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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : C08C 19/02, C08F 8/04	A3	**(11) International Publication Number:** WO 93/14130 **(43) International Publication Date:** 22 July 1993 (22.07.93)

(21) International Application Number: PCT/US93/00088

(22) International Filing Date: 7 January 1993 (07.01.93)

(30) Priority data:
819,420 10 January 1992 (10.01.92) US

(71) Applicant: THE B.F. GOODRICH COMPANY [US/US]; 3925 Embassy Parkway, Akron, OH 44333-1719 (US).

(72) Inventor: ABRAHAM, Tonson ; 16936 Deer Path Drive, Strongsville, OH 44136 (US).

(74) Agent: SHUST, Nestor, W.; The B.F. Goodrich Company, 9921 Brecksville Road, Brecksville, OH 44141-3289 (US).

(81) Designated States: AU, CA, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the international search report:
14 October 1993 (14.10.93)

(54) Title: HIGHLY HYDROGENATED NONFUNCTIONAL OR FUNCTIONAL TERMINATED CONJUGATED DIENE POLYMERS

(57) Abstract

In a first embodiment of the present invention, poisoning or deactivation of conventional homogeneous catalysts to be used in hydrogenation of the backbone unsaturation in liquid monofunctional and difunctional-terminated conjugated diene polymers, is prevented by reacting a blocking agent compound with the functional end groups present in these polymers. More specifically, subsequent to formation of a selected starting material monofunctional or difunctional-terminated conjugated diene polymer, a suitable blocking agent is reacted with the functional end groups of the polymer enabling relatively inexpensive titanium, iron, cobalt, or nickel-based homogeneous catalysts to be used in hydrogenating the backbone unsaturation of the polymer to a high degree. Subsequent to hydrogenation, the polymer is subjected to conventional hydrolysis using a mineral acid or base to remove the blocking groups and return the hydrogenated conjugated diene polymer to its original functionality. In a second embodiment, conventional homogeneous catalysts based on cobalt, nickel, titanium, or iron are utilized to hydrogenate low molecular weight liquid copolymers and homopolymers to a high degree. More particularly, butadiene-alkenylpyridine and butadiene-acrylate liquid copolymers and butadiene homopolymers are formed in a conventional manner are hydrogenated using such catalysts.

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INTERNATIONAL SEARCH REPORT

International Applic. .. No PCT/US 93/00088

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl.5 C 08 C 19/02 C 08 F 8/04

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl.5	C 08 C C 08 F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	US,A,4999405 (TONSON A:) 12 March 1991 see column 1, line 14 - line 16; claim 1 see column 4, line 5 - line 16 see column 5, line 49 - line 52	1-3
X	US,A,3766300 (DE LA MARE H.E.) 16 October 1973 cited in the application see column 3, line 47; claim 1 see column 4, line 3	1

° Special categories of cited documents : [10]

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

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"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

"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

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22-04-1993	10.09.93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	VAN HUMBEECK

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 93/00088

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

1:claims 1-7
2:claims 8-11
3:claims 12-15

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 searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

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.:

1-7

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9300088 SA 68917

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 23/08/93
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4999405	12-03-91	EP-A- 0505495	30-09-92
		WO-A- 9109061	27-06-91
		US-A- 5231143	27-07-93
US-A- 3766300	16-10-73	None	