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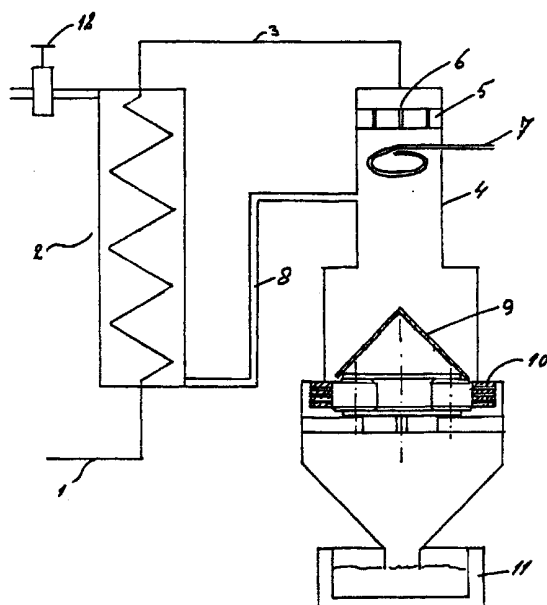
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(54) Title: METHOD FOR PRODUCING CRYOGENIC PARTICLES FROM FLUID CARBON DIOXIDE



(57) Abstract: The invention concerns of a method to produce cryogenic particles from liquid carbon dioxide. The particles are pressed from cristallised carbon dioxide in an equipment where a carbon dioxide snow generator is combined with an annular mould and a heat exchanger. The invention concerns the conditions which are required to produce very hard cryogenic particles. The method consists of cooling the fluid carbon dioxide before expansion to a temperature between minus 30 to minus 40 degrees Celcius.

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Method for producing cryogenic particles from fluid carbon dioxide.

The invention concerns of a method to produce cryogenic particles from liquid carbon dioxide.

The particles are pressed from crystalised carbon dioxide in an equipment where a carbon
05 dioxide snow generator is combined with a annular mould and a heat exchanger.

It is found that the form of crystallisation of solid carbon dioxide varies greatly by the conditions while come into being. It is found that deviation of conditions results in soft particles and superfluous snow.

10 The invention concerns the conditions which are required to produce very hard cryogenic particles. The method consists of cooling the fluid carbon dioxide before expansion to a temperature between minus 30 to minus 40 degrees Celcius by preference minus 35 degrees Celcius.

When 4 to 8 and by preference 6 expansion openings are used with a diameter of 0,3 to 1,0
15 millimetre, by preference 6,0 millimetre, for carbon dioxide snow production hard carbon dioxide crystals come into being which compressed with a annular mould with a diameter between 250 millimetre and 350 millimetre and by preference 300 millimetre according to NL-A-9401327 delivers particles with an side of about 3 millimetre and break off spontaneous at a length of about 4 millimetre. Small differences of these conditions cause a decrease of hardness and
20 shorter or much longer particles.

Description of the process.

Fig. 1 shows the installation.

25 Input (1) of liquid carbon dioxide is led through heat exchanger (2) and cooled to a temperature between minus 30 to minus 40 degrees Celcius and via conduit (3) led to carbon dioxide snow generator (4). At (5) is the spraying head with 4 to 8 expansion openings (6). Expansion openings (6) have a diameter between 0,3 and 1,0 millimetre. Under spray head (5) is placed a heat coil (7) to prevent that the temperature in the carbon dioxide snow generator (4) is getting
30 too low and freezing of the expansion openings (6) in the case that the liquid carbon dioxide contains too much water. A constant temperature inside the carbon dioxide snow generator (4) is also important for the right crystallisation.

In carbon dioxide snow generator (4) comes into being a mixture of carbon dioxide gas and carbon dioxide crystals. This mixture is separated by leading carbon dioxide gas via conduit (8)
35 to heat exchanger (2) where this is used to cool the input of liquid carbon dioxide. The temperature of the exhaust carbon dioxide gas is about minus 80 degrees Celcius and via heat exchanger (2) expelled to the open air. At (12) is a choke valve to keep a low atmospheric pressure in carbon dioxide snow generator (4).

The carbon dioxide crystals fall via a with the rollers rotating cone (9) into extrusion ring (10). Inside extrusion ring (10) the carbon dioxide crystals are compressed by rollers into bars of solid carbon dioxide with a triangle cross section. It is found that an extrusion ring with a diameter between 250 and 350 millimetre and a width between 40 and 70 millimetre (of the type as
05 described in NL-A-9401327) in this equipment produces 250 to 350 kilogram cryogenic particles per hour which is nearly free of snow.

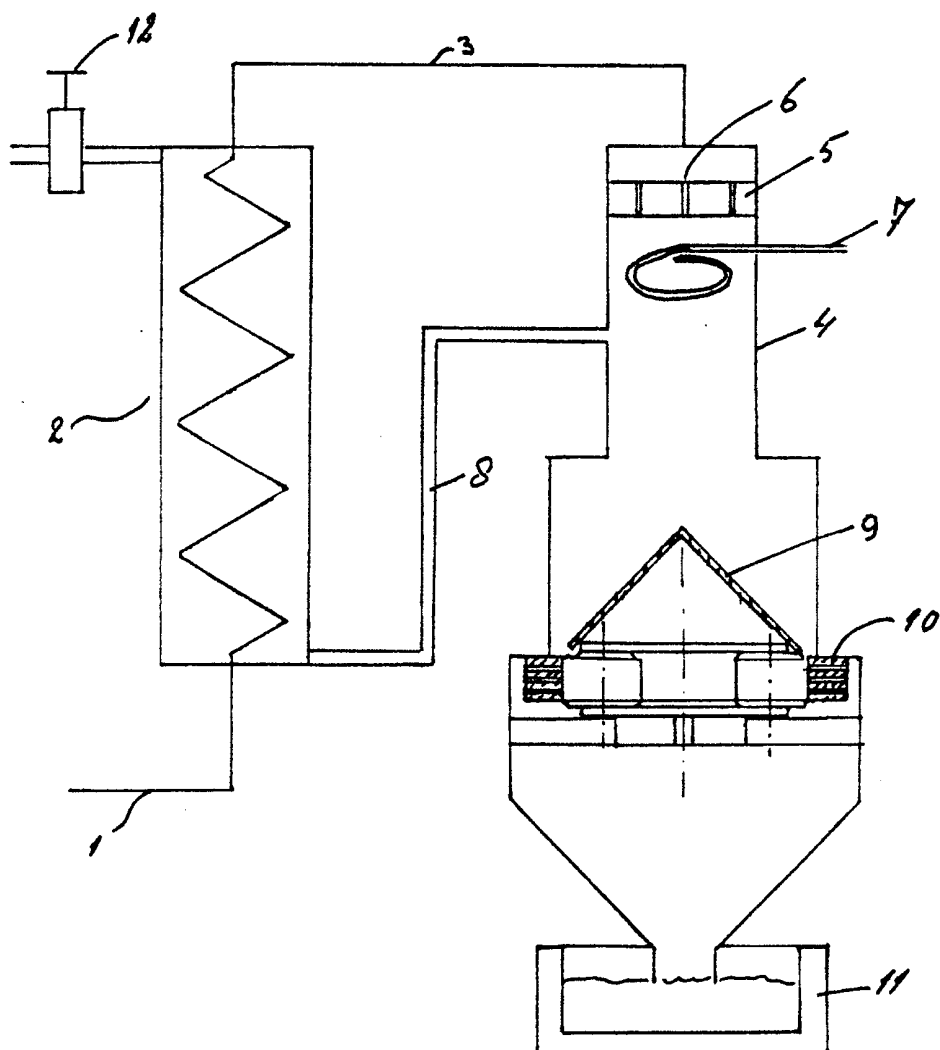
The cryogenic particles are received in isolating crates (11) and used for cleaning operations by spraying.

Claims.

- 05 1. Method for producing cryogenic particles from liquid carbon dioxide using a annular mould which has a diameter between 250 and 350 millimetre and a width between 40 and 70 millimetre characterised by that liquid carbon dioxide is cooled to a temperature between minus 30 to minus 40 degrees Celcius and then expanded in carbon dioxide snow generator (4) into a mixture of carbon dioxide gas and crystalised carbon dioxide, where carbon dioxide crystals in the annular mould (10) are pressed into triangular particles with a side of 3 to 6 millimetre.
- 10 2. Method for producing cryogenic particles from liquid carbon dioxide as in claim 1 characterised by that the carbon dioxide snow generator (4) is foreseen with 4 to 8 expansion openings (6) with a diameter of 0,3 to 1,0 millimetre, where inside the space of the carbon dioxide snow generator (4) near the expansion openings (6) a heating spiral (7) is mounted.
- 15 3. Method for producing cryogenic particles from liquid carbon dioxide as in claim 1 and 2 characterised by that gaseous carbon dioxide from the carbon dioxide snow generator (4) is led to a heat exchanger (2) where the liquid carbon dioxide supply is cooled to a temperature of minus 30 to minus 40 degrees Celcius, where heat exchanger (2) is foreseen with choke valve (12).
- 20 4. Method for producing cryogenic particles from liquid carbon dioxide as in claim 1, 2 and 3 characterised by that to produce the cryogenic particles an extrusion ring (10) is used where the number of revolutions per minute of the rollers is kept between 180 and 360 where the carbon dioxide snow is directed via cone (9) to the horizontal mounted extrusion ring (10).
- 25 5. Method for producing cryogenic particles from liquid carbon dioxide as in claim 1, 2, 3 and 4 characterised by that the cryogenic particles consists of solid hard crystalline carbon dioxide in the form of triangular bars with a side of about 3 millimetre and a length of 3 to 6 millimetre.

* * * *

FIG. 1



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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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.
A	FR 2 078 442 A (AIR REDUCTION) 5 November 1971 (1971-11-05) the whole document ---	1,3,4
A	WO 92 09525 A (HARKO BV) 11 June 1992 (1992-06-11) the whole document ---	1,4,5
A	NL 9 401 327 A (HUIBERT KONINGS) 1 April 1996 (1996-04-01) cited in the application -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

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