A.D. 1872, 20th November. N° 3464.

SPECIFICATION

OF

EDWIN HILLS AND BENJAMIN BIGGS.

TREATING SEWAGE.

LONDON:
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A.D. 1872, 20th November. N° 3464.

Treating Sewage.

LETTERS PATENT to Edwin Hills, of Warsash, in the County of Southampton, Manufacturing Chemist, and Benjamin Biggs, of No. 3, Laurence Pountney Hill, in the City of London, Merchant, for the Invention of "IMPROVEMENTS IN DEODORIZING AND PURIFYING SEWAGE AND OTHER EXCREMENTITIOUS MATTERS, AND IN OBTAINING CERTAIN USEFUL PRODUCTS THEREFROM."

Sealed the 16th May 1873, and dated the 20th November 1872.

PROVISIONAL SPECIFICATION left by the said Edwin Hills and Benjamin Biggs at the Office of the Commissioners of Patents, with their Petition, on the 20th November 1872.

We, EDWIN HILLS, of Warsash, in the County of Southampton, Manufacturing Chemist, and BENJAMIN BIGGS, of No. 3, Laurence Pountney Hill, in the City of London, Merchant, do hereby declare the nature of the said Invention for "IMPROVEMENTS IN DEODORIZING AND PURIFYING SEWAGE AND OTHER EXCREMENTITIOUS MATTERS, AND IN OBTAINING CERTAIN USEFUL PRODUCTS THEREFROM," to be as follows:—

Our Invention consists in treating sewage, night soil, and other excrementitious matters in the ways herein-after described so as to deodorize

and purify such sewage, night soil, or other matters, and to obtain manure, ammonia, and sulphur as residual products.

According to one of the processes constituting our Invention we proceed as follows:—We construct air-tight tanks or vessels which communicate with one another by means of pipes passing from the upper part of one tank to the lower part of the next tank. Into the first of these tanks we pass the sewage or other matters to be treated, with which we mix a sufficient quantity of lime to set free the ammonia. We then force atmospheric air (by any known suitable means) through the said sewage or matters, which air precipitates or promotes the precipitation of the solid parts of such sewage or matters, and then passes over to the second tank or vessel, carrying with it sulphuretted hydrogen and ammoniacal gases. In the second tank we put sulphurous acid (in vapour or in solution), through which the aforesaid gases are caused to pass, which acid will fix the ammonia and decompose the sulphuretted hydrogen, and we thus obtain sulphite of ammonia and sulphur. Or we put in the said second tank sulphuric or muriatic or other acid suitable for fixing the ammonia, through which acid we pass the aforesaid gases, and we pass the sulphuretted hydrogen and other uncondensed gases through sulphurous acid in vapour or solution, or through hydrated oxide of iron contained in a third tank, and thus decompose the said sulphuretted hydrogen and obtain sulphur therefrom.

We prefer to arrange two or more sewage tanks in connection with each series of acid tanks and to work the said sewage tanks alternately, so that while the sewage contained in one tank is being treated the other tank is being charged with sewage. These tanks are furnished with the necessary pipes and valves for the introduction of the lime and air, for the ingress of the sewage, for the egress of the purified effluent, and for the withdrawal of the sewage precipitate or sludge, which may be dried and used as a manure.

Where hydrated oxide of iron is used as aforesaid the tank in which it is to be used is furnished with man-holes for the insertion and withdrawal of the said oxide.

According to another process instead of forcing atmospheric air through the sewage or other excrementitious matters in the first tank, we force through such sewage or matters (by any known suitable means) sulphurous acid (in vapour or in solution), and thereby precipitate or pro-

mote the precipitation of the solid parts of such sewage or matters, and also fix the ammonia and decompose the sulphuretted hydrogen and obtain sulphur therefrom. The sewage precipitate or sludge thus obtained may either be dried and used as a manure, or it may be burnt so as to cause it to give off its sulphur in the form of sulphurous acid gas or be otherwise utilized. In this last described process the acid tanks herein-before referred to are not required.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Edwin Hills and Benjamin Biggs in the Great Seal Patent Office on the 20th May 1873.

TO ALL TO WHOM THESE PRESENTS SHALL COME, we, EDWIN HILLS, of Warsash, in the County of Southampton, Manufacturing Chemist, and BENJAMIN BIGGS, of No. 3, Laurence Pountney Hill, in the City of London, Merchant, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twentieth day of November, in the year of our Lord One thousand eight hundred and seventy-two, in the thirty-sixth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto us, the said Edwin Hills and Benjamin Biggs, Her special license that we, the said Edwin Hills and Benjamin Biggs, our executors, administrators, and assigns, or such others as we, the said Edwin Hills and Benjamin Biggs, our executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN DEODORIZING AND PURIFYING SEWAGE AND OTHER EXCREMENTITIOUS MATTERS, AND IN OBTAINING CERTAIN USEFUL PRODUCTS THEREFROM," upon the condition (amongst others) that we, the said Edwin Hills and Benjamin Biggs, our executors or administrators, by an instrument in writing under our or their hands and seals, or under the hand and seal of one of us or them, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

Hills & Biggs' Improvements in Treating Sewage.

NOW KNOW YE, that I, the said Benjamin Biggs, on behalf of myself and the said Edwin Hills, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:— 5

Our Invention consists in treating sewage, night soil, and other excrementitious matters in the ways herein-after described so as to deodorize and purify such sewage, night soil, or other matters, and to obtain manure, ammonia, and sulphur, or some of them as residual products. 10

According to one of the processes constituting our Invention we proceed as follows:—We construct air-tight tanks or vessels which communicate with one another by means of pipes passing from the upper part of one tank to the lower part of the next tank. Into the first of these tanks we pass the sewage or other matters to be treated, 15 with which we mix a sufficient quantity of lime to set free the ammonia. We then force atmospheric air through the said sewage or matters, which air precipitates or promotes the precipitation of the solid parts of such sewage or matters, and then passes over to the second tank or vessel, carrying with it sulphuretted hydrogen and ammoniacal gases. 20 In the second tank we put sulphurous acid (in vapour or in solution), through or into which the aforesaid gases are caused to pass, which acid will fix the ammonia and decompose the sulphuretted hydrogen, and we thus obtain sulphite of ammonia and sulphur, or instead of decomposing the sulphuretted hydrogen and ammoniacal gases, as above described, we put 25 in the said second tank sulphuric or muriatic or other acid suitable for fixing the ammonia, through or into which acid we pass the aforesaid gases; and we pass the sulphuretted hydrogen and other uncondensed gases from this tank through or into sulphurous acid in vapour or in solution, or over or through hydrated oxide of iron contained in a third 30 tank, and thus decompose the said sulphuretted hydrogen and obtain sulphur, or where oxide of iron is used sulphuret of iron from which sulphuric acid may be obtained.

We prefer to arrange two or more sewage tanks in connection with the acid tank or tanks described, and to work the said sewage tanks 35 alternately so that while the sewage contained in one tank is being treated the other tank is being charged with sewage. These tanks are

furnished with the necessary pipes, valves, and openings for the introduction of the lime and air for the ingress of the sewage, for the egress of the purified effluent, and for the withdrawal or removal of the sewage precipitate or sludge which may be dried and used as a manure.

Where hydrated oxide of iron is used as aforesaid the chamber in which it is to be used is furnished with man-holes for the insertion and removal of the said oxide.

According to another process, instead of forcing atmospheric air through the sewage or other excrementitious matters in the first tank, we force into such sewage or matters sulphurous acid (in vapour or in solution), and thereby precipitate or promote the precipitation of the solid parts of such sewage or matters, which is or are thus deodorized, and also fix the ammonia and decompose the sulphuretted hydrogen and obtain sulphur therefrom. The sewage precipitate or sludge thus obtained may either be dried and used as a manure, or it may be burnt so as to cause it to give off its sulphur in the form of sulphurous acid gas, or be otherwise utilized. In this last described process the acid tanks herein-before referred to are not required.

Having now described the nature of our Invention we will proceed to describe the manner in which the same is to be performed, reference being had to the accompanying Drawings and to the letters and figures marked thereon, in respect of which we would observe that the same letters indicate the same parts in all the Figures.

Figure 1 represents in vertical longitudinal section (taken on the line A, B, Figure 2, an arrangement of apparatus suitable for carrying into effect the process herein-before first described; Figure 2 is a plan of the said apparatus. a^1, a^2, are tanks into which the sewage or other matters is or are alternately run through branch pipes b^1, b^2, respectively, which pipes are bolted to the sewage main b. The pipes b^1, b^2, are furnished with valves b^3, b^4, for admitting and shutting off the sewage as herein-after described; c^1, c^2, are hoppers through which the lime is put into the tanks, which hoppers are furnished with valves c^3, one of which is seen in Figure 1; d^1, d^1, d^2, d^2, are perforated pipes bolted to branch pipes d^3, d^4, furnished with valves d^5, d^6, which pipes are bolted to a main through which air is forced by a pump fan or other suitable blowing apparatus; e^1, e^2, are pipes which communicate with the pipe e^3, by which the gases are conveyed from the tanks a^1, a^2, to the tank f.

These pipes are respectively furnished with stop-cocks. e^4, e^5, e^6, is a spreader; g^1, g^2, are man-holes through which the sewage mud is removed from the tanks; h^1, h^2, are pipes through which the sewage or other matters is or are run out after treatment; h^3, h^4, are the valves thereof; i is a pipe through which the sulphurous acid or sulphurous acid gas is introduced into the tank f; i^1 is the stop-cock thereof, and i^2 is the spreader; j is a pipe through which the air or gas passes out of the tank f; j^1 is a stop-cock, and j is a test tap; k is a tap through which the sulphite of ammonia produced is drawn off; l^1, l^2, l^3, l^4, l^5, are test taps; m is a man-hole through which the sulphur is removed.

In using this apparatus we first close the valves b^4, h^3, and d^5, and then run a charge of sewage into the tank a^1 through the pipe b^1. We then close the valve b^3, and draw off through the tap l^1 a given quantity of the sewage as a sample, and test it to see how much combined ammonia it contains, and we mix with the said sample a sufficient quantity of lime to liberate such ammonia. We then note the proportion of lime thus added to the sample, and add lime in the same proportion through the hopper c^1 to the sewage in the tank. We then shut the valve c^3 and the cock e^5, and open the cock d^5 so as to turn on the blast of air which precipitates or promotes the precipitation of the solid matters in the sewage, and drives off the ammoniacal and sulphuretted hydrogen gases which pass over to the tank f, into which we run a small quantity of sulphurous acid through the pipe i. As the said acid becomes saturated with ammonia (which we ascertain by drawing off a sample from time to time through one of the test taps l^3, l^4, l^5, and testing it) we add more acid till the tank is nearly full. We then open the test tap j^2 and test the escaping air or gas, and if we find that it contains ammonia we shut off the blast of air, shut the stop-cock e^4, and draw off the contents of the tank (now sulphite of ammonia), and then run a little fresh sulphurous acid into the tank and continue the process as before. We pass the air through the charge of sewage until on testing it we find it free or nearly free from ammonia and sulphuretted hydrogen, when we turn off the blast, open the valves c^3 and h^3, and run out the purified effluent, which we pass into a river or dispose of in any other suitable way. The sewage mud (which may be dried and used as a manure) is removed from time to time by a workman who enters the tank through the man-hole g^1. While this is being done the tank a^2 is charged with sewage, which is purified as herein-before described with

reference to the sewage in the tank a^1, the valve b^3 and the stop-cock e^4 being shut, and the valve b^4 being opened to charge the tank a^2 with sewage, which done, the cock d^6 and the cock e^5 are opened. As the quality of the sewage varies it must be tested from time to time as herein-before described, and the proportion of lime added be regulated as required. The sulphite of ammonia may be stored in its liquid form or be evaporated. The precipitated sulphur is removed from the tank f from time to time by a workman who enters the tank through a manhole m. When we use sulphurous acid gas we pass it into the tank through the pipe i, and we run into the said tank through the pipe n, furnished with a stop-cock n^1 enough water to rise a few inches above the lower end of the said pipe i so as to condense the sulphurous acid gas.

Figure 3 represents in vertical longitudinal section an arrangement of apparatus suitable for carrying into effect the second process herein-before described. o is a tank into which sulphuric, muriatic, or other acid which will fix ammonia is run through a pipe p furnished with a stop-cock p^1, into which acid the pipe e^3 from the sewage tanks a^1, a^2, (herein-before described with reference to Figures 1 and 2) dips; q is a pipe furnished with a stop-cock q^1 through which the sulphate or muriate of ammonia or other product obtained is drawn off; r^1, r^2, r^3, are test taps; s is a pipe furnished with a spreader s^1, which pipe leads from the tank o to a third tank t containing sulphurous acid, which is introduced (in vapour or in solution) through a pipe u furnished with a stop-cock u^1 and spreader u^2, and is drawn out through a pipe v furnished with a stop-cock v^1; 1 is a pipe furnished with a stop-cock 2, through which the air and any undecomposed gases escape; 3 is a test tap; n is the pipe through which a small quantity of water is forced into the tank t when the sulphurous acid is introduced in the form of vapour, as herein-before described with reference to Figures 1 and 2.

Figure 4 represents in vertical longitudinal section apparatus suitable for use when it is wished to purify the sulphuretted hydrogen from the tank o by passing it over oxide of iron instead of through sulphurous acid in the tank t. w is a chamber containing shelves w^1, w^1, on which the oxide of iron is spread, access being gained to the said shelves by the door w^2; x is a pipe leading from the upper part of the tank o into the chamber w; x^1 is a stop-cock; y is a pipe through which the air and

any undecomposed gases escape from the said chamber; y^1 is a test tap; and y^2 is a stop-cock.

In using the apparatus described with reference to Figures 3 and 4, we pass the sewage or other matters into the tank a^1 or the tank a^2, and having added the lime we force air through the contents of the tank as herein-before described. From such tank the ammoniacal and sulphuretted hydrogen gases are passed through the acid in the tank *o*, which acid fixes the ammonia. From this tank the sulphuretted hydrogen passes by the pipe *s* to the tank *t*, where it is decomposed by the sulphurous acid and the sulphur is precipitated, and the air and any undecomposed gases escape through the pipe 1. We test the acids in the tank from time to time, and when we find them become neutral we add more acid. When the sulphuretted hydrogen from the tank *o* is passed through the chamber *w* instead of through the tank *t* the sulphur is taken up by the oxide of iron, and sulphuret of iron is formed, which sulphuret may be burnt for the manufacture of sulphuric acid, or be otherwise utilized. When we find on testing the air or gas escaping from the chamber *w* that it contains sulphuretted hydrogen we remove the spent oxide of iron and add fresh, first shutting the stop-cock x^1.

In carrying into effect the third process herein-before described we use the sewage tanks a^1, a^2, Figures 1 and 2, as follows:—We do away with the lime hoppers c^1, c^2, and the pipes e^1, e^2, e^3, and substitute for the latter escape pipes with stop-cocks and test taps, and we run sewage into one of the tanks while the other is being emptied, as herein-before described, but instead of adding lime to such sewage and forcing air through the mixture, we force through the pipes d^1, d^1, or the pipes d^2, d^2, (as the case may be) sulphurous acid (in vapour or in solution), and thus precipitate or promote the precipitation of the solid matters in such sewage (which is thus deodorized) and the sulphur, both of which fall to the bottom of the tank, and we fix the ammonia in the form of sulphite of ammonia. The sewage precipitate or sludge thus obtained may either be dried and used as a manure or it may be burnt, so as to cause it to give off its sulphur in the form of sulphurous acid gas or be otherwise utilized.

We prefer to produce the sulphurous acid gas used in the foregoing processes by burning sulphur in a cylinder, through which we force

atmospheric air by means of an air pump, a fan, or any other blowing apparatus, from which cylinder the sulphurous acid gas passes by a pipe or pipes to the tank in which it is to be used. By this process (which is old) we get the pressure necessary to force the sulphurous acid or sulphurous acid gas through the contents of the tank and also the power of proportioning the supply of the said acid or gas to the work which it has to do. This is important, because if more gas or acid be passed into the tank than is necessary to neutralize or decompose the ammoniacal and sulphuretted hydrogen gases, there is a waste of acid; and on the other hand, if an insufficient quantity be supplied the gases are not purified to the same extent. We therefore test the air or gas which passes out from the tank, and if it give an acid reaction we decrease the speed of the blowing apparatus or shut off the blast for a time, and thereby diminish the supply of sulphurous acid or gas; but if the test show an alkaline reaction we increase the speed of the blowing apparatus and thereby increase the quantity of sulphurous acid or gas passed into the tank, until the test shows the air or gas which escapes from the tank to be sufficiently purified.

Having now described the nature of our Invention, and the manner in which the same is to be performed, we wish it to be understood, that we make no claim to any of the details or stages of the processes herein-before described, separately considered, neither do we make any claim to the exact arrangements of apparatus herein-before described and illustrated in the accompanying Drawings, as any other suitable arrangements may be used for carrying out our said Invention; but we claim as our Invention,—

Firstly. The improvements in treating sewage and other excrementitious matters, herein-before described with reference to Figures 1 and 2 of the accompanying Drawings, that is to say, passing such sewage or matters into a closed tank, mixing lime with it or them and forcing air through the mixture; and condensing or decomposing in a second closed tank the gases evolved from such mixture by forcing them through sulphurous acid in such second tank, essentially as and for the purposes described.

Secondly. The improvements in treating sewage and other excrementitious matters, herein-before described with reference to Figures 3 and 4 of the accompanying Drawings, that is to say, passing such

sewage or matters into a closed tank and mixing lime with it or them, forcing air through the mixture, passing the gases evolved from the said mixture into a second closed tank, and there fixing the ammonia which they contain by passing them through sulphuric, muriatic, or other suitable acid, and passing the sulphuretted hydrogen from this second tank through sulphurous acid in a third closed tank or through or over oxide of iron in a closed chamber, essentially as and for the purposes described.

Thirdly. The improvements herein-before last described in treating sewage and other excrementitious matters, that is to say, passing it or them into a closed tank, and there forcing sulphurous acid through it or them, essentially as and for the purposes described.

In witness whereof, I, the said Benjamin Biggs, have hereunto set my hand and seal, this Nineteenth day of May, in the year of our Lord One thousand eight hundred and seventy-three.

B. BIGGS. (L.S.)

Witness,

H. H. MURDOCH,
7, Staple Inn,
London.

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Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
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HILLS & BIGGS' SPECIFICATION.

(2 SHEETS)
SHEET 1

FIG. 1.

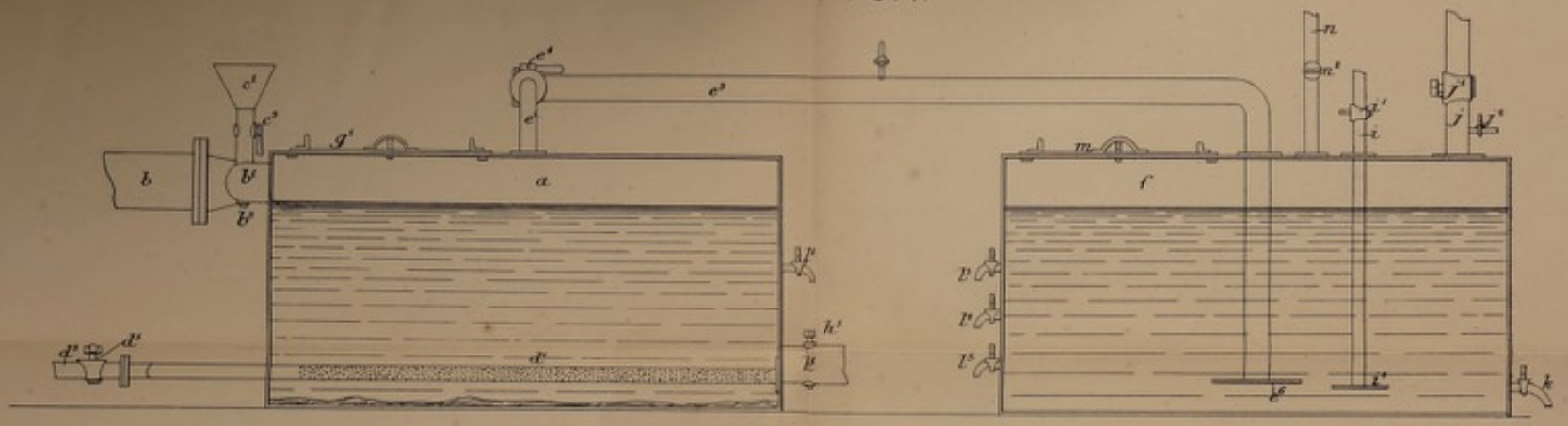
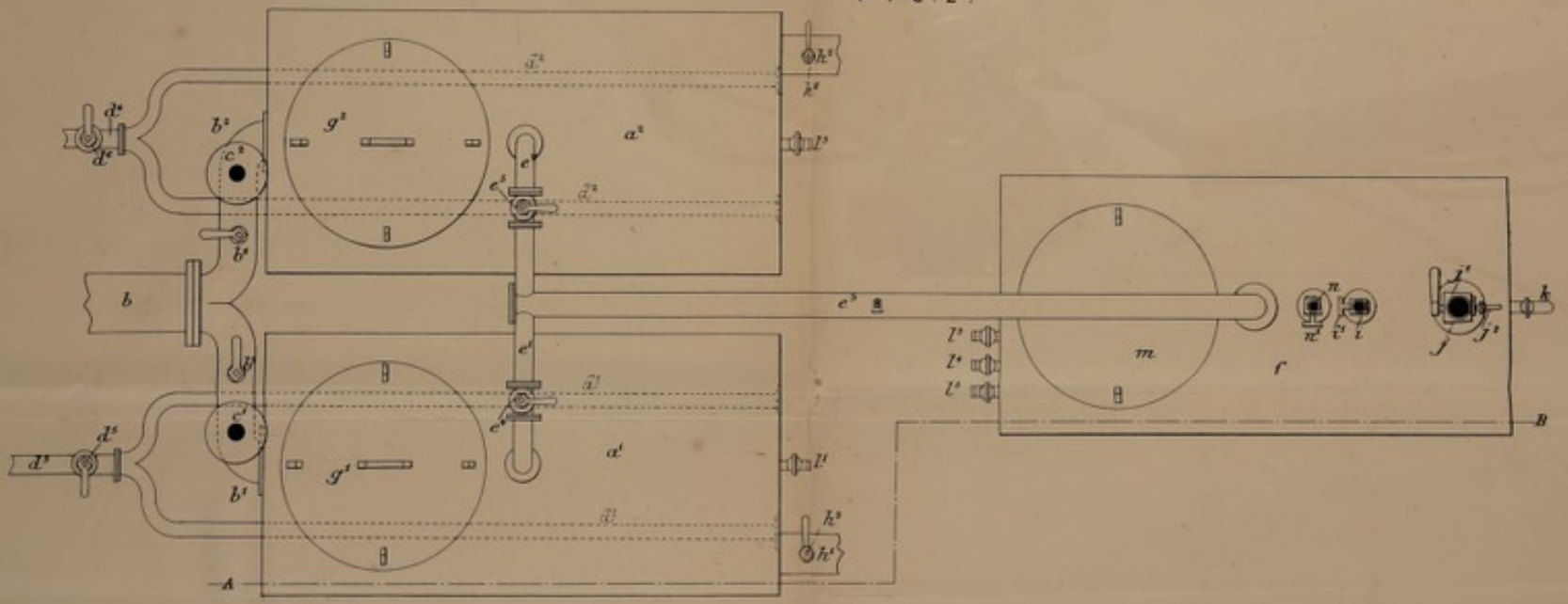


FIG. 2.



The filed drawing is partly coloured.

Drawn on Stone by Malby & Sons.

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(2 SHEETS)
SHEET 2

FIG. 3.

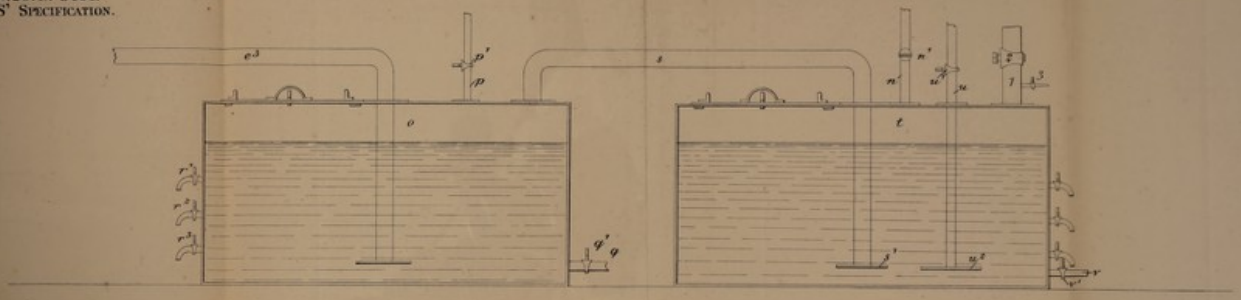
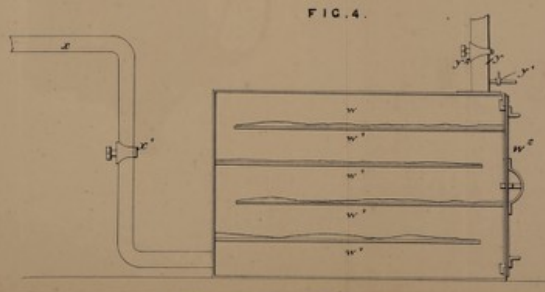


FIG. 4.



The filed drawing is not colored.

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