

N^o 22,736



A.D. 1914

Date of Application, 19th Nov., 1914

Complete Specification Left, 19th May, 1915—Accepted, 23rd 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 by 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.

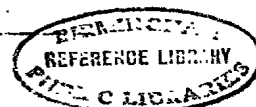
The objects and effects of the present invention are generally to provide improvements in connection with systems of sewage or analogous liquid purification systems of the kind referred to, and plant used, by which the process of purification can not only be carried out at a high rate, but it can be effected more uniformly, and the condition necessary for obtaining best results or effects more easily obtained and preserved; and also generally to provide a construction and mode of operation which is convenient, easily worked, and advantageous.

In the method of carrying on the process of purification hereinafter described, and the plant and arrangement of parts specified, the improvements hereunder are comprised.

In a system of purification of sewage and analogous liquids according to this invention, say at starting, the tank will contain a quantity of sludge in cultivated state, containing bacteria of the necessary species in a high degree of purifying activity and effect. The tank is gradually and quietly filled with fresh sewage, and while it is being so filled, air is supplied to the contents at the bottom at various points, and preferably in the form of fine or minute bubbles properly distributed or diffused, so as to act on the sludge life, and on the liquid, as it comes in, and distribute the bacteria uniformly throughout the mass. The gradual filling of the tank may be distributed over several hours, say three to six hours.

When the tank is full, the contents having been acted upon all the time during filling by the air, the process of the breaking down of the impurities, and nitrification of the sludge will have been accomplished. The supply both

[Price 6d.]



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of liquid and air are then stopped, and the contents of the tank will remain quiescent for a period, say about an hour; and after a time of quiescent precipitation of the sludge and solid matters, purified water at or near the surface will be gradually decanted or drawn off; the whole drawing off operation taking say about one hour. 5

In some cases, a plurality of tanks are employed, and are arranged to work in sequence, as hereinafter described, so that there will be a continuous flow of sewage or liquid into the system, and out of it. The method of treatment may be carried out as following:—

When one tank is full, the second tank will be nearly full (say it will be full one hour later), and so on; some of the tanks will be being filled, and the contents aerated, whilst in another or others precipitation and gradual discharge will be taking place; but directly a tank is full, the aeration will be stopped, and this is adapted to be effected automatically, say by an auto-gear, such as a floater and valve and cylinder gear actuating the air supply, or air and liquid supply; and this gear may also operate the purified liquid discharge valve or means so as to carry it off. And so on in sequence, the automatic air and liquid supply, and the liquid discharge means, would be operated at periods required, and quiescent periods in sequence automatically produced. 15

As a modified mode of accomplishing this automatic sequential operations of controlling the supply of liquid and air to the tanks, the carrying off of the supply of the liquid, and other operations may be a species of water clock or other time piece may be employed, which at one hour intervals or other periodic times, will cause through pneumatic cylinders and pistons or like gear, or electric motors, the various actuations of valves or the like to be actuated will be accomplished, so that the cycles of actions referred to of the tanks, and their performances in sequence, will take place. 20

An illustration of a table of sequences of the method referred to, in which a series of tanks operate in sequence, is as follows:—

1. The completion of filling of the first tank causes the air and liquid supplied to it to be shut off to itself, and opens the outlet or discharge means of the 6th tank in series, and also opens air and liquid to the 5th. 25

2. The completion of filling of the second tank causes the air and liquid supplied to it to be shut off to itself, and opens the supply of air and liquid to the first tank, and opens the discharging or outlet to the 1st tank. 30

3. The completion of filling of the third tank causes the air and liquid supplied to itself to be shut off, and opens the supply of air and liquid to the first tank, and opens the discharge or outlet of the second tank. 35

4. The completion of filling of the fourth tank causes the air and liquid supplied to it to be shut off to itself, and opens the supply of air and liquid to the second tank, and causes the discharge or outlet of the third tank to take place. 40

5. The completion of filling of the fifth tank, causes the air and liquid supplied to it to be shut off to itself, and causes a supply of air and sewage to take place to the third tank, and effects the operation or opening of the discharge of the fourth tank. 45

6. The completion of the filling of the sixth tank causes the air and liquid supplied to it to be shut off to itself, causes the opening of the air and sewage supplied to the fourth tank, and effects the commencement of discharge or opening of the outlet to the fifth tank. 50

If the flow is variable, the various actuations of fluid supply and discharge mechanism will be best effected through a time piece.

One of the chief objects and effects of the gradual and continuous supply of liquid and filling of the tanks, is to promote the supply of average quality of sewage to the plant, so that the constitution and quality of the sludge life or active principle in the treatment, is not so much affected deleteriously by sudden flows of relatively large proportion of disinfectant matter or trade waste 55

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which sometimes occur, and which act deleteriously on the active qualities and characteristics of the sludge life take place.

In cases where the sewage or liquid to be treated contains disinfectant matter or matters which deteriorate the activity of the sludge life or its active principle; there may be combined with the treating and purifying tanks, another tank or tanks, connected up by pipes or conduits, and with liquid forcing means for transferring fluids from one to the other and in this other tank or tanks sludge which has become deteriorated—say from causes such as referred to—and forced and transferred from one or more of the purifying tanks; and this tank or tanks will have connected with it air supply means, such as in the purifying tanks; and the debilitated sludge life will be recuperated or regenerated as regards its active principle; and restored to its full intensity or strength by acting on the sludge with air similarly as on the sewage in the purifying tanks, until it is brought up to the required condition. Thus any tank or vessel containing deteriorated sludge can have this sludge transferred from it to a recuperating or hospital tank; and the affected purifying tank supplied from a recuperating or hospital tank with recuperated sludge; and so the process, in spite of having set backs due to causes such as referred to, may be rendered continuous at practically the maximum rate of purification.

With regard to the mode of operating the tanks in sequence as above described, in the case of the application of the process to small purification plants, it is important that the sequential mode of operating described should be automatic, so as to avoid cost of attendants to operate the plant; and the power means or mechanism employed for effecting the actuations of the valves, pen-stocks or parts used in the control and operation of the system may advantageously be pneumatic, so that the compressed air for actuating it, as well as that used for aerating and energising the sludge life will be furnished by the same machinery or from the same source. But where electricity is used on a plant, this power may be employed.

In the case of existing plants, having filter beds, the process herein described may be applied to the purification of the sewage for the dry weather or medium weather day flow; whereas the night flow, and also the storm flow, may be treated by the existing method and arrangement.

According to this invention, in the treatment and purification of sewage and other analogous foul liquids by the process wherein the purifying effect is due to the action of the sludge life or aerobic bacteria and other similar forms of germ life, the active principle of the sludge is kept at a high degree, by working with a sludge containing or diluted with a relatively large proportion of water (which will preferably be the purified liquid on the sewage), and this condition is produced and maintained by supplying the raw or crude sewage to a tank gradually and continuously, and causing it to be acted upon by air as it is supplied into it from the sludge portion.

This arrangement of plant and mode of carrying out the process may be applied to a continuous supply and discharge tank system, as well as to the gradual filling method, as in the latter case where the tank is gradually filling, and then emptied, the contents of the tank by the constant supply of air from the first introduction of liquid, keep it more and more diluted; and when the tank is nearly full, the liquid portion of the contents will be nearly all water. Thus the sludge life or active principle in such cases, is not subjected to the introduction upon or into it of large volumes of raw or crude sewage, which is very liable from its nature, to debilitate it and render its purifying powers of less effect, and so slowing down the whole progress. In other words as the liquid under treatment receives crude sewage in small quantities or doses, the sludge life will always have an environment of dilute impurity sewage or liquid (and air) and this tends to its retaining its undiminished purifying action and effect.

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In some cases, there is combined with the plant a tank or tanks containing organisms or cultures containing organisms of different kinds, and provided with means for supplying these organisms to the purifying tanks and plants, as and when required; and it may be that according to the character or quality of the sewage being delivered to the purifying plant, so will be the kind of organism or combinations of organisms that would be supplied to the tanks. 5

An organism of a type which is serviceable in connection with the method of purification of sewage or other liquids herein described, is one that in the presence of a certain quantity of iron salts in the sewage or liquid has the power of rapid purification or clarification. 10

Organisms of this kind are known and a proportion of iron salts in the sewage or liquid constitute a powerful and rapid purifying medium.

Dated this 18th day of November, 1914.

E. R. ROYSTON & Co.,
Applicants' Patent Agents, 15
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. 20**

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:— 25

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 (and generally a large proportion of sludge, say 20% to 30%), 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. 30 35

The objects and effects of the present invention are generally to provide improvements in connection with systems of sewage or analogous liquid purification systems of the kind referred to, and plant used, by which the process of purification can not only be carried out at a high rate, but it can be effected more uniformly, and the condition necessary for obtaining best results or effects more easily obtained and preserved; and also generally to provide a construction and mode of operation which is convenient, easily worked, and advantageous. 40 45

In the method of carrying on the process of purification hereinafter described, and the plant and arrangement of parts specified, the improvements hereunder are comprised, 50

Improvements in the Purification of Sewage and analogous Liquids.

In a system of purification of sewage and analogous liquids according to this invention, say at starting, the tank will contain a quantity of sludge in cultivated state, containing bacteria of the necessary species in a high degree of purifying activity and effect. The tank is gradually and quietly filled with fresh sewage, and while it is being so filled, air is supplied to the contents at the bottom at various points, and preferably in the form of fine or minute bubbles properly distributed or diffused, so as to act on the sludge life, and on the liquid, as it comes in, and distribute the bacteria uniformly throughout the mass. The gradual fillings of the tank may be distributed over several hours, say one to six hours.

When the tank is full, the contents having been acted upon all the time during filling by the air, the process of the breaking down of the impurities, and nitrification of the liquid will have been accomplished, while the sludge will be highly nitrogenous, and have a high manurial value.

The supply both of liquid and air are then stopped, and the contents of the tank will remain quiescent for a period, say about one hour to two hours; and after a time of quiescent precipitation of the sludge and solid matters, purified water at or near the surface will be gradually decanted or drawn off; the whole drawing off operation taking say about half an hour.

In some cases, a plurality of tanks are employed, and are arranged to work in sequence, as hereinafter described, so that there will be a continuous flow of sewage or liquid into the system, and out of it. The method of treatment may be carried out as follows:—

When one tank is full, the second tank will be nearly full (say it will be full one hour later), and so on; some of the tanks will be being filled, and the contents aerated, whilst in another or others precipitation and gradual discharge will be taking place; but directly a tank is full, the aeration will be stopped, and this is adapted to be effected automatically, say by an auto-gear, such as a floater and valve and cylinder gear actuating the air supply, or air and liquid supply; and this gear may also operate the purified liquid discharge valve or means so as to carry it off. And so on in sequence, the automatic air and liquid supply, and the liquid discharge means, would be operated at periods required, and quiescent periods in sequence automatically produced.

In some cases the aeration may go on, but will be stopped say half an hour after filling; and the closing of air valve may be delayed by a suitable device.

As a modified mode of accomplishing these automatic sequential operations of controlling the supply of liquid and air to the tanks, the carrying off of the supply of the liquid, and other operations may be effected by a species of water clock or other time piece, which at one hour intervals or other periodic times, will cause, through pneumatic cylinders and pistons or like gear, or electric motors, the various actuations of valves or the like to be actuated, so that the cycles of actions referred to of the tanks, and their performances in sequence, will take place.

An illustration of a table of sequences of the method referred to, in which a series of tanks operate in sequence, is as follows:—

1. The completion of filling of the first tank causes the air and liquid supplied to it to be shut off to itself, and opens the outlet or discharge means of the 6th tank in series, and also opens air and liquid to the 5th.

2. The completion of filling of the second tank causes the air and liquid supplied to it to be shut off to itself, and opens the supply of air and liquid to the sixth tank, and opens the discharging or outlet to the 1st tank.

3. The completion of filling of the third tank causes the air and liquid supplied to itself to be shut off, and opens the supply of air and liquid to the first tank, and opens the discharge or outlet of the second tank.

4. The completion of filling of the fourth tank causes the air and liquid supplied to it to be shut off to itself, and opens the supply of air and liquid to

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the second tank, and causes the discharge or outlet of the third tank to take place.

5. The completion of filling of the fifth tank, causes the air and liquid supplied to it to be shut off to itself, and causes a supply of air and sewage to take place to the third tank, and effects the operation or opening of the discharge of the fourth tank. 5

6. The completion of the filling of the sixth tank, causes the air and liquid supplied to it to be shut off to itself, causes the opening of the air and sewage supplied to the fourth tank, and effects the commencement of discharge or opening of the outlet to the fifth tank. 10

If the flow is variable, the various actuations of fluid supply and discharge mechanism may be effected through a time piece.

An arrangement of a plurality of tanks adapted to operate in sequence, as above described, (in which however three tanks instead of six are employed) is illustrated in the accompanying drawings, in which Figure 1 is a plan; 15 Figure 2 a longitudinal section; and Figure 3 a cross section.

In this drawing 1 are the air supplying means or diffusers at the bottom of the tank; 2 are the pipes for supplying them with air; 3 the valves on the separate air pipes leading to the separate tanks, by which the supply and cut-off of air at the required times as described, is effected; and 4 are the liquid 20 supply pipes to the tanks, from a common well 5, having pneumatically operated valves 6 upon them for closing and opening the supply of liquid, at the required times.

7 represent a float actuated valvular device connected with each tank, which will be operated when the liquid in the tank reaches the full level, and when 25 it recedes from this level in emptying; and this valve device will actuate the air and water valves 3 and 6 in any known suitable way, so as to carry out the sequential operations above specified. The air valves 7 may be of the kind shown in Figure 10 of our Patent Application No. 1141 of 1915; and the valves 3 and 6 may be worked similarly to the valves 21 in the said patent 30 application.

The discharge means or valves of the tank are designated 10, and they are opened and closed by a species of water clock, namely liquid from the tank when nearly full passes by a tap 11 into the cistern 12, and thence by a regulating tap 13 in the bottom of same it flows in a regulated quantity into the 35 bucket 14, carried by a chain or cord 15 connected with the discharge valves 10, so that when the bucket 14 is filled to a certain extent from the cistern 12; the valves 10 are opened by the weight of liquid, and the liquid from tank is discharged from its upper level.

The tap 16 is so regulated that, while the bucket will fill from the cistern 12, 40 it will gradually empty itself in the time allotted.

The crude sewage is distributed to the tanks by a distributing trough 8 at the head of each tank, from which it overflows into the tank.

The purified effluent is discharged from the tanks through the discharge pipes 9, on which the discharge controlling valves 10 are placed. 45

The float device 7 has on it, a pilot valve arrangement, such as commonly used in connection with pneumatic sewage ejectors or pumping apparatus or pneumatic liquid lifts, for controlling the supply of air to and from the main valves for controlling the supply, discontinuance of supply, of both air and liquid; but in the case where the aeration of the liquid is continued after the tank is full, say half an hour or so, the air must still be supplied; and this can be effected through a small auxiliary valve on the pipe connections, which will delay the air going to the main air supply valve to the diffusers; or, again the piston of the automatic cylinder of this valve may have a long stroke, and be provided with a cataract arrangement for retarding 50 its closure. In one case the cataract would be part of the delay valve, and in the other it could be part of the actuating arrangement itself. That is to say 55

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there is employed in connection with the apparatus a mechanism of known kind, which would delay the closing of the main air supply valve of each tank.

5 Instead of the above method, two pilot valves on the same spindle operated by one float, may be used, so that the air will not be cut off when the tank is full, but when the next tank in series is partly filled.

10 This would also be arranged to control the operation of the discharge valves 10; and in this arrangement also, a suitable means of delaying water flowing into the first cistern 12 until aeration is over will be used; or the tap 11 supplying the cistern may be arranged so as to take a longer time in filling the cistern; but the former method is better, as the sewage supply flow will be a varied one, and the length of aeration will also vary.

15 One of the chief objects and effects of the gradual and continuous supply of liquid and filling of the tanks, is to promote the supply of average quality of sewage to the plant, so that the constitution and quality of the sludge life or active principle in the treatment, is not so much affected deleteriously by sudden flows of relatively large proportion of disinfectant matter or trade waste which sometimes occur, and which act deleteriously on the active qualities and characteristics of the sludge life, take place.

20 In cases where the sewage or liquid to be treated contains disinfectant matter or matters which deteriorate the activity of the sludge life or its active principle, there may be combined with the treating and purifying tanks, another tank or tanks, connected up with same by pipes or conduits, and liquid forcing means for transferring fluids from one to the other; and to this other tank or tanks, sludge which has become deteriorated—say from causes such as referred
25 to—can be forced and transferred from one or more of the purifying tanks; and this separate tank or tanks will have connected with it air supply means, similarly as in the purifying tanks; and the debilitated sludge life will be recuperated or regenerated as regards its active principle, and restored to its full intensity or strength by acting on the sludge with air, similarly as on the
30 sewage in the purifying tanks, until it is brought up to the required condition. Thus any tank or vessel containing deteriorated sludge can have the sludge transferred from it to a recuperating or hospital tank; and the affected purifying tank supplied from a recuperating or hospital tank with recuperated
35 sludge; and so the process, in spite of having set backs due to causes such as referred to, may be rendered continuous at practically the maximum rate of purification.

40 With regard to the mode of operating the tanks in sequence as above described, in the case of the application of the process to small purification plants, it is important that the sequential mode of operating described should be automatic, so as to avoid cost of attendants to operate the plant; and the power means or mechanism employed for effecting the actuations of the valves, penstocks or parts used in the control and operation of the system may advantageously be pneumatic, so that the compressed air for actuating it, as well
45 as that used for aerating and energising the sludge life will be furnished by the same machinery or from the same source. But where electricity is used on a plant, this power may be employed.

50 According to this invention, in the treatment and purification of sewage and other analogous foul liquids by the process wherein the purifying effect is due to the action of the sludge life or aerobic bacteria and other similar forms of germ life, the active principle of the sludge is kept at a high degree, by working with a sludge containing or diluted with a relatively large proportion of water (which will preferably be the purified liquid in the sewage), and this condition is produced and maintained by supplying the raw or crude sewage to a tank containing the dilute sludge, gradually and continuously, and causing
55 it to be acted upon by air as it is supplied into it.

In some cases, there is combined with the plant a tank or tanks containing organisms or cultures containing organisms of different kinds, and provided

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with means for supplying these organisms to the purifying tanks and plants, as and when required; and it may be that according to the character or quality of the sewage being delivered to the purifying plant, so will be the kind of organism or combinations of organisms what would be supplied to the tanks.

An organism of a type which is serviceable in connection with the method of purification of sewage or other liquids herein described, is one that in the presence of a certain quantity of iron salts in the sewage or liquid has the power of rapid purification or clarification. Such an organism is known as M⁷.

Organisms of this kind are known, and a small proportion of iron salts in the sewage or liquid constitute a powerful and rapid purifying medium. If the sewage, as supplied, has not this iron-salt content, it should be added to it.

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. The process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, consisting of gradually filling the treating tank with the crude sewage, and forcing air through it while so filling, or while filling and a short period afterwards, whereby the complete purification of the sewage is effected by the time the filling has taken place, or a short time after it; substantially as described.

2. The process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, consisting of gradually filling the treating tank with the crude sewage, and forcing air through it while so filling, or while filling and a short period afterwards; and then allowing the contents of the tank to remain quiescent for about one to three hours, after which the purified effluent is removed; substantially as described.

3. The process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, as in Claim 2, and wherein after the quiescent precipitation of the sludge and solid matters the purified water is gradually drawn off from near the surface so that it is emptied in about one half hour to one hour; substantially as described.

4. In the purification of sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, effecting the production of a highly nitrogenous sludge created in the process by forcing air through the liquid in the presence of a large volume of previously prepared or produced bacterial sludge; substantially as described.

5. In connection with processes of the purification of sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matters, the manufacture herein described, consisting of a highly nitrogenous sewage sludge (thus having a high manurial quality) by forcing air through sewage containing a large percentage of pre-existing prepared bacterial sludge, and removing the nitrogenous sludge so formed after treatment; substantially as described.

6. In the process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, the improvement consisting in treating the sewage in a plurality of tanks arranged and adapted to be filled, operated upon by air, and emptied in sequence as described, so that a continuous supply of liquid or sewage, and a continuous discharge from the plant of fully purified effluent may be obtained, and at practically the normal rate; substantially as described.

7. In the process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, in a plurality of tanks the method of treating consisting in the employment of a tank or tanks separate from the treating tanks, and transferring from the

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treating tanks, to the separate tank or tanks, sludge which has become deteriorated as regards the activity of the sludge life, and treating this debilitated sludge with air and recuperating it; and transferring the recuperated sludge to the treating tank or tanks; substantially as set forth.

5 8. The process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, substantially as specified in Claim 6, and wherein the operation of valves and parts for supplying air and sewage, are effected automatically through pneu-
10 matic valvular apparatus (so that the compressed air for actuating such mechanism, as well as that used for aerating, may be furnished from the same source) through floater automatic actuated mechanisms, worked by the rise and fall of liquid flowing into and out of the tanks; substantially as described.

15 9. The process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, wherein the bacterial sludge retained and employed in the tanks, to which the crude sewage is delivered, and which it mixes with, is diluted with and contains a relatively large proportion of water, by supplying the raw or crude sewage to the tank or tanks gradually and continuously, and causing it to be acted upon by air as it is supplied into it or them; substantially as described.

20 10. The process of purifying sewage or analogous liquids in which air is delivered into the liquid in the presence of bacterial sludge or solid matter, as in any of the preceding claims, and wherein to the organisms of the sludge or solid matters referred to, there is combined or added cultures containing organisms which in the presence of iron salts in the sewage or liquid, possess
25 known purifying effects; substantially as described.

11. In processes of purifying sewage or analogous liquids of the kind herein specified, plant or apparatus arranged and adapted to operate; substantially as herein set forth and shown.

Dated this 19th day of November, 1914.

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

EXTENSION OF PATENT.

The term of the Patent No. 22736, A.D. 1914, has been extended so as to expire on the thirty-first day of December, 1932, by Order of the High Court.

THE PATENT OFFICE,

6th November, 1930.

D G 1916 - 125 K J

ERRATUM.

SPECIFICATION No. 22,736, A.D. 1914.

Page 2, line 56, for "affected" read "affected"

PATENT OFFICE,

February 14th, 1916.

ERRATUM.

SPECIFICATION, No. 22,736, A.D. 1914.

In the heading on Page 1

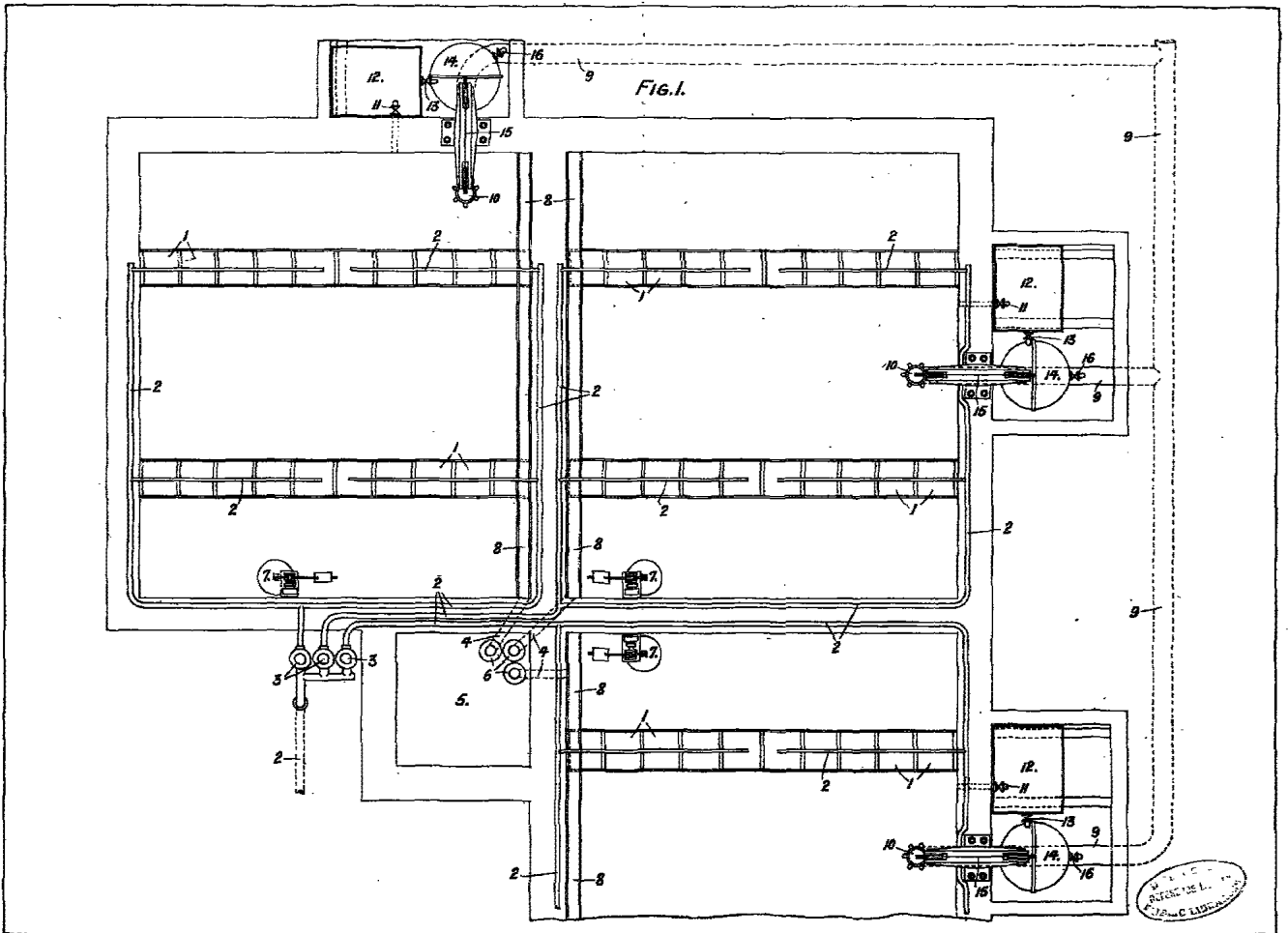
For Date of acceptance, 23rd Dec. 1915 (as printed)
read 20th Dec. 1915.

PATENT OFFICE,

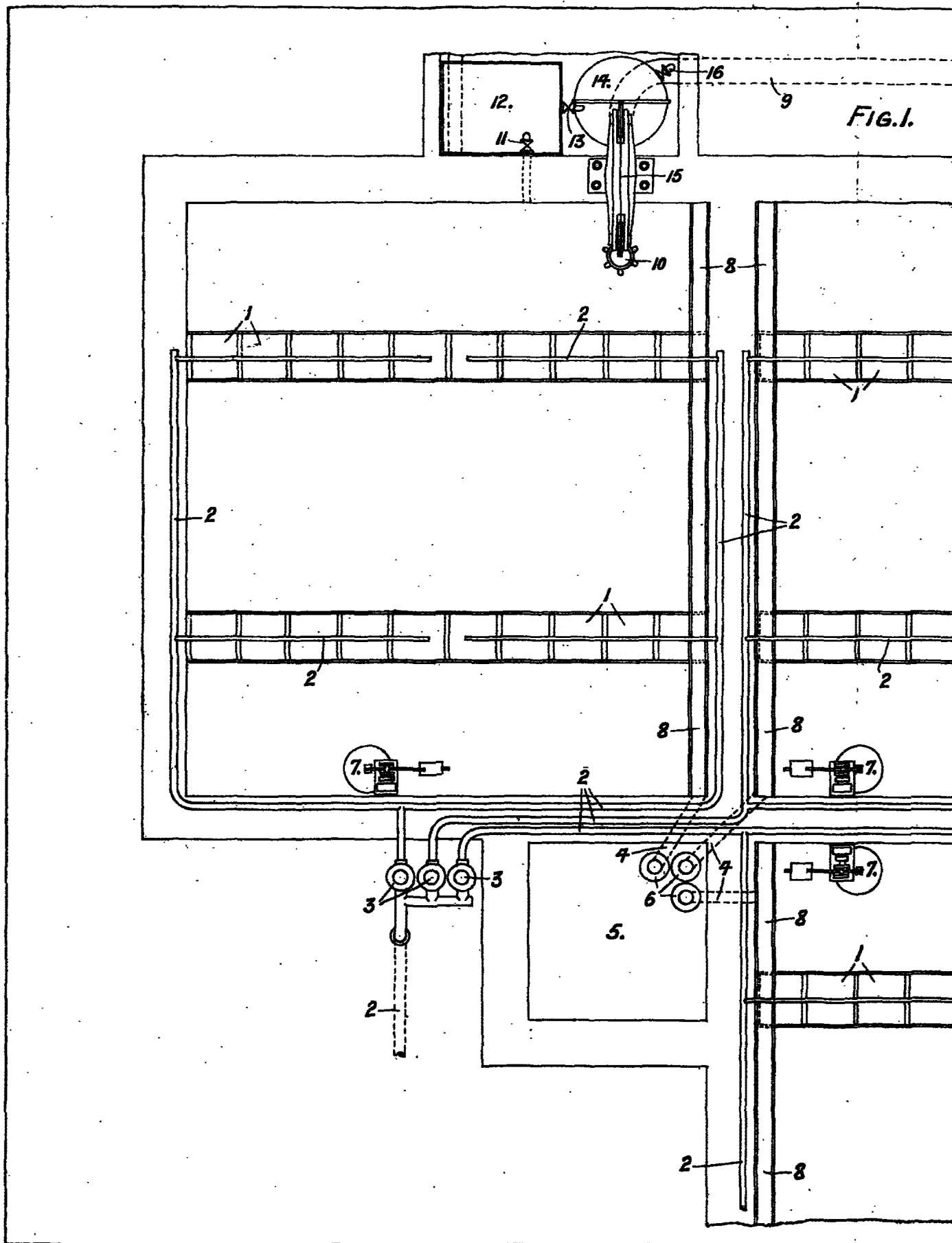
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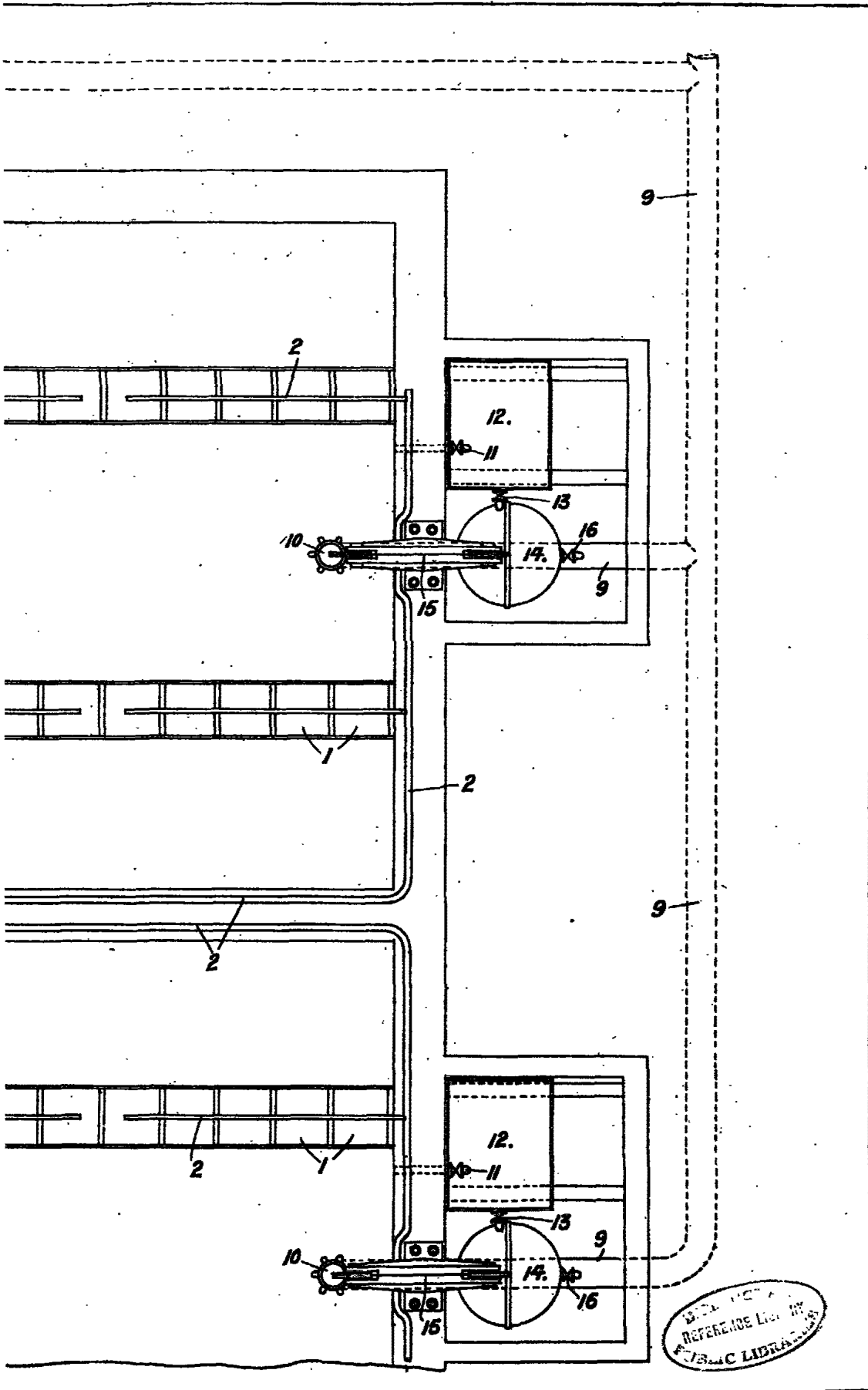
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Fig. 2.

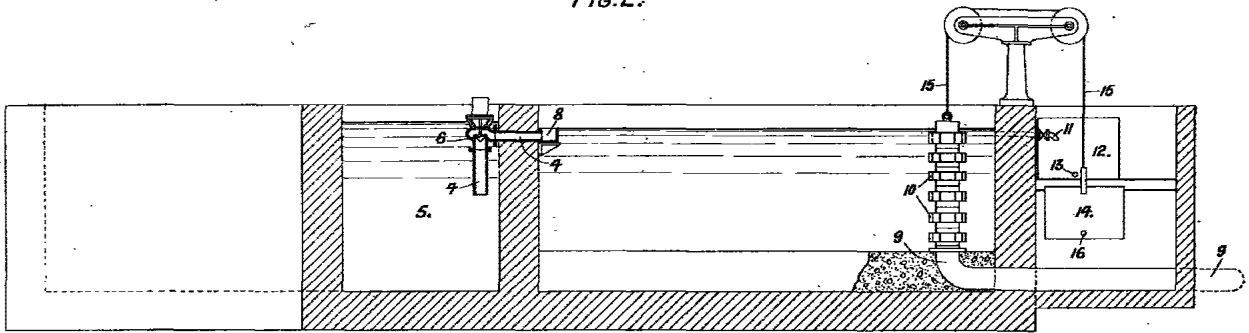
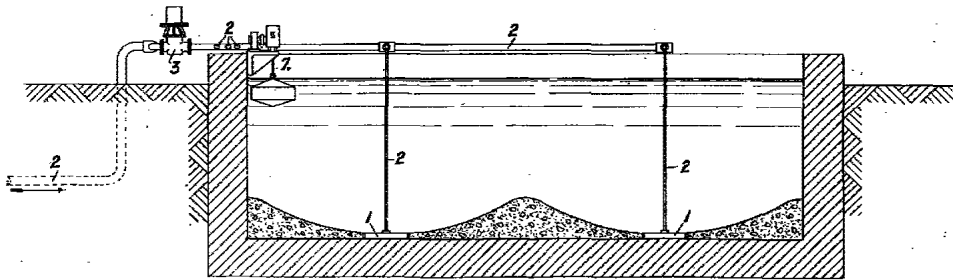


Fig. 3.



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

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FIG. 2.

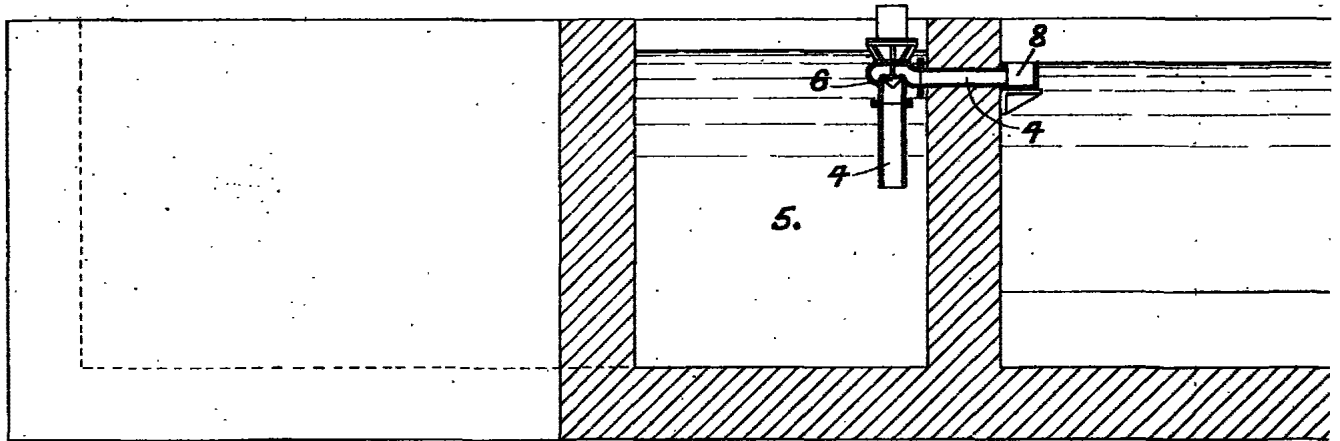
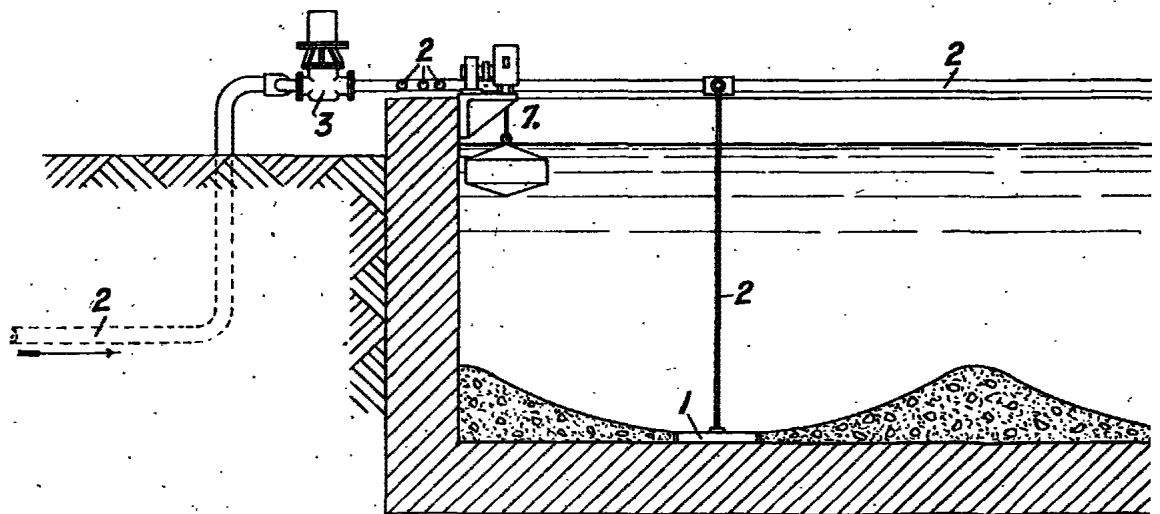
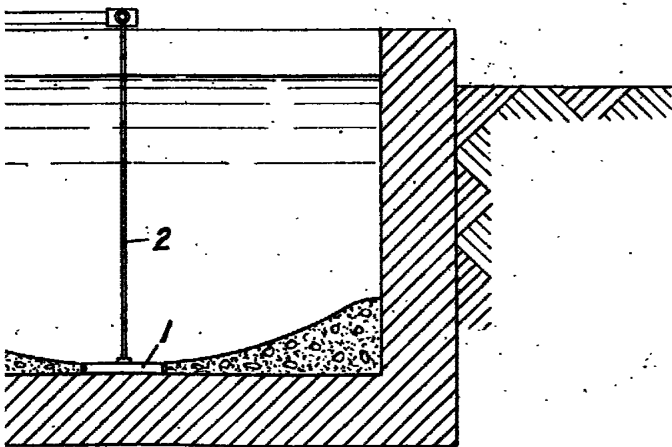
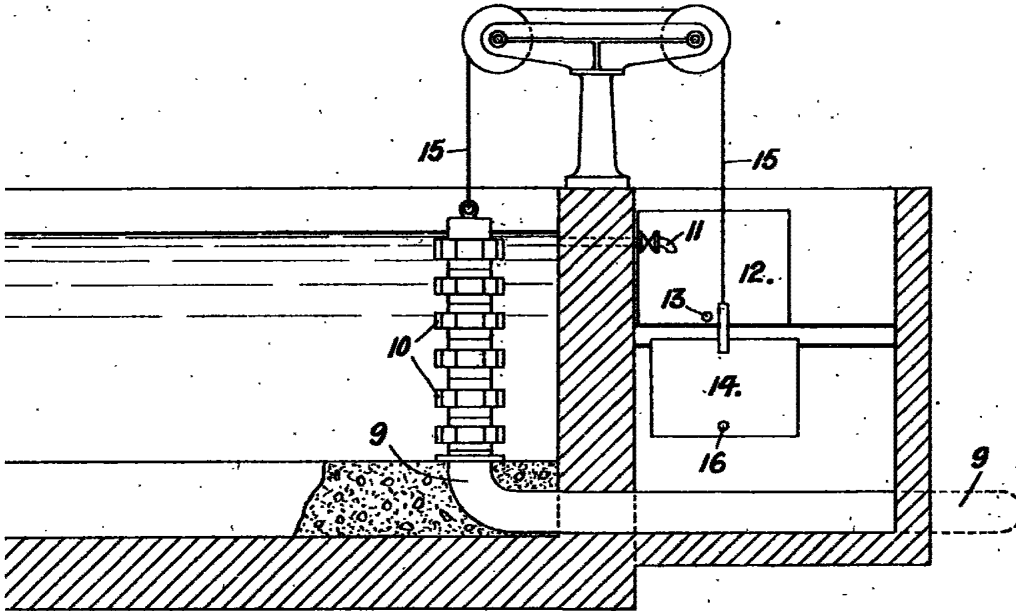


FIG. 3.



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



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