Patented Aug. 27, 1946

2,406,683

UNITED STATES PATENT OFFICE

2,406,683

ELECTROPLATED DRIFT FREE SPRING

Franz R. Hensel, Earl I. Larsen, and Alfred M. Suggs, Indianapolis, Ind., assignors to P. R. Mallory & Co., Inc., Indianapolis, Ind., a corporation of Delaware

No Drawing. Application February 9, 1943, Serial No. 475,276

2 Claims. (Cl. 204—27)

1

This invention relates to plated metal springs.

An object of the invention is to improve electroplated metal springs.

Other objects of the invention will be apparent from the description and claims.

It often becomes necessary or desirable to electroplate metal springs for the purpose of improving their corrosion resistance, oxidation resistance or improving their appearance. Heretofore the electroplating operation has been applied to the finished springs.

We have discovered that electroplating the springs introduces undesired stresses in the springs which accelerate their drift characteristics. The present invention contemplates a process of making electroplated springs free of plating stresses. According to the present invention, the springs are subjected to a process step after plating which relieves such plating stresses. This comprises a low temperature annealing step. This may be applied immediately after plating or the plating may be done at a semi-finished stage followed by subsequent rolling or other cold reduction operations and the annealing step applied after such operations have been performed.

The springs may be formed of age-hardened copper alloys such as copper-beryllium alloys as well as non-aged materials such as phosphor-bronze, spring brass, nickel base spring materials such as zinc-nickel, Monel metal, iron base spring materials such as spring steel, alloy steel, and carbon steel and silver base spring materials such as silver-nickel alloys.

The spring stock may be in flat strips, wires or other shapes depending on the use to which it is to be applied.

The electroplated coatings may be applied by conventional electroplating processes for plating pure metals or alloys. Electroplates which may be applied are nickel, zinc, cadmium, tin, the precious metals such as silver, palladium, platinum, rhodium and gold, and alloys such as silver-thallium alloys, silver-lead, gold-thallium, and gold-lead. Chromium may also be used as the electroplated coating but in this case it is only applicable where the coating is applied after all mechanical working or reduction operations have been performed.

In the case of the other coatings, they may be applied during an intermediate stage in the processing of the spring material followed by rolling, swaging, drawing and similar operations, or they may be applied after the final reduction.

In any event, a low temperature annealing operation is applied after electroplating. Where

2

reduction operations are applied after plating, the annealing is preferably applied after these have been completed. The annealing comprises raising the plated spring material to a temperature between 100 and 350° C. depending on the composition of the spring material and plating and holding them at that temperature for a period of from several minutes to several hours. The period will depend on temperature and on spring and plate composition but will generally fall between 10 minutes and 4 hours.

The preferred range of annealing temperatures is between 200 and 300° C. In the case of cold worked alloys, the annealing temperature should be kept below the temperature of recrystallization of the spring alloys. In the case of age-hardened alloys, the annealing temperature should be at or below the age-hardening temperature which is used. In the case of steels, the annealing temperature should be below the drawing temperature of the steel. These temperatures may be described generally as below the annealing temperature of the spring metal which may be defined as the temperature at which no further deleterious recrystallization or aging or tempering takes place depending on the composition of the spring material. In other words, the annealing temperature for the electroplate should be below the temperature where the physical, and particularly the elastic, properties of the spring metal are adversely affected.

In some cases, the annealing treatment or the hot and cold working operations subsequent to plating will also result in a certain amount of diffusion between the electroplate and the spring metal improving the bond and increasing the uniformity of the spring.

As an example of the improvement obtained by the present invention, springs of phosphor bronze strip .010 inch thick were tested under 17,000 pounds per square inch stress. An unplated spring, "as received," showed a drift of .0037 inch per year. A similar spring which had been nickel plated, on the other hand, showed a rate of drift of .0151 inch per year. By annealing at 200° C. for two hours, the drift of the nickel plated spring was reduced to .0034 inch per year. The drift of the unplated spring was substantially unaffected by this annealing.

The effect of plating stresses, and hence the improvement obtained by annealing, is most pronounced with thin springs as the ratio of plate thickness to spring thickness is higher in these and so residual plating stresses have a greater effect on the spring.

While specific embodiments of the invention have been described, it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. The method of making a corrosion resistant spring having low drift characteristics which comprises electro-plating a layer of corrosion resistant material upon a spring metal body composed of a copper-beryllium alloy, said plating accelerating the drift characteristics of said spring metal, and heat treating the plated spring metal body at a temperature within the range of about 100° C. to about 350° C. but below the recrystallization temperature of the copper-beryllium spring alloy for a period of about 10 minutes to about 4 hours to thereby eliminate the accelerated drift characteristics of the spring metal.

2. The method of making a corrosion resistant spring having low drift characteristics which comprises electroplating a layer of corrosion resistant material upon a spring metal body composed of a copper-beryllium alloy, said plating accelerating the drift characteristics of said spring metal, cold working the plated spring metal body, and heat treating the cold worked plated body at a temperature within the range of about 100° C. to about 350° C. but below the recrystallization temperature of the copper-beryllium spring alloy for a period of about 10 minutes to about 4 hours to thereby eliminate the accelerated drift characteristics of the spring metal and relieve the internal stresses caused by the cold working.

FRANZ R. HENSEL.
EARL I. LARSEN.
ALFRED M. SUGGS.