

N^o 22,737



A.D. 1914

Date of Application, 19th Nov., 1914

Complete Specification Left, 19th May, 1915—Accepted 20th Dec., 1915

PROVISIONAL SPECIFICATION.

**Improvements in and Connected with the Purification
of Sewage and Analogous Liquids.**

We, WALTER JONES, J.P., and JONES AND ATTWOOD, LIMITED, Engineers, all of Titan Works, Amblecote, Stourbridge, in the County of Worcester, do hereby declare the nature of this invention to be as follows:—

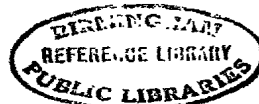
This invention has reference to systems of purifying sewage and analogous impure liquids, in which the purification is effected by the action of aerobic bacteria, or other similar forms of germ life, upon the sewage or liquid; and it relates moreover, mainly to such systems wherein the sewage or liquid to be purified is introduced into a tank or vessel, and is together with sludge containing the bacteria or germ life, subjected to the action of air delivered into it in small bubbles, such as those produced by forcing air through a porous stone or other air diffusing body; and the sewage and sludge are brought to and kept by the air supplied to them in intimate contact, the sludge being distributed or dispersed throughout the whole of the liquid portion of the sewage uniformly, causing the liquids of the tank to be continuously circulated and in motion by the air, which also aerates the liquid, and keeps the bacteria in a vigorous, and very active and effective state.

In the carrying out of this process by the continuous fill and draw off operation under this invention, the tank will be of an endless type, and the crude sewage will be introduced into it at one part, and the purified effluent will be discharged at another part; and in one form, the tank is of channel form, with semi-circular ends, and its inside wall forming within it another tank, to which the treated or purified liquid, and any sludge carried over with it, will pass; and from which at a suitable point at the surface, the purified liquid will be drawn off while the deposited sludge will be lifted from the bottom of this chamber or tank by an air lift back into the first or purifying tank. The liquid in the second tank will be quiescent, while that in the purifying tank will be continuously aerated and circulated, so as to be a homogeneous mixture.

The outer and treating tank or portion will be provided at certain distances apart, at the bottom, with air supply means or diffusers, and with curtain walls extending down into same to near the bottom, so that as the liquid flows under same, it becomes charged with air rising from the air supplying diffusers or means in the bottom, and thereby rendered lighter than the liquid above, and in consequence rises on this side of the curtain wall above the level of the liquid not so charged with air, and so produce a forward flow and circulation through the tank. Thus the liquid receives a succession of propelling actions, due to the air lightening and lifting effect, and thus the air serves as a pump or series of pumps, as well as an upward and downward circulating and distributing means, and in addition to its function as the medium of energizing and keeping up the active principle of the sludge life.

At one part of the treating tank, there is connected with it, at its upper part or level, a weir, say of a tray form, extending over the inner tank; and this

[Price 6d.]



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weir portion will be connected with a part of the purifying tank in which there are no air supplying devices or diffusers, or where they are a large distance apart, so that in this part of the purifying tank the sludge will largely fall from the upper strata of the liquid, and only that liquid, from which the greater part of the sludge has precipitated, will pass out and by way of the weir, into the inner tank; which constitutes a precipitation tank and from the upper part of which the clarified and purified liquid is continuously drawn off.

The inner tank may have an inclined bottom or sump; and the sludge which falls to the bottom, gravitates to the lowest point, and is forced from it by an air lift into the purifying tank; and it may be delivered at or near the inlet of raw sewage.

The discharge from the weir tray into the inner tank may be below the level of the liquid in the latter, or it may be at or near the surface.

If desired, the sludge lift, and the purified liquid outlet pipe or conduit—the mouth of which is at the liquid level—may be placed at the same part of the inner tank; in which case they should be at the end farthest away from the weir delivery.

The tank instead of being elongated with oval or curved ends, may have a plurality of zigzag courses, or it may be of annular-form in a portion forming the second tank.

When the inner tank lies between the inner walls of an oblong purifying tank, and the water is taken off practically continuously, the weir or take off part may be on one end of this inner elongated tank, and its final discharge at the other, the outflow being at the upper level, and passing away into a mouth or trough of a conduit; and if the sludge is arranged to deposit or gravitate to this end, it may be forced by an air lift up into a trough, say on one of the walls, and conducted to the opposite end, and re-transferred to the purifying tank, and be delivered directly over one of the air supplying means or diffusers, so that it is broken up and deposited again, and this point of introduction may be near the inlet of the crude sewage.

Also the portion or surface of sludge over and above that required in the tank, may be conducted away from this pipe or conduit by fitting to it a separate piece of pipe when required.

Dated this 18th day of November, 1914.

E. R. ROYSTON & CO.,
Applicants' Patent Agents,
Tower Building, Water Street, Liverpool;
and
Donington House, Norfolk Street, London.

COMPLETE SPECIFICATION.**Improvements in and Connected with the Purification
of Sewage and Analogous Liquids.**

We, WALTER JONES, J.P., and JONES AND ATTWOOD, LIMITED, Engineers, all of Titan Works, Amblecote, Stourbridge, in the County of Worcester, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

This invention has reference to systems of purifying sewage and analogous impure liquids, in which the purification is effected by the action of aerobic bacteria, or other similar forms of germ life, upon the sewage or liquid; and it relates moreover, mainly to such systems wherein the sewage or liquid to be

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purified is introduced into a tank or vessel, and is together with sludge containing the bacteria or germ life (and generally a large proportion of sludge—say 20 per cent. or over) subjected to the action of air delivered into it in small bubbles, such as those produced by forcing air through a porous stone or other air diffusing body; and the sewage and sludge are brought to and kept by the air supplied to them in intimate contact—the sludge being distributed or dispersed throughout the whole of the liquid portion of the sewage uniformly—by causing the liquids of the tank to be continuously circulated and kept in motion by the air, which also aerates the liquid, and keeps the bacteria in a vigorous and very active and effective state.

In the carrying out of this process by the continuous fill and draw off operation, under this invention the tank will be of an endless type, and the crude sewage will be introduced into it at one part, and the purified effluent will be discharged at another part; and in one form, the tank is of channel form, with semi-circular ends, and its inside wall forming within it another tank, to which the treated or purified liquid, and any sludge carried over with it, will pass; and from which at a suitable point at the surface, the purified liquid will be drawn off, while the deposited sludge will be lifted from the bottom of this chamber or tank by an air lift back into the first or purifying tank. The liquid in the second tank will be quiescent, while that in the purifying tank will be continuously aerated and circulated, so as to be a homogeneous mixture.

The outer and treating tank or portion will be provided at certain distances apart, at the bottom, with air supply means or diffusers, and with curtain walls extending down into same to near the bottom, so that as the liquid flows under same, it becomes charged with air rising from the air supplying diffusers or means in the bottom, and thereby rendered lighter than the liquid above, and in consequence rises on this side of the curtain wall above the level of the liquid not so charged with air, and so produce a forward flow and circulation through the tank. Thus the liquid receives a succession of propelling actions, due to the air lightening and lifting effect, and thus the air serves as a pump or series of pumps, as well as an upward and downward circulating and distributing means, and in addition to its function as the medium of energising and keeping up the active principle of the sludge life.

At one part of the treating tank, there is connected with it, at its upper part or level, a weir, say of a tray form, extending over the inner tank; and this weir portion will be connected with a part of the purifying tank in which there are no air supplying devices or diffusers, or where they are a large distance apart, so that in this part of the purifying tank the sludge will largely fall from the upper strata of the liquid, and only that liquid, from which the greater part of the sludge has precipitated, will pass out and by the way of the weir, into the inner tank; which constitutes a precipitation tank and from the upper part of which, the clarified and purified liquid is continuously drawn off.

The inner tank may have an inclined bottom or sump; and the sludge which falls to the bottom gravitates to the lowest point, and is forced from it by an air-lift into the purifying tank; and it may be delivered at or near the inlet of raw sewage.

The discharge from the weir tray into the inner tank may be below the level of the liquid in the latter, or it may be at or near the surface.

If desired, the sludge lift, and the purified liquid outlet pipe or conduit—the mouth of which is at the liquid level—may be placed at the same part of the inner tank; in which case they should be at the end farthest away from the weir delivery.

The tank instead of being elongated with oval or curved ends, may have a plurality of zigzag courses, or it may be of annular form the inner portion forming the second tank.

Drawings illustrating the above arrangement and construction of purifying plant, and mode of operating are hereto annexed.

Improvements in the Purification of Sewage and Analogous Liquids.

Figure 1 is a longitudinal section; Figure 2 is a plan; and Figure 3 a cross section through one arrangement, involving improvements hereunder.

Figure 4 is a plan; Figure 5 is a cross section taken at the line AA Figure 4, and Figures 6 and 7 are longitudinal sections taken at the line BB and CC of Figure 4 respectively, of a modified arrangement of tanks or plant. 5

Figure 8 is a plan showing another slight modification of the arrangement of tanks or plant.

Referring now to the drawing, 1 generally represents the tank or tanks of endless type in which the treatment is effected, and 2 represents the tank or chamber in which the deposition of the sludge takes place, and from which the purified and clarified effluent is carried off. 10

The air supplying diffusers or means for introducing air in fine bubbles into the liquid are marked 3, they being placed at the bottom of the tank; and 4 are the curtain walls disposed just on the up-stream side of the air suppliers 3, and depending down into the tank to a point near the bottom; but their lower edge may stand a relatively large distance from the bottom. 15

9 are projecting portion of the floors of the tank 1 on the down-stream side of the air supplying means 3; and between each of the curtains 4 and these parts 9, the air charged column of sewage will rise, and will be lifted above the normal level of liquid, due to its consisting of a combined volume of air and liquid. 20

5 is the raw sewage inlet pipe, and 6 is the clarified and purified effluent discharge pipe. 7 is the air-lift for elevating the sludge from the bottom of the depositing tank or chamber 2; and 8 is the conduit into which this sludge air-lift discharges, and which conducts the sludge back into the tank 1. 25

The weir over which the flow of fluid from the tank 1, into the tank 2, takes place, is marked 10.

In the arrangement shown in Figures 1 to 3, the tank 1 is of endless form, consisting of two parallel channel portions, relatively long to their width, and connected together at their ends; whilst the depositing tank 2 lies within the inner walls of this channel, and is also relatively narrow as shown. 30

The crude sewage is directed into one of the channels of the tank 1 about the centre and near the top of same; and when it is full, the overflow passes through an opening in one of the inner walls on to the weir 10, which is in the form of a tray, whence it falls down into the liquid at one end of this tank or chamber. 35

Between this weir and the air supplying means 3 on the up-stream side, a relatively long distance is left, as shown in Figure 2, so that between this point and the weir an opportunity is given the liquid for the depositing of sludge.

The floor of the tank 2 is inclined, and in flowing from the inlet end to the other downwards, the sludge deposits, and it gravitates towards the opposite end down the inclined bottom of the sump or inlet of the air-lift 7, whence it is pumped by it into the channel 8, and is re-delivered into the sewage at the inlet end of the treating tank 1, just in advance of the inlet pipe 5. 40

The clarified sewage or effluent is carried off from the upper level of the liquid in the tank 2, by the weir 10, from which the discharge pipe 6 leads. 45

The effect of the air being supplied to the sewage or liquid from the bottom, between the vertical planes in which the curtains 4 and the raised portions 9, lie, is that the liquid receives a succession of propelling actions due to the lightening effect of the air and its lifting result; and so this arrangement constitutes so many pumps (as well as so many means of supplying the sewage with air for bacteriological purposes), and so forcing the sewage round and round the tank. 50

The portion or surplus of sludge over and above that required in the tank, which say is about 20 per cent. to 30 per cent. of the total contents, may be conducted away from the sludge conduit 8 by a separate pipe connected with it, or a trough or the like, and delivered to any suitable place of deposit. 55

The sludge which is re-transferred to the treating and purifying tank 1 is de-

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livered into it near the point of crude sewage inlet, and to one of the diffusers 3, so that it is broken up and re-distributed again.

In the arrangements shown in Figures 4 to 7, the tank 1 is continuous, but arranged in a zigzag manner, in which there are a plurality of parallel channel parts; and the depositing chamber or tank 2 is disposed at one side of same, and communicates with same by way of the weir 10, which may have removable boards in it, to raise and lower its sill level.

The liquid from the weir 10 first falls into the intermediate chamber 13, having an opening 14 at the bottom, opposite one end of the depositing tank 2; whilst at the opposite end, a clarified effluent discharge weir 12 is placed, which discharges into the intercepting tank 15.

The sludge in this case is pumped by the air-lift 7 from the sump 16 in the bottom of the tank 2 near the weir 12; and it is discharged into the gutter 8, which carries it into a supply sump 17, into which the crude sewage flows, and from which it passes into the first portion of the tank 1. In this sump 17 the mixing of the sludge and raw sewage takes place.

The tank 1 may have the sludge, or a portion of it, as may be desired, carried away from it by the pipes 18, the entrance of which will be at about the level of the air supplying means or diffusers 3, they being controlled by suitable valves or chambers; and all of the diffusers in line connecting with one another at their surfaces by way of holes through the division walls.

In the modification shown in Figure 8, the tank is largely of the type shown in Figures 1 to 3, but the settling or sludge deposit tank 2 is arranged outside the tank 1, and parallel with the channels of same, instead of within same.

The bottom of the depositing tank 2 as set forth with reference to Figures 1 to 3, is inclined from one end towards the other; but in this case Figure 8, or in others, it may be assumed that the bottom is arranged in a plurality of inclined parts, similarly to the bottom of the tank 1; and that the sludge collects at the lowest portions of these sections, and flows towards the sumps 16, from whence it is lifted and re-delivered into the tank 1 at a suitable part.

In another slightly modified arrangement, the treating and depositing tanks may be in line, and separated by a transverse wall, the upper part of which would form the weir, over which the purified liquid from the treating tank would flow; and raw sewage to be treated being introduced at the opposite end to the weir; and the treating tank may itself be of a plain type, the sewage supplied to it being distributed at one end, so that it gradually and uniformly passes from this end through the whole tank, over the weir dividing it from the depositing vessel or tank beyond.

In some cases the bottom of the treating tank when of the latter type, will be provided with a series of air supply diffusers, extending across it from side to side, at each side of which are ridges, so that the up-current caused by the air will take place in the spaces between the ridges; and the down current of liquid and its contained sludge will be directed by the inclined bottom parts or ridges again over the air suppliers or diffusers, which lie between the ridges.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In the purifying of sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, continuously supplying crude sewage or liquid to a tank in which the liquid is subject to the action of air forced through it in the presence of bacterial sludge; and drawing off the top liquid of this tank and delivering it into a separate tank, and depositing the sludge contained in it therein; substantially as described.

2. In the purifying of sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter continuously supplying crude sewage or liquid to a tank in which the liquid is subject to the

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action of air forced through it in the presence of bacterial sludge; drawing off the top liquid of this tank and delivering it into a separate tank, and depositing the sludge contained in it therein; and transferring this sludge to the sewage or liquid in the treating and purifying tank; substantially as described.

3. In the purifying of sewage or analogous liquids, as in claim 1, the arrangement of tanks or plant substantially as set forth with reference to Figures 1 to 3; Figures 4 to 7; and Figure 8 respectively, of the drawings. 5

Dated this 18th day of May, 1915.

E. R. ROYSTON & CO.,
Applicants' Patent Agents,
Tower Building, Water Street, Liverpool; 10
and
Donington House, Norfolk Street, London.

EXTENSION OF PATENT.

The term of the Patent No. 22737, A.D. 1914, has been extended to expire on the thirty-first day of December, 1932, by Order of the High Court.

THE PATENT OFFICE,

6th November, 1930.

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[This Drawing is a reproduction of the Original on a reduced scale.]

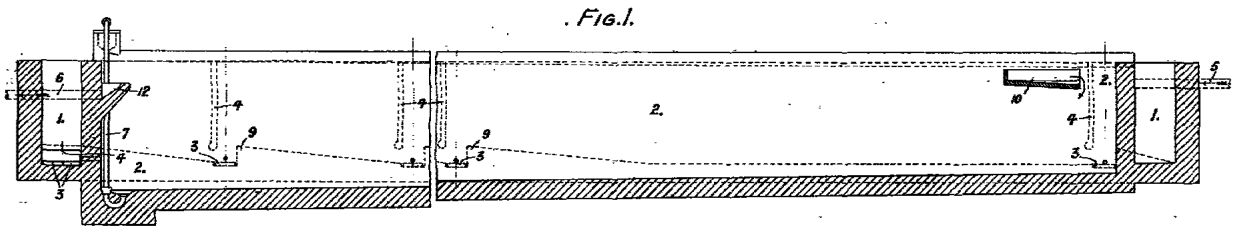


Fig. 2.

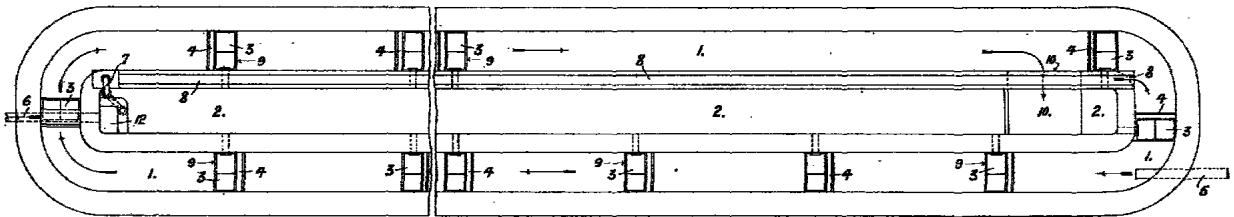
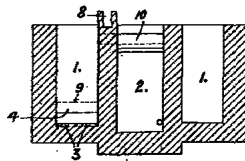


Fig. 3.



[This Drawing is a reproduction of the Original on a reduced scale.]

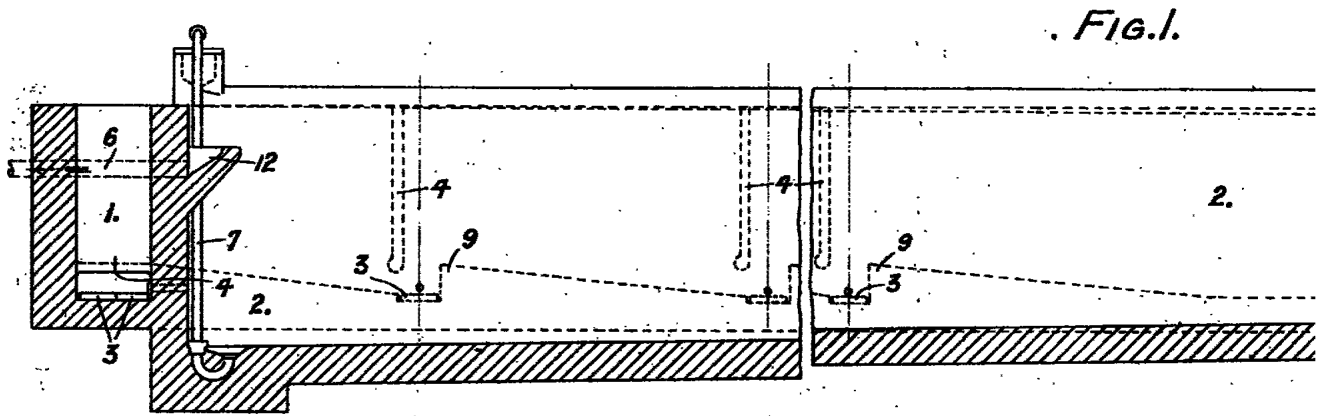


FIG. 1.

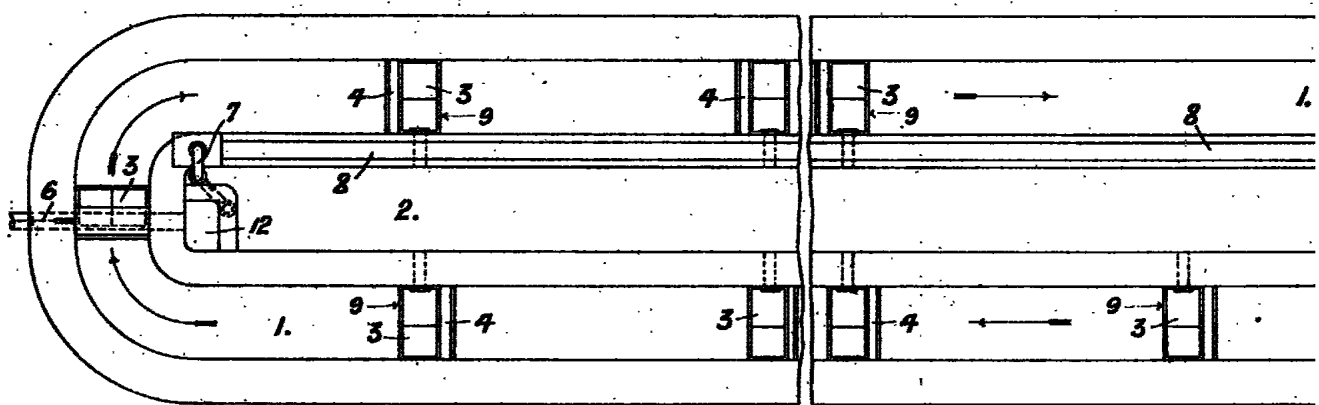


FIG. 2.

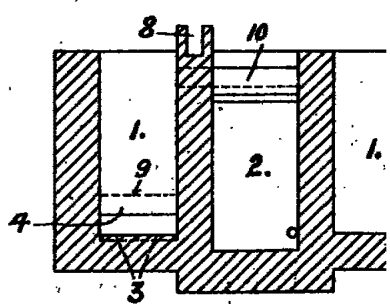
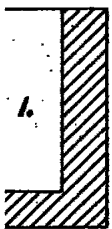
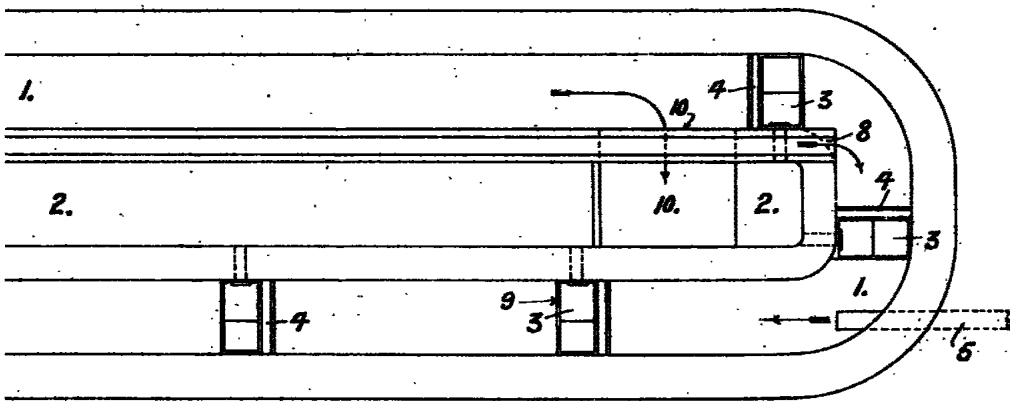
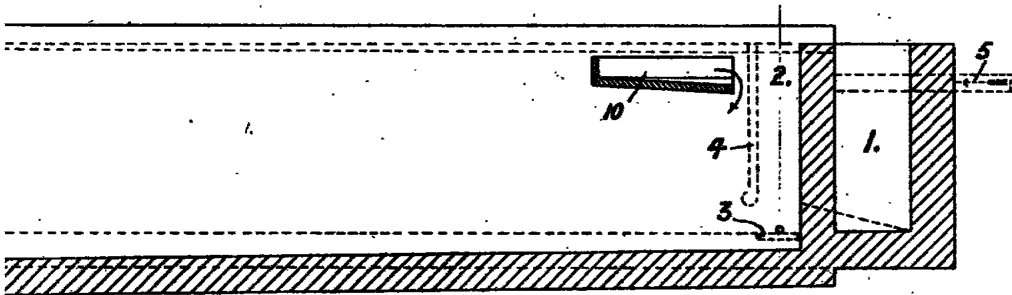
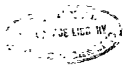
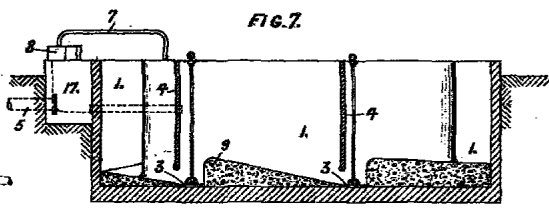
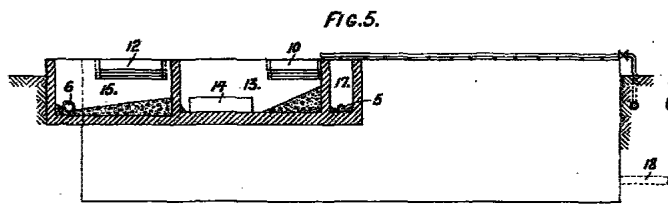
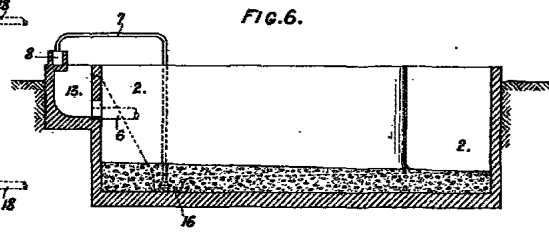
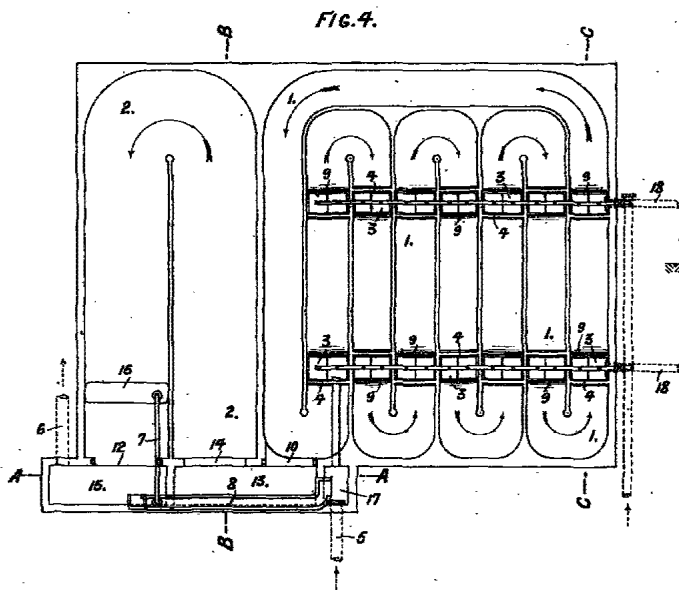


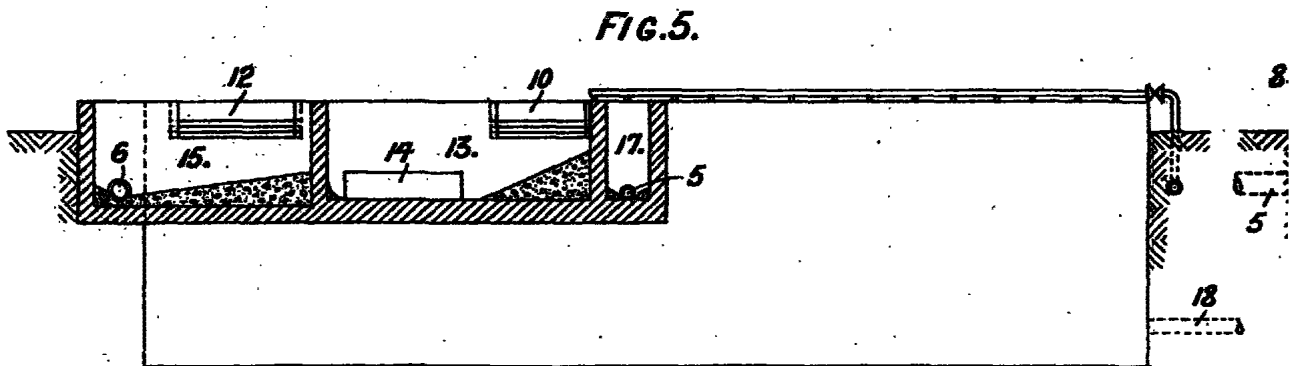
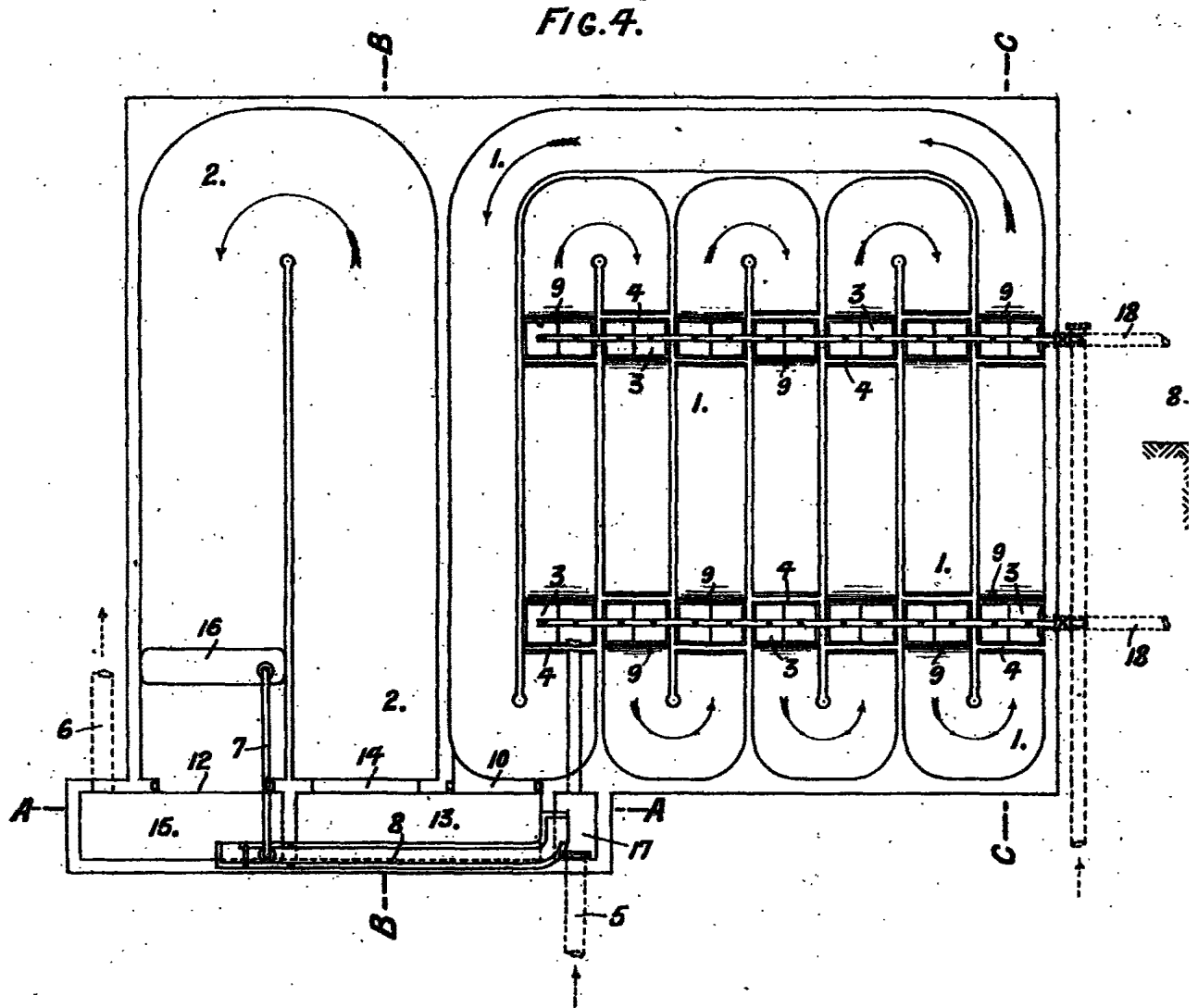
FIG. 3.



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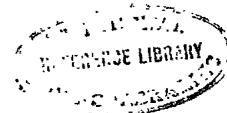
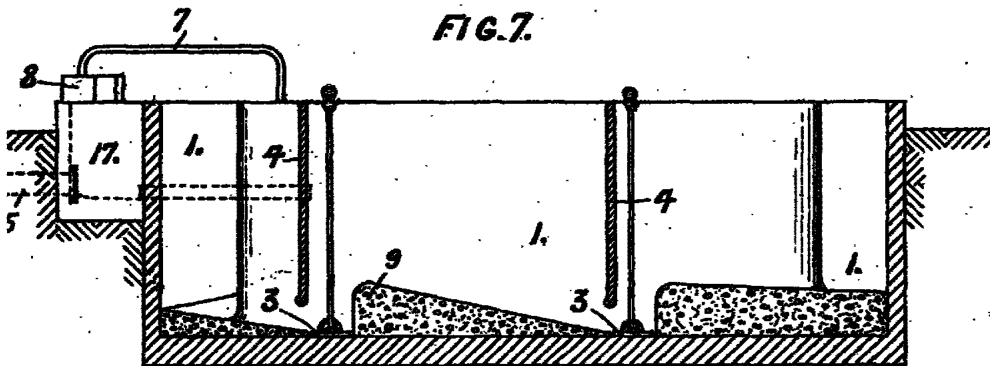
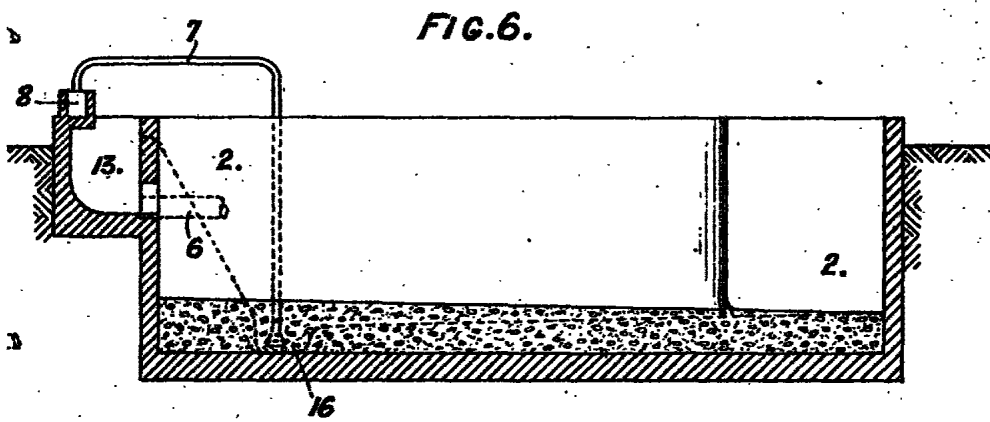
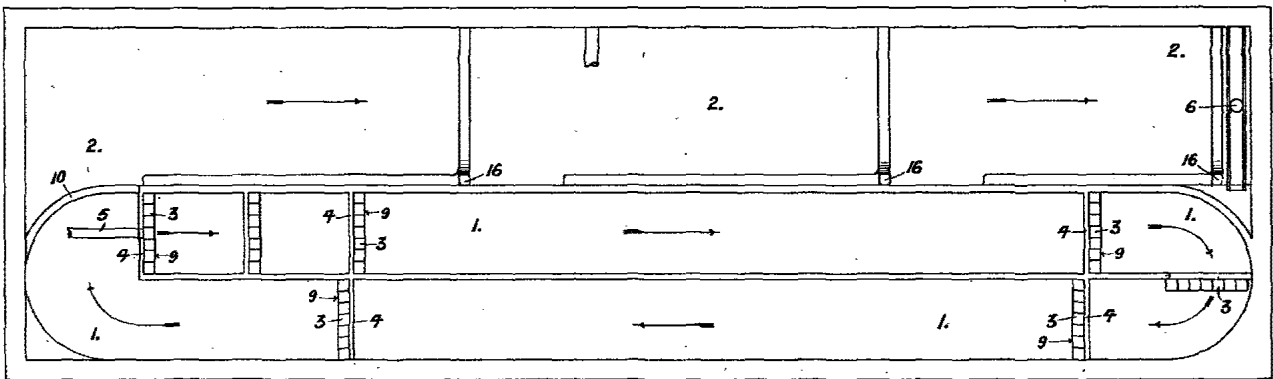


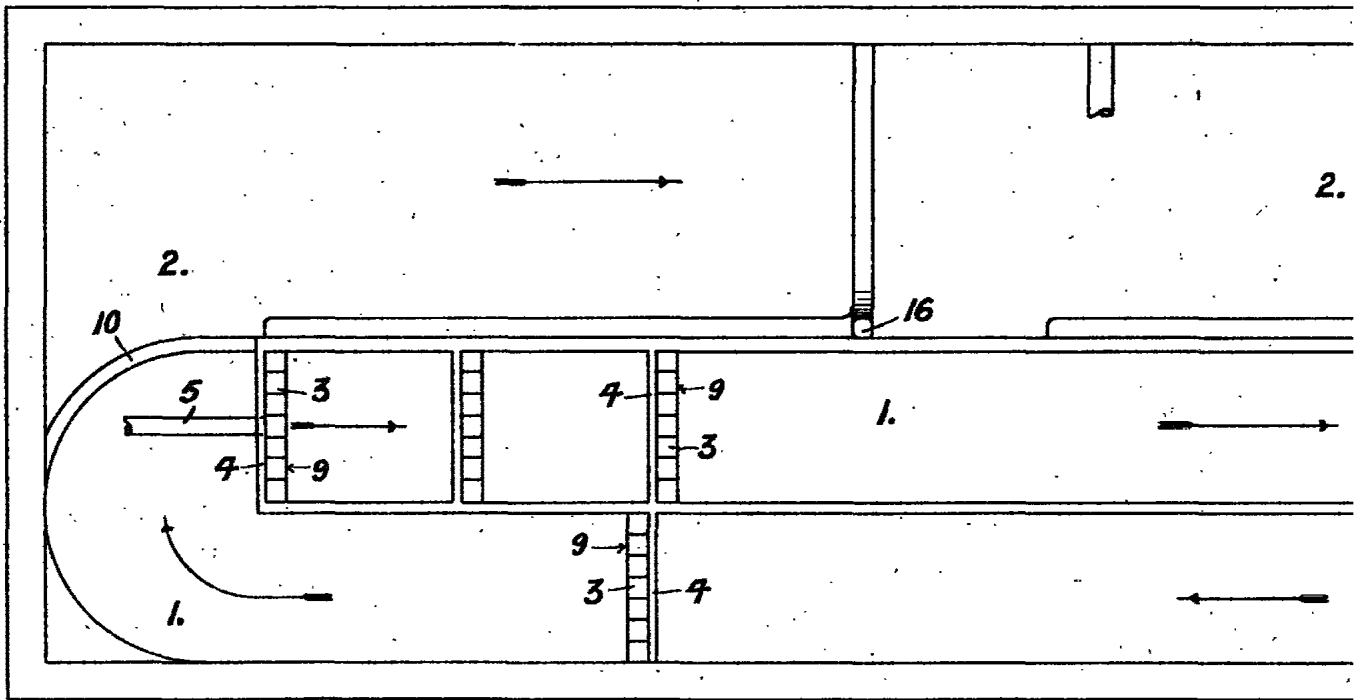
FIG. 8.



[This Drawing is a reproduction of the Original on a reduced scale.]



FIG. 8.



[This Drawing is a reproduction of the Original on a reduced scale.]

