(No Model.) 4 Sheets—Sheet 1.

G. H. SELLERS.

FILTER.

No. 564,943. Patented July 28, 1896.

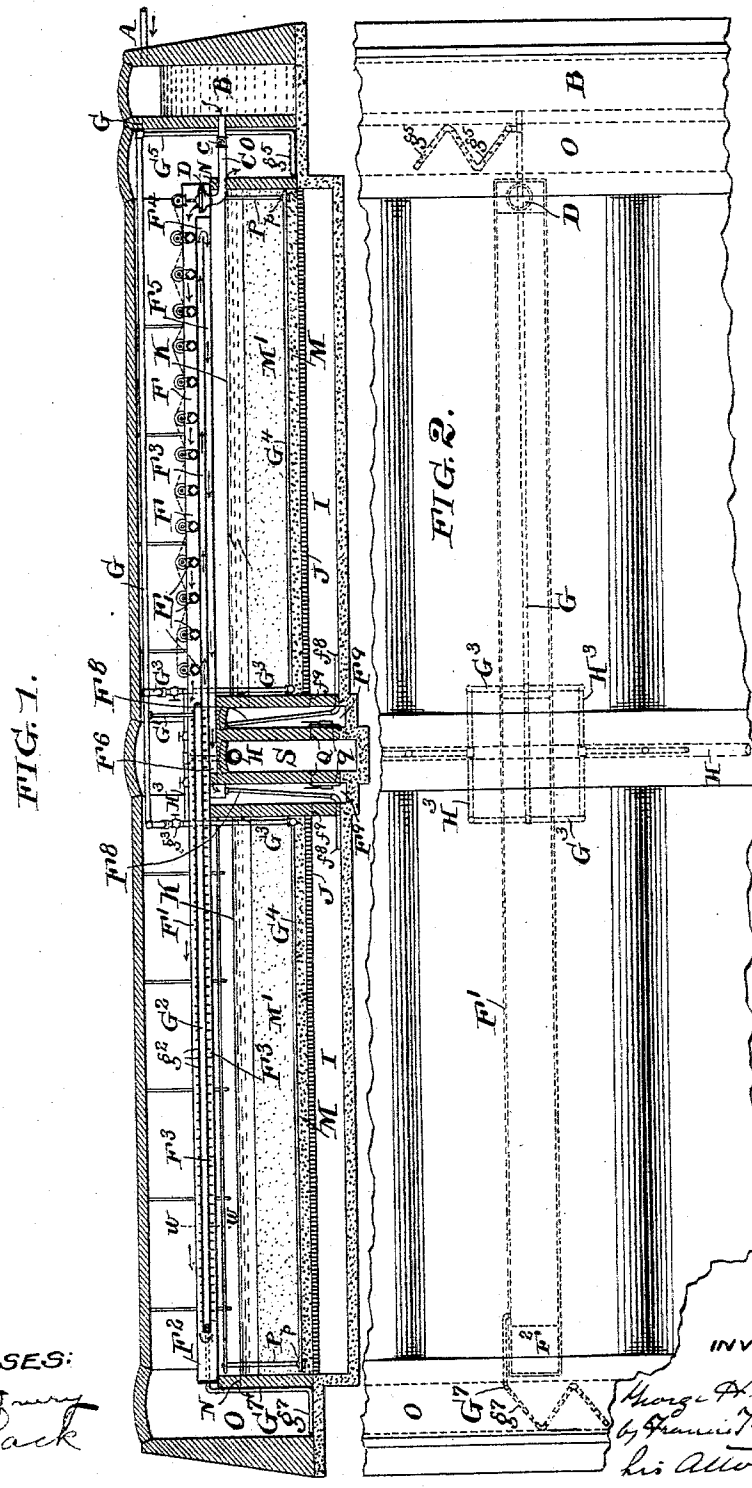


FIG. 1.

FIG. 2.

WITNESSES:

H. J. Pack

INVENTOR:

George H. Sellers

by Francis T. Chambers

his Attorney

(No Model.) 4 Sheets—Sheet 2.

G. H. SELLERS.

FILTER.

No. 564,943. Patented July 28, 1896.

FIG. 3.

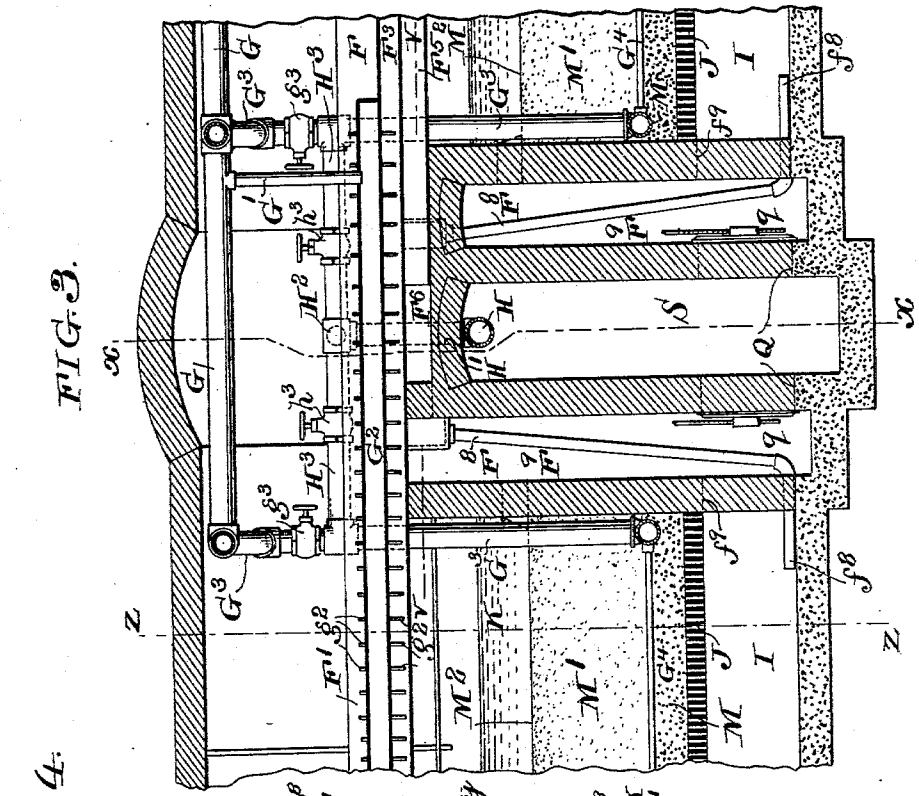
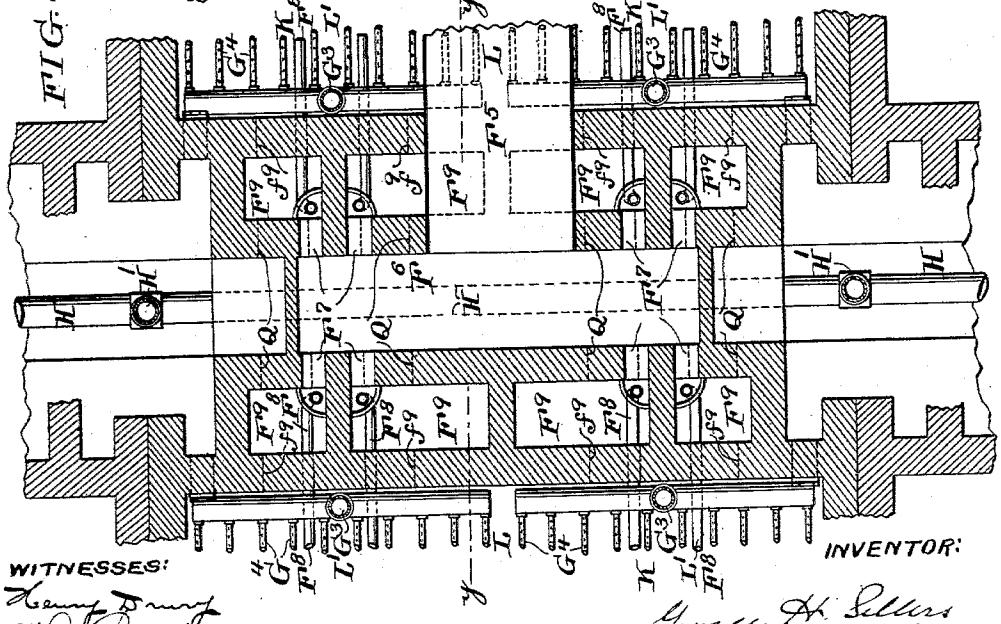


FIG. 4.



WITNESSES:

Henry Bruce

A. J. Pack

INVENTOR:

George H. Sellers

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(No Model.) 4 Sheets—Sheet 3.

G. H. SELLERS.

FILTER.

No. 564,943. Patented July 28, 1896.

FIG. 5.

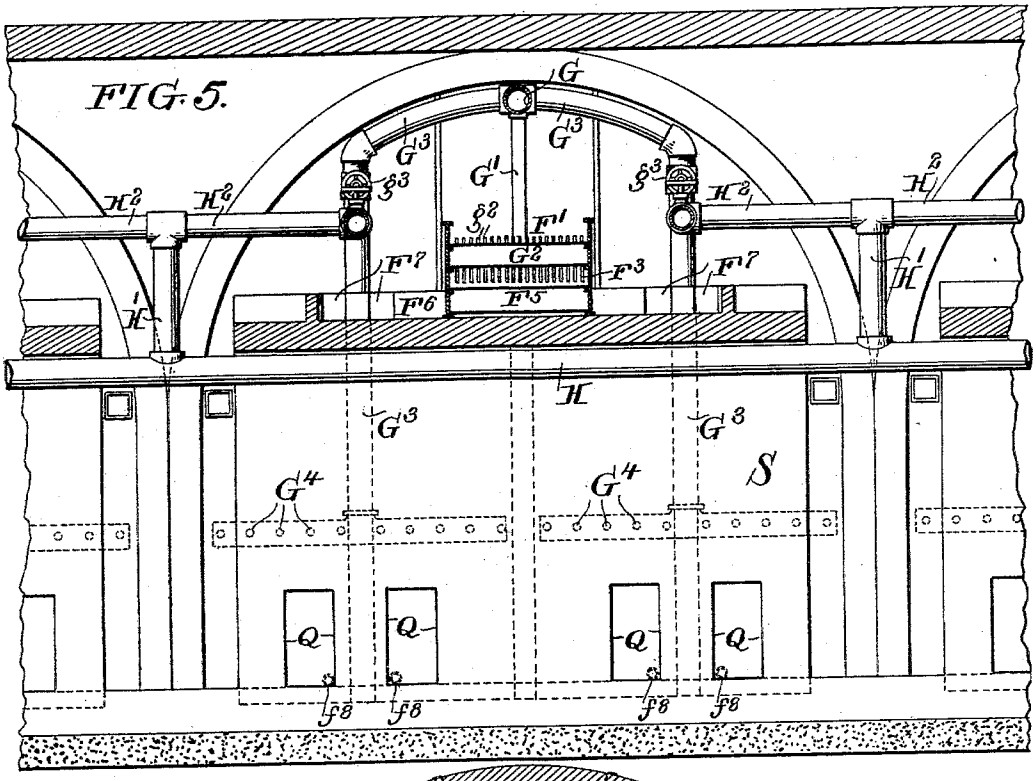
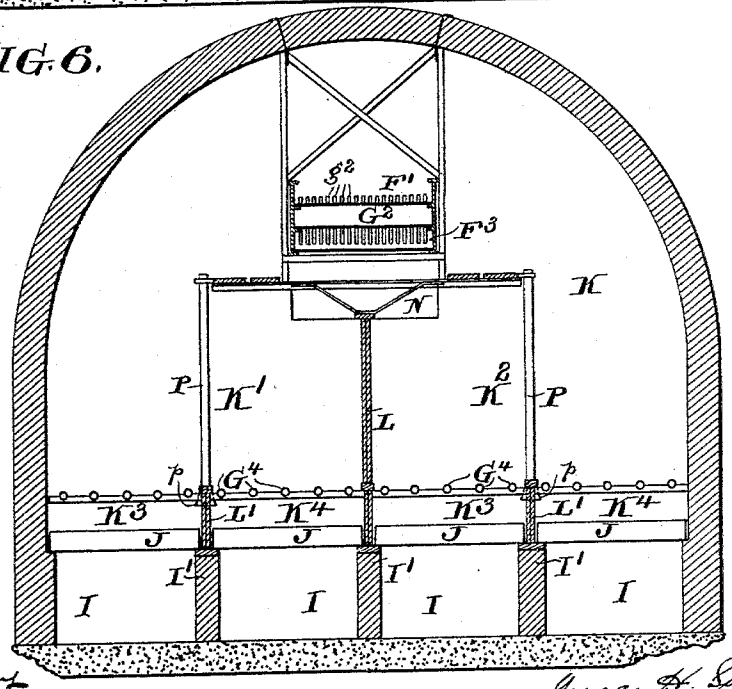


FIG. 6.



WITNESSES:

Henry Dunn

A. J. Pack

INVENTOR:

George H. Sellers

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(No Model.) 4 Sheets—Sheet 4.

G. H. SELLERS.

FILTER.

No. 564,943. Patented July 28, 1896.

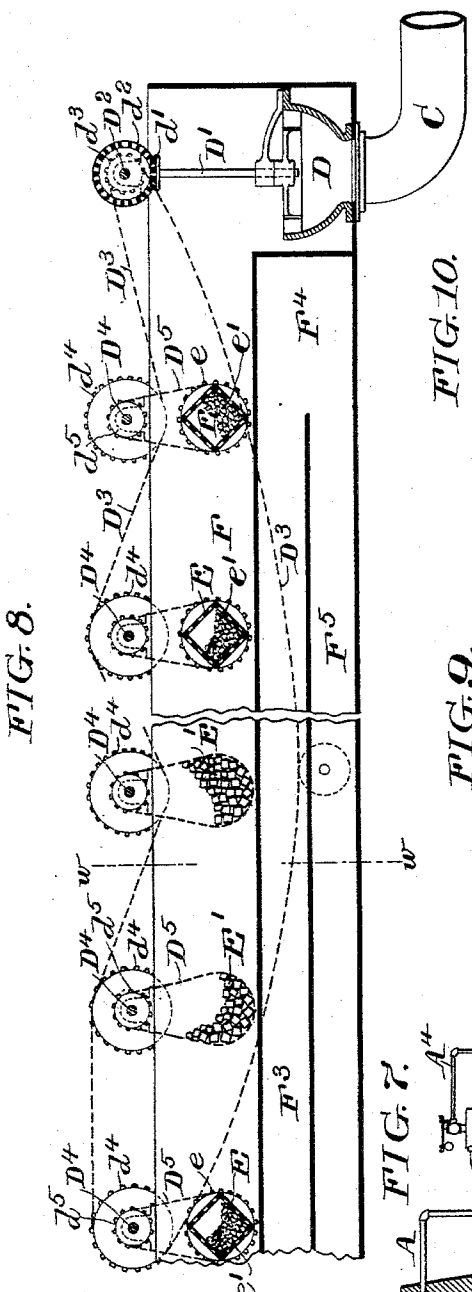

FIG. 8.

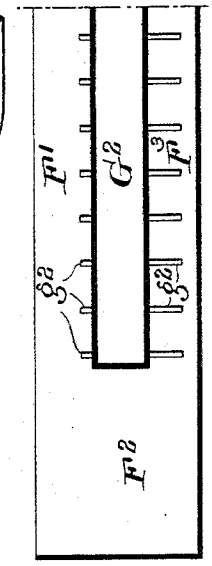

FIG. 10.

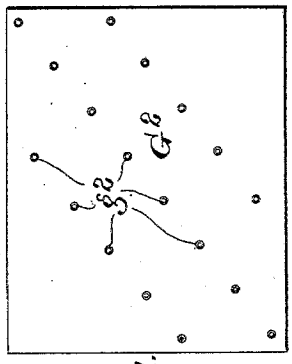

FIG. 11.

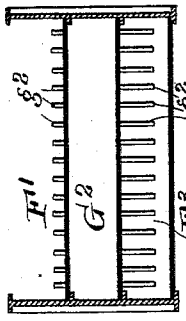

FIG. 9.

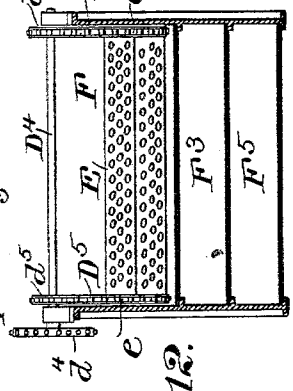

FIG. 12.

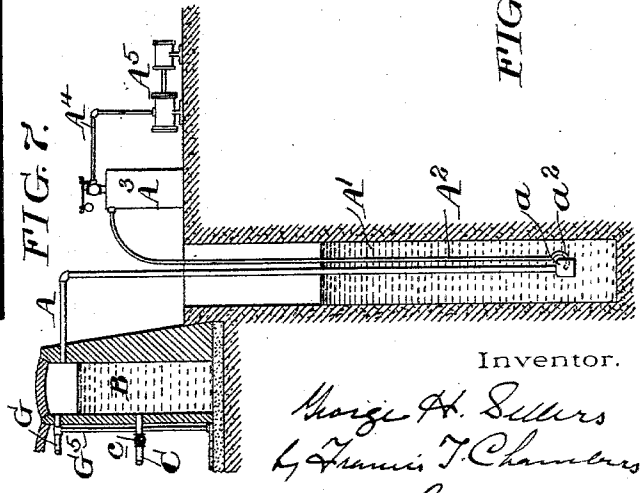

FIG. 7.

Witnesses.

Henry Dewey

A. J. Pack

Inventor.

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his Attorney.

UNITED STATES PATENT OFFICE.

GEORGE H. SELLERS, OF WILMINGTON, DELAWARE.

FILTER.

SPECIFICATION forming part of Letters Patent No. 564,943, dated July 28, 1896.

Application filed September 19, 1895. Serial No. 562,973. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. SELLERS, a citizen of the United States, residing in Wilmington, in the county of New Castle, in the State of Delaware, have invented a certain new and useful Improvement in Filters, of which the following specification is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to the construction of filters, and particularly to that class of filters in which the water passes upward through the filter-bed; and the object of my invention is to provide an efficient filter of this description, and particularly one having improved means for the cleansing and washing of the filtering material.

I have shown my improved filter in the drawings which form a part of this specification in connection with appliances for imparting a coagulant to the water previous to filtration, and also with appliances for effecting a thorough aerification of the water both before and after filtration and before and after the water is impregnated with the coagulant. This device, however, for effecting the purification of the water or bringing it to proper condition for effective filtration forms the subject-matter of an application filed herewith, bearing the serial number 562,972, and of an application filed September 16, 1895, Serial No. 562,630, as a division of my prior application, filed May 29, 1893, Serial No. 475,843, upon which last-mentioned application my present invention is in part an improvement.

The nature of my improvements will be best understood as described in connection with the drawings, in which they are illustrated, and in which—

Figure 1 is a longitudinal section through a filter constructed in accordance with my invention, Fig. 2 being a plan view of a portion of such a filter; Fig. 3, an enlarged sectional view similar to that shown in Fig. 1 of the central portion of the filter-plant, said section being also indicated as taken on the section-line *y y* of Fig. 4, while Fig. 4 is a plan view taken on the section-line *v v* of Fig. 3. Fig. 5 is a longitudinal section taken on the section-line *x x* of Fig. 3; Fig. 6, a transverse section on the line *z z* of Fig. 3; Fig. 7, an elevation, partly in section, of the mechanism which I prefer to use for forcing the water into the reservoir, from which I take it for purification. Fig. 8 is an enlarged view of the water-channel shown at the upper right-hand corner of Fig. 1. Fig. 9 is a transverse section through the water and air conduits, taken, for instance, on the line *w w* of Fig. 1. Fig. 10 is an enlarged sectional view of the water and air conduits, as shown at the upper left-hand corner of Fig. 1; Fig. 11, a view of the top of the portion of the air-box shown in Fig. 10, and Fig. 12 a side view taken on the section-line *u u* of Fig. 8.

A is the pipe through which water, and, preferably, air as well, is introduced into the reservoir B. As shown, this pipe leads to the bottom of a well or reservoir A′ and is provided with a flared mouthpiece *a*, into which leads the turned-up end a^2 of a pipe A^2, which leads in turn from a compressed-air reservoir A^3, supplied with compressed air by a pipe A^4, leading from a compressor A^5. This is a familiar type of air-lift pump, and will force both water and air under pressure into the reservoir B.

C is a water-conduit leading from below the water-level of the chamber B into the receiving end F of a water-conduit.

D is a turbine water-wheel placed in the end of the pipe C and actuated by the water issuing from it, which gives motion to a vertical shaft D′, having attached to it a miter-wheel *d′*, which engages a miter-wheel d^2, secured to a shaft D^2, said shaft also carrying a sprocket-wheel d^3, which by means of a sprocket-chain D^3 gives motion to a series of transverse shafts D^4, each such shaft having a sprocket-wheel d^4 secured to it, over which the chain D^3 passes, as shown. The water-channel into which the conduit C delivers the water from the reservoir consists of a portion F, made comparatively deep, as shown, and continuing, as indicated at F′, over the top of an air-box G^2, over the end of which it passes, as indicated at F^2, and then returns, as indicated at F^3, beneath the air-box and beneath the portion F, turning again downward at F^4 and continuing through the portion F^5 to a distributing-chamber F^6.

Before passing to the description of the fil-

ter proper I will state that each shaft D^4 extending across the portion F of the water-conduit is provided with two or more chain-loops D^5, which are sustained upon and rotated by the shafts D^4, as indicated. There are sprocket-chains passing over sprocket-wheels d^5, and suspended in the lower loops of the chains are, as indicated at E E, rectangular boxes, the sides of which are filled with holes and which contain iron scrap or other coagulating material. At the end of the boxes are sprocket-wheels *e*, around which the chains D^5 pass and by which the boxes are made to rotate, keeping the scrap in constant agitation. As indicated at E', however, the boxes are omitted, and the chains pass directly around bundles of iron rods, the length of which is nearly the breadth of the channel F. The rods are kept in constant rotation and agitation by the rotating chains D^5. After passing through the portion F of the water-conduit where these coagulating devices are assembled, the water passes first above and then beneath the air-box G^2, which is supplied with air in the plan shown by a branch G', leading from a pipe G, which in turn leads from above the water-level of the reservoir B. The box G^2 is provided with a multiple series of pipes or openings, as indicated at g^2 g^2, leading to the bottoms of the conduit-sections F' and F^3, and by means of which air is forced into the water passing through these sections of the conduit.

It will be seen that by the devices which I have above described I not only thoroughly impregnate the water with air in the reservoir and before it passes to the reservoir, but also effect a most thorough aerification after the water has been impregnated with the coagulant in the conduit-section F and before it enters the filter. This thorough aerification I have found to be of the greatest value and importance in effecting a real purification of the water.

The water passes from the distributing-chamber F^6 through openings F^7 F^7, corresponding in number to the settling and supply chambers I, to which I preferably connect the distributing-chamber F^6 by means of pipes F^8, leading to the bottom of the chambers I and opening thereon, as indicated at f^8. My preference for the use of these pipe-conduits is based on the fact that they insure a gradual and quiet supply of water directly to the bottom of the settling-chambers, but under some conditions the pipes F^9 may be dispensed with, in which case the passages F^7 will open into the corresponding vertical chambers F^9, which open in turn into the chambers I through openings indicated at f^9. Those chambers F^9, communicating with the chambers, I prefer should be used in all cases, as they form, in effect, stand-pipes, and provide a proper head and pressure to the water to force it through the filter-bed.

I will here note that passages Q Q lead from each chamber I or from its connected chamber F^9 to a waste-water conduit S, these passages being normally closed by gates or valves *q*.

J J indicate gratings upon which the filter-bed is supported, and which gratings rest upon the walls I' I', separating the chambers I I, &c.

M M' indicates the material of the filter-bed, which may be made up in any desired way, the line of separation between the two parts indicated being the zone of deposit, so to speak, in which the greater part of the impurities are intercepted and held. M^2 indicates the top of the filter-bed above which the water is represented.

As shown, my filter is made up of two sections K, one situated on each side of the distributing-chamber F^6 and waste-water conduit S, and beneath each chamber K, I have shown four settling and supply chambers I.

L indicates a partition dividing the filter-bed into two sections and extending above the water-level of the filter, so as to form two compartments or sections K' and K^2. Each of these sections again are divided into subsections K^3 and K^4 by means of partitions L', which extend up from the walls I' to a point below the water-level of the filter, and preferably, as shown, to or about the level of the zone of deposit in the filter-bed.

It will be noticed that my filter may consist of any number of chambers K, three such, for instance, being indicated in Fig 5, but each constitutes practically a separate filter. Indeed this is true in a sense also of the sections K' and K^2, and while, for reasons which will be understood as I explain the operation of washing the filter, I prefer to divide each chamber-section K' and K^2 into two subsections K^3 and K^4 more of such subsections may be included in each chamber-section, if desired.

From the filter-chambers K the water passes through openings N into the pure-water reservoirs O, from which it can be drawn in any desired manner. I have found it desirable, however, to aerify the water in these chambers, so as to drive off any deleterious gases which the water may take up in the filter, and for this purpose I lead a pipe G^5 from the pipe G to the bottom of the chambers O, where it terminates in a perforated section, as indicated at g^5.

As shown, pipes G^3 G^3 lead from the air-pipe G down into the bed of the filter, where they connect with a series of transversely-extending perforated pipes G^4, lying preferably at about the zone of greatest deposit in the filter.

g^3 indicates valves by which the air supply is cut off at will from the perforated pipes G^4.

H indicates a supply-pipe for water under pressure from which I lead branches H', communicating at H^2 with branches H^3, provided with valves h^3 and communicating with the pipes G^3. By means of this connection water

under pressure can at will be introduced into the perforated pipes G^4, and thus I am enabled to force either air or water, or both air and water, into the filter-bed.

In washing the filter constructed in accordance with my invention I am enabled to wash one section or substation at a time. Thus, cutting off the supply of water to the settling chamber or chambers of any particular section, I open the corresponding gates *q*, whereupon the water accumulated above the filter will rush downward through the filter into the chamber I and thence to the waste-conduit S. While this is going on I can, and find it advantageous to do so, inject the pressure-water through the pipes G^6, effecting a stirring up of the sand at the very point where the washing is most required, and I also find it a decided advantage to inject air at this point, so that it will pass upwardly through the filter while the water is passing downward through the bed.

For the mode of use last mentioned it is important that the perforated pipes should be situated at or near the zone of deposit in the bed, because it is, in the first place, this part and the part above it which need the stirring action of the air, a stirring action which is peculiarly efficient, as the sand is simultaneously exposed to the action of water passing down and air passing up through it, and because, in the second place, air introduced near the bottom of the bed would not pass up, but would be sucked down by the descending body of water, a contingency which I avoid by flaring the perforated pipes sufficiently above the bottom of the bed, as described.

I am also enabled, as will be readily seen, to pass water up through one subsection while it is passing downward through the other subsection. Thus water may be passed upward through the subsection K^4 of Fig. 6 while the subsection K^3 is being washed. The filtered water passing upward through K^4 passes in turn downward through K^3, and in this way a more thorough washing can be effected than would be the case if I were to rely entirely upon the accumulated water above the bed, and at the same time I wash always with purified or filtered water.

I find it advisable to provide an escape for air held in the lower part of the filter-bed and which cannot escape freely through the wet upper layers when the filter is put in operation after washing, and this I do by providing a pipe P, leading above the water-level of the filter and opening at *p* at or below the zone of greatest deposit.

Having now described my invention and the manner in which it is to be used, I claim as new and desire to secure by Letters Patent—

1. An upward filter-bed having a settling and supply chamber beneath it, a waste-water conduit connected to the said chamber and means for supplying water to the top of the filter-bed above the settling and supply chamber in combination with a series of perforated pipes lying in the filter-bed at or near the zone of deposit, and a pressure air-pipe connected to said perforated pipes whereby water can be passed down through the bed to the settling and supply chamber at the same time that air is injected into and passes up through the bed.

2. An upward filter-bed having a settling and supply chamber beneath it, a waste-water conduit connected to said chamber and means for supplying water to the top of the filter-bed above the settling and supply chamber in combination with a series of perforated pipes lying in the filter-bed at or near the zone of deposit and pressure-water and air-pipes connected to said perforated pipes whereby water can be passed down through the bed to the settling and supply chamber at the same time that air is injected into and passes up through the bed and whereby also water can be injected into the body of the filtering material at will.

3. An upward filter-bed having its filtering-bed divided into sections K' K^2 by a partition or partitions L extending above the water-level, and each such section again subdivided by a partition or partitions L' extending from the bottom of the bed to a point below the water-level in combination with a series of settling and supply chambers I situated one beneath each subdivision of the bed, connections from a source of water supply to each chamber I and connections provided with a closing valve or gate from each chamber I to a waste-water conduit.

4. An upward filter-bed having its filtering-bed divided into sections K' K^2 by a partition or partitions L extending above the water-level, and each such section again subdivided by a partition or partitions L' extending from the bottom of the bed to a point below the water-level in combination with a series of settling and supply chambers I situated one beneath each subdivision of the bed, connections from a source of water supply to each chamber I, connections provided with a closing valve or gate from each chamber I to a waste-water conduit, a series of perforated pipes G^4 lying in each filter-bed and a connection from a pressure water-main to said perforated pipes.

5. An upward filter-bed having its filtering-bed divided into sections K' K^2 by a partition or partitions L extending above the water-level, and each such section again subdivided by a partition or partitions L' extending from the bottom of the bed to a point below the water-level in combination with a series of settling and supply chambers I situated one beneath each subdivision of the bed, connections from a source of water supply to each chamber I, connections provided with a closing valve or gate from each chamber I to a waste-water conduit, a series of perforated pipes G^4 lying in each filter-bed, a connection

from a pressure water-main to said perforated pipes and a connection from a pressure air-main to said pipes.

6. An upward filter-bed having its filtering-bed divided into sections K′ K² by a partition or partitions L extending above the water-level, and each such section again subdivided by a partition or partitions L′ extending from the bottom of the bed to a point below the water-level in combination with a series of settling and supply chambers I situated one beneath each subdivision of the bed, a chamber F⁹ connected to each chamber I and rising above the water-level of the filter, connections from a source of water supply to each chamber I, and connections provided with a closing valve or gate from each chamber I to a waste-water conduit.

7. An upward filter-bed having its filtering-bed divided into sections K′ K² by a partition or partitions L extending above the water-level and each such section again subdivided by a partition or partitions L′ extending from the bottom of the bed to a point below the water-level in combination with a series of settling and supply chambers I situated one beneath each subdivision of the bed, a chamber F⁹ connected to each chamber I and rising above the water-level of the filter, a water-supply conduit situated above the water-level of the filter, pipes leading from such conduit to the bottom of each chamber I and connections provided with a closing valve or gate from each chamber I to a waste-water conduit.

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