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METHOD OF LUBRICATING A METAL SURFACE

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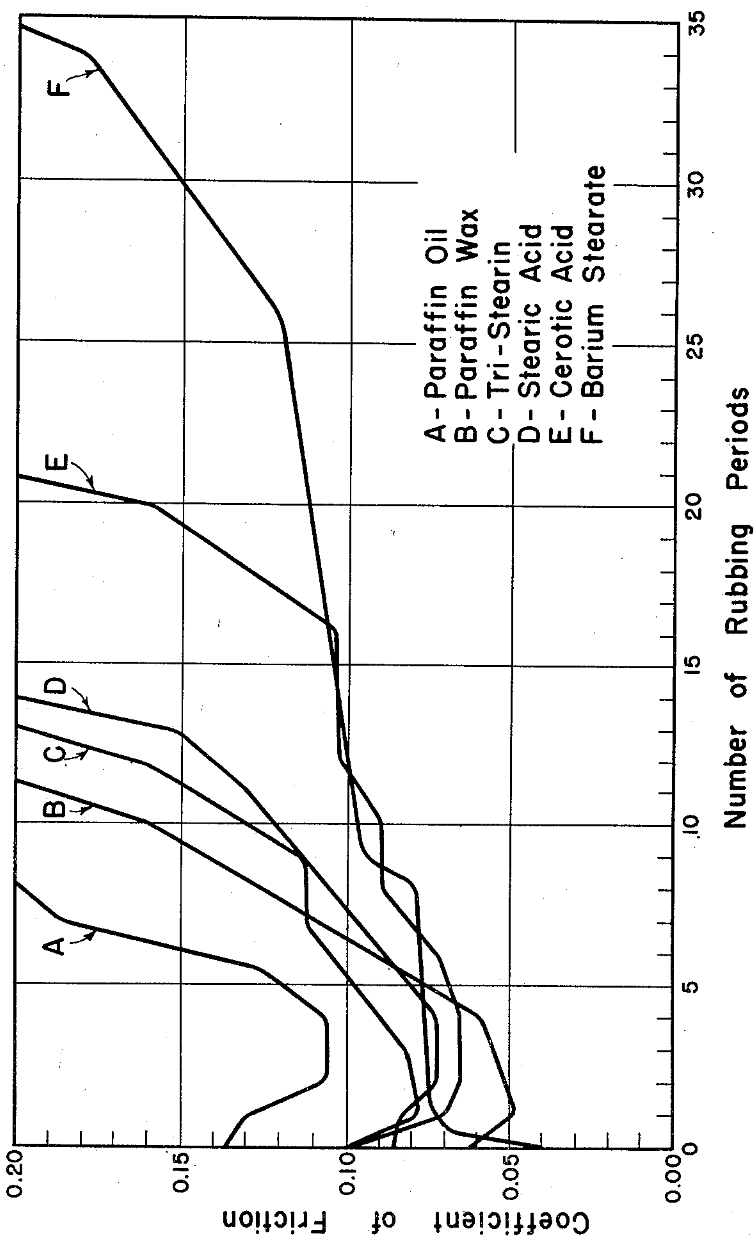

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METHOD OF LUBRICATING A METAL SURFACE

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This invention relates to lubrication and more particularly a novel method of lubrication that is particularly useful for lubricating small parts of precision instruments such as watch or chronometer pivots, camera shutters and the bearings of delicate measuring instruments and ordnance control mechanisms. This application is a continuation-in-part of my prior application, Serial No. 623,884 filed October 22, 1945, now abandoned.

In one aspect this method may be considered as an improvement of the so-called "Epilame" process disclosed in French Patent No. 612,077 issued to Wisner. In the Wisner patent it is pointed out that in the lubrication of small parts such as, for example, watch pivots, it is not possible to achieve satisfactory lubrication by applying a mineral oil directly to the bearing surfaces because of the fact that the oil tends over a period of time to migrate to adjacent metal surfaces. As a result of this migration the quantity of oil remaining on the bearing surfaces to which the oil was originally applied becomes insufficient to lubricate them properly. The patentee suggests that this migration is due to attractive forces between the oil and the metal surface, and advances the theory that the migration of the oil can be inhibited by first neutralizing the fields of force which emanate from the metal surface. The procedure disclosed by the patentee for accomplishing this purpose comprises dipping the part to be lubricated in a solution of stearic acid in a volatile solvent, such as benzene or toluene, evaporating the solvent to deposit a layer of stearic acid on the metal surface and thereafter lubricating the surface with a conventional lubricant.

Although the process of the Wisner patent represents a significant advance in this art it is subject to a number of disadvantages. Thus with an immersion method as disclosed in the Wisner patent it is difficult to limit the application of the neutralizing layer to the area that it is desired to lubricate, and in many cases the stearic acid layer will be deposited in areas which are not supposed to be lubricated. Also the stearic acid layer deposited by the Wisner process has a relatively poor resistance to abrasion. This poor resistance to abrasion becomes important in cases where the subsequently applied mineral oil drys up after long use or where there is a sudden increase in load on the bearing and the lubricity of the underlying fatty layer is used for lubrication. Also the poor abrasion resistance of the stearic acid layer becomes important at low temperatures where the lubricity of the conventional lubricating medium diminishes and the underlying fatty layer may be called upon to perform the primary lubricating function.

It is accordingly an object of the present invention to provide an improved process for lubricating metal surfaces, which process is particularly

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useful in lubricating the bearing surfaces of very small parts of delicate instruments and other like mechanisms. It is another object of the invention to provide a preliminary treatment of such surfaces which will permit lubrication with a conventional lubricating oil without substantial migration of the lubricating oil away from the bearing surface to which it is applied. It is a further object of the invention to provide a method of lubricating such surfaces to produce a lubricating film that retains lubricity over a long period of time. It is a still further object of the invention to provide a method of lubricating certain surfaces in such manner that their lubricity is retained over a wide range of temperatures, particularly sub-zero temperatures. Other objects of the invention will in part be obvious and in part pointed out hereafter.

In one of its broader aspects the present method comprises applying to a metal surface by dry rubbing an extremely thin, continuous, dry layer of a substance selected from the group consisting of the stearates of barium, lead and zinc. and then applying a conventional lubricant to the stearate layer thus produced. The metal stearate layer may be conveniently applied by rubbing the stearate, in the form of a powder, on the metal surface with a soft paper or cloth such as a chamois skin. It has been found that the stearates of barium, lead and zinc, when applied in accordance with the present method, produce surfaces having an unusually low coefficient of friction as compared with other chemically related substances, and that when combined with a subsequently applied conventional lubricant they produce a composite lubricating layer that is significantly superior to that produced by the Wisner process.

It has been further found that barium stearate in particular adheres exceptionally well to metallic surfaces, and, as pointed out in more detail hereafter, possesses a surprising resistance to abrasion. Moreover it has been found that the lubricity of the barium stearate layer remains substantially constant over the temperature range −60° C. to +100° C. This property of the barium stearate layer renders the present method particularly useful in the lubrication of instrument parts that are to be used in Arctic and sub-Arctic regions, since under such extreme temperature conditions a conventional lubricating oil largely loses its lubricity and the underlying fatty layer becomes the primary lubricant.

The present method is particularly useful for the lubrication of ferrous metal surfaces, although it may also be used with advantage in lubricating the surfaces of copper, brass and aluminum and their alloys. The conventional lubricant subsequently applied to the stearate layer is preferably a mineral lubricating oil although such lubricants as vegetable oils, greases, petrolatum and synthetic oils may also be used in particular cases.

The superiority of dry rubbing over the solvent deposition technique of Wisner and the superiority of the stearate of barium, lead and zinc over various other metal stearates are illustrated by the data embodied in Tables I and II below. These tables set forth in the coefficients of friction that were obtained when stearic acid and various metal soaps were applied in thin layers to polished steel surfaces under comparable conditions.

Table I

Fatty Compound	Coefficient of Friction
Solvent deposited stearic acid	0.105
Dry rubbed stearic acid	0.089
Dry rubbed barium stearate	0.048

Table II

Dry Rubbed Metal Stearate	Coefficient of Friction
Aluminum	greater than 0.200.
Barium	0.048.
Copper	0.071.
Ferric	0.074.
Beryllium	0.101.
Manganese	0.071.
Lead	0.062.
Vanadium	0.077.
Zinc	0.055.

The data of Table I show that dry rubbing produces a layer having a lower coefficient of friction than layers produced by deposition from solvents. The data of Table II show that layers of the stearates of barium, lead and zinc, when applied by the present method, have significantly lower coefficients of friction than the similarly prepared layers of other metal stearates.

The superior resistance to abrasion of dry rubbed barium stearate layers is shown by the data plotted in the accompanying drawing. These data were obtained with a modified dynamometer-type friction meter comprising a rotatable steel cylinder having a highly polished surface, and a pair of jaws shaped to conform with the curvature of the surface of the cylinder and provided internally with layers of abrasive paper confronting the cylinder surface. The fatty material to be tested was applied by dry rubbing to the surface of the cylinder and thereafter the jaws of the clamp were held together in such manner as to cause the abrasive paper to bear against the surface of the cylinder with a predetermined pressure. In order to secure comparative results the cylinder was rotated at constant speed for a series of rubbing periods of two minutes duration. The linear speed at the test surface was about 41 millimeters per minute. The coefficient of friction of the surface was measured between each rubbing period and the test of each substance was continued until the coefficient of friction had attained a value of 0.200.

Referring to the drawing, the test results show that some 34 rubbing periods were required to increase the coefficient of friction of the barium stearate layer to 0.200, whereas the best of the other substances tested gave a layer of which the coefficient of friction increased to 0.200 after only some 21 rubbing periods. These data show that the barium stearate layer is substantially superior to both the fatty acids and the paraffin oils and waxes in its resistance to abrasion.

From the foregoing discussion, it is apparent that the method of the present invention is capable of producing on metal parts a composite lubricating layer that is substantially superior to those previously available. The underlying fatty layer composed of barium, lead or zinc stearate gives a lower coefficient of friction and higher abrasion resistance than surfaces produced by other chemically related substances. The stearate layer prevents migration of the subsequently applied lubricating oil. The composite layer gives, over a wide temperature range including very low temperatures, more reliable lubrication than heretofore available because of the fact that at the lower temperatures at which the lubricity of the conventional lubricant diminishes, the tenaciously adherent stearate layer assumes the primary lubricating function. Since the stearate layer retains its lubricity at low temperatures, and the conventional lubricating oil has high lubricity at ordinary temperatures, the composite layer produces satisfactory lubrication over an unusually wide temperature range.

It may be further pointed out that while the composite lubricating layer of the present invention is exceptionally useful at moderate and low temperatures because of the fact noted above that barium stearate, for example, has substantially constant lubricity over the range −60° C. to +100° C., these composite layers may also be used with advantage at higher temperatures.

I claim:

1. A method of lubricating a metal surface which comprises applying to said surface by dry rubbing, a continuous, extremely thin, dry layer of a metal stearate selected from the group consisting of barium, lead and zinc stearates, and thereafter applying a lubricating oil to said metal stearate layer.

2. A method of lubricating a metal surface which comprises applying to said surface by dry rubbing, a continuous, extremely thin, dry layer of barium stearate, and thereafter applying a lubricating oil to said layer of barium stearate.

3. A method of lubricating a metal surface which comprises applying to said surface by dry rubbing, a continuous, extremely thin, dry layer of lead stearate, and thereafter applying a lubricating oil to said lead stearate layer.

4. A method of lubricating a metal surface which comprises applying to said surface by dry rubbing, a continuous, extremely thin, dry layer of zinc stearate, and thereafter applying a lubricating oil to said zinc stearate layer.

5. The method of lubricating a ferrous metal surface which comprises rubbing dry, finely divided barium stearate on said surface to produce thereon a continuous, extremely thin, dry layer of said barium stearate, and then applying a lubricating oil to said barium stearate layer.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,694,148	Spalding	Dec. 4, 1928
2,293,580	Walker	Aug. 18, 1942

FOREIGN PATENTS

Number	Country	Date
612,077	France	July 24, 1925

OTHER REFERENCES

Metallic Soaps, Copyright 1940 by Metasap Chem Co. Inc., Harrison, N. J., pp. 5, 9, 13 and 17.