Sept. 20, 1966 I. A. JOHNSON ETAL 3,273,753

PUMPING SYSTEM AND LEAK DETECTION UNIT CONTROL THEREFOR

Filed March 25, 1965. 4 Sheets-Sheet 1

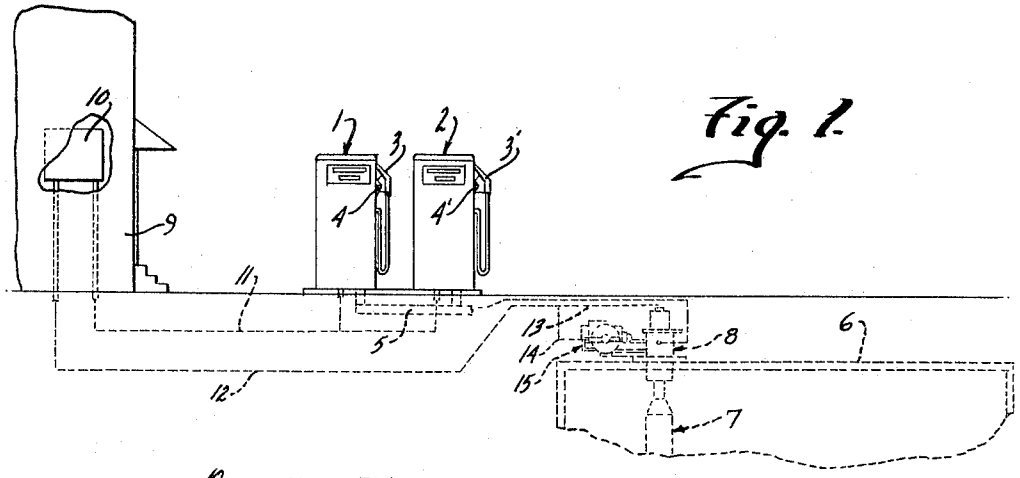

Fig. 1.

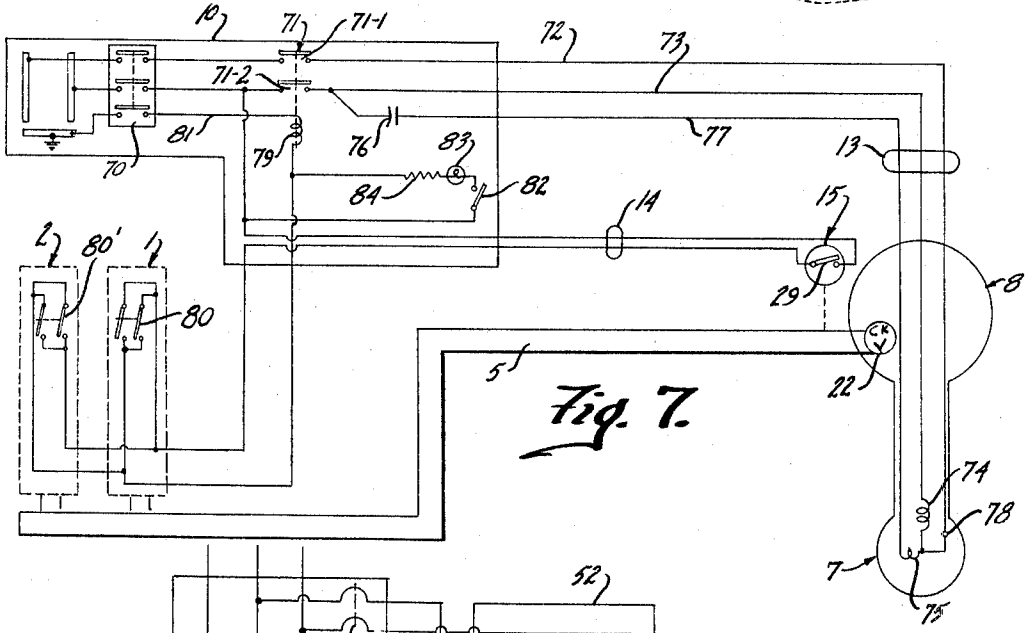

Fig. 7.

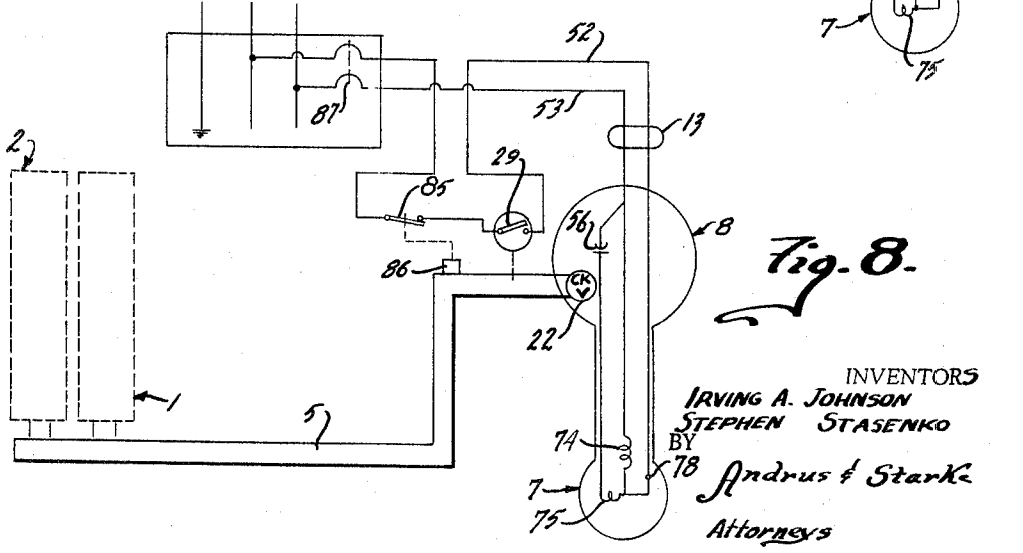

Fig. 8.

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PUMPING SYSTEM AND LEAK DETECTION UNIT CONTROL THEREFOR

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Fig. 2.

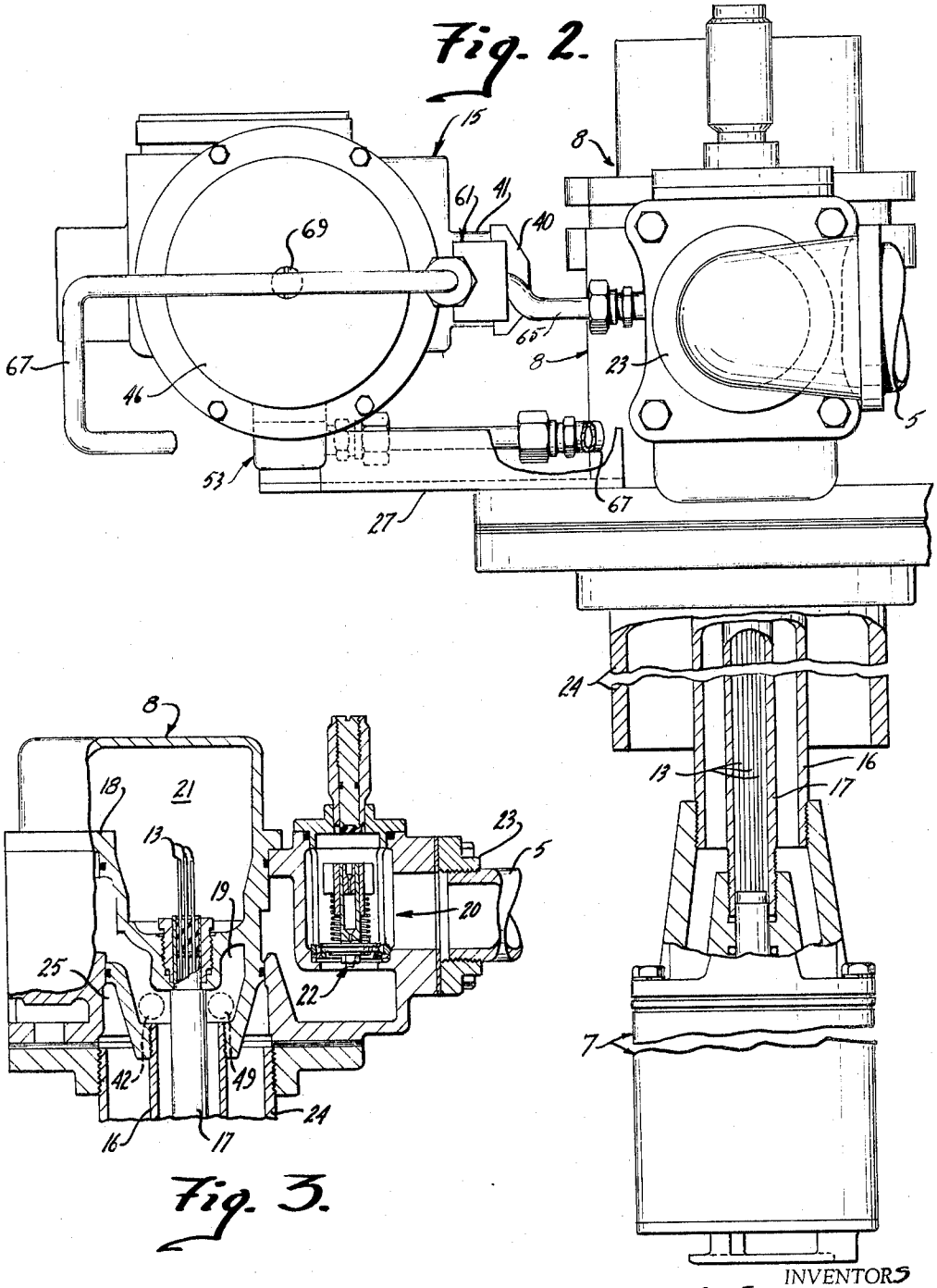

Fig. 3.

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PUMPING SYSTEM AND LEAK DETECTION UNIT CONTROL THEREFOR

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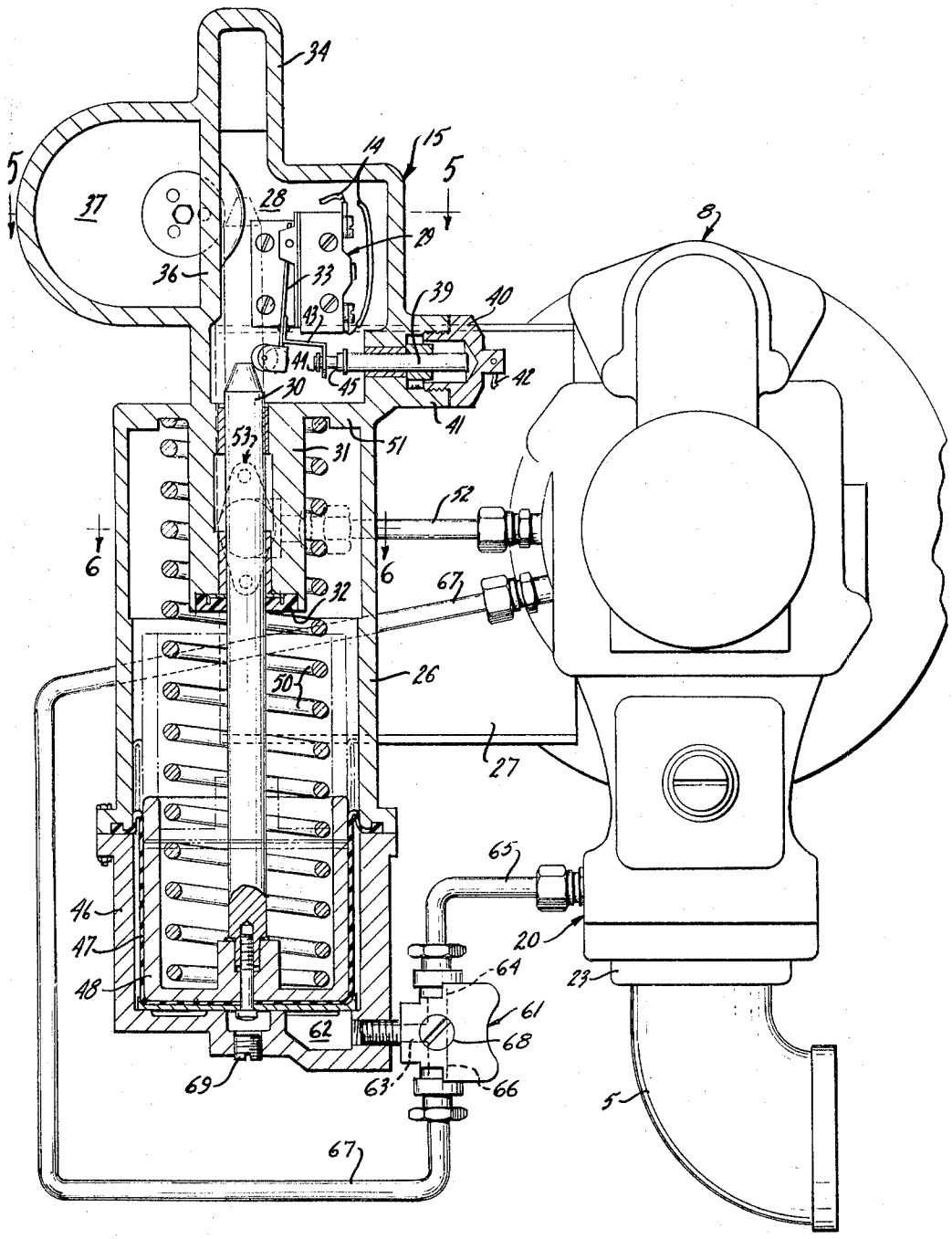

Fig. 4.

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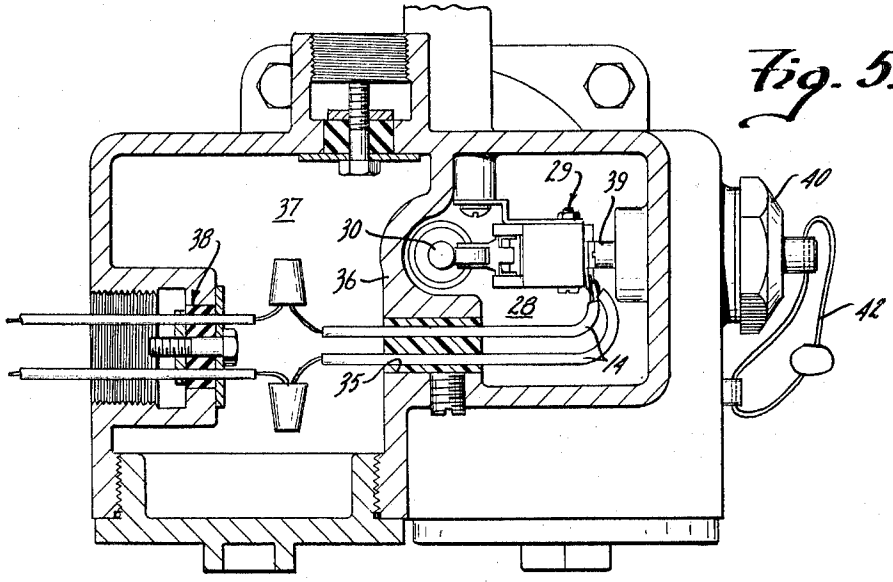

Fig. 5.

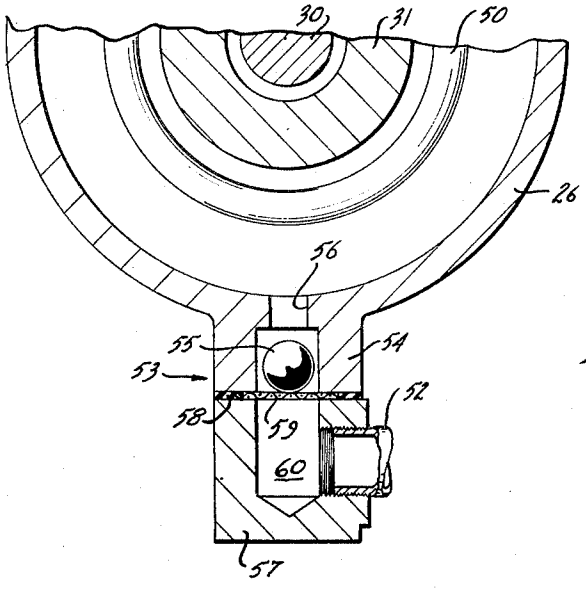

Fig. 6.

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3,273,753

PUMPING SYSTEM AND LEAK DETECTION UNIT CONTROL THEREFOR

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18 Claims. (Cl. 222—52)

This invention relates to a pumping and leak detection control therefor and in particular to such a system for retail dispensing of gasoline or other similar petroleum products through dispensing means remotely located with respect to a storage unit.

In connection with the pumping of fluids and the like, means are preferably provided to guard against loss as a result of leakage not only because of the economic consequences but where the product is explosive or otherwise dangerous because of the attendant danger involved. In any fluid pumping system, however, the joints along the packing glands, the valve systems and the like provide inherent possible sources of leakage. In pressurized systems, pressure responsive elements have found wide application for controlling the electrical pumping mechanism.

In certain flow systems, the main control may be pressure sensitive. For example, in retail gasoline dispensing systems, a common header may connect a storage tank to a plurality of different dispensing units. A check valve is provided immediately adjacent the storage tank to maintain the lines filled with gasoline or other liquid being pumped when the system is in standby position. One method of starting the pump mechanism employs the inital pressure drop in the line when the main control dispensing nozzle is opened. Thus, the drop in pressure closes a pressure sensitive switch and actuates the pumping mechanism to produce a continuous discharge from the storage tank. The pump system operates during the discharge pumping because the pumping pressure is below the cut off level of the pressure responsive switch. When the valve is closed, the pressure builds rapidly in the line and actuates the pressure sensitive switch to open the circuit to the motor and discontinue the pumping action. Through the action of the check valve or other similar means, the liquid is trapped within the line at the increased pressure and will hold the line circuit open.

However, such a sensitive circuit means prevents the normal usage of pressure sensitive responsive leak detection means. For example, if a pressure responsive leak detector were connected to the system and a leak occurred, the pressure in the main line would drop. This would start the pumping mechanism with the resultant resupplying of fluid to the line and if the leak were of sufficient size the system would maintain pumping of the fluid or liquid through the leak.

The present invention is particularly directed to an improved volume sensitive leak detection unit which can be directly incorporated into a pressure sensitive automatic start system. It can also be used in a conventional electrical controlled system and thus provides a very versatile unit. Generally, in accordance with the present invention, a fluid accumulator is connected to the pressurized discharge line between the motor-pump unit and the dispensing unit. It is filled with fluid from the discharge line to a selected volume and actuates a resiliently movable member to hold a control switch in an enabling position. It will hold the switch in such position until the fluid within the accumulator has decreased to a selected degree. Thus, in operation with a pressure sensitive control, the opening of the main valve to discharge fluid produces the temporary decrease in pressure. This permits leakage of fluid from the accumulator. However, under normal operation, the pump system starts and begins pumping of fluid through the system prior to the required movement of the control element in the accumulator chamber. As a result, the accumulator does not discharge sufficiently to actuate the safety cutoff and in fact will be again filled to the initial standby condition. However, if a leak occurs during a standby, the fluid will be forced out from the accumulator by the resiliently mounted member. After a selected loss in fluid, the member actuates a switch to the disabling position.

A manual override or reset switch can be provided to allow discharging independently of the accumulator actuated switch and in this manner permit dispensing of products until the leak can be corrected.

In a preferred construction of the present invention, an accumulating chamber is divided by a diaphragm into a piston chamber and a fluid accumulating chamber. A piston is secured to the diaphragm within the piston chamber and carries a piston rod which extends outwardly therefrom. The diaphragm chamber is connected to the hydraulic fluid line to receive fluid in accordance with the above description. Thus, under normal operation the fluid will hold the piston in an extended position with the piston rod moved outwardly to a selected maximum degree. A switch mecahnism is mounted adjacent the piston rod with the lever engaging the piston rod. If a leak occurs the spring loaded piston will cause the diaphragm to collapse toward the hydraulic line connection forcing the fluid therefrom and permitting the piston to be retracted into its chamber. After a selected movement the piston rod disengages the switch which moves to the disenabling position.

In order to provide manual check on the system, a three way valve may be provided for interconnecting of the fluid chamber of the accumulator to the hydraulic line or to a reference which will allow manual emptying of the system. This permits checking on the operation of the accumulator actuated switch in a relatively simple and rapid manner.

The present invention thus provides a highly improved leak detection system relying on a volume change and one which is substantially insensitive to pressure changes. This permits use of the device with or without a pressure sensing start system.

The drawings furnished herewith illustrate a preferred construction of the present invention clearly illustrating the above advantages and features as well as others which will be clear from the following description.

In the drawings:

FIG. 1 is a diagrammatic simplified illustration of a retail gasoline dispensing station;

FIG. 2 is a side elevational view of a motor pump and header assembly with a leak detecting accumulator connected thereto, with parts broken away and sectioned to show the output path of the motor pump assembly;

FIG. 3 is a partial vertical section through the header shown in FIG. 2;

FIG. 4 is an enlarged top elevational view of FIG. 2 with the accumulator of the present invention shown in horizontal section to more clearly illustrate the details of the preferred construction;

FIG. 5 is a section taken on line 5—5 of FIG. 4;

FIG. 6 is a section taken on line 6—6 of FIG. 4;

FIG. 7 is a circuit diagram of an electrically operated control system for the accumulator employing the accumulator of FIGS. 1–4; and

FIG. 8 is a circuit diagram similar to FIG. 5 illustrating the use of the leak detecting accumulator in a pressure sensitive automatic start circuit.

Referring to the drawings and particularly to FIG. 1, a retail gasoline dispensing service station is diagrammatically illustrated and includes a pair of dispensing pumps 1 and 2 of the usual construction. Thus, each includes a nozzle 3 through which the gasoline is dispensed and a reset switch lever 4 which must be actuated to reset the computer mechanism, not shown, and a start switch. A common header or feeder line 5 interconnects pumps 1 and 2 to a gasoline storage tank 6. A submersible motor-pump assembly or unit 7 is mounted within the storage tank 6 by a discharge header assembly 8 which is mounted within a suitable top opening in the tank 6. A service station building 9 is provided in appropriately spaced relation to the pumps 1 and 2 and the tank 6. A power control panel 10 may be provided within the building 9 for connecting of control and operating power to the various components as presently described. A switch control line 11 may be connected from the panel 10 to the pumps 1 and 2. This connects the control switches as hereinafter described into the power circuit which includes a common power and control line conduit 12 connecting power lines 13 from the panel 10 to the motor-pump unit 7. A control switch branch line 14 of conduit 12 is interconnected to a leak detection unit 15 shown mounted adjacent to the header assembly 8. As hereinafter described, the leak detection unit 15 includes a switch mechanism connected in the power circuit through the switch line 14 such that the motor-pump unit 7 cannot be energized if a selected leak occurs in the system during a standby.

Thus, generally under normal operation the leak detection unit 15 will hold the motor-pump unit circuit in a standby enabled position to receive power upon the actuation of the reset switch lever 4. Gasoline will then be dispensed from the tank 6 to and through the nozzle 3. If during standby, however, a leak occurs in the feeder line 5 or the related connections from the header assembly 8, the leak detection unit 15 will respond after a selected volumetric loss of the liquid to open the power control circuit and positively prevent motor-pump unit 7 from being energized via the line 13.

More particularly, referring particularly to FIGS. 2 and 3, the motor-pump unit 7 may be any well known construction and is shown by a support and discharge pipe 16 which depends into the tank 6 from the assembly 8. A power conduit 17 is concentrically located within the pipe 16 and connects the power lines 13 to the motor-pump unit 7 through the assembly 8 for motor operation.

The header assembly 8 generally includes a central body 18 within which a cup-shaped discharge chamber 19 is constructed or formed by appropriate intermediate walls. The chamber 19 is connected to the upper end of the discharge pipe 16 and to a check valve housing 20 for discharging of the gasoline when the motor-pump unit 7 is energized. A power chamber 21 is integrally formed immediately above the discharge chamber 19 with the power leads 13 extending therethrough into a power circuit connection in any desired manner. A motor capacitor not shown in FIGS. 1–6, may also be mounted within cavity 21. A check valve 22 is provided in the housing 20 and restricts the flow therethrough from the discharge chamber 19 to the header line 5 which is connected to the housing 21 by a suitable flange 23. Additionally, a vent pipe 24 is connected to the header assembly and projects downwardly through the tank opening into the top portion of the tank. The vent pipe 24 communicates with a passageway 25 which encircles the lower end of the discharge chamber 19 and is vented to the atmosphere.

The header assembly 8 is more or less a well known structure in the art and no further description thereof is believed necessary or is given herein.

Referring particularly to FIGS. 2 and 4–6, the leak detection unit 15 and its connection to the header assembly 8 is clearly shown. Generally, the leak detection unit 15 includes a cylinder 26 interconnected and mounted to the header assembly 8 to one side of the header assembly 8 by a suitable mounting bracket 27. The outer end of the cylinder 26 is formed with an integral switch chamber 28 within which a control switch 29 is sealed. A piston rod or shaft 30 is reciprocally or slidably mounted within a supporting hub 31 which is integrally formed and projects into the cylinder 26 from a common integral wall between the switch chamber and a piston chamber. A vapor seal 32 of a sliding lip construction as shown or any other suitable construction encircles the shaft 30 within the inner end of hub 31 to seal the chamber 28 against explosive vapors. A switch lever 33 of the switch 29 has its outer end located in the path of shaft 30 such as to hold the switch 29 in an enabling position for the motor 7 so long as the shaft is projected outwardly of the cylinder 26 in the path of the lever 33. In the illustrated embodiment of the invention, the outward movement of the shaft is accommodated by an integral tubular extension 34 on the switch chamber 28.

The switch lines 14 are connected to the control switch 29 and extend from chamber 28 through a potted opening 35 in chamber wall 36 into a connection chamber 37 integrally formed to the side of chamber 28 with wall 36 common to both. Opening 35 is sealed with any suitable material; for example, a plastic-like compound of litharge and glycerin. Power leads, shown in FIG. 1 as extensions of lines 14 for the motor-pump unit 7 are connected to the lines from switch 29 within chamber 37 and pass outwardly through a fluid tight seal 38 of suitable construction. The system provides a pair of separated explosion proof chambers to separate the motor field connection from the switch connection, as generally required for approved installation in explosive environments.

A mechanical override control for switch 29 is shown in FIG. 4 and includes an operating plunger or rod 39 slidably supported in the wall of switch chamber 28 in alignment with the end of shaft 30 when in the fully retracted position, as shown. A sealing cap 40 is secured to the exterior wall overlying rod 39, as by the threaded connection within a tubular extension 41 of the chamber wall with a wire interlock 42 to indicate removal of the cap. A coupler 43 is slidably mounted on the inner end of rod 39 between a pair of stop flanges or rings 44 and 45 on the inner end thereof. The coupler 43 is also riveted or otherwise fixed to the lever 33 such that if rod 39 is pulled outwardly, the switch 29 is actuated to energize the motor. This will permit dispensing operation while servicing or repairing the detection unit 15.

The opposite end of the cylinder 26 is closed by a cup-shaped end cap 46 which is bolted or otherwise suitably interconnected to the end of the cylinder. A positioning control diaphragm 47 spans the open end of the cylinder 26 and is clamped in sealing engagement between the end of the cylinder 26 and the adjacent end of cap 46. A piston 48 is secured to the inner end of the piston shaft 30 and to the diaphragm 47 by a suitable clamp plate and securement bolt assembly 49. Additionally, a coil spring 50 encircles the piston rod 30 between the common wall 51 of chamber 28 and the inner end or the back side of the piston 48 and continuously urges the piston 48 to a fully retracted position, as shown in FIG. 4.

A vent tube 52 interconnects the piston and spring chamber of cylinder 26 to the vent passageway 25 encircling the discharge chamber 19 in the header assembly 8. This allows ready movement of the piston in response to injection of fluid within the chamber within the end cap 46. As most clearly shown in FIG. 6, a check valve unit 53 connects the vent tube 52 to cylinder 26 and includes a housing 54 projecting from the wall of cylinder 26 within which a check ball 55 is disposed.

Check ball 55 is smaller than the cylinder chamber defined by housing 54 and larger than an opening 56 in the aligned wall of cylinder 26. An outer housing cap 57 is bolted or otherwise secured to the housing 46 with

sealing gasket 58 disposed therebetween. A screen 59 is secured to the inner edge of gasket 58 and spans the chamber of housing 54 to hold the check ball 55 within the chamber. Housing cap 57 includes an L-shaped opening or chamber 60 having one end aligned with the opening of housing 54 and the other end secured to the drain or vent tube 52.

The check ball 55 is formed of any suitable material which is lighter than gasoline or the other fluid being discharged from the system. The ball 55 permits free discharge from cylinder 26 but moves into sealing engagement with opening 56 if the liquid attempts to move through tube 52 into cylinder 26. This is primarily a protective precaution in the event the tank 6 should be overfilled.

A three way valve 61 interconnects the end cap 46 to the downstream side of the check valve housing 20 such that the chamber formed by the end cap 46 and the diaphragm 49 is connected directly to the system of the main header line 5. Cap 46 includes an enlarged head portion having a coupling chamber 62 with a side wall opening. The valve 61 is secured within the opening of chamber 62 and includes a first port 63 connected directly to the chamber 62. A sensing port 64 of valve 61 is connected by a sensing line 65 to the check valve housing 20 and a vent port 66 thereof is connected by a vent line 67 to the vent passageway 25 of the header assembly 8. The three way valve 61 includes a manual control 68 for selective positioning of the valve to selectively connect the port 63 to either sensing port 65 or vent port 66. An optional axial end tapped inlet normally sealed by a plug 69, is provided in the end wall of cap 46 and adjacent the chamber 62. The side wall mount is desirable to more readily evacuate air from the unit.

Briefly, the operation of the detection unit is summarized as follows. The manual position control 68 of the three way valve 61 is positioned to interconnect the main port 63 to the sensing line port 64 such that the fluid within the line 5 will also be present and under the same pressure conditions within the volume accumulator unit 15 and particularly within the chamber between the end cap 46 and the diaphragm 47. As a result, the piston 48 is forced outwardly to a full or partially extended position. As a result, the piston rod 30 moves past the switch lever 33 and holds it in the actuated position as shown in phantom in FIG. 4. Under normal operation, during the discharge of fluid, the piston 48 will move outwardly until a pressure balance within the chamber 26 and the pressure of a flowing fluid is established. Such will be insufficient to allow complete retraction of the piston 48 to the full line position shown and consequently the switch lever 33 will be held in the actuated position. However, if during standby a leak occurs in the system of line 5, the spring 50 causes the piston 39 to move inwardly with the fluid forced outwardly into line 5 via the ports 63 and 64 and the line 65. After substantially all of the fluid has been discharged, the piston rod 30 has moved to the full line position, releasing the switch lever 33 such that the switch 29 moves to the disabling position.

A control circuit incorporating the operational control switch 29 is schematically shown in FIG. 7. In the illustrated circuit, a main power switch 70 provides connection to a single phase, three wire 220 volt power supply for operation of the motor-pump unit 7. Switch 70 is manually controlled to selectively shut down the system and to provide the standby power connection. Energizing of the motor-pump unit 7 is controlled by a main control relay 71 having a pair of ganged contacts 71–1 and contacts 71–2 connected respectively in a pair of motor power lines 72 and 73 forming a part of line 13. The motor of the motor-pump unit 7 is schematically shown in FIG. 5 as a permanent split capacitor motor having a pair of windings 74 and 75. Winding 74 is connected directly in series in line 73 whereas winding 75 is connected in parallel with winding 74 and in series with a capacitor 76. In the illustrated circuit of FIG. 7, the capacitor 76 is mounted within a control box and is interconnected to the winding 75 and to the lead 73 by a capacitor connecting line 77. Alternatively, the capacitor 76 may be mounted as a part of the motor-pump assembly 7 and particularly within the power chamber 21 of the header assembly as previously noted. An overload protection device 78 interconnects the common junction of windings 77 and 75 to the power line 72 to complete the power circuit in accordance with well known circuit connections. Thus, the motor-pump unit 7 will be energized whenever the control relay 71 is operated to close its contacts 71–1 and 71–2.

Relay 71 includes an operating coil 79 connected to one side of the control switch 70 in series with a dispensing switch 80 of the pump 1, or a corresponding paralleled switch 80′ of pump 2 and the detection unit switch 29 and to the opposite side by a line 81. In the illustrated embodiment of the invention, the dispensing switches 80 and 80′ are each shown as a normally open double pole, single throw switch having the contacts connected in parallel within the dispenser. Thus, switch 29 which is also normally open must be held closed by the accumulator structure or unit 15, as heretofore noted, and one of the switches 80 or 80′ of the dispensing units 1 or 2 must be closed to complete the circuit to the relay coil 79 thereby operating the relay to close the related contacts 71–1 and 71–2.

If a leak occurs in the system when the pumping is shut down the liquid trapped in the line 5 will slowly leak from the line. This will result in leakage from the accumulator with the inward movement of the piston until the piston rod 30 disengages lever 33. Thereupon the switch 29 opens and requires manual resetting before a subsequent discharge can be made.

This system also compensates for liquid expansion and contraction with corresponding temperature variations by selecting the accumulating liquid chamber defined by the diaphragm 48 and the end cap 46 of sufficient size to accumulate and discharge gasoline in volume corresponding to a selected temperature variation. At a set point temperature the piston 48 may be located to maintain the accumulated liquid at approximately one half its maximum capacity. The accumulator unit 15 will not drop out switch 29 under normal temperature drops but will detect leakage after loss corresponding to that in the accumulator. For example, a typical gasoline dispensing system may have a volumetric reduction in the order of 30 cubic inches for a 40 degree drop in temperature. The accumulator may be selected with a 60 cubic inch effective liquid volume such that the overall volume will generally be sufficient to compensate for volumetric changes and also detect any leakage from the system.

In the illustrated embodiment of the invention, a reset switch 82 is connected in parallel with the series connection of switch 80 and switch 29 to permit operation of the system in the presence of a defect or leak. The reset switch 82 is a manually operable switch and is connected between the one side of the relay and the one power line through switch 70 in series with a leak detection lamp 83 and a current limiting resistor 84. When the switch 82 is moved to the closed position to provide overriding control, the lamp 83 or other suitable detection alarm will provide a visual indication of the fact that the system is being operated without the safety control and that a leak has occurred which required correction. This will also allow resetting of the system in the event the leak is not of such a character as to warrant correction or was in fact incurred by some other malfunctioning other than an actual leak.

Generally, when the system includes a control box with the reset switch 82, the mechanical reset employing the

rod 39 will not be provided. The mechanical reset is normally employed when the capacitor 56 is mounted within the header and a control box is not employed, for example, as shown in FIG. 8.

As previously noted, the present invention is also particularly useful in that it can be employed with an electrical system such as shown in FIG. 7 or with an automatic pressure sensitive system. A system of the latter structure is shown in FIG. 8 which is described with the elements corresponding to those of the circuit of FIG. 7 similarly numbered for simplicity and clarity of explanation.

In FIG. 8, a normally closed pressure responsive switch 85 is connected in series with the switch 29 and in particular in one of the signal lines 14. The pressure responsive switch 85 is controlled by a pressure responsive element 86 such as a bellows or other pressure sensing element mounted in the discharge line to the discharge side of the check valve 22.

In this system, normally a control valve will be controlled by the reset lever 4 and the nozzle 3 provides a final manual control of the discharge. Upon opening of the respective valves, the pressure in line 5 will immediately drop. This will result in a closure of the pressure responsive switch 85 through the action of the pressure sensing element 86. Motor-pump unit 7 is thereby started to provide pressurized continuous flow of gasoline or other fluid from the storage tank 6. Although the pressure rises in the line 5 during the dispensing operation, it will not rise to the operating level of the unit 86 and the associated switch 85 and as a result switch 85 is held closed. When the nozzle 3 is closed, there is an immediate buildup of pressure in the line 5 as a result of the continued operation of the motor-pump unit 7. This is quickly reflected in the pressure sensing element 86 which moves to open switch 85 and terminate the energization and operation of the motor-pump unit.

The system thus operates to permit intermittent and cyclic discharge of the stored liquid as long as the accumulator control switch 29 is held closed. If for any reason, a leak occurs in the system, the accumulator will function as heretofore described to open the switch 29 and prevent discharge from the storage tank 6. The override switch 82 of FIG. 7 is not shown in FIG. 8 as the capacitor 76 is mounted as a part of the header. In this type of installation the manual reset employ reset rod 39 of FIG. 4 is employed to permit removal of the stored product until the leak can be found and corrected.

Further, in FIG. 8, the two main motor leads 52 and 53 are connected to the incoming leads through a fuse or circuit breaker unit 87, as shown.

The present invention thus provides an improved leak detection and pump control system wherein the unit can be adapted and interconnected directly in an electrical or pneumatic controlled unit. The structure is relatively simple and will provide long life reliable operation.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. In a pumping system having a pressurized discharge line and an electrical control circuit for actuating a pumping means to discharge fluid through the line, a volume sensitive leak detector comprising,

a chamber connected to the pressurized line and having a member movably mounted to respond to the volume of fluid therein and having means urging said member against the force of the line pressure, and

a control means having a circuit enabling means adapted to be connected in the control circuit and operably associated with said member to dispose the enabling means in the enabling position with a selected amount of fluid within the chamber and to dispose the enabling means to a disabling position in response to selected volumetric reduction as a result of fluid discharged from said chamber whereby said control means is insensitive to pressure changes and sensitive to volumetric changes to control the pumping means.

2. In a pumping system,

a pressurized discharge line,

a pumping means connected to the line and selectively operable to discharge a fluid through the line from a source,

valve means in opposite ends of the line to prevent return movement of fluid to the source,

a chamber connected to the pressurized line between said valve means and having a member movably mounted and having resilient means urging said member against the force of the of the line pressure, and

a pumping control means connected to operate the pumping means and operably associated with said member and held in an enabling position by said member with a selected minimum amount of fluid within the chamber and released to a disenabling position to prevent discharge of fluid while in the disenabling position of the member in response to selected fluid discharge from said chamber by said member thereof whereby said control means is volume sensitive.

3. The pumping system of claim 2 having a pressure sensitive switch means coupled to the discharge line and connected in the control means to condition the means for actuating the pumping means.

4. In a pumping system having a pressurized discharge line and an electrical control circuit for actuating an electric pumping means to discharge fluid through the line, a volume sensitive leak detector comprising,

a cylinder adapted to be connected at one end to the pressurized line and having a piston member slidably mounted therein and having a piston shaft projecting therefrom,

bias means urging the piston member to the end connected to the pressurized line against the force of the line pressure, and

an electric switch means for connection in the control circuit and disposed in the path of the shaft and held in a circuit enabling position by said shaft with a selected fluid volume within the chamber and released to a circuit disenabling position in response to selected reduction in the fluid volume, said piston member serving to force the fluid from said chamber in the event of a leak in the flow system whereby said control means is volume sensitive.

5. The pumping system of claim 4 wherein said cylinder includes a vapor sealed switch chamber secured thereto to receive the outer end of the piston shaft and said switch means is mounted within the switch chamber.

6. The pumping system of claim 4 wherein said cylinder includes a pair of adjacent vapor sealed chambers with said switch means mounted within one of said chambers,

switch lead means connected to the switch means and passing through an opening into the adjacent chamber,

sealing means within the opening to hermetically seal the opening about the lead means,

circuit lead means extending through an outer chamber wall opening into the second of said chambers and connected to the switch lead means, and

sealing means within the last named opening to hermetically seal the opening about the circuit lead means.

7. The pumping system of claim 4 having means secured to the said piston members dividing the chamber into a fluid chamber and a bias chamber for said bias means,

means to vent said bias chamber, and

presettable valve means interposed between said cylinder and the connection of the fluid chamber to said pressurized line and having a first position providing a fluid connection therebetween to control the switch means in accordance with the condition of the pressurized line and a second position to vent the fluid chamber and seal the fluid connection to the pressurized line to check the operability of the switch means.

8. The pumping system of claim 7 wherein the means to vent the bias chamber connects the bias chamber to the top of a vented storage tank and said means includes a check valve to prevent liquid flow from the storage tank into the bias chamber.

9. A remote fluid pumping system having a plurality of dispensing units located in spaced relation to a fluid storage tank and connected thereto by a feeder line and having a motor-pump unit disposed within the tank and connected to the feeder line by a check valve unit, comprising

a motor control circuit,

a control switch connected in the motor control circuit and responsive to actuation of any dispensing unit,

a leak sensing switch connected in series with said control switch,

a fluid accumulator connected to said line and having a resiliently mounted wall means moved by fluid from said line to expand the chamber, and

means coupling said wall means to the sensing switch to hold the sensing switch closed with the chamber expanded and responsive to selected collapse thereof to open the sensing switch.

10. The remote fluid pumping system of claim 9 having an override means operable to permit operation independently of the operation of said sensing switch by said accumulator, and

indicating means actuated by the override means to create a sensible signal during such period of independent operation.

11. A remote fluid pumping system, comprising

a plurality of dispensing units located in spaced relation to a fluid storage tank and connected thereto by a feeder line,

a motor-pump unit disposed within the tank and connected to the feeder line by a check valve unit,

a motor control circuit for the motor pump,

a control switch in the control circuit and responsive to operation of a dispensing unit to condition the control circuit for operation,

a leak sensing switch connected in a control circuit with said control switch,

a fluid accumulator divided by a flexible diaphragm into a fluid chamber and a piston chamber and having an integral switch chamber adjacent the piston chamber,

a vapor seal encircling the shaft between the piston chamber and the swtch chamber to seal the swtch chamber,

means to hold the sensing switch within the switch chamber in the path of the piston shaft to actuate the switch with the chamber expanded to permit motor operation and responsive to selected collapse thereof to actuate the sensing switch to prevent motor operation,

an override means operable to bypass the operation of said sensing switch by the piston shaft to permit operation independently thereof,

indicating means actuated by the override switch means to create a sensible signal during such period of independent operation,

a three way valve connecting said fluid chamber to the line and to a vent, and

a vent means connected to said piston chamber.

12. The fluid pumping system of claim 11 wherein said override means includes a manually operable means connected to the sensing switch means and movable to a position holding the switch means in the position to permit motor operation.

13. A remote fluid pumping system having a plurality of dispensing units located in spaced relation to a fluid storage tank and connected thereto by a feeder line and having a motor-pump unit disposed within the tank and connected to the feeder line by a check valve unit, comprising

a motor control circuit,

a pressure sensitive switch in the line downstream of the check valve unit and connected in the motor control circuit, said switch being held open by a selected line pressure and held closed at all pressure below said selected line pressure,

a leak sensing switch connected in series with said pressure sensitive switch,

a fluid accumulator connected to said line and having a resiliently mounted wall means moved by fluid from said line to expand the chamber, and

means coupling said wall means to the sensing switch to hold the sensing switch closed with the chamber expanded and responsive to selected collapse thereof to open the sensing switch.

14. The remote fluid pumping system of claim 13 having override switch means operable to bypass said sensing switch to permit operation independently thereof, and

indicating means actuated by the override switch means to create a sensible signal during such period of independent operation.

15. A remote fluid pumping system, comprising

a plurality of dispensing units located in spaced relation to a fluid storage tank and connected thereto by a feeder line,

a motor-pump unit disposed within the tank and connected to the feeder line by a check valve unit,

a motor control circuit,

a pressure sensitive switch in the line downstream of the check valve unit and connected in the motor control circuit, said switch being held open by a selected line pressure and held closed at all pressure below said selected line pressure,

a leak sensing switch connected in series with said pressure sensitive switch,

a fluid accumulator divided by a flexible diaphragm into a fluid chamber and a piston chamber and having an integral switch chamber adjacent the piston chamber,

a piston within the piston chamber and secured to the flexible diaphragm and having a piston shaft projecting outwardly therefrom into the switch chamber,

a vapor seal encircling the shaft between the piston chamber and the switch chamber to seal the switch chamber,

means to hold the sensing switch within the switch chamber in the path of the piston shaft to close the switch with the chamber expanded and responsive to selected collapse thereof to open the sensing switch,

override switch means operable to bypass said sensing switch to permit operation independently thereof,

indicating means actuated by the override switch means to create a sensible signal during such period of independent operation,

a three-way valve connecting said fluid chamber to the line and to a vent, and

a vent means connected to said piston chamber.

16. In a remote fluid pumping system having a plurality of dispensing units located in spaced relation to a fluid storage tank and connected thereto by a common feeder line and having a motor-pump unit in the tank and connected to the feeder line through a check valve unit, the combination therewith of a leak detector comprising,

an accumulating cylinder divided by a flexible diaphragm into a fluid chamber and a piston chamber,

a piston secured to the diaphragm and slidably mounted within the piston chamber and having a piston rod projecting outwardly therefrom,

a motor control switch disposed adjacent the piston rod and actuated thereby and held in a first enabling position for selected extended positions of the piston rod and released to a disabling position in response to a selected retracted position of the piston,

circuit means connecting said control switch in the power circuit of the motor, and

a three-way valve having a port connected to the fluid chamber, a port connected to the downstream side of the check valve and a vent port connected to a reference source and two position means having one position connecting the first port to the second port whereby the piston is held in an expanded position by passing of fluid into the fluid chamber from the feeder line and is responsive to a selected leakage from the fluid chamber to release said control switch and a second position connecting the first port to the third port whereby said piston is fully retracted to release said control switch.

17. In a remote fluid pumping system having a plurality of dispensing units located in spaced relation to a fluid storage tank and connected thereto by a common feeder line and having a motor-pump unit in the tank and connected to the feeder line through a header assembly having a vent passageway for the tank and flow, a check valve unit permitting flow from the tank, the combination therewith of a leak detector comprising,

an accumulating cylinder divided by a transverse flexible diaphragm into a fluid chamber and a piston chamber and having a closed switch chamber secured to the outer end of the piston chamber,

a piston secured to the diaphragm and slidably mounted within the piston chamber and having a piston rod projecting outwardly therefrom into the switch chamber,

a seal encircling the piston rod adjacent the switch chamber to seal the switch chamber,

a resilient means disposed with the piston chamber and urging the piston toward the fluid chamber,

a motor control switch disposed within the switch chamber adjacent the piston rod and actuated thereby and held in a first enabling position for selected extended positions of the piston rod and released to a disabling position in response to a selected retracted position of the piston,

circuit means connecting said control switch in the power circuit of the motor,

a vent connection to the piston chamber and to the vent passageway, and

a three-way valve having a port connected to the fluid chamber, a port connected to the downstream side of the check valve and a port connected to the vent passageway and two position means having one position connecting the first port to the second port whereby the piston is held in an expanded position by passing of fluid into the fluid chamber from the feeder line and is responsive to a selected leakage from the fluid chamber to release said control switch and a second position connecting the first port to the third port whereby said piston is fully retracted to release said control switch.

18. The pumping system of claim **17** wherein the fluid chamber includes a head opposite the flexible diaphragm, said head having an L-shaped recess passageway terminating in the side wall of the head, and said three-way valve is mounted to the head with the first named port aligned with the passageway.

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