March 18, 1952 J. V. O'GRADY 2,589,283

WIRE ANNEALING MACHINE

Filed July 29, 1949 2 SHEETS—SHEET 1

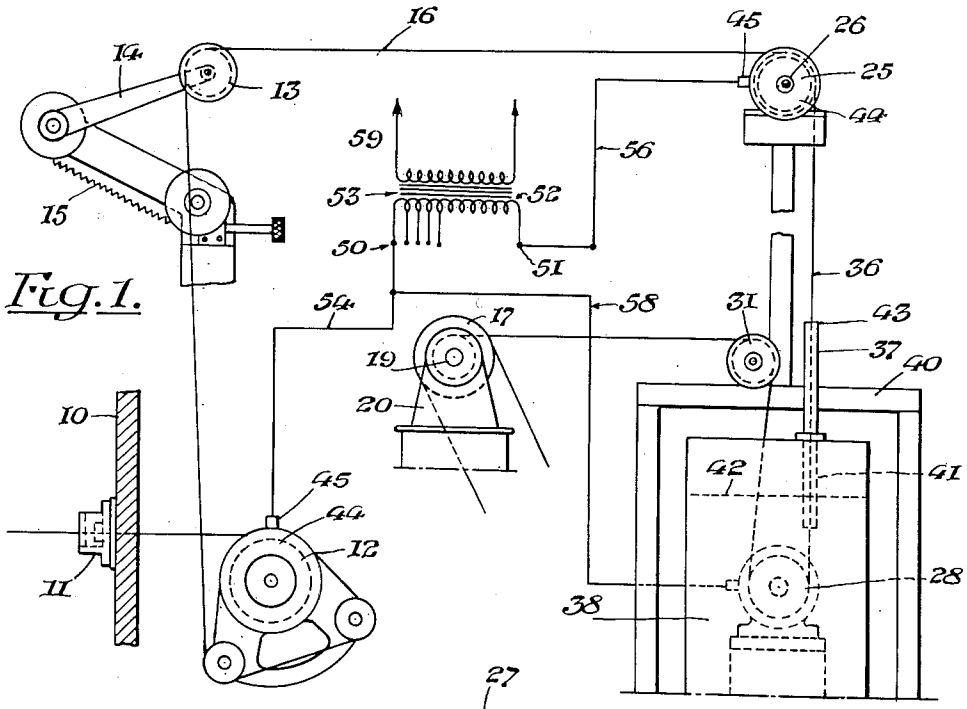


Fig. 1.

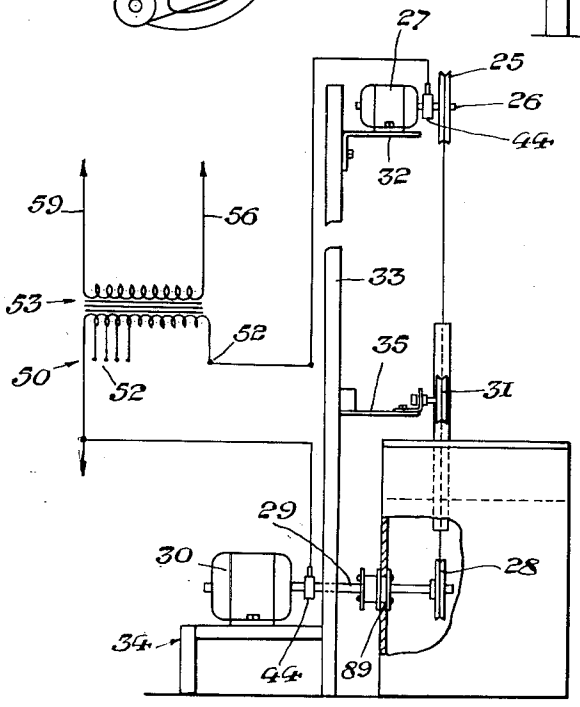


Fig. 2.

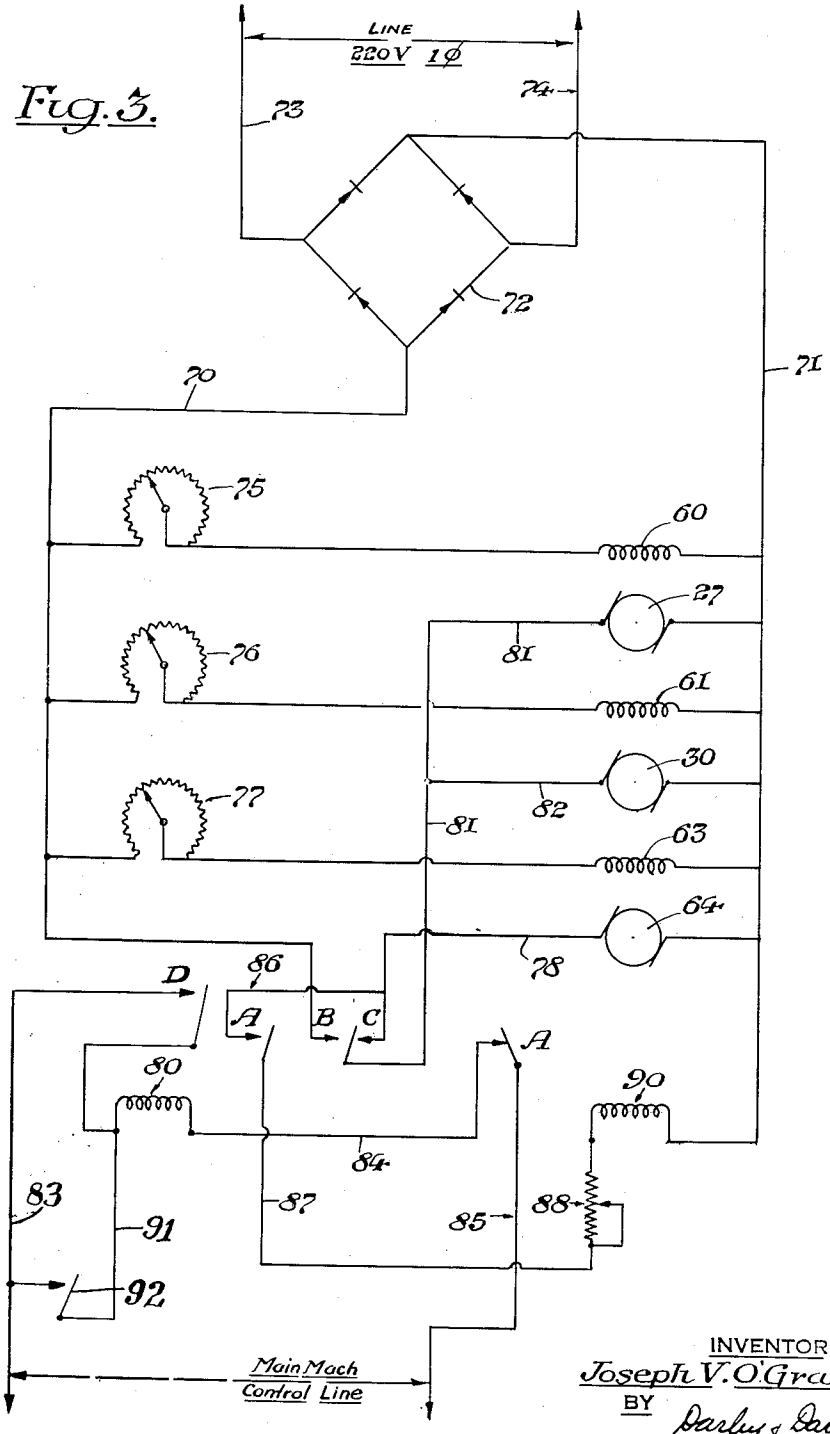
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Fig. 3.



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WIRE ANNEALING MACHINE

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4 Claims. (Cl. 219—11)

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The present invention relates to wire annealing machines, and particularly to machines of the type in which the wire is heated to an annealing temperature while in motion. In the machine of this invention wire is annealed by passing an electric current through a portion thereof intermediate the final capstan of the drawing machine and a spooling machine. A section of the wire intermediate the last two mentioned devices is led over a pair of sheaves which serve as contact elements to conduct a flow of electric current through a portion of the wire to heat it to annealing temperature. That portion of the wire which is at annealing temperature is surrounded by an atmosphere of steam or other inert gas to prevent oxidation of the heated wire.

In the machine it is important that the contact sheaves mentioned be driven synchronously with each other and with the final drawing capstan since the wire at the temperature necessary for annealing is subject to elongation and breakage. Therefore, there is provided by the machine of my invention a means for driving these two sheaves synchronously both at operating speeds and also during periods of acceleration and deceleration.

It is an object of the invention to provide a mechanism for annealing wire while that wire is in motion as, for example, passing from the final wire drawing machine to a spooling device.

It is another object of the invention to provide a driving mechanism for such an annealing device which will assure that the wire is not subjected to strains which would cause elongation or breakage.

It is another object of the invention to produce such a drive in which during the accelerating and decelerating periods synchronism is maintained.

It is a still further object of the invention to provide a driving mechanism as described above having purely electrical interconnection with the wire drawing machine drive.

Other objects and features of the invention will be apparent when the following description is considered in connection with the accompanying drawings, in which—

Figure 1 is a fragmentary side view of a combined wire drawing, annealing and spooling apparatus embodying the features of this invention;

Figure 2 is a front view of the wire annealing mechanism, including a diagrammatic illustration of the electrical circuit utilized for producing heating of the wire to annealing temperature; and

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Figure 3 is a schematic wiring diagram showing the mode of driving the contact sheaves of the wire annealing portion of the machine in Figure 1.

Referring now to the drawings wherein like reference numerals denote like parts throughout the several views, numeral 10 indicates the end wall of the casing of the wire drawing mechanism; 11 the final drawing die; 12 the wire pulling capstan; and 13 a wire guide pulley mounted on a resilient buffer arm on 14 which is connected to a coil spring 15.

17 indicates a rotatable driven spool upon which the wire, after passing through the annealing apparatus, is finally wound. Spool 17 is mounted upon a pair of spindles 19 carried by a pair of upstanding bearing brackets 20 supported upon a rigid part of the machine. Brackets 20 are electrically insulated from the machine by a suitable plate of insulating material and in a like manner the pulley 13 and arm 14 are insulated from the remainder of the machine.

As illustrated particularly in Figures 1 and 2, the wire 16 is led horizontally from the buffer pulley 13 over a sheave 25 mounted upon a shaft 26. Shaft 26 is an extension of the shaft of electric motor 27 which is suitably mounted, see Figure 2, in an elevated position on a portion of the machine frame. Wire 16 passes downwardly from the sheave 25 and around a second sheave 28, which sheave is mounted upon the shaft 29 of the electric motor 30. From the sheave 28 wire 16 is led up and over a guide pulley 31 from which it is directed to the spool 17. The upper driving motor 27 is mounted on an insulating bracket 32 secured to the vertical standard 33 and is arranged to be operated in the manner hereinafter described at a speed such that the linear speed of the periphery of sheave 25 is approximately equal to the linear speed of wire 16. The lower motor 30 is similarly mounted upon insulated bracket 34 and is likewise controlled as hereinafter described so that the peripheral speed of the sheave 28 is equal to the linear speed of the wire 16. Guide pulley 31 is likewise supported upon an insulating bracket 35 supported by the standard 33.

In order to provide a non-oxidizing gaseous envelope for the lower portion 36 of the travelling wire 16 the sheaves 25 and 28, an open tube 37 is provided, preferably of insulating material such for example as Pyrex, glass or suitable plastic, this tube having its lower end 41 immersed in a tank 38 of quenching water, the

pulley or sheave 28 being below the level 42 of the water in the tank. As is obvious, the shaft 29 passes through a stuffing box 89, see Figure 2. Tube 37 is rigidly supported, as for example by the cross bar 40, in such a manner that the upper end 43 of the tube will be a considerable distance above the tank 38 and will maintain an atmosphere of hot steam or other inert gas around that portion of the wire between sheaves 25 and 28 which is at annealing temperature. In order to supply heat to the rapidly moving wire between the final drawing capstan 12 and the sheave 25, as well as between sheave 25 and sheave 28, the shaft of the drawing capstan 12, as well as the motor shafts 26 and 29, each has a metal disc 44 secure thereon. Bearing against each of these metal discs is a brush contact member 45, these contact brushes being insulatingly supported and being resiliently held against respective contact discs.

As is indicated in Figure 1, current is supplied to the brushes 45 from the terminals 50 and 51 of a secondary coil 52 of a suitable transformer 53. Terminal 50 of coil 52 is connected by means of conductor 54 to brush 45 of the capstan 12. Terminal 51 of transformer coil 52 is connected by means of conductor 56 to brush 45 of the upper sheave 25 and terminal 50 is connected through conductors 54 and 58 with the brush 45 of the lower sheave 28.

The terminals of the primary coil 59 of transformer 53 are connected by means of suitable conductors to a source of suitable electrical energy, such for example as an alternating current source operating at 220 volts. It is to be noted that the secondary coil 52 of the transformer 53 is provided with a plurality of taps so that the voltage applied to the various brushes 45 may be varied as desired.

It is essential that the sheaves 25 and 28 rotate at substantially the same peripheral speed as the final drawing capstan 12, and even more essential that there be no speed difference as between sheaves 25 and 28 since the heated wire has very little tensile strength and would be elongated or broken in the event that sheave 28 should rotate more rapidly than sheave 25.

In order to be sure that the condition mentioned will exist, motors 27 and 30 are supplied with their current in the manner illustrated in the wiring diagram, Figure 3.

Referring now to that figure, it will be noted that motors 27 and 30 are direct current motors of the shunt wound type. The field windings of these two motors, respectively designated 60 and 61, are connected between the conductors 70 and 71 which are supplied with current through the rectifier 72 which is fed with alternating current power of any suitable voltage through conductors 73 and 74. A rheostat is connected in series with each of the field windings 60 and 61 of motors 27 and 30, these rheostats being designated 75 and 76, respectively. Likewise connected across conductors 70 and 71 in series with rheostat 77 is the field winding 63 of generator 64. The armature of generator 64 is normally connected to the armatures of motors 27 and 30 in a manner to be described. Generator 64 is driven by one of the shafts of the wire drawing machine proper to thereby cause the voltage output of the generator to be proportional to the speed of the wire drawing machine.

The armature of generator 64 is normally connected by means of conductor 78, normally closed contacts C of relay 80 and conductors 81 and 82 to one side of the armatures of motors 27 and 30, the opposite sides of these armatures being connected to conductor 71. The connection just described, that is the connection through closed contact C of relay 80, is that which prevails when the machine is running at its predetermined desired speed. Under these circumstances, motors 27 and 30 are supplied with armature current which is derived solely from the generator 64 and is, as explained, necessarily proportional to the voltage output of the generator and consequently to the speed of the wire drawing machine proper.

However, during the initial starting period of the apparatus the voltage output of generator 64 is insufficient to operate the motors 27 and 30. For this reason, I have supplied the relay 80, as well as the relay 90. Upon operation of the main controls i. e. completion of the main drawing machine control line circuit, relay 80 is energized due to a flow of current through conductor 83, normally closed relay contact 92 on the main drawing machine, conductor 91, winding of relay 80, conductor 84, closed contact A of relay 90 and conductor 85. Operation of relay 80 causes opening of its contact C, and closure of contacts A—B and D. Contact 92 opens immediately after the main drawing machine starts to run, and thereupon relay 80 is maintained energized by a flow of current through conductor 83, contact D of relay 80, conductor 91, winding of relay 80, closed contact A of relay 90, and conductor 85. Closure of contact B completes a circuit from conductor 70 through contact B of relay 80 to conductors 81 and 82, thus putting the motor armatures directly across the D. C. supply line comprising conductors 70 and 71.

As soon as generator 64 supplies sufficient output voltage, relay 90 is caused to operate due to the fact that relay 90 is at this time connected across the generator armature. This connection extends from conductor 78 to conductor 86, now closed, contact A of relay 80, conductor 87, adjustable resistance 88 and winding relay 90, conductor 71, and back to the other side of the generator armature. Thus, after the initial stage of operation, relay 90 is caused to operate, breaking the circuit to winding of relay 80 at contacts A of relay 90 and thereby permitting relay 80 to restore to its normal position as shown in Figure 3 connecting the generator output line to the two motors 27 and 30.

Due to the driving circuit of the motors 27 and 30 as described above, wire 16 is driven at a constant peripheral speed throughout its traverse from the drawing capstan 12 to the final spooling on the spool 17. During the wire traverse from capstan 12 to sheave 25 it is preheated to a temperature which is not sufficiently high to cause annealing. The circuit for this heating extends from terminal 50 of secondary coil 52 of transformer 53, over conductor 54 to the brush 45 associated with capstan 12, thence through the wire 16 to sheave 25, through disc 44 associated with that sheave, and over conductor 56 to the other terminal 51 of the transformer secondary 52.

The wire 16 is heated to annealing temperature as it passes from sheave 25 to sheave 28, the circuit for this purpose extending from terminal 50 of transformer secondary 52, over conductors 54 and 58, through brush 45 and disc 44 associated with sheave 28, through sheave 28 and wire 16 to sheave 25, through the brush 45 and disc 44 associated therewith, and over conductor 57 to the opposite terminal 51 of transformer coil 52.

As stated, the wire is preheated during its traverse from capstan **12** to sheave **25**. As the wire passes over the upper contact sheave **25** and moves downwardly toward the lower contact sheave **28** the temperature is gradually and rapidly increased until it reaches an annealing temperature. At the point of annealing temperature the wire is protected by the tube **37**. Oxygen and corrosive gases which may be in the air are prevented from entering the tube **37** since this tube is filled with steam which is generated by the quenching of the heated wire as it makes contact with water in tank **38**, said steam rapidly rising in the tube and forming a protective vapor about the wire therein. If desired other inert gases such as nitrogen may be piped into tube **37**, under pressure to provide a protecting atmosphere.

I claim:

1. Means for driving the contact sheaves of an annealing device of the type in which wire is electrically heated as it passes over said sheaves, said means comprising, in combination, a direct current generator, said generator being driven at a speed proportional to the speed of a drawing machine from which the wire is passing to the annealing device, a direct current motor directly mechanically connected to each of the sheaves, means for adjusting the current flowing through the field winding of each of said motors, means connecting the output of said generator to the armature of each of said motors whereby said motors may be adjusted to operate at the same speed and will then have speed variations dependent only on the speed variation of the generator.

2. Means for driving the contact sheaves of an annealing device of the type in which wire is received continuously from a drawing machine and electrically heated as it passes over said sheaves, said means comprising, in combination, a direct current generator, said generator being driven at a speed proportional to the speed of the drawing machine from which the wire is passing to the annealing device, a direct current motor directly mechanically connected to each of the sheaves, means for adjusting the current flowing through the field winding of each of said motors, and means normally connected to the output of said generator to each of said motors, a relay connectable with the drawing machine and operable upon starting the drawing machine to connect said motor armatures across a power source and a voltage responsive relay connected across said generator, said voltage responsive relay being operative to restore said normal connection from said motor to said generator upon said generator reaching a speed sufficient to drive said motors.

3. In a driving mechanism for a continuous annealing device of the type described and in which the wire to be annealed is heated electrically after it passes over a final drawing capstan as it comes from a drawing machine subsequent to its final drawing operation in combination, a pair of contact sheaves over which said wire passes, contacting means associated with each of said sheaves and with the final drawing capstan of the wire drawing machine, said contact means supplying current to one of said sheaves and through said wire to said other sheave to the final wire drawing capstan, said wire being heated to annealing temperature between the second of said sheaves and the first of said sheaves being pre-heated between said first sheave and drawing capstan, means for driving said sheaves at angular speed corresponding at all times to the linear speed of the wire, said means comprising a direct current generator driven by the drawing machine which supplies the wire, a direct current motor mechanically connected to each of said contact sheaves, each said motor being of the shunt wound type, a rheostat in series with the shunt field of each said motor to provide adjustments of the speed thereof, said shunt windings being energized from a suitable direct current source, means connecting the armature of each of said motors to said generator for supply of current therefrom, and relay means operable upon starting of the wire drawing machine and annealing devices to connect said motors across said direct current source.

4. In a driving mechanism for a continuous annealing device of the type described and in which the wire to be annealed is heated electrically after it passes over a final capstan of a drawing machine subsequent to its final drawing operation, in combination, first and second contact sheaves over which said wire passes, contacting means associated with each of said sheaves and with the final drawing capstan of the wire drawing machine, said contact means supplying current to the second of said sheaves and through said wire to said first sheave to the final wire drawing capstan, said wire being heated to annealing temperature between the second of said sheaves and the first of said sheaves being pre-heated between said first sheave and drawing capstan, means for driving said sheaves at angular speed corresponding at all times to the linear speed of the wire, said means comprising a direct current generator driven by the drawing machine which supplies the wire, a direct current motor mechanically connected to each of said contact sheaves, each said motor being of the shunt wound type, a rheostat in series with the shunt field of each said motor to provide adjustments of the speed thereof, said shunt windings being energized from a suitable direct current source, means connecting the armature of each of said motors to said generator for supply of current therefrom, means operable upon starting of the wire drawing machine and annealing devices to connect said motors across said direct current source, and voltage responsive means for restoring said normal connection from said generator to said motors when said generator output is sufficient to supply said motors.

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