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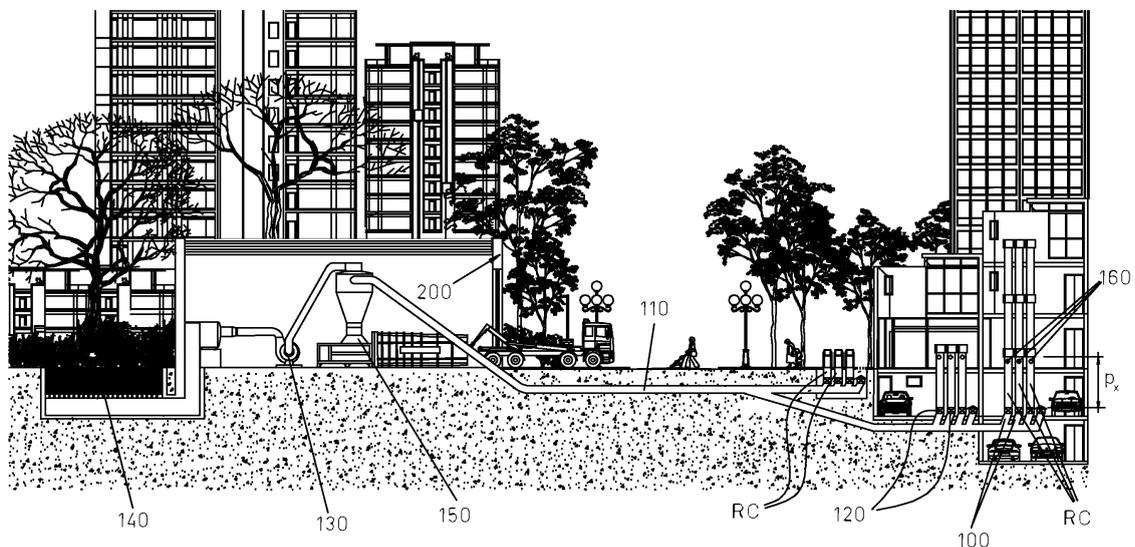
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(54) Method for controlled disposal of refuse

(57) Refuse is collected from n refuse chutes (RC) through waste pipes (100) leading to transport pipes (110). The transport pipes (110) comprise several branches (b) and at least one refuse chute (RC) is connected to each branch (b) through a corresponding waste pipe (100) for driving refuse to at least one collection station (200). The method consists in emptying a first refuse chute (RC₁); establishing the refuse chute being emptied as a reference refuse chute (RC_R); selecting a

new refuse chute to be analyzed (RC_x); determining whether at least a first condition is met, said condition depending on said reference refuse chute (RC_R) and said refuse chute to be analyzed (RC_x); if said condition is met, emptying the selected refuse chute (RC_x), establishing said refuse chute (RC_x) as a new reference refuse chute, and selecting again a new refuse chute to be analyzed (RC_x); and if said condition is not met, selecting another new refuse chute to be analyzed (RC_x) and then determining again whether said first condition is met.

FIG. 1



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Description

FIELD OF THE INVENTION

5 **[0001]** The present invention relates to air refuse collection and more particularly to a method for controlled disposal of refuse from refuse chutes through waste pipes to at least one collection station and a system for collecting such refuse.

BACKGROUND OF THE INVENTION

10 **[0002]** Disposal of waste products, such as for example, inorganic refuse (paper, plastics, metals, rubber, leather, textiles), and organic refuse (food scraps, wood, and household refuse containing organic matter) and the like by means of air waste disposal systems is a well known prior art technique in which refuse are conveniently driven through a pipe system into a collection station. Air waste disposal systems are usually used in inner city, private communities, building areas, hospitals, hotels, industrial facilities, airports, etc. and places in general where refuse are produced in large amounts, this being a rapid, clean and efficient technique for centrally disposing of waste products.

15 **[0003]** In such disposal system, a network of fixed refuse chutes where refuse is to be selectively placed is distributed on a determined area. Each of the refuse chutes is connected to waste pipes leading to a common air transport pipe system through corresponding discharge valves. Waste products are driven by the air transport pipe system by an air stream (typically at vacuum conditions) drawing them to at least one collection station for treating, recycling or disposal.

20 **[0004]** The refuse chutes are emptied when a volume of refuse considered to be sufficient to be discharged into the collection station is detected. This is carried out by level sensors associated to the refuse chutes which output a level-indication signal to control means for opening the corresponding discharge valve.

25 **[0005]** Since a plurality of refuse chutes exists in the network of refuse chutes, a control system has to be provided in order to improve performance, especially in large networks. Thus, emptying can be performed on a first to come first to serve basis or by forming groups of refuse chutes according to a priority value that represents the relative importance of collecting refuse from the group.

[0006] To this effect, level controlled emptying has been developed in recent years in which level sensors associated to refuse chutes are provided for detecting the level of refuse. When a predetermined level is reached, a level indication signal is sent to a control system such that higher priority is given to refuse chutes with higher level for them to be emptied.

30 **[0007]** WO0105683 discloses a system for refuse collection by grouping of the refuse chutes such that a control system operates discharge valves associated with refuse chutes on a group basis. One group is selected at a time by the control system for opening a series of discharge valves within the selected group. The group of refuse chutes having the highest priority value among the groups with valid emptying conditions is selected for emptying and collection of refuse.

35 **[0008]** W02004094270 discloses a refuse collection system with a multi-branch transport pipe system in which a number of refuse chutes connected thereto are provided such that refused is emptied by branches. For each number of possible next-hop candidates, future refuse chute load levels are predicted in a plurality of branches. A system consequence value is determined based on these predicted load levels and a hop to a next branch is selected among those candidates that have the most favorable system consequence values. Load levels may be weighed by priority coefficients for taking the relative importance of emptying different refuse chutes into account.

40 **[0009]** Since the above prior art systems and methods have been proved to be efficient, they however suffer from an undesirable high-energy consumption.

SUMMARY OF THE INVENTION

45 **[0010]** The present invention provides a method for controlled disposal of refuse from a number of refuse chutes through an air system, such as for example, a system working at vacuum conditions for controlled disposal of refuse.

[0011] Refuse chutes, as used herein, means a container for receiving refuse therein. This container is usually arranged fixed outdoors (in the street) or indoors (hotel halls, etc) providing easy access so that the refuse may be selectively disposed therein.

50 **[0012]** Refuse chutes are connected to waste pipes leading to at least one transport pipe that is usually built underground. At least one portion of the waste pipes is also built underground. However surface installations may be alternatively built, such as for example with some portions underground and some portions on the ground. The refuse from the refuse chutes is driven by the transport pipes to at least one collection station where refuse is processed.

55 **[0013]** Variable speed fan assemblies are provided for generating an air stream such that refuse is suitably driven from the refuse chutes to the respective collection stations. Air leaving the installation is then conditioned, i.e. washed, deodorized, etc, through bio-filter means, before being discharged out to the atmosphere. Bio-filter means are not described herein as they are not part of the present invention.

[0014] The method of the present invention is directed to the controlled disposal of the refuse from refuse chutes

containing the same type of refuse selectively disposed therein by the user. Refuse chutes are connected to waste pipes leading to transport pipes. The transport pipes are arranged in branches and at least one refuse chute is connected to each branch through the corresponding waste pipe. Refuse is thus driven to at least one collection station.

5 [0015] The method of the invention consists in emptying a first refuse chute and establishing the refuse chute being emptied as a reference refuse chute. Then, a new refuse chute to be analyzed is selected and a control system determines whether at least a first condition is met. This first condition, which will be described in detail hereinbelow, depends on the reference refuse chute and the refuse chute to be analyzed.

[0016] If said condition is met, the control means causes the selected refuse chute to be emptied and said selected refuse chute is now considered as a new reference refuse chute. Then, a new refuse chute to be analyzed is selected.

10 [0017] If the above mentioned first condition is not met, another new refuse chute to be analyzed is selected and it is determined again whether said condition is met.

[0018] In some embodiments of the method of the invention it is provided that the step of emptying the analyzed refuse chute comprises acting on a corresponding discharge valve associated with said refuse chute. Acting on a discharge valve involves opening the discharge valve during a first period of time and closing the discharge valve during a second period of time. Said first and second periods of time may be the same and at least one of said first and second periods of time may be of about 3 seconds.

15 [0019] The above mentioned first condition in the method of the invention is met if the current filling level of the refuse chute being analyzed is equal to or greater than a theoretical parameter that is directly proportional to the maximum capacity of the refuse chute being analyzed and that of the reference refuse chute and inversely proportional to a distance associated with the refuse chute being analyzed, the reference refuse chute and the collection station.

[0020] In some embodiments of the invention, the theoretical parameter may also depend on an additional parameter, for example a parameter corresponding to the time slot during which the waste collection is being carried out.

20 [0021] In the event that the refuse chute being analyzed and the reference refuse chute are both in the same branch of the network, the distance to be taken into account will be the distance associated with a refuse chute being analyzed, a reference refuse chute in said branch and the distance of said refuse chutes to the collection station.

25 [0022] In the event that the refuse chute being analyzed and the reference refuse chute are instead in different branches, the distance will be the distance associated with a refuse chute being emptied (reference refuse chute) and a point of intersection in the branch of the refuse chute being analyzed taking into account the distance of said refuse chutes to the collection station.

30 [0023] D_{NR} that represents a distance associated with these refuse chutes RC_1 , RC_2 and the collection station 200.

[0024] According to the invention, it is preferred that the step of emptying a refuse chute is only carried out if a second condition is met. Said second condition is preferably met if the filling level in said refuse chute is equal to or greater than a preset minimum filling level. "Filling level" as used herein corresponds to the volume occupied by the refuse associated with a refuse chute. In some embodiments, the preset minimum filling level ranges from about 0.20 to about 0.50, and more preferably the preset minimum filling level is 0.25.

35 [0025] The above mentioned step of selecting a new refuse chute to be analyzed can be performed according to a preset order of refuse chutes.

[0026] It is also preferred that the refuse chutes of the network are intended to contain the same type of refuse.

40 [0027] In one example of the method of the invention, a fully loaded refuse chute is first emptied and during emptying operation a second refuse chute of the network is sequentially analyzed. The above mentioned theoretical parameter associated with both refuse chutes is then determined and compared with the actual filling level of said second refuse chute. If the actual filling level corresponding to the second refuse chute is equal to or greater than the determined theoretical parameter, this second refuse chute will be considered to be emptied (distance values become less relevant for example in nighttime, when electricity tariff is lower).

45 [0028] Then a new theoretical parameter associated with the last emptied refuse chute and a third refuse chute is determined and subsequently compared with the actual filling level of said third refuse chute such that if its actual filling level is equal to or greater than said new theoretical parameter this third refuse chute will be considered to be emptied, and so on.

50 [0029] If, in the above comparison according to the theoretical parameter, the second refuse chute was considered not to be emptied, then a next theoretical parameter associated with the last emptied refuse chute (i.e., the first emptied refuse chute in this example) and the third refuse chute is then determined and subsequently compared with the actual filling level of said third refuse chute such that if its actual filling level is equal to or greater than said theoretical parameter it will be considered to be emptied.

55 [0030] It is further provided that the step of emptying the refuse chute is only carried out when a minimum filling level is reached in the corresponding refuse chute. Said minimum value of filling level of said refuse chute may be, for example, 0.25. This means that usually only those refuse chutes having a minimum filling level of 25% would be considered for being emptied. In other words, for a refuse chute to be considered for being emptied, two conditions have to be met: the refuse chute has to be at least 25% full and its actual filling level has to be equal to or greater than said theoretical

parameter.

[0031] The invention further relates to a system for controlled disposal of refuse from refuse chutes, which comprises waste pipes connecting each of the refuse chutes to at least one transport pipe leading to at least one collection station. Such a system may be suitable for performing the above mentioned steps of the method of the invention.

[0032] The system includes means for emptying refuse chutes and control means. Such control means may in turn comprise means for establishing a refuse chute being emptied as a reference refuse chute, means for selecting new refuse chutes to be analyzed, means for determining whether a condition is met for either emptying said refuse chute or determining another new refuse chute to be analyzed.

[0033] The system further includes means for determining the filling level corresponding to one refuse chute. Said means for determining the filling level comprise level sensors.

[0034] The above mentioned control means provided in the system of the invention operates through an associated application software that compares the transport energy associated to refuse chutes with the filling level associated therewith so a single refuse chute is then emptied.

[0035] Said control means are capable of monitoring the filling level of all the refuse chutes in the system so that filling level is known at every time. Therefore, fully (or almost fully) loaded refuse chutes which can not be emptied because other refuse chutes are being emptied in that moment, are reduced or even eliminated. Consequently the time elapsed since a full filling level (i.e. 100%) is detected in one refuse chute until it can be emptied is advantageously reduced.

[0036] Carrying out the described method according to the invention, the efficiency of the system is improved and energy saving is therefore greater. The yield of the system is thus highly improved since a 24h-enhanced service is available for user by the system of the present invention.

[0037] In addition, operating time of the fan assemblies is reduced and the working life of the system can be longer since the refuse chutes are sequentially emptied. Furthermore, the starts of the fan assemblies are also reduced at the end of the day and therefore durability is highly improved. That fact should be stressed that the fan assemblies are operated through frequency inverters which allows the speed of the fans to be varied according to the quantity of refuse being transported for each refuse chute, and the distance to the collection station. This is made possible since the filling level as well as the capacity and distances for refuse chutes are known. Advantageously, this also allows the refuse disposed by each user to be monitored.

[0038] This above all in consideration, and the fact that fan operating times and system starts are reduced, the fully (or almost fully) loaded refuse chutes which can not be emptied are reduced or even eliminated, capacity of the system becomes greater than other systems performing different refuse disposal systems. This will be of particular significance in high demand systems. For example, when capacity of a whole system is 100%, for example, in a 25000-40000 population system, there may be of the order of 400 refuse chutes with the corresponding discharge valves, which involves an improved performance for a population that is twice as great as compared to prior art systems.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] A particular embodiment of the present invention will be described in the following, only by way of a non-limiting example, with reference to the appended drawings, in which:

Fig.1 is a view in which the main parts of one embodiment of a system according to the invention is shown;

Fig. 2 is a diagrammatical plan view of a network of branches of refuse chutes according to the invention; and

Fig. 3a is a diagrammatical plan view of a portion of the network of refuse chutes in fig. 2 showing how the distance associated with refuse chutes in the same branch is defined.

Fig. 3b is a diagrammatical plan view of a portion of the network of refuse chutes in fig. 2 showing how the distance associated with refuse chutes --in different branches is defined.

DETAILED DESCRIPTION OF PARTICULAR EMBODIMENTS

[0040] Figure 1 shows a system according to one possible embodiment of the invention. The system allows a method to be carried out for controlled disposal of refuse from refuse chutes RC.

[0041] Refuse chutes RC generally comprise receptacles or housings which are arranged fixed on a determined area, such as, for example, private communities, public buildings and other building areas, hospitals, hotels, industrial facilities, airports, etc. and places in general where refuse (mainly solid products) are produced in large amounts. In the particular example shown in figure 1, refuse chutes RC are arranged in the street, inside a building and a garage.

[0042] As shown in said figure 1 of the drawings herein enclosed, the system comprises a network of n refuse chutes

RC where refuse is to be placed (with n being the total number of refuse chutes RC to be considered in the network). A general refuse chute will be denoted as "RC" throughout the description, whereas a particular refuse chute will be denoted as "RC_x", for example RC₁, RC₂, RC₃,... RC_n. "RC_R" denotes a reference refuse chute, that is, the one that is being emptied at a given time.

5 **[0043]** Each refuse chute RC of the network of n refuse chutes RC₂, RC₃, RC₄,... RC_R, RC_x... RC_n is connected by means of waste pipes 100 leading to one common transport pipe 110 in a transport pipe system. The transport pipes 110 comprise several branches b, b1, b2 and the refuse chutes are connected to each branch b, b1, b2 such that refuse is driven through said transport pipe 110 in branches b to at least one collection station 200 where refuse is treated, compacted, etc. for further transporting for recycling or disposal. Waste pipes 100 are connected to the transport pipe system through corresponding discharge valves 120 which configuration will not be disclosed herein as not being part of the present invention.

10 **[0044]** Variable speed fan assemblies 130 are further provided in the system for controlled disposal of refuse. Fan assemblies 130 serve the purpose of generating an air depression for conveniently drawing the refuse. Refuse is usually packaged in plastic bags which are piled up on the corresponding discharge valve 120 of each refuse chute RC_x. Refuse is thus driven from the refuse chutes RC to a catch means 150, e.g. a cyclone, in the respective collection station 200 for separating refuse from air. Air leaving the installation is then conditioned, i.e. washed, deodorized, etc. through bio-filter means 140, before being discharged out to the atmosphere.

15 **[0045]** The system further includes remote control means -not shown- which are operated through a suitable software application. The control means are adapted for receiving incoming signals from filling level means (which determine the filling level corresponding to one refuse chute, such as for example level sensors 160 associated with the refuse chutes RC) and outputting signals to the corresponding discharge valves 120 in the refuse chutes RC when a volume of refuse considered to be sufficient has been detected.

20 **[0046]** Said control means comprise means for establishing a refuse chute being emptied as a reference refuse chute RC_R, means for selecting new refuse chutes RC_x to be analyzed, means for determining whether a condition is met for either emptying said refuse chute RC_x or determining another new refuse chute RC_x to be analyzed.

25 **[0047]** There is also provided means for determining the filling level p_x corresponding to one refuse chute RC_x. Said means for determining the filling level comprise level sensors.

30 **[0048]** The system operates according the method described below. It is to be noted that all the refuse chutes involved in the method described herein are intended to contain the same type of refuse.

[0049] The method consists in the following steps:

- A- emptying a first refuse chute RC₁;
- B- establishing the refuse chute being emptied as a reference refuse chute RC_R;
- C- selecting a new refuse chute to be analyzed RC_x;
- 35 D- determining whether at least a first condition is met, said condition depending on said reference refuse chute RC_R and said refuse chute to be analyzed RC_x;
- E- if said condition is met, emptying the selected refuse chute RC_x, establishing said refuse chute RC_x as a new reference refuse chute, and returning to step C; and
- F- if said condition is not met, selecting another new refuse chute to be analyzed RC_x and returning to step D.

40 **[0050]** The step of emptying the analyzed refuse chute RC_x involves acting on a corresponding discharge valve 120 associated with the refuse chute RC that is considered to be emptied. This emptying operation comprises opening the discharge valve 120 during a first period of time TA and closing the discharge valve 120 during a second period of time TB. In one embodiment, the first and second periods of time TA, TB are the same, and at least one of them is about 3 seconds.

45 **[0051]** It is to be noted that the selection of new refuse chutes to be analyzed RC_x is performed according to a preset order of refuse chutes RC.

[0052] The above mentioned first condition can be therefore expressed as follows:

50

$$p_x \geq V_{xR}$$

55 wherein p_x is the current filling level of a refuse chute RC_x (that is, the volume occupied by the refuse associated with said refuse chute) and V_{xR} is a theoretical parameter that is directly proportional to the maximum capacity A, B of the refuse chute being analyzed RC_x and that of said reference refuse RC_R chute and inversely proportional to a distance d_{xR}, D_{NR} associated with said refuse chute being analyzed RC_x, said reference refuse chute RC_R and the collection

station 200. The calculation of parameter V_{xR} will be explained below in detail.

[0053] The above mentioned distance d_{xR} , D_{NR} associated with refuse chute RC_x and reference refuse chute RC_R is calculated depending on the branches b , b_1 , b_2 where the refuse chute being analyzed RC_x and the reference refuse chute RC_R are located. For example, if refuse chutes RC_x , RC_R are in the same branch b , the distance d_{xR} will be the distance between the refuse chute being analyzed RC_x and the reference refuse chute RC_R along said branch b . In contrast, if said refuse chutes RC_x , RC_R are in different branches b_1 , b_2 , said distance D_{NR} is the distance between the reference refuse chute RC_R and a point of intersection N in the branch b_1 of the refuse chute RC_x being analyzed.

[0054] In the embodiment herein described by way of an example, a second condition is taken into account such that the step of emptying a refuse chute RC_x is only carried out if said first and second conditions are met. In this particular case, the second condition is met if the filling level p_x in said refuse chute RC_x is equal to or greater than a preset minimum filling level p_m . This preset minimum filling level p_m will range from about 0.20 to about 0.50, with 0.25 being preferred.

[0055] Therefore, only a refuse chute RC_x will be considered by the control means for being emptied only if the first and the second conditions are met:

$$p_x \geq V_{xR}$$

$$p_x \geq p_m$$

[0056] It is to be noted that the parameter V_{xR} could also depend on additional parameters such as the time slot t_x during which the waste collection is being carried out.

[0057] One particular example of the method for controlled disposal of refuse of the invention according to the drawings, particularly figure 2, is disclosed below.

[0058] A first refuse chute RC_1 is emptied based on a first parameter p_1 . Parameter p_1 corresponds in this example to filling level (that is, the refuse volume present in a refuse chute RC_x). Although said first refuse chute RC_1 is emptied based on said first parameter p_1 , it may of course be first discharged or emptied according to another different condition (e.g. by simple decision of the operator, depending on time slot and the like).

[0059] It is apparent that the value for the filling level p_x can be translated into a weight value where necessary. In any case, sensors 160 associated with the refuse chutes RC_x allow the filling level of said refuse chutes RC_x in the system to be monitored at every time.

[0060] When emptying said first refuse chute RC_1 then a following refuse chute RC_2 of the network is sequentially analyzed according to a preset order and a theoretical parameter V_{12} associated therewith is then determined. This theoretical parameter V_{12} , as stated above, is directly proportional to the maximum capacity A , B of the refuse chutes RC_1 , RC_2 being analyzed and inversely proportional to a distance d_{xR} , D_{NR} that represents a distance associated with these refuse chutes RC_1 , RC_2 and the collection station 200.

[0061] The value of the obtained theoretical parameter V_{12} is then compared by the control means with the actual filling level p_2 of said refuse chute RC_2 such that if said actual filling level p_2 corresponding to said refuse chute RC_2 is equal to or greater than said theoretical parameter V_{12} , the refuse chute RC_2 will be considered by the control means as the one to be emptied.

[0062] A next theoretical parameter V_{23} associated with the last emptied refuse chute RC_2 is calculated and a next refuse chute RC_3 is then selected and subsequently compared with the actual filling level p_3 of said next refuse chute RC_3 such that if its actual filling level p_3 is equal to or greater than said theoretical parameter V_{23} said refuse chute RC_2 will be considered to be emptied.

[0063] If, in the above comparison according to the theoretical parameter V_{12} the refuse chute RC_2 was considered not to be emptied, then a next theoretical parameter V_{13} associated with the last emptied refuse chute RC_1 (in this case, the first emptied refuse chute) is calculated and the next refuse chute RC_3 is then selected and subsequently compared with the actual filling level p_3 of said next refuse chute RC_3 such that if its actual filling level p_3 is equal to or greater than said theoretical parameter V_{13} it will be considered to be emptied, and so on.

[0064] In the event that both the analyzed refuse chute RC_x and the reference refuse chute RC_R are in the same branch b , the above mentioned theoretical parameter V_{xR} (that is used by the control means for comparison with the current filling level p_x of each analyzed refuse chute RC_x) is obtained as explained below.

[0065] Energy consumption in refuse transportation associated with a refuse chute RC_1 through a distance d_1 (which will be explained below according to fig. 3a) is obtained, in one example, as follows:

$$E_1 = P_1 \left(\frac{d_1}{v} + T \right)$$

5

[0066] The next refuse chute RC_2 to be analyzed in the same branch b of the network would have a distance d_2 (which will be explained below) associated therewith such that $d_2 > d_1$. Therefore, the associated energy for this refuse chute RC_2 will be obtained as follows:

10

$$E_2 = P_2 \left(\frac{d_{12}}{v} + T \right) + E_1$$

15

[0067] In accordance with the above, the energy for sequentially transporting refuse associated with RC_1 to RC_2 will be, in the same branch b, as follows:

20

$$E_{12} = P_2 \left(\frac{d_{12}}{v} + T \right) + E_1$$

25

wherein:

$P = k_1 \cdot d + k_2$ is the power (in kW). However, power can be obtained from other different ways depending on the inlet air point in the system.

30

d_{12} = distance between the refuse chute being analyzed RC_x and the reference refuse chute RC_R along the same branch b.

35

d_1, d_2 = distance from refuse chutes RC_1, RC_2 to a collection station 200, respectively, such that $d_{12} = d_2 - d_1$ (see fig. 3a).

v = refuse average speed

T = safety time

40

[0068] Therefore

45

$$V_{12} = \left(\frac{E_{12} \cdot A}{E_1 + E_2} \right) - B$$

[0069] Wherein A and B take constant values depending on the filling capacity of the refuse chutes RC. In some cases, $A = 200$ and $B = 100$.

50

[0070] The above equation for the theoretical parameter V_{xR} (V_{12} in this example) associated with energy E_{12} can be given as a distance basis as follows:

55

$$V_{12} = \frac{(k_1 \cdot d_2 + k_2) \cdot \left(\frac{(d_2 - d_1)}{v} + T \right) + (k_1 \cdot d_1 + k_2) \cdot \left(\frac{d_1}{v} + T \right)}{2 \cdot (k_1 \cdot d_1 + k_2) \cdot \left(\frac{d_1}{v} + T \right) + (k_1 \cdot d_2 + k_2) \cdot \left(\frac{(d_2 - d_1)}{v} + T \right)} \cdot A - B$$

[0071] The above is for the event that $d_2 > d_1$. In the event that $d_2 < d_1$ then V_{12} is assumed to be a minimum value, for example 0.25.

[0072] V_{xR} (V_{12} in this example) would of course include a series of correcting factors which may depend e.g. on the time slot during which the analysis is being carried out (either taking into account when the electricity costs are lower or when a maximum demand period occurs), the number of emptyings of the refuse chute to be compared, safety factors, the total volume of the system, etc.

[0073] Where refuse chutes RC_x and RC_R are in different branches b1, b2, the above mentioned theoretical parameter V_x is obtained as follows.

[0074] As above, the energy consumption in refuse transportation associated with a refuse chute RC_1 is obtained, in one example, as follows:

$$E_1 = P_1 \left(\frac{D_1}{v} + T \right)$$

$$E_2 = P_2 \left(\frac{D_2}{v} + T \right)$$

[0075] So the energy for sequentially transporting refuse associated with RC_1 to RC_2 will be, when in different branches b1, b2, as follows:

$$E_{12} = P_2 \left(\frac{D_{n1}}{v} + T \right) + E_1$$

wherein:

$P = k_1 \cdot D_{n1} + k_2$ is the power (in kW). However, power can be obtained from other different ways depending on the inlet air point in the system.

v and T being as stated above

[0076] In this case, for calculating the distance D_{NR} in this case in which the analyzed refuse chute RC_x and the reference refuse chute RC_R are in different branches b1, b2, the node or point of intersection N of the two different branches b1, b2 associated to the refuse chutes RC_x , RC_R has to be taken into account.

[0077] In this example, and according to fig. 3b in the drawings:

D_{n1} = distance between the refuse chute being emptied RC_R (reference refuse chute), that is, RC_1 in this example, and a point of intersection N in the branch b1 of the refuse chute being analyzed (RC_2 in this example), such that:

$D_{n1} = D_1 - D_n$, in which:

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D_1 = distance from one refuse chute RC_1 to a collection station 200
 D_2 = total distance from another refuse chute RC_2 to the collection station
 D_n = distance from node or the point of intersection N of both branches b1, b2 to the collection station

5 **[0078]** Therefore

10
$$V_{12} = \left(\frac{E_{12} \cdot A}{E_1 + E_2} \right) - B$$

[0079] Wherein A and B take constant values, as above, depending on the filling capacity of the refuse chutes RC. In some cases, A= 200 and B= 100.

15 **[0080]** The above equation given as a distance basis is as follows:

20
$$V_{12} = \frac{(k_1 \cdot D_1 + k_2) \cdot \left(\frac{(D_1 - D_n)}{v} + T \right) + (k_1 \cdot D_2 + k_2) \cdot \left(\frac{D_2}{v} + T \right)}{(k_1 \cdot D_1 + k_2) \cdot \left(\frac{D_1}{v} + T \right) + (k_1 \cdot D_2 + k_2) \cdot \left(\frac{(D_2 - D_1)}{v} + T \right)} \cdot A - B$$

25 **[0081]** With said theoretical value V_{12} obtained as explained above for the refuse chutes RC_1 , RC_2 analyzed, the control means of the system compares it with the current filling level p_1 , p_2 associated with the refuse chutes RC_1 , RC_2 respectively.

30 **[0082]** The control means will only act on the discharge valve 120 corresponding to that refuse chute RC_x that meets these two conditions:

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$$p_x \geq V_{xR}$$

$$p_x \geq p_m$$

40 with p_m being a preset minimum filling level of a refuse chute RC_x . The value of the preset minimum filling level p_m may take values ranging from about 0.20 to about 0.50 and it is preferred that $p_m = 0.25$.

[0083] This means that a refuse chute RC_x that is at least 25% full (according to the above preferred minimum value for the filling level) would be individually emptied by the system if it is determined that its current filling level p_x is equal to or greater than the value taken by its associated theoretical parameter V_{xR} .

45 **[0084]** The discharge valve 120 of said refuse chute RC_x meeting the above established conditions is thus selected to be operated by the control means such that a single refuse chute RC_x is emptied during a period of time. The selected discharge valve 120 is then opened during a first period of time T_A and closed during a second period of time T_B . The first and second periods of time T_A , T_B may be the same and at least one of them equal to 3 seconds.

50 **Claims**

1. A method for controlled disposal of refuse from n refuse chutes (RC), through waste pipes (100) leading to transport pipes (110), the transport pipes (110) comprising several branches (b), with at least one refuse chute (RC) being connected to each branch (b) through a corresponding waste pipe (100) for driving refuse to at least one collection station (200), **characterized in that** it comprises the steps of:

A- emptying a first refuse chute (RC_1);

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B- establishing the refuse chute being emptied as a reference refuse chute (RC_R);

C- selecting a new refuse chute to be analyzed (RC_x);

D- determining whether at least a first condition is met, said condition depending on said reference refuse chute (RC_R) and said refuse chute to be analyzed (RC_x);

E- if said condition is met, emptying the selected refuse chute (RC_x), establishing said refuse chute (RC_x) as a new reference refuse chute, and returning to step C; and

F- if said condition is not met, selecting another new refuse chute to be analyzed (RC_x) and returning to step D.

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2. A method as claimed in claim 1, wherein said step of emptying the analyzed refuse chute (RC_x) comprises acting on a corresponding discharge valve (120) associated with said refuse chute (RC).
 3. A method as claimed in claim 2, wherein said step of acting on a discharge valve (120) comprises opening the discharge valve (120) during a first period of time (TA) and closing the discharge valve (120) during a second period of time (TB).
 4. A method as claimed in claim 3, wherein said first and second periods of time (TA, TB) are the same.
 5. A method as claimed in claim 3 or 4 wherein at least one of said first and second periods of time (TA, TB) is about 3 seconds.
 6. A method as claimed in claim 1, wherein said first condition is met if the current filling level (p_x) of a refuse chute (RC_x) is equal to or greater than a parameter (V_{xR}) that is directly proportional to the maximum capacity (A, B) of the refuse chute being analyzed (RC_x) and that of the reference refuse chute (RC_R) and inversely proportional to a distance (d_{xR} , D_{NR}) associated with the refuse chute being analyzed (RC_x), the reference refuse chute (RC_R) and the collection station (200).
 7. A method as claimed in claim 6, wherein if the refuse chute being analyzed (RC_x) and the reference refuse chute (RC_R) are in the same branch (b), said distance (d_{xR}) is the distance between the refuse chute being analyzed (RC_x) and the reference refuse chute (RC_R) along said branch (b).
 8. A method as claimed in claim 6, wherein if the refuse chute being analyzed (RC_x) and the reference refuse chute (RC_R) are in different branches (b1, b2), said distance (D_{N1}) is the distance between the refuse chute being emptied (RC_R) and a point of intersection (N) in the branch (b1) of the refuse chute being analyzed (RC_x).
 9. A method as claimed in any of the preceding claims, wherein the step of emptying a refuse chute (RC_x) is only carried out if a second condition is met.
 10. A method as claimed in claim 9, wherein said second condition is met if the filling level (p_x) in said refuse chute (RC_x), corresponding to the volume occupied by the refuse associated with said refuse chute (RC_x), is equal to or greater than a preset minimum filling level (p_m).
 11. A method as claimed in claim 10, wherein the preset minimum filling level (p_m) ranges from about 0.20 to about 0.50.
 12. A method as claimed in claim 6, wherein the parameter (V_{xR}) also depends on an additional parameter (t_x).
 13. A method as claimed in claim 12, wherein said additional parameter (t_x) is the time slot during which the waste collection is being carried out.
 14. A method as claimed in claim 1, wherein said step of selecting a new refuse chute to be analyzed (RC_x) is performed according to a preset order of refuse chutes (RC).
 15. A method as claimed in any of the preceding claims, wherein the refuse chutes (RC) are intended to contain the same type of refuse.
 16. A system for controlled disposal of refuse from n refuse chutes (RC), which comprises waste pipes (100) connecting each of the refuse chutes (RC) to at least one transport pipe (110) leading to at least one collection station (200), **characterized in that** it further comprises means for emptying refuse chutes (RC_x), means for establishing a refuse chute being emptied as a reference refuse chute (RC_R), means for selecting new refuse chutes to be analyzed

(RC_x), means for determining whether a condition is met for either emptying said refuse chute (RC_x) or determining another new refuse chute to be analyzed (RC_x).

17. A system as claimed in claim 16, wherein it includes means for determining the filling level (p_x) corresponding to one refuse chute (RC_x).

18. A system as claimed in claim 17, wherein said means for determining the filling level (p_x) comprise level sensors (160).

Amended claims in accordance with Rule 137(2) EPC.

1. A method for controlled disposal of refuse from n refuse chutes (RC), through waste pipes (100) leading to transport pipes (110), the transport pipes (110) comprising several branches (b), with at least one refuse chute (RC) being connected to each branch (b) through a corresponding waste pipe (100) for driving refuse to at least one collection station (200), the method comprising the steps of

A- emptying a first refuse chute (RC₁);

B- establishing the refuse chute being emptied as a reference refuse chute (RC_R);

C- selecting a new refuse chute to be analyzed (RC_x);

D- determining whether at least a first condition is met,

characterized in that said first condition is dependent on said reference refuse chute (RC_R) and said refuse chute to be analyzed (RC_x); and in that it further comprises the steps of

E- if said condition is met, emptying the selected refuse chute (RC_x), establishing said refuse chute (RC_x) as a new reference refuse chute, and returning to step C; and

F- if said condition is not met, selecting another new refuse chute to be analyzed (RC_x) and returning to step D.

2. A method as claimed in claim 1, wherein said step of emptying the analyzed refuse chute (RC_x) comprises acting on a corresponding discharge valve (120) associated with said refuse chute (RC).

3. A method as claimed in claim 2, wherein said step of acting on a discharge valve (120) comprises opening the discharge valve (120) during a first period of time (TA) and closing the discharge valve (120) during a second period of time (TB).

4. A method as claimed in claim 3, wherein said first and second periods of time (TA, TB) are the same.

5. A method as claimed in claim 3 or 4 wherein at least one of said first and second periods of time (TA, TB) is about 3 seconds.

6. A method as claimed in claim 1, wherein said first condition is met if the current filling level (p_x) of a refuse chute (RC_x) is equal to or greater than a parameter (V_{xR}) that is directly proportional to the maximum capacity (A, B) of the refuse chute being analyzed (RC_x) and that of the reference refuse chute (RC_R) and inversely proportional to a distance (d_{xR}, D_{NR}) associated with the refuse chute being analyzed (RC_x), the reference refuse chute (RC_R) and the collection station (200).

7. A method as claimed in claim 6, wherein if the refuse chute being analyzed (RC_x) and the reference refuse chute (RC_R) are in the same branch (b), said distance (d_{xR}) is the distance between the refuse chute being analyzed (RC_x) and the reference refuse chute (RC_R) along said branch (b).

8. A method as claimed in claim 6, wherein if the refuse chute being analyzed (RC_x) and the reference refuse chute (RC_R) are in different branches (b1, b2), said distance (D_{N1}) is the distance between the refuse chute being emptied (RC_R) and a point of intersection (N) in the branch (b1) of the refuse chute being analyzed (RC_x).

9. A method as claimed in any of the preceding claims, wherein the step of emptying a refuse chute (RC_x) is only carried out if a second condition is met.

10. A method as claimed in claim 9, wherein said second condition is met if the filling level (p_x) in said refuse chute (RC_x), corresponding to the volume occupied by the refuse associated with said refuse chute (RC_x), is equal to or greater than a preset minimum filling level (p_m).

11. A method as claimed in claim 10, wherein the preset minimum filling level (p_m) ranges from about 0.20 to about 0.50.

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12. A method as claimed in claim 6, wherein the parameter (V_{xR}) also depends on an additional parameter (t_x).

13. A method as claimed in claim 12, wherein said additional parameter (t_x) is the time slot during which the waste collection is being carried out.

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14. A method as claimed in claim 1, wherein said step of selecting a new refuse chute to be analyzed (RC_x) is performed according to a preset order of refuse chutes (RC).

15. A method as claimed in any of the preceding claims, wherein the refuse chutes (RC) are intended to contain the same type of refuse.

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16. A method as claimed in claim 6, wherein said parameter (V_{xR}) for comparison with the current filling level p_x of each analyzed refuse chute (RC_x) includes a series of correcting factors selected from those depending on the time slot during which the analysis is being carried out, the number of emptyings of the refuse chute to be compared, safety factors and the total volume of the system.

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17. A system for controlled disposal of refuse from n refuse chutes (RC), which comprises waste pipes (100) connecting each of the refuse chutes (RC) to at least one transport pipe (110) leading to at least one collection station (200), means for emptying refuse chutes (RC_x), means for establishing a refuse chute being emptied as a reference refuse chute (RC_R), means for selecting new refuse chutes to be analyzed (RC_x), means for determining whether a condition is met for either emptying said refuse chute (RC_x) or determining another new refuse chute to be analyzed (RC_x)-, **characterized in that** said condition is dependent on said reference refuse chute (RCR) and said refuse chute to be analyzed (RCx).

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18. A system as claimed in claim 17, wherein it includes means for determining the filling level (p_x) corresponding to one refuse chute (RC_x).

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19. A system as claimed in claim 18, wherein said means for determining the filling level (p_x) comprise level sensors (160).

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FIG. 1

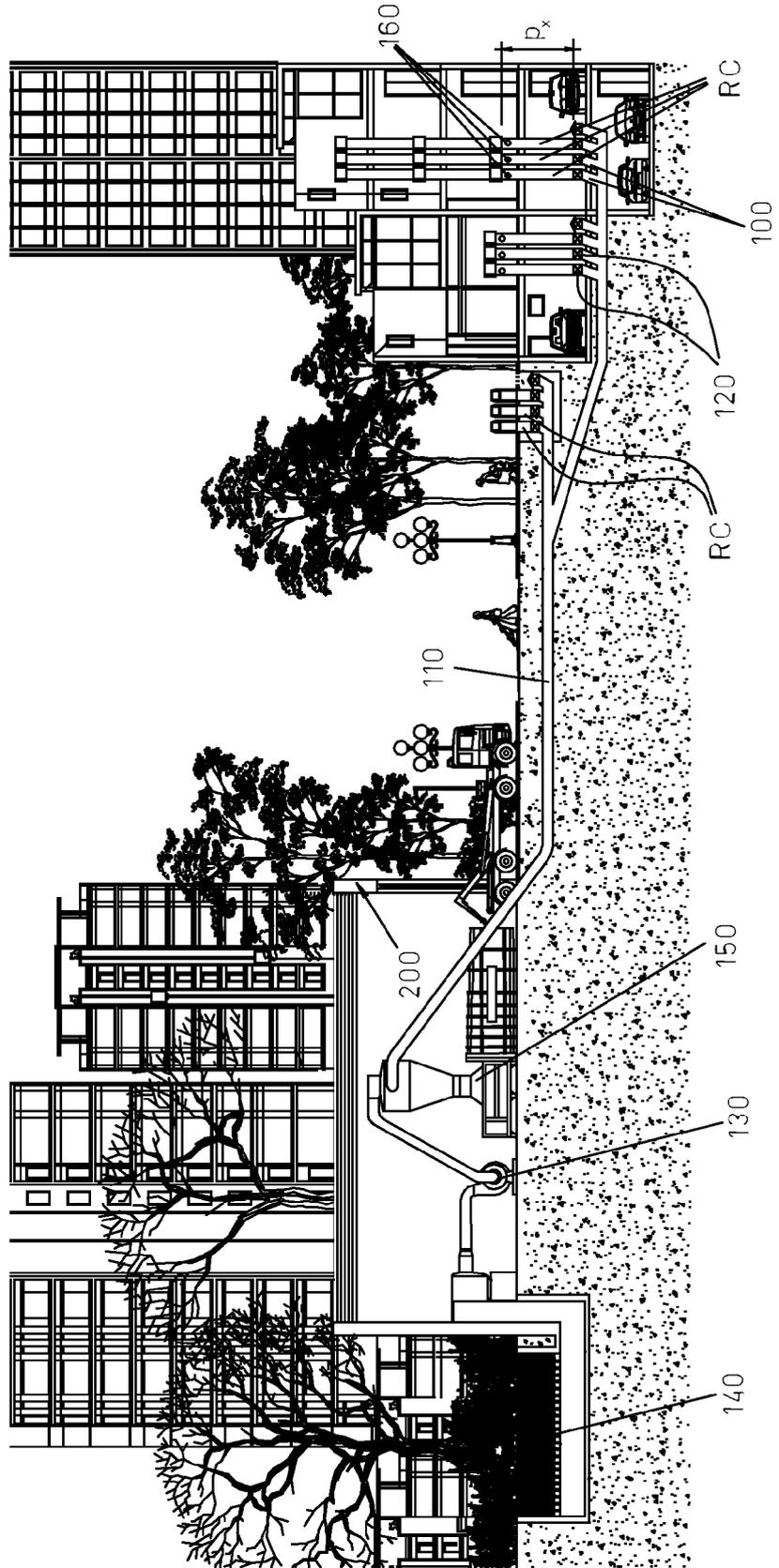


FIG. 2

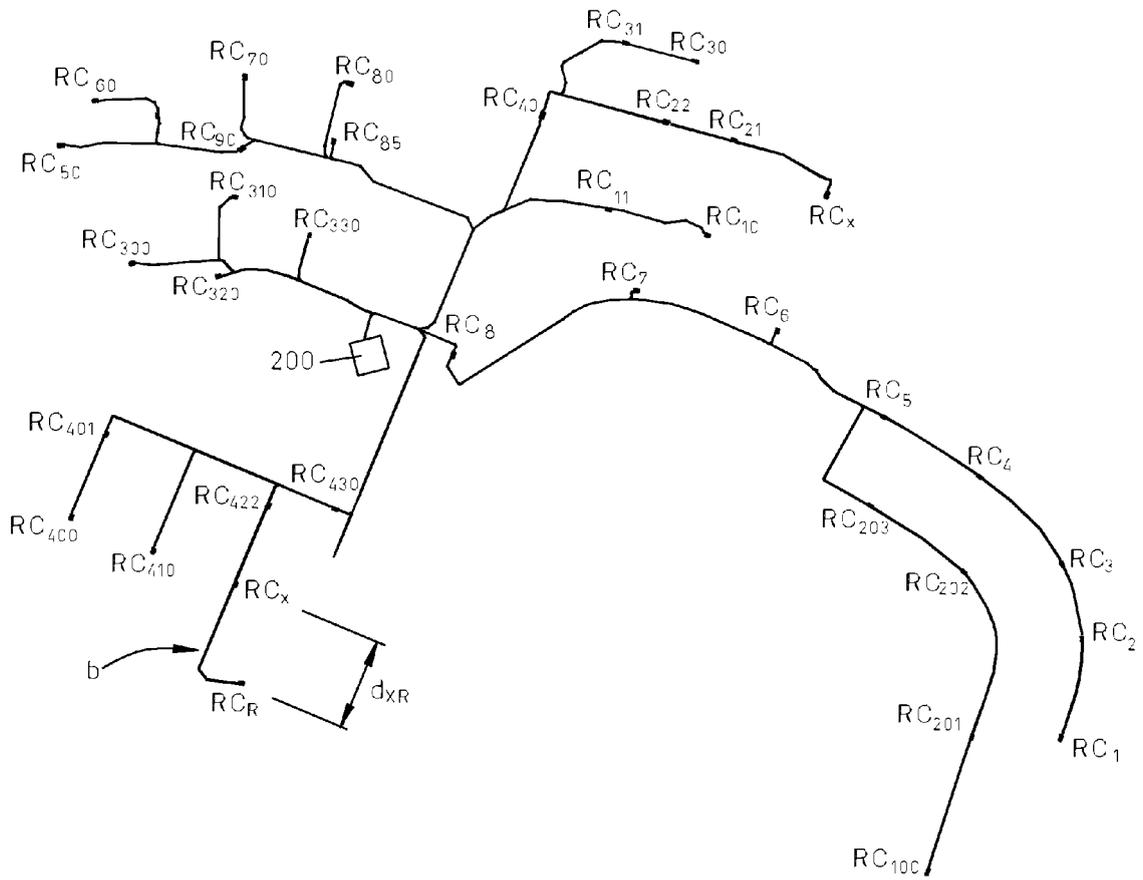


FIG. 3a

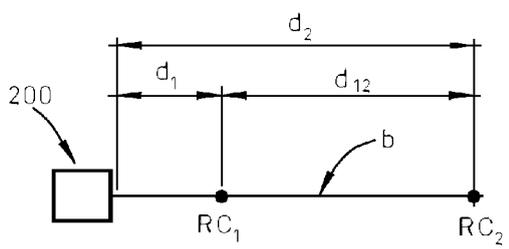
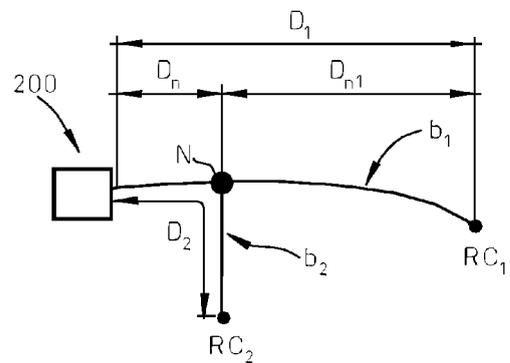


FIG. 3b





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Place of search		Date of completion of the search	Examiner
The Hague		7 December 2007	MARTINEZ NAVARRO, A
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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