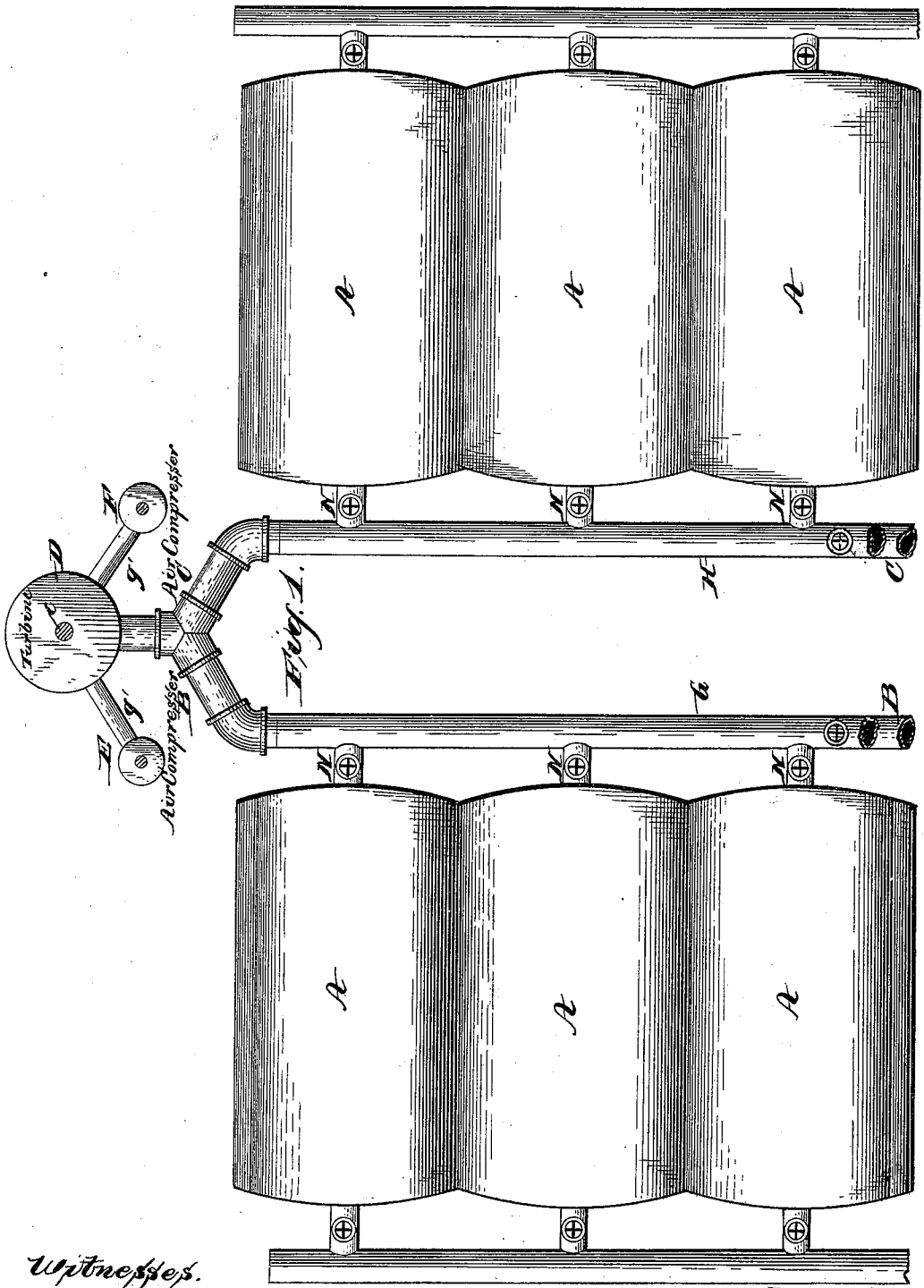
(No Model.) 4 Sheets—Sheet 1.

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FILTER.

No. 402,657. Patented May 7, 1889.



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(No Model.) 4 Sheets—Sheet 2.

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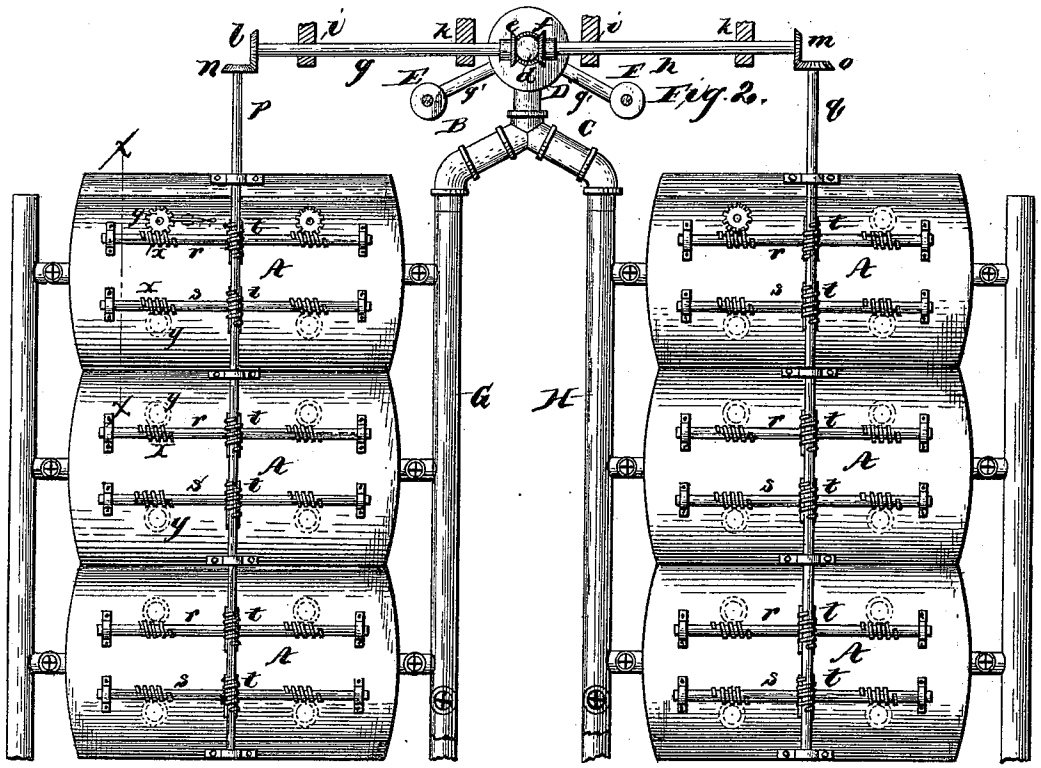


Fig. 2.

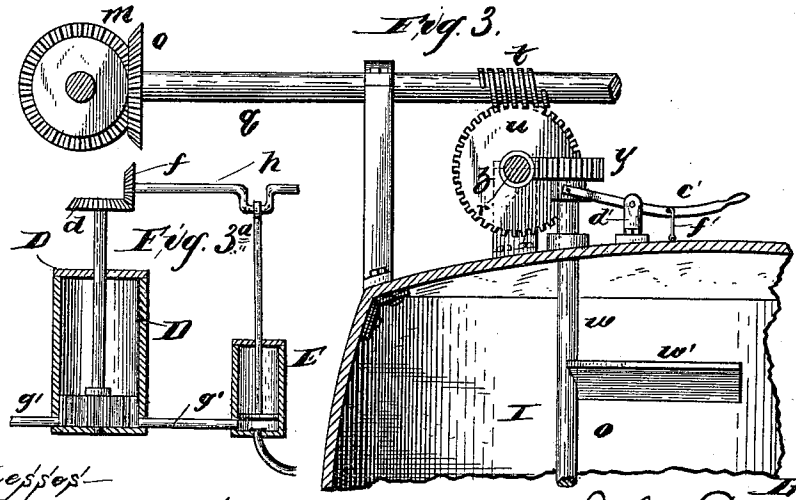


Fig. 3.

Fig. 3a.

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Fig. 4.

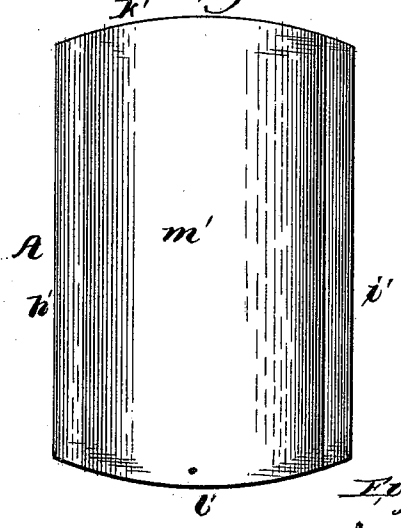


Fig. 5.

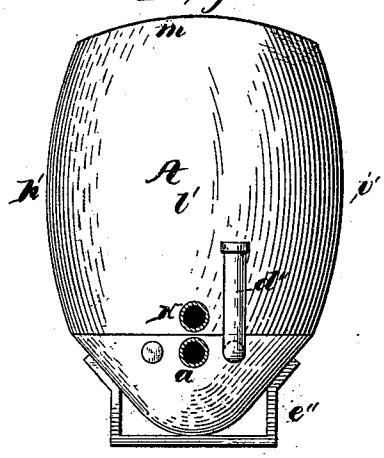


Fig. 6.

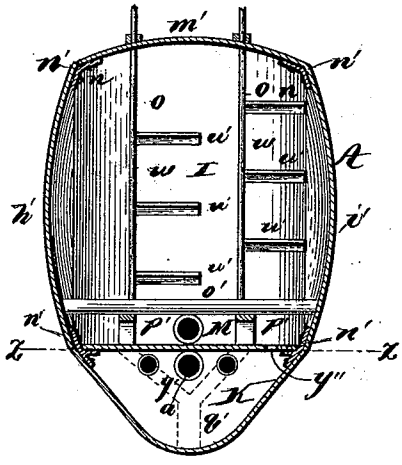


Fig. 7.

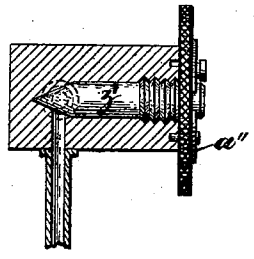


Fig. 8.

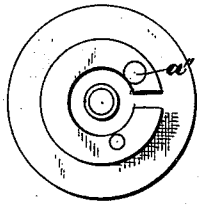
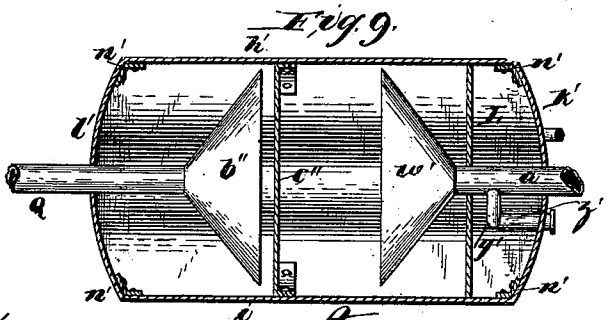


Fig. 9.



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(No Model.) 4 Sheets—Sheet 4.

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FILTER.

No. 402,657. Patented May 7, 1889.

Fig 10.

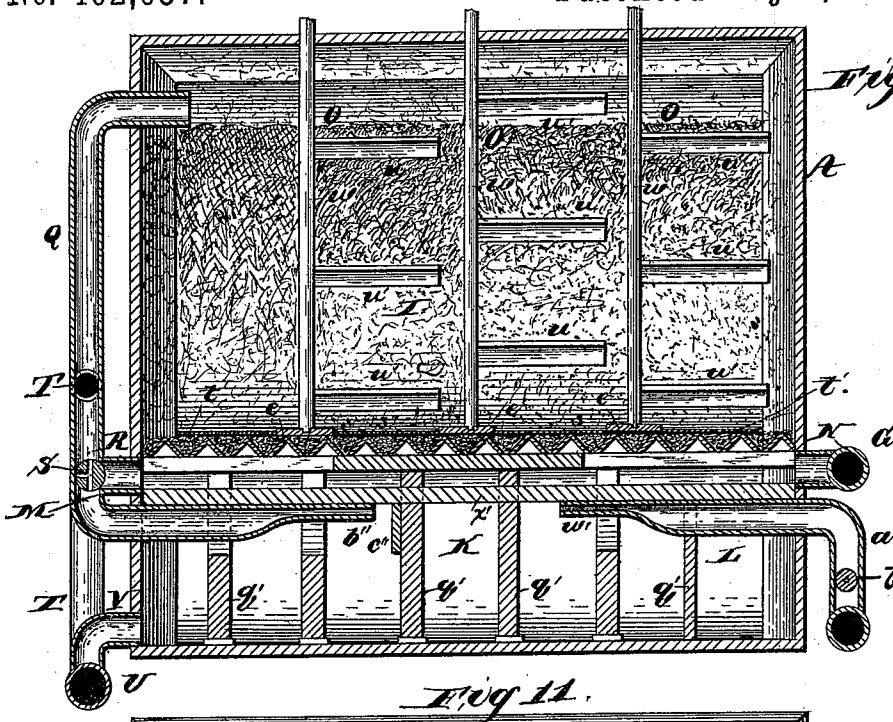
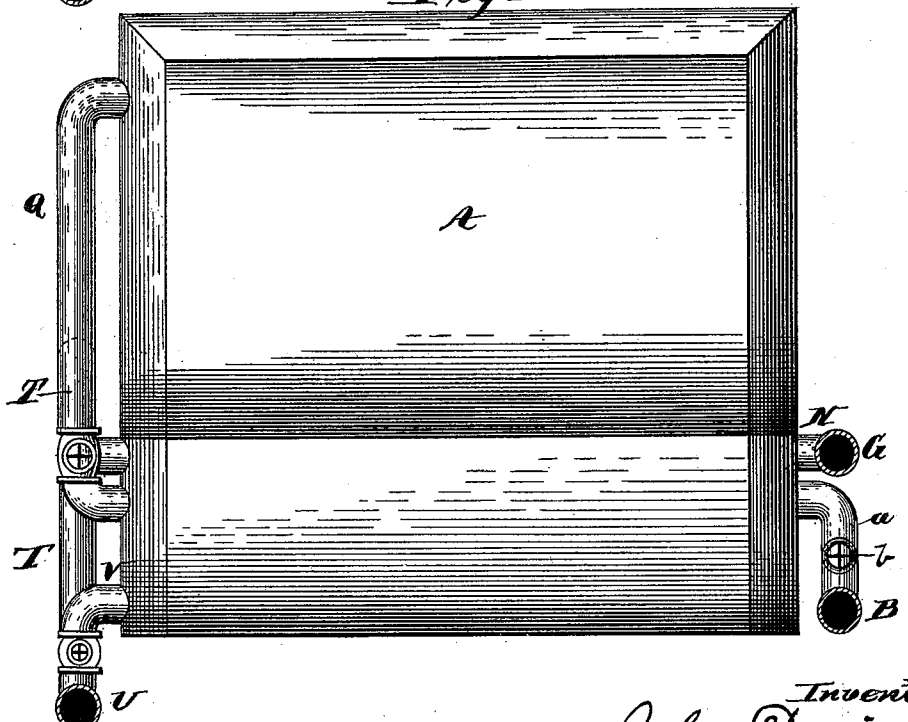


Fig 11.



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UNITED STATES PATENT OFFICE.

JOHN DAVIS, OF ALLEGHENY, PENNSYLVANIA.

FILTER.

SPECIFICATION forming part of Letters Patent No. 402,657, dated May 7, 1889.

Application filed March 10, 1888. Serial No. 266,845. (No model.)

To all whom it may concern:

Be it known that I, JOHN DAVIS, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Filters; and I do hereby 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 appertains to make and use the same.

My invention relates to filters, and has for its object an improvement in the constructions shown in my applications for patents, Serial No. 220,215, filed November 29, 1886, and Serial No. 245,716, filed July 30, 1887.

The invention will be hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, which form part of this specification, Figure 1 represents a plan of a system of filters; Fig. 2, a similar view, on a reduced scale, showing mechanism for operating the agitators. Fig. 3 is an enlarged sectional view showing the mechanism for operating the agitators and the configuration of one blade of the agitators. Fig. 3ª is a vertical section of the penstock, turbine wheel, and one of the air-pumps operated by said wheel. Fig. 4 is a plan of one of the filters. Fig. 5 is an end view. Fig. 6 is a vertical transverse section. Fig. 7 is a vertical section of a valve for controlling the supply of chemicals to the filter. Fig. 8 is a plan of the valve. Fig. 9 is a horizontal section on line *x x*, Fig. 6. Fig. 10 is an enlarged vertical longitudinal section, and Fig. 11 a side elevation.

Reference being had to the drawings and the letters marked thereon, A represents an elongated vessel constituting my improved filter-vessel, which may be used singly, or two or more may be grouped together to form a system of filters for supplying towns or cities. When grouped to form a system, they are by preference arranged in sets on opposite sides of a building, and are connected to supply-mains B C, as shown in Figs. 1 and 2, by branches *a*, provided with suitable stop-cock, *b*.

D represents a penstock for a turbine water-wheel, and is supplied with water from any suitable source—such as a reservoir, stand-pipe, or Artesian well—by a conduit (not shown) which discharges into the penstock and operates the turbine wheel. To the shaft *c* of the wheel is secured a miter-wheel, *d*, which engages with similar wheels, *e f*, movably secured on the inner ends of the shafts *g h*, which are suitably supported on brackets *i k*, and are provided at their outer ends with miter-wheels *l m*, which engage with corresponding wheels *n o* on the shafts *p q*, for transmitting motion from the turbine wheel to the shafts *r s* on the several filters. The shafts *p q* are provided with worm-gear *t*, which engages with the disk gear-wheel *u* on each shaft *r s*, which is connected thereto, as shown in Fig. 3.

Each agitator-shaft *w* is provided with a gear-wheel, *y*, which is movably secured thereon, and is thrown in and out of gear with a worm, *z*, on the shaft *r* or *s* by means of a lever, *c'*, secured to the hub of the wheel *y*, and fulcrumed in a support, *d'*, on top of the vessel A. The shafts *p q* are supported in suitable bearings, *e'*, on top of the vessels, and the lever *c'* is provided with a suitable locking device, *f'*, for holding the wheel *y* in operative engagement with the worm *z* when it is desired to agitate the filter-bed for the purpose of cleansing it.

The mechanism shown is used simply as an illustration of a means for operating the agitators from the motor propelled by water from a reservoir or other suitable source of supply on its way to the filters, and whereby all of the filters may be agitated simultaneously, or those on one side of the building may be agitated, while those on the opposite side are at work supplying filtered water, or any one or more of the filters on either side may be operated while all the others are at work filtering water.

E F represent air-pumps, which are connected to the penstock D by pipes *g'*, which are provided with check-valves (not shown) at their inner ends, and discharge air into or upon the buckets of the turbine wheel for the purpose of aerating the water to be filtered. By forcing the air into the penstock at the point described it comes in contact with water in a high state of agitation, produced by the vanes or buckets of the turbine

wheel, and mingles readily with the water before it enters the receiving-chamber of the filter, where it is further treated before it enters the filter-chamber. The oxygen in the air unites with such impurities in the water as have an affinity for it, and the impurities are precipitated in the sediment-chamber. The air may, however, be delivered into the supply-mains B C, or into the filters, or it may be conducted into the distributing-mains G H. The air-pumps are also operated by the turbine wheel, with which they are connected by any suitable mechanical connections (not shown) leading to the shafts *g h*. As these connections may be in a variety of forms, and do not constitute any part of my invention, I have not deemed it necessary to illustrate any particular kind.

In the construction of large rectangular filters, one of the principal obstacles in the way of their practicability lies in the enormous amount of metal usually required to brace vessels of this form to resist the internal pressure brought to bear upon them. To counteract this pressure without the use of braces or stays crossing the filter-chamber, I have adopted the construction of the vessel shown.

The sides *h' i'* are curved from the top to the bottom of the filter-chamber. The ends *k' l'* are curved transversely, and the top *m'* is curved from one side, *h'*, to the other side, *i'*, thus distributing the pressure on all of the sides, ends, and top, causing each to brace and support the other. The sides, ends, top, and bottom are secured together by angle-irons *n'* at their several points of juncture. I represents the filter-chamber, below which is a receiving and precipitating sediment-chamber, K, and at one end of said chamber K is partitioned off a chamber, L, for containing suitable chemicals to be mingled with the water, as fully described in my applications hereinbefore referred to.

The bottom of the filter-chamber is formed of sections of angle-iron *o'*, which cross the chamber transversely, and are supported upon beams or stringers *p'*, which in turn are supported upon columns *q'*, which rest upon the bottom of the chamber K, as shown in Fig. 10. The angle-irons thus placed form troughs *r'*, which are filled with small spherical bodies *s'*, such as shot, and are covered by wire-cloth *t'* of a mesh sufficiently fine to prevent the spherical bodies from being displaced when water is being forced up through the filter-bed for the purpose of cleansing it.

The filter-bed is composed of any suitable material—such as clean sand, granulated coke, &c.—and rests upon the wire-cloth *t'*. In placing the sections of angle-iron *o'* in position in the chamber I sufficient space will be afforded by the irregularities in the metal to form passages for the filtered water to pass through between the angle-irons into the intermediate chamber, M, from which the filtered water is discharged through pipe N, leading into the distributing-mains G H. Should the irregularities in the sections of angle-iron not be sufficient to form passages for the filtered water, small openings (not shown) will be made in their edges where they come together. The several branches connecting the supply-mains B C and the distributing-mains G H with the filters are provided with stop-cocks, so that any filter in the battery may be disconnected at any time for cleansing or other purposes.

Each filter is provided with one or more agitators, O, according to the size of the filter, and upon the shaft *w* of the agitator are secured a series of blades, *w'*, set at an angle of about fifteen degrees from a right angle with the shaft, and which are arranged directly over each other in a vertical plane, with the lower edge in advance, in the direction of rotation of the shaft, as clearly shown in Fig. 3, where the upper arm only of one agitator appears.

By this construction of the arms of the agitators the filter-bed is raised in columns, affording a free passage of the water through it and affording a thorough cleansing of the filter-bed. The agitator-shafts are supported in suitable bearings *e'*, resting upon the bottom of the filter-chamber. Water is supplied to the filters through a branch pipe, *a*, which communicates with the supply-main B or C, passes through the chemical chamber L, and discharges the water into the receiving and precipitating chamber K in a thin horizontal sheet directly under the top *x'* of said chamber through the flattened nozzle *w'*. Connection is made with the pipe *a* by a pipe, *y'*, provided with a valve, *z'*, for supplying and regulating the quantity of chemicals to the water to be filtered, and water is supplied to the chemical-chamber from the receiving-chamber through an opening, *y''*, in the top of the chemical-chamber, or it may be supplied from the intermediate chamber for filtered water. The valve *z'* is provided with an automatic spring locking device, *a''*, which is fully described and claimed in my application, Serial No. 245,716, and need not therefore be further described.

By discharging the water into the receiving-chamber directly under the top of said chamber, and in a thin horizontal sheet, it is directed across the receiving-chamber, and a large proportion of the impurities contained in the water are precipitated in the sediment-chamber. Q is a pipe for conducting water from the receiving-chamber into the filtering-chamber above the surface of the filter-bed and at the rear end of the filter. The pipe Q is also provided with a flattened receiving-nozzle, *b''*, which is located in a plane with the discharge-nozzle *w'*, to collect the water at the upper portion of the receiving-chamber after the major portion of the sediment has been precipitated to the bottom of the chamber. Immediately in front of the nozzle *b''* and crossing the receiving-chamber is a ver-

tical bar, c'', which forms a barrier to and arrests any light substance which may be floating upon the surface of the water and prevents it entering the pipe leading to the filter-chamber. The bar c also quiets the water and compels it to pass under the bar, carrying down with it the sediment which it contains in the direction of the sediment waste-cock, so that it will not be taken into the filtering-chamber. In large filters two or more of these bars may be used.

It will be observed that the water enter the filter-chamber I at the rear end, passes forward over and through the filter-bed diagonally, thus deriving the benefit of the maximum filtering capacity of the filter-bed, and is discharged at the front of the filter through pipe N into the distributing-main G or H.

In the construction of a system or battery of filters for towns or cities the filters will be about thirty feet long, ten feet wide, and seven feet deep or high.

Under such a construction the water enters the filter-chamber at one end, and flowing toward the other end has ample time to percolate through the filter-bed and deposit all of the remaining impurities which have not been precipitated in the sediment-chamber.

R is a pipe connecting the chamber M with the pipe Q, which is provided with a three-way cock, S, for conducting water into the chamber M, for the purpose of passing it up through the filter-bed when it is desired to cleanse it. While the filter-bed is being cleansed the agitator is put into operation, the bed raised, and the foul water from the bed flows off from the surface of the bed through pipe Q, (which is provided with a suitable strainer,) and is discharged therefrom by pipe T and conducted into the waste-pipe U. The sediment-chamber K is also connected to the waste-pipe U by a pipe, V, so that the sediment can be flushed out whenever it becomes necessary.

While the filters are being cleansed communication with the distributing-mains must be cut off by suitable stop-cocks.

The chamber L is charged with chemicals through pipe d'', and when the receiving and precipitating chamber is of the trough shape shown the filter is supported in cast-metal cradles e'', which are distributed throughout its length. This chamber may, however, be made rectangular, in which instance the bottom would be flat, and the filter would then rest upon a corresponding flat foundation.

Suitable openings are provided for charging the filter-chamber with filtering material, and in large filters a man-hole is provided in the end wall of the sediment-chamber. These openings being of ordinary and well-known construction, they are not shown in the drawings.

In another application, filed November 20, 1888, Serial No. 291,377, I have claimed a coagulating and precipitating chamber, a chemical-chamber, and a supply-pipe communicating with both of said chambers, and a discharge-pipe for purified water.

Having thus fully described my invention, what I claim is—

1. A filter having an elongated body and provided with a combined receiving and precipitating chamber, a separate filter-chamber above the receiving-chamber, and a filter-liquid chamber between the filter and receiving chambers, in combination with a supply-pipe provided with a flattened and laterally-distended nozzle, a pipe for conducting liquid from the receiving-chamber into the filter-chamber at one end thereof, and a pipe for drawing filtered liquid from the liquid-chamber at the opposite end of the filter, substantially as described.

2. A filter having a receiving and precipitating chamber, in combination with a supply-pipe provided with a flattened and laterally-distended nozzle arranged to discharge liquid in a thin horizontal sheet at the top of said chamber, whereby sediment is precipitated, a filter-chamber, and suitable pipes for conducting liquid to and from the filter-chamber, substantially as described.

3. A filter provided with a receiving and precipitating chamber, in combination with a horizontal supply-pipe and a similar discharge-pipe, each having a flat nozzle, a transverse vertical bar between the nozzles, and a filter-chamber, substantially as described.

4. A filter having a horizontally-elongated body and provided with a receiving and precipitating chamber, a chemical-chamber crossing one end of the receiving-chamber, a horizontal supply-pipe passing through and communicating with the chemical-chamber, a laterally-distended discharge-nozzle in the receiving-chamber, and means of communication between the receiving and chemical chambers, in combination with a filter-chamber, substantially as described.

5. A filter having a horizontally-elongated body and provided with a bottom composed of separate sections of angle-iron crossing the filter transversely and having water-passages between them, supporting beams and columns, in combination with a filter-chamber above said bottom and a liquid-chamber below the same, substantially as described.

6. A filter-vessel consisting of a horizontally-elongated body having its ends curved transversely, its sides curved vertically, and its top curved transversely from side to side, whereby each wall braces the walls adjacent thereto without the intervention of stay-rods, substantially as described.

7. In a filter, an agitator consisting of a shaft and a series of blades projecting therefrom in the same vertical plane and at an oblique angle to the horizon, whereby the filter-bed is raised in columns and forms passages for the liquid supplied from beneath the bed to cleanse it, substantially as described.

8. The combination of a motor operated by water from a supply-conduit, an air-compressor, and suitable pipes for conducting air from the compressor into the water flowing into the motor, in combination with a supply-main communicating with the motor and a filter or filters, substantially as described.

9. The combination of a water-motor, an air-compressor operated by said motor and discharging compressed air into the water, a supply-main, and one or more filters, substantially as described.

10. The combination of a motor, a series or system of filters provided with agitators, suitable operating mechanism connecting the motor and the agitators of all the filters, and shipping devices whereby all of the filter-beds may be agitated simultaneously, or one or more beds agitated, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN DAVIS.

Witnesses:
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J. C. MCELROY.