Sept. 27, 1960 C. O. BRUESTLE 2,954,459

APPARATUS FOR ANNEALING AND DRYING WIRE

Filed Sept. 6, 1957 3 Sheets-Sheet 1

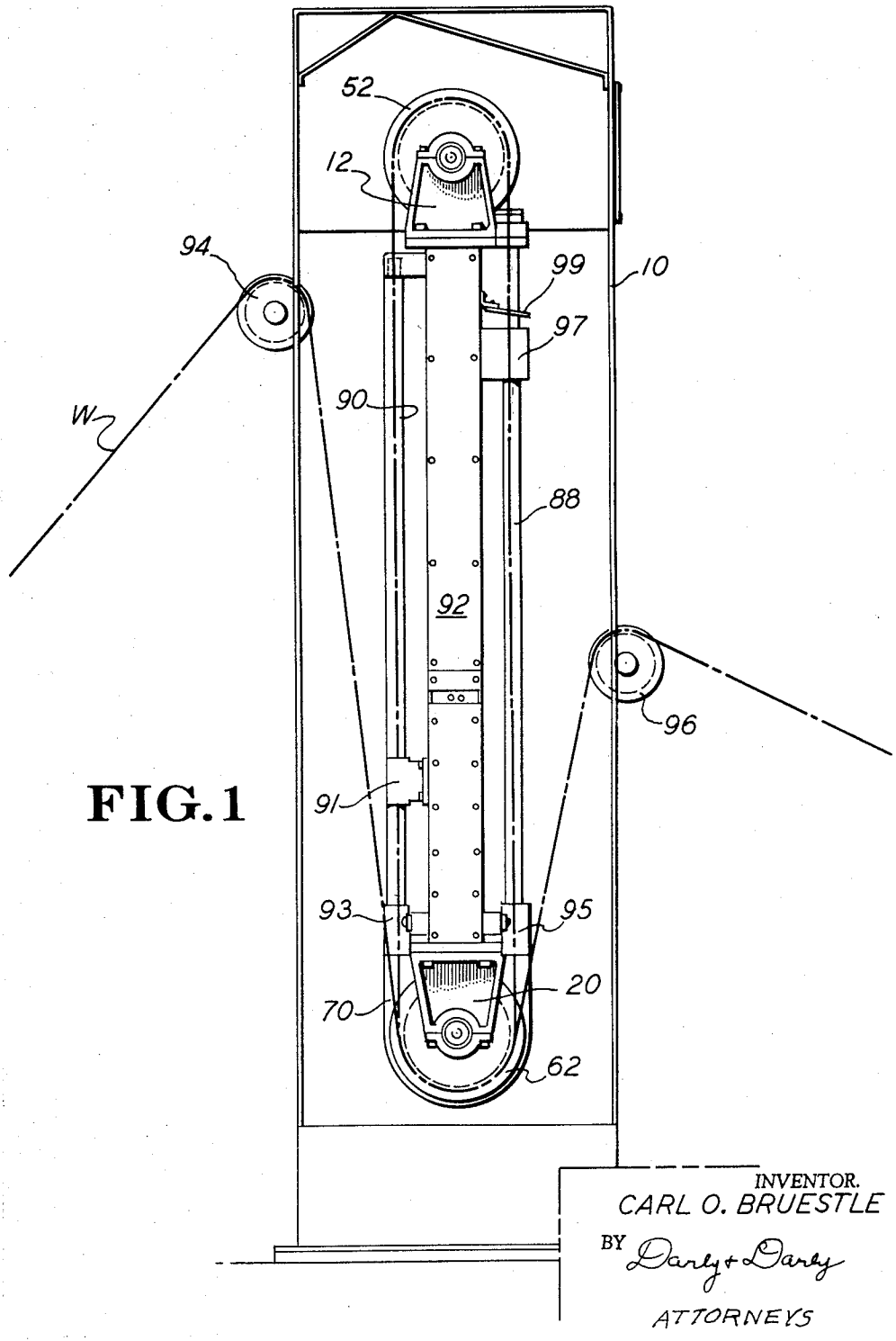


FIG. 1

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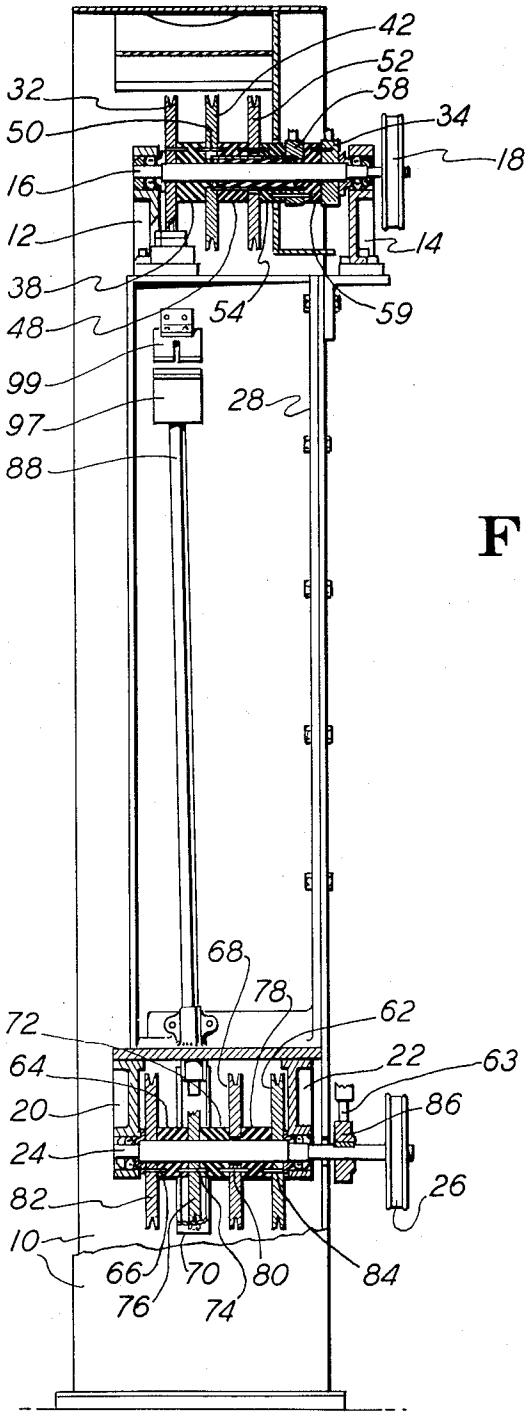


FIG. 2

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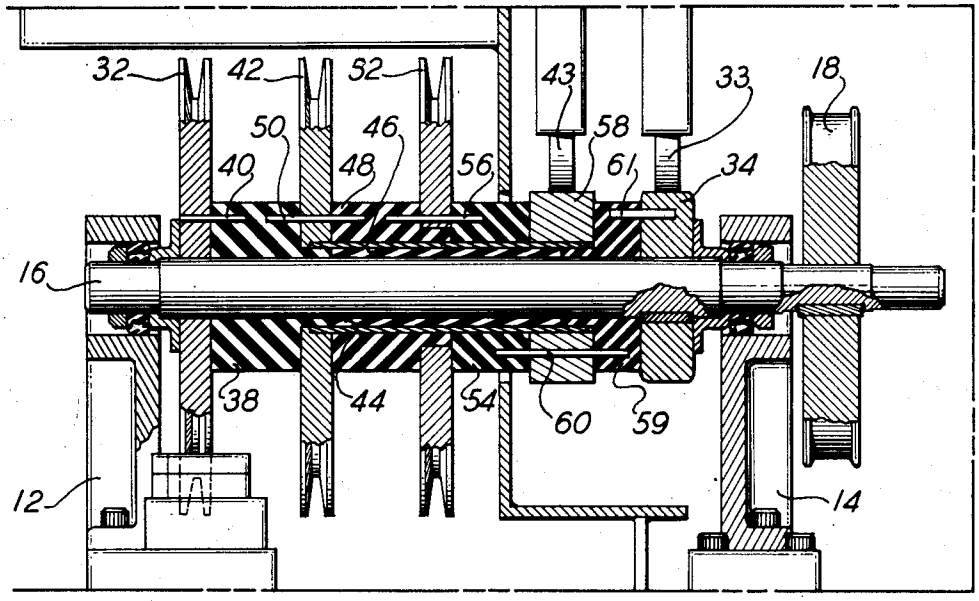


FIG. 3

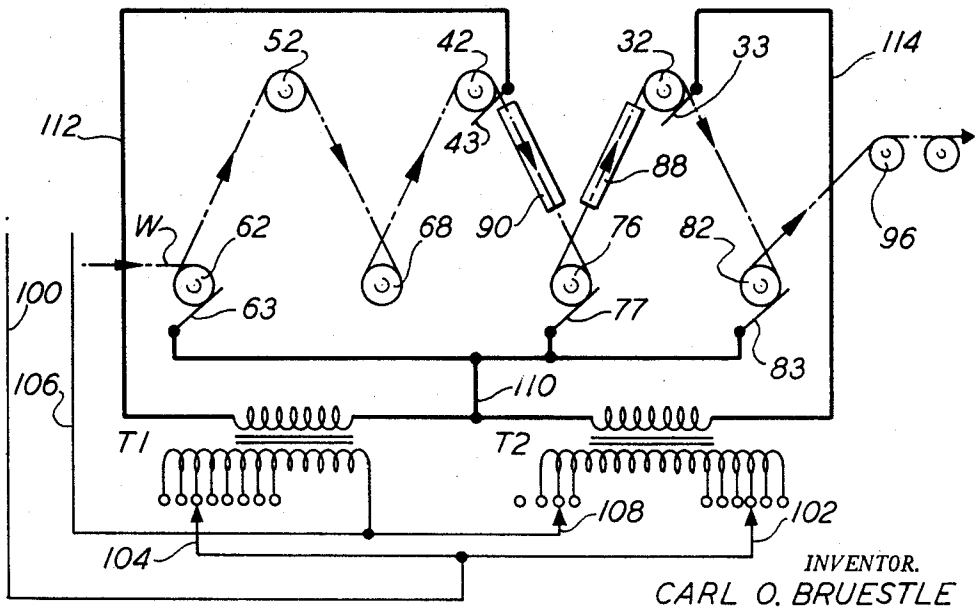


FIG. 4

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2,954,459

APPARATUS FOR ANNEALING AND DRYING WIRE

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6 Claims. (Cl. 219—155)

The present invention relates to apparatus for annealing and drying wire and particularly to a sheave assembly for use in a wire annealing machine in which the wire is brought to annealing temperature and to drying temperature by the passage of an electrical current therethrough.

The machine is in many ways similar to that disclosed in O'Grady Patent No. 2,726,971, issued December 13, 1955, but provides a more efficient mode of operation due to the arrangement of the sheaves or pulleys. The arrangement of the O'Grady patent requires a number of pulleys for reversing the direction of the wire which is detrimental to quality especially at the high speed at which the machine is run for the finer wire sizes. Additionally the old machine requires a considerable space whereas the instant machine, due to the sheave arrangement, does not require the reversing pulleys and may be made much more compact while at the same time retaining the features of preheating the wire, heating to annealing temperature, quenching and thereafter drying.

In the present invention all of the required pulleys are mounted on two shafts and the pulleys are assembled in such a manner that current is conducted to required ones thereof without using a complex arrangement of multiple shafts and electrical brushes.

As was stated in the O'Grady patent, 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 is requisite. In order to avoid corrosion problems incident to the quenching it has been found that a drying step is highly desirable since generally the wire is spooled immediately following the annealing. Additionally it has been found best to heat the wire in stages to the annealing temperature. This sequence of steps is followed in the present machine utilizing the improved arrangement mentioned above.

It is an object of the invention to provide a simple compact apparatus for preheating, heating, quenching and drying wire as a continuous process, the wire being heated by passing electrical currents through sections thereof.

It is another object of the invention to provide a sheave or pulley arrangement for such a machine which makes possible the compactness thereof and which is efficient in conducting the current to the various wire sections.

Other objects and features of the invention will appear when the following description is considered in connection with the appended drawings, in which,

Fig. 1 is a front elevational view of the device of my invention illustrating the path of the wire through the machine;

Fig. 2 is a vertical cross-sectional view taken through the center of the drive shaft and showing particularly the mode of mounting the sheaves on the drive shafts and of conducting current to certain of the sheaves;

Fig. 3 is an enlarged cross-sectional view similar to Fig. 2, to show the upper sheave assembly in greater detail; and

Fig. 4 is a schematic diagram showing the electrical

connections to the pulley assemblies as well as the path of the wire about the various pulleys.

Referring now to the drawings, and particularly to Figs. 2 and 3, there is shown at **10** a housing within which the various machine elements are mounted. Near the top of the housing there is a bushing or bearing and support **12** and a second similar support and bearing **14** in spaced relation to the first. Mounted in these bearings is a shaft **16** which at one end carries a pulley **18** driven in any suitable manner as for example by an electric motor.

In similar manner adjacent the base of the housing **10** there is supplied a shaft **24** mounted in the bearing members **20** and **22** suitably supported by the housing **10**. Shaft **24** is supplied with a pulley **26** and it will be understood that the pulleys **18** and **26** are driven from the same source and operate at the same rate.

On shaft **16** three pulleys are mounted, these pulleys being designated respectively (reading from right to left), **52**, **42** and **32**, the particular mounting means being hereinafter described. In a similar manner there are mounted on the lower shaft four pulleys designated respectively (reading from right to left), **62**, **68**, **76** and **82**. The exact mounting will be hereinafter described.

Referring now to Fig. 4, it will be seen that wire W from the drawing machine is passed about pulley **62**, thence upwardly around pulley **52**, downwardly and about pulley **68**, thence again upwardly and about pulley **42**, downwardly through the steam tube **90**, about pulley **76**, thence upwardly through the water tube **88**, over pulley **32**, downwardly and about pulley **82** and thence out of the machine and to a spooling machine.

As is indicated in Fig. 4, two transformers T1 and T2 are provided, the primaries being tapped and connected to an external source of power over conductors **100**, **102**, **104**, **106** and **108** as shown. Current from the secondary of transformer T1 is supplied over conductors **110** and **112** and brushes **63** and **43** to the pulleys **62** and **42**. The length of this path and the voltage supplied are such that between pulleys **62** and **42** the wire is preheated to a desired temperature less than the oxidation temperature. The adjustment of the voltage is of course made in consideration of the particular wire size so that the desired temperature is attained.

The reach of wire extending between pulleys **42** and **76** is provided with current from the secondary of transformer T1 through conductors **112** and **110** and brushes **43** and **77**, conductor **112** being common to the two circuits described above. Since the length of wire is approximately one-quarter as long between pulleys **42** and **76** as between pulleys **62** and **42**, the wire will reach a much higher temperature. During its passage between the two pulleys **42** and **76** the wire is surrounded by steam which is supplied to the tube **90** in any suitable manner, this tube extending upwardly from a generally cylindrical casing **70** (Fig. 2) surrounding pulley **76**. The casing **70** is provided with couplings **93** and **95** which respectively couple the casing to the steam tube **90** and the water tube **88**, these tubes being suitably supported as, for example, by means of the brackets **91** and **97** respectively.

Current is supplied between the pulleys **76** and **32** from the secondary of transformer T2 over conductors **100** and **114** and brushes **77** and **33**. Similarly current is supplied to the wire between pulleys **32** and **82** from the secondary of transformer T2 over conductors **114** and **110** and brushes **33** and **83**. Thus the wire after being quenched is reheated as it passes from pulley **76** to pulley **82**, and is dried during the last half of its passage where it has emerged from the water tube **88**. This reheating and drying serves to prevent oxidation of the wire and assures that the final product on the spool will have the proper bright appearance.

As has been indicated, the wire after passing about

pulley 82 passes over pulley 96 and then ordinarily feeds to a spooling machine.

Referring now particularly to Fig. 3, the mode of assembling the pulleys 32, 42 and 52, together with current conducting rings, on the shaft 16 will be described. Adjacent the right hand bearing 14 an electrically conductive ring 34, serving as a slip ring to conduct current to the shaft 16 from the transformer T1 previously mentioned, is fixed by any suitable means such, for example, as the key illustrated. An insulating sleeve 59 is slipped over the shaft and abuts the slip ring 34, this sleeve being pinned to the slip ring by means of the pin 61. As is clearly shown in the drawings, the sleeve 59 is reduced at its outer or left hand side forming a shoulder.

Mounted on the reduced end of sleeve 59 is a metallic sleeve 46 which thus seats against the shoulder of the sleeve 59. Mounted on the metallic sleeve 46 is the slip ring 58 which, as shown in the drawings, is pinned to the sleeve 59 by means of the pin 60. Between the metallic sleeve 46 and the shaft 16 there is an insulating sleeve 44 which at its right hand end abuts against the left hand reduced end of the sleeve 59.

Mounted on the sleeve 46 adjacent the left hand side of the slip ring 58 is a sleeve or bushing of insulating material designated at 54, this sleeve being pinned to the slip ring 58 by means of the pin 60 previously mentioned. Also mounted on the metallic sleeve 46 is another bushing or sleeve 48 which has a reduced diameter portion at its right-hand end, on which the hub portion of the pulley 52 is mounted. The pulley 52 is pinned for rotation with the members 48 and 54 by means of the pin 56 which extends through pulley 52 and into blind bores in the sleeves 48 and 54.

Mounted on the shaft 16 is a sleeve 38, the right-hand end of which is so reduced that it extends within the metallic sleeve 46 and abuts against the inner insulating sleeve 44. Sleeve 38 thus provides a groove between the left-hand end of sleeve 48 and its own body. In this groove pulley 42 is mounted, this pulley being provided with a slightly enlarged bore at its right-hand side thus seating firmly on the left-hand end of sleeve 46. Pulley 42 is pinned to rotate with the sleeves 48 and 38 by means of a pin 50 which extends through the pulley and into the two sleeves mentioned.

Mounted directly on the shaft 16 is the left-hand pulley 32 which is pinned to the sleeve 38 by means of the pin 40. As will be seen, due to the parts being pinned together as described, all of the parts mentioned above will rotate with the shaft 16. Moreover, a direct metallic path is formed from the brush 33 through slip ring 34 and shaft 16 to the pulley 32 and another direct metallic path is formed extending from the brush 43 through slip ring 58 and sleeve 46 to pulley 42. Pulley 52 is completely insulated from the slip rings and shaft by virtue of its mounting on the shoulder of the insulating sleeve 48.

The lower pulley structure is similar to that described above. However, in this instance the structure is somewhat less complicated since the metallic sleeve 46 is unnecessary, this being due to the fact that three of the pulleys are connected to a common electrical terminal and the fourth pulley is completely insulated. Thus, referring to Fig. 2, it will be seen that pulleys 62, 76 and 82 are directly mounted on the shaft and are spaced apart by means of the insulating sleeves 78, 72 and 64. Additionally it will be seen that the sleeve 78 is provided with a shoulder at its left-hand end on which the pulley 68 is mounted.

In this lower sheave assembly, a slip ring 86 is provided, the slip ring being keyed to the shaft in the manner shown. Cooperating with this slip ring is a brush 63 which appears in the schematic diagram of Fig. 4 as three brushes designated 63, 77 and 83 for the purpose of convenience in illustration. The actual physical arrangement is, however, that shown in Fig. 2. The pulley assembly described above is fixed for rotation with the shaft 24, this being done in any suitable manner, as for example by means of key fastening pulley 62 to shaft 24 and pins 84, 80 and 74 and 66 fastening the various sleeves and pulleys to pulley 62 for rotation therewith.

It will be seen that due to the arrangement just above described brush 63 is electrically connected through the slip ring 86 and shaft 24 to pulleys 62, 76 and 82, while pulley 68 is completely insulated. Thus, by means of the pulley assemblies described the electrical circuits described in connection with Fig. 4 are established and the wire is heated to the required temperature in the preheating, annealing and drying zones.

Although the pulleys or sheaves have been described and are shown in the drawings as being solid, they may, in order to assure of the proper wearing qualities of their driving surfaces and to provide for highly polished cylindrical surfaces, be made with replaceable bands in the manner described in my copending application, Serial No. 685,151, filed September 20, 1957, now abandoned.

Reference to Fig. 1 will show that the wire path through the annealing mechanism when the present invention is utilized is relatively short and direct and that therefore the space occupied by the annealing mechanism is relatively small. As will be seen, the wire enters from the drawing machine near the upper left-hand side of the housing 10 and is passed over a pulley 94 from which it passes beneath the pulley 62, thence upwardly and slightly to the left, as seen in Fig. 2 and over pulley 52, thence downwardly and around pulley 68, upwardly over pulley 42, downwardly through the steam tube 90 and about pulley 76, thence upwardly through the water tube 88, through the slot in the wiper blade 99 (suitably fixed to the housing 28), about pulley 32, thence downwardly around pulley 82, upwardly and over pulley 96 (supported externally on the housing) and thence to the spooling machine.

Although I have described a preferred embodiment of my invention it will be understood that other embodiments may readily be devised. I wish therefore to be limited not by the foregoing description but solely by the appended claims.

What is claimed is:

1. In a wire annealing device of the type wherein the wire is electrically heated in sections to annealing temperature, quenched and dried, in combination, a pair of shafts extending substantially parallel to each other in spaced relation in a common plane, a plurality of sheaves mounted on each shaft and means including slip rings for applying different voltages across selected pairs of said sheaves on said respective shafts, whereby wire passing successively over said sheaves has predetermined currents passing therethrough to heat it to desired temperatures in the various sections between said sheaves and the wire passes to and from said sheaves in two parallel planes, and wherein four sheaves are mounted on one of said shafts, means connecting three of said sheaves directly to said shaft and to said slip ring and wherein three sheaves are mounted on the second of said shafts, one of said sheaves being connected to a slip ring and a second being electrically connected to a sleeve, said sleeve having a second slip ring mounted thereon.

2. A device as claimed in claim 1 wherein a section of wire between a sheave on one of said shafts and a sheave on the second of said shafts passes through a tube and wherein said tube is filled with a protective atmosphere.

3. A device according to claim 2 further characterized in that the section of a wire between the second sheave and a third sheave on the first said shaft extends through a tube containing a quenching medium.

4. A device in accordance with claim 1 characterized in that a section of wire extending from the first of said sheaves on the first said shaft about the first sheave on the second said shaft, the second sheave on the first said

shaft and the second sheave on the second said shaft is connected in series connection with a variable source of electrical voltage, whereby the wire may be heated to a desired temperature, a section of wire extending from said second sheave on said second shaft to the third sheave on the first said shaft is connected in series with said source of variable voltage, the section of wire from said third said sheave on said first shaft to said third sheave on said second shaft is connected in series with a second source of variable voltage and the section of wire from said third sheave on said second shaft to said fourth sheave on said first shaft is connected in series with said second source of variable voltage.

5. In a wire annealing device of the type wherein the wire is electrically heated in section to annealing temperature, quenched and dried, in combination, a pair of shafts extending parallel to each other in spaced relation in a common plane, a slip ring fixed to the first said shaft, a sheave of conductive material mounted on said shaft for rotation therewith, an insulating sleeve mounted on said shaft adjacent said sheave, said sleeve having a reduced diameter portion at the end remote from said sheave, a second sheave mounted on said reduced diameter portion of said sleeve and insulated from said shaft, a second sleeve mounted on said shaft adjacent said second sheave, a third sheave mounted on said shaft adjacent the end of said sleeve remote from said second sheave, a third insulating sleeve mounted on said shaft adjacent said third sheave, a fourth sheave mounted on said shaft and electrically connected thereto at the end of said third sleeve and means fixing said first sheave to said first sleeve, said second sheave to said first and second sleeves, said third sheave to said second and third sleeves and said fourth sheave to said third sleeve.

6. In a wire annealing device of the type wherein the wire is electrically heated in sections to annealing temperature, quenched and dried, in combination, a pair of shafts extending parallel to each other in spaced relation in a common plane, a slip ring fixed to the first said shaft, an insulating sleeve mounted on said shaft adjacent said slip ring, means fixing said sleeve for rotation with said slip ring, said sleeve having a reduced diameter portion at the end remote from said slip ring, a second sleeve mounted on said shaft adjacent said first sleeve, said second sleeve having an external diameter equal to the external diameter of said reduced portion of said first sleeve, a metallic sleeve mounted on said second sleeve and extending over the reduced portion of said first sleeve, a second slip ring mounted on said metallic sleeve, a third insulating sleeve mounted on said metallic sleeve adjacent said second slip ring, means fixing said first and third sleeves and said second slip ring for rotation with said first sleeve, a fourth sleeve mounted on said metallic sleeve adjacent said third sleeve, said fourth sleeve having a reduced portion adjacent said third sleeve, a first sheave mounted on said reduced portion of said fourth sleeve, said mounting insulating said sheave from said shaft and said metallic sleeve, means fixing said first sheave for rotation with said third and fourth sleeves, a fifth sleeve mounted on said shaft, said fifth sleeve having a reduced diameter portion, said reduced diameter portion being of the same external diameter as said second sleeve and extending within the end of said metallic sleeve, a second sheave mounted between said fourth and fifth sleeves, said second sheave having a portion of its hub of a greater diameter than the remainder, said greater diameter portion seating on said metallic sleeve thereby electrically connecting said second sheave through said metallic sleeve to said second slip ring, means fixing said second sheave to said fourth and fifth sleeves for rotation therewith, a third sheave mounted on said shaft adjacent the end of said fifth sleeve remote from said second sheave and means fixing said third sheave for rotation with said fifth sleeve.

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