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PROCESS FOR HEATING WIRE

Wilber H. Convers, Poughkeepsie, N. Y.

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This invention relates to a method for annealing or oxidizing a moving wire during its travel through the device. The invention is especially adaptable for the purpose of annealing wire which is to be insulated. The device for carrying out the method may be installed in a wire insulating machine, or in other machines where it is desired to anneal the wire at a high rate of speed or at the same rate of speed as that at which the wire moves through the machine to which the device is attached. The invention is very suitable for use where it is desirable to clean or prepare the surface of bare wire before it is coated with insulation. The wire may be only annealed, or, by increasing the temperature the wire may be oxidized, if desired.

In the usual method now employed for annealing wire, the wire after being wound upon spools is placed in an oven and brought to the required heat for annealing, depending upon the size of the wire, etc. In this method, any soap or grease compound used in drawing the wire to size, which is wound up with the wire on the spools and annealed in the oven, is deposited upon the surface of the wire. When this soap or compound is covered with insulating material it will cause spots in the insulation. The same sort of trouble may occur when the wire is passed through a heated pipe or oven, or brought into contact with a flame or other direct heating means, either in a suitable chamber or exposed to the air.

Prior annealing methods are slow, require much handling, labor and expense and another great disadvantage in such methods is that the heated wire will stretch or elongate under any strain while it is hot. This is especially true of the smaller sizes of wire, and this elongation of the heated portion of the wire makes it hard to feed through an automatic winding machine for winding the wire into a coil, etc. In some cases, the diameter of the wire will be reduced by the stretch, thus rendering it unfit for many electrical purposes, due to increased resistance caused by the reduced diameter of the wire.

With my invention, it has been found that a speed of 400 to 600 feet per minute for #40 gauge wire and 200 to 300 feet per minute for #30 gauge wire can be employed without any noticeable stretch or elongation. With the degree of the annealing heat under perfect control, speeds higher than this can be easily reached without objectionable or appreciable elongation of the wire.

One of the objects of my invention is to pro-
vide a method for annealing or oxidizing a wire in a continuous manner during the travel of the wire through the apparatus.

Another object of this invention is to provide a method whereby, during the heating of the wire, no elongation or stretch of that portion of the wire which is being heated or any other portion of the wire takes place during such heat treatment.

Still another object is to provide a method whereby the wire is rendered free from oil and foreign matter preparatory to its being coated or enameled, when coating or enameling of the wire is desired.

A further object is to provide automatic method so that when heat is to be applied through an electric current to successive portions of the wire, the electric current is turned on and off by the travel of the wire in such a manner that should the wire become stationary, the current and therefore the heat will be reduced to prevent melting or overheating of that portion of the wire that is at that instant in position to be heated and the current is turned on when the travel of the wire attains a predetermined rate of speed. Also provision is made whereby variations in the speed of travel of the wire will not cause appreciable variations in the degree of annealing.

While I show and describe herein an illustrative embodiment of a suitable apparatus for carrying out my invention, it is understood that modifications may be employed, such, for example, as a duplication of parts and change in material and that the device may be enclosed or exposed to the air, and that suitable changes may be made to suit it to different sizes of wire or to wire of different material or metals, also that by suitable housing the device can be operated so that the annealing takes place in the presence of inert gases, steam, etc. to prevent tarnish forming on the surface of the wire due to the annealing operation.

My invention comprises a process which may be carried out by certain construction and combination of parts illustrated for example in the accompanying drawing in which Fig. 1 is a side view of the device showing it installed near a wire insulating machine; Fig. 2 is an enlarged side elevation of a portion of the device; Fig. 3 is a front elevation of the same, shown partly in section; Fig. 4 is a sectional view, taken on the line A—A of Fig. 3; Fig. 5 is a side elevation of the wheel for suspending the wire during the heating; Fig. 6 shows how the electric current that is supplied to the device may be varied within cer-
tain limits, and in proportion to speed changes in the rate of travel of the wire; Fig. 7 shows a modi-
ification by which automatic control of the cur-
cent can be secured.

The device as here illustrated comprises a base
of insulating material, and to which are se-
cured the two uprights 11 and 11' which are
formed at their upper ends with aligned bear-
ings 12 and 12' or a single support may be used
if desired.

A rotor comprising two sheaves or wheels 13
and 14 formed of a good electrical conductor such
as brass, are secured together side by side by
means of bolts or rivets 15 which are insulated
therefrom by the insulating bushings 16 and the
washers 17, while the sheaves 13 and 14 are se-
parated by a disk 18 of insulating material, in
such a manner that a sheave 13 is electrically
insulated from the sheave 14.

The sheave 14 is formed with a solid shaft 19
projecting from its outer face and adapted to
rotate freely in the bearing 12. The outer end of
this shaft 19 is pointed as shown at 20 and contacts with a flat spring 21, which is se-
cured to the upright 11 by the screw 22. If a
central upright is employed, as mentioned above,
the two sheaves may be mounted on one each side
thereof, and the spring 21 may be hinged to a
suitable base so that by removing the spring from
contact with the end of the shaft the wire may be
readily placed on or taken from the wheel.

This sheave 14 is also formed on its inner face
with a bore 23 extending partway therethrough
in line with the stud shaft 19. Within this bore
23 is mounted a cup-shaped bushing 24, and with
in this bushing 24 is secured one end of a shaft
25, the other end of which is freely rotatably
mounted in the bearing 12' of the upright 11'.
The shaft 25 is pointed at the end as shown at
26 and is in contact with a flat spring 21'. The
shafts 19 and 25 thus rotate in the bearings 12
and 12' and contact with the springs 21 and 21'.

The sheave 13 is recessed as at 27. Within the
recess 27 are pivoted on pivots 28 two con-
 tact arms 29 which are formed with weighten ends
30 which, when the sheave 13 is rotated, will by
centrifugal force move outwardly and bring the
arms 29 into contact with the shaft 25 thus es-
tablishing an electrical connection between the
sheave 13 and the shaft 25. This connection is
broken by the springs 45 when the wheel 13 stops
its rotation or reaches a sufficiently low speed to
enable the springs 45 to overcome the centrifugal
force.

The uprights 11 and 11' are connected by lead
wires 32 and 33, respectively, to an electrical
transformer 34 or other source of current which
in turn is connected to a power line 35 and 36,
the amount of current from which is governed by
a rheostat 37 connected in said power line. Each
of the sheaves 13 and 14 thus constitute a ter-
minal of the electric circuit.

Above the device and at some suitable dis-
sance (which may be varied to suit conditions) is
mounted a single sheave or wheel 38 which is
freely rotatable in a bracket 39 which is mounted
on a base 39' of insulating material, so that the
wheel 38 is insulated from all other parts of the
machine. This sheave may be made of heat re-
 sis tive or heat insulating material, such as
moulded mica or asbestos material with a proper
center bearing.

The wire 40 to be annealed is carried from a
supply spool 41 to the sheave 14, around which
it is given approximately one turn, and is then
carried up and around the sheave 38, then down
to the sheave 13, around it and to the idler wheel
42, to the applicer 43 for coating material, the
oven 44 and thence to the wheel 46 and take-up
spool 47.

It is understood that the sheave 38 may be lo-
cated at such a predetermined or justifiable distance
from the sheaves 13 and 14 depending upon the size
of the wire to be treated, the length of time
required for each treatment and the degree of
heat applied. In the application of electrical heat
in the commercial process, the current may be of
any desired voltage being controlled by a rheo-
 stat and automatic means applied to the device.

In this particular it may be here stated that while
I have shown an automatic switch built into the
wheel, that this may be located in connection
with any of the moving parts or other pulleys or
wheels and may be of any suitable construction
to open and close an electrical circuit by the
change of speed of travel of the wire.

In the automatic control illustrated in Fig. 8
of the sheave 42 comprising a ball governor 50
similar to that type used in phonographs, etc., so
arranged that speed variations, such as would
occur during starting and stopping, will vary the
current and thus insure an even annealing, this
being accomplished by a sliding collar 51 mounted
on the shaft 52 to which is pivotally secured one
end of the ball arms 50. The collar 51 is formed
with a groove 53 within which is placed one end
of a pivoted arm 54, the other end of which forms
the arm for the rheostat 55 which is connected
in the power line from the transformer 56, the
wires 32 and 33 being carried to the wheels 15
and 14.

It has been found in practice that sufficient
current to cause a proper annealing heat to be
generated in the wire when traveling is too great.
If the speed of travel is reduced and will vary to
fuse the wire. Also if the speed of the wire is
increased the flow of current must be increased
to anneal properly and it is highly desirable that
the annealing temperature be kept at the proper
amount at all times.

By having a constant or controlling arm 54
operated by the sliding collar 51, the pivot point
of the arm being at 57, the arm can be made to
move over a suitable row of contacts of the rheo-
stat 55 and vary the current applied to the trans-
former 56, thus any variation in speed of the wire
traveling over the wheel 46 will vary the cur-
cent for annealing.

Where no speed variations are encountered in
operation, a simple arrangement, as shown in
Fig. 7, may be employed. The motor 60 draws the
wire 40 and winds it on the spool 47 by the belt 61
and pulley 62. I have shown the primary of the
transformer 63 and leads 64 to the motor 62 con-
 nected in parallel to the power line 65 so that
as the motor is started the drop in voltage across
the terminals will drop across the transformer
and as the motor comes up to speed the current
will increase also in proportion. The secondary
of transformer 63 is used for annealing and I
have found this entirely satisfactory provided a
commutator starting type of motor is employed.

The simple centrifugal switch shown in Figs. 3
and 4 will suffice if a small amount of unannealed
wire is not objectionable at the start and stop of
the operation.

In the operation of the device, it will be seen
that part of the wire 40 which travels up from the
sheave 14 to the sheave 38 and back to the sheave

13 is always in the electrical circuit between the sheaves 13, 14 and acting as a resistance to the current is heated and annealed during its travel from the sheave 13 to the sheave 14, but that part of the wire 40 leading from the supply spool 41 to the sheave 14 and from the sheave 13 to the idler 42 is cold and as the two sheaves 13 and 14 are secured together they move in synchronism. Therefore, as the wire 40 is pulled from the sheave 13, the sheave 14 simultaneously turns the same amount. No elongation strain is exerted on the hot portion of the wire 40 between the sheaves 13 and 14, this part of the wire traveling freely. It is important that just sufficient tension be employed to keep the wire 40 in good electrical contact with sheaves 13 and 14, there being an expansion and contraction on heating and cooling the wire, so the wire should be slightly free to accommodate this action on the sheaves.

These portions of the wire which are in contact with the sheaves 13 and 14 act as contacts for leading the current to that portion of the wire which is looped up from the sheaves 13 and 14 to the sheave 38. Due to the heat conductivity of the sheaves 13 and 14, the wire which is in contact therewith is not heated. That portion of the wire which is being heated by the electric current may, if desired, be passed through a chamber and heated by any other suitable means.

Also the distance between the device and the pulley 38 may be varied as desired to govern the length of wire being heated and also the device may be so arranged that the sheaves 13 and 14 may be mounted on a central bearing and the springs 21 hinged so that the wire may be placed thereon from the side and not have to be threaded between the uprights 11 and 11'. It is also understood that direct current could be used instead of alternating, with suitable changes.

I claim:

1. The process of heating a wire which comprises moving said wire longitudinally in contact with separate electrical terminals whereby electric current flows through said wire between said terminals while tension on said wire is prevented, the direction of motion of said wire being reversed between said electrical terminals.

2. The process of heating a wire which comprises moving said wire longitudinally in contact with separate electrical terminals whereby electric current flows through said wire between said terminals, said terminals being located side by side and connected to each other by means other than said wire and moved at the same rate of speed as said wire.

3. The process which comprises moving a wire longitudinally and heating portions thereof in succession, in the shape of a U in accordance with the speed of movement of said wire and avoiding tension on the portions of the wire as they are being heated.

4. The process which comprises moving a wire longitudinally and heating portions thereof in succession in the shape of a U, avoiding tension on the portions of the wire as they are being heated, and cooling said wire at the hot end of said heated portions.

5. The process which comprises moving a wire longitudinally and heating portions thereof in succession, relieving tension on the portions of the wire as they are being heated, and cutting off the heat when the speed of movement of said wire becomes less than a predetermined amount.

WILBER H. CONVERS.