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663255

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NOTICE OF ENTITLEMENT

Insert name of applicant

We, FCB

of, 38, rue de la Republique, F-93100 Montreuil, France

being the applicant(s) in respect of the Australian Patent Application entitled "CONE-TYPE VIBRATING CRUSHER AND METHOD FOR ADJUSTING OPERATION OF SUCH CRUSHER"

state the following:-

Complete only for PCT applications

The person nominated for the grant of the patent:

(i)i is the applicant of the application listed in the declaration under Article 8 of the PCT; and

(i) has entitlement from the inventor(s) of the application listed in the declaration under Article 8 of the PCT by virtue of being a person who would, if a patent was to be granted upon an application made by the actual inventors, be entitled to have the patent assigned to it.

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The basic application listed:

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is the first application made in a Convention country in respect of the invention.

.....
Signature

2 February 1995
.....
Date

REGISTERED PATENT ATTORNEY
.....
Executive Position

AU9462858

(12) PATENT ABRIDGMENT (11) Document No. AU-B-62858/94
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 663255

(54) Title
CONE-TYPE VIBRATING CRUSHER AND METHOD FOR ADJUSTING OPERATION OF SUCH CRUSHER

(51)[5] International Patent Classification(s)
B02C 002/04

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(71) Applicant(s)
F C B

(72) Inventor(s)
ALAIN CORDONNIER; RENAUD EVRARD

(74) Attorney or Agent
CALLINAN LAWRIE , Private Bag 7, KEW VIC 3101

(56) Prior Art Documents
US 4272030
US 4964584

(57) Claim

1. A grinding mill comprising a frame, a vessel without bottom supported by a chassis movable with respect of said frame, a cone fitted inside said vessel with an annular gap between said cone and said vessel, the means capable of imparting circular and approximately horizontal vibrations to said vessel whereby a layer of material builds up between said cone and said vessel during grinding, wherein said cone is so mounted on its support as to be able to rotate freely around its axis and is equipped with means for measuring the speed of rotation of said cone around its axis, and wherein control means are provided for adjusting the frequency and/or amplitude of the vibrations of said vessel in response to variations in the rotation speed of said cone.

OPI DATE 11/10/94 APPLN. ID 62858/94
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(71) Déposant *(pour tous les Etats désignés sauf US)*: FCB [FR/FR]; 38, rue de la République, F-93100 Montreuil (FR).

(72) Inventeurs; et

(75) Inventeurs/Déposants *(US seulement)*: CORDONNIER, Alain [FR/FR]; 28 bis, rue Nicolas-Leblanc, F-59000 Lille (FR). EVRARD, Renaud [BE/FR]; 1693, rue des Fèves, F-59226 Lecelles (FR).

(74) Mandataire: FONTANIE, Etienne; Compagnie de Fives-Lille, 38, rue de la République, F-93100 Montreuil (FR).

(81) Etats désignés: AU, BR, CA, CN, CZ, HU, JP, KR, KZ, NZ, RU, SK, UA, US, brevet européen (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

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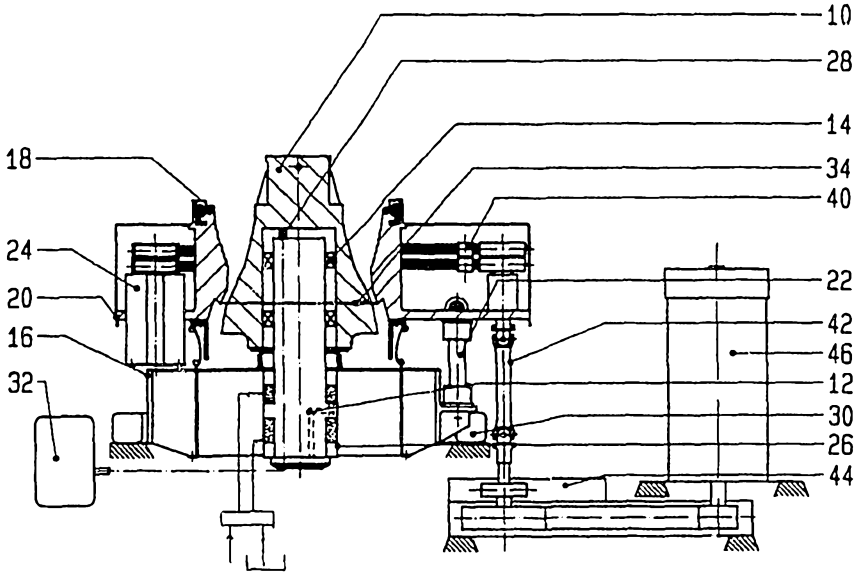
663255

(54) Title: CONE-TYPE VIBRATING CRUSHER AND METHOD FOR ADJUSTING OPERATION OF SUCH CRUSHER

(54) Titre: BROYEUR VIBRANT A CONE ET PROCEDE DE REGLAGE DE LA MARCHE D'UN TEL BROYEUR

(57) Abstract

The invention relates to crushers wherein the material is crushed between a cone (10) and a bottomless frustroconical body (18) surrounding the cone and wherein the body is mounted on a frame (20) movable with respect to the structure and provided with means (24) capable of transmitting circular, substantially horizontal oscillations or vibrations to the body. In order to control operation of the crusher and to provide for improved monitoring of its operating status, while increasing the useful life of the working surfaces, the cone (10) is mounted on its support (16) in such a way as to rotate freely and is provided with means (28) for measuring the rotation speed thereof about its axis of connection with means (32) of adjustment of the frequency and/or amplitude of the vibrations or oscillations of the body.



(57) Abrégé

L'invention concerne les broyeurs dans lesquels la matière est broyée entre un cône (10) et une cuve tronconique sans fond (18) entourant le cône et dans lesquels la cuve est montée sur un châssis (20) mobile par rapport au bâti et équipé de moyens (24) aptes à communiquer à la cuve des vibrations ou oscillations circulaires, approximativement horizontales. Pour permettre le contrôle de la marche du broyeur et une meilleure surveillance de son état, tout en augmentant la durée de vie des surfaces de travail, le cône (10) est monté sur son support (16) de façon à pouvoir tourner librement et est équipé de moyens (28) de mesure de sa vitesse de rotation autour de son axe en liaison avec des moyens (32) de réglage de la fréquence et/ou de l'amplitude des vibrations ou oscillations de la cuve.

UNIQUEMENT A TITRE D'INFORMATION

Codes utilisés pour identifier les Etats parties au PCT, sur les pages de couverture des brochures publiant des demandes internationales en vertu du PCT.

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The present invention concerns grinding mills in which the material is ground between a cone and a truncated vessel without bottom which surrounds the cone, the working surfaces of the cone and of the vessel being provided with an anti-wear coating, and in which the vessel is mounted on a chassis which is mobile with respect to the frame and is equipped with means capable of transmitting to the vessel circular and approximately horizontal vibrations or oscillations, which successively result in all the radial planes moving together and then moving apart of the cone and the vessel. The means used to make the vessel vibrate or oscillate can be imbalance vibrators, electro-magnetic vibrators etc.

Such apparatus have been known in their principle for a long time, but in practice they have been little used. In the known apparatus of this type the cone is fixed rigidly on its support. Thus, the movements of coming together and of coming apart of cone and vessel, which cause the crushing of the material to be ground, are accompanied, because of the circular movements of the vessel, by relative parallel displacements parallel to the tangential planes which bring about an instability of the machine and rapid wear of the working surfaces of cone and vessel. Furthermore, the known apparatus do not lend themselves easily to automatic operation for obtaining products of a given size grading.

The aim of the present invention is to permit automatic control of the operation of the grinding mill and a better surveillance of its condition, while increasing the life of the working surfaces.

In accordance with the present invention there is provided a grinding mill comprising a frame, a vessel without bottom supported by a chassis movable with respect of said frame, a cone fitted inside said vessel with an annular gap between said cone and said vessel, the means capable of imparting circular and approximately horizontal vibrations to said vessel whereby a layer of material builds up between said cone and said vessel during grinding, wherein said cone

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is so mounted on its support as to be able to rotate freely around its axis and is equipped with means for measuring the speed of rotation of said cone around its axis, and wherein control means are provided for adjusting the frequency and/or amplitude of the vibrations of said vessel in response to variations in the rotation speed of said cone.

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Knowing the speed of rotation of the cone one can determine, for a given control of the grinding mill (size of the annular aperture in the outlet plane of the ground material), the thickness of the layer of material in the outlet plane of the ground material and, if necessary, modify by control the frequency and/or the amplitude of the means of vibration of the vessel and/or of the ~~height~~ position of the cone, to obtain a ground product having the desired size grading; these means make it possible to automate the operation of the grinding mill. Furthermore, for given controls of the frequency and amplitude of the means of vibration of the vessel and of the size of the outlet aperture, the development of the speed of rotation of the cone permits the detection of the wear of the working surfaces of the cone and the vessel.

Another aim of the invention is a control procedure for a grinding mill of the type defined above consisting in the measurement of the speed of rotation of the cone around its axis, in determining the minimum thickness of the layer of material in the outlet plane of the ground material starting from the measured value of the speed of rotation of the cone and the size of the annular aperture existing in the plane between cone and the vessel when the grinding mill is turned off, and in controlling the parameters of the means of vibrating the vessel and/or the height position of the cone in relation of the vessel in order to maintain the minimum thickness of the layer of material equal to a desired value.

The following description refers to the attached drawing and shows, as a non-limiting example, a ~~form of execution~~ preferred embodiment of the invention. In this drawing :

Figure 1 is a view from above of a vibrating cone grinding mill constructed in accordance with the invention ; and

Figure 2 is a vertical section view following line A-A of the grinding mill of figure 1;

In the grinding mill of figures 1 and 2 the cone 10 is mounted, by way of the bearings 14, on a shaft 12 which is supported by a frame 16 ; this mounting permits free rotation of the cone around its axis. The frame 16 is mounted on an elastic system 30 which reduces transmission to the floor of strains and vibrations.

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In order to reduce the amplitude of the vibrations of the frame, the latter could be equipped with means of vibrating by subjecting it to strains of the opposite phase to those originating from vessel 18 during grinding. The frame 16 could be mounted directly on a correctly dimensioned pillar.

The vessel 18 is fixed on a chassis 20 supported by means of a series of connecting rods 22 the ends of which are linked to the chassis and the frame.

Unbalance vibrators 24 are mounted on the chassis 20. ~~The~~ They are driven synchronously in such a fashion as to produce circular horizontal movements of small amplitude of the chassis-vessel assembly. The drive operates by way of a mechanism containing belts 36, tensioning rollers 38, driving pulleys 40, universal transmissions 42, a motor 46 and a phase shift device 44 of a type described in French patent No. 9201642 (publication No. 2 687 080) making possible the control of the amplitude of the vibrations. The motor 46 is equipped with an infinitely variable speed change allowing the control of the frequency of the vibrations.

The vibratory movements of the chassis-vessel assembly cause the ~~priodical~~ periodical coming together of the vessel and the cone in each radial plane and, as a consequence, crushing of the material between the vessel and the cone. On the internal surface of the vessel a layer of material forms, the thickness of which depends on the output, the frequency and the amplitude of the vibrations. This layer moves toward the bottom of the vessel and the ground product is withdrawn through the outlet aperture and drops into a collecting hopper which is placed underneath the grinding mill, across an annular passage installed in the frame.

The movements of the vessel are accompanied by a rotation of the cone 10 around it axis under the action of the tangential stresses produced by the vessel, by way of the material to be ground. This rotation makes it possible to obtain a stable fragmentation process and to greatly reduce the wear of the protective coatings of cone and vessel.

The grinding mill is equipped with a control system 26 for adjusting the ~~height~~ position of the cone in relation to the longitudinal axis of the

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vessel 18, for example a fastening lug or hydraulic jack. This system permits the control of the size of the annular aperture existing between the cone and the vessel in the outlet plane 34 of the ground material; when the grinding mill is turned off, this aperture has a size which is constant over its whole periphery and which is equal to the difference of the radii of cone and vessel in the plane of outlet 34.

During grinding a layer of material is formed between the cone and the vessel the minimum thickness of which, defined by the minimum space between cone and vessel in the outlet plane, is a function of the initial control of the ~~height~~ position of the longitudinal axis of the cone in relation to the vessel and of the amplitude and the frequency of vibrations. The size grading of the ground product depends on the minimum thickness of the layer of material and it is, therefore, possible to control the quality of the ground product by controlling the amplitude or the frequency of the vibrators, and to a certain extent the ~~height~~ position of the cone, by means of system 26.

A device 28 measuring the speed of rotation of the cone, such as a magnetic induction sensor (trademark IFM-type IFK3004BPOG for example), makes it possible to always know this value and, knowing the control value of the size of the annular outlet aperture, to deduce from it the thickness of the layer of material.

The speed of rotation of the cone is given by the formula:

$$N = K \frac{n \cdot (f \cdot e)}{D \cdot \cos \alpha}$$

where K = a constant

n = frequency of vibrations (speed of rotation of the vibrators)

f = control value of the annular outlet aperture

e = thickness of the layer

α = $\frac{1}{2}$ angle at the top of the cone

This formula permits the calculation of e, the comparison of the value obtained with a desired value and, if necessary the control of the amplitude and/or the frequency of the vibrations or the size f of the aperture.

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Thus, the operation of the grinding mill can be automated so as to obtain a ground product of the desired size grading, by means of an automatic control or a calculator 32 which receives the information from the sensor 28 and which can transmit instructions to the phase shift device 44 and to the motor 46, for controlling the amplitude and/or the frequency of the vibrations, and to the system 26 for modifying the ~~height~~ position of the cone.

As explained above one can also, by observing the variations in the speed of rotation of the cone under given conditions of operation, detect the wear of the working surfaces of the cone and the vessel.

It is understood that the modifications, which can be made to the modes of realisation described, by the use of equivalent and relative technical means, especially to the rotary mounting of the cone on the frame and to the means of producing vibrations of the vessel, enter into the framework of the invention.

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The claims according to the invention are as follows:

1. A grinding mill comprising a frame, a vessel without bottom supported by a chassis movable with respect of said frame, a cone fitted inside said vessel with an annular gap between said cone and said vessel, the means capable of imparting circular and approximately horizontal vibrations to said vessel whereby a layer of material builds up between said cone and said vessel during grinding, wherein said cone is so mounted on its support as to be able to rotate freely around its axis and is equipped with means for measuring the speed of rotation of said cone around its axis, and wherein control means are provided for adjusting the frequency and/or amplitude of the vibrations of said vessel in response to variations in the rotation speed of said cone.

2. The grinding mill according to claim 1, wherein the movements of said vessel are generated by vibrators mounted on said chassis.

3. The grinding mill according to claim 1 or claim 2, including a system for adjusting the position of the cone with respect to the longitudinal axis of the vessel.

4. A control process for a grinding mill according to any one of claims 1 to 3, comprising the steps of measuring the speed of rotation of said cone around its axis, determining the thickness of that layer of material in a ground material outlet plane from the measured value of the cone rotation speed and the set value of the width of said annular gap in said outlet plane, and adjusting the frequency and/or amplitude of the vibrations of said vessel so as to maintain the thickness of said layer of material at a desired value.

5. The control process according to claim 4, wherein the position of the cone with respect to the longitudinal axis of the vessel is adjusted so as to maintain the thickness of said layer of material in said outlet plane at the desired value.

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6. The control process according to claim 4 or claim 5, wherein wear of active surfaces of said vessel and said cone is determined from variations in the speed of rotation of said cone around its axis for given settings of the frequency and amplitude of the vibrations and of the width of said annular gap in said outlet plane.

7. A grinding mill, substantially as described herein with reference to the accompanying drawings.

8. A process for controlling a grinding mill, as claimed in claim 4, substantially as described herein with reference to the accompanying drawings.

DATED this 27th day of July, 1995.

FCB
By Their Patent Attorneys:
CALLINAN LAWRIE

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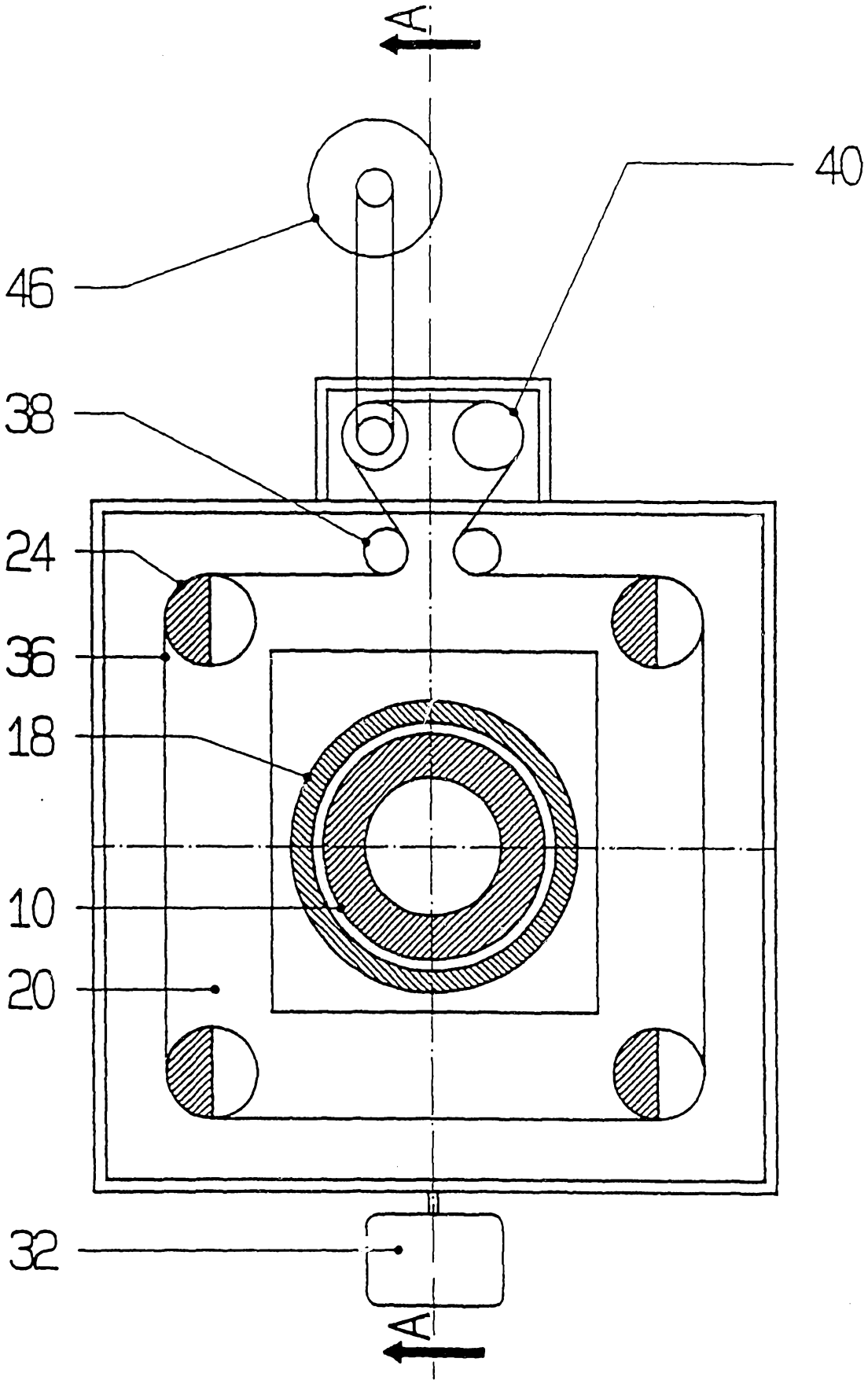

FIGURE 1

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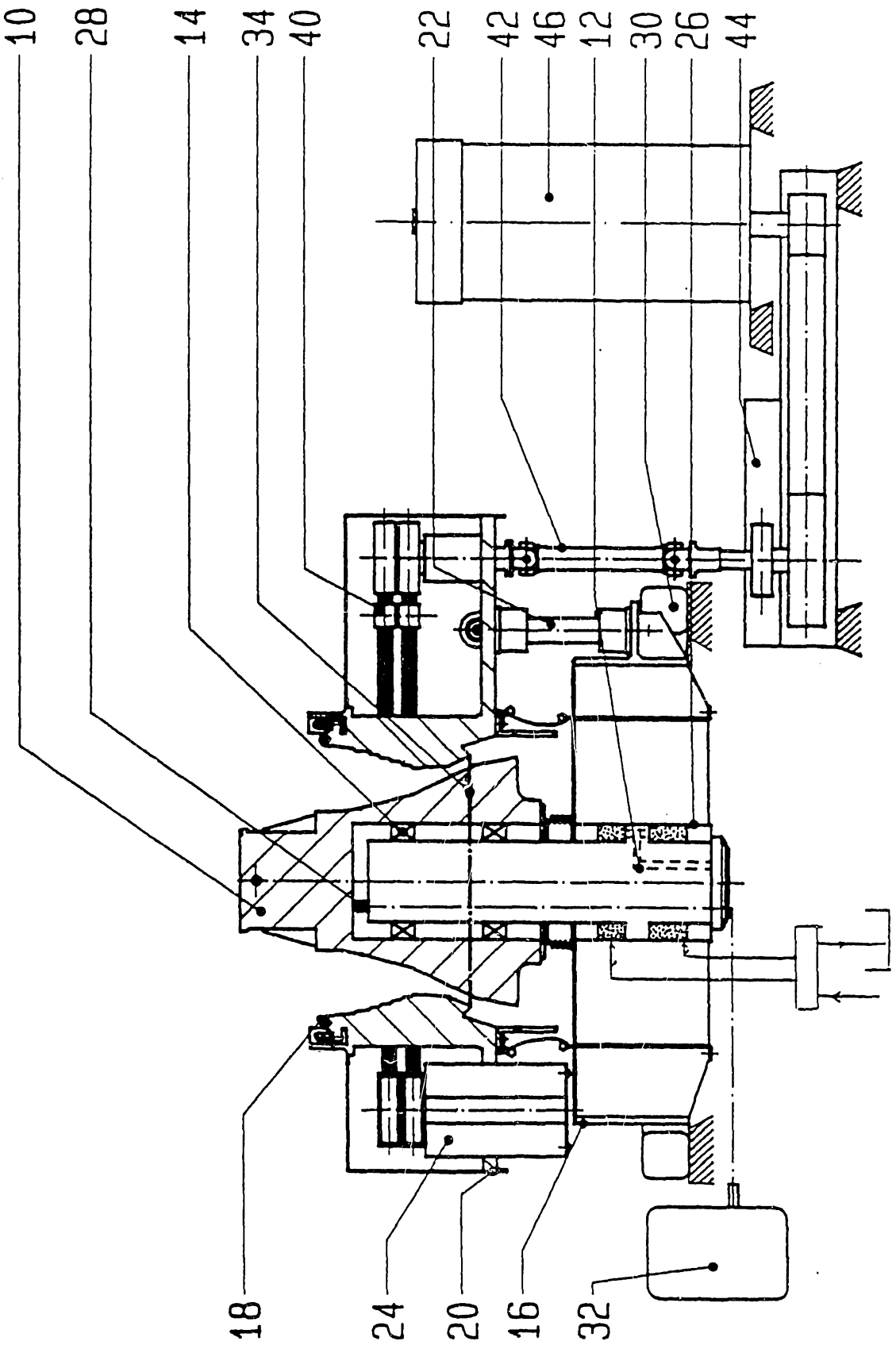

FIGURE 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FR 94/00309

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 B02C2/04

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)
IPC 5 B02C

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SOVIET INVENTIONS ILLUSTRATED Section PQ, Week E41, 24 November 1982 Derwent Publications Ltd., London, GB; Class P, AN N5190 E & SU,A,886 969 (A.E. AVRAKHOV) 7 December 1981 see abstract ---	1,2,4,6
A	SOVIET INVENTIONS ILLUSTRATED Week 8920, Derwent Publications Ltd., London, GB; AN 89-149341 & SU,A,1 416 181 (MEKHANOBR MINERALS) 15 August 1988 see abstract --- -/--	1,3-6

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

[X] Patent family members are listed in annex.

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"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.

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Date of the actual completion of the international search	Date of mailing of the international search report
13 June 1994	27. 06. 94
Name and mailing address of the ISA 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	Authorized officer Verdonck, J

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FR 94/00309

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 272 030 (M.M. AFANASIEV; N.A. IVANOV) 9 June 1981 see column 6, line 31 - column 8, line 64 ---	1,3-6
A	US,A,4 964 580 (T. AKESAKA) 23 October 1990 see column 5, line 38 - line 46; figure 1 ---	1,4,6
A	SOVIET INVENTIONS ILLUSTRATED Section PQ, Week E11, 28 April 1982 Derwent Publications Ltd., London, GB; Class P41, AN D0627 E/11 & SU,A,837 396 (BELGOROD MEKHANOBRC) 18 June 1981 see abstract -----	1,4,6

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/FR 94/00309

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4272030	09-06-81	NONE		
US-A-4964580	23-10-90	AU-B-	616533	31-10-91
		AU-A-	3654789	26-04-91
		EP-A,B	0402545	19-12-90

RAPPORT DE RECHERCHE INTERNATIONALE

Demande Internationale No.
PCT/FR 94/00309

A. CLASSEMENT DE L'OBJET DE LA DEMANDE
CIB 5 B02C2/04

Selon la classification internationale des brevets (CIB) ou à la fois selon la classification nationale et la CIB

B. DOMAINES SUR LESQUELS LA RECHERCHE A PORTE

Documentation minimale consultée (système de classification suivi des symboles de classement)
CIB 5 B02C

Documentation consultée autre que la documentation minimale dans la mesure où ces documents relèvent des domaines sur lesquels a porté la recherche

Base de données électronique consultée au cours de la recherche internationale (nom de la base de données, et si cela est réalisable, termes de recherche utilisés)

C. DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie *	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
A	SOVIET INVENTIONS ILLUSTRATED Section PQ, Week E41, 24 Novembre 1982 Derwent Publications Ltd., London, GB; Class P, AN N5190 E & SU,A,886 969 (A.E. AVRAKHOV) 7 Décembre 1981 voir abrégé ---	1,2,4,6
A	SOVIET INVENTIONS ILLUSTRATED Week 8920, Derwent Publications Ltd., London, GB; AN 89-149341 & SU,A,1 416 181 (MEKHANOBR MINERALS) 15 Août 1988 voir abrégé --- -/--	1,3-6

[X] Voir la suite du cadre C pour la fin de la liste des documents

[X] Les documents de familles de brevets sont indiqués en annexe

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"&" document qui fait partie de la même famille de brevets

1

Date à laquelle la recherche internationale a été effectivement achevée	Date d'expédition du présent rapport de recherche internationale
13 Juin 1994	27. 06. 94

Nom et adresse postale de l'administration chargée de la recherche internationale	Fonctionnaire autorisé
Office Européen des Brevets, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+ 31-70) 340-3016	Verdonck, J

Formulaire PCT/ISA/210 (deuxième feuille) (juillet 1992)

RAPPORT DE RECHERCHE INTERNATIONALE

Demande Internationale No.
PCT/FR 94/00309

C.(suite) DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie *	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
A	US,A,4 272 030 (M.M. AFANASIEV; N.A. IVANOV) 9 Juin 1981 voir colonne 6, ligne 31 - colonne 8, ligne 64	1,3-6
A	US,A,4 964 580 (T. AKESAKA) 23 Octobre 1990 voir colonne 5, ligne 38 - ligne 46; figure 1	1,4,6
A	SOVIET INVENTIONS ILLUSTRATED Section PQ, Week E11, 28 Avril 1982 Derwent Publications Ltd., London, GB; Class P41, AN D0627 E/11 & SU,A,837 396 (BELGOROD MEKHANOBRC) 18 Juin 1981 voir abrégé	1,4,6

RAPPORT DE RECHERCHE INTERNATIONALE

Renseignements relatifs aux membres de familles de brevets

Demande Internationale No.
PCT/FR 94/00309

Document brevet cité au rapport de recherche	Date de publication	Membre(s) de la famille de brevet(s)		Date de publication
US-A-4272030	09-06-81	AUCUN		
US-A-4964580	23-10-90	AU-B-	616533	31-10-91
		AU-A-	3654789	26-04-91
		EP-A,B	0402545	19-12-90