

Sept. 21, 1943.

S. SPRING

2,329,731

DRAWING LUBRICANT

Filed Feb. 12, 1942

2 Sheets-Sheet 1

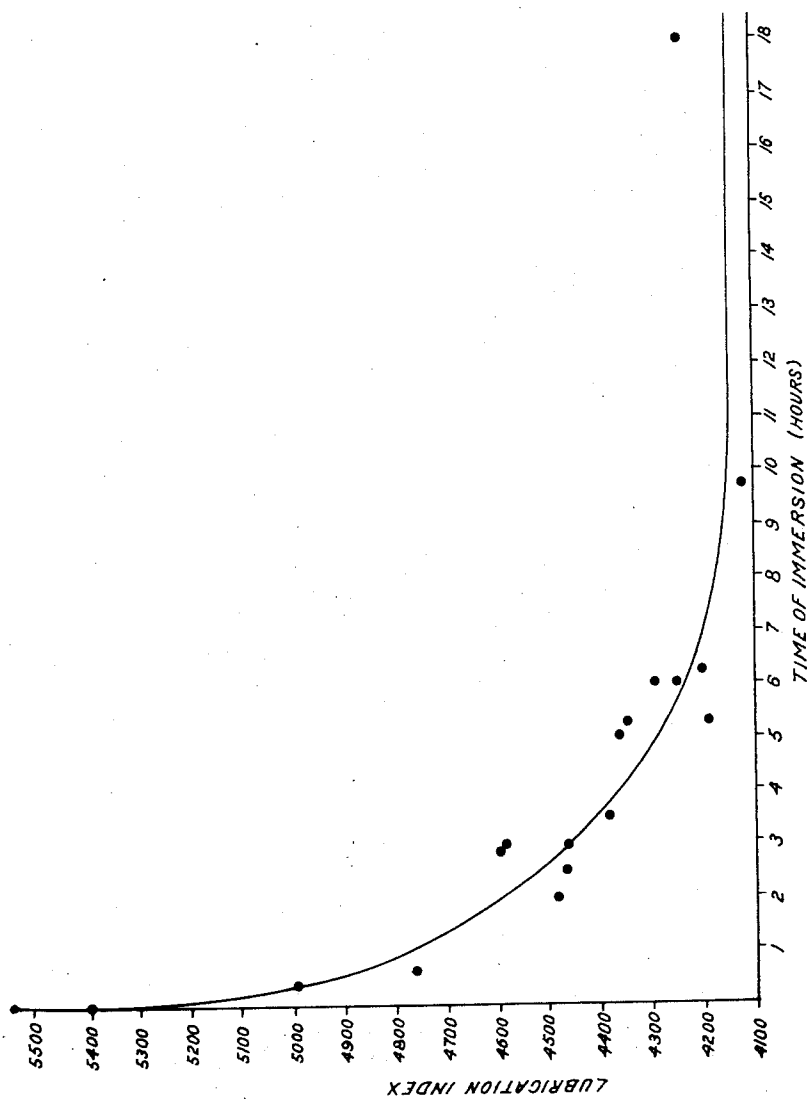


Fig. 1-

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2 Sheets-Sheet 2

Fig. 2 -

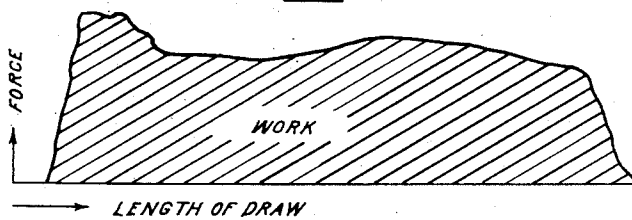


Fig. 3 -

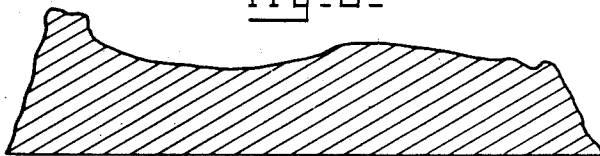


Fig. 4 -

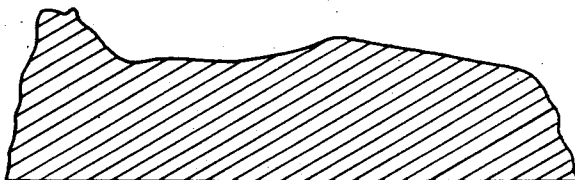
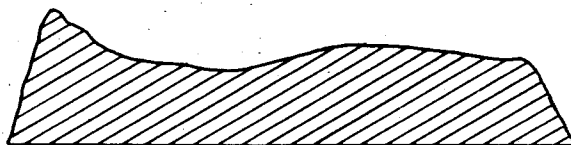


Fig. 5 -



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UNITED STATES PATENT OFFICE

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DRAWING LUBRICANT

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10 Claims. (Cl. 205—8)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a drawing lubricant which is particularly suitable for drawing relatively soft metals such as brass.

In drawing brass it is customary to use an aqueous soap solution as a lubricant. Ordinarily about 2% by weight of soap is used, and the solution is applied to the work before drawing by dipping or spraying.

It is the object of the present invention to provide an improved method of using known drawing lubricants. The improved method herein described results in lower drawing pressures, lower tool and die wear and less pickup of metal by the drawing tools. In some applications it also enables one to eliminate an anneal between drawing operations or to perform a longer draw in a single operation.

In conventional drawing operations the lubricant, consisting of an aqueous soap solution, is applied to the piece to be drawn immediately before drawing. It has now been found that if a more dilute soap solution is used and the metal to be drawn is immersed, sprayed or otherwise placed in contact for some time with the solution, much better results are obtained. The strength of the soap solution should vary from about 0.025% to 0.5% by weight of soap and preferably from 0.1% to 0.2% of soap is used. If extremely hard water is used in the preparation of the soap solution, slightly more soap may be used to compensate for the hardness. Although most ordinary soaps are satisfactory, preferably the soap used is one having a very low alkalinity and a fairly low titer, i. e., one which contains a high proportion of alkali metal oleate.

The most important factor in drawing operations according to the present invention is the soaking or residence time of the metal to be drawn. It has been found that the soaking time should be from about 1 to 15 or more hours and preferably from 3 to 8 hours.

Although this invention is not predicated on any theory of its operation, it is believed that the long soaking time gives the molecules of the soap solution more opportunity to orient themselves at the water-metal interface, and result in a more complete adsorption of the fatty acid and/or acid soap. Similarly the use of the more dilute soap solution aids in orientation by lessening its normal gel structure which permits a

greater rate of diffusion of the fatty acid and/or acid soap molecules. A further effect of using a dilute soap solution is to increase hydrolysis and thus increase the concentration of acid soap which is formed.

Figure 1 illustrates how the time of immersion affects the "lubrication index." It can be seen that the index falls off rapidly when the time of immersion increases from a few seconds to several hours. The lubrication index is an expression used to show the approximate force required throughout the drawing operation. It is obtained by measuring the force continuously while drawing and adding the first maximum, the first minimum and the second maximum forces. Some lubricants require high initial force and much lower subsequent forces, while others require equal or higher subsequent forces in the drawing operation. Therefore, the "lubrication index" as herein used is representative of the over-all results which a lubricant gives. Obviously, the lower the index, the better is the lubricant.

According to Figure 1, increasing the immersion time from a few seconds to 1 hour causes a considerable decrease in the lubrication index. Increasing the time to 3 hours causes an even greater decrease, and the decrease continues until a time of about 8 or 10 hours is reached. Thus, increasing the immersion time to only 1 hour gives very advantageous results according to the present invention, while increasing the time to about 8 hours gives the maximum benefit obtainable.

Figures 2 to 5 show the effect of immersion time and also show the effect of concentration of soap on drawing forces. In each figure the ordinate represents force while the abscissa represents the length of draw. The scale is the same in each case. These curves are copies of the actual traces of an automatic recorder. Work is represented by the shaded area of each figure. Figure 2 illustrates the conventional practice, using a 2% solution of soap and immersing the piece to be drawn for 30 seconds. Figure 3 illustrates the use of the same concentration of soap with a 12 hour immersion period. It is apparent that considerably less power is consumed when the immersion time is increased. Figure 4 illustrates the effect of using an aqueous solution containing 0.1% soap and immersing the pieces to be drawn for 30 seconds. The results are equal to or only slightly better than when the more concentrated soap solution is used. Figure 5 illustrates the effect of using the

0.1% soap solution and immersing the pieces to be drawn for 12 hours. Both the initial force and the over-all power consumption are lower under these conditions. All of the above figures were obtained on an experimental machine making the fourth draw of a calibre .30 cartridge case.

Power consumption measurements were also made using a high speed commercial drawing machine. It was found that the machine running empty consumed 205 watt hours in a cycle equivalent to a drawing operation. When the machine was used for drawing cups the power consumption increased to 533 watt hours per draw for cups which had been immersed in 2% soap for 1 to 5 minutes. When cups were used which had been immersed in 0.1% soap solution for 7 hours the power decreased to 496 watt hours per draw.

In addition to decreasing the power consumption, another advantage of the present invention is the freedom from metal pick-up by the tools and dies. In one test 47 draw pieces were drawn which had been immersed in 2% soap solution for 30 seconds. At the end of this time the punch was found to be heavily coated with brass. Analysis of the coating disclosed that 2 mg. of copper had been deposited on the punch. The test was then repeated, using draw pieces which had been immersed for 6 hours in 0.1% soap. After drawing about 100 draw pieces, there was no visible deposit of brass on the punch.

A further advantage of the present invention is that the apparent ductility of the metal is increased as determined by the Olsen cupping test. This test is one in which a sheet of the metal to be tested is supported by a die ring 1 inch in diameter and a $\frac{1}{8}$ inch steel ball is pressed into the test metal to form a cup. The height of the cup which is formed before fracture and the distance from the die ring to the point of fracture give an indication of the apparent ductility of the metal.

In the data given below a cup was preformed to a height of .28 inch before a lubricant was applied. When a sheet of 70-30 brass, 0.042 inch thick was used, the following data were obtained:

Lubricant	h/F	d
None.....	.490	.29
Light mineral oil.....	.500	.25
2% soap solution.....	.529	.31
0.1% soap solution 6 hours immersion.....	.584	.49

Where: h/F=height of cup in in. at time of fracture.

d=distance in in. from base of cup to point of fracture

This improved ductility allows longer individ-

ual draws or, in some instances, the elimination of an anneal between drawing operations.

Throughout this specification frequent reference has been made to the drawing of brass. It is obvious that this invention is equally applicable to the drawing of other ductile metals, such as, copper, zinc, or gilding metal, and is also applicable to other metal forming operations where metal is formed in a manner similar to drawing, such as cupping, extrusion, reverse extrusion, upsetting and the like.

In the claims the term metal forming is used to include drawing, cupping, extrusion, reverse extrusion, upsetting and the like.

15 I claim:

1. In the process of metal forming the improvement comprising immersing the metal to be formed in an aqueous soap solution for a period of at least one hour prior to forming.

20 2. In the process of metal forming the improvement comprising immersing the metal to be formed in an aqueous soap solution containing from about 0.025% to 0.5% soap for a period of at least one hour prior to forming.

25 3. The process of claim 2 in which the soap has a low titer.

4. In the process of metal forming the improvement comprising immersing the metal to be formed in an aqueous soap solution containing from about 0.025% to 0.5% soap for a period of from 3 to 8 hours prior to forming.

5. In the process of metal forming the improvement comprising immersing the metal to be formed in an aqueous soap solution for a period of from 3 to 8 hours prior to forming.

6. In the process of metal forming the improvement comprising immersing the metal to be formed in an aqueous soap solution containing from about 0.1% to 0.2% of soap for a period of at least one hour prior to forming.

7. In the process of metal forming the improvement comprising immersing the metal to be formed in an aqueous soap solution containing from about 0.1% to 0.2% soap for a period of from 3 to 8 hours prior to forming.

8. In the process of drawing metals the improvement comprising immersing the metal to be drawn for a period of at least one hour in an aqueous soap solution.

9. The process of claim 8 in which the soap has a low alkalinity and titer.

10. In the process of drawing brass the improvement comprising immersing the brass in an aqueous soap solution containing from about 0.1% to 0.2% soap for a period of from 3 to 8 hours prior to drawing.

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