A further disadvantage of standard friction modifiers based on molybdenum compounds is the relatively short duration over which these compounds are effective. Typically, the additives form a coating on the surfaces of the engine elements which come into contact with the lubricant. However, this coating is degraded over time, and a considerable portion of the friction-reducing effect is lost after a kilometrage of 10 000 km, such that an oil change is needed to maintain the friction-reducing action.

Interactions between the various additives used with one another and with the lubricant oil itself thus lead to disadvantages for the function and durability of the customary exhaust-gas aftertreatment systems (catalytic converters, soot particle filters). It would consequently be desirable to reduce the content thereof in modern lubricant oils as far as possible.

The elements and lubricant oil compositions described above already lead to a useable profile of properties. However, there is a constant need to improve this profile of properties.

In view of the prior art, it is thus an object of the ~~present invention~~embodiments disclosed herein to provide an element which surpasses the prior art.

More particularly, the ~~inventive~~disclosed element should enable provision of the advantages of a DLC surface which is friction-reducing compared to conventional steel surfaces in combination with the friction-reducing properties of a lubricant composition.

In addition, it was an aim of the present ~~invention~~disclosure to provide a friction-reducing additive for DLC-coated steel surfaces which brings about a multitude of desirable properties in the lubricant oil composition. This can minimize the number of different additives.

Even though DLC-coated metal parts have a lower friction value compared to uncoated parts, further measures are desirable for reducing friction losses and the associated decrease in fuel consumption.

It was a further object of the ~~invention~~embodiments disclosed herein to provide elements, lubricant oil compositions and friction-reducing additives which can be produced in a simple and inexpensive manner, and it was a particular intention to use commercially available elements. At the same time, production was to be possible on the industrial scale without any requirement for new plants or plants of complex construction for this purpose.

Furthermore, the additive was to lead to an improvement in fuel consumption, without any resulting impairment in the environmental compatibility of the lubricant oil composition.

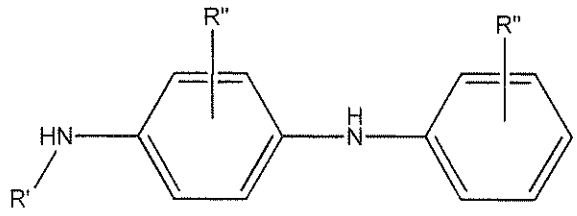
The additives used are to improve the service life of the lubricant oil used to such an extent that the necessary oil change intervals can be extended without resulting in any decrease in quality of the lubricant oil.

These objects, and further objects which are not stated explicitly but are immediately derivable or discernible from the connections discussed herein by way of

introduction, are achieved by an element having all features of claim 1. Appropriate modifications of the inventive element are protected in the dependent claims 2 to 15.

The present ~~invention~~disclosure accordingly provides an element comprising at least two components movable with respect to one another, between the surfaces of which is provided a film formed by a lubricant oil composition, characterized in that the surface of at least one of the movable components is at least partly formed by a diamond-like-carbon layer (DLC layer) and the lubricant oil composition comprises at least one polymer comprising repeat units derived from amine derivatives of at least one polar ethylenically unsaturated monomer.

In an aspect, there is provided an element comprising at least two components movable with respect to one another, between the surfaces of which is provided a film formed by a lubricant oil composition, characterized in that the surface of at least one of the movable components is at least partly formed by a diamond-like-carbon layer (DLC layer) and the lubricant oil composition comprises at least one polymer comprising repeat units derived from amine derivatives of at least one polar ethylenically unsaturated monomer, the polar ethylenically unsaturated monomer from which the amine derivative is derived being selected from the group consisting of maleic acid, maleic monoester, maleic diester, maleic anhydride and methyl maleic anhydride and the amine derivative of the polar ethylenically unsaturated monomer being derived from a primary amine having the general formula (IIIa)



(IIIa)

in which R′ is hydrogen and R″ are each independently hydrogen or an alkyl radical having 1 to 9 carbon atoms.

The inventive element can additionally achieve the following advantages among others:

Through the present ~~invention~~disclosure, it is possible in an unforeseeable manner to provide an element and a lubricant oil composition with an improved profile of properties, it being possible especially through the combination of the favorable properties of a DLC coating of the elements with the lubricant oil compositions to be used in accordance with the invention to improve the service life of the engines, the fuel consumption and further desirable properties. More particularly, it is possible to achieve a very low friction value and a surprisingly high abrasion resistance.

5. The element as claimed in at least one of the preceding claims, characterized in that the polymer is a graft copolymer, having a graft base comprising repeat units derived from olefins, and a graft layer comprising the repeat units derived from amine derivatives of the polar ethylenically unsaturated monomer.

6. The element as claimed in at least one of the preceding claims, characterized in that the polymer is a graft copolymer, wherein the graft base comprises repeat units derived from (meth)acrylates having 6 to 22 carbon atoms in the alcohol radical, and the graft layer comprises the repeat units derived from amine derivatives of the polar ethylenically unsaturated monomer.

7. The element as claimed in at least one of the preceding claims, characterized in that the polar ethylenically unsaturated monomer from which the amine derivative is derived is maleic anhydride.