Patented July 12, 1927. 1,635,443

UNITED STATES PATENT OFFICE.

WILLOUGHBY STATHAM SMITH, OF NEWTON POPPLEFORD, AND HENRY JOSEPH GARNETT, OF SEVENOAKS, ENGLAND.

MANUFACTURE OF CABLES LOADED WITH ALLOYS OF HIGH-MAGNETIC PERMEABILITY.

No Drawing. Application filed January 8, 1926, Serial No. 80,100, and in Great Britain June 17, 1925.

It is well known to be necessary, in order to develop high inductances in cables loaded with alloys of high magnetic permeability, that the loading material should be annealed and left entirely free from strain in situ.

This invention relates to a process by which it is possible to develop high inductances in loaded conductors covered with very tightly wound ribbon, tape or wire.

According to this invention, the process of annealing a tightly wound loaded conductor comprises a comparatively low temperature heat treatment, followed, after cooling, by a comparatively high temperature heat treatment. The purpose of the preliminary heat treatment is to relieve the tension and remove substantially all strain in the winding, so that the loading material is brought to a condition adapted for its magnetic properties to be more fully developed by the subsequent heat treatment proper.

Generally, a temperature in the region 500 to 650° C. is sufficient for the preliminary heat treatment in the case of loading alloys commonly employed, whilst the temperature of the second heat treatment lies substantially between 880° and 920° C. according to the particular alloy employed and the inductance required. After each treatment the conductor is cooled at a moderate speed to room temperature.

To avoid deterioration of the copper, the heat treatments are preferably effected in a current of an inert gas, such as nitrogen, and the conductor is not allowed to come into contact with air until cold.

The annealing is preferably carried out in a tube within an electric furnace of the metallic resistor type. In practice it is advantageous to use a number of annealing tubes within one furnace so that several conductors may be annealed at the same time. The duration of annealing is governed by the size of the conductor, and controlled by the speed of its forward travel.

It should not be unduly short, but preferably, say about two minutes for conductors of normal size. The duration of each cooling preferably approximates to the duration of heating.

In practice to prevent the annealed conductor from coming into contact with the air before it is cold, a cooling tube is formed as a continuation of the annealing tube. Preferably the cooling tube is provided with a water-circulating jacket so that the conductor is cooled to room temperature in a tube of approximately the same length as the furnace tube.

The following are examples of the annealing and results obtained according to the inventon:—

Example 1.

A copper conductor weighing 350 lbs. per nautical mile, and loaded with wire 36 S. W. G. of an alloy composed of

	Per cent.
Nickel	74.0
Iron	20.2
Copper	5.3
Manganese	.5

has given an inductance of 75.7 millihenries per nautical mile, after annealing at 515° C. and 880° C. and a conductor of the same size, loaded with wire (of the same size), and formed of the same alloy, has given an inductance of 140 millihenries per nautical mile after annealing at 650° C. and 920° C.

For a conductor of the above size, and with a furnace 14 feet long, a forward travel of seven feet per minute is found to be suitable.

Example 2.

A conductor weighing 600 lbs. per nautical mile, and loaded with wire 34 S. W. G. of an alloy composed of:—

	Per cent.
Nickel	76.0
Iron	16.5
Copper	5.0
Manganese	.5
Chromium	2.0

has an inductance of 75 millihenries per nautical mile after a single heat treatment at 650° C., but after a second heat treatment at a temperature of 880° C. the same loaded conductor has an inductance of 140 millihenries per nautical mile.

For a conductor of this size, and with a furnace 14 feet long, a forward travel of 6.5 feet per minute is suitable.

What we claim is:

1. The process of annealing a tightly wound loaded conductor which comprises a comparatively low temperature heat treat-

ment followed, after cooling, by a comparatively high temperature heat treatment.

2. The process of annealing a tightly wound loaded conductor which comprises a heat treatment at a temperature between about 500° and 650° C. followed, after cooling, by a heat treatment at a temperature between about 880° and 920° C.

3. The process of annealing a tightly wound loaded conductor which comprises a heat treatment at a temperature between about 500° and 650° C. followed, after cooling substantially to room temperature, by a heat treatment at a temperature between about 880° and 920° C.

In testimony that we claim the foregoing as our invention we have signed our names this tenth day of December, 1925.

WILLOUGHBY STATHAM SMITH.
HENRY JOSEPH GARNETT.