United States Patent

[11] 3,567,032

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[21] Appl. No. 829,486
[22] Filed June 2, 1969
[45] Patented Mar. 2, 1971
[73] Assignee Monogram Industries, Inc.
Los Angeles, Calif.
Continuation-in-part of Ser. No. 737,232, June 14, 1968, now abandoned.

[54] **FILTER AND PUMP FOR A RECIRCULATING SANITARY SYSTEM**
6 Claims, 8 Drawing Figs.

[52] U.S. Cl. 210/355, 210/413, 210/416, 4/1
[51] Int. Cl. B01d 29/38
[50] Field of Search 210/355, 413, 414, 415, 416, 192; 4/1

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Primary Examiner—John Adee
Attorneys—Golove and Kleinberg, Leonard Golove and Marvin H. Kleinberg

ABSTRACT: In a recirculating sanitary system, an improved filter and pump assembly provides a source of flushing liquid. A diaphragm pump is provided with a coupling to a plurality of needle members that reciprocate through an apertured plate. The needle members extend beyond the plate into the storage tank at all times, and the reciprocating motion imparted to the needle members tends to clean the needle-aperture combination, which acts as the filter. The pump also supplies a limited backflow through the filter for cleaning purposes during a portion of the operating cycle. In addition, a novel, pneumatic timing device assures the completion of an operating cycle.

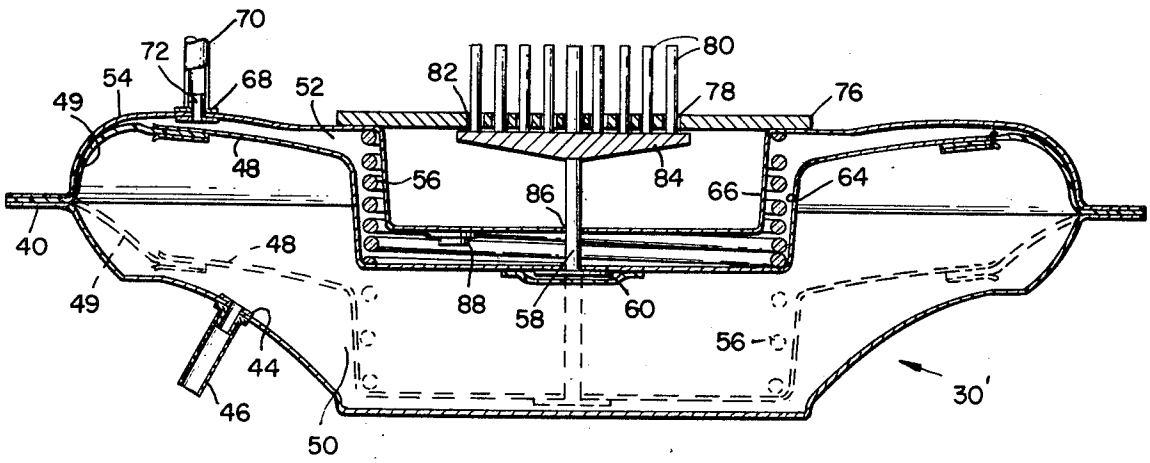


Fig. 1.

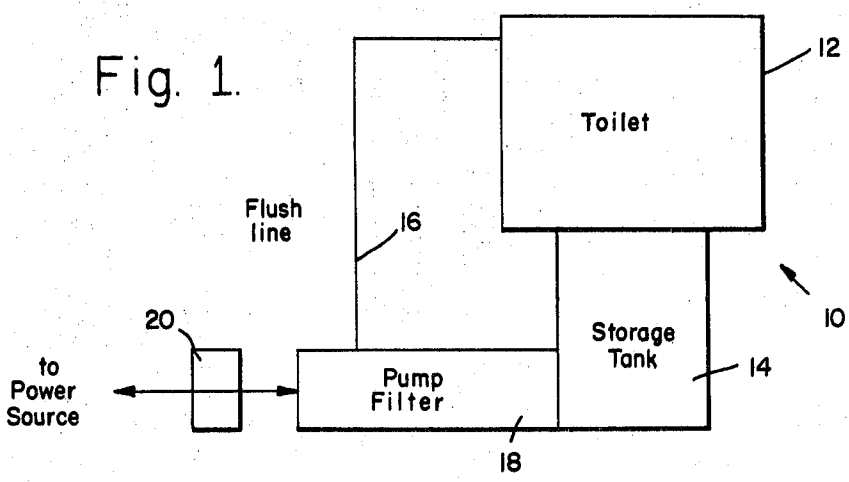
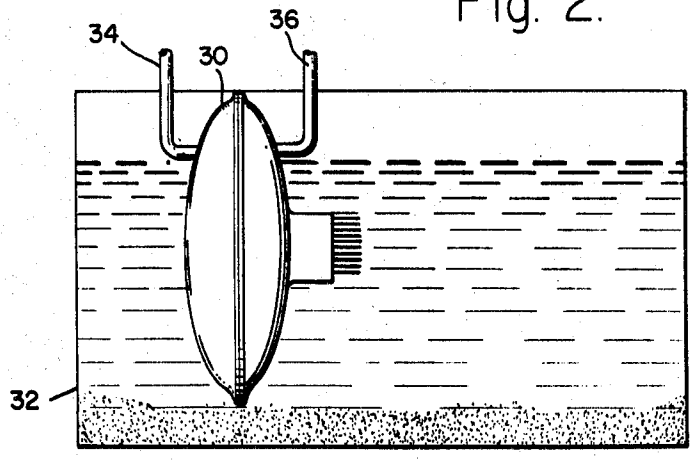


Fig. 2.



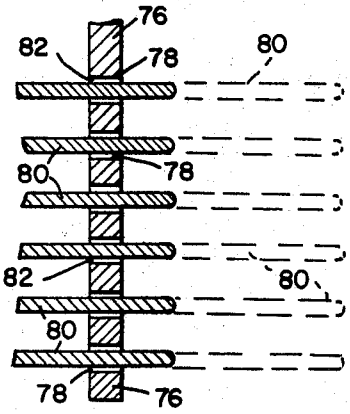


Fig. 5.

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Fig. 3.

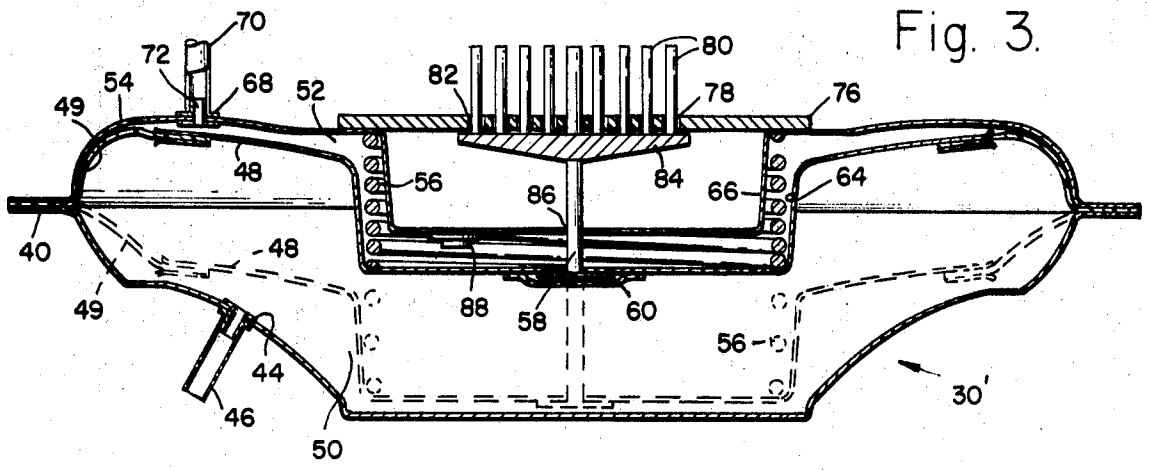
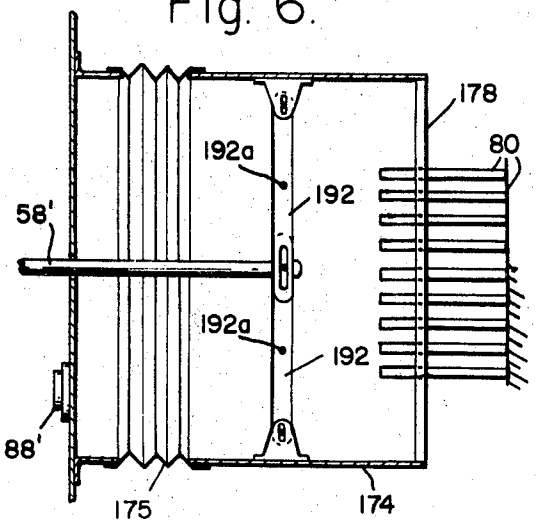


Fig. 6.



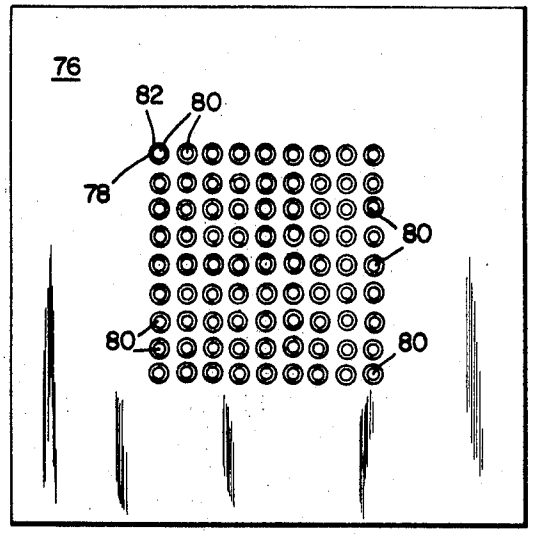


Fig. 4.

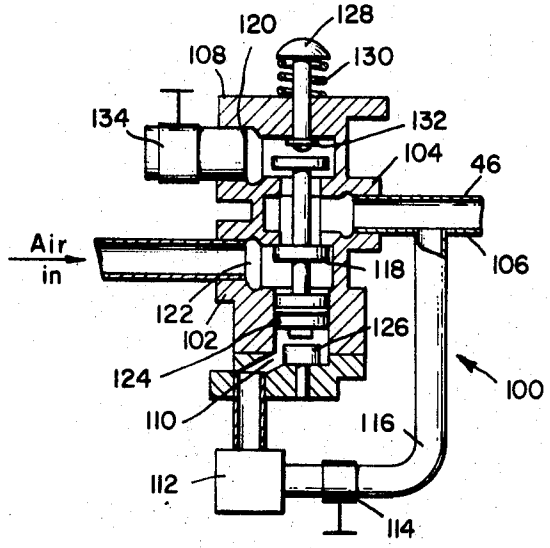


Fig. 7.

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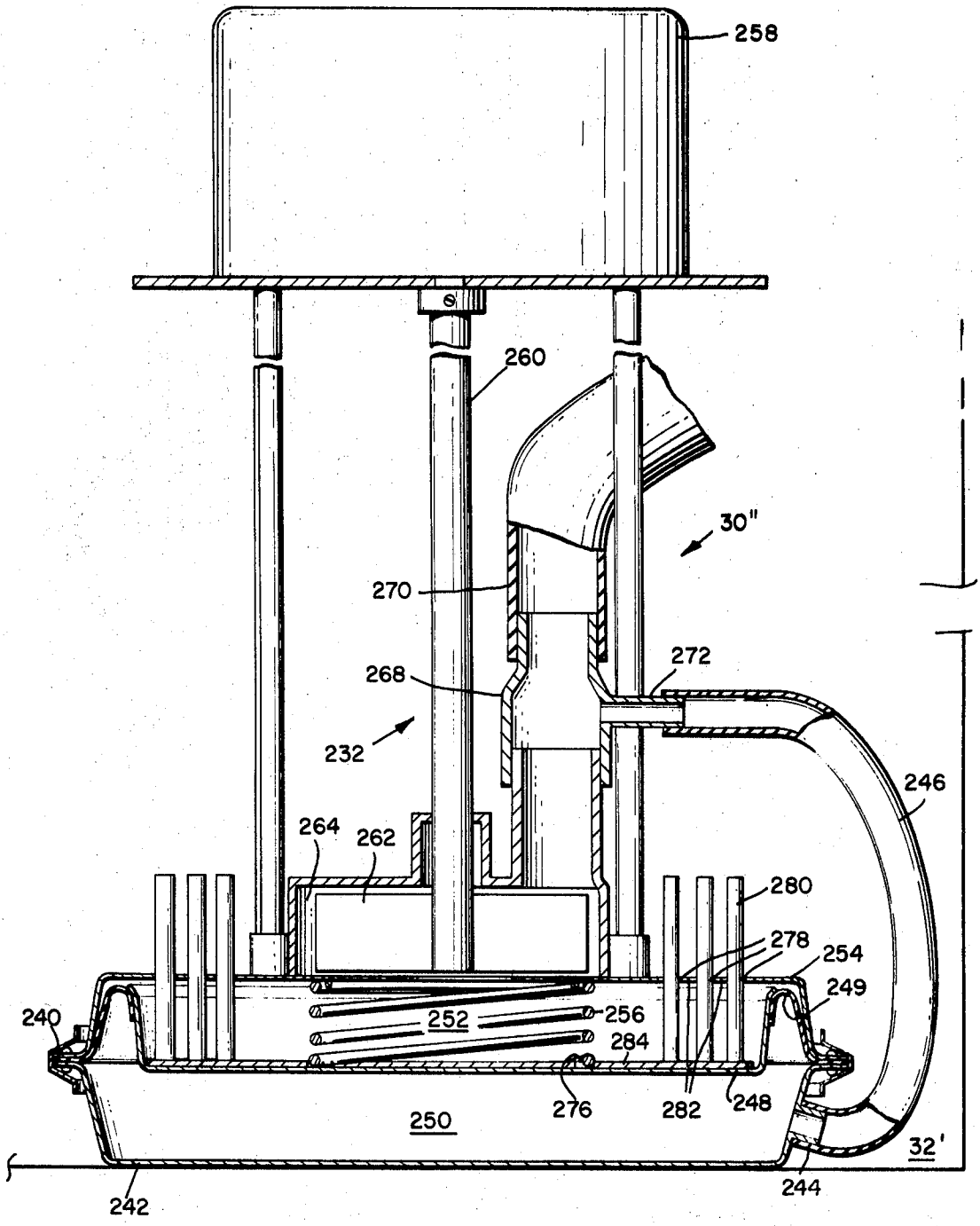


Fig. 8.

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FILTER AND PUMP FOR A RECIRCULATING SANITARY SYSTEM

This is a continuation-in-part of the application filed Jun. 14, 1968, Ser. No. 737,232, now abandoned.

The present invention relates to recirculating sanitary systems, and, more particularly, to a system including a toilet, a storage tank, and pumping and filtering means for providing a supply of flushing liquid to the toilet.

Circulating sanitary systems in which the present invention is useful have been described and shown in the patents to W. F. Katona, et al., U.S. Pat. No. 3,256,221 and J. W. Dietz, et al., U.S. Pat. No. 3,067,433. Pneumatically operated recirculating systems have been disclosed, for example, in the recent patents to C. A. Garver, U.S. Pat. No. 3,024,933, and W. D. Hicks, U.S. Pat. No. 3,001,205.

The recirculating sanitary systems, exemplified by the patent to Katona, et al., or Dietz, above, utilize an electrically driven rotary pump in combination with a rotating filter cup. A wiper assembly is provided to clean the filter during operation to remove solid or particulate residue from the filter itself. The pump is capable of reversible operation to allow limited backflushing through the filter for cleaning purposes. Since, in sanitary systems, fibrous materials such as paper or fabric, and yet other foreign objects may become entangled with the filter cup and cleaning scrapers or combs, the relative rotation as between the cup and the scraper or comb during operation, may cause the fibrous materials or other foreign objects to be wound around the filter or merely jammed in the assembly. In either event, rotation is prevented, locking the filter and causing either a stalling and burnout of the electrical motor or a failure within the power train.

It is also noted that with impeller-type pumps, the intake of flushing liquid is contemporaneous with the flushing operation, resulting in a requirement that a high volume of liquid be passed through the filter basket at a time when the storage tank contents are in agitation. Consequently, the high volume flow may be impaired by the circulation of the waste and solid matter being drawn toward the filter and pump.

What is needed, and what has been provided by the present invention, is an improved, recirculating system with a novel filter element, that is not subject to the problems of the prior art.

According to a preferred embodiment of the invention, a large diaphragm pump is provided with a reciprocating arm connected to the diaphragm thereof. In the preferred embodiment, a pneumatic system drives the diaphragm and a bias spring returns the diaphragm to a set initial position.

The intake to the diaphragm pump includes an apertured plate member and a plurality of needle members connected to the reciprocating arm. The needle members reciprocate through the aperture on each actuation of the diaphragm. On the pump stroke of the diaphragm, the needle members move through the apertures into the storage tank portion and, on the return stroke, the needles are withdrawn into the filter assembly.

The clearance provided between each aperture and the corresponding needle member creates the filtering structure. In the preferred embodiment, the needle members at all times extend through the plate member and into the storage tank, to prevent an occluding of the apertures by impermeable foreign objects.

The diaphragm pump is provided with a first unidirectional flow valve, which is connected to the toilet flushing supply line, and a second, unidirectional flow valve which admits fluid from the storage tank. The reciprocating arm is loosely mounted in the pump housing so that on the pumping stroke, some fluid is permitted to flow through the filter assembly and into the storage tank, thereby "backflushing" the filter and cleaning particulate residue from the vicinity of the filter apertures.

In the preferred embodiment, the pneumatic system drives the diaphragm pump and a novel, pneumatic time delay apparatus is provided to permit a complete cycle of operation to be "triggered" by the momentary actuation of a pushbutton or other start mechanism. The pneumatic system is, at all times, isolated from the recirculating liquid system, and operates wholly independently therefrom. Because the pump stores the liquid to be used in the "flush" portion of the cycle, high volume flow through the filter is not required. Rather, the filter operates during a "fill" portion of a cycle and the rate of fill can be selectively adjusted so as not to disturb the sedimentary contents of the storage tank. Depending upon the demand cycle of the sanitary system, the fill portion of the cycle can be extended so that even a relatively fine filter can be utilized in the system.

In alternative embodiments, the placement of the return spring can be changed and the diaphragm pump can be operated utilizing a vacuum line rather than a pressure line. In yet other embodiments, a hydraulic system could be utilized, since the driving system is maintained isolated from the driven system.

Still other pumping mechanisms can be adapted for use in the present invention, including electrically driven systems which can provide a reciprocating motion to the filtering combination.

For systems wherein a ready supply of pneumatic "fluid" is not available, it has been deemed desirable to provide a system which incorporates the diaphragm pump and filter assembly of the copending application and the electrically operated pump of Katona, et al. supra.

In yet another alternative, of the present invention, a diaphragm pump acts as a partial reservoir of filtered flushing liquid. A conventional impeller pump drives filtered liquid through the system and a bypass drives the pump diaphragm. The impeller pump draws additional liquid through the filter as needed and a portion of this liquid is returned, through a bypass to drive the diaphragm, reciprocating the filter needles with respect to the plate.

Because the pump stores some of the liquid to be used in the flush portion of the cycle, high volume flow through the filter is not required. Rather, the filter operates both during the flush and fill portions of a cycle. Further, the diaphragm pump, at the end of a flush stroke, refills itself, primarily through the filter.

The fluid that is expelled from the driving chamber of the diaphragm pump is returned, through the bypass and will, during the intake "stroke" tend to stand in the discharge line. At the conclusion of the intake stroke, the standing fluid will provide a limited backflow through the filter and into the tank, tending to clean the filter plate.

The reciprocating filter assembly may, in alternative embodiments, utilize a reciprocating apertured plate in combination with stationary needle members. Further, the "fineness" of the filter can readily be modified by the appropriate choice of aperture size relative to the cross section of the individual needle members.

The novel features which are believed to be characteristic of the invention, both as to organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawings in which several preferred embodiments of the invention are illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention.

FIG. 1 is an overall block diagram of a recirculating sanitary system in which the present invention is useful;

FIG. 2 is a side view of an integral pump and filter unit according to the present invention;

FIG. 3 is a side sectional view of a preferred embodiment of a pump and filter adapted to be mounted below the storage tank of a sanitary system;

FIG. 4 is a top view of the filter portion of the unit of FIG. 3;

FIG. 5 is a magnified side sectional view of the filter portion of the apparatus of FIG. 3;

FIG. 6 is a side sectional view of an alternative filter arrangement in which an apertured plate reciprocates and needle members are held stationary;

FIG. 7 is a side sectional view of a pneumatic trigger vent combination; and

FIG. 8 is a side sectional view of the alternative embodiment of an impeller and diaphragm pump and filter combination adapted to be mounted either within or below the storage tank of a sanitary system.

Turning first to FIG. 1, there is shown, in generalized diagrammatic form, the recirculating sanitary system according to the present invention in which general blocks have been utilized to represent each of the elements of such a system. Basic to the system 10 is a toilet element 12 which is mounted in conjunction with storage tank 14. A flush line 16 supplies flushing liquid to the toilet 12 and the flush liquid and waste matter exits from the toilet 12, directly into the storage tank 14.

A pump and filter combination 18 is connected to the storage tank 14 and is also connected to a source of power through an appropriate connection. The power may be electrical, hydraulic, or pneumatic, or, may be solely mechanical, depending upon the intended location and use of the system 10.

An appropriate trigger and timing mechanism 20 controls the application of power to the pump and filter combination 18 for a predetermined period of time. The period depends upon the intended use of the system and the volume of flushing fluid required for normal operation of the toilet 12 relative to the storage capability of the storage tank 14.

In operation, actuation of the trigger assembly 20 permits the application of power to the pump and filter combination 18 for the predetermined period of time. The pump and filter combination 18 draws and filters fluid from the storage tank 14 and pumps this fluid through the flush line 16 into the toilet 12. The fluid is then returned to the storage tank 14 for subsequent recirculation. Typically, recirculating sanitary systems 10 are utilized in mobile vehicles such as aircraft, trailers and mobile homes, buses, campers and boats.

Turning next to FIG. 2, there is shown a novel pump and filter assembly 30 according to the present invention, shown partially submerged in a storage tank 32. The storage tank 32 contains both liquid and solid matter, such as is generally found in a waste disposal system. As shown, the pump and filter assembly 30 is an integral, a self-contained unit with a first flexible connection 34 to a source of pneumatic fluid, in this application, compressed air, and with a second flexible connection 36, which carries the flushing liquid to the flush input line of an appropriate toilet assembly, such as has been shown in the prior art set forth above.

A modified pump and filter assembly 30' is shown in greater detail in FIG. 3, which is a side sectional view of a preferred embodiment according to the present invention which is adapted to be mounted below a storage tank. As shown, a pair of rectangular members are joined at a perimeter flange 40. A first rectangular member 42, which is on the "driving" side of the pump, is provided with a fitting 44 to which is connected a flexible hose 46, that leads to the source of pneumatic fluid (air) under pressure.

An internal diaphragm 48 isolates a driving chamber 50 from a driven chamber 52 and may be made of a metal or other impervious material. The diaphragm 48 is mounted in the flange 40, either by extending the diaphragm 48 into the flange 40 and capturing it therebetween, or, a flexing strip 49 of a more flexible material having a much higher resistance to fatigue and stress is bonded to the diaphragm 48 and is held by the flange 40. A second rectangular member 54 completes the pump portion and forms the driven chamber 52 of the pump.

In the embodiment of FIG. 3, the pump is driven by compressed air and, accordingly, a return spring 56 is provided to bias the diaphragm 48 into a first or rest position, representing the quiescent portion of the pumping cycle. A reciprocating rod member 58 is concentrically mounted with respect to the return spring 56 and has a disc-shaped fitting 60 at one end, which is fastened to the diaphragm 48. The diaphragm is provided with a cup-shaped indentation 64 to receive the return spring 56. At the opposite end of the spring 56, a corresponding cup-shaped indentation 66 is provided in the second member 54 through which the reciprocating rod member 58 extends and which retains the return spring 56 in position.

An outlet fitting 68 is provided through which filtered liquid can be provided, through a flexible line 70, to the flush inlet of the toilet. A unidirectional flow valve 72 permits the flush line 70 to have filtered fluid standing therein at all times. The cup-shaped indentation 66 provides, external to the pump a filter cylinder which is connected to a filter plate 76. A plurality of circular apertures 78 are formed in the filter plate 76, into which are fitted a corresponding plurality of needle members 80.

The needle members 80 have a cross-sectional area that is only slightly less than the area of the corresponding aperture 78, an annular flow space 82 is provided of limited area. The plurality of needle members 80 and apertures 78 function as a filter since, in general, the annular space 82 provided is sufficiently small to exclude most particulate matter that may be found in the storage tank and yet enable an adequate flow of filtered liquid to the pump 30.

The plurality of needle members 80 are fixedly mounted on a reciprocating plate 84 which is attached to the reciprocating rod member 58. The reciprocating rod member 58 extends through the aperture 86 of the cup-shaped indentation 66 and some clearance is provided, as between the rod member 58 and the aperture 86. A second, unidirectional flow valve 88 is positioned to permit a flow of filtered liquid into the driven chamber 52 from the inner volume of the cup 66.

In operation, air under pressure is connected to the pneumatic line 46, is applied to the driving chamber 50, forcing the diaphragm 48 upward, as viewed in FIG. 3. Motion of the diaphragm 48, assuming no fluid within the driven chamber 52, compresses the return spring 56 and moves the reciprocating arm 58 and the attached needle members 80 upward and through the apertures 78 of the filter plate 76, into the volume of the storage tank.

The diaphragm 48 is driven upward until a final position is reached, as indicated in FIG. 3, determined by the height of the cup-shaped indentations 64, 66. After the predetermined period of time, the connection to the pressurized source is broken and the line 46 is then vented to atmosphere, permitting a reduction of the pressure in the driving chamber 50.

The diaphragm 48 then moves downward, under the force of the return spring 56. The increase in volume resulting thereby produces a pressure differential between the fluid in the storage tank and the driven chamber 52. Liquid then flows through the annular filtering spaces 82 between the needle members 80 and the filter apertures 78 and through the unidirectional valve 88 into the driven chamber 52.

At the same time, the reciprocating arm 58 moves downward, pulling the needle members 80 through the filter apertures 78, thereby removing any matter which might be adhering to the needle members 80. At the completion of the return stroke, the diaphragm 48 is at the rest position again shown in dashed lines and the driven chamber 52 is now filled with filtered liquid. Since the return or fill stroke is different from the pump or flush stroke, the flow rate of fluid through the filter is not critical.

On the next operation of the pump, the compressed air is again applied to the driving chamber 50 and the diaphragm 48 is driven upward at any desired velocity. The filtered fluid then in the chamber 52 flows through the unidirectional valve 72 into the outlet fitting 68 and into the flush ring of a toilet and the stored volume of fluid flushes the toilet.

At the same time, a limited amount of fluid flows through the aperture 86 surrounding the reciprocating member 58, and this limited flow of fluid is forced through the apertures 78 of the filter plate 76 thereby clearing the apertures 78 while the needle members 80 are moving upward. It will be seen that any matter tending to clog the filter apertures 78 during the in-

take stroke is both mechanically and hydraulically propelled away from the apertures 80, on the pumping stroke.

The driven chamber 52 can hold a volume of liquid sufficient to completely flush the toilet during the pumping stroke and, in a typical system may be as much as two gallons of fluid. It will be noted that as soon as the pumping, or flush stroke is completed, the return, or fill stroke is instituted and the pump is refilled with fluid for the next operation. Since the rate of fill need not be as great as the rate of flow during the flush cycle, the filter need not draw solids toward the filter plate. An appropriate bleed vent to atmosphere in the operating mechanism selectively determines the time required for the filling stroke, so that the complete cycle time from flush to flush can be kept as brief or as long as is desirable.

The reciprocating action of the filter needle members 80 with respect to the filter aperture 78 keeps the filtering area clear, and the back flow of fluid during the pumping stroke helps to remove potentially clogging material from the vicinity of the filter opening. Also, the extent to which the needle members 80 project into the storage tank volume after the completion of the return stroke, determines the extent to which potentially clogging material of a relatively impermeable nature can be kept form the vicinity of the filtering openings.

Turning next to FIG. 4, there is shown a front view of the filter plate 76, the filter apertures 78, and the corresponding needle members 80. The size of the filter annulus 82 formed by concentrically fitting a needle member 80 into a filter aperture 78 can be varied and is determined only by the number of annuli provided and the size of the smallest particle which may be passed by the filter without objection. If the fill time is extended, the filter can be relatively fine since a slower rate of flow will not adversely affect the flush portion of the cycle.

FIG. 5 shows, in somewhat greater detail, the arrangement of the filter plate 76, the apertures 78, the needle members 80 fitting therein and the annuli 82. Also, shown in dashed lines is the position of the needle members 80 relative to the filter plate 76 during a pumping stroke of the diaphragm 48. With reference to FIG. 5, it can be seen that other variations are possible in which the needle members 80 might be provided with a cleaning collar or other appropriate fitting, so that at the end of a pumping stroke, the filter apertures 78 could be substantially occupied by the needle member 80 forcibly driving out foreign particulate matter.

Turning next to FIG. 6, there is shown a possible alternative embodiment in which a reciprocating arm 58' drives reciprocating filter plate 176 that contains filter apertures 178. A corresponding plurality of filter needle members 180 is fixedly mounted with respect to the filter assembly. In all other respects the operation of the pump and filter assembly is substantially the same as the embodiments illustrated in FIGS. 3, 4 and 5.

The difference in operation is that the coupling of the reciprocating arm 58' to the filter plate 176 is by means of a suitable linkage 190 to which is connected appropriate driving arms 192. A filter cylinder 174 is provided with a flexible, collapsible portion 175, so that the volume inside the filter cylinder can be changed during the reciprocation of the filter plate 176.

On a pump stroke, with the arm member 58' moving to the right, the filter plate 176 is moved to the left and the filter cylinder 174 is collapsed upon itself partially reducing the volume therein and resulting in an enhanced flow of fluid to the right, thereby clearing the apertures 178 and the filter plate 176. During the intake stroke, the reciprocating rod 58' moves to the left and the reciprocating filter plate 176 moves to the right. On the pump stroke, the limited flow of fluid from the pump into the filter cylinder 174 has an enhanced effect on cleaning the apertured plate in that the collapsing of the filter cylinder 174 also results in a flow of fluid to the right.

It will be understood by those skilled in the art that particular pump arrangement illustrated herein is merely exemplary and that the present structure could easily be modified for use with a vacuum system by placing a return spring in the driving space of the pump. Other modifications will be evident to those skilled in the art.

Turning to FIG. 7, there is shown an improved trigger-type valve mechanism 100 which is suitable for use as a flush valve in a sanitary system according to the present invention. An intake port 102 is connected to a source of compressed air and an outlet port 104 is connected to the driving side of the pump filter through the flexible tubing 46. A tee section 106 is provided in the flexible tubing 46. The valve body 108 is provided with a control chamber 110, that is coupled to a small, pressure accumulator tank 112. Compressed air is supplied to the tank 112 through a controllable restriction 114, from a flexible connection 116 to the tee 106.

A spool valve 118 permits the outlet port 104 to communicate either with an exhaust chamber 120 or an air supply chamber 122 in a first and second configuration, respectively. An iron piston 124 is connected to the spool valve 118 and cooperates with a permanent magnet 126 in the control chamber 110 to hold the spool valve 118 in the second or operating configuration, in which the air supply is applied to the pump.

A pushbutton plunger 128 is mounted in the end of the valve housing 108 and, in this embodiment, is adapted to contact the opposite end of the spool valve 118. A return spring 130 biases the pushbutton 128 out of contact with the spool valve 118 and a pin 132 retains the pushbutton 128 in the valve body 108. Normally, the spool valve 118 is in the first configuration shown in FIG. 7 coupling the pump to the exhaust chamber 120 which communicates to atmosphere through an adjustably controllable restriction 134.

To operate the valve assembly 100, the pushbutton 128 is depressed, forcing the spool valve 118 into its second, flush configuration. The piston 124 is thereby moved into operative proximity of the permanent magnet 126 which securely holds the piston and spool valve 118. Air from the supply is transmitted to the pump through the outlet port 104 and the flexible tubing 46 and a pumping cycle is initiated. The pushbutton 128, when released, returns to its normally extended position under the force of the return spring 130.

While the full air pressure is being applied to drive the pump, the air under pressure is also applied through the tee 106 and through the controllable restriction 114 into the accumulator tank 112 which is connected to the control chamber 110 in which the piston 124 is being held by the permanent magnet 126. As the pressure builds in the tank 112, the pneumatic force in the control chamber 110 exerted upon the piston 124 eventually is sufficient to overcome the magnetic attraction between the piston 124 and the permanent magnet 126 at which time the piston and spool valve 118 are moved into the first or fill configuration. Since the attractive force of a magnet is based upon an inverse cube law relationship, a force of magnitude sufficient to break the magnetic attraction between the piston and magnet is, after the piston has moved slightly, more than sufficient to drive the valve into the first configuration. It will be appreciated that once the magnetic attraction is overcome, the valve might be considered as a "snap action" valve.

In the first configuration of the trigger-type valve 100, the pressure applied to the pump and the tank 112 is permitted to vent to atmosphere through the exhaust chamber 120 and the controllable restriction 134. As the pressure drops, the pump operates in the fill portion of the cycle and filtered liquid is drawn into the driven chamber.

The operating cycle divides into a first or flush part, during which the pump is energized to provide a flushing liquid to the toilet, and a second or fill part, during which the pump is refilled with filtered liquid. Depending, of course, upon the air pressure of the source of compressed air, the duration of the flush and fill portions of the cycle are separately adjustable by adjusting the pneumatic flow through the restrictions 114 and 134. For example, the volume of flushing liquid provided the toilet can be controlled somewhat by shortening the flushing

part of the cycle by admitting air to the accumulator tank 112 at a greater rate. Similarly, the time available for refilling the pump is controlled by regulating the rate of air flow through exhaust restriction 132.

The valve 100, in operation, is "monostable" in that actuation of the pushbutton 128 causes the valve to continue to operate for a predetermined period of time whether or not the button 128 is released. The period is determined by the setting of restriction 114, after which the spool valve 118 "snaps" back to the stable, first configuration. As long as air under pressure is applied to the pump, air under pressure is also being applied to the piston chamber to force the valve into the first configuration. Once in the first configuration, the air pressure applied to the supply chamber 122 tends to maintain the needle valve seated in the first configuration since a greater surface area is provided for seating the valve than on the piston side of the spool valve 118.

In the alternative embodiment of FIG. 8, a pump assembly 30'' includes a diaphragm pump 230 which is partially driven by fluid from the flush line, and partly by the action of an impeller pump assembly 232, which is the primary pumping element of the system. A return spring 256 is provided to bias a diaphragm 248 into a first or rest position, representing a relatively quiescent portion of the pumping cycle.

The impeller pump assembly 232 includes an electric motor 258 which may be substantially identical in placement and operation to the electric motor shown in the above-described patent to Katona, et al., and is connected to a drive shaft 260, which operates a rotating impeller member 262 in an appropriate pump cavity 264. Operation of the electric motor 258 causes the impeller 262 to rotate, drawing fluid from the driven chamber 252 into a pump outlet fitting 268 which applies driven fluid through a flexible line 270. Fluid is also applied to the outlet 272.

As shown, the upper surface of the second rectangular member 254 is fitted with a plurality of filter apertures 278 and a corresponding plurality of needle member 280 are fitted therein. The needle members 278 are mounted on a plate member 284 which is held against the diaphragm 248 by the return spring 265, one end of which rests in a groove 276 provided for that purpose in the plate member 284.

In operation, the diaphragm 248 normally biased into the driving chamber 250 and the return spring 256 is fully extended. Depending upon the level of fluid in a tank 32', filtered liquid will stand in the flushing system at that height and, generally, will be above the outlet 268 of the impeller pump 232. When the electric motor 258 is energized, the drive shaft 260 rotates to drive the impeller 262, which forces filtered fluid up through the outlet 268 and into the first and second flexible connections 270, 246.

The action of the impeller 262 reduces the fluid pressure in the driven chamber 252 and the diaphragm 248 begins to move upwards. Further, the needle members 280 are set in motion through the apertures 278. Part of the output of the impeller 262 is "fed back" through the outlet 272 into the flexible line 246, which tends to drive the diaphragm 248 towards the upper surface of the driven chamber 252.

The volume of fluid flow into the flexible lines 270, 246 exceeds the fluid storage capability of the driven chamber 252. Accordingly, while the needle members 280 are moving outward through the apertures 278, the reduced fluid pressure within the driven chamber 252 causes an inflow of liquid from the tank 32, through the filter in a direction opposite to the motion of the needle members 280.

When sufficient liquid has been pumped into the driving chamber 250, the diaphragm 248 advances to its limit of travel which is determined, either by the compressed height of the return spring 256, or by the upturned portion of the diaphragm edges. A timing device (not shown) on the motor 258 continues to operate the impeller pump 232 until a predetermined quantity of liquid has circulated through the flush line, at which time the power to the motor 258 is interrupted. During this operating interval, any fluid requirements of the impeller pump 232 are furnished through the needle-aperture filter combination.

When the impeller pump 232 stops, the weight of the liquid standing in the discharge line 270, and the force of the return spring 256 combined, fill the driven chamber 252 and the diaphragm 248 is forced downward, reversing the travel of the needles 280 through the apertures 278, thereby "cleaning" the needles 280. If the fluid standing in the discharge line is insufficient to fill the chamber 252, additional fluid will then be drawn in through the filter so long as a pressure differential exists as between the driven chamber 252 and the fluid standing in the tank 32'.

In addition, fluid is expelled from the driving chamber 250, back through the first flexible line 270 and into the impeller pump outlet 268. Generally, the volume of the fluid in the discharge line 270 plus the volume of fluid stored in the driving chamber 250, will exceed the volume of the driven chamber 252, even with the diaphragm 248 in its extreme rearward position. Under those circumstances, a backflow will take place, from the driven chamber 252, through the filter and into the tank 32', thereby cleaning the area in the vicinity of the filter apertures 278 and needles 280.

Thus, there have been shown and described novel pump-filter combinations especially useful in recirculating sanitary systems and incorporating a novel, snap action, fluid valve. Variations and modifications will occur to those skilled in the art and, accordingly, the scope of the invention should be limited only by the claims appended below:

I claim:

1. A pump filter comprising:

a. pumping means having an intake and including a source of reciprocating motion;

b. filter plate means interposed between said pumping means intake and a supply of liquid to be filtered and pumped, said filter plate means having at least one aperture communicating with the supply;

c. needle means including at least one needle member positioned in said aperture to restrict the flow of liquid therethrough;

d. motion transmission means for coupling said source of reciprocating motion to said filter plate and needle means for imparting relative motion therebetween;

whereby said needle member and said plate aperture are in motion relative to each other, and whereby all fluid flow into said pumping means intake is through said aperture partially blocked by said needle member acting in combination as a filter.

2. Apparatus as in claim 1, above, further including flow control means for permitting a back flow of liquid through the pumping means intake during the pumping portion of an operating cycle, whereby fluid is forced through said filter plate and into the supply during relative motion, tending to clear the area of foreign matter in the vicinity of the filter plate means.

3. Apparatus of claim 1, above, wherein said pumping means is a reciprocating pump and said source of reciprocating motion provides a first stroke corresponding to a pump intake stroke and a second stroke corresponding to a pumping stroke.

4. Apparatus of claim 3, wherein said needle member is coupled to said source of reciprocating motion and whereby said needle member reciprocates relative to said filter plate means, for cleaning said needle member and said aperture.

5. Apparatus as in claim 4, above, wherein the direction of motion of said needle member at all times opposes the direction of liquid flow as between said pumping means intake and the source of liquid, whereby said needle member tends to move foreign matter away from said aperture during a pump intake stroke and tends to be cleaned by fluid flow during a pumping stroke.

6. Apparatus as in claim 3, above, wherein said filter plate means are coupled to said motion transmission means, whereby said aperture reciprocates relative to said needle member.