(19) DANMARK

Patent- og Varemærkestyrelsen

(10) **DK/EP 3094449 T3**

(12) # Oversættelse af europæisk patentskrift

(51) Int.Cl.: ***B 24 C 5/02 (2006.01)*** ***B 24 C 5/04 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2022-07-04**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2022-05-11**

(86) Europæisk ansøgning nr.: **15737488.5**

(86) Europæisk indleveringsdag: **2015-01-15**

(87) Den europæiske ansøgnings publiceringsdag: **2016-11-23**

(86) International ansøgning nr.: **US2015011616**

(87) Internationalt publikationsnr.: **WO2015109101**

(30) Prioritet: **2014-01-16 US 201461928398 P**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **BLÆSEMEDIEFRAGMENTERINGSENHED**

(56) Fremdragne publikationer:
US-A- 4 253 610
US-A- 6 042 458
US-A1- 2003 073 392
US-A1- 2010 075 579
US-A1- 2010 170 965
US-A1- 2011 059 681
US-B1- 6 283 833
None

DESCRIPTION

[0001] The present invention relates to method and apparatus for reducing the size of blast media entrained in a subsonic fluid flow, and is particularly directed to a method and apparatus for reducing the size of carbon dioxide particles entrained in a subsonic gas flow.

BACKGROUND

[0002] Carbon dioxide systems, including apparatuses for creating solid carbon dioxide particles, for entraining particles in a transport gas and for directing entrained particles toward objects are well known, as are the various component parts associated therewith, such as nozzles, are shown in U.S. Patents 4,744,181, 4,843,770, 5,018,667, 5,050,805, 5,071,289, 5,188,151, 5,249,426, 5,288,028, 5,301,509, 5,473,903, 5,520,572, 6,024,304, 6,042,458, 6,346,035, 6,695,679, 6,726,549, 6,739,529, 6,824,450, 7,112,120 and 8,187,057. Additionally, United States Patent Provisional Application Serial No. 61/394,688 filed October 19, 2010, for Method And Apparatus For Forming Carbon Dioxide Particles Into Blocks, United States Patent Application Serial No. 13/276,937, filed October 19, 2011, for Method And Apparatus For Forming Carbon Dioxide Particles Into Blocks, United States Patent Provisional Application Serial No. 61/487,837 filed May 19, 2011, For Method And Apparatus For Forming Carbon Dioxide Particles, United States Patent Provisional Application Serial No. 61/589,551 filed January 23, 2012, for Method And Apparatus For Sizing Carbon Dioxide Particles, and United States Patent Provisional Application Serial No. 61/592,313 filed January 30, 2012, for Method And Apparatus For Dispensing Carbon Dioxide Particles, 14/062,118 filed October 24, 2013 for Apparatus Including At Least An Impeller Or Diverter And For Dispensing Carbon Dioxide Particles And Method Of Use. Although this patent refers specifically to carbon dioxide in explaining the invention, the invention is not limited to carbon dioxide but rather may be applied to any suitable cryogenic material. Thus, references to carbon dioxide herein are not to be limited to carbon dioxide but are to be read to include any suitable cryogenic material.

[0003] It is sometimes desirable to reduce the size of blast media entrained in a fluid flow, prior to directing the flow to a desired location or for a desired effect, such as directing the flow out of a blast nozzle toward a target, such as a work piece. Blast media fragmenters are well known apparatuses, configured to reduce the size of blast media, such as but not limited to carbon dioxide particles, entrained in a fluid flow, such as but not limited to air. Fragmenters define an internal flow path through which the entrained flow of blast media flows and include means for fragmenting the blast media disposed to be impacted by at least a portion of the flow of blast media.

[0004] One such prior art fragmenter is known from document US 2010/0170965 A1 which discloses a (supersonic) blast media fragmenter comprising a body defining an internal flow path configured to maintain a fluid flow with entrained cryogenic blast media particle at (supersonic) speed throughout the length of the internal flow path, said internal flow path comprising an inlet, a converging section disposed downstream of said inlet, and an outlet disposed downstream of said converging section; as well as at least one fragmenting element disposed intermediate said converging section and said outlet. The document also discloses a method of changing a size of blast media particles entrained in a (supersonic) fluid flow, each of said blast media particles having a respective initial size, the method comprising propelling a plurality of said blast media particles through one or more openings defined by a fragmenting element and changing at least one of the propelled plurality of blast media particles from its respective initial size to a second smaller size by said propelling of said at least one of the plurality of said blast media particles through said one or more openings.

[0005] The invention is defined by the fragmenter of independent claim 1 and the associated method of independent claim 8.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The accompanying drawings illustrate embodiments, and, together with the specification, including the detailed description which follows, serve to explain the principles of the present innovation.

FIG. 1 illustrates a particle blasting apparatus;

FIG. 2 is a side cross-sectional view of a fragmenter;

FIG. 3 is perspective view the fragmenter of FIG. 2;

FIG. 4 is a side cross-sectional view of the fragmenter of FIG. 2 with examples of options of upstream and downstream flow control geometry;

FIG. 5 is a plan view of a fragmenting element;

FIG. 6 is perspective view of fragmenting element and support; and

FIG. 7 is a plan view of another fragmenting element; and

FIG. 8 is a side cross-sectional view of two fragmenters connected together with examples of options upstream and downstream flow control geometry.

DETAILED DESCRIPTION

[0007] In the following description, like reference characters designate like or corresponding parts throughout the several views. Also, in the following description, it is to be understood that terms such as front, back, inside, outside, and the like are words of convenience and are not to be construed as limiting terms. Referring in more detail to the drawings, an embodiment constructed according to the teachings of the present invention is described.

[0008] Referring to Fig. 1, there is shown a particle blast apparatus, generally indicated at 2, which includes cart 4, delivery hose 6, hand control 8, fragmenter 10 and blast nozzle 12. Internal to cart 4 is a blast media delivery assembly (not shown) which includes a hopper, a feeder disposed to receive particles from the hopper and to entrain particles into a flow of transport gas. Particle blast apparatus 2 is connectible to a source of transport fluid, delivered in the embodiment depicted by hose 14 which delivers a flow of air at a suitable pressure, such as 80 PSIG. Blast media, such as carbon dioxide particles, indicated at 16, is deposited into the hopper through top 18 of the hopper. The carbon dioxide particles may be of any suitable size, such as a diameter of 3mm length of 3mm. The feeder entrains the particles into the transport gas, thereafter flowing at a subsonic speed through the internal flow passageway defined by delivery hose 6. Delivery hose 6 is depicted as a flexible hose, but any suitable structure may be used to convey the particles entrained in the transport gas. Hand control 8 allows the operator to control the operation of particle blast apparatus 2 and the flow of entrained particles. Downstream of control 8, the entrained particles flow into the internal flow path defined by fragmenter 10, and then into entrance 12a of blast nozzle 12. The particles flow from exit 12b of blast nozzle 12 and may be directed in the desired direction and/or at a desired target, such as a work piece (not shown).

[0009] Blast nozzle 12 may be of any suitable configuration, for example, nozzle 12 may be a supersonic nozzle, a subsonic nozzle, or any other suitable structure configured to advance or deliver the blast media to the desired point of use.

[0010] Control 8 may be omitted and the operation of the system controlled through controls on cart 4 or other suitable location. For example, the blast nozzle 12 may be may mounted to a robotic arm and control of the nozzle orientation and flow accomplished through controls located remote to cart 4.

[0011] Referring to FIG. 2, a side cross-sectional view of fragmenter 10 is illustrated. Although fragmenter 10 is described herein as being disposed adjacent blast nozzle 12, it may be located at any suitable location between the feeder exit and blast nozzle inlet 12a, including for example in the middle of delivery hose 6, such as at the junction of a two piece delivery hose 6. Fragmenter 10 includes body 20 which defines at least a portion of internal flow path 22 through which the entrained flow of blast media flows. Internal flow path 22 includes entrance 22a and exit 22b. Body 20 carries fragmenting element 24 which is disposed to be impacted by at least a portion of the flow of entrained blast media. In the embodiment depicted, fragmenting element 24 is disposed in internal flow path 22 such that the entirety of the flow flows through fragmenting element 24 resulting in all blast media larger than the openings (described below) of fragmenting element 24 impacting fragmenting element 24.

[0012] In the embodiment depicted, internal flow path 22 includes converging section 26 which provides a reasonably smooth transition from the slower speed of the entrained flow upstream of fragmenter 10 to a notably higher velocity fluid flow, resulting in minimum loss of available compressed fluid energy. By converging to a smaller area, there is a corresponding change in fluid static pressure, which, for the subsonic flow, corresponds to the creation of a pressure pulse which is communicated through the fluid upstream and downstream of converging section 26. Downstream of converging section 26 is disposed constant cross-section area section 28 having a suitable length, L, to allow the Mach number of the entrained flow to remain sufficiently high enough for the media's kinetic energy to be sufficiently high enough, in view of diameter the cross-sectional area of section 28 and the area of the openings of fragmenting element 24, to ensure the media consistently impact and pass through fragmenting element 24 to avoid clogging. It is within the scope of teachings of this application to achieve the same results by configuring fragmenter 10 without constant cross-section area section 28, with converging section 26 having a convergence angle and length configured to produce equivalent results.

[0013] In the embodiment depicted, downstream of constant cross-section area section 28 and upstream of fragmenting element 24 there is shown expansion section 30, having a diverging or increasing cross-sectional area, of a relatively short length and low angle α which may optionally be included to account for water ice buildup along the wall of internal flow path 22 thereby reducing the potential for water ice clogging of fragmenting element 24. As illustrated in the embodiment depicted, internal flow path 22 may include section 32 which presents a slight increase in cross-sectional area immediately downstream of fragmenting element 24, also reducing the potential for water ice clogging. Section 32 may be slightly converging as illustrated. In the embodiment depicted, body 20 is formed of two pieces, 20a and 20b secured to each other by fasteners with seal 20c therebetween. The two piece construction permits assembly of fragmenting element 24 therebetween in internal flow path 22.

[0014] Although internal flow path 22 is depicted as circular, as can be seen in FIG. 3, any suitable cross-sectional shape may be used, having the appropriately suitable cross-sectional areas as described herein.

[0015] The step of converging the entrained particle flow prior to fragmenting element 24 may alternately be accomplished upstream of fragmenter 10 or in addition to converging section 26 of fragmenter 10. Referring to FIG. 4, adapter 34 defines converging section 36 of internal flow path 22 which reduces the larger cross-section area of the entrained flow at inlet 38 to the cross-section area at entrance 40 of converging section 26, providing an even greater area reduction than depicted in converging section 26. Adaptor 34 is configured to mate complementarily with any component disposed immediately upstream thereof, such as control 8 in the embodiment depicted. As discussed above, the upstream component may be any suitable component, and by having different adaptor 34 configurations, a single fragmenter 10 configuration may be used with a range of upstream components. Adaptor 34 may be secured to body 20 in any suitable manner, such as by fasteners 42, and seal 44 may be included.

[0016] Similarly, adaptor 46 may, as illustrated, be connected to the exit end of fragmenter 10, configured to mate complementarily with any component disposed immediately downstream thereof. Thus, a variety of different adaptor configurations may be provided having a common upstream configuration to mount to fragmenter 10 and a variety of downstream mounting configurations dependent on the configuration of the downstream component. In the embodiment depicted, adaptor 46 includes diverging section 48. As mentioned above, downstream components include a supersonic blast applicator or nozzle, a subsonic applicator/nozzle or any other component suitable for the intended use of the entrained particle flow.

[0017] Referring to FIGS. 5, 6 and 7, there are shown embodiments of fragmenting elements. Any suitable configuration of fragmenting element may be used. Fragmenting element 24 provides a plurality of passages 50, 52 also referred to herein as openings or cells, which are sized based on the desired final size of the media when the media exits the system. The openings of fragmenting element 24 may have any suitable shape, including rectangular, elongated, circular.

[0018] FIG. 5 illustrates fragmenting element 24a configured as a wire mesh screen. To provide structural support for fragmenting elements, such as the wire mesh configuration of fragmenting element 24a, support 54 may be provided as illustrated in FIG. 6. Fragmenting element 24a may be attached to support 52 in any suitable manner, such as by welding at a plurality of locations about periphery 24b of fragmenting element 24a. FIG. 7 illustrates fragmenting element 24c with passages 52 laser cut or die cut. Fragmenting element 24c may therefore have sufficient thickness to need no additional support. Openings 52 may be undercut, have break edge or have a bell mouth shape.

[0019] A plurality of fragmenting elements may be utilized, which may also be configured to have their relative angular orientations externally adjustable so as to provide a variable sized opening to provide variable control to the reduced size of the media.

[0020] Fragmenting element 24 functions to change the blast media, such as the disclosed carbon dioxide particles, also referred to as dry ice particles, from a first size, which may be a generally uniform size for the media, to a second smaller size. Thus, all or a portion of the entrained media flows through the openings of fragmenting element 24, with each of the media colliding and/or passing through the openings, being reduced from their initial size to a second size, the second size being dependent upon the cell or opening size. A range of second sizes may be produced.

[0021] FIG. 8 is a side cross-sectional view of two fragmenters 10a, 10b connected sequentially. Although two fragmenters are illustrated, more than two fragmenters may be sequentially arranged. Fragmenters 10a and 10b collectively define at least a portion of internal flow path 56 through which the entrained flow of blast media flows. Body 58a carries fragmenting element 60a which is disposed to be impacted by at least a portion of the flow of entrained blast media. In the embodiment depicted, fragmenting element 60a is disposed in internal flow path 56 such that the entirety of the flow flows through fragmenting element 60a resulting in all blast media larger than the openings of fragmenting element 60a impacting fragmenting element 60a. Body 58b carries fragmenting element 60b which is disposed to be impacted by at least a portion of the flow of entrained blast media. In the embodiment depicted, fragmenting element 60b is disposed in internal flow path 56 such that the entirety of the flow, which has previously passed through fragmenting element 60a, flows through fragmenting element 60b resulting in all blast media larger than the openings of fragmenting element 60b impacting fragmenting element 60b.

[0022] In the embodiment depicted, internal flow path 56 includes converging section 26a which provides a reasonably smooth transition from the slower speed of the entrained flow upstream of fragmenter 10a to a notably higher velocity fluid flow, resulting in minimum loss of available compressed fluid energy. By converging to a smaller area, there is a corresponding change in fluid static pressure, which, for the subsonic flow, corresponds to the creation of a pressure pulse which is communicated through the fluid upstream and downstream of converging section 26a. Downstream of converging section 26a is disposed constant cross-section area section 28a having a suitable length, L_a, to allow the Mach number of the entrained flow to remain sufficiently high enough for the media's kinetic energy to be sufficiently high enough, in view of diameter the cross-sectional area of section 28a and the area of the openings of fragmenting element 60a, to ensure the media consistently impact and pass through fragmenting element 60a to avoid clogging. It is within the scope of teachings of this application to achieve the same results by configuring fragmenter 10b without constant cross-section area section 28a, with converging section 26a having a convergence angle and length configured to produce equivalent results.

[0023] In the embodiment depicted, downstream of constant cross-section area section 28a and upstream of fragmenting element 60a there is shown expansion section 30a, having a diverging or increasing cross-sectional area, of a relatively short length and low angle α_a which may optionally be included to account for water ice buildup along the wall of internal flow path 56 thereby reducing the potential for water ice clogging of fragmenting element 60a. As illustrated in the embodiment depicted, internal flow path 56 may include section 32a which presents a slight increase in cross-sectional area immediately downstream of fragmenting element 60a, also reducing the potential for water ice clogging. Section 32a may be slightly converging as illustrated.

[0024] In the embodiment depicted, internal flow path 56 also includes converging section 26b and downstream converging section 26b having a constant cross-section area section 28b having a suitable length, L_b, to allow the Mach number of the entrained flow to remain sufficiently high enough for the media's kinetic energy to be sufficiently high enough, in view of diameter the cross-sectional area of section 28b and the area of the openings of fragmenting element 60b, to ensure the media consistently impact and pass through fragmenting element 60b to avoid clogging. It is within the scope of teachings of this application to achieve the same results by configuring fragmenter 10b without constant cross-section area section 28b, with converging section 26b having a convergence angle and length configured to produce equivalent results.

[0025] In the embodiment depicted, downstream of constant cross-section area section 28b and upstream of fragmenting element 60b there is shown expansion section 30b, having a diverging or increasing cross-sectional area, of a relatively short length and low angle α_b which may optionally be included to account for water ice buildup along the wall of internal flow path 56 thereby reducing the potential for water ice clogging of fragmenting element 60b. As illustrated in the embodiment depicted, internal flow path 56 may include section 32b which presents a slight increase in cross-sectional area immediately downstream of fragmenting element 60b, also reducing the potential for water ice clogging. Section 32b may be slightly converging as illustrated.

[0026] Similar to the above description, adapter 34a defines converging section 36a which reduces the larger cross-section area of the entrained flow at inlet 38a to the cross-section area at entrance 40a of converging section 26a, providing an even greater area reduction than depicted in converging section 26a. Similarly, adaptor 46b may, as illustrated, be connected to the exit end of fragmenter 10b, configured to mate complementarily with any component disposed immediately downstream thereof. Thus, a variety of different adaptor configurations may be provided having a common upstream configuration to mount to fragmenter 10b and a variety of downstream mounting configurations dependent on the configuration of the downstream component. In the embodiment depicted, adaptor 46b includes diverging section 48b. As mentioned above, downstream components include a supersonic blast applicator or nozzle, a subsonic applicator/nozzle or any other component suitable for the intended use of the entrained particle flow.

[0027] Lengths L_a and L_b are suitable to together allow the Mach number of the entrained flow through flow path 56 to remain sufficiently high enough for the media's kinetic energy to be sufficiently high enough, in view of diameters D_a and D_b, the cross-sectional areas of sections 28a and 28b and the areas of the openings of fragmenting elements 60a and 60b, to ensure the media consistently impact and pass through fragmenting elements 60a and 60b to avoid clogging. Of course, corresponding sections of fragmenter 10a and 10b may have the same dimensions, e.g., L_a may equal L_b, D_a may equal D_b.

[0028] Fragmenting elements 60a and 60b may be the same or may be different. For example, fragmenting element 60a may be sized to reduce the particle size to a first size, such as for example 3mm roughly in diameter, and fragmenting element 60b may be sized to reduce the particles to a second size, such as for example 2mm roughly in diameter. As particles impact and are reduced in size by first fragmenting element 60a, gas will be released off, thereby compensating to some degree for the pressure drop across first fragmenting element 60a.

[0029] The foregoing description of an embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiment was chosen and described in order to best illustrate the principles of the innovation and its practical application to thereby enable one of ordinary skill in the art to best utilize the innovation in various embodiments and with various modifications as are suited to the particular use contemplated. Although only a limited number of embodiments of the innovation is explained in detail, it is to be understood that the innovation is not limited in its scope to the details of construction and arrangement of components set forth in the preceding description or illustrated in the drawings. The innovation is capable of other embodiments and of being practiced or carried out in various ways. Also specific terminology was used for the sake of clarity. It is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar purpose. It is intended that the scope of the invention be defined by the claims submitted herewith.

REFERENCES CITED IN THE DESCRIPTION

Cited references

Patent documents cited in the description

- US4744181A [0002]
- US4843770A [0002]
- US5018667A [0002]
- US5050805A [0002]
- US5071289A [0002]
- US5188151A [0002]
- US5249426A [0002]
- US5288028A [0002]
- US5301509A [0002]
- US5473903A [0002]
- US5520572A [0002]
- US6024304A [0002]
- US6042458A [0002]
- US6346035B [0002]
- US6695679B [0002]

- US6726549B [0002]
- US6739529B [0002]
- US6824450B [0002]
- US7112120B [0002]
- US8187057B [0002]
- US61394688 [0002]
- US27693711 [0002]
- US61487837 [0002]
- US61589551 [0002]
- US61592313 [0002]
- US14062118B [0002]
- US20100170965A1 [0004]

Patentkrav

1. Subsonisk blæsemediefragmenteringsenhed (10; 10a, 10b), der omfatter

a. et legeme (20; 58a, 58b), der definerer en intern strømningsvej (22; 56), som er konfigureret til at opretholde en fluidstrøm med indeholdt kryogene blæsemediepartikler ved subsonisk hastighed hele vejen igennem længden af den interne strømningsvej, hvilken interne strømningsvej omfatter:

i. et indløb (22a; 38; 38a),

ii. en konvergerende sektion (26; 36), der er anbragt nedstrøms for nævnte indløb, og

iii. et udløb (22b), der er anbragt nedstrøms for nævnte konvergerende sektion, og

b. mindst ét fragmenteringselement (24; 60a, 60b), der er anbragt mellem nævnte konvergerende sektion og nævnte udløb.

2. Subsonisk blæsemediefragmenteringsenhed ifølge krav 1, hvor nævnte legeme er en enhedskonstruktion.

3. Subsonisk blæsemediefragmenteringsenhed ifølge et hvilket som helst af de foregående krav, hvor nævnte konvergerende sektion er anbragt umiddelbart nedstrøms for nævnte indløb.

4. Subsonisk blæsemediefragmenteringsenhed ifølge et hvilket som helst af de foregående krav, der omfatter en konstanttværsnitsarealsektion, som er anbragt mellem nævnte konvergeringssektion og nævnte mindst ene fragmenteringselement.

5. Subsonisk blæsemediefragmenteringsenhed ifølge krav 4, der omfatter en ekspansionssektion, som er anbragt mellem nævnte konstanttværsnitsarealsektion og nævnte mindst ene fragmenteringselement.

6. Subsonisk blæsemediefragmenteringsenhed ifølge et hvilket som helst af de fore-gående krav, hvor nævnte interne strømningsvej har et større tværsnitsareal umiddelbart nedstrøms for nævnte mindst ene fragmenteringselement end umiddelbart opstrøms for nævnte mindst ene fragmenteringselement.

7. Subsonisk blæsemediefragmenteringsenhed ifølge et hvilket som helst af de foregående krav, der omfatter en ekspansionssektion, som er anbragt mellem nævnte konvergerende sektion og nævnte mindst ene fragmenteringselement.

8. Fremgangsmåde til ændring af en størrelse af blæsemediepartikler, der er indeholdt i en subsonisk fluidstrøm, idet hver af nævnte blæsemediepartikler har en respektive indledende størrelse, hvilken fremgangsmåde omfatter:

a. konvergering af nævnte subsoniske fluidstrøm (22; 56) fra en første hastighed til en anden hastighed, idet nævnte anden hastighed er subsonisk og større end nævnte første hastighed,

b. fremdrivning af en flerhed af nævnte blæsemediepartikler gennem en eller flere åbninger (50; 52), der er defineret af et fragmenteringselement (24; 60a, 60b), og

c. ændring af mindst én af den fremdrevne flerhed af blæsemediepartikler fra dens respektive oprindelige størrelse til en anden mindre størrelse ved hjælp af nævnte fremdrivning af nævnte mindst ene af flerheden af nævnte blæsemediepartikler gennem nævnte ene eller flere åbninger.

9. Fremgangsmåde ifølge krav 8, der omfatter opretholdelse af nævnte subsoniske fluidstrøm ved nævnte anden hastighed i en første længde før fremdrivning af nævnte flerhed af nævnte blæsemediepartikler gennem nævnte ene eller flere åbninger.

10. Fremgangsmåde ifølge et hvilket som helst af kravene 8-9, der, efter at nævnte subsoniske fluidstrøm har opnået nævnte anden hastighed, omfatter ikke-konvergering af nævnte subsoniske fluidstrøm i en første længde før fremdrivning af nævnte flerhed af nævnte blæsemediepartikler gennem en eller flere åbninger.

11. Fremgangsmåde ifølge krav 10, hvor ikke-konvergering af nævnte subsoniske fluidstrøm i en første længde omfatter at lade nævnte subsoniske fluidstrøm strømme gennem en intern passage, hvilken intern passage har et konstant tværsnitsareal langs nævnte første længde.

12. Fremgangsmåde ifølge et hvilket som helst af kravene 8-11, der omfatter udvidelse af den subsoniske fluidstrøm umiddelbart før fremdrivning af nævnte flerhed af nævnte blæsemediepartikler gennem en eller flere åbninger.

13. Fremgangsmåde ifølge et hvilket som helst af kravene 8-12, der omfatter udvidelse af den subsoniske fluidstrøm umiddelbart efter fremdrivning af nævnte flerhed af nævnte blæsemediepartikler gennem en eller flere åbninger.

14. Fremgangsmåde ifølge et hvilket som helst af kravene 8-13, der omfatter konvergering af den subsoniske fluidstrøm efter fremdrivning af nævnte flerhed af nævnte blæsemediepartikler gennem en eller flere åbninger.

DRAWINGS

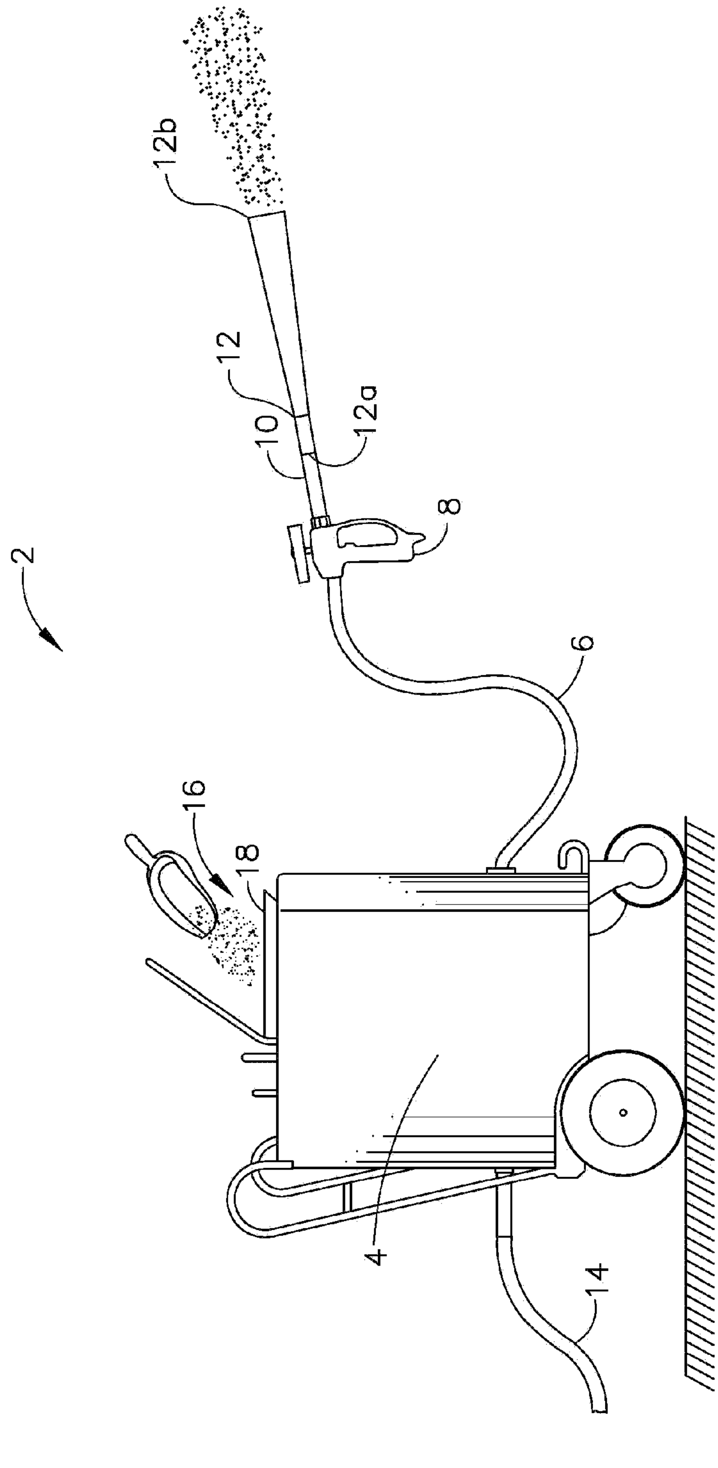

FIG. 1

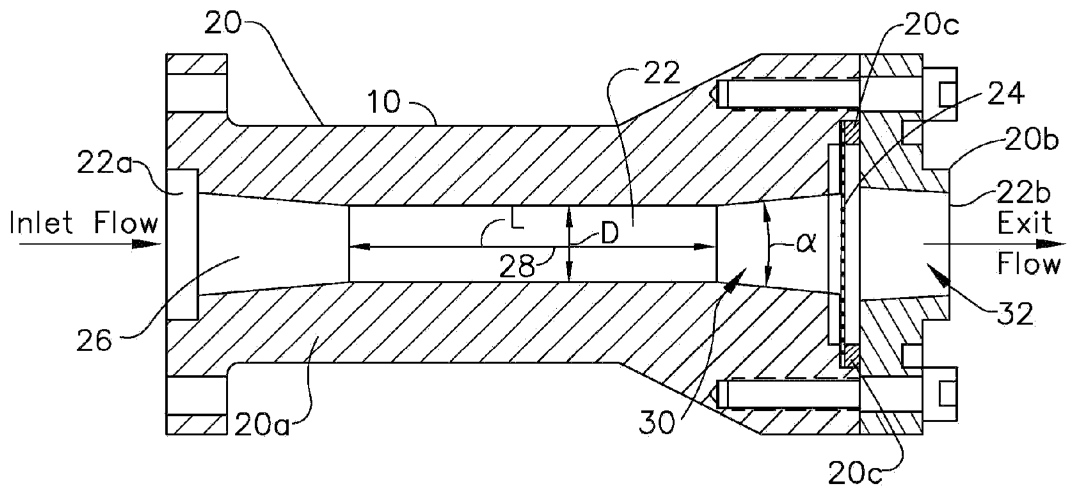
20
10
22
20c
24
20b
22a
22b
Inlet Flow
Exit
Flow
L
D
28
α
26
32
20a
30
20c

FIG. 2

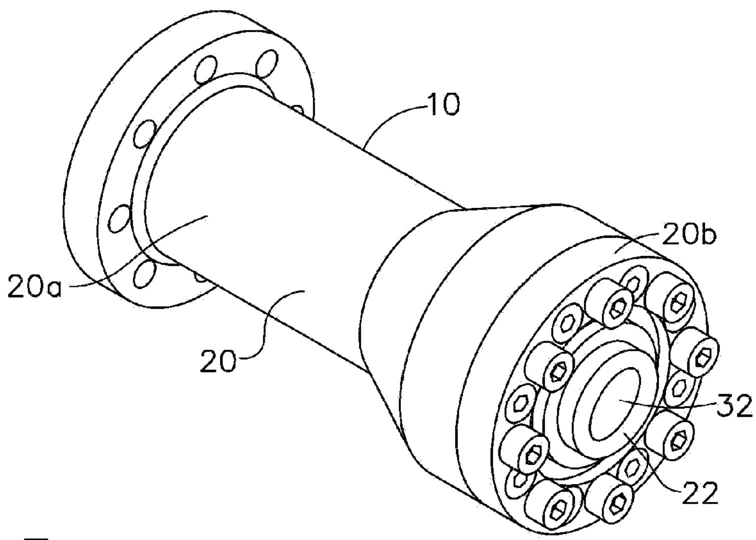
10
20b
20a
20
32
22

FIG. 3

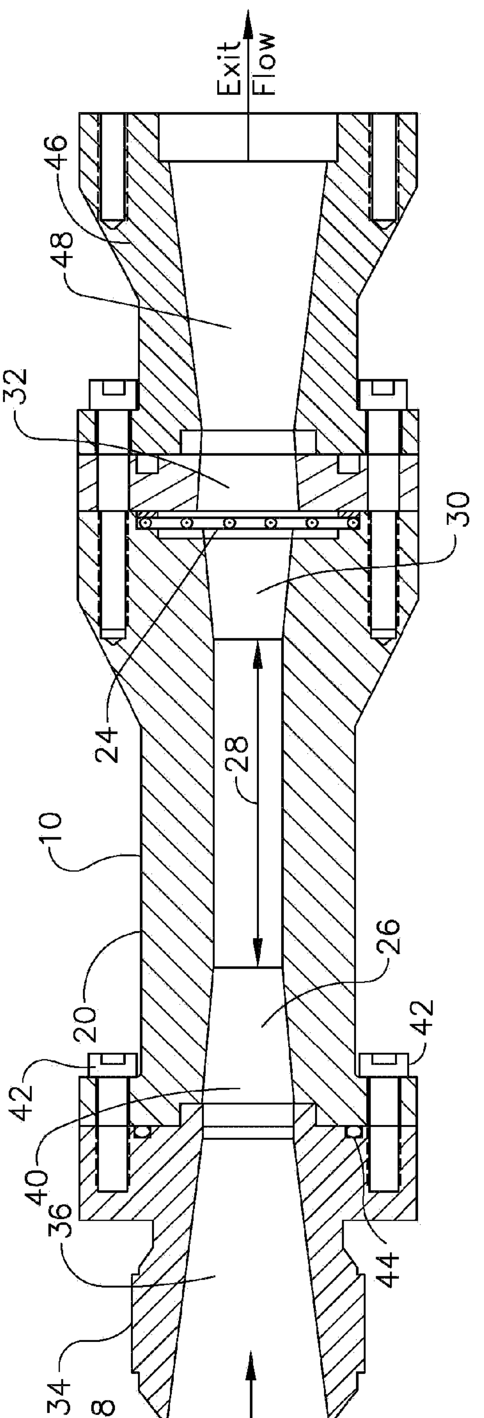

FIG. 4

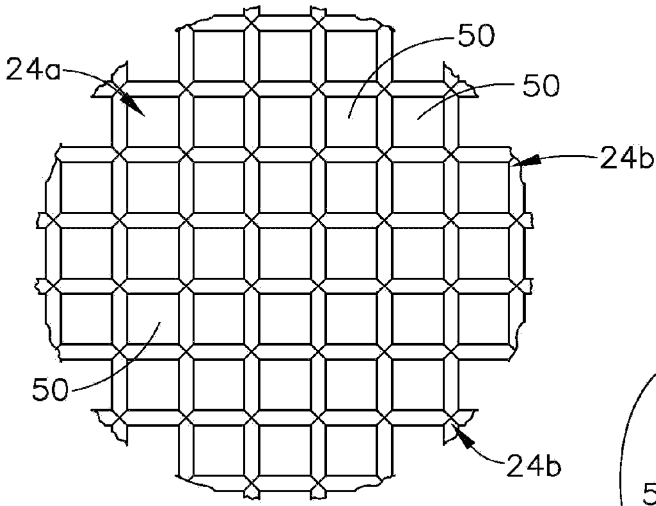

FIG. 5

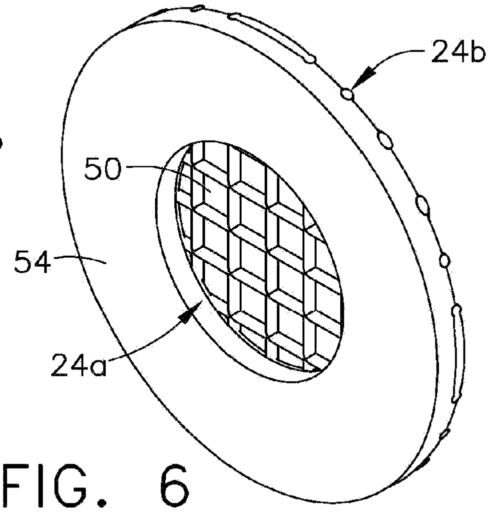

FIG. 6

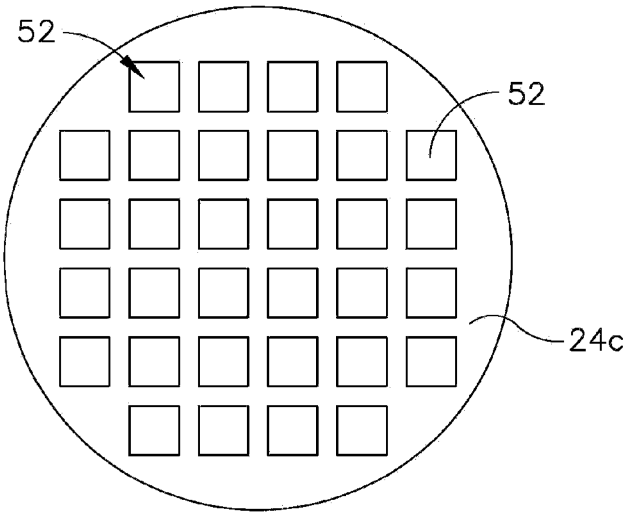

FIG. 7

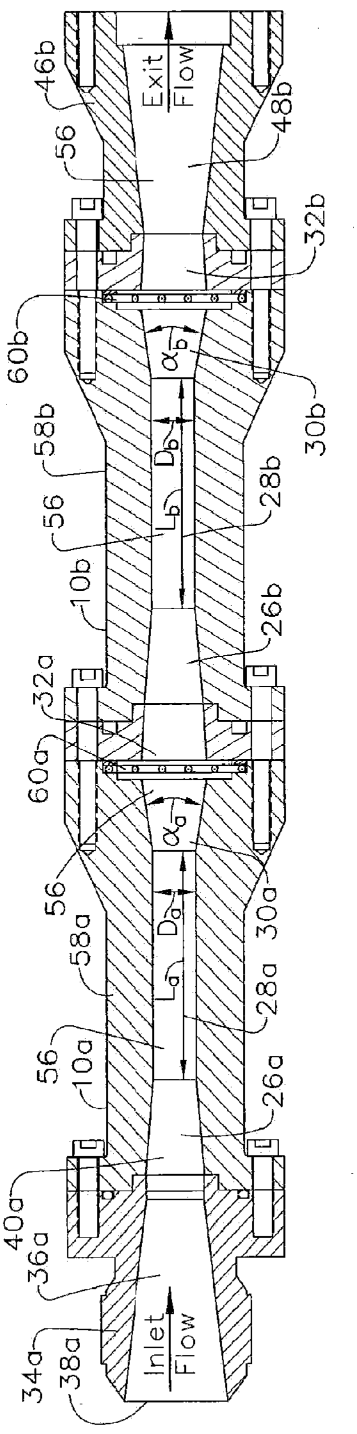
Exit Flow
Inlet Flow
46b
56
48b
32b
60b
30b
58b
56
28b
10b
26b
32a
60a
56
30a
58a
28a
56
10a
26a
40a
36a
34a
38a
α_b
D_b
L_b
α_a
D_a
L_a

FIG. 8