Dec. 13, 1955 J. V. O'GRADY 2,726,971

APPARATUS FOR DRYING AND ANNEALING WIRE

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Fig. 1.

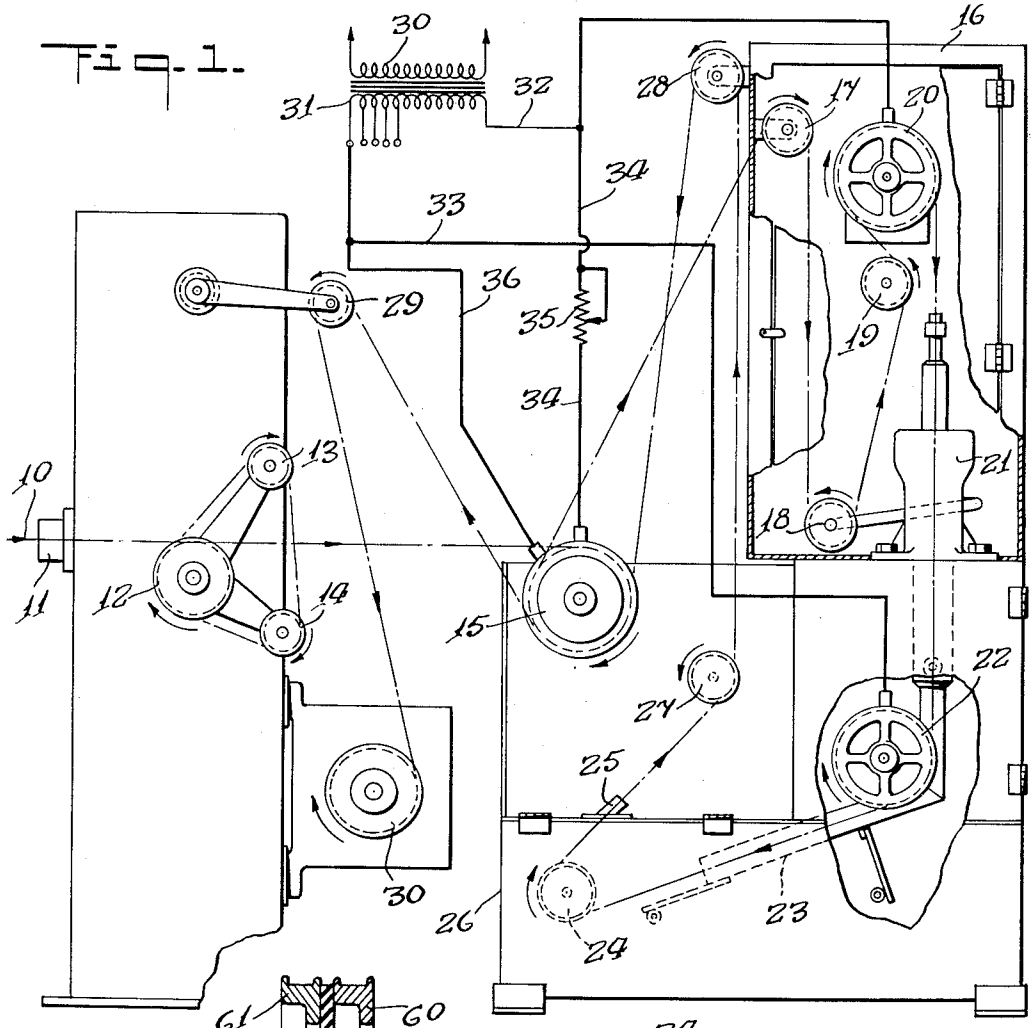
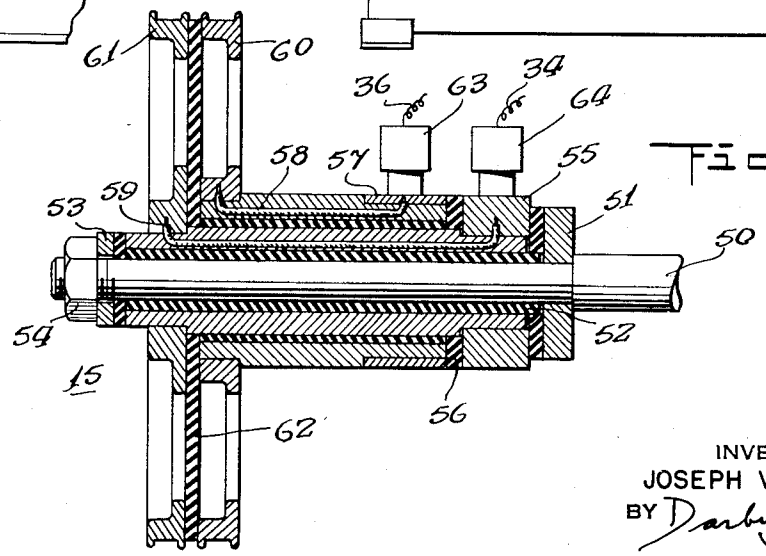


Fig. 2.



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APPARATUS FOR DRYING AND ANNEALING WIRE

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1 Claim. (Cl. 148—10)

This invention relates to an electrical apparatus for use in continuous annealing of wire and in particular it relates to the sequence of operations involved in heating a wire continuously, quenching a length of the wire and subsequently drying it prior to spooling the product.

The nature of the operation involving wire drawing and the fabrication of the finished wire practically demands continuous operation in which the raw material is fed into one end of the machine and appears continuously as product at the other. When wire is drawn through a die, it is subjected to a certain amount of working and, to restore the physical properties, an annealing operation in the process is needed. Annealing can be accomplished by passing a wire through a furnace to heat a given length thereof and subsequently quench the wire. To avoid corrosion problems incident to the quenching operation it has been found that a drying step is highly desirable as the mechanical operations call for spooling the wire substantially immediately after the quenching. Generally, and particularly where relatively fine wire is being dried, the product will not have sufficient thermal capacity to retain therein enough heat following the quenching to dry the wire prior to its being spooled. Accordingly, it is a fundamental object of the instant invention to provide a wire drawing operation which allows for annealing, quenching and drying a wire prior to storing it on a spool.

It is a second object of the instant invention to provide an apparatus by which the heating and drying of the wire is accomplished electrically.

It is a third object of the instant invention to provide an apparatus by which the heating of a wire in a drawing operation can be accomplished electrically by making the wire itself a part of the circuit.

It is a further object of the instant invention to provide a pulley construction for use in a wire drying operation adaptable for making electrical contact with a wire thereby to accomplish the desired heating.

Other objects and advantages of the invention will in part be obvious and in part appear hereinafter.

The invention accordingly comprises a wire drawing and heating apparatus involving spooling mechanism and an electric circuit for accomplishing the desired heating, said apparatus including an arrangement of pulleys for guiding the wire from the final drawing capstan to an annealing zone, where it is guided over a second electrical pulley into an annealing unit and therefrom into a quenching bath, from which it is passed over the first mentioned pulley, where it is subjected to further electrical heating for drying purposes and then is guided to a finished spooling arrangement. Thus the invention comprises an apparatus involving the features of construction, combination of elements and arrangement of parts involved in the arrangement whereby the wire is guided through its cycle of treatment and subjected to the desired drying operation following the annealing.

In the drawings, a diagrammatic layout of the apparatus is shown in:

Figure 1 where the course traveled by a wire in passing through apparatus and the cycle of treatments is shown; and

Figure 2 is a cross section through the electrically conducting pulley showing the means for bringing power thereto from the source.

Referring now to Figure 1, **10** represents a wire passing through a die **11**, where it is drawn down to the desired diameter, from which it passes around capstan **12**, around tensioning pulleys **13** and **14**, back around capstan **12** and then to pulley assembly **15**. The purpose of this arrangement is to provide a means for keeping the wire taut. The wire actually passes seriatim around pulley **60** of pulley assembly **15**, which is electrically conducting to accomplish a moderate preliminary heating of the wire, and therefrom it passes into annealing furnace **16**, wherein the wire first passes over pulley **17**, then around pulley **18**, past **19**, which serves to keep it taut, and then over electrically conducting pulley **20**, which serves as one terminal of the heating circuit for the wire in the annealing operation. From the pulley **20**, the wire passes through annealing chamber **21** and around the second electrified pulley **22**, which serves as the second electrical terminal in the annealing circuit, so that the segment of wire **20** to **22** is a conductive part of electric circuit between the contact points and, while it is in contact with those two points, the wire is conducting electricity and being heated.

Upon leaving pulley **22**, the wire passes through the guide conduit **23**, which is a continuation of the annealing chamber **21**, into the quenching bath. In the bath it passes over pulley **24** and out through orifice **25**, to the drying chamber of the furnace. In passing from the orifice **25** over pulley **27**, up out of the chamber the wire is cooled to the temperature of the quenching bath and then passed up to pulley **28**, back around pulley **61** of pulley assembly **15**, from which it passes over pulley **29** to the spooler **30**, where it is packaged for eventual shipment upon completion of a spool. It is apparent that the spooler **30**, guide pulleys **12**, **13**, **14** and **15**, die **11**, and pulley **29** can be mounted on the same base.

The heating operations for the wire are accomplished by the electrical circuit which draws power from a source connected to the primary **30** of a transformer having the secondary coil **31**. One lead **32** from the secondary is connected to the pulley **20**, which is mounted so as to be electrically insulated from its base, to form the first electrical contact for the wire in the annealing chamber. The other side **33** of the secondary coil **31** is brought to the second pulley **22** in the annealing furnace, which serves as the other contact for the electric heating circuit of the wire in the annealing zone.

A controlled drying of the wire is accomplished at the pulley **15** where a branch lead **34** from the secondary coil of the transformer is brought from one point on pulley **15** through the potentiometer **35**. The preheating circuit is made through lead **36** which is brought to the pulley **15** and to the other side of the secondary of the transformer through the wire and pulley **20**.

The structure of the pulley **15** will be understood more clearly by reference to Figure 2 where shaft **50** is shown having a flange **51**, an insulating flange **52**, an end flange **53** and an end bolt **54** to hold the entire assembly in place.

Separated from flange **51** by insulation is slip ring **55** and adjacent thereto a second insulator **56** which holds a second slip ring **57** separated from **55**. The two slip ring structures are connected by wires **58** and **59** to pulleys **60** and **61**, respectively, which are electrically insulated from each other and the shaft by insulating material **62**. Leads **34** and **36** from the secondary cir-

cuit are brought to contact with brushes **63** and **64** to provide the desired electrical circuit for giving the wire **10** the desired amount of preliminary preheating as it passes over one side of the said circuit prior to entering the annealing zone and over the other side thereof for drying thereof as it leaves the annealing and quenching operation.

Detailed exposition of the operation of the apparatus is unnecessary in view of the fact that from the explanation of the structure and arrangement of parts, the operation is clear. The several pulleys **18** and **29** are mounted hingedly to permit keeping the wire taut through the various heating cycles by the application to it of appropriate tension as it expands and contracts in the heating and cooling. The preferred degree of control of temperature is accomplished of course by variation of the amount of electrical current applied to the wire which will vary with the size and the annealing temperature sought.

The annealing zone **21** constituting the approach to the quenching chamber is made longitudinal in form so that during its passage therethrough the wire is immersed in an inert atmosphere of vapors from the quenching liquid.

Upon review, it will be seen that the wire in passing progressively over the pulleys shown is electrically divided into three sections, the first of which is subjected to preheating, the second of which to further heating to annealing temperature, and the third of which after quenching is heated to a dry temperature. These three wire sections are supplied with electrical currents from three parallel circuits energized from the secondary of the power supply transformer. The preheating section extends between pulley **60** and pulley **20**. Current is supplied to pulley **60** by wire **36** from one side of the secondary and to pulley **20** by wire **32** from the other side of the secondary. The section which is heated to annealing temperature extends between pulleys **20** and **22**. Current is supplied to pulley **22** through wire **33** from one side of the current source and again to pulley **20** through wire **32** from the other side of the current source. The third section of the wire, that is the drying section, extends from pulley **22** to pulley **61**. Current is supplied

to pulley **22** from one side of the current source through the wire **33** and to pulley **61** from the other side of the current source through wires **32** and **34**.

Having described my invention and the operation thereof, it will be understood that the single embodiment shown is intended to serve as an operative and illustrative example and that variations of the invention within the spirit and scope thereof may be made.

What is claimed is:

In a machine for continuously annealing wire, the combination comprising a plurality of conductive rotatable pulleys over which a wire to be annealed is passed progressively, an annealing chamber positioned between a pair of said pulleys so that the section of wire between said pair of pulleys passes through said chamber, a quenching chamber into which the wire passes from the annealing chamber, a source of electrical current, and parallel circuit connections from said source to said pulleys in three pairs including said mentioned pair, to separately heat three sections of said wire, one prior to reaching the annealing chamber, one in the annealing chamber, and one after leaving said annealing chamber, whereby the wire is preheated in said first section, heated to annealing temperature in said second section and dried in said third section.

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