

UNITED STATES PATENT OFFICE

2,529,191

COLD-WORKING LUBRICANT AND LUBRICATING METAL SURFACES THEREWITH

Albert G. Rocchini, Springdale, and Richard J. Neely, Oakmont, Pa., assignors to Gulf Research & Development Company, Pittsburgh, Pa., a corporation of Delaware

No Drawing. Application April 7, 1948,
Serial No. 19,648

2 Claims. (Cl. 252—59)

1

This invention relates to an improved cold-working lubricant and to the lubrication of metal surfaces during cold working; and it comprises, in cold working a metal subsequently to be annealed, a process improvement which resides in lubricating the surfaces of said metal by means of a petroleum lubricating oil containing a small amount of triisopropyl toluene; all as more fully hereinafter set forth and as claimed.

The cold working of metals, such as the cold rolling, drawing, or stamping of aluminum, stainless steel, Monel metal, and the like, is ordinarily followed by an annealing process. Annealing is often performed in a gas-fired furnace wherein the products of combustion come in contact with the metal. Owing perhaps to the restricted space adjacent the bulk of the metal surfaces, and furthermore to the fact that conditions in the furnace are not conducive to good combustion, it has been found that considerable staining of the metal has resulted. The stains which are formed may, in general, be classed according to three specific types. The first, a tempering stain, is believed to be an oxide formation which appears at the edge of a strip and is not thought to be dependent upon the type of lubricant employed. The second, having the appearance of a gray oxide, may appear in different positions on the strip and is believed to be caused by foreign matter such as dirt adhering to the surface and being carried on the strip into the annealing furnace. The third type of stain which may appear in streaks or spots is believed to be a carbon formation resulting when the working lubricant is subjected to the reducing atmosphere in the annealing furnace. It is the prevention of the latter type of stain with which this invention is concerned.

In the past, the elimination of the stain resulting from the lubricant has been accomplished by one of several alternatives. In one embodiment, the oil stain has been eliminated by removing the lubricating oil film from the cold-worked metal with a solvent prior to the annealing step. Other embodiments have included chemically or mechanically removing the stain after the annealing operation. These embodiments, however, introduce expensive processing steps.

The type of lubricant employed in cold working processes has also been the subject of many prior investigations. Among the lubricants which have been used are included animal oils, vegetable oils, mineral oils, and mixtures of these and water-oil emulsions. Animal and vegetable oils are effective lubricants, but they have certain dis-

2

advantages in that they are rather expensive, are not good coolants, and are easily oxidized with the resultant development of rancidity. Furthermore, animal and vegetable oils, having high carbon residue values, have been unsatisfactory in that unless they are removed from the worked metal prior to its being annealed, they will leave stains in the form of carbon deposits on the metal when it is subsequently annealed. While straight mineral oils are satisfactory with respect to their cost, cooling properties, and stability, they, as do the animal and vegetable oils, also have a disadvantage in that unless they are removed from the worked metal prior to its being annealed, they will leave a stain on the surface of the annealed metal. Water-oil emulsions are advantageous in that they may easily be removed from metal surfaces by washing with water prior to annealing, but this step in itself complicates the working process. Water-oil emulsions have a further disadvantage in that with repeated use as cold-working lubricants the water tends to evaporate from the water-oil emulsions thereby changing the ratio of water to oil. Since the ratio of water to oil should be kept as uniform as possible to obtain optimum results, frequent analysis of the lubricant is required thereby adding complexity to the process.

It is an object achieved by this invention to provide a lubricant for lubricating metal surfaces during the cold working thereof, said lubricant which if allowed to remain on the metal during a subsequent annealing operation will not stain the metal or form carbon residues thereon.

A further object achieved by this invention is to provide a method of lubricating metal surfaces during cold working by means of a lubricant which if allowed to remain on the metal during a subsequent annealing operation, will not stain the metal or deposit carbon residues thereon.

These and other objects achieved by this invention will become apparent in the following detailed description thereof.

We have discovered that a cold-working lubricant comprising a petroleum lubricating oil normally tending to stain metals during the annealing thereof can be made substantially non-staining by incorporating in said lubricant a small amount, sufficient to substantially retard the formation of stain on the metal when it is subsequently annealed, of triisopropyl toluene. We have found that the triisopropyl toluene is advantageously incorporated in the oil normally tending to stain metals in an amount between

about 0.5 and 3.0 per cent by weight. If less than about 0.5 per cent of triisopropyl toluene is employed, the staining properties of the oil are not substantially improved. While more than about 3.0 per cent of triisopropyl toluene may be added to the oil without deleteriously modifying its lubricating properties, it is not ordinarily desirable from an economic standpoint. In accordance with our invention, the surfaces of a metal being worked are lubricated by establishing and maintaining thereon a film of the herein disclosed improved cold-working lubricant.

In the practice of our invention, any suitable lubricating oil base, whether it is derived from a paraffinic, naphthenic, or mixed base crude, may be employed. Although it is seldom necessary in compositions of the type disclosed herein, the lubricating oil base may contain one or more of the so-called "additive" agents including oiliness and extreme pressure agents, viscosity index improvers, pour point depressants, detergents, foam inhibitors, and corrosion and oxidation inhibitors. The particular lubricant chosen depends on the type of cold-working operation for which it is intended. For example, oils used in cold rolling are generally highly refined and are relatively volatile having viscosities between about 50 and 200 SUS at 100° F., whereas oils used in drawing operations may have viscosities as high as 5000 SUS at 100° C. It is not intended to limit this invention with respect to the particular lubricating oil base.

The advantages to be obtained in accordance with our invention are illustrated in the following comparative laboratory tests made on a highly refined naphthenic base oil having a Saybolt Universal Viscosity of 53 at 100° F. and the same oil containing a small amount of triisopropyl toluene. To simulate actual operating conditions of the annealing of cold-rolled aluminum, 1 ml. of the oil to be tested was placed between two aluminum plates (99.2% aluminum). The aluminum plates were then placed in a muffle furnace for 30 minutes at a temperature of 650° F., this being the temperature of the metal as determined by a thermocouple. The plates were then removed and inspected. The appearance of the aluminum after annealing, as tabulated hereinbelow, was determined by visual inspection and comparison with a blank set of plates.

Lubricating Composition	Per Cent by Weight Triisopropyl Toluene	Appearance of Aluminum after Annealing
Base Oil (53 SUV at 100° F.)	0	Severe Stain.
Do.	0.5	No Stain.
Do.	1.0	Do.
Do.	2.0	Do.
Do.	3.0	Slight Strain.

While the above compositions have been tested on cold-rolled aluminum plates, the method of our invention is advantageous when applied to any metal being cold-worked and subsequently to be annealed. For instance, the method of our invention is applicable to the cold-working of nonferrous metals other than aluminum, such for example, as magnesium or Monel metal, and is also satisfactory for the cold rolling of stainless steel, particularly when such metals are to be annealed after cold-working, and where it is desirable that the surfaces of such metals be clean and bright after annealing. The improved lubricant in accordance with our invention obviates the expensive step of removing the oil film from the metal prior to its being annealed and, at the same time, overcomes the staining which normally would occur in the annealing operation when employing a straight mineral lubricating oil as a lubricant for the cold working of metals.

While our invention has been described herein with particular reference to certain specific embodiments thereof by way of illustration, it is to be understood that the invention is not limited to such embodiments except as hereinafter defined in the appended claims.

We claim:

1. An improved cold-working lubricant comprising a petroleum lubricating oil normally tending to stain metals during the annealing thereof and 0.5 to 3.0 per cent by weight of triisopropyl toluene.

2. In cold rolling aluminum subsequently to be annealed, the improvement which comprises lubricating the surfaces of the aluminum being rolled by establishing and maintaining thereon a film of lubricant comprising a highly refined relatively volatile petroleum lubricating oil which would normally tend to stain said aluminum surfaces during annealing thereof and between about 0.5 and 3.0 per cent by weight of triisopropyl toluene.

ALBERT G. ROCCHINI.
RICHARD J. NEELY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,203,044	Brown	June 4, 1940
2,258,930	Haefner	Oct. 14, 1941
2,344,912	Young	Mar. 21, 1944
2,355,993	Morgan	Aug. 15, 1944
2,403,238	Rosenstiehl	July 2, 1946
2,430,400	Hoelscher	Nov. 4, 1947