TANK CLEANING-IN-PLACE PUMPING SYSTEM

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Filed Dec. 19, 1966, Ser. No. 602,701
Int. Cl. B68B 3/04, 13/00
U.S. Cl. 134—101

4 Claims

ABSTRACT OF THE DISCLOSURE

A tank cleaning system consisting of two separate tanks, one for rinse liquid and the other for detergent liquid, connected to a simple pump through a selector valve, whereby either liquid is supplied to a service tank for cleaning. A portion of the same liquid is diverted through an eductor which creates a suction in a return line from the service tank to draw either liquid therefore. There is a valve in the return line manipulatable to direct the return liquid either to drain or to the tank from which detergent was supplied.

As will appear from the ensuing description, the tank cleaning system of the present invention may be used to clean tanks, referred to herein as service tanks, for containing various materials. However, the invention is concerned primarily with cleaning and sterilizing service tanks which are used in the dairy industry for storing, transporting, and/or processing various dairy products, such as milk, ice cream, and cultured milk products. For this reason, the invention will be described in connection with this particular application. In view of what was just said concerning the general usage of the present tank cleaning system, it will be understood that the disclosed application of the invention is intended to be illustrative and not limiting in nature.

Dairy tanks of the kind referred to above must be periodically cleaned, rinsed, and sterilized to maintain the tanks in a sanitary condition. Generally speaking, a typical tank cleaning operation for this purpose involves an initial or primary rinse cycle using clean water, a subsequent detergent wash cycle using a detergent solution, a post or final rinse cycle using one or more successive sterilizing solutions, and a final drying cycle using compressed air. The final rinse cycle typically involves initial rinsing of the tank with an acid solution, such as an aqueous solution containing 75% phosphoric acid base, and subsequent rinsing of the tank with an aqueous chlorine solution. These various cleaning liquids are commonly injected into the upper end of the tank through a spray head, or the like, and are then pumped from the lower end of the tank. In most if not all cases, the liquids are heated to a predetermined temperature prior to injection into the tank, and timing of the various rinse and wash cycles is not commenced until the tank has been heated to the temperature of the incoming cleaning liquid by initial recirculation of the liquid through the tank. At this point, attention is directed to the fact that the various tank cleaning cycles and liquids set forth in this disclosure are intended to be illustrative and not limiting in nature and that these liquids and cycles may vary within the dairy industry and, of course, from one industry to another, depending upon the particular residue to be removed from each tank. In this regard it will become evident as the description proceeds that the present tank cleaning system is susceptible of various cyclic tank cleaning operations.

A variety of dairy tank cleaning systems have been devised. One of the more common tank cleaning systems for use in the dairy industry, for example, utilizes separate centrifugal supply and return pumps for pumping the various rinse, detergent wash, and sterilizing liquids under pressure to the service tank to be cleaned and pumping the liquids from the tank. The existing tank cleaning systems of this kind, however, are characterized by certain inherent deficiencies which the present invention seeks to overcome. One of these deficiencies resides in the fact that the existing cleaning systems require multiple, electrically powered supply and return pumps and, as a consequence, rather complex electrical installations for energizing and controlling the pumps. The existing systems, therefore, tend to be somewhat costly and time consuming to install, expensive to operate, and prone to malfunctioning. Another disadvantage of these existing tank cleaning systems is that the centrifugal pumps employed therein, and particularly the return pumps, require suction air vent devices for venting trapped air in the pumps. In addition, substantial inventory liquid must be maintained in the tanks to insure proper operation of and prevent loss of suction in the return pumps. The inventory liquid which must thus be maintained in the tanks often creates residue or "bath tub" rings in the tanks which must somehow be removed. A further major disadvantage of the existing tank cleaning systems involves the troublesome and difficult problem of balancing the liquid flows between the supply and return pumps. This balancing of flows, of course, is necessary to maintain a proper inventory liquid level in the tanks, i.e., to prevent the accumulation of excessive liquid in the tanks as well as to prevent complete loss of the inventory liquid and resultant loss of suction in the return pumps. As is well known in the art, properly balanced flow between the supply and return pumps is extremely difficult to accomplish, even for short periods of time, and is decidedly more difficult if not impossible to maintain throughout the entire tank cleaning operation. As a result, tank cleaning operations performed with the existing tank cleaning systems are characterized by improper cleaning of the tank and/or frequent loss of suction in the return pumps. These difficulties, of course, prolong and thereby increase the cost of the tank cleaning operations.

It is a general object of the present invention to provide an improved tank cleaning system which avoids the above noted and other deficiencies of the existing tank cleaning systems. A particularly important object of the invention is to provide an improved tank cleaning system which utilizes a venturi eductor for aspirating the cleaning liquid from the tank being cleaned, whereby the problems attendant to the use of a centrifugal return pump for pumping the cleaning liquid from the tank are avoided, and wherein further the working fluid for operating the eductor may comprise the cleaning liquid itself.

A further object of the invention is to provide an improved tank cleaning system of the character described which is relatively simple in construction, economical to fabricate and operate, eliminates the priming, venting, inventory liquid level, and flow balancing requirements of the existing tank cleaning systems with centrifugal return pumps, avoids the formation of residue or "bath tub" rings in the tank being cleaned, is simple to operate, reliable, immune to malfunctioning, and is otherwise ideally suited to its intended purpose.

Yet a further object of the invention is to provide an improved tank cleaning system which is uniquely adapted for cleaning dairy tanks but which is completely capable of cleaning tanks for other purposes.

Other objects, advantages, and features of the invention will become readily evident as the description proceeds.

With these and other objects in view, the invention consists in the construction, arrangement, and combination
of the various parts of the device, whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In these drawings:

FIGURE 1 schematically illustrates a typical tank cleaning system according to the invention; and

FIGURE 2 schematically illustrates a modified tank cleaning system according to the invention.

Generally speaking, a tank cleaning system according to the invention may comprise an inflow conduit for conveying a cleaning liquid to the service tank to be cleaned, a venturi eductor, and an outflow conduit for communicating the suction opening of the eductor to the service tank, and delivery means for supplying a cleaning liquid under pressure to the inflow conduit and a working fluid under pressure to the eductor inlet, whereby the cleaning liquid enters the tank through the inflow conduit and is aspirated from the tank by the eductor through the outflow conduit. According to a further feature of the invention, the delivery means may comprise flow splitting means for supplying cleaning liquid under pressure to both the inflow conduit and the eductor inlet so that the cleaning liquid serves both as a cleansing medium for the service tank and a working fluid for the eductor. Preferably, the flow splitting means divides the flow of cleaning fluid substantially equally between the inflow conduit and the eductor inlet to effect proper balancing of the inflow of cleaning liquid and the outflow of cleaning liquid from the service tank. In most if not all applications of the present tank cleaning system, such as the dairy tank cleaning application referred to earlier, operation of the system will involve successive rinse and wash cycles using different cleaning liquids, including an expendable cleaning liquid and a reusable cleaning liquid. In this case, the present tank cleaning system may comprise supply tanks for containing the different cleaning liquid and return means for selectively conveying the efflux liquid from the eductor to a drain, when this efflux liquid is the expendable cleaning liquid, and returning the efflux liquid to the appropriate supply tank, when the efflux liquid is the reusable cleaning liquid.

In the ensuing description, two different tank cleaning systems according to the invention are disclosed. These disclosed systems are intended primarily for use in the dairy cleaning system, which employs cleaning tanks which are employed in the storage, transportation, and/or processing of dairy products. As noted earlier, and as will become evident from the description, these systems may be used for other purposes. One of the disclosed tank cleaning systems comprises a single pump, a flow splitter, and a suitable diverting valve for selectively pumping an expendable cleaning liquid and a reusable cleaning liquid, such as rinse water, and a detergent wash solution, to the inflow conduit leading to the service tank to be cleaned and to the eductor inlet, and return means including a suitable diverting valve for selectively communicating the eductor outlet to the supply tank for the reusable cleaning liquid, i.e., the detergent wash solution, and to a drain. In this disclosed system, the flow splitter divides the efflux liquid from the single pump substantially equally between the inflow conduit and the eductor. The return diverting valve is set to return the efflux liquid from the eductor to the appropriate supply tank when this liquid is the reusable cleaning liquid or detergent solution, and to direct the eductor efflux liquid to the drain when this liquid is the expendable cleaning liquid or rinse water.

The second disclosed embodiment of the invention is essentially identical, from the functional standpoint, to the first inventive embodiment. The essential difference between the two embodiments resides in the fact that the second inventive embodiment utilizes separate supply and motive pumps for dividing the flow of each cleaning liquid substantially equally between the inflow conduit and the eductor. In this case, the supply pump feeds the inflow conduit and the motive pump feeds the eductor.

In addition, the second tank cleaning system under consideration utilizes three separate supply tanks, to wit a rinse tank and a drain tank for containing the expendable cleaning liquid or rinse water and a third wash tank for containing the reusable cleaning liquid or detergent solution. The rinse and wash tanks are connected, while the wash and drain tanks feed the motive pump. The return means of the system may be selectively conditioned to direct the efflux liquid from the eductor to the wash tank, when this liquid is reusable cleaning liquid, and to the drain tank, when the efflux liquid is the expendable cleaning liquid or rinse water so disposed with drain means for draining liquid from the tank.

Operation of the two disclosed tank cleaning systems of the invention are substantially identical. Typical operation of these systems, for example, involves an initial or primary rinse cycle, during which the service tank is flushed with the expendable cleaning liquid or rinse water and the latter is disposed of through the drain after use, a subsequent wash cycle, during which the service tank is flushed with the reusable cleaning liquid or detergent solution and the latter, after use, is returned to its supply tank, and a final rinse cycle, during which the service tank is flushed with a sterilizing solution or successive sterilizing solutions consisting of a mixture of the expendable cleaning liquid or rinse water and a suitable sterilizing agent or agents. This sterilizing solution is disposed of through the drain after use. Both of the inventive embodiments may contain rinse means for selectively cleaning liquid to the suction opening of the eductor to the inflow conduit for aspirating cleaning liquid from this conduit at the conclusion of each cycle.

Referring now to the drawings, in particular to FIGURE 1, the illustrated tank cleaning system 10 includes a supply tank 12, to wit a rinse tank 12, to which is connected, respectively, an expendable cleaning liquid, such as rinse water, and a reusable cleaning liquid, such as a detergent wash solution, an inflow conduit 16 for conveying each cleaning liquid to a service tank 18 to be cleaned, a venturi eductor 20 for aspirating the cleaning liquid from the service tank, an outflow conduit 22 for communicating the suction opening of the eductor to the inflow conduit, delivery means 26 for selectively pumping cleaning liquid from the supply tanks to the inflow conduit 16 and the eductor inlet 28, and return means 30 for selectively connecting 33 the eductor outlet 32 to the supply tank 12 for the reusable cleaning liquid and a drain 34. In the ensuing description, it will be assumed that the expendable cleaning liquid contained in the supply tank 12 is rinse water and the reusable cleaning liquid contained in the supply tank 14 is a detergent wash solution. For this reason, the tanks 12 and 14 will be hereinafter referred to as a rinse tank and a wash tank, respectively.

Briefly, in a typical tank cleaning operation, the tank cleaning system 10 is initially set for a rinse cycle, during which rinse water from the rinse tank 12 is pumped to the service tank 18 through the inflow conduit 16 and is aspirated from the lower end of the service tank through the outflow conduit 22 by the eductor 20. The efflux rinse water from the eductor is directed to the drain 34. Thereafter, the system is set for a wash cycle, during which detergent wash solution from the wash tank 14 is pumped to the service tank 18 through the inflow conduit 16 and is aspirated from the service tank 18 to the outflow conduit 22 by the eductor 20. The efflux wash solution from the eductor is returned to the wash tank 14. The system is then set for a final rinse cycle, during which rinse water from the rinse tank 12 is again pumped to the service tank 18. In this case, a suitable sterilizing agent is injected, via a conduit 36 into the rinse water entering the service tank to provide a sterilizing solution for the latter tank. The sterilizing solution is aspirated from the service tank by the eductor 20 and is then directed to the drain 34. As will appear from the ensuing description, the rinse cycles may involve a number of periodic burst
rinses of the service tank and the rinse and wash cycles may involve final aspirating of liquid from the inflow conduit 16 by the eductor 20 through a by-pass conduit 38.

Referring now in greater detail to the illustrated tank cleaning system 10, the rinse tank 12 and wash tank 14 have inlet valves 40 and 42, respectively, through which the rinse tank may be filled with rinse water and which tank may be filled with detergent wash solution. The delivery means 26 comprise a pump 44, typically a centrifugal pump, having an intake and an outlet. Between this pump and the supply tanks 12, 14 is a diverter valve 46 for selectively communicating the pump intake to either tank. This valve, as well as the other diverter valves, referred to later, of the tank cleaning system may be operated in any convenient way. Preferably, however, these valves comprise remote controlled pneumatic valves.

A flow splitter 48 located downstream of the pump 44 has an inlet connected to the pump outlet, a first outlet connected to the inlet end of the inflow conduit 16 through a shut-off valve 50, and a second outlet connected to the inlet 28 of the eductor 20. This flow splitter is effective to divide the stream of efflux liquid from the pump 44 substantially equally between the inflow conduit 16 and the efflux conduit 38. Shut-off valve 50 has an open position and a closed position. In its open position, this valve permits unrestricted flow from the flow splitter 48 to the inflow conduit 16. In its closed position, the valve blocks flow from the flow splitter to the inflow conduit.

As is common practice in the tank cleaning art, the outlet end of the inflow conduit 16 mounts a spray head or nozzle 52 which is permanently or removably disposed within the upper end of the service tank 18 to be cleaned in such a way that the rinse water and the detergent wash solution supplied to the spray head is discharged outwardly against the inner surfaces of the tank wall. The sterilizer injection valve 36 and the by-pass conduit 38 connect to the inflow conduit 16 downstream of the shut-off valve 50. In practice, means are provided for supplying sterilizing agents, such as phosphoric acid and chlorine, under pressure to the sterilizing conduit. A combined shut-off and metering valve 54 is installed in the sterilizer conduit 36 for regulating sterilizer flow therethrough into the inflow conduit 16.

The outflow conduit 22 leads from the bottom end of the service tank 18 to a diverter valve 56. This diverter valve connects the outflow conduit and the by-pass conduit 38 to the suction opening 24 of the eductor 20 and includes means for selectively communicating the suction opening to either conduit.

The return means 30 comprise a diverter valve 58 which connects the eductor outlet 32 to the drain 34 and a return conduit 60 leading to the wash tank 14. This diverter valve includes means for selectively communicating the eductor outlet to either the drain or the return conduit.

The general operation of the tank cleaning system 10 has already been described. It will be recalled, however, that the detailed operation of the system may vary depending upon the particular tank cleaning application for which the system is employed. The following discussion sets forth a typical operating sequence of the system when the latter is employed to clean a dairy tank. In view of what was just said, it will be understood that this particular operating sequence of this system is intended to be merely illustrative and not limiting in any respect.

At the outset of the cleaning operation, the diverter valve 46 is set to communicate the intake of the supply pump 44 to the rinse tank 12, the diverter valve 56 is set to communicate the eductor suction opening 24 to the outflow conduit 22, and the diverter valve 58 is set to communicate the eductor outlet 32 to the drain 34. The shut-off valves 50 and 54 are initially closed. At this point, the pump 44 is energized to pump rinse water from the rinse tank 12 to the flow splitter 48. Since the shut-off valve 50 is closed at this time, the only flow from the flow splitter occurs through the eductor 20 to the drain 34. This flow of rinse water through the eductor creates a suction in the outflow conduit 22.

The actual rinse cycle is initiated by intermittently opening and closing the shut-off valve 50. Each time the shut-off valve opens, a burst of rinse water flows from the flow splitter 48 and the rinse water enters the service tank 18. The efflux rinse water emerging from the eductor outlet 32, which includes the rinse water entering the eductor from the flow splitter 48 and the rinse water entering the water from the service tank 18, passes to the drain 34. As noted earlier, the flow splitter 48 is designed to divide the efflux rinse water from the pump 44 substantially equally between the inflow conduit 16 and the eductor 20, thus to properly balance the flows of rinse water into and out from the service tank. The above described method of burst rinsing the service tank 18 is preferred for the reason that it achieves optimum cleansing of the tank. In actual practice, the rinse cycle may involve three such burst rinses. At the conclusion of the rinse cycle, the shut-off valve 50 is closed and the diverter valve 56 is shifted to communicate the eductor suction opening 24 to the by-pass conduit 38. The rinse water remaining in the inflow conduit 16 is thereby aspirated from this conduit through the by-pass conduit by the eductor 20. Such removal of the remaining rinse water from the inflow conduit 16 at the conclusion of the rinse cycle is desirable to avoid dilution of the detergent wash solution during the following wash cycle of the tank cleaning system. After the inflow conduit 16 has been emptied, the diverter valve 56 is returned to its original position, to communicate the eductor suction opening 24 to the outflow conduit 22.

At the outset of the following detergent wash cycle of the tank cleaning system 10, the diverter valve 46 is shifted to communicate the intake of the pump 44 to the wash tank 14, and the diverter valve 58 is shifted to communicate the eductor outlet 32 to the detergent return conduit 60. The pump 44 is then started, the shut-off valve 50 is opened. Under these conditions, detergent wash solution is pumped from the wash tank 14 to the flow splitter 48, from whence the detergent solution flows both to the inflow conduit 16 and the eductor 20. The detergent wash solution which flows through the inflow conduit 16 is discharged into the interior tank surfaces and is then aspirated from the bottom of the tank through the outflow conduit 22 by the eductor 20. The efflux wash solution emerging through the eductor outlet 32 is returned to the wash tank 14 through the detergent return conduit 60. After a predetermined wash period, the shut-off valve 50 is reclosed to block detergent flow from the flow splitter 48 to the inflow conduit 16. The diverter valve 56 is now shifted to communicate the eductor suction opening 24 to the by-pass conduit 38, thus to aspirate the remaining detergent solution from the inflow conduit 16. After the inflow conduit has been emptied of detergent solution, the pump 44 is stopped and the diverter valves 46, 56, and 58 are returned to their initial positions to complete the wash cycle and condition the cleaning system for the final rinse cycle.

This final rinse cycle is identical to the initial rinse cycle except that the sterilizer injection valve 54 is opened to meter a suitable sterilizer or sterilizers into the rinse water flowing to the service tank 18, thus to provide a sterilizing solution for the tank. In actual practice, the final rinse cycle may involve an initial acid rinse of the service tank, obtained by injecting phosphoric acid into the rinse water entering the tank, and a final sterilizing rinse, obtained by injecting chlorine into the rinse water. During this final rinse cycle, as in the initial rinse cycle,
the liquid efflux from the eductor 20 is directed to the drain 34. In order to provide a more thorough understanding of the invention, there is set forth below a chart itemizing the operating sequence and time intervals involved in a typical tank cleaning operation of the tank cleaning system 10. In this chart, it is assumed that the diverter valves 46, 56, and 58 are initially set in positions wherein the valve 46 opens to the rinse tank 12, the valve 56 opens to the outflow conduit 22, and the valve 58 opens to the drain 34.

A. Initial rinse cycle—total time 3 minutes:
(1) Pump 44 starts.
(2) Valve 50 opens—20 seconds.
(3) Valve 50 closes—20 seconds.
(4) Valve 56 opens—20 seconds.
(5) Valve 56 closes—20 seconds.
(6) Valve 58 opens—20 seconds.
(7) Valve 58 closes.
(8) Valve 56 opens to by-pass conduit 38—20 seconds.
(9) Valve 56 reopens to outflow conduit 22.

B. Wash cycle—total time 12 minutes:
(1) Valve 46 opens to wash tank 14.
(2) Valve 58 opens to detergent return conduit 60.
(3) Pump 44 starts.
(4) Valve 50 opens—15 minutes.
(5) Valve 50 closes.
(6) Valve 56 opens to by-pass conduit 38.
(7) Valve 56 reopens to outflow conduit 22.
(8) Pump 44 stops.
(9) Valve 46 reopens to wash tank 12.
(10) Valve 58 reopens to drain 34.

C. Final rinse cycle—total time 3 minutes:
Same as initial rinse cycle except that valve 54 opens during the final 20 seconds of the cycle to inject sanitizing liquid into the rinse water entering the service tank.

The modified tank cleaning system 100 illustrated in FIGURE 2 is similar to the tank cleaning system 10, just described, in that the tank cleaning system of FIGURE 2 comprises an inflow conduit 102 for conveying cleaning liquid to a spray head in the upper end of the service tank 104 to be cleaned, an outflow conduit 106 for conveying the cleaning liquid from the bottom end of the tank, an eductor 108 for aspirating the cleaning liquid from the tank through the outflow conduit 106, delivery means 110 for pumping cleaning liquid from supply tank means 112 to the inflow conduit 102 and the inlet 114 of the eductor 108 at substantially equal flow rates, and return means 116 for selectively returning the efflux liquid emerging from the eductor outlet 118 to the supply tank means 112 and a drain 120. In contrast to the tank cleaning system 10, on the other hand, the supply tank means 112 of the modified tank cleaning system 100 comprise three separate supply tanks 122, 124, and 126. The supply tanks 122 and 126 contain an expendable cleaning liquid, such as rinse water, and the remaining tank 124 contains a reusable cleaning liquid, such as detergent wash solution. The drain 120 comprises an overflow tube which opens to the tank 126. In the ensuing description, the supply tanks 122, 124, and 126 are referred to respectively, as rinse, wash, and drain tanks. The rinse and drain tanks 122, 126 have a common inlet connection 128 through which the tanks may be filled with rinse water. The wash tank 124 has an inlet 130 through which this tank may be filled with detergent wash solution.

In further contrast to the tank cleaning system 10, the delivery means 110 of the modified tank cleaning system 100 comprise three separate pumps 132, 134 and 135 which are typically centrifugal pumps. Pump 132 feeds the inflow conduit 102 and is hereinafter referred to as a supply pump. Pump 134 feeds the eductor 108 and is hereinafter referred to as a motive pump. The intake of the supply pump 132 is connected to the rinse tank 122 and the wash tank 124 through a diverter valve 136 which may be operated to selectively communicate the pump intake to either tank. The outlet of the supply pump 132 connects to the inflow conduit 102 through a shut-off valve 138. The intake of the motive pump 134 connects to the wash tank 124 and the drain tank 126 through a diverter valve 140 which may be operated to selectively communicate the pump intake to either tank. The outlet of the motive pump 134 connects to the eductor inlet 114.

The suction opening 142 of the eductor 108 is connected to the outflow conduit 106 and to a by-pass conduit 144 through a diverter valve 146. This valve may be operated to selectively communicate the suction opening to either the outflow conduit or the by-pass conduit. The distal end of the by-pass conduit connects to the inflow conduit 102, downstream of the shut-off valve 138.

The return means 116 comprises a diverter valve 148 which connects the eductor outlet 118 to the wash tank 124 and the drain tank 126. Diverter valve 148 is operable to selectively communicate the eductor outlet to either tank 124 or 126.

Operation of the tank cleaning system 100 involves essentially the same steps and wash cycles described above in connection with the tank cleaning system 10. Accordingly, it is unnecessary to set forth the detailed operating sequence of the system 100. Suffice it to say that during each rinse cycle, the diverter valves 136, 140 open to the rinse and drain tanks 122, 126, respectively, the shutter-off valve 138 is open, the diverter valve 146 opens to the outflow conduit 106, and the diverter valve 148 opens to the drain tank 126. Under these conditions, the supply pump 132 pumps rinse water from the rinse tank 122, through the inflow conduit 102, to the service tank 104 to rinse the latter. The motive pump 134 pumps rinse water from the drain tank 126, through the eductor 108, back to the drain tank to create a suction in the outflow conduit 106. Rinse water is thereby aspirated from the service tank 104, through the outflow conduit 106, into the eductor 108. The rinse water from the service tank then flows with the rinse water from the motive pump 134 into the drain tank 126. The rinse water is drained from the tank 126 through the overhead drain 120. As in the previous embodiment of the invention, the shutter-off valve 138 may be periodically opened and closed during the rinse cycle to effect burst rinsing of the service tank 104. At the conclusion of each rinse cycle, the shutter-off valve 138 is closed and the diverter valve 146 is opened to the by-pass conduit 144 to aspirate any remaining rinse water from the inflow conduit 102.

During the wash cycle, the diverter valves 136, 140, and 148 are opened to the wash tank 124 and the diverter valve 146 is reopened to the outflow conduit 106. Under these conditions, the supply pump 132 pumps detergent wash solution from the wash tank 124, through the inflow conduit 102, to the service tank 104 to wash the latter. The motive pump 134 pumps detergent wash solution from the wash tank 124, through the eductor 108, back to the wash tank to create a suction in the outflow conduit 106. Detergent wash solution is thereby aspirated from the service tank 104 into the eductor 108 and then flows with the detergent solution from the motive pump 134 to the wash tank 124. At the conclusion of the wash cycle, the shutter-off valve 138 is reclosed and the diverter valve 146 is opened to the by-pass conduit 144 to aspirate any remaining detergent solution from the inflow conduit 102.

As in the earlier form of the invention, during the final rinse cycle, a sterilizing liquid is injected into the rinse water flowing to the service tank 104 through the inflow conduit 102 to effect sterilizing of the tank. This sterilizing liquid is injected through a conduit 150 which connects to the inflow conduit 102 downstream of the shutter-off valve 138 and contains a shut-off valve 152.
It is evident at this point that the essential difference between the illustrated tank cleaning systems 10 and 100 resides in the fact that the system 10 utilizes a single pump and a flow splitter for supplying rinse water and detergent solution at substantially equal rates of flow to the service tank and the eductor, while the system 100 utilizes two separate pumps for this purpose. The tank cleaning system 10, therefore, is superior to the tank cleaning system 100 in that the former system requires but a single pump and pump motor. On the other hand, the tank cleaning system 100 is superior to the tank cleaning system 10 from the standpoint of the required flow rate of rinse water and detergent solution through the service tank to achieve a given rate of flow of rinse water and detergent solution through the service tank being cleaned. In this regard, for example, it is evident that in the tank cleaning system 10, the pump 44 must deliver rinse water and detergent solution to the flow splitter 48 at a flow rate which is twice the flow rates of the inflow conduits through the service tank 18. In the tank cleaning system 100, on the other hand, the pumps 132 and 134 are each required to deliver rinse water and detergent solution only at a flow rate equal to the desired rate of flow of these liquids through the service tank 104.

It is now obvious, therefore, that the invention herein described and illustrated is fully capable of obtaining the several objects and advantages preliminarily set forth.

While the invention has herein been shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

What is claimed as new in support of Letters Patent is:

1. A cleaning system for a service tank comprising:
   first supply tank means for containing a first cleaning liquid,
   second supply tank means for containing a second cleaning liquid,
   an inflow conduit for conveying said cleaning liquids to the interior of said service tank including an inlet end for receiving said cleaning liquids under pressure and an outlet end for connection to said service tank,
   an eductor for aspirating said cleaning liquids from said service tank including an inlet, an outlet, and a suction opening at which a suction is created in response to flow of a working fluid through said eductor from its inlet to its outlet,
   an outflow conduit for communicating said service tank interior to said eductor suction opening including an inlet end for connection to said service tank and an outlet end connected to said suction opening,
   cleaning liquid delivery means connecting said supply tank means and said inflow conduit including means for selectively pumping cleaning liquid from either supply tank means to said inflow conduit,
   said first cleaning liquid being expendable rinse water and said second cleaning liquid being reusable detergent solution,
   said first supply tank means comprising a supply tank for containing said rinse water and said second supply tank means comprising a supply tank for containing said detergent solution,
   said delivery means comprising a pump having an intake and an outlet, a diverter valve for selectively communicating said pump intake to either supply tank, and a flow splitter having an inlet connected to said pump outlet and outlets connected to the inlet ends of said inflow conduit and said eductor jet, respectively, for dividing the efflux liquid from said pump substantially equally between said inflow conduits and eductor, whereby said delivery means are adapted to selectively deliver rinse water from said first supply tank and detergent solution from said second supply tank to said inflow conduit and eductor at substantially equal flow rates, and said rinse water and detergent solution each serve both as a cleaning medium for said service tank and a working fluid for said eductor.

2. A tank cleaning system according to claim 1 including:
   means for selectively communicating the inlet end of said inflow conduit to said eductor suction opening to permit aspirating of liquid from said inflow conduit,
   an inflow conduit for conveying said cleaning liquids to the interior of said service tank including an inlet end for receiving said cleaning liquids under pressure and an outlet end for connection to said service tank,
   an eductor for aspirating said cleaning liquids from said service tank including an inlet, an outlet, and a suction opening at which a suction is created in response to flow of a working fluid through said eductor from its inlet to its outlet,
   an outflow conduit for communicating said service tank interior to said eductor suction opening including an inlet end for connection to said service tank and an outlet end connected to said suction opening,
   cleaning liquid delivery means connecting said supply tank means and the inlet end of said inflow conduit including means for selectively pumping cleaning liquid from either supply tank means to said inflow conduit,
   said first cleaning liquid being expendable rinse water and said second cleaning liquid being reusable detergent solution,
   said first supply tank means comprising a rinsing tank and a separate drain tank for containing said rinse water and said second supply tank means comprising a wash tank for containing said detergent solution,
   said delivery means comprising a supply pump having an outlet connected to the inlet end of said inflow conduit and an intake, a diverter valve for selectively communicating said pump intake to said rinse tank and wash tank, a motive pump having an outlet connected to said eductor inlet and an intake, and a second diverter valve for selectively communicating said motive pump intake to said wash tank and drain tank,
   said diverter valves and pumps being adapted to be set and operated, respectively, to selectively supply rinse water and detergent solution at substantially equal rates of flow to said inflow conduit and eductor, whereby said rinse water and detergent solution each serve as a cleaning medium for said service tank and a working fluid for said eductor.

3. A cleaning system for a service tank comprising:
   first supply tank means for containing a first cleaning liquid,
   second supply tank means for containing a second cleaning liquid,
   an inflow conduit for conveying said cleaning liquids to the interior of said service tank including an inlet end for receiving said cleaning liquids under pressure and an outlet end for connection to said service tank,
   an eductor for aspirating said cleaning liquids from said service tank including an inlet, an outlet, and a suction opening at which a suction is created in response to flow of a working fluid through said eductor from its inlet to its outlet,
   an outflow conduit for communicating said service tank interior to said eductor suction opening including an inlet end for connection to said service tank and an outlet end connected to said suction opening,
   cleaning liquid delivery means connecting said supply tank means and the inlet end of said inflow conduit including means for selectively pumping cleaning liquid from either supply tank means to said inflow conduit,
   said first cleaning liquid being expendable rinse water and said second cleaning liquid being reusable detergent solution,
return means connecting said eductor outlet, said wash tank, and said drain tank including a diverter valve for selectively communicating said eductor outlet to said wash tank and said drain tank to permit the efflux liquid from said eductor to be returned to said wash tank when said efflux liquid is detergent solution and said efflux liquid to be returned to said drain tank when said efflux liquid is rinse water.

4. A tank cleaning system according to claim 3 including:

means for selectively communicating the inlet end of said inflow conduit to said eductor suction opening to permit aspirating of liquid from said inflow conduit.

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