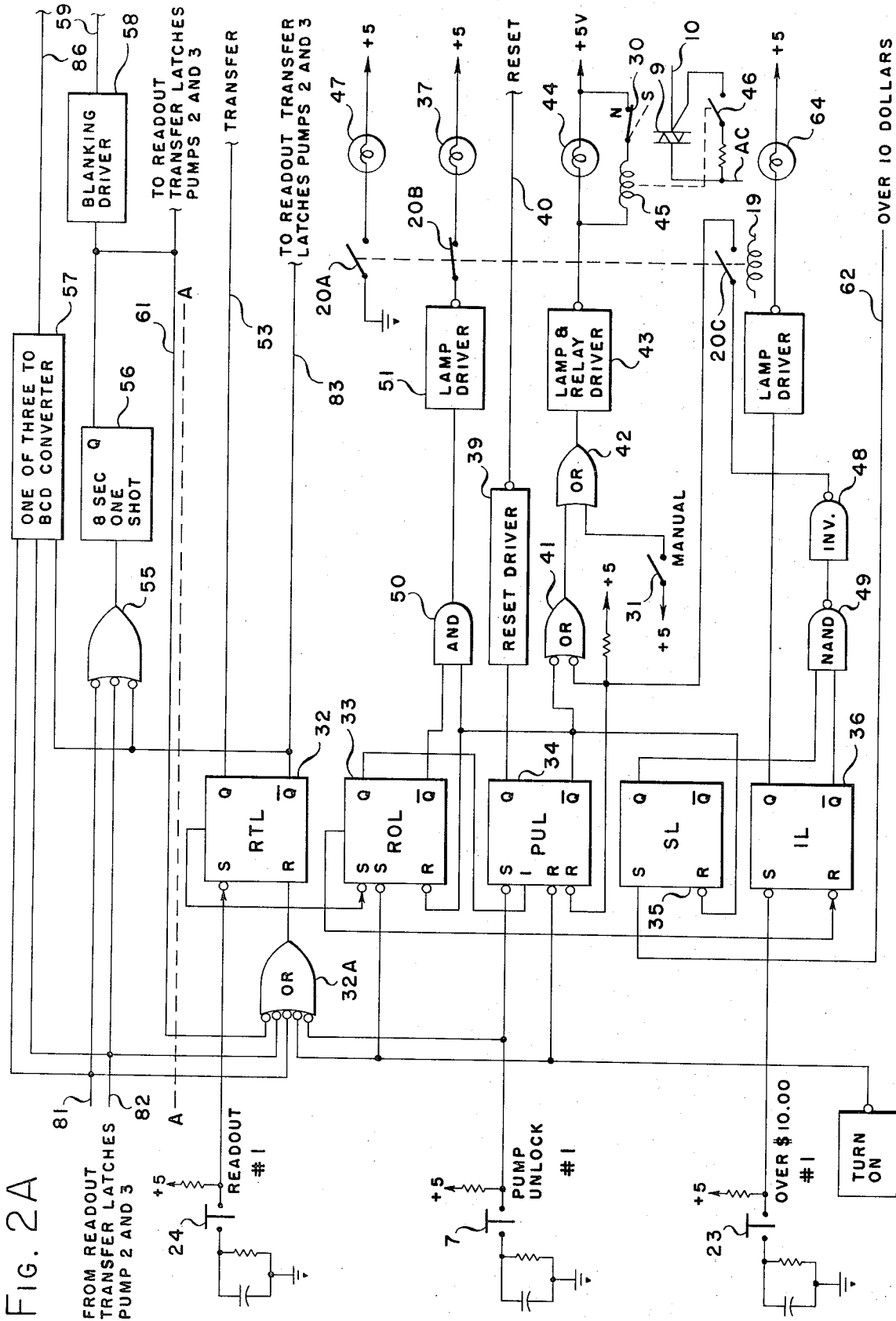
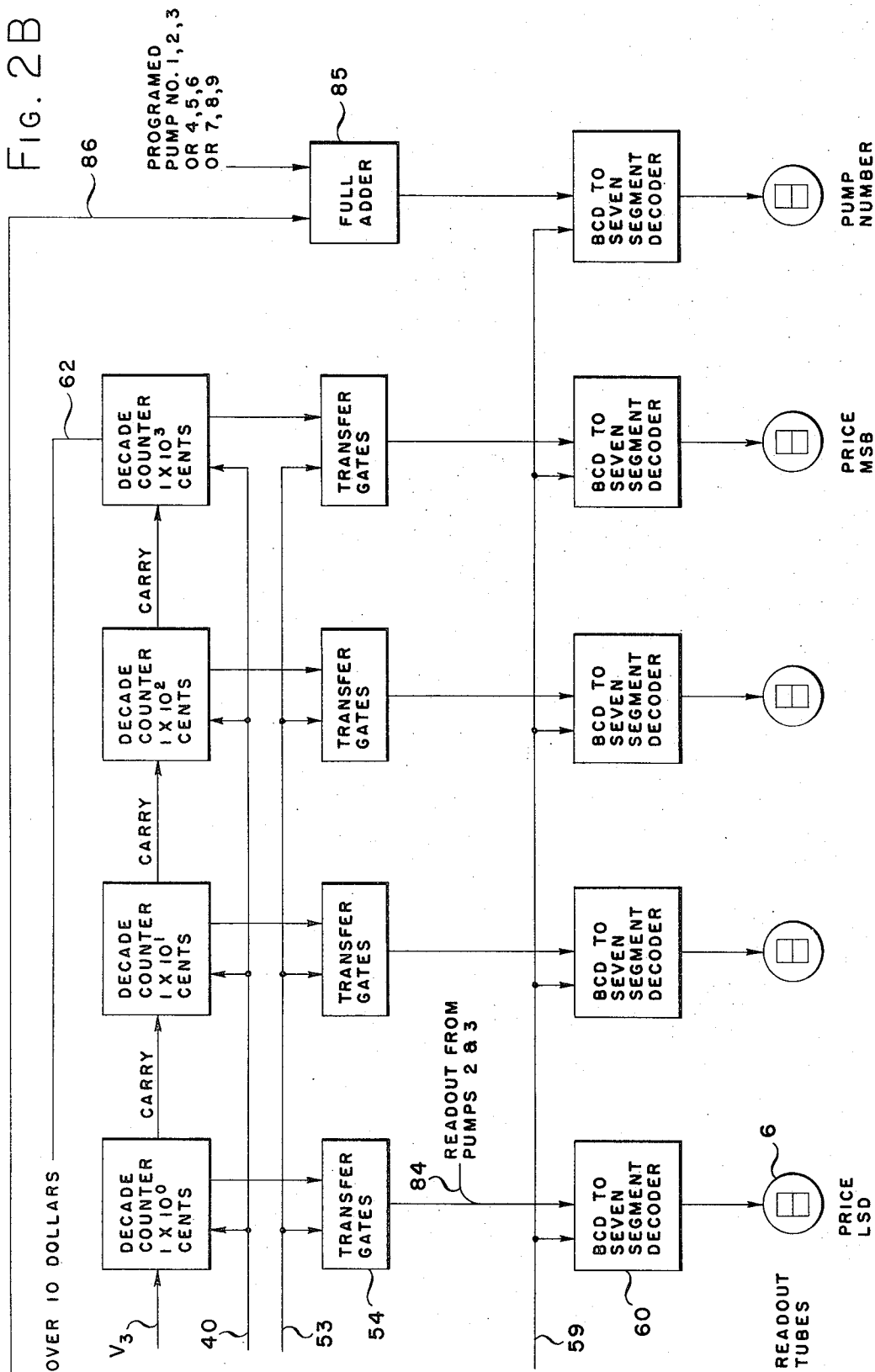


FIG. 2B



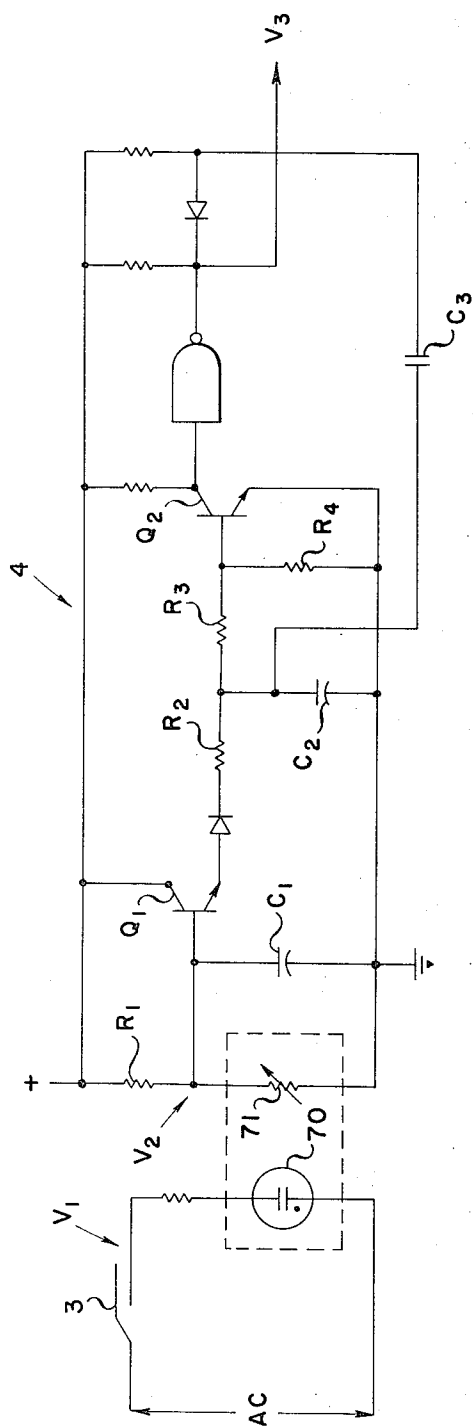
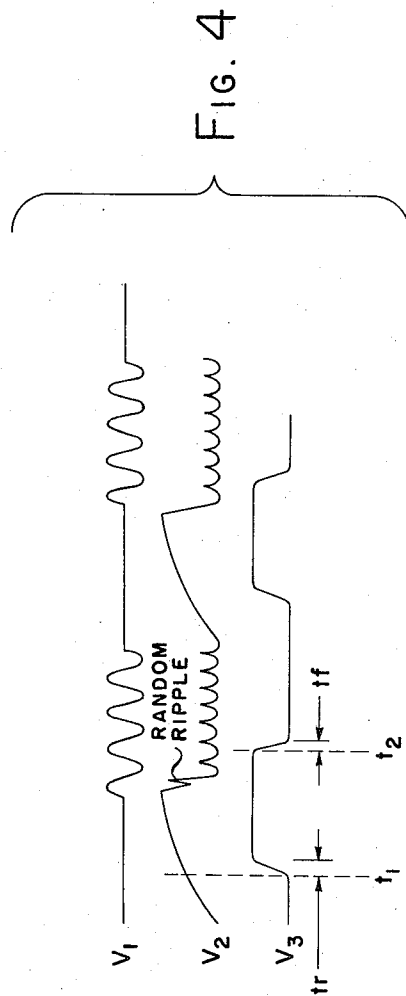


Fig. 3



REMOTE CONTROL AND DISPLAY FOR A LIQUID DISPENSING SYSTEM

This invention relates to a fluid dispensing system for calculating the monetary amount of the sale, and more particularly to a control and display unit for such a system. As described herein, the invention is applied to a gasoline dispenser of the type presently in use at gasoline service stations. A typical dispenser includes a fluid pump, control switch, hose with a nozzle which has a flow control and means to start and stop the pump and reset the calculators. Generally, there are three such dispensers at each service island; therefore, it is desirable to provide control for each island.

In the past, calculators for gasoline dispensers and the like have been largely mechanical or electromechanical. One calculator of this type is shown in U.S. Pat. No. 3,400,255. However, in more recent years, a number of electronic calculators have been proposed. For example, see U.S. Pat. No. 3,666,928 and the patents cited therein. These patents are primarily concerned with various arrangements for counting pulses, which are generated as a function of fluid flow.

Present trends indicate that self-service gasoline dispensing is becoming more popular, not only from the public viewpoint but from the station operators or owners as well. In such cases, the customer pumps his own gasoline and then pays an attendant. Generally, however, except in small service stations a number of attendants are required. It is apparent that a reduction in the number of attendants will result in a lowering of operating costs of the price of gasoline. Furthermore, many of the known calculating systems using mechanical or moving parts were subject to frequent repair and service due to wear and lack of reliability.

Briefly, the calculator includes a pulse generator which produces pulses as a function of the monetary sale and an accumulator for counting and storing the pulses. The control/display unit includes control logic, which provides for operation of a plurality of dispensers by applying power to the dispenser at the beginning of fuel delivery and to remove power at the end of the delivery. The control logic also provides signals to transfer an accumulated count to a readout display. Provision is made to turn off the dispenser in the event the sale exceeds a predetermined amount or an override if the actual sale is expected to exceed such amount. Interlocks are provided to prevent a turn on of the dispenser until a previous transaction has been completed, to prevent erroneous operation by the attendant and to prevent operation of the dispenser until turned on by the attendant.

Accordingly, it is a primary object of this invention to provide a control system for self-service gasoline stations which is not only highly reliable but requires a minimum number of attendants.

Another object of the invention is to provide a control system for a plurality of dispensers, and utilizing a single set of display devices.

Another object of the invention is to provide a calculator for a dispensing arrangement which is under the control of the station operator.

A further object of the invention is to provide a control system for a plurality of dispensers, which includes a system of interlocks.

Another object of the invention is to provide a new and improved pulse generator.

These and other objects of the invention will become apparent from the following description when taken with the accompanying drawings, in which:

FIG. 1 is a partial block diagram illustrating a general arrangement of a dispenser and a control and display unit in accordance with the invention;

FIGS. 2A and 2B are more detailed block diagrams of the control and display unit;

FIG. 3 is a schematic diagram of a preferred embodiment of an AC to DC converter or pulse generator; and

FIG. 4 illustrates the waveforms at the designated points of FIG. 3.

With reference to FIG. 1, the preferred embodiment of the invention is illustrated and comprises a pump (or dispenser) unit 1 and a control and display unit 2. While one pump is shown, additional pumps may be controlled by the control and display unit as will be explained later. A pulser 3, which is shown as a reed switch, is actuated by small magnets located under the digits on the penny wheel of the money wheels of the pump. The output of the pulser is a series of bursts of the AC voltage and is coupled to converter 4 in the control unit. The converter output is a series of pulses, each representing one cent (\$0.01) of the amount of fuel or other material dispensed. The pulses are then counted in the accumulator 5, which may be conventional binary coded digital counters, with the output of each decade driving one element of a four element readout display 6.

At the start of a transaction, the operator (attendant) turns on the dispenser by depressing the PUMP ON button 7 in the control unit. If the previous transaction has been completed, the control logic 8 will turn on the Triac (Thyristor) switch 9 which applies the AC voltage to the pump over the AC switched line 10. The customer then lifts the hose nozzle and puts the handle switch 11 to the ON position. The handle switch contacts 12 close applying the AC through the normally closed (NC) contacts 13 of the reset switch assembly to the reset motor 14. After the reset cycle first sets all the money wheels to the zero position, the contacts of the reset switch assembly are activated. This serves to close all the normally open (NO) contacts and open the normally closed (NC) contacts. Thus, contacts 13 are now open, removing the AC from the reset motor, and the motor stops. Contacts 15, 16 and 17 are now closed, applying AC to the flow valve solenoid, penny pulser and pump motor. Closed contacts 16 also apply AC to the AC reset line 18 which energizes the pump relay 19 in the control unit. The now closed contacts 20 of the pump relay signals the control logic 8 that the dispenser 1 is in use, and the pump in use indicator 21 is energized.

Note, however, that the AC switched by contacts 15 is under control of the Triac switch 9. This allows the control logic to stop the flow of gasoline when a stop decision is initiated. This would originate by setting the EMERGENCY switch (not shown) to the STOP position or when the sale reached \$10.00 (see line 22 from the accumulator to the control logic) and the OVER \$10.00 button 23 has not been depressed. (The details of the stop decision will be fully explained hereinafter.) If a stop decision is not initiated, the customer can proceed to use the dispenser. As the gasoline is dispensed, the penny wheel is turning, thus keeping track of the amount of the sale. As the penny wheel turns, it opens

and closes the penny pulser, applying pulsed AC to the AC pulser line. This pulsed AC activates the AC to DC converter 4 and the DC pulses are passed on to the accumulator 5.

When the customer is finished using the dispenser, the handle switch 11 is placed in the OFF position. This opens the handle switch contacts 12 and sets the switch contacts 13, 15, 16 and 17 of the reset switch assembly back to the original position. The AC is removed from the pump motor, the solenoid flow valve and the penny pulser. This also removes the AC from the AC reset line 18 (via contacts 16) and the pump relay 19 is de-energized, which in turn signals the control logic that the customer is finished with the dispenser and that the transaction should be readied for display on the readout tubes 6.

At this point, the Triac switch is turned off and cannot be turned on by depressing the pump on button 7 until the operator completes the readout cycle of the present transaction by depressing button 24. Also, when the Triac switch is held off by the control logic, the handle switch 11 cannot initiate another reset cycle until the control logic reactivates the Triac switch.

Referring now to FIG. 2, the control and interlock system is shown in FIG. 2A and the accumulator and readout indicators are shown in FIG. 2B. Before describing FIG. 2, consideration of the symbology used will be helpful toward a better understanding of the invention. A small circle (o) at the input of a device indicates that a low voltage will activate the device, and the absence thereof indicates that a high voltage will activate the device. Similarly, at the output of a device the small circle indicates that the device is inverting and the absence thereof indicates a noninverting device. For purposes of illustration only, a low may be zero volts (0V), or substantially so, and a high may be five volts (+5V). Also in keeping with industry standards $\bar{Q}$ is NOT Q (or the inverse of Q).

The control logic previously referred to (FIG. 1) consists of five (5) flip-flops, designated as latches, and the associated circuitry. The five latches 32 through 36 are designated RTL (Read Transfer Latch), ROL (Read Once Latch), PUL (Pump Unlock Latch), SL (Stop Latch) and IL (Inhibit Latch), respectively. Considering FIGS. 2A and 2B, actuation of PUL 34 resets the decade counters and energizes relay 45, which results in applying power to the dispenser. RTL 32 functions to transfer the accumulated count to the readout tubes. ROL 33 prevents actuation of PUL 34 until at least one readout has been made. SL 35 and IL 36 determine whether or not a stop decision has been made. Keeping in mind the overall system as previously described, a typical operation is now considered.

Prior to turning on the equipment, the operator should ensure that the EMERGENCY switch 30 is in the closed (N) position, as shown, and the manual switch 31 is open, i.e., the equipment as shown, is in automatic operation when the proper voltage is applied and the switches are as indicated. At turn on, RTL 32 and PUL 34 are reset while ROL 33 is set, thereby resetting IL 36. It will be noted that at this time the contacts 20B of pump relay 19 are closed and contacts 20A and 20C are open. However, since the $\bar{Q}$ output of ROL 33 is low, the "readout" lamp 37 is off.

Assuming any previous transaction has been completed, and a customer desires to use a particular dispenser, the operator will depress the corresponding

pump unlock button 7 (in this case No. 1). RTL 32 is reset through the OR gate 32A, where set by a previous transaction and the PUL 34 is set, the Q output is high and the $\bar{Q}$ output is low. The Q output activates the reset driver 39 which resets the decade counter (FIG. 2B) over line 40. The $\bar{Q}$ output is gated through OR gates 41 and 42 to the lamp/relay driver 43, which in turn energizes the pump unlock lamp 44 and the DC relay 45. The relay contacts 46 are closed, turning on the Triac switch 9 and AC is applied to the dispenser over line 10, as previously described. The low $\bar{Q}$ (PUL 34) also resets the SL 35, and resets ROL 33. The now low Q (ROL 33) is applied to latch 34 as an inhibit (I) to prevent further operation of the set state until at least one readout has been accomplished. The customer removes the hose nozzle and sets the handle switch 11 (FIG. 1) to ON. The dispenser money wheels are reset and the reset switch assembly is energized, which applies AC to the pump relay 19 (FIG. 1), and contacts 20A and 20C close and contacts 20B open. The "in use" lamp 47 is now on and the "readout" lamp 37 stays off. The now closed contacts 20C connect the output of inverter 48 to one input of the OR gate 41 and to latch 34 reset. The output of the inverter 48 is normally low and when the contact 20C closes, a low signal resets PUL 34 and gates through OR 41 to maintain the DC relay 45 in the energized state. This is because SL 35 is reset, Q is low and the NAND gate 49 output is high. Resetting of PUL 34 also removes the reset pulse from line 40 and the counters.

Gasoline is delivered and the pulse output from converter 4 is counted in conventional decade counter, as shown in FIG. 2. Counting continues until the desired amount of sale is reached, unless a stop decision is made. A stop decision may be initiated by opening the emergency switch 30, or when the sale reaches \$10.00 to avoid excess spillage. When the delivery of less than \$10.00 is completed, the customer returns the switch handle to the off position, which results in the opening of contacts 16 and thereby de-energizing AC relay 19, which opens contacts 20A and 20C and closes contact 20B. The "in use" lamp 47 goes out, and the low input to OR gate 41 is removed and rises toward +5 volts. Since PUL 34 is reset, its $\bar{Q}$ output is also high and as a result the DC relay is de-energized, the Triac switch is turned off and AC is removed from the dispenser. Pump unlock lamp 44 goes out.

It will be recalled that ROL 33 was previously reset ($\bar{Q}$ high). Also, PUL 34 is reset ($\bar{Q}$ high). Since both inputs to AND gate 50 are high, an output is provided to lamp driver 51 to turn on the readout lamp 37, which indicates to the operator that gasoline delivery is complete and readout is now ready.

The readout cycle begins when the operator depresses the readout button 24. The read transfer latch (RTL) 32 is now set. ROL 33 is also set, the $\bar{Q}$ output is now low, which in turn extinguishes the readout lamp 37. The $\bar{Q}$ output of RTL 32 is now high and is applied over line 53 to open the transfer gates 54 (FIG. 2B). The Q output of RTL 32 is low and is gated through OR gate 55 to start an 8 second one shot 56, the output being applied to the blanking driver 58 which generates a blanking pulse on line 59 to decoders 60 to turn on the readout tubes 6. Thus, the contents of the decade counters are transferred to the readout display. At the same time, the Q output of ROL 33 is high and removes the inhibit (I) from PUL 34. The operator may now

press the pump unlock button, when desired. The inhibit function is to ensure against accidentally depressing the pump unlock before depressing the readout button.

The readout will remain displayed for about 8 seconds. At the end of the 8 seconds the RTL 32 is reset over line 61 (output of one shot 56) to OR gate 32A, and the transfer and blanking signals are removed, turning off the readout tubes. Since the decade counters still hold the present count, the amount of sale can be redisplayed, simply by depressing the readout button 52 which repeats the readout cycle. Otherwise, the pump can be assigned to a new customer by depressing the pump unlock button 38.

Now, let it be assumed that the pump is in operation, fuel is being delivered and the count is being registered as before. At a predetermined amount of sale, say \$10.00, provision is made to turn off the pump. Also, the operator may override the turn off when so desired. Returning now to FIGS. 2A and 2B, the foregoing functions are provided by latches 35 and 36, the stopover \$10.00 latch (SL) and the Inhibit over \$10.00 latch (IL), respectively.

When the counters reach the predetermined amount (\$10.00), an output from the fourth decade (1×10^3 cents) (FIG. 2B) will be applied over line 62 to the set input of latch 35, the Q output thereof goes high. Latch 36 (IL) was previously reset either at turn on or by a previous readout, and the $\bar{Q}$ output is high. Since both inputs to NAND gate 49 are high, the output goes low and the output of the inverter is high. Since the $\bar{Q}$ output of latch 34 is high (previously reset when contacts 20C closed), both inputs to OR gate 41 are high, the output is low which results in the DC Relay 45 being de-energized. AC power is removed from the pump, whereupon the flow valve closes and the pump motor stops.

Now suppose the operator recognizes that the particular customer desires more fuel than the predetermined amount, such as for example in the case of a truck. In such case, the operator presses the "over \$10.00" button 23, which sets latch 36 (IL), the Q output goes high and the "over \$10.00" lamp 64 illuminates to act as a remainder that this transaction is being allowed to exceed the predetermined limit. At the same time, the $\bar{Q}$ output of IL 36 is low, and thus when the predetermined amount is reached and latch 35 is set, one input to NAND gate remains low and the DC relay remains energized.

Thus, the "over \$10.00" button should be depressed prior to reaching the predetermined amount to avoid removing AC from the pump. However, once the "over \$10.00" button has been depressed, no further action is necessary by the operator and the \$10.00 limit will be in operation again once the transaction is completed, i.e., the readout cycle.

Earlier it was stated that additional pumps could be controlled by the present invention. It is common practice at most service stations to have three pumps at each service island. Thus, for convenience and other reasons which will become apparent, the following description will illustrate how the invention will accommodate three pumps with one set of readout tubes.

Referring again to FIGS. 2A and 2B, it will be noted that there are five inputs to OR gate 32A. Two of these inputs are designated "From Readout Transfer Latches 2 and 3", lines 81 and 82. These lines are also con-

nected to the OR gate 55, and also to the input of the "One of Three to BCD converter". The signals on these lines are generated by the $\bar{Q}$ output of the corresponding latch 32 (RTL) for pumps No. 2 and No. 3. Likewise, the $\bar{Q}$ output for latch 32 is connected to the OR gates 32A of pumps No. 2 and No. 3 over line 83. The output of the 8 second one shot 56, which is connected to the OR gate 32A of pump No. 1, is also connected to the OR gates 32A of the other pumps. Thus, the OR gate 32A of each pump receives a signal from the 8 second one shot 56 and a signal from ROL 32 of the other two pumps. Thus, it will be apparent that, except as noted later, each pump is assigned the equipment below the broken line A—A, viz. the three push buttons, the five latches, etc. The elements above the broken line are shared by all pumps. In FIG. 2B, a set of decade counters and transfer gates are assigned to each pump, whereas all pumps share the decoders 60 and readout tubes 6.

As will be seen, the control logic and counters for each pump operate independently of the control logic and counters of the other pumps, and the interconnections to the OR gates 32A of the three pumps provide an interlocking feature so that readout is accomplished for one pump at a time, and at the same time protect a count (sale) being registered for one or both of the other pumps. Consider now the operation of pump No. 1, as before described, and with pumps No. 2 and No. 3 on the line.

When the operator depresses pump unlock switch 7 for pump No. 1, the latch 32 is reset, and $\bar{Q}$ goes high. This output is applied to OR gate 55, and OR gates 32A of the control logic for the other pumps. Since the OR gates respond only to a low signal, there is no reaction in the control logic for pumps No. 2 and No. 3. Therefore, all three pumps can be in operation, gasoline being dispensed and the count accumulating in each set of counters. The pump unlock lamp(s) 44 and the pump in use lamp(s) 47 are on, indicating current status to the operator.

Recalling that during fuel delivery the latches 32 (RTL) are reset, let it be assumed that the readout lamp 37 for No. 1 pump comes on. The operator presses the readout button 24, which sets latch 32 for pump No. 1, and Q is high, $\bar{Q}$ is low. As previously described the Q output is used to energize the transfer gates 54. The low $\bar{Q}$ output is now applied to OR gate 55, starting the one shot 56, and to OR gates 32A for pumps No. 2 and No. 3, resetting the latches 32 or holding them in the reset state. The blanking driver 58 energizes the decoders 60 and the decade counter contents for No. 1 pump are displayed on the readout tubes. The readout display will remain for approximately 6 to 8 seconds. If the operator completes the readout of No. 1 pump within the period of the one shot 56, he can immediately depress the readout button of another pump which is ready for readout. The latch 32 for the other pump (say No. 2) is set which resets latch 32 for pump No. 1, removing the transfer pulse from the transfer gates for the No. 1 counters, and simultaneously the transfer pulse for pump No. 2 is applied to the transfer gates 54 of pump No. 2. The contents of No. 2 decade counters are then displayed (via lines 84, FIG. 2B) on the readout tubes for the remainder of the blanking period. In the event of insufficient time to complete the readout for No. 2 pump, the oper-

ator depresses the readout button again and the one shot recycles.

The Q outputs of the three latches 32 (RTL) are connected to a "one of three to BCD converter" 57 (FIG. 2A), the output thereof being connected to the adder 85 (FIG. 2B) over line 86, where it is combined with a programmed binary coded digital signal such that the output of the adder when applied to the decoder will provide an indication of the pump number on the readout tube, i.e., pump No. 1, 2, 3 or 4, 5, 6 or 7, 8, 9. For example, during readout, one of the inputs to converter 57 will be low and the other inputs will be high, and the output will be the binary for No. 1, No. 2 or No. 3, which is added to binary for 0, 3, 6, etc. to obtain the pump number. Thus, any number of three dispenser control units can be stacked to accommodate any number of pumps.

When it is desired to operate the pumps manually, the MANUAL switch 31 is closed which connects the +5 volts to the input of OR gate 42 and the DC relay 45 remains energized. The pumps may now be used without regard to the control functions of the control unit.

It is understood that the various blocks of FIG. 2, such as converter 57 and decoder 60, are conventional state of the art devices.

With reference to FIG. 3, a preferred embodiment of an AC-DC converter 4 (FIG. 1) and a pulse shaper is shown. The penny pulser 3 is connected in series with a neon lamp 70 across the AC lines (switch 16, FIG. 1, not shown, is assumed to be closed). The neon lamp and photosensitive material represented by the variable resistance 71 comprise an optical coupler, which couples the pulsed AC from the penny pulser 3 to the pulse shaper consisting of the NPN transistors Q_1 and Q_2 and associated components.

Considering also the waveforms of FIG. 4, as the penny pulser opens and closes, the AC (V_1) turns the neon lamp 70 on and off. When the lamp is on, the resistance of the photosensitive material decreases and the voltage V_2 falls. With the lamp off, the resistance of the photosensitive material increases and V_2 rises. Note that the rise of V_2 has a long time constant, which is due to the response of the photosensitive material. The transistor circuit takes advantage of this fact to integrate the 60 Hz AC, i.e., the optical coupler not only serves as a groundless connection but also as a filter to the AC. The transistor circuit itself acts as a Schmitt trigger circuit where the lag provided by capacitor C_2 introduces a hysteresis that overlaps any random ripple that occurs on the fall of V_2 . Capacitor C_3 provides positive feedback to reinforce the trigger action and to improve the rise and fall times of V_3 . The rise and fall times of V_3 are typically less than 2 microseconds. These rapid rise and fall times are necessary when interfacing with diode transistor logic as is the case here. Not only does the circuit provide a groundless connection between the logic circuitry and the AC, it is also immune to contact bounce in the penny pulser and acts as an integrating filter without the need for large value capacitors. In addition, the need for two power supplies, both AC and DC at the dispenser, is eliminated.

It is believed readily apparent that the invention has many advantages over known calculating systems. The operator need only follow the information on the display panel. The indicator lamps show the status

throughout a transaction. Thus, a single operator can readily supervise or attend several control units, each controlling three dispensers. The invention also permits the use of the latest integrated circuit technology with the acknowledged high reliability. It is also apparent that the outputs of the accumulators can be used as inputs to totalizers, computers or printers for credit card transactions.

While the control-display system has been described in connection with a penny pulser and the monetary value of the sale is displayed, it will be recognized that where the dispenser pulser provides pulse proportional to volume or gallons, counting and control is the same. Since as described, the decimal would be on the readout tube displaying the count of the second decade (1×10^1), conversion to count one-tenths gallons may be made by shifting the readout tube with decimal to the least significant digit (LSD).

While a preferred embodiment has been described, it will be apparent to those skilled in the art that various modifications may be made without departing from the scope of the invention as defined by the appended claims. For instance, where a high output is shown as connected as a low input to another device, those skilled in the art will recognize the use of an inverter.

What is claimed is:

1. A calculator and control system for fuel dispensing or the like comprising a plurality of dispensers, control logic and a decade counter for each dispenser, pulse generator means at each dispenser producing pulses as a function of fuel dispensed, means connecting the pulse generator output to the decade counters for each dispenser, the control logic comprising

a first latch means for resetting the counters and energizing a relay for applying AC power to the dispenser,

a dispenser switch when actuated resets the dispenser counters and actuates the pulser,

a second latch means responsive to resetting of the second latch for inhibiting further operation of said first latch until at least one readout from a counter decade has been made,

a third latch means for transferring the accumulated count from the decade counters to a readout display, and actuating said second latch to remove the inhibit from said first latch,

a fourth latch means responsive to a predetermined count for de-energizing said relay applying power to the dispenser, and

a fifth latch means for overriding said fourth latch when said predetermined count is to be exceeded.

2. A system as defined in claim 1 wherein the second latch resets the fifth latch.

3. A system as defined in claim 1, wherein the first latch resets the second and fourth latches.

4. A system as defined in claim 1, and further including transfer gates for each decade and a decoder for converting the binary output of the counters to a decimal readout and wherein the third latch actuates the transfer gates and a blanking driver responsive to the third latch actuates the decoder.

5. A system as defined in claim 1, wherein the pulse generator comprises a pulse responsive to fuel dispensed for opening and closing the AC potential at the dispenser for providing a pulsed AC, a light emitting device responsive to the pulsed AC, a light sensitive element responsive to the light emitting device for generating a ramp-type voltage, and a Schmitt-type pulse shaper for generating a DC pulse for application to the decade counter.

* * * * *