

G. F. HODKINSON.
FILTER.

(Application filed Dec. 30, 1901.)

(No Model.)

3 Sheets—Sheet 2.

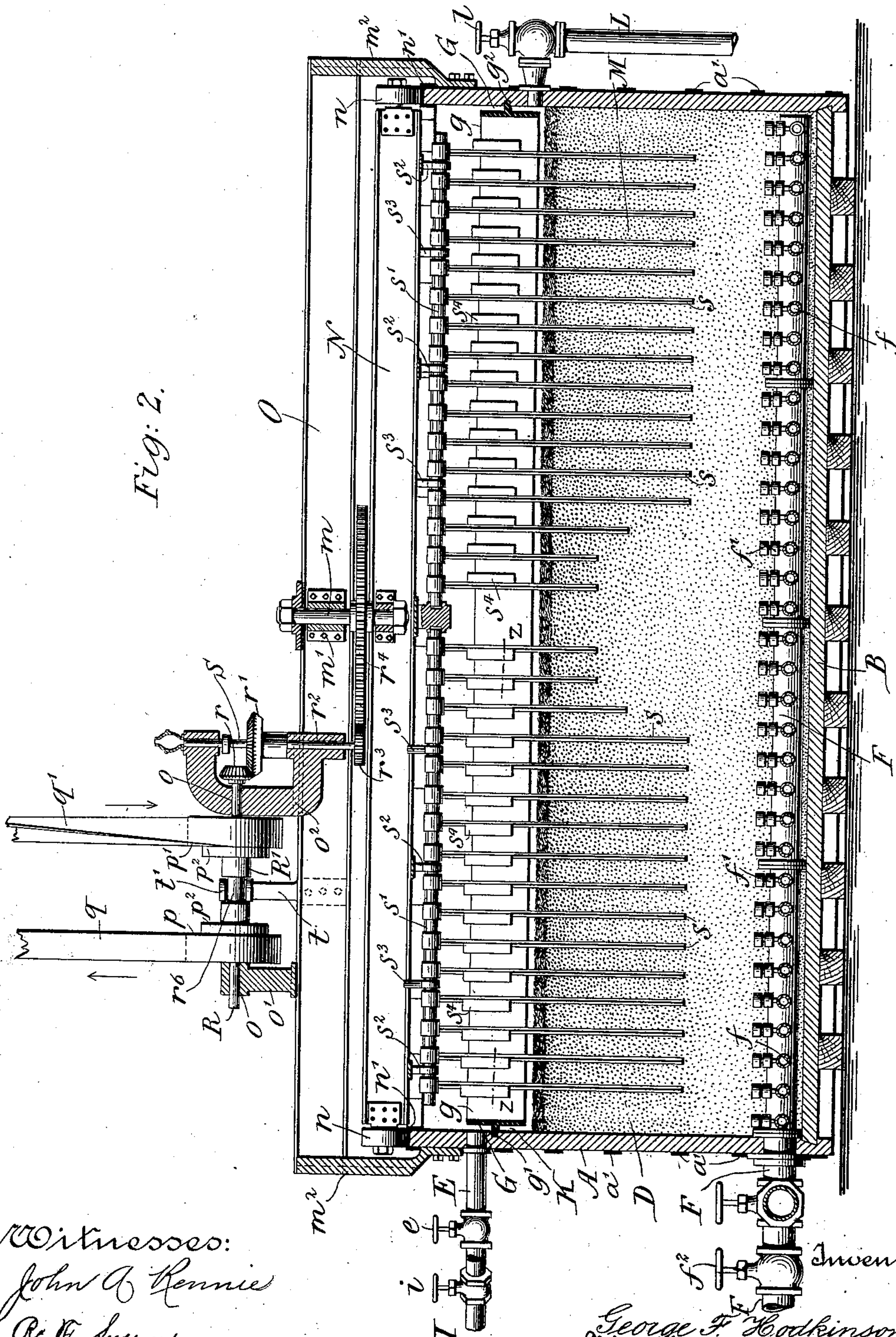


Fig. 2.

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UNITED STATES PATENT OFFICE.

GEORGE F. HODKINSON, OF CHICAGO, ILLINOIS.

FILTER.

SPECIFICATION forming part of Letters Patent No. 701,726, dated June 3, 1902.

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To all whom it may concern:

Be it known that I, GEORGE F. HODKINSON, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Filters, of which the following is a specification.

My invention relates to that class of filters the beds of which are composed either of sand, gravel, or other granular material alone or in different combinations, and especially to that form thereof in which the washing or cleansing of the bed is effected by reversing the direction of the flow of the water therethrough, and a raking or agitating apparatus is employed for coöperation therewith during the breaking up and removal of the film or crust and the washing operation.

As thus related the objects of the invention are to provide not only for the more thorough breaking up and removal of any film or crust that may be formed upon the upper surface of the bed and the more efficient washing of such bed and the carrying away of the impurities liberated therefrom, but also for the automatic adjustment of the teeth of the rake or agitating apparatus, whereby to adapt them to the different operations of breaking up the crust and the agitation of the material of the filter-bed as the removal of the one and the washing of the other may be required.

To these ends the invention consists, first, in the employment, in connection with the filter-walls, the filter-bed, and the means for conducting the water thereto and for conducting it therefrom, of both an open-top trough and an open-bottom trough arranged around the inner side of the walls and in relation to the filter-bed, whereby the water to be filtered is delivered to the open-top trough and passes over its inner walls to the filter-bed, and the crust and the water with which it is mixed after the former has been broken is passed to the waste weir or sewer beneath the inner edge of the open-bottom trough; second, in the construction of the raking or agitating apparatus and in the means whereby it is mounted and operated, and, third, in various other constructions and combinations of parts, all as will hereinafter more fully appear.

Referring to the accompanying drawings, which form a part of this specification, Figure 1 is a plan view of a filter constructed in accordance with my invention, a portion of the filter-bed being removed and the belts for operating the raking or agitating apparatus being broken away for convenience of illustration; Fig. 2, a vertical central sectional elevation thereof, taken in the plane xx of Fig. 1, with the axis of one of the water-supplying pipes shown arranged in that plane; Fig. 3, a similar vertical central sectional elevation of the same, taken in the plane yy of Fig. 1 at right angles to Fig. 2; Fig. 4, a horizontal sectional detail of a portion of the raking or agitating apparatus, taken in the plane zz of Fig. 2; and Fig. 5, a detail showing the rake-carrier-operating shaft, with the operating pulleys and clutch by means of which they are connected therewith shown in longitudinal section.

In all the figures like letters of reference are employed to designate corresponding parts.

A indicates the side walls of a filter, and B the bottom thereof. In the construction of these filters any approved form may be adopted, and the side walls and bottom thereof may be composed of any appropriate material. In the form of the invention which I have selected for the purpose of illustration, however, the filter is constructed of circular form and the walls thereof are composed of segmental staves of wood a , which are firmly bound together edge to edge by suitable bands or hoops a' , with the bottom B of similar material secured within the lower portion of the walls by a groove a^2 , in which its periphery enters, as shown.

D indicates the filter-bed, which is or may be constructed of sand, gravel, or other appropriate granular material or of two or more of them combined, as may be desired. I prefer, however, to construct it of sand and gravel and to arrange these materials within the filter-walls in the order of their fineness, with the largest or coarsest of their grains at the bottom and the progressively smaller or finer grains above in regular order to the top, where the finest grains are disposed. As thus constructed the water to be filtered is delivered upon the top of this filter-bed and after having traversed the same is discharged from the

bottom thereof. To permit of this being accomplished, I provide the filter, near its top, with a pipe E, which is connected with the source of the water-supply, and also near its
 5 bottom with a second pipe F, that is connected with the pipe or main leading to the point of consumption. Instead, however, of delivering the water directly from the pipe E upon the top of the filter-bed I preferably make use
 10 of an open-top gutter G, into which it is discharged and from which it is delivered upon the top of the filter-bed. This gutter is located at some distance above the upper surface of the filter-bed and may be constructed in various forms and of divers materials. In the
 15 preferred embodiment of my invention, however, it is constructed in rectangular form in cross-section, with the inner wall g and the bottom g' formed from metal, and the outer wall
 20 formed by the walls A of the filters, in a suitable groove g^2 formed in the interior of which the outer edge of the bottom g' enters and is firmly clamped and secured. As thus constructed the discharge of the water delivered thereto by
 25 the pipe E upon the filter-bed is over its inner wall g , and in order to obviate the disarrangement of the top of the filter-bed by the erosion incident to the discharge of the water upon it at a single point the gutter G is preferably extended
 30 entirely around the interior of the filter-walls, whereby to cause the discharge of the water upon the filter-bed entirely around its edge.

While the pipe E thus terminates in the gutter G, the pipe F, on the other hand, extends
 35 inward across the bottom of the filter-bed and is provided at suitable points along its length with laterally-extending branches f , which, with the main pipe F, are provided at the
 40 proper distances apart upon their upper surfaces with strainers f' .

The filter being constructed and equipped as above described serves to receive the water from the source of supply and after filtering it deliver it to the point of consumption, which operations when initiated may be continued until the filter-bed becomes so contaminated and clogged by the impurities separated out from the water and taken up by
 50 it in the filtering operation that the passage of the water through the bed is so retarded that the washing and cleansing of the latter becomes necessary. In order, therefore, to accomplish this washing and cleansing operation, the pipes H and I are employed, of which
 55 the former is connected with the pipe F outside of the filter and with the pipe E or other source of water-supply, while the latter is connected with the gutter G and leads to the
 60 sewer or other convenient waste-weir. By these means the washing of the filter-bed by the passing of a current of water upwardly through the same to the sewer or other point of waste is effected, and in order to permit of
 65 this being accomplished the supply-pipe E and the discharge-pipe F are respectively provided with valves e and f^2 , which are first

closed, and the valves h and i , with which the pipes H and I are respectively provided, then opened, when the water will enter
 70 at the bottom of the bed and passing upwardly through the same will cleanse and wash out all the impurities taken up by it, carrying them over into the gutter G, and thence to the sewer or other waste-weir
 75 through the pipe I. In those cases, however, where the quantity of the impurities carried by the water to be filtered is considerable or its character is tenacious a film or crust is formed upon the surface of the filter-bed during the filtering operation, which requires removal before the washing operation can be commenced and in some instances at other frequent intervals. To permit of this removal, the open-bottom trough K is employed, which, extending along the edges of
 80 the filter-bed, is disposed slightly above the same with its open-bottom portion in close relationship thereto and is connected with a sewer or other convenient place of discharge
 90 through the intervention of a pipe L, which leads from a point in the former near the surface of the filter-bed to the latter and is provided with a valve l , by means of which it may be closed or opened, as may be desired.
 95 In some instances a single pipe L will be found sufficient, while in others a plurality of these pipes may be necessary, and the same is true respecting the pipe I, which will be similarly varied to meet the requirements demanded. As thus arranged the trough K may be constructed in various forms. When the form of open-top gutter G (shown in the drawings) is employed, however, its inner walls g^3 are preferably constructed by
 105 extending the inner wall g of that gutter downward the proper distance below the bottom g' to form it and to avail of that bottom and of the side walls A of the filter to form its respective top and outer walls, as shown. 110

With the trough K and pipe L arranged as above explained the removal of the film or crust is effected by first closing the valves in all of the various pipes, with the exception of the valve e in the pipe E, which will remain open until the water rises above the filter-bed to near the top of the inner wall g of the open-top gutter G, when that valve will likewise be closed and the film or crust then thoroughly broken into small fragments by agitation or otherwise and intermixed with the water above the filter-bed, after which the valve
 115 l in the pipe L will be quickly opened and the water, with the fragments of the film or crust therein, passed outwardly beneath the lower edge of the inner walls g^3 of the open-bottom trough K to the pipe L and thence through it to the sewer or other point of discharge. In most instances a single discharge of the water thus stored through the pipe L
 125 will be sufficient to carry away the entire broken film or crust. When, however, it is not sufficient for the purpose, the valve l in the pipe L will be closed after the first dis- 130

charge, the valve *e* in the pipe E again opened, and the water above the filter-bed again raised therefrom to near the top of the inner walls of the open-top gutter G, when the valve *e* will be again closed, the portions of the film or crust remaining again intermixed by agitation with the water thus supplied, the valve *l* in the pipe L again quickly opened, and the water and portions of the film or crust remaining conducted outward beneath the inner walls of the open-bottom trough K to the pipe L and thence to the place of discharge, as before explained, and so on until the entire film or crust is carried away. It will thus be seen that by arranging the open-bottom trough K in close relationship to the surface of the filter-bed a practically closed tubular mouth extending entirely around the edges of the filter-bed is formed for the pipe or pipes L, with only a narrow slit provided in the trough along its lower edge, into and through which the water and broken film or crust is drawn in all directions outward from the filter-bed to the interior of the trough when the valve *l* is open instead of in a direct line toward the pipe or pipes L, and a more efficient removal of the same before its subsidence and settling upon the filter-bed thereby effected. Instead, however, of supplying the water necessary to the floating away of the film or crust through the pipe E it may be supplied through the pipe H from the source of supply by opening the valve *h* and retaining it in that condition until the water is raised to the proper height above the filter-bed, when it will be closed and the breaking up and removal of the film or crust effected. It is preferred, however, to supply it through the pipe E by opening the valve *e*; but the supply may be through either of the pipes and the same result accomplished with equal efficiency. The removal of the film or crust from the surface of the filter-bed being effected, the filtering operation may then be resumed or the washing of the filter-bed resorted to. When economy in the use of water for washing purposes is necessary or desirable, then the breaking up and removal of the film or crust a number of times between any two successive washings of the filter-bed may be effected, and in these cases the valves *e* and *f*² in the respective pipes E and F, after the film or crust has been removed and the valve *l* closed, will be opened and the filtering operation thereby resumed. On the contrary, when after the breaking up and removal of the film or crust has been accomplished the washing of the filter-bed is desired, then after the removal of the film or crust has been effected and the valve *l* closed the valves *h* and *i* will be opened, when the water will enter through the pipes H and F, and, passing upward through the filter-bed and over the inner walls *g* of the open-top gutter G, will flow to the sewer or other convenient place of discharge through the pipe I and accomplish the washing operation, as before explained. With the

completion of the washing of the filter-bed the valves *h* and *i* will be closed, the valves *e* and *f*² opened, and the filtering operation resumed, and so on.

With a view to the breaking up of the film or crust preparatory to its removal and the loosening up and agitation of the components of the filter-bed during the washing operation the rakes M are employed, which, extending outward radially from the center of the filter to near the outer walls thereof, are secured to the under side of the rotatable carrier N and are carried around by it over the filter-bed in one or the other direction, as the breaking up of the film or crust or the loosening up and agitation of the bed may be respectively required. To permit of this being accomplished, the carrier N extends diametrically across the top of the filter and is provided at its middle point with an upwardly-extending vertical stud *m*, that is journaled in a suitable bearing *m'*, which is secured between the cross-beams O, that are supported above the filter, from the side walls A thereof, through the intervention of appropriate standards *m*², with the opposite ends of the rotatable carrier provided with wheels *n*, that are adapted to travel upon an annular track *n'*, secured upon the upper edge of the side walls A, as shown. As thus supported and arranged, the movement of the rakes M over the filter-bed in one or the other direction is effected by rotating the carrier N in the direction required. The means through which this rotation may be imparted to the carrier may be of various forms. I prefer, however, to impart it thereto through the instrumentality of a shaft R, which, mounted in suitable bearings *o*, formed in the stands or hangers *o'* and *o*², that are secured to the cross-beams O, is connected with the prime mover through appropriate means whereby to be operated therefrom. For making this connection I preferably employ the pulleys *p* and *p'*, which are loosely mounted upon the shaft R and are respectively embraced by a straight belt *q* and a cross-belt *q'*, that lead to and around corresponding pulleys (not shown) upon the shaft of the prime mover, as will be readily understood. With the shaft R mounted and operated as thus described it is connected with the carrier N through the intervention of a bevel-gear *r*, which, fixedly secured to the inner end of the shaft, intermeshes with a corresponding bevel-gear *r'*, secured to the upper end of a vertical shaft S, that in turn is mounted in a suitable bearing *r*² in the stand or hanger *o*² and is provided at its lower end with a spur-gear *r*³, which intermeshes with a corresponding spur-gear *r*⁴, that is fixedly secured to the upper side of the rotatable carrier, with its axis in coincidence with that of the stud *m*, upon which carrier rotates. As thus connected with the source of power, the rotation of the carrier in one direction will be effected when required by simply connecting the pulley *p*

with the shaft R. On the other hand, the rotation of the same in the opposite direction will be accomplished when desired by connecting the other pulley p' therewith. In order, therefore, to provide for the connection of one or the other of these pulleys with the shaft R and its disconnection therefrom as the rotation of the carrier in one or the other direction is required, I provide each of these pulleys with a clutch member p^2 on its inner face and employ in connection therewith a sliding clutch member R' , which, loosely mounted upon the shaft, is connected therewith through the intermediary of a feather r^5 , whereby to be capable of a back-and-forth movement thereon, and may be brought into engagement with the clutch member p^2 of either of the pulleys p or p' , as may be desired, through the intervention of a lever T, which, pivoted intermediate of its length upon a stand t , extending upwardly from the cross-beams O, engages at its forked inner end t' with a circumferential groove r^6 , formed in the clutch member R' , as shown.

With the parts connected as above described when the breaking up of the film or crust and the intermixture of its fragments with the water above the filter-bed are required the rotation of the carrier N in the proper direction to cause the rakes M to trail over it will be effected by bringing the sliding clutch member R' into engagement with the appropriate pulley p or p' , when the rakes by the resistance afforded to their teeth s by the material of the filter-bed as they are carried over it will be swung backward with respect to the carrier, as shown by dotted lines in Fig. 3, and in their forward movements over it in these positions will break up such film or crust and intermix its fragments with the water. On the other hand, when the loosening up and agitation of the components of the filter-bed is required during the washing operation then the rotation of the carrier in the opposite direction to cause the teeth s of the rakes to move around through them will be accomplished by bringing the sliding clutch R' into engagement with the other of these pulleys p or p' , when the rakes will be brought into vertical positions, as shown by full lines in Fig. 3, and there held so long as the carrier is rotated in that direction and the loosening up and agitating operations are to be effected. In order, therefore, to provide for these movements of the rakes, the supports for their teeth s are preferably constructed in the form of shafts s' , which, journaled to the underside of the carrier N through the intervention of stands or hangers s^2 , are severally provided with upwardly-extending arms s^3 , which, fixedly secured thereto, cooperate with the sides of the cross-beams O, whereby to permit of the rakes swinging backward to trail their teeth upon the film or crust when the carrier is rotated in one direction and hold them firmly in vertical positions when it is rotated in the other. Thus, as will be

seen, the breaking up of the film or crust and the loosening up and agitation of the components of the filter-bed are accomplished by simply rotating the carrier N in the required direction, and in order to aid in the carrying of the water passed upward through the filter-bed during the washing operation outward and into the gutter G over the inner wall g thereof I sometimes find it expedient to provide some or all of the rake-teeth s with deflecting-blades s^4 , which, secured thereto, extend outwardly and backwardly therefrom at an angle of approximately forty-five degrees, as shown more fully in Fig. 4.

With the axis of the supporting-shafts s' disposed in a vertical plane passing through the axis of rotation of the carrier N the free ends of the teeth s of the rakes M when trailing upon the film or crust or the top of the filter-bed during their revolution over the same describe a very much larger circle than the ends thereof that are secured to their respective supporting-shafts s' , and as a consequence of this the strain imparted to them instead of being in a direction of their length is more or less transversely of them, as they are disposed near or remote from the axis about which they are revolved. To resist this strain and insure of the proper working of all the teeth automatically when the direction of rotation of the carrier is reversed, these teeth s instead of being loosely mounted upon their respective supporting-shafts s' are fixedly secured thereto, and whatever swinging movements with respect to the carrier N that are necessary to allow of their assuming a trailing and vertical position are permitted through the journaling of their supporting-shafts in the stands or hangers s^2 . By this arrangement, as will be seen, the efficient operation of these teeth is insured at all times, and the liability to distortion of their bearings and the consequent binding of the same incident to excessive lateral strains thereon obviated.

It will thus be perceived from the foregoing that I produce a filter which while simple in construction and efficient in operation permits of the breaking up and removal of any film or crust that may be formed on the surface of the filter-bed, as well as the loosening up and agitation of the components of the filter-bed during the washing operation, by simply rotating the rakes or agitating devices in one and then in the other direction.

Although in the foregoing I have described the form of the invention which I prefer to employ in practice, I wish it distinctly understood that I do not limit myself thereto, as it is obvious that various modifications may be made therein without departing from the spirit thereof.

Having now described my invention and specified certain of the ways in which it is or may be carried into effect, I claim and desire to secure by Letters Patent of the United States—

1. The combination, with a filter, a filter-bed, and means for supplying water thereto from the source of supply, of an open-bottom trough arranged in close relationship to the upper surface of the filter-bed, and a conductor leading from the open-bottom trough to the place of discharge whereby the film or crust formed on the top of the filter-bed when broken may be removed therefrom, substantially as described.

2. The combination with a filter, a filter-bed, and means for supplying water thereto from the source of supply, of an open-top trough, an open-bottom trough, and a conductor leading from the open-bottom trough slightly above the level of the surface of the filter-bed to the place of waste, whereby the water is supplied to the filter, and the film or crust formed upon the surface of the filter-bed when broken may be floated away, substantially as described.

3. The combination, with a filter, a filter-bed, means for supplying water thereto from the source of supply, an open-bottom trough arranged in close relationship to the upper surface of the filter-bed, and a conductor leading from the open-bottom trough to the place of waste, of a series of rake-teeth arranged above the filter-bed and adapted to trail upon its upper surface, and means for supporting and revolving these teeth around over such upper surface, whereby not only is the water supplied to the filter, but the film or crust formed on the top of the filter-bed broken and carried away to the place of waste, substantially as described.

4. The combination, with a filter, a filter-bed, an open-top trough, an open-bottom trough, conductors for respectively supplying water to the open-top trough and to the underside of the filter-bed, and means for controlling the flow of water through these conductors, of conductors leading from both the open-top trough and the open-bottom trough to the place of waste, means for controlling the flow of water through these conductors, a series of rake-teeth arranged in relation to the filter-bed, a carrier for supporting these rake-teeth, and means for rotating such teeth in one and in the other direction, whereby not only may water be supplied to the filter, the film or crust formed on the top of the filter-bed broken, and the fragments carried away to the place of waste, but the washing of the filter-bed and the agitation and loosening up of the components thereof effected during the washing operation, substantially as described.

5. The combination, with a filter, and the

filter-bed arranged therein, of a rake comprising a shaft and teeth fixedly secured thereto, a carrier in which such shaft is rotatably journaled whereby to permit of the teeth being swung upwardly by the action of the filter-bed upon them and trailed upon the upper surface thereof, when the rake is carried around in one direction, and of being swung downward by its action upon them, when the rake is carried around in the opposite direction, and mechanism for limiting the downward swinging movement of the teeth, and for rotating such carrier in one and in the other direction over the filter-bed, substantially as described.

6. The combination, with a filter provided with a track around its upper edge, and a filter-bed arranged therein, of a carrier extending across the filter-bed and provided with wheels for coöperation with such track, rakes, each of which comprises a shaft and teeth fixedly secured thereto, journaled to such carrier whereby to permit of the teeth being swung upward by the action of the filter-bed upon them and trailed upon its upper surface, when the rakes are carried around over the same in one direction, and of being swung downward by its action upon them, when the rakes are carried around over it in the opposite direction, and mechanism for limiting the downward swinging movement of such teeth and for rotating said carrier in one and in the other direction over the filter-bed, substantially as described.

7. The combination, with a filter, a filter-bed arranged therein, and a carrier N provided with the stands or hangers s^2 , of rakes M, each of which comprises a shaft s' journaled in such stands or hangers and provided with teeth s fixedly secured thereto, whereby such teeth are rendered capable of being swung upward by the action of the filter-bed upon them and trailed upon its upper surface, when the rakes are carried around over the same in one direction, and of being swung downward by its action upon them when the rakes are carried around over it in the opposite direction, stops s^3 for limiting the downward swinging movement of said teeth, and mechanism for rotating the carrier in one and in the other direction over the filter-bed as required, substantially as described.

In witness whereof I have hereunto set my hand this 19th day of December, 1901.

GEORGE F. HODKINSON.

Witnesses:

WM. H. APPLETON,
R. F. SWEENEY.