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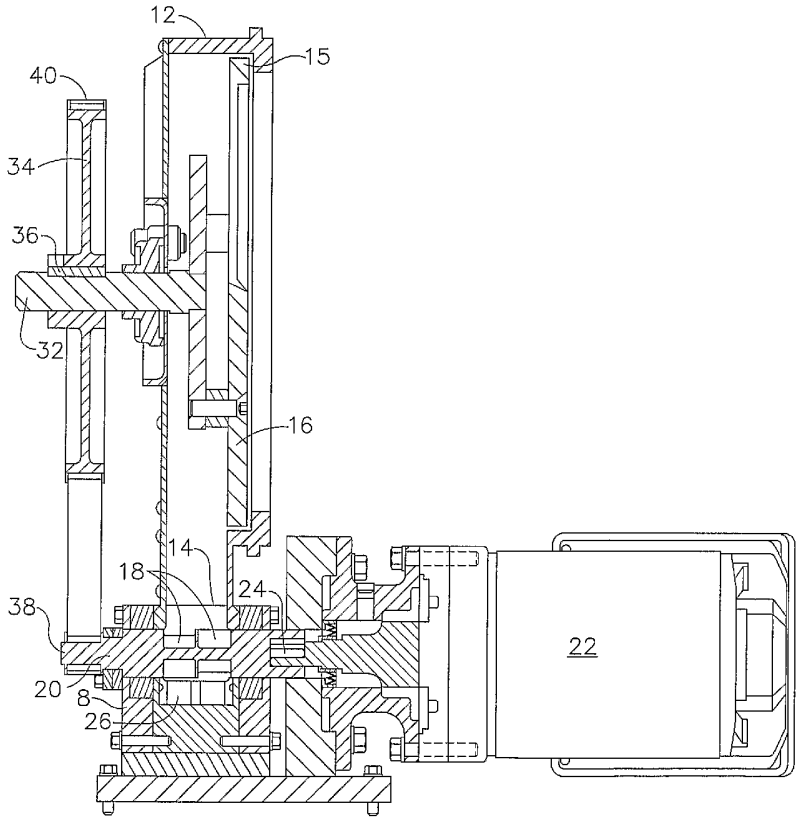
(54) Title: PARTICLE BLAST SYSTEM WITH SYNCHRONIZED FEEDER AND PARTICLE GENERATOR



(57) Abstract: A particle blast apparatus has a particle generator the speed of which is synchronized with the speed of the feeder which introduces particles into the flow of transport gas.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

PARTICLE BLAST SYSTEM WITH SYNCHRONIZED FEEDER AND PARTICLE GENERATOR

Richard K. Dressman

Field of the Invention

[0001] The present invention relates generally to particle blast systems apparatus, and is particularly directed to a device with a synchronized feeder and particle generator. The invention will be disclosed in connection with, but not limited to, a carbon dioxide blasting system having a shaver which is synchronized by a drive belt to the feeder.

Background of the Invention

[0002] Particle blasting systems have been around for several decades. Typically, particles, also known as blast media, are fed by a feeder into a transport gas flow and are transported as entrained particles to a blast nozzle, from which the particles exit, being directed toward a workpiece or other target. Particles may be stored in a hopper or generated by the blasting system and directed to the feeder for introduction into the transport gas. One apparatus for generating carbon dioxide particles is known as a shaver, such as disclosed in USP 5,520,572 which is incorporated herein by reference, in which a working edge, such as a knife edge, is urged against and moved across a block of carbon dioxide. Particles, also referred to as granules, are thus generated and fed to the inlet of a feeder. One such feeder is disclosed in United States Patent Application Serial Number 10/123,974, filed on April 17, 2002 for Feeder Assembly For Particle Blast System, which is incorporated herein by reference.

[0003] Although the present invention will be described herein in connection with a particle feeder for use with carbon dioxide blasting, it will be understood that the present invention is not limited in use or application to carbon dioxide blasting. The teachings of the present invention may be used in particle blast apparatus in which particles are generated and directed to a feeder.

Brief Description of the Drawings

[0004] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and, together with the general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the present invention.

[0005] FIG. 1 is a perspective view of a particle blast system constructed in accordance with the teachings of the present invention, with the outer panels removed to reveal the components.

[0006] FIG. 2 is a an end view of a portion of the particle blast system of FIG. 1.

[0007] FIG. 3 is a side view of the drive motor, the feeder, the end of the shaver, and the drive belt.

[0008] FIG. 4 is a side cross-sectional view similar to FIG. 3, taken along line A-A of FIG. 1.

[0009] FIG. 5 is an enlarged view of the rotor of the feeder

[0010] Reference will now be made in detail to the present preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings.

Detailed Description Of An Embodiment Of The Invention

[0011] 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. Terminology used in this patent is not meant to be limiting insofar as devices described herein, or portions thereof, may be attached or utilized in other orientations. Referring in more detail to the drawings, the invention will now be described.

[0012] Referring to Fig. 1, particle blast system, generally indicated at 2, include frame 4 which provides support for the components, and to which outer panels (not shown) are attached, enclosing most of the components. System 2 includes particle generator 6,

feeder 8 and control panel 10. Generator 6 is depicted as a shaver configured to received a standard size commercially available block of dry ice, such as a 6" x 6" x 12" block.

[0013] As seen in FIGS. 2, 3 and 4, one end of generator 6 includes housing 12 within which the particles, or granules, are formed and allowed to flow by gravity to inlet 14 of feeder 8. In the case of a shaver, housing 12 houses rotatable carrier 15 which carries one or more working edges 16, which is urged against and moved relative to the dry ice block (not shown) to shave granules off of the block. Particles flow from the block downwardly into inlet 14 and into cavities 18, also referred to as pockets, formed in the circumferential surface of rotor 20. Rotor 20 may be driven directly by motor 22 as shown, such as through legs 24, or may be driven indirectly through any suitable power transmission configuration. The particles are transported to discharge 26 of feeder 8, where they are introduced into the transport gas flow, exiting out exit port 28 to which the delivery hose (not shown) is directly or indirectly connected, for transport to the blast nozzle (not shown). Inlet port 30 of feeder 8 is connected to a source of transport gas (not shown) having suitable flow capacity and pressure, such as up to 125 psi.

[0014] Carrier 15 is supported and driven by shaft 32 which is rotatably supported by housing 12. Drive pulley 34 is fixed to shaft 32, with key 36 preventing rotation therebetween. Any suitable construction may be used to connect drive pulley 34 non-rotatably to shaft 32, such as splines. Drive pulley 34 is connected to end 38 of rotor 20 by drive belt 40. Drive pulley 34 includes a plurality of teeth 42 which engage complementarily shaped teeth formed on the inside of drive belt 40. End 38 also includes a plurality of complementarily shaped teeth 44 which engage the inside of drive belt 40. An idler 46 may also be used.

[0015] Rotor 20, driven by motor 22, thus drives carrier 15 and therefore working edges 16 at a fixed ratio. This synchronizes the generation of particles by particle generator 6 relative to the feed rate of the particles through feeder 8. By synchronizing the rate of production of particles with the rate at which particles are delivered to and from the feeder, the particles are transported immediately into the transport gas, thereby preferably moving continuously, avoiding being in a static state and avoiding agglomerating.

[0016] In the embodiment depicted, the ratio is approximately 10:1, with the feed rate of particles being about one pound per minute introduced to a transport gas of 25 to 50 standard cubic feet per minute. Different ratios may be used, depending on the desired feed rate, such as might be necessary when higher flow rate nozzles are utilized.

[0017] Any suitable drive mechanism may be used, such as a chain and sprocket. A variable transmission may be provided, allowing easy use of different flow rate nozzles and transport gas flows. Motor 22 may be interposed between shaft 32 and rotor 20, with the appropriate drive mechanisms between shaft 32 and motor 22 and rotor 20 and motor 22. Any suitable source of rotary motion and power may be used.

[0018] The foregoing description of a preferred 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 invention and its practical application to thereby enable one of ordinary skill in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims submitted herewith.

What is claimed is:

1. A particle blast cleaning apparatus comprising a particle generator configured to generate particles at a first rate, a particle feeder disposed to receive particles from said particle generator and configured to feed particles into a flow of transport gas at a second rate, said first rate being synchronized with said second rate.

2. The particle blast cleaning apparatus of claim 1, further comprising a drive mechanism operably connected to said particle generator and said particle feeder, said drive mechanism synchronizing said first rate with said second rate.

3. The particle blast cleaning apparatus of claim 2, wherein said drive mechanism comprises a belt.

4. The particle blast cleaning apparatus of claim 2, wherein said drive mechanism comprises a chain.

5. The particle blast cleaning apparatus of claim 2, wherein said drive mechanism comprises a variable transmission.

6. The particle blast cleaning apparatus of claim 1, wherein said particle feeder comprises

i. an inlet disposed to receive particles from said particle generator,

ii. a discharge configured to discharge particles into a flow of transport gas; and

iii. a rotatable rotor interposed between said inlet and said discharge, said rotable rotor being rotatable at a rotational speed, said rotational speed defining said second rate.

7. The particle blast cleaning apparatus of claim 6, wherein said particle generator comprises a rotatable member having a speed of rotation which defines said first rate, and said apparatus comprises a drive mechanism, said drive mechanism operably connected to said rotor and said rotatable member, said drive mechanism synchronizing said first rate with said second rate.

8. The particle blast cleaning apparatus of claim 7, wherein said drive mechanism comprises a drive belt, said rotor comprises a first plurality of teeth, and said rotatable member comprises a second plurality of teeth, said belt engaging said first plurality of teeth and said second plurality of teeth.

9. The particle blast cleaning apparatus of claim 8, wherein said rotatable member comprises a pulley having said second plurality of teeth.

10. The particle blast cleaning apparatus of claim 7, wherein said rotatable member comprises a carrier and a plurality of working edges carried by said carrier.

11. The particle blast cleaning apparatus of claim 1, wherein said particle generator includes a rotatable member having a speed of rotation which defines said first rate.

12. A method of entraining particles in a flow of pressurized transport gas, said method comprising the steps of:

a. generating particles at a first rate;

b. feeding said particles into a flow of pressurized transport gas at a second rate; and

c. synchronizing said first rate with said second rate.

13. The method of claim 12, comprising the step of directly controlling said second rate.

14. The method of claim 12, wherein the step of synchronizing said first rate with said second rate is done at a fixed ratio between said first and second rates.

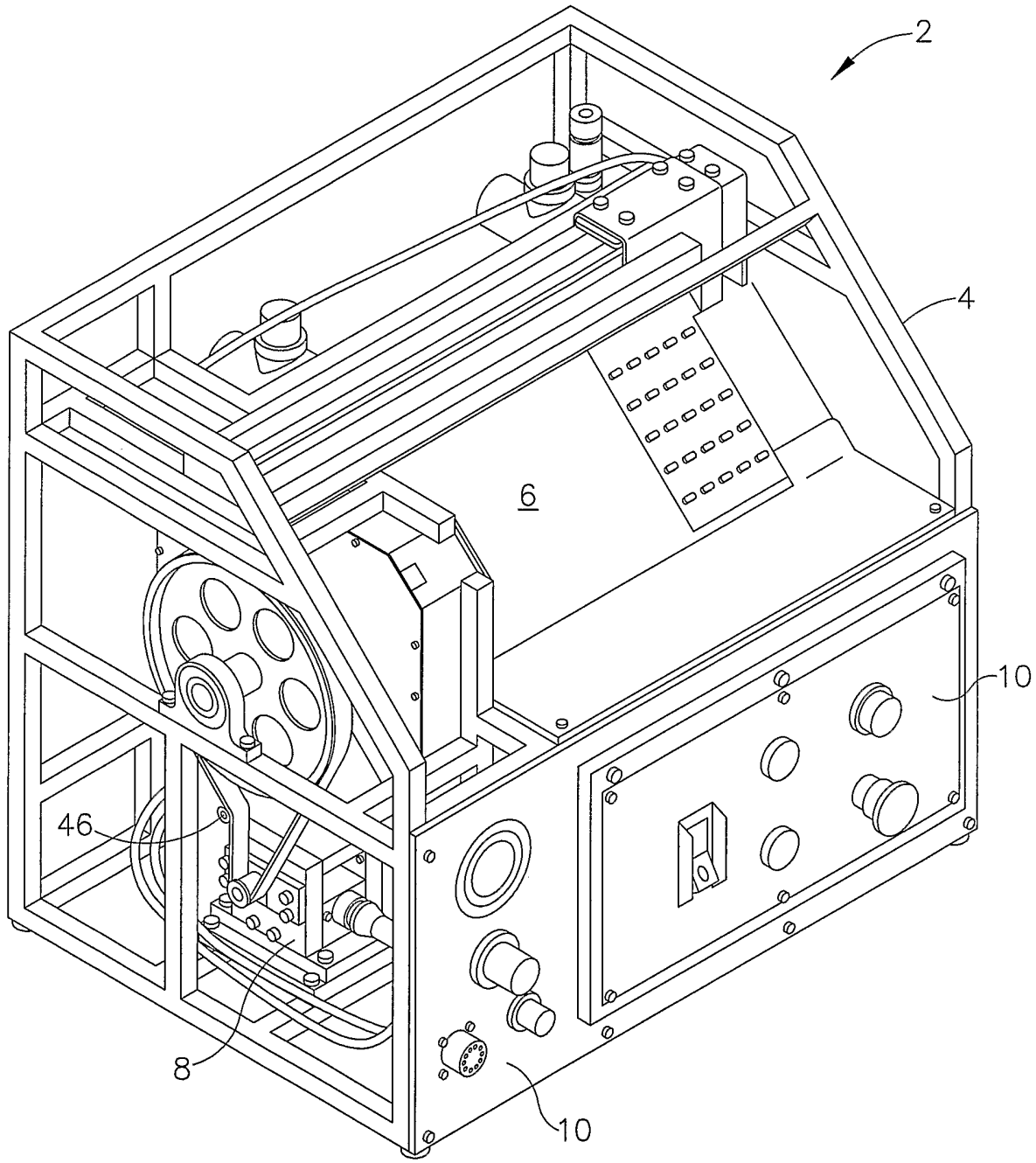

FIG. 1

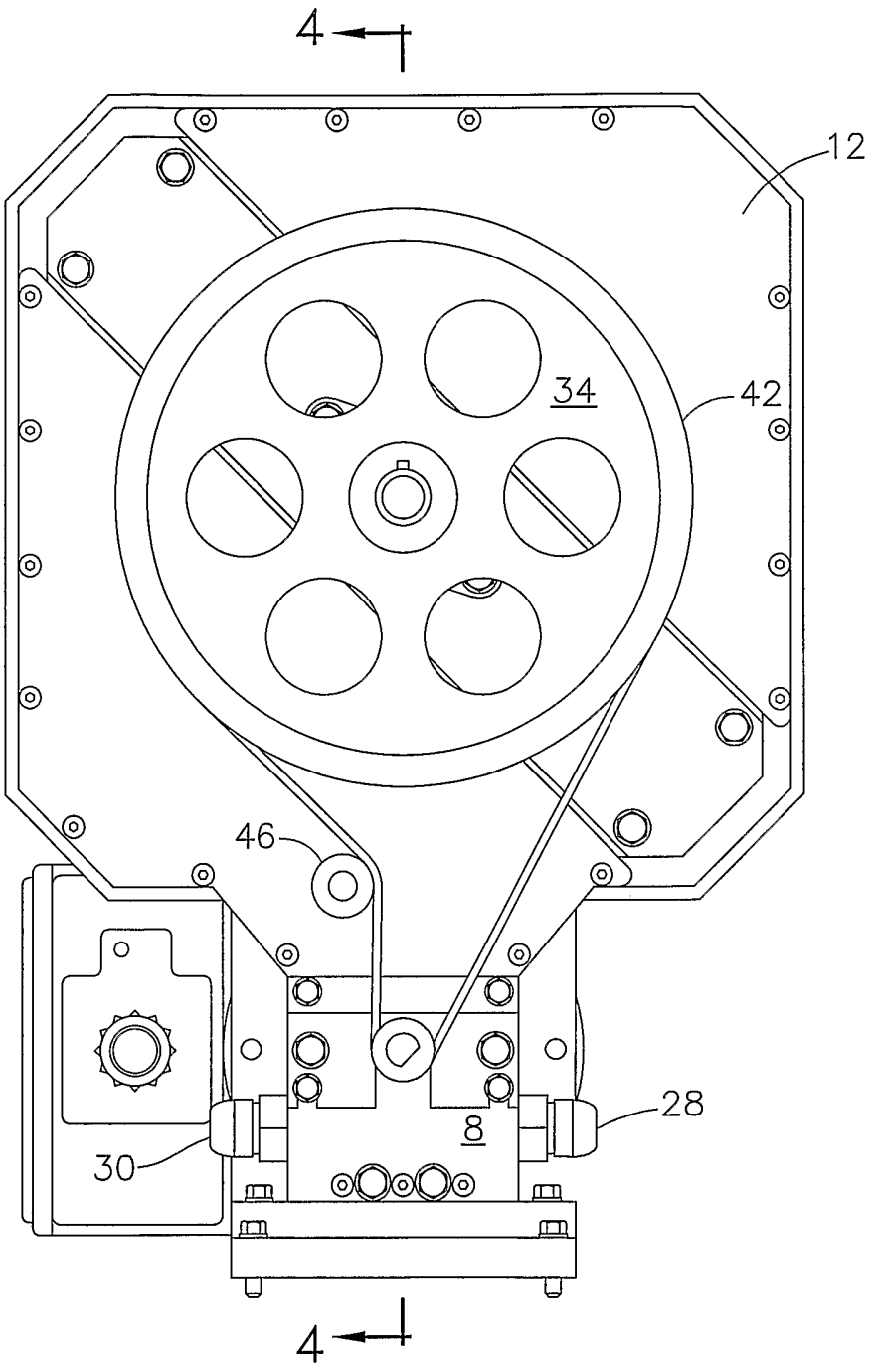

FIG. 2

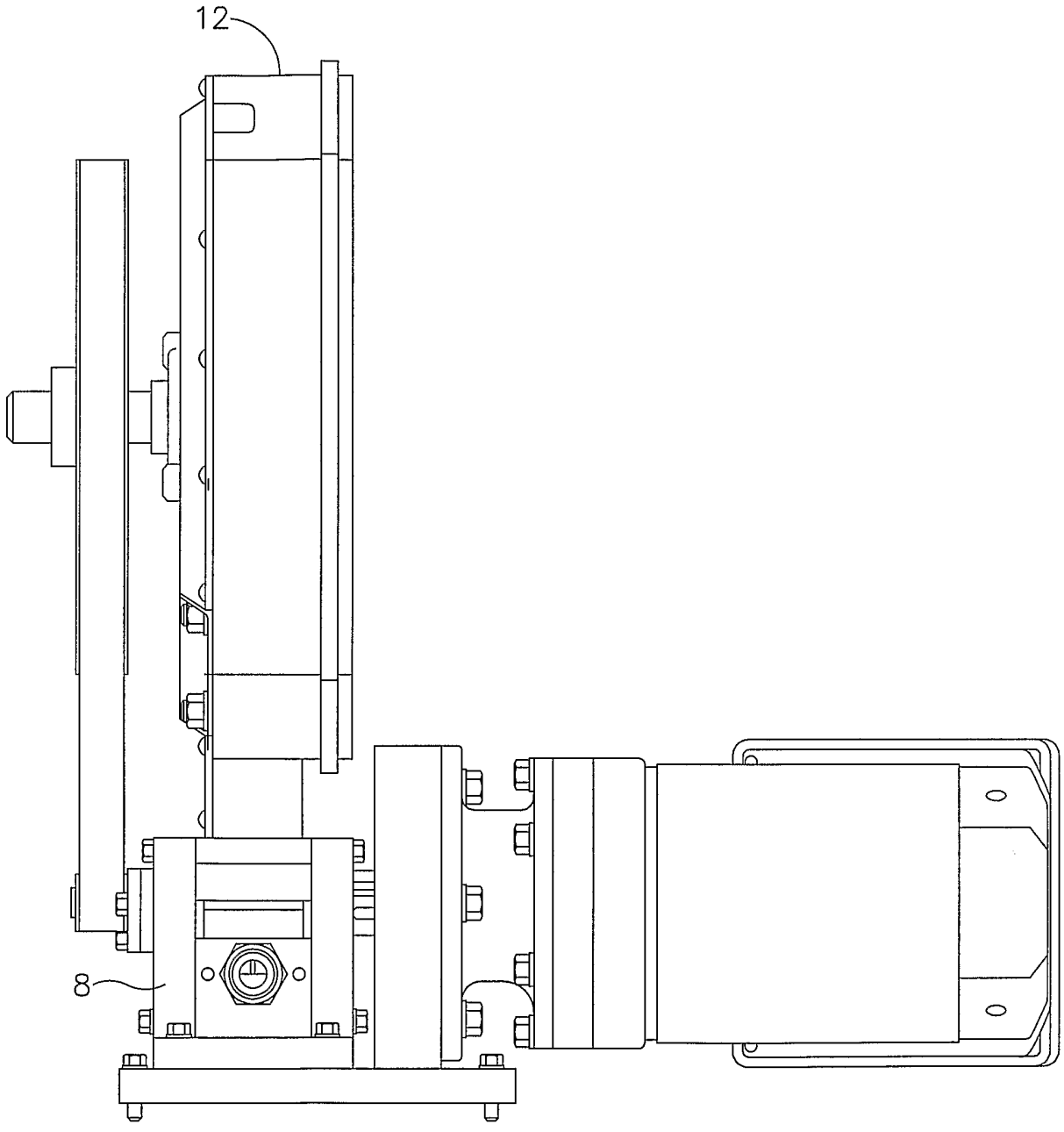

FIG. 3

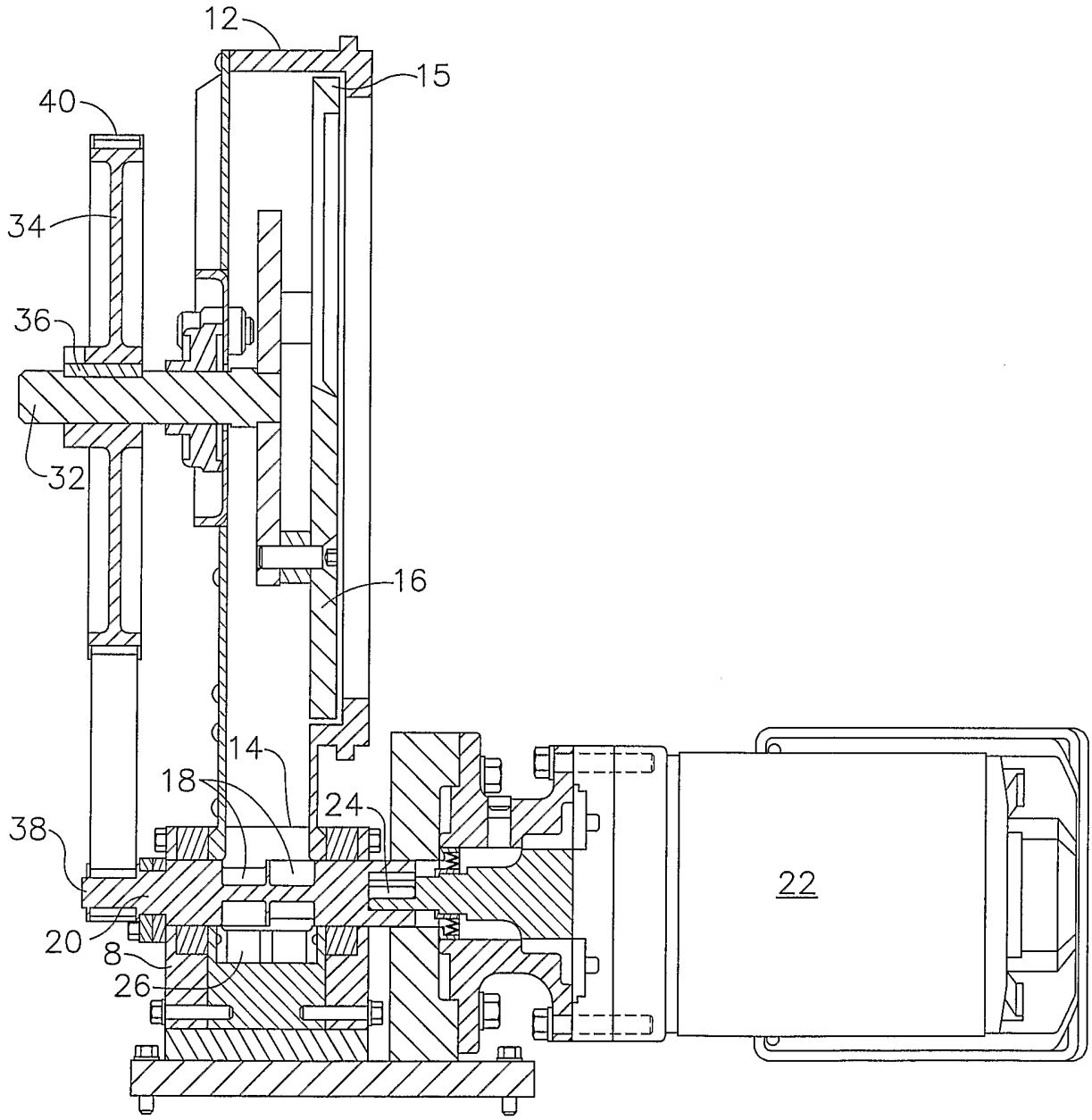

FIG. 4

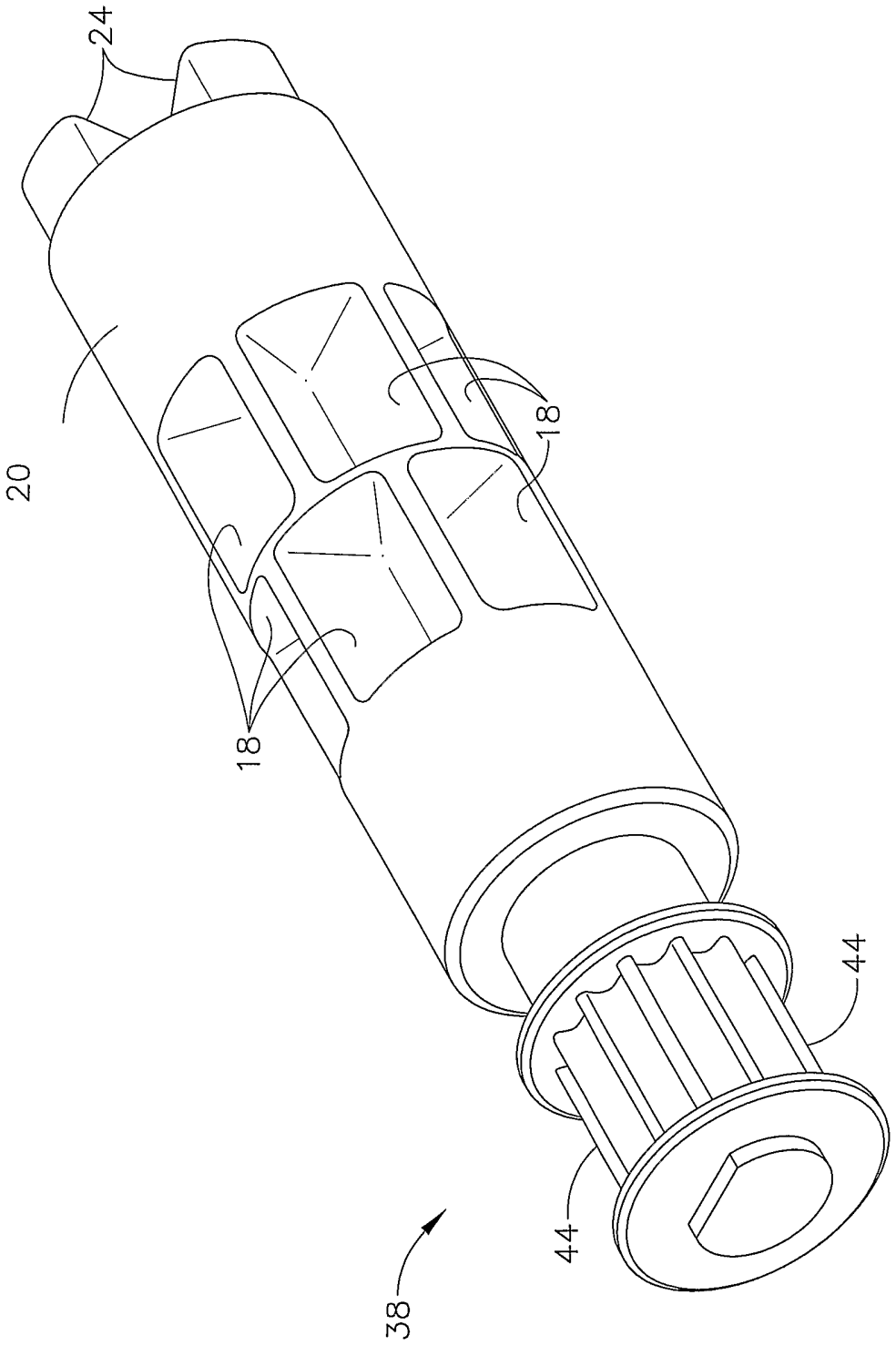

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/009017

A. CLASSIFICATION OF SUBJECT MATTER
INV. B24C1/00 B24C7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B24C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 91/04449 A (IXTAL BLAST TECHNOLOGY CORP) 4 April 1991 (1991-04-04) page 8, line 15 - page 9, line 14 figures 1-6,12-21	1-14
X	US 2004/121711 A1 (OPEL ALAN E) 24 June 2004 (2004-06-24) paragraph [0032]	1-14
X	WO 94/16861 A (ICE BLAST INTERNATIONAL LTD) 4 August 1994 (1994-08-04) page 10, line 15 - page 11, line 20 page 12, line 22 - page 13, line 2 page 21, lines 3-5 figures 1,4-11	1-14

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
27 June 2006	05/07/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Eder, R

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/009017

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 94/14572 A (ICE BLAST INTERNATIONAL LTD) 7 July 1994 (1994-07-07) page 5, line 24 - page 6, line 10 figures 1,2	1-14
A	US 5 623 831 A (MESHER ET AL) 29 April 1997 (1997-04-29) column 4, line 63 - column 5, line 5 figures 1-3	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/009017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9104449 A	04-04-1991	AU 6335890 A	18-04-1991
		CA 1324591 C	23-11-1993
US 2004121711 A1	24-06-2004	US 2003064665 A1	03-04-2003
WO 9416861 A	04-08-1994	AU 5842494 A	15-08-1994
		CA 2113291 A1	27-07-1994
WO 9414572 A	07-07-1994	AU 6808394 A	19-07-1994
		CA 2111648 A1	24-06-1994
		CN 1093635 A	19-10-1994
US 5623831 A	29-04-1997	AU 5394996 A	29-11-1996
		CA 2175269 A1	11-11-1996
		CA 2220572 A1	14-11-1996
		WO 9635913 A1	14-11-1996
		EP 0824657 A1	25-02-1998
		JP 11505012 T	11-05-1999