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OR 3,641,536

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Prosprich [45] Feb. 8, 1972

[54] **GASOLINE PUMP MULTIPLEXER SYSTEM FOR REMOTE INDICATORS FOR SELF-SERVICE GASOLINE PUMPS**

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[73] Assignee: **Veeder Industries Inc.**, Hartford, Conn.

[22] Filed: **Apr. 14, 1970**

[21] Appl. No.: **28,379**

[52] U.S. Cl. .... **340/203**, 340/206, 340/184, 340/310, 235/92 FL, 222/23

[51] Int. Cl. **G08c 19/16**

[58] Field of Search .... 340/203, 206, 310, 182, 184; 222/26, 23, 76; 235/92 FL, 92 AC, 151.34; 73/194 E

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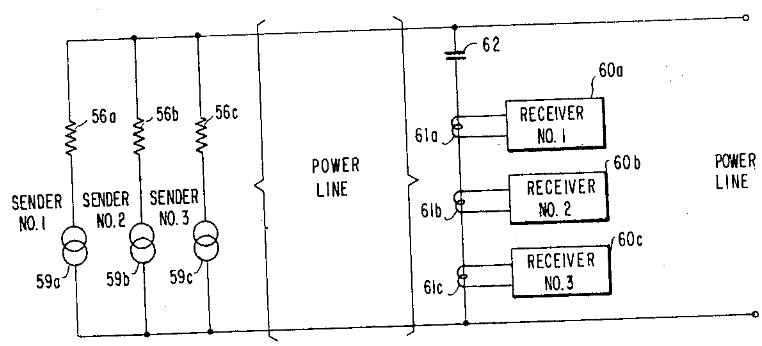
Assistant Examiner—Robert J. Mooney

Attorney—Prutzman, Hayes, Kalb & Chilton

[57] **ABSTRACT**

A multiplexer system employing a form of pulse width modulation and detection. The system is particularly adapted to use in a telemetering system for remote indicators. The system operates in connection with a self-service gasoline pump and transmits via a 60 Hz. powerline gallons and dollars information. A modified form of the system transmits only dollars or only gallons information for a plurality of pumps. The system can be further adapted for inventory control purposes. Variants include signal forcing and totalizing circuits for a plurality of independent information sources providing absolute accuracy.

15 Claims, 10 Drawing Figures



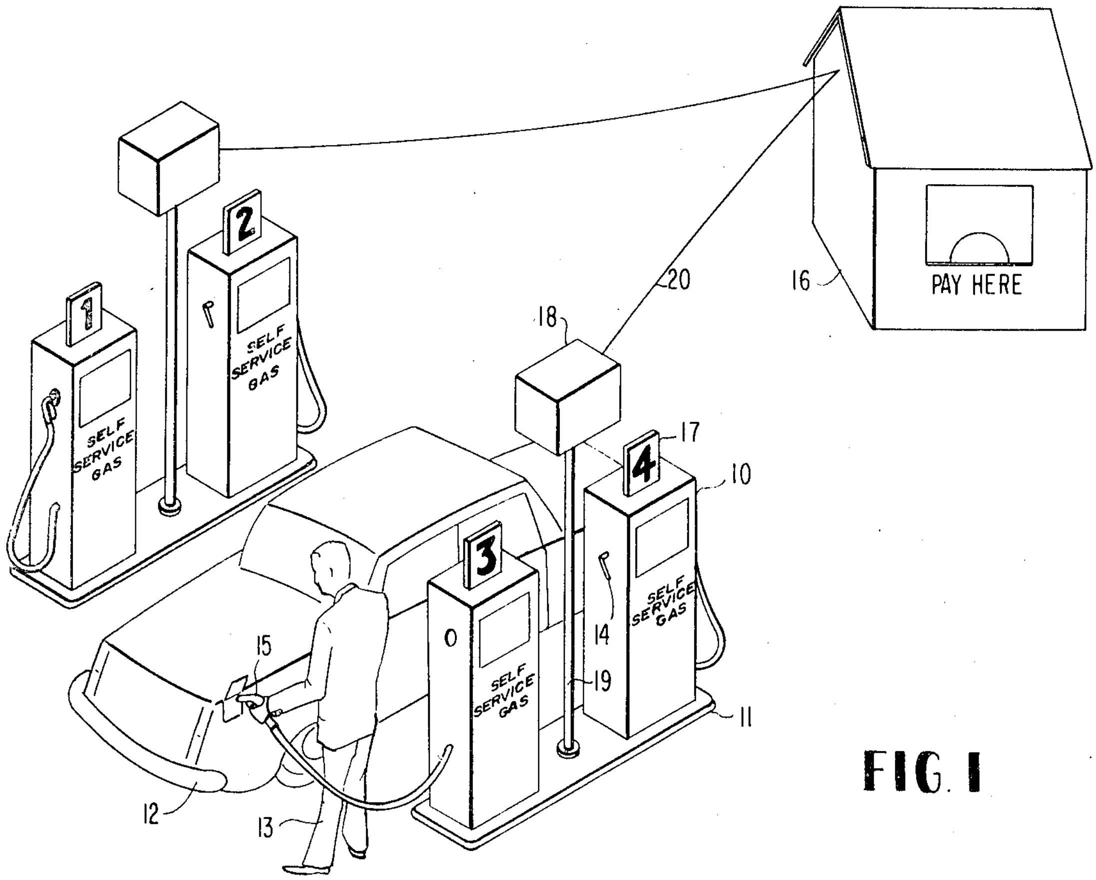


FIG. 1

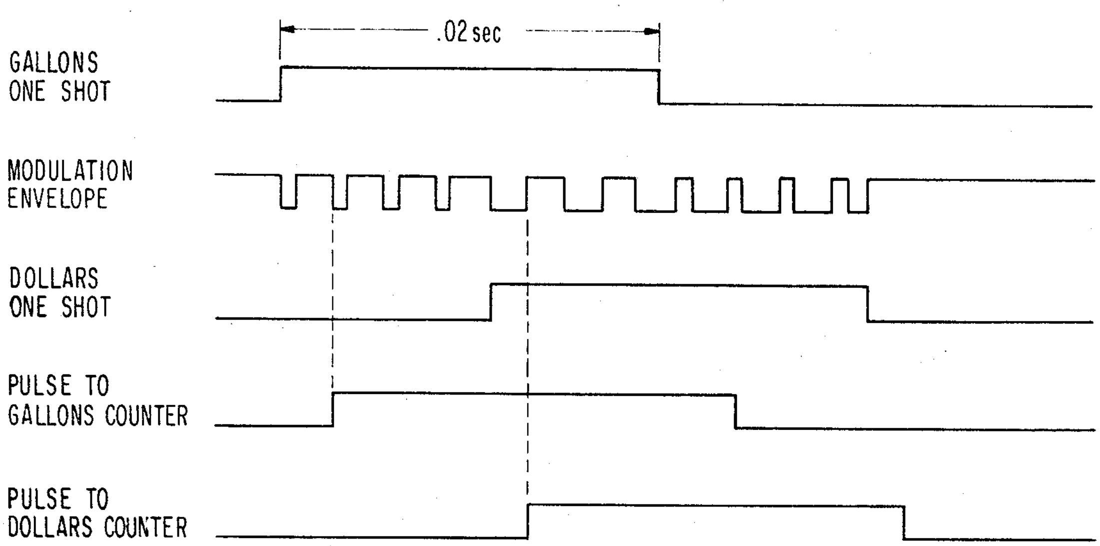


FIG. 4

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ATTORNEYS

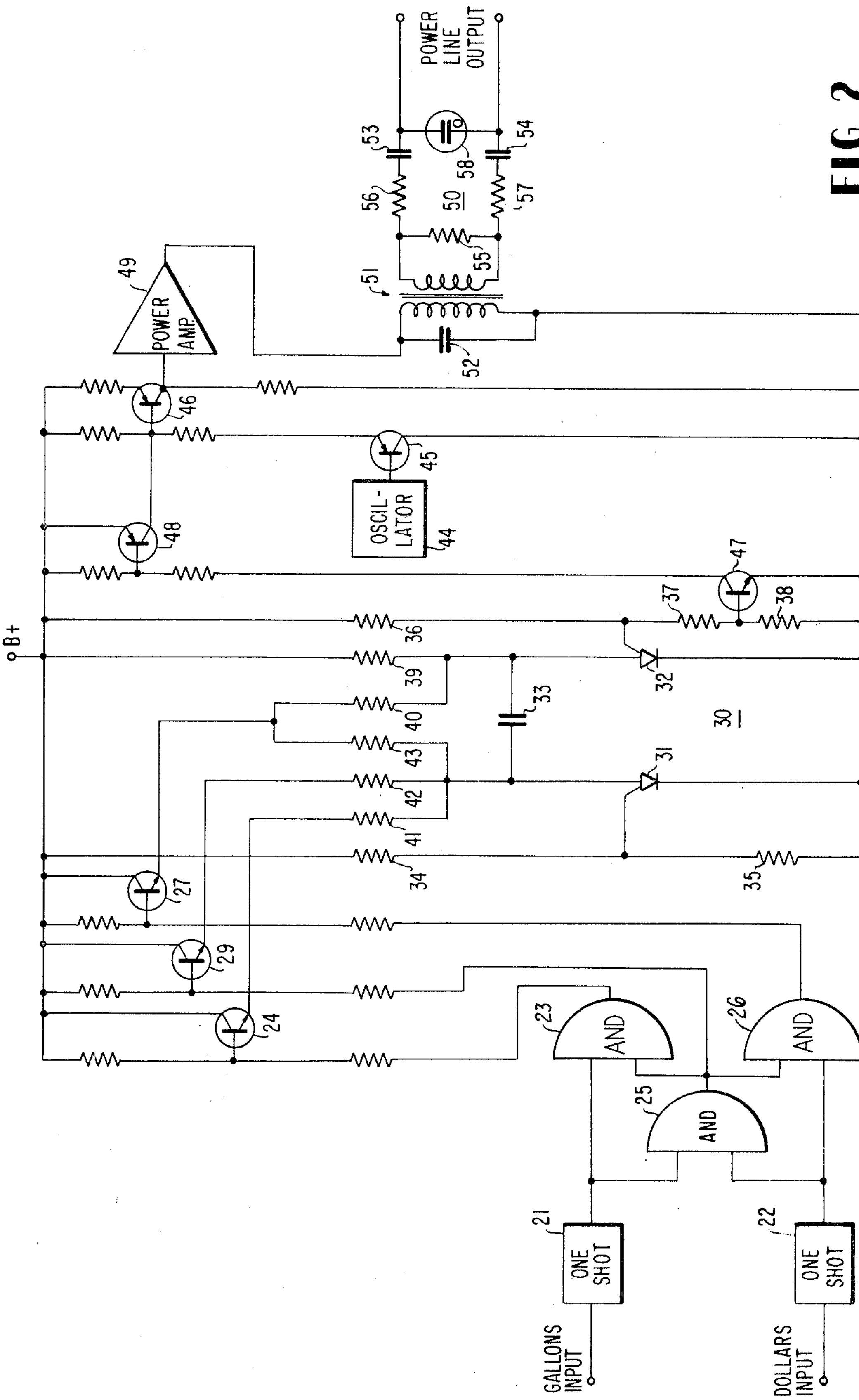
POWER LINE OUTPUT
POWER AMP.
OSCIL-LATOR
B+
AND
AND
AND
ONE SHOT
ONE SHOT
GALLONS INPUT
DOLLARS INPUT
21
22
23
24
25
26
27
29
30
31
32
33
34
35
36
37
38
39
40
41
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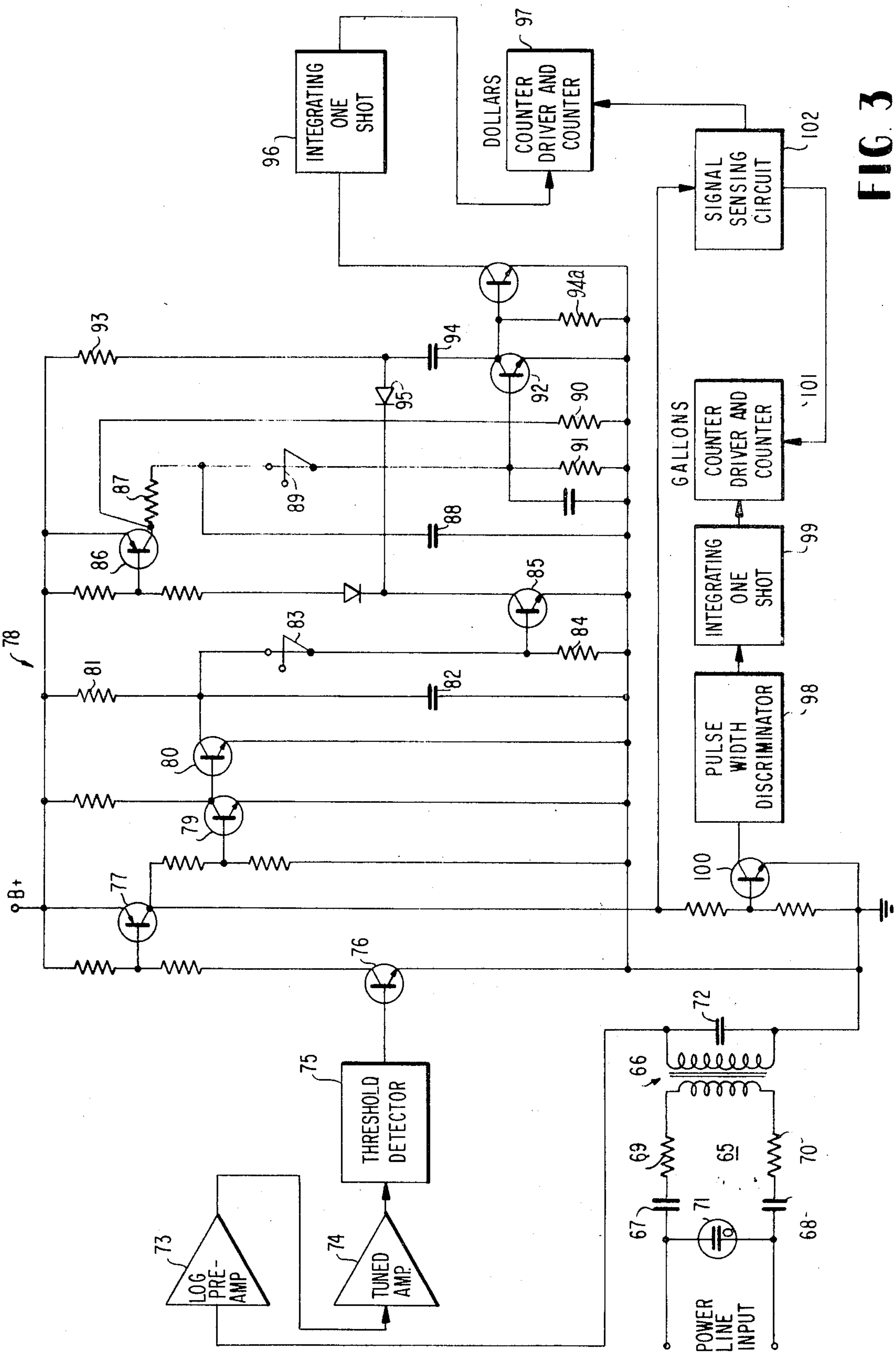
FIG. 2


INTEGRATING ONE SHOT
DOLLARS
COUNTER DRIVER AND COUNTER
SIGNAL SENSING CIRCUIT
GALLONS
COUNTER DRIVER AND COUNTER
INTEGRATING ONE SHOT
PULSE WIDTH DISCRIMINATOR
THRESHOLD DETECTOR
LOG PRE-AMP
TUNED AMP.
POWER LINE INPUT
B+
78
77
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
94a
95
96
97
98
99
100
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102
76
75
74
73
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68
71

FIG. 3

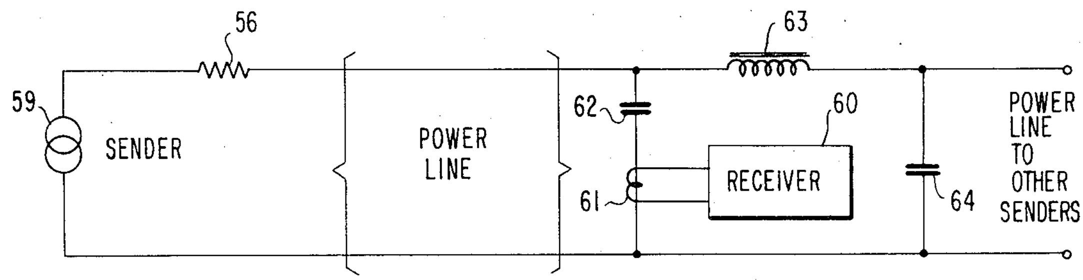

FIG. 5A

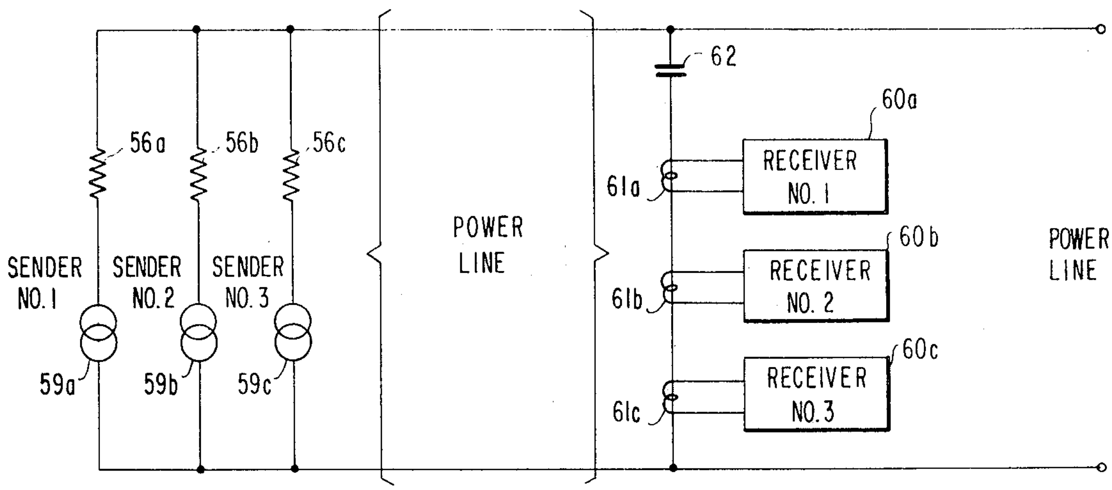

FIG. 5B

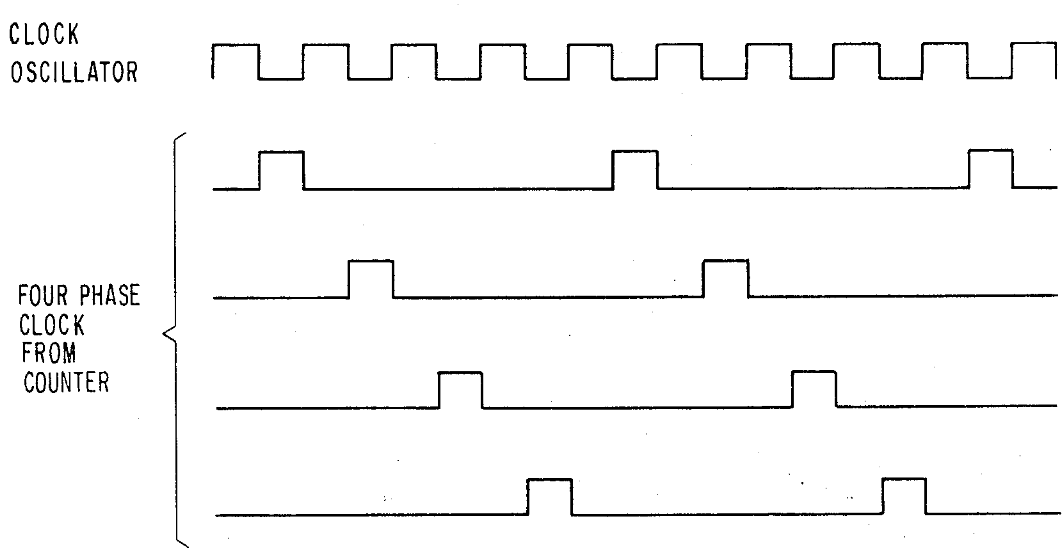

FIG. 8

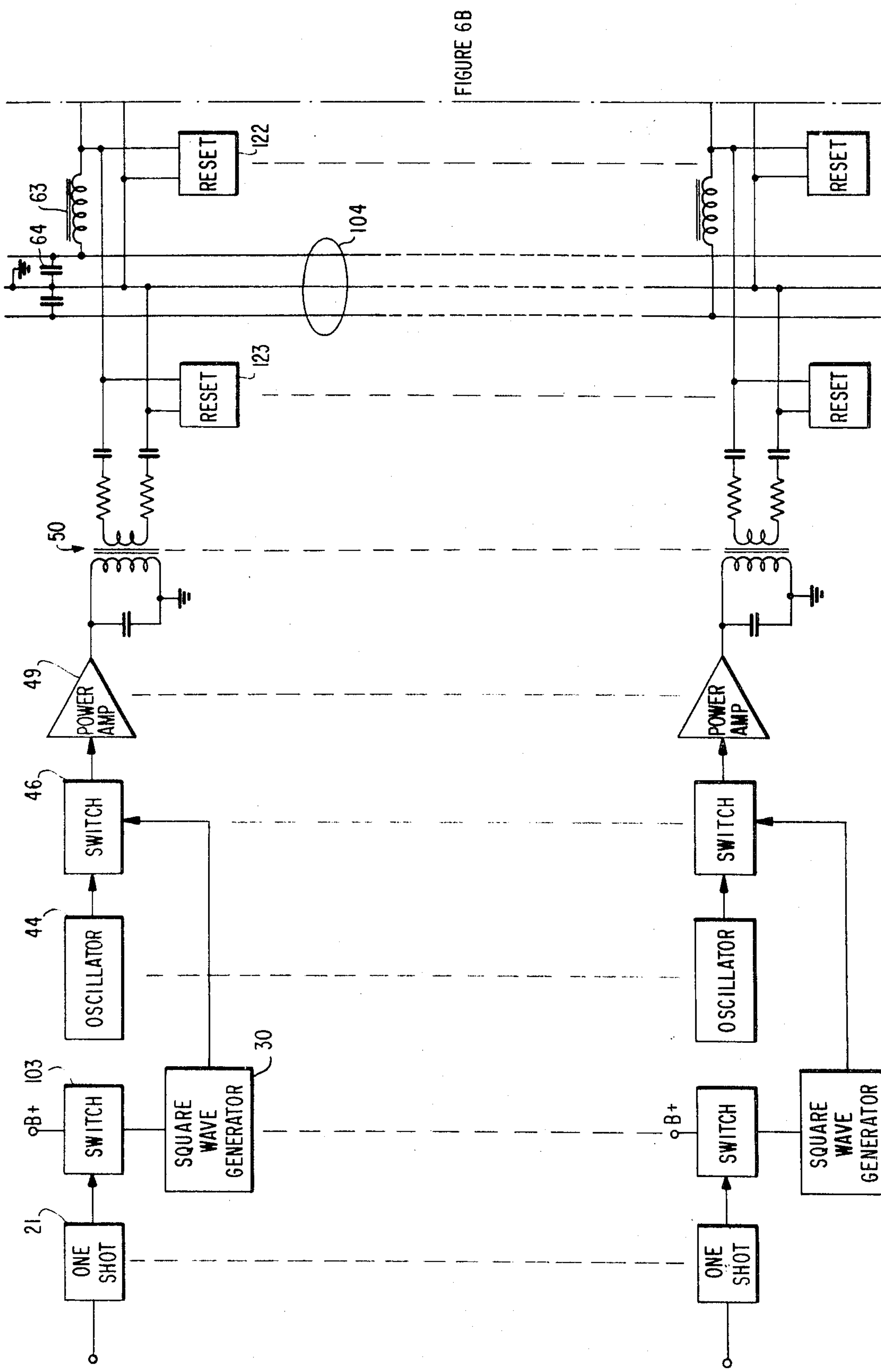
FIGURE 6B
RESET
122
63
64
104
RESET
123
50
49
POWER AMP
46
SWITCH
44
OSCILLATOR
103
B+
SWITCH
SQUARE WAVE GENERATOR
30
21
ONE SHOT
RESET
RESET
POWER AMP
SWITCH
OSCILLATOR
B+
SWITCH
SQUARE WAVE GENERATOR
ONE SHOT

FIG. 6A

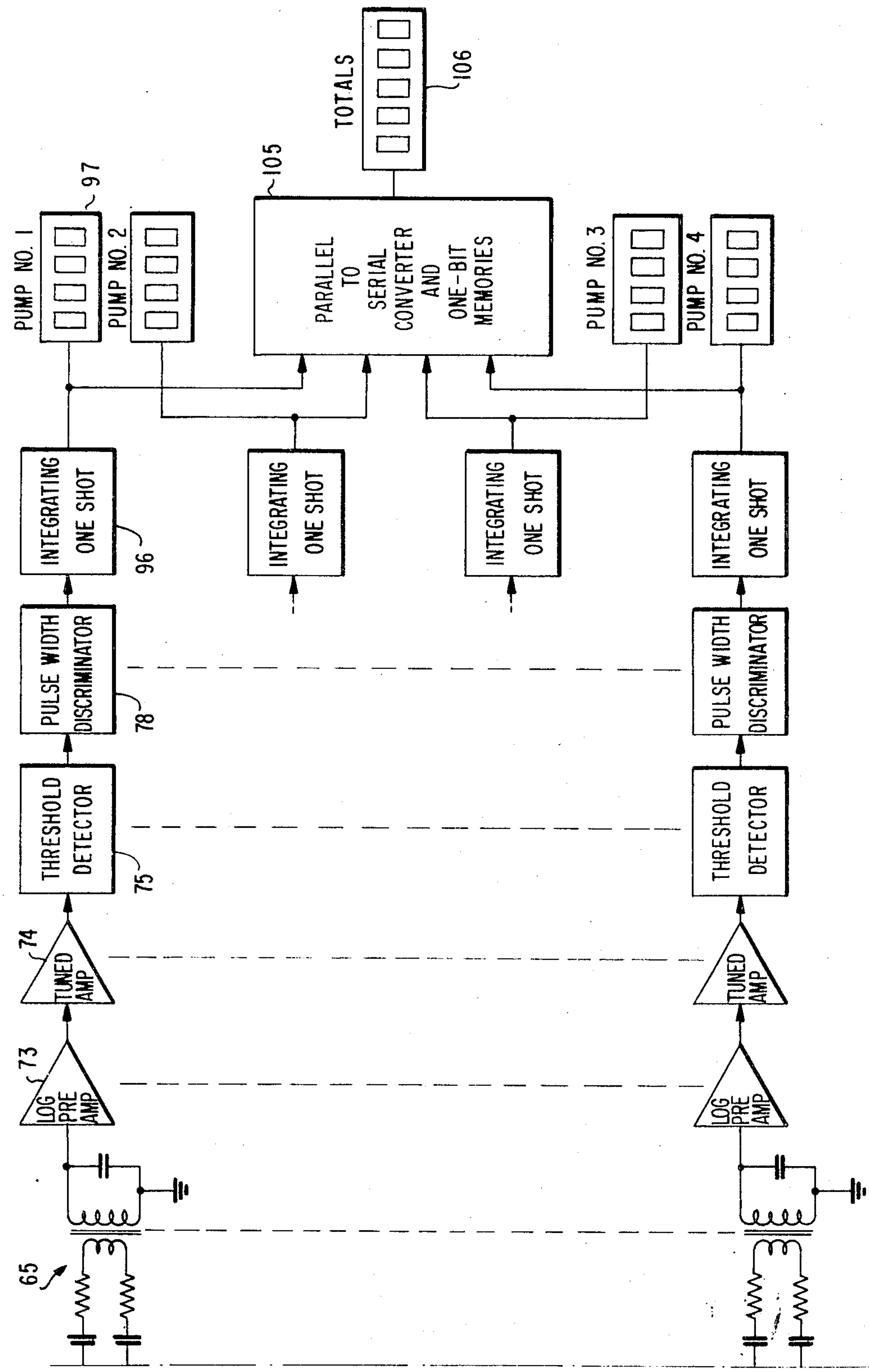

FIG 6B

FIGURE 6A

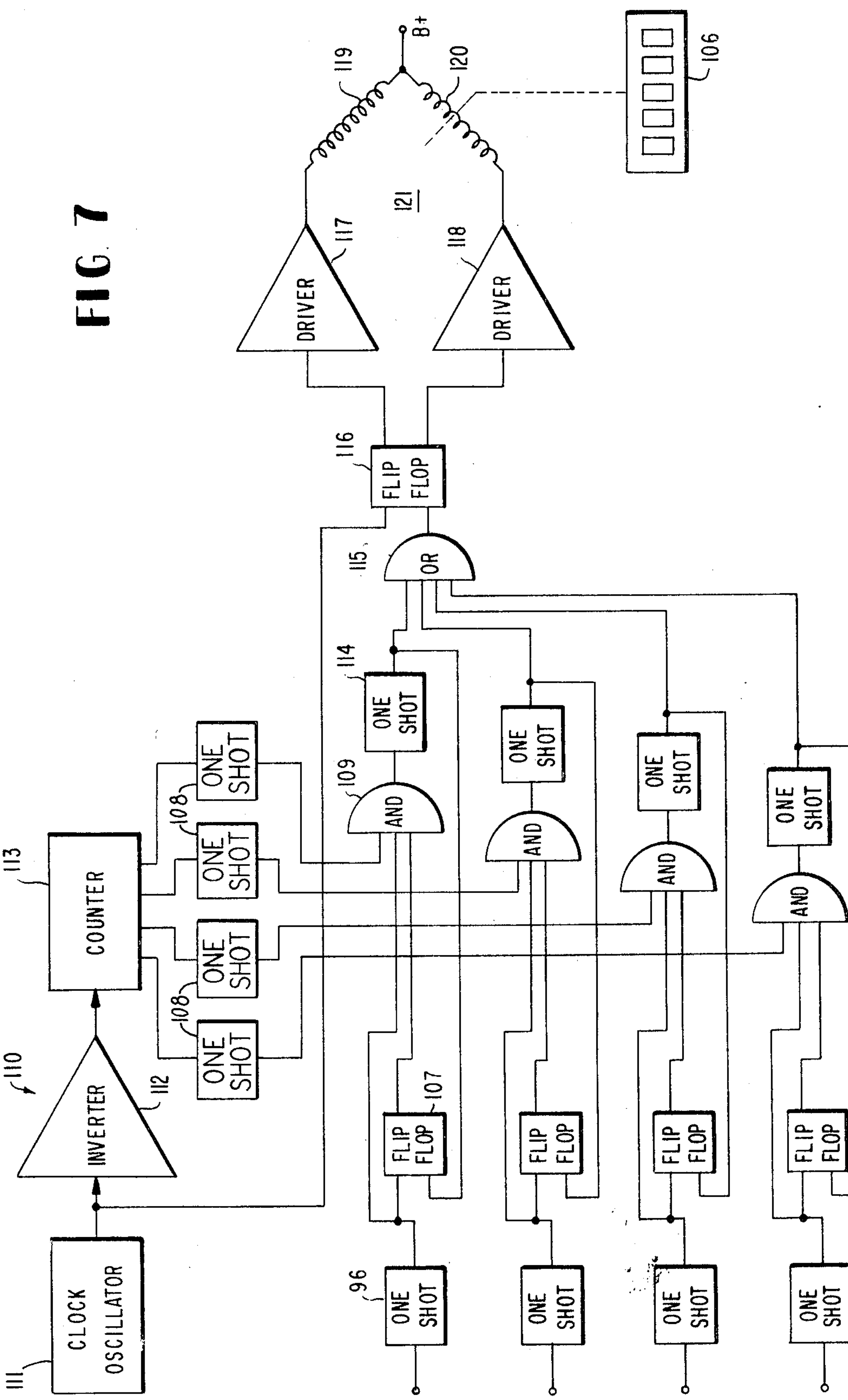
B+
119
120
106
121
117
118
DRIVER
DRIVER
116
FLIP FLOP
115
OR
114
ONE SHOT
109
AND
108
113
COUNTER
110
112
INVERTER
107
96
111
CLOCK OSCILLATOR

FIG 7

GASOLINE PUMP MULTIPLEXER SYSTEM FOR REMOTE INDICATORS FOR SELF-SERVICE GASOLINE PUMPS

SUMMARY OF THE INVENTION

The invention generally relates to multiplexer and telemetering systems, and is of special significance to a remote control system for one or more gasoline pumps at a filling station in which signals reflecting the operation of each pump are conducted on the 60 Hz. powerline to a control point inside the station.

Most multiplexer systems in common use generally employ frequency or amplitude modulation techniques or a combination of both. Where the intelligence to be transmitted in the several channels is fairly complex or broadband, these systems are highly suitable. However, in those applications involving the most simple form of information, i.e., on or off, frequency and amplitude modulation techniques as applied to multiplexing become too complicated when compared to the data to be transmitted. Furthermore, in the transmission of elementary on-off data, reliability is of utmost importance. Noise, therefore, becomes an increasingly important factor inasmuch as noise-induced frequency and amplitude variations on transmissions can cause serious error in an accumulated total at the receiver. Pulse modulation techniques are uniquely suited to the transmission of this type of information. Multiplexing of simultaneously occurring pulse data usually requires some form of elaborate buffer memory system in order to avoid losing bits of data. As a result, this type of system becomes prohibitively expensive for many applications.

A simple pulse multiplex data transmission system is particularly useful in a self-service gasoline station wherein data pertaining to each pump, such as dollar amount of sale and total gallons, is supplied to a central pay booth which would require only one attendant. In addition, such a system may provide a means of automatic inventory control.

It is therefore an object of the present invention to provide a simple pulse data multiplexer system.

It is another object of this invention to provide a multiplexer and telemetering system for a dispensing system.

It is a further object of the instant invention to provide a gasoline pump multiplexer system with remote indicators for a self-service gasoline station.

It is yet another object of the invention to provide a multiplexer system for a dispensing system which incorporates an inventory control.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

A better understanding of the invention will be obtained from the following detailed description and accompanying drawings which set forth certain illustrative embodiments and are indicative of the various ways in which the principles of the invention are employed.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a pictorial illustration showing gasoline pumps in a remote control service station;

FIG. 2 is a block and schematic diagram of a sender unit in the multiplexing system according to the invention;

FIG. 3 is a block and schematic diagram of a receiver unit for the multiplexing system according to the invention;

FIG. 4 is a timing diagram useful in understanding the operation of the circuits shown in FIGS. 3 and 4;

FIGS. 5A and 5B are simplified schematic diagrams which illustrate a scheme for obtaining a stable signal at the receiver over a powerline regardless of load variations and noise on the powerline;

FIGS. 6A and 6B are block diagrams illustrating modifications of the system according to the invention which are useful in transmitting price only information or in inventory control;

FIG. 7 is a logic diagram illustrating the circuitry of the parallel to serial converter and one-bit memories in FIGS. 6A and 6B; and

FIG. 8 is a timing diagram useful in understanding the operation of the logic shown in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Briefly stated, the present invention provides a simple pulse multiplexing system which generates two different pulses which represent, for example, gallons and dollars. Pulsers representing fractions of a dollar and fractions of a gallon of gasoline provide inputs to a modulator which includes one-shot multivibrators that act to switch different timing resistors into the modulator. Each one-shot switches a switch to gate a burst of carrier frequency of a fixed duration such as 20 ms. The dollar pulser provides a pulse for each cent and operates through the modulator to cause the switch to produce a burst of spaced pulses which are ON 1.9 ms. throughout the 20 ms. burst. The gallons pulser operates on the OFF cycle to provide a burst of spaced OFF pulses of 1.9 ms. for the 20 ms. interval. The pulses can overlap partially or entirely. This results in a system which is neither frequency nor amplitude sensitive but rather is sensitive to the pulse width of the ON or OFF pulses. In a simplified version, the invention is useful in a system which operates to telemeter price or gallons information only. A modification of this system contemplates the telemetering of gallons information from a plurality of pumps to a central station where the information is totalized for purposes of inventory control. Incorporated into this system is a parallel to serial converter having simple one-bit memories to buffer the input data from the several pumps.

Referring now to the drawings, wherein like reference numerals refer to identical or similar structures throughout the several views, FIG. 1 generally illustrates a self-service gasoline station which employs the gasoline pump multiplexer system according to the invention. Such a station typically comprises a plurality of gasoline pumps **10** on each of the several service islands **11**. Typically, a customer **13**, upon alighting from his vehicle **12**, removes the nozzle **15** from its support, turns the handle **14** to reset the computer and proceeds to dispense gasoline into the tank of his vehicle **12**.

Data, such as gallons dispensed and price of sale, are transmitted to a remote station **16**, which may be conveniently located at the exit ramp of the service station, and after filling the tank of his vehicle **12**, the customer replaces the nozzle **15** of pump **10** on its support and proceeds to the station **16** where the attendant on duty then looks at a display panel, collects the indicated amount in his remote control panel corresponding with the pump used by the customer.

For purposes of illustration only, the electronics of the multiplexer system is shown as housed in a box **18** supported above the service island **11** by a pole **19**. The pole **19** serves as a conduit for wires that connect the multiplexer system to the mechanism of pump **10**. Box **18** is shown as connected to the service station **16** by the normal 60 Hz. powerlines **20** which supply power to the pump motors of the pumps **10** and signals between the box **18** and the service station **16** may be by way of carrier modulation superimposed on the 60 Hz. powerline frequency although other forms of transmission may be employed.

The basic multiplexer system of the invention employs a form of pulse width modulation and detection in which the carrier is switched on and off, effectively producing a resultant wave form analogous to 100 percent square wave modulation. At a given carrier frequency, by varying both ON and OFF times and employing ON time and OFF time recognition circuitry at the receiving end, it is possible to transmit two distinctive signals simultaneously. FIG. 2 of the drawings illustrates how this is done. This circuit is the sender which is associated with a specific one of the gasoline pumps **10**. The circuit has two inputs, a gallons input and a dollars input. These inputs are pulses which are generated by conventional pulsers which are a part of the mechanism of the pump **10**. Each pulse at the gallons input would represent a fractional part of a gallon, say one-tenth of a gallon, and each pulse at the dollars input would represent a fractional part of a dollar, say one cent. These pulse inputs trigger respective one-shots **21** and **22** which produce output pulses having a fixed duration of, for example, 20 ms. The output of one-shot **21** is connected to one input of AND-gate **23** which in combination with NPN **24** forms an electronic switch. The output of one-shot **21** is also connected to one input of AND-gate **25**. In like manner, the output of one-shot **22** is connected to one input of AND-gate **26** which in combination with NPN-transistor **27** forms another electronic switch. The output of one-shot **22** is also connected to the second input of AND-gate **25**. The output of AND-gate **25** is connected to the second input of AND-gates **23**, **26** and to the base of NPN-transistor **29** to provide a third electronic switch.

Each of the three electronic switches just described are used to control the period of a square wave generator **30** which is preferably an astable multivibrator. Generator **30** comprises two programmable unijunction transistors (PUTs) having their cathodes connected in common to ground and their anodes connected by a timing capacitor **33**. The gate electrode of PUT **31** is connected to a voltage divider comprising resistor **34** and resistor **35** connected in series across a source of positive voltage and ground. Similarly, the gate electrode of PUT **32** is connected to a voltage divider comprising resistor **36** and resistors **37** and **38** connected in series across the source of positive voltage and ground. A timing resistor **39** is connected between the anode of PUT **32** and the source of positive voltage. A switchable timing resistance **40** is also connected to the anode of PUT **32**. Three switchable timing resistances **41**, **42** and **43** are connected to the anode of PUT **31**. Timing resistor **41** is connected to the emitter of transistor **24**, timing resistor **42** is connected to the emitter of transistor **29**, and timing resistors **40** and **43** are connected in common to the emitter of transistor **37**.

A pulse at the gallons input triggers one-shot **21**. As shown at the top of FIG. **4** of the drawings, this pulse enables AND-gate **23** which causes transistor **24** to conduct. Transistor **24** is biased into saturation effectively connecting timing resistor **41** to the source of positive voltage. Under these conditions, the astable multivibrator **30** begins to oscillate, producing a series of pulses at the gate electrode of PUT **32** as represented by the modulation envelope shown in FIG. 4. The value of timing resistor **41** is selected such that the duration of the output pulses is relatively short, say 0.7 ms., compared with the interval between pulses which might be 1.9 ms. If, on the other hand, a pulse at the dollars input triggers one-shot **22**, AND-gate **26** and transistor **27** will conduct with the result that timing resistors **40** and **43** are effectively connected to the source of positive voltage. The values of timing resistors **40** and **43** are chosen such that the pulse pattern output at the gate of PUT **32** is just the opposite of that produced by a pulse at the gallons input, that is the pulse would be ON for 1.9 ms. and OFF for 0.7 ms. This is shown at the right-hand part of the modulation envelope illustrated in FIG 4. It is possible for the pulses produced by one-shot **21** and one-shot **22** to overlap. When this happens, the output of AND-gate **25** causes transistor **29** to conduct and inhibits AND-gates **23** and **26**. This in turn causes timing resistor **42** to be effectively connected to the source of positive voltage. The value of timing resistor **42** is chosen such that a symmetrical pulse pattern output is produced at the gate electrode of PUT **32**. In other words, the output of astable multivibrator **30** during this overlap period will be a series of pulses 1.9 ms. in duration separated by intervals of 1.9 ms.

A Colpittis oscillator **44** with good temperature stability is used to generate the carrier. The output of oscillator **44** is connected to the base of PNP-transistor **45** which is connected as an emitter follower. The output of emitter follower transistor **45** is connected to the base of transistor **46** which acts as a gated buffer amplifier.

Resistors **37** and **38** form a voltage divider which is connected to the base of NPN-transistor **47** which in combination with PNP-transistor **48** comprises an electronic switch. The collector of transistor **48** is connected to the base of transistor **46**, and when transistor **48** conducts, transistor **46** is biased to nonconduction. When transistor **48** is off, transistor **46** passes the output of oscillator **44** to the input of power amplifier **49**.

The power amplifier **49** provides sufficient line drive to overcome the effects of powerline loading at the carrier frequency, delivering approximately 100 milliwatts to the line through a line coupling network **50**. The coupling network **50** comprises a coupling transformer **51** having primary and secondary windings. A capacitor **52** is connected across the primary of coupling transformer **51** to form therewith a tank circuit resonant at the carrier frequency. Relatively broad tuning is employed in the primary circuit, and care is taken to ensure a clean undistorted carrier signal on the line to avoid harmonic sideband problems. Small coupling capacitors **53** and **54** presenting a high impedance at the powerline frequency are employed for isolation in series with the secondary of the output transformer **51**. Interposed between these coupling capacitors and the secondary winding of transistor **51** is a resistance network comprising a shunt resistance **55** and two series resistances **56** and **57**. A neon indicator lamp **58** may be connected across the output to the powerline.

The series resistances **56** and **57** may be described as current or signal forcing resistances and have as their objective to ensure a stable signal at the receiver over the powerline regardless of load variations and noise on the powerline. FIG. 5A shows in simplified schematic form the relationship of the current forcing resistance **56** to the circuitry of the system. The sender which is shown in FIG. 2 may be considered analogous to a current generator **59**. Resistance **56** is placed in series with the current generator **59**, and a receiver **60** is connected to a current transformer **61** placed across the powerlines in series with capacitor **62**. Resistance **56** has a value chosen sufficiently high so that capacitor **62**, which serves as a high frequency short across the powerlines, produces a substantially constant current output for an information signal delivered to the receiver **60** regardless of variations in the line loading and noise. Also shown in FIG. 5A is a filter comprising a choke coil **63** connected in series with the powerline and a capacitor **64** connected in shunt with the powerline. The filter isolates the signal from the remainder of the powerline so that the information is not conducted to the right of the filter. Not only will this prevent possible information from being available to a competitor who might be connected to the same powerline, but it also makes it possible to use the same powerline for carrying other signals at the same carrier frequency from a different sender when another gasoline pump is connected to the powerline. The filter could be eliminated in the situation where a different carrier frequency is used for each gasoline pump and where the power transformer for the station is relied upon to block the pickup of information by a competitor from the powerline.

A variation of the current forcing technique shown in FIG. 5A is illustrated in FIG. 5B. In this case, three senders represented by current generators **59*a***, **59*b*** and **59*c*** are each connected in series with current forcing resistances **56*a***, **56*b*** and **56*c***, respectively. Each of these current generators and their series connected resistances are connected in shunt with the powerline. The receivers **60*a***, **60*b*** and **60*c*** for each of the different signal generators are powered by the same powerline. The current transformers **61*a***, **61*b*** and **61*c*** which pick up the input signal for each of the respective receivers are placed on the same powerline shunt.

It should be noted at this point that while the invention has so far been described as senders located at gasoline pumps and receivers located at a central station, it is also possible to provide a signal generator at the central station and a receiver at the pump islands for resetting the computer and turning the power on and off at each pump from the station. The same powerlines could be used for a plurality of pumps, and the same carrier frequency could be used for controlling each pump as is used for transmitting information such as dollars and cents from the pump to the station.

Referring now to FIG. 3 of the drawings, the receiver is connected to the powerline by a coupling network 65 similar to that used at the output of the sender. Coupling network 65 comprises a coupling transformer 66 having primary and secondary windings. Connected in series with the primary winding are a pair of coupling capacitances 67 and 68 each of which is connected in series with a resistance 69 and 70, respectively. A neon indicator lamp 71 may be connected in shunt with the powerline. Connected in parallel with the secondary winding of coupling transformer 66 is a capacitance 72 which together with the secondary winding of the transformer forms a parallel resonant tank circuit. The tank circuit is resonant to the carrier frequency.

When more than one pump is connected in the system, it is desirable to have a high Q tank circuit for selectivity between pumps, i.e., between oscillator frequencies. However, a high Q results in the slow buildups of the signal and ringing or slow decay. This, of course, seriously distorts the pulse envelope. In order to limit the effects of ringing of the tuned coupling circuit and provide good selectivity, the tank circuit is connected to the input of a logarithmic preamplifier 73. As is known in the art, the property of such an amplifier is to amplify small amplitude signals greater than large amplitude signals. This has the effect of "squaring up" the input pulse burst. The output of the logarithmic preamp 73 is connected to a tuned amplifier 74 which provides additional gain and selectivity. This output is connected to a threshold detector 75 which detects the pulse modulation envelope. The pulse output of detector 75 causes a switch comprising NPN-transistor 76 and PNP-transistor 77 to be turned on and off synchronously with the pulse modulation envelope.

The output of the switch is connected to a first pulse with discriminator 78. This discriminator comprises at its input a pair of NPN-transistor 79 and 80 which are connected in cascade. Transistor 79 is turned on by an ON pulse from transistor 77. This in turn causes transistor 80 to be turned off. Connected in series across a source of positive voltage and ground are a timing resistance 81 and a charging capacitance 82. The junction of resistor 81 and capacitor 82 is connected to the collector of transistor 80, and when transistor 80 is biased to nonconduction, capacitor 82 is charged through resistor 81. If the pulse output from detector 75 is of sufficient duration, approximately 1.9 ms., capacitor 82 will charge sufficiently to fire a four layer threshold device 83 connected thereacross.

A load resistor 84 is connected in series with four layer threshold device 83 and the voltage produced across this load resistor is applied to the base of NPN-transistor 85. Transistor 85 in combination with PNP-transistor 86 forms an electronic switch which controls another timing circuit comprising timing resistance 87 and charging capacitance 88 connected in series with the collector of transistor 86 and ground. If the pulse appearing at the base of transistor 85 is too long, capacitor 88 will charge sufficiently to fire four layer threshold device 89 connected thereacross. Otherwise, capacitor 88 is discharged through resistor 87 and resistor 90.

The four layer threshold device 89 is connected in series with a load resistance 91, and the voltage developed thereacross is applied to the base of an NPN-transistor 92. The emitter of transistor 92 is connected directly to ground and the collector is connected to a source of positive voltage by a resistor 93 and a firing capacitor 94 connected in series. The junction of resistor 93 and capacitor 94 is connected by way of an isolating diode 95 to the collector of transistor 85. When transistor 85 conducts, capacitor 94 is discharged through transistor 85 and resistor 94*a*. If the pulse at the base of transistor 85 is not too long, transistor 85 will turn off allowing capacitor 94 to be charged through resistor 93. The charge accumulated on firing capacitor 94 triggers a retriggerable or integrating one-shot 96. If, on the other hand, the pulse at the base of transistor 85 is too long, then four layer threshold device 89 discharges capacitor 88 providing a pulse at the base of transistor 92 which conducts and prevents capacitor 94 from triggering one-shot 96. So long as the pulses applied to the input of the integrating one-shot 96 are of sufficient duration, the output of the one-shot will remain on. Thus, the one-shot 96 provides an output having a duration of 20 ms. as shown at the bottom of FIG. 4. This output is used to drive the counter driver and counter 97 which in the specific example is the dollars counter.

The gallons information is detected in a similar manner with an identical pulse width discriminator 98 and integrating one-shot 99. However, since the gallons information is represented by OFF pulses rather than ON pulses, an inverting transistor 100 is connected between the switch comprising transistor 76 and 77 and the pulse width discriminator 98. The output of integrating one-shot 99 is applied to a counter driver and counter 101 which is the gallons counter.

It may be appreciated from the foregoing discussion that the pulse width discriminators 78 and 98 operate to reject both short duration pulses, such as characteristic of transient noise, and long duration pulses, which might be generated during equipment turn off and turn on, and to identify only the desired pulse. A signal sensing circuit 102 may also be provided. This circuit would be connected to the output of detector 75 or the switch comprising transistors 76 and 77 and would serve to enable the counters 97 and 101 only when a carrier is present. The signal sensing circuit then provides protection against false counting since a discriminator output alone cannot initiate the counter drive unless the sensing circuit 102 is on.

In the embodiment described it is assumed that both gallons and dollar information are to be transmitted. There are many applications where only dollar information or only gallon information are needed to be transmitted. These possibilities are shown in FIGS. 6A and 6B of the drawings which illustrate a four channel system transmitting only dollars information or only gallons information. In this situation a different carrier frequency for each pump is selected. Since only one item of information is to be transmitted, only one one-shot 21, for example, is required. The output of one-shot 21 gates a switch 103 which supplies power to a square wave generator 30. The output of square wave generator 30 gates the output of oscillator 44 through switch 46 to power amplifier 49. The output of power amplifier 49 is connected to the powerlines 104 through a coupling network 50. The powerlines 104 comprise a three conductor 230 volt line having the center conductor grounded. One hundred and fifteen volt service is thus available across either of the two outside lines and the grounded centerline. If desired, a filter comprising series connected choke 63 and shunt connected capacitance 64 may be interposed between the powerline and the coupling network 50.

At the receiver end, a coupling network 65 couples the signal on the powerline to a log preamp 73 and tuned amplifier 74. Threshold detector 75 receives the output from tuned amplifier 74 and provides a detected pulse output to pulse width discriminator 78. Since only one item of information is being transmitted by a particular pump, only one pulse width discriminator is required. The output of discriminator 76 is applied to integrating one-shot 96 which provides a counting pulse to counter 97. A separate counter 97 is provided for each pump at the central station when only dollar information is to be transmitted.

In applications where the information desired is the total number of gallons sold from a plurality of pumps, the outputs of each of the integrating one-shots 96, representing quantity delivered by each of the pumps, are applied to a parallel to serial converter and one-bit memories 105 which provides an output to a totalizing counter 106.

A schematic representation of a logic circuit suitable for providing the parallel to serial converter and one-bit memories 105 is shown in more detail in FIG. 7 of the drawings. Each of the one-shots 96 from the four channels is applied to °respective flip-flop memory 107. The output of one-shot 96 is also applied to one input of a three input AND-gate 109. The output of flip-flop 107 is applied to another input of AND-gate

109. The AND-gates 109 are each strobed by a clock 110 applied to their third input.

Clock 110 comprises a clock oscillator 111 which produces a symmetrical square wave output as illustrated at the top of FIG. 8. This square wave output is applied to inverter 112 in order to shift the phase of the output 180 . The phase shifted clock oscillator output is then applied to a counter 113 which in its simplest form may be a four stage ring counter. Counter 113 produces a four phase clock or strobe which applies a pulse to one-shots 108 to produce a pulse of short duration (as compared to the duration of the strobe pulse) which is applied to the AND-gates 109 at uniform intervals as illustrated in FIG. 8 to ensure that pulses are evenly spaced at input of OR-gate 115. The frequency of clock oscillator 111 is sufficient to strobe each AND-gate 109 twice for each input pulse from its one-shot 96.

In operation, if a pulse is generated by one-shot 96 at a time when there is no strobe input to AND-gate 109 from counter 113, flip-flop memory 107 will be set. The output of flip-flop 107 enables AND-gate 109 until it is reset. When a strobe pulse later appears from counter 113 it is passed by AND-gate 109 to trigger one-shot 114. The output of one-shot 114 resets flip-flop 107 and is also connected to OR-gate 115. OR-gate 115 is a four input OR gate, receiving one input for each channel in the system. The output of OR-gate 115 sets a flip-flop 116. Flip-flop 116 is reset by the output of clock oscillator 111. Thus, flip-flop 116 is caused to toggle back and forth with a frequency that depends upon the rate at which gallons information is applied to all of the several channels of the system. The outputs of flip-flop 116 are each connected to respective driver circuits 117 and 118. These driver circuits each are operative to energize a respective winding 119 or 120 of a stepper motor 121. The stepping motor 121 has a mechanical output drive which drives the totalizer counter 106.

Where a pulse is generated by one-shot 96 at the same time as there is a strobe input to an AND-gate 109 from counter 113, AND-gate 109 will not pass a signal to trigger one-shot 114 and the pulse is not then passed to OR-gate 115. Neither is flip-flop 107 reset. However, since the frequency of clock oscillator 111 is sufficient to strobe AND-gate 109 twice for each input pulse from one-shot 96 at the maximum pulse repetition rate of the pulsers in the pumps, counter 113 will cycle twice between the receipt of two consecutive bits of information from the same source. As a result, on the next cycle there will be no output pulse from one-shot 96 and the strobe pulse from counter 113 will be passed to trigger one-shot 114 and reset flip-flop 107. Thus, only one-bit memories are required to prevent the loss of any bit of information thereby ensuring that the total count at counter 106 is accurate.

In its most comprehensive form, the invention would comprise the transmission of both dollars and gallons information as particularly described with respect to FIGS. 2 and 3. In addition the system would also include a totalizing output for either dollars or gallons or both. For example, it is possible to provide the attendant on duty in the station with price information from each pump and at the same time provide total gallons information for purposes of inventory control.

As stated previously, it is also possible to provide a sender at the station and a receiver at each pump. This is illustrated in FIGS. 6A and 6B by the blocks 122 and 123 labeled "reset." Block 122 in this case would be a sender and block 123 would be a receiver similar to those described in detail with respect to FIGS. 2 and 3. The purpose of such a provision would be to allow the attendant to have complete control of the pumps from the station. Specifically, the attendant could use the resets to make power available at the individual pumps only when he wishes to authorize a customer to use the pump.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. In a dispensing system having at least one dispensing apparatus which is capable of generating separate triggering pulses corresponding to fractional parts of at least two different units of measurement related to the dispensed product, a multiplexer system comprising:

a pulse width modulator responsive to one of said triggering pulses for generating a series of pulses having a first duration separated by intervals having a second duration, said pulse width modulator also being responsive to another of said triggering pulses for generating a series of pulses having said second duration separated by intervals having said first duration, and said pulse width modulator further being responsive to the simultaneous occurrence of the two triggering pulses for generating a series of pulses having said first duration separated by intervals having said first duration,

a gated carrier frequency oscillator connected to said pulse width modulator and providing a pulse modulated output,

transmission means receiving said pulse modulated output from said gated carrier frequency oscillator for transmitting the modulated signal to a central point,

receiver means at said central point for receiving the transmitted signal and providing a detected output,

pulse sorter means connected to receive the detected output from said receiver for providing a first output in response to a series of pulses having said first duration and a second output in response to a series of pulses separated by intervals having said first duration, and

indicator means connected to each of said first and second outputs of said pulse sorter means for providing an indication at the central point whenever either of said triggering pulses occur.

2. A multiplexer system as recited in claim 1 wherein said pulse width modulator comprises:

an astable multivibrator, and

switching means responsive to said triggering pulses for selectively changing the time constants of said astable multivibrator.

3. A multiplexer system as recited in claim 2 wherein said astable multivibrator includes a plurality of timing resistors and said switching means further comprises:

a first one-shot triggered by one of said triggering pulses for producing a pulse output having a fixed duration substantially longer than both said first and second durations,

a second one-shot triggered by another of said triggering pulses for producing an output pulse having a duration equal to that of the output of said first one-shot,

a first electronic switch connected to the output of said first one-shot and operable to connect a first combination of said timing resistances to said astable multivibrator,

a second electronic switch connected to said second one-shot and operable to connect a second combination of timing resistances to said astable multivibrator,

an AND gate receiving as its inputs the outputs of both said first and said second one-shots and providing an output only when the outputs from said first and second one-shots are coincident, and

a third electronic switch connected to said AND gate and operable to connect a third combination of timing resistances to said astable multivibrator.

4. A multiplexer system as recited in claim 1 wherein said pulse sorter means comprises:

first and second pulse width discriminators each operable to detect a pulse having said first duration, one of said pulse width discriminators receiving the detected output from said receiver means and the other of said pulse width discriminators receiving the inversion of the detected output from said receiver means, and

first and second integrating one-shots connected to the output of said first and second pulse width discriminators, respectively.

5. A multiplexer system as recited in claim 1 wherein said dispensing apparatus is a gasoline pump and said units of mea-

surement are dollars and gallons, respectively, and said indicator means provides numerical readouts of the number of gallons dispensed and the dollar value thereof.

6. A multiplexer system comprising

a pulse width modulator responsive to a first data pulse for generating a series of pulses having a first duration separated by intervals having a second duration, said pulse width modulator also being responsive to a second data pulse for generating a series of pulses having said second duration separated by intervals having said first duration, and said pulse width modulator further being responsive to the simultaneous occurrence of said first and second data pulses for generating a series of pulses having said first duration separated by intervals having said first duration,

a gated carrier frequency oscillator connected to said pulse width modulator and providing a pulse modulated output,

transmission means receiving said pulse modulated output for transmitting the modulated signal to a remote point,

receiver means at said remote point for receiving the transmitted signal and providing a detected output,

pulse sorter means connected to receive the detected output from said receiver for providing a first output in response to a series of pulses having said first duration and a second output in response to a series of pulses separated by intervals having said first duration, and

indicator means connected to each of said first and second outputs of said pulse sorter means for providing an indication at the remote point whenever either of said first or second data pulses occur.

7. A multiplexer as provided in claim 6 wherein said pulse width modulator comprises:

an astable multivibrator, and

switching means responsive to said first and second data pulses for selectively changing the time constants of said multivibrator.

8. A multiplexer system as recited in claim 7 wherein said astable multivibrator includes a plurality of timing resistances and said switching means comprises

a first one-shot responsive to said first data pulse for generating an output pulse having a duration substantially longer than either said first or second durations,

a second one-shot responsive to said second data pulse for generating an output pulse equal to that generated by said first one-shot,

a first electronic switch connected to said first one-shot and operable to connect a first combination of said timing resistances to said astable multivibrator,

a second electronic switch connected to said second one-shot and operable to connect a second combination of said timing resistances to said astable multivibrator,

an AND gate connected to both said first and said second one-shots and producing an output when the outputs of said first and said second one-shots are coincident, and

a third electronic switch connected to the output of said AND gate and operable to connect a third combination of said timing resistances to said astable multivibrator.

9. A multiplexer system as recited in claim 8 wherein said receiver means comprises:

an input tank circuit resonant at the carrier frequency,

a logarithmic amplifier connected to said input tank circuit and providing an amplified output which emphasizes smaller signal amplitudes,

a tuned amplifier connected to the output of said logarithmic amplifier, and

a threshold detector connected to said tuned amplifier providing an output substantially identical to the modulation envelope.

10. A multiplexer system as recited in claim 9 wherein said pulse sorter means comprises:

first and second pulse width discriminators each operable to detect pulses having said first duration, one of said pulse width discriminators being connected to receive the output of said threshold detector and the other of said pulse width discriminators being connected to receive the inversion of the output of said threshold detector, and

first and second integrating one-shots connected to respective ones of the outputs of said pulse width discriminators for providing output pulses having durations equal to the duration of the outputs of said first and second one-shots.

11. In a self-service gasoline dispensing system having a plurality of gasoline pumps each of which are capable of generating trigger pulses corresponding to fractional parts of units of measurement related to the dispensed gasoline, a remote indicator system comprising

a sender for each pump responsive to the trigger pulses produced thereby and producing a modulated signal characteristic of its particular pump, each of said senders being connected to a common powerline,

a receiver for each sender located at a central station and also coupled to said common powerline, each of said receivers being responsive to the characteristic modulated signal produced by its corresponding sender, and output means connected to each receiver for producing an indication of the amount of gasoline dispensed, said output means comprising:

a plurality of one-bit memories, each of said memories being connected to a respective receiver corresponding to one of said plurality of gasoline pumps,

strobing means for strobing the outputs of each memory at least twice between two consecutive trigger pulses generated by its related pump, and

accumulating means connected to said strobing means for totalizing the total number of trigger pulses generated by all of said plurality of gasoline pumps.

12. A remote indicator system as recited in claim 11, wherein said strobing means comprises:

a plurality of AND gates each connected to a respective one of said plurality of one-bit memories,

a clock oscillator, and

a counter connected to said clock oscillator and operative to strobe each AND gate in succession.

13. A remote indicator system as recited in claim 12 wherein said accumulating means comprises:

a flip-flop connected to be toggled back and forth by the combined outputs of said AND gates and the output of said clock oscillator,

a stepping motor driven by the outputs of said flip-flop, and

a totalizing counter driven by said stepping motor.

14. A remote indicator system as recited in claim 11 wherein said strobing means comprises:

a plurality of AND gates each associated with a respective one of said plurality of one-bit memories,

said AND gates each having three inputs, the first of said inputs connected to receive a signal from its associated one-bit memory, the second of said inputs connected to receive the input signal to said one-bit memory, and the third of said inputs connected to said strobing means

whereby an input signal to said one-bit memory prevents said AND gates from passing a signal.

15. In a self-service gasoline dispensing system having a plurality of gasoline pumps each of which are capable of generating trigger pulses corresponding to fractional parts of units of measurement related to the dispensed gasoline, a remote indicator system comprising

a sender for each pump responsive to the trigger pulses produced thereby and producing a modulated signal characteristic of its particular pump, each of said senders being connected to a common powerline,

a receiver for each sender located at a central station and also coupled to said common powerline, each of said receivers being responsive to the characteristic modulated signal produced by its corresponding sender, and output means connected to each receiver for producing an indication of the amount of gasoline dispensed, each sender being connected to the powerline by a coupling network comprising:

a coupling transformer having primary and secondary windings, said primary winding receiving the output of said sender,

a capacitor connected across said primary winding to form a tank circuit resonant at the signal frequency,

at least one coupling capacitor connected in series with the secondary winding of said coupling transformer and the powerline for blocking the powerline frequency, and

at least one current forcing resistor connected in series between said coupling capacitor and said secondary winding.

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