(No Model.) 3 Sheets—Sheet 1.

B. S. CHURCH.

PROCESS OF AND APPARATUS FOR FILTERING.

No. 560,777. Patented May 26, 1896.

FIG. 1.

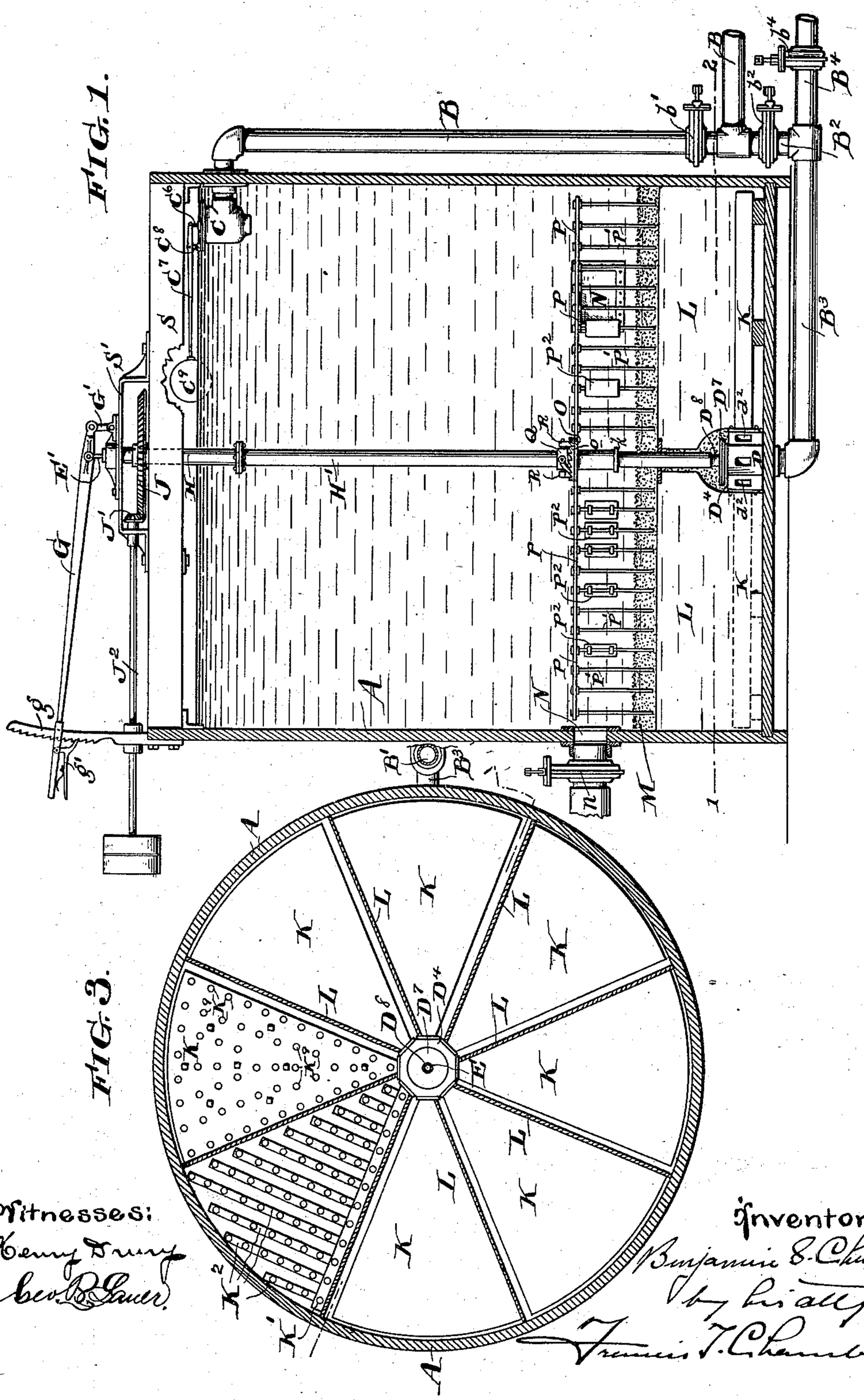

FIG. 3.

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Geo. B. Sauer.

Inventor:
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by his atty.
Francis T. Chambers

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FIG. 2.

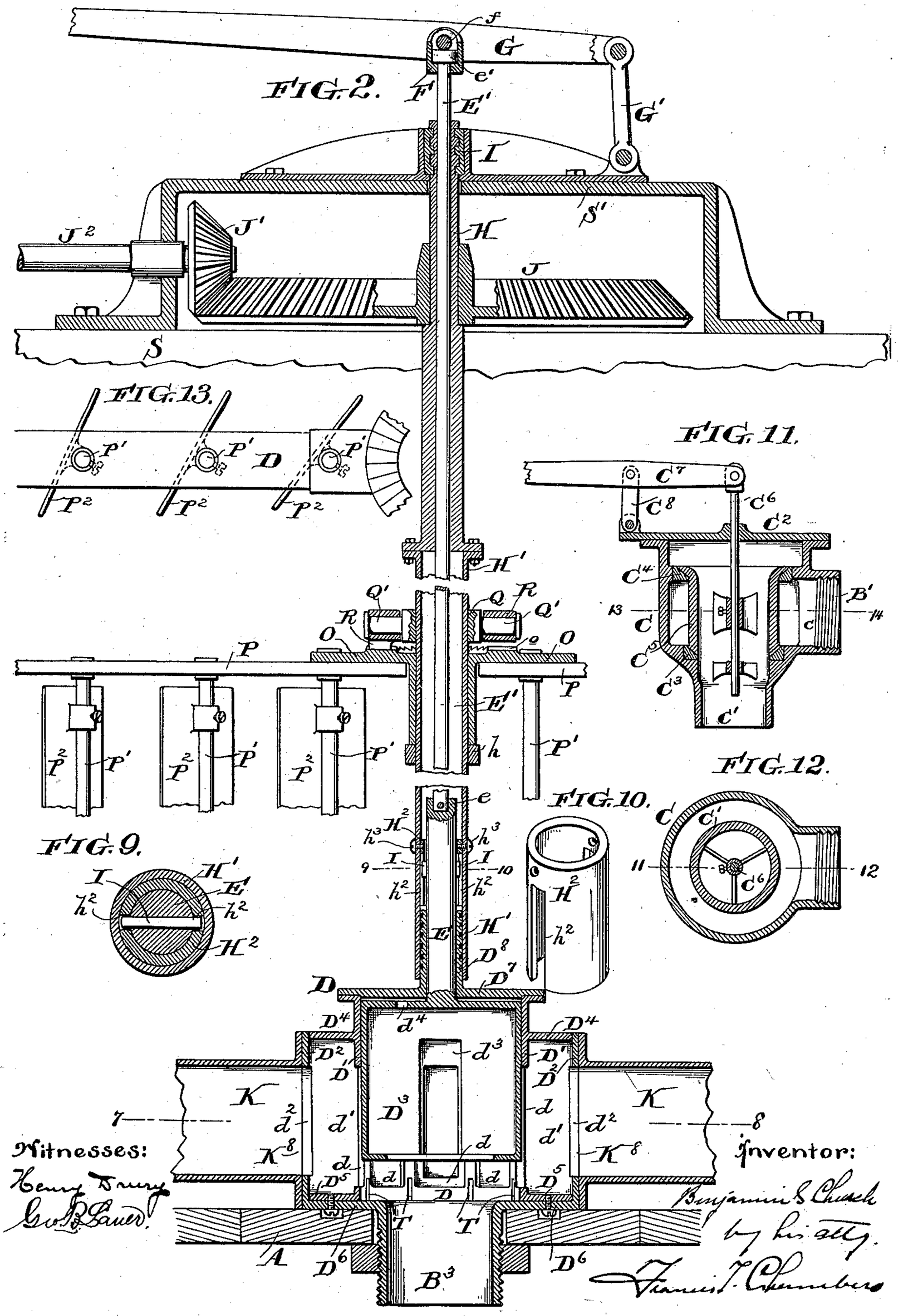

FIG. 13.

FIG. 11.

FIG. 12.

FIG. 10.

FIG. 9.

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FIG. 8.

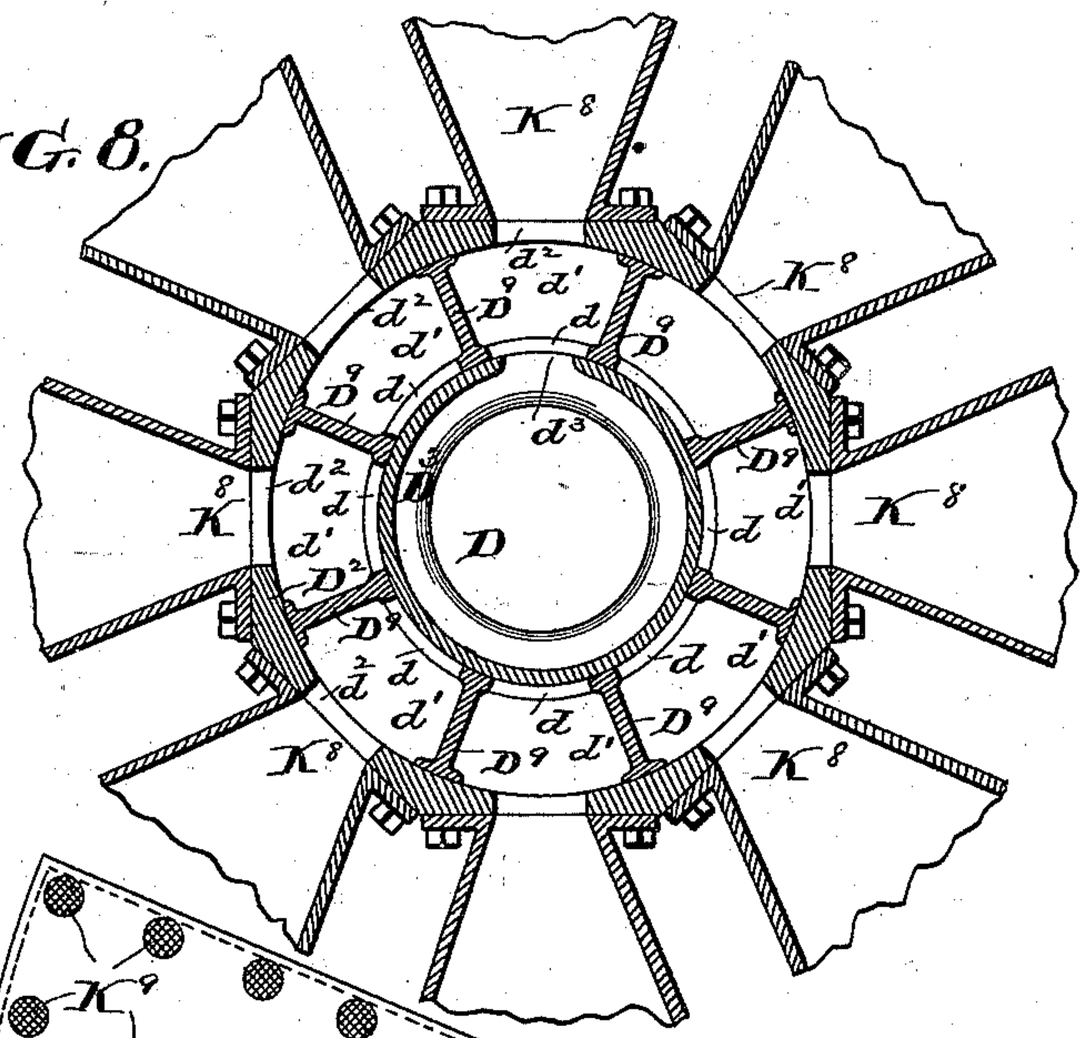


FIG. 4.

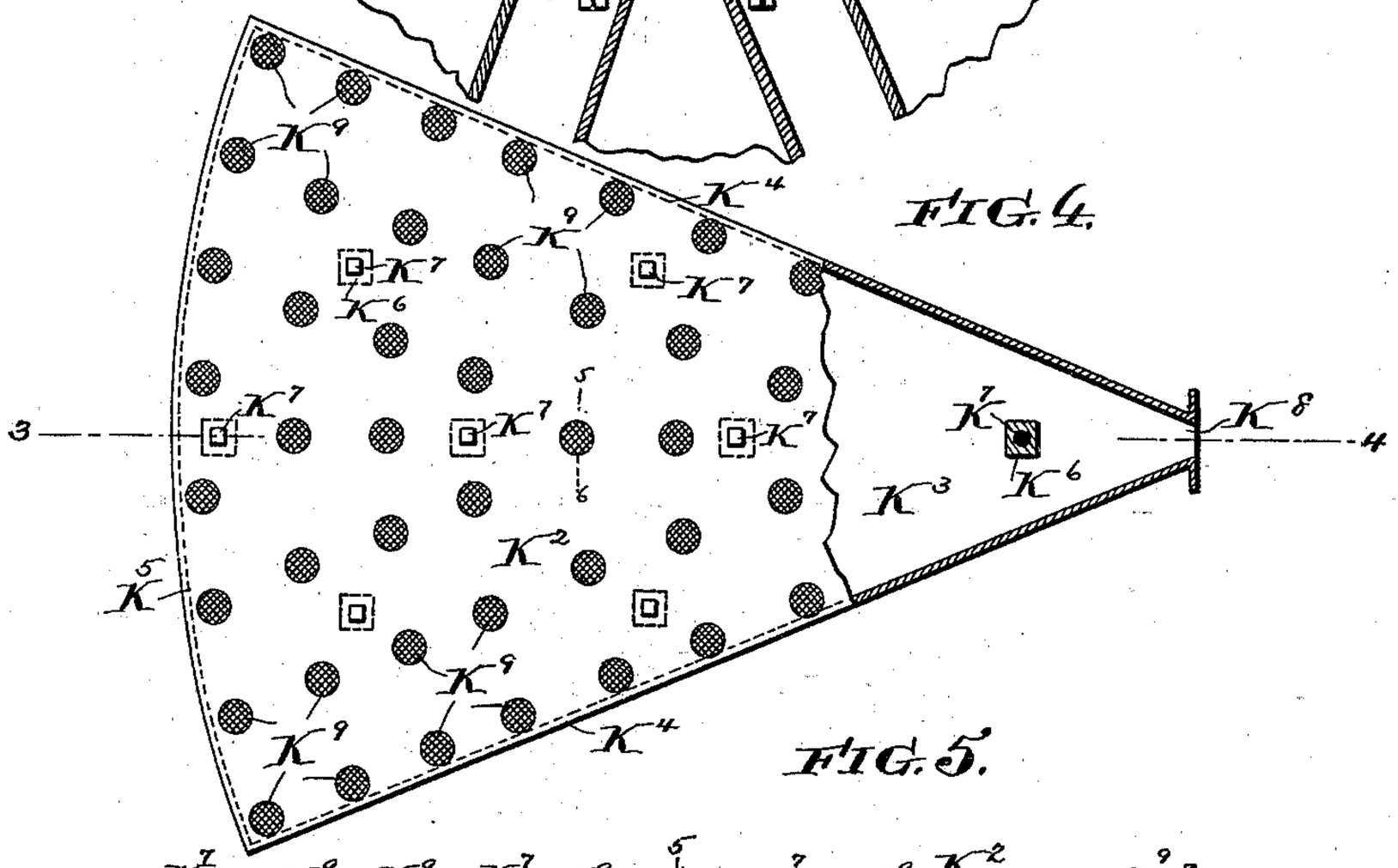


FIG. 5.

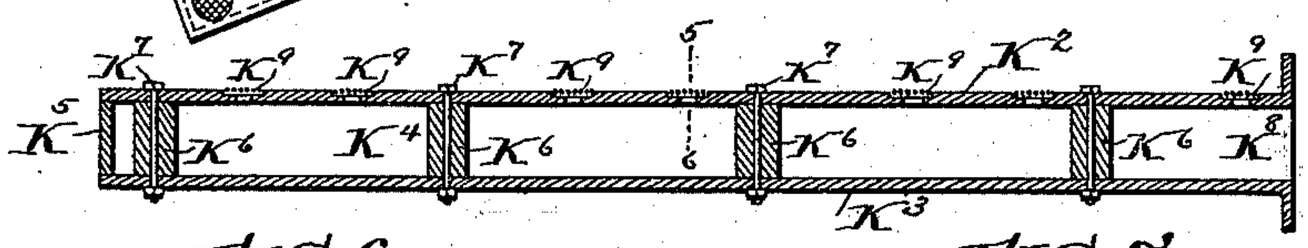


FIG. 6.

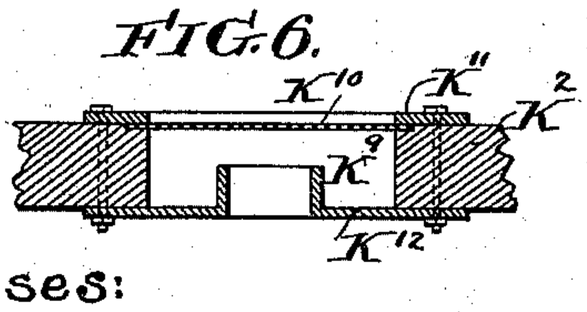
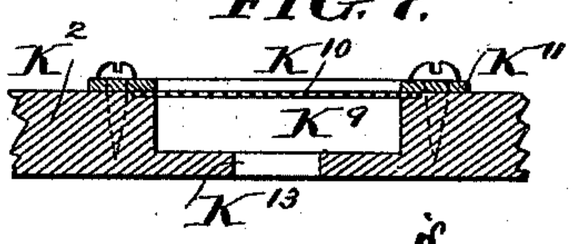


FIG. 7.



Witnesses:
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UNITED STATES PATENT OFFICE.

BENJAMIN S. CHURCH, OF NEW YORK, N. Y.

PROCESS OF AND APPARATUS FOR FILTERING.

SPECIFICATION forming part of Letters Patent No. 560,777, dated May 26, 1896.

Application filed November 20, 1891. Serial No. 412,528. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN S. CHURCH, of the city and county of New York, State of New York, have invented a certain new and useful Process of and Apparatus for Filtering, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to the construction and operation of filters, and principally, though not exclusively, to the cleansing of filters by the reversal of the current of water through the filtering-bed. Filters have heretofore been constructed in which reversed currents of water were made to pass up through the filtering-bed for the purpose of cleansing it and in which this reversed current was passed through but a portion of the filter-bed at a time, the rest of the bed remaining substantially unaffected until reached in turn by the ascending current, which was directed into one section of the bed after another. I have discovered that a much more effectual cleansing of the bed can be accomplished by directing a substantially uniform current of water upward through all of its parts and at the same time directing a current of greater intensity and volume through different sections of the bed *seriatim;* and this method of cleansing the filters forms an important part of my invention. I have also devised mechanical devices especially adapted for my new method and certain other improvements in the construction of the filters and its parts, all of which will be best described in connection with the drawings in which they are illustrated, and in which—

Figure 1 is a vertical section through the center of a filter-tank provided with my improved devices; Fig. 2, a sectional view, on a larger scale, showing the details of construction of the central valve-actuating rods and stirrers; Fig. 3, a plan view of the filter, taken on the section-line 1 2 of Fig. 1; Fig. 4, an enlarged plan view of one of the divisional segments constructed in the manner in which I prefer to construct them. Fig. 5 is a cross-section on the line 3 4 of Fig. 4. Figs. 6 and 7 indicate cross-sections taken, for instance, on the line 5 6 of Fig. 5, illustrating alternative constructions of the nozzles or perforations in the top of the divisional segments. Fig. 8 is a cross-sectional view of the valve, taken on the line 7 8 of Fig. 2. Fig. 9 is a cross-section on the line 9 10 of Fig. 2. Fig. 10 is a perspective view of a slotted sleeve, which is a detail of the construction shown. Fig. 11 is a cross-sectional view through the admission-valve on the line 11 12 of Fig. 12. Fig. 12 is a cross-sectional view of the valve on the line 13 14 of Fig. 11, and Fig. 13 is a plan view of one of the stirring-arms illustrated in elevation in Figs. 1 and 2.

A is the filtering-tank; B, the water-supply pipe, having a branch B′, which enters the top of the filter and, as shown, terminates in the automatic admission-valve C. Also connected with the supply-pipe B is the pipe B^2, from which leads the pipe B^3, which enters the bottom of the filter, connecting with the interior of the valve-chamber D.

B^4 is the delivery-pipe connecting with pipe B^3, and b', b^2, and b^4 valves situated, respectively, in the pipes B′, B^2, and B^4.

D is a valve-casing which, as shown, is of cylindrical form and connects at the bottom with the pipe B^3. Through the walls of the casing D are formed a series of apertures or openings d equal in number to the number of divisional sections into which the receiving and discharge apparatus is divided. These apertures are of considerable vertical height. On the outside of the casing D and preferably cast integral with it are the flanges D^4 and D^5 and the dividing-ribs D^9 D^9, &c., against the outer edges of which fits the exterior casing D^2. The ribs D^9 are equal in number to the apertures d, forming around the box D, in connection with the outer casing D^2, a series of chambers d', and into each of these chambers opens an aperture d^2, formed in the periphery of the casing D^2.

D^3 is a valve which fits neatly in the cylindrical casing D, but so as to have a vertical motion within the casing as well as the capacity to rotate therein. The valve D^3 consists of a cylinder having an opening at its bottom and an elongated aperture formed in its side, as indicated at d^3, though more than one aperture may be provided if found desirable. It is evident that the valve D^3 will close or partially close, according to its vertical position in casing D, the apertures d,

except at that aperture or apertures which register with the aperture d^3. By raising and lowering the valve D^3 the apertures d can be uniformly opened to any desired degree, while by rotating the valve the apertures are brought *seriatim* to register with the aperture d^3, through which they can receive a greater supply of water than they could through the portions which lie beneath the bottom of the valve D^3. I prefer to so construct the valve and casing that the valve D^3 can never entirely close the series of apertures d, and for this purpose I have indicated a series of stops T T, &c., which prevent the valve from being pushed downward below a determined point. The described motions may be given to the valve D^3 by any convenient mechanism, though I believe the mechanism shown and which I am about to describe will be found thoroughly well adapted for the purpose. Before describing the actuating mechanism I will call attention to the fact that D^7 indicates the top of the valve-box D, and D^8 a hollow projecting boss extending upward from the center of this cover, this construction of the valve-cover being especially designed for use with the mechanism I am about to describe.

E E′ is a rod extending from the top of the valve D^3 to above the top of the tank A. As shown, it consists of a portion E, formed integral with the valve D^3 and extending up through the hollow boss D^8, and a portion E′, attached to the portion E by a pin *e*. At the top of the rod E E′ is formed or attached a collar *e′*, which rests in a stirrup F, pivoted on a lever G, which is fulcrumed on the link G′ and, as shown, has at its end a spring-pawl *g′* working in a ratchet-rack G^2, and for the purpose of holding the lever G in any desired position. By moving this lever G, and through it the rod E E′, the valve D^3 is raised or lowered at will and to any desired extent.

H H′ is a hollow shaft, through which the rod E′ passes and which is suspended in the split box I, which, like the link G′, is secured on a casting S′, which, in turn, is supported by braces S, extending across the top of the tank. The hollow shaft is conveniently made in two parts, as shown, and is attached to the rod E E′ in such a way as to cause said rod to rotate with it while not interfering with its independent vertical motion. This attachment, as shown in the drawings, is made as follows: A sleeve H^2 is secured inside of the portion H′ of the hollow shaft by means of pins h^3 h^3. The lower part of the sleeve H^2 is slotted, as shown at h^2, and into these slots project the ends of a pin I, which extends through the portion E of the central shaft. The sleeve H^2 of course turns with the hollow rod H′ and by engaging the ends of the pin I causes the rod E and the valve D^3, attached to it, to rotate. As shown, the lower end of the hollow shaft H′ extends over the hollow boss D^8, and a water-packing, as indicated, should be provided to exclude water and more particularly sand from the inside of the hollow shaft.

J is a miter-wheel secured on the upper portion H of the hollow shaft H H′, and J′ a driving-gear made of miter form to properly engage the wheel J and connected with the driving-shaft J^2, which may be actuated by any convenient mechanism and in either direction. It is evident, of course, that the revolution of the shaft causing the valve D^3 to revolve with it will cause the aperture d^3 to register in turn with each of the apertures d. Connected with the valve-casing are a series of receiving and delivering sectors K K K, &c., one of which registers with each of the apertures d^2 in the casing D^2. Preferably these are constructed as indicated in Figs. 4, 5, and 6, consisting of a sector-shaped box connecting with one of the valve-apertures through a passage K^8 and having on its upper side a series of perforations K^9, each covered by a screen K^{10}, which may be of perforated sheet metal, woven wire, &c., and which is clamped to the sector conveniently by a ring K^{11}. I consider it best to make these boxes of wood, in which case they would consist of the sides K^4 K^4 and K^5, the top K^2, and the bottom K^3, the top and bottom being secured together by bolts K^7 and prevented from collapsing by a series of properly-distributed struts or supports K^6, the bolts, as in the construction shown, passing through the supports. It is advisable that the exit-passage from the inside of the box should be somewhat smaller than the opening covered by the screen K^{10}. This may be accomplished either by boring the hole, as indicated at K^{13}, or by the use of a metal plate, as indicated at K^{12}.

While I prefer to use the sector-boxes above described, an arrangement of pipes, as indicated at K′, Fig. 3, may conveniently replace them. In this arrangement a pipe *k′* is connected with the aperture d^2, while from the side of pipe *k′* projects a series of perforated pipes k^2, formed so as to fill up the desired segment in the bottom of the tank

Passing next to the stirring apparatus, O is a hub which is journaled on the hollow shaft H′, resting on a collar *h*. From the hub O extends one or more horizontal arms P, from which depend a series of stirring-fingers P′ P′, &c.

P^2 indicates adjustable blades secured on the upper ends of the fingers P′ in such a way that when the arms P revolve the blades will cause the water to move outward toward the sides of the tank, so that the dirty water will not remain in the center of the tank, but will be thrust out toward the sides, from which it is taken off through a series of outlet-openings N, controlled by valves *n*. The stirring apparatus is made independent of the shaft H H′ and is to be operatively connected with the said shaft at proper intervals. This connection may be made by any convenient clutch, by which the attachment

and its connection with the stirring apparatus will be within the control of the operator. As shown, the following simple device is used—that is to say, a ratchet *o* is formed on the upper face of the hub O and one or more pawls R pivoted to projecting pins Q, extending out from the shaft H′. The arrangement here is such that when the shaft H′ is turned in one direction it will not revolve the stirring-arms, but when reversed and turned in the other direction it will, by means of the pawl and ratchet described, engage the arms and cause them to revolve with the shaft.

The last feature of the apparatus consists of the admission-valve C, which is secured on the end of the pipe B′. This valve consists of a casing C, connected by side passage *c* with the supply-pipe B′ and having an exit-passage *c*′ in its bottom. Above and below the passage *c* are formed the valve-seats C^4 and C^3, upon which fits a cylindrical valve C^5, which is operated by means of a spindle C^6, passing through the cover C^2 of the valve-casing and connected with a lever C^7, which is fulcrumed on the link C^8 and provided with a ball-float C^9 on its end. It will be seen that the valve constructed in the way described will be perfectly balanced, so that there will be little or no work required in raising and lowering it. In this way I provide against the danger heretofore commonly incident to float-valves of having the valve stick, so that there is either an overflow of the tank or an insufficient supply of water.

L L L, &c., indicate a series of projections extending up from the segmental divisions of the distributing system, the function of which is to prevent the disturbance incident to the passage of a considerable body of water through one section of the bed from being connected to the adjacent sections.

The operation of my improved filter is as follows: When it is desired to operate the filter, the rod E E′ is raised, so that the valve B^3 will be drawn to or nearly to its uppermost position, the valve *b*′ is opened, the valve b^2 closed, and the valve b^4 opened. The valves *n* in the conduits N are also closed. Water then passes through the pipe B′ into the top of the filter through the valve C, which will remain open until the level of water in the tank, acting on the ball C^9 and through the lever C^7 and the rod C^6, causes the valve C^5 to seat itself on its double seats. The water in the tank will then pass down through the bed of filtering material, (indicated at M,) and thence through the perforations K^9 to the inside of the divisional sector-boxes, from which it passes through the passage K^8 and through the passages d^2 into the chambers *d*′, and thence through the open portion of the aperture *d* to the inside of the casing D, whence it passes through the pipes B^3 and B^4 to the place of use or storage. When it is desired to cleanse the filter, the valves *b*′ and b^4 are closed, the valve b^2 opened, and the valves *n* also opened. Whatever water is in the tank will then run out through the passages N, which are situated close to the surface of the filter-bed. The water from the supply-pipe B will pass through the pipes B^2 and B^3 into the valve-casing D and through the apertures *d*, the chambers *d*′, the apertures d^2, and the divisional boxes K K, &c., into the bottom of the filter-bed, passing up through which it escapes through the passages N N. While the water is thus passing I depress the rod E E′, causing the valve D^3 to move downward so as to partly close the aperture *d*, the point being fixed in the construction by the stops T. I then rotate the shaft H H′ through the mechanism described, causing the valve D^3 to rotate in the casing D. It will be seen that a constant supply of water is passing through the uncovered portions of the apertures *d* to each of the sector-boxes, while, as the valve revolves, each sector-box receives in turn a greatly-accelerated supply of water as its particular aperture *d* registers with the aperture d^3 of the valve. In this way a constant supply of wash-water is passing through the whole of the filter-bed, while each portion in turn is subjected to a rapid and strong washing action, which I have found to be best adapted for the complete and rapid cleansing of the filter. By this method of washing the filter-bed the whole mass is constantly being washed and stirred up, each section at intervals is subjected to a more violent stirring up by wash-water, and the result is a wave-like action around the filter, which gives the very best cleansing results. After the bed has been well washed I throw the hub O into operative connection with the rotating shaft, causing the stirring-fingers to agitate the surface of the filter-bed, this agitation taking place while water is still passing upward through the bed, but preferably after the function of the valve D^3 in supplying a rapid current to each of the segments is performed. Thus in the construction shown the valve D^3 is drawn up, so as to open the whole series of apertures *d* to their fullest extent, and then the shaft H H′ rotated in the opposite direction, so as to engage, by means of the pawls R, the hub O, which has not been in operation during the first part of the washing action. A uniform supply of water is thus made to pass up through all parts of the filters while the stirrers are in action.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The described method of cleansing a filter-bed which consists in directing an upward current of water through all portions of the bed and at the same time directing a current of greater intensity through the different sections of the bed in series.

2. In a filter, a valve-box D situated at the bottom thereof and connected with the supply and delivery conduits as described having perforations *d d*, &c., through its sides, a series of sectional collectors as K K, &c., together making up the bottom of the filter

and each connecting with box D by one of its perforations and a rotatable and longitudinally-movable valve D^3 working inside box D and having a side passage d^3 adapted to register with perforations *d d*, &c., in turn, said valve being also adapted to cover the perforations *d* or leave them wholly or partly uncovered as described.

3. The valve-box consisting of the inner casing D having openings *d d*, &c., flanges D^4 and D^5; and the outwardly-extending divisional webs D^9 in combination with the outer casing D^2 having peripheral openings d^2 d^2, &c., and the rotatable and longitudinally-movable valve D^3 having a slot d^3 in its side adapted to register with openings *d*.

4. The combination with valve D^3 of the hollow suspended shaft H H′, means for securing the valve to the said shaft so that they will rotate together while leaving the valve free to move longitudinally, means for rotating shaft H H′, a shaft E′ attached to the valve and situated in the hollow shaft H H′ and means for moving said shaft E′ longitudinally.

5. In combination with the valve-box having the projecting boss D^8 and containing the valve D^3, the hollow suspended and rotatable shaft H H′ extending over the boss D^8 and operatively connected with the valve as described and the rod E′ extending through and longitudinally movable in shaft H H′ and also operatively connected with valve D^3.

6. In a filter, the combination with the valve-box having openings *d d* and containing the valve D^3 the hollow suspended and rotatable shaft H H′ operatively connected with the valve as described; the rod E′ extending through and longitudinally movable in shaft H H′ and also operatively connected with valve D^3; the hub O supported on shaft H H′ as described, and means for intermittently connecting the hub O and shaft H H′.

7. In combination with the valve-box containing the valve D^3 the hollow suspended and rotatable shaft H H′ operatively connected with the valve as described; the rod E′ extending through and longitudinally movable in shaft H H′ and also operatively connected with valve D^3; the hub O supported on shaft H H′ as described and having a ratchet *o* on its face; a pawl R secured to shaft H H′ so that it will engage said ratchet in one direction; and stirrers P P′ secured to hub O, all substantially as shown and described.

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