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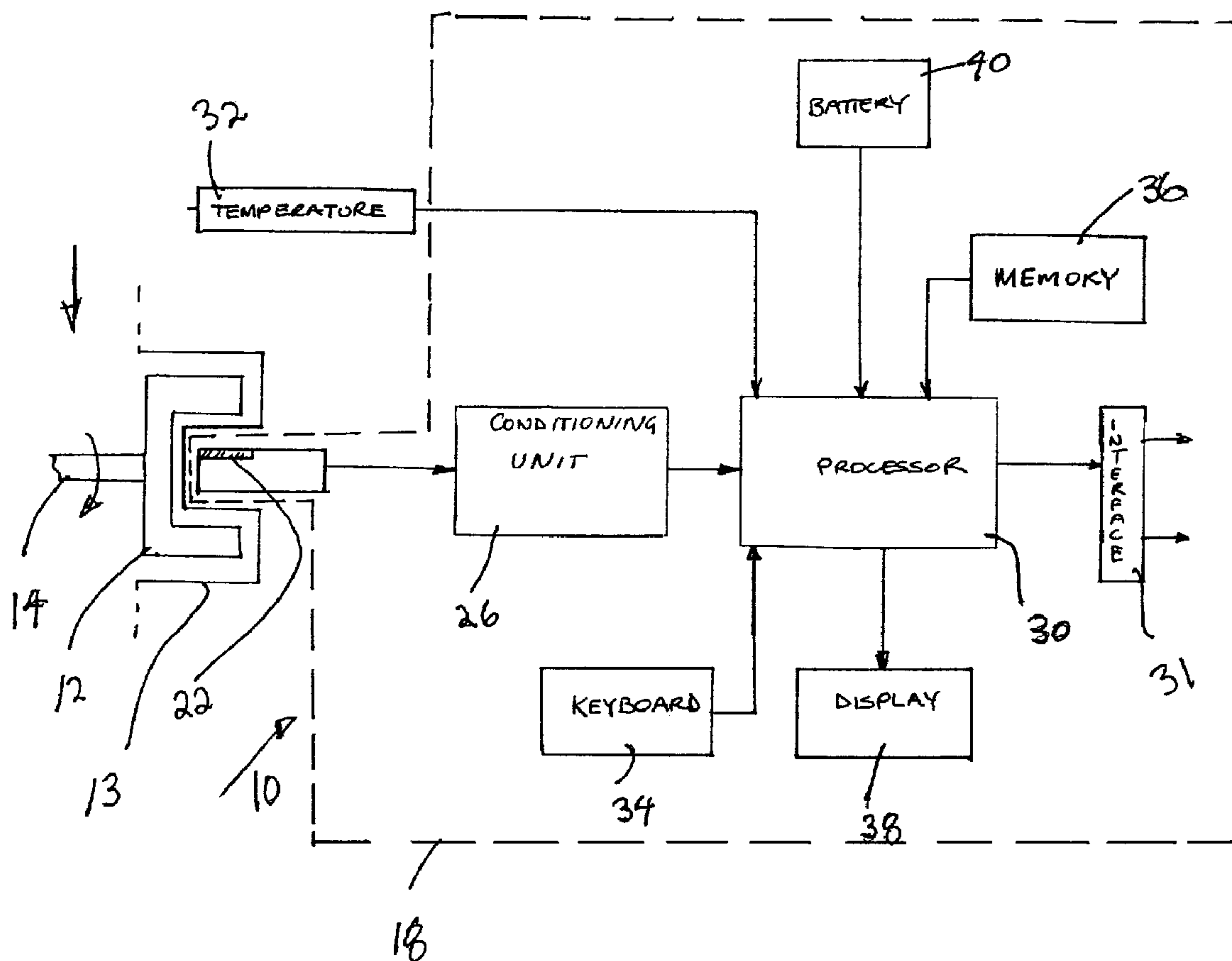
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(54) Titre : COMPTEUR DE GAZ ELECTRONIQUE

(54) Title: ELECTRONIC GAS METER



(57) Abrégé/Abstract:

According to the present invention, there is provided an electronic device for correcting a volume indicated by a gas meter, the device comprising pulse input means, connected to the gas meter for receiving pulses, means for determining a rough uncorrected



(57) **Abrégé(suite)/Abstract(continued):**

volume from the pulses, means for determining a flow rate from the rough uncorrected volume and the frequency of pulses, memory means for storing a table comprising a plurality of meter factors each factor being indicative of a respective percentage of a maximum flow rate for the meter, means for calculating an uncorrected volume by multiplying an appropriate meter factor with the rough uncorrected volume such that the uncorrected volume is indicative of an uncompensated flow rate through the meter.

ABSTRACT

According to the present invention, there is provided an electronic device for
5 correcting a volume indicated by a gas meter, the device comprising pulse input means,
connected to the gas meter for receiving pulses, means for determining a rough
uncorrected volume from the pulses, means for determining a flow rate from the rough
uncorrected volume and the frequency of pulses, memory means for storing a table
comprising a plurality of meter factors each factor being indicative of a respective
10 percentage of a maximum flow rate for the meter, means for calculating an uncorrected
volume by multiplying an appropriate meter factor with the rough uncorrected volume
such that the uncorrected volume is indicative of an uncompensated flow rate through the
meter.

ELECTRONIC GAS METER

This invention relates to gas meters such as positive displacement rotary, turbine
5 or diaphragm meters.

BACKGROUND OF THE INVENTION

Conventional gas meters that measure the volume of flowing gas by mechanical means require correction because they do not take into account the effect of pressure and
10 temperature on volume. Generally, a volume measuring type gas meter measures gas volume by passing a stream of gas through a chamber in the gas flow line. In the case of rotary meters the flow of gas through the chamber causes rotation of impellers inserted in the chamber. Rotation of the impellers causes a predetermined volume of gas to be displaced through the chamber. By knowing the volume of gas displaced by a rotation of
15 the impeller at predetermined conditions of temperature and pressure, revolutions of the impellers may be correlated to volumes of gas passing through the chamber. Thus, changes in temperature and pressure of the gas will correspondingly effect the volume of gas displaced by each revolution of the impellers.

It is therefore usually desirable to correct the actual measured volume to the
20 corresponding volume as if measured at a standard base condition of pressure and temperature.

Mechanical meters provide a measurement of gas volume or usage by displacement of a know volume of gas per revolution of the impeller. The known volume of gas is a function of the mechanical configuration of the meter. As outlined earlier,
25 both temperature and pressure of the gas affect volume and, therefore, it is necessary to employ a correction mechanism to compensate for these changes in temperature and pressure. Mechanical meters, however, are designed to operate at different maximum flow rates. Generally, higher flow rates expected in a given gas pipeline will require larger mechanical gas meters. However, meters designed to measure at higher maximum
30 flow rates may not be particularly accurate at low rates, since the volume of gas through the meter is measured by the movement of a mechanical device such as a diaphragm, impeller, turbine and such like. Thus, the gas in moving these mechanical devices does a

certain amount of work on the meter, the affect of this is more significant at low flow rates. The subsequent measurement of the volume is less accurate at these lower flow rates. It has been found that the accuracy of these meters decreases at flow rates approximately 10% of the maximum flow rate for a specific meter. Therefore, it is usually desirable to correct the actual measured volume not only to accommodate changes in temperature and pressure, but also changes in flow rate, and in particular, to compensate for inaccuracies of the meter when measuring a low rate.

A number of devices have been developed to take into account the effect of pressure and temperature on volume. These devices provide correction of volume based on the formula derived from the combination of Charles' and Boyle's laws, supplemented by a super compressibility factor as follows:

$$v = v_m \times \frac{p_m}{p_b} \times \frac{t_b}{t_m} \times z$$

where v_m is the measured uncorrected volume obtained from the meter at line pressure and line temperature,

P_m is the measured line pressure of the flowing gas,
 t_m is the measured line temperature of the flowing gas,
 P_b is the base pressure,
 t_b is the base temperature, and
 z is the square of the super compressibility factor.

Electronic correctors effecting such corrections are disclosed, for example, in U.S. Patent Nos. 3,537,312; 3,588,481; 5,455,781 and 4,910,519. None of these patents, however, disclose a system that is capable of correcting for low flow effect.

SUMMARY OF THE INVENTION

According to the present invention, an electronic device for pulse correcting the volume indicated by a gas meter, the device comprising volume input means connected to the gas meter for receiving pulses indicative of gas flow rate;

means for determining a rough uncorrected volume from the pulses;

means for determining a flow rate from the rough uncorrected volume and the frequency of pulses;

memory means for storing a table comprising a plurality of meter factors each factor being indicative of a respective percentage of a maximum flow rate for the meter;

5 and

means for calculating an uncorrected volume by multiplying an appropriate meter factor with the rough uncorrected volume such that the uncorrected volume is indicative of an uncompensated flow rate through the meter.

10 The invention also provides a method for correcting a mechanical gas meter which provides a measure of volume of gas flow, the method comprising the steps of:

receiving pulses from a pulse input means connected to the gas meter;

determining a rough uncorrected volume from the pulses;

15 determining a flow rate from the rough uncorrected volume and the frequency of pulses;

storing a table including a plurality of meter factors wherein each factor is indicative of a respective percentage of a maximum flow rate for the meter; and

20 calculating an uncorrected volume by multiplying an appropriate meter factor with the rough uncorrected volume such that the uncorrected volume is indicative of an uncompensated flow rate through the meter.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention will be obtained by reference to the detailed description below in conjunction with the following drawings in which:

25 Figure 1 is a functional block diagram of the system according to an embodiment of the invention;

Figure 2 is a graph of an output voltage pulse from a Wiegand sensor;

Figure 3 is a circuit diagram of the main processor board;

30 Figure 4 is a flow chart showing the processing steps for determining a corrected volume according to the present invention; and

Figure 5 is a graph showing the percentage error between the corrected volume and the actual volume; and

Figure 6 is a front view of a meter according to the present invention.

5 DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to Figure 1, a block diagram of an electronic volume corrector is shown generally by numeral 10. The base number impeller revolutions R_b and a displacement value V_d indicate the volume of gas flowing through a positive displacement rotary gas meter (not shown). The displacement value V_d is the volume of gas transported from the
 10 input to the output of the gas meter for one impeller revolution. Furthermore, the volume of gas displaced relates to the size of the meter.

The rotation of the impeller shaft 14 is coupled magnetically to a volume indicator shown by block 18. The volume indicator 18 measures the rotation of the shaft 14 by counting the number of pulses produced by a Wiegand sensor 22 that translates
 15 mechanical motion into electrical pulses. The Wiegand sensor 22 is a magnetic sensor that generates output pulses as alternating magnetic fields (actuators) pass near the sensor. The amplitude of the pulse is determined by the field strength of the actuator. Thus Wiegand sensors do not require external power. Thus the sensor simply requires an alternating polarity magnetic field to generate a series of pulses. Without reversing the
 20 fields, the sensor will not generate a second pulse. A typical Wiegand pulse 41 is shown in Figure 2. The actuator is formed from a ring of three magnets 12 attached to the end of the impeller shaft 14. Isolation is provided between the Wiegand sensor 22 and the gas meter by an annular wall 13 of the gas meter. Thus the gas meter and the impeller and the associated magnetic actuator may be completely sealed off from the volume indicator
 25 electronics 18.

The output from the Wiegand sensor 22 is connected to a conditioning circuit 26 which buffers the pulses before passing the pulses onto a processor 30, which processes the pulses to produce various output values of compensated and uncompensated gas volume at an output interface 31. A temperature sensor 32 provides a digital temperature
 30 input to the processor 30, indicative of the temperature of the gas flowing through the gas meter. The volume indicator also includes a keyboard 34, a memory 36 and a liquid

crystal display 38 all of which communicate with the central processor 30. A power source for the volume indicator 18 is provided by way of a lithium battery 40.

Referring now to Figure 3, a circuit diagram of the volume indicator 18 is shown in greater detail. As mentioned above signal pulses indicative of the impeller rotation are obtained from the Wiegand sensor 22 and supplied to an input port RC2 of a master microcontroller 60 (PIC16C65). The input pulse signal as shown in Figure 2 is first passed through a rectifying diode 62, the output of which is clamped by a zener diode 64, which then drives a base input connection of a transistor 66. The collector of the transistor is connected to an input port RC2 of the master microcontroller 60. The input port RC2 is also connected to a pin 28, RD7 of a slave microcontroller 67 (PIC16C63). The PIC 16CXX is a family of low-cost, high-performance CMOS fully standard 8-bit microcontrollers made by Microchip Technology Inc. The microcontrollers 60 and 67 each have a sleep (powerdown) mode which offers a power saving mode. Thus, the microcontrollers can be programmed to wake from the sleep mode through several external and internal interrupts and resets. Each of the controllers 60 and 67 has 192 bytes of RAM and five and three bi-directional I/O ports respectively. The I/O pins for the ports of slave controller 60 are referred to as RAO-RA5; RBO-RB7; RCO-RC7; RDO-RD7 and REO-RE2. In the following description a prime (') shall be used to represent the I/O pins of the slave controller e.g. RAO'. The I/O pins of port C may also be programmed to have additional functionality, which will be discussed below. The keyboard 34 comprising four push button switches (not shown) that are each connected to ports RB4, RB6 and RB7 of the master controller 60. The keyboard 34 allows various modes for the controller to be accessed and data to be entered into the controller memory.

An LCD display 68 part number ED16100GR, is driven from ports D and E of the master controller 60. Because the display board is supplied by a 3.6 volts DC battery supply 40, a step-up converter 70 is provided to convert the 3.6 volt DC voltage to a higher voltage compatible with the requirements of the liquid crystal display 68. Details of the circuit will not be described further as it is well-known in the art. In addition, an E²PROM memory 72 type NM93C86A is provided for saving of historical data and constants related to the calculation of volume and such-like. This will also be discussed in greater detail below. The E²PROM has a pair of data lines D0 and D1 which are

connected to V_0 pins RC4, RC5 and RC4' and RC5' of the controllers 60 and 67 respectively. Data read and write operations are controlled via pins CS and SK which are connected to pins RA3, RC3 and RA5' and RC3' respectively. Data to be written into this memory is driven by pins 23, 24, 18 and 7 of the PIC16C65.

5 The microcontrollers 60 and 67 are configured as a master and slave respectively. The purpose of this configuration is to ensure that the high-speed pulses received from the impeller are processed immediately by the master controller 60 while volume correction calculations and other supervisory activity is performed by the slave controller 67. This also ensures that both controllers may be operated in the sleep mode while the
10 slave is activated only when computations are to be performed. Furthermore, the master controller operates in the sleep mode and is awakened when a pulse is received at the input on pin RC2. This provides a significant energy saving which is an important feature for this type of application. A real-time timer 74 (DS 1302) has its clock output signal connected to the RA1 input of the slave controller 67. The real-time timer 74
15 provides the ability for the display to indicate time information with all critical events.

 The master controller 60 communicates data information with the slave controller 67 via pins RA4, RB0, RB1 on the master controller which are connected to respective pins RC2', RB0' and RB1' on the slave controller 67. A temperature input signal is connected to the slave microcontroller 67 at input pin RA0. The temperature
20 signal is derived from a temperature transducer 32 (shown in figure 1) which includes an analog to digital converter thus producing a 9 digit binary string value indicative of temperature. This type of temperature sensor is available from Dallas Semiconductor as part number DS1820. The slave controller 67 provides as outputs an uncorrected volume output, a corrected volume output and an alarm output, from pins RB5', RB6' and RB4'
25 respectively. Each of the output pins RB5', RB6' and RB4' are connected to respective optocouplers via transistor drivers thereby isolating the outputs from externally connected devices. A microprocessor supervisory circuit 84 (MAX825) is connected to the master clear reset voltage input MCLR and MCLR' of the master and slave controllers 60 and 67 respectively. These devices serve both to monitor the voltage level
30 V_{DD} of the battery supply to indicate a low voltage alarm, as well as to provide a master

reset to both the master and slave controllers. A second LCD display 86 is driven by the output pins RA3 and RA5' of the master 60 and slave 67 controllers respectively.

Referring now to Figure 4, the operation of the circuit will be described in conjunction with the flow chart shown therein. As indicated earlier, input pulses from the Wiegand sensor are received on pin RC2 of the master microcontroller 60. Because there are three magnets on the impeller, each revolution of the impeller 14 produces three pulses at the output of the Wiegand sensor. The total number of pulses are counted and accumulated in the master controller 60. Rough uncorrected volume is determined by multiplying the number of pulses (or the number of pulses received per revolution of the impeller) by the displacement factor V_d (previously stored in the E²PROM 72) of the given gas meter and dividing this result by three. This is given by the equation:

$$\text{RuncVol} = \# \text{ pulses} \times V_d / 3$$

When RuncVol is approximately equal to the preset volume equivalent V_{EQ1} the master controller 60 sends a pulse to the slave controller 67.

The master controller continues to monitor the incoming pulses again until a further volume equivalent of gas is measured. A second pulse is then sent to the slave controller. The slave controller thus determines a current flow rate value Q_x . As outlined earlier, all rotary meters introduce error in the volume determination if the flow rate is less than approximately 10% of the maximum flow rate Q_{max} for a given meter. Thus, this error may be compensated for by introducing a meter factor F_m . In one embodiment the meter factor F_m is derived from a look-up table as shown below, this table is stored in the E²PROM 72. The meter factors listed in the table below are merely examples for a given meter, and will vary for different meters.

Current Flow Rate	% Max Flow Rate	Meter Factor F_m
Q_r	> 10.00% Q_{max}	1.0000
Q_r	5.00% - 10.00% Q_{max}	1.0030
Q_r	4.00% - 5.00% Q_{max}	1.0050
Q_r	3.00% - 4.00% Q_{max}	1.0075

Q _r	2.00% - 3.00% Q _{max}	1.0100
Q _r	1.50% - 2.00% Q _{max}	1.0125
Q _r	1.25% - 1.50% Q _{max}	1.0150
Q _r	1.00% - 1.25% Q _{max}	1.0175
Q _r	0.75% - 1.00% Q _{max}	1.0200
Q _r	0.50% - 0.75% Q _{max}	1.0300
Q _r	< 0.50% Q _{max}	1.0500

Thus, the meter factor may be determined for various values of percentages of the maximum flow rate Q_{max}. An uncorrected volume is thus determined in the slave controller which is given by:

5

$$\text{UncVol} = \text{RuncVol} \times F_m$$

Once the uncorrected volume UncVol is determined, temperature compensation T_{comp} may also be applied to the uncorrected volume UncVol and a pressure correction factor P_{comp} may also be applied. As outlined earlier, the temperature T of the gas is
 10 obtained via the temperature transducer 32 and the corrected volume CorrVol is thus given by the products of the uncorrected volume UncVol, the temperature factor T_{comp} and a fixed factor P_{comp} where

15

$$\text{Temperature factor (T}_{\text{comp}}) = \frac{(273.15 + \text{base temperature } (^{\circ}\text{C}))}{(273.15 + \text{gas temperature } (^{\circ}\text{C}))}$$

OR

20

$$\text{Temperature factor (T}_{\text{comp}}) = \frac{(459.67 + \text{base temperature } (^{\circ}\text{F}))}{(459.67 + \text{gas temperature } (^{\circ}\text{F}))}$$

Furthermore, the pressure factor P_{comp} is determined at the time of setup and stored in the E²PROM which corresponds to the specific meter being used. The corrected volume CorrVol may then be displayed on the liquid crystal display 68 as outlined later.

Thus, two simultaneous corrections of the volume are performed. First, the
 25 uncorrected volume UncVor as determined by the rotary meter, is corrected to base conditions, ie. gas temperature, and pressure. Second, a correction of the gas meter error

for low flow below 10% of the maximum flow rate is also determined. Therefore, the rangeability of the gas meter is increased to 200:1 or even better. Finally the flow rate of the gas flowing through the meter is given by:

$$\text{Flow rate} = \text{UncVol}/\text{Time}.$$

5 Referring now to Figure 5, a graph of the percentage error versus percentage flow for a gas meter utilizing the low-flow correction and for a gas meter without low flow correction is shown generally by numerals 92 and 94 respectively. It may be seen that the percentage error in the low flow region of below 10% of maximum flow is approximately 0.5 %.

10 The meter employs various safety features. For example, should any of the inputs fail, for example, should there be a failure in the inputs or an alarm condition should occur, the slave controller automatically stops the output pulses to both the corrected outputs 76 and the uncorrected outputs 78 and switches or pulses the alarm output 82 with the uncorrected value. At the same time, a date stamp of the time and date of the
15 alarm condition is saved to the E² PROM. Furthermore, should there be a low battery condition detected, the values of corrected and uncorrected volume and accumulated volumes are saved to the E²PROM along with its corresponding date stamp. This may be used to recover historical data to resume normal operations of the meter. Thus all data is not lost should the battery supply fail.

20 The controller may also be operated in one of many modes which include normal mode, proving mode, calibration mode, temperature correction test mode, setup mode, diagnostic mode and a custom display mode. In the proving mode, the pulses for a given volume equivalent which represent the uncorrected volume determined by the meter are delivered to an output and used as an input signal to the prover. The essential difference
25 between the normal and proving modes is the minimum value of pulses generated for a volume equivalent, ie. 0.01 m³ for metric and 1 ft³ for imperial meters. Introducing these values in normal mode will increase power consumption and decrease battery life, therefore having lower pulse intervals reduces overall power consumption.

The calibration mode is generally utilized to calibrate the temperature sensor, the
30 temperature sensor 32 is placed in a temperature bath (not shown) at a known temperature. The gas temperature is also measured by a thermometer and displayed, thus

the operator may employ a correction factor to adjust the displayed temperature as read by the gas meter to that of the known temperature of a thermometer in the temperature bath.

Referring now to figure 6, a plan view of the showing the outside of the basic meter unit is shown generally by 100. A front face 102 includes two cut-out sections 104 and 106 which accommodates the liquid crystal displays 68 and 69 described with reference to figure 3. Arranged along a lower portion of the front face 102 are the three four keyboard buttons designated by 108, 110, 112 and 114 respectively. These buttons have the functions respectively of "esc", "ent", up and down respectively. The upper display 104 is generally utilized to indicate meter readings and set values while the lower display 106 is utilized as an entry display for entering, updating and monitoring various parameters and settings of the meter. It is to be noted that the software implemented in the microcontrollers allows setting of the gas meter parameters to be selected from a list of displayed options. This obviates the need for a alpha numeric keyboard and also provides strict control of critical parameters related to the calculation of gas volume.

In the temperature corrections test mode (tc test mode) the accuracy of the temperature correction is performed. In this mode, the controller is set to read the impeller pulses. These pulses are processed and on the basis of a known number of pulses the volume equivalent is calculated, to which is then applied the temperature correction. This corrected volume is displayed on the upper display 106. It is to be noted that in this mode only temperature correction is employed i.e. no low flow error correction or fixed factor correction is employed.

In the normal mode, pressing the escape key presents a menu list of selectable modes in the AD window. One of these entries may be selected by using the up and down scroll keys and then pressing the "ent" key. If one of the set up, proving, calibration or "tc" test modes is selected, a four digit password is required. The password once entered allows access to the requisite mode.

In the set up mode, the user may select various options such as meter type. The following is a list of menu options available to the user in the various modes described above.

SET BASE TEMPERATURE

This allows the user to select the base temperature.

SET FIXED FACTOR

- 5 This is selected from a prestored set of values.

SET DATE D/M/Y

This allows the user to scroll through and select, individually, the day, month and year.

10 SET TIME H/M/S

This allows the user to scroll through and select, individually, the hour, minute and second.

SET UNC UNITS CF (for imperial meters)

- 15 This is a multiplication factor for an uncorrected volume in ft^3 presented on ETC's display. There is a possibility to choose numbers: 1, 10, 100, 1000, 10000.

SET UNC UNITS CM (for metric meters)

- 20 This is a multiplication factor for an uncorrected volume in m^3 presented on ETC's display. There is a possibility to choose numbers: 0.01, 0.1, 1, 10, 100.

SET COR UNITS CF (for imperial meters)

- 25 This is a multiplication factor for an corrected volume in ft^3 presented on ETC's display. There is a possibility to choose numbers: 1, 10, 100, 1000, 10000.

SET COR UNITS CM (for metric meters)

- 30 This is a multiplication factor for an corrected volume in m^3 presented on ETC's display. There is a possibility to choose numbers: 0.01, 0.1, 1, 10, 100.

SET UNC OUT CF (for imperial meters)

- 35 This is a volume equivalent for uncorrected output pulses. There is a possibility to choose values: 10, 100, 1000, 10000.

SET UNC OUT CM (for metric meters)

This is a volume equivalent for uncorrected output pulses. There is a possibility to choose numbers: 0.1, 1, 10, 100.

5 SET COR OUT CF (for imperial matters)

This is a volume equivalent for corrected output pulses. There is a possibility to choose values: 10, 100, 1000, 10000.

SET COR OUT CM (for metric meters)

10 This is a volume equivalent for corrected output pulses. There is a possibility to choose numbers: 0.1, 1, 10, 100.

RESET PEAK FLOW

15

CLEAR ALARM FLAG

20 SET CUST DISPLAY

If operator chooses this mode by pressing ENT the all items from DIAGNOSTIC MODE will appear when UP and DOWN keys are used. By pressing ENT when particular item is presented on display this item will be included in CUSTOM DISPLAY mode.

25

SET UNC DIGITS

Operator chooses the number of digits presenting uncorrected volume.

30 SET COR DIGITS

Operator chooses the number of digits presenting corrected volume.

35 SET UNC* ... CF
SET UNC* ... CM
SET COR* ... CF
SET COR* ... CM

Set value of:

40 Uncorrected volume for imperial (ft³) or metric (m³) meters,
Corrected volume for imperial (ft³) or metric (m³) meters.

DIAGNOSTIC MODE

45 Time out to normal mode: thirty seconds if no button pressed.
There is an access to following data:

- display test
- type of the meter
chosen in setup
- 5 - value of base temperature
chosen in setup
- live value of gas temperature
- determined by temperature sensor
- value of fixed factor
- 10 - entered by operator
- value of temperature factor
calculated by ETC on the base of measured gas temperature
- value of total correction factor
TEMPERATURE FACTOR X FIXED FACTOR
- 15 - DATE
- TIME
- Value of uncorrected volume multiply by chosen factor
- Value of corrected volume multiply by chosen factor
- Value of flow rate
- 20 - Calculated by ETC
- value of peak flow rate
Calculated by ETC
- date of peak flow rate occurrence
- time of peak flow rate occurrence
- 25 - reset date of peak flow rate value
- reset time of peak flow rate value
- volume equivalent of uncorrected pulses
chosen in setup
- volume equivalent of corrected pulses
- 30 - chosen in setup
- last stored value of uncorrected volume
ETC memorized some values every one hour
- last stored value of corrected volume
- last stored date
- 35 - last stored time
- temperature sensor malfunction date
- temperature sensor malfunction time
- value of uncorrected volume since temperature sensor malfunction occurred

40 While the invention has been described in connection with a specific embodiment thereof and in a specific use, various modifications thereof will occur to those skilled in the art without departing from the spirit of the invention as set forth in the appended claims. For example the pressure correction factor may also be implemented by an active pressure sensor providing realtime continuous pressure correction. Furthermore, the low

flow correction may be implemented by interpolation on a mathematical function or other suitable methods.

The terms and expressions which have been employed in the specification are used as terms of description and not of limitations, there is no intention in the use of such
5 terms and expressions to exclude any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the claims to the invention.

CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An electronic device for correcting the volume indicated by a gas meter, the device comprising:

volume pulse input means connected to the gas meter for receiving pulses indicative of flow rate volume;

means for determining a rough uncorrected volume from the pulses;

means for determining a flow rate from the rough uncorrected volume and the frequency of pulses;

memory means for storing a table comprising a plurality of meter factors each factor being indicative of a respective percentage of a maximum flow rate for the meter;

and

means for calculating an uncorrected volume by multiplying an appropriate meter factor with the rough uncorrected volume such that the uncorrected volume is indicative of an uncompensated flow rate through the meter.
2. A device as defined in claim 1 wherein said calculating is applied after at least two pulses have been received.
3. A device as defined in claim 1 wherein said pulse input means is a magnetic sensor for detecting changing magnetic field created by a magnet rotated by said gas meter.
4. A device as defined in claim 3 wherein said magnetic sensor is a Wiegand sensor producing high frequency pulses.

5. A device as defined in claim 1, further including a temperature indicating means exposed to the gas and for producing a value indicative of the temperature of said gas.
6. A device as defined in claim 1 wherein said means for determining a rough uncorrected volume is a master microcontroller.
7. A device as defined in claim 6 wherein said means of calculating uncorrected volume is a slave microcontroller.
8. A device as defined in claim 1 wherein said rough uncorrected volume is calculated by multiplying the number of pulses received, in a given time, by the displacement of the gas meter, and dividing by the number of pulses received in a single revolution of the gas meter.
9. A device as defined in claim 7, wherein said master microcontroller transmits to said slave microcontroller a pulse indicative of a volume equivalent determined by said master microcontroller.
10. A device as defined in claim 9, wherein said slave controller determines a current flow rate, Q_r , by counting said pulses received from said master microcontroller and dividing said number of pulses received from said master microcontroller by a value indicative of the time difference between said pulses and selecting from said table a meter factor, F_m , corresponding to said calculated current flow rate in order to calculate said uncorrected volume.

11. A device as defined in claim 5, further including a means for calculating a temperature factor, said factor being a ratio of a predetermined base temperature and said measured gas temperature.
12. A device as defined in claim 11, wherein said temperature factor is applied to said uncorrected volume, UncVol, by multiplying said temperature factor with said uncorrected volume to produce a corrected volume, CorrVol.
13. A device as defined in claim 12, further including a means for storing a pressure factor, P_{comp} , and wherein said corrected volume, CorrVol, may be corrected for pressure by multiplying said pressure factor by said corrected volume.
14. A device as defined in claim 1, wherein the volume pulse input means is connected to the gas meter directly, while rough uncorrected volume is computed electronically.
15. A device as defined in claim 1, wherein the memory means is non-volatile memory means.
16. A device as defined in claim 1, wherein the non-volatile memory is an interchangeable high capacity serial EEprom.
17. An electronic device for correcting the volume indicated by a gas meter, the device comprising:

volume pulse input means connected to the gas meter for receiving pulses indicative of flow rate volume;

means for determining a rough uncorrected volume from the pulses;

means for generating internally volume equivalent pulses representing the rough uncorrected volume;

means for determining a flow rate from the volume equivalent pulses and the frequency of the pulses;

memory means for storing a table comprising a plurality of meter factors each factor being indicative of a respective percentage of a maximum flow rate for the meter; and

means for calculating an uncorrected volume by multiplying an appropriate meter factor with the rough uncorrected volume such that the uncorrected volume is indicative of an uncompensated flow rate through the meter.

18. A method for correcting a mechanical gas meter which provides a measure of volume of gas flow, said method comprising the steps of:

- (a) receiving pulses from a pulse input means connected to the gas meter;
- (b) determining a rough uncorrected volume from the pulses;
- (c) determining a flow rate from the rough uncorrected volume and the frequency of pulses;
- (d) selecting a factor from a stored table including a plurality of meter factors wherein each factor is indicative of a respective percentage of a maximum flow rate for said meter; and
- (e) calculating an uncorrected volume by multiplying an appropriate meter factor with said rough uncorrected volume such that the uncorrected is indicative of an uncompensated flow rate through said meter.

19. A method for correcting a mechanical gas meter which provides a measure of volume of gas flow, said method comprising the steps of:

- (a) receiving pulses from a pulse input means connected to the gas meter;

- (b) determining a rough uncorrected volume from the pulses;
- (c) generating internally volume equivalent pulses representing the rough uncorrected volume
- (d) determining a flow rate from the volume equivalent pulses and the frequency of the pulses;
- (e) selecting a factor from a stored storing a table including a plurality of meter factors wherein each factor is indicative of a respective percentage of a maximum flow rate for said meter; and
- (f) calculating an uncorrected volume by multiplying an appropriate meter factor with said rough uncorrected volume such that the uncorrected is indicative of an uncompensated flow rate through said meter.

20. An electronic device for correcting the volume indicated by a gas meter, the device comprising:

volume input means, connected to the gas meter for receiving pulses indicative of flow rate volume;

means for determining a rough uncorrected volume from the pulses;

means for determining a flow rate from the rough uncorrected volume and the frequency of pulses;

memory means for storing a table comprising a plurality of meter factors each factor being indicative of a respective percentage of a maximum flow rate for the meter;

means for calculating an uncorrected volume by multiplying an appropriate meter factor with the rough uncorrected volume such that the uncorrected volume is indicative of an uncompensated flow rate through the meter;

alpha numeric display means for successively displaying said uncorrected volume; and

a keyboard for providing user input to said device.

21. A device as defined in claim 20, wherein said volume input means is a magnetic sensor for detecting changing magnetic field created by a magnet rotated by said gas meter.
22. A device as defined in claim 21, wherein said magnetic sensor is a Wiegand sensor producing high frequency pulses.
23. A device as defined in claim 20, further including a slave controller for determining a current flow rate, Q_r , by counting said pulses received from said master controller and dividing said number of pulses received from said master controller by a value indicative of the time difference between said pulses and selecting from said table a meter factor, F_m , corresponding to said calculated current flow rate in order to calculate said uncorrected volume.
24. A device as defined in claim 20, wherein the memory means is non-volatile memory means.

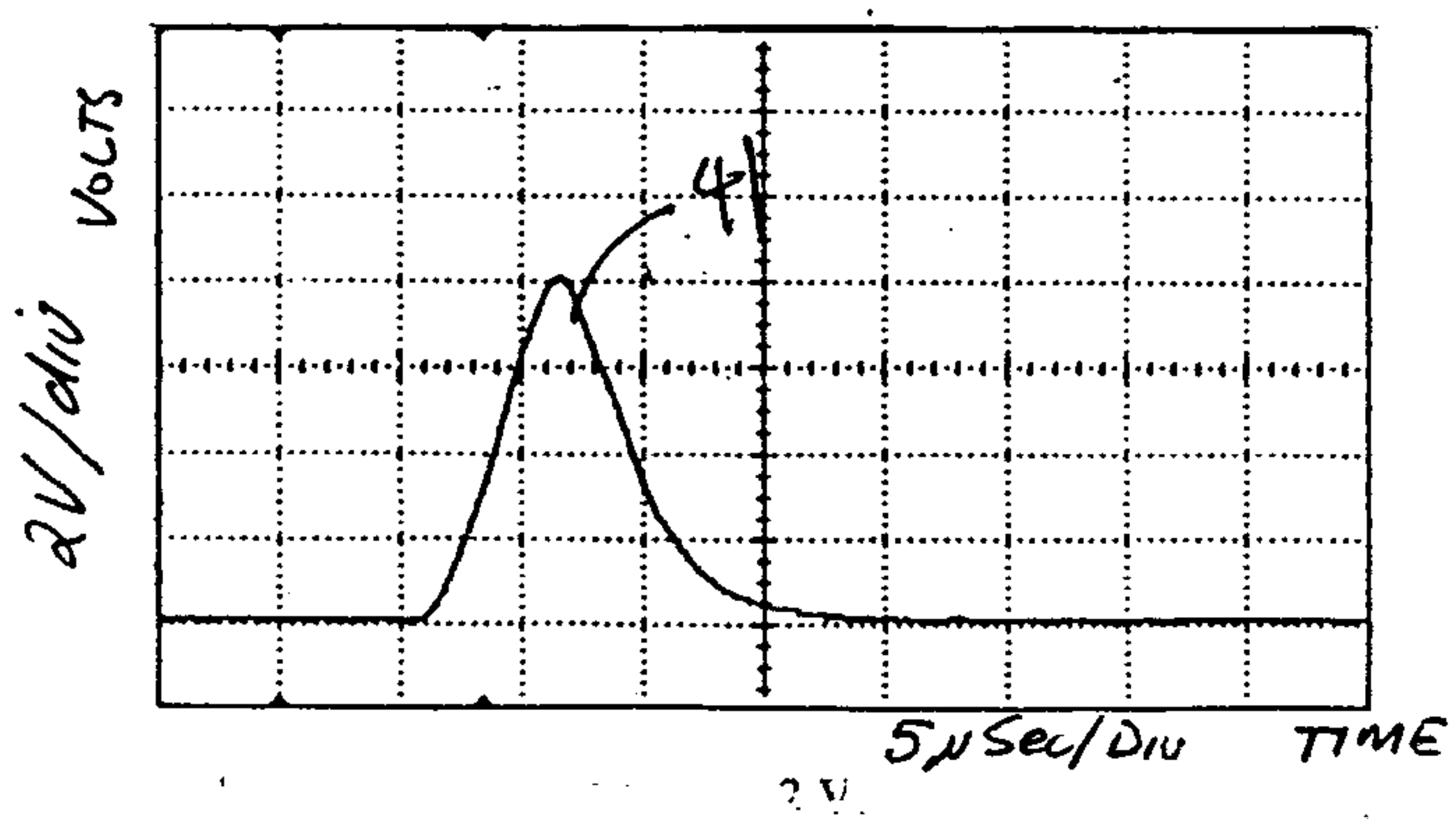
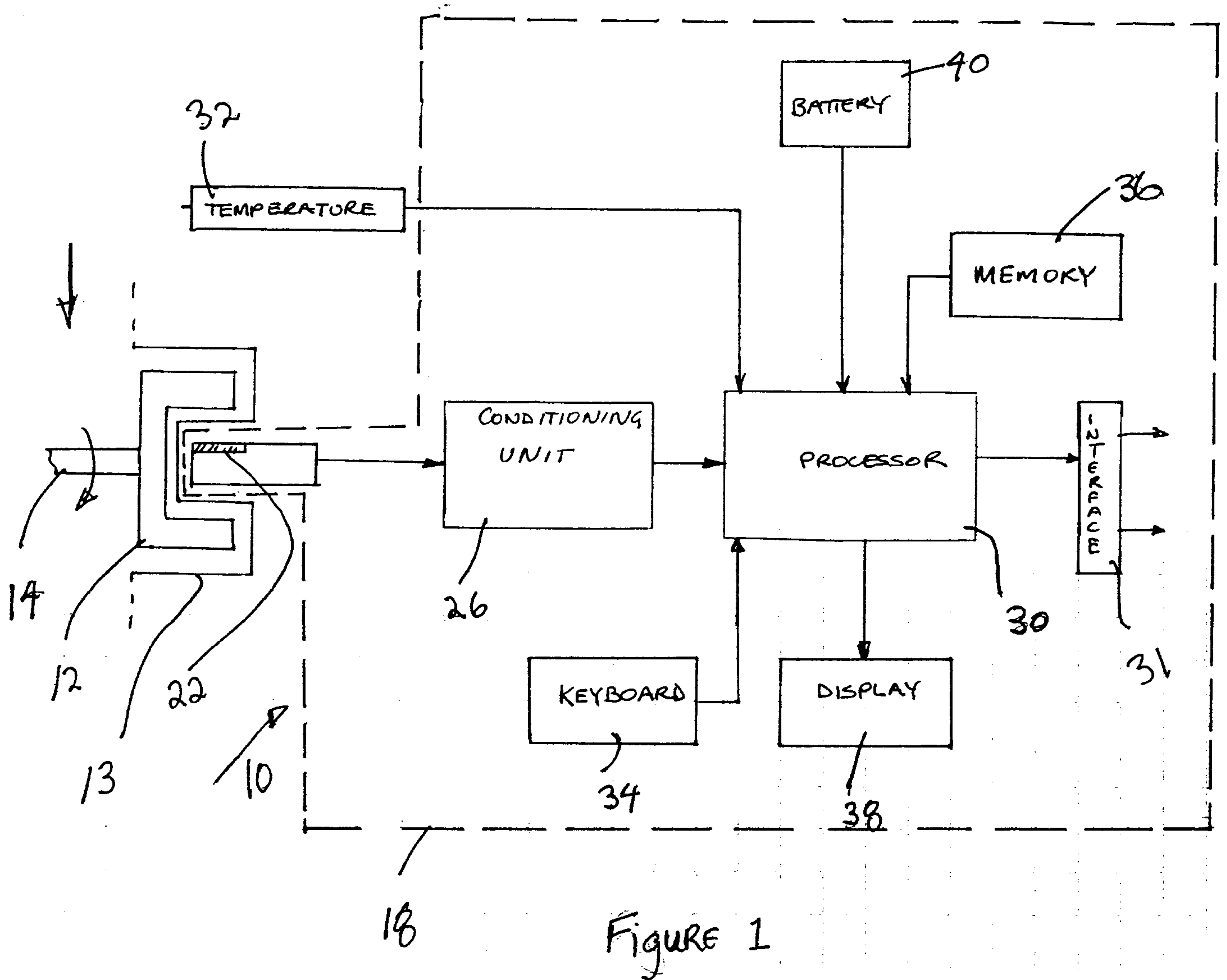


FIGURE 2

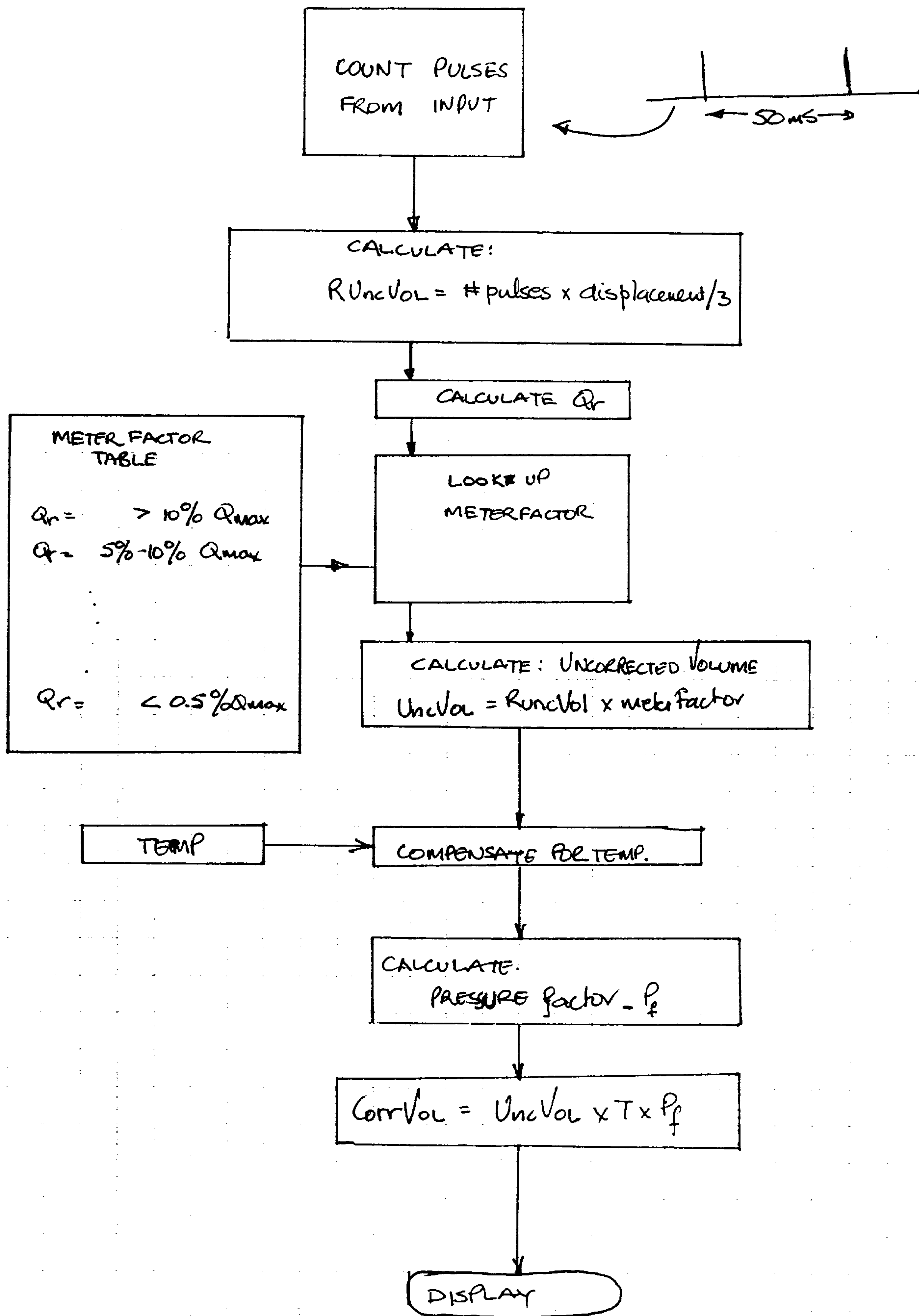


FIGURE 4.

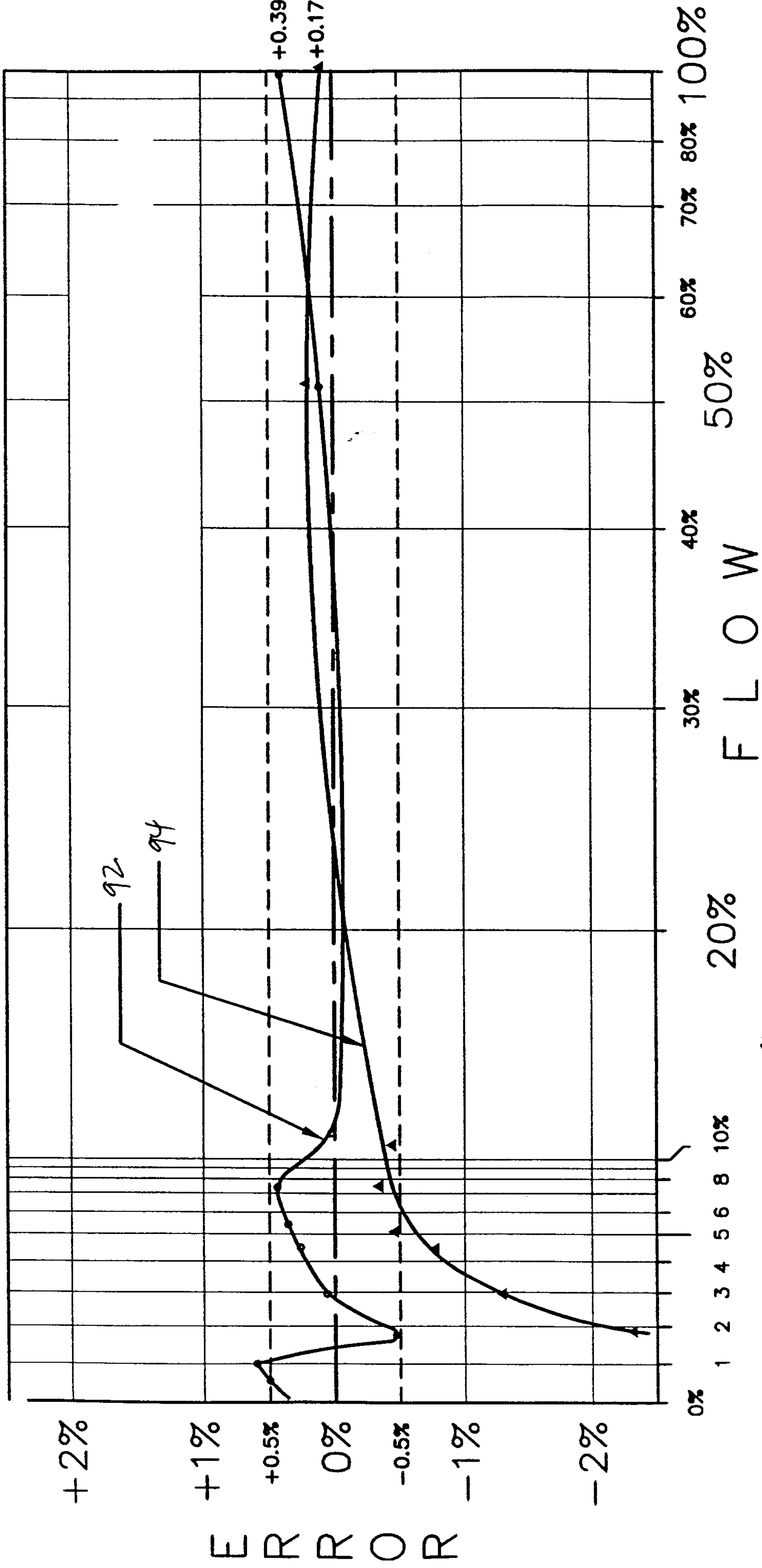


Figure 5

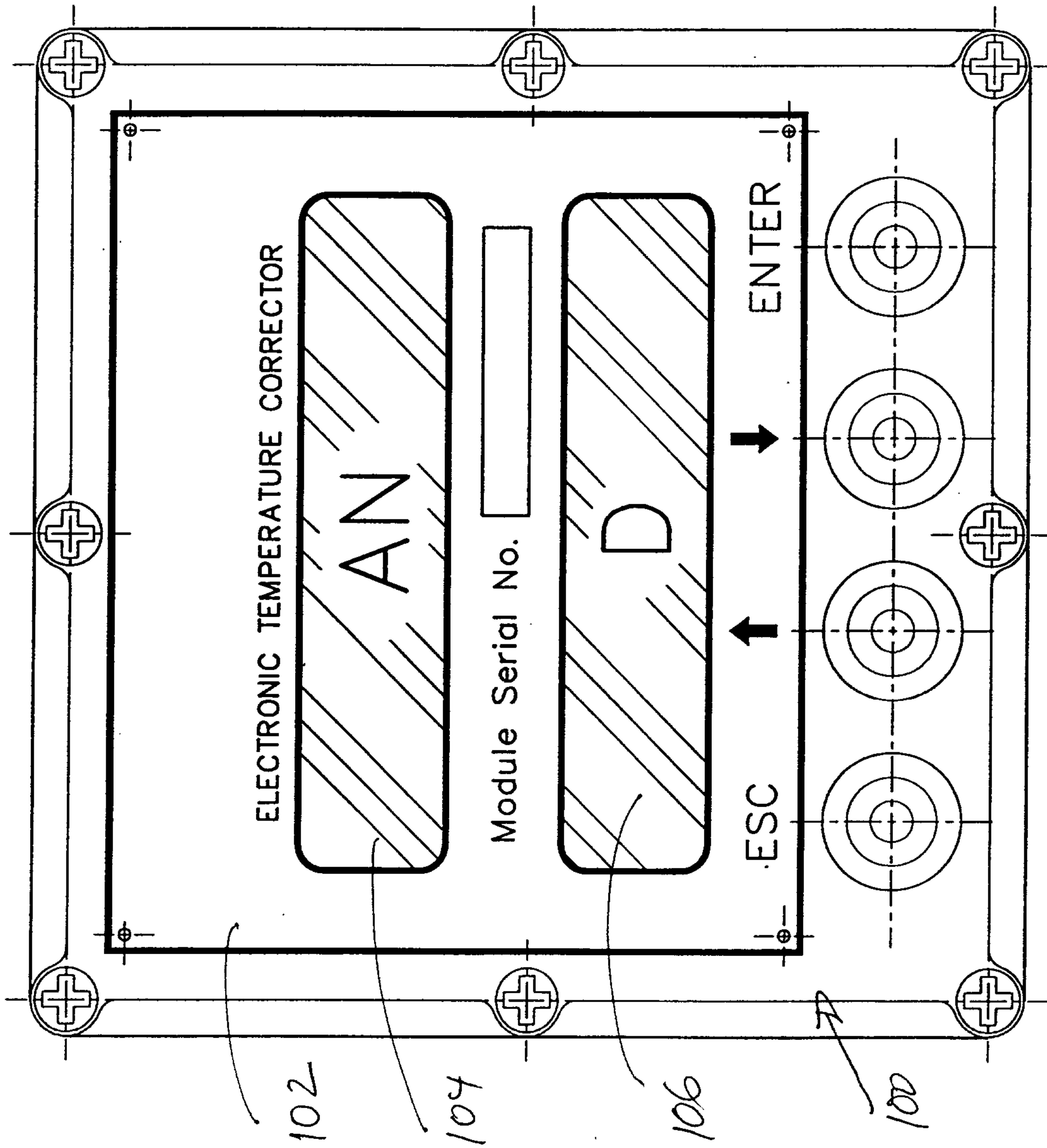


FIGURE 6

