Patented Dec. 13, 1932 1,891,050

UNITED STATES PATENT OFFICE

CLEMENS A. LAISE, OF NORTH BERGEN, NEW JERSEY, ASSIGNOR TO EISLER ELECTRIC CORPORATION, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE

ELECTRICAL CONTACT

No Drawing. Application filed September 11, 1930. Serial No. 481,337.

My invention relates to electrical contacts and particularly to tungsten electrical contacts and to a method of producing same.

An object of the invention is to produce a tungsten contact having not only a longer life than the ordinary tungsten contact, but also one which can be welded more readily to its support or backing of base metal. The contact is particularly useful as an electrical make and break contact of the vibratory impact type.

In the manufacture of tungsten contacts at present, wrought tungsten is employed which has either a fibrous structure or a flaky structure depending upon the mechanical process employed in working the tungsten. If the tungsten is worked by swaging it into rods, then the material assumes a fibrous structure; if the tungsten is rolled into a sheet, the individual grains have a flattened or flaky structure.

Tungsten contacts consist of tungsten disks suitably brazed or soldered to a base metal support. To make these contact disks out of the tungsten rod, the latter is transversely sliced into the thin contact disks by any suitable cutting means. On the other hand, the contact disks may be made from the sheet by punching them out of the sheet. Tungsten disks prepared as described from the rod have a fibrous structure; and disks prepared from the sheet have a flaky structure.

I have found that if I subject these contact disks possessing either the fibrous or flaky structure to a special heat treatment, either before or after they have been prepared from a tungsten rod or sheet, I can destroy the structure produced by the mechanical working and recrystallize same into a very fine grained structure which is neither fibrous nor flaky.

Contact disks having this recrystallized finely grained structure give better results than those having the flaky or fibrous structure. Not only is the life of the contacts improved but also the contact disks may be welded more readily to the base metal mounting or backing. There may be various explanations for this but it seems that, through the recrystallization treatment, the strain in the tungsten grains is relieved and consequently when these grains are subjected to vibratory impact action, the growth of the grains is far less than it would be if they were under strain, it being a well known fact that grain-growth of metal under strain is far more rapid than when the grains are equiaxed or not under strain. Since the rate of disintegration of electrical contacts depends upon the rate of growth of the grains, it follows that the life of contacts in which the grains are under strain, such as in the fibrous or flaky condition, is shorter than that in which the grains are not under strain. In short, a carefully recrystallized contact of fine grained structure coming within my present invention has a longer life than the fibrous or flaky structured contacts in which the grains are under strain. Moreover, my recrystallized tungsten disks have such a superior surface for co-action with the brazing metals to attach same to the base metal support of the disks, that a much stronger joint is produced at the weld than is the case with fibrous or flaky structured contact disks. This is especially true when the recrystallized tungsten disks are slightly etched with an alkaline peroxide or ferrocyanide solution or other suitable etching solution. The result is not only a very strong joint between the contact disk and the backing but also a joint having good electrical conductivity. In this regard also my improved contact is superior to the fibrous or flaky structured contact.

My specially recrystallized tungsten contact disks may be produced by several processes. The preferred process consists in starting with very finely grained sintered tungsten ingot. This is then worked down mechanically with repeated annealings alternating with the mechanical workings. The annealing is performed approximately after every 25% reduction in diameter of the material. Thus, if I started swaging at .400″ diameter, my first step of re-annealing would be at .300″, my second step at .225″, and my third step at .180″. Each annealing comprises subjecting the tungsten rod to a white heat of about 2000° C. to 2600° C. for

a period of a few minutes. Usually two to ten minutes is sufficient depending upon the degree of purity of the tungsten. This annealing is done in a reducing, inert or hydrogen atmosphere. The annealing heating may be effected electrically by sending a current through the material, or by placing the material in an electric furnace such as a carbon tube furnace; or it may be done in a specially high temperatured gas furnace. Similarly, if the tungsten be prepared in sheet form, it will be appropriately annealed in accordance with the foregoing between the rolling operations. The swaging or rolling is, of course, carried out while the metal is hot according to well known metal working practice.

After I have the finished rod or finished sheet, the rod is cut up into disks of the desired thickness or the sheet is punched out in round or square disks of the size desired, and these disks are again subjected carefully to a quick heat recrystallizing treatment in a carbon tube furnace or in a special tungsten tube or other high temperature furnace. However, in most cases I prefer to give the recrystallizing treatment to the finished rod or sheet before it is cut or punched into the contact disks in order to convert any fibrous or flaky structure into the described finely grained structure.

In other words, recrystallization may be carried out by heating the rod or sheet before cutting or punching the disks; or the flaky sheet or fibrous rod may be punched or cut into disks which, of course, may be either flaky or fibrous, and these disks may then be recrystallized by the described recrystallizing heat treatment.

This recrystallizing treatment comprises a high temperature heat treatment, preferably by sending a current through the tungsten material for a short period of time, from one-half minute to ten minutes depending upon the size of the bar, sheet or ribbon. The temperature of this recrystallizing treatment is arranged to be between 1800° C. and 2400° C., and said temperature and the time of treatment are carefully chosen to accord with the size of the bar or sheet under treatment so that the resultant recrystallization is very finely grained. This high temperature treatment is carried out in a reducing, inert or hydrogen atmosphere like the annealing. Naturally, the contact disks formed from the recrystallized rod or sheet have a structure which is also very finely grained and free from tension or equiaxed and have neither a fibrous nor flaky structure.

I prefer a grain count for these contacts which is above 10,000 to the square millimeter but, as stated, this is preferential and not essential to the invention.

It will be understood that my invention applies not only to tungsten but also to tungsten alloys and to other refractory metals suitable for use in contacts, such as molybdenum.

Without limiting the invention to the precise details herein described, what I claim as my invention is:

1. A wrought tungsten electrical contact having a finely grained structure as distinguished from a fibrous or flaky structure.

2. A wrought tungsten electrical contact having a recrystallized structure of fine grain count as distinguished from a fibrous or a flaky structure.

3. A wrought tungsten electrical make and break impact contact having a finely grained structure as distinguished from a fibrous or flaky structure.

4. A wrought tungsten electrical contact having a finely grained structure as distinguished from a fibrous or a flaky structure and having a grain count above 10,000 to the square millimeter.

5. Method of making electrical contact points which comprises, as a final step without being followed by any mechanical working, subjecting tungsten metal for said contact points having a fibrous or flaky structure to a high temperature for a short time sufficient to recrystallize same to have a finely grained structure, substantially free from flakes or fibers.

6. Method of making electrical contact points which comprises, as a final step without being followed by any mechanical working, subjecting tungsten metal for said contact points having a fibrous or flaky structure in a reducing or inert atmosphere to a temperature between substantially 1800° C. and 2400° C. to recrystallize same to have a finely grained structure, substantially free from flakes or fibers.

7. Method of making electrical contact points which comprises, as a final step without being followed by any mechanical working, subjecting tungsten metal for said contact points having a fibrous or flaky structure to a white heat for a short time sufficient to recrystallize same to have a finely grained structure, substantially free from flakes or fibers.

8. Method of making electrical contact points which comprises mechanically working down a finely grained sintered tungsten ingot, alternating said mechanical working with annealings at a white heat for a period of a few minutes in a reducing or inert atmosphere to produce a rod or sheet, the rod adapted to be cut up into disks and the sheet to be punched out into disks for making up into the contacts; and finally subjecting said rod or sheet or contacts to a white heat treatment for a short period of time sufficient to recrystallize a fibrous or flaky structure into a finely grained structure.

9. A wrought refractory metal electrical

contact having a finely grained structure as distinguished from a fibrous or a flaky structure.

10. A wrought refractory metal electrical contact having a recrystallized structure of fine grain count as distinguished from a fibrous or a flaky structure.

11. A wrought refractory metal electrical contact having a finely grained structure as distinguished from a fibrous or a flaky structure and having a grain count above 10,000 to the square millimeter.

12. Method of making electrical contact points which comprises subjecting a refractory metal for said contact points having a fibrous or a flaky structure to a white heat for a short time sufficient to recrystallize same to have a finely grained structure.

In witness whereof, I have hereunto subscribed my name this 9th day of September, 1930.

CLEMENS A. LAISE.