



(51) International Patent Classification:

C07F 7/08 (2006.01)

C07F 9/06 (2006.01)

C07F 9/02 (2006.01)

(21) International Application Number:

PCT/US2018/059814

(22) International Filing Date:

08 November 2018 (08.11.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/583,472

08 November 2017 (08.11.2017) US

62/685,979

16 June 2018 (16.06.2018) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,

SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(88) Date of publication of the international search report:

02 April 2020 (02.04.2020)

(54) Title: METHOD FOR PRODUCING PHOSPHORUS CHEMICALS FROM WET PROCESS PHOSPHATE

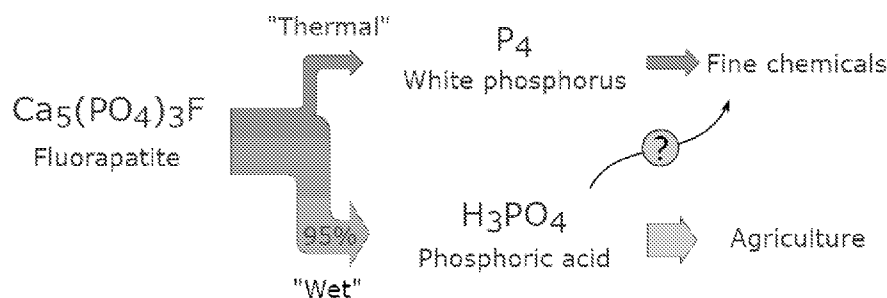


FIG. 1

(57) Abstract: Preparation of phosphorus fine chemicals from phosphate sources is described.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 18/59814

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:
Please see Supplemental Box

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 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.:
1-8, 37-41 and 47

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/US 18/59814

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - C07F 7/08, C07F 9/02, C07F 9/06 (2019.01)
CPC - C07F 9/06, C07F 9/062

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)

See Search History Document

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

See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y -- A	US 2,907,785 A (Parshall) 06 October 1959 (06.10.1959); col 7 ln 15, 27-28	1-2 ----- 40-41 ----- 3-8, 47
X -- A	MARSMANN H. et al., "Chemical Shifts and Coupling Constants for Silicon-29", in: Landolt-Bornstein - Group III Condensed Matter (Numerical Data and Functional Relationships in Science and Technology), vol 35F, Springer: Berlin, Heidelberg, 2008 (2008) [retrieved on 27.12.2018], retrieved from the Internet: <DOI: 10.1007/978-3-540-45278-2_103> for isopropylbis(trichlorosilyl)phosphine (pg 209); <DOI: 10.1007/978-3-540-45278-2_187> for diethylaminobis(trichlorosilyl)phosphine (pg 297); <DOI: 10.1007/978-3-540-45278-2_495> for bis(trimethylsilyl)methylbis(trichlorosilyl)phosphine (pg 648); <DOI: 10.1007/978-3-540-45278-2_802> for 1-adamantyl-bis(trichlorosilyl)phosphine (pg 978).	37-38 ----- 4, 6-8, 39
Y	US 3,387,934 A (MINKLEI) 11 June 1968 (11.06.1968); col 1 ln 17-18, 32-34; col 2 ln 37-41; claim 1	40-41
Y	HASZELDINE et al., "Perfluoroalkyl derivatives of sulphur. Part I. Trifluoromethanesulphonic acid", Journal of the Chemical Society [online], December 1954 (12.1954) [retrieved on 27.12.2018], issue 12, retrieved from the Internet: <DOI: 10.1039/JR9540004228>, pp. 4228-4232; see entire document, especially, pg 4230.	41
A	WO 2000/036683 A2 (MOLTECH CORPORATION) 22 June 2000 (22.06.2000); pg 11 ln 22-27	3, 5, 47



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search

15 March 2019

Date of mailing of the international search report

02 APR 2019

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 18/59814

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BECKER G. et al., "Tris(trimethylsilyl)phosphine and lithium bis(trimethylsilyl)phosphide bis(tetrahydrofuran)", in: Inorganic Syntheses, volume 27, 01 January 1990 (01.01.1990) [retrieved on 27.12.2018], retrieved from the Internet: <10.1002/9780470132586.ch48>, pp. 243-249; see entire document, especially, pg 248-249	3, 5, 47
A	US 3,446,605 A (FINHOLT) 27 May 1969 (27.05.1969); col 2 ln 50-52	39

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 18/59814

Box III: Lack of Unity:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1-8, 37-41 and 47 directed to a compound comprising a bis(silyl)phosphide and a cation.

Group II: Claims 9-16 directed to a method of preparing a bis(silyl)phosphide comprising contacting a phosphate source with a silane reducing agent.

Group III: Claims 17-28 and 42-45 directed to a method a method of preparing a phosphorus chemical comprising contacting a bis(silyl)phosphide with an electrophilic reagent to form the phosphorus chemical.

Group IV: Claims 29-34 directed to a method of creating a carbon-phosphorus bond comprising contacting a phosphate source with an alkylating agent.

Group V: Claims 35 and 46 directed to a method of preparing an organophosphate comprising contacting a phosphoric acid, a polyphosphoric acid, a metaphosphate, or an inorganic source of phosphate with an alcohol to form the organophosphate.

Group VI: Claim 36 directed to a method of preparing phosphoryl chloride comprising contacting a phosphoric acid, a polyphosphoric acid, a metaphosphate, or an inorganic source of phosphate with hydrogen chloride, an element oxy chloride, or an element chloride to form phosphoryl chloride.

The group of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features:

Group II includes the technical feature of a method of preparing a bis(silyl)phosphide comprising contacting a phosphatesource with a silane reducing agent, not required by Groups I and III-VI.

Group III includes the technical feature of a method a method of preparing a phosphorus chemical comprising contacting a bis(silyl)phosphide with an electrophilic reagent to form the phosphorus chemical not required by Groups I, II and IV-VI.

Group IV includes the technical feature of a method of creating a carbon-phosphorus bond comprising contacting a phosphate source with an alkylating agent not required by Groups I-III and V-VI.

Group V includes the technical feature of a method of preparing an organophosphate comprising contacting a phosphoric acid, a polyphosphoric acid, a metaphosphate, or an inorganic source of phosphate with an alcohol to form the organophosphate not required by Groups I-IV and VI.

Group VI includes the technical feature of a method of preparing phosphoryl chloride comprising contacting a phosphoric acid, a polyphosphoric acid, a metaphosphate, or an inorganic source of phosphate with hydrogen chloride, an element oxy chloride, or an element chloride to form phosphoryl chloride not required by Groups I-V.

Common technical features:

The inventions of Groups I-III share the technical feature of compound comprising a bis(silyl)phosphide.

These shared technical features, however, do not provide a contribution over the prior art, as being anticipated by US 2,907,785 A to Parshall (hereinafter Parshall). Parshall discloses a compound comprising a bis(silyl)phosphide and a cation (col 7 ln 27-28: the reaction mixture containing the "lithium bis(trimethylsilyl)phosphide"; also col 7 ln 15 chemical equation with $[(CH_3)_2Si]_2P^- Li^+$ formula comprising $[(CH_3)_2Si]_2P^-$ anion and Li^+ cation).

As said compound and compositions were known in the art at the time of the invention, these cannot be considered special technical features that would otherwise unify the inventions of Groups I-VI. The inventions of Groups I-VI thus lack unity under PCT Rule 13.