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INTERLOCKING MEANS FOR BATTERY OF LIQUID TREATING UNITS

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1 Claim. (Cl. 210—108)

This invention relates to automatic liquid treating apparatus of the gravity type which operates essentially without valves. An apparatus of this character is disclosed in the copending application of Bohner and Miller, Serial No. 665,404 filed June 13, 1957, upon which this invention is an improvement.

In an installation comprising a battery of similar liquid treating units operating in parallel it is generally desirable to recondition one unit only at a time while the remaining units of the battery supply liquid to service.

It is an object of this invention to provide automatic interlocking means for a battery comprising a plurality of similar liquid treating units whereby the simultaneous reconditioning of several units of the battery is prevented.

It is another object of this invention to provide interlocking means which in the event that one unit of a battery is ready to go into reconditioning while another unit of the same battery is already in reconditioning delay the reconditioning of the first unit until the reconditioning operation of said other unit has been substantially completed, whereupon said first unit will automatically and without further delay go into the reconditioning operation.

Other objects will appear from the following detailed description and the drawings in which:

Fig. 1 is a diagrammatic elevation, partly in cross-section, of a battery of similar liquid treating units having an interlocking system in accordance with my invention; and

Fig. 2 is a plan view of the weir box 10 of Fig. 1.

Referring now to the drawings there are shown three similar liquid treating units, "A", "B" and "C". A weir box 10 is divided by baffles 11 into an inlet compartment 12 and three outlet compartments 13A, 13B and 13C. A supply pipe 14 is adapted to supply liquid to be treated to the inlet compartment 12. The height of the baffles 11 and the length of their tops which lead from the inlet compartment 12 into the outlet compartments 13A, 13B and 13C are equal so that they form weirs which divide or split the flow of liquid entering through supply pipe 14 into three equal streams flowing into the compartments 13A, 13B and 13C.

As has been stated above, the units A, B and C are similar. Unit A is shown in cross-section and will now be described in detail. The unit A has a tank 20A with side walls 21, a bottom 22, a false bottom 23 and a head 24. Thus there are defined in the tank 20A a lowermost underdrain chamber 25, an intermediate treating compartment 26 and an upper reconditioning liquid storage space 27A. Tubes 28 welded to the false bottom 23 and the head 24 interconnect the underdrain chamber 25 and the reconditioning liquid storage space 27A.

Within the treating compartment 26 is a bed 29 of granular liquid treating material, as, for example, sand supported on the false bottom 23 and a plurality of strainers 30 attached thereto. The strainers 30 are advantageously of the disc type as shown in Pick U.S. Patent 2,743,016.

An inlet pipe 15A is connected to the outlet compartment 13A of the weir box 10. The inlet pipe 15A is provided with a loop seal 16 and a manually operable cutoff valve 17 and leads to the upper portion of the treating compartment 16.

An effluent duct 31 is connected to the underdrain chamber 25 and has an open top extending to about the same elevation as the top of tank 20A. From the upper portion of the effluent duct 31 a treated liquid outlet pipe 32A leads to a treated liquid header 33 which discharges the treated liquid by gravity to a point of use, as, for example, a clearwell.

A backwash pipe 40A is connected to the head 24 so as to communicate with the top of the treating compartment 26, a baffle 41 being mounted on the head 24, as shown, to force the liquid entering pipe 40A to flow in a horizontal direction adjacent to the head 24. The backwash pipe 40A has a vertical portion 42 continuing in an inclined portion 43 up to a return bend 44A and then in a downwardly extending vertical portion 45 terminating in a waste sump 46A which is located at an elevation below the reconditioning liquid storage space 27A. The waste sump 46A has a waste outlet 47A connected to a waste header 49 which leads to a point of disposal for waste liquid. The waste sump 46A is provided with a weir 48 to keep the lower end of the vertical portion 45 of the backwash pipe 40A submerged and liquid-sealed. At the lower end of the vertical portion 45 is a backwash regulator comprising a cup-shaped member 51 which is manually adjustable so as to regulate the flow through the backwash pipe 40A.

A vent pipe 55A has one end connected to the return bend 44A and its other end terminating within a cup 56 located in the lower portion of the reconditioning liquid storage space 27A.

The units B and C each comprise a tank 20B and 20C, respectively; an inlet pipe 15B and 15C connected to inlet compartments 13B and 13C, respectively; a reconditioning liquid storage space 27B and 27C, respectively; a return bend 44B and 44C with respectively connected vent pipes 55B and 55C; an outlet pipe 32B and 32C respectively connected with the treated liquid header 33; and a waste sump 46B and 46C connected by the respective waste outlets 47B and 47C to the waste header 49.

The unit A has an interlock header 60 connected to its return bend 44A and provided with branches 61 and 62 terminating in the upper portion of tanks 20B and 20C, respectively.

The unit B has an interlock header 70 connected to its return bend 44B and provided with branches 71 and 72 terminating in the upper portion of tanks 20A and 20C, respectively.

The unit C has an interlock header 80 connected to its return bend 44C and provided with branches 81 and 82 terminating in the upper portion of tanks 20A and 20B, respectively.

In describing the operation of this apparatus, let it be assumed that the granular liquid treating material 29 is sand and that the battery is used for removing suspended matter from a water supply, raw water to be treated 25 being admitted through supply pipe 14. The level in the reconditioning liquid storage space 27A is as indicated by the line marked "OLA" and this level in turn is determined by the upper portion of the outlet pipe 32A which is located near but below the top of the reconditioning liquid storage space 27A. It is probable, though not really necessary, that the outlet pipes 32A, 32B and 32C are located at the same elevation. With the outlet pipes so
located the level OLB in unit B and the level OLC in unit C are at the same elevation as the level OLA in unit A. These levels are practically constant, being subject to but minor variations in accordance with changes in the rate of flow through the apparatus and the flow resistance in the treated liquid header 33.

The lower ends of branches 71 and 81 are located just below the level OLA and ILA representing the loss of head through the apparatus, mainly the bed 29. The level in the backwash pipe 40A is essentially the same as in the inlet pipe 15A since they are in communication through the upper portion of the treating compartment 26, the level in the inlet pipe 15A being higher by the relatively small friction loss in pipe 15A. Analogously, the level ILB in the inlet pipe 15B of unit B is essentially the same as in backwash pipe 40B, and the level ILC in inlet pipe 15C of unit C is essentially the same as in backwash pipe 40C.

The level ILA, ILB and ILC have been shown at different elevations. All these levels gradually rise subsequent to reconditioning of a unit due to the fact that impurities are collected on and in the beds of granular liquid treating material (as shown at 29). The level ILA in unit A is highest and at a point where the initiation of reconditioning is imminent. The level ILB of unit B is at an intermediate point and the level ILC of unit C is the lowest of the three.

Water enters unit A through pipe 15A and flows through the open valve 17 (closed only when the unit is to be taken out of service for inspection, repair, etc.) and the return bend 16 into the upper portion of the treating compartment 26, down through bed 29 and through the strainers 30 into the underdrain chamber 25. Thence it passes through the effluent duct 31 and the outlet pipe 32A into the treated liquid header 33. Simultaneously, there is a similar flow through inlet pipe 15B, unit B, and outlet pipe 32B and also through inlet pipe 15C, unit C, and outlet pipe 32C, all these flows passing to a point of use through header 33. As the filtering step continues and the impurities accumulate on top of and within the beds of granular filtering material (29 in unit A) the level ILA shows a gradual rise. The level ILA in the inlet pipe 15A and backwash pipe 40A is already close to the return bend 44A, as shown in Fig. 1. Shortly this level ILA will rise further so that liquid then flows through the return bend 44A down into the vertical portion 45 of the backwash pipe 40A. The backwash pipe 40A becomes substantially filled with water and acts as a siphon. Water now flows from the reconditioning liquid storage space 27A through the tubes 28 into the underdrain chamber 25, then upwardly through the strainers 30 and the bed 29, around baffle 41, through the backwash pipe 40A into the waste sump 46A and over the weir 48 through waste outlet 47A into the waste header 49 and, thence, to a suitable place for disposal of waste liquid.

The backwash regulator 51 has initially been set and adjusted to provide the desired backwash rate by partially opening the lower end of the vertical portion 45 of backwash pipe 40A. Such rate of flow is higher at the beginning of the backwash operation and gradually decreases as the level in the reconditioning liquid storage space 27A drops, since this reduces the effective head of the siphon in backwash pipe 40A. Thus, for example, the backwash rate through the bed may, in this case, start at about 20 gallons per square foot per minute and gradually slow down to about 10 gallons per square foot per minute of filter bed area near the end of the backwash step. Such diminishing backwash rate is more effective than the uniform flowrate generally used in conventional apparatus. The higher initial flow quickly lifts and expands the bed about 50% and provides greater initial turbulence to wash and scrub the liquid treating material 29. The lower flowrates toward the end of the backwash step hydraulically grades the medium 29 and settles the bed evenly and smoothly. During the backwash step the incoming flow of water through the inlet pipe 15A continues. This flow passes directly to waste through the upper portion of the treating compartment 26 and the backwash pipe 40A. During backwashing the siphon in backwash pipe 40A causes a lowering of the pressure in the upper portion of treating compartment 26 and the weir seal 16 is provided to prevent any air from being sucked into the compartment 26 through the inlet pipe 15A at such time.

While the backwash pipe 40A runs full as a siphon it draws a flow of water through interlock header 60 and branches 61 and 62 from units B and C directly to waste. To keep such waste flow relatively low, the header 60 should be made as small as possible in diameter, just large enough to permit venting the return bend 44A during reconditioning of units B and C (as explained later). Interlock headers made of half inch diameter copper tubing have been found entirely satisfactory for filters 6 to 8 feet in diameter.

As soon as the level OLA in the reconditioning liquid storage space 27A has dropped a relatively small amount it exposes the branches 51 of header 60 and 71 of header 70. This vents the return bend 44B of unit B and the return bend 44C of unit C and thus prevents these two units from going into the reconditioning operation since their backwash pipes 40B and 40C, respectively, are vented and, therefore, cannot act as siphons. If the level ILB in unit B or the level ILC in unit C should climb up to the return bends 44B and 44C, respectively, merely a small dribble of water will flow to waste without permitting these units to backwash. Thus units B and C must remain in service where they supply treated water to the outlet header 33.

During the backwash step a relatively insignificant amount of water flows from the reconditioning liquid storage space 27A, through the vent pipe 55A, directly to waste. When the level in the reconditioning liquid storage space 27A of unit A has dropped below the top of cup 56 the aforementioned flow through the vent pipe 55A directly to waste still continues, lowering the level within the beds ILA, ILB and ILC and the reconditioning liquid storage space 27A outlets the cup 56 drop further because of the flow through the backwash pipe 40A. As soon as the level in the cup 56 has reached the lower end of vent pipe 55A, air enters through the vent pipe 55A and flows to the return bend 44A, thus quickly breaking the siphon in backwash pipe 40A and terminating the backwash operation. The water in the portions 42 and 43 of the backwash pipe 40A drops back and slightly raises the level in the reconditioning liquid storage space 27A, but not sufficiently to enter the cup 56. Thus, the backwash operation is cleanly and positively terminated.

Without the cup 56 the aforesaid backflow of water from the backwash pipe 40A plus the continuing inflow through pipe 15A would again close off the lower end of the vent pipe 55A as soon as a little air has been admitted to the return bend 44A and the siphon would therefore start again, the water leaking over the backwash and stopping of the siphon might repeat itself several times if the cup 56 was omitted. As soon as the backwash operation has been terminated, the water entering through inlet pipe 15A flows down through bed 29 and thence through the underdrain formed by the strainers 30 and the underdrain chamber 25, and through tubes 28 into the reconditioning liquid storage space 27A. Thus the bed 29 and the underdrain chamber 25 are rinsed clean of any small amount of impurities left at the end of the backwash step and the spent rinse water is stored up in the reconditioning liquid storage space 27A. As soon as the reconditioning oper-
tion has been completed when the reconditioning liquid storage space 27A has been filled to the level of the outlet pipe 32A the rinse step is automatically terminated and filtered water now flows to service again as initially described.

Just prior to this time the level in reconditioning liquid storage space 27A has reached and sealed the lower ends of branches 81 and 71, thus no longer venting the return bends 44B and 44C of units B and C, respectively. Thus, if either of these units has reached a condition where it is ready to start backwashing while unit A was being reconditioned, such backwash operation will start now due to the fact that the backwash pipe is no longer vented and, therefore, is capable of acting as a siphon.

Analogously, while unit B is being reconditioned and going through the steps of backwashing and rinsing, the lowering of the level in reconditioning liquid storage space 27B exposes branches 61 and 82 of the respective interlock headers 60 and 70, thus venting the return bends 44A and 44C and preventing units A and C from reconditioning. Also, while unit C is being reconditioned the lowering of the level in reconditioning liquid storage space 27C exposes the branches 62 and 72 and through headers 60 and 70 vents the return bends 44A and 44B and so prevents units A and B from reconditioning.

Thus, the provision of the interlock headers 60, 70 and 80, with their branches and connections as shown, effectively prevents more than one unit from reconditioning at the same time. On the other hand, if any one unit of a battery gets ready for reconditioning while another unit of the same battery is in the process of reconditioning, it will automatically go into the cycle of reconditioning operations at the time said other unit has substantially completed its cycle of reconditioning operations which consists of backwashing and rinsing in the described example.

While I have specifically described my invention in connection with a battery of water filters, it is, of course, applicable to other similar types of liquid conditioning equipment employing a bed of granular liquid treating materials other than sand, such as activated carbon, ion exchange resin, etc. My invention has been shown incorporated in a battery of three liquid treating units, but it is, of course, applicable to any battery having two or more units.

While I have shown what I consider the preferred embodiment of my invention, changes and modifications may obviously be made without departing from its spirit, and reference is, therefore, made to the following claim for a definition of the scope of my invention.

What I claim is:

In a battery comprising a plurality of similar liquid treating units each having a treating compartment, a bed of granular liquid treating material in said treating compartment, an underdrain for said treating compartment, a reconditioning liquid storage space having an open top and being located above said treating compartment, tube means interconnecting said underdrain and the lower portion of said reconditioning liquid storage space, an inlet pipe leading from a source of supply of liquid to be treated to the upper portion of said treating compartment, an effluent duct for treated liquid communicating with said underdrain and having its highest portion located at an elevation near but below the top of said reconditioning liquid storage space, a waste sump located at an elevation below said reconditioning liquid storage space, a backwash pipe connected to the top of said treating compartment, said backwash pipe having a return bend located above the top of said reconditioning liquid storage space, a portion extending upwardly from said treating compartment to said return bend, and a portion extending downwardly from said return bend and terminating in said sump, and a vent pipe connected to said return bend and terminating in the lower portion of said reconditioning liquid storage space, the improvement which comprises a plurality of interlock headers, each of said headers being connected with the said return bend of one of said liquid treating units and having an open end branch terminating in the said reconditioning liquid storage space of each other liquid treating unit of said battery at an elevation adjacent to and below the highest elevation of its said effluent duct portion.

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