No. 758,845. PATENTED APR. 26, 1904.

K. ABRAHAM.

FILTER.

APPLICATION FILED MAR. 4, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.

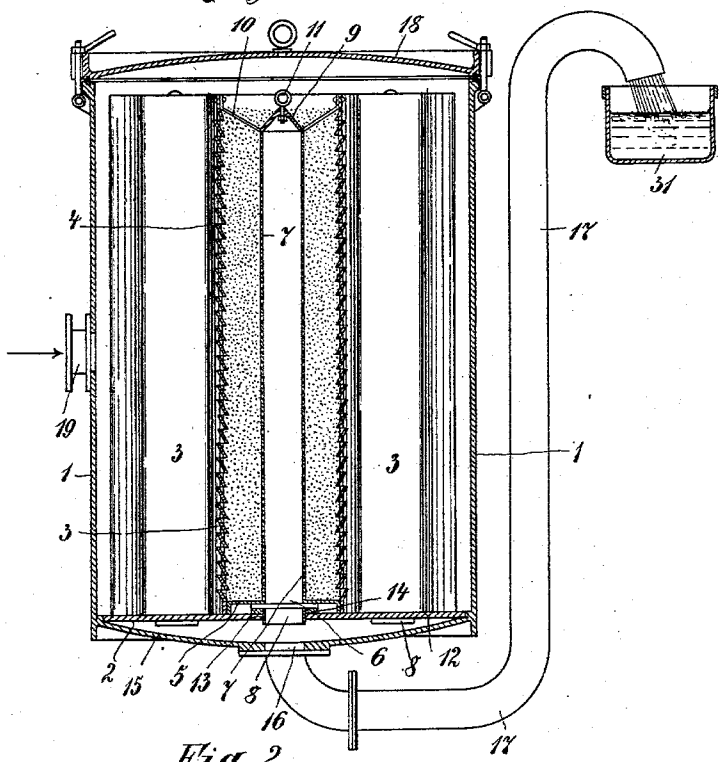
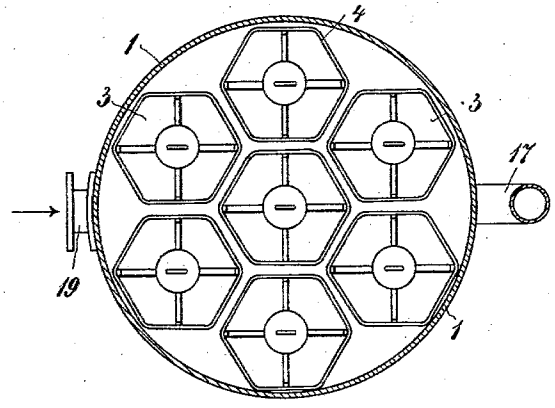


Fig. 2.



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No. 758,345. PATENTED APR. 26, 1904.

K. ABRAHAM.

FILTER.

APPLICATION FILED MAR. 4, 1903.

NO MODEL. 4 SHEETS—SHEET 2.

Fig. 3.

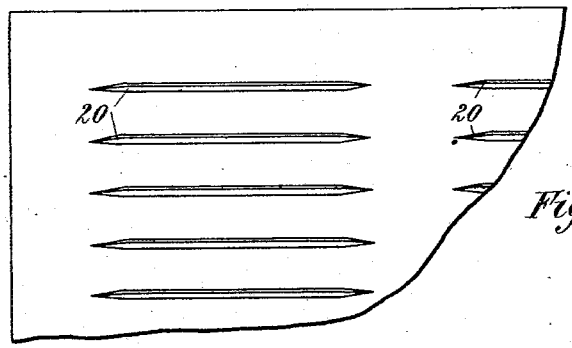


Fig. 4.

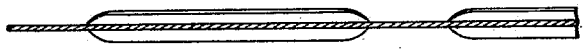


Fig. 5.

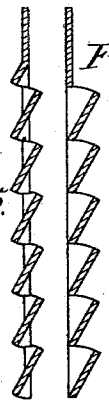


Fig. 6.



Fig. 7.

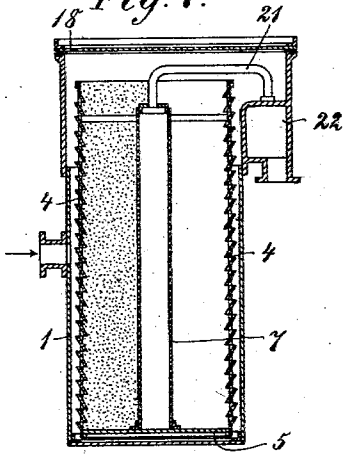


Fig. 8.

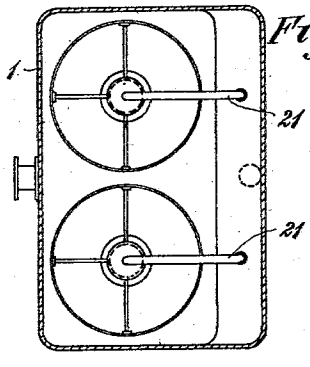


Fig. 9.

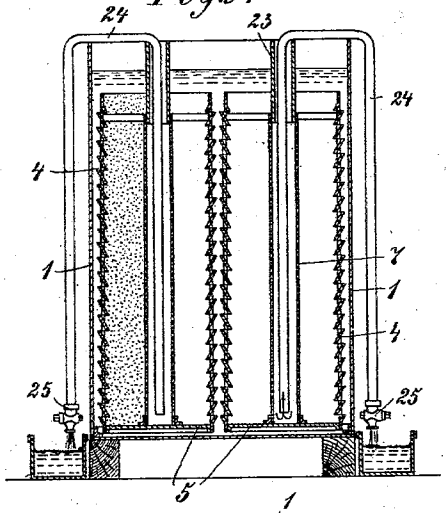
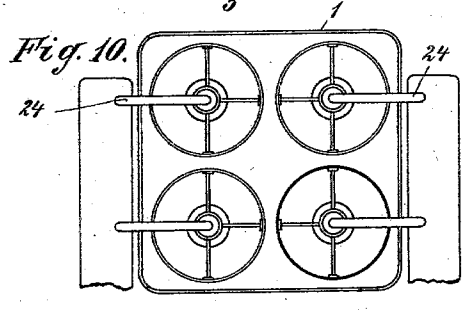


Fig. 10.



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No. 758,345. PATENTED APR. 26, 1904.

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NO MODEL. 4 SHEETS—SHEET 3.

Fig. 11.

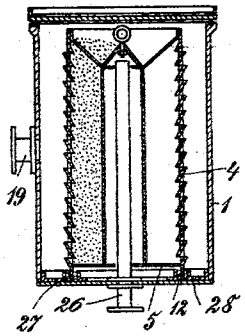


Fig. 12.

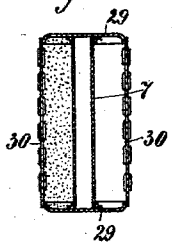


Fig. 13.

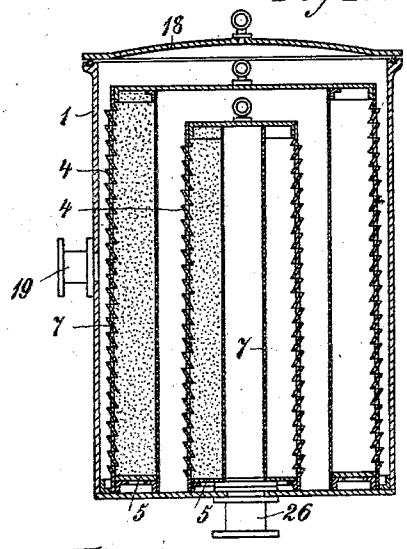
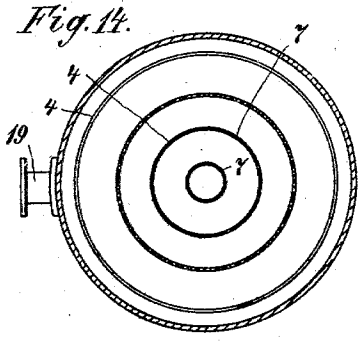


Fig. 14.



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No. 758,345. PATENTED APR. 26, 1904.

K. ABRAHAM.

FILTER.

APPLICATION FILED MAR. 4, 1903.

NO MODEL. 4 SHEETS—SHEET 4.

Fig: 15.

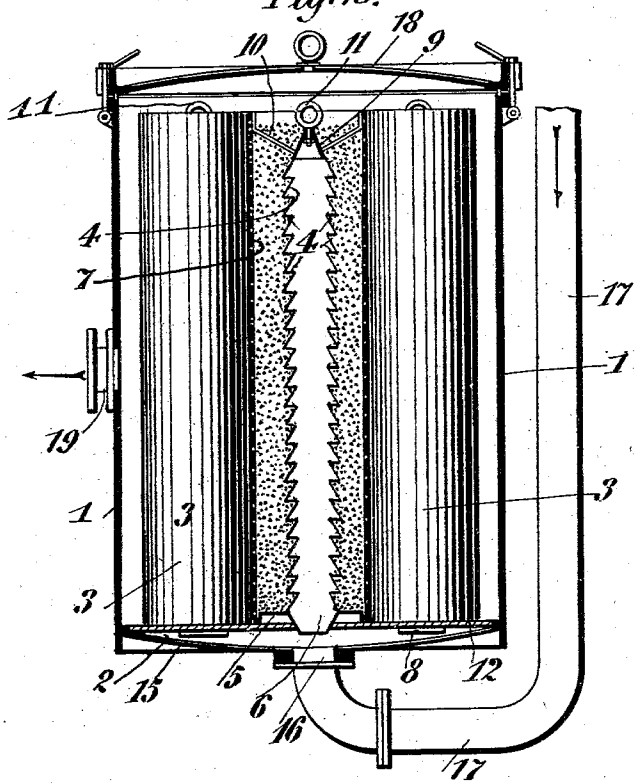
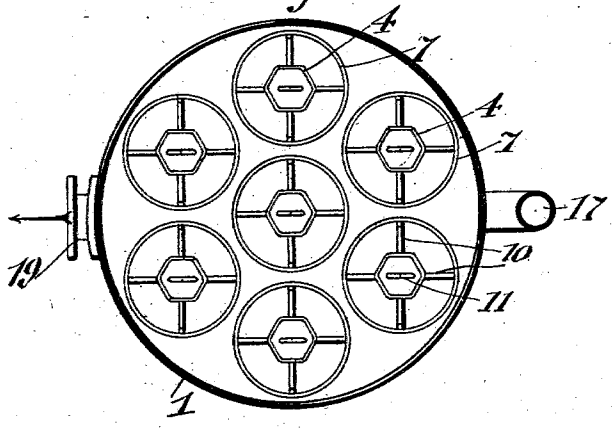


Fig: 16.



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No. 758,345. Patented April 26, 1904.

UNITED STATES PATENT OFFICE.

KARL ABRAHAM, OF KIEW, RUSSIA.

FILTER.

SPECIFICATION forming part of Letters Patent No. 758,345, dated April 26, 1904.

Application filed March 4, 1903. Serial No. 146,075. (No model.)

To all whom it may concern:

Be it known that I, KARL ABRAHAM, engineer, of 24 Boulevard Bibikowski, Kiew, in the Empire of Russia, have invented certain new and useful Improvements in Filters, of which the following is a specification.

Experience in the use of a filter in which the filtering medium is of a granular nature has shown that there is not under all circumstances sufficient free space below for the discharge of the filtering medium; further, in all cases the operators do not succeed in properly managing the filter, and, finally, when the quantities of liquid to be dealt with are large the plant is costly, owing to the large number of filters which are necessary.

The object of this invention is to obviate these defects. This end is attained by the substitution for the special removable annular plates which have hitherto been employed and which serve to cause the granular filtering material to rest on an inclined plane of specially-shaped plates which directly produce the inclination of the filtering material, owing to the fact that from these plates are formed cases of cylindrical, angular, or other convenient form which serve for the reception of the filtering material and which are introduced, together with this material, into the body of the filter and which when required may be readily removed from this vessel.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal section through a constructional form of filter in accordance with this invention. Fig. 2 is a corresponding plan view of the filter in an open condition, showing the seven filter elements which it contains. Fig. 3 is an elevation of a special perforated plate serving for the formation of the boxes or filter elements or filters proper. Fig. 4 is a horizontal section through this plate. Fig. 5 is a vertical section through the same. Fig. 6 is a similar section illustrating another bending of the strips of the plate. Fig. 7 is a vertical section through a filter in which the filtrate is discharged at the upper part owing to the pressure of the liquid to be filtered. Fig. 8 is a horizontal section through the same. Fig. 9 is a vertical section though a filter in which the filtrate is discharged in the upward direction by means of a siphon-tube. Fig. 10 is a plan view of Fig. 9. Fig. 11 is a vertical section through a filter in which the filtrate is discharged at the lower part, but in which a double bottom is not employed. Fig. 12 is a horizontal section through a filter box or element of special form. Fig. 13 is a vertical section through a filter in which boxes or elements are fitted one within the other, one of these cases being filled with coarse and the other with fine sand. Fig. 14 is a corresponding horizontal section. Fig. 15 is a longitudinal section through a filter in which the fluid to be filtered is forced from the inside to the outside or in reverse direction to that shown in Fig. 1, and Fig. 16 is a plan view of the filter shown in Fig. 15 with cover removed.

In a vessel 1 of any suitable cross-section and magnitude which is provided with a double bottom 2 a number of boxes 3 or filters proper are arranged—seven in the present instance. (See Figs. 2 and 15.) These boxes or filters proper consist of a perforated or sieve-like wall 4, which may advantageously be of hexagonal form, as shown, and which is provided with a bottom 5, but is open at the top. In the middle point of the bottom 5 is formed an opening 6, through which passes the tube 7, the short end portion 8 of which extending beyond the bottom of the vessel is not perforated, while that part of it above this bottom is perforated. This tube is closed at its upper extremity by a cone 9 of unperforated material. This conical stopper is supported by stays 10 against the walls 4, and thus maintained in a central position. A handle 11 is arranged at the upper point of the cone. If desired, this handle may be used for supporting the perforated cylinder, in which case the stays 10 may be dispensed with. In the upper bottom 12 of the filter vessel are formed a number of openings 13, the cross-section of which corresponds to that of the tubular extremities 8, so that these latter fit exactly therein. Around these openings 13 are arranged india-rubber rings 14, which are inserted in the bottom 12 and upon which the bottoms 5 of the boxes 4 rest when they are placed in the filter vessel.

Owing to the weight of the boxes and of the filtering material contained therein the bottom 5 is pressed upon the india-rubber washer, thereby making a tight joint between the space surrounding the boxes and the interior of the sieve-tube 7. This may also be effected, as shown in Fig. 15, without the use of rubber packing by making the tubular extremity 8 of conical form and boring the openings 13 to exactly correspond therewith in size. The entire space between the walls 4 and the tube 7 is filled with the filtering medium, so that the liquid to be filtered must necessarily pass through the filtering material before it can reach the tube 7. The lower bottom 15 of the vessel 1 is provided at its lowest point with an opening 16, to which the overflow-pipe 17 is fitted. This latter leads to the conduit 31. If desired, the double bottom may be dispensed with, in which case the filtrate flows into a lower vessel or is carried away by a special conduit. The openings 13 may also be provided with a common tubular connection if it is not desired to fit a double bottom. The vessel 1 is closed at its upper portion by a cover 18. Laterally it is provided with a socket or flange 19, through which the fluid to be filtered (or steam and water) enters. In using the filter as shown in Fig. 15 the order of operation is reversed and the outlet-pipe 17 becomes the inlet-pipe and the inlet-pipe 19 becomes the outlet-pipe.

In order to utilize the advantages of inclined surfaces for the filtering material in filters in accordance with this invention, it is preferable to employ for the removable boxes walls 5, which are not merely of perforated material, but which consist of specially-formed sheets provided with parallel slots 20, Fig. 3. These slots do not quite meet nor do they extend to the edge of the plate. The parts lying between each pair of superposed slots are so bent outward or inward as to form a predetermined angle with the plate. The parts may be bent in such a manner that the upper edges are bent outward and the lower edges inward. The ends of the strips therefore project left and right from the plane of the plate, Figs. 4 and 5, or only the upper edges may be bent outward, the under edges remaining in the plane of the plate, Fig. 6. The strips consequently all receive a uniform inclination to the plate itself, similar to Venetian shutters, except that here the ends of the bent portions do not loose their connection with the plate. If plates of this kind are bent so as to form angular bodies, the extremities united and the body so formed provided with a bottom, a box or casing of the desired kind is obtained in which the filtering medium will present the required inclined surfaces owing to this special formation, so that an increased surface is presented to the fluid to be filtered.

The manner of employing this filter is as follows: The separate filter elements 3 are filled with sand, gravel, coke, or the like filtering material to their upper edge and then placed in the filtering vessel. When all the boxes or filters proper have been placed in position, the fluid to be filtered is carefully admitted at 19. It passes through the orifices in the walls 4 to the filtering medium, which owing to the inclined surfaces in which it lies presents to it a considerable superficial extent. After traversing the layer of filtering medium in the horizontal direction the fluid passes through the sieve into the tube 7, whence it flows through 8 to the tube 17. The filtering operation is only fully started when the vessel 1 is quite full of fluid so that it flows from the outlet-pipe 17. The whole of the filtering-surface is then operative. When the filter no longer furnishes a supply, the admission-aperture is closed, the fluid which it contains is withdrawn from the filter, and the separate filtering elements are removed. When the clogged filtering medium has been replaced by fresh or washed material, the elements are replaced and the filtration may be resumed. The filtering elements may be removed by means of an aerial railway, in hand-trucks, or in any other appropriate manner to the spot where the cleansing of the filtering medium can be most conveniently effected.

In order to obviate the necessity for employing a vessel provided with a double bottom, the filtrate may be withdrawn from the upper part of the sieve-cylinder 7. This may be effected either by means of pressure or of a siphon-tube. In Figs. 7 and 8 filters are shown which are adapted to operate under pressure. The wall 4 of the filter elements is in this case provided with an unperforated bottom 5. The sieve-cylinder 7 is closed above and is provided at its upper portion with a tube 21, presenting a double bend. The other extremity of this tube extends through the upper wall of the casing 22, being packed by means of a rubber washer. The vessel 1 is hermetically closed by the cover 18 and the pressure of the fluid to be filtered itself forces the filtrate out of the cylinder 7 through the tube 21 into the vessel 22. If, however, it is desired to operate without pressure while still drawing off the filtrate at the upper part of the apparatus, the form of filter shown in Figs. 9 and 10 should be employed. In this case the vessel 1 is open above, the boxes 4 are provided with unperforated bottoms 5, the inner collecting-cylinder 7 is open above and is furnished somewhat below the upper level of the filtering medium with an unperforated tubular socket 23. In this socket is fitted one extremity of an unperforated siphon-tube 24, the other extremity of which is provided with a regulating-cock 25, by means of which the outflow of the filtrate may be regulated in such a manner that the whole of the filtering-surface is always operative—that is to say, that the

level of the fluid to be filtered does not fall below the upper edge of the filter elements.

In special cases in which the fluid to be filtered is lighter than water provision may be made for removing it at the upper part of the filter when filtration is completed. On the bottom 12 tubes 24 are arranged, and upon these the filter elements are placed, Fig. 11, these latter being formed in the same manner as those shown in Fig. 1, except that the tube 8 beneath the bottom 5 is dispensed with and the opening in the bottom 5 is made large enough to permit of the element being readily passed over the tube 26. The lower edge 27 of the wall 4 of the filter element must, however, project in this case and either enter a layer of sand laid upon the bottom 12 of the filtering vessel or else there are formed by means of angle-irons 28 upon the bottom 12 special channels, which are filled with sand, into which the edges 27 extend when the filter element is placed in position. A joint may, however, be made in any other convenient manner. The essential point is that the liquid outside the filter element must always be obliged to pass through the layer of filtering material in order to reach the cylinder 7 and flow through the pipe 26. As the filtrate is only able to flow downwardly and outwardly through 26, whereas the forcing medium employed when filtration is completed enters below and flows upwardly, the whole of the filtrate will be forced from the filter before the filter is filled with the forcing medium.

Obviously the filter elements or filters proper may be of any desired cross-section. For example, they may be cylindrical, as in Figs. 8 and 10, polygonal, as in Fig. 2, or rectangular, as in Fig. 12. In the boxes represented in Fig. 12 the narrow sides 29 are shown closed or solid and only the long sides 30 are slotted and bent out in the manner described, so that the filtering medium is exposed only on these sides where the inclined surfaces are formed and the filtering-surface presented. As the boxes are readily removable, a set of reserve boxes may be provided for each filtering vessel, so that only such boxes as are stopped up may be replaced by boxes containing fresh filtering material. The novel construction is very inexpensive, of high capacity, and presents the important technical advantage that the filters may be readily adapted to any special conditions as to place, &c., and require little or no attention by workmen.

In order to effect filtration from the inside to the outside, it is only necessary to form the inner tube or cylinder 7 of the special plates, while the walls 4 are of ordinary sieve material, as clearly shown in Figs. 15 and 16, where the liquid to be filtered of course enters and leaves the filter in reverse directions to that described for Figs. 1 and 2. These filters are adapted for the filtration of fluids of all kinds, but more particularly for filtering vapors and gases.

In cases in which owing to the nature of the substance to be filtered it is desirable to submit it to a twofold or multiple filtration, this may be readily effected, owing to the interchangeable arrangement of the filtering elements or boxes, by placing two filters in series or it may carried out in one and the same filter. In this latter case two or more filter elements of the kind described are inserted one within the other, the outer element or elements being of cylindrical form, (see Figs. 13 and 14,) the device being confined on one side by slotted plates of the kind described and on the other by sieve-surfaces. These latter may be cylindrical, while the former are preferably polygonal, and in all cases the sieve-wall of one element is arranged in proximity to the sheet-metal wall of the adjacent element. According as the filtration is to take place from the inside or from the outside the various filter elements are provided with filtering material of different degrees or coarseness, this material becoming finer from the inside to the outside, or vice versa. The substance to be filtered which has already been passed over coarse filtering medium in one element reaches the inclined surfaces of the finer filtering medium of the next element, and so on. As the elements are removable, the different grades of filtering medium may be cleansed in different washing devices, so that mixing of the various kinds of material may be readily avoided. Upon the side on which the filtrate passes out of the filtering medium the sieves may be replaced or augmented by fabric.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a filter, the combination, with a vessel having a bottom and supply and discharge pipes, of a filter proper removably supported on the bottom of the vessel, comprising a wall for the entrance of the liquid to be filtered having apertures and inclined projecting surfaces in proximity to the same, a perforated wall secured to said first-named wall for the exit of the filtered liquid, a bottom for the filter proper connecting the apertured wall with the perforated wall, and a filtering material interposed between the walls, substantially as set forth.

2. In a filter, the combination, with a vessel having a bottom and supply and discharge pipes, of a filter proper removably supported on the bottom of the vessel, comprising a wall for the entrance of the liquid to be filtered, consisting of a single piece of metal having apertures, and the metal between the apertures bent for forming inclined projecting surfaces in proximity to the same, a perforated wall secured to said first-named wall for the exit of the filtered liquid, a bottom for the

filter proper connecting the apertured wall with the perforated wall, and a filtering material interposed between the walls, substantially as set forth.

3. In a filter, the combination, with a vessel having supply and discharge pipes, of a filter proper removably supported on the bottom of the vessel, comprising a wall for the entrance of the liquid to be filtered having apertures and inclined projecting surfaces in proximity to the same, a perforated wall secured to said first-named wall for the exit of the filtered liquid, a bottom for the filter proper connecting the apertured wall with the perforated wall, a filtering material interposed between the walls, and a fabric in proximity to the wall for the exit of the filtered liquid for retaining the finer grades of filtering material, substantially as set forth.

4. In a filter, the combination, with a vessel having a bottom and supply and discharge pipes, of a plurality of filters proper, each removably supported on the bottom of the vessel and each comprising a wall for the entrance of the liquid to be filtered having apertures and inclined projecting surfaces in proximity to the same, a perforated wall secured to said first-named wall for the exit of the filtered liquid, a bottom for the filter proper connecting the apertured wall with the perforated wall, and a filtering material interposed between the walls, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

K. ABRAHAM.

Witnesses:
THOMAS MILES,
T. E. HEENAN.