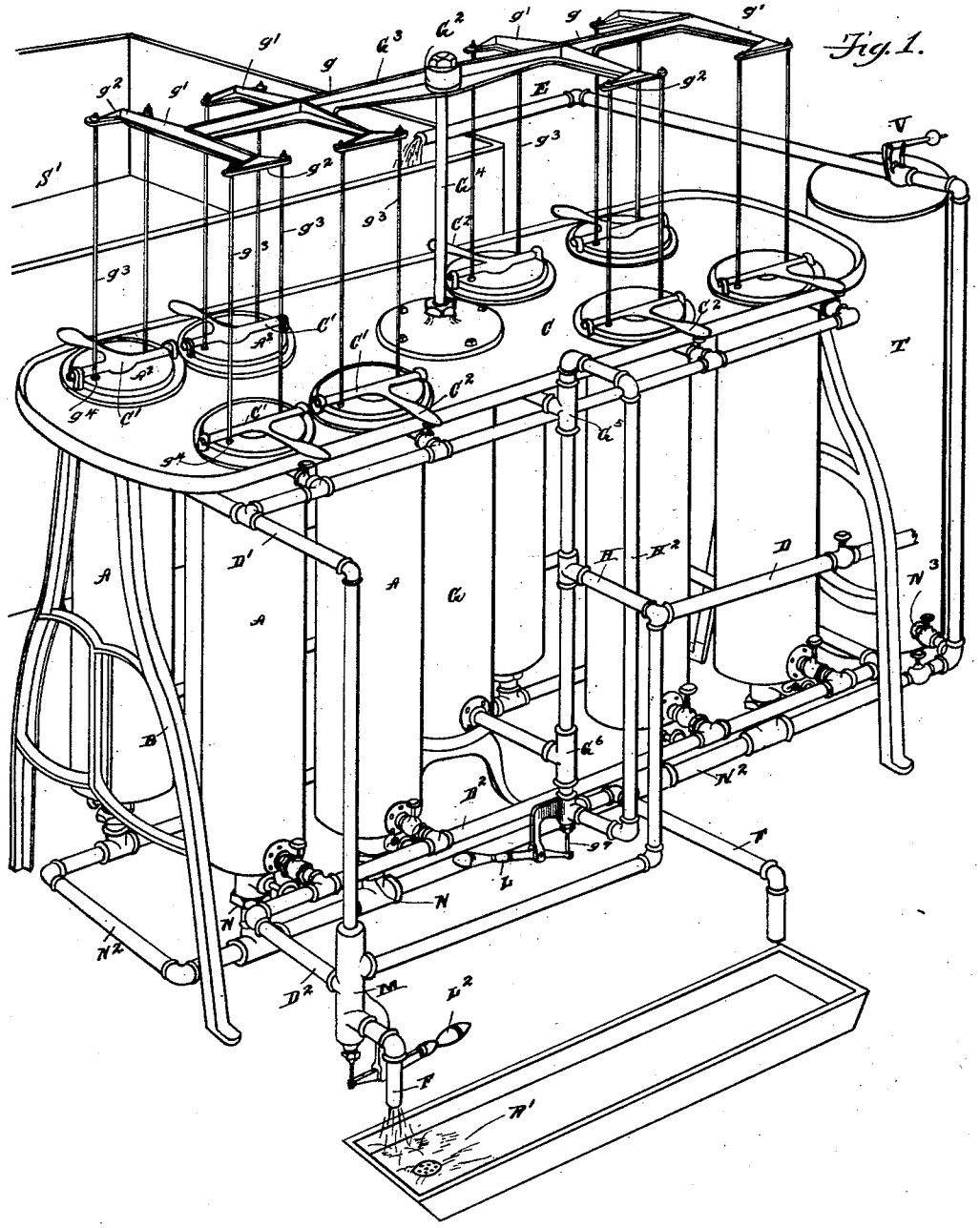
(No Model.) 4 Sheets—Sheet 1.

J. A. BOWDEN.

FILTER.

No. 564,776. Patented July 28, 1896.

Fig. 1.



WITNESSES

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D. W. Bradford

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Junius A. Bowden

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(No Model.) 4 Sheets—Sheet 2.

J. A. BOWDEN.

FILTER.

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Fig. 2.

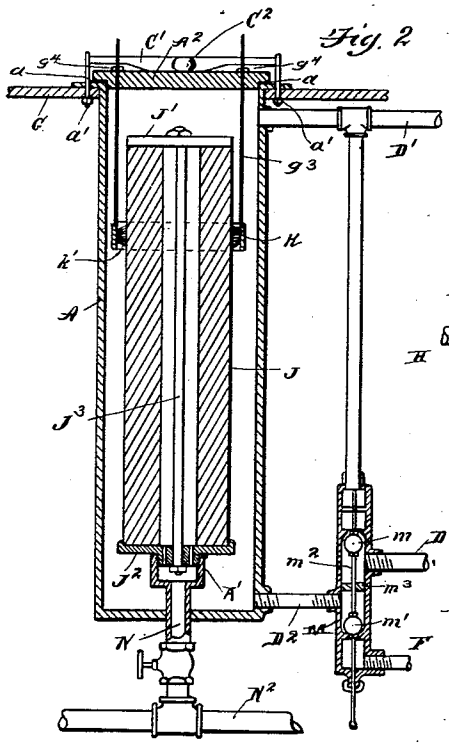


Fig. 7.

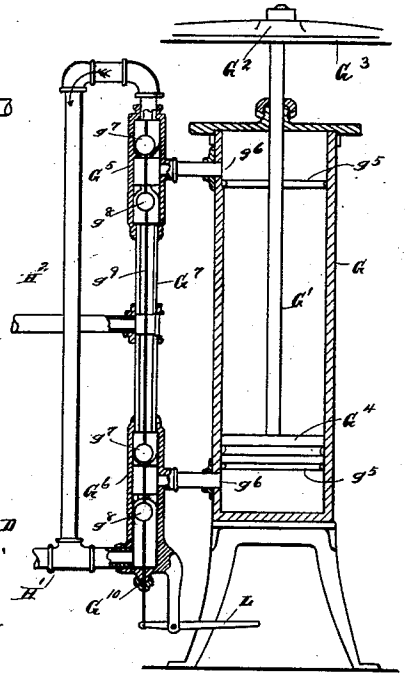


Fig. 3.

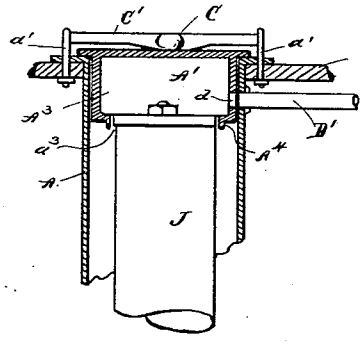


Fig. 5.

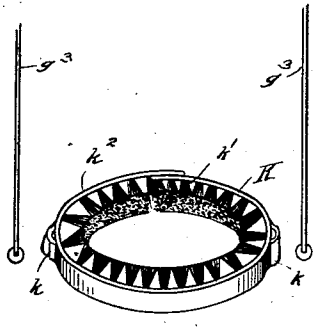


Fig. 6.

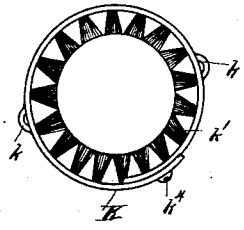
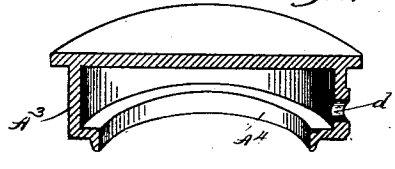


Fig. 4.



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J. A. BOWDEN.

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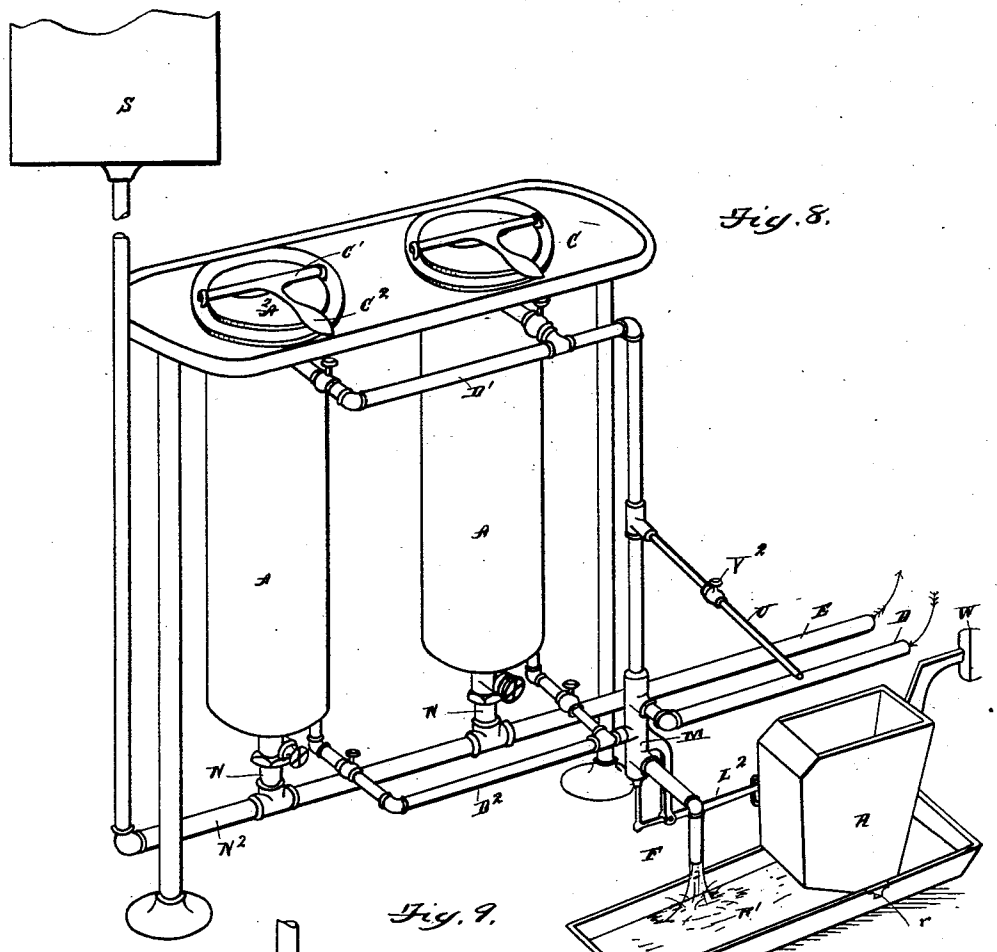
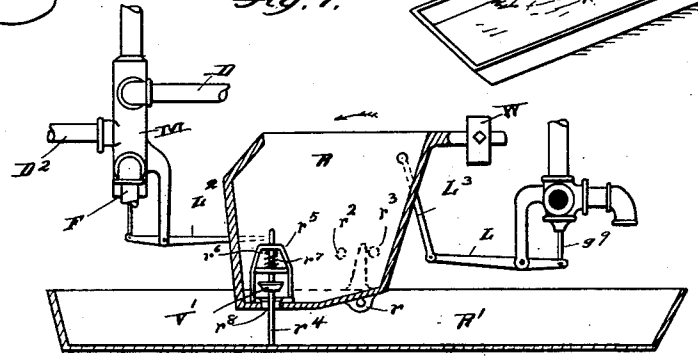


Fig. 8.

Fig. 9.



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J. A. BOWDEN.

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Fig. 10.

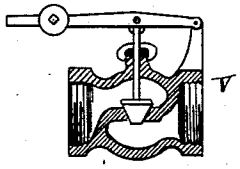


Fig. 11.

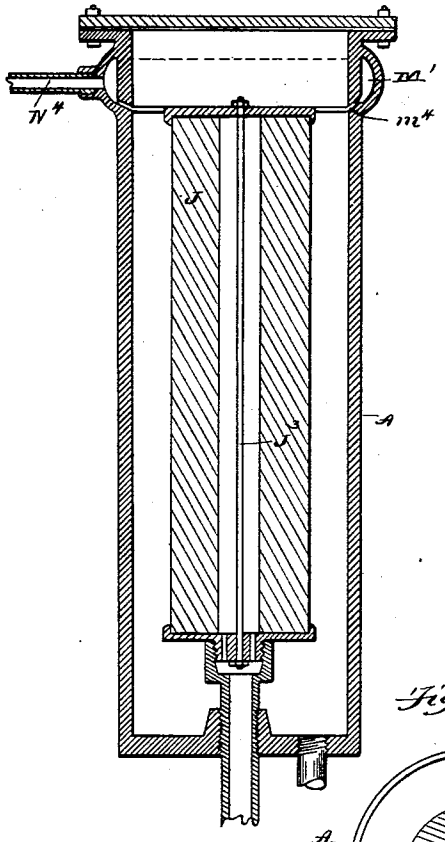


Fig. 12.

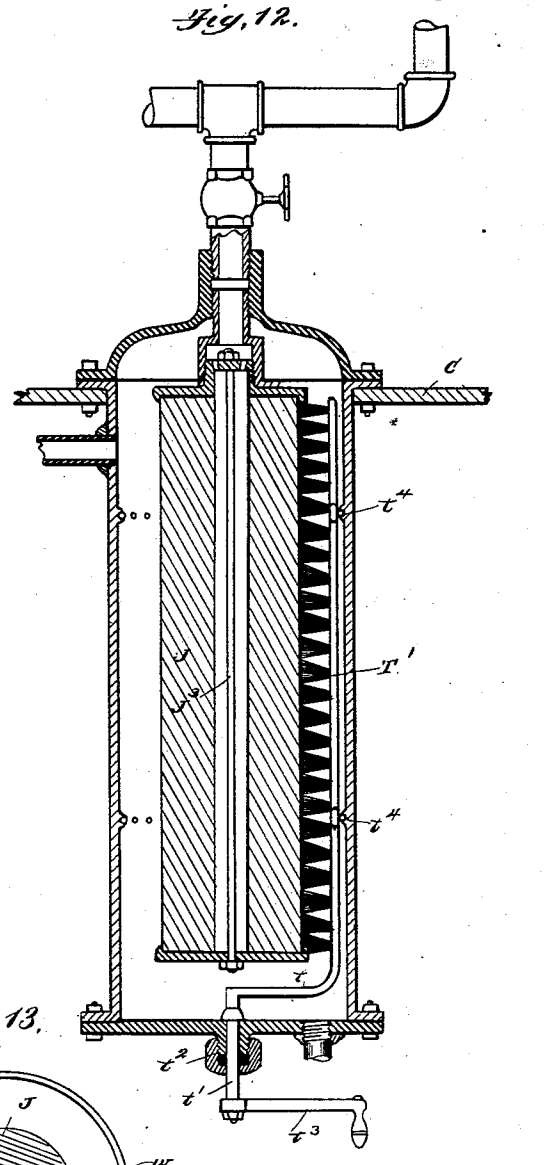
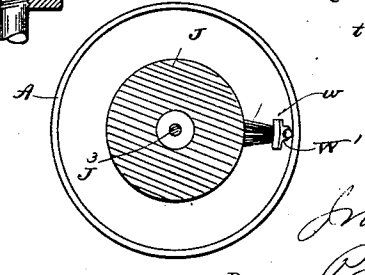


Fig. 13.



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UNITED STATES PATENT OFFICE.

JUNIUS A. BOWDEN, OF DETROIT, MICHIGAN.

FILTER.

SPECIFICATION forming part of Letters Patent No. 564,776, dated July 28, 1896.

Application filed April 24, 1894. Serial No. 508,798. (No model.)

To all whom it may concern:

Be it known that I, JUNIUS A. BOWDEN, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Filters; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to filters, and especially that class which comprises a cleansing arrangement; and it consists in the various combinations hereinafter described and claimed.

In the drawings, Figure 1 represents a perspective view of my improved filtering-machine, with the exception of the automatic arrangement for effecting the cleansing. Fig. 2 is a sectional view of the internal construction of each of the internal tanks. Figs. 3, 4, 5, and 6 are detail views of various portions thereof and modifications. Fig. 7 is a sectional view of the operating-ram and valves connected therewith. Fig. 8 is a view in perspective of a filter in combination with the automatic device for operating the currents. Fig. 9 is a sectional view, vertically and longitudinally, through the automatic device, showing its arrangement and the arrangement of the valves and levers connected therewith. Fig. 10 is a sectional view of the relief-valve. Fig. 11 shows a modified form with an annular jet-orifice adapted for washing the filtering-tube. Fig. 12 shows a simple brush arrangement for cleaning. Fig. 13 is a sectional view showing a modified form of bearing for the brush.

In the various figures, A A represent cases containing filtering-tubes, and having the proper waterway connections. These are supported by a framework B, carrying a supporting-plate C.

D is the inlet-pipe for unfiltered water.

E is a discharge-pipe for filtered water.

F is a discharge-pipe for foul water from the washings of the filter.

G is the casing of a ram adapted to operate, as hereinafter described, the brushes for cleansing filtering-tubes.

G′ is the piston-rod of the ram, carrying a head G^2. This head is of peculiar construction. It supports and operates a framework G^3, rigidly attached thereto, which framework also carries and operates the brushes, in the manner hereinafter described. As shown in the drawings, the framework consists of one longitudinal member g g, carrying rigidly cast therewith cross members g' g', and these at the ends also carry other cross members parallel with g, and marked g^2. To these are bolted perpendicular rods g^3 g^3. These rods operate through stuffing-boxes g^4 in the heads of the casings A A, as more especially shown in Fig. 2. The interior construction of the ram is shown in Fig. 7. It consists of a piston G^4. This piston is adapted to reciprocate water-tight by appropriate stuffing, in the usual form, in the cylinder G.

g^5 g^5 are ledges, preferably elastic, and are upon the inner sides of the cylinder G and just short of the two ports or openings g^6 g^6. These limit the movement of the piston G^4, and are sufficiently strong and firmly attached to the walls of the cylinder G to resist any pressure that may be brought against the faces of the piston G^4 in either direction. These ports g^6 g^6 lead to valve-chest G^5 G^6. These valve-chests carry valves g^7 g^8, the upper ones respectively being g^7 g^7, and the lower ones respectively being g^8 g^8. These are seated upon appropriate seats and may be ball-valves, as shown, composed of rubber or metal, or they may be frustums of cones seated upon corresponding seats. About the construction of these valves in themselves there is nothing new, and therefore they will not need any extended description.

It will be noticed that, as shown, the valves g^7 g^7 are closed, while g^8 g^8 are open. The two valve-chests G^5 G^6 are connected by a communicating pipe G^7, and the valves are all connected by one rod g^9, which extends through the tube G^7 and outwardly through a stuffing-box G^{10} at the lower end of the lower valve. The rod g^9 is controlled, as shown in Fig. 7, by a hand-lever L. It is obvious that, by means of this lever, the valves g^7 g^8 can be shifted as may be desired. The induction-pipe for the ram is at H, and the eduction-pipe is shown at H′. The valves being in the situation as shown in Fig. 7, water from a

head or end pressure flows, as shown by the arrow, under pipe H, and necessarily rises, passing the upper valve g^8, and from thence through the upper port g^6 above the piston G^4. It is obvious that it cannot enter into the space in the cylinder G below the piston-head G^4, because the lower valve g^8 is correspondingly closed. It is also obvious that whatever water may be under the piston G^4 is allowed to pass out through the lower port g^6, past the lower valve g^8, and from thence out through the eduction-pipe H'. If the valves g^7 g^8 are reversed by the action of the lever L, the water which has heretofore been supposed to be above the piston G^4 now passes out through the upper port G^6 past the open upper valves G^7, over and downward through the pipe H^2 in the direction of the arrow, and out through the education-pipe H', while water entering through the pipe H passes the lower open valve g^7 and enters the cylinder G underneath the piston G^4 through the port g^6 and compels the piston to rise, being a reverse action from that heretofore described. It is obvious, therefore, that by shifting the valve-lever L and the valves connected therewith through the connecting-rod g^9 this action can be repeated as often as desired, the ledges g^5 g^5 in the interior of the cylinder G forming abutments against which the pistons G^4 will respectively come to rest at each end of the stroke. This action obviously operates the whole framework connected at G^2 with the piston-rod G', carrying therewith, through the medium of the rods g^3 g^3, the brushes illustrated in Fig. 2 in connection with the filtering-cylinder, and illustrated in detail in Fig. 5.

The filtering-cylinders J are each located, respectively, within the cylinders A A, substantially as shown in Fig. 2, or in connection with the heads, as shown in Fig. 3. The special form, however, of connection therein is not necessary to the operation of the device for cleansing. I have shown, however, two forms which I consider preferable. The filtering-cylinders are preferably made up of a single hollow cylinder of peculiar filtering-stone located between two disks J' J^2, which are packed at the ends and held together by the tie-rod J^3. The structure is substantially the same as the filtering-cylinders and their attachments shown in my former application, Serial No. 472,955, filed May 4, 1893, but with some slight modifications to adapt them to be supported within the cylinders A A in the form herein shown. In the former application they were shown to be attached by suspending them from the upper head of the inclosed casing or cylinder, leaving the lower ends free from all attachment thereto. In this form I prefer to attach them solely at the lower end in substantially the form shown in Fig. 2, so that by detaching the upper head, the filtering structure, consisting of the cylinder J, the caps J' J^2, and the tie-rod J^3, can be removed as one piece, and can also be put together and reinserted, as may be desired, by simply engaging the lower cap J^2 with a hollow support A' in the bottom of the cylinder A.

As hereinbefore stated, the rods g^3 g^3, passing through stuffing-boxes in the head, engage a circumferential brush K by any appropriate means of attachment, such as is shown in Fig. 5, in which lugs or ears are fastened thereon, and the rods g^3 g^3 pass therethrough with nuts upon the bottom, and the ears are held against rigid flanges thereon, so that the brush is movably held by these means. The ears k k contain holes that are somewhat larger than the rods g^3 g^3, for the purpose of allowing the brush to expand and contract without twisting or straining the rods, and to take up for the wear of the stone. The brush K proper is made with an elastic backing k^2, carrying bristles k' upon its interior face, the elastic backing k^2, as shown in Fig. 5, being in the form of a ring, one end passing by and sliding upon the inner face, and the other end being clear from bristles to permit the sliding movement. The brushing-ring is preferably sprung with a slight tension on and around the filtering-cylinder J, and, as it is operated longitudinally thereon, when the proper connections are made, by means of the apparatus hereinbefore described, the tendency is to wear away both the brush and the filtering-cylinder to some extent, and the elastic tension of the spring-backing of the brush keeps the brush held up to the surface of the filtering-cylinder. I do not intend to limit myself, however, to an elastic brush in this connection, nor to one of the exact form shown, as it might be made in various forms, and possess elasticity; or it might be made without elasticity to operate for a length of time, due to the elasticity and life of the bristles; or it might be made to be adjustable by hand; and I have shown such a one in Fig. 6, in which the ring K is adapted to be closed and held by a set-screw k^4.

In Figs. 3, 4, and 11 I have shown a modified form of head to the casing A, by means of which a jet or surface washing of the filtering-cylinder can be obtained in combination with the reverse action of filtered water through the filtering-cylinder in substantially the same manner as that shown in my previous application heretofore mentioned. As shown in Fig. 2, the head of the casing or cylinder A is made in a simple form, and consists of a disk A^2, having a flange adapted to fit the upper end of the casing A, and between which and the casing a packing a is interposed. This is held firmly in place by means of two eyebolts a' a', bolted through the table c, the eyes carrying as journals a T cam-lever C'. By forcing the handle C^2 of this lever downward, the cam portion of the lever engages the upper surface of the head A^2 and forces it firmly against the packing and the flanged upper end of the casing A.

In Figs. 3 and 4 the form of the head is

modified by having a cylindrical interior flange A^3, adapted to enter into the inner side of the cylinder A to a distance below the mouth of the inlet-pipe D', and having coincident with the mouth D' an opening *d*, which forms a continuation of the waterway in D'.

The lower portion of the flange A^3 is choked at A^4, and is brought down coincident with the top of the filtering-tube, and sufficiently close to it to form a narrow annular slit between the inner face of the choking A^4 and the top of the filtering-cylinder, as shown in Fig. 3 at a^3. A sectional view of this head is shown in Fig. 4.

As shown in Fig. 11, the casing A is constructed with an annular chamber M', into which the inlet-pipe N^4 enters. The inner wall of this annular chamber M' is brought quite close to the main wall of the chamber at m^4, thus leaving a narrow annular slit surrounding and adjacent to the upper end of the filtering-cylinder J. This slit is directed downward and inward on an angle, so that when water is forced through it the water is thrown angularly downward upon the surface of the filtering-cylinder, thus assisting in cleansing the surface simultaneously with forcing filtered water through the same in a reverse direction. As the inlet-pipe N^4 is connected with the automatic mechanism described, the double flow of water is thus provided automatically.

It is obvious that either form of construction of the head could be used, and the whole structure of the filtering-cylinder otherwise remain the same, although the form of cleansing apparatus be omitted, and brushing be accomplished by hand by taking off the heads A^2. If desired to be cleaned by hand, the brush shown in Figs. 5 or 6, without the rods g^3 g^3 and without any means of operating them, might be used by taking the heads off and operating them by hand in any convenient manner; or a brush shown in Fig. 12 may be used, where the filtering-cylinder J is swept by a brush T', extending longitudinally with the filtering-cylinder and carried upon an arm *t*, revolving crank fashion upon a shaft having its axial center *t'* operating in a stuffing-box t^2 coincident with the center of the filtering-cylinder, and controlled and operated by the hand-crank t^3.

In Fig. 12 I have shown a ball-bearing located in the walls of the filtering-case at t^4 t^4, and against which the backing of the brush impinges in its evolution. In Fig. 13 I have shown a modification in which a ball is shown in a socket *w'* in the back *w* of the brush. As these constructions are common, I do not deem a detailed description necessary.

As shown at M in Figs. 1, 2, and 9, there is another valve-chest having an internal construction, as illustrated in Fig. 2 in section, in connection with a single filtering-cylinder. In this structure, D is the pipe leading to the source of supply; D', a pipe leading from the valve-chamber to the upper end of the filter-case, as shown in Fig. 2. D^2 is a pipe leading to the lower end of the filter-case from the valve-casing. The valve-casing M contains two ball-valves *m m'*, located upon a valve-stem m^2 and adapted to move longitudinally upon appropriate valve-seats, one being above the valve *m* and the other being below the valve *m'*. These may be of any practical form, whether ball-valves or conical valves, as may be desired. The lower end of the valve-stem *m'* is connected to a lever L^2. (Not shown in Fig. 2, and shown in Fig. 3 as being connected with an automatic device to be hereinafter described.) By means of this lever the valves *m m'* are operated. The valves *m m'* are in two different sections of the valve-chest M, which is centrally divided by a diaphragm m^3, and through which the valve-stem M passes substantially water-tight. In the position shown in the drawings the water from the supply-pipe D would pass into the upper chamber of the valve-chest M, past the valve *m*, and thence upwardly through the pipe D' into the upper portion of the filtering-case A. Correspondingly the lower valve *m'* is closed, and no communication is afforded through the pipe D^2.

If the valves be entirely reversed, the source of supply through the pipe D' is shut off and a communication is open through the pipe D^2, which passes out through the spout F.

By means of appropriate connections the valve-chest M is made to communicate with not only the cylinder A, but all of the cylinders, in substantially the same relation, so that the same effect takes place throughout all of them, as shown in Fig. 1, the form of the pipes or the number of cylinders thus connected being wholly immaterial. As shown in Fig. 8, this valve-chest M is connected with two cylinders only. In connection with the cylinders there is shown a storage-tank S, which is sufficiently elevated above them to produce a back pressure when the hydrant or initial pressure is removed.

It is obvious that the unfiltered water, entering through the pipe D in the ordinary filtering operation of the device, passes through the filtering-cylinder J to its interior, and thence through the communication N at its lower end, and from thence through the pipe N^2 to the storage-tank S. By shutting off the source of supply through the pipe D, by closing the valve *m* and opening the valve *m'*, the back pressure of the storage-tank S, as shown in Fig. 8, would force the storage of filtered water in a reverse direction through the pipe N^2 into the interior of the cylinder J, and from thence through the cylinder as a filtering medium into the space surrounding it, and between it and the wall of the casing A, from whence it would be drawn off through the pipe D^2, past the valve *m'*, and delivered at the discharge F. As shown in Fig. 1, this arrangement is varied by using a compression-tank T. In this form the con-

nections N from the bottom of each filtering-cylinder all communicate with a single discharge-pipe N^2, which enters the bottom of the compression-tank T at N^3 and ends with the discharge E, which empties into any convenient receptacle, as a tank S'. The water in its course toward the discharge E is checked by means of an adjustable resistance-valve, (shown at V and illustrated in section at Fig. 10.) By interposing this resistance-valve at this point, or at a point between the connection N^3 and the discharge E, and having the valve variable in tension, any assignable degree of pressure can be placed upon the passage of the water in the pipe N^2, and thus cause it to enter through the passage N^3 into the storage-tank T against an atmospheric head caused by the accumulation of water therein. As soon as there is a balance reached between the pressure in the air-chamber in the compression-tank T and the resistance-valve V the water will commence to flow past the resistance-valve and out at the outlet E.

By manipulating the valves *m m'* in the valve-chest M, as heretofore described in relation to Fig. 8, the air-pressure in the compression-tank T, coupled with the closing of the valve V, will force the accumulated water in the tank T backward through the pipes N^2, the connections N, to the interior of the filtering-cylinders J, from thence through the filtering material, and discharged by the pipes D^2 out at the outlet F. In this form, therefore, the compression-tank T is substituted for the hydraulic pressure derived from the storage-tank S in Fig. 8.

In order to automatically operate the valves in either valve-chest G^5, G^6, or M, I have shown a device which is a modification of one shown and claimed in an application filed by me on the 2d day of March, 1894, and serially numbered 502,066, which device is illustrated in Figs. 8 and 9. This consists in a tilting tank R, pivoted at *r* in a trough R'. This tank has the same features as the tank described in my former application of keeping one position when empty by means of an adjustable overbalancing-weight W. The rocking motion is limited by means of an arm and two legs attached to any convenient fixed point, as shown at r^2 r^3 by dotted lines in Fig. 9. Any convenient means, however, of limiting the motion in either direction may be adopted. Upon the side of the tilting tank R opposite to that carrying the weight W is located a valve V', which is adapted to seat in an opening r^8 in the bottom of the tank R. The valve V' is carried on a stem which slides in ways formed in a frame r^5, erected upon the inner side of the tank R. A lug r^6 on the stem carries above it a spiral spring r^7, which is adapted to be compressed between the lug and the upper portion of the frame r^5. A nut threaded on the valve-stem in place of the lug can be used, and by means thereof the tension of the spring may be graduated. The valve-stem r^4 extends below the valve-case and centrally through the opening adapted to be closed by the valve and some little distance below, whereby when the tank is tilted in the direction of the arrow it comes in contact with the bottom of the pan R'. The further tilting of the tank R in the same direction would cause the valve V' to open by lifting it relatively to the tank R against the tension of the spiral spring r^7. By regulating this tension it is obvious that it can be caused to open under varying weights, as may be desired. This apparatus of the tilting tank is so placed with reference to the lever L^2 that a continuation of the handle thereof is adapted to engage the tilting tank R, so that the rotation of the tank in tilting will actuate the lever, as shown in Fig. 9. In order to operate the lever L, which actuates the valve controlling the arm, the outer end of the lever is connected by a connecting-rod L^3 to the weighted side of the tank R, so that the reverse tilting of the tank in the direction of the weight will lift the valves in the valve-seats G^5 and G^6, whereas the raising of the weight and the tilting of the tank in the direction of the arrow will so operate the lever L as to depress the valves in the valve-chests G^5 and G^6. By properly adjusting this device with the length of the lever-arms and in their proper relation to each other, all of which is a matter of mere mechanical construction and detail, this device may be made to operate the levers L and L^2, carrying their respective valves in the valve-chests hereinbefore described. All that remains is to automatically furnish a discharge and counterbalancing weight to W in the tank R at regular intervals. This I accomplish by means of an auxiliary supply-pipe U, connecting with the main supply-pipe D'. From thence, by means of an adjustable valve V^2, I permit water to flow gradually into the tank R, and thus control a period of its depression, it being obvious that the slower the water is pouring in the longer the time it will take to fill and thus furnish the counterbalancing-weight to W, as when it it is tilted the water is allowed to flow from it rapidly. It follows that the tilting action and the return are both comparatively rapidly accomplished, while the length of time when it is in the position with the valve V' closed is regulated by the valve V^2.

In Fig. 9 the tank R is shown in an intermediate position just after opening the valve V', and therefore the valves referred to in the various valve-chests G^5, G^6, and M are in the process of shifting. The mode of operation of this device is apparent from the foregoing description.

What I claim is—

1. In a filtering apparatus, a series of filter-tanks independently connected with a source of supply, a porous filtering-tube suitably held in each tank, a discharge-pipe leading from the interior of each tube through the bot-

tom of the case and into a main common to all, a wash-outlet leading from the bottom of each filter, valves controlling the inflow and outflow of water and arranged to enable any one of the series to be cut out from filtering action, a cover to the case and means for securing the same, the said cover being adapted to be removed, and the filtering-tube thereby being rendered accessible for cleansing or removal upward without disturbing any of the pipe connections, substantially as described.

2. In a filtering apparatus, a series of filter-tanks independently connected with a source of supply, a porous filtering-tube held in each tank, a discharge-pipe leading from the interior of each tube through the bottom of the case and into a main common to all, a waste-outlet leading from the bottom of each filter, a cover to the case and means for securing the same, the said cover being removable and the filter-tube being thereby rendered accessible for cleansing or removal upward without disturbing any of the pipe connections, substantially as described.

3. In an automatic self-cleansing filter, the combination of the casings; appropriate connections for inlet and outlet waterways; inclosed, hollow filtering-cylinders carried within said casings; means for brushing the outer surfaces thereof, operated by a water-engine; a valve-chest and valves connected by appropriate waterways whereby the circulation can be reversed; a source of pressure for filtered water for causing a reversal; valve-chests and appropriate valves, with proper connections for operating the water-engine; and an automatic means of simultaneously operating the valves of the water-engine and the valves adapted to reverse the current, substantially as set forth.

4. In a filter employing a hollow filtering-tube, the combination of a casing A; a removable head adapted to inclose the upper end of said filtering-case, said head having an inner depending annular flange adapted to enter within the inclosing case A; a waterway therethrough in conjunction with the inlet-pipe; the said annular flange forming, with the upper end of the inclosed filtering-tube, an annular slot surrounding said tube communicating with a chamber formed by said head and annular flange and the upper end of said tube, and the annular space surrounding said filtering-cylinder, substantially as described and for the purpose set forth.

5. In combination with a filter having its outlet at the bottom, also a waste-outlet at the bottom, a porous tube having an imperforate cap on its upper end, and on its opposite end a cap with a waterway, and threads adapted to engage with a fitting in the bottom of the filter-casing, and means for binding the said tube between the two caps, and means for brushing the tube from the top of the filter-casing without disturbing any pipe connections, substantially as shown.

6. In combination with a filter having its outlet at the bottom, also a waste-outlet at the bottom, a porous tube having an imperforate cap on its upper end, and on its opposite end a cap with a waterway, and threads adapted to engage with the bottom of the filter-casing, and means for binding the said tube between the two caps, and means for brushing the tube from the top of the filter-casing without disturbing any pipe connections, the said filter-tube secured by said threads to the bottom of the filter-casing without a lock-nut or its equivalent.

7. In a filtering apparatus, the combination with a porous filtering-tube arranged in combination with other like filtering-tubes, and means for discharging filtered water through a fitting secured to the bottom of the filter-casing, said fitting being adapted to receive the filter-tube from the inside of the casing and also adapted to discharge into one main outlet, and means for brushing said filter-tube from the top of the filter-casing without disturbing any pipe connection, and a controllable valve-outlet at bottom of each filter-tube.

8. In a filtering apparatus, the combination with a porous filtering-tube arranged in combination with other like filter-tubes, and means for discharging filtered water through a fitting secured to the bottom of the filter-casing, said fitting being adapted to receive the filter-tube from the inside of the casing, and also adapted to discharge into one main outlet, and means for brushing said filter-tube from the top of the filter-casing without disturbing any pipe connection.

9. In a filtering apparatus, consisting of a series of independent filter-casings containing porous filtering-tubes, with means for discharging filtered water from the bottom of said casings into one main connected with a receptacle for filtered water for reverse washing, and a waste-outlet at the bottom of the filter-casings, and a controllable valve for each filter-tube whereby one or more tubes may be cut off and the balance remain in service, and means for brushing the filter-tubes from the top of the casings, substantially as shown.

10. In a self-cleaning filtering apparatus, consisting of a series of independent filter-casings containing porous filtering-tubes, with means for discharging filtered water from the bottom of said casings into one main connected with a receptacle for filtered water, and a waste-outlet at the bottom of the filter-casings, and means for removing the filter-tubes from the top of the casings, substantially as shown.

In testimony whereof I sign this specification in the presence of two witnesses.

JUNIUS A. BOWDEN.

Witnesses:
MARION A. REEVE,
FRANCES CLOUGH.