(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 119 057**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **10.08.88**

(51) Int. Cl.[4]: **B 05 B 12/00**

(21) Application number: **84301516.5**

(22) Date of filing: **07.03.84**

(54) **Dispenser malfunction detector.**

(30) Priority: **10.03.83 US 474201**

(43) Date of publication of application:
19.09.84 Bulletin 84/38

(45) Publication of the grant of the patent:
10.08.88 Bulletin 88/32

(84) Designated Contracting States:
DE FR GB

(56) References cited:
FR-A-2 135 505
US-A-3 763 380
US-A-4 313 111
US-A-4 420 957

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EP 0 119 057 B1

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Courier Press, Leamington Spa, England.

Description

This invention relates to monitoring devices and more particularly relates to monitoring devices used to detect malfunctioning fluid dispensers.

Typical fluid dispensing systems in one form include a pump having an inlet connected to a supply of material and a discharge connected to a dispenser. For precision dispensing, the dispenser may include a valve which permits fluid to pass through a discharge opening such as a nozzle or fluid tip. In some systems the dispenser valve is operated by a programmed control device so that fluid is dispensed in precise or metered amounts.

In many applications it is often desirable that precise patterns, metered amounts or both be dispensed. In operation, precision or accurate metering is affected by many factors including nozzle wear, fluid impurities, nozzle clogging, and pump performance.

Clogging of the material flow path, especially in the dispenser, is a typical problem that adversely affects the performance of precision dispensing systems. For example, in precision dispensing system used to coat the interior surface of multipiece can bodies, a clogged or worn nozzle may cause the can body to be incompletely or improperly coated.

The can bodies are typically coated during the process of manufacture at rates of up to many hundreds of cans per minute. Thus, an improperly functioning dispenser and more particularly a clogged or worn nozzle can result in many improperly coated cans before detection by inspection or other known means. An improperly coated can may have an adverse effect on the can's ability to function for storage. In some cases, the can may suffer accelerated deterioration (i.e., shortened shelf life), and in others (e.g. for foods and beverages) the contents may be adversely affected (e.g., taste, spoilage). Improper coating, therefore, is undesirable and may also be costly because cans that are improperly coated typically are not usable.

Other systems, for example, those involving the precise deposition of thermoplastics or similar materials, are also susceptible to clogging. An example of such a system is described in U.S.—A—4,166,246-Matt. These systems are typically used in the manufacturing of packaging (e.g., cardboard cartons) and in product assembly. Clogging of the dispensing system may result in defective products and in turn result in delays or otherwise introduce undesirable additional costs in the manufacturing process.

Clog sensing systems heretofore known are not applicable or useful for the accurate and prompt clog sensing desired. For example, U.S.—A—4,072,934-Hiller, et al., discloses a method and apparatus for detecting blockages in a vapor flow line such as those used in liquid gasoline dispensing systems. Such an apparatus would not be useful in a precision coatings application because the nozzle condition, whether clogged or worn, cannot be determined. Hiller et al. determines whether a blockage exists in a vapor line by sensing the pressure on either side of the clog and activating an alarm when the differential pressure exceeds a predetermined maximum value.

U.S.—A—3,816,025-O'Neill describes a fluid circulation system for a paint spray installation. A secondary recirculation loop pressure sensor senses the pressure in the secondary loop dropping below a preselected value in order to shut down the paint supply pump if a paint flow line should break.

U.S.—A—4,315,317-Orchard et al. discloses a measuring, computing and recording system for monitoring of spray application parameters for pesticides dispensed from an aircraft. Orchard et al. records pressure information, total liquid volume, liquid flow rate, spray passes and spray time. The user is required to interpret the results of the items recorded to determine whether among other things a clog condition is present. Such a delay in system condition determination is wholly unacceptable for precision coating applications such as the can body example illustrated above.

U.S.—A—3,482,781-Sharpe contains a paint spray gun which uses air to atomize the paint during dispensing. A pressure gauge is affixed to the gun to indicate the pressure of the atomizing air during dispensing operation. This device cannot accurately and reliably determine whether the paint flow path is clogged.

EP—A—0061922 describes a method and system for continuous spraying including monitor means for evaluating dispenser operation and control means for providing signals to the dispenser for controlling the output of the dispenser. A pressure sensing means is attached to the dispenser feedline to provide signals to a comparator and voltage monitor for comparison with predetermined pressure control limits. The comparator generates a malfunction system which can either operate an alarm or be used to automatically adjust the system.

In accordance with one aspect of the invention a monitor means for evaluating dispenser operation and for a system incorporating a dispenser for fluid under pressure and control means providing operation signals to the dispenser for controlling the open and closed conditions of the dispenser comprises sensing means, attached to the dispenser to sense the pressure of the fluid therein and generate a pressure signal reflective of the fluid pressure; and comparison means, connected to receive the pressure signal and the operation signal, for comparing the pressure signal to a preselected band of pressure values having a first pressure value at one end and a second pressure value at the other wherein the comparison is effected when the controller provides an operation signal to open the dispenser, and wherein the comparison means generates a malfunction signal when the pressure signal is

outside of the band of pressure values characterised in that the control means provide cyclical operation signals to the dispenser for controlling the cyclical open and closed conditions of the dispenser and in that the comparison is disabled when the controller provides an operation signal to close the dispenser.

Preferably, a second comparator is provided to compare the fluid pressure signal to a preselected pressure value when the dispenser is not open. If the fluid pressure signal exceeds the preselected pressure value, a malfunction signal is generated to indicate that the system pump is malfunctioning or that the system fluid pressure is inadequate.

In accordance with another aspect of the invention a system with a dispenser for fluid under pressure control means providing operation signals to the dispenser for controlling the open and closed conditions of the dispenser and monitor means for evaluating dispenser operation, the monitor means comprises, sensing means, attached to the dispenser to sense the pressure of the fluid therein and generate on electrical pressure signal indicative of the fluid pressure; conditioning means connected to receive the electrical pressure signal, for conditioning the pressure signal to an analog pulse signal, switching means connected between the sensing means and the conditioning means and comparator means connected to receive the conditioned analog signal and the operation signal, for comparing the analog signal to first and second preselected analog values when the operation signal indicates the opening of the dispenser and for generating a malfunction signal indicative of the analog signal not being between the first and second analog values inclusive, characterised in that the control means provide cyclical operation signals to the dispenser for controlling the cyclical open and closed conditions of the dispenser and in that the switching means are responsive to the operating signals to pass the pressure signal to the conditioning means when the controller provides an operation signal to open the dispenser and to block the pressure signal when the controller provides an operation signal to close the dispenser.

The invention will now be further described by way of example with reference to the accompanying drawings in which:—

Figure 1 is a diagram of a dispenser system in accordance with the invention;

Figure 2 is a block diagram of the monitor depicted in Figure 1;

Figure 3 is a block diagram of an alternate embodiment of a system of the invention;

Figure 4 is a circuit diagram of the pre-shaper circuit of Figure 3;

Figure 5 is a circuit diagram of the switch and signal shaper of Fig. 3;

Figure 6 is a circuit diagram of the first signal comparator circuit of Fig. 3;

Figure 7 is a circuit diagram of the stretcher circuit of Fig. 3;

Figure 8 is a circuit diagram of the clamp circuit of Fig. 3;

Figure 9 is a circuit diagram of the second signal comparator circuit of Fig. 3;

Figure 10 is a circuit diagram of the information processor circuit of Fig. 3; and

Figure 11 is graph of wave forms at different points in Figs. 4 through 10, during different phases of the dispensing operation and during different dispensing conditions.

Referring to the drawings, Figure 1 shows a monitor 15 connected in a dispensing system comprised of primary dispenser 20, dispenser controller 22 and fluid source 30. The dispenser controller 22 provides an enable signal via conductors 23 to energize solenoid 24 which in turn opens a valve (not shown) in dispenser 20 to allow the fluid from the source 30 to flow through nozzle 26. The fluid to be dispesed by dispenser 20 is continuously circulated by a reciprocating pump 31 through a heated hose 33, dispenser 20, and hose 34 as shown. A sensor 40 is affixed to dispenser 20 to provide a signal reflective of the pressure of the fluid within the dispenser 20.

The dispenser 20 is preferably of the type described and illustrated in U.S. Patent Application Serial No. 339,730, filed January 15, 1982, which is assigned to the assignee of the instant invention and the disclosure of which is incorporated herein by reference.

In a preferred embodiment of the instant invention, sensor 40 is a transducer which provides an electrical signal reflective of the pressure sensed. The signal is transmitted via conductors 42 to the monitor 15. Monitor 15 also receives the enable signal provided by dispenser controller 22 via conductors 23 and 50. Monitor 15 compares the sensed pressure signal to a preselected range of pressures each time an enable signal is generated by controller 22. The magnitude or value of pressures against which the sensor signal is compared are pre-selected empirically to be reflective of nozzle 26 being clogged or worn.

Switch 62, shown in Fig. 2, is a normally open switch which closes for the duration of the enable signal from controller 22. As used herein and in the claims the terms "operation signal" and "controller signal" are used interchangeably and refer to the signal emanating from controller 22 to cyclically open and close dispenser 20 whereas the term "enable signal" refers to that portion of the operation signal which is effective to open dispenser 20. Upon closing of the switch 62, the sensor signal passes through to the signal shaper 64, which changes the pressure signal into substantially pulse form before it is transmitted to the signal comparator 66. Comparator 66 compares the magnitude of the pulse signal received from shaper 64 to pre-selected pressure values. If the magnitude of the shaped signal is outside the range of pre-selected pressure values, a malfunction signal is supplied to ouptut 68.

In a preferred embodiment of the instant invention, monitor 15 also includes an information processor 70. Information processor 70 recives

the signal from the comparator output 68 and the enable signal from the controller 22 for example to increment a counter, or activate an alarm which may be audible, visual or both as selected by the user.

In the alternate embodiment shown in Fig. 3, monitor 15 receives an electrical signal from sensor 40 via conductors 42 to a pre-shaper (not shown). The pre-shaper conventionally pre-amplifies the AC and DC components of the pressure signal received from sensor 40 and inverts the pressure signal so that a drop in pressure is reflected by a positive signal amplitude.

The signal from controller 22 is transmitted through conductor 50 to a stretcher 100 which makes the enable portion of the control signal longer in time or stretched. The stretched control signal ensures that the portion of the controller signal which causes dispenser 20 to close will not be transmitted through monitor 15 until after the dispenser has actually closed. The stretched signal is thereafter transmitted to OR gate 199 and second signal comparator 500 by conductor 101. The output of OR gate 199 follows the shape of the stretched pulse signal provided by conductor 101 if the signal generated by information processor 600 on conductor 601 is low. Accordingly, a signal substantially indentical to that transmitted from stretcher 100 to OR gate 199 is transmitted to the switch and signal shaper 200, first signal comparator 300 and information processor 600. Switch and signal shaper 200 functions substantially the same as switch 62 and shaper 64 described hereinbefore and more fully illustrated in Fig. 5. The first signal comparator 300 compares the signal received via conductor 201 with a preselected band of pressure values which are reflective of dispenser 20 operating in a predetermined manner. A malfunction signal is generated reflective of this comparison and transmitted through comparator 300 to information processor 600. Comparator 300 will only operate on the signal from conductor 201 when the dispenser 20 is enabled by the controller 22.

It should be noted that when the dispenser has not been enabled by controller 22 the signal from sensor 40 reflects information about the fluid source 30 and pump operation. The pump circulates fluid from the fluid source through dispenser 20 back to the fluid source. When a continuous action reciprocating pump is incorporated into the system, a pressure drop occurs between strokes. In a properly functioning pump, such as manufactured by Nordson Corporation, Amherst, Ohio, this pressure drop is approximately 30 to 40 psi (2×10^5 to 3×10^5 N/M^2). Should the pump performance deteriorate, for example because of worn seals, the pressure drop between strokes is approximately between 100 to 200 psi (5×10^5 to 15×10^5 N/m^2). Thus, comparing this signal to a preselected pressure value reflective of the pressure in a properly operating pump, proper performance can be monitored and mechanical defects such as a worn seal detected. This is accomplished by pasing the signal from the pre-shaper through clamp 400. Clamp 400 serves to suppress any DC components of the sensor signal from the preshaper and hold that portion of the signal when the pump is stroking, i.e. when a pressure drop is not occurring, and clamps or holds that portion at a zero value. The clamped signal is transmitted to a second signal comparator 500 by conductor 401.

Second signal comparator 500 also receives the stretched pulse signal from conductor 101 so that the second signal comparator 500 will not operate when dispenser 20 has been enabled. If the clamped pressure signal from conductor 401 exceeds a preselected pressure value, comparator 500 sends a malfunction signal to information processor 600.

Information processor 600 receives signals from OR gate 199, comparator 300 and comparator 500. An embodiment of processor 600 will be more fully described hereinafter, to indicate the type of malfunction, significance of malfunction and/or activate an alarm or other remedial equipment. In the embodiment of Fig. 10, if a worn or clogged nozzle or worn pump seals are detected, information processor 600 transmits a signal to OR gate 199, comparator 300 and comparator 500 to prevent the monitor 15 from providing any further output. In effect monitor 15 will no longer provide malfunction signals due to conductor 601 providing a high signal to the output of OR gate 199, disabling shaper 200 and first comparison 300. As will be more fully described in connection with Fig. 10, this state continues until the monitor is reset.

Fig. 4 depicts the pre-shaper including pre-amplifier 80 previously described. The arrangement of resistors and capacitors of the values shown in Fig. 4 serves to smooth out the pressure signal removing unwanted noise. Operational amplifier 90 operates to only amplify the AC portion of the pressure signal. The signal appearing at point 96 is provided to the input of switch and signal shaper 200 and clamp 400.

A circuit diagram of a prefered embodiment of switch and signal shaper 200 is shown in Fig. 5. The signal from the pre-shaper is first filtered by a high pass filter 850. The signal thereafter passes through analog switch 206. In the position shown in Fig. 5, switch 206 connects the signal from the pre-shaper to operational amplifier 210 and prevents capacitor 218 from discharging to ground at point 208 and is instead charged by amplifier 210. If the signal at point 198 forces switch 206 to move to the position opposite that shown, capacitor 218 will discharge to ground.

Calibration network 228 is used to calibrate operational amplifier 220 to have a preselected voltage output. In this embodiment, the output voltage of operational amplifier 220 is calibrated to be 5 volts when dispenser 20 is functioning properly. To calibrate, variable resistor 222 is adjusted and the brightness of light emitting diodes 252 and 262 is thereby affected. Once the diodes are of a substantially even brightness, operational amplifier 220 has been calibrated.

The pre-shaped signal transmitted through conductor 201 is applied to the first signal comparator 300 which is shown in greater detail in Fig. 6. The signal from conductor 201 is the negative input of comparator 310 and the positive input of comparator 320. The reflective voltage as applied to comparators 310 and 320 establish the parameters of the range of preselected values. Comparator 310 is arranged as an inverted comparator, such that its output remains at the level of the voltage at point 318 until the input voltage from conductor 201 approaches the input voltage at point 311, at which point the comparator forces its output to ground. The reference voltage applied to input 311 is selected in the preferred embodiment by switch 316 connected to point A—B, B—C, or C—D.

Comparator 320 is arranged in Fig. 6 as a comparator, and does not have an inverted output. Comparator 320 allows the voltage at point 324 to charge capacitor 330 in accordance with the time constant provided by resistor 326 and capacitor 330. Capacitor 330 will dicharge through resistor 328 in accordance with the time constant associated with those two elements.

The outputs of comparators 310 and 320 is applied to the input of OR gate 340. The output of which is provided to the input 354 fo OR gate 350. Schmitt trigger 360 is used to invert the output of OR gate 350 while Schmitt trigger 352 serves to invert the output from OR gate 199.

Referring back to Fig. 1, the signal from dispenser controller 22 is transmitted via conductors 50 to the stretcher circuit shown in Figure 7, which includes initially a diode bride (102, 104, 106 and 108), and an optical isolator 110. Capacitor 122 is charged in accordance with the time constant associated with capacitor 122 and resistor 124, so that until the threshold level of Schmitt Trigger 130 is reached a low output is generated on conductor 101 thereby extending the signal from controller 22. A 'low' output in this embodiment refers to electrical ground. The time constant is selected so that the output of trigger 140 remains high until after dispenser 20 has actually closed.

The signal from the pre-shaper shown in Fig. 4 is applied to the input of clamp 400, as shown in Fig. 8, is transmitted via conductor 401 to the second signal comparator 500 shown in Fig. 9. The signal from conductor 401 passes through a variable resistor to the positive input of comparator 510 which is connected as a basic comparator. The variable resistor is adjusted so that the voltage level of the pressure signal is 2.5 volts when the dispenser is operating in an acceptable manner. Accordingly, as the signal from conductor 401 approaches the reference voltage which in this embodiment is 2.5 volts, the output of comparator 510 goes from ground to an open circuit. While the output of comparator 510 remains grounded, the voltage at point 540 will travel to ground through the operational amplifier. When the output becomes an open circuit, the voltage at point 540 will travel through switch 530, closing the switch to point 534. Switch 530 is now latched closed and the voltage at point 540 will be transmitted via conductor 501 to information processor 600.

The output of OR gate 199, traveling through diode 520, serves to maintain switch 530 in the position shown in Fig. 9, when dispenser 20 is enabled by a signal from controller 22. A signal transmitted from stretcher 100 to the input of OR gate 199 will force the output at point 198 to go low which in turn holds the voltage at the output of comparator 510 at a level insufficient for switch 530 to change positions.

Fig. 10 is a schematic diagram of an embodiment of information processor 600. This processor counts the number of times the dispenser has dispensed material in an unacceptable fashion; it also indicates whether the sensed pressure is above or below the preselected range of pressures; and it also indicates whether the pump pressure is above or below the preselected value. Processor 600 also provides apparatus for resetting the system after a malfunction has been determined and monitor 15 ceases to provide any further malfunction indications. The information processor additionally provides a signal at output 700 which can be used to set off an auditory alarm, or shut down a conveyor line which may be moving substrate beneath the dispenser.

Processor 600 includes a counter 620 having its clock input as the output from OR gate 199. The reset input of the counter is connected to conductor 301. Pins 11, 9, 6 and 5 are connected to pins 4, 2, 5 and 12 of multiplexor 630. The outputs of counter 620 at pins 11, 9 and 6 are also connected to inverter drivers 621, 622 and 623 respectively. The signal from driver 621 passes through idode 624 and 625, which in this embodiment are 1N4148 diodes. Thus, a high signal appearing at pin 11 of counter 620 will cause a low signal to appear at the output of driver 621, allowing the voltage to flow from point 631 through light emitting diode 627. Driver 622 and 623 operate in a similar manner. In one embodiment, light emitting diodes 627, 628 and 629 correspond to 2, 4 and 8 respective consecutive counts of dispenser malfunction.

The output of multiplexer 630 is connected to the input of OR gate 650. The output of OR gate 650 is connected to a driver inverter 660. In this embodiment all of the driver inverters depicted in Fig. 10 are Motorola MC11416B.

The output of multiplexer 630 is also provided to the enable input of OR gates 640A, 640B and 640C which in this embodiment are R—S flip-flops contained on a single electronic component such that unless the component is enabled, no output will appear at points QA, QB or QC. A Schmitt trigger inverter 604 has also been provided to this circuit.

The QA output of latch 640A is tied to ground so that a normally low signal may be applied to OR gate 199 so that the output thereof will generally follow the input provided from stretcher 100. When latch 640A is not enabled, the output at QA, QB and QC is seen as a high impedance. When

the output of latch 640B becomes high, the output of driver 642 becomes low allowing the voltage applied to point 648 to flow through light emitting diode 645. Light emitting diode 646 is activated in a similar fashion.

When a high signal is provided through conductor 501 to processor 600, inverter driver 652 provides a low output, allowing the voltage at point 656 to flow through light emitting diode 654.

A reset input has also been provided, whereby inverter driver 670 and 672 provide a high signal to conductor 603 through diode 676 to conductor 602 through diode 674.

Fig. 11 depicts four pressure wave forms which appear at point 96 of the pre-shaper shown in Fig. 5. Wave form A is reflective of pump pressure. Wave form B is reflective of fluid pressure in the dispenser which is within the preselected range. Wave form C is reflective of fluid pressure in the dispenser, which exceeds the preselected range, for example a pressure greater than 60 PSI (4×10^5 N/m^2) generally indicates a worn nozzle. Wave form D is reflective of fluid pressure in the dispenser 20 which is below the preselected range, for example a pressure less than 40 PSI (2.7×10^5 N/m^2) generally indicates a clogged nozzle. The height of the wave form is in terms of voltage and the length of the wave form is in relation to time.

Wave form A signifies a pressure drop sensed between strokes of the reciprocating pistion pump referred to hereinabove. This signal is acted on when dispenser 20 is not enabled as shown by the wave form appearing at point 32. "Low" in the preferred embodiment refers to the signal being zero volts or grounded. When the signal at point 32 is continuously low, the signal at Point 198 is continuously high. Accordingly, latch 206 will be in the position opposite that which is shown in Fig. 5. Consequently, the wave form appearing at points 207 and 219 is a low signal. Since the signal at point 219 is continuously low, the output of comparators 310 and 320 at points on conductors 318 and 321 will be continuously high and continuously low respectively. This in turn provides a continuously high output from OR gate 340 to the input of OR gate 350 at point 354. With the wave form at point 198 continuously high, inverter 352 provides a continuously low input to OR gate 350 at point 353. Accordingly, the output of OR gate 350 will be continously high and the wave form appearing on conductor 301 is continuously low.

When the wave form at point 198 is high, switch 530 in Fig. 9 is vulnerable to change from the position shown to point 534 if the pump pressure exceeds the reference established in comparator 510. For the purpose of illustration, it is assumed that wave form A has exceeded the preselected pressure value. Consequently, point 198 is grounded and the voltage at point 540 flows through 530 latching it to point 534.

Wave form B of Fig. 11 represents an acceptable pressure condition in dispenser 20. Since the dispenser has been enabled, a signal of the type shown appears at point 32. As previously described, dispenser 20 has an inherent mechanical delay between the time when the enabling signal is received and the time when the dispenser actually opens. This same condition occurs at the time of closing. These two conditions are depicted in Fig. 11 by the time periods designated 800 and 801 respectively.

Since dispenser 20 has been enabled, a signal will now appear at point 198. The stretched output at point 198 is designated 802. Since the wave form at point 198 becomes low, switch 206 will be in the position shown in Fig. 5. The wave form at point 207 will appear as shown in Fig. 11 and will be detected by operational amplifier 210 which serves to charge capacitor 218. Consequently, the signal appearing at point 219 is reflective of capacitor 218 charging and discharging. The time of discharge causes the output of comparator 310 to remain low at a point on conductor 318 until the capacitor has discharged to a point where its voltage is below the reference voltage applied at point 311. This period of time is designated 804 in Fig. 11. Since the voltage of the wave form at point 219 does not exceed the reference voltage at point 324 applied to comnparator 320, the output at a point on conductor 321 will remain continuously low. It becomes apparent that during the time period 804, OR gate 340 will have a low signal applied to inputs 342 and 344. Consequently, a pulse will appear in the wave form being transmitted by conductor 301. This pulse serves to reset counter 620, shown in Fig. 10 from having counted the rising edge of the wave form at point 198. This count has now been erased and no enabling signal is applied to the latches 640 A, B or C.

Wave form C is reflective of a high pressure drop in dispenser 20, which for example may be generally indicative of a worn dispenser nozzle in the can coating process described herein. Since the dispenser 20 has been enabled, a signal identical to that described in connection with wave form B is present at points 32 and 198. The wave form appearing at point 207 is similar to that appearing for wave form B except for magnitude. Consequently, the wave form appearing at point 219 is very similar to that discussed in connection with wave form B, except that its amplitude is higher. With this high signal at point 219, the output of comparator 310 at a point on conductor 318 is generally identical to the wave form discussed in connection with wave form B, except that the time 804 may be slightly longer since capacitor 218 has been charged to a higher voltage. With the pressure drop of wave form C being so high, the reference voltage at point 324 for comparator 320 has been exceeded, consequently, the voltage at point 324 will be allowed to charge capacitor 330 in accordance with the time constant of resistor 326 capacitor 330. This signal appears at a point on conductor 321. When capacitor 218 has discharged sufficiently such that the input to comparator 320 is less than the reference voltage at point 324, capacitor 330 will

discharge through resistor 328 to ground according to the time constant for those components. The discharge of the capacitor delays the voltage at a point on conductor 321 from becoming zero because if a low signal is provided to inputs 344 and 342 of OR gate 340, a low signal will be provided to input 354 of OR gate 350 which will force OR gate 350 to go temporarily low providing a false pulse to conductor 301. Accordingly, the time constant established by resistor 328 and capacitor 330 allows sufficient time, designated as 806 on Fig. 11, for the signal at a point on conductor 318 to return to high. The resultant signal on conductor 301, is a continuous low. Since no pulse appears on conductor 301, counter 620 of information processor 600 is not reset and the rising edge at point 198 clocks the counter.

If counter 620 were to have counted a preselected number of consecutive pulses from OR gate 199, a signal is transmitted through multiplexor 630 to OR gate 650 and enables latches 640A, B and C. The point RA of latch 640A will receive a high signal while the point SA receives a low signal, providing a high output at point QA. Schmitt trigger inverter 604 also provides a high signal to the inhibit input of multiplexor 630 through conductor 605. Since the output at QA is high, the output of OR gate 199 will remain high, effectively "freezing" the system.

When the enable signal is provided by multiplexor 630, the latch 640C, for wave form C, has a high input at RC and a high input at SC providing a low output at QC. The low output at QC in turn provides a high input at SB and after being inverted by inverter driver 644, provides a low input at RB providing a high output at QB. The subsequent activation of light emitting diode 645 indicates that a high pressure drop condition has occurred.

Wave form D of Fig. 11 is reflective of a pressure drop in dispenser 20 which is too low indicating a clog. Since dispenser 20 has been enabled, a signal occurs at points 32 and 198 which has been discussed in greater detail in connection with wave form B. Switch 206 will thus be in the position shown in the drawings and the wave form at point 207 will be present. The charging of capacitor 218 again yields the wave form shown at point 219. The signal at point 219 is relatively smaller in amplitude such that neither of the reference voltages for comparators 310 or 320 is approached, consequently, the output at a point on conductor 318 remains high and the wave form at a point on conductor 321 remains low for the entire enabling time. Since a high-low signal is presented to the inputs of OR gate 340, a high output will be presented to input 354 of OR gate 350. Accordingly, OR gate 350 will have a high output which will provide a low output signal by Schmitt trigger inverter 360 on conductor 301. As previously discussed, a low signal on conductor 301 permits counter 620 to count the pulse output of OR gate 199. If wave form D represents the appropriate number of consecutive counts by counter 620, mutliplexor 630 will provide a high signal to OR gate 650 and also enable latches 640A, B and C. Since the output of comparator 310 remains continuously high, a low signal will be applied to the RC input of latch 640C. As previously discussed, a high signal is received at input SC. In the preferred embodiment, inverters have been placed before each of the inputs of latches 640A, B and C and the inputs of the fourth unused latch (not shown in the drawings) contained in the set have been each tied to ground. Once enabled, the latch 640C will have a high output at QC. The activation of light emitting diode 646, indicates that the pressure drop in dispenser 20 is too small.

Claims

1. Monitor means for evaluating dispenser operation and for a system incorporating a dispenser for fluid under pressure and control means providing operation signals to the dispenser for controlling the open and closed conditions of the dispenser comprising sensing means, attached to the dispenser to sense the pressure of the fluid therein and generate a pressure signal reflective of the fluid pressure; and comparison means, connected to receive the pressure signal and the operation signal, for comparing the pressure signal to a preselected band of pressure values having a first pressure value at one end and a second pressure value at the other wherein the comparison is effected when the controller provides an operation signal to open the dispenser, and wherein the comparison means generates a malfunction signal when the pressure singal is outside of the band of pressure values characterised in that the control means (22) provide cyclical operation signals to the dispenser (20) for controlling the cyclical open and closed conditions of the dispenser (20) and in that the comparison is disabled when the controller (22) provides an operation signal to close the dispenser (20).

2. A monitor as claimed in claim 1 wherein the dispenser (20) comprises a nozzle (26) having an opening through which the fluid is dispensed and the first pressure is reflective of the opening being clogged.

3. A monitor as claimed in claim 1 or 2 wherein the dispenser (20) comprises a nozzle (26) having an opening through which the fluid is dispensed and the preselected second pressure is reflective of the opening being worn.

4. A monitor as claimed in any of the preceding claims wherein the comparison means comprises switch means (62, 200), connected to receive the pressure signal and the operation signal, for transmitting the pressure signal when the operation signal indicates the opening of the dispenser (20) and comparator means (66, 300) connected to receive the pressure signal from said switch means (62, 200), for comparing the pressure signal to the preselected band of pressure values and for generating the malfunction signal.

5. A monitor as claimed in any of the preceding claims wherein the pressure signal is an electrical signal, the comparison means including shaping means (64, 200), connected to receive the pressure signal, for shaping the pressure signal into a substantially pulse form and transmitting the shaped pressure signal to the comparator means (66, 300).

6. A monitor as claimed in either claim 4 or 5, further comprising system disable means (199), connected between the control means (22) and the switch means (62, 200), for disabling the reception of the operation signal by the switch means (62, 200) when the malfunction signal indicates that the pressure signal is not within the first and second preselected pressures inclusive.

7. A monitor as claimed in any of the preceding claims including information processing means (70, 600) connected to receive the enable signal and the malfunction signal, for processing the signals by counting each of the dispenser malfunctions and generating a signal reflective of the count.

8. A monitor as claimed in any of the preceding claims further comprising second comparison means (500), connected to receive the pressure signal and the operation signal, for comparing the pressure signal to a third preselected pressure value and for generating a malfunction signal indicative of the pressure signal exceeding the third pressure value when the operation signal indicates the dispenser (20) is open.

9. A system with a dispenser for fluid under pressure includes control means providing operation signals to the dispenser for controlling the open and closed conditions of the dispenser and monitor for evaluating dispenser operation, the monitor means comprising, sensing means, attached to the dispenser to sense the pressure of the fluid therein and generate an electrical signal indicative of the fluid pressure; conditioning means including switching means connected to receive the electrical signal, for conditioning the electrical signal to an analog pulse signal which is generally proportional to that part of the electrical signal which is indicative of the dispenser in an open condition and comparator means connected to receive the conditioned analog signal and the operation signal, for comparing the analog signal to first and second preselected analog values when the operation signal indicates the opening of the dispenser and for generating a malfunction signal indicative of the analog signal not being between the first and second analog values inclusive, characterised in that the control means (22) provide cyclical operation signals to the dispenser (20) for controlling the cyclical open and closed conditions of the dispenser (20) and in that the switching means (62, 200) are responsive to the operating signals to pass the pressure signal to the conditioning means (64, 200) when the controller (22) provides an operation signal to open the dispenser (20) and to block the pressure signal when the controller (22) provides an operation signal to close the dispenser (20).

Patentansprüche

1. Überwachungsmittel zum Auswerten der Ausgabegerätefunktion un fur eine Anlage mit einem Ausgabegerät für Flüssigkeit unter Druck und dem Ausgabegerät Funktionssignale zum Steuern der offenen und geschlossenen Zustände des Ausgabegerätes zuführenden Steuermitteln, mit am Ausgabegerät angebrachten Abfühlmitteln zum Abfühlen des Druckes der darin befindlichen Flüssigkeit und Erzeugen eines den Flüssigkeitsdruck abbildenden Drucksignals; und für Aufnahme des Drucksignals und des Funktionssignals verbundene Vergleichsmittel zum Vergleichen des Drucksignals mit einem vorgewählten Bereich von Druckwerten mit einem ersten Druckwert an seinem einen Ende und einem zweiten Druckwert an seinem anderen, wobei der Vergleich getätigt wird, wenn die Steuerung ein Funktionssignal zum Öffene des Ausgabegerätes liefert und das Vergleichsmittel ein Funktionsunfähigkeitssignal erzeugt, wenn daß Drucksignal ausserhalb des Bereiches der Druckwerte liegt, dadurch gekennzeichnet, dass das Steuermittel (22) an das Ausgabegerät (20) cyclische Funktionssignale zum Steuern der cyclischen offenen und geschlossenen Zustände des Auggabegerätes (20) liefert, und dass der Vergleich gesperrt wird, wenn die Steuerung (22) ein Funktionssignal zum Schliessen des Ausgabegerätes (20) liefert.

2. Überwachungsvorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass das Ausgabegerät (20) eine Düse (26) mit einer Öffnung, durch die die Flüssigkeit ausgegeben wird, umfasst und der erste Druck eine Verstopfung der Öffnung abbildet.

3. Überwachungsvorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, dass das Ausgabegerät (20) eine Düse (26) mit einer Öffnung, durch die die Flüssigkeit ausgegeben wird, umfasst, und der vorgewählte zweite Druck eine Abnützung der Öffnung abbildet.

4. Überwachungsvorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass das Vergleichsmittel zum Aufnehmen des Drucksignals und des Funktionssignals verbundene Schaltermittel (62, 200) zum Übertragen des Drucksignals, wenn das Funktionssignal das Öffnen des Ausgabegerätes (20) anzeigt, und zum Aufnehmen des Drucksignals von besagten Schaltermitteln (62, 200) verbundene Vergleichermittel (66, 300) zum Vergleichen des Drucksignals mit dem vorgewählten Bereich von Druckwerten und zum Erzeugen des Funktionsunfähigkeitssignals umfasst.

5. Überwachungsvorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, dass das Drucksignal ein elektrisches Signal ist, wobei das Vergleichsmittel zum Aufnehmen des Drucksignals verbundene Signalformungsmittel (64, 200) zum Formen des Drucksignals in eine im wesentlichen pulsförmige Form und Übertragen des geformten Drucksignals zum Vergleichermittel (66, 300) umfasst.

6. Überwachungsvorrichtung nach Anspruch 4 oder 5, weiterhin gekennzeichnet durch zwischen das Steuermittel (22) und das Schaltermittel (62, 200) geschaltete Systemsperrmittel (199) zum Blockieren des Empfanges des Funktionssignals durch das Schaltermittel (62, 200), wenn das Funktionsunfähigkeitssignal anzeigt, dass das Drucksignal nicht innerhalb einschliesslich der ersten und zweiten vorgewählten Druckwerte liegt.

7. Überwachungsvorrichtung nach einem der vorhergehenden Ansprüche, gekennzeichnet durch zum Aufnehmen des Freigbesignals und Funktionsunfähigkeitssignals verbundene Informationsverarbeitungsmittel (70, 600) zum Verarbeiten der Signale durch Zählen der Ausgabegerätefehlfunktionen und Erzeugen eines den Zählerstand abbildenden Signals.

8. Überwachungsvorrichtung nach einem der vorhergehenden Ansprüche, weiterhin gekennzeichnet durch zum Aufnehmen des Drucksignals und des Funtionssignals verbundene zweite Vergleichsmittel (500) zum Vergleichen des Drucksignals mit einem dritten vorgewählten Druckwert und zum Erzeugen eines Funktionsunfähigkeitssignals, das anzeigt, wann das Drucksignal den dritten Druckwert überschreitet, wann das Funktionssignal anzeigt, dass das Ausgabegerät (20) offen ist.

9. Anlage mit einem Ausgabegerät für Flüssigkeit unter Druck mit Funktionssignale zum Steuern der geöffneten und geschlossenen Zusatände des Ausgabegerätes an das Ausgabegerät liefernden Steuermitteln und überwachungsmitteln zum Auswerten der Ausgabegerätefunktion, wobei das Überwachungsmittel am Ausgabegerät angebrachte Abfühlmittel zum Abfühlen des Druckes der darin befindlichen Flüssigkeit und Erzeugen eines den Flüssigkeitsdruck anzeigenden elektrischen Signals umfasst; Aufbereitungsmitteln mit zum Aufnehmen des elektrischen Signals verbundenen Schaltmitteln, zum Aufbereiten des elektrischen Signals zu einem analogen Pulssignal, das allgemein zu dem einen offenen Zustand des Ausgabegerätes anzeigenden Teil des elektrischen Signals proportional ist, und zum Aufnehmen des aufbereiteten Analogsignals und des Funktionssignals verbundenen Vergleichermitteln zum Vergleichen des Analogsignals mit ersten und zweiten vorgewählten Analogwerten, wenn dass Funktionssignal das Öffnen des Ausgabegerätes anzeigt und zum Erzeugen eines Funktionsunfähigkeitssignals, das anzeigt, dass daß das Analogsignal nicht zwischen einschliesslich den ersten und zweiten Analogwerten liegt, dadurch gekennzeichnet, dass das Steuermittel (22) zum Steuern der cyclischen geöffneten und geschlossenen Zustände des Ausgabegerätes (20) cyclische Funktionssignale an das Ausgabegerät (20) liefert, und dass die Schaltmittel (62, 200) auf die Funktionssignale ansprechen, um das Drucksignal an das Aufbereitungsmittel (64, 200) weiterzuführen, wenn die Steuerung (22) ein Funktionssignal zum öffnen des Ausgabegerätes (20) liefert, und um das Drucksignal zu blockieren, wenn die Steuerung (22) ein Funktionssignal zum Schliessen des Ausgabegerätes (20) liefert.

Revendications

1. Moyen de surveillance pour évaluer le fonctionnement d'un distributeur et pour un système auquel sont intégrés un distributeur pour du fluide sous pression et un moyen de contrôle qui fournit des signaux d'actionnement au distributeur pour contrôler les conditions ouverte et fermée du distributeur, comportant un moyen de détection, attaché au distributeur pour detecter la pression du fluide en son intérieur et pour générer un signal de pression qui reflète la pression du fluide; et un moyen de comparaison, connecté de façon à recevoir le signal de pression et le signal d'actionnement, pour comparer le signal de pression à une bande présélectionnée de valeurs de pression ayant un première valeur de pression à une extrémité et une seconde valeur de pression à l'autre, dans lequel la comparaison est réalisée quand le moyen de contrôle fournit un signal d'actionnement pour ouvrir le distributeur, et dans lequel le moyen de comparaison génère un signal de mauvais fonctionnement quand le signal de pression se situe hors de la bande de valeurs de pression, caractérisé en ce que le moyen de contrôle (22) fournit au distributeur (20) des signaux d'actionnement cycliques pour le contrôle des conditions ouverte et fermée cyliques du distributeur (20) et en ce que la comparaison est invalidée quand le moyen de contrôle (22) fournit un signal d'actionnement pour fermer le distributeur (20).

2. Un dispositif de surveillance selon la revendication 1, dans lequel le distributeur (20) comprend une buse (26) ayant une ouverture au travers de laquelle le fluide est distribué, et la première pression est reflective du fait que l'ouverture est obstruée.

3. Un dispositif de surveillance selon la revendication 1 ou la revendication 2, dans lequel le distributeur (20) comprend une buse (26) ayant une ouverture au travers de laquelle le fluide est distribué et la seconde pression présélectionnée est reflective du fait que l'ouverture est usée.

4. Un dispositif de surveillance selon l'une quelconque des revendications précédentes, dans lequel le moyen de comparaison comprend des moyens de commutateur (62, 200), connectés de façon à recevoir le signal de pression et le signal d'actionnement, pour la transmission du signal de pression quand le signal d'actionnement indique l'ouverture du distributeur (20) et des moyens de comparateur (66, 300) connectés de façon à recevoir le signal de pression provenant desdits moyens de commutateur (62, 200), pour comparer le signal de pression à la bande présélectionnée de valeurs de pression et pour générer le signal de mauvais fonctionnement.

5. Un dispositif de surveillance selon l'une quelconque des revendications précédentes, dans lequel le signal de pression est un signal électrique, les moyens de comparaison compor-

tant des moyens de mise en forme (64, 200), connectés de façon à recevoir le signal de pression, pour mettre en forme le signal de pression en une forme sensiblement d'impulsion et transmettre le signal de pression mis en forme aux moyens de comparateur (66, 300).

6. Un dispositif de surveillance selon l'une ou l'autre de la revendication 4 ou la revendication 5, comprenant en outre un moyen d'invalidation de système (199), connecté entre le moyen de contrôle (22) et les moyens de commutateur (62, 200), pour invalider la réception du signal d'actionnement a' l'aide des moyens de commutateur (62, 200) quand le signal de mauvais fontionnement indique que le signal de pression n'est pas dans les première et seconde pressions présélectionnées inclusives.

7. Un dispositif de surveillance selon l'une quelconque des revendications précédentes comportant des moyens de traitement d'information (70, 600) connectés de façon à recevoir le signal de validation et le signal de mauvais fonctionnement, pour traiter les signaux en comptant chacun des mauvais fonctionnements du distributeur et en générant un signal qui reflète le compte.

8. Un dispositif de surveillance selon l'une quelconque des revendications précédentes comprenant en outre un second moyen de comparaison (500), connecté de façon à recevoir le signal de pression et le signal d'actionnement, pour comparer le signal de pression à une troisième valeur de pression présélectionnée et pour générer un signal de mauvais fonctionnement qui indique que le signal de pression dépasse la troisième valeur de pression quand le signal d'actionnement indique que le distributeur (20) est ouvert.

9. Un système avec un distributeur pour du fluide sous pression comporte un moyen de contrôle qui fournit des signaux d'actionnement au distributeur pour le contrôle des conditions ouverte et fermée du distributeur et un moyen de surveillance pour l'évaluation du fonctionnement du distributeur, le moyen de surveillance comprenant un moyen de détection, attaché au distributeur pour détecter la pression du fluide en son intérieur et génerer un signal électrique qui est indicatif de la pression du fluide; un moyen de conditionnement comportant des moyens de commutateur connectés de façon à recevoir le signal électrique, pour conditioner le signal électrique en un signal d'impulsion analogique qui est généralement proportionnel à cette partie du signal électrique qui indique que le distributeur est dans une condition ouverte, en un moyen de comparateur connecté de façon à recevoir le signal analogique conditionné et le signal d'acttionnement, pour comparer le signal analogique aux première et seconde valeurs analogiques présélectionnées quand le signal d'actionnement indique l'ouverture du distributeur et pour générer un signal de mauvais fonctionnement qui indique que le signal analogique ne se trouve pas entre les première et seconde valeurs analogiques inclusives, caractérisé en ce que le moyen de contrôle (22) fournit des signaux d'actionnement cycliques au distributeur (20) pour contrôler les conditions ouverte et fermée cycliques du distributeur (20) et en ce que les moyens de commutateur (62, 200) sont sensibles aux signaux d'actionnement pour passer le signal de pression aux moyens de conditionnement (64, 200) quand le moyen de contrôle (22) fournit un signal d'actionnement pôur ouvrir le distributeur (20) et pour bloquer le signal de pression quand le moyen de contrôle (22) fournit un signal d'actionnement pour fermer le distributeur (20).

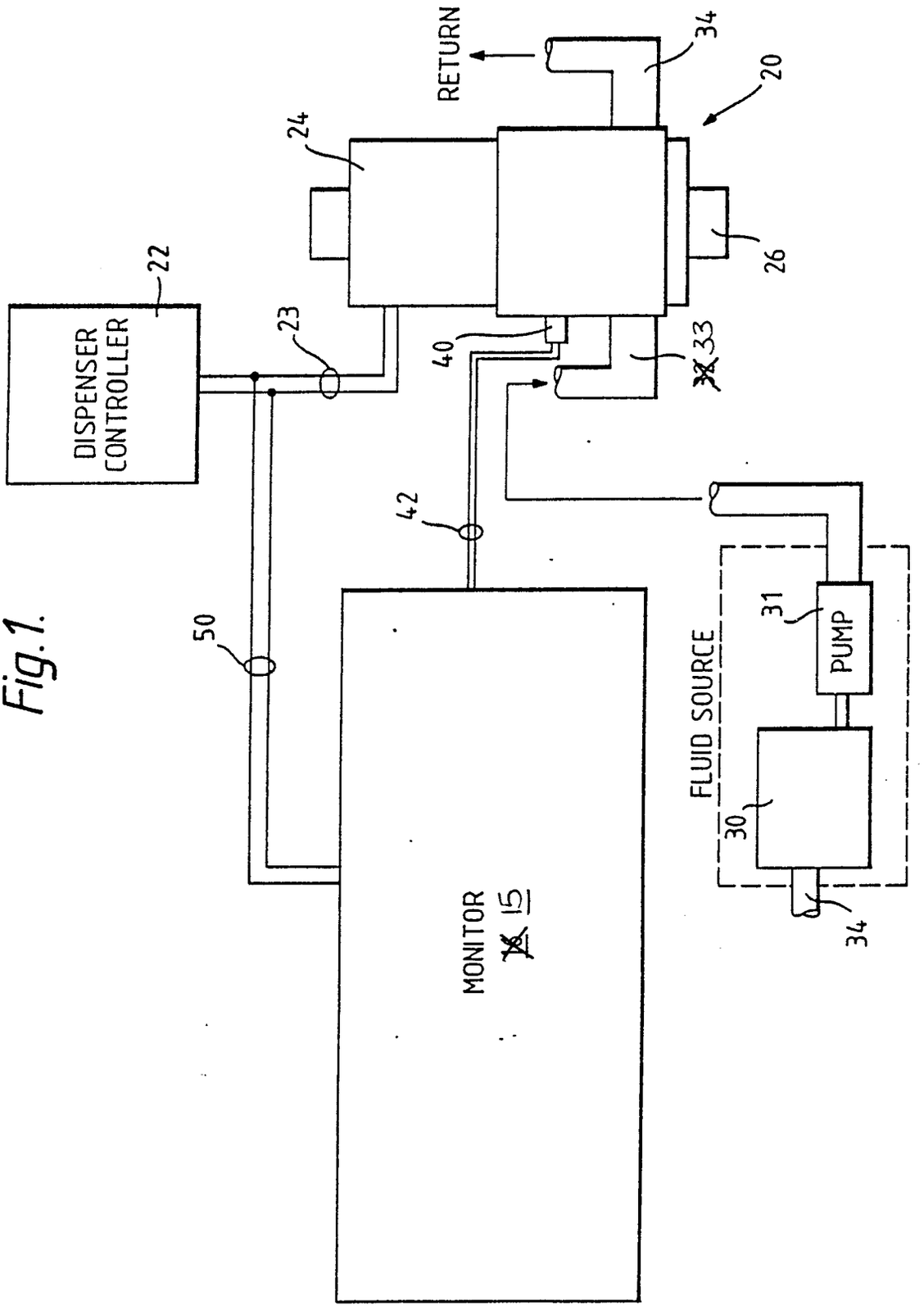

RETURN
34
20
24
26
22
DISPENSER CONTROLLER
23
40
33
42
50
FLUID SOURCE
31
PUMP
30
MONITOR
15
34

Fig. 1.

Fig.2.

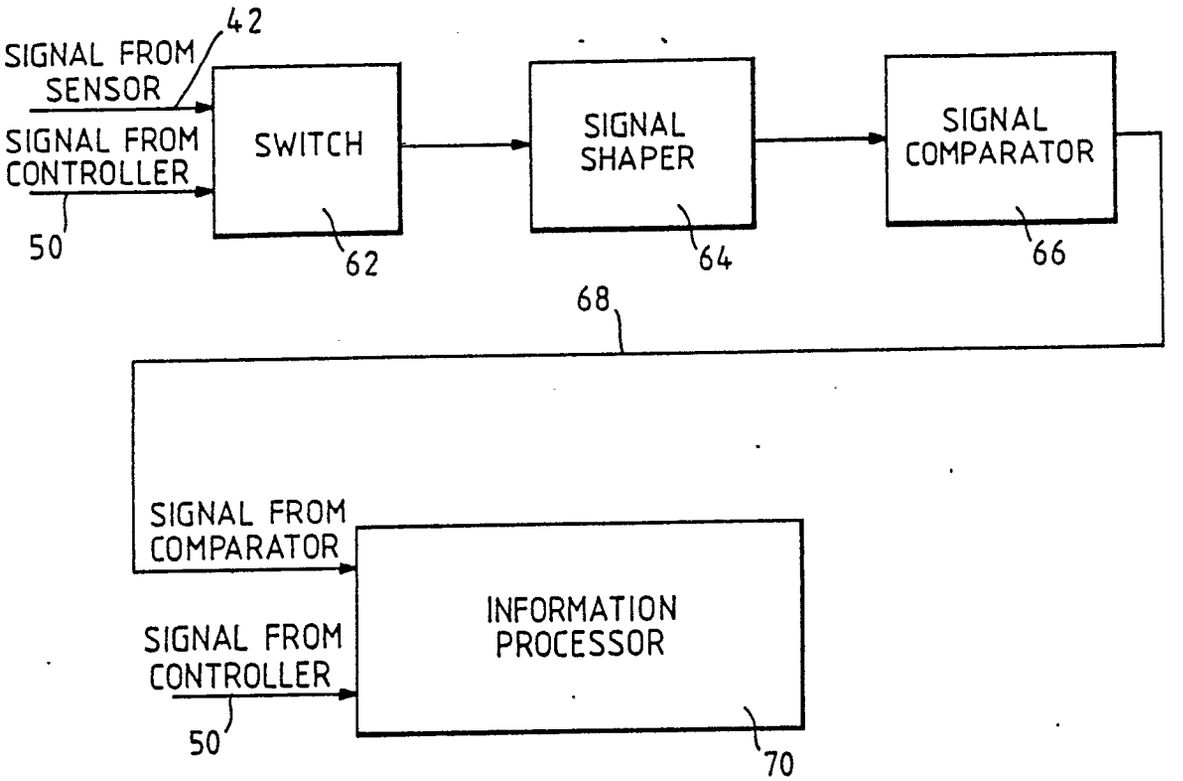

42
SIGNAL FROM SENSOR
SIGNAL FROM CONTROLLER
50
SWITCH
62
SIGNAL SHAPER
64
SIGNAL COMPARATOR
66
68
SIGNAL FROM COMPARATOR
SIGNAL FROM CONTROLLER
50
INFORMATION PROCESSOR
70

Fig.7.

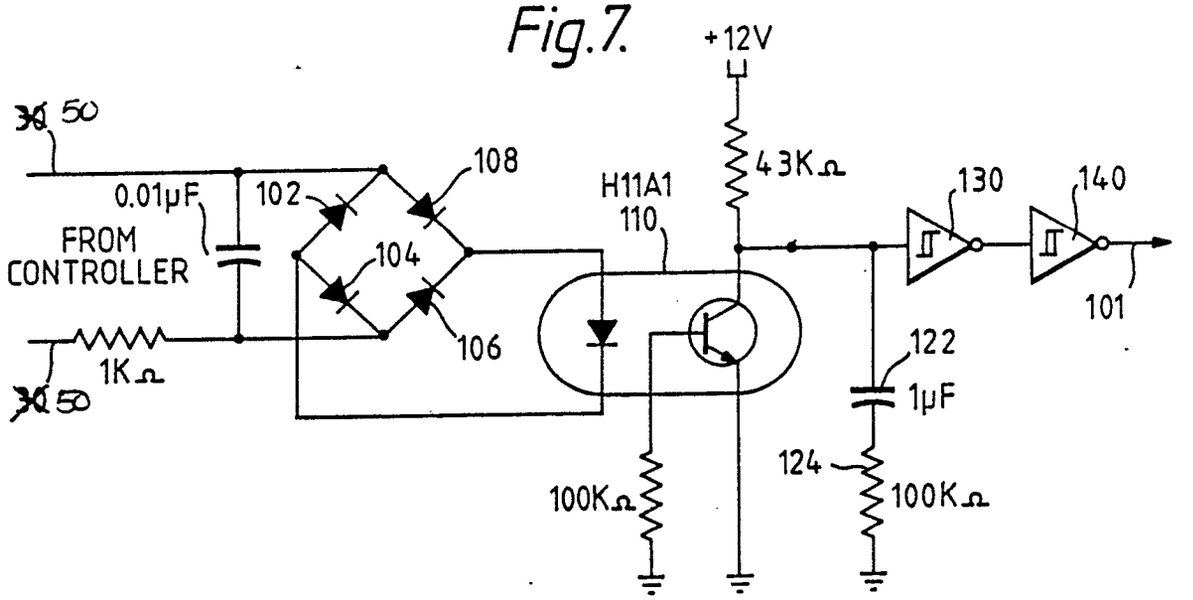
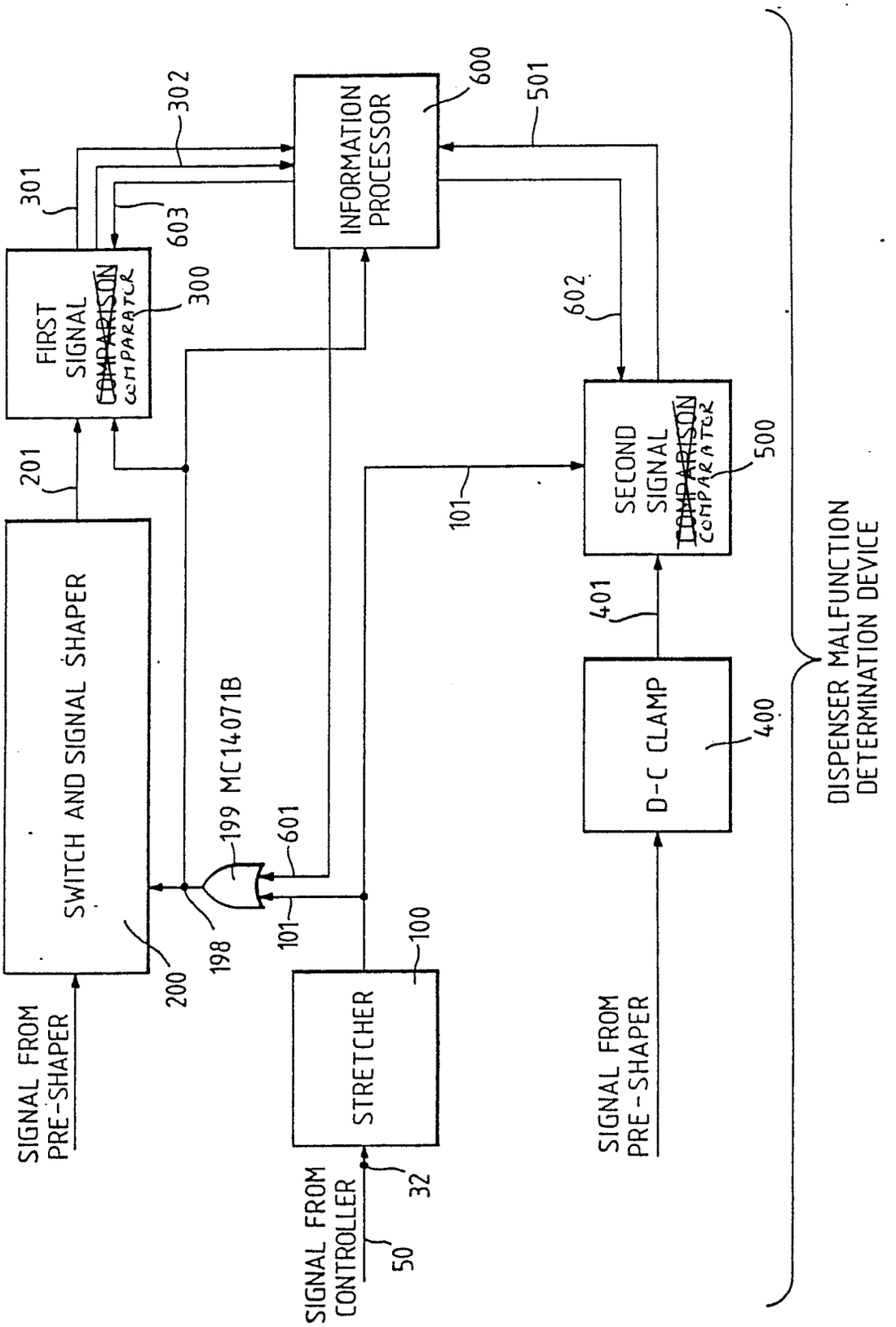

+12V
50
0.01μF
FROM CONTROLLER
102
108
104
106
1KΩ
50
H11A1
110
43KΩ
130
140
101
122
1μF
124
100KΩ
100KΩ

Fig.3.


SIGNAL FROM PRE-SHAPER
SWITCH AND SIGNAL SHAPER
201
200
FIRST SIGNAL COMPARATOR
300
301
302
603
INFORMATION PROCESSOR
600
501
602
SECOND SIGNAL COMPARATOR
500
101
199 MC14071B
601
198
101
100
STRETCHER
SIGNAL FROM CONTROLLER
50
32
SIGNAL FROM PRE-SHAPER
D-C CLAMP
401
400
DISPENSER MALFUNCTION DETERMINATION DEVICE

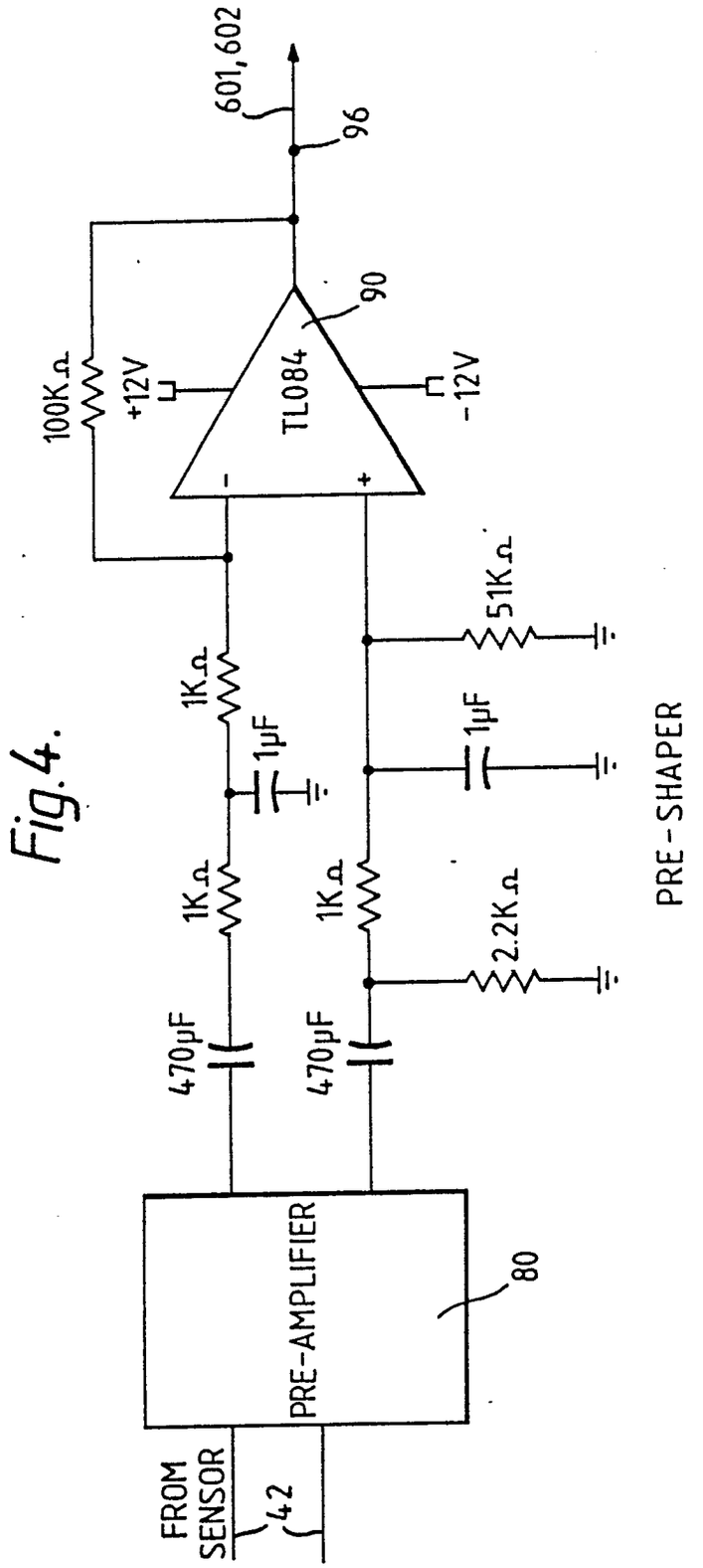

601, 602
96
90
TL084
100K Ω
+12V
-12V
51K Ω
1K Ω
1μF
1μF
1K Ω
1K Ω
2.2K Ω
470μF
470μF
PRE-AMPLIFIER
80
FROM SENSOR
42
PRE-SHAPER

Fig. 4.

Fig.5.

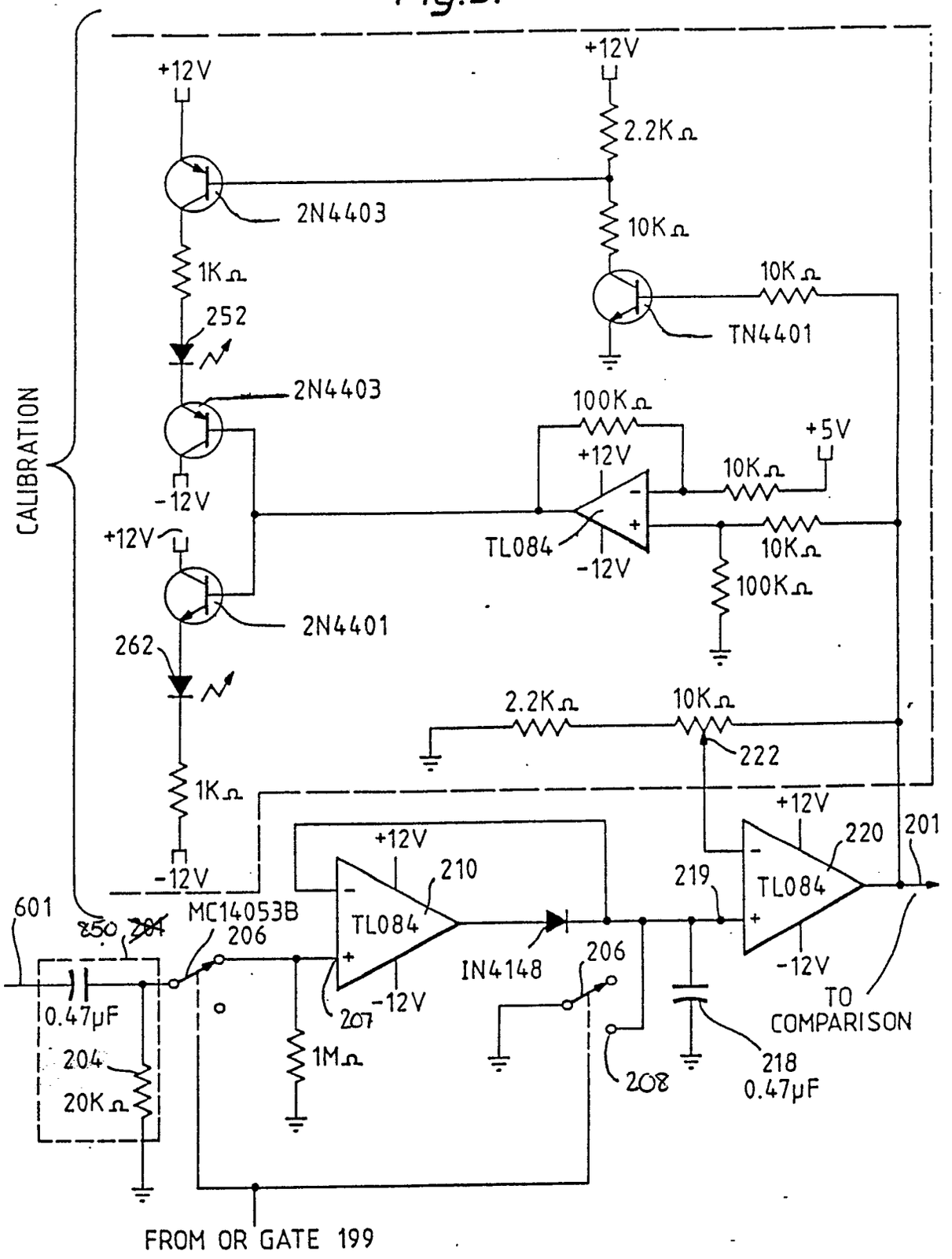

CALIBRATION
+12V
2N4403
1K Ω
252
-12V
+12V
2N4401
262
1K Ω
-12V
+12V
2.2K Ω
10K Ω
TN4401
10K Ω
100K Ω
+12V
+5V
10K Ω
TL084
-12V
10K Ω
100K Ω
2.2K Ω
10K Ω
222
+12V
220
201
TL084
219
-12V
TO COMPARISON
601
MC14053B
206
0.47μF
204
20K Ω
+12V
210
TL084
-12V
207
1M Ω
IN4148
206
208
218
0.47μF
FROM OR GATE 199

Fig.6.

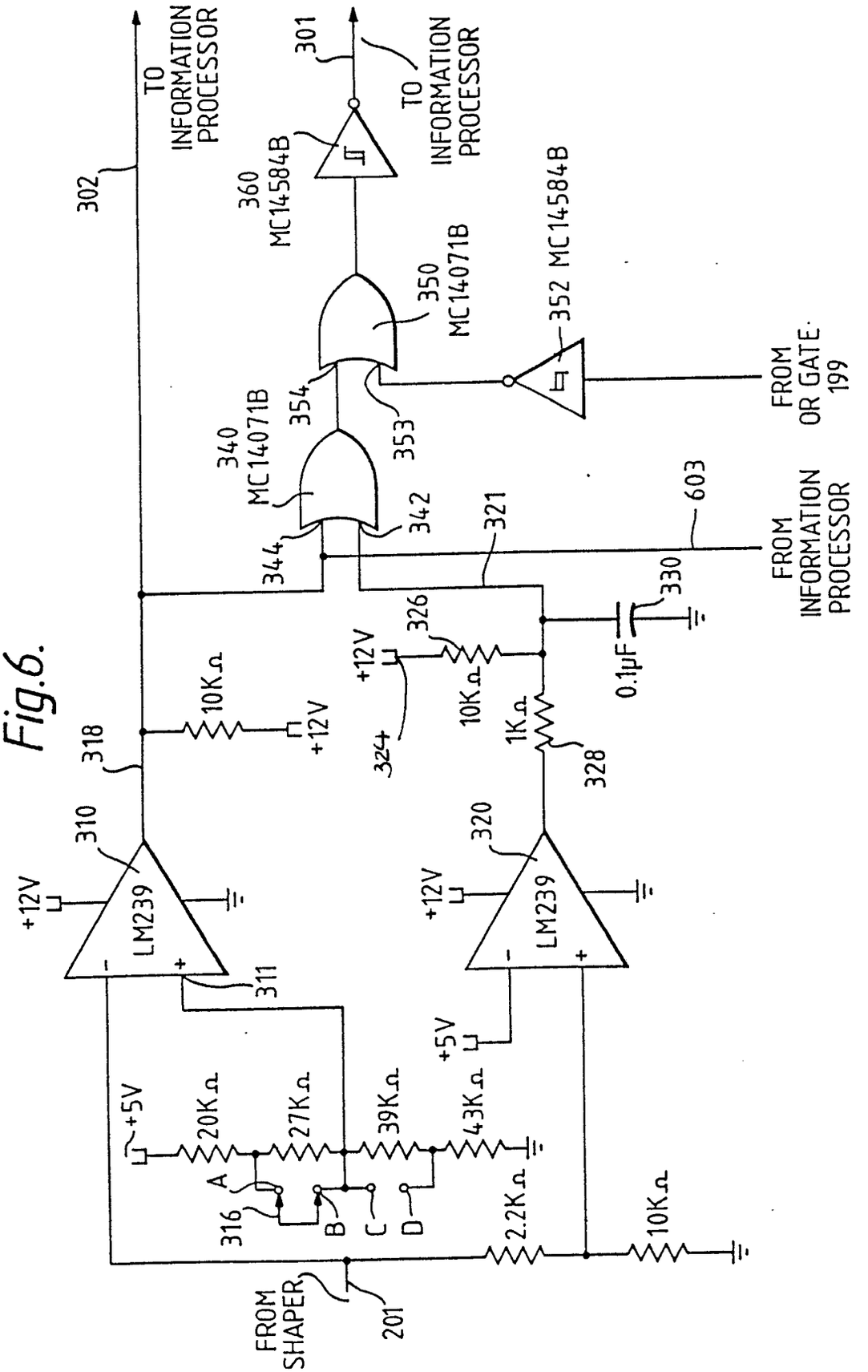

TO INFORMATION PROCESSOR
302
301
TO INFORMATION PROCESSOR
360 MC14584B
350 MC14071B
352 MC14584B
FROM OR GATE 199
340 MC14071B
354
353
342
344
321
603
FROM INFORMATION PROCESSOR
330
0.1μF
326
+12V
10KΩ
324
10KΩ
1KΩ
328
318
+12V
10KΩ
310
320
+12V
LM239
LM239
311
+5V
20KΩ
27KΩ
39KΩ
43KΩ
316
A
B
C
D
+5V
2.2KΩ
10KΩ
FROM SHAPER
201

Fig.8.

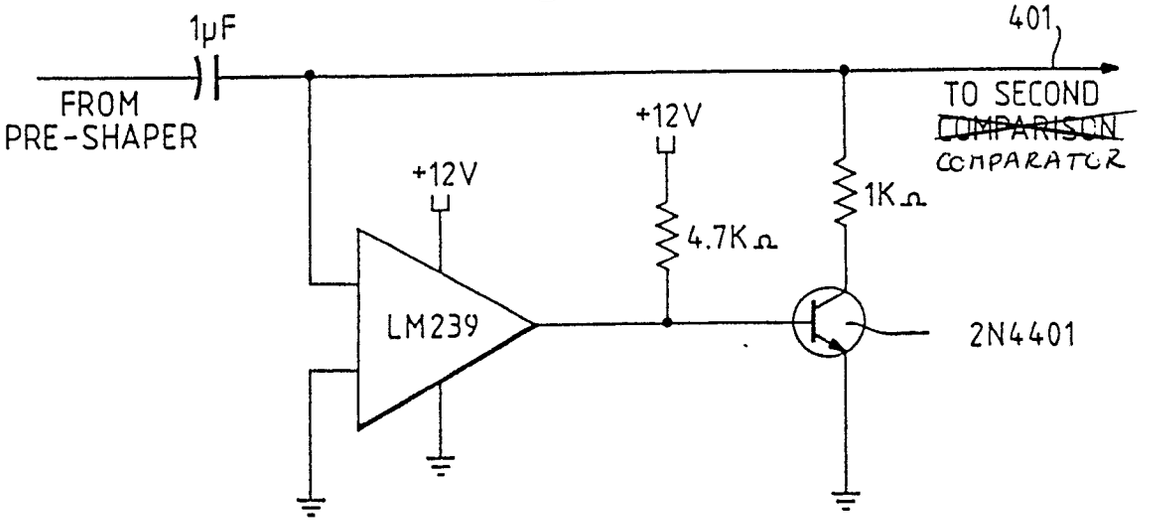

1μF
FROM
PRE-SHAPER
401
TO SECOND
COMPARISON
COMPARATOR
+12V
+12V
4.7KΩ
1KΩ
LM239
2N4401

Fig.9.

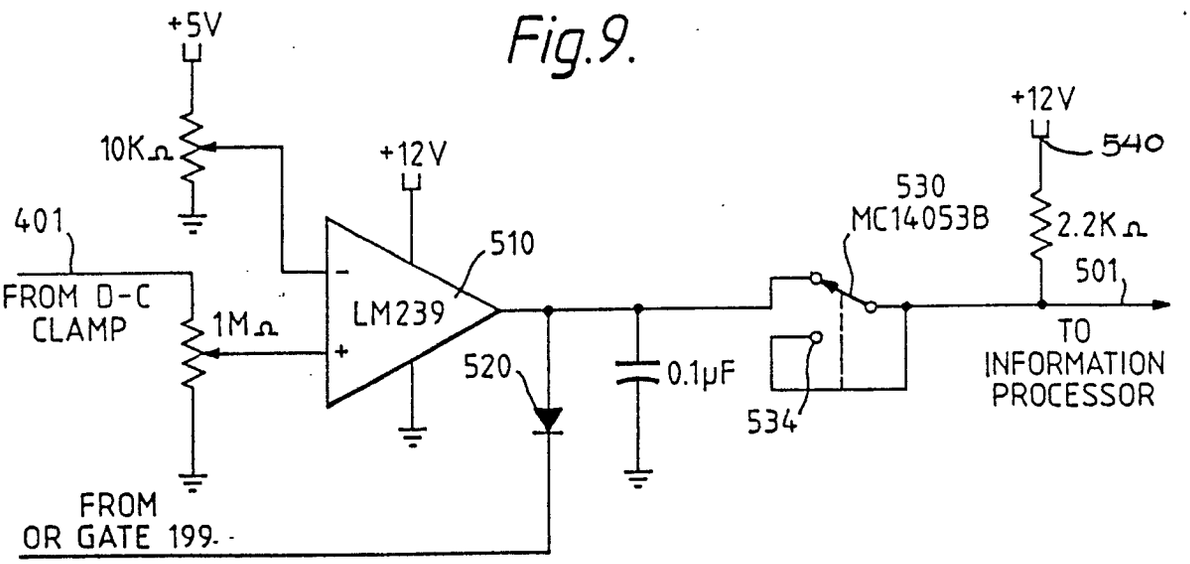

+5V
10KΩ
+12V
+12V
540
530
MC14053B
2.2KΩ
401
510
501
FROM D-C
CLAMP
1MΩ
LM239
520
0.1μF
534
TO
INFORMATION
PROCESSOR
FROM
OR GATE 199

Fig.10.

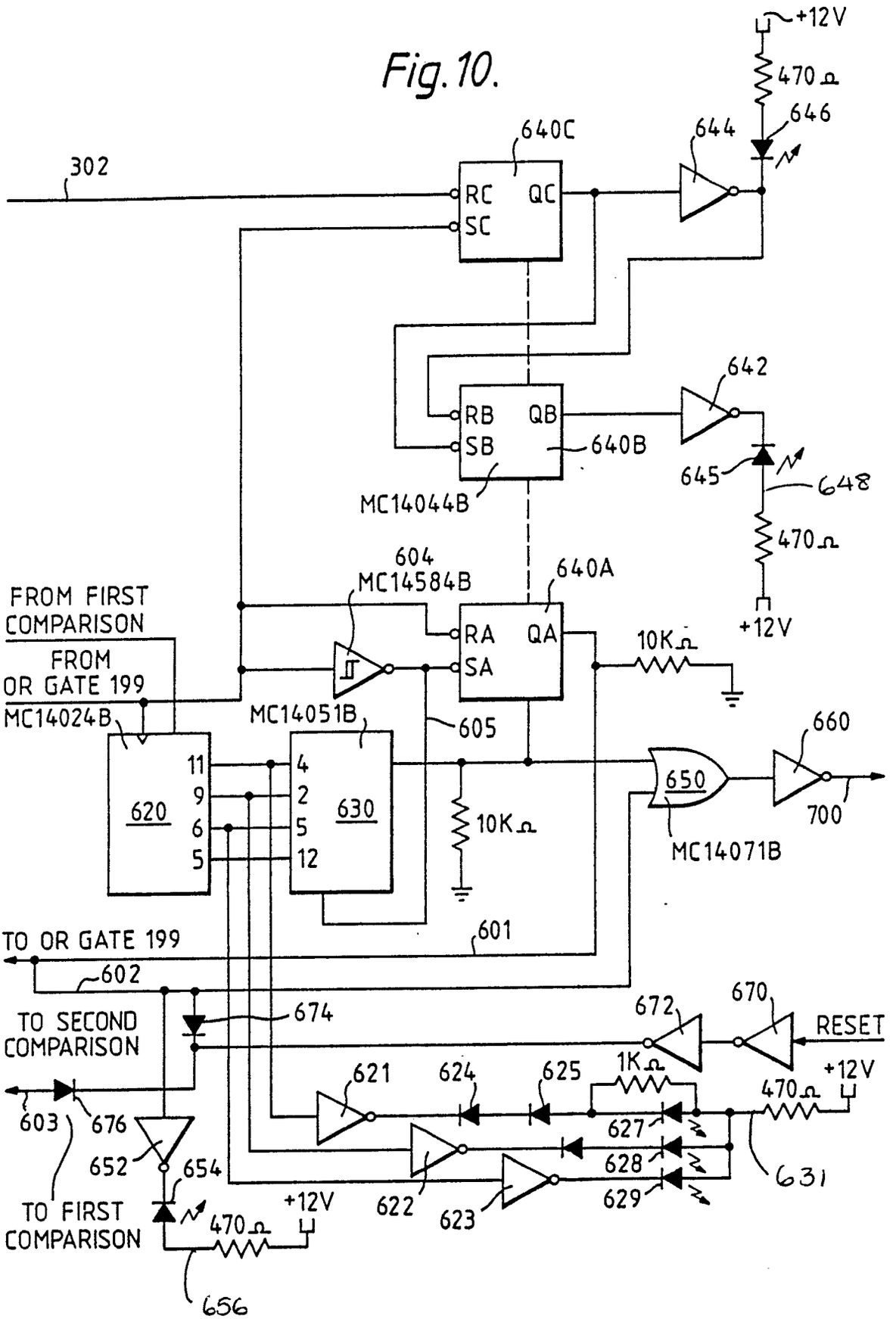
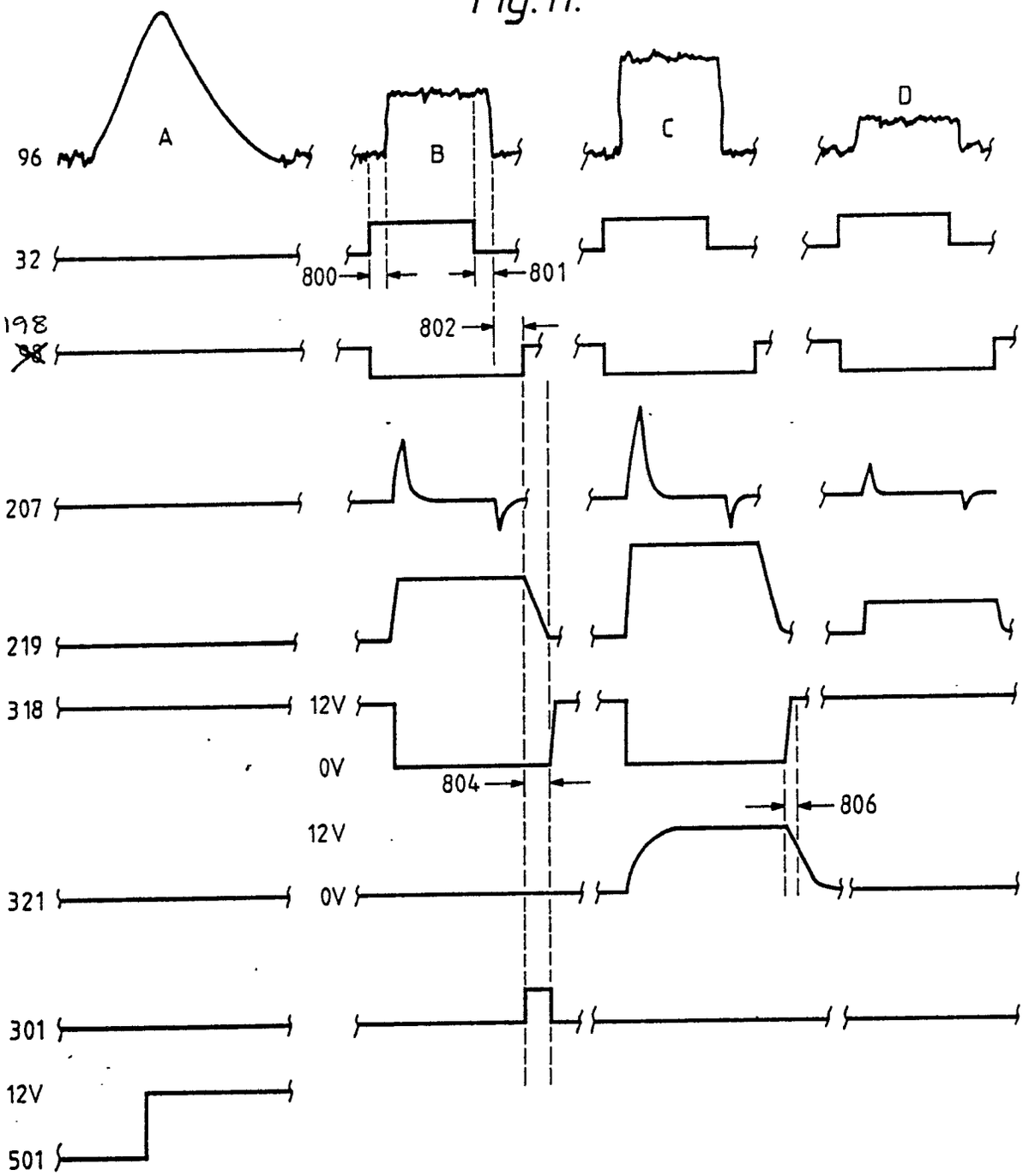

+12V
470Ω
646
644
640C
302
RC
QC
SC
642
RB
QB
SB
640B
645
648
MC14044B
470Ω
+12V
604
MC14584B
640A
FROM FIRST COMPARISON
RA
QA
SA
10KΩ
FROM OR GATE 199
MC14024B
MC14051B
605
660
620
630
650
700
MC14071B
10KΩ
TO OR GATE 199
601
602
TO SECOND COMPARISON
674
672
670
RESET
621
624
625
1KΩ
+12V
470Ω
603
676
627
628
629
631
652
654
622
623
TO FIRST COMPARISON
+12V
470Ω
656

Fig. 11.


96
A
B
C
D
32
800
801
198
802
207
219
318
12V
0V
804
806
12V
321
0V
301
12V
501