May 17, 1927. 1,629,345

F. KOREF

DEVICE FOR TRANSFORMING THE CRYSTALLINE STRUCTURE OF WIRES

Filed July 6, 1922

Fig. 1.

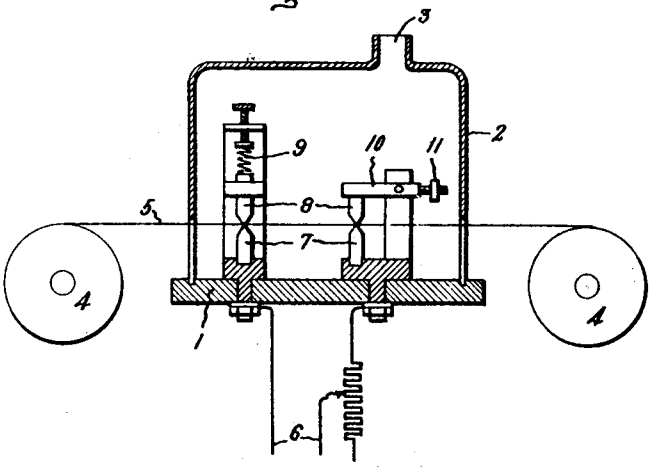


Fig. 2.

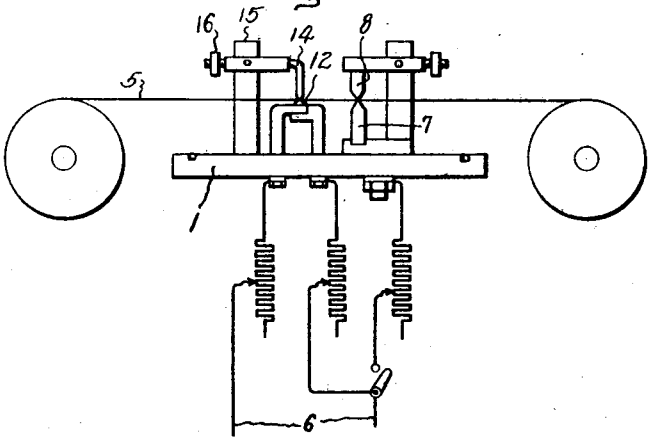
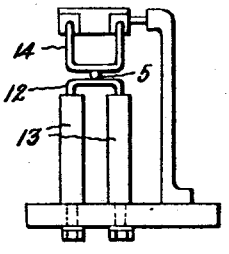


Fig. 3.



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UNITED STATES PATENT OFFICE.

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DEVICE FOR TRANSFORMING THE CRYSTALLINE STRUCTURE OF WIRES.

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The object of the invention is a device for the transformation of the structure of wires, filaments, strips and the like from refractory metals, such as tungsten. This transformation may be effected in such manner that the wires, filaments, strips and the like are moved continuously between two current-supplying members and the part situated between the members is brought to an extremely high temperature by the electric current. The current-supplying members utilized for this purpose have previously been mercury contacts. At the high temperature of the wires, filaments, and the like, the mercury contacts must be greatly cooled. Nevertheless, it is difficult to avoid the vaporization of the mercury and its deposition on the cooler parts of the apparatus.

The device of the present invention is free from this difficulty. According to the invention the current-supplying members consist, as to the portions that come in contact with the wire, of extremely high fusing materials, tungtsen for example. The cooling operation is dispensed with and provision is made, by reason of the shape of the parts that come in contact with the wire, or otherwise as described hereinafter, that these parts assume quite a high temperature, a bright red glow for example. This is particularly true of the current-supplying member which is situated at the admission side of the wire which is being moved. It has been found that, when such a current-supply member is employed at the admission side of the wire, filament or the like which is being moved, the transformation of the structure into the structure desired is much more perfect and uniform. The reasons for this will be understood if the progress of the transformation is more closely considered. The transformation consists in a continuous crystallization, the arriving structural elements, that is, the fresh portions of the wire which enter the circuit, being absorbed by the larger crystal or piece of crystal which is formed. The more abrupt the rise of temperature, the more uniform or free from disturbances will the transformation be. In particular, there is a zone of temperature, within which the new structural formation, is possible, but proceeds more slowly than the speed of feeding the wire, which zone must be passed through as quickly as possible. Moreover the progress of the rise of temperature in the wire being moved must always be the same after passing the place of contact, so that the point where the crystallization sets in, is always the same distance from the place of contact. Even with variations of fractions of a millimeter, the progressive crystallization might easily be interrupted, and this would result in defects, for example places of coarse-crystalline structure. These conditions of a rapid and persisting rise of temperature are fulfilled in the device of the invention in a much more perfect manner than in the case of the use of the mercury contacts heretofore used. After passing the cooled mercury contacts, the rise of temperature extends over a wide range, namely from about 200 to 300 degrees as a lower limit up to the temperature of transformation, which is about 2300 to 2500 degrees. But when contact points of extremely high fusing materials are used, the temperature at the contact point itself may rise nearly to that temperature where the speed of crystallization in the wire finally begins to assume values, that is, about 1500 to 1800 degrees. The rise of temperature therefore in this case extends between two points much nearer together and therefore is more readily preserved from disturbances.

My invention will be better understood by reference to the accompanying drawing in which I have illustrated certain embodiments of my invention and in which Fig. 1 is a longitudinal section through one form of device embodying my invention; Fig. 2 in a side view of another form; Fig. 3 is an end view of the left half section of the device of Fig. 2.

The particular apparatus illustrated in Fig. 1 comprises a base 1 and a removable cover 2 cooperating with the base to form a substantially closed chamber into which inert gas, such as forming gas, can be introduced through an inlet 3, and allowed to escape through any suitable vents. Forming gas, of course, consists of a mixture of hydrogen and nitrogen. Feeding mechanism, such as rolls 4, moves the wire 5, which is to be transformed, longitudinally through the chamber through slots in the cover 2. Current for heating a short section of the wire 5 in the chamber is furnished from a supply circuit 6 which is connected to contacts mounted in the chamber and spaced apart at the proper distance.

In a suitable construction of the device in accordance with my invention the contacts or current supply members for supplying the heating current to the wire 5 consist of two blocks 7 and 8 of extremely high fusing metal which are pressed together by a light spring 9 against the wire 5 which is moved forward between them. The power of the spring will be so selected that it is just enough to maintain continuous contact and to avoid unnecessary friction on the moving wire 5. One of the two blocks, such as 7 must necessarily be of conducting metal, for example, tungsten or molybdenum, while the other one, 8, may be a poor heat conductor and may consist for example of highly sintered thorium oxide. Since the blocks need not be cooled they assume and maintain a high temperature.

It has been found desirable to grind both blocks 7 and 8, or at least one of them at the point of contact to a knife edge which is arranged transversely to the direction of movement of the wire 5. The advantage of this form of contact is that the heat conduction is reduced so that the point of contact assumes a higher temperature than is the case with a cylindrical block.

The pressing together of the two blocks 7 and 8 by spring power such as the spring 9 is recommended in cases where the wire 5 is being moved in a perpendicular direction. If the movement of the wire is in a horizontal direction some other construction may be selected and the two blocks 7 and 8 may be arranged one above the other perpendicularly and coaxially. In this case, the upper block 8 is free to move and presses by its own weight the wire 5 against the lower block 7 and thus assures a contact. In order to limit the load on the wire 5 and its friction to the least possible mount which is necessary for good electrical contact, the upper block 8 may be inserted in one end of a pivoted or scale beam 10 and its pressure on the lower block may be regulated by means of a suitable counterweight 11 arranged on the other end of the beam 10 which counterweight may, if desired, be adjustable.

It has in many cases been found to be particularly advantageous to adopt another construction in which instead of the two or one of the two blocks 7 and 8, a contact wire or strip 12 of extremely high fusing metal, preferably tungsten, arranged transversely to the direction of movement of the wire 5 is employed and this wire contact 12 is heated electrically. For example, as illustrated in Figs. 2 and 3 the wire contact 12 which is made of comparatively heavy tungsten wire, is mounted on pedestals 13 secured to the base 1 and insulated from each other but connected to the source of current 6, as shown diagrammatically in Fig. 2, so that the desired amount of current may be passed through the wire contact 12. In this way it becomes possible in a simpler manner to bring the point of contact of the wire 5 with the heated wire contact 12 to any desired temperature. This latter temperature is so chosen that at that temperature, crystallization does not take place in the wire 5 that is being moved over the contact. The choice of a higher temperature is prohibited for the reason that the wires 5 and 12 would then easily adhere. As indicated in Fig. 2, this construction will be chosen only for the leading contact which engages the wire 5 as it enters the zone of incandescence, while at the exit side the simpler construction of the contacts, such as the knife edged blocks 7 and 8 will be sufficient. In order to maintain good electrical contact between the wire 5 and the heated wire contact 12 I provide a presser 14 of some high fusing metal such as tungsten wire bent into the form of a yoke and carried on a pivoted fork 15 provided with a counterweight 16 by means of which the pressure exerted by the presser 14 to hold the wire 5 against the heated wire contact 12 can be regulated as desired.

I wish it understood that the temperature scale to which I refer in this specification is centigrade.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In apparatus for transforming the crystalline structure of wires and the like composed of high fusing metals such as tungsten by a continuous process comprising the heating of a portion of the wire to high incandescence, the combination with contacts of very high fusing material, such as tungsten or molybdenum and adapted to be connected to a source of current, of means for guiding the wire to be transformed over said contacts to heat the portion of the wire between them.

2. In apparatus for transforming the crystalline structure of small crystal tungsten wires by electrical heating, the combination of two sets of contacts, each consisting of two blocks of very high fusing material and resilient means for pressing one toward the other, and means for passing the wire to be transformed through said contacts and between said blocks whereby current may pass through said wire.

3. In apparatus for transforming the crystalline structure of tungsten wire by electrical heating, the combination of electrical contacts, each comprising a pair of blocks mounted one above the other to permit the upper block to move freely toward the lower one by gravity, and means for passing the wire to be transformed between said contacts and between said blocks to pass current through said wire.

4. In apparatus for transforming the crystalline structure of tungsten wire by electrical heating, the combination of an electrical contact comprising two blocks mounted one above the other with the upper block free to move toward the lower, an adjustable counterweight for regulating the pressure of the upper block on the lower one, and means for passing a wire between said blocks to make electrical contact therewith.

5. In apparatus for transforming the crystalline structure of tungsten wire, the combination of contacts for passing current through said wire, one of said contacts comprising two blocks and means for pressing one toward the other, one of said blocks being composed of a refractory material of poor heat conductivity such as thorium oxide, and means for passing the wire to be transformed between said contacts and between said blocks.

6. In apparatus for transforming the crystalline structure of tungsten wires by electrical heating, the combination of two contacts, one composed of two knife edged blocks one mounted to move freely toward the other to bring said knife edges into engagement, and means for moving a wire through said contacts and between said knife edge in a direction transverse to said knife edges.

7. In apparatus for transforming the crystalline structure of tungsten wires by electrical heating, the combination with means for moving longitudinally the wire to be transformed, a pair of contacts mounted to engage said wire and spaced apart to heat a portion of said wire to high incandescence and maintain a zone of high temperature, one of said contacts comprising an electrically heated wire or strip of very high fusing metal such as tungsten arranged transversely to the direction of movement to the wire to be transformed and in engagment with it.

8. In a device for transforming the structure of a strip of a refractory metal into macro-crystalline form, in combination a pair of contacts, one being of a refractory metal, between which contacts the strip is adapted to be drawn, and a source of current connected to said contacts for heating the strip between the contacts and for heating one of the contacts to a temperature at or in the neighborhood of read heat.

9. In a device for transforming the structure of a strip of a refractory metal into macro-crystalline form, in combination a pair of contacts, one being of a refractory metal, between which contacts the strip is adapted to be drawn, and a source of current connected to said contacts for heating the strip between the contacts and for heating one of the contacts to a temperature at or in the neighborhood of red heat, one of said contacts comprising two elements between which the metal passes while being drawn, and means for yieldingly holding one of said elements against the metal.

10. In a device for transforming the structure of a strip of a refractory metal into macro-crystalline form, in combination a pair of contacts, one being of a refractory metal, between which contacts the strip is adapted to be drawn, and a source of current connected to said contacts for heating the strip between the contacts and for heating one of the contacts to a temperature at or in the neighborhood of red heat, said contacts located in a non-liquid surrounding medium.

11. The process of transforming a refractory metal into macro-crystalline form which consists in moving the metal across two contacts which are the terminals of a source of potential, and thereby heating the metal to a temperature corresponding to red heat and thereby also heating one of the contacts to prevent the metal from being chilled.

12. The process of transforming a refractory metal into macro-crystalline form which consists in subjecting the metal to a heating electric current between two terminals of a source of current and thereby heating the metal to a red heat and at the same time heating one of said terminals to assist in maintaining the temperature of the metal.

13. The process of transforming a refractory metal from one form to another, which consists in drawing the metal across the terminals of an electric circuit and thereby heating the metal and in maintaining the temperature of the wire as it passes from one terminal to the other at substantially the same temperature, the terminal at which the metal leaves the circuit being at a temperature approximately equal to that of the metal as it leaves the circuit.

14. The process of transforming a wire of refractory metal into a macro-crystalline form which consists in subjecting the wire to an electric current to thereby heat the wire by drawing the wire across the terminals of an electric circuit and in maintaining the temperature at the point of crystallization, the terminal at which the metal leaves the circuit being a solid and being maintained at a temperature approximately equal to that of the heated metal as it leaves the circuit.

In witness whereof, I have hereunto set my hand this 15th day of June, 1922.

FRITZ KOREF.