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United States Patent [19]

Buell, Jr.

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[45] **July 15, 1975**

[54] **DISPENSING CONTROL SYSTEM FOR FLUIDS**

[75] Inventor: **John A. Buell, Jr.,** Solana Beach, Calif.

[73] Assignee: **General Atomic Company,** San Diego, Calif.

[22] Filed: **June 20, 1974**

[21] Appl. No.: **481,107**

[52] **U.S. Cl.** .... **222/26;** 222/27; 222/28; 222/76; 235/92 FL; 235/151.34; 340/184

[51] **Int. Cl.** **G07f 13/00**

[58] **Field of Search** .... 222/23, 25, 26, 27, 28, 222/30, 36, 37, 38, 76; 340/184, 310 R, 347 AD; 235/92 FL, 92 AC, 151.34

[56] **References Cited**

UNITED STATES PATENTS

3,221,934	12/1965	Klaffky	222/26
3,498,501	3/1970	Robbins et al.	222/76 X
3,510,630	5/1970	Ryan et al.	222/26 X
3,641,536	2/1972	Prosprich	222/23 X
3,731,777	5/1973	Burke	222/26 X
3,765,567	10/1973	Maiocco	222/30
3,813,527	5/1974	Langston	235/92 FL

Primary Examiner—Allen W. Knowles
Attorney, Agent, or Firm—Fitch, Even, Tabin & Luedeka

[57] **ABSTRACT**

A dispensing control and display system for fluid products is disclosed which is adapted to control the operation of a number of dispensers from a remote location and also provide a visual display at the remote location of quantity and cost data for the fluid being dispensed by each of the dispensers. The system utilizes pulse code and multiplexing in a telemetering system that requires little modification of the dispensers themselves, which may be gasoline pumps or the like. The system uses existing power conductors for transmitting information between a dispenser control unit associated with each of the dispensers and a central control unit at the remote location. Each dispenser control unit responds to an individual identification code signal sent by the central control unit and transmits the data to the central control unit which is then received and forwarded to and displayed by a corresponding console control unit. The identification code signals permit the system to operate with a single carrier frequency. The system includes features that insure accurate display of the cost and quantity by saving the data for retransmission in the event the system determines that the data was not properly transmitted. The operation of individual dispensing units may be interrupted and thereafter resumed by an operator at the remote location if desired, without affecting the display of the data.

30 Claims, 29 Drawing Figures

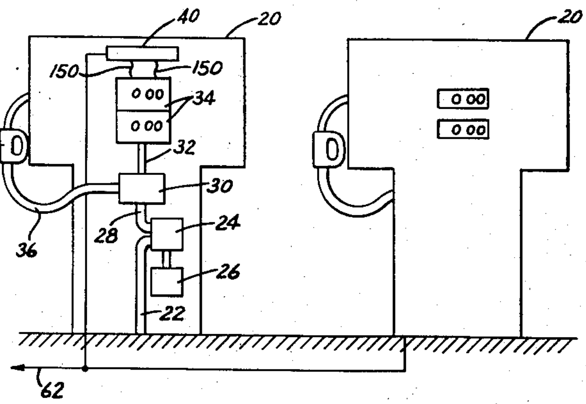

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FIG. 1

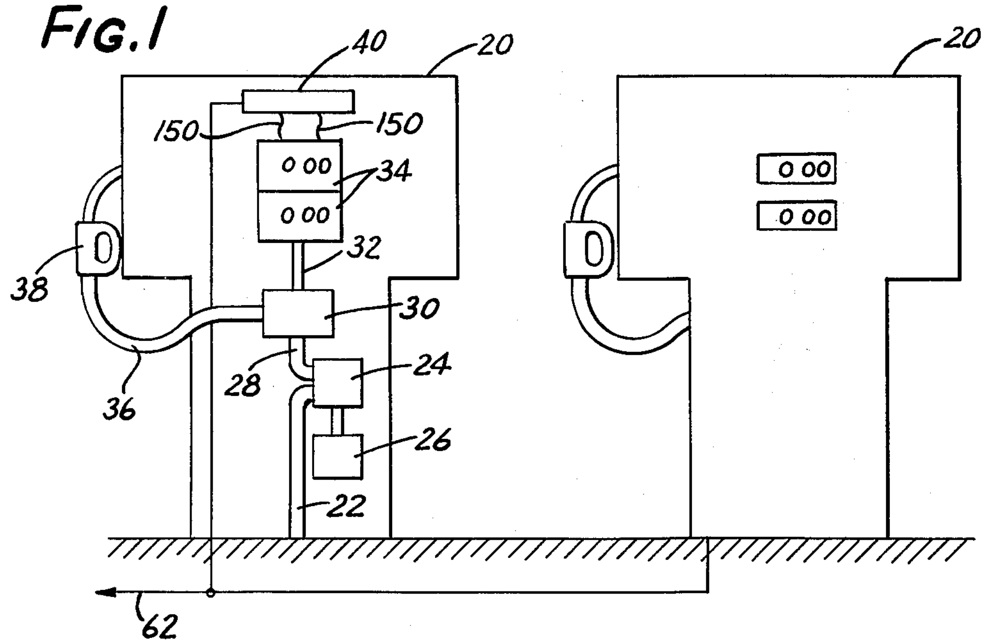


FIG. 2a

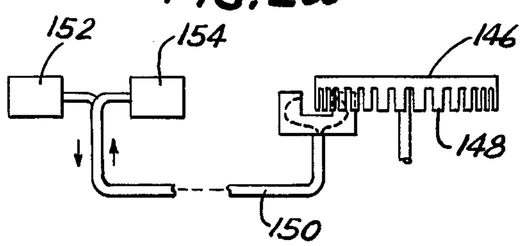


FIG. 2b

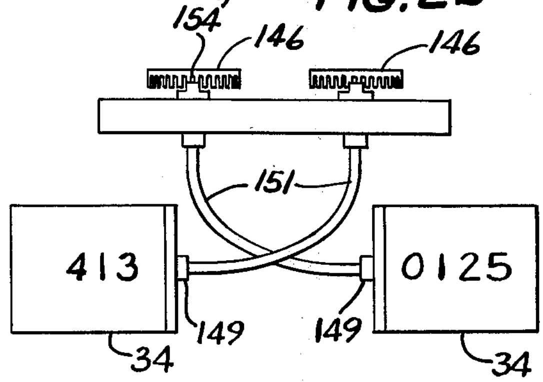
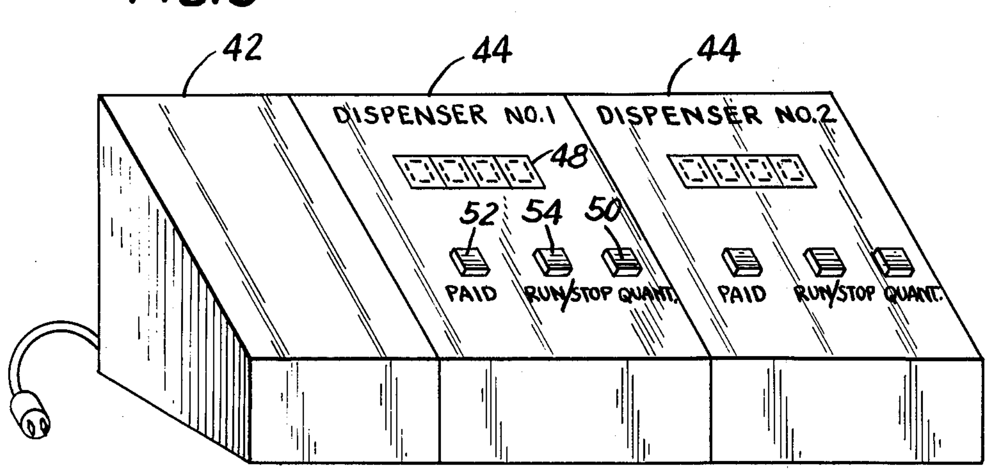


FIG. 3



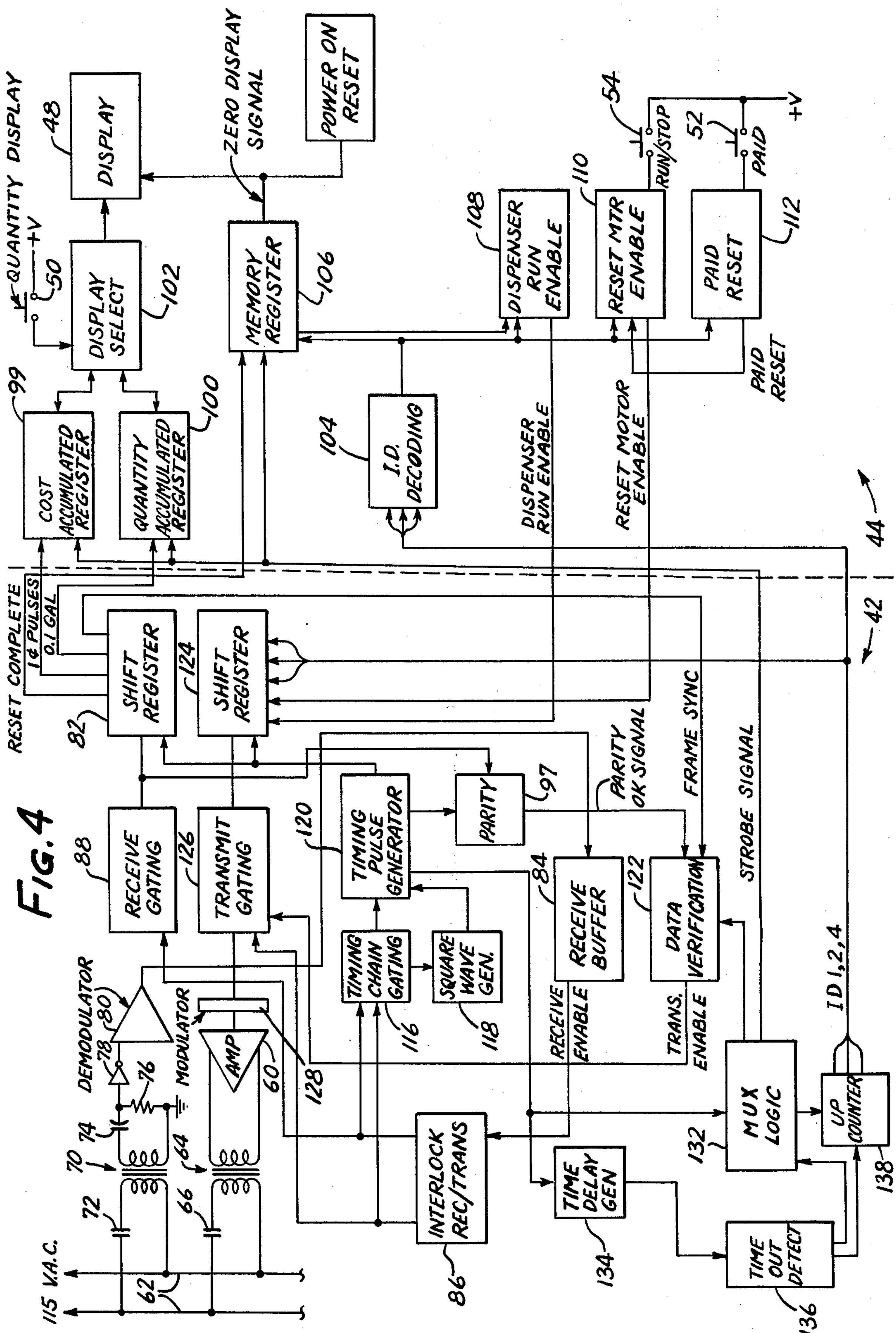
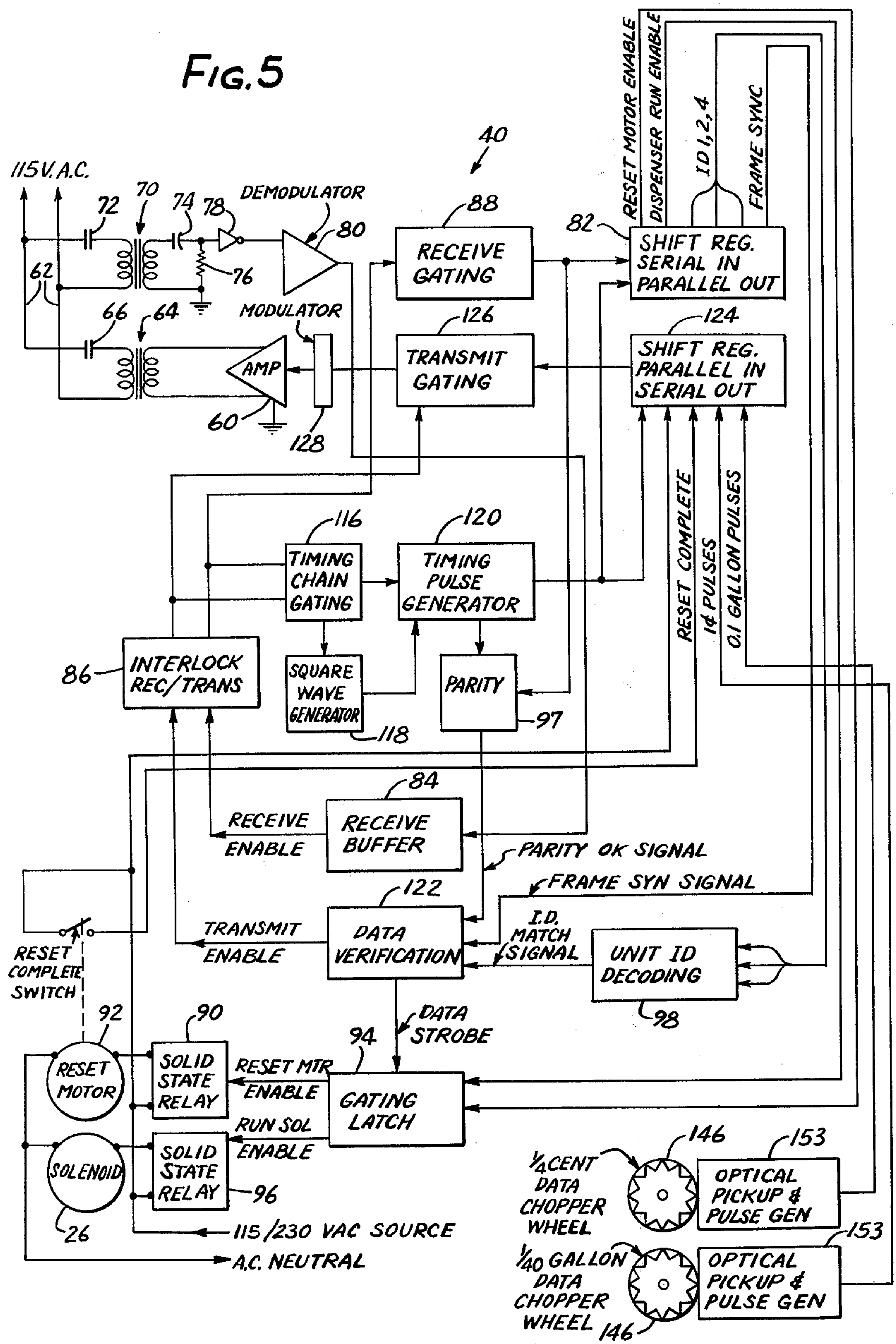

QUANTITY DISPLAY
48
DISPLAY
ZERO DISPLAY SIGNAL
POWER ON RESET
54
RUN/STOP
52
PAID
+V
50
DISPLAY SELECT
102
MEMORY REGISTER
106
DISPENSER RUN ENABLE
108
RESET MTR ENABLE
110
PAID RESET
112
99
COST ACCUMULATED REGISTER
QUANTITY ACCUMULATED REGISTER
100
104
I.D. DECODING
DISPENSER RUN ENABLE
RESET MOTOR ENABLE
PAID RESET
44
42
RESET COMPLETE
1¢ PULSES
0.1 GAL
82
SHIFT REGISTER
124
SHIFT REGISTER
PARITY
97
PARITY OK SIGNAL
FRAME SYNC
STROBE SIGNAL
88
RECEIVE GATING
126
TRANSMIT GATING
120
TIMING PULSE GENERATOR
84
RECEIVE BUFFER
122
DATA VERIFICATION
TIMING CHAIN GATING
116
SQUARE WAVE GEN.
118
DEMODULATOR
80
78
76
MODULATOR
AMP
60
128
RECEIVE ENABLE
TRANS. ENABLE
ID 1,2,4
MUX LOGIC
132
UP COUNTER
138
74
70
64
INTERLOCK REC/TRANS
86
TIME DELAY GEN
134
TIME OUT DETECT
136
72
66
115 V.A.C.
62

FIG. 4

FIG. 5


40
115V.A.C.
72
70
74
78
DEMODULATOR
80
62
76
66
64
MODULATOR
AMP
60
128
88
RECEIVE GATING
126
TRANSMIT GATING
82
SHIFT REG. SERIAL IN PARALLEL OUT
124
SHIFT REG. PARALLEL IN SERIAL OUT
RESET MOTOR ENABLE
DISPENSER RUN ENABLE
ID 1,2,4
FRAME SYNC
116
TIMING CHAIN GATING
120
TIMING PULSE GENERATOR
86
INTERLOCK REC/TRANS
SQUARE WAVE GENERATOR
118
PARITY
97
RESET COMPLETE
1¢ PULSES
0.1 GALLON PULSES
84
RECEIVE ENABLE
RECEIVE BUFFER
PARITY OK SIGNAL
FRAME SYN SIGNAL
122
TRANSMIT ENABLE
DATA VERIFICATION
I.D. MATCH SIGNAL
UNIT ID DECODING
98
RESET COMPLETE SWITCH
92
90
DATA STROBE
94
RESET MOTOR
SOLID STATE RELAY
RESET MTR ENABLE
GATING LATCH
RUN SOL ENABLE
SOLENOID
SOLID STATE RELAY
96
26
115/230 VAC SOURCE
A.C. NEUTRAL
146
153
1/4 CENT DATA CHOPPER WHEEL
OPTICAL PICKUP & PULSE GEN
1/40 GALLON DATA CHOPPER WHEEL
146
153
OPTICAL PICKUP & PULSE GEN

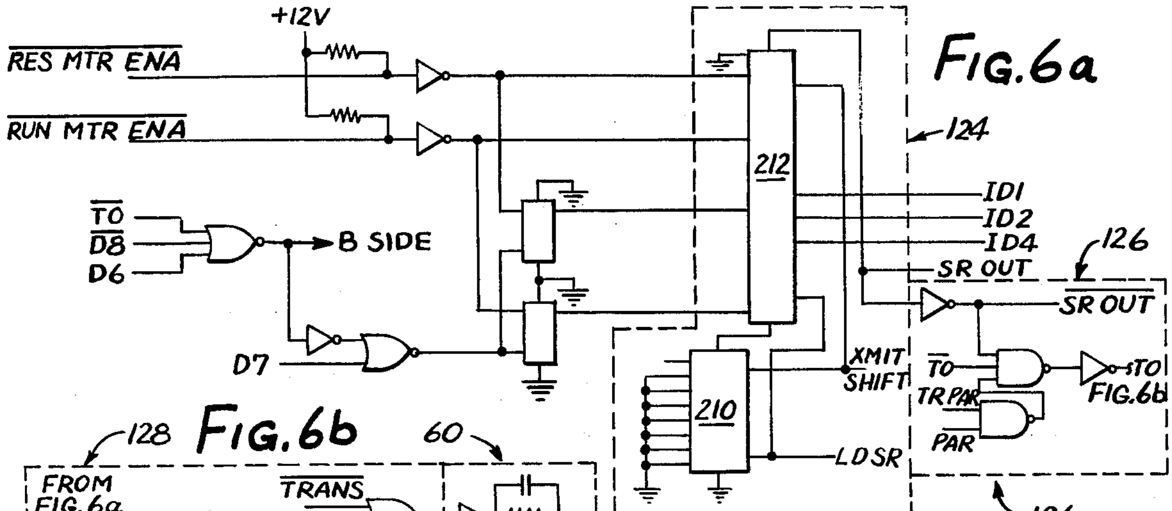


FIG.6a

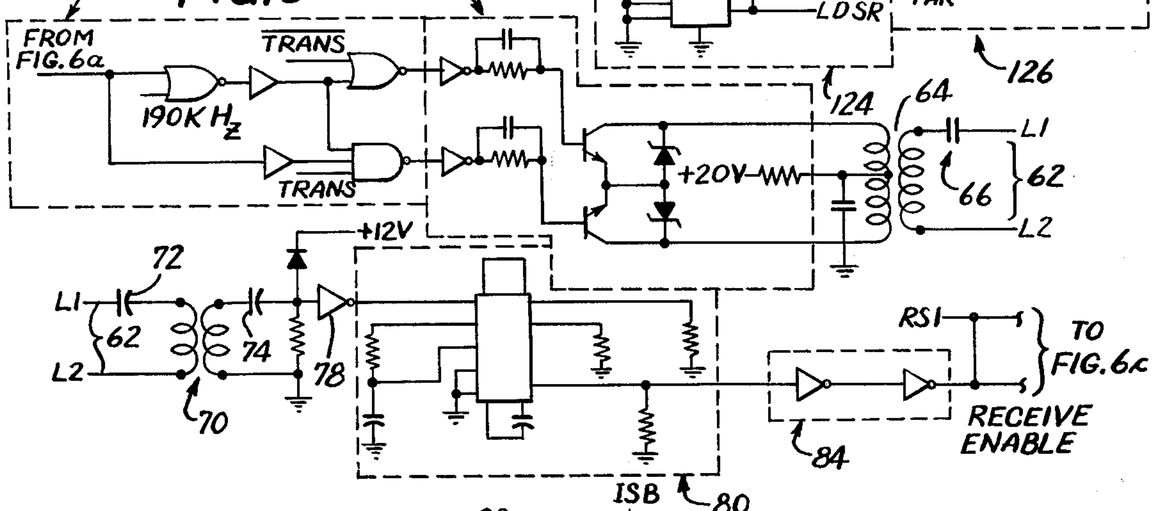


FIG.6b

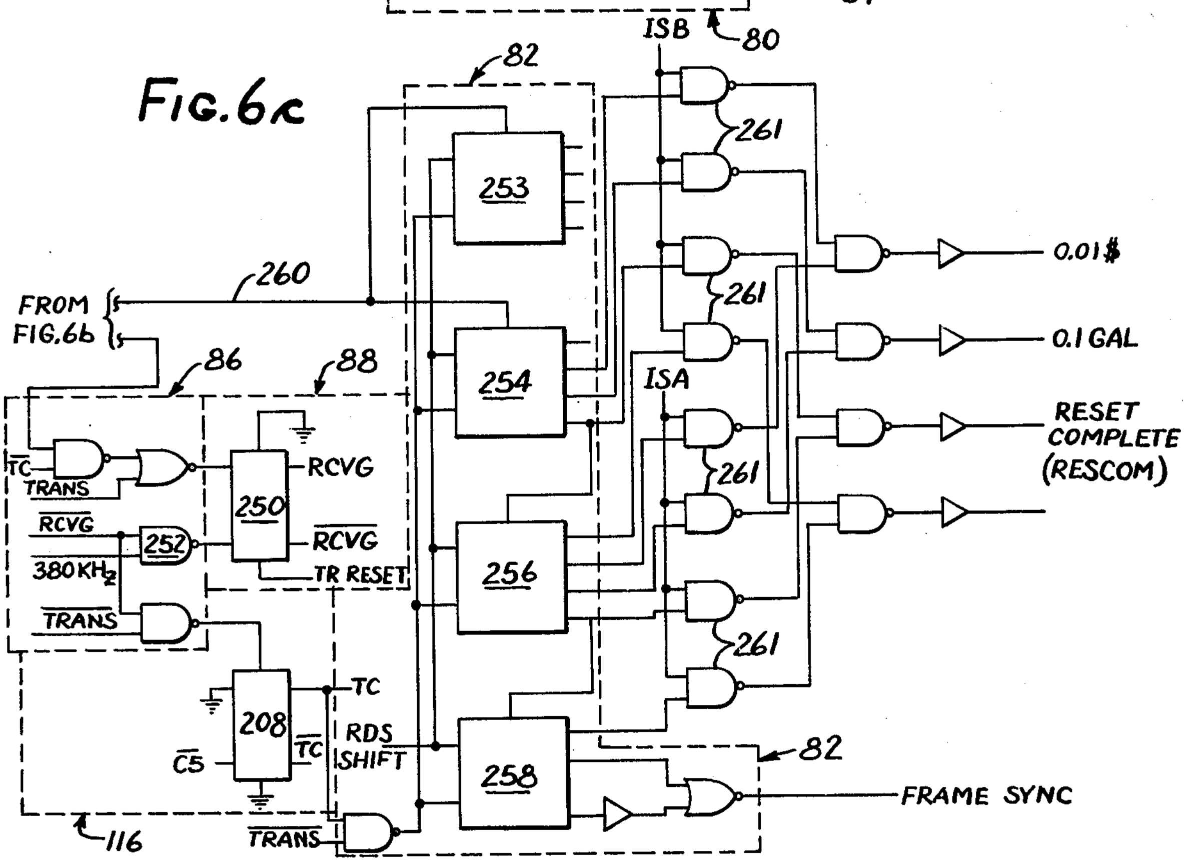


FIG.6c

FIG. 7a

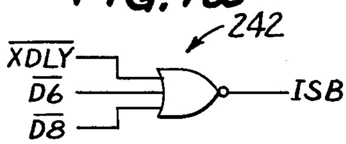


FIG. 7b

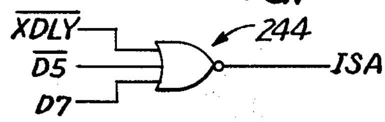


FIG. 7c

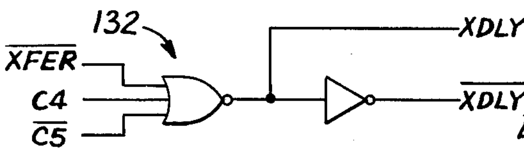


FIG. 7d

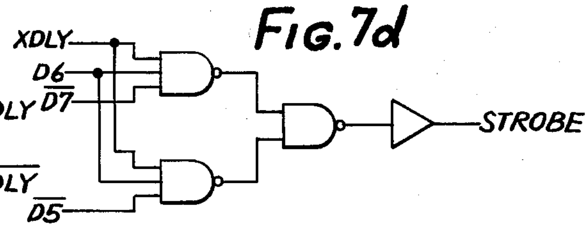


FIG. 8

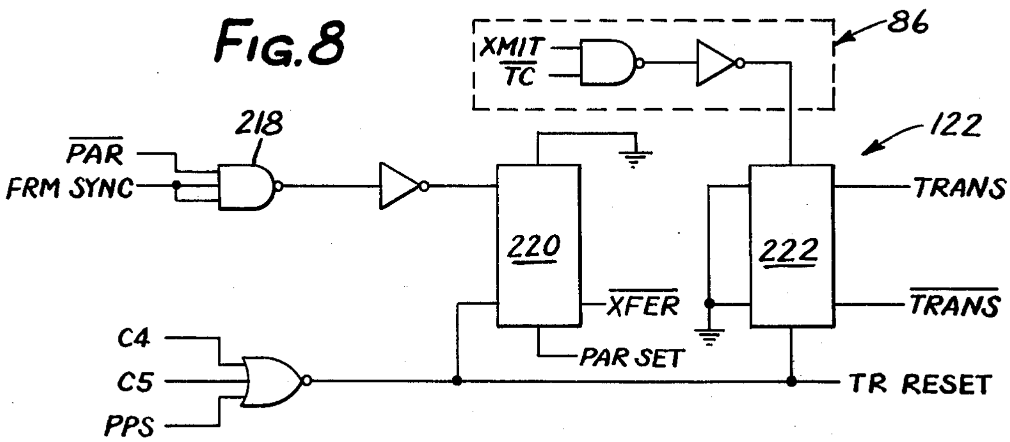


FIG. 9

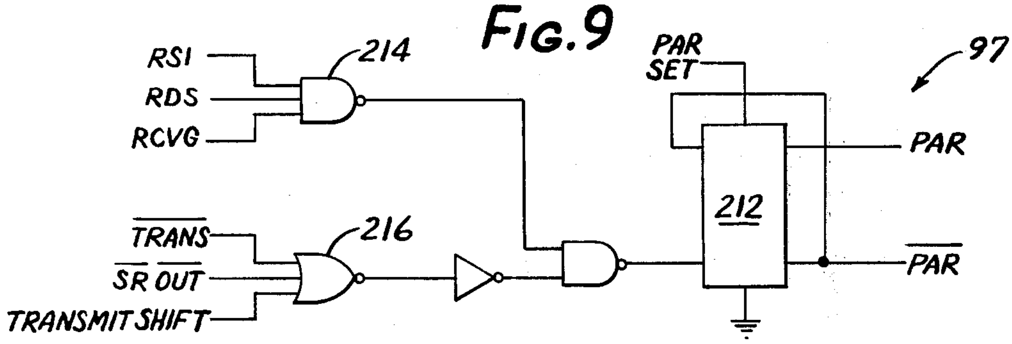


FIG. 10

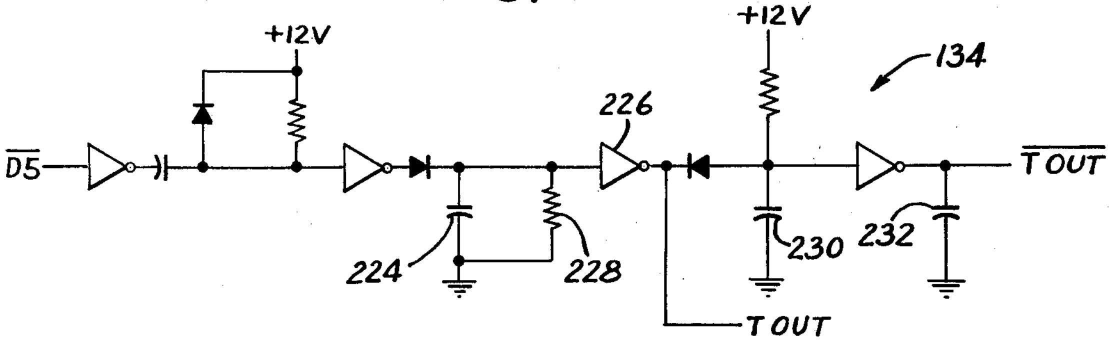


FIG. 11a

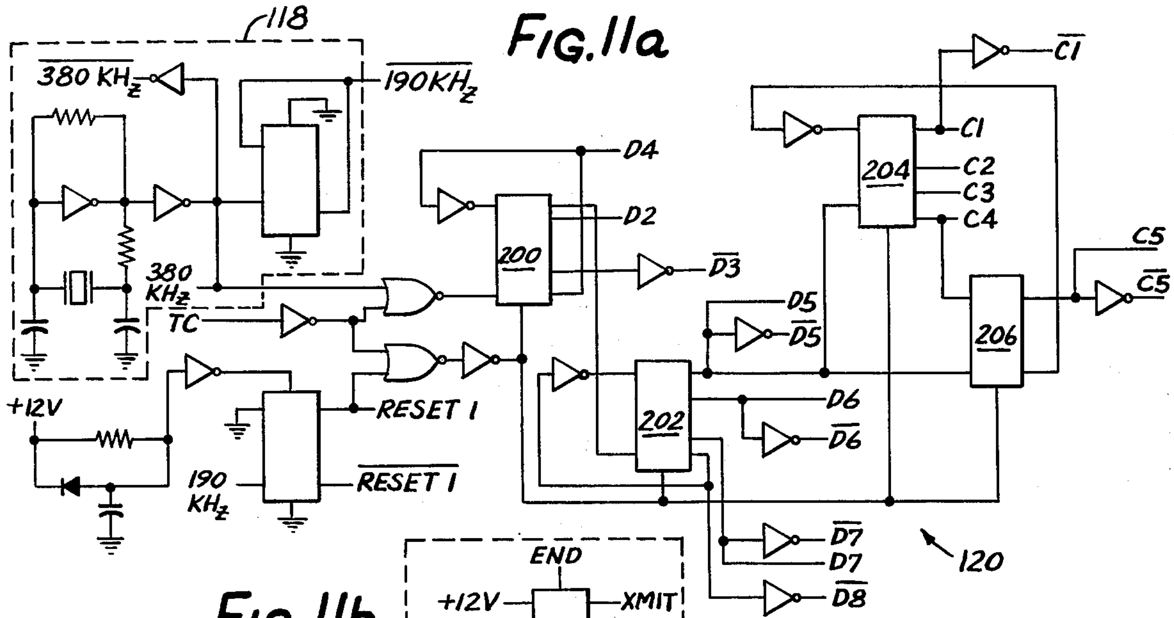


FIG. 11b

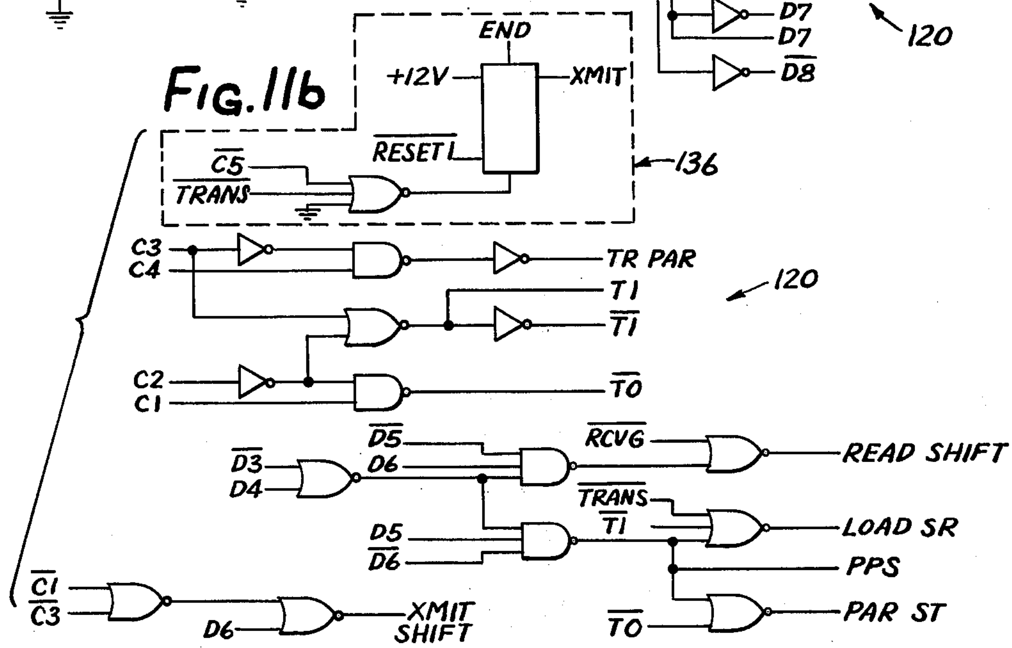


FIG. 12

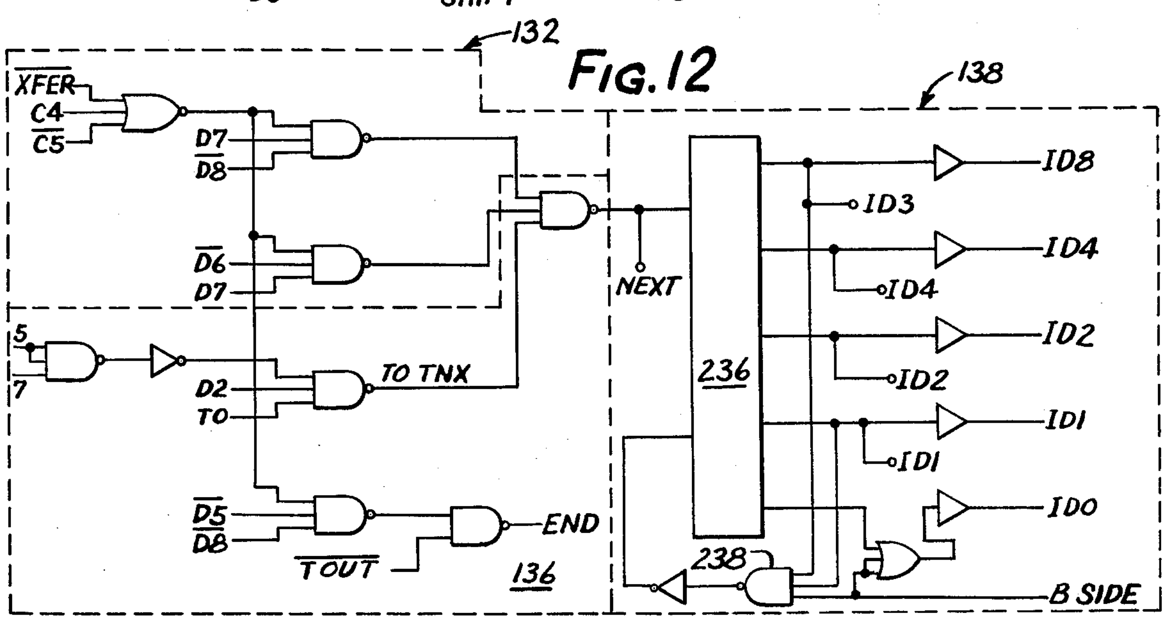


FIG. 13

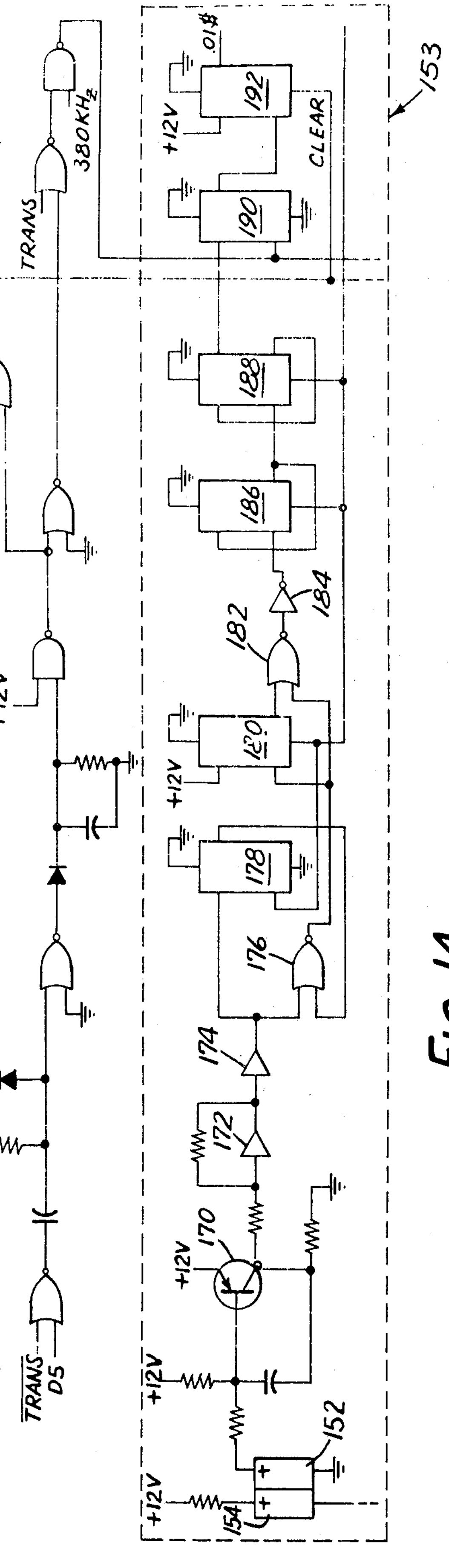


FIG. 14

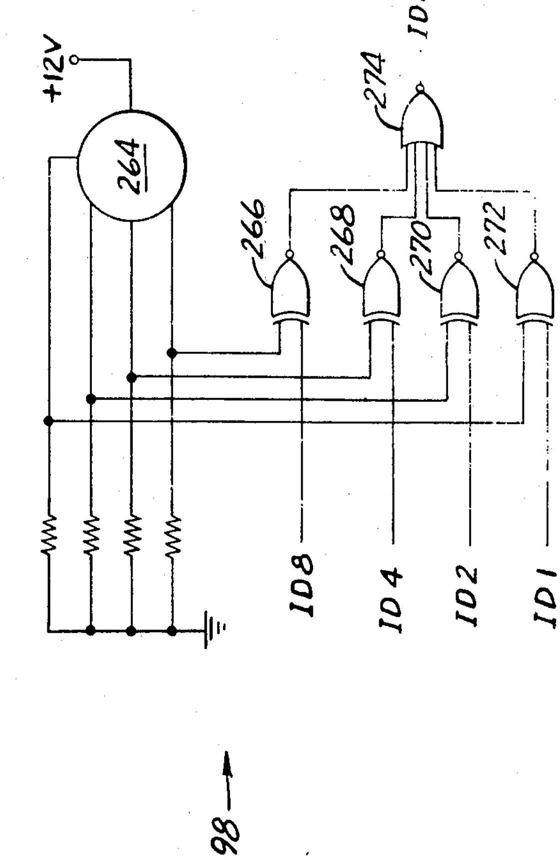
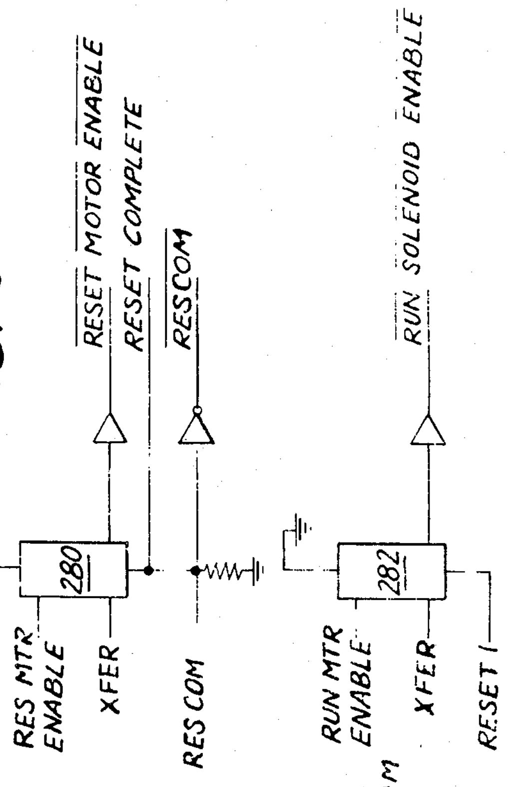


FIG. 15



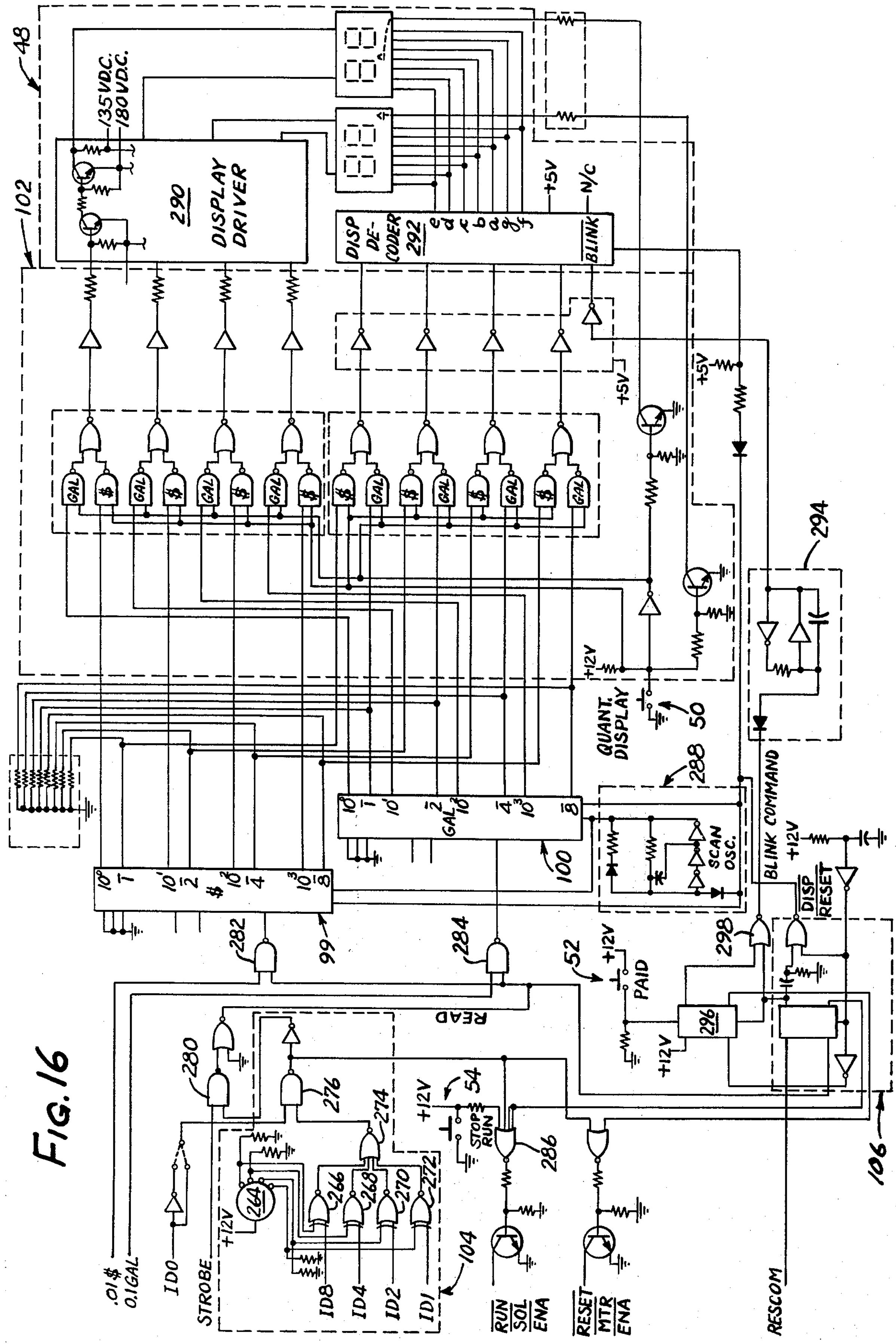

48
102
135 V.D.C.
180 V.D.C.
290 DISPLAY DRIVER
DISP DE-CODER 292
BLINK
+5V
N/C
GAL
$
+12V
QUANT. DISPLAY
50
288
SCAN OSC.
100
99
282
284
294
BLINK COMMAND
DISP RESET
298
296
52
PAID
READ
280
276
274
264
266
268
270
272
54
STOP
RUN
286
104
106
.01 $
0.1 GAL
ID0
STROBE
ID8
ID4
ID2
ID1
RUN SOL ENA
RESET MTR ENA
RESCOM

FIG. 16

FIG. 17a

RECEIVE MODE TIMING

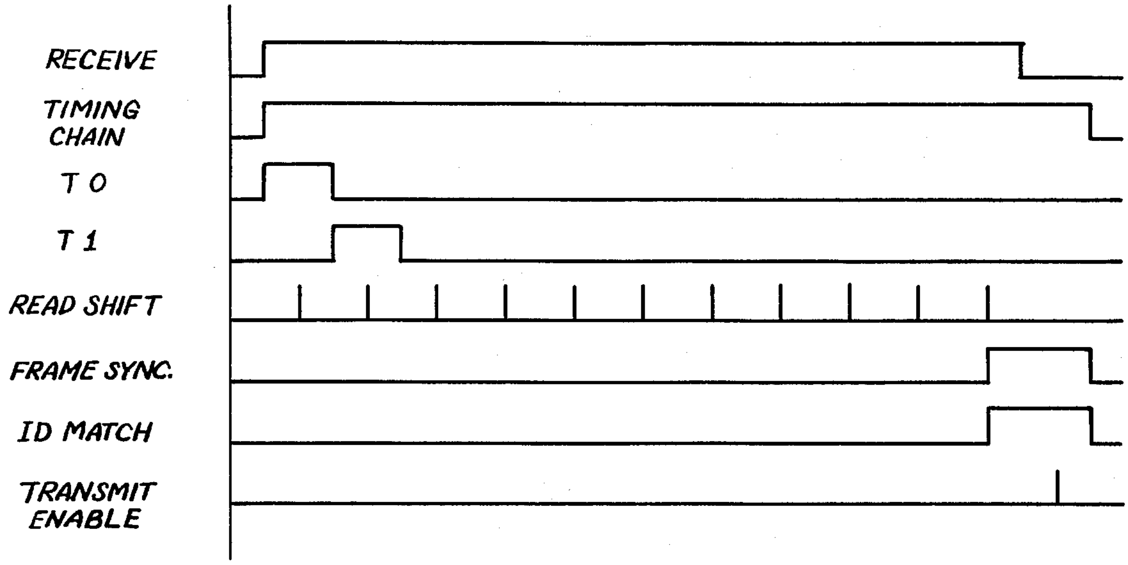


FIG. 17b

TRANSMIT MODE TIMING

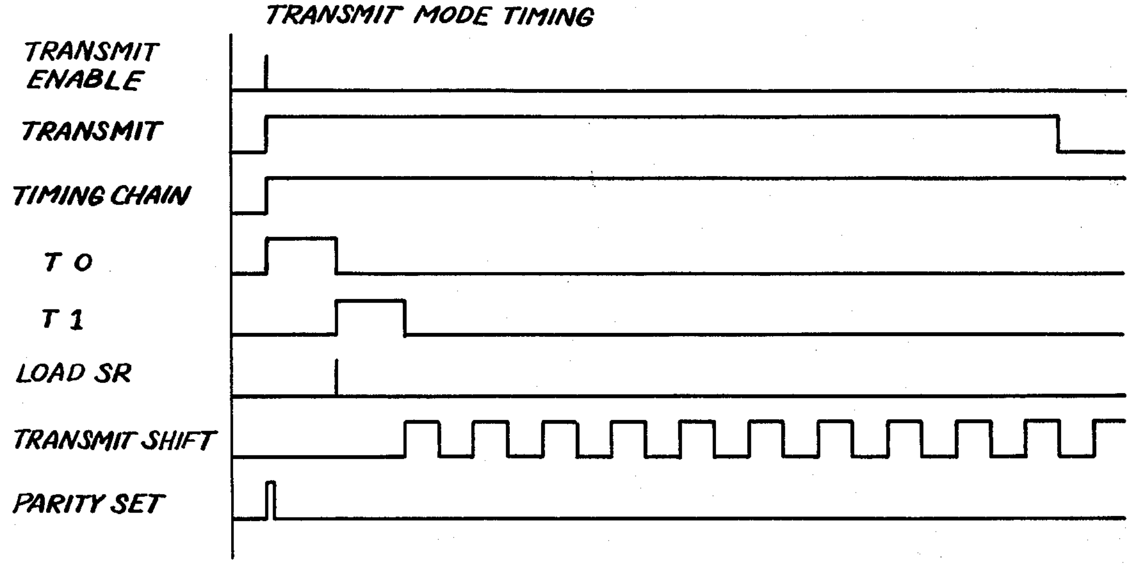


FIG. 17c

IF NO RESPONSE, TIME DELAY GENERATOR WILL TIME OUT & START NEW TRANSMIT

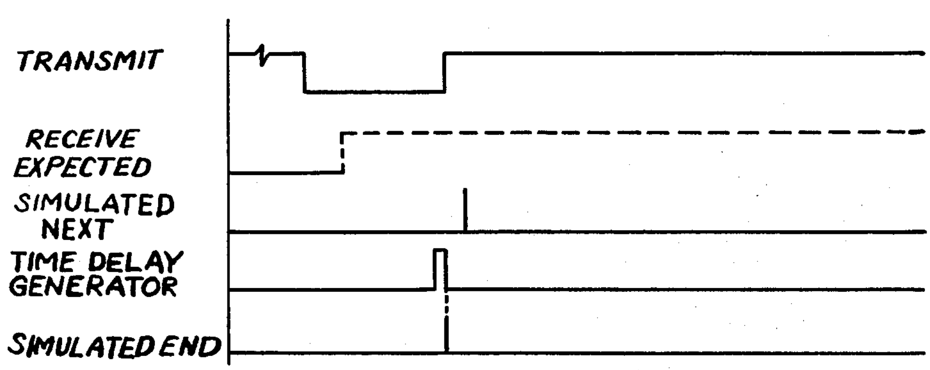


FIG. 18a

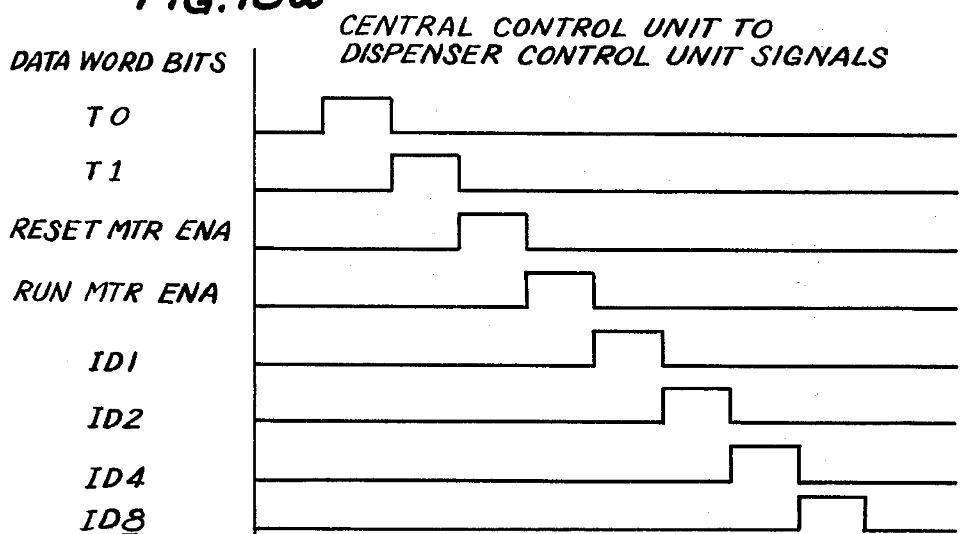


FIG. 18b

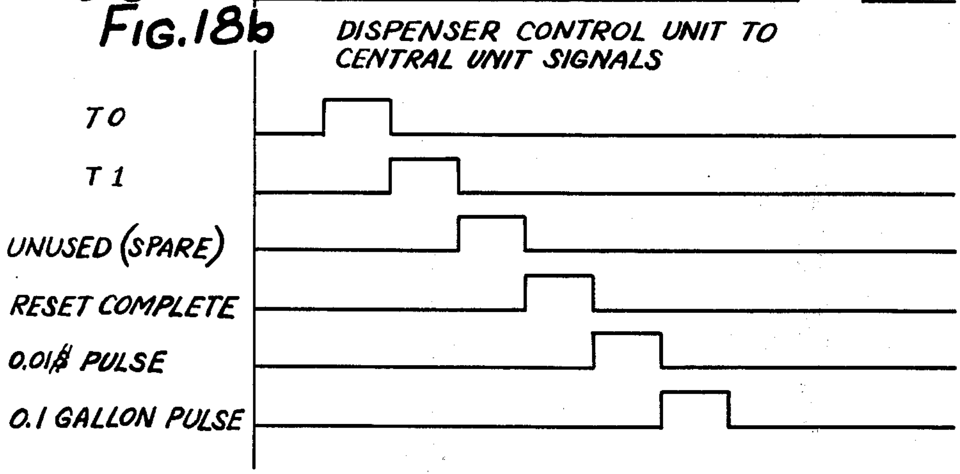
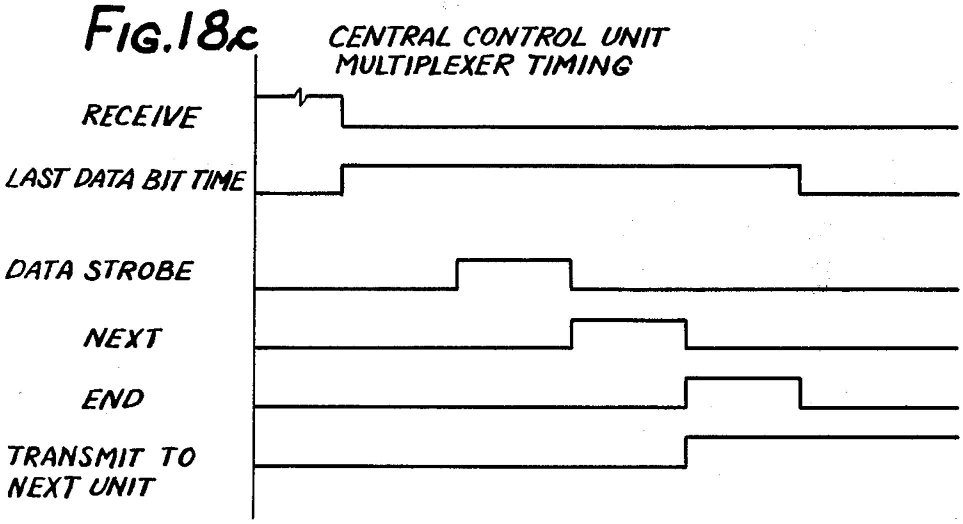


FIG. 18c



DISPENSING CONTROL SYSTEM FOR FLUIDS

This invention relates generally to multiplexing and telemetering systems, and, more particularly, to a system for remotely controlling the operation of one or more fluid dispensing units and for providing a visual display of the quantity and cost data of the fluid being dispensed by each of the dispensing units.

Installations that are commonly referred to as self-service gasoline stations are becoming increasingly more prevalent in many geographical areas. Such installations have advantages to both the consumer and the operator of the station, in that the cost of the gasoline may be less to the consumer, reflecting the lower overhead costs of the operator, since fewer attendants may be needed for dispensing gasoline. The operator of the station is able to sell the gasoline at a more competitive price because a station having a large number of pumps or dispensing units may require only a single attendant. However, it is difficult for a gasoline station to be efficiently converted to self-service operation having only one attendant unless some system for remotely controlling the operation of the individual dispensing units is installed, since it would be quite difficult for an attendant to walk from unit to unit and effectively control the operation of each of them without any supplementary control.

Accordingly, it is highly desirable that a self-service station have some means for controlling the operation of each of the dispensing units from a single remote location by an attendant who can visually monitor all of the units as well as provide a visual display at the remote location of quantity and cost data for the gasoline being dispensed. Although systems have been devised for controlling the individual pumps and for displaying the quantity and cost information data at such remote location, many of the existing systems require extensive modification of the service station, due either to the installation of overhead electrical conductors, the channelling of the hard surface between the dispenser islands and the remote location, or the extensive modification of the dispenser or pump hardware itself during installation of the system. Other types of systems require the installation of electrical switches, relays or the like below the 48 inch elevation line inside of the dispenser housing which requires explosionproof electrical fittings, because of the defined explosive environment in which the switches and the like are located. It is quite apparent that extensive modifications to the dispenser, the installation of additional electrical conduits and the like through existing concrete or other hard surface between the remote location and the dispenser islands, or the addition of explosion-proof electrical fittings or the like are disadvantageous not only because of the increased installation costs, but because of possible disruption of the normal operation of the service station during installation.

Accordingly, it is a primary object of the present invention to provide an improved dispensing control system for fluid products, wherein the system can be relatively easily installed with a minimum of installation time without disrupting the operation of an existing facility, and which results in effective control of the operation of the individual dispensing units and provides accurately displayed quantity and cost data at the remote location of the fluid being dispensed.

Another object of the present invention is to provide an improved system as described above that is adapted to monitor and control either a small or large number of dispensing units from the remote location, and which is adapted to have other dispensing units added to the system with virtually no modification of the basic system.

Other objects and advantages will become apparent upon reading the following detailed description, in conjunction with the attached drawings, in which:

FIG. **1** is a front elevation of two fluid dispensing units with parts removed to show portions of the present invention in conjunction with the internal construction of a dispensing unit;

FIGS. **2***a* and **2***b* are enlarged schematic diagrams of portions of the dispensing unit shown in FIG. **1** and respectively illustrating fiber optic and mechanical linkages interconnecting the mechanical computer of the dispensing unit with the electronic dispenser control unit of the present invention;

FIG. **3** is a perspective view of the central control unit and two representative console control units embodying the present invention that are placed at the remote location;

FIG. **4** illustrates schematic block diagrams of the central control unit (shown to the left of the dotted line);

FIG. **5** illustrates a schematic block diagram of the dispenser control unit that is associated with each of the dispensers being controlled;

FIGS. **6***a*, **6***b*, **6***c*, **7***a*, **7***b*, **7***c*, **7***d*, **8**, **9**, **10**, **11***a*, **11***b*, **12**, **13**, **14**, **15** and **16** are more detailed schematic diagrams of the system of the present invention shown in the block diagrams in FIGS. **4** and **5**; and

FIGS. **17***a*, **17***b*, **17***c*, **18***a*, **18***b* and **18***c* illustrate the electrical timing diagrams of the present invention.

Broadly stated, the system of the present invention comprises a dispenser control unit for each of the dispensers that are to be controlled by the system, the dispenser control units being placed in the dispenser enclosures above the 48 inch elevation line. A mechanical or fiber optic linkage connects the dispenser control unit to a mechanical computer that is provided in each dispenser so that the cost and quantity data is supplied to the dispenser control unit for subsequent transmission to the remote location where the attendant is located. The dispenser control unit is also connected to the solenoid valve or pump motor (depending upon the kind of system that is utilized at the station) so that the attendant can control the operation of the dispensers from the remote location. The system also includes a central control unit at the remote location as well as a console control unit for each of the dispenser control units, each of the console control units having visual displays and switches for controlling the operation of the individual dispensers. Thus, in the event there are eight dispensers being controlled, for example, there would be a dispenser control unit located in each of the dispensers and a console control unit for each of the dispensers, together with a single central control unit.

The system sequentially interrogates each of the dispensers or pumps to yield pulses that are a measure of the fluid quantity and price and displays the quantity and price data at the remote location by telemetering the data over existing power conductors that extend from the remote location (which is probably a location in the station building) to the dispenser islands. By connecting the pump motor or solenoid valve to the system, provision is made for controlling the operation of the dispenser from the remote location to insure that the customers dispense the fluid in accordance with the proper safety requirements and also prevents a customer from beginning to dispense fluid until it has been authorized.

The data is transmitted over the existing alternating current power lines using serial pulse coded time division multiplexing, with the pulses being frequency modulated and utilizes a single carrier frequency, notwithstanding the number of dispensers that are controlled by the system. As previously alluded to, the system has provision for stopping the operation of a dispenser at any time by operating a switch located on each console control unit, in the event inexperienced customers are violating laws, such as dispensing gasoline while they are smoking or if they are intoxicated. The present invention enables an attendant to provide surveillance of the operation of all of the dispensers to insure that a hazardous condition will not arise, and permits the attendant to shut off individual dispensers if a potentially hazardous situation does present itself.

Data transactions between the dispenser control units and the central control unit as well as between the central control unit and the console control unit are bidirectional. The data is transmitted and received between the central control unit and the dispenser control units via the a.c. power lines that are normally used for the power and lighting circuits for the dispensers, thereby necessitating no additional conduit installation between the dispensers and the station building.

With respect to the overall operation of the system, and referring to FIGS. 1–3, dispensers **20** are shown to include a conduit **22** that extends downwardly into a storage tank (not shown) and which terminates at a pump **24** that is driven by a pump motor **26.** The outlet of the pump has a conduit **28** extending to a metering device **30** having a mechanical shaft **32** that drives a mechanical computer **34** for providing cost and quantity data that can be viewed by a customer. The outlet of the metering device **30** is connected to a flexible hose **36** having a nozzle **38** for dispensing the fluid. While the dispenser **20** illustrated in FIG. 1 has a motor **26** driving the pump **24,** it should be understood that the present system may be used with an arrangement where a submerged pump is located within the storage tank and a solenoid valve may be substituted for the motor **26** and both types of arrangements are commercially used. The dispensers **20** typiclly have lighting circuits so that the cost and quantity information can be read at night and other electrical circuits are provided for energizing a mechanical computer reset motor (not shown) and the pump motor **26.** With these existing electrical circuits, very little additional electrical work is required for the installation of the system of the present invention. Moreover, typical dispensers have an explosion-proof junction box located near the ground elevation within the dispenser housing and have conduits extending to the pump motor and also to the lighting fixtures within the dispenser. Thus, access to the electrical conductors supplying power to the motor **26** may be gained at the junction box, and in most instances, all that may be required is to install a conduit from the junction box upwardly to the top of the dispenser housing, preferably above the 48 inch elevational line, in the event one does not exist.

In accordance with the present invention, a dispenser control unit **40** is installed above the 48 inch line and is connected to the a.c. power conductors which lead back to a lighting or power panelboard that is usually located within the station house. Relays are provided for controlling the computer reset motor as well as the motor **26.** The system can control the operation of the relay and thereby control the operation of the dispenser.

The dispenser control unit **40** is interconnected with the mechanical computer **34** to provide input data to the dispenser control unit of the quantity and cost information that is registered on the mechanical computer. The interconnection can be either by a mechanical linkage shown in FIG. 2*b* or a fiber optic arrangement as shown in FIG. 2*a*, both arrangements being more fully described hereinafter. An important feature common to both arrangements is the absence of electrical devices located below the 48 inch elevation, which alleviates the need for explosionproof fittings and the like. The conductors extending back to the electrical panelboard in the station building are used for transmitting the data from the dispenser control unit **40** to a central control unit **42** which is interconnected with console control units **44** that provide a visual display of the quantity and cost data for each of the dispensers and also includes switches which control the operation of the dispenser. The central control unit **42** is merely plugged into a power outlet within the station building which, by virtue of the electrical continuity between the outlet and the panelboard, and the panelboard and the dispensers, enables data to be transmitted and received. Accordingly, virtually no electrical installation work is needed in the station building since all that is necessary is to plug in the central control unit at an electrical outlet (having electrical continuity with the power lines extending to the dispensers) near a location where the attendant can visually observe all of the dispensers.

Each of the dispensers has a console control unit **44** associated with it that includes a four digit visual display **48** and three control switches as shown in FIG. 3. The display **48** automatically indicates the cost of the amount of sale and will display the quantity (such as gallons) dispensed when a QUANTITY switch **50** is actuated. A PAID switch **52** and a RUN/STOP switch **54** are also provided to control the start of the dispenser as well as stop its operation at any time. When a customer requests service by rotating the reset lever on the dispenser, the reset motor is started which resets the mechanical computer at the dispenser and allows the amount of sale and number of gallons that were previously dispensed to be zeroed. As soon as it is reset to zero, a signal is sent to the central control unit **42** indicating this condition, and the console control unit display for that particular dispenser is also reset to zero. Once the console control unit display is reset, another signal is automatically issued to the dispenser allowing it to dispense fuel.

As the quantity and cost data is generated in the dispenser control unit and transmitted via a power line to the central control unit, it is received and strobed into the proper console control unit. The display indicates the total cost of the sale, and at the operator's command, (by depressing the QUANTITY switch **50**), the total quantity of fuel purchased. When the customer finishes dispensing fuel, he returns the reset lever to its normal position and replaces the dispenser hose which sends a signal that the central control unit which signal causes the associated console control unit display to flash or blink the cost of sale to the attendant. To complete the transaction, the attendant depresses the PAID switch **52** at the control module console for that dispenser which terminates the sale and releases the dispenser for use for another sale. The RUN/STOP switch **54** can be used at any time during the dispensing transaction to suspend service in the event such action is desired. Operation of the RUN/STOP switch does not change the display and does not cancel any quantity and cost data thatt had been registered. Thus, from the foregoing, it should be understood that the physical operation of the system by the attendant is extremely simple and requires very little instruction or special knowledge beyond common business procedures for service station attendants.

Turning now to a more specific description of the operation of the systems of the present invention and referring to the electrical block diagrams shown in FIGS. **4** and **5** in combination with FIGS. **1** and **3**, the equipment used to carry out the operations previously described include the dispenser control unit **40**, the block diagram of which is shown in FIG. **5**, the central control unit **42** shown to the left of the dotted line in FIG. **4**, and the console control units **44**, one of which is shown to the right of the dotted line in FIG. **4**.

As previously mentioned, the system of the present invention employs serial pulse coded time division multiplexing for communicating the data over the alternating current power lines, with the pulses being frequency modulated. The central control unit **42** and dispenser control units **40** each have several elements which perform substantially similar functions and which carry the same designating numbers.

With respect to the transmitting function, an amplifier **60** is connected to the a.c. power lines **62** through a coupling transformer **64** and a line voltage blocking capacitor **66.** A choke (not shown) may be included to reduce the effect of the transmitted signal on the power supply voltage if desired. The receiver consists of a coupling transformer **70** connected to the power lines **62** through a line voltage blocking capacitor **72** and also includes a capacitor **74** and resistor **76** which drives a demodulator **80** which applies the demodulated data to the input of the serial receiver circuitry. The signals that are transmitted from the central control unit to the dispenser control unit are shown in the timing diagram of FIG. **18***a* and include the signals **T0**, **Tl**, **ID1**, **ID2**, **ID4** as well as the RESET MOTOR ENABLE and RUN MOTOR ENABLE signals. The signals **T0** and **T1** are synchronizing bits that allow the serial receive circuitry of the dispenser control unit to recognize that the data for the transmission has been completely shifted into a shift register circuit **82**, the signals having passed through the demodulator **80**, a receive buffer **84**, an interlock circuit **86** and a receive gating circuit **88**. The shift register **82** provides a RESET MOTOR ENABLE signal for energizing a solid state relay **90** which allows a reset motor **92** in the dispenser associated with the mechanical computer **34** to run in order to zero the computer. The shift register **82** also provides a DISPENSER RUN ENABLE signal which passes through a gating latch **94** and energizes a relay **96** which controls the fuel control or pump motor **26** in the dispenser and allows fuel to flow through the hose **36** and nozzle **38.**

The signals **ID1**, **ID2** and **ID4** are identification bits with binary weights of 1, 2 and 4, respectively, which are coded by the central control unit **42** and sent to all dispensers simultaneously. Accordingly, the identification code signals are transmitted by the shift register **82** to a dispenser control unit identification decoding logic circuit **98** which provides an identification MATCH signal in the event the code transmitted from the central control unit matches the code that has been preprogramed into one of the dispenser control units. Under normal operating conditions there is a one to one correspondence between a particular central control unit transmission of data and an individual dispenser and it should be realized that with the binary weighted bits of 1, 2 and 4, eight different dispensers can be multiplexed in the system. It should also be realized that an additional number of identification bits could be transmitted which would allow the system to be expanded to a larger number of dispensers if desired. For example, the addition of ID8 (FIG. **18***a*) would allow the system to operate with 16 dispensers.

The signals transmitted by the dispenser control unit to the central control unit include RESET COMPLETE, ONE CENT pulse and 0.1 GALLON pulse, in addition to the **T0** and **T1** pulses, all of which are shown in the timing diagram of FIG. **18***b*. The RESET COMPLETE signal is transmitted to the console control unit **44** for that particular dispenser to indicate that the mechanical computer has completed its reset cycle and this results in the console control unit also zeroing its display **48.** The ONE CENT pulse is used to increment the cost register in the console control unit and the 0.1 GALLON pulse similarly increments the quantity register. It should be realized that although the cost and quantity pulses are for one cent and one-tenth gallons, other amounts can be used as the pulse increments, if desired.

Referring to the logic diagram for the console control unit **44** shown in FIG. **4**, the RESET COMPLETE, ONE CENT and 0.1 GALLON pulses are sent from the shift register of the central control unit to cost and quantity registers **99** and **100**, respectively, which are connected to the visual display **48** through a display select circuit **102** which automatically displays the cost information, but which can be changed to the quantity display responsive to actuating the QUANTITY switch **50.** The console control unit **44** has an identification decoding logic circuit **104** substantially similar to the decoding circuit **98** in the dispenser control unit. If the identification code transmitted by the central control unit is a true signal, it sends a signal to the reset complete logic of circuit **106** as well as to the circuits **108**, 110 and **112** which respectively produce the DISPENSER RUN ENABLE, RESET MOTOR ENABLE and PAID RESET signals. When the memory register circuit **106** receives signals from the identification decoding circuit **104**, the RESET COMPLETE signal from the shift register **82** of the central control unit, as well as the STROBE signal from the multiplex circuit of the central control unit, causing a zero display signal to be forwarded to the display **48** to zero it. The console control unit **44** is then ready to accept pulses from the central control unit **42** representing the cost and quantity of the liquid being dispensed.

More specifically, all of the signals transmitted from a dispenser control unit 40 are eventually received by that particular dispenser's matching console control unit 44. The memory register 106 contains a memory device that stores the signal information reset complete, while registers 99 and 100 are upcounter multiplexers with binary coded decimal outputs that are used to drive the electronic display 48. The QUANTITY display switch 50 is used to selectively display the cost or quantity information. Each of the console control units 44 generate signals responsive to actuation of the PAID switch 52 and the RUN/STOP switch 54. The RUN/STOP switch 54 controls the pump motor 26 (or solenoid valve depending upon the type of pump system that is used), and allows the operator to stop the flow of fluid at any particular dispenser without altering the state of the electronic readout 48. PAID switch 52 prevents a successive sale from being started without the prior customer making payment for his sale; a customer can also be prevented from dispensing liquid from the dispenser until such time as the attendant depresses the PAID switch which enables the pump reset motor to be energized to reset the mechanical computer 34.

As previously mentioned, the dispenser control unit 40 receives pulse modulated signals from the central control unit 42 which are demodulated by the demodulator 80 and sent to the receive buffer circuit 84. As soon as it detects a logical one signal, it allows the dispenser control unit 40 to go into the receive mode, provided that a transmit cycle was not already in progress, this function being controlled by an interlock circuit 86. Thus, when the receive mode is entered, a timing chain gating circuit 116 enables a square wave generator 118 having an output preferably of 380 kHz which drives a timing pulse generator circuit 120 which produces the timing diagram shown in FIG. 17*a*. In addition to the T0 and T1 pulses, READ SHIFT pulses bring the received data into the shift register 82 which then generates the signal FRAME SYNC, which together with signals ID MATCH from circuit 98 and a PARITY signal from circuit 97 produces a TRANSMIT ENABLE signal from the data verification circuit 122. The TRANSMIT ENABLE signal sends the dispenser control unit 40 into its transmit mode via the interlock circuit 86 and a shift register 124 is then loaded with the dispenser transmit data by a LOAD SR pulse. The data is then shifted out of the shift register 124 to the central control unit by the signal TRANSMIT SHIFT (from the timing pulse generator 120) and the data goes to a transmit gating circuit 126 where parity and synchronizing bits are added and then to a modulator 128, the modulated signal being amplified by the amplifier 60 and transmitted to the power lines 62 where it is transmitted to the central control unit 42.

At the end of each transmit or receive cycle, the timing generator 120 becomes inactive until it is stimulated by new incoming data or the internal generation of a transmit cycle. The central control unit 42 receives and transmits data in a substantially similar manner.

More specifically, and referring to the central control unit 42 shown in FIG. 4, the central control unit additionally includes a multiplexing circut 132, a time delay generator 134, a time out circuit 136, as well as an upcounter 138 which generates the identification codes which are forwarded to the shift register 124 for transmission to the dispenser control units and also to the console control unit.

The central control unit 42, by means of the multiplexing circuit 132 and upcounter 138, transmits identification codes to all of the dispensers by sequentially changing or upcounting the code for selecting other dispensers. This occurs during one data bit time, which is approximately 169 microseconds, after the central control unit 42 receives transmission from a particular dispenser control unit, along with other multiplexed control signals.

During this bit time, several multiplexing operations occur, as shown in FIG. 18*c*. First, the data that has been received from a particular dispenser control 40 is strobed from the central control unit shift register 82 into the data registers 99, 100 and 106 of the console control unit associated with that particular dispenser. A NEXT signal is then generated by the multiplex logic circuit 132 to increment the upcounter circuit 138 to effect the generation of a new identification code selecting a different dispenser control unit 40. Since the timing pulse generator 120 and the central control unit become inactive at the end of each transmit or receive mode cycle, it is also necessary for the multiplex logic circuit 132 to generate an END signal which forces the data verification logic circuit 122 to generate a TRANSMIT ENABLE signal which will then start the central control unit 42 transmit cycle. It is this sequential operation that advances the multiplexer from one dispenser control unit to another for the purpose of transmitting the data information relating to the quantity and cost of each of the dispensers to its associated console control unit.

During normal operation the central control unit logic 42 alternates between two modes, i.e., transmitting and receiving. In the receiving mode one of three conditions will exist, the central control unit will be receiving "good" data, "bad" data, or "no" data. Good data is received if the dispenser control unit which was addressed in the central control unit's transmission responds with an error free answer. The multiplexing upcounter circuit 138 generates the unique ID code (address) to be inserted in the central control unit's transmitted message. If bad data is received, the central control unit ignores the data and the multiplexing logic circuit 132 operates in the same manner as is done when no data is received. The no data conditions occurs either when the addressed dispenser control unit received the central control unit's transmission in error (and therefore did not respond) or when there is no dispenser control unit with the particular identification code. This latter case is experienced when less than nine dispensers are used in the presently described installation. Thus, if data received from a dispenser is in error, or there is no dispenser associated with a particular identification code or no response to a particular identification code is generated, a number of events take place.

As previously stated, since the timing pulse generator 120 is deactivated after the central control unit 42 finishes its transmit cycle or bad data was received from the previous transmit cycle, the time delay generator 134 will "time out" in approximately 1.5 milliseconds. When this occurs, the time out detect circuit 136 creates a simulated NEXT signal to increment the upcounter circuit 138 and also causes the multiplex circuit 132 to generate a simulated END signal to the data verification circuit **122**, forcing the central control unit **42** to transmit to the next dispenser (see FIG. 17*c*). Under normal operating conditions, a dispenser control unit **40** will enter a receive mode every time the central control unit **42** transmits data to all dispensers. When a dispenser receives its ID code, and answers the central control unit **42**, it can expect to again enter a receive mode within 0.2 milliseconds after finishing its current transmit cycle. If the central control unit **42** receives data containing an error, its time delay generator circuit **134** will time out before allowing the central control unit **42** to enter a new transmit cycle, causing a delay before transmission of about 1.5 milliseconds. Accordingly, if the dispenser control unit **40** receive mode is not entered before about 1.0 milliseconds has elapsed (indicating error), a pulse generated to clear the element that stored the quantity and cost pulses for transmission is inhibited and the same cost and quantity data is retransmitted during that dispenser's next interrogation by the central control unit **42.** Because of this data saving circuitry, the console control units **44** maintain excellent display accuracy.

To produce the pulses indicating the quantity and cost data of the liquid being dispensed from the dispensers, and referring to FIGS. **1, 2, 4** and **13**, the rotating cost and quantity shafts within the mechanical computer **34** are used to produce pulses in the dispensing control unit **40** which are indicative of the incremental units of cost and quantity of the fluid being dispensed. The cost and quantity shafts of the mechanical computer **34** are each attached to a disk **146** having forty teeth **148** and the outer periphery thereof with the alternating teeth and spaces therebetween being adapted to break and make a light circuit using the arrangement shown in either FIGS. **2***a* or **2***b*.

With the arrangement shown in FIG. **2***a*, a light conducting flexible fiber optic tubing **150** is used to extend from the dispenser control unit **40** to the disk **146.** The tubing comprises a number of small fiber optic bundles, one set of which extends from a photosensitive semiconductor such as phototransistor **152,** the other extending to a light source such as a light emitting diode **154,** with the ends of each bundle being directed toward one another adjacent the teeth **148** of each of the disks **146** so that the light circuit will be interrupted when a tooth comes within the light beam. In this manner, the phototransistor will be turned on and off responsive to the rotation of the disk **146** and will provide an accurate indication of the amount of rotation of the cost and quantity disks of the mechanical computer **34.** An advantage of the fiber optic tubing **150** is that a non-electrical pickoff is used which requires no explosion-proof conduits and fittings and the like, the fiber optic bundles extending from above the 48 inch elevation line within the dispenser enclosure, where the dispenser control unit **40** is located, to the disk which is below the **48** inch elevation line. Although only one fiber optic bundle and gear arrangement is shown in FIG. 2*a*, it should be realized that there would be one of these combinations for the cost shaft as well as the quantity shaft of the mechanical computer so as to provide electrical pulses to the dispenser control unit **40** for each of these types of information.

An alternative arrangement shown in FIG. **2***b* utilizes a mechanical linkage comprising a connector **149** coupled to the cost or quantity shaft of the computer **34** and to a flexible rotatable wire **151** or the like that extends upwardly to the disk **146** which is preferably located above the 48 inch elevation line, and an integral phototransistor and light emitting diode are positioned to provide a light circuit that is alternatingly made and broken by the teeth of the disk **146.**

As previously mentioned, the disks **146** are driven by the shafts of the computer **34** which typically make 1 revolution for every 10 cents cost or 1 gallon quantity. Accordingly, four pulses are produced for every one cent and four pulses are also produced for every one-tenth gallon dispensed. As the teeth break the line beam between the light emitting diode **154** and the phototransistor **152,** the latter is cut off and that signal provides the input to circuit **153** shown in FIG. **13** which ultimately provides the ONE CENT and 0.1 GALLON pulses which are loaded into a shift register **124** of the dispenser control unit for transmission to the central control unit. With respect to the specific circuit **153** used to provide the ONE CENT and 0.1 GALLON pulses, the integrally packaged light emitting diode **154** and phototransistor **152** operate to alternatingly cut off and turn on phototransistor **152** the output of which is amplified by an amplifier **170** and sent to a Schmitt trigger **172** and another amplifier **174** which is connected to a NOR gate **176** and flip-flop **178,** the NOR gate **176** being connected to a flip-flop **180** as well as a NOR gate **182.** The elements **176, 178, 180** and **182** are used to remember the last state of the toothed disk **146,** i.e., whether it stopped on or off a tooth when it was last used. Inverting gate **184** is connected to a flip-flop **186** which is in turn connected to another flip-flop **188,** the two comprising a divide-by-four circuit, having an output which indicates a one cent amount. The output of flip-flop **188** is connected to flip-flop **190** and its output is connected to flip-flop **192,** its output providing the ONE CENT pulse that is sent to the shift register **124** of the dispenser control unit.

The output of flip-flop **190** goes high when a ONE CENT pulse is present and the transmit signal is not true and thereby insures that flip-flop **192** is not set during a transmit cycle and is cleared after a time delay to insure that the data was received by the central control unit. A CLEAR signal provides this delay function and comes from the output of a NOR gate **194.** The normal sequence of events involves the dispenser control unit transmitting the ONE CENT pulse, and the central control unit receiving the pulse.

If the central control unit rejects the data because of either a parity error or framing synchronization error, the central control unit time delay generator **134** will time out and cause the central control unit to delay before retransmitting to the next dispenser. As previously mentioned, all dispensers receive the central control unit transmission but only one will receive it as good data since the identification code requirements provided by the multiplexer upcounter **138** can be satisfied by only one dispenser control unit at a time. A delayed transmission from the central control unit causes NOR gate **194** not to qualify the CLEAR signal and, accordingly, flip-flop **192** is not cleared which allows the ONE CENT pulse to be retransmitted at the next interrogation of that dispenser. If the central control unit receives the ONE CENT pulse information as good data, the CLEAR pulse will be generated to clear flip-flop **192.**

It should be realized that a similar optical pickoff and pulse generating circuit **153** is provided for the quantity data. Additionally, there may be two dispensing units within each dispenser housing, and with such an arrangement, two additional optical pick-off and pulse generating circuits may be provided for the other half of the dispenser. However, only one CLEAR signal generating circuit as shown in FIG. 13 is required for a dispenser control unit **40.**

With respect to the more detailed circuitry of the central control unit and one of the dispenser control units, both of which have specific circuits that are substantially similar in their structure and operation and which accordingly carry the same designating numbers, the operation of the specific circuitry will now be broadly described in conjunction with the central control unit shown in FIG. 4 together with the specific circuitry hereinafter described and shown in FIGS. 6–16. Additional circuits in the dispenser control units that are not found in the central control unit will then be described, as well as the console control unit circuitry.

The square wave generator **118** shown in FIG. 11*a* provides the timing for the complete circuit and provides a signal at the same frequency as the generator of the dispenser control module and thereby allows synchronization of the data being transmitted from each unit. The remaining portion of FIG. 11*a* and most of the circuitry in FIG. 11*b* comprise the timing pulse generator **120** which generates all of the timing signals used in the central control unit with the signal TC being used to gate the 380kHz into the circuit. Shift register **200** divides the input frequency by eight, so that the input signal to the shift register **202** is a 47.5kHz signal. Its outputs are divided by eight yielding signals **D5** through **D8** which have a frequency of 5.95kHz that is used as the basic bit timing of the system. Similarly, shift registers **204** and **206** generate time slice signals for every positive transition of signal **D5**, producing the time slice signals **C1** through **C8**. After **12** transmissions of signal **D5** which corresponds to eleven bits of information and one bit of multiplexer timing, $\overline{C5}$ goes true, which disables the timing chain. The gating circuit shown in FIG. 11*b* produces the signals shown to the right which are shown in the timing diagrams of FIGS. 17*a*, 17*b* and 18*a*.

The timing chain gating circuit **116** shown in FIG. 6*c* controls the generation of the timing pulses for the central control unit, with either RECEIVING or TRANSMIT setting a flip-flop **208** which allows signal TC to go true. The TC signal is automatically turned off by the $\overline{C5}$ signal which is generated by the timing pulse generator **120** shown in FIG. 11*a*. Therefore, once it is started, the timing chain automatically shuts off after an exact length of time, which is when the signal $\overline{C5}$ goes true as previously described.

During transmission, the shift register **124** shown in FIG. 6a which includes a pair of eight bit parallel to serial shift registers **210** and **212**, shifts data out of these units with the application of the clock signal XMIT SHIFT applied to each unit. The output signal SHIFT REGISTER OUT (SR OUT) is sent to the transmit gating circuit **126** and the signals **ID1, ID2** and **ID4** determine which dispenser control unit and associated console control unit is being addressed. The RESET MOTOR ENABLE and RUN MOTOR ENABLE signals from the console control unit are also sent to the dispenser to allow the reset motor and pump motor to run.

The transmit gating circuit **126**, also shown in FIG. 6*a* gates the output of the parallel to serial shift register **124** with the PARITY bit and the TO bit. The timing is constructed so that the sequence is to first send the TO bit followed by the data from the shift registers, i.e., **ID1, ID2** and **ID4, RESET MOTOR ENABLE, RUN MOTOR ENABLE,** etc., and then the PARITY bit is added to the end of the transmission.

The data is then modulated with a 1.90kHz signal by the modular **128** (shown in FIG. 6*b*) for transmitting the data to the dispensers once it has been amplified by amplifier **60** which is coupled to the alternating current power lines **62.**

With respect to the parity generation circuit **97**, shown in FIG. **9**, its output is used to validate the data when the central control unit is operating in the receive mode, i.e., it is forwarded to the data verification circuit **122** which will be hereinafter described. When the central control unit is operating in the transmit mode, the PARITY signal is gated into the last transmitted bit position by the timing signal TRANSMIT PARITY (TR PAR) from the transmit gating circuit **126**. The parity generation circuit includes a flip-flop which is initially set by the signal PAR SET at the beginning of a receive or transmit cycle. If a receive cycle is occurring, the output of gate **214** causes flip-flop **212** to toggle according to the received data RSI input, provided that the input RECEIVE is true and each data bit is read at the proper time which is a function of the RDS signal. If the correct number of true bits has been received, the PARITY signal (PAR) will be true which is one of the inputs for the data verification circuit **122.**

When the central control unit is in the transmit mode, the PARITY signal is generated in a similar manner using a gate **216**. The SR OUT signal is the data being transmitted and the input signal TRANS insures that a transmit cycle is occurring and the TRANSMIT SHIFT input clocks the SR OUT data at the proper time. The flip-flop **212** toggles to the proper state, and is then sent to the transmit gating circuit **126.**

The verification circuit **122** shown in FIG. **8** controls the transmit function as well as the reception of data that is forwarded to the multiplexing circuit **132.** Whenever the RECEIVE signal is true and the central control unit is in the RECEIVE mode, a gate **218** determines if the received data has the proper framing and parity before allowing the output of a flip-flop to go false. if the data received is good, the $\overline{\text{XFER}}$ signal enables the multiplexing circuit **132** to strobe the data into the proper console within one bit time from the shift register **82.** After the multiplexing circuit **132** runs for one bit time, i.e., 1/5950 seconds, a portion of the interlock circuit **86** shown in FIG. **8** sets a flip-flop **222** causing it to go true and set the transmit mode. The input XMIT signal for the interlock circuit **86** is derived from the time out circuit **136** and the $\overline{\text{TC}}$ signal is derived from the timing chain gating circuit **116.**

The time delay generator **134** shown in FIG. **10** causes signal T OUT to go false with the first positive $\overline{\text{D5}}$ pulse being used to charge a capacitor **224.** When the timing chain stops due to the signal TC (FIG. 6*c*) going false, the signal $\overline{\text{D5}}$ ceases and causes $\overline{\text{T OUT}}$ to go high after a considerable delay produced by the capacitor **224** discharging slowly into a gate **226** and resistor **228.** $\overline{\text{T OUT}}$ goes low a short time later after a small delay caused by capacitors **230** and **232.**

With respect to the time out detect circuit 136 shown in FIGS. 11*b* and 12, the signal $\overline{\text{T OUT}}$ generates the signal END when a time out is encountered as would occur in the event the data transmitted is bad or nonexistent. The END signal is also generated at the end of each multiplex cycle causing the central control unit to transmit to the next dispenser unit. The signal NEXT is also generated at the end of the multiplex cycle for the purpose of incrementing the upcounter to produce a new identification code for addressing the next dispenser. The signal TOTNX is generated during a time out cycle to generate the NEXT signal.

The upcounter circuit 138 shown in FIG. 12 includes a seven bit binary counter 236 which is incremented by the NEXT signal from the time out detector circuit 136 to generate the dispenser identification codes. A gate 238 resets the counter after all the dispenser control units have been communicated with.

As previously mentioned, the system of the present invention may be used with dispensers that have two dispensing nozzles in the same dispenser housing (labeled A and B) and which utilize the same dispenser control unit 40. If this feature is incorporated into the system, the logic circuits 242 and 244, shown respectively in FIGS. 7*a* and 7*b*, generate the multiplex signals ISA and ISB for selecting side A or B console control modules for a given dispenser unit.

Turning now to other circuits that are operable when the central control unit is operating in the receive mode, i.e., it is receiving data from one of the dispenser control units responsive to the transmission of the identification code for one of the dispensers and that dispenser control unit is transmitting the cost and quantity data to the central control unit, the data is transmitted over the a.c. power lines 62 to the transformer 70 and the signal is then fed into the inverter 78 and demodulator 80 as shown in FIG. 6*b*.The demodulator 80 includes an integrated phase-lock-loop circuit which detects the data pulses from the dispenser control unit 40 and the output is then amplified by the receive buffer amplifier 84. Its output is fed to the interlock circuit 86 shown in FIG. 6*c* which inhibits the receive cycle unless the timing chain is not running and the transmission of data by the central control unit is not taking place.

Another portion of the interlock circuit 86 is also shown in FIG. 8 and is used to enable the transmit mode of the central control unit to turn it on as previously described. Referring again to FIG. 6*c*, an output of the interlock circuit 86 controls a flip-flop 250 in the receive gating circuit 88 and is set by the clock input and a receive data bit from the interlock circuit 86. Once the receive flip-flop 250 is set, the 380kHz signal cannot clock it, since the signal $\overline{\text{RECEIVING}}$ goes low and inhibits the output of a gate 252. When the central control unit is in its RECEIVE mode, the signal RS1, i.e., the data being received from the phase-lock-loop of demodulator 80 is fed to the shift register 82, which comprises shift registers 253, 254, 256 and 258. Eleven data bits are shifted into the shift register 82 via the input lead 260. The timing pulse generator 120 generates a read shift signal RDS that clocks the received data into the shift registers 253–258 and the output of these individual shift registers include the PARITY, 0.1 GALLON pulses and the ONE CENT pulses as well as the RESET COMPLETE pulses. The outputs of the individual shift registers are then forwarded to the console control units together with the proper identification code for selecting the proper console control unit.

The identification decoding circuit 98 located in each of the dispenser control units 40 shown in FIGS. 5 and 14 (which is substantially similar to the decoding circuit 104 in FIGS. 4 and 16 located within each of the console control units 44) will now be described. More particularly, the decoding circuits 98 and 104 each have a switch 264 which is preset to a particular binary code so that each of the individual dispensers and console control units can be identified. The outputs of the switch 264 are connected to four EXCLUSIVE-OR gates 266, 268, 270 and 272, each of which has a second input from the incoming signals ID1, ID2, ID4 and ID8. When any pair of inputs for the EXCLUSIVE-OR gates compare, the output of that gate goes low and all of the outputs are connected to the input of a gate 274. If all of the EXCLUSIVE-OR gates are satisfied simultaneously, gate 274 is satisfied and provides the identification MATCH signal that is forwarded to the data verification circuit 122. With respect to the decoding circuit 104 shown in FIG. 16, the output of gate 274 is one of the inputs to a gate 276, the other of which is ID0 signal which is provided by the central control unit for the purpose of sending the incoming data to the "A" side or "B" side console control module in the event that two nozzles are present in the dispenser.

Turning to the gating latch 94 shown in FIG. 15 which controls the operation of the solid state relays 90 and 96, the latch includes a flip-flop 280 which receives the RESET MOTOR ENABLE signal from the shift register 82 as well as a TRANSFER signal which latches flip-flop 280 and causes the reset motor to run. The signal RESET COMPLETE, (RESCOM) is sent back to the central control unit so that when the RESCOM signal is received at the particular console control unit, the console control unit automatically zeros its display and issues a signal to enable the solenoid (or pump motor) to operate when the transfer signal strobes flip-flop 282 controlling the solid state relay 96.

Referring now to FIG. 16 which illustrates the circuitry for one of the console control units 44, including the identification decoding circuit 104 previously described, other inputs to the console control unit that are received from the central control unit are shown (to the left) and include the quantity and cost inputs, the STROBE signal, and the RESET COMPLETE signal. When the identification signals compare to satisfy gate 274 and the correct side of the dispenser is satisfied from the signal ID0, gate 276 is enabled and its output is inverted and fed to gate 280. Thus, when the STROBE signal is transmitted from the central control unit, gate 280 is enabled to produce a READ signal which allows the ONE CENT and 0.1 GALLON pulses to be strobed through gates 282 and 284 to their respective counters 99 and 100. The READ pulse also strobes memory register 106 which is a flip-flop that produces a dispenser reset pulse which clears the counters 99 and 100.

The RUN/STOP switch 54 may be used at any time to temporarily stop the operation of a dispenser without affecting the display. The switch must be in the closed position to enable the solenoid to run, since it is one of the inputs to a NOR gate 286 and its output generates the RUN SOLENOID ENABLE signal that controls the operation of the dispenser.

The counters 99 and 100 are divided by 10,000 counters and are used to count the ONE CENT and 0.1 GALLON pulses as they are transmitted from the corresponding dispenser control unit. The counters also multiplex the four decimal digits using a scan oscillator 288 to turn on one of four digits in the display at a time. The scan frequency is preferably about 500 Hz. As shown, the outputs of the counters provide the four digits that are eventually displayed and these outputs are connected to the display select circuit 102 which comprises gating circuits which allow the cost data to be displayed under normal conditions, but which can be switched to the gallon display when the QUANTITY display switch 50 is depressed.

The display circuit 48 comprises a display driver 290 which includes a transistor pair for each of the digits wherein a low voltage signal switches a 180 VDC potential and causes the display digit to illuminate for those segments that have a conducting path from a display decoder 292. Each digit has seven segments which are selectively illuminated to provide the proper digit and the segments are selectively driven by the decoder 292 which receives signals from the display select circuit 102 which are provided by the binary coded decimal output of the counters 99 and 100. The display also includes two decimal points positioned to indicate dollars and cents when the cost data is displayed and gallons and tenths of gallons when the quantity is being displayed.

As previously mentioned, the display is adapted to blink when a customer has completed the dispensing of the fluid and the blinking alerts the controlling attendant of that fact and that the customer should then pay for the fluid. To provide the blinking of the display, an oscillator 294 is provided and is connected to the decoder 292 for the purpose of blinking the illuminated display, preferably at a frequency of about one Hz. The attendant may depress the PAID switch 52 to cause the display blink command to turn off, the closing of the switch 52 applying a 12VOC signal to set a flip-flop 296 and disqualify a gate 298 causing its output to go low. The low output causes the display oscillator 294 to stop which in turn disables the blink command of the dispenser decoder 292. Memory register 106 latches up the signal RESET COMPLETE signal which originates at the dispenser control unit from the reset motor mechanism that is used to reset the mechanical computer.

From the foregoing description, it should be understood that an improved dispenser control system has been shown and described which is relatively easily installed in an existing gasoline station or the like with a minimum disruption to the station operation since additional conduit installation in the concrete or other surface is not required. Moreover, the system provides sufficient control of the individual dispensers that one attendant may monitor and control the operation of several dispensers with little risk of a customer leaving undetected without paying for a transaction. The system utilizes a single carrier frequency with the dispenser control units and console control units being identified by an identification code and thereby enables the addition of more pumps with little modification to the basic system. The system has excellent accuracy in the remote display, since data that is not accurately transmitted is saved for a future transmission and this capability virtually insures that information is not lost, which could provide an incorrect cost and/or quantity display.

Although various embodiments of the invention have been illustrated and described, they will suggest a number of variations and modifications to persons skilled in the art. Accordingly, the scope of the protection to be afforded this invention should not be limited by the particular embodiments shown and described, but should be determined in terms of the definitions of the invention set forth in the appended claims, and equivalents thereof.

Various features of the invention are set forth in the following claims.

What is claimed is:

1. A fluid dispensing system for controlling and dispensing cost and quantity data relating to the dispensing of liquid from one or more dispensers, such as gasoline dispensers or the like, which are of the type that have a mechanical computer therein for displaying the cost and quantity data during dispensing of the liquid, said dispenser having a reset motor for zeroing the mechanical computer and an electrically actuated flow control means for enabling liquid to flow therethrough, said system comprising:

a dispenser control means for each of said dispensers and adapted to transmit and receive data by modulated serial pulse coded time division multiplexing for communicating information concerning the operation of the dispenser and including means for controlling the mechanical computer reset motor and the dispenser flow control means, optomechanical means for producing pulses indicative of the cost and quantity of the liquid being dispensed, identification decoding means for comparing identification code signals with internally generated precoded signals and producing an output in response to an identical comparison of said identification code and precoded signals, and means for transmitting said cost and quantity data responsive to said decoding means producing said predetermined output;

central control means adapted to selectively transmit and receive said data and including means for generating said identification code signals and for sequentially changing said signals so that said central control means can sequentially communicate with each of said dispenser control means;

a console control means for each of said dispenser control means, and including data registers adapted to receive said cost and quantity data from said central control means as it is received thereby and including visual display means for providing a visual readout of said data as it is registered, said console control means having identification decoding means with internally generated precoded signals identical to those of the dispenser control means with which it is associated, so that said cost and quantity data sent by the dispenser control means is displayed by the proper console control means.

2. A system as defined in claim 1 wherein said dispenser control means and said central control means are adapted to operate in transmit and receive modes, said central control means operating in transmit mode for interrogating said dispenser control means and for transmitting said identification codes thereto, one of said dispenser control means responding to said prede-

termined identification code signals when it is in its receive mode and switching to its transmit mode for transmitting information to the central control unit, including pulse coded signals indicative of the cost and quantity data of the fluid being dispensed.

3. A system as defined in claim 1 wherein said identification decoding means includes a precoded switching means having at least an equal number of outputs as identification code bits transmitted in the identification code signal and means for comparing the outputs of said precoded switching means with said transmitted identification code signal from said central control means, the comparing means producing an output in response to said switching means outputs comparing with the transmitted identification code signal, each of said switching means in the dispenser control means being differently precoded from other of the switching means, so that only one of said dispenser control means responds to a particular identification code signal.

4. A system as defined in claim 3 wherein said comparing means comprises a number of EXCLUSIVE-OR gates, each of which has an input from the identification code signal being transmitted from the central control means as well as from the precoded switching means located within the dispenser control means.

5. A system as defined in claim 1 wherein said console control means includes means for generating signals for transmission to the dispenser control unit associated therewith enabling said dispenser electrically actuated flow control means to be actuated so that said dispenser may be run, and for enabling a motor for resetting the mechanical computer in said dispenser.

6. A system as defined in claim 5 wherein said dispenser control means includes a plurality of one bit memory devices that are responsive to said reset enable and flow control enable signals generated by said associated console control means, said memory devices driving solid state relays which control the operation of said mechanical computer reset motor and said electrically actuated flow control means.

7. A system as defined in claim 6 wherein said console control means includes means for generating a signal for transmission to the associated dispenser control means for temporarily interrupting the operation of said dispenser by controlling the electrically actuated flow control means, said dispenser being interrupted without affecting the visual display related to the cost and quantity of the fluid being dispensed.

8. A system as defined in claim 1 wherein said console control means includes data registers adapted to receive and register said cost and quantity data of the fluid being dispensed, including a switch for alternatively changing the visual display between the cost and quantity of the fluid being dispensed.

9. A system as defined in claim 1 wherein said console control means includes means for blinking said visual display when the dispenser is manually shut off at the termination of dispensing of fluid at the dispenser.

10. A system as defined in claim 1 wherein said optomechanical means for providing pulses indicative of the cost and quantity of the fluid being dispensed comprises a light sensitive semiconductor and light producing means positioned to provide a light circuit therebetween, and a rotating disk having a predetermined number of teeth therein adapted to open and close said light circuit to thereby switch said light sensitive semiconductor off and one, said disk being mechanically coupled to said mechanical computer and rotatable responsive to the operation of the mechanical computer.

11. A system as defined in claim 10 wherein said dispenser control unit is located within said dispenser near the top thereof and said mechanical linkage of said optomechanical means comprises a flexible rotatable link, one end of which is connected to the shaft of said mechanical computer, the other end of which is connected to said rotatable disk, said disk being positioned immediately adjacent said dispenser control means, said light sensitive semiconductor and light emitting means being positioned adjacent said disk.

12. A system as defined in claim 10 wherein said dispenser control means is located within said dispenser near the top thereof, said light sensitive semiconductor and light emitting means being located within said dispenser control means, said rotatable disk being attached to the shaft of said mechanical computer and including a fiber optic bundle extending from said light sensitive semiconductor and light emitting means to a location adjacent said rotatable disk so that rotation of said disk causes the teeth thereof to make and break said light circuit.

13. A system as defined in claim 10 wherein said opto-mechanical means further includes a dividing counter connected to said light sensitive semiconductor and adapted to divide the number of pulses produced by the switching of said light sensitive semiconductor, a memory device for buffering said data pulses, and a second memory device for saving said data for retransmission in the event the previous data transmission containing said data pulse was received with error by said central control means.

14. A system as defined in claim 13 wherein said memory device stores a data pulse that is indicative of either one cent or 0.1 gallon of dispensed fluid.

15. A system as defined in claim 2 wherein said dispenser control means includes means for inhibiting a clearing pulse for clearing a memory device in which said cost and quantity data is stored, in the event the data is not properly received by the central control means, said pulse being inhibited in the event the dispenser control means fails to switch into the receive mode within said predetermined time, thereby enabling retransmission of said data at the next interrogation of that dispenser control means by said central control means.

16. A system as defined in claim 1 wherein said central control means includes means for generating said external identification code signals, including a binary upcounter having a plurality of binary outputs which are sequentially changed to generate new identification code signals for interrogating other of the dispenser control means.

17. A system as defined in claim 16 wherein said central control means includes time delay means for advancing said upcounter to produce a new identification code signal in response to said central control means receiving either an incorrect or no response from one of said interrogated dispenser control means within said predetermined time.

18. A system as defined in claim 17 wherein said central control means includes multiplexing means for producing a signal incrementing the upcounter upon receiving said cost and quantity data from an interrogated dispenser control means within said predetermined time, and thereby enabling a new interrogation

cycle to be inititated, said time delay means producing a signal for incrementing said upcounter in the event that correct data was not received within said predetermined time after said transmit mode has been completed.

19. A system as defined in claim 1 wherein said central control means includes means for strobing said cost and quantity data to all of said console control means together with an identical identification code signal sent to the dispenser control means, so that the console control means corresponding to the dispenser control means receives and registers said data.

20. A system for providing a remote indication of data relating to the dispensing of fluid from one or more dispensers of a service station or the like, comprising:

dispenser control means associated with each of the dispensers, console control means associated with each of the dispenser control means, and central control means, all of said control means transmitting and receiving electrical signals, including the data relating to the dispensed fluid, the signals between said dispenser control means and said central control means being adapted to be transmitted over electrical conductors between said dispensers and a remote location;

said central control means including means for sequentially interrogating individual dispenser control means associated with each dispenser to gather the data related to the fluid being dispensed, said central control means selectively transmitting identification code signals to all of said dispenser control means, each of said dispenser control means individually transmitting the data to said central control means responsive to receiving an identification code signal that matches an internally generated precoded signal within the dispenser control means;

said console control means receiving said data from the central control means together with an identification code signal corresponding to the identification signal associated with the dispenser control means from which the data originated, each of said console control means providing a visual display of said data.

21. A system as defined in claim 20 wherein the signals between said dispenser control means and central control means are transmitted by modulated serial pulse coded time division multiplexing.

22. A system as defined in claim 20 wherein said sequential interrogation means generates a series of binary coded pulses comprising said identification code signal and includes a binary upcounter having a plurality of binary outputs that are sequentially changed to generate new binary identification code signals for said sequential interrogation of said individual dispenser control means.

23. A system as defined in claim 20 wherein said central control means includes means for strobing said data relating to the dispensed fluid to all of said console control means together with an identification code identical to the identification code transmitted to the dispenser control means, so that said console control means corresponding to the dispenser control means receives and registers said data.

24. A system as defined in claim 22 wherein said central control means includes time delay means for advancing said upcounter to produce a new identification code signal in response to said central control means receiving either an incorrect or no response from one of said interrogated dispenser control means.

25. A system as defined in claim 24 wherein said central control means includes multiplexing means for producing a signal for incrementing the upcounter upon accurate receipt of said data from the dispenser control means, thereby enabling a subsequent dispenser control means to be interrogated, said time delay means producing a false signal incrementing the upcounter in the event that said data was not received or was faulty, the false signal being generated by said time delay means in the event correct data transmitted from a dispenser control means is not received within a predetermined time.

26. A system as defined in claim 20 wherein said dispenser control means includes means for generating pulse signals indicative of the cost and quantity of the fluid being dispensed, including opto-mechanical means adapted to monitor the operation of the dispenser.

27. A system as defined in claim 20 wherein said console control means includes means for generating a signal for transmission to the dispenser control means for temporarily interrupting the operation of said dispenser, said dispenser being interrupted without affecting the visual display of the data relating to the dispensed fluid.

28. A system as defined in claim 20 wherein said visual display of said data by said console control means comprises a visual display of the cost data relating to the fluid being dispensed, and including a switch for changing the visual display to illustrate the quantity of fluid being dispensed.

29. A system as defined in claim 20 wherein the signals between said dispenser control means and said central control means are transmitted over existing AC power conductors extending to the dispenser.

30. A system as defined in claim 10 wherein the light circuit is completed by reflection from the teeth of said rotating disc.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,894,658
DATED : July 15, 1975
INVENTOR(S) : John A. Buell, Jr.

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

Col. 1, line 47 "explosionproof" should be --explosion-proof--.

Col. 3, line 51 "typiclly" should be --typically--.

Col. 4, line 20 "explosionproof" should be --explosion-proof--.

Col. 5, line 2 "that" should be --to--.

Col. 5, line 13 "thatt" should be --that--.

Col. 7, line 64 "circut" should be --circuit--.

Col. 8, line 38 "Good" should be --"Good"--.

Col. 8, line 44 bad should be --"bad"--.

Col. 8, line 47 The no data should be --The "no" data--.

Col. 10, line 11 "line" should be --light--.

Col. 15, line 40 "12VOC" should be --12VDC--.

Col. 17, line 67 "off and one" should be --off and on--.

Signed and Sealed this

seventh **Day of** *October 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks