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SEWERAGE SYSTEM.
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To all whom it may concern:

I, ISAAC SHONE, of Westminster, London, S. W., in the county of Middlesex, England, have invented certain new and useful Improvements in and Connected with Sewerage Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

This invention has reference generally to sewerage systems, and to their ventilation, the term “sewerage system” being used to include the main and tributary sewers, drains, soil pipes, and other conduits or apparatus employed in connection with them.

While all are agreed as to the essentials of the hydraulics and pneumatics of drainage—namely their self-cleansing character, and their ventilation—so that the air getting into houses and existing in the vicinity of houses, and in the streets, shall not be hurtful, yet, as a fact, the drainage systems and apparatus as at present employed are not such as attain these essentials; and the objects and effects of the present invention have been to provide such improvements and methods or means as to fulfil the requirements, and so render these essentials attainable, so that the improved system—shall be as reasonably perfect in a sanitary sense as it is possible to make it.

In the following description, the improvements in connection with sewerage systems, and their ventilation, are comprised.

The system of sewers, drains, soil pipes, with their tributaries and accessories, at present in vogue, is, as stated, often hydraulically extremely defective, the means adopted for effecting the functions they are intended to perform, such as the prevention of access of foul air or gases from them into houses, or into the atmosphere about houses, being faulty. In other words, the methods adopted are incomplete as regards obtaining a reasonably complete sanitary or pure condition of the drains and sewers, and the rendering of houses reasonably immune against the entry of sewer or drain gases, which are deleterious to health, and sometimes dangerous to life. And furthermore, the same defects exist with regard to the atmosphere about or in the immediate vicinity of houses and in the streets, in that the present system does not in many cases prevent this atmosphere from being polluted to a degree which is not only objectionable, but inimical to health.

There have been numerous and various efforts made from time to time to ventilate drains and sewers, by arranging and constructing them, and their accessories, in a manner that the ventilation should be effective, and that the sewage gas nuisances which now frequently invade houses, and are present about houses and in the streets, should be rendered as reasonably non-existent, and as harmless in a sanitary sense as possible; but, as stated, these either do not accomplish the objects aimed at, or the systems or proposals have been such that if adopted, the cost would be so great that there is no practical possibility of their adoption in towns and districts; and an additional object of the present invention is that of accomplishing true safety and sanitariness, is that of providing such a system and means as can be applied generally to towns, urban districts, houses, and other buildings, and the like, at such an expense as shall render their adoption practicable. Moreover, in cases where drains and sewers cannot be laid at self-cleansing gradients so as to prevent deposits, and where in consequence the air or atmosphere will be impure within them, the object and effect of the present methods or means is to render harmless and pure this atmosphere or air in the drains and sewers.

While this system largely practically involves the reversal of existing methods, yet notwithstanding this radical change, it can be readily adapted to existing old, or to proposed new drainage and sewerage works, whether such works are of the combined or "dual," or on the separate system.

In the system comprised hereunder every portion of domestic, or other liquid waste waters, whether separate from or combined with rainfall—no matter how small or large these may be, can be automatically and economically arrested, until any predetermined volume of them is accumulated, and this latter can afterward be made to pass away speedily and effectually in sufficient bulk to cause it to flush the drains etc., into and through which it is discharged to the
public sewers. By thus systematically utilizing the droplets of the waste fluids of houses and other buildings, and the rain waters falling upon them for flushing purposes, enormous volumes of potable waters, which are now used and literally wasted for drain and sewer flushing purposes, can be saved, wherever the English water carriage system of sewage removal is in vogue. Moreover by systematically utilizing the waste and rainfall waters of houses and other buildings in the manner stated above, enormous volumes of fresh air will be induced to circulate within all the waste pipes connected to the drainage arrangements of houses and buildings to ventilate them. This additional ventilation being derived from plenum and vacuum forces which, according to the principles now described, can always be generated by judiciously manipulating the sewage and rainfall resources of houses and other buildings, and converting them continuously into invisible but effectual powers for accomplishing that special and most important hygienic purpose. Furthermore as intimated already in this system, all the liquids of a house, building, or the like, flow through short lengths of small drains sharply graded, to a collector, in connection with the house or building, and they are there stored, while quite fresh until the apparatus is filled; and then the whole volume of liquid so collected is sent down through the drains in a body to the sewer. The beneficial sanitary effects of the continuous self active working of the automatic house-sewage collector and ejector apparatus, both hydraulically and pneumatically, that is, as regards its cleansing action, and the promotion of ventilation, and the manner in which it is accomplished, are hereafter explained.

Regarding the improvements connected with the ventilation of sewage systems, in this system, fresh air is constantly caused to pass down through the house soil pipes, ventilating pipes, house drains, interceptor chambers, street gullies, and other parts, to the sewer, and so a more or less constant changing of the atmosphere of, and introduction of fresh air into, the soil pipes, ventilating pipes, drains, sewers, etc., is obtained; and this is augmented as much as possible by the columns of air which will be caused to pass down the soil and ventilating pipes into the drains, and through these into the sewers, by the fall and flow of liquids through them as hereinafter explained.

The invention will be further described in connection with the accompanying drawings, which illustrate it.

In these drawings, Figure 1 is a sectional elevation, showing the drains, conduits, and other parts and apparatus, connected with a house, arranged and constructed to operate according to this invention. Figs. 2, 3 and 4, are, respectively, longitudinal sectional elevation, cross section, and plan of the hydraulic collector and ejector apparatus, and the interceptor; and Figs. 5, 6, 7, and 8 are, respectively, longitudinal section, cross sections at the lines A A and B B Fig. 5, and plan of a modified form of the hydraulic collector and ejector. Figs. 8 and 9 are respectively, a sectional elevation of the valve, and a front elevation showing a detail of the same.

Referring now to these drawings, and more particularly to Fig. 1, 1 is the main or street sewer; 2 is the hydraulic collector and ejector apparatus; 3 is the interceptor; and 4 is the inspection or junction chamber connected with it. 5 are the soil pipes, 6 the ventilating pipes on them, and 7 the various house drains leading between the house and the various parts, and the sewer 1. The sewer 1 will have connected with it means for artificially creating a rarefaction of the atmosphere within it, so that a constant tendency of flow of air through the drains to it, is maintained; and in this system—the air—is caused to pass down through the ventilating pipes 6, and soil pipes 5, into those of the house drains 7 which are connected with them. The house drains will be mostly connected with and discharge into the hydraulic collector and ejector 2; but some of them will be joined to the main drain 7 at the inspection junction chamber 4 which adjoins the ventilated interceptor 3, as shown in Fig. 1; and from the hydraulic collector and ejector 2, the air introduced in the system passes down the house drains 7 between it and the interceptor, and this air which reaches the inspection junction chamber 4 is mostly caused to pass thence down through the house drain 7 into the sewer 1. The flow of this air, in this manner, from the hydraulic collector and ejector 2 to the house drains 7 is effected by the provision of a small separate air pipe 15, that may be called the by-pass air pipe of the ventilated interceptor 3, which has upon it a reflex valve 16 of the character hereinafter described, and which permits of the air flowing freely in a direction toward the sewer 1, but which checks it in the opposite direction. The connection of the pipe 15 with the ejector 2, and the house drains 7, will be at points on the house and the sewer side, respectively, of the siphon discharge and trap portion of this ejector 2. A similar air pipe 15 is provided on the interceptor 3, and connects the two sides of its seal above the liquid level. The general action of this system therefore, is that all, or a large proportion of the liquids from a house or building pass from it into the hydraulic collector and ejector 2; and if this ejector has a capacity of about 10 gallons it would soon become
filled by the sewage discharges of a moderate sized house, situated in London for example, where the water-supply averages about 35 gallons per day. When full, it is caused to automatically discharge as hereinafter described, and the whole contents flow in a body down the house drains 7 to the interceptor 3, and thence through it direct into the sewer 1. The effect of this is that the house drains 7 between the collector ejector 2 and the sewer 1 are thoroughly flushed and cleaned, and a large volume of air is also thereby caused to pass down through the ventilating pipes 6 and soil pipes 5 and drains 7, causing a pneumatic sweeping and flushing of the drains, pipes, and apparatus, following directly on the discharging action of the house-sewage ejector. Separate and full descriptions of these various acts of the apparatus will now be given.

Regarding the house sewage hydraulic collector ejectors 2—shown in detail in Figs. 2 to 4—these are so constructed and adapted to work, that intermittent actions, having the effect of small collectors, and rapid subsequent flushings of discharges, take place; which as stated, not only serve to produce artificial currents of sewage or water, but also as an aspirator and force of ventilating air in the various pipes, drains, and sewers. The automatic hydraulic collector and ejector consists of a closed vessel 2, which, at one part, is connected by an inlet conduit 21 with the house drain or drains 7, which enter it from above, and some distance above the discharge level; and at another part has a siphonic discharge conduit 22, and a trapped outlet 23, connected with the house drain 7 on the sewer side, or with the sewer. At the bottom of the short leg is the trap 23, while the long leg is connected with the public sewer. In connection with this ejector apparatus, air flow and ventilating conduits 15, with a reflux valve 16 on them—see Figs. 2 and 4—will be used connecting the top of the ejector 2 with the house drains 7, on the sewer side of it, for the purposes already described.

In an advantageous arrangement of the ejector, it should be fixed within the curtilages of the premises of the house or houses draining into it, in the position best suited for short circuiting; so to say, the drains which carry sewage to it; so that the collecting drains 7 converging at or near to the ejector chamber 13, can be made short in length, and perfect in grade or declination to insure the quick flow of the minimum, as well as the maximum volume of sewage to the ejector. This apparatus will be formed so as to be capable of self-cleansing—say hopper shape, as will also be all the conduits and parts connected with it; and the inlet and outlet pipes carrying sewage into and out of the ejector should not be less than 3½ inches in diameter throughout. The inlets or feeding conduits 7—see Figs. 2 to 4—to it are, as above stated, disposed above it, so that when the body of the ejector is full, and a quantity of sewage or waters falls into it, as by a water closet discharge, it will give a sudden rise of level of liquid in the inlet pipe 21 between the ejector 2 and the feeder pipes 7, 5; and this sudden supply of liquid, and rise in this portion 21 of the pipes, must be and is, after the body of the ejector is filled with sewage, sufficient to raise the level, instantaneously, to the highest level needed to force enough of sewage or water over the top end of the short leg of the siphon 22 into and down the long leg, before the siphon can be made to discharge and act properly. And by the use of this type of ejector, its proper siphonic action can be and is insured by the sudden discharge in comparatively small volumes of sewage or water into the ejector inlet 21, or the drain communicating with it. The sewage or water enters at the back end, and where it falls, the body is inclined, as shown, so that the falling sewage or water tends to cleanse this end.

The discharge bend 24 of the discharge siphon 22—see Figs. 2 to 4—should be above the top of the ejector body 2; and there is provided at the cover 25 of the ejector, and air way 66 communicating between the pipe 21, the body of the ejector, and the by-pass pipe 15. The bottom of the ejector body may be gutter-shaped in cross section, as shown, for the promotion of the "self-cleansing" effect.

As an illustration of the application of this invention, when one house or building which is to be drained on the new system, is occupied by six persons, for example, and another house is to be drained upon it, which is occupied by ten persons, and the dry weather flow of sewage on the average from each person is equal to 30 gallons per day, or respectively 180 and 300 gallons per day per house, an ejector of 10 gallons capacity—which is a suitable average capacity—fixed at each house would suffice to receive and eject the sewage discharges promptly and compactly from each into the public sewer with which the drainage of each house would be connected. In the one case, the ejector would be filled and emptied eighteen times, and in the other case it would be filled and emptied thirty times per day, and each ejector would be filled as rapidly or as slowly as the sewage would be discharged into the apparatus from each house, but each ejector would discharge into the main or other drain large volumes of sewage which would suffice to fill the drain full bore; and so continuous until the whole contents of the apparatus would be exhausted; and such operations would obvi...
only be most beneficial in the flushing and ventilating actions upon the public sewers. Such discharges in the higher reaches of flat sewers inadequately filled with sewage to render them self-cleansing would be of in-
calculable sanitary value in the working of
such sewers. Below this ejector apparatus,
namely, between it and the public sewer,
the interceptor trap 3 and chamber 8, will,
in some cases—as in Figs. 1 to 4—be em-
ployed; and it may be of the form hereina-
after described. But, in some cases, as
where new drainage works are planned, the
ejector may be made to take the place of
ordinary interceptors, as well as perform its
own functions, and it may be placed as far
from the public sewer as possible, and so
the excavation required for fixing it in its
manhole-like chamber would be less than if
done as interceptors now in vogue are ar-
 ranged at the bottom end of the main drain
of the house; and, moreover, with conduits
or pipes of 4 inches in diameter this main
drain need not be laid at a steeper gradient
in the direction of the sewer than about 1
in 60. In cases where the interceptor and
its chamber, as usually employed, are dis-
 patched with, the pipes 7 which normally
lead to it will be let to the ejector collector
2, which, as stated, will perform the func-
tion of both.

With regard to the cases as above de-
scribed, where interceptor chambers 8, and
traps 3, are employed, and into which drain-
age, or some of the drainage or water from
different parts of a house, or separate build-
ings, is discharged, the pipes and conduits
within these chambers will preferably all be
closed—see Fig. 2—and the various pipes
led to a point where they would be provided
with a readily removed and fixed lid 27, of
any known suitable kind, and placed on the
house side of the interceptor trap 3; while
the cover 28 of the manhole or chamber 8
may be a ventilated one. The trap 3 con-
sists of a box-shaped chamber, having a
curved lower bend into which dips a septum
18, extending from the top; and the inlet
from the drain 7 to this interceptor trap 3
would be above the discharge level—viz.,
the drain 7—of the trap on the sewer side;
while the body of the trap is carried up
above this point, and the two sides of it on
the opposite sides of the septum are con-
 nected together by the ventilating or air
supply conduit 15, with a reflux valve 16 on
it. By this construction, when the inter-
ceptor trap receives a charge of liquid, the
level on the inlet side of the trap would be
suddenly raised—the trap being of about the
same sectional area as the drain pipes—and
this will produce a sudden discharge, and
flushing and self-cleansing action.

In the modified form of hydraulic ejector
2 shown in Figs. 5 to 7, a water trap 25 is
provided at the bottom of the long leg of
the siphon 22, and this trap 25 is so made
that it does not fill the 3½ inch diameter
trap pipe opening between the bottom of the
long leg of the siphon and the main drain
7. The object and effect of this trap are
two-fold, namely, that by having the aerial
opening in the trap 25, directly the sewage
waters overflow from the short leg to the
long leg of the siphon 22, the falling waters
drive the air in front of them freely through
this air opening in the trap 25 into the drain
7, and by so doing, a partial vacuum is cre-
ated behind them, which causes the water in
the ejector body 2 to rise quickly over the
top of the siphon bend 24, and so immedi-
ately fall down the long leg, and fill the
air opening in the trap 25; and they also
rise rapidly above that opening sufficiently
to force the water in the trap 25 in bulk out
of it into the drain 7. In this way, the
vacuum will be augmented, and its power
will be effectual in causing the whole con-
ten of the tank or ejector to be discharged
speedily in the drain 7.

In all forms of ejectors, not only is the
ejector caused to start work when filled to
the right height, but its ceasing to work is
also assured when its charge has been ejected
out of it into the drain leading to the sewer
as the air passing through the influx from
the house side of the siphon will insure this.

With regard to the construction of the
reflux valve 16 on the air pipes 15—shown
in detail in Figs. 8 and 9—the valve proper
is marked 60, and is normally so made that
it is adapted to be opened by the current of
air, as described, flowing down from the
house drains toward the sewer, and to be
closed by a flow in the opposite direction.
It should be light, so that a small current of
air or pressure would open it, and, con-
versely, a very small current close it; and it
can be placed at an angle, as shown, say
about 45°, so that its weight will bring it on
to its seat 61. The material of the valve
and seat should be such that does not oxidize
readily in a moist atmosphere, such as that
which exists in sewers and drains, nor at-
tacked by sulfur of hydrogen, or carbonic
acid or other gas, so that its durability and
uncorrosible character may be relied upon.
Furthermore, in order that the ventilation of
the drains should not cease in case of the
pressure of air being so low as will not open
the valve, that is, move it off its seat, a small
hole 62, say about ⅛ of an inch or ⅜ths of
an inch, may be provided through the valve,
so that a stream of air will pass through
this hole from the one side, namely from the
house side in the interceptor trap or hy-
draulic ejector, or the like, to the drain on
the sewer side; and in such a case, by the
flow being continuous, although through a
small hole, the volume entering and passing
along through the drains and sewers will be very substantial, and such as to keep the atmosphere of the drains and the sewers in a condition which is not dangerous, should any of such atmosphere escape either into a house, or into the street or road about. But, obviously, when the flow and pressure of the air is such—as will be the case under normal conditions—that the valve is opened, then the volume passed through the drains will be much greater, and such as to produce a constant aerial flushing, so that a higher and better ventilating or airing and purifying effect is obtained. Should, on the other hand, there be a back pressure or flow of air from the drains through the filling of the sewers with sewage or rainfall or both, the back flow to the drains on the house side is restricted to that which passes through the small hole; and, in any event, as, prior to the closing of the valve through this cause, the drains on the sewer side would be filled with a fresh and not foul atmosphere, a small proportion or percentage of such air entering the house drains will not produce an evil effect, even should it enter the house; and for the reason that the quantity of air passing through the small hole to the house drains on the house side, it will not be such as to contaminate the air in them, or the parts connected with them, to such a degree as to render it dangerous. The volume of air passing through the hole will be about 1000 times less than that which would pass where the ventilation is effected by a house drain of 4-inch diameter, as is generally done.

With regard to the form of the reflux valve itself, this may be made as shown, out of this sheet metal, or alloy of a character such as referred to, and their seats may be made of similar material; and it will be suspended on bearings 63, such as that of the knife edge type, or points, and so as to open and shut with the least movement of air. In some cases, instead of the small hole being provided in the valve, it may be formed in the seat, or in any suitable or convenient part or point; while in other cases, where desired, no hole for the return flow of air need be used.

What is claimed is:

1. In a sewerage system, a siphon collector apparatus, drains on the building side of the collector apparatus, drains on the sewer side of the collector apparatus, an air pipe connecting the drains on one side of the collector apparatus with the drains on the other side of the said collector apparatus, and an automatic valve in the air pipe, whereby when the sewerage is siphoned through the collector apparatus a partial vacuum is created in the air pipe and opens the automatic valve and air introduced into the building drain will be drawn into and through the sewer drains, and subsequently said valve automatically closes to prevent air in the drains on the sewerage side of the collector apparatus passing into the drains on the building side of said collector apparatus.

2. In a sewerage system, a sewer, a hydraulic collector ejector apparatus of the rapid discharge type, drains connected to the building side of the apparatus, drains connected to the sewer side of the apparatus, and an air pipe communicating with the building side of the apparatus and the drains on the sewer side of said apparatus, a valve in said pipe, whereby the rapid discharge of the contents of the apparatus creates minus pressure in the drains on the sewer side of the apparatus and opens the valve and admits atmospheric air from the house drains to said sewer drains to accelerate the flow of the sewage and to clean and flush the drains with fresh air, and means for automatically closing the valve when pressure in the pipe is normal.

3. In a sewerage system, a sewer, a hydraulic collector ejector apparatus, an interceptor, drains connecting the ejector apparatus and interceptor, a drain connecting the interceptor and the sewer, means for creating a minus pressure in the drain, connecting the ejector apparatus and the interceptor to facilitate the flow of sewage, means for automatically introducing atmospheric air into the last mentioned drain, a pipe connected with the interceptor and the drain between the latter and the sewer, a valve in said pipe, and means for automatically closing said valve, whereby when sewerage passes through the drain from the interceptor, a supply of air will be drawn through the pipe, and the valve will be subsequently closed and prevent foul air from the sewerage passing to the interceptor.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ISAAC SHONE.

Witnesses:
SAMUEL JOHN EARL,
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."