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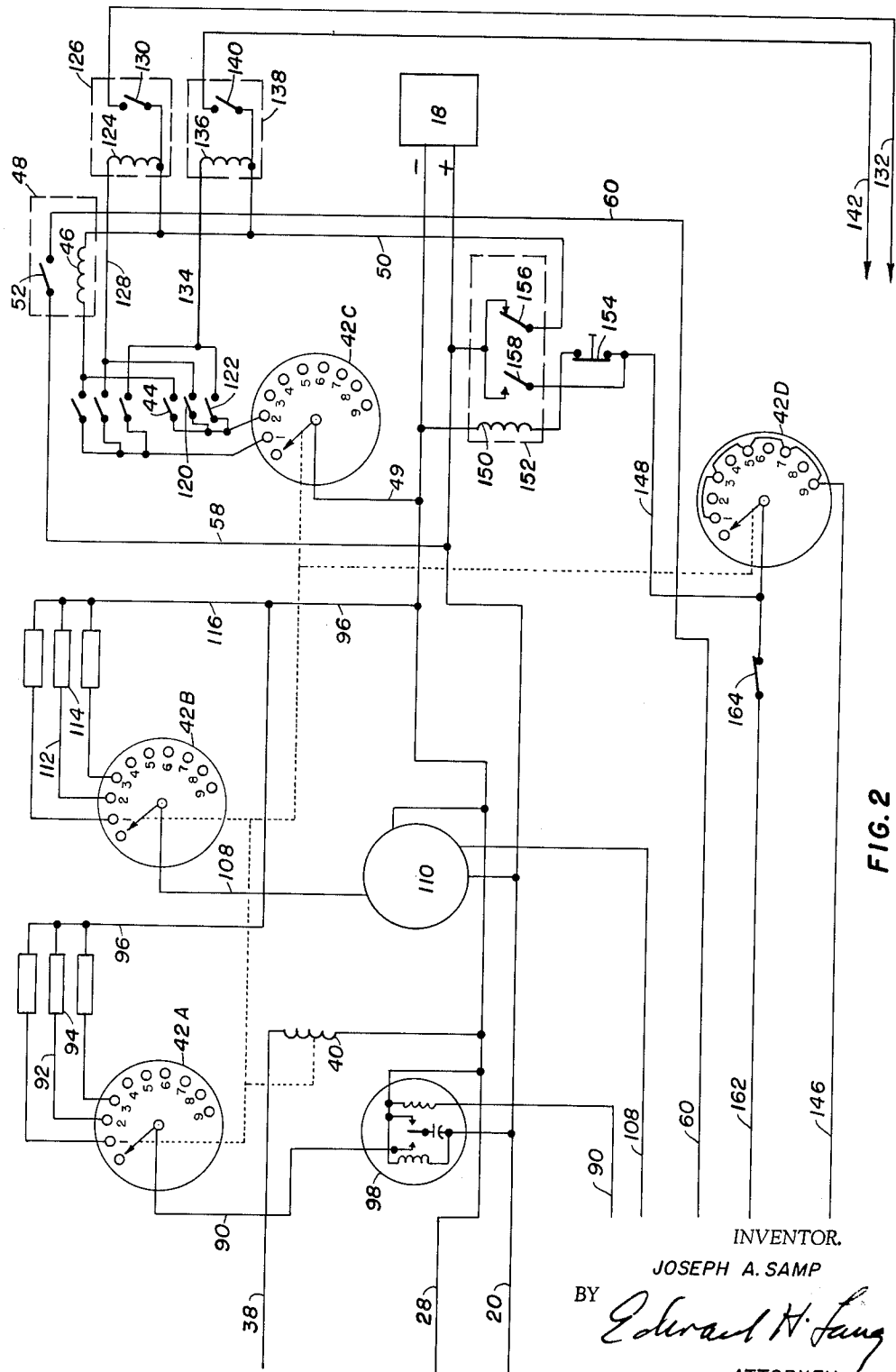
J. A. SAMP

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ELECTRICAL CONTROLLED DISPENSING SYSTEM

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INVENTOR.
JOSEPH A. SAMP
BY *Edward H. Lang*
ATTORNEY.

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ELECTRICAL CONTROLLED DISPENSING SYSTEM

Joseph A. Samp, Arlington Heights, Ill., assignor to The Pure Oil Company, Palatine, Ohio, a corporation of Ohio

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This invention relates to electrical control systems and, more particularly, to commodity dispensing systems which are actuated by any one of a plurality of switches and include remote means for indicating the quantity of the commodity dispensed for each switch. The control system of this invention is especially useful in a truck loading terminal for dispensing petroleum products, i.e., gasolines, fuel oils, etc.

Unattended truck loading terminals are frequently used in the petroleum industry to dispense bulk quantities of petroleum products, such as gasolines (with or without additives), furnace fuel oils, diesel fuels, etc. The facilities of these terminals basically consist of a central control station which includes a totalizer console to record the amounts of the various petroleum products purchased by each account or customer of the terminal, and a plurality of remote loading islands. The loading islands are relatively small curbsings surrounding the equipment for metering, ticket printing, connecting the truck to the dispensing means (such as swivel-type loading arms), set-stop counting, and individual key-operated switches for each account to initiate the flow of product. It is customary to equip the loading islands so that only one truck can load at a time, thus requiring a plurality of loading islands for each terminal.

The expense of installing and maintaining the prior art electrical systems of the truck loading terminals is excessive since the number of electrical conductors required between each loading island and the totalizer console is over twice the number of the account key-operated switches on the island.

In the control system of this invention, the number of electrical conductors required between each loading island and the totalizer console are considerably reduced by utilizing electromagnetically operated step switches, which are well known in the electrical art. The advantages of the control system of this invention include the following:

- (1) Reduced installation cost with respect to both labor and material.
- (2) Relatively simple circuitry for ease in installation, maintenance and trouble-shooting, and
- (3) Future accounts can be incorporated in the system without costly additions.

It is, therefore, the primary object of this invention to provide an improved, but simplified electrical control system. Another object of this invention is to provide a commodity dispensing system utilizing step switches. Still another object of this invention is to provide an improved electrical system for unattended truck loading terminals for dispensing petroleum products, which system utilizes step switches to reduce the number of electrical conductors. These and further objects of the invention will be described or become apparent as the description thereof herein proceeds and reference is made to the accompanying drawings in which a preferred embodiment of the invention is shown by way of example and in which:

FIGURE 1 is a schematic circuit diagram of one of several loading islands, and

FIGURE 2 is a schematic circuit diagram of the remote control totalizer console.

Referring to FIGURES 1 and 2, the numeral 10 represents a key box which is located on the loading island and contains a plurality of key-operated switches, which are switches coupled to key lock tumblers. Each of the key-operated switches represents a separate account or customer of the terminal, and each account has a key which will operate only its switch. It will be obvious that switch-actuating devices other than keys can be used, such as plastic cards perforated so as to complete an electrical circuit if inserted in the proper slot of key box 10. It will be noted that the wiring is illustrated for only a few of the account switches and other associated electrical equipment to be hereinafter described, for the purpose of simplicity and clarity.

Assuming for the purpose of illustration that the holder of the key for switch 12 desires to purchase one of two grades of gasoline sold at the terminal, the island loading arm is coupled with the account's truck, and the key is then inserted in the key lock tumbler coupled to switch 12 and turned to close switch 12. Switch 12 is a double-pole, single-throw switch having contacts 14 and 16, which are connected to the positive terminal of 115 volt D.C. power supply 18 through conductor 20. Upon the closing of switch 12, the terminal of stepping switch 22 corresponding to the specific account, i.e., terminal 2, is connected to the positive terminal of power supply 18 through conductor 20, contact 14 and conductor 24, and thereby has electrical potential impressed on it. The closing of switch 12 also causes the energization of operating or stepping coil 26 of stepping switch 22, which is connected to the negative terminal of power supply 18 through conductor 28 and resistor 30. This circuit is completed by interrupter spring contact 32, conductor 34, contact 16, and conductor 20, which is in turn connected to the positive terminal of power supply 18.

The energization of operating coil 26 cocks stepping switch 22 and opens interrupter spring contact 32. Upon the opening of interrupter spring contact 32, coil 26 is deenergized causing the interrupter spring contact 32 to close and the wiper contact of stepping switch 22, which is in the "home" position, to advance one step to the first terminal. If potential does not exist at the terminal to which the wiper contact of stepping switch 22 has advanced, operating coil 26 reenergizes and the wiper contact advances to the next terminal. This sequence is repeated until the wiper contact of stepping switch 22 reaches the terminal that has electrical potential impressed on it to complete shunt circuit 36, thereby stopping the action of stepping switch 22 and maintaining the wiper in a fixed position.

Operating coil 26 of stepping switch 22 is connected in parallel by conductors 28 and 38 to operating coil 40 of stepping switch 42 located in the totalizer console. Stepping switch 42 comprises contact levels or banks 42A, 42B, and 42C, having contacts which are similar in number and correspond to the contacts of stepping switch 22. The wiper contacts of banks 42A, 42B, and 42C are mechanically connected so that they will step or rotate in synchronism. Since coils 26 and 40 are parallel connected, the wiper contacts of stepping switch 42 will step in synchronism with the wiper contact of stepping switch 22 and stop in their respective banks at positions corresponding to the position at which the wiper contact of stepping switch 22 stopped, i.e., terminal 2.

Assuming product permissive switch 44 is closed, it will be apparent that as soon as the wiper contact of bank 42C has moved from its "home" position to terminal 1, coil 46 of relay 48 will tend to be energized. This circuit is completed from the negative terminal of power supply 18 through conductor 28, conductor 49, the wiper arm of bank 42C, permissive switch 44, conductor 50 and conductor 20 to the positive terminal of power supply 18.

However, relay 48 is of the "time delay" type and will not be operated during the movement of the wiper of bank 42C, because the energizing circuit for relay 48 is periodically broken by the movement of the wiper of bank 42C. Since no invention is claimed in using a specific time delay and such relays are commonly found in electrical circuits, the mechanism and operation of relay 48 will not be discussed in detail. However, as soon as the wiping contact of bank 42C has come to rest, coil 46 will be energized after a predetermined interval to close contacts 52 to connect the positive terminal of power supply 18 to "regular" grade gasoline set-stop switch 54 and "premium" grade gasoline set-stop switch 56 through conductor 20, conductor 58, contacts 52, and conductor 60.

The permissive switches, such as product permissive switch 44, are present so that an account can receive a specific product and additive, or no additive (determined by agreement with that account), or so that both product and additive services for a specific account can be conveniently locked out in the event that an account is cancelled, but may still have the key to close the switch in key box 10. Set-stop switches 54 and 56 are double-pole single-throw switches mechanically operated by the set-stop lever on the loading island meters, not shown for the sake of simplicity, which will automatically open after the account has received the quantity of the product pre-set on the island meters.

Again assuming for the purpose of illustration that the key holder of switch 12 desires to purchase "regular" grade gasoline, after inserting his key and turning it to close switch 12, he pre-sets the set-stop counter of the loading island meter to the amount of gasoline he desires to purchase and actuates the set-stop lever to close set-stop switch 54. One contact of set-stop switch 54 is connected by conductors 62 and 64 to solenoid-operated valve 66 and motor starter 68, respectively. The closing of set-stop switch 54 actuates solenoid-operated valve 66, which controls the flow of "regular" grade gasoline, and "regular" grade gasoline pump motor starter 68. The circuits to solenoid-operated valve 66 and motor starter 68 are completed by conductors 70 and 72, respectively, and conductor 28 connected to the negative terminal of power supply 18. If either of set-stop switches 54 and 56 are closed before key-operated switch 12, time delay relay 48 prevents the premature energization of the motor starter and solenoid circuits as the wiper of bank 42C seeks the terminal corresponding to key-operated switch 12. After a predetermined interval, time delay relay 48 closes contacts 52 to provide potential at set-stop switches 54 and 56.

The second contact of set-stop switch 54 is connected to coil 74 of time delay relay 76 by conductor 80 so that the closing of set-stop switch 54 also causes the energization of coil 74. This circuit is completed through conductor 82, and conductor 28 which is connected to the negative terminal of power supply 18. The energization of coil 74 closes normally-open contact 84 of relay 76 to provide potential at meter pulse contact 86. The normally-closed contact 88 is opened upon energization of relay 76 to prevent a false "homing" operation of stepping switch 22 if the key should be removed from key box 10 prior to completion of the loading operation.

Pulse contact 86 is mechanically coupled to the island meter so that it closes and opens once for each gallon of product passing through the meter. Therefore, during the flow of product passing through the island meter, pulse contact 86 sends pulses through conductor 90 to the wiper contact of bank 42A. Since the wiper of bank 42A stops at the terminal corresponding to the contact or terminal at which the wiper of stepping switch 22 stops, as hereinbefore described, the pulse from pulse contact 86 is transmitted through the wiping contact of bank 42A and conductor 92 to "regular" grade gasoline counter 94 of the holder of key-operated switch 12.

Counter 94 is a pulse-actuated digital counter which serves as a totalizer for the key holder of switch 12. The circuit to counter 94 is completed through conductor 96 and conductor 28, which is connected to the negative terminal of power supply 18. Conductor 90 preferably includes stray pulse protection device 98 which prevents a false registration on the counters in the event that meter pulse contact 86 is closed at the start of the loading operation, and which also protects counter 94 against transient disturbances in the electrical supply system. Since the structure and operation of stray pulse protection devices are well known to those skilled in the art and no invention is claimed in using a specific stray pulse protection device, the structure and operation of stray protection device 98 will not be described in detail.

The procedure and operation of the system is the same as hereinbefore described if the account should desire to purchase "premium" grade gasoline. In this event, set-stop switch 56 will be closed to complete the circuits from one contact of switch 56 through conductor 100 to motor starter 102 of "premium" grade gasoline pump and conductor 103 to solenoid-operated valve 104 in the pipe controlling the flow of "premium" grade gasoline. Pulse contact 106 of the "premium" meter will then be opened and closed to send pulses through conductor 108, which preferably includes stray pulse protection device 110, to wiper of bank 42B, conductor 112 to "premium" counter 114. The circuit to counter 114 is completed through conductor 116, conductor 96, and conductor 28, which is connected to negative terminal of power supply 18.

After the amount of "regular" grade gasoline which was pre-set on the island meter has passed through the set-stop counter, set-stop switch 54 is automatically opened through mechanical means to shut off the product pump controlled by starter 68, de-energize solenoid-operated valve 66 and de-energize coil 74 of relay 76 so that relay 76 begins to time-out. The time delay is to provide potential at meter pulse contact 86 until the island meter has fully stopped rotating. On timing-out, relay 76 opens contacts 84 to remove potential from meter pulse contact 86, and closes contacts 88 to provide potential at off-normal contact 118 of stepping switch 22. Off-normal contact 118 assumes an open position when the wiper of stepping switch 22 is in the "home" position and is closed whenever the wiping contact is in any other position.

When key-operated switch 12 is opened by the removal of the key from key box 10, the terminal of stepping switch 22 which corresponds to the specific account loses potential and shunt 36 across coil 26 of stepping switch 22 is open-circuited. Because off-normal contact 118 is closed when stepping switch 22 is in any position except the "home" position, a circuit is completed to operating coil 26 through contact 88 of relay 76, off-normal contact 118 and interrupter spring contact 32 so that stepping switch 22 will step around to the "home" position. It will be apparent that stepping switch 42 will simultaneously step around to its "home" position since interrupter spring contact 32 is also connected to coil 40 of stepping switch 42. The return to the "home" position of the wiper contacts of stepping switch 42 will result in the de-energization of time delay relay 48, which in turn opens contacts 52 to remove potential from set-stop switch 54 and consequently de-energize motor starter 68 and solenoid-operated valve 66 through conductors 64 and 62 respectively. The above-described shutdown-sequence of operation will also take place after a customer has received a pre-set amount of "premium" grade gasoline.

Those familiar with the operation of gasoline truck loading terminals will be aware of the fact that the gasoline purchased from the terminal may be sold under different brand names, which differ from each other only in the specific additive combinations con-

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tained in the gasoline. It is therefore advantageous to incorporate in the system hereinbefore described means for adding different additive combinations to the gasolines purchased by the various customers. Again assuming for the purpose of illustration that the key holder of key-operated switch 12 is purchasing gasoline and that the terminal contains provisions for blending either of two additive packages with the dispensed gasoline, additive permissive switches 120 and 122 are connected to the terminal of bank 42C corresponding to the key holder of key-operated switch 12. If it was determined by agreement with said account that it is to receive one of the additive combinations, the specific additive permissive switch for that additive will be closed. For example, if the key holder of switch 12 is to receive the additive controlled by permissive switch 120, switch 120 is closed so that when the wiper arm of bank 42C stops at position 2, coil 124 of time delay relay 126 is energized. This circuit is completed from the negative terminal of power supply 18, through conductor 28, the wiper arm of bank 42C, permissive switch 120, conductor 128, coil 124 and conductor 50 to the positive terminal of power supply 18.

After a predetermined interval, contacts 130 of relay 126 are closed to send energizing current through conductor 132 to actuate the additive pump and valve mechanisms which are similar to the gasoline pump and valve mechanisms. Accordingly, details of these mechanisms have been omitted from the description for the purpose of simplicity, and therefore clarity. On the other hand, should it be determined that the customer is to receive the additive controlled by switch 122, the stopping of the wiper contact of bank 42C at position 2 will complete a circuit from the negative terminal of power supply 18 through wiper arm of bank 42C, switch 122, conductor 134, coil 136 of relay 138, and conductor 50 to the positive terminal of power supply 18. After a predetermined interval, relay 138 is energized to close relay contacts 140 and send current through conductor 142 to the valve and pump mechanisms for the second additive.

It is preferred to incorporate in the system means for deactivating the same if the wipers on the respective banks of stepping switches 22 and 42 should fall out of step. This can be accomplished by providing both stepping switches 22 and 42 with an additional contact bank (i.e., 22A and 42D, respectively) having contacts or terminals similar in number and corresponding to the contacts on the first bank of switch 22 and wipers which are mechanically connected to the other wipers of the respective stepping switches. Contact level 22A of stepping switch 22 is wired so that every other point, starting with the "home" position is connected together and the wiper arm is connected to the positive terminal of power supply 18 through conductors 144 and 20. Contact level 42D of stepping switch 42 is wired so that every other point, starting with the position after the "home" position, is wired together. The contacts on bank 42D that are connected are connected by conductor 146 to the contacts that are wired together on bank 22A. The wiper of bank 42D is connected by conductor 148 to coil 150 of lock-out relay 152 through a normally closed reset button 154. If stepping switches 22 and 42 fall out of step with each other, a circuit will be completed from the negative terminal of power supply 18, through conductor 28, coil 150 of lock-out relay 152, reset button 154, conductor 148, wiper of bank 42D, wired-together contacts on bank 42D, conductor 146, wired-together contacts on bank 22A, wiper of bank 22A, conductor 144, and conductor 20 to the positive terminal of power supply 18. Coil 150 of relay 152 is thereby energized to open normally-closed contact 156 and close normally-open contacts 158. The opening of contact 156, which is in the supply circuit for

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time delay relays 48, 126 and 138, prevents the starting of the product and additive pumps.

In the event that an open circuit connection should occur in the portion of the key switch circuit connected with the terminals of stepping switch 22, the wiper arm will travel past each point and upon not finding potential in any point, will return to the "home" position, rendering the system inoperative. If an open circuit connection should occur in the portion of the key switch circuit connected with the coil circuit of stepping switch 22, the wiper arm thereof will not leave the "home" position, rendering the system inoperative.

Normally-open, spring-operated contact 160 in conductor 162 is provided in key box 10 and connected so that if the cover of key box 10 is removed by unauthorized persons, lock-out relay 152 will be energized to open the supply circuit for time delay relays 48, 126, and 138, thereby preventing the start-up or operation of the product and additive pumps. Lock-out relay 152 will remain energized until reset button 154 is pressed. Conductor 162 also preferably includes normally-closed switch 164 in the totalizer console. Switch 164 is opened when it is desired to have the lock-out circuit inoperable while the cover of key box 10 is removed for maintenance purposes.

Although this invention has been described in relation to specific embodiments, it will be apparent that obvious modifications may be made by one skilled in the art without departing from the intended scope of the invention. For example, a diode may be series connected with each of the permissive switches to prevent stray currents from entering the permissive circuits of one customer from another customer. However, it will be apparent that the diodes will have to be periodically replaced. The task of periodically replacing the diodes can be obviated by replacing stepping switch 42 with one having a greater number of contact banks so that there is a contact bank for each additive combination. The terminals of each of the additional contact banks will then be electrically connected to a plurality of additive permissive switches, i.e., one for each account, which will be electrically connected to the additive control circuits, i.e., conductors 128 and 134. In such a system diodes need not be included in conductors 128 and 134. It will also be obvious that off-normal contact 118 and associated electrical components, e.g., contacts 88 can be deleted from the system. In this modification, relays 48, 126 and 138 are preferably without the time delay feature and contacts of a time delay relay are included in conductor 49. The coil of this time delay relay is connected between conductors 28 and 34. As a result of such a modification, the wipers of the contact banks will not return to a "home" position upon the opening of set-stop switches 54 and 56, but will remain in contact with the terminals corresponding to the last user of the system. Although this invention has been described in relation to a system for dispensing two grades of gasoline and two additives, it will be obvious that it may be modified to dispense any number of liquid products and additives for the liquid products. In fact, the control system of this invention may be used in systems other than those for dispensing liquids such as one for dispensing grain by using suitable indicating means in place of the counters.

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

1. In an electrical control system adapted to be actuated by any one of a first plurality of switch means,

(a) a first selector switch including a first stepping means and a first contact bank having a first plurality of spaced contacts and a first contact arm adapted to successively engage said first contacts,

(b) said first stepping means being adapted to successively engage said first contact arm with said first contacts,

- (c) each of said first contacts being electrically connected to one of said first plurality of switch means, said plurality of switch means being electrically connected to a potential source, whereby one of said contacts has electrical potential impressed on it upon closure of one of said switch means,
- (d) a first circuit, including a potential source and said first stepping means, adapted to stop the movement of said first contact arm when said first contact arm is engaged with the contact having electrical potential impressed on it,
- (e) a second selector switch including a second stepping means and a second contact bank having a second plurality of spaced contacts and a second contact arm adapted to successively engage said second contacts, said second contacts being similar in number and corresponding to said first contacts,
- (f) said second stepping means being adapted to successively engage said second contact arm with said second contacts, said first and second stepping means being electrically connected such that said first and second contact arms move in synchronism,
- (g) a second circuit including a potential source, said second contact arm, said second contacts, and first time delay means, and
- (h) a third circuit including a potential source and electrically-actuated control means, said first time delay means including switch means for closing said third circuit.
2. A system in accordance with claim 1 in which each of said first and second stepping means includes a stepping coil and said stepping coils are parallel connected.
3. A system in accordance with claim 2 which includes at least one indicating circuit containing an indicating circuit contact bank having a contact arm mounted for movement in unison with said second contact arm and adapted to successively engage a plurality of spaced contacts which are similar in number and correspond to said second contacts, each of said indicating circuits including indicating means electrically connected to each of the contacts of the contact bank contained therein and means electrically connected to the contact arm of the contact bank contained therein for actuating said indicating means in response to movement actuated by said control means.
4. A system in accordance with claim 3 in which said third circuit includes at least one switch means adapted to control the flow of a fluid and the contacts on the indicating-circuit contact banks are electrically connected

to indicating means adapted to indicate quantity of fluid flow.

5. A system in accordance with claim 4 in which each of said first and second selector switches includes a monitoring contact bank having a contact arm adapted to successively engage a plurality of spaced contacts, the contacts on said additional contact banks being similar in number and corresponding to said first contacts, the contact arms on said monitoring contact banks being mounted for movement in unison with the contact arms of the other banks of the respective selector switches, every other contact of each of said monitoring contact banks being electrically connected such that different contacts on the monitoring contact banks of said first and second selector switches are electrically connected, and a fourth circuit, including the electrically connected contacts of said monitoring contact banks electrically connected to each other, is adapted to open a normally-closed contact in said second circuit if the contact arms of said monitoring contact banks do not move in unison.

6. A system in accordance with claim 5 in which said first, second and third circuits include the same potential source.

7. A system in accordance with claim 6 in which said second circuit includes a second plurality of switch means, each of said second plurality of switch means being electrically connected to a time delay means including switch means adapted to control the flow of a different fluid, and there is an indicating circuit having the flow thereof controlled.

8. A system in accordance with claim 7 in which said first contact arm is movable from a home position and is adapted to successively engage said first contacts upon closing of one of said first plurality of switch means and said system includes means adapted to cause operation of said first stepping means to return said first contact arm to home position after a predetermined interval of time upon opening of the closed switch means of said first plurality.

9. A system in accordance with claim 8 in which each of said indicating circuits includes stray pulse protection means.

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