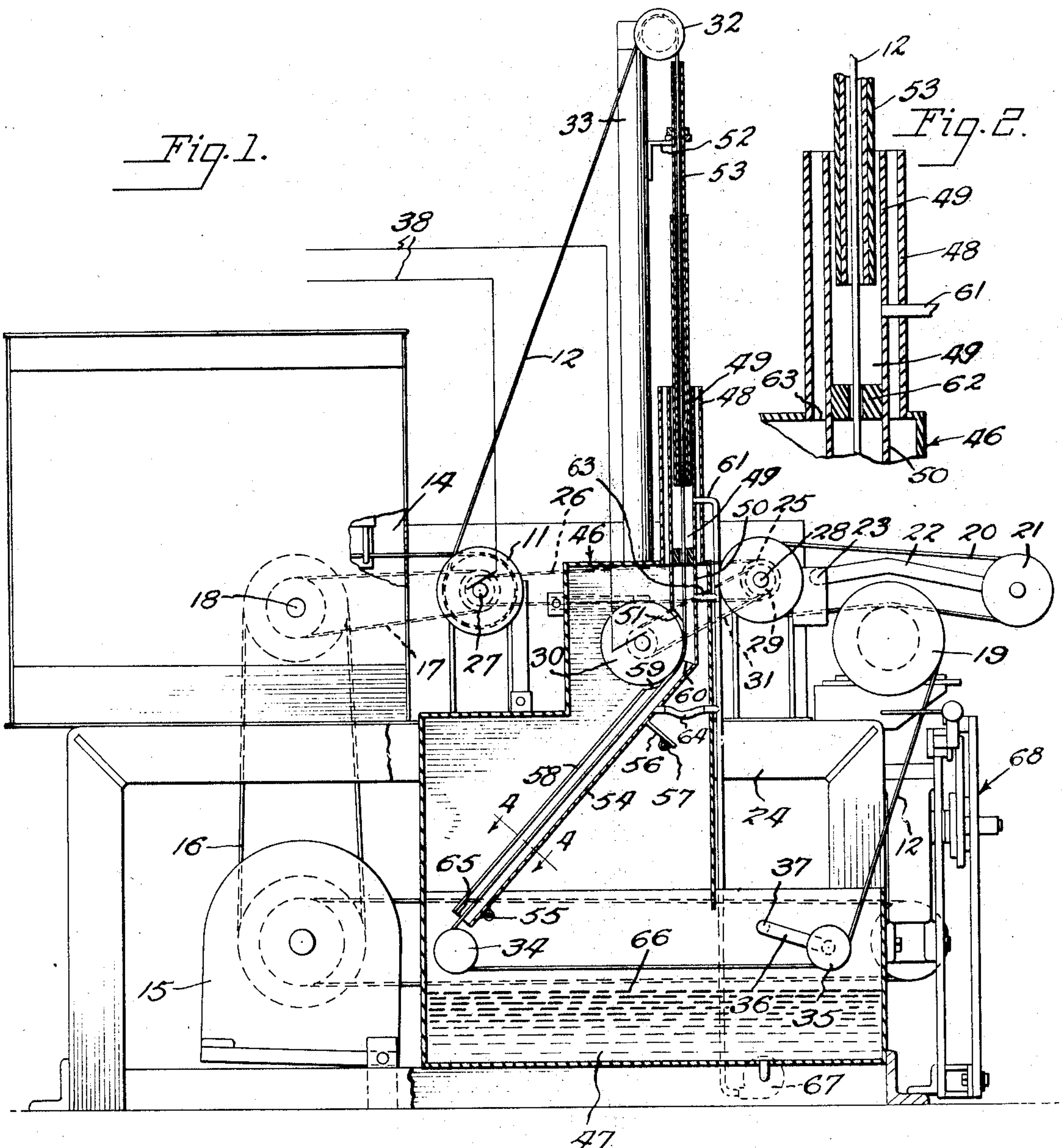
March 30, 1943. J. COOK 2,315,189

WIRE PRODUCING MECHANISM

Filed July 7, 1941

Fig. 1.

Fig. 2.



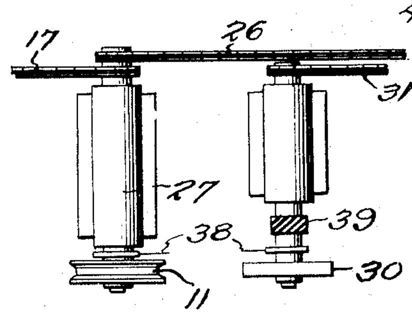


Fig. 3.

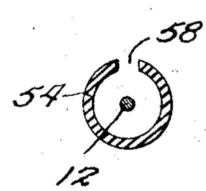


Fig. 4.

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WIRE PRODUCING MECHANISM

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4 Claims. (Cl. 266—3)

This invention pertains to apparatus for producing wire, and more particularly to the art of annealing wire.

The mechanism of the invention is directed to the art of heat-treating and quenching wire continuously, as it travels longitudinally. The cold-working of the wire-drawing operation hardens wire, and it is usually desirable to anneal drawn wire to the desired degree of softness. One object of the present invention is to provide apparatus to anneal wire more efficiently, and at less cost, than has been possible heretofore. Pursuant to this object the wire is heat-treated continuously, as it travels from the wire-drawing machine to the spooling machine, the wire being quenched continuously in the apparatus.

Heat is preferably applied to the wire by passing an electrical current through a predetermined length thereof between the drawing and spooling machines. The wire passes over electrical contactors through which the current of electricity is supplied. This causes the temperature to increase progressively from one contactor to the other.

The present invention is an improvement over my prior inventions, disclosed and claimed in my patents, Nos. 2,176,582 and 2,176,583, both granted to me October 17, 1939.

The surface of metal exposed to atmospheric conditions has a tendency to tarnish, or oxidize, and oxidation is greatly accelerated when the metal is heated to heat-treating temperatures. In the case of copper, oxidation is more pronounced than with some other metals. The practice of the present invention enables wire to be heat-treated without it becoming oxidized, and this is accomplished by passing that length of wire which is at oxidizing temperatures through a protecting atmosphere of steam.

The wire is preferably passed through an enclosing chamber into which water, or a water solution, is fed into contact with the surface of the wire. The heat of the wire operates to generate steam, which permeates the enclosing chamber to produce the steam atmosphere.

In the preferred practice of the invention, the length of wire heated to the higher temperatures at which oxidation takes place is directed downwardly through the steam containing chamber into a bath of water, or similar quenching liquid. The water operates to cool the wire, and cooling of the wire generates steam which rises in the steam chamber. The steam is maintained dry by the heat of the length of wire which extends downwardly from the top of the chamber to the bath.

In the practical application of the invention it is found desirable to afford added protection against oxidation to the hottest portion of the wire. To accomplish this purpose the quenching bath is positioned for the wire to plunge into it before it reaches the last electrical contactor and moves out of the electrical circuit. The quenching liquid cools the surface of the wire to a temperature low enough to prevent oxidation, while heat continues to be applied to the wire by the electrical current to heat the body of the wire to its annealing temperature. The quenching bath is continued beyond the electrical contactor, and at this place it operates to cool the wire through and through to approximately atmospheric temperature.

The temperature required to anneal, or soften, metal is generally so high that the tensile strength thereof is greatly reduced. The machine of the present invention operates to heat wire as it travels at a high speed to a spool on which it is wound, heating the wire to its annealing temperature at which its tensile strength is greatly reduced, and subjecting the wire to the stress of spooling. This is done without rupture, and without straining the wire beyond its elastic limit. This is made possible by reducing the tension on the wire far below the spooling tension, and practically to a no-load condition, in that length of wire which is subjected to high temperature.

For a more complete understanding of the nature of the invention, attention is directed to the accompanying drawing, in which:

Figure 1 is a longitudinal elevation of the machine, viewed partly in section for the purpose of clearness;

Figure 2 is a cross-sectional elevation, illustrating in detail the system which prevents oxidation of the wire;

Figure 3 illustrates the bearing structure of electrical contactor rollers; and

Figure 4 presents a cross-section taken on line 4—4 of Figure 1.

The invention finds application in any mechanical arrangement in which wire travels lengthwise, and in which it is desirable to heat-treat the wire in transit. An example of such an arrangement is found when wire passes from a wire-drawing machine to a spooling machine, it being usually desirable to reduce the hardness of the wire caused by the drawing operation. Accordingly, the disclosed embodiment of the invention is presented as it applies to a machine for drawing wire and spooling it.

Shown in the drawing is the capstan 11, which draws wire from the wire-drawing machine, illustrated generally at 14. The capstan 11 is driven by the motor 15, through any suitable interdrive mechanism, such as the sprocket chains 16 and 17. The motor 15 also drives the wire-drawing machine 14, through shaft 18. The wire drawing machine 14 may be of any suitable or conventional construction, and requires no further description herein.

The wire is wound on the spool 19 by any suitable spooling mechanism. The details of construction of the spooling machine are not important for an understanding of the present invention. In the embodiment shown, the spool 19 is surface driven by the belt 20, which passes over the idler pulley 21, mounted at the end of the arm 22 to swing therewith. The arm 22 is pivoted at 23, and supported by the frame 24 of the machine. The belt 20, which is driven by sprocket 25 through shaft 28, rests on the surface of the spool 19 in driving engagement therewith.

The sprocket 25 is driven from the motor 15 by chain 26, driven from the shaft 27, which carries the capstan 11 keyed thereto. Shaft 28, which carries the sprocket 25 keyed thereto, also carries sprocket 29, which drives the roller 30 through the chain 31.

The wire 12 passes over capstan 11, and around the capstan upwardly over idler sheave 32, which is bearinged at the top of the post 33, supported by the frame 24. From idler sheave 32 the wire travels downwardly into contact with the roller 30, and beyond roller 30 downwardly at an angle to and around the idler sheave 34. From idler sheave 34 the wire moves in a generally horizontal direction, under idler sheave 35 and upwardly onto spool 19. The sheave 35 is mounted to swing with arm 36, which is pivoted at 37. The weight of the sheave 35 rests on the length of wire between idler sheave 34 and the spool 19 to take up slack, and to maintain tension on the wire.

The capstan 11 and the roller 30 comprise contactors for a supply of electricity, indicated diagrammatically at 38. The length of wire between the capstan 11 and the roller 30 closes the circuit of electricity supplied from the source 38.

Suitable means are provided to insulate the electrical contactors comprising the roller 30 and the capstan 11 from each other. In the embodiment shown, the roller 30 is insulated from its driving chain 31, and from the machine frame as a ground, by means of the insulated coupling 39. With this structure capstan 11 can be grounded without danger of a short circuit.

The voltage and amperage of the electrical current through the wire 12 between capstan 11 and contactor 30 is such as to cause the wire to heat to its annealing temperature, the temperature of the wire increasing from the capstan 11 to roller 30. The height of the post 33, and accordingly the distance of the idler sheave 32 away from the electrical contactors comprising the capstan 11 and the roller 30, is determined, with reference to the resistance of the wire at the several temperatures in the temperature range, and also with reference to the speed of travel of the wire, to provide the desired temperature rise in the upwardly directed length between capstan 11 and sheave 32, and in the downwardly directed length between sheave 32 and roller 30.

The resistance of the wire increases with increase of temperature, and therefore the greater portion of temperature rise takes place between idler sheave 32 and contactor roller 30. This is important with reference to the tensile strength of the heated wire, and more particularly with reference to the tendency of the wire to oxidize, for properly positioning sheave 32. In its passage over contactor roller 30, around idler sheave 34, and around slack take-up sheave 35, the wire travels through the housing 46, the lower portion of which comprises the container 47 for quenching liquid.

Projecting upwardly from the housing 46, to surround the wire for a predetermined distance in its passage from idler sheave 32 towards roller 30, is the stand pipe 48, which constitutes an overflow pipe for receiving liquid from the internally concentric tube 49, also supported on the housing 46. The tube 48 projects downwardly at 50 into the housing 46 to enclose the wire to a point where it passes onto the roller 30. The end of the tube portion 50 is cut curved, as indicated at 51, to conform with the periphery of the sheave 30.

Supported by the bracket 52, which projects from the post 33, and suspended from the bracket to project downwardly into the upper end of the tube 49, is the tube 53. The tube 53 is long enough to extend from a position close to the idler sheave 32 to a position within the tube 49. The tube 49, and the tube 53 provide an enclosing chamber through which the wire 12 passes from the sheave 32 to the contactor roller 30, which chamber encloses the wire preferably throughout virtually the entire length from sheave 32 to roller 30.

The length of wire between the contactor roller 30 and the idler sheave 34 is also surrounded by a length of tubing 54, this tube being positioned on an incline, as shown. In the preferred construction shown, the tube 54 is mounted to pivot at 55 and is held in position to enclose the wire by means of the brace 56, which pivots at 57 into or out of position to engage and support the tube 54. The tube 54 is slotted throughout its length along its uppermost surface, to enable the wire to pass through the slot 58 into and out of the tube when tube 54 is, respectively, lifted and supported by the brace 56 in wire enclosing position, and lowered out of operative position. Thus, the tube 54 can be lowered out of its operative position, to facilitate threading wire through the machine. The tube 54 is cut curved at 59 to conform with the periphery of the roller 30 when held in upper operative position. The upper end of tube 54 is beveled at 60 to fit end to end with the lower end of tube 49. Tubes 49 and 54 thus provide a continuous passage surrounding the wire, the roller 30 forming, with the lower end of tube 49 and with the upper end of tube 54, an enclosure for the wire in its passage over the surface of the contact roller 30.

Positioned within the tube 49, at a predetermined position in its length, is the nsert 62, which closes the passage of the tube, except for the constricted opening through which the wire 12 passes. The insert 62 permits a limited amount of quenching liquid to pass downwardly from tube 49 to the portion 50 thereof. The insert 62 operates to guide the wire 12 accurately onto the periphery of the contactor roller 30.

Quenching liquid is fed to the length of tubing 49 through the inlet 61, water, or a water solution, being preferred as the quenching liquid. The constricted insert 62, Figure 2, operates to restrain the water in tube 49, and it rises therein until it overflows into the standpipe 48. The overflow falls through the pipe 48 into the container 47.

The tubes 53, 49, and 54, and the constricted insert 62, are insulated, for example by being constructed of dielectric material, against grounding the length of wire between capstan 11 and contactor roller 30. The idler sheave 32 is also insulated, for example by being constructed of dielectric material, to prevent grounding of the wire circuit at this point of contact. Idler sheaves 34 and 35 are similarly insulated, and the spool 19 is insulated from the machine frame. The various insulations described, including the insulated coupling 39, protect the wire circuit against short circuit through the machine frame as a ground.

In its passage from capstan 11, over the idler sheave 32 to roller 30, the wire is constantly being subjected to heat by action of the electric current which flows through it from the source 38.

When the hot wire plunges into the water in tube 49 steam is generated, which rises in tubing 53 and surrounds the wire to the top of the tube 53. In the upper portion of the tube 53 the heated wire heats the steam and prevents its condensation. Thus, from the position where it enters tubing 53 after leaving sheave 32, and until it reaches the level of water in tube 49, the wire is enclosed in an atmosphere of steam, which affords an effective protection against the wire oxidizing. It is at a point beyond the idler sheave 32 that the wire attains a temperature high enough to cause oxidation, and the tubing 53 is so positioned that the wire is advanced well into the tubing, where it is in the protecting steam atmosphere, before it attains oxidizing temperature.

When the wire plunges into the quenching liquid contained in tube 49 its surface is chilled and cooled. This is important because it is difficult, and practically impossible, to seal the tube 49, and the tube 54, at the parts 51 and 59 in proximity with the contactor roller 30, against air containing atmosphere coming into contact with the wire. Accordingly, it is desirable to cool the surface of the wire below a temperature at which oxidation takes place, while the body of the wire continues to be heated to the heat-treating temperature, which reaches its maximum at the contactor 30. The height of the tube 49 above the contactor 30, and accordingly the level of the water in tube 49, is such that the surface of the wire 12 is cooled only so much by the time it reaches the contactor roller 30 as is necessary to prevent its oxidation. Beyond this requisite, the length of the tube 49 is such that the wire is cooled by the liquid contained therein to the minimum extent required.

By means of the described construction the surface of the wire is completely protected against oxidation, first by being enclosed in an atmosphere of steam in tubing 53, and then by being maintained below the temperature at which oxidation takes place by the cooling action of the quenching liquid.

Some quenching liquid is carried with the wire through the insert 62 into tube 49, which contains additional quenching liquid fed to it through inlet 63. From tube 49 the quenching liquid flows into tube 54, to which additional quenching liquid is fed through inlet 64. Inlet 64 is preferably constructed flexible as shown, to permit movement of the tube 54 into and out of operative position. From tube 54 the quenching liquid flows into container 47.

In the preferred construction shown, the pump 67 is provided to pump liquid from the container 47 to the tubes 49 and 54, through the respective inlets 61, 63 and 64. In the container 47, the liquid is maintained to a level 66 somewhat below the idler sheaves 34 and 35, by any suitable means.

As the wire 12 passes out of tube 49 into tube 54, it passes beyond the electrical contactor 30, and is out of the electrical circuit. Accordingly, it is no longer subjected to heat. The wire is cooled completely to approximately atmospheric temperature by the time it leaves tube 54, at which temperature it has regained its tensile strength, and is no longer subject to oxidation under atmospheric conditions.

In its rapid travel around idler sheave 34 the wire 12 throws the quenching liquid by centrifugal force, and as the wire passes around idler sheave 35 where it is again subjected to centrifugal force, and out of the housing 46, the wire is completely dry. In this condition it is wound on the spool 19. The spooler may be provided with any suitable traversing mechanism, such for example as is shown generally at 68. The structure of the traversing mechanism forms no part of the present invention, and requires no further disclosure herein.

The spool 19 is driven at a speed to wind the wire 12 as rapidly as it is produced in the wire-drawing machine 14, the spool 19 being driven to provide the desired spooling tension. The capstan 11 is actually driven at a slightly greater speed, to advance the wire into the annealing machine and through it towards the spooling machine at a reduced tension. As will be noted in the drawing, the wire passes downwardly from the sheave 32 to the contactor 30, preferably in a vertical direction, and the sheave 34 is positioned to direct the wire 12 out of line with the vertical path. The direction of travel of the wire is changed at the contactor roller 30 to maintain the wire in contacting engagement with the contactor to form a good electrical connection.

The contactor 30 produces a drag on the wire 12, which, in addition to producing a good electrical connection, maintains the length of wire between the contactor 30 and the spool 19 under spooling tension. The drive of capstan 11 is such, relative to the drive of the spool 19, to push the wire towards the spooling machine. In this manner the tension on the wire between capstan 11 and the contactor 30 is reduced to practically a no-load condition. The wire being dragged over the surface of the contactor 30 by the spooling tension produces friction. For this reason the contactor 30 comprises a roller, and the roller is driven positively through chain 31 at a speed slightly less than the speed of travel of the wire, to reduce wear of contactor 30 to a minimum.

The machine of the present invention spools wire rapidly and efficiently, directly from the drawing machine. The wire is heat-treated continuously, the heat-treatment being performed without oxidation. The wire is spooled continuously, at the desired spooling tension, without straining the wire, even though the wire is heated to a temperature at which it has lost its tensile strength.

As will be clear to persons skilled in the art, the disclosed embodiment is susceptible of a number of modifications without departing from the spirit of the invention. Accordingly, the invention is not limited to the disclosed embodiment, but the scope thereof is determined by the accompanying claims.

I claim:

1. A wire heat-treating device comprising a pair of electrical contactor rollers, means to transmit wire longitudinally from one roller to the other into electrical contacting engagement therewith, wire quenching means comprising a container of water or the like liquid in proximity with the second roller, and having an opening shaped to conform with the roller to confine the liquid to engagement with the roller at its periphery, the container being provided with an overflow predetermining the height of liquid above the second roller, guide means to direct the wire along a predetermined path passing through the liquid, the path of the wire approaching the second contactor roller in a downwardly direction.

2. A wire heat-treating device comprising a pair of electrical contactor rollers, means to transmit wire longitudinally from one roller to the other into electrical contacting engagement therewith, quenching means comprising a container of water or the like liquid in proximity with the second roller, and having an opening shaped to conform with the roller to confine the liquid to engagement with the roller at its periphery, the container being provided with an overflow predetermining the height of liquid above the second roller, guide means to direct the wire along a predetermined path passing through the liquid, the path approaching the second contactor roller in a downwardly direction, an elongated chamber surrounding the path of wire above the level of the liquid, and extending upwardly from below the surface thereof to provide an atmosphere of steam for the heated wire to pass through.

3. A wire heat-treating device comprising a pair of electrical contactor rollers, means to transmit wire longitudinally from one roller to the other into electrical contacting engagement therewith, quenching means comprising a container of water or the like liquid in proximity with, and extending above and below, the second contactor roller, and having an opening shaped to conform with the roller to confine the liquid to engagement with the roller at its periphery, the container being provided with an overflow predetermining the height of the liquid above the second roller, guide means to direct the wire along a predetermined path passing through the liquid for a predetermined distance before and after engagement with the second roller, the path of wire approaching the second contactor roller in a downwardly direction, an elongated chamber surrounding the path of wire above the level of the liquid, and extending upwardly from below the surface thereof to provide an atmosphere of steam for the heated wire to pass through.

4. A wire heat-treating device comprising a pair of electrical contactor rollers, means to transmit wire longitudinally from one roller to the other into electrical contacting engagement therewith, quenching means comprising a container of water or the like liquid in proximity with, and extending above and below, the second contactor roller, and having an opening shaped to conform with the roller to confine the liquid to engagement with the roller at its periphery, the container being provided with an overflow predetermining the height of liquid above the second roller, guide means to direct the wire along a predetermined path passing through the liquid for a predetermined distance before and after engagement with the second roller, the path of wire approaching and leaving the second roller in a downwardly direction, one or more rollers in the path of the wire after leaving the liquid container providing a curved passage for the wire to remove its moisture by centrifugal force.

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