To all whom it may concern:

Be it known that I, GEORGE E. WARING, Jr., of Newport, in the county of Newport and State of Rhode Island, have invented a new and useful Improvement in Sewering and Draining of Cities; and I hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

This invention has reference to an improved system for removing the sewage-waste from houses, the drainage of the subsoil, and the ventilation of the sewers. The invention has nothing to do with storm-water, and the latter is left to other means for removal.

The object of the invention is to provide for the removal of the waste from the houses of cities or towns in the shortest possible time, at the least cost in the construction of the system.

Another object of this invention is to secure the perfect ventilation of the system, so as to prevent the formation of sewer-gas, to prevent the lodgment of solid matter in any part of the sewers, and to facilitate the construction of the system in wet or saturated soil and to drain the soil.

The invention consists in providing a system of sewerage for the collection and removal of house-waste and foul waters, and their removal—indeed, the removal of the sewage-water—through one main pipe to each system, providing flushing-tanks at the ends of the branch pipes, connecting the house-drains with the sewers by a branch as large at their junction as the sewer, and ventilating the system by providing open gratings to admit air to the sewer, and connecting house-drains with the sewer without the use of traps, extending the same above the house, so as to ensure a continuous circulation of air through all parts of the sewer.

The invention further consists in laying into the same trench with the sewer-pipe a drain-pipe, and in the peculiar and novel devices, more fully set forth hereinafter, by which the construction of the system is facilitated and its continuous and efficient operation secured.

Figure 1 is a plan view, showing the application of my improved system for sewer ing and draining a town or city, showing the main sewer pipe with its branches, the ends of each being provided with flushing-tanks. Fig. 2 is a plan view, and Fig. 3 a vertical sectional view, of one of the flushing-tanks. Fig. 4 is a sectional view of the ventilating man-hole and its connection with the sewer-pipe. Fig. 5 is a section showing the trench for the sewer-pipe, the drain-pipe, and the piles for supporting the sewer-pipe. Fig. 6 is a perspective view, showing the supports for the sewer-pipes in wet, marshy, or water-soaked filled in ground. Fig. 7 is a sectional view, showing the switch-pipe used for directing the discharge of the sewage from the main pipe. Fig. 8 is a side view, and Fig. 9 an end view, of the branches by which the house-drains are connected with the sewer-pipes and the branch sewers to the main sewer. Fig. 10 is a sectional view, and Fig. 11 a perspective view, of a drain-pipe, showing the method for making the joint. Fig. 12 is a cross-section, and Fig. 13 a longitudinal section, of the sewer-pipe, showing the device used to secure an absolutely true and smooth surface of the interior of the pipes at the joints. Fig. 14 is a sectional view, showing the connection from the sewer to and through a house, and the arrangement of the drain-pipes.

Inasmuch as my invention has no relation to the draining of storm-water or the ventilation of the same, it will be understood that wherever in the specification I speak of a "sewer" I mean one which does not remove the storm-water. The removal of storm-water may be by any suitable means, but must be by means independent of those which constitute this invention.

In the drawings, a represents the squares of a town or city surrounded by the streets b b, and e represents a river or creek into which the sewage is to be discharged. c and d are lines indicating corresponding levels and showing natural drainage of the surface. e represents an outlet of the sewer, and f an outlet farther down the stream. g is the main sewer, and h h are the branch sewers, on the ends of which, and therefore at their highest ends, the flush-tanks i i are located, so that the flushing-water will periodically wash the branches and carry all matter therein contained into the main sewer, where, by the united effect of all the flushing-tanks, the sewage is rapidly swept to the outfall.

On examination of Fig. 1 it will be seen that
the two last lateral branches are each provided with five flushing-tanks, so that not only are the branches frequently flushed, but, as all this water from the ten flushing-tanks is rushing into the highest end of the main sewer-pipe, the same is frequently swept by a rush of water, carrying all impurities contained therein to the outlet, and discharging the contents at frequent intervals.

In my improved system of sanitary sewerage no sewer should be used of a smaller diameter than six inches, first, because it will not be safe to adopt a smaller size than four inch for house-drains, and the sewer must be large enough, surely, to remove whatever may be delivered by these; second, because a smaller pipe than six inches would be less ventilated than is desirable; and, third, because it is not necessary to adopt a smaller radius than three inches to secure cleansing of the channel by reasonably copious flushing. No sewer should be more than six inches in diameter until it and its branches have accumulated a sufficient flow at the hour of greatest use to fill this half full, because the use of a larger size would be wasteful, and because, when a sufficient ventilating capacity is secured, as it is in the use of a six-inch pipe, the ventilation becomes less complete as the size increases, leaving a larger volume of contained air to be moved by the friction of the current or by extraneous influences, or to be acted upon by changes of temperature and of volume of flow within the sewer. The size should be increased gradually, and only so rapidly as is made necessary by the filling of the sewer half-full at the hour of greatest flow. Every point of the sewer should, by the use of gaskets or otherwise, be protected against the least intrusion of cement, which, in spite of the greatest care, creates a roughness that is liable to accumulate obstructions. The upper end of each branch sewer should be provided with a flush-tank of sufficient capacity to secure the thorough daily cleansing of so much of the conduit as, from its limited flow, is liable to deposit solid matters by the way. There should be sufficient man-holes, covered by open gratings, to admit air for ventilation. If the directions already given are adhered to, man-holes will not be necessary for cleansing. The use of the flush-tank will be a safeguard against deposit. With the system of ventilation about to be described, it will suffice to place the man-holes at intervals of not less than one thousand feet.

For the complete ventilation of the sewers it should be made compulsory for every householder to make his street-connection without a trap, and to continue his soil-pipe to a point above the roof of his house—that is, every house-connection should furnish an uninterrupted ventilation-channel four inches in diameter throughout its entire length. With the system of small pipes now described the flushing would be so constant and complete, and the amount of ventilation furnished, as compared with the volume of air flushed, would be so great, that what is popularly known as "sewer-gas" would never exist in any part of the public drain. Even the gases produced in the traps and pipes of the house itself would be amply rectified, diluted, and removed by the constant movement of air through the latter. All house-connections with the sewers should be through inlets entering in the direction of the flow, and these inlets should be funnel-shaped, so that their flow may be delivered at the bottom of the sewer, and so that they may withdraw the air from its crown—that is, the vertical diameter of the inlet at its point of junction should be the same as the diameter of the sewer. All changes of direction should be on gradual curves, and, as a matter of course, the fall from the head of each branch to the outlet should be continuous. Reductions of grade within this limit, if considerable, should always be gradual.

Referring now to the special features by which the construction of such a system is facilitated and its efficient operation assured, the flushing-tank shown in Figs. 2 and 3 is what is known as "Field's flush-tank." It consists of the tank proper, provided with the inlet-pipe a', by which a small quantity of water is constantly flowing into the tank. b' is the outlet-pipe, and c' is a larger pipe, closed at the upper end and open near the bottom, set over the pipe b', and held by distance-pieces, so as to form an annular passage, which, with the pipe b', forms a siphon for the discharge of the water from the tank. The efficiency of this tank depends on the pipe b', which must be set perfectly plumb, so that the first flow of water into the pipe will establish a partial vacuum and cause the water in the tank to flow quickly over into the pipe b', and to facilitate the accurate setting of the pipe b', I construct the plate d' with a recess, into which the flange e' of the pipe b' fits. I now place the plate d' on the masonry and level the same with an ordinary level, and then set the flange e' into the recess, and the pipe b' will be in its proper position without the difficulty of adjusting the same heretofore experienced. To be sure the prompt action of the siphon, the lower end of the pipe b' should be sealed with water at the beginning of the discharge, and to insure the permanent cessation of its action when the tank becomes emptied the lower end of the pipe b' should be unsealed, which conditions are effected by the necessary siphon f'. This siphon has hitherto been made separate from the other parts of the work. I have caused the same to be cast in one piece with the iron outlet-chamber f', so that its just position will always be secured.

Referring now to Fig. 4, a' represents an open grating forming an air-inlet to the sewer, b' is a box constructed so as to prevent the entrance of solid matter into the sewer, c' is a grating, and d' a connecting pipe or sleeve
extending above the bottom of the box \( \theta \), so that solid matter cannot enter the sewer. \( \phi \) is a covering-plate (shown in solid black) as protecting the entrance to the sewer. It is also shown in broken lines placed lower down, when the box \( \theta \) is being cleaned out, so as to prevent any matter entering the sewer, and also shown as placed against one side of the box \( \theta \) when the sewer is to be inspected. By this peculiar construction the inspection and cleaning of the main-holes or air-inlets is greatly facilitated and the entrance of gravel or sand prevented—a most essential feature in this system.

To insure a healthy atmosphere in a city or town, the draining of the subsoil becomes a necessity. It is well known that valleys and low lands in cities or towns are subject to the charge of breeding fevers, refuse matter and surface-water being retained in such localities and slowly evaporated into the atmosphere. By carrying out my invention in such districts it is essential to support the sewer-pipes temporarily, and to drain the soil so that it shall become dry and solid, to prevent the settling of the pipes and leakage of sewage into this already unhealthy soil.

Fig. 5 represents a trench made into such made land, and shows the sewer-pipe \( \Delta \) temporarily supported on a board pile and the drain-pipe \( B \) laid in the same trench close to the sewer-pipe, but disconnected from the same. By this arrangement the sewer-pipe can be laid into any kind of swampy soil, and in a short space of time the earth near the sewer, and in fact for a considerable distance on each side of the same, will be found dry and solid. This pipe \( B \) is a subsoil-drain, and has nothing to do with the disposal of storm-water.

Fig. 6 shows the manner of thus supporting the sewer-pipe in perspective view.

In sandy or in fact in any kind of soil the board piles \( D \), which may be made short, will facilitate the laying of the sewer-pipes, as they can be more accurately lined to true incline, and as they extend a little above the bottom of the trench the joints can be much more readily and better made, as the gasket can be driven into the socket more easily, and the cement can be allowed to set free from contact with the bottom of the trench.

It becomes frequently desirable to secure two outlets to a system of sewerage, either for discharging the sewage to the best advantage at the varying stages of the water in the river, or for distributing the sewage.

When the direction of the flow of the sewage is to be changed from one outlet to another, the main sewer with the collar \( e \), and secure to this collar the tube \( \phi \), which is supported on the ways \( e \), and is hinged in the collar \( e \) by the pivotal bearing \( \theta \), the inner face of the ring \( a \) being curved, so as to form a tight bearing of the tube on the ring, the pivotal center of the ring \( a \) forming radius for such curve. The tube \( \phi \) is covered by plates, one or more of which can be readily lifted, so as to swing the mouth or end of the tube in line with either of the discharging-sewers \( \phi \); the ends of which form a curved line of which the pivotal center is at \( \phi \) in the ring \( a \).

To prevent any accumulation of matter in the sewer, secure the full force of the flushing water throughout the whole length, and the rapid change of air or ventilation in the sewer, all the connections are made by specially-constructed lengths of sewer-pipes having branches, which, at the junction with the sewer, are of the same diameter as the sewer-pipe; or the branch pipe may be made oval at the junction with the main pipe, so that the air can be withdrawn from the top of the main pipe.

Figs. 8 and 9 represent a connecting-piece of sewer-pipe. \( A \) is the sewer-pipe, and \( A' \) the branch pipe.

Drain-pipes are usually laid with a ring surrounding the shutting ends of the pipe. This ring serves to hold the pipes in line until the trench is filled in and the soil is settled around the pipe. This joint increases the cost of the drain-pipe without adding to its durability or usefulness, and it is desirable to dispense with the same.

In Figs. 10 and 11 my improved joint is shown. \( B \), \( B' \) are lengths of drain-pipe, and \( X \) is a strip of stout paper wrapped around the joint. This paper is sufficient to retain the joint in place until the drain-pipe is securely laid. It is much cheaper than the other sleeve, and as it settles down the mouth of the moisture, the open joint of the porous pipe becomes available for drainage.

The success of this improved system of sewerage and drainage depends on the rapid removal of the refuse. Any imperfection in the pipes becomes an obstacle on which solid matter is liable to lodge, and by collecting other matter is liable to build up such obstructions as will cause the complete stoppage of the sewer. The joints in the sewer-pipes are most liable to form the primary cause for such stoppage. It is therefore necessary to guard against this defect.

In Figs. 12 and 13 a device is shown by means of which sewer-pipes can be laid more rapidly than heretofore, and so that the inner face of the pipe at the joint will present no obstruction. The device consists of the frame \( \phi \), provided with two elastic cushions, \( b' b' \), a yielding bar, \( e \), provided with an elastic cushion, \( a \), a wedge-shaped block, \( d \), provided with a nut in which a screw-threaded bolt secured to the crank \( f \) is turned, so as to draw in the wedge-shaped block or push the same out. This device is set into the sewer-pipe, the cushions \( b' \) and \( b' \) reaching beyond the joint, so as to bear partly on the interior of the fixed and partly on the interior of the pipe to be secured, the cushions \( b' b' \) resting against the sides of the pipe. When now the wedge \( e \) is drawn in by turning the crank \( f \) to the
right, the cushion is placed against the interior of the pipe, and the loose pipe to be secured is placed at the joint exactly on a line with the pipe already secured and is firmly held. If now a gasket is driven into the socket and the joint is made with cement, the two pipes will present a smooth surface on the joint without the slightest projection to form an obstacle to the flow of the sewage.

The above-described device for forming line-joints of two consecutive pipe sections, as shown in Figs. 12 and 13 of the drawings, does not constitute part of this invention, and is hereby reserved as subject-matter for a separate application.

It will be seen that the system of sewerage here described is radically different from the usual practice. It is in all essential particulars much better adapted to the purposes of sanitary drainage. It is cheaper, it is much more completely ventilated, and is more exactly suited to the work to be performed. It obviates the filthy accumulation of street-manure in catch-basins and sewers, and it discharges all that is delivered to it at the points of ultimate outlet outside the town before decomposition can even begin.

If the discharge is of domestic sewage only, its solid matter will be consumed by fishes, if it is delivered into a water-course, and its dissolved material will be taken up by aquatic vegetation. The limited quantity and the uniform volume of the sewage, together with the absence of dilution by rain-fall, will make its disposal by agricultural or chemical processes easy and reliable.

The cost of construction, as compared with that of the most restricted storm-water sewers, will be so small as to bring the improvement within the reach of smaller communities. In other words, while the system is the best for large cities, it is the only one that can be afforded in the case of small towns. The various devices are essential to the success of the system and to its economical construction.

Having thus described my invention, I claim as new and desiring to secure by Letters Patent—

1. The improved system of sewerage herein described, the same consisting in a main sewer-pipe gradually diminishing in size and provided with branches, on the ends of which automatic flush-tanks are provided, constructed to flush the branches and the main sewer, connecting-sewers extending from the sewer-pipe or branches into and through the houses, formed in an open flue from the sewer to the top, or practically to the top, of the house, and air-inlets constructed to ventilate the sewers, substantially in the manner as described.

2. The improved system of sewerage and drainage, the same consisting in the combination, with a system of sewer-pipes and branches, constructed to discharge the sewage independent of the storm-water, as described, of a system of subsoil-drains laid in the same trench with the sewer-pipe, as and for the purpose set forth.

3. The combination, with the main sewer-pipes, of the branch pipes made at their junction of the same size as the main pipes, so as to discharge the liquid on a line with the bottom and withdraw the air on a line with the top of the pipe, as and for the purpose set forth.

4. The combination, with air-inlets to a system of sewers, of a house-drain connected with the sewer by a connection practically of the same height as the sewer, extending to and through the house, constructed to ventilate the sewer, as and for the purpose described.

5. The combination, with a system of sewer-pipes constructed to discharge the sewage independent of the storm-water, of flush-tanks located at the heads of the branches, air-inlets and house-connections extending through to the house-top, without traps between the house and the sewer, constructed to clean the sewer-pipes by the rush of water from the flush-tanks, and ventilate the same by currents of air passing in by the air-inlet and out by the unobstructed house-connections, as described.

6. The improvement in the construction of the flush-tanks, the same consisting in providing the pipe with the flange, the plate, the shell, the flange, the plate, the cover, the cover, the box, provided with the grated or open cover, the grate, and the cover, constructed to operate as described.

7. In combination with the system of sewerage, as described, the box, provided with the grated or open cover, the grate, and the cover, constructed to operate as described.

8. In the herein-described system of sewerage, the combination, with a pipe, of the piles having their lower ends pointed and their upper ends respectively provided with recesses in which the pipe rests, substantially as set forth.

9. The combination, with a system of sewers constructed to discharge the sewage independent of the storm-water, of the tube, pivoted in the concaved collar or ring, and constructed to change the direction of the outflow of the sewage, as described.

10. A branch pipe consisting of the main pipe and the conical branch, the interior of which is practically on a line with the top and bottom of the main pipe, as described.

11. The improved joint for drain-pipes, the same consisting in a strip of paper or similar material wrapped around the pipe at the joint, as described.

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No. 236,740. Patented Jan. 18, 1881.
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Fig. 4.

Fig. 5.

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Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

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