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Title of the Invention

PARTICLE SEPARATOR FOR USE IN BLASTING APPARATUS

Field of the Invention

- The present invention relates to a particle separator for use in a blasting apparatus, and more particularly to a particle separator that extracts only reusable particles from a mixture of used particles and particle dust which have been produced during a blasting process.

Background of the Art

In blasting apparatuses, particle separators have been used for the purpose of recycling particles that have been used during a blasting process. Namely, in the blasting process, some of the particles are crushed into particle dust. However, in order to maintain a desired blasting performance, it is necessary for the particles to maintain their prescribed particle diameter. Therefore, it is necessary to provide a particle separator for removing such particle dust in order to reuse the particles.

In the conventional apparatuses, a cyclone type particle separator has been used as such particle separator. This particle separator separates reusable particles from particle dust and the like by utilizing a rotating air flow which produces a centrifugal force. This utilizes the character that particle dust has a relatively small diameter rather than a prescribed particle and therefore the mass of the particle dust is smaller than that of the reusable particles.

In this connection, Fig. 5 is a side view of such a cyclone type particle separator, and Fig. 6 is a top plan view thereof.

In the drawings, the reference numeral 50 denotes a separator

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container. In this separator container 50, there is provided with an inlet port 51 to allow a mixture of used particles and particle dust produced by a blasting process to be sucked into the inside of the separator container 50 together with compressed air. Further, an exhaust port 54 is provided in a central portion of the separator container 50 in such a manner that it passes through the upper surface of the separator container 50.

Now, when the mixture of used particles and particle dust produced by a blasting process are sucked into the inside of the separator container 50 together with compressed air through the inlet port 51, they form a rotating flow that rotates in the direction indicated by the arrow 52. Then, due to the relatively large mass of each of such prescribed diameter reusable particles and the centrifugal force produced by such rotating flow, the reusable particles slowly move down toward the bottom of the separator container 50 as they flow in the vicinity of the inner circumferential side wall of the separator container 50. Upon reaching the bottom of the separator container 50, the reusable particles are collected in a hopper tank 55.

In this case, the un reusable particle dust flows more toward the center of the separator container 50 due to their relatively small mass. Consequently, such small-mass particle dust gets sucked out of the separator container 50 together with compressed air through the exhaust port 54, and then fed to a dust collector.

In the drawing, a metal screen indicated by the numeral 53 is provided for preventing peeled coating or bits of paint which have a relative large size and has been discharged during the blasting process from being mixed into the reusable particles. This is because there is a case that such peeled coating or bits of paint falls into the hopper tank 55 without being discharged from the exhaust port 54.

However, because such conventional particle separators do not have



any obstructive member inside the separator container for diffusing the mixture of reusable particles and particle dust, a mixture of large and small mass particles and particle dust is caused to flow in the vicinity of the inner circumferential side wall of the separator container 50 when the particle separator is in actual operation, thus rendering such centrifugal separation ineffective.

Furthermore, it is not possible to achieve a sufficient centrifugal separation with such conventional particle separators because the mixture of reusable particles and particle dust either falls into the hopper tank 55 or is sucked out through the exhaust port 54 before the mixture has flowed even halfway around the inside of the separator container 50. For these reasons, there is a problem in that such conventional particle separators do not perform an accurate separation of reusable particles and particle dust.

Furthermore, if relatively large material such as peeled coating which has been exhausted in the blasting process would enter into the separator container, the rotating air flow is disturbed. In the conventional apparatus, the centrifugal force required for the separation process is obtained by the stable rotating air flow, there is a problem in that such a disturbance of the rotating air flow deteriorates stable separation accuracy.

Accordingly, it is an object of the present invention to provide a particle separator for use in a blasting apparatus which can achieve a highly accurate separation of particles by using a diffusion member instead of a centrifugal force produced by the rotating flow, and thereby being able to have high accuracy of separation and excellence in stable particle separation accuracy.

Disclosure of the Invention

In order to achieve the object stated above, a particle separator for use in a blasting apparatus according to the present invention comprises; a



separator container; an intake port for blowing reusable particles and particle dust obtained after the blasting into said separator container; a diffusion member for diffusing the reusable particles and particle dust, said diffusion member including two more porous diffusion plates which are laminated through a predetermind space therebetween; an exhaust port for exhausting the particle dust and compressed air; and a reusable particle accommodating tank disposed below the diffusion member.

Further, a particle separator for use in a blasting apparatus according to the present invention comprises; a separator container; an intake port for blowing reusable particles and particle dust obtained after the blasting into said separator container; a diffusion member for diffusing the reusable particles and particle dust, said diffusion member including two more rotatable slit plates which are laminated through a predetermind space therebetween; an exhaust port for exhausting the particle dust and compressed air; and a reusable particle accommodating tank disposed below the diffusion member.

In short, an extremely efficient diffusion of the mixture of reusable particles and particle dust can be created with a particle separator according to the present invention, thus making it possible to achieve highly accurate separation.

Furthermore, as the particle separator according to the present invention does not utilize a rotational air flow to generate a centrifugal force, it is possible to maintain a stable particle separation accuracy.

Further, the particle separator for use in the blasting apparatus according to the present invention is characterized in that said exhaust port includes a first exhaust port for exhausting particle dust which has not passed said diffusion member and compressed air, and a second exhaust port for exhausting particle dust which has passed said diffusion member together with compressed air.

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Further, the particle separator for use in the blasting apparatus according to the present invention is characterized in that said first exhaust port is disposed so as to be opposed to a particle receiving surface of said diffusion member.

Further, the particle separator for use in the blasting apparatus according to the present invention is characterized in that said first exhaust port is disposed above the particle receiving surface of the diffusion member.

Further, the particle separator for use in the blasting apparatus according to the present invention is characterized in that said second exhaust port is disposed above the reusable particle accommodating tank.

Further, the particle separator for use in the blasting apparatus according to the present invention is characterized in that said diffusion member is constructed so as to be removable from the upper surface of the separator container.

Brief Description of the Drawings

Fig. 1 is a side view of a particle separator for use in an embodiment of a blasting apparatus according to the present invention;

Fig. 2 is a top plan view of the particle separator shown in Fig. 1;

Fig. 3 is a perspective view of a diffusion member of the particle separator shown in Fig. 1;

Fig. 4 is a perspective view of a diffusion member of another embodiment of the particle separator according to the present invention;

Fig. 5 is a side view which shows a particle separator of a conventional cyclone type; and



Fig. 6 is a top plan view of the particle separator shown in Fig. 5.

Detailed Description of the Preferred Embodiments

(First Embodiment)

With reference to the drawings, a detailed description of a first embodiment of a particle separator according to the present invention will now be given below.

In this connection, Fig. 1 is a cross-sectional side view of the first embodiment of the particle separator according to the present invention, and Fig. 2 is a top plan view thereof. As shown in these figures, the particle separator 1 includes a cylindrically shaped housing container 2, a cylindrically shaped separator container 3 arranged inside the housing container 2, and a hopper tank 4 arranged below the separator container 3 to collect reusable particles from the separator container 3.

Provided in an upper portion of the circumferential wall of the separator container 3 is an inlet port 6 which allows a mixture of reusable particles and particle dust produced by a blasting operation to be fed together with compressed air to the inside of the separator container 3. As shown in Fig. 2, the inlet port 6 faces toward the central portion of the upper section of the separator container 3. In this connection, because the present invention does not utilize a rotating air flow, it is possible to provide a plurality of inlet ports 6.

Further, the top of the separator container 3 is provided with an inner cover 13 which has four first exhaust openings 7 formed therein.

Arranged on the inside of the separator container 3 is a diffusion member 10. The diffusion member 10 is supported by a stay 15 at a lower portion thereof. The diffusion member 10 can be removed from the housing container 2 by opening the outer cover 14 and the inner cover 13.

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Further, the diffusion member 10 includes five circular-shaped punched metal diffusion plates 11a, 11b, 11c, 11d, 11e which are spaced a prescribed distance from each other and a diffusion plate support member 12 which passes through a central portion of the respective diffusion plates 11a - 11e to support the diffusion plates 11a - 11e. Fig. 3 is a perspective view of the diffusion member 10. As shown in Fig. 3, the five diffusion plates 11a - 11e are spaced an equal distance from each other in a layered arrangement that is fixed to the diffusion plate support member 12. —

In this connection, the diameter of each hole of the punched metal diffusion plate is set in accordance with the diameter of the reusable particles. For example, based on experiments carried out by the present inventor, it was determined that holes having a diameter of 3 mm are preferred for reusable particles having a diameter of 0.8 mm.

Further, four second exhaust openings 8 are formed in the top of the hopper tank 4 and a particle discharge outlet 17 is provided at the bottom of the hopper 4.

Further, a delivery pipe 5 passes through the housing container 2 from the left side of Fig. 1. One end thereof is connected to a blasting apparatus (not shown) to receive a mixture of reusable particles and particle dust together with compressed air, and the other end thereof is connected to the inlet port 6 of the separator container 3 to deliver such mixture of reusable particles and particle dust to the inside of the separator container 3. Further, provided in the right side wall of the housing container 2 shown in Fig. 1 is a dust exhaust port 18 which is connected to an exhaust pipe 19 which sends particle dust to a dust collector (not shown).

Now, the operation sequence of the above-described first embodiment of the particle separator according to the present invention will be given below.

First, a mixture of reusable particles and particle dust produced by a





blasting operation is delivered to the inside of the separator container 3 together with compressed air through the delivery pipe 5. At the same time, the dust collector (not shown) is activated to create a negative pressure inside the separator container 3, and this causes the mixture of reusable particles and particle dust entering the inside of the separator container 3 from the inlet port 6 to strike the inner wall of the separator container 3, the bottom surface of the inner cover 13 and the top surface of the uppermost diffusion plate 11a at high velocity, thereby being dispersed over the top surface (the particle reception surface) of the diffusion plate 11a. At this time, because the particle dust has a smaller mass than the reusable particles, the particle dust gets sucked out of the separator container 3 through the first exhaust openings 7 and passes through the upper space defined between the upper surface of the separator container 3 and the bottom surface of the outer cover 14 of the housing container 2, and they are discharged from the dust exhaust port 18 to the dust collector via the exhaust pipe 19.

At this point, the more massive reusable particles and the particle dust that does not get sucked out through the first exhaust openings 7 pass through the punched holes in the diffusion plate 11a and fall onto and strike onto the top of the diffusion plate 11b to be dispersed. At this time, any relatively low mass particle dust that is present will be sucked upwards again to pass through the punched holes in the diffusion plate 11a and out of the first exhaust openings 7. Then, the reusable particles and particle dust that have fallen onto the diffusion plate 11c through the punched holes of the diffusion plate 11b are separated again in the same manner described above.

This process continues until the reusable particles and the remaining particle dust pass through the punched holes in the bottommost diffusion plate 11c, at which point they fall into the hopper tank 4. At this time, any relatively low mass particle dust that is still present is sucked up through the



second exhaust openings 8 and the space defined between the outside walls of the separator container 3 and the inside walls of the housing container 2, and then they are discharged through the dust exhaust port 18.

Now, as was described for the present embodiment, in addition to the first exhaust openings 7, the separator container 3 is provided with the second exhaust openings 8 to allow the particle dust and compressed air that have passed through the diffusion member 10 to be sucked up and expelled out through the dust exhaust port 18. As a result, the particle separator 1 has an additional step for removing the particle dust. This prevents any particle dust from being mixed with the reusable particles, which is advantageous to achieve a highly accurate separation.

Furthermore, in the present embodiment of the particle separator according to the present invention, the first exhaust openings 7 are arranged so as to face with the top surface of the uppermost diffusion plate 11a (the particle reception surface) of the diffusion member 10. As a result, it becomes possible to easily suck out the particle dust diffused by the diffusion member 10, thus enabling the present invention to achieve a high separation accuracy.

Furthermore, in the present embodiment of the particle separator according to the present invention, the first exhaust openings 7 are arranged above the top surface of the uppermost diffusion plate 11a (the particle reception surface) of the diffusion member 10. As a result, it is possible to prevent the large-mass reusable particles from being sucked out through the first exhaust openings 7, and this enables the present invention to achieve an even higher separation accuracy.

Furthermore, in the present embodiment of the particle separator according to the present invention, the second exhaust openings 8 are additionally arranged in the top of the hopper tank 4 in which the reusable particles are received. As a result, it is also possible to prevent the



large-mass reusable particles from being sucked out through the second exhaust openings 8, and this enables the present invention to achieve an even higher separation accuracy.

Furthermore, in the present embodiment of the particle separator according to the present invention, the diffusion member 10 can be easily removed from the separator container 3 and the housing container 2 by opening the outer cover 14 and the inner cover 13. As a result, it is possible easily remove the relatively large bits of peeled paint that remain on the tops of the diffusion plates 11a - 11e.

(Second Embodiment)

Fig. 4 is a perspective view of a second embodiment of a diffusion member 40 of a particle separator according to the present invention. In this regard, the diffusion member 40 is interchangeable with the above-described diffusion member 10 of the first embodiment of the particle separator according to the present invention. Namely, in contrast with the diffusion member 10 of the first embodiment of the particle separator which utilizes five punched metal diffusion plates having a plurality of holes, the diffusion member 40 of the second embodiment of the particle separator utilizes an equally spaced layered arrangement of five diffusion plates 41a - 41e having a plurality of slits formed therein. As shown in Fig. 4, each slit plate is rotatably supported by a diffusion plate support member 42.

Now, in the arrangement shown in Fig. 4, the slits of adjacent diffusion plates are out of alignment with each other. In this case, such an arrangement facilitates diffusion of the mixture of reusable particles and particle dust, which leads to increased amount of waste material sucked out through the first exhaust openings 7. However, if too much diffusion is created, some of the reusable particles may be mixed into the waste material. For this reason, it may be necessary to lower the degree of diffusion created

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by the diffusion member 40.

In this connection, it is possible to adjust the degree of diffusion created by the diffusion member 40 by rotating one or more of the diffusion plates 41a - 41c to change the direction of the slits thereof with respect to the slits of adjacent diffusion plates. For example, it is possible to rotate the three diffusion plates 41a - 41c in order to align the slits of the diffusion plates 41a - 41c with each other. If this is done, the mixture of reusable particles and particle dust will easily pass through the slits of the first three diffusion plates 41a - 41c and then become violently diffused at the diffusion plates 41d and 41e which are located relatively far from the first exhaust openings 7. As a result, it is possible to prevent the reusable particles from being sucked out through the first exhaust openings 7.

Thus, by simply rotating one or more of the diffusion plates 41a - 41c, a user of the particle separator according to the second embodiment of the present invention can adjust the degree of diffusion created by the diffusion member 40 in order to prevent reusable particles from being expelled to the dust collector.

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What is Claimed is:

1. A particle separator for use in a blasting apparatus, comprising:

a separator container;

an intake port for blowing reusable particles and particle dust obtained after the blasting into said separator container;

a diffusion member for diffusing the reusable particles and particle dust, said diffusion member including two more porous diffusion plates which are laminated through a predetermind space therebetween;

an exhaust port for exhausting the particle dust and compressed air; and

a reusable particle accommodating tank disposed below the diffusion member.

2. A particle separator for use in a blasting apparatus, comprising:

a separator container;

an intake port for blowing reusable particles and particle dust obtained after the blasting into said separator container;

a diffusion member for diffusing the reusable particles and particle dust, said diffusion member including two more rotatable slit plates which are laminated through a predetermind space therebetween;

an exhaust port for exhausting the particle dust and compressed air; and

a reusable particle accommodating tank disposed below the diffusion member.





3. The particle separator for use in the blasting apparatus as claimed in any one of claims 1 to 2, wherein said exhaust port includes a first exhaust port for exhausting particle dust which has not passed said diffusion member and compressed air, and a second exhaust port for exhausting particle dust which has passed said diffusion member together with compressed air.
4. The particle separator for use in the blasting apparatus as claimed in claim 3, wherein said first exhaust port is disposed so as to be opposed to a particle receiving surface of said diffusion member.
5. The particle separator for use in the blasting apparatus as claimed in claim 4, wherein said first exhaust port is disposed above the particle receiving surface of the diffusion member.
6. The particle separator for use in the blasting apparatus as claimed in claim 4, wherein said second exhaust port is disposed above the reusable particle accommodating tank.
7. The particle separator for use in the blasting apparatus as claimed in claim 1 or 2, wherein said diffusion member is constructed so as to be removable from the upper surface of the separator container.

