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[Continued on next page]

(54) Title: LUBRICATED MACHINE ELEMENT AND METHOD FOR ITS LUBRICATION

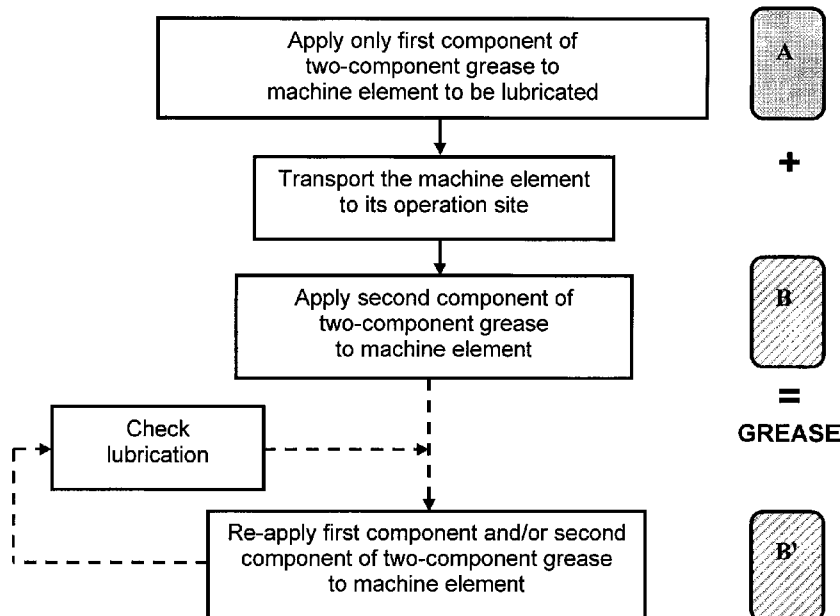


Fig. 2

(57) Abstract: Machine element (10) that comprises only a first component (A) of a two-component grease that comprises a first component (A) comprising a thickener, and a second component (B) comprising a fluid lubricant, whereby said two-component grease is obtained by mixing together said first and second components (A and B).

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TECHNICAL FIELD

The present invention concerns a machine element, and a method for supplying such a machine element.

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BACKGROUND OF THE INVENTION

The term grease, in the context of lubrication, is used to describe a semi-solid lubricant consisting of a thickener, typically a soap, emulsified with mineral or vegetable oil and/or other fluid lubricant. Grease possesses a high initial viscosity, which upon the application
10 of shear, drops to give the effect of oil lubrication of approximately the same viscosity as the base oil used in the grease. Greases are applied to machine elements that can only be lubricated infrequently and where a lubricating oil would not stay in position.

Grease also protects the machine elements that it lubricates against corrosion and wear,
15 it helps to dissipate heat, seal out solid and liquid contamination, and reduces noise. Adequate lubrication allows for smooth continuous operation of equipment, with only mild wear, and without excessive stresses or seizures at components such as bearings. When lubrication fails, components can rub destructively over each other, causing damage, heat, and failure. Lubrication failure can be caused by insufficient lubricant quantity or
20 viscosity, deterioration due to prolonged service without replenishment, excessive temperatures, contamination with foreign matter, the use of an incorrect grease for a particular application and/or over-lubricating.

To ensure that a machine element is correctly lubricated, the grease used has to be
25 precisely selected for the particular application and applied in the right amount, at the right frequency and to the right place(s) in/on the machine element. Factors influencing the choice of grease for a bearing application for example, include the bearing's rotational speed, service temperature range, running noise requirements, re-lubrication intervals, sealing, starting torque, load and running conditions and environmental influences.

30

Over time, the grease may leak, evaporate and/or harden. Oil may be depleted from the grease leaving a thick waxy substance with little or no ability to lubricate. New grease may be applied, using a grease gun or pump for example which applies the grease to the

part(s) being lubricated under pressure, forcing the grease into the spaces in the part(s). However, to prevent premature wear and damage, manufacturers recommend that old grease is removed and replaced with new grease on a periodic basis, which can be a complex and time consuming process since it often requires equipment to be dismantled
5 and carefully cleaned.

SUMMARY OF THE INVENTION

An object of the invention is to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

10

At least one of these objects is achieved by a machine element that comprises only a first component of a two-component grease that comprises a first component comprising a thickener and a second component comprising a fluid lubricant, whereby the two-component grease is obtained by mixing together said first and second components.

15

The first component comprising a thickener is selected depending on the application in which the machine element will be used, and constitutes a carrier for fluid lubricant. The first component may namely be applied to at least a part of a machine element that is to be lubricated, such as on cage bars of a bearing or inside the bearing itself, such as on an
20 inner or outer ring thereof. The second component comprising a liquid lubricant that is also selected depending on the application in which the machine element will be used, may then be applied to at least a part of the machine element. When the first component is mixed with the second component the thickener partially dissolves in the liquid lubricant and combines to form grease having the optimum composition for the application in which
25 the machine element will be used.

Factors influencing the choice of the thickener and fluid lubricant for a bearing application for example, may include the bearing's rotational speed, service temperature range, running noise requirements, re-lubrication intervals, sealing, starting torque, load and
30 running conditions and environmental influences.

If/when the first component comprising a thickener and/or the second component comprising a fluid lubricant become(s) depleted, a first component and/or second component may be applied to the machine element to re-lubricate the machine element.
35 More of the first and/or second component may namely be added periodically and/or

if/when re-lubrication is needed. It should be noted that the first component and/or second component which is/are added to re-lubricate the machine element need not necessarily be of the same composition as the first component and/or second component which was/were previously applied to lubricate the machine element. The subsequently added
5 first component and/or second component may for example comprise only that part of the previously applied first component and/or second component which has been consumed during the use of the machine element. Only small amounts of liquid lubricant may for example be required for re-lubrication of the machine element.

10 Such a two-component grease package provides several advantages over greases according to the prior art. Re-lubrication of a machine element is namely much simpler since old grease does not have to be removed from a machine element, a plurality of machine elements lubricated with different greases for different applications does not have to be kept in stock by a machine element manufacturer and the amount of waste
15 grease is reduced since the grease's thickener is re-used. Furthermore, such a two-component grease package increases the possibilities for improved automated and application-tailored lubrication and re-lubrication.

The first and the second component of the two component grease may be provided as a
20 package, such as a wrapped/ sealed unit, or the first component and the second component may be provided as related items that are intended to be used together, even if not provided as a package such as a wrapped/sealed unit.

According to an embodiment of the invention the fluid lubricant comprises at least one of
25 the following: mineral oil, such as synthetic oil, vegetable oil, a polyalphaolefin, an ester, a polyether.

According to another embodiment of the invention the thickener comprises at least one of the following: a polymeric thickener, polypropylene, polyethylene, polyalkylene glycol,
30 polyethylene glycol, polyolefin phenol, lanolin, lanoline polyethylene glycol, polyoxyethylene lanolin, silicon oil, ionic soap, urea soap, metal organic soap.

The selection of the type of thickener is determined by the application. A soap may for example include calcium stearate, sodium stearate, lithium stearate, as well as mixtures
35 of these components. A fatty acid derivative other than a stearate, such as lithium 12-

hydroxystearate, may also be used as a thickener. The nature of the thickener influences the temperature resistance, water resistance, and chemical stability of the resulting grease. The thickener may also comprise tar, graphite or mica, which also increase the durability of the grease.

5

According to a further embodiment of the invention the thickener comprises at least one high molecular weight component and at least one low molecular component, where the high molecular weight component and/or the low molecular component comprises at least one of the following: a polymeric thickener, polypropylene, polyethylene, polyalkylene
10 glycol, polyethylene glycol, polyolefin phenol, lanolin, lanoline polyethylene glycol, polyoxyethylene lanolin, silicon oil.

The molecular weight of polymer molecules determines the physical properties of the polymer, for example the temperatures at which transitions from liquids to solids occur,
15 and mechanical properties such as the stiffness, strength, viscoelasticity, toughness and viscosity of the polymer. By combining thickener components of high and low molecular weight, physical and mechanical properties of the thickener can be optimized for a particular application.

20 According to an embodiment of the invention the first component and/or the second component comprises at least one of the following: a tackifier, an elastomer, an anti-wear additive, an anti-corrosion additive, an EP additive, an anti-oxidant. Some greases are labeled "EP", which indicates "extreme pressure". Under high pressure or shock loading, normal grease can be compressed to the extent that the greased parts come into physical
25 contact, causing friction and wear. EP grease contains solid lubricants, usually graphite and/or molybdenum disulfide, to provide protection under heavy loadings. The solid lubricants bond to the surface of metal components, and prevent metal-to-metal contact and the resulting friction and wear when the lubricant film gets too thin.

30 It should be noted that the first component comprising a thickener and/or the second component comprising a fluid lubricant may comprise at least one additive. Teflon may for example be added to improve the lubricating properties of the resulting grease. Glycerol and sorbitan esters may be added to grease that is intended to be used in low temperature conditions. Copper may be added to grease intended for a high pressure
35 applications.

According to an embodiment of the invention the two-component grease package comprises a thickener comprising at least one polyolefin component, for example comprising polyethylene or polypropylene or mixtures of these substances, at least one fluid lubricant component such as mineral oil, vegetable oil, synthetic oil-like
5 polyalphaolefins, esters or polyethers, and at least one additive component which is selected from the group antioxidants, corrosion inhibitors, anti-wear agents or extreme pressure/load carrying capacity increasing additives. The content of the thickener component(s) may be between 5% and 30% by weight, preferably between 9 and 15% by weight, the content of the fluid lubricant(s) is between 60% and 90% by weight and the
10 additive component(s) by weight between 0.2 and 15%, preferably between 1 and 8% by weight.

According to an embodiment of the invention the two-component grease package comprises a high molecular weight component and a low molecular weight component.
15 For example, the thickener may comprise a mixture of a) a (co- or homo-)polymer of propylene with a weight average molecular weight greater than 200,000 and (b) a (co- or homo-)polymer of propylene with a weight average molecular weight less than 100,000. The ratio between the high molecular weight component and the low molecular weight component may be 1:40 - 1:5, preferably 1:25 - 1:15, more preferably 1:19. The low
20 molecular weight component may be a polypropylene homopolymer. The low molecular weight component may have an average molecular weight between 50,000 and 100,000 with a melt flow rate (ASTM D-1238) of 500-1000, preferably 750-850. The high molecular weight component may be a polypropylene homopolymer or a propylene/ethylene-copolymer. The high molecular weight component may have an average molecular weight
25 of 200,000-250,000 and a melt flow rate (ASTM D-1238) of 1.5-15, preferably 1.5-7.

According to another embodiment of the invention the two-component grease package comprises a mineral oil, at least one of the following: a thickening agent, oil-soluble polypropylene, oil-soluble propylene or mineral, metal soaps (soap-salt thickener), oil-
30 soluble polypropylene, oil-soluble propylene or amorphous polyolefine polymers or semicrystalline polyolefine polymers e.g. isotactic or atactic polyolefin polymers.

Esters can effect solubility and boost oil-solubility of additives and thickening agents like polymers. Esters may be derived from carboxylic acids, branched, unbranched, straight or
35 with cyclic alkyl group, aryl, alkaryl or aralkyl group group with 1 - 30 carbons, cyclic fatty

esters, alkyl esters, saturated and unsaturated esters, diesters (from dicarboxylic organic compounds), dibasic acid esters, polyol esters, synthetic esters, phthalate esters, carboxylic acid esters. Alkylated naphthalenes may be used as a synthetic fluid lubricant.

- 5 According to an embodiment of the invention the two-component grease package may comprise a paraffin based wax of a carbon chain length up to C40, either in pure form or in mixtures of different alkenes, or mixed with other polyolefin polymers (polyethylene) or ester waxes like cetyl myristoleate esters or cetyl palmitate esters. Waxes are natural, organic compounds that characteristically consist of long alkyl chains.

10

According to an embodiment of the invention the machine element is at least part of a one of the following a shaft, coupling, key, spline, gear, fastener, spring, seal, belt, clutch, brake, chain, or a bearing element, such as a ball bearing, a roller bearing, a needle bearing, a tapered roller bearing, a spherical roller bearing, a toroidal roller bearing, a ball thrust bearing, a roller thrust bearing, a tapered roller thrust bearing, a wheel bearing, a hub bearing unit, a slewing bearing, a ball screw, or a component for an application in which it is subjected to alternating Hertzian stresses, such as rolling contact or combined rolling and sliding and/or an application that requires high wear resistance and/or increased fatigue and tensile strength.

20

The machine element according to the present invention is particularly, but not exclusively, suitable for use in high speed or low temperature applications and in application where large machine elements are required.

- 25 The present invention also concerns a method for supplying a machine element which comprises the steps of applying only a first component of a two-component grease comprising a first component comprising a thickener and a second component comprising a fluid lubricant to said machine element and transporting said machine element to its operation site, whereby said grease is obtained by mixing said first and second components. It should be noted that it is preferable to apply the first component comprising a thickener to the mechanism before applying a second component comprising a fluid lubricant, however the first and second component need not necessarily be applied in that order but the second component may be applied before the first component, or the first and second components may be applied simultaneously.

35

According to an embodiment of the invention the method comprises the step of applying the first component to the machine element prior to transporting the machine element to its operation site i.e. transporting the machine element from the machine element manufacturer to a client/user, or transporting the machine element from some other site
5 to its operation site where it is installed/mounted for operation. A client/user will therefore receive a machine element to which the first component of the two-component grease package has already been applied. The client/user will then apply the second component of the two-component grease package whereby grease of the optimum composition for the client's/user's application will be obtained. Furthermore, the thickener may provide
10 corrosion protection during the transportation of the machine element.

According to another embodiment of the invention the method comprises the step of re-applying the first and/or second component to the machine element to re-lubricate the machine element. A first component and/or second component having a different chemical composition and/or different physical and/or mechanical properties than the first
15 component and/or second component which was /were previously applied may be more suitable as re-lubrication.

According to an embodiment of the invention the lubrication may be checked to determine whether re-lubrication is needed and/or exactly what type of re-lubrication is needed.

20

Further embodiments of the method according to the present invention are recited in the dependent method claims.

BRIEF DESCRIPTION OF THE DRAWINGS

25 The present invention will hereinafter be further explained by means of non-limiting examples with reference to the appended figures where;

Figure 1 shows a bearing according to an embodiment of the invention, and

30

Figure 2 shows the steps of a method for applying grease to a machine element according to an embodiment of the invention.

It should be noted that the drawings have not been drawn to scale and that the
35 dimensions of certain features have been exaggerated for the sake of clarity.

DETAILED DESCRIPTION OF EMBODIMENTS

Figure 1 schematically shows an example of a machine element 10, namely a rolling element bearing, that may range in size from 10 mm in diameter to a few metres in diameter and have a load-carrying capacity from a few tens of grams to many thousands of tonnes. The bearing component 10 may namely be of any size and have any load-carrying capacity. The bearing component 10 has an inner ring 12, an outer ring 14 and a set of rolling elements 16.

10 Grease must be provided between the rolling elements 16 and the inner ring 12 and outer ring 14 to lubricate the rolling element bearing 10. A two-component grease package is therefore selected depending on the bearing's rotational speed, service temperature range, running noise requirements, re-lubrication intervals, sealing, starting torque and/or environmental influences.

15

A first component A comprising a thickener, such as at least one of the following: a polymeric thickener, polypropylene, polyethylene, polyalkylene glycol, polyethylene glycol, polyolefin phenol, lanolin, lanoline polyethylene glycol, polyoxyethylene lanolin, silicon oil, ionic soap, urea soap, metal organic soap is then applied to at least one part of volume between the rolling elements 16 and the inner ring 12 and outer ring 14 such as on at least a part of the inner ring 12 and outer ring 14. The thickener may for example comprise polypropylene having both molecules of a high molecular weight and molecules of a low molecular weight. This first component A may be applied to the rolling element bearing 10 before it is transported to its operation site, i.e. before it is transported to a client/user and/or installed/mounted for operation.

The second component B of the two-component grease package comprising a fluid lubricant comprising at least one of the following: mineral oil, synthetic oil and/or vegetable oil, may then be applied by the client/user before the rolling element bearing 10 is put into use. Grease is thereby obtained by mixing together the first and second components A and B.

According to an embodiment of the invention the resulting grease (A+B) comprises 60-90% of the second component B comprising a liquid lubricant. For example, the resulting grease comprises 85% liquid lubricant and 15% thickener. The resulting grease (A+B)

may also comprise at least one of the following: a tackifier, an elastomer, an anti-wear additive, an anti-corrosion additive, an EP additive, an anti-oxidant.

The first component A and/or the second component B may be applied to a single point,
5 area or volume of a machine element or to a plurality of points, areas or volumes. The first component A and/or the second component B may be applied manually or using an automatic lubricator. The first component A and/or the second component B may for example be sprayed onto at least one part of a machine element.

10 Figure 2 shows the steps of a method for supplying a machine element to a client/user or to its operation site. The method comprises the steps of applying only a first component A of a two-component grease comprising a first component A comprising a thickener and a second component B comprising a liquid lubricant to the machine element and transporting the machine element to its operation site. A second component B comprising
15 a fluid lubricant, which may be transported to a client/user together with the machine element comprising the first component A, may be applied before the machine element is put into use whereby the grease is obtained by mixing the first and second components A and B.

20 According to another embodiment of the invention a first component A' and/or a second component B' comprising only that part of a previously applied first component A and/or second component B which have been consumed during the use of the machine element may be re-applied to re-lubricate the machine element if/when needed or periodically. In the embodiment illustrated in Figure 2 only a second component B' comprising that part of
25 a previously applied second component B which has been consumed during the use of the machine element, mineral oil for example, is re-applied to re-lubricate the machine element. The lubrication may optionally be checked to determine whether re-lubrication is needed and/or exactly what type of re-lubrication is needed and re-lubricated accordingly.

30 Further modifications of the invention within the scope of the claims will be apparent to a skilled person.

CLAIMS

1. Machine element (10), **characterized in that** it comprises only a first component (A) of a two-component grease that comprises a first component (A) comprising a thickener, and a second component (B) comprising a fluid lubricant, whereby said two-
5 component grease is obtained by mixing together said first and second components (A and B).
2. Machine element (10), according to claim 1, **characterized in that** said fluid lubricant comprises at least one of the following: mineral oil, synthetic oil, vegetable oil, a
10 polyalphaolefin, an ester, a polyether.
3. Machine element (10), according to claim 1 or 2, **characterized in that** said thickener comprises at least one of the following: a polymeric thickener, polypropylene, polyethylene, polyalkylene glycol, polyethylene glycol, polyolefin phenol, lanolin, lanoline
15 polyethylene glycol, polyoxyethylene lanolin, silicon oil, ionic soap, urea soap, metal organic soap.
4. Machine element (10), according to any of the preceding claims, **characterized in that** said thickener comprises at least one high molecular weight component and at least
20 one low molecular component.
5. Two-component grease package according to claim 4, **characterized in that** the ratio of high molecular weight component(s) to a low molecular component(s) is 1:40-1:5.
- 25 6. Machine element (10), according to claim 5, **characterized in that** said thickener high molecular weight component and/or said low molecular component comprises at least one of the following: a polymeric thickener, polypropylene, polyethylene, polyalkylene glycol, polyethylene glycol, polyolefin phenol, lanolin, lanoline polyethylene glycol, polyoxyethylene lanolin, silicon oil.
- 30 7. Machine element (10), according to any of the preceding claims, **characterized in that** said two-component grease comprises at least one of the following: a tackifier, an elastomer, an anti-wear additive, an anti-corrosion additive, an EP additive, an anti-oxidant.

8. Machine element according to any of the preceding claims, **characterized in that** said two-component grease comprises 3-30 weight-% thickener and 60-97 weight-% fluid lubricant.
- 5 9. Two-component grease package according to claim 7, **characterized in that** said two-component grease comprises 0.2-15 weight-% of said at least one additive.
10. Machine element (10), according to any of the preceding claims, **characterized in that** said machine element (10) is at least part of a bearing element.
- 10 11. Method for supplying a machine element (10), **characterized in that** it comprises the steps of applying only a first component (A) of a two-component grease comprising a first component (A) comprising a thickener and a second component (B) comprising a fluid lubricant to said machine element (10) and transporting said machine element to its
15 operation site, whereby said grease is obtained by mixing said first and second components (A and B).
12. Method according to claim 11, **characterized in that** it comprises the step of re-applying said first component (A) and/or said second component (B) to said machine
20 element (10) to re-lubricate said machine element (10).
13. Method according to claim 12, **characterized in that** it comprises the step of re-applying only that part (A') of said first component (A) and/or that part (B') of said second component (B) to said machine element (10) which has been consumed to re-lubricate
25 said machine element (10).
14. Method according to any of claims 11-13, **characterized in that** said fluid lubricant comprises at least one of the following: mineral oil, synthetic oil, vegetable oil, a polyalphaolefin, an ester, a polyether.
- 30 15. Method according to any of claims 11-14, **characterized in that** said thickener comprises at least one of the following: a polymeric thickener, polypropylene, polyethylene, polyalkylene glycol, polyethylene glycol, polyolefin phenol, lanolin, lanoline polyethylene glycol, polyoxyethylene lanolin, silicon oil, ionic soap, urea soap, metal
35 organic soap.

16. Method according to any of claims 11-15, **characterized in that** said thickener comprises at least one high molecular weight component and at least one low molecular component.
- 5 17. Method according to claim 16, **characterized in that** the ratio of high molecular weight component(s) to a low molecular component(s) is 1:40-1:5.
18. Method according to claim 16 or 17, **characterized in that** said thickener high molecular weight component and/or said low molecular component comprises at least one
10 of the following: a polymeric thickener, polypropylene, polyethylene, polyalkylene glycol, polyethylene glycol, polyolefin phenol, lanolin, lanoline polyethylene glycol, polyoxyethylene lanolin, silicon oil.
19. Method according to any of claims 11-18, **characterized in that** said first
15 component (A) and/or said second component (B) comprise(s) at least one of the following: a tackifier, an elastomer, an anti-wear additive, an anti-corrosion additive, an EP additive, an anti-oxidant.
20. Method according to any of the preceding claims, **characterized in that** said
20 grease comprises 3-30 weight-% thickener and 60-97 weight-% fluid lubricant.
21. Method according to any of the preceding claims, **characterized in that** said grease comprises 0.2-15 weight-% of said at least one additive.
- 25 22. Method according to any of claims 11-21, **characterized in that** said machine element (10) is at least part of one of the following: a shaft, coupling, key, spline, gear, fastener, spring, seal, belt, clutch, brake, chain.
23. Method according to any of claims 11-22, **characterized in that** said machine
30 element (10) is at least part of one of the following: a ball bearing, a roller bearing, a needle bearing, a tapered roller bearing, a spherical roller bearing, a toroidal roller bearing, a ball thrust bearing, a roller thrust bearing, a tapered roller thrust bearing, a wheel bearing, a hub bearing unit, a slewing bearing, a ball screw, or a component for an application in which it is subjected to alternating Hertzian stresses, such as rolling contact
35 or combined rolling and sliding and/or an application that requires high wear resistance and/or increased fatigue and tensile strength.

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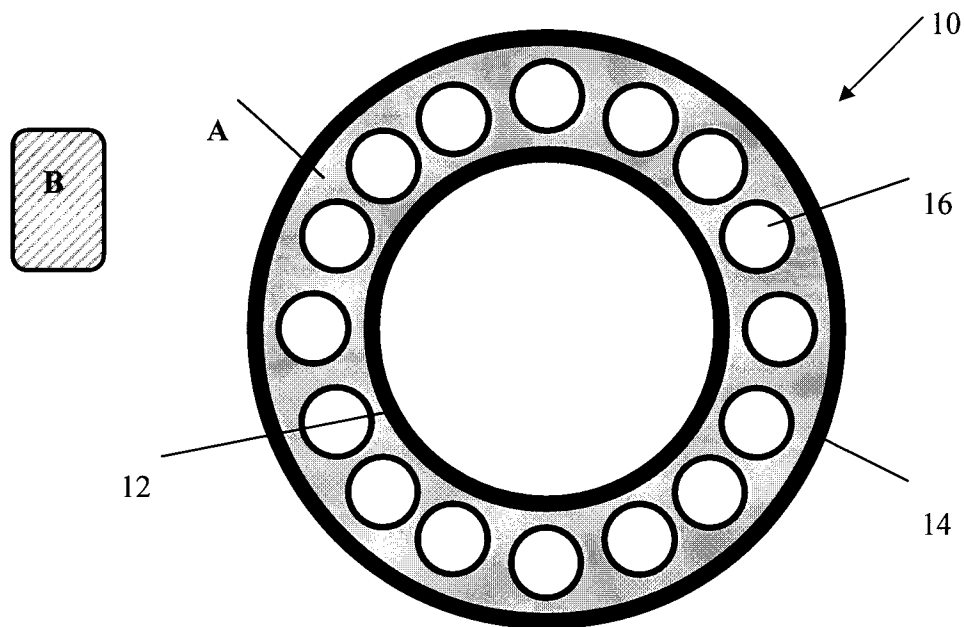


Fig. 1

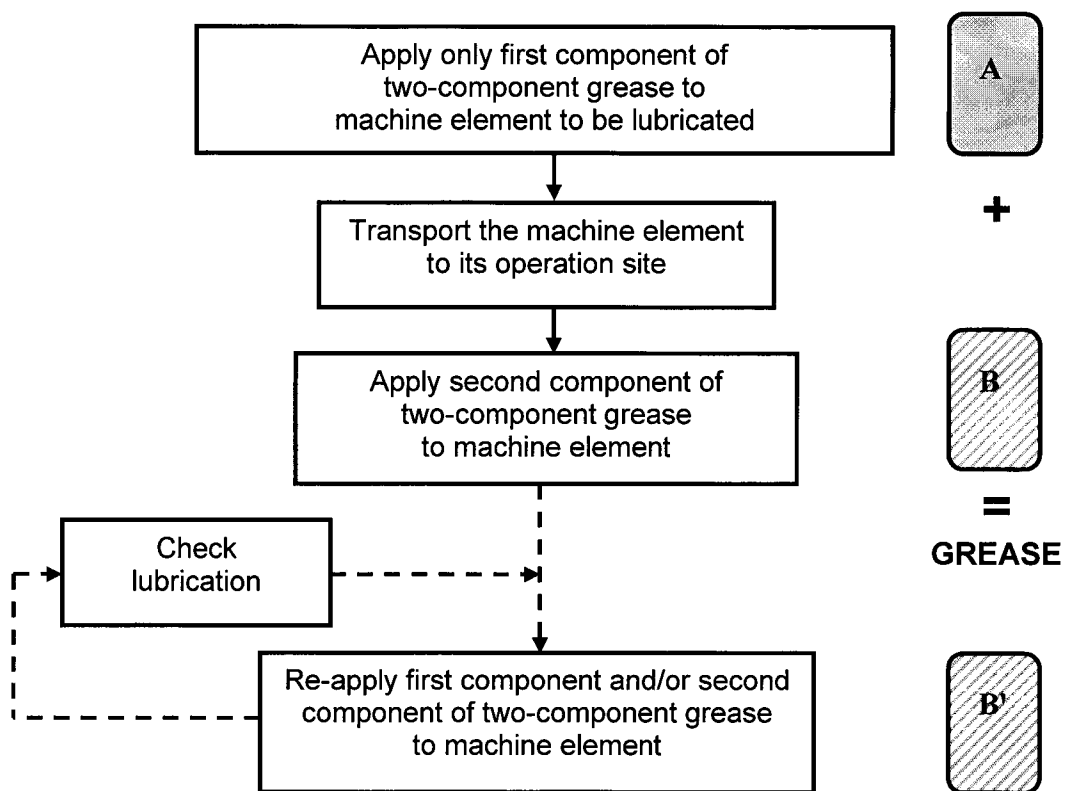


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/000203

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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: C10M, C10N, F16C, F16N

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0700986 A2 (SKF ENG & RES CENTRE BV -(A3 B1) SKF IND TRADING & DEV [NL]), 13 March 1996 (1996-03-13); claims 1-4, 7; examples on pages 6-8 -- -----	1-10

☐ 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)

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22-04-2013

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Name and mailing address of the ISA/SE

Patent- och registreringsverket

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Continuation of: second sheet**International Patent Classification (IPC)*****F16C 33/66*** (2006.01)***C10M 111/00*** (2006.01)***C10M 169/02*** (2006.01)***F16N 15/00*** (2006.01)***C10N 40/02*** (2006.01)***C10N 50/10*** (2006.01)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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