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(54) Title: MULTISTAGE PROCESS FOR THE POLYMERIZATION OF OLEFINS

(57) **Abstract:** A process for polymerizing olefins at temperatures of from 30°C to 140°C and pressures of from 1.0 MPa to 10 MPa in the presence of a polymerization catalyst in a multistage polymerization of olefins in at least two serially connected gas-phase polymerization reactors, the process for transferring polyolefin particles from a first gas-phase polymerization reactor to a second gas-phase polymerization reactor comprising the steps of a) discharging polyolefin particles from the first gas-phase polymerization reactor into a separation chamber in which the polyolefin particles are separated from concomitantly discharged reaction gas, the separation chamber being at a lower pressure than the pressure in the first gas-phase polymerization reactor; b) transferring the polyolefin particles within the separation chamber into a lower part of the separation chamber which contains a bed of polyolefin particles which moves from top to bottom of this part of the separation chamber and into which a fluid is introduced in an amount that an upward stream of the fluid in the bed of polyolefin particles above the fluid introduction point is induced, c) withdrawing polyolefin particles from the lower end of said lower part and transferring them to one of at least two lock hoppers working intermittently in parallel; and d) simultaneously pressurizing another of the at least two lock hoppers working intermittently by means of a gas comprising reaction gas coming from the second gas-phase polymerization reactor, and apparatus for the multistage polymerization of olefins, comprising at least two serially connected gas-phase polymerization reactors and a device for transferring polyolefin particles from an up-stream gas-phase polymerization reactor to a downstream gas-phase polymerization reactor, the transferring device comprising - a gas/solid separation chamber placed downstream of the upstream gas-phase polymerization which gas/solid separation chamber is equipped at a lower part with an inlet for introducing a fluid, and - connected to the gas/solid separation chamber at least two lock hoppers, placed in a parallel arrangement, each connected to the downstream gas-phase polymerization reactor.



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2014/059680

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-9

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/059680

A. CLASSIFICATION OF SUBJECT MATTER

INV. C08F210/00 C08F2/00 C08F2/34
ADD.

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)
C08F

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 practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/058839 A2 (BASELL POLIOLEFINE SRL [IT]) 22 May 2008 (2008-05-22) cited in the application the whole document -----	1-9
A	WO 2009/037080 A1 (BASELL POLIOLEFINE SRL [IT]; DORINI MAURIZIO [IT]; PENZO GIUSEPPE [IT]) 26 March 2009 (2009-03-26) the whole document -----	1-9
A	EP 0 192 427 A1 (BP CHEM INT LTD [GB]) 27 August 1986 (1986-08-27) cited in the application the whole document -----	1-9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/059680

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008058839	A2	22-05-2008	AR 063796 A1 18-02-2009
			AT 526348 T 15-10-2011
			BR PI0718752 A2 03-12-2013
			CL 2007003255 A1 20-06-2008
			CN 101578302 A 11-11-2009
			EP 2087015 A2 12-08-2009
			JP 5457833 B2 02-04-2014
			JP 2010509475 A 25-03-2010
			TW 200831540 A 01-08-2008
			WO 2008058839 A2 22-05-2008
WO 2009037080	A1	26-03-2009	AT 549080 T 15-03-2012
			CN 101827869 A 08-09-2010
			EP 2190889 A1 02-06-2010
			ES 2383628 T3 22-06-2012
			JP 2010539307 A 16-12-2010
			KR 20100071997 A 29-06-2010
			RU 2010115333 A 27-10-2011
			US 2010305283 A1 02-12-2010
			WO 2009037080 A1 26-03-2009
EP 0192427	A1	27-08-1986	AU 591650 B2 14-12-1989
			AU 5370186 A 28-08-1986
			CA 1248692 A1 10-01-1989
			DE 3664050 D1 27-07-1989
			EP 0192427 A1 27-08-1986
			ES 8707976 A1 16-11-1987
			FI 860723 A 20-08-1986
			FR 2577558 A1 22-08-1986
			JP H0667977 B2 31-08-1994
			JP S61200104 A 04-09-1986
			NO 860606 A 20-08-1986
			NZ 215189 A 28-07-1988
			PT 82040 A 01-03-1986
			US 4703094 A 27-10-1987
			US 4902483 A 20-02-1990
			ZA 8601201 A 28-10-1987

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9

A process for polymerizing olefins at temperatures of from 30°C to 140°C and pressures of from 1.0 MPa to 10 MPa in the presence of a polymerization catalyst in a multistage polymerization of olefins in at least two serially connected gas-phase polymerization reactors, the process for transferring polyolefin particles from a first gas-phase polymerization reactor to a second gas-phase polymerization reactor comprising the steps of a) discharging polyolefin particles from the first gas-phase polymerization reactor into a separation chamber in which the polyolefin particles are separated from concomitantly discharged reaction gas, the separation chamber being at a lower pressure than the pressure in the first gas-phase polymerization reactor; b) transferring the polyolefin particles within the separation chamber into a lower part of the separation chamber which contains a bed of polyolefin particles which moves from top to bottom of this part of the separation chamber and into which a fluid is introduced in an amount that an upward stream of the fluid in the bed of polyolefin particles above the fluid introduction point is induced, c) withdrawing polyolefin particles from the lower end of said lower part and transferring them to one of at least two lock hoppers working intermittently in parallel; and d) simultaneously pressurizing another of the at least two lock hoppers working intermittently by means of a gas comprising reaction gas coming from the second gas-phase polymerization reactor.

2. claims: 10-15

An apparatus for the multistage polymerization of olefins, comprising at least two serially connected gas-phase polymerization reactors and a device for transferring polyolefin particles from an upstream gas-phase polymerization reactor to a downstream gas-phase polymerization reactor, the transferring device comprising a gas/solid separation chamber placed downstream of the upstream gas-phase polymerization which gas/solid separation chamber is equipped at a lower part with an inlet for introducing a fluid, and connected to the gas/solid separation chamber at least two lock hoppers, placed in a parallel arrangement, each connected to the downstream gas-phase polymerization reactor.
