

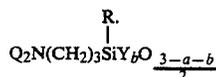
## FILM-FORMING SILICONE COMPOSITIONS HAVING LUBRICATING PROPERTIES

### BACKGROUND OF THE INVENTION

The instant invention relates to a film-forming silicone composition having a non-reactive lubricating component dispersed or distributed within a reactive component such that when the composition is applied to or used in conjunction with a substrate surface, it coats and adheres to the surface while providing surface lubrication.

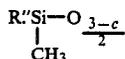
Certain silicone coating compounds are well known in the art for their lubricating properties. Those compounds disclosed have various disadvantages and shortcomings which the inventive compositions seek to overcome. U.S. Pat. No. 3,574,073 discloses the use of cured organosiloxane copolymers on fine cutting edges such as razor blades and hypodermic needles. The copolymers of this reference consist of:

(1) 5 to 20 weight percent of polymeric units of the formula:



wherein R is an alkyl radical C<sub>1-6</sub>; Y is —OH and OR' where R' is an alkyl radical up to 3 carbons; Q is —CH<sub>3</sub> or —CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub>; a and b have a value of 0 or 1 where their sum is from 0 to 2; and

(2) 80 to 95 weight percent of polymeric units of the formula



wherein R'' is —OH or —CH<sub>3</sub> radicals and c has a value of 1 or 2.

The coatings of this reference suffer several shortcomings and disadvantages. To begin with, these polymers are moisture cured. Although some lubricating effect is obtained while these films are in the uncured state, it takes from two to ten days to obtain a fully cured coating. The polymers of this reference are amine terminated, thus the surfaces of this polymer due to the amine functionality are alkaline in nature. This alkalinity may potentially initiate a hemolytic and/or thrombogenic reaction when used in articles which contact blood.

Another known silicone lubricant widely used in the biomedical field on hypodermic needles is polydimethylsiloxane (PDMS). While the medical grade fluids have the advantage of being chemically inert, these materials have a tendency to creep or migrate from the surface to which they are applied. For example, in the case of a hypodermic needle coated with PDMS, the coating might be substantially removed due to frictional forces during penetration of the skin and vein, making subsequent removal of the needle difficult and painful to the patient. Migration during storage and inadvertent removal during processing is also a concern.

Heretofore, the prior art has not disclosed a lubricating siloxane composition which cures quickly to an adherent film, without migration problems or long cure times. It is apparent that a need exists for a lubricating composition which when applied to substrate surfaces

such as hypodermic needles, cutting edges, razor blades and the like, adheres to the substrate surface and provides lubrication, durability and biocompatibility. In the case of hypodermic needles, the lubricating composition serves to decrease the penetration force into the skin or vein, as well as decrease the drag and retract force during removal.

### SUMMARY OF THE INVENTION

The instant invention relates to a film-forming composition comprising:

(a) a reactive component comprising of a first siloxane polymer having two or more vinyl groups; a second siloxane crosslinking polymer having two or more pendent hydrogen groups; and a third siloxane chain-extending polymer having two or more terminal hydrogen groups; and

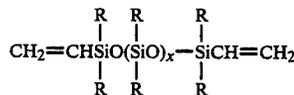
(b) a non-reactive lubricating component comprising a siloxane polymer dispersed within said reactive component.

The reactive component is a chemically crosslinked, surface adherent polydimethylsiloxane, which serves as a matrix for the non-reactive component dispersed therein. Each of the three siloxane polymers of the reactive component is required to achieve the durability and adherent properties required for the intended usefulness of the compositions as a film or coating. Preferably a mixture of polymers is used for each of the three types of required polymers in the reactive component. For example, a mixture of vinyl terminated or vinyl pendent siloxane polymers can be used as the first siloxane; a mixture of polymers having at least two pendent hydrogen groups can be used as the second polymer; and a mixture of chain-extending polymers having terminal hydrogen groups can be used as the third siloxane polymer.

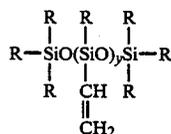
### DETAILED DESCRIPTION OF THE INVENTION

The First Siloxane Polymer of the Reactive Component

The first siloxane polymer of the reactive component is present in amounts of about 3% to about 35% by weight of the total film-forming composition; and preferably in amounts of about 10% to about 30% weight percent. This polymer corresponds to the following structural formulae:



OR



wherein R is alkyl C<sub>1-20</sub>, haloalkyl, aryl, haloaryl, cycloalkyl, silacyclopentyl, aralkyl and mixtures thereof; X is about 60 to about 1000, and preferably about 200 to about 320; and y is about 3 to about 25. Copolymers and mixtures of these polymers are also contemplated.