Title: METHOD AND APPARATUS IN A PNEUMATIC MATERIAL CONVEYING SYSTEM, AND A WASTE CONVEYING SYSTEM

Abstract: Method in a pneumatic material conveying system, such as in a waste conveying system, which conveying system comprises at least one input point (61) of material, more particularly of waste material, a material conveying pipe (100), which can be connected to an input point (61), and a separating device, in which the material to be transferred is separated from the conveying air, and also means for achieving a pressure difference and/or a conveying air flow in the conveying pipe (100) at least during the transfer of material. In the method material is conveyed from an input point (61) to the separating means (106) or an accumulator tank of a subsystem (1), where the material is separated from the conveying air, and in a second phase the separating means (106) or the accumulator tank of the subsystem (1) is emptied.
METHOD AND APPARATUS IN A PNEUMATIC MATERIAL CONVEYING SYSTEM, AND A WASTE CONVEYING SYSTEM

Background of the invention

The object of the invention is a method as defined in the preamble of claim 1.

The object of the invention is also an apparatus as defined in the preamble of claim 10.

The object of the invention is also a pneumatic waste conveying system as defined in the preamble of claim 18.

The invention relates generally to pneumatic material conveying systems, such as to partial-vacuum conveying systems, more particularly to the collection and conveying of wastes, such as to the conveying of household wastes.

Systems wherein wastes are conveyed in piping by means of suction and/or conveying air are known in the art. In these, wastes are conveyed long distances in the piping by sucking. The apparatuses are used for, among other things, the conveying of wastes in different institutions. It is typical to these systems that a partial-vacuum apparatus is used to achieve a pressure difference, in which apparatus a partial vacuum is achieved in the conveying pipe with partial-vacuum generators, such as with vacuum pumps or with an ejector apparatus. A conveying pipe typically comprises at least one valve means, by opening and closing which the replacement air coming into the conveying pipe is regulated. One of the convenient solutions of new regional building projects is waste management that will operate with a pipe transport system. This means that sorted wastes are sucked along underground pipes to a waste station that is common to the whole region. The system is clean, odorless and noise-free, and is also a more environmentally friendly solution than the conventional waste management and safer from the viewpoint of the adjacent area. In regional building sites in which it has been decided to use a pneumatic pipe transport system in waste transportation, it is typical that it is necessary to build conveying piping to completion and a shared waste station for the region even though the whole construction project would progress slowly and in stages. In this case it is necessary to build the system to completion in respect of the conveying piping and
the waste station, although the construction project might last for years or even decades. The capacity of the piping and of the waste station of the system has, however, been made ready taking into account the amount of users to be realized at some time in the future. A waste station is conceived to typically comprise also means for achieving a pressure difference in the piping, e.g. partial-vacuum generators, such as vacuum pumps or corresponding. In this case in the initial phase of a construction project a situation is encountered wherein it is necessary to make sizable investments in equipment, even though the designed full capacity will not be needed in the system for years yet.

The aim of the present invention is to achieve a new type of solution in connection with material conveying systems, by means of which solution the drawbacks of prior art solutions are avoided. Another aim of the invention is to achieve a solution applicable to partial-vacuum conveying systems, by means of which it is possible to modularly increase the size of the system, and in which e.g. the commissioning of equipment that is unnecessary with respect to the capacity requirement, and in a stage that is too early, can be avoided.

**Brief description of the invention**

The invention is based on a concept wherein a total system consists of subsystems, each of which comprises its own means for achieving a partial vacuum, and which subsystems can be connected to trunk piping, which trunk piping is arranged to be connected to a waste station in which the waste station's own partial-vacuum generators/pump devices are not used, but instead the partial-vacuum generators and/or fans of the subsystems are used to achieve the partial vacuum needed. In the concept of the invention, the means required for developing the partial vacuum needed in the conveying of the material of an extensive system are distributed in the system into subsystems.

The method according to the invention is characterized in that in the method material is conveyed from an input point to a separating means or an accumulator tank of a subsystem, where the material is separated from the conveying air, and in a second phase the separating means or the accumulator tank of the subsystem is emptied.
The method according to the invention is also characterized by what is stated in claims 2 - 9.

The apparatus according to the invention is characterized in that the apparatus comprises means for conveying material from an input point to a separating means or an accumulator tank of a subsystem, where the material is separated from the conveying air and which subsystem is fitted to be connected to a local partial-vacuum generating apparatus and to at least one partial-vacuum generating apparatus of a second subsystem of a more extensive waste conveying system.

The apparatus according to the invention is also characterized by what is stated in claims 11 - 17.

The pneumatic waste conveying system according to the invention is characterized by what is disclosed in claim 18.

The solution according to the invention has a number of important advantages. When using a solution according to the invention the costs of the early stage of a waste system in extensive construction projects can be distributed better over a longer time span than before. The system can be expanded modularly by means of subsystems. In the solution partial-vacuum generators are arranged in connection with each subsystem such that they can be used to produce the suction, or the suction and blowing, of the system needed in the use of a more extensive system. In this case wastes can be conveyed from the separating means or the accumulator tank of the waste of subsystems in the desired transfer manner to further treatment. The system according to the invention enables reliable operation and in addition it provides an easy possibility for using a backup system, i.e. the partial-vacuum generator of some other subsystem, in a malfunction situation of the partial-vacuum generating apparatus of one subsystem. In addition, the diameter of the conveying piping of a subsystem can be smaller than the diameter of the trunk piping. In this case the power requirement of the partial-vacuum generating apparatus of a subsystem can be kept small and the dimensioning and the costs of the drive devices of the apparatus effective. In this case when conveying wastes from the separating means of a subsystem to the waste station of an extensive system along a trunk pipe, the diameter of which is typically greater than the pipe of the subsystem, the
partial-vacuum generating apparatus of a number of subsystems is used to achieve the suction/blowing needed in transfer. In this case the operating power needed for the partial-vacuum generating/blowing of an extensive system can be efficiently distributed into subsystems. In this case an own partial-vacuum generating apparatus is not needed at the waste station.

In the construction phase of a more extensive system the emptying of subsystems can be performed by using the suction/pressure of the subsystem by transferring wastes e.g. to a tank of a transport means. In this case the transport means can be any transport means whatsoever that comprises a suitable tank, such as a container, or corresponding. By arranging the piping of the system to comprise a circuit where at least a part of the conveying air circulates, the volume of outlet air can be decreased. At the same time the energy consumption of the system decreases. By maintaining a partial vacuum and at the same time maintaining blowing, an effective circulation of conveying air in the circuit and conveying transfer of material in the conveying pipe can be achieved. With the solution according to the invention, it is possible to essentially reduce the volume of outlet air and, at the same time, to reduce possible dust problems and fine particle problems in the outlet pipe. With the solution according to the invention, the noise problem caused by prior art can also be essentially reduced. When the amount of air to be sucked in decreases, the use of energy also decreases. By opening and closing the input points of the system according to the invention, efficient conveying of material into the conveying pipe and transfer in the conveying pipe is achieved, while at the same time it is possible to keep the noise impact caused by the operation of the system small.

By arranging the conveying pipe of the material conveying system to be composed of operating areas, i.e. subcircuits, the transfer of material in the conveying piping and the emptying of input points into the conveying pipe can be effectively arranged. By arranging the conveying air circulation in the opposite direction an effective removal of clogging can be achieved. The change of the conveying air circulation into the other direction can be arranged easily in a ring piping. The solution according to the invention is suited for use in both conventional conveying systems comprising one or more conveying pipes and conveying systems comprising ring piping.
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Brief description of the figures

In the following, the invention will be described in more detail by the aid of an example of its embodiment with reference to the attached drawings, wherein

Fig. 1 presents one system according to an embodiment of the invention as a diagram,

Fig. 1a presents a simplified view of a part of the system according to the invention,

Fig. 2 presents one system according to an embodiment of the invention as a diagram, in a second operating phase,

Fig. 3 presents one system according to an embodiment of the invention as a diagram, in a third operating phase,

Fig. 4 presents one system according to an embodiment of the invention as a diagram, in a fourth operating phase,

Fig. 5 presents one system according to the invention as a diagram, in a fifth operating phase,

Fig. 6 presents one system according to the invention as a diagram, in a sixth operating phase,

Fig. 7 presents a diagrammatic and simplified view of one total system according to the invention,

Fig. 8a presents a diagrammatic view of an embodiment of a waste station of the invention in a first operating phase,

Fig. 8b presents a diagrammatic view of an embodiment of a waste station of the invention in a second operating phase,

Fig. 9 presents a diagrammatic and simplified view of one total system of the invention, in one operating phase,
Fig. 10 presents a diagrammatic and simplified view of one total system of the invention, in a second operating phase.

Fig. 11 presents a diagrammatic and simplified view of one total system of the invention, in a third operating phase, and

Fig. 12 presents a diagrammatic and simplified view of another operating phase of a subsystem of an embodiment of the invention.

Detailed description of the invention

Figs. 1 - 6 present the operation of a subsystem 1 of a material conveying system according to the invention, in different operating phases. Fig. 7 presents the total system, which comprises five subsystems 1 (I, II, III, IV, V) and also a waste station 2 and the necessary conveying piping 10, 11, 12, 114 between the subsystems 1 (I, II, III, IV, V) and the waste station 2.

Fig. 1 presents a subsystem 1, which comprises a material conveying pipe 100, along the side of which at least one, typically many, input points 61 are arranged. An input point 61 is a feed-in station of material, more particularly of waste material, intended to be conveyed, from which station the material, more particularly waste material, such as household waste, intended to be conveyed is fed into the conveying system. The feed-in station 61 can also be a refuse chute, into which material is fed from input apertures on different floors of a building. The system can comprise a number of feed-in stations 61, from which the material intended to be conveyed is fed into conveying piping 100, 100A, 100B, 100C, 100D, 100E, of a subsystem 1. A feed-in station 61 is marked in the figure with a dot, in which case by opening and closing a shut-off means, such as a valve means 60, that is in connection with the feed-in station, material can be conveyed from an input point 61 into the conveying pipe 100. Fig. 1a presents one input point 61 to be used in a system according to the invention and the discharge valve 60 of said input point in more detail. The input point is connected on the valve side to a conveying pipe 100 or to a pipe in connection with it. Typically conveying piping comprises a main conveying pipe 100, to which it has been possible to connect a number of branch conveying pipes and in turn to which branch
conveying pipes it has been possible to connect a number of feed-in stations 61. The material fed in is conveyed along the conveying piping 100, 100A, 100B, 100C, 100D to a separating device 106, in which the material being transferred is separated, e.g. due to the dropping of speed and due to centrifugal force, from the conveying pipe. The separated material is removed, e.g. according to need, from the separating device 106. In the embodiment of Fig. 1 the main conveying pipe 100 is formed into a circuit, which is divided by means of the line valves 101A, 101B, 101C, 101D, 101E into a number of parts 100A, 100B, 100C, 100D, 100E. In this case the emptying of the input points of certain areas and the conveying of the material of them along the conveying piping into the separating means 106 can be regulated.

The material fed in is transferred along the conveying piping 100, 100A, 100B, 100C, 100D, 100E, to the separating means 106 of a subsystem 1, where the transferred material is separated from the conveying air. The separating means 106 and the means for achieving a partial vacuum can be arranged in the waste space 120 of a subsystem 1, e.g. in a waste space specific to a city block.

In the embodiment of the figure a pipe 107 is connected to the separating means 106, to the upper part of it, which pipe can be connected to a partial-vacuum source 3. In the figures, the own partial-vacuum source 3 of a subsystem 1 comprises a partial-vacuum generator 30, such as a vacuum pump and its drive device 31. In the figure there is also a second separating means 110, more particularly a particle separator, between the separating means 106 and the partial-vacuum source 3. From the first separating means to the second separating means 110 is a pipe 107, and from the second separating means, from its upper part, onwards is a pipe 117 to the suction side of the partial-vacuum generator 30 of the partial-vacuum source 3. The blowing side of the partial-vacuum generator 30 can be connected to the pipe 130 and onwards to blow into the outward blowing pipe 131 and/or into the conveying pipe 100 of the subsystem. The outward blowing pipe is provided with a valve 125 and a filter 126. Furthermore, the outward blowing pipe 131 can, if necessary, be used as a replacement air pipe.

The apparatus comprises means, with which the direction of circulation of the conveying air of the conveying pipe of a subsystem formed into a circuit can be changed in the conveying pipe. In the embodiment and operating phase of Fig. 1
the valve 104 is open, in which case the separating means and the suction side of
the partial-vacuum generator are connected to a conveying pipe 100 from the side
of its sub-area 100D. Correspondingly, a connection is opened from the blowing
side of the partial-vacuum generator by opening the valve 123 to the conveying
pipe 100 to the side of its sub-area 100A. The direction of circulation of the
conveying air in the piping can be changed by closing the valve 104 and opening
the valve 105 in the pipe 102, which connects the conveying pipe from the side of
the sub-area 100A to the separating means and to the suction side of the partial
vacuum generator. In this case also the valve 123 is closed and the valve 124 in
the pipe 103 is opened, which valve connects the pipes 130, 131 and the sub-area
100A of the conveying pipe.

Furthermore, the separating means 106, 110 of a subsystem can be emptied from
its lower part via the pipeline 114 into the trunk piping 10. This is explained in more
detail later. Further, there is a connection from the pipe 114 connected to the trunk
pipe 10 with the pipe 115 to the pipe 130, i.e. to the blowing side of the partial-
vacuum generating apparatus. The pipe 115 comprises a valve 116, with which
the connection can be opened and closed.

Means are thus arranged in connection with a subsystem, with which means the
separating means 106 or a corresponding accumulator tank of the subsystem can
be emptied into a trunk pipe 10 by using at least the suction external to the
subsystem as an aid in the trunk pipe 10.

When it is desired to empty the separating means 106 of a subsystem into the
trunk pipe 10 and onwards along the trunk pipe 10 to a waste station 2 of a more
extensive system, the situation of Fig. 2 is arrived at, wherein the suction acts in
the trunk pipe 10 and onwards in the pipe 114. The valve means 111 between the
separating means 106 and the trunk pipe 10 is opened, in which case the material
in the separating means is able under the effect of the suction to be conveyed in
the pipe 114 into the trunk pipe 10. The valves of a subsystem are opened and
closed such that there is access for replacement air into the upper part of the
separating means 106. In the embodiment of Fig. 12 at least the connection from
the replacement air pipes 121', 121 and 131 to the upper part of the separating
means 106 is opened. In the embodiment of Fig. 2 the separator means is emptied
by the aid of the suction acting in the trunk line and by the aid of replacement air.
In the embodiment of Fig. 3 the blowing of a subsystem's own partial-vacuum generating apparatus is used as an aid of the suction acting in the trunk line. In this case the replacement air pipe 121 is closed with the valve 122, and the valve 119 in the pipe 117 is further closed, as in Fig. 1. The blowing side of the pump device 30 of the partial-vacuum generating apparatus is connected to blow into the conveying pipe 100, which leads to the upper part of the separating means. The pump device receives replacement air from the replacement air pipe 121', which is on the suction side of the pump device.

In the embodiment of Fig. 4, an operating phase is presented in which a suction effect is exerted in the trunk line 10 with a partial-vacuum generating device 30 of a subsystem 1. The suction side of the partial-vacuum generating device 30, i.e. of a pump device, is connected via the pipes 117, 109, 114 to the trunk line 10. In this case the connection of the suction side of the partial-vacuum generating device 30 to the subsystem's own conveying pipe 100 is typically closed. The blowing side of the partial-vacuum generating device is connected to blow into the outward blowing pipe 131.

In the embodiment of Fig. 5, an operating phase is presented in which a blowing effect is exerted in the trunk line 10 with a partial-vacuum generating device 30 of a subsystem 1. The blowing side of the partial-vacuum generating device 30, i.e. of a pump device, is connected via the pipe 115 to the trunk line 10. In this case the connection of the suction side of the partial-vacuum generating device 30 to the subsystem's own conveying pipe 100 is typically closed. Also the connections of the separating means to the pipe 114 leading to the trunk pipe are closed with the valves 111, 112 and 113. The pump device 30 of the partial-vacuum generating apparatus receives replacement air from the replacement air pipe 121', which is on the suction side of the pump device.

In the embodiment of Fig. 6, an operating phase is presented in which the partial vacuum acting in the trunk pipe 10 is used, in addition to the suction achieved with a subsystem's own partial-vacuum source 3, in emptying the conveying pipe and input points of the subsystem. With respect to the situation of Fig. 1, only the connection from the upper part of the separating means 106 via the pipeline 109 to the trunk pipe via the pipeline 114 is opened. In this case the valve in the pipeline 109 is in the open position.
Means, with which the suction side and/or the blowing side of the partial-vacuum source of the subsystem can be connected to act in the trunk pipe 10, are thus arranged in connection with a system. On the other hand, the subsystem comprises means with which the suction acting in the trunk pipe 10 can be utilized in a subsystem 1, e.g. in emptying the separating means 106 of the subsystem into the trunk pipe and/or in emptying the input points of the subsystem and in conveying material to the separating means of the subsystem.

In the following the operation of the system is described by the aid of Figs. 1-6. Fig. 1 shows a situation in which it is desired to empty one or more material input points of the branch conveying pipe 100A.

When the suction side of the partial-vacuum generator is connected directly or via a conveying air duct to the accumulator tank, to which the discharge end of a conveying pipe 100 is in turn connected, a partial vacuum is produced in the conveying pipe 100. In this case the suction acts in the conveying pipe 100 via the medium pathway 107 connecting to the accumulator tank. An area valve is between the main conveying pipe 100 and the branch conveying pipe 100A, which valve is open in this operating phase. In this case the suction is able to act also in the branch conveying pipe 100A. In the case according to the figure, when the valve means 60 of the point is opened in an input point 61, the material batch intended to be conveyed transfers into the branch conveying pipe 100A and onwards into the main conveying pipe 100. Possible replacement air into the conveying pipe comes e.g. via the input point 61 when opening the valve 60 to the conveying pipe. When the valve 60 of an input point is closed, the line valve can be opened for receiving replacement air into the conveying pipe or the line valve can be kept open when emptying material, in which case the material of the feed-in container 61 to be emptied is dropped into the air current moving in the conveying pipe 100A.

The waste material is conveyed along the conveying piping 100A, 100 to the accumulator tank 106, where the conveying air separates from the waste material and the waste material remains in the accumulator tank 106 (Fig. 2).

When all the input points intended to be emptied have been emptied and the material is conveyed from the branch conveying pipe 100A into the conveying pipe 100, the area valve can be closed and the area valve 101B (Fig. 3) of the branch
conveying pipe 100B of the area intended to be emptied next can be opened. After the input points of this branch conveying pipe have been emptied into the conveying pipe 100B, 100 and conveyed in the piping onwards to the accumulator tank 106 in a corresponding manner to that described above in connection with Figs. 1 and 2, the area valve of the branch conveying pipe 101B is closed and it is possible to move to the next area to be emptied by opening e.g. the area valve 101C (Fig. 4) of the branch conveying pipe 100C.

When the accumulator tank has filled up and it is desired to empty it onwards (Fig. 5), either into the conveying pipe 10 or into another reservoir, e.g. into a transport tanker, the connection from the conveying pipe 100 of the subsystem to the accumulator tank 106 is closed by closing the valve 104. Also the connection from the partial-vacuum generators to the medium pathway 107 to the upper part of the accumulator tank is closed with the valve means 119. The suction effect is transferred to the pathway 115 arranged in the lower part of the accumulator tank, in which case the material of the accumulator tank starts to move from the accumulator tank via the pathway 114 into the conveying pipe 10. Replacement air is received in the accumulator tank 106, in the upper part of it, via the replacement air pipe 109 and the medium pathway 107, when the valves 108 and 113 are in the open position.

The following addresses a more extensive material conveying system, which is formed from a number of subsystems 1, which can be connected via a trunk pipe 10 to a waste station 2. In the embodiment of Fig. 7 the trunk pipe 10 is arranged into a circuit, the ends of which are connected via the pipes 11 and 12 to a waste station 2 and to the separating means 20 disposed there. The waste station is described in more detail in Figs. 8a and 8b. The waste station comprises means for changing the conveying air circulation in the circuit of the trunk pipe. In the operating phase of Fig. 8a the first pipe 11 that is in connection with the trunk pipe is connected to a separating device 20. A conveying air duct 22 leads from the separating device 20, from its upper part, to a second separating device 21, to a particle separator, and onwards via the conveying air ducts 23 and 15 to a second pipe 12. In the situation according to Fig. 8a the suction effect achieved with the partial-vacuum sources of the subsystems acts in the second pipe 12, which suction effect is able to further act via the separating means 20, 21 in the first pipe 11 and further in the trunk pipe connected to it. This type of situation is presented e.g. in Fig. 10.
In the operating phase of Fig. 10 it is desired to empty the material collected in the separating means of the subsystem 1(11) and to conduct it along a trunk pipe to a waste station 2 of a more extensive system. Area valves 10A, 10B, 10C, 10D, 10E are arranged in the trunk pipe, with which valves the trunk pipe 10 can be divided into areas. In the case of Fig. 10 the area valve 10C is closed. In this case a suction effect (S) exerted in the conveying piping is achieved with the partial-vacuum sources of the subsystems 1(11), 1(V) and 1(IV) via the pipes 114. The device of the waste station 2 is connected according to Fig. 8a. The devices of the subsystem 1(11) are connected to a phase according to Fig. 2. In the figure the direction of movement of the material to be conveyed is described with black arrows and mainly the movement of conveying air during the conveying of material is described with pale arrows. The waste material is conveyed from the separating means of a subsystem 1(11) to the waste station 2 along the route in the trunk pipe described by the black arrows of Fig. 10.

Alternatively the operating phase of Fig. 3 can also be used, in which case the suction effect coming from the trunk line can be assisted with blowing achieved by the partial-vacuum generating device of the subsystem 1(11).

In the operating phase of Fig. 9 the partial-vacuum sources of the subsystems 1(1), 1(11) and 1, (III) are used to form the partial vacuum needed in material conveyance in the conveying piping 10, by connecting the suction sides of them to the separating device 20 of a waste station via the pipe 11 according to Fig. 8b. In the figure, it is desired to empty the material collected in the separating means of the subsystem 1(V) into the separating means of the waste station 2. The area valve 10D is closed, in which case the suction effect of the partial-vacuum sources of the subsystems 1(I), 1(II) and 1(III) travels in the trunk pipe via the waste station 2 to the subsystem 1(V). The devices of the subsystem 1(V) are connected to a phase corresponding to Fig. 2. The waste material is conveyed from the separating means of the subsystem 1(V) to the waste station 2 along the route in the trunk pipe described by the black arrows of Fig. 10.

In the operating phase of Fig. 11 the intention is to empty the material collected in the separating means of the subsystem 1(11) along the trunk piping 10 into the separating means of a waste station 2. In the operating phase of Fig. 11, a suction effect is achieved by the aid of the partial-vacuum sources of the subsystems 1(IV)
and 1(V) via the pipe 12 via the separating means of a waste station to the pipe 11
and onwards via a trunk pipe to the subsystem 1(11). In addition, the blowing effect
achieved by the partial-vacuum generating apparatus of the subsystem 1(11) is
used in the trunk pipe 10. The area valve 10D is closed. A blowing effect is
achieved with the pump device of the partial-vacuum generating device of one or
more subsystems, which pump device is farther from the waste station in the
direction of material conveying of the trunk pipe than the subsystem intended to be
emptied. With the blowing achieved by the subsystem 1(11) sufficient air flow is
achieved in the trunk pipe 10, in which case, together with the suction effect
achieved by the subsystems 1(IV) and 1(V), the pressure difference needed in the
conveying of the material collected in the separating means of the subsystem 1(11)
to the waste station is achieved.

The conveying piping 100 of a subsystem 1 is typically much smaller in diameter
than the diameter of the trunk piping 10 and, that being the case, requires a
smaller air flow rate. For example, when the conveying piping of a subsystem is
type NS 300, the flow rate requirement of which is approx. 6000m³/h. When the
pipe type of a trunk line is NS 500, the flow rate requirement of which is approx.
18000m³/h. In this case the trunk line requires approx. three times the volumetric
air flow rate. In this case it can be noted that three partial-vacuum generating
apparatuses of a subsystem can together also handle the air flow rate requirement
of the trunk piping. This can also be arranged such that one subsystem 1 blows
into the conveying pipe, such as in Fig. 11, and the partial-vacuum generating
apparatus of two subsystems sucks. In this case a suitable speed for the air flow is
achieved in one embodiment.

According to Fig. 8a the waste material to be conveyed is conveyed from the
subsystems 1 (I, II, III, IV, V,) of Fig. 7 along the piping 114, 10, 11 leading to the
waste station 2 to the separating device 20, in which the material being conveyed
separates, e.g. due to the dropping of speed and due to centrifugal force, from the
conveying air. The separated material is removed, e.g. according to need, from the
separating device 20 to a material container, such as to a waste container 40, or to
further treatment. There can be many separating devices 20, 21, as in Figs. 8a, 8b
two, a first separating device 20 and a second separating device 21, e.g. a particle
separator. In addition, the waste station can have a waste press in connection with
the waste container.
The first separating device 20 is connected with the duct 22 to the second separating device 21 and onwards with the conveying air duct 23 to the means for forming a partial vacuum in the conveying pipe.

The conveying air circulation of the waste station 2 and the direction of travel of the material in the conveying pipe 10 can be adjusted according to Figs. 8a and 8b. In Fig. 8a the pipe 11 is an inlet pipe of the conveying pipe 10, the valve 14 of which pipe 11 is open to the pipe 19, which leads the pathway onwards to the separating device 20. The first end 11 of the conveying pipe 10, i.e. the inlet pipe in figure 8a, is thus connected via the separator means 20 to the suction side of the pump devices of the subsystems achieving suction in the embodiment of the figure, via the pipe 22, the second separating device 21, and the pipes 23, 15 and 12. In Fig. 8b the pipe 12 is an inlet pipe of the conveying pipe 10, the valve 13 of which pipe 12 is open to the pipe 19, which leads the pathway onwards to the separating device 20. In the transfer of material the suction to be achieved with the subsystems acts in the conveying pipe 10, which is connected via the pipe 11 to the separating device 20 of the waste station 2 via the pipe 16, 23, the second separating device 21 and the pipe 22.

In the system presented by Fig. 7 the main conveying pipe 10 is ring-shaped, in which case the conveying air circulation in the trunk pipe 10 can be varied, depending on whether suction is arranged via the first end 11 or via the second end 12 of the main conveying pipe. It can be conceived that the trunk pipe is a terminating pipe, in which case the waste station is disposed most suitably such that the subsystems are disposed alongside the trunk pipe on both sides of the waste station. In this case, however, the advantages produced by a ring-type trunk pipe are not achieved.

Fig. 12 presents another embodiment in which an embodiment is presented according to which the separating means 106 or a material accumulator tank of a subsystem can be emptied with a transport means into a tank 200 intended to be transported, e.g. when an extensive system is still in the construction phase or for some other reason. It must be noted that the emptying can be performed by utilizing the partial-vacuum generating apparatus 3, 30, 31 of a subsystem 1. In this case an own partial-vacuum generating apparatus is not needed in the transport means. In the figure a discharge pipe 203 is connected to the lower part of the separating means 106 or of the accumulator tank, which pipe is connected,
e.g. with a hose, to a branch coupling 201 arranged in the upper part of a transport tanker 200. The hose comprises connectors, and the pipe 203 and the branch coupling 201 comprise counterparts. In order to achieve the suction needed a pipe 204 is arranged from the suction side of the partial-vacuum generating apparatus of the subsystem, which pipe can be connected, e.g. with a hose, to a branch coupling 202 arranged in the upper part of a transport tanker 200. The hose comprises connectors, and the pipe 204 and the branch coupling 202 comprise counterparts. A valve 206 is arranged in the pipe 204 and a valve 205 in the discharge pipe 203 of the separating means. When it is desired to empty the separating means of a subsystem into a transport tanker 200, the suction side of the partial-vacuum generating apparatus is connected to the transport tanker and correspondingly the discharge pipe 203 of the separating means 105 or of the accumulator tank is connected to the transport tanker 200. When the partial vacuum apparatus 30, 31 is started up, the suction/partial vacuum achieved conveys material from the separating means 106 along the pipe 203 via the branch coupling 201 into the transport tanker 200.

The invention thus relates to a method in a pneumatic material conveying system, such as in a waste conveying system, which conveying system comprises at least one input point 61 of material, more particularly of waste material, a material conveying pipe 100, which can be connected to an input point 61, and a separating device, in which the material to be transferred is separated from the conveying air, and also means for achieving a pressure difference and/or a conveying air flow in the conveying pipe 100 at least during the transfer of material. In the method material is conveyed from an input point 61 to the separating means 106 or an accumulator tank of a subsystem 1, where the material is separated from the conveying air, and in a second phase the separating means 106 or the accumulator tank 106 of the subsystem 1 is emptied. According to one embodiment in the method in the first phase, the subsystem's own partial-vacuum generating apparatus 3, 30, 31 is used in connection with the emptying of the input points 61 of a subsystem 1 to achieve the suction effect needed in material conveyance.

According to one embodiment in the method in the second phase the partial-vacuum generating apparatus of at least one second subsystem 1 of a more extensive waste conveying system is used to achieve the suction effect needed in material conveyance to convey in the conveying pipe, i.e. in the trunk pipe 10, the
wastes collected in the separating means 106 or the accumulator tank of one first subsystem to the separating device 20 of a waste station 2. According to one embodiment the material is conveyed from a separating device of a subsystem 1 onwards along a conveying pipe 10 to the separating device 20 of a waste station 2, where the material to be conveyed is separated from the conveying air.

According to one embodiment the conveying pipe, i.e. the trunk pipe 10, of a more extensive system is connected into a circuit such that conveying air can be circulated in the conveying pipe 10.

According to one embodiment in the method a partial vacuum is achieved in the conveying pipe, i.e. in the trunk pipe 10, of a more extensive system with at least one pump device, such as with a partial-vacuum generator, of a second subsystem 1, the suction side of which pump device is connected to a separating device 20 of an extensive system, i.e. of the total system.

According to one embodiment in the method pressure, i.e. blowing, is achieved with the fan of a second subsystem 1, which fan is disposed in the conveying pipe, i.e. in the trunk pipe 10, farther from the separating means 20 in the direction of travel of the material than the subsystem 1 to be emptied.

According to one embodiment in the method material is fed into the conveying pipe 100 from the input points 61 of material, which are the input points of waste, such as waste receptacles or refuse chutes.

According to one embodiment in the method the subsystems 1 are waste conveying systems of a certain area, such as of a city block.

According to one embodiment an extensive system, i.e. a total system, is a waste conveying system of a certain area, such as of a city district, which extensive system comprises a number of subsystems 1.

The invention also relates to an apparatus in a pneumatic material conveying system, such as in a waste conveying system, which comprises at least one input point 61 of material, more particularly of waste material, a material conveying pipe 100, which can be connected to an input point 61, and a separating device, in which the material to be transferred is separated from the conveying air, and also means 30, 31 for achieving a pressure difference in the conveying pipe 100 at least during the transfer of material. The apparatus comprises means for conveying material from an input point 61 to a separating means 106 of a subsystem 1, where the material is separated from the conveying air and which subsystem is fitted to be connected to a local partial-vacuum generating apparatus.
and to a partial-vacuum generating apparatus of at least one second subsystem of a more extensive waste conveying system. According to one embodiment the apparatus comprises means for conveying material from an accumulator tank of a subsystem 1 onwards along a conveying pipe 10 to the separating device 20 of a waste station 2, where the material to be conveyed is separated from the conveying air. According to one embodiment the conveying pipe 10 of a more extensive system is fitted to be connected into a circuit such that conveying air can be circulated in the conveying pipe 10.

According to one embodiment at least one pump device, such as a partial-vacuum generator and/or a fan, the suction side of which is connected to a separating device 20, is fitted into the circuit of a more extensive system. According to one embodiment the input points 61 of material are the input points of waste, such as waste receptacles or refuse chutes.

According to one embodiment a subsystem 1 is a waste conveying system of a certain area, such as of a city block. According to one embodiment an extensive system, i.e. a total system, is a waste conveying system of a certain area, such as of a city district, which extensive system comprises a number of subsystems 1.

Waste conveying system, which comprises an apparatus according to any of claims 1 - 16.

The object of the invention is also a pneumatic waste conveying system, which comprises a number of subsystems, such as pneumatic waste systems for a specific city block, and conveying piping 10, with which the wastes of the subsystems 1 can be conveyed to a separating means of a waste station 2, where the wastes are separated from the conveying air. In the system the partial vacuum and/or blowing needed to convey the material collected in the separating means 106 or the collection tank of one subsystem 1 from the separating means of the subsystem 1 in the conveying pipe, i.e. in the trunk pipe 10, to the separating means of a waste station 2 of an extensive system is fitted to be achieved with the partial-vacuum generating device/fan of at least one second subsystem 1.

According to one embodiment the partial-vacuum generating device of at least two subsystems 1 is used for achieving the necessary suction or partial vacuum.
According to one embodiment the blowing side of a partial-vacuum generating device of at least one second subsystem 1 is connected to a conveying pipe, i.e. to a trunk pipe 10, to a point which is farther from the separating means in the conveying direction of the material than the connection point of the subsystem to be emptied in the conveying pipe, i.e. in the trunk pipe 10.

According to one embodiment an extensive system, i.e. a total system, is a waste conveying system of a certain area, such as of a city district, which extensive system comprises a number of subsystems 1.

According to one embodiment the apparatus comprises means for conveying material from an accumulator tank of a subsystem 1 onwards along a conveying pipe 10 to the separating device 20 of a waste station 2, where the material to be conveyed is separated from the conveying air.

According to one embodiment the waste conveying system comprises an apparatus according to any of claims 10 - 17.

The embodiments of a pneumatic waste system according to the invention can vary according to the requirements of the application sites. The pressure difference needed in the material conveyance of the system is produced e.g. with an air flow, the magnitude of which depends on a number of factors. In a distributed system according to the invention, in which an own partial-vacuum generating apparatus is typically not needed at a waste station 2, the amount of the other subsystems 1 producing the partial vacuum and/or blowing needed in the conveying of material at any given time from the separating means 106 or the accumulator tank of one subsystem to the separating means 20 of a waste station 2 therefore depends on the application site.

It is obvious to the person skilled in the art that the invention is not limited to the embodiments presented above, but that it can be varied within the scope of the claims presented below. The characteristic features possibly presented in the description in conjunction with other characteristic features can, if necessary, also be used separately to each other.
Claims

1. Method in a pneumatic material conveying system, such as in a waste conveying system, which conveying system comprises at least one input point (61) of material, more particularly of waste material, a material conveying pipe (100), which can be connected to an input point (61), and a separating device, in which the material to be conveyed is separated from the conveying air, and also means for achieving a pressure difference and/or a conveying air flow in the conveying pipe (100) at least during the transfer of material, in which method material is conveyed from an input point (61) to a separating means (106) or an accumulator tank of a subsystem (1), where the material is separated from the conveying air, and in a second phase the separating means (106) or the accumulator tank of the subsystem (1) is emptied, characterized in that in the method in the second phase the partial-vacuum generating apparatus (3, 30, 31) of at least one second subsystem (1) of a more extensive waste conveying system is used to achieve the suction effect needed in material conveyance to convey in the conveying pipe, i.e. in the trunk pipe (10), the wastes collected in the separating means (106) or the accumulator tank of one first subsystem, to the separating device (20) of a waste station (2).

2. Method according to claim 1, characterized in that in the method in the first phase, the subsystem's own partial-vacuum generating apparatus (3, 30, 31) is used in connection with the emptying of the input points (61) of a subsystem (1), to achieve the suction effect needed in material conveyance.

3. Method according to claim 1 or 2, characterized in that the material is conveyed from a separating device of a subsystem (1) onwards along a conveying pipe, i.e. a trunk pipe (10), to the separating device (20) of a waste station (2), where the material to be conveyed is separated from the conveying air.

4. Method according to any of claims 1 - 3, characterized in that the conveying pipe, i.e. trunk pipe (10), of a more extensive system is connected into a circuit such that conveying air can be circulated in the conveying pipe (10).

5. Method according to any of claims 1 - 4, characterized in that in the method a partial vacuum is achieved in the conveying pipe, i.e. in the trunk pipe (10), of a more extensive system with at least one pump device, such as with a
partial-vacuum generator, of one second subsystem (1), the suction side of which pump device is connected to a separating device (20) of an extensive system, i.e. of the total system.

6. Method according to any of claims 1 - 5, characterized in that in the method pressure, i.e. blowing, is achieved with the fan of a second subsystem (1), which fan is disposed in the conveying pipe, i.e. the trunk pipe (10), farther from the separating means (20) in the direction of travel of the material than the subsystem (1) to be emptied.

7. Method according to any of claims 1 - 6, characterized in that in the method material is fed into a conveying pipe (100) from the input points (61) of material, which are the input points of waste, such as waste receptacles or refuse chutes.

8. Method according to any of claims 1 - 7, characterized in that in the method the subsystems (1) are waste conveying systems of a certain area, such as of a city block.

9. Method according to any of claims 1 - 8, characterized in that an extensive system, i.e. a total system, is a waste conveying system of a certain area, such as of a city district, which extensive system comprises a number of subsystems (1).

10. Apparatus in a pneumatic material conveying system, such as in a waste conveying system, which comprises at least one input point (61) of material, more particularly of waste material, a material conveying pipe (100), which can be connected to an input point (61), and a separating device, in which the material to be conveyed is separated from the conveying air, and also means (30, 31) for achieving a pressure difference in the conveying pipe (100) at least during the transfer of material, characterized in that the apparatus comprises means for conveying material from an input point (61) to a separating means (106) or an accumulator tank of a subsystem (1), where the material is separated from the conveying air and which subsystem (1) is fitted to be connected to a local partial-vacuum generating apparatus (3, 30, 31) and to at least one partial-vacuum generating apparatus of one second subsystem of a more extensive waste conveying system.
11. Apparatus according to claim 10, characterized in that the apparatus comprises means for conveying material from a separating means (106) or an accumulator tank of a subsystem (1) onwards along a conveying pipe (10) to the separating device (20) of a waste station (2), where the material to be conveyed is separated from the conveying air.

12. Apparatus according to claim 10 or 11, characterized in that the conveying pipe, i.e. the trunk pipe (10), of a more extensive system is fitted to be connected into a circuit such that conveying air can be circulated in the conveying pipe (10).

13. Apparatus according to any of claims 10 - 12, characterized in that at least one pump device, such as a partial-vacuum generator (30, 31), of a second subsystem (1) is fitted in the conveying pipe, i.e. in the trunk pipe (10), of the circuit of a more extensive system, the suction side of which pump device is connected to a separating device (20) of an extensive system, i.e. of the total system.

14. Apparatus according to any of claims 10 - 13, characterized in that at least one fan of a second subsystem (1) is fitted in the conveying pipe, i.e. in the trunk pipe (10), of the circuit of a more extensive system at a point that is disposed in the conveying pipe, i.e. in the trunk pipe (10), farther from the separating means (20) in the conveying direction of the material, than the subsystem (1) to be emptied.

15. Apparatus according to any of claims 10 - 14, characterized in that the input points (61) of material are the input points of waste, such as waste receptacles or refuse chutes.

16. Apparatus according to any of claims 10 - 15, characterized in that a subsystem (1) is a waste conveying system of a certain area, such as of a city block.

17. Apparatus according to any of claims 10 - 16, characterized in that an extensive system, i.e. a total system, is a waste conveying system of a certain area, such as of a city block.
area, such as of a city district, which extensive system comprises a number of subsystems (1).

18. Pneumatic waste conveying system, which comprises a number of subsystems, such as pneumatic waste systems for a specific city block, and conveying piping (10), with which the wastes of the subsystems (1) can be conveyed to a separating means of a waste station (2), where the wastes are separated from the conveying air, characterized in that in the system the pressure difference needed to convey the material collected in the separating means (106) or the collection tank of one subsystem (1) from the separating means of the subsystem (1) in the conveying pipe, i.e. in the trunk pipe (10), to the separating means of a waste station (2) of an extensive system is fitted to be achieved with the partial-vacuum generating device/fan of at least one second subsystem (1).

19. Waste conveying system according to claim 18, characterized in that the partial-vacuum generating device of at least two subsystems (1) is used for achieving the necessary suction or partial vacuum.

20. Waste conveying system according to claim 18 or 19, characterized in that the blowing side of a partial-vacuum generating device of at least one second subsystem (1) is connected to a conveying pipe, i.e. to a trunk pipe (10), to a point which is farther from the separating means in the conveying direction of the material than the connection point of the subsystem to be emptied in the conveying pipe, i.e. in the trunk pipe (10).

21. Waste conveying system according to any of claims 18 - 20, characterized in that it comprises an apparatus according to any of claims 10 - 17.