PATENT SPECIFICATION

Convention Date (Australia): July 23, 1936.

494,854

Application Date (in United Kingdom): July 19, 1937. No. 19958/37.

Complete Specification Accepted: Nov. 2, 1938.

COMPLETE SPECIFICATION

Improvements in or relating to Filters

We, FILTRATION & WATER SOFTENING PROPRIETARY LIMITED, a company duly organised and existing under the laws of the State of Victoria, carrying on business as Manufacturers and Contractors, at 395, Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to enclosed filters and concerns an improved method of and apparatus for effectively cleansing the beds of such filters to remove accumulated impurities therefrom.

In the cleansing of enclosed filters, the operation is usually effected by passing filtered water upwardly through the filter bed whereby the impurities are discharged from the top of the filter chamber through a suitable outlet.

The upward flow of wash water may be effected at a relatively low rate, in which case it is necessary to agitate the bed by extraneous means, as for example by the injection of compressed air or steam into the bed, or by the use of rotating rakes, in order to dislodge impurities from the bed.

This method of cleansing is known as the " low velocity " wash method.

An alternative method, known as the " high velocity " method, consists in passing the wash water upwardly through the filter bed at a rate sufficient to effect hydraulic suspension of the grains thereof and to agitate said grains with such vigour as to dislodge and break up the gelatinous material which accumulates on the surface of the bed. This latter method, therefore, obviates the need for extraneous agitating means and provides the further advantage that, upon the cessation of the upward flow of wash water, the particles forming the bed automatically settle in order of size or density.

The present invention relates primarily to filters which are cleansed by the " high velocity " method.

A further procedure which is known consists in projecting jets of filtered or unfiltered water at a relatively high velocity on to the surface of the filter bed in order effectively to break up the matter accumulated thereon and thus facilitate its discharge from the filter by an upward current of water introduced below the filter bed, the upward and surface flows of wash water being simultaneously effective during a portion of the cleansing operation and the flow of surface wash water being terminated while the upward flow is still proceeding.

The object of the present invention is to provide an improved method and corresponding apparatus for cleansing the filter bed of an enclosed filter, employing this last-mentioned procedure and the upward wash through the filter bed preferably being effected at a high velocity.

According to the invention, there is provided a method of cleansing a filter apparatus comprising an enclosed filter chamber having a filter bed therein, means for introducing wash water below the filter bed to pass upwardly therethrough, means for directing wash water under a relatively high pressure on to or adjacent the surface of the filter bed, a wash water effluent pipe or passage and valve means controlling the respective flows of wash water, the method employing the procedure of so operating the various valve means that the upward and surface flows of wash water are simultaneously effective during a portion of the cleansing operation and the surface flow is terminated while the upward flow is still proceeding, which method consists in this that by appropriate regulation of the valve means the rate of flow of surface wash water is maintained substantially constant for a substantial portion of the time during which the flow of surface wash water takes place and the rate of discharge of wash water from the filter is also maintained substantially constant for a substantial portion of the time during which the discharge takes place.

Further according to the invention the substantially constant rate of discharge of wash water from the filter in the improved method of cleansing an enclosed filter set forth above is of sufficient magni-

tude to cause the filter bed to be subjected to an upward wash at high velocity after the flow of surface wash water has been terminated.

Further according to the invention, there is provided an enclosed filter adapted for carrying into effect the improved method of cleansing referred to above, and comprising an enclosed filter chamber having a filter bed therein, means for introducing wash water below the filter bed to pass upwardly therethrough, means for directing wash water under a relatively high pressure on to or adjacent the surface of the filter bed, valve means controlling the respective flows of wash water, a wash water effluent pipe or passage and valve means controlling the flow of wash water through said effluent pipe or passage, wherein the valve means controlling the respective flows of wash water comprises a pair of rotary valve members, one of which is operable to cut off the supply of water to be filtered to the filter chamber and simultaneously establish communication between the filter chamber and the wash water effluent pipe or passage and the other is operable to control the flow of wash water on to or adjacent the surface of the filter bed.

Preferably, the pair of rotary valve members are interconnected so as to be operable in unison with one another, the interconnecting means being capable of adjustment to regulate the phase relationship between the valve members.

The invention is concerned particularly with that type of filter which embodies one or more groups of enclosed filter chambers containing such a number of chambers that each individual chamber may be cleansed by the high velocity method by directing thereinto the combined flow of filtered water passing at a normal rate from the remaining chambers.

From this point of view the invention includes filter apparatus comprising a group of enclosed filter chambers each having a filter bed therein, a common pipe or passage for discharging filtered water from said filter chambers, a cut-off valve in said common pipe or passage, means for directing wash water under a relatively high pressure on to or adjacent the surface of each filter bed independently of the remaining filter beds, means tending to maintain a substantially uniform rate of flow of said surface wash water, valve controlled means for discharging wash water from an upper portion of each filter chamber whereby, when said cut-off valve is closed and said valve-controlled means of one chamber is open, filtered water from the remaining filter chambers of the group will pass upwardly through the filter bed in said first-mentioned filter chamber, means operable to cause the upward and surface flows of wash water to commence substantially in unison during the cleansing of each filter bed, and to cause said flow of surface wash water to terminate whilst the upward flow of wash water is still proceeding, and means tending to maintain a substantially uniform discharge of wash water from each filter chamber during the cleansing thereof.

In the Specification of United Kingdom Patent No. 346,376, there is disclosed a rotary valve by the operation of which the chambers in such a group as that above mentioned may be successively cleansed and another feature of the present invention resides in employing a second rotary valve of analogous type for controlling the supply of surface wash water and in operating said second valve in unison with a rotary valve arranged to control the supply of impure water and the upward flow of wash water substantially as disclosed in the Specification No. 346,376.

The invention will now be further described with reference to the accompanying drawings, which are to a certain extent diagrammatic, and in which:—

Figure 1 is a view in vertical section on the line 1—1 of Figure 2 of a filter constructed and arranged to operate in accordance with the invention;

Figure 2 is a view in plan of the filter shown in Figure 1, but drawn to a smaller scale than that Figure;

Figure 3 is a view in vertical section of valve means forming part of the filter apparatus as hereinbefore described, this Figure being drawn on a larger scale than either of the preceding Figures;

Figure 4 is a horizontal section on the line 4—4 through the valve means shown in Figure 3;

Figure 5 is a horizontal section on the line 5—5 through the said valve means shown in Figure 3;

Figure 6 is a view in elevation but partly in section of a rotary distributor for wash water, the distributor forming part of the apparatus as shown in Figures 1 and 2;

Figure 7 is a view in plan of the rotary distributor shown in Figure 6, and

Figure 8 is a vertical section through the distributor shown in Figure 6, the cross-section being taken on the section line 8—8 of that Figure.

Referring particularly to Figures 1 and 2 of the drawings two groups 10 and 11 respectively of filter chambers are arranged in juxtaposition each of such groups consisting of six individual enclosed filter chambers 12 provided with the usual beds of graded sand and gravel

tude to cause the filter bed to be subjected to an upward wash at high velocity after the flow of surface wash water has been terminated.

Further according to the invention, there is provided an enclosed filter adapted for carrying into effect the improved method of cleansing referred to above, and comprising an enclosed filter chamber having a filter bed therein, means for introducing wash water below the filter bed to pass upwardly therethrough, means for directing wash water under a relatively high pressure on to or adjacent the surface of the filter bed, valve means controlling the respective flows of wash water, a wash water effluent pipe or passage and valve means controlling the flow of wash water through said effluent pipe or passage, wherein the valve means controlling the respective flows of wash water comprises a pair of rotary valve members, one of which is operable to cut off the supply of water to be filtered to the filter chamber and simultaneously establish communication between the filter chamber and the wash water effluent pipe or passage and the other is operable to control the flow of wash water on to or adjacent the surface of the filter bed.

Preferably, the pair of rotary valve members are interconnected so as to be operable in unison with one another, the interconnecting means being capable of adjustment to regulate the phase relationship between the valve members.

The invention is concerned particularly with that type of filter which embodies one or more groups of enclosed filter chambers containing such a number of chambers that each individual chamber may be cleansed by the high velocity method by directing thereinto the combined flow of filtered water passing at a normal rate from the remaining chambers.

From this point of view the invention includes filter apparatus comprising a group of enclosed filter chambers each having a filter bed therein, a common pipe or passage for discharging filtered water from said filter chambers, a cut-off valve in said common pipe or passage, means for directing wash water under a relatively high pressure on to or adjacent the surface of each filter bed independently of the remaining filter beds, means tending to maintain a substantially uniform rate of flow of said surface wash water, valve controlled means for discharging wash water from an upper portion of each filter chamber whereby, when said cut-off valve is closed and said valve-controlled means of one chamber is open, filtered water from the remaining filter chambers of the group will pass upwardly through the filter bed in said first-mentioned filter chamber, means operable to cause the upward and surface flows of wash water to commence substantially in unison during the cleansing of each filter bed, and to cause said flow of surface wash water to terminate whilst the upward flow of wash water is still proceeding, and means tending to maintain a substantially uniform discharge of wash water from each filter chamber during the cleansing thereof.

In the Specification of United Kingdom Patent No. 346,376, there is disclosed a rotary valve by the operation of which the chambers in such a group as that above mentioned may be successively cleansed and another feature of the present invention resides in employing a second rotary valve of analogous type for controlling the supply of surface wash water and in operating said second valve in unison with a rotary valve arranged to control the supply of impure water and the upward flow of wash water substantially as disclosed in the Specification No. 346,376.

The invention will now be further described with reference to the accompanying drawings, which are to a certain extent diagrammatic, and in which:—

Figure 1 is a view in vertical section on the line 1—1 of Figure 2 of a filter constructed and arranged to operate in accordance with the invention;

Figure 2 is a view in plan of the filter shown in Figure 1, but drawn to a smaller scale than that Figure;

Figure 3 is a view in vertical section of valve means forming part of the filter apparatus as hereinbefore described, this Figure being drawn on a larger scale than either of the preceding Figures;

Figure 4 is a horizontal section on the line 4—4 through the valve means shown in Figure 3;

Figure 5 is a horizontal section on the line 5—5 through the said valve means shown in Figure 3;

Figure 6 is a view in elevation but partly in section of a rotary distributor for wash water, the distributor forming part of the apparatus as shown in Figures 1 and 2;

Figure 7 is a view in plan of the rotary distributor shown in Figure 6, and

Figure 8 is a vertical section through the distributor shown in Figure 6, the cross-section being taken on the section line 8—8 of that Figure.

Referring particularly to Figures 1 and 2 of the drawings two groups 10 and 11 respectively of filter chambers are arranged in juxtaposition each of such groups consisting of six individual enclosed filter chambers 12 provided with the usual beds of graded sand and gravel

supported by a suitable strainer system which is generally designated as 13.

As shown in the drawings each group of filter chambers is in the form of a unitary reinforced concrete structure though this arrangement is immaterial to the invention, as any suitable form of filter chamber may be used.

A distribution valve, generally designated by the reference numeral 14, is arranged centrally above each group of filter chambers, and impure water is supplied thereto from main 15 through branch pipes 16. Each of the branch pipes is fitted with a stop valve 17 to enable the respective group of filter chambers to be isolated when desired.

The impure water so delivered to each distribution valve 14 passes through radially arranged pipes 18 to the upper ends of the filter chambers 12 and thence downwardly through the filter beds therein.

The filter chambers 12 of each group communicate at their lower ends with a common effluent chamber 19 to which an effluent branch pipe 20 provided with a stop valve 20^1 is connected.

The effluent branch pipes 20 from the two groups of chambers connect with a common effluent pipe 21 fitted with a combined rate control and cut-off valve 22 of any suitable type.

The construction of each of the distribution valves 14 is shown in greater detail in Figures 3 and 5 such construction being generally in accordance with that described in the Specification No. 346,376. Thus the valve includes an inlet chamber 23 to which the branch 16 of the impure water main 15 is connected and the lower end of this chamber 23 is closed by a flat horizontal valve seat 24 provided with equally spaced radial ports 25 each of which communicates with one of the aforesaid pipes 18 leading to the upper ends of the individual filter chambers.

A radial valve member 26 arranged within the inlet chamber of the valve 14 engages the valve seat 24 and is connected to a vertical spindle 27 which passes centrally through the top of the chamber and which serves for imparting rotary motion to the said valve member.

The underside of the valve member 26 is formed with a passage 28 the inner end of which is in constant communication with a waste water discharge port 29 provided axially in the valve seat whilst the outer end of the valve passage 28 is adapted to successively register with the aforesaid radially disposed ports 25 when the valve member is rotated. It will be evident that, when the valve passage 28 is in register with any one of the radial ports 25, the supply of impure water to the respective filter chamber is cut off and that the upper end of said chamber is in communication with the central waste water discharge port 29. In order to prevent impure water passing direct from the chamber 23 to the port 29 as the valve member is moving into and out of register with a radial port 25 the said valve member is provided with lateral extensions 30 which closely engage the valve seat.

It will be evident also from an inspection of the drawings that, when the valve member 26 is disposed intermediate any pair of radial ports 25 (which is its normal position) all of such ports communicate with the inlet chamber 23 of the valve.

The waste wash water discharge port 29 of each valve 14 communicates with an individual discharge pipe 31 and the pipes 31 from the two groups of filter chambers are connected to a common discharge pipe 32 fitted with a rate control valve 33 of any approved type (see Figures 1 and 2).

Referring back to Figure 3, the valve spindle 27 is connected through suitable reduction gearing 34 with an electric motor 35. This motor may be controlled either manually or automatically by means not forming part of the present invention, or alternatively the valve member 26 may be actuated manually as by means of a crank handle fitted to spindle 36 embodied in the said reduction gearing.

Irrespective of the manner in which the valve member is actuated it is preferred, when the respective group of filter chambers require cleaning, to cause said valve member to undergo at least one complete revolution at a slow speed. When this operation is carried out, the supply of impure water to the filter chambers is successively cut off such chambers being successively connected to the waste wash water discharge port 29. Thus, as hereinafter described, whilst the valve member 26 undergoes one complete revolution, the filter chambers of the respective group are successively cleansed.

The upper end of each valve spindle 27 is connected by an adjustable coupling 27^1 to the lower end of a coaxially arranged spindle 37 which extends centrally into a second valve casing 38. This valve casing 38 contains an inlet chamber 39 the lower end of which is formed with a flat valve seat provided with a plurality of equally spaced radial ports 40 corresponding in number to the filter chambers 12 in the group.

A rotary valve member 41 in the form of a flat disc engages the valve seat and is provided with a single aperture 42 capable of successively registering with the radial ports 40.

In order to relieve the downward pressure on the valve seat, the valve member 41 may be formed with an upward tubular extension 43 constituting a piston, provided with suitable sealing means, which engages a cylinder 44 formed in the valve casing, said cylinder communicating with the atmosphere or other source of low pressure.

During the normal filtering operation, the aperture 42 in the valve disc 41 is disposed intermediate a pair of radially disposed ports 40 in the valve seat whereby all of said ports are shut off from communication with the inlet chamber 39.

Water (which has preferably been filtered) is delivered to the inlet chamber 39 of the valve casing 38 by means of a pipe 46 provided with a rate control valve 45 and leading from a centrifugal pump 47 or other source of high pressure.

As shown diagrammatically in Figure 2 the pipes 46 leading to the valves 38 of the respective groups of filter chambers are preferably connected to a common pipe to which the pump 47 is connected whereby the one pump will serve the two groups of filter chambers.

Each of the radial ports 40 in each valve casing 38 communicates with an individual pipe 48 leading into the top of one of the filter chambers of the respective group (see Figures 1 and 2).

It will be noted that, for the sake of clarity, valve 38 and the pipes 48 associated therewith have not been shown on the lower group 11 of filter chambers of Figure 2.

As shown chiefly in Figure 1 the pipes 48 are connected within the respective filter chambers to horizontally arranged distribution pipes 49 which are disposed somewhat above the normal level of the surface of the filter bed. The pipes 49 are provided with nozzles at suitable intervals and at suitable inclinations to direct the jets of water which issue therethrough onto the surfaces of the filter beds. The pipes 49 may be fixed or movable and may be arranged in various ways, the arrangement to be adopted in any particular filter being influenced by the shape of the filter chambers and by other factors

In the preferred arrangement, however, the distribution pipes are rotatable in horizontal planes for which purpose they may be pivotally mounted on the lower ends of the pipes 48 as shown more clearly in Figures 6, 7 and 8 of the drawings.

In these figures a single distribution pipe 49 formed of coaxially aligned sections, is pivoted centrally on the lower end of the respective branch pipe 48, the distribution pipe being provided on each side of the pivotal axis with two sets of nozzles 50 and 51 respectively, the former of which are arranged horizontally whilst the latter are inclined downwards (see Figure 8). Nozzles are also arranged at the ends of the pipe 49 as shown. The rotation of the pipe 49 is effected by the reaction of the jets discharged from the nozzles.

It will be noted that, when viewed in plan (Figure 7) the nozzles disposed adjacent the pivotal axis are directed approximately radially of the pipe 49 whilst as they approach the outer ends of the pipe 49 said nozzles are directed outwardly at increasing angles towards the walls of the chamber. This disposition of the nozzles is indicated more clearly by the centre lines at the right hand side of Figure 7.

Furthermore, the sizes of the nozzles preferably increase from a minimum adjacent the pivotal axis to a maximum at the free ends of the pipe 49 and the distance therebetween may decrease towards the free ends.

In these various ways the projected jets of water tend to subject substantially the whole surface of the bed to a fairly uniform disintegrating action during the rotation of the distribution pipe 49. If desired, flexible extensions as of rubber hose may be connected to the ends of the distribution pipe 49 to more effectively direct water jets into the corners of the respective filter chambers. A portion of one such flexible extension is indicated at 52 in Figure 6.

It will be evident that, when desired (as e.g. when the filter chambers are of oblong shape in plan) two or more rotatable distributor pipes 49 may be arranged in each filter chamber.

In order that the jets discharged by a rotary distribution pipe will serve to mechanically break up the accumulated material on the surface of the filter bed, said jets must leave the distribution pipe at a substantial velocity relatively to the filter chamber. Consequently it is important to prevent an excessive rate of rotation of the said pipe 49. For this purpose the rotation of the pipe may be retarded as by means of a vane 52^1 (shown in broken lines in Figures 6 and 7), by arranging some of the nozzles 50 to act in opposition to the majority of such nozzles (as shown in broken lines in Figure 8) or by rotating the sections of the distribution pipe 49 about their axes to vary the inclinations of the nozzles from the positions shown in Figure 8.

Alternatively the rate of rotation of each distribution pipe 49 may be controlled as by a suitable friction device 53

(shown diagrammatically at the left-hand side of Figure 1), which is located above the respective filter chamber and fitted to a tubular spindle 54 connected to the distribution pipe and enclosing the lower portion of the pipe 48.

An indicator hand 55 may also be fitted to the tubular spindle 54 so that the rate of rotation may be readily ascertained.

In lieu of utilising the energy of the issuing jets to rotate the distribution pipes 49 they may be otherwise rotated in any approved manner.

In the normal operation of the filter plant the valve members 26 of the distribution valves 14 are arranged in inoperative positions intermediate an adjacent pair of radial ports 25 all of which are thus in communication with the respective inlet chambers 23 of the valves. The valve discs 41 in the upper valve casings 38 are also arranged in inoperative positions—that is to say the aperture 42 in each valve disc is arranged intermediate an adjacent pair of radial ports 40 all of which are therefore closed.

Consequently raw water from the main 15 passes into each of the distribution valves, thence downwardly through each of the 12 filter chambers in the two groups and finally the filtered water is discharged through the common effluent pipe 21 and the rate control valve 22 therein. The paths of the water are indicated by arrows in Figures 1 and 2.

When the filter requires cleansing as indicated by the loss of head across the filter beds the cut-off valve 22 in the pipe 21 is closed to prevent the flow of water therethrough and the motor 35 associated with one of the distribution valves 14 is started up to cause the respective valve member 26 to slowly rotate. The closing of valve 22 and the starting up of the motor are preferably effected automatically and simultaneously, though the means for effecting this result do not form part of this invention.

As previously described the valve member 26 is mechanically coupled to the valve member 41 in the casing 38 disposed thereabove and thus the two valve members rotate in unison.

During the initial movement of the valve members 26 and 41, the aperture 42 in the latter valve member commences to uncover the adjacent radial port 40 at substantially the same time as the passage 28 in the valve member 26 commences to communicate with the corresponding radial port 25.

The centrifugal pump 47 is started up either automatically or manually at or about the time the motor 35 is started, and consequently, under the circumstances just described, water (preferably filtered water) is delivered at a relatively high pressure from any convenient source by the pump through the respective valve casing 38 and through the rate control valve 45 and the appropriate pipe 48 to the respective filter chamber 12. This water issues from the nozzles 50 in the distribution pipe 49 which is thereby caused to rotate in the manner already described whereby the jets of water emerging therefrom sweep over the surface of the filter bed and tend to disintegrate material such as "floc" which has accumulated thereon.

The surface wash water which enters the chamber in this way is discharged therefrom through pipe 18 to the valve 14 through passage 28 in the valve member 26 (said passage as previously stated being in communication with the respective radial port 25) and thence through the waste water discharge pipes 31 and 32 and through the rate control valve 33 in the latter.

During the further rotation of the valve members 26 and 41 the flow of wash water through the distribution pipe 49 tends to increase due to the increased opening of the respective valves.

It will be evident also that filtered water from the remaining eleven filter chambers of the two groups tends to pass upwardly through the filter beds as soon as the surface wash commences and that the velocity of such upward flow also increases as the valve passage 29 moves into register with the respective radial port 25.

The rate at which wash water may pass into and out of the filter chamber is limited by the rate control valve 33 in the discharge pipe 32 and as the surface wash water supplied by the pump 47 is delivered at a relatively high pressure and at a controlled rate through the medium of the rate control valve 45, the arrangement provides as it were a preference for surface wash water over the upward flow of wash water.

The effective angle subtended by each of the radial ports 40 is less than the angle subtended by each of the radial ports 25 and thus, during the continued rotation of the valve members, the flow of surface wash water is finally cut off whilst the upward flow of wash water is still proceeding. Upon the cessation of the flow of surface wash the upward flow of wash water rises to the maximum permitted by the rate control valve 33 and is finally cut off as the movement of the valve member eventually closes communication between the respective filter chamber and the waste discharge pipe and simultaneously connects said filter cham-

bers with the impure water main.

The result is that, when the operation of cleansing a filter chamber is commenced, the flow of surface wash water quickly reaches the full value permitted by the rate control valve 45 whilst the rate of flow of filtered wash water delivered to the bottom of the chamber is equal to the difference between the maximum rate of flow of all the wash water as determined by the rate control valve 33 in the waste discharge pipe and the rate of flow of the surface wash water.

As the flow of surface wash water is reduced and finally stopped during the further rotation of the control valves, the rate of flow of the wash water delivered below the filter bed progressively rises to its full value and thus serves to subject the filter bed to a normal high velocity wash.

The maximum rate of flow of surface wash water may conveniently approximate to about 20% of the maximum rate of flow of the combined wash water effluent—that is to say the rate control valve 45 may be set to permit the passage of about 20% of the total for which the rate control valve 33 is set.

In lieu of employing a rate control valve 45, the pump 47 may be of a variable speed type and may be controlled to deliver water at a constant rate.

These operations are repeated with the various filter chambers in succession whilst the valve members 26 and 41 complete one revolution. When the valve members are eventually brought to rest in one of the inoperative positions previously described by stopping the motor 35 all the filter chambers of the group are free to resume normal filtration to service.

Ordinarily, however, the second group of filter chambers would then be washed in a similar manner, means being provided if desired to cause the motor 35 of the second group to start up automatically as soon as the cleansing of the first group of chambers has been completed, suitable interlocking means being provided to prevent both motors 35 being simultaneously energised.

When all of the filter chambers have been cleansed the combined rate control and cut-off valve 22 in the common effluent pipe 21 is re-opened either manually or automatically and normal filtration to service is resumed.

The surface wash may be terminated at an early stage of the cleansing operation by advancing the valve disc 41 relatively to the valve member 26 after releasing the coupling 27^1.

It will be understood that the number of filter chambers 12 to be used is influenced by various factors the chief of which are the velocity at which it is desired to effect the high velocity upward wash and the head or pressure of water available for the purpose. The arrangement shown in Figure 2 and which permits of the combined flow of filtered water from eleven filter chambers being used to effect the cleansing of the remaining chamber is suitable for efficiently carrying out the washing operation at a " high velocity " even when the filtering rate per unit of filtering area—i.e. galls. per square foot per minute — is considerably below the normal filtering rate.

In many cases, however, it is satisfactory to employ only one group of six, seven or eight filter chambers in which case each filter chamber would be cleansed by the combined flow of filtered water passing from the remaining five, six or seven chambers as the case may be. It will be evident, for example, from an inspection of Figure 2 that this result would be obtained by isolating one of the groups of filter chambers by means of the appropriate stop valves 17 and 20^1.

Even when it is desired to employ as many as twelve filter chambers in combination, it would be possible to arrange them in one group provided with a single distribution valve as 14 and a single valve as 38 for controlling the surface wash water. In such circumstances, however, it is considered to be preferable to employ two sets of smaller valves as shown in Figure 2.

In a modification surface wash water may be caused to issue from all of the distribution pipes 49 in the one group of filter chambers throughout the whole or a portion of the whole washing cycle or even at intervals during normal filtration to service. This result may be conveniently attained by lifting the appropriate valve member 41 off its seat in any convenient manner without disturbing its phase relationship with the coacting valve member 26. For this purpose the valve spindle 37 is shown in Figure 3 as being slidable in the adjacent member of the coupling 27^1.

In a further modification the rotary valve for distributing the surface wash water may be similar in construction to the rotary valve 14 in which case the central port in the valve and the passage as 28 in the valve member are in constant communication with the pipe 46 means being provided to hold the valve member in contact with its seat. Thus, when the outer portion of the valve passage 28 is moved into register with any one of the radially disposed parts, wash water from pipe 46 passes through valve passage 28 and thence through the port to the branch pipe 48 leading to the distribution pipe

49 in the appropriate filter chamber.

Whilst it is preferred to employ rotary valves of the kind above indicated for controlling the surface and upward flows of wash water, it will be understood that this is not essential as any form of valve mechanism by which the same operations may be performed sequentially for all the chambers in the group, may be used in lieu thereof.

Whilst the invention is directed chiefly to filters having a group of filter chambers so arranged that any one chamber may be cleansed by passing upwardly therethrough the combined filtrate from the remaining chambers of the group, it will be understood that the invention is not confined thereto. For example, the invention may be applied to a filter having only one filter chamber adapted to be cleansed when required by water obtained from an elevated storage chamber or from a low level storage chamber through the medium of a suitable pump.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A method of cleansing a filter apparatus comprising an enclosed filter chamber having a filter bed therein, means for introducing wash water below the filter bed to pass upwardly therethrough, means for directing wash water under a relatively high pressure on to or adjacent the surface of the filter bed, a wash water effluent pipe or passage and valve means controlling the respective flows of wash water, the method employing the procedure of so operating the various valve means that the upward and surface flows of wash water are simultaneously effective during a portion of the cleansing operation and the surface flow is terminated while the upward flow is still proceeding, which method consists in this that by appropriate regulation of the valve means the rate of flow of surface wash water is maintained substantially constant for a substantial portion of the time during which the flow of surface wash water takes place and the rate of discharge of wash water from the filter is also maintained substantially constant for a substantial portion of the time during which the discharge takes place.

2. The method of cleansing a filter according to Claim 1, wherein said substantially constant rate of discharge of wash water from the filter is of sufficient magnitude to cause the filter bed to be subjected to an upward wash at high velocity after the flow of surface wash water has been terminated.

3. The method of cleansing a filter according to Claim 1 or 2, wherein the upward flow of wash water and the flow of surface wash water commence substantially simultaneously.

4. The method of cleansing a filter according to any preceding Claim wherein the maximum rate of flow of surface wash water is approximately 20 per cent. of the maximum rate of flow of effluent wash water.

5. The method of cleansing a filter having a group of enclosed filter chambers provided with a common discharge for filtered water comprising shutting off said common discharge and successively subjecting the filter beds in the individual chambers to a cleansing operation as claimed in any preceding Claim, characterised in that said upward flow of wash water is drawn from the remaining filter chambers of the group.

6. An enclosed filter adapted for carrying into effect the method claimed in any of the preceding Claims, and comprising an enclosed filter chamber having a filter bed therein, means for introducing wash water below the filter bed to pass upwardly therethrough, means for directing wash water under a relatively high pressure on to or adjacent the surface of the filter bed, valve means controlling the respective flows of wash water, a wash water effluent pipe or passage and valve means controlling the flow of wash water through said effluent pipe or passage, wherein the valve means controlling the respective flows of wash water comprises a pair of rotary valve members, one of which is operable to cut off the supply of water to be filtered to the filter chamber and simultaneously establish communication between the filter chamber and the wash water effluent pipe or passage and the other is operable to control the flow of wash water on to or adjacent the surface of the filter bed.

7. An enclosed filter as claimed in Claim 6, wherein the pair of rotary valve members are interconnected so as to be operable in unison with one another, the interconnecting means being capable of adjustment to regulate the phase relationship between the valve members.

8. An enclosed filter as claimed in Claim 6 or Claim 7, wherein the means for directing wash water on to or adjacent the surface of the filter bed comprises one or more perforated members which are disposed above and adjacent to the surface of the bed and are rotatable in a substantially horizontal plane by the reaction of the jets of water discharged from them.

9. An enclosed filter as claimed in Claim 8, wherein means are provided for retarding the rotation of the perforated member or members, whereby the jets of water

discharged therefrom will have a substantial velocity relatively to the filter chamber.

10. An enclosed filter as claimed in Claim 6 or Claim 7, wherein the means for directing wash water on to or adjacent the surface of the filter bed comprises one or more perforated members which are disposed above and adjacent to the surface of the bed, are rotatable in a substantially horizontal plane and are provided with discharge nozzles or orifices for the wash water which are disposed at varying angles to one another so as to direct the jets of water over substantially the entire area of the filter bed.

11. Filter apparatus for carrying out the method claimed in any of the preceding Claims 1 to 5, comprising a group of enclosed filter chambers each having a filter bed therein, a common pipe or passage for discharging filtered water from said filter chambers, a cut-off valve in said common pipe or passage, means for directing wash water under a relatively high pressure on to or adjacent the surface of each filter bed independently of the remaining filter beds, means tending to maintain a substantially uniform rate of flow of said surface wash water, valve controlled means for discharging wash water from an upper portion of each filter chamber whereby, when said cut-off valve is closed and said valve-controlled means of one chamber is open, filtered water from the remaining filter chambers of the group will pass upwardly through the filter bed in said first-mentioned filter chamber, means operable to cause the upward and surface flows of wash water to commence substantially in unison during the cleansing of each filter bed, and to cause said flow of surface wash water to terminate whilst the upward flow of wash water is still proceeding, and means tending to maintain a substantially uniform discharge of wash water from each filter chamber during the cleansing thereof.

12. Filter apparatus according to Claim 11, wherein valve means for controlling the supply of surface wash water and valve means for controlling the discharge of effluent wash water are arranged to be operated so as to cause the individual filter chambers of the group to be washed in sequence.

13. In filter apparatus according to Claim 12, means for adjusting the valve means controlling the supply of surface wash water to cause the supply of surface wash water to be cut off at an earlier or later stage of the cleansing of each filter chamber.

14. Filter apparatus according to Claim 11, wherein a common pipe or passage is provided for the discharge of wash water from the individual filter chambers, and a rate control valve for controlling the discharge of effluent wash water is provided in said common pipe or passage.

15. Filter apparatus according to Claim 11 or 14, wherein a common pipe or passage is provided for the supply of surface wash water to the individual filter chambers of the group and a rate control valve for controlling the flow of surface wash water is provided in said common pipe or passage.

16. In filter apparatus according to Claim 11, 14 or 15, a valve chamber having a valve seat therein, a plurality of radially disposed ports in the valve seat, each of said ports being in communication with an upper portion of one of said filter chambers, a central waste discharge port in the chamber, a radial valve member in the valve chamber and engaging the valve seat, a passage in the under-surface of the valve member, said passage being in constant communication with the central waste discharge port and being adapted to be moved into register with any of the said radially disposed ports and means for supplying raw or impure water to the valve chamber.

17. In filter apparatus according to Claim 11, 14, 15 or 16, a valve chamber provided with a valve seat, a plurality of radially disposed ports in the valve seat each of said ports being connected to said means for directing surface wash water to one of said filter chambers, means for supplying wash water to the valve chamber and a rotary valve member engaging said valve seat and having an aperture adapted to be moved into register with any one of the radially disposed ports to permit of the passage of water to the means for directing wash water to the corresponding filter chamber.

18. In filter apparatus according to Claim 17, the construction wherein the rotary valve member for controlling the flow of surface wash water may be lifted off its seat to permit of wash water passing simultaneously to the distribution means of all of the filter chambers in the said group.

19. Filter apparatus according to Claims 16 and 17, wherein the said rotary valve members are arranged coaxially and are coupled together by means which permit of the adjustment of their phase relationship.

20. Filter apparatus according to Claim 11 having two groups of filter chambers, a common rate control valve for controlling the flow of surface wash water to each of the filter chambers of each group, a common rate control valve for controlling

the rate of flow of effluent wash water from each filter chamber of each group, a filtered water effluent pipe common to said groups of filter chambers, said cut-off valve being arranged in said common effluent pipe, and rotary valves individual to each group of filter chambers for controlling the flow of surface wash water to and the discharge of effluent wash water from the individual filter chambers of the respective groups thereof.

21. The method of cleansing a filter substantially as hereinbefore described.

22. A filter comprising a plurality of filter chambers having means substantially as hereinbefore described and as illustrated in the drawings, for effecting the cleansing of the filter beds therein in accordance with the method claimed in any of the preceding Claims 1 to 5 or Claim 21.

Dated this 19th day of July, 1937.

G. F. REDFERN & CO.,
Chartered Patent Agents,
15, South Street, London, E.C.2,
Agents for the Applicants.

Closed. DH.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1938.

I Certify this, including the Drawing forming part thereof, to be a True Copy

22 JUN 1939

Acting for Comptroller.