(No Model.) 3 Sheets—Sheet 1.

E. M. KNIGHT.

FILTER.

No. 557,399. Patented Mar. 31, 1896.

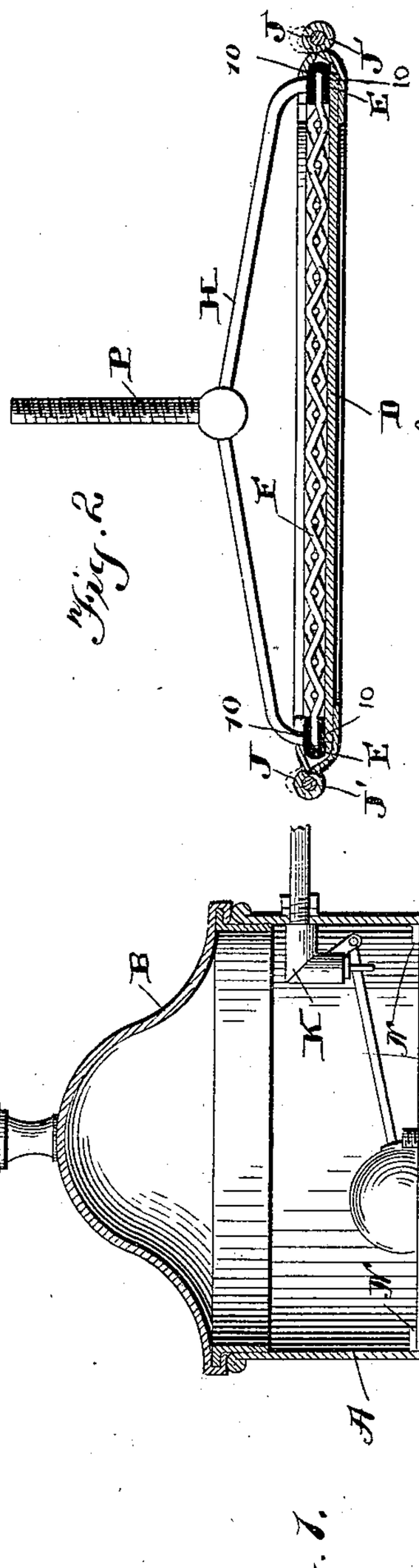


Fig. 2.

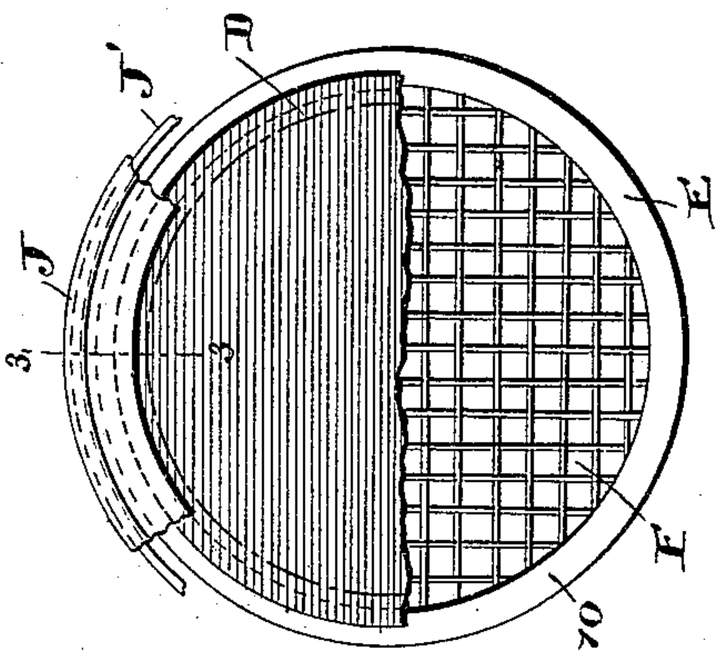


Fig. 3.

Fig. 4.

Fig. 1.

Witnesses:

Geo. E. Frech.

B. A. Rauch.

Inventor.

Edward M. Knight,

by P. Walter Fowler

his Attorney.

(No Model.) 3 Sheets—Sheet 2.

E. M. KNIGHT.

FILTER.

No. 557,399. Patented Mar. 31, 1896.

Fig. 5.

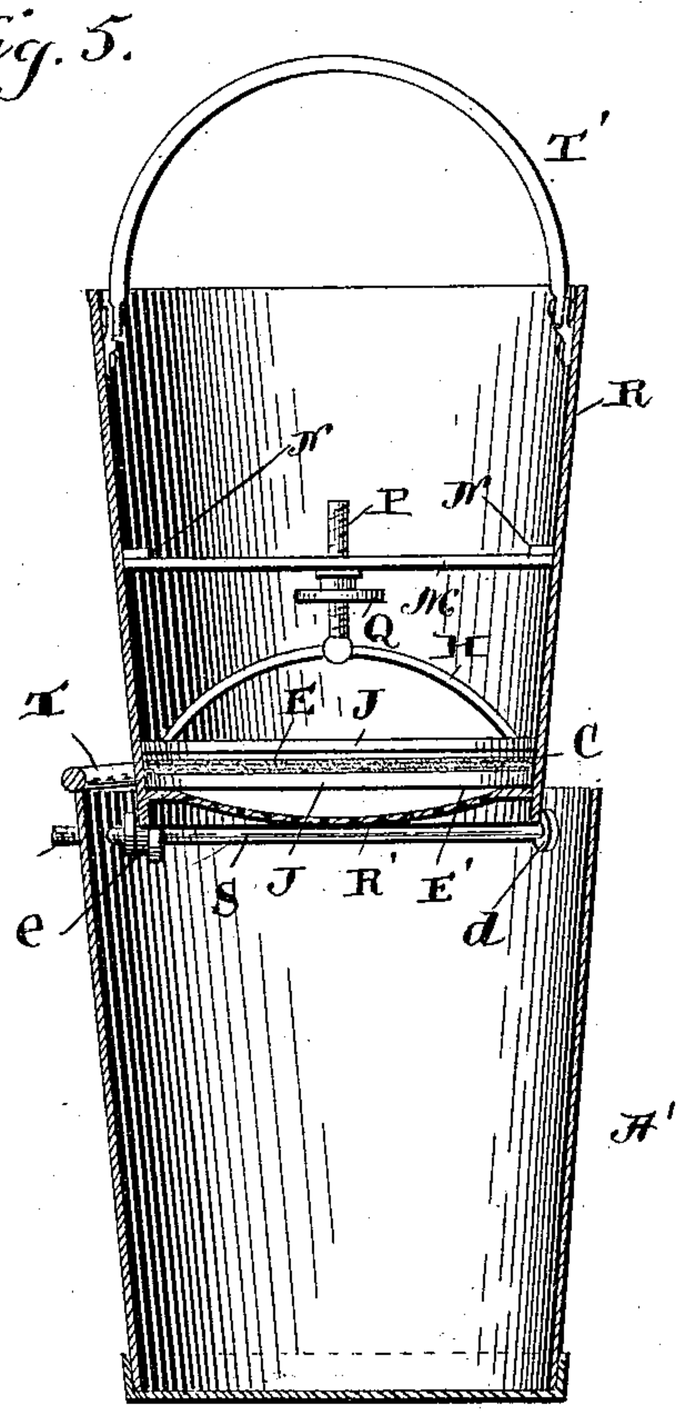


Fig. 7.

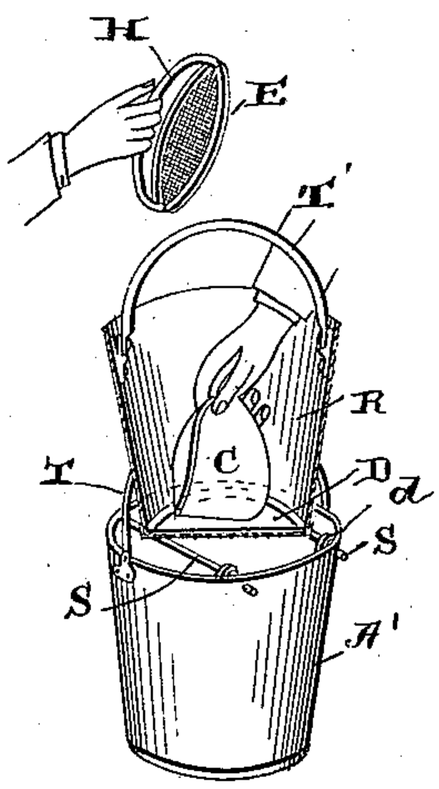


Fig. 6.

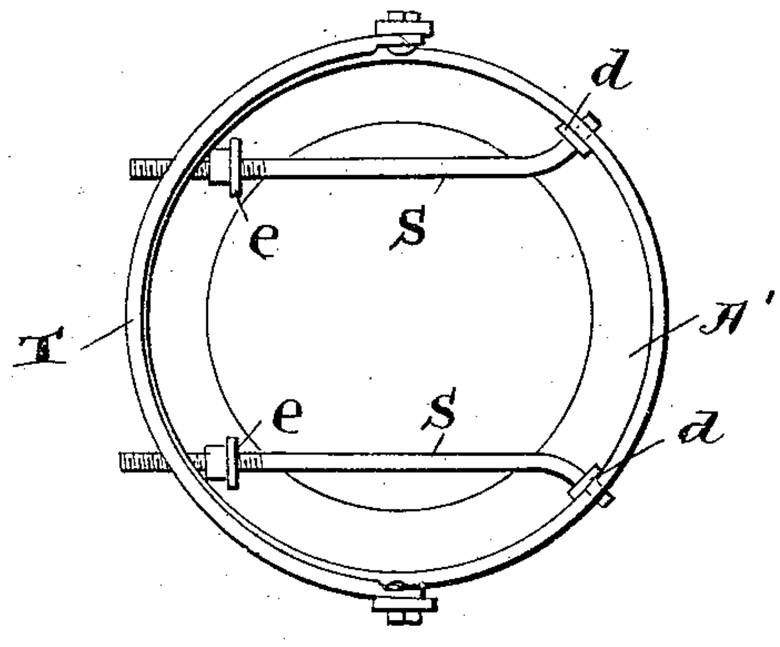
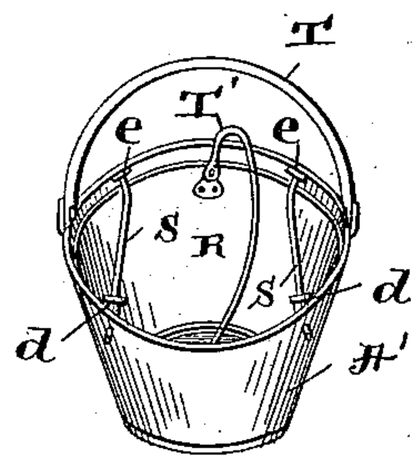


Fig. 8.



Witnesses:
Geo. E. Frech.
A. St. Rouch.

Inventor.
Edward M. Knight,
by P. Walter Fowler,
his Attorney.

(No Model.) 3 Sheets—Sheet 3.

E. M. KNIGHT.

FILTER.

No. 557,399. Patented Mar. 31, 1896.

Fig. 9.

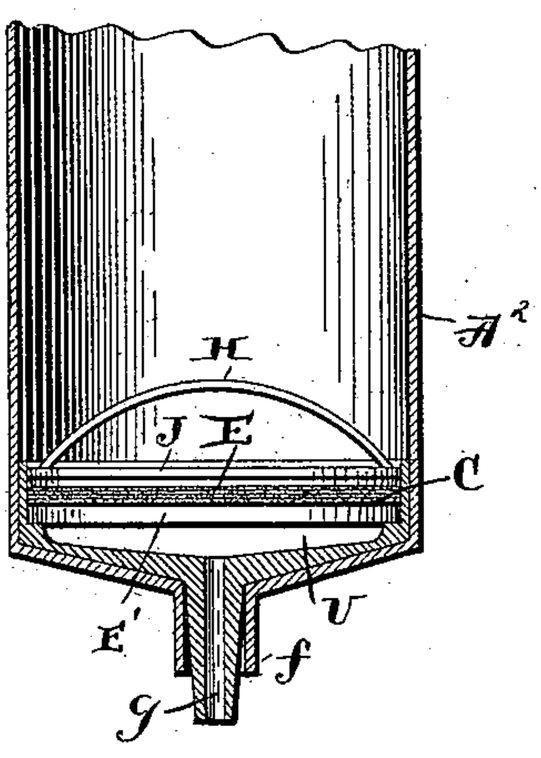


Fig. 10.

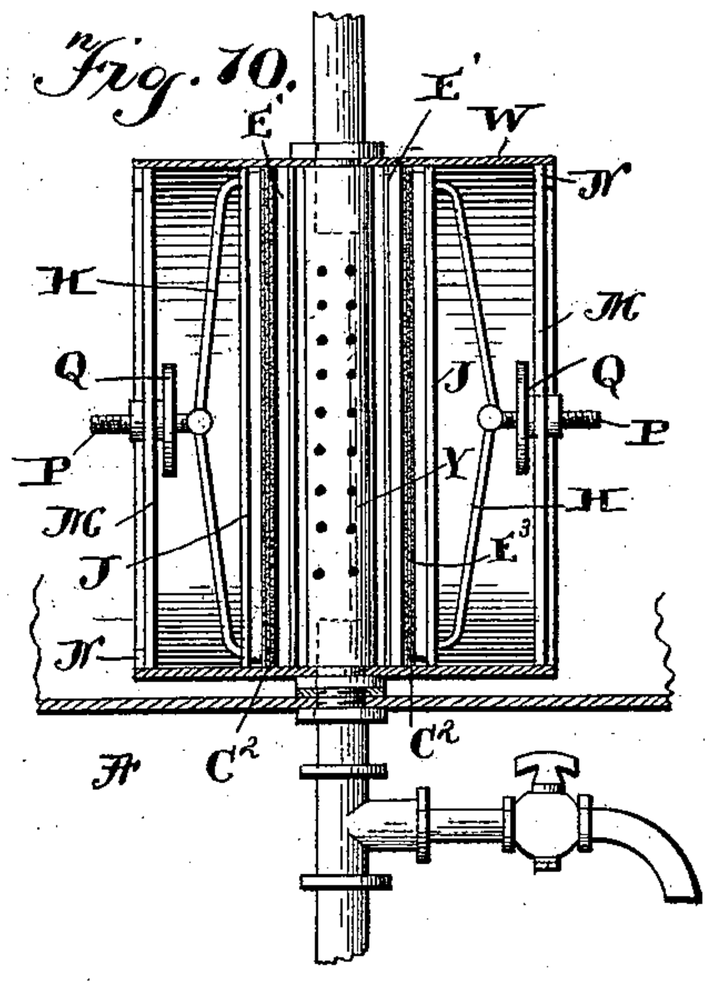


Fig. 11.

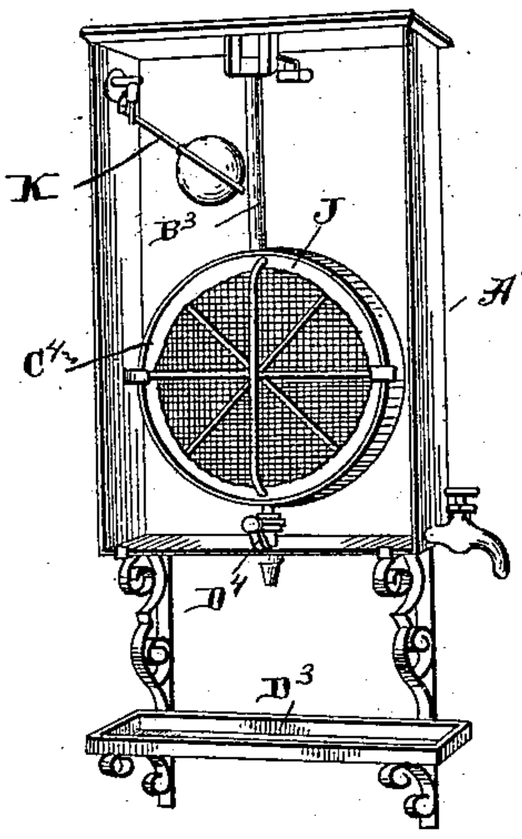
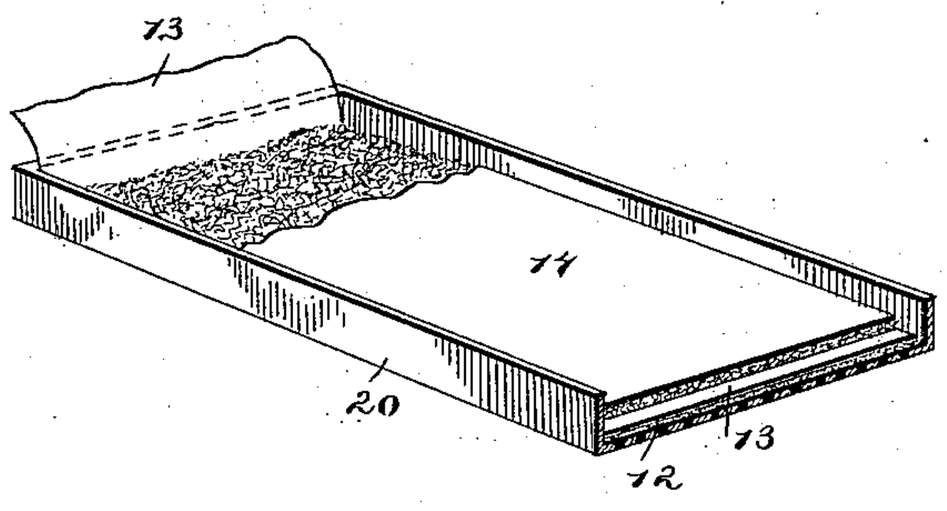


Fig. 12.



Witnesses:

Geo. E. Frech.

R. K. Rawks.

Inventor.

Edward M. Knight,

by P. Walter Fowler

his Attorney.

UNITED STATES PATENT OFFICE.

EDWARD M. KNIGHT, OF NEW YORK, N. Y.

FILTER.

SPECIFICATION forming part of Letters Patent No. 557,399, dated March 31, 1896.

Application filed May 4, 1895. Serial No. 548,096. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. KNIGHT, a citizen of the United States, residing at New York, in the county of New York and State of New York, 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 is chiefly designed to improve the construction and increase the efficiency of filters of that kind or class wherein a fibrous material is used as the filtering medium, in such form and so arranged that it can be easily removed and replaced or renewed at pleasure—for example, filters such as that shown and described in my former patent, No. 494,426, dated March 28, 1893.

My invention consists of the constructions and combinations of devices which I shall hereinafter fully describe and claim.

In the accompanying drawings, Figure 1 represents a vertical section showing one form of my improved filter adapted to work with a constant supply of water from a water-main or other convenient source. Fig. 2 is a sectional view of the upper disk removed. Fig. 3 is a bottom plan view of the same, showing some of the parts broken away. Fig. 4 is an enlarged section on the line 3 3 of Fig. 3. Fig. 5 is a vertical sectional view of my improved bucket-filter, showing the same in operative position ready for use. Fig. 6 is a plan view of Fig. 5. Fig. 7 is a perspective view, on a reduced scale, showing the manner of removing the filter-disk and filtering medium. Fig. 8 is a similar view showing the parts contained one within the other and the filter ready for transport. Fig. 9 is a vertical section illustrating a modification of my invention. Fig. 10 is a vertical section illustrating another modification of my invention. Fig. 11 is a perspective view with some of the parts removed, showing still another modified form of my invention. Fig. 12 illustrates a method of making the improved felt or filtering medium.

Like letters and figures indicate corresponding parts throughout the drawings.

The manufacture of my improved asbestos felt or filtering medium is an important feature of my said invention. In my said former patent, No. 494,426, dated March 28, 1893, I have described a filtering medium consisting of a thin wafer-like film of asbestos which is so arranged that it will arrest the impurities contained in the water. Now, although the thin films of this kind are very efficient for the purpose for which they are intended, yet I have found in practice that they are so fragile that they are liable to be broken or damaged in handling or transport, so as to permit leakage of unfiltered water through them, and also that it is very difficult to make them of even or uniform thickness, as, by reason of the peculiar nature of asbestos fiber, a very thin film made by the process I have described in my said former patent may appear all right to the eye when dry, but if wetted and then held up to a strong light it will be seen to be uneven in thickness and extremely thin in some places. It is in these thin places that it is liable to break in handling, and even if it does not break, fine micro-organisms may soon eat their way through the thin places. Now it is to correct these imperfections that I have devised my improved felt or filtering medium, the express purpose of which is to extract from water the finest micro-organisms and not only to extract them but to retain them on its surface and prevent them from eating their way through. To accomplish this result I manufacture my improved felt or filtering medium as follows—that is to say:

I take crude asbestos, crush it, and pass it through a carding-machine similar to those used in carding cotton, or through any other machine that will effectually separate the fibers or flakes of asbestos, and I allow the separated fibers or flakes of asbestos to fall lightly one above another into a box or other receptacle 20 directly from the carding or other machine, so that the asbestos is deposited in the box or other receptacle in very fine flakes, like snow. In fact, the action is similar to the falling of snow. The receptacle for the asbestos fibers or flakes is preferably constructed in the form of a shallow tray (see Fig. 12) of dimensions varying according to the size and thickness of the felt required. The bottom of the said tray is perforated and covered with flannel or simi-

lar material 12, upon which is laid a piece of fine muslin 13 or the like to enable the mass of asbestos to be lifted out of the tray. The flannel and muslin are damped with water and the tray is then placed under the carding-machine and quickly moved to and fro as the carded asbestos falls into it, this being done in order to promote the evenness or uniformity of the deposit. When sufficient asbestos has been deposited in the tray, the latter is withdrawn and another piece of muslin 14 placed on the top of the mass of asbestos. Water is then sprayed over the said mass until it is thoroughly soaked. A piece of board is now taken and placed on top of the mass of asbestos. This board should be of the exact dimensions of the inside of the tray. Pressure is now applied to the board evenly or uniformly and the wet asbestos is thus squeezed down into a small compass and a large proportion of the water forced out through the perforations in the bottom of the box. The pressure is then relaxed, the loose board is removed, and the asbestos felt thus formed, with the piece of muslin on either side thereof, is lifted out of the tray and laid on one side till a number of sheets of felt have been made in a similar manner, the said sheets being laid one upon another until there is a suitable number of the same in the pile. The pile of sheets is then taken and put into a press sufficiently powerful to exert a pressure of from one to two tons per square inch, more or less, the heavier pressure being preferable. The sheets of felt are then taken from the press, after which the pieces of muslin may be removed and each sheet is laid separately in a hot room or drying-chamber and the remaining moisture evaporated. When dry, the sheets of felt are laid between sheets of paper or the like and cut into disks or pieces of other suitable form. The object of placing them between sheets of paper is that the felt may be cut much more evenly in this manner.

In the manufacture of my asbestos felt it is important that the fibers or flakes of asbestos should be allowed to fall lightly one upon another, as above set forth, and that the mass should not be touched or disturbed before being compressed in the manner described, because if the mass of asbestos were handled or lifted in handfuls from the box or receptacle and placed in the press the resulting felt would be lumpy and of uneven structure, whereas when the felt is made as above described it is of very uniform structure throughout.

By the method above described I am enabled to manufacture a felt for filtering purposes entirely out of an inorganic substance—*i. e.*, pure asbestos—with no admixture whatever. Felt made in this way not only possesses all the advantages I claim for my films in my said former patent, No. 494,426, but also others—viz., it is more even, compact, and solid, it will not break in handling, and will not show imperfections when wet. It will, moreover, while effecting the filtration of the water very rapidly, effectually retain on its surface minute micro-organisms that might eat through the earlier form of film made as described in the said former patent, and it can be produced much more cheaply and rapidly.

In order to efficiently support and utilize the felt manufactured as above described or other filtering media of a delicate nature, I employ the arrangements hereinafter described, although it must be understood that my improved asbestos felt may be employed in any other suitable manner, if desired.

In the form of my improved filter shown in Fig. 1, A is the vessel or container. B is the lid or cover thereof.

C is the asbestos felt or filtering medium. This felt is supported between and protected by two layers D of open-woven asbestos cloth mounted on upper and lower frames E E′, the upper of which E is shown detached in Figs. 2 and 3. The asbestos cloth D that covers these frames is not intended to serve as a filtering medium, but only as a support and protection for the felt C, and in order that the said cloth may in no way retard the flow of the water it is made of a very open mesh. This is a matter of importance, since the interstices between the meshes of the ordinary closely-woven asbestos cloth when used in a filter gradually close up, not merely because the pores of the material become clogged with impurities from the water, but from the nature of the asbestos itself, the result being that in the course of time the flow of the water through the filter is so retarded that the filter becomes useless. To obviate this difficulty, I use asbestos cloth which is woven very open indeed, so as to insure that it shall never close up and thus retard or arrest the flow of the water through the filter.

By my present improvements I reduce the resistance to the flow of water through the filter to a minimum and thus insure a rapid filtration of the water without the aid of a high pressure.

The supporting-frames E E′ consist of disks or pieces F of wire-cloth surrounded and bound by metal rings or rims 10 and having sewed thereto upon one side the openly-woven asbestos cloth D, the said frames being tinned or made of or coated with such metals or materials as are not liable to be chemically acted upon by the liquid to be filtered. The lower frame E′ rests on an internal flange G or on projections on the interior of the vessel A. The upper frame E is provided with a handle H to facilitate its insertion into and removal from the vessel A, and the passage of unfiltered water between its outer edge and the wall of the vessel A is prevented by means of an asbestos packing or jointing device made and applied as shown in Figs. 2, 3, and 4. The said jointing device consists of a folded tape or band J of asbestos inclosing a piping, cord, or core J′, of asbestos or other suitable

material, which is secured in position by sewing, as shown at *a*, Fig. 4.

The jointing device (shown in Figs. 1, 2, and 3) is made in the form of a ring which is secured around the outer edge of the frame E by sewing or otherwise fastening the free edges of the tape or band J thereto, the fold of the said tape and the inclosed cord or core J′ surrounding the periphery of the said frame.

The flexibly-jointed projecting part of the said jointing-ring presses tightly against the walls of the container and adapts itself to inequalities or undulations of the wall of the container, whether the latter be made of metal, earthenware, or other material, and thus insures a water-tight joint around the edge of the frame E when the said frame is in its operative position, while permitting ready insertion and removal of the said frame by means of the handle H. This peculiar asbestos joint will answer equally well in a cylindrical container as in one which is taper or conical. It is also useful in combination with other kinds of filter-disks—for example, stoneware or other perforated disks.

To retain the frames E E′ and the filtering-felt C in position, I provide a bar M, which engages with offsets N secured to the interior of the vessel A, and through which extends a screw P fixed to the handle H of the upper frame E and provided with a nut Q beneath the said bar, or other suitable means may be employed for securely retaining the said frames and felt in place, while permitting their ready removal when necessary.

The upper part of the vessel A is provided with a valve K controlled by a ball or float, whereby water will be admitted, as required, to the said vessel from a water-main or other source of supply. Taps L, either in the side or bottom of the vessel, are also provided for drawing off the water, when desired, from the upper and lower compartments of the vessel A. The ball or float lever is so arranged that it can be readily removed to permit the withdrawal of the filter disks or diaphragms E E′ and felt.

It will be seen that the filter above described is so constructed that the withdrawal of the felt C, when it becomes fouled by the impurities extracted from the water, and its replacement can be effected very readily and expeditiously. Moreover, one or both the filter disks or frames E E′ can be easily taken out, put into boiling water and thoroughly sterilized, and the containing vessel A, being thus left quite clear of all obstructions, can in like manner be sterilized, and the whole construction can be fitted up again with a fresh disk of felt, without the slightest difficulty, in a few minutes.

By supporting the felt C between the two layers of asbestos cloth D on the filter disks or diaphragms I am, moreover, enabled to protect it against disintegration and to prevent disturbances of the said felt by vibration or oscillation when the filter is used on board ship, in railway-trains, or in similar situations. It is evident that my improved filter disks or diaphragms can, if desired, be used with asbestos films such as are described in my said former patent.

In Figs. 5 to 8 I have shown a very effective, cheap, and portable form or modification of my improved filter, which I term my "bucket-filter." This filter comprises a lower bucket-shaped receptacle A′ for receiving the filtered water and a smaller similarly-shaped receptacle R for the unfiltered water. The receptacle R is provided with somewhat similar filtering arrangements bearing corresponding reference-letters to those above described with reference to Fig. 1, and it is adapted to be inserted in the bucket A′ when the filter is not in use, (see Fig. 8,) or is to be packed or carried from place to place. The bucket A′ is provided with movable or detachable cross-bars S in the upper part thereof, which serve for supporting the smaller bucket R over the larger bucket A′ when the filter is in use, Fig. 7, and for retaining it in the bucket A′ when the filter is not in use, Fig. 8. These cross-bars in the arrangement shown fit into apertures in the wall of the bucket A′, and each bar is provided near one end with a collar *d* and at the other end with a screw-thread on which is fitted a nut *e*, so that the said bars may be firmly secured in position or may be removed as and when required. The handle T of the bucket A′ is secured thereto on the outside thereof in the usual manner. The handle T′ of the bucket R is, however, secured on the inside thereof, so that the bucket R may fit closely within the bucket A′, as shown in Fig. 8. The frame E′ may, if desired, rest upon a flange or upon projections on the interior of the bucket R. To prevent displacement of the frames and felt, however, I prefer to make the bucket R with a perforated bottom R′, which may, if desired, be dished as shown, and which is protected by the chime at the lower end of the said bucket. In this arrangement the felt C and frames E E′ may, if desired, be held down by means of a cross-bar and screw, as above described, or by other convenient means.

In Fig. 9 I have shown a further modification of my improved filter adapted for small sizes. This filter comprises an outer vessel or container A^2 formed with a downwardly-extending neck or nozzle *f* adapted to be inserted into the mouth of a bottle or the like. Inside the container I provide a funnel-shaped vessel U having a nozzle *g*, which passes into the neck *f* of the container A^2. The vessel U serves to support the filtering-felt C and frames E E′, which may, if desired, be held in position by means of a cross-bar and screw, substantially as described with reference to Fig. 1, or in any other suitable manner.

In Fig. 10 I have shown a further modification of my invention in which two sets of felt disks C^2 and frames E^2 E^3 are arranged in an internal cylinder or chamber W provided with

a perforated tube Y. By this arrangement I provide a much larger area of the filtering medium, the water filtering through each of the felt disks C^2 into the interior of the cylinder or chamber W and the filtered water flowing from the said chamber through the tube Y. This arrangement can be conveniently employed in a vessel or tank of large size.

In Fig. 11 is shown another form of constant-supply filter, in which A^4 is a suitable vessel adapted to contain water, said vessel having a rod or pipe B^3, which supports a frame C^4 in a vertical position, this frame containing the filtering disks and medium whereby said filter is designed for lateral filtration, the water passing through the disks to the inside of the frame C^4 and being drawn off by means of a cock or faucet D^4, placed in the lower portion of its side or bottom, but herein shown as discharging from the bottom in line above a drip-pan D^5. It will be understood that in this form of device the arrangements and operations are essentially the same as described for the other forms.

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

1. In a filter, disks or diaphragms of woven asbestos of an extremely open mesh whereby the disks still remain with open meshes and freely pervious to water when thoroughly saturated, an intermediate disk of compressed asbestos flakes or fibers, and a woven-wire fabric to which the woven asbestos disks are secured one of said woven disks having its periphery bound with a flexible tubular binding provided with a flexible joint outside of the plane of the periphery of the woven disk, adapted to form a self-adjusting water-tight joint with the walls of the containing vessel, said tubular binding having an internal filling or core.

2. A filter disk or diaphragm the periphery or outer edge of which has a tubular binding flexibly united to it and adapted to form a self-adjusting water-tight joint with the wall of the containing vessel, and a filling or core for the tubular binding.

3. The combination, with a filter-disk composed of a foraminous backing, and a woven asbestos sheet or piece attached thereto, of a folded flexible strip or binding surrounding the edges of the disk and asbestos sheet, having a core or cord secured in its bight, said strip having its members united exterior of the edge of the disk to form a flexible joint whereby the surrounding binding automatically conforms to the inner wall of the containing vessel and forms a water-tight joint therewith.

4. A filter consisting of a bucket or vessel provided with a filter-bed and a second bucket or vessel adapted to receive the first-named bucket or vessel, and provided with means for supporting the first-named bucket or vessel upon it when in use, said means being detachably secured and adapted to confine the first-named bucket within the other bucket when the filter is not in use.

5. A filter consisting of a supply bucket or vessel provided with a filter-bed, a second bucket or vessel adapted to both support and receive the supply bucket or vessel, rods or bars detachably fitted to the second bucket having one end threaded and adapted to enter bearings in said bucket, and nuts on the threaded portions of the rods or bars adapted to engage the bucket or vessel to lock the bars in place, either when the supply bucket or vessel is supported upon the other bucket or vessel or contained within the latter.

6. The combination, of two vessels one for unfiltered fluids and the other for the fluids when filtered one of said vessels having opposing bearings in its sides, transversely-extending rods or bars detachably fitted to said bearings to form a support for the other vessel, and means comprising collars on one end of the rods and nuts engaging threaded portions of the other ends for detachably securing the bars in place, said bars adapted to extend across the top of the said other vessel to secure it within the companion vessel.

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

EDWARD M. KNIGHT.

Witnesses:
T. W. FOWLER,
GEO. E. TERRY.