Specification of Burton Henry Vallé : treating sewage.

A.D. 1874, 3rd NOVEMBER. N° 3784.

SPECIFICATION

OF

BURTON HENRY VALLÉ.

TREATING SEWAGE.

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Treating Sewage.

LETTERS PATENT to Burton Henry Vallé, of Stow-on-the-Wold, in the County of Gloucester, for the Invention of "**Improvements in the Treatment and Utilization of Sewage, and in Means employed therein.**"

Sealed the 26th January 1875, and dated the 3rd November 1874.

PROVISIONAL SPECIFICATION left by the said Burton Henry Vallé at the Office of the Commissioners of Patents, with his Petition, on the 3rd November 1874.

I, Burton Henry Vallé, of Stow-on-the-Wold, in the County of Gloucester, do hereby declare the nature of the said Invention for "**Improvements in the Treatment and Utilization of Sewage, and in Means employed therein,**" to be as follows:—

My Invention relates to an improved treatment of sewage, whereby all nuisance is prevented, and valuable and useful products are obtained, the whole of the sewage being effectually utilized.

In carrying out my Invention the sewage is collected in filtering tanks, wherein the solid portion is separated from the liquid, and the

latter is effectually defecated and rendered fit for domestic use before being allowed to flow into any river or other channel.

The Invention consists more particularly in treating the sewage sludge remaining in the tanks in such a manner as to completely utilize it by converting it into illuminating gas, and a substance capable of defecating sewage, and of being used for other useful purposes, as hereafter described.

I provide two or more series of tanks, to which the sewage is conveyed by conduits from the outlet of main sewer, said conduits being so arranged as to effect a gentle flow of the sewage into the tanks, and the latter are so constructed that the sewage as it flows therein is screened and filtered, and the solid matter retained. There are, say, two or more tanks for each series, each tank being divided by partition walls into a number of compartments, through which the sewage filters as it flows. The bottom of each compartment also consists of a filtering bed having an inclined permanent water-tight floor beneath, on which the effluent water drains, and whence it flows through sluices into a suitable channel in which it may be applied as a source of motive power for use in the works. Over each compartment of the tanks provision is made for the admixture. Over each compartment of the tanks provision is made for the admixture of a small quantity of quicklime, as occasion may require, to accelerate the subsidence of the solid matter of the sewage.

The sets of tanks one intended to be used alternately, that is to say, the fresh sewage is run into the one set whilst the sludge is being removed from the other set, and so on.

In order to remove the sewage sludge from the tanks the filtering bed is constructed to be raised at one side by a mechanical arrangement, so as to cause the sludge to flow through sluices into a receptacle or bed outside the tanks, wherein it may be allowed to remain a suitable length of time exposed to the action of the atmosphere.

Suitable works are erected in convenient proximity to the tanks for the manufacture of the sewage sludge into illuminating gas, provision being made for readily charging the retorts with the sewage. The sewage sludge is propelled by machinery through one or more cylindrical retorts placed within a suitable furnace, the ends projecting a convenient distance beyond the exterior walls of the furnace. At the end where the retorts are charged there is a syphon from each retort to the upper

end of a vertical condenser, the syphon being connected with each in an oblique or diagonal direction to admit of its being readily cleansed if required. This syphon is the only passage for the escape of the steam and gases from the retort into the condenser, from whence the gases pass through another syphon into a cylindrical refrigerator, and thence through a purifier, after which the gas passes into a gasometer fit for use. One end of the retort is open to admit a fireproof shaft having a spiral line of teeth, and also for connecting a tube and receiving the sewage sludge, and the other or opposite end is closed.

At a suitable distance from the charging end of the retort in front of it is placed a metal frame, in which is fixed a hollow cylinder partly open at one end and closed at the other in a direct line with the retort, and also a metal tube of sufficient length is connected with the cylinder and the mouth or open end of the retort, so that when the tube is charged with sewage sludge no external air can enter the retort at that end, nor any gas can escape therefrom, which is safely effected by a valve apparatus within the cylinder at that end of it which connects with the tube. Within the cylinder there is a revolving shaft placed axially therein, and provided with radial arms or blades arranged spirally thereon. At the closed end of the cylinder furthest from the furnace this cylinder is surmounted by another of the same diameter, open at both ends, one of which joins a corresponding opening in the upper side of the horizontal cylinder, thus forming one continuous right-angled cylinder. In this vertical cylinder a similar revolving shaft is fitted, provision being made for kneading the sewage sludge prior to its entry in the horizontal cylinder.

The sewage sludge enters the upper end of the vertical cylinder, and by the revolution of the shafts it is propelled through the tubes into the retort. From the end of the horizontal cylinder connected with the tube and connected with the horizontal revolving shaft thereon there is a metal shaft in the line of the retort axis to the mouth of the retort, which is prolonged by means of a fireproof shaft prepared for the purpose, which passes axially through the retort to the closed end thereof, and which shaft is made to revolve in a certain ratio to the revolving shafts within the cylinder.

Along that length of the shaft within the tube from the cylinder to the retort radial arms or blades are arranged spirally for assisting the

propulsion of the sewage sludge into the retort. Along the shaft within the retort there are a number of sharp or cutting radial projections or blades also disposed spirally, which break up the carbon or charcoal and move it onward and discharge it into a vertical tube near the closed end of the retort. This tube leads from an opening of the retort, and is provided at the upper and lower ends with moveable covers or sliding plates, both of which are connected with the revolving shaft in the retort, and the machinery is so arranged that at certain intervals of time the shaft in revolving opens one of the covers or plates, and at the same moment closes the other, by which means the carbon or charcoal is discharged from the retort without allowing any gas to escape at that end of the retort, which end with the perpendicular tube and machinery connected therewith are enclosed in an air-tight chamber of sufficient capacity to contain a convenient quantity of the carbon or charcoal discharged from the retorts. Within the chamber and under the perpendicular tube there is a spreader which distributes the charcoal as it falls from the tube over the floor of the chamber, provision being made for readily removing it from thence when required.

Instead of a fireproof shaft running the whole length of the retort the carbon or charcoal can be moved forward to be discharged by means of a hollow cylinder or tube, one end of which is open and connected with the centre of that end of the retort which in this case has a circular opening of the diameter of the tube which is within the air-tight chamber, and the other end of the cylinder, which is closed, is supported by a frame within the chamber. Midway in the tube there is a vertical plate which divides the tube into two partitions, that one nearest the retort having a fireproof shaft in the axial line of the tube, along which there are a number of movable jointed knives, which are arranged spirally, and the other partition furthest from the retort is for the purpose of a stuffing box to prevent the admission of any air into the retort, or the escape of any gas therefrom. The end of the fireproof shaft nearest the retort has a sharp spiral penetrating point, and the end furthest from the retort is connected by a metal axle, which extends through the centre of the covered or extreme end of the tube, and thence through the side wall of the chamber, where it is connected with the motor which makes it revolve, and at the same time move in the axial line of the retort towards the charging end thereof, and back to its former position, whereby the carbon or charcoal is discharged into the

perpendicular tube, the covers of which are opened and closed alternately, as before described.

In the partition of the tube in which the fireproof shaft works there is an opening in the lower side thereof near the vertical plate, and communicating with a vertical tube having movable covers or plates, which alternately open and close similar to those before described for the purpose of allowing the escape of the carbon or charcoal which is carried with the fireproof shaft in its return into the tube, by which means the same result is attained.

The gas works are so arranged that coal gas may first be made in the ordinary way, the resulting coke being used for the purpose of heating the sewage sludge retorts, so that no smoke or other nuisance injurious to health may arise from the whole process. The coal gas is passed through a sewage gas purifier before entering the holder, whereby the quality of the gas is rendered identical with that of the sewage gas which is supplied to the same holder to mix with the coal gas.

The residue in the sewage sludge retorts is of value, inasmuch as it possesses the property of defecating sewage, as before mentioned, and in case the whole of the sewage sludge should not be required for the manufacture of gas it can be used for agricultural purposes, its transport being effected without nuisance by the application of the said defecating substance, or the sewage sludge can be manufactured into bricks for building purposes by the admixture of a small proportion of clay with the filtering substance used in the tanks. Or the sewage sludge may be made into cement of good quality by the admixture of lime and a neutralizing substance prepared at the works.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Burton Henry Vallé in the Great Seal Patent Office on the 3rd May 1875.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, Burton Henry Vallé, of Stow-on-the-Wold, in the County of Gloucester, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Third day of November, in the

year of our Lord One thousand eight hundred and seventy-four, in the thirty-eighth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Burton Henry Vallé, Her special licence that I, the said Burton Henry Vallé, my executors, administrators, and assigns, or such others as I, the said Burton Henry Vallé, my 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 THE TREATMENT AND UTILIZATION OF SEWAGE, AND IN MEANS EMPLOYED THEREIN," upon the condition (amongst others) that I, the said Burton Henry Vallé, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, 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.

NOW KNOW YE, that I, the said Burton Henry Vallé, 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, reference being had to the two Sheets of Drawings hereunto annexed, and to the letters and figures marked thereon, that is to say:—

My Invention relates to an improved treatment of sewage whereby valuable and useful products are obtained, the whole of the sewage being effectually utilized and all nuisance is avoided.

In carrying out my Invention the sewage is collected in filtering tanks wherein the solid portion is separated from the liquid, and the latter is effectually defecated and rendered fit for domestic use before being allowed to flow into any river or other channel.

The Invention consists more particularly in treating the sewage sludge remaining in the tanks in such a manner that it is completely utilized by converting it into illuminating gas, and a substance capable of defecating sewage, and of being used for other useful purposes as hereinafter described.

And in order that my Invention may be more readily understood, I will describe it with reference to the accompanying Drawings in which I have illustrated the principal apparatus I employ in carrying the Invention into effect.

Figure 1 represents a plan view of one series of filtering tanks; Figure 2, a longitudinal sectional elevation, and Figure 3, a transverse section of the same on lines 1, 1, 2, 2, respectively; Figure 4 shows a plan, and Figure 5, an elevation of the apparatus used for converting the solid matters retained in the said filtering tanks into illuminating gas.

I provide two or more series of filtering tanks, each series constructed in brick or stone, and arranged as shown in Figures 1, 2, 3, to which the sewage is conveyed from the outlet of main sewer, in such manner as to effect a gentle flow of the sewage into the tanks, and the latter are so constructed that the sewage as it flows therein is screened and filtered, and the solid matter retained. The series of tanks are intended to be used alternately, that is to say, the fresh sewage is run into the one set, while the sludge remaining after filtration is being removed from the other set, and so on. Each series is composed of any convenient number of tanks or compartments (two or more) A, A^1, A^2, A^3, A^4, each tank or compartment being divided from the adjacent ones by partition walls B, the upper part B^1 of each partition wall being constructed to filter and allow the supernatant portion of the sewage to flow through into the next tank, for which purpose the tanks or compartments and partition walls are constructed at successively lower levels, as shown. The bottom of each compartment also consists of a filtering bed C supported at a convenient distance above an inclined permanent water-tight floor D on to which the effluent water drains, and whence it flows through sluices *a* into an inclined channel E common to all the tanks or compartments of the series. In this channel E there may be a number of filtering banks E^1 (of the same materials hereafter mentioned for filters B^1 and C) for still further purifying the water as it flows down this channel. The filters B^1 of the partition walls are composed of a mixture of the carbon or charcoal residue (obtained by the distillation of the sewage sludge in retorts as hereafter described), sand, and earth which is filled in between narrow walls *b*, b^1, provided with apertures for the passage of the sewage, a thin vertical layer of coarse gravel being interposed between the filtering mixture and the wall b^1 to retain the mixture. The filter beds C are composed of the same mixture upon a

horizontal layer of gravel, the whole being placed between upper and lower filtering floors c, c^1, constructed of oak with cast and wrought-iron girders, and provided with apertures c^2 for the passage of the liquid sewage, the upper floor c being made double with friction rollers between to enable the upper half of the floor to slide longitudinally upon the lower half, for the purpose of making their apertures coincide or not as required. This movement is effected by means of a gearing chain wheel and capstan. The thickness of filters B^1 and the depth of filtering beds C, and the number of filtering compartments A depends upon the quality of the sewage to be filtered, and must be determined by the result of analysis of the effluent water at the outfall channel.

In order to remove the sludge remaining in the tanks A after filtration of the sewage the upper floor c is constructed to be raised at one side (the apertures c^2 having been previously closed) so as to cause the sludge to flow through sluices d and spouts d^1 into a receptacle or bed G, outside the tanks, wherein it may be allowed to remain exposed for a short time to the action of the atmosphere until sufficiently dry for conveyance where required.

The raising of the upper floor of the filtering beds may be effected by means of chains attached to hooks bolted to the lower half of floor c, and passing through slots in the upper half to admit of the sliding movement before mentioned. The chains from either end pass over guide pulleys to two independent shafts, as shown in Figure 3. This arrangement admits of the floor being raised at the end furthest from the sluices d by revolving one of the shafts, and also, as occasion may require, of being raised at both ends by the simultaneous revolution of the two shafts sufficiently for the purpose of renewing the filtering bed. The sluices d are opened and closed by means of a rack and pinion.

The sewage, which it is preferred should be kept separate from the rainfall drainage, is first received from the sewer in a tank F, which may be termed an intercepting or settling tank, whence the sewage is conveyed by a conduit F^1 to the one or other series of filtering tanks A, the flow of the sewage being controlled by valves or sluices e. The floor of the intercepting tank F has a downward slope from one side of the tank to the other, where two pumps f are placed for emptying the intercepting tank F when required, the one serving to pump the fluid part of the sewage into the conduit F^1, and the other to raise the sludge deposited

into a trough *g*, by which it is conveyed to a tank *h* provided with a layer of stones and coarse gravel through which the watery part drains, and is conveyed by a channel *i* to the upper end of the channel E, the solid matter remaining being removed to the sludge bed G. The bottom or floor of this sludge bed, and likewise the bed of the channels are so constructed as to prevent any sewage from percolating through them.

The sewage flows from the sewer into the intercepting tank, and it may either be pumped up into conduit F^1 or where the level of the locality will admit of tanks A being constructed in the ground the sewage may flow into the conduit F^1, and thence into the filtering tanks. *k*, *k*, are gratings.

A small quantity of quicklime is supplied to the intercepting tank, as occasion may require, to accelerate the subsidence of the solid matter of the sewage. The lime is placed in a trough (not shown), to which a sufficient quantity of sewage is admitted from the sewer. In the trough is a shaft provided with blades, and operated by any suitable motive power to agitate and mix up the lime with the sewage, which is then allowed to flow through spouts into the intercepting tank.

Suitable works, of which a portion is shown in Figures 4 and 5, are erected in convenient proximity to the tanks for the manufacture of the sewage sludge into illuminating gas, provision being made as hereafter described for readily charging the retorts, of which there may be one or more with the sewage. H is one of these retorts. It is of cylindrical shape, and is placed within a suitable furnace I, the ends of the retort projecting a convenient distance beyond the exterior walls of the furnace. The charging end of the retort is open, and the opposite end is closed. To the charging end is connected the open end of a hollow cylinder K closed at the other end, and supported on a frame K^2. This cylinder is of the same diameter as the retort of which it forms a continuation. K^1 is a vertical cylinder or hopper by which the sewage sludge is fed into the cylinder K through an opening in its top side. The frame K^2 is made moveable, in order that the cylinder K may be readily disconnected and removed to give access to the interior of the retort. The retort H and cylinder K are traversed from end to end by a longitudinal revolving shaft *l* placed axially therein, and provided with blades arranged spirally thereon. That part of the shaft which is within the retort H must be made of a material capable of withstanding the great heat in the retort, and I propose to make it either of cerium or

platinum, that within cylinder K being of iron. The vertical cylinder or hopper K^1 is also provided with a shaft having knives or blades for the purpose of kneading the sludge before it enters the horizontal cylinder K. The sewage sludge enters the upper end of the vertical cylinder, and by the revolution of the shafts it is conveyed into the retort. When the cylinder K is charged with sludge no air can enter the retort, neither can any gas escape therefrom. The rate at which the sludge is conveyed into and passed through the retort will depend on the state of the sludge, and the heat of the furnace. The blade within cylinder K is a continuous spiral for conveying the sludge into the retort, but within the latter they are short cutting blades, also disposed spirally, which break up the carbon or charcoal residue, and move it onward, and discharge it into a vertical tube *m* near the closed end of the retort. This tube leads from an opening in the bottom of the retort, and may be closed at the upper and lower ends by a movable cover or plate, the two being coupled together, so that when one is opened the other is closed. The upper one is so geared with the shaft *l* that at certain intervals it will be closed, and the lower one opened to discharge the carbon or charcoal contained in the tube without allowing any gas to escape. This end of the retort with the perpendicular tube and machinery connected therewith are enclosed in an air-tight chamber L of sufficient capacity to contain a convenient quantity of the carbon or charcoal discharged from the retort. The covers may be mounted on horizontal axes, and the gearing may consist of a train of cog wheels and pinions driven by the shaft *l*, and operating a small crank arm jointed by a link to the connecting rod to which a balance weight is attached to operate the covers as above mentioned, which takes place whenever a blank part of one of the wheels comes opposite the pinion of the crank arm, and so releases the latter. Within the chamber L and under the perpendicular tube there is a spreader which is rapidly rotated by gearing from shaft *l* to distribute the charcoal as it falls from the tube over the floor of the chamber.

The steam and gases from the retort escape through a syphon M near the charging end of the retort which leads to the upper end of a condenser N containing water into which the syphon dips. The gases pass thence through another syphon O connected to top of condenser and leading to a drier P, in the upper portion of which is a purifier R through which the gas rises and passes off by a pipe S to a gas holder fit for use.

The purifier is composed of a number of perforated shelves, on which there is placed a thin layer of the charcoal residue from the retorts and lime, and the lower part of the apparatus (the drier) is filled with the same mixture. T is a tank receiving the overflow from the condenser by a pipe *n* which dips into a vessel containing water; *p* is another pipe leading from the top of the purifier, by which the quality of the gas therein may be tested.

Instead of a shaft running the whole length of the retort the carbon or charcoal can be moved forward to be discharged by means of a hollow cylinder or tube, one end of which is open and connected with the centre of that end of the retort which in this case has a circular opening of the diameter of the tube which is within the air-tight chamber, and the other end of the cylinder which is closed is supported by a frame within the chamber. Midway in the tube there is a vertical plate which divides the tube into two compartments, that one nearest the retort having a shaft in the axial line of the tube along which there are a number of moveable jointed knives which are arranged spirally, and the other compartment furthest from the retort is for the purpose of a stuffing box to prevent the admission of any air into the retort or the escape of any gas therefrom. The end of this shaft nearest the retort has a sharp spiral penetrating point, and the end furthest from the retort is connected by a metal axle which extends through the centre of the covered or extreme end of the tube, and thence through the side walls of the chamber where it is connected with the motive power which makes it revolve and at the same time move in the axial line of the retort toward the charging end thereof and back to its former position, whereby the carbon or charcoal is discharged into the perpendicular tube, the covers of which are opened and closed alternately, as before described.

In the portion of the tube in which the shaft works there is an opening in the lower side thereof near the vertical plate and communicating with a vertical tube having moveable covers which alternately open and close similar to those before described for the purpose of allowing the escape of the carbon or charcoal which is carried with the fireproof shaft in its return into the tube, by which means the same result is attained. Or the shaft in the retort may be dispensed with if the sewage sludge be dried or broken into small pieces before distillation in the retorts. In this case the length of the retorts within the

furnace would be made shorter and the furnace narrowed accordingly, the remaining machinery of either the other methods herein described being made suitable for charging the sewage sludge into the retorts and extracting the carbon or charcoal therefrom.

The drying of the sludge may be effected in an air-tight chamber, on the floor of which there are several iron partitions placed vertically and longitudinally from the entrance door of one side of the chamber to the opposite side thereof which make several compartments into which the sludge is put. Under the floor of the chamber there is a furnace to heat the same. In the centre of the top or roof of the chamber there is an opening in which a bent pipe is inserted, and the other end of the pipe is connected with the upper end of the condenser, similar to the syphons connected with the retorts. Prior to the sewage sludge being removed from the chamber the furnace is allowed to sufficiently cool so that no more vapor may be generated in the chamber.

In the bent pipe near the end which joins the roof of the drying chamber there is a valve, and any gas which may be in the chamber can be expelled by an exhauster and then the valve closed. The sludge is then removed and broken up into the required pieces.

I prefer to make coal gas in the ordinary way in a separate set of retorts and to use the resulting coke for heating the sewage sludge retorts, the coal gas being either used separately or mixed with the sewage gas, in which case it would be passed through a purifier like that before described before entering the holder to mix with the sewage gas.

The residue in the sewage sludge retorts possesses the property of defecating sewage, as before mentioned, and in case the whole of the sewage sludge should not be required for the manufacture of gas it can be used for agricultural purposes, its transport being effected without giving rise to any nuisance by the application of the said defecating substance; or the sewage sludge can be manufactured into bricks for building purposes by the admixture with the sludge of the filtering mixture after use in the filtering tanks and of the carbon residue from the retorts, and a small proportion of earth, sand, and clay, the proportion of these various materials depending upon the quality of the sludge. The bricks are burnt in the ordinary way.

Vallé's Improvements in Treating Sewage.

Having described the nature of the said Invention, and the manner of performing the same, I declare that what I claim as the Invention to be protected by the herein-before in part recited Letters Patent is,—

First. The manufacture of illuminating gas from sewage sludge by the improved process or treatment and means, substantially as herein set forth. I also claim the mixing the gas so obtained with coal gas for consumption, as specified.

Second. The production of a substance having defecating and filtering properties by the distillation of sewage sludge in retorts, as herein described, and the employment thereof either alone or mixed with other substances, substantially as and for the various purposes herein set forth.

Third. The construction and arrangement of the filtering tanks for filtering the sewage, and the means of removing the sludge therefrom, substantially as herein shown and described.

Fourth. The combination of machinery and parts used for charging the retort with sludge and withdrawing the deposit from the retorts without allowing the gas to escape, substantially as herein set forth.

Fifth. The manufacture of clay suitable for bricks by a mixture of a small proportion of natural clay with the sewage sludge, and the filtering mixture used in the filtering tanks, as specified.

In witness whereof, I, the said Burton Henry Vallé, have hereunto set my hand and seal, this Thirtieth day of April, in the year of our Lord One thousand eight hundred and seventy-five.

BURTON H. VALLÉ. (L.S.)

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Printers to the Queen's most Excellent Majesty. 1875.

A.D. 1874. Nov. 3. Nº 3784.
VALLÉ'S SPECIFICATION.

(2 SHEETS)
SHEET 1

FIG. 1

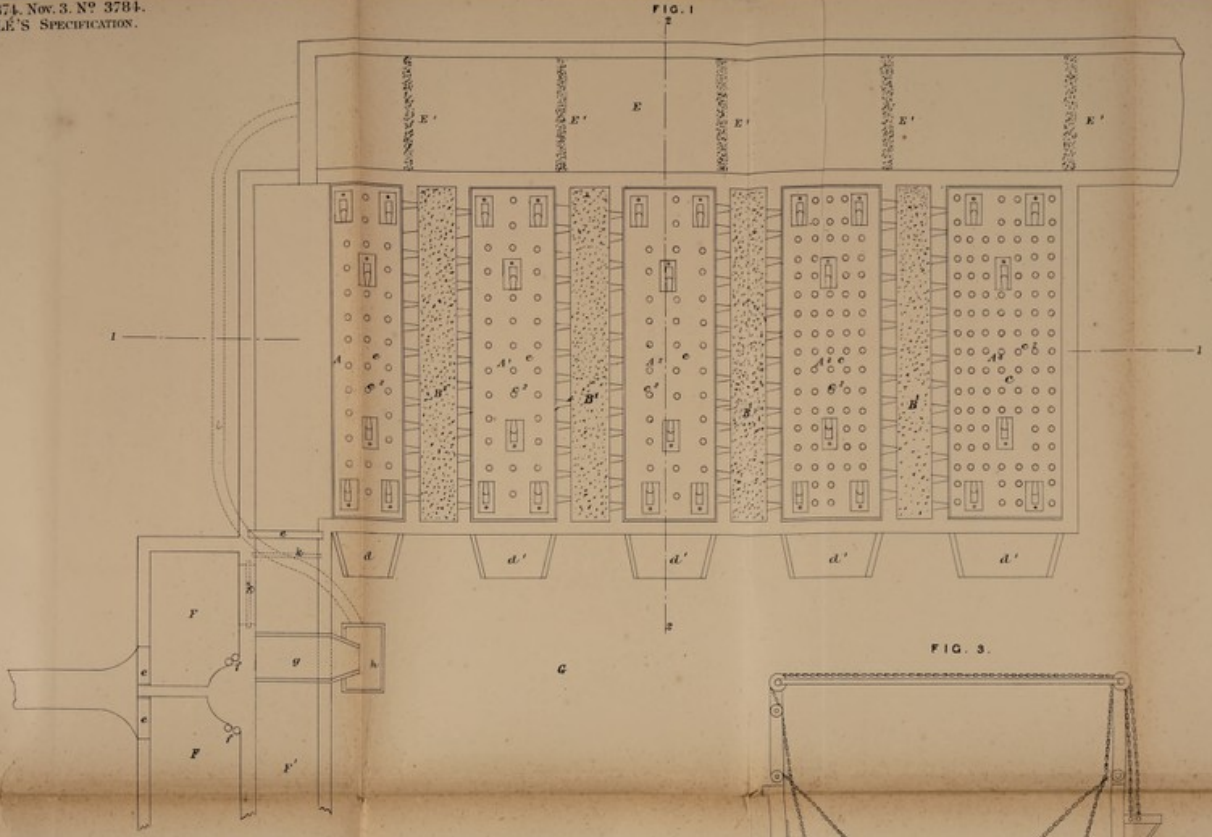


FIG. 3.

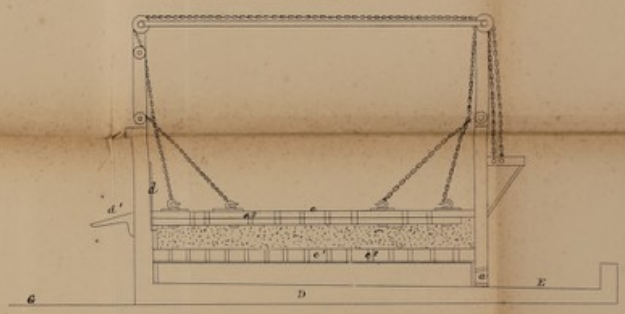
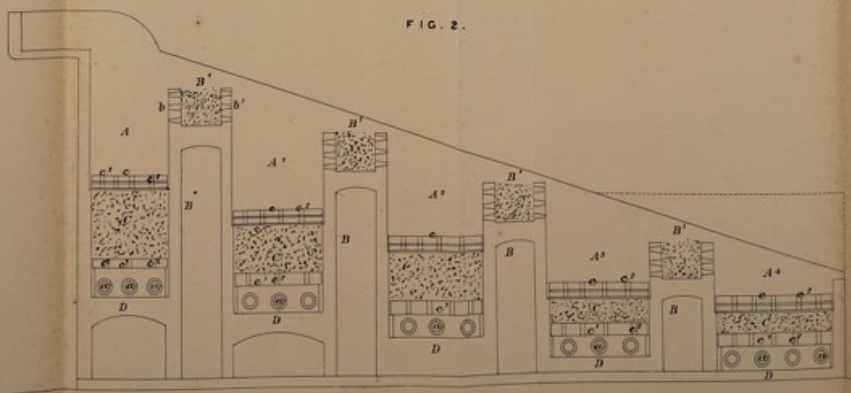


FIG. 2.



The first drawing is partly colored.

Drawn on Stone by Malby & Sons.

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Printers to the Queen's most Excellent Majesty 1875