CONTROL MEANS FOR CLEANING MACHINES HAVING SOLVENT RECOVERY SYSTEM


9 Claims. (Cl. 65—12)

This invention relates generally to control means for cleaning machines employing a solvent recovery system, and refers more particularly to means for maintaining surveillance over and effecting control of the machine in response to conditions obtaining in the machine during solvent recovery.

One of the principal fields in which my invention finds special value is in the so-called coin operated dry cleaning machine industry. At present the usual practice in such machines is to control the operation cycle of the machine on a straight time program. In other words, once the machine is set in operation, a program controller establishes the length of the cleaning period, that is, when the load is being contacted with the solvent, and the length of the solvent recovery period wherein the solvent is vaporized, withdrawn from the tumbler and condensed and returned to the reservoir. In order to prevent injury to users, such machines are locked against access to the interior during the entire operating cycle, the completion of the cycle actuating the locking mechanism to release same whereby to prevent access to the interior of the machine.

Because of variance in the size of loads fed to the machines, as well as types of materials which will be cleaned therein, the recovery time allowed must be that which will permit complete recovery from the maximum possible load and most reflective materials. The recovery period in conventional machines therefore ordinarily represents at least 50% of the total cycle time of the machine. Efforts have been made to provide in such machines a control for the recovery period based on actual solvent conditions and operable to terminate recovery when the recovery is complete, independent of time. However, for reasons of complexity, cost and operational difficulty, such as plugging of the equipment by sediment and the like, the proposed arrangements have not, to my knowledge, met with success.

One of the main objectives of my invention is to provide a control arrangement for the purposes generally set forth above which, because of its structure and manner of combination in the machine, avoids or eliminates the difficulties heretofore set forth, as well as provides advantages over presently known equipment of this type. One aim of the invention is to provide a self-cleaning, non-plugging combined solvent meter and controller of simple construction which is connected into the solvent recovery line from the solvent condenser, and which serves to monitor the entire flow from the condenser and to effect changes in a control mechanism in response thereto. In its preferred embodiment, the meter is so constructed as to provide a chamber into which the condensed solvent is directed, the chamber containing a spring loaded diaphragm which is connected with a needle valve extending into and normally closing an outlet from the chamber. The valve is constructed to vary the size of the outlet opening as the diaphragm moves in response to the housing, thus providing an arrangement wherein the size of the opening is gradually enlarged as the flow to the meter increases. In other

words, the position of the valve and diaphragm is directly proportional to the flow rate through the meter. If dirt should collect at the orifice when the valve is almost closed, to the extent that flow through the meter is stopped, the liquid will back up in the line and build up an increasing pressure head on the diaphragm. This increased head will open the valve and permit the dirt to be washed through. The diaphragm, as it moves in response to changing conditions in the solvent recovery line, also affects operation of the control mechanism and provides a ready means of accurately determining exactly what the condition in the meter or flow line is at any given time while it is in use.

In addition to the specific meter construction, and as previously indicated, an important object of the invention is to provide a combination in which the flow sensing meter is utilized in conjunction with certain program control equipment to affect the over-all operation of the machine. In one form of the combination the recovery period of the machine is determined by and made directly responsive to the condition of the meter diaphragm during the recovery period. The machine will not proceed to the completion of the total operating cycle until the meter indicates that recovery has, in fact, been completed to the standards required for safe operation. Since by the nature of the machine it is unlocked only at the end of the cycle, obviously this prevents access to the machine until the load is dry and the solvent has been removed.

By tying the completion of the cycle to actual ending of the recovery period, rather than to the termination of a preestablished "safe" time interval in which recovery theoretically should have been completed, average loads which require less than the "safe" time will result in completion of the cycle in considerably less time than where the machine is on a straight time program. The difference represents time available for cleaning of the next load. For example, a 30% reduction of the recovery cycle will increase by 25% the number of loads that can be handled in a given operating day. This provides a great advantage to users as well as to owners of the machines. Of course, in addition to shortening the cycle time of the machine, the present invention will also increase the recovery time as necessary to completely dry the exceptional load of heavy clothing or retentive fabrics that would not be thoroughly dry in any straight time program.

In another form of the combination the time program is interrupted once the solvent recovery system has been set in operation, unless and until a preselected flow from the condenser has been sensed. If the latter occurs, the program is again started. However, if solvent recovery does not occur in normal fashion through some malfunction of the machine, the machine will not proceed on through the program, but will remain locked, thus again preventing access by the user to the interior of the machine and protecting him from exposure to dangerous fumes or contact with the solvent itself.

These forms of the combination noted above can be combined in a single machine, and usually will be. The single pressure-sensing meter serves as the central element in the over-all combination and controls the response of the machine thereto.

Other and further objects of the invention, together with the features of novelty appurtenant thereto, will appear in the course of the following description.
In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith, and in which like reference numerals indicate like parts in the various views;

FIG. 1 is a diagrammatic view showing a typical cleaning mechanism with which is connected a combined solvent meter and controller according to the invention;

FIG. 2 is a circuit diagram illustrating a typical time programmer and manner of connection of my meter therewith;

FIG. 3 is an enlarged front elevational view of the meter, parts being broken away for purposes of illustration;

FIG. 4 is a side elevational view taken from the left hand side of FIG. 3, parts again being broken away and shown in section for purposes of illustration;

FIG. 5 is a sectional view considerably enlarged taken along the line 5—5 of FIG. 4 in the direction of the arrows; and

FIG. 6 is an enlarged fragmentary section taken along line 6—6 of FIG. 4 in the direction of the arrows.

Referring now to the drawings and initially to FIG. 1, reference numeral 10 indicates generally the basket or tumber housing for a typical cleaning mechanism. The housing is provided with an access door 11 having a solenoid actuated latch 12. The latch is normally closed, being opened upon energization of the solenoid.

Solvex, for example perchloroethylene, is supplied to the basket housing by a pump 13 through filter 14 and fill line 15. The intake of the pump is connected with a solvent storage tank 16.

The solvent recovery system for the machine embraces the blower 17 having drive motor 18 which forces air through the baskets 19 and into the housing. The heated air as it passed through the housing serves to evaporate the solvent entrained in the load in the basket and carry it from the housing. The solvent-laden air is taken from the housing through duct 19 and lint trap 20, and passed through the water cooled condenser 21.

The solvent condensate which collects in condenser 21 is carried from the condenser through a separator 22 and the separated solvent is delivered therefrom into the flow line 23. Flow line 23 is connected with the input side of the combined solvent meter and controller 24, the details of which will subsequently be described. It suffices to note at this point that the liquid flows through element 24, passing therefrom through line 25 to the main solvent drain line 26 from the basket housing 19. The drain line 26 connects with the solvent storage tank 16.

Turning now to FIGS. 3 to 6 and to the details of construction of the element 24, the main body comprises a circular front member 27 having a diametrically extending boss 27a formed on the front face thereof. The inner side of member 27 is dished inwardly to provide a conical inside face 27b bordered by an annular flat surface 27c. The member 27 is provided centrally with a threaded opening 27d into which is screwed a fitting 28 having the orifice 29. The conical cylindrical coupling means to the line 25 earlier described.

The upper end of boss 27a is bored longitudinally to provide a passageway 30 which merges with the conical inner face. A fitting 31 is threaded into passageway 30. This fitting is coupled through a conventional coupling with the flow line 23 from the condenser. The opposite end of boss 27a is also drilled and tapped to provide a gravity drain passageway 32 into which is threaded a removable plug 33.

The conical inner face 27b forms one wall of an enclosed chamber 34, the opposed wall of which is formed by a flexible impermeable diaphragm 35 preferably formed of rubber-like material. The margin of the diaphragm is secured between the annular surface 27c and a matching annular surface 35a provided on a back member 36. Back member 36 is provided with an enlarged cylindrical cavity 36b which is vented to the atmosphere by a vent 37. The back member 36 is secured to the member 27 by circumferentially spaced bolts 38 which extend through the front member, through registering apertures 35c in the margin of the diaphragm, and into registering tapped apertures (not shown) in the back member 36. The front member is tightened securely against the margin of the diaphragm whereby to compressibly seal the joint against leakage.

Secured centrally to the diaphragm 35 and projecting through orifice 29 is the needle valve member 39. The valve member 39 is of tapered construction and preferably is formed integral with a rod member 40 extending centrally through an opening in the diaphragm. The rod 40 is secured to the diaphragm by the circular plate 41, 42 which engage opposite sides of the diaphragm and are confined between a front flange 43 and a rear locking nut 44 which is screwed onto the threaded portion 45a of rod member 49 and tightens the plates 42 and 43 and intermediate portion of the diaphragm against flange 43.

As best seen in FIG. 5, the rearward portion of rod 48 is slidably received in and supported by the axial bore 45a of a bushing 45 which is threaded into a correspondingly threaded aperture 45c in the center of back member 36. The rod 40 terminates at its rearward end in a reduced diameter threaded portion 45a which is secured, as by nut 46, a cross bar 47.

The diaphragm 35 and valve member 39 are resiliently biased toward the front member 27 by a compression spring 48 which loosely encircles rod 49 and bears at one end against bushing 45 and at the other against nut 44. As will be evident, the force exerted by spring 48 against the diaphragm can be adjusted by screwing bushing 45 further into or out of the back member.

The valve member 39 is provided with a tapered configuration, as previously noted. Preferably the taper is such that when the diaphragm is in the most forward position the valve member seats in and closes orifice 29 to any flow therethrough. By virtue of the taper, it will be evident that as the valve member is backed out of the orifice the area open to flow through the orifice around the valve member will progressively increase.

The cross bar 47 is utilized to operateally connect the valve rod 48 with a stopper to engage the reverse switch 49 and a nut 44 on the wall of back member 26 by a mounting bracket 50. The switch 49 has the actuating arm 51 which is resiliently biased toward a position in which one of the contacts normally is closed and the other is open, but normally the arm is held in a deflected position so that the contacts are in the opposite condition. As best seen in FIGS. 4 and 5, cross bar 47 carries at that end adjacent the switch a threaded bolt 53 having a disk 53 secured to its inner end. Disk 53 is positioned to engage arm 52 and restrain it in the deflected position described above. Upon sufficient rearward movement of the bar, the disk permits the switch arm to open the closed contact and close the open one. More will be said of this later. The bolt 52 is threadedly received in a correspondingly threaded aperture in the cross bar to permit adjustment of the relationship between the disk and switch arm, while a lock nut 54 permits locking the bolt in any desired adjustment.

The other end of arm 46 carries an adjustable stop member 55 which is in the form of a bolt which extends through a tapped aperture (not shown) in the cross bar. The stop member 55 is used to index the forwardmost position of the valve member 39. Obviously, if desired, by twisting bolt 55, the foremost position can be changed to one in which there is a slight opening through the orifice 29.

For protective purposes the switch 49 and associated operating mechanism, including the cross bar 47, is encased within a casing 55 which is secured to back member...
The timer motor remains deenergized until the flow reaches the rate sufficient to shift contact 49a to the broken line position. When this occurs, relay 7 is energized, opening contact 72a and deenergizing relay 74. Thus, the motor 69 is again energized and cam lobe 66a will move out from engagement with contact 76, permitting it to open. Obviously, if the desired recovery rate has been reached at the time that cam contact 70 is closed, then the timer will continue on through the closing and energizing of contact 79. The circuit to relay 74 is broken due to the energization of relay 72 at the time of shifting of contact 49a to the broken line position. In either event, it will be evident that the time for the machine will stop until and unless a desired flow rate is reached. If it is never reached, due to malfunction of the machine or any other cause, the cycle of the machine will never be completed. Since completion of the cycle is necessary to unlock the machine, the customer is prevented access to the machine at a time when, because of lack of recovery, dangerous quantities of solvent remain therein.

Assuming, however, that recovery is normal and operation of the timer is resumed, the lobe 67a will now approach and close its associated contact 79. The lobe 67a is so located relative to lobe 65a that only a short interval, say two minutes, exists following the opening of contact 79 and the closing of contact 49a before the contact 49a will still be in the broken lines position. Therefore, closing of contact 79 energizes a second relay 80, having a contact 83a in series with timer motor 69 again stopping the timer. Relay 80 is in a circuit from line L1 through conductors 81, 82, normally closed relay contact 83a and conductor 84 to line L2.

The timer will remain stopped until the meter controlled contact 49a returns to the normal position which corresponds to a flow approximately zero through the meter.

When contact 49a returns to its "normal" position, which is the solid line position of FIG. 2, relay 83 is energized, opening contact 83a and breaking the circuit to relay 80. This results in reclosing of the circuit to the timer motor 66, permitting it to continue the rotation of the shat 61. Cam 69 will thereafter shut off the recovery system and cam 69 triggers the door release circuit through closing the contact 83 to energize door latch solenoid 85.

Obviously, such additional cams or circuits as needed will be provided to reset the machine and provide for starting of the cycle. These, however, play no part in my invention, and further details are believed unnecessary.

From the foregoing it will be evident that I have provided an arrangement wherein the length of the solvent recovery period and the progress of the machine through its cycle is made dependent on the occurrence of certain desired conditions in the solvent recovery system. If none, or an insufficient amount of condensed solvent is delivered to the meter as to trip switch 49, then the machine will remain locked against access. Thus, the unit produces a safety lock in the event of any malfunctions, including power failure, cooling water failure, circulating fan failure, heater failure, basket dry belt failure, stoppage of air circulation for any reason, and failure to condense and drain solvent in the recovery system for any reason. While each of these failures can be detected by other devices, such as centrifugal switches, pressure switches, thermal elements, differential pressure switches and the like, in my invention all of these can be replaced by the combination herein set forth.

The meter and control device in and of itself, has many advantages also. Since the meter receives all the solvent from the condenser there is no need for a bypass sample system. The orifice 29 can be made of relatively large diameter, say \(\frac{3}{8}\) inch, which is large enough to pass any normal sediment that may be in the solvent. If sediment should collect at the orifice when the valve
is almost closed, it will, of course, shut off flow. However, if this happens, the solvent will accumulate in the inlet line and build up an increasing head on the diaphragm. This increased head will cause the valve to open further and permit the sediment to be washed through. In other words, the meter is self-cleaning if sufficient sediment is collected to cause plugging of the meter.

In the unlikely event that dirt particles larger than 1/8 inch are present in the solvent, which would jam the orifice even when the valve is fully open, the unit can be cleaned by simply removing the fitting 28. The fitting is removable without taking the unit from the machine and it will not affect the calibration thereof.

It will also be evident that through the combination set forth the system is such that it is safe. If prior to the start of recovery the diaphragm should rupture, the meter would never indicate that recovery had been established and the machine would stay locked just as under the conditions where insufficient solvent is delivered to the unit to trip switch 49 and restart the timer mechanism. By the same token, during recovery the orifice is unable to clean itself when plugged, the diaphragm will fail to return to the normal position because of the pressure of solvent contained within chamber 34 and the unit would never indicate, through switch 49, that recovery had been completed. Therefore, the machine will remain locked.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In a cleaning machine having a housing wherein solvent is contacted with work to be cleaned, a solvent recovery system including a condenser and means for withdrawing solvent vapor from said housing during the solvent recovery period and passing it to said condenser, and means operable to establish the sequence of operation of the machine, including initiation of said recovery period and release of said locking means, the combination therewith of a solvent flow line connected with said condenser to carry condensed solvent therefrom, a solvent meter interposed in said line and including pressure sensitive means normally substantially closing the meter to flow of liquid therethrough but operable in response to the presence of liquid solvent in the meter to open a flow path through the meter, and means operable connected with and actuated in response to said pressure sensitive means to control the effectiveness of said program means.

2. The combination as in claim 1, said last named means operable to deactivate said program control means following the start of the recovery period if the solvent pressure in the meter is less than a predetermined value.

3. The combination as in claim 1, said last named means operable to end the recovery period in response to a preselected minimum pressure in the meter.

4. In a cleaning machine having a housing wherein solvent is contacted with work to be cleaned, a solvent recovery system including a condenser and means for withdrawing solvent vapor from said housing during the solvent recovery period and passing it to said condenser, and an electrically powered program controller operating to initiate the recovery period and control the operation of the machine following recovery, the combination therewith of a solvent flow line connected with said condenser to carry condensed solvent therefrom, a solvent meter interposed in said line and including pressure sensitive means normally substantially closing the meter to flow of liquid therethrough but operable in response to the presence of liquid solvent in the meter to open a flow path through the meter, and means operably connected with and actuated in response to said pressure sensitive means to prevent the operations of the program controller subsequent to the recovery period until the pressure in said meter has dropped to a preselected minimum.

5. In a cleaning machine having a housing wherein solvent is contacted with work to be cleaned, an access door to said housing releasable lock means normally locking said door closed during operation of the machine, a solvent recovery system including a condenser and means for withdrawing solvent vapor from said housing during the solvent recovery period and passing it to said condenser, and an electrically powered program controller operating to initiate the recovery period and control the operations of the machine following recovery, the combination therewith of a solvent flow line connected with said condenser to carry condensed solvent therefrom, a solvent meter interposed in said line and including pressure sensitive means normally substantially closing the meter to flow of liquid therethrough but operable in response to the presence of liquid solvent in the meter to open a flow path through the meter, and means operably connected with and actuated in response to said pressure sensitive means to prevent the operations of the program controller subsequent to the recovery period until the pressure in said meter has reached a predetermined minimum.

6. In a cleaning machine having a housing wherein solvent is contacted with work to be cleaned, an access door to said housing releasable lock means normally locking said door closed during operation of the machine, a solvent recovery system including a condenser and means for withdrawing solvent vapor from said housing during the solvent recovery period and passing it to said condenser, and a program means operable to establish the sequence of operation of the machine, including initiation of said recovery period and release of said locking means, the combination therewith of a solvent flow line connected with said condenser to carry condensed solvent therefrom, a solvent meter interposed in said line and including pressure sensitive means normally substantially closing the meter to flow of liquid therethrough but operable in response to the presence of liquid solvent in the meter to open a flow path through the meter, and means operably connected with and actuated in response to said pressure sensitive means to control the effectiveness of said program means.

7. The combination as in claim 6 including means operably connected with and actuated responsive to said pressure sensitive means to deactivate said program means following the initiation of the recovery period until the pressure in the meter reaches a preselected value.

8. For use in a cleaning machine having a housing wherein solvent is contacted with work to be cleaned, a solvent recovery system including a condenser and means for withdrawing solvent vapor from said housing during the solvent recovery period and passing it to said condenser, and means operably connected with and actuated in response to said pressure sensitive means to control the effectiveness of said program means.
9. A solvent meter as in claim 8 wherein said control means includes a switch, and said operating means include switch trigger means connected with said diaphragm and operated responsive to movement of said diaphragm to actuate said switch.

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