

Specification of James Brough Pow : treating sewage.

Contributors

Pow, James Brough.

Publication/Creation

London : Great Seal Patent Office, 1872 (London : George E. Eyre and William Spottiswoode)

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A.D. 1871, 17th OCTOBER. N^o 2760.

S P E C I F I C A T I O N

OF

JAMES BROUGH POW.

TREATING SEWAGE.

LONDON:

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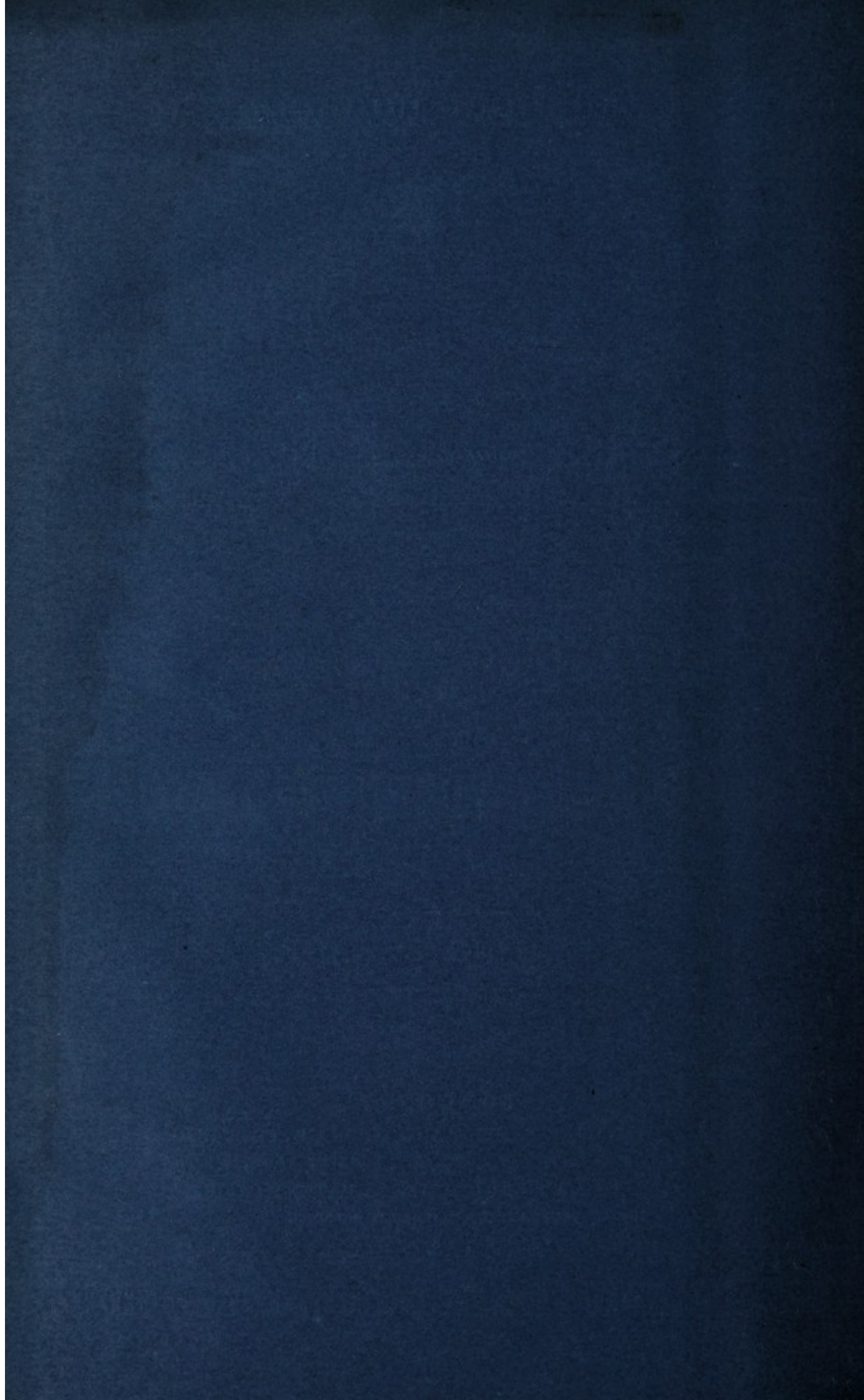
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A.D. 1871, 17th OCTOBER. N° 2760.  
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Treating Sewage.

LETTERS PATENT to James Brough Pow, of Worcester, for the Invention of "**IMPROVED ARRANGEMENTS FOR FILTERING AND PURIFYING, ALSO FOR COLLECTING FOR UTILISATION THE SOLID MATTER IN SUSPENSION IN SEWAGE, ESPECIALLY APPLICABLE FOR OBTAINING PURE POTABLE WATERS.**"

Scaled the 12th April 1872, and dated the 17th October 1871.

PROVISIONAL SPECIFICATION left by the said James Brough Pow at the Office of the Commissioners of Patents, with his Petition, on the 17th October 1871.

I, JAMES BROUGH POW, of Worcester, do hereby declare the nature of the said Invention for "**IMPROVED ARRANGEMENTS FOR FILTERING AND PURIFYING, ALSO FOR COLLECTING FOR UTILISATION THE SOLID MATTER IN SUSPENSION IN SEWAGE, ESPECIALLY APPLICABLE FOR OBTAINING PURE POTABLE WATERS,**" to be as follows:—

By these improvements I purify water for the use of cities and other uses, and this Invention is especially adapted for use in towns which lie low and have little fall; and I utilize sewage by collecting the solid

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matter in suspension, also chemically precipitating that in solution, so as to obtain the whole matter contained in the sewage. This plan being also adapted for the purification of water from the "hush" or minerals in suspension, or in solution from lead mines, chemical works, tannaries, or other manufacturing works, so that the water from them may innocuously pass into any river. The following description sets forth proper means for carrying the same into practical effect:—

Pits with ascension filters, hereafter described, are erected in duplicate, triplicate, or in other number, according to the amount of sewage, to ensure a frequent charge for the removal of the deposit, which will form a most valuable manure. The charges used for the ascension filters may in degree depend upon the nature of the sewage, and the geological stratification through which it flows. The separation of matter in suspension is very easy, but it is much more difficult to arrest and utilize that which is in solution; therefore the charges of the filters will differ for sewage, potable water, and for streams containing minerals or matter from manufacturing works.

As sewage generally contains sulphuretted hydrogen, carbonic acid, urea phosphates, and nitrogenous constituents, these must be removed by the material used in the charges of the filters.

It has been stated that London sewage by analysis contains the proportion by weight of chemical matter in solution as three parts to one of matter mechanically in suspension, and in one hundred tons the value of the former is 15*s.* 4½*d.*, whilst the latter is 2*s.* 2½*d.* It is therefore proposed that the first filter be charged with aluminum shale from the lias, and in some cases with one-third chalk, the effects expected is to precipitate all colouring matter; to take up part of the soda, potass, and sulphur, and all phosphates, with two-thirds of the nitrogen in any form. A second filter is charged with spongy iron, this being according to Dr. Vockler more powerful in its effects than charcoal. Third filter is to be charged with cocoa-nut charcoal, firmly consolidated. The materials except the cocoa-nut charcoal to be granulated or as fine powder.

The Construction of the Filters.—The material or charges for the filters I pack in boxes of half a ton or upwards, which can easily be put in or taken out of the filtering case by a portable crane, when fully saturated or renewed a great saving in labour is effected, which cannot be done by the principle of filtration by descension in the ordinary way. The bottom

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of each filter is composed of strong galvanised wire, supported by cross diagonal iron bars, the wire covered with a coarse cloth. The top of the filter is protected in a similar manner, and secured so that the upward force of the water cannot remove it. The water passes freely through
5 the charges, as can be demonstrated experimentally by a zinc model. The water after passing the third filter is discharged on to two sets of iron bars below each other, which break the stream and oxidise the water before flowing into any river.

In some cases to ensure perfect precipitation it may be needful to put
10 a certain quantity of sulphate of iron (copperas) dissolved in water into the first pit, the cost of which is only trifling, say 3s. 9d. to 4s. per hundredweight. The effect produced on gas tar or refuse from gas works is very apparent when such material forms part of the sewage when it comes in contact with aluminum shale.

15 Filtration of Potable Water for Cities.—The proposed Invention for the better purification of water by the ascension principle for the use of densely populated towns as a sanitary measure at the present time demands grave and mature consideration.

The present method of filtration in use by our large water companies
20 by descension, by merely percolating water through beds of sand and gravel to a lower level, is attended with great expense without being thoroughly efficient. This unscientific process simply removes (and indeed sometimes very partially) the matter in mechanical suspension, as the turbid liquid dispensed to householders after heavy rains optically
25 demonstrates, and does not in the slightest degree remove the more important constituents in solution, generally so prejudicial to the public health.

My new method it is most confidently expected will readily achieve both, and effectually remove with other dangerous constituents the
30 phosphates, without the presence of which the fungi peculiar to polluted water cannot exist, or in any way be developed.

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SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said James Brough Pow in the Great Seal Patent Office on the 17th April 1872.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, JAMES BROUGH POW, of Worcester, send greeting. 5

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Seventeenth day of October, in the year of our Lord One thousand eight hundred and seventy-one, in the thirty-fifth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said James Brough Pow, Her special 10 licence that I, the said James Brough Pow, my executors, administrators, and assigns, or such others as I, the said James Brough Pow, 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, 15 and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVED ARRANGEMENTS FOR FILTERING AND PURIFYING, ALSO FOR COLLECTING FOR UTILISATION THE SOLID MATTER IN SUSPENSION IN SEWAGE, ESPECIALLY APPLICABLE FOR OBTAINING PURE POTABLE WATERS," upon the condition (amongst others) that I, 20 the said James Brough Pow, 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 25 calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said James Brough Pow, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the 30 following statement:—

My Invention consists, firstly, of improved modes of treating sewage matter so as to collect and utilize the valuable products contained therein, and of purifying the effluent water so that it may be discharged into rivers without polluting them. I carry out this part of my Invention 35 by subjecting the sewage matter to a triple treatment, videlicet, that of

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subsidence, the use of chemical reagents, and filtration by means of my improved ascension filters; by which means I collect all the solid matter held in mechanical suspension, and by precipitating the combinations I obtain nearly the whole of the oxidisable material that is found
5 in chemical solution. And I consolidate the precipitated mass of sewage matter and dry it on improved kilns, herein-after shewn and described, and employ it as manure. And I purify the effluent water by subjecting it to a process of filtration, aëration, and oxidation.

My Invention consists, secondly, of improved modes of purifying
10 waters which feed rivers, more especially salmon rivers, by removing from such tributary streams the particles of poisonous mineral matters held in suspension or solution technically called "hush," which flow from lead and copper mines, or impure water ejected by chemical works, gas works, tanneries, or other manufacturing works, and I carry out this
15 part of my Invention also by the use of my improved ascension filters, and by the process of aëration and oxidation herein-after described.

My Invention consists, thirdly, of more effectually purifying potable water intended for consumption in cities and towns, where the water
generally supplied for domestic purposes is very impure, owing to the
20 imperfect means of filtration adopted; and I carry out this part of my Invention by the application of my improved ascension filters, and by my process of aëration and oxidation.

And my Invention consists, fourthly, of an improved kiln for drying sewage, and of a mode of excluding rain water from sewers.

25 And in order that my said Invention may be fully understood, I will proceed to describe in detail the process and the apparatus I adopt for carrying out the same, and will refer to the Drawings hereunto annexed, and firstly with regard to my works for collecting, drying, and utilising the sewage of cities and towns. I place them in the most convenient
30 spot for intercepting or collecting the sewage water, and my arrangement consists of a series of four, five, or any number of tanks or reservoirs, and which may be erected in duplicate, triplicate, or larger number of series according to the requirements of the city or town, but they should all be in communication. The sewage matter after flowing
35 into the first tank, which should be larger than the others, passes thence to the second tank through a vertical filter which is charged with

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chemical reagents, and then before entering into the second tank it is thoroughly aerated, and the matters held in solution are oxidised by three successive falls of the sewage water which enter the second tank in the form of spray. The fall between each of the tanks should be from eighteen to twenty-four inches. This treatment is repeated in every tank in succession. The charges of the filters must to some extent depend upon the nature of the sewage and the soil of the district, and also upon the purpose to which they are to be applied, whether for sewage water, potable water, or for streams containing minerals or the refuse from manufacturing works, since complete oxidation of the matters in solution must necessarily take place in every tank, from the fact that the sewage water not only passes through the filter, but from being broken into spray an extensive precipitation will also occur, as the addition of the oxygen of the atmosphere adds to the weight of the material in solution and consequently tends to precipitate it. 15

When it is required to empty the tanks, which may be necessary once a week, the sewage water is turned off into the second or duplicate series of tanks, and the mass in the first tank is allowed to settle for twelve hours, but in respect to the first tank the sluice between the first and second tank which is protected by the horizontal filter is opened after a shorter period, and the water is drawn off gradually into the second compartment, which is eighteen inches or two feet lower than the first; when the water is reduced two feet in the first the sluice is then closed, and in this condensed form the chemicals in solution are added to assist deodorisation and precipitation, acting upon the natural elements in solution, combining with them and forming an insoluble soap which is blended in precipitation with the natural deposit of the materials in suspension. After the specified time the third and fourth sluices are opened in rotation, the effluent water slowly flowing into the river perfectly innocuous. The chief deposit remains in the first tank, which after a proper time allowed for drainage is in due course removed to the drying kilns, there further deodorised and rendered fit for removal to the depôt or by the contractor. 25 30

I will now proceed to describe the construction of the filters.

Figure 1, Sheet A, of the Drawings annexed hereunto represents the ground plan of the pits or tanks; Figure 2, a profile section thereof; Figure 3 is a top view of the filter, and Figure 4 shews the manner in 35

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which the sewage water falls from the filter into the pit and becomes aerated.

Figure 8 shews a double row of filtering boxes, seven in each row, each box 3 feet + 4 feet and 4 feet deep.

5 B, E, D, F, is the front appendage over which the water flows from the filters and then falls upon the second shelf *a, b, c, d*, placed two inches below the first, from which the water is projected from each side on to the rows of iron bars which form the fall of spray into the next tank; A, B, C, D, is over the first tank, and B, E, D, F, projects over
10 the second. Each tank in succession is twenty-four inches below the other to give space for the flow of spray. Therefore in using four tanks the water passes through sixteen feet of depth of filtering material.

The construction of the filters is as follows:—Each filter consists of one or more boxes which may be increased or extended according to the
15 amount of sewage. Each box is a filter in itself; it consists of four sides of galvanised iron, the bottom being made of strong galvanised iron wire supported by diagonal iron bars; the interior is covered with coarse cloth, matting, or bagging, which should be of sufficient length to come partly up the sides, the better to effect the emptying of the
20 charge. The charge may be placed in three or four layers, each protected by a cloth between. To afford fine filtration the best and finest pounded material is placed next to the bottom. The charges are packed as closely and as solidly as practicable. The top of the filter is protected and secured, being of fine and coarse galvanised wire, with a
25 cloth or matting between so that the upward force of the water, which is very considerable, cannot remove it. The sewage water passes freely upwards through the chemical charges however solidly packed, the materials of which are only partially soluble yet having affinity with the matter in solution; what is removed is again restored by a replacing
30 material. The water is then projected from a semicircular plate in front of the filter upon two sets of iron bars, and descends into the second tank as a fountain of spray, and in a similar manner through the succeeding filters and tanks. The boxes forming the filter are intended to be each two feet in length, three or four feet wide, and three or four feet in
35 depth placed against each other, and may be lifted out and renewed when saturated with the matter in solution by a portable crane. The passage of the sewage through the filters may be regulated by the quantity and may be made to occupy a considerable time when neces-

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sary, say from five to ten times the duration of time the sewage occupies in flowing from the main sewer into the tank. Provision should be made in the main sewer to confine the water which enters the tanks to sewage water only, to the exclusion of rain water as far as may be practicable, and I describe herein-after a mode of getting rid of 5 storm water so as not unnecessarily to dilute the sewage. In reference to the deposit from the tanks the largest amount being in the first, I erect drying kilns herein-after described at the top or side of the first tank raised above the quay three or four feet; the deposit is then to be raised by a lift on to a tramway eight feet or so above the quay 10 and from thence run into the drying works. The deposit may be raised in tubs by the aid of geers or drops similar to those used for putting coals into ships' holds in the "Tyne" and "Wear" rivers. The trucks are then run into the drying house at once and emptied upon the stove, where it is turned over by mechanical means, and when thoroughly dried 15 and reduced to powder sent off to the depôt or to the contractor.

The machinery for raising the drops or geers may be worked by steam power or compressed air, and the haulage carried on in the same manner.

I would here remark that the sewage matter in a fresh state is not 20 offensive in odour; it may be partially deodorised when in a liquid state in the pits, and be thoroughly deodorised in the kilns; and the water flowing from it returned, not to the pit where the sewage came from, but to the adjacent pit or duplicate then working.

The charges I use in my improved ascension filters must depend to 25 some extent upon the nature of the sewage, and the stratification of the soil through which it passes and to the object to be effected, that is to say, whether it is desired to purify sewage water or to more effectually filter potable water, or to purify streams polluted by mineral admixture, or the refuse from factories or works. 30

Sewage water generally contains sulphuretted hydrogen, carbonic acid, urea phosphates, and nitrogenous constituents; these must be removed by the chemical affinity of the material used in the charges of the filters.

It is generally believed that London sewage contains the proportion by 35 weight of chemical matter in solution of three parts to one part of matter held in mechanical suspension, and that in one hundred tons of

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liquid sewage, the value of the former is fifteen shillings and fourpence halfpenny, while that of the latter is only two shillings and twopence halfpenny, hence the importance of eliminating the former constituents as well as the latter, which by my process is effected.

- 5 The filter No. 1 I charge with granulated gypsum, with a portion of magnesian limestone combined with peat or vegetable charcoal, which may be formed by moulds into compressed cubes or half cubes of twelve inches for the facility of package in the filtering boxes; this will take up a considerable portion of urea or ammonia, and the charge when
10 saturated would contain a large portion of sulphate of ammonia, which is a valuable manure.

The filter No. 2 I charge with aluminum shale from the lias containing sulphate of aluminum and potassium, with a portion of sulphate of iron combined with vegetable charcoal. The effect of this charge is
15 to precipitate all colouring matter to take up parts of the soda, potass, and sulphur, and the greater part of the phosphates with two-thirds of nitrogen in any form.

The filter No. 3 I charge with spongy iron or the best substitute obtainable.

- 20 The filter No. 4 I charge with cocoa-nut charcoal, or peat charcoal, which will remove 170 volumes of ammonia and 96 of carbonic acid.

In some cases to ensure perfect precipitation, it may be needful to put a certain quantity of sulphate of iron (copperas), sulphate of aluminum, or sulphate of magnesia into the first pit, prior to being
25 finally drawn off and cleansed.

I will now proceed to describe my improved drying kiln and process of deodorisation:—The floor of the drying kiln in size ought to have the same superficial area as the floor of the first reservoir, to be flagged with fine quarles or tiles of an inch in thickness; the floor to incline
30 towards the side where the fires are placed, and also to have a slight fall towards the end of the building, so as to drain off in a channel any superfluous water or drainage into the tank then in operation. The tiles or bricks at the side of the floor which forms the general flue into which all the others pass, to be “holed,” so as to allow of the radiation
35 of the heat into the building. This general flue may be six to eight inches wide by three feet in height. The building itself is to be eight

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to nine feet in height, with a slanting roof supplied with skylights and a ventilator capable of being closed.

The entire building to be closed in and easily ventilated.

After the sewage is deposited upon the kiln the fires are to be lighted, coke to be used instead of coal; the heated air will range from 70 5 to 90° Fahr. and the evaporation will commence. I then introduce through small apertures as the means of deodorising the material basins containing four pounds of common salt, into which is poured a pint of sulphuric acid; a red hot heater is then dropped into the basin and the aperture closed. This quantity will generate sufficient 10 chlorine gas to disinfect 1,000 cubical yards of air, and can be repeated in number according to the size of the kiln. The gas generated is two and a half times heavier than atmospheric air, and will speedily decompose and dissipate the bad odour and deodorise the sewage matter. The ventilator when opened will throw off the deodorised air 15 having a smell of seaweed. After a sufficient time has elapsed which experience will dictate, the doors of the kiln can be gradually opened and the air admitted; an arrangement can be made at all times for the evolution of this gas to a moderate extent to keep the buildings sweet and free from all offensive smells. 20

The buildings must be constructed of wood, brick, or stone, without any iron or metal work, on account of the nature of the gas.

Figure 5 represents a section of the fire-places for the drying kiln; C, C, C, the general flue six to eight inches wide by three or four feet in height, perforated with holes, to allow of the dispersion of the hot 25 air. E represents the chimney (if one be needed), but if good coke be used there is little or no smoke; a fall from A to B on the floor of the kiln and a floor from B to C for the better drainage of water thrown off by the sewage. a, a, a, an open space at the end of each fire which will admit the heated air which must pass under the fires; b, b, the 30 flues, six inches deep by four feet wide, may be divided by intermitting bricks to rest the tiles of the floor, and will produce a great draught.

Figures 6 and 7 show my improved plan of confining sewage water in the sewage, to the exclusion of rain water. Figure 6 is the ordinary sewer, the basin is supposed to be sufficient for all the ordinary sewage 35

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water, from the crown of the arch to the dotted line is intended to be filled up with brickwork, at all events it may be built up from *a* to *b*; when the water rises to *a* then the storm water sewer No. 7 comes into operation. The object as far as possible is to confine the sewer for
5 sewage water only. Figure 7 is the same in perspective. It does not necessarily follow that the sewers are to diverge; they may run parallel to each other, the storm water sewer direct to the river.

Having now described my process as applied to sewage matter, I will proceed to describe its application to the purification of tributary
10 streams, and for the purification of potable water:—It is well known that in many rivers salmon might be profitably reared were they not polluted by the waters which flow from mines, and by the refuse from manufactories and chemical works, and that in many smaller towns the expense of collecting and of attempting to utilise sewage costs more
15 than the returns obtained from the products.

By the use of my improved ascension filters, which may be constructed on a small scale, firstly, the water which feeds rivers may be thoroughly purified by simply causing it to pass through the filters at the head of the river or at the sources of supply, and when requisite by charging the
20 filters with materials adapted for the absorption of "hush" or mineral matter in suspension or solution, and when the object in minor towns is to get rid of the sewage at a small cost, the use of my filters will enable the local boards to purify the sewage water, which may then be permitted to flow into rivers or canals without detriment to the health of the
25 surrounding population.

When water charged with lead in solution from mines is desired to be purified, I charge my filters with pulverised iron pyrites (bi-sulphide of iron) combined with vegetable charcoal and formed into compressed cubes or half cubes in half cubes when there are three or more layers,
30 each layer overlapping the joints of the other.

When it is intended to filter water charged with copper, I employ a charge or charges of bright steel or iron filings profusely mixed with charcoal and formed into compressed cubes.

The adoption of my principle for the better purification of water
35 intended for domestic purposes will be a great improvement upon the present method of filtration by percolation through sand beds and gravel as commonly practised by the water companies of large cities.

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The present process is capable only of removing the matters held in machanical suspension, and that very imperfectly, and cannot eliminate the more dangerous elements held in solution.

By my principle the water is oxidised by aëration, and is further purified by passing through the carbonised charges of the filters by which the phosphates are removed with all other prejudicial constituents, and by which means the generation of fungi so common in polluted water is entirely prevented. 5

Having now particularly described and ascertained the nature of my said Invention and how the same is to be carried into effect, I wish it to be understood that I make no claim to the principle of ascension filters in general, but what I do claim and desire to secure by these Letters Patent is,— 10

Firstly. The peculiar construction and arrangement of the ascension filters herein-before described and shown. 15

Secondly. I claim the mode of aërating water herein-before described and shown for purifying sewage and other water.

Thirdly. I claim the construction and arrangement of kilns for drying sewage as herein-before described and shown.

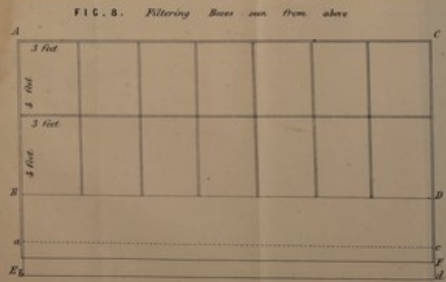
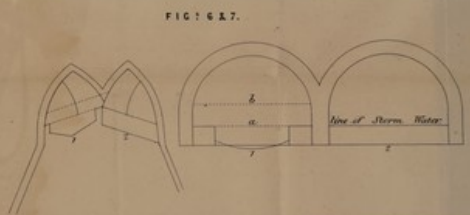
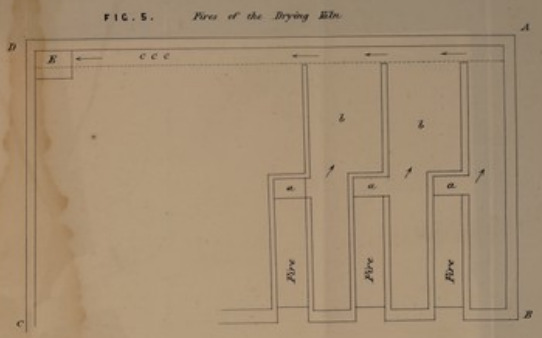
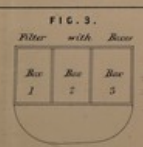
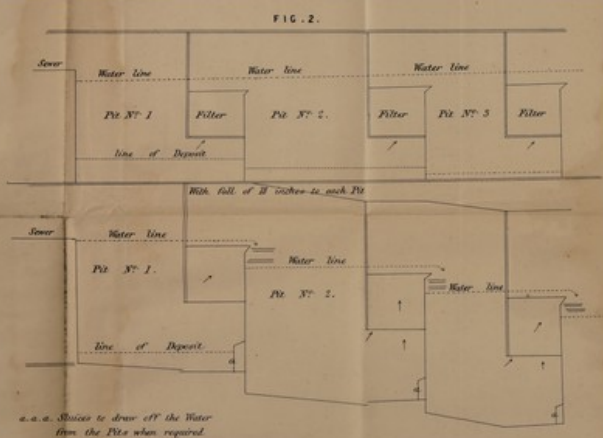
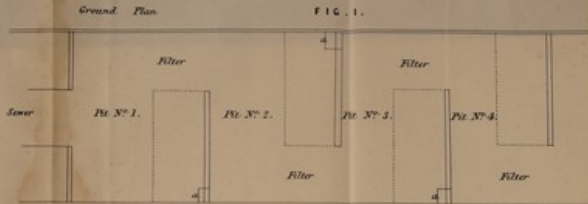
And, lastly, I claim the arrangements for confining sewage water in the sewer herein-before set forth. 20

In witness whereof, I, the said James Brough Pow, have hereunto set my hand and seal, this Thirteenth day of April, One thousand eight hundred and seventy-two.

JAMES BROUGH POW. (L.S.) 25

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