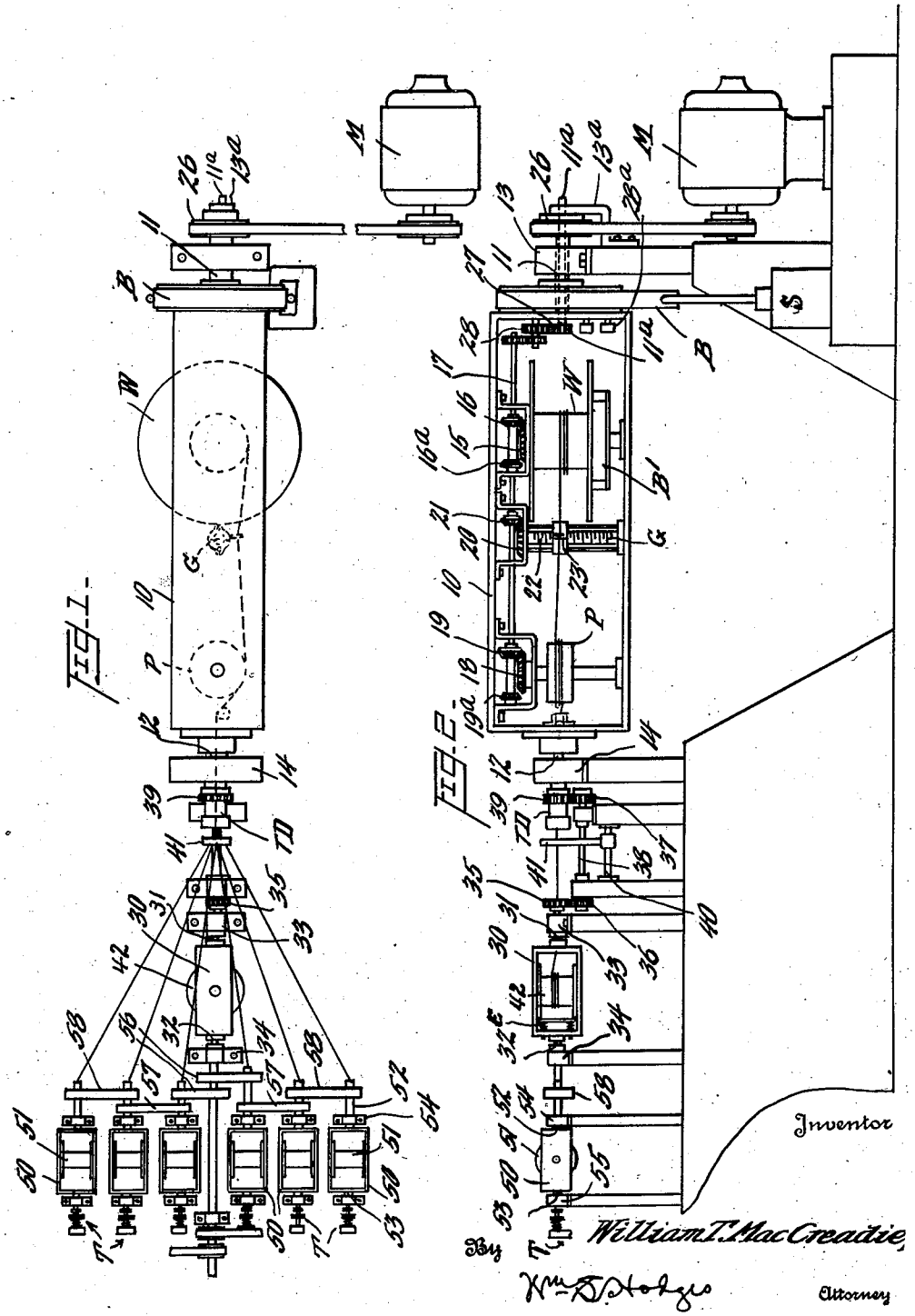
Oct. 17, 1944. W. T. MacCREADIE 2,360,783

WIRE ROPE MANUFACTURING MACHINE

Filed Dec. 20, 1943 2 Sheets-Sheet 1



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WIRE ROPE MANUFACTURING MACHINE

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FIG. 3.

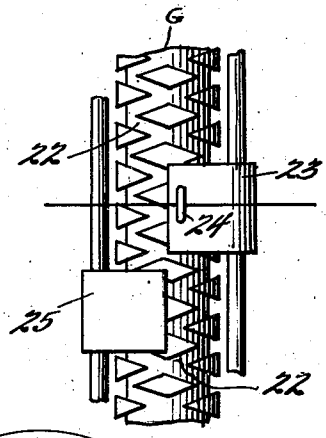


FIG. 4.

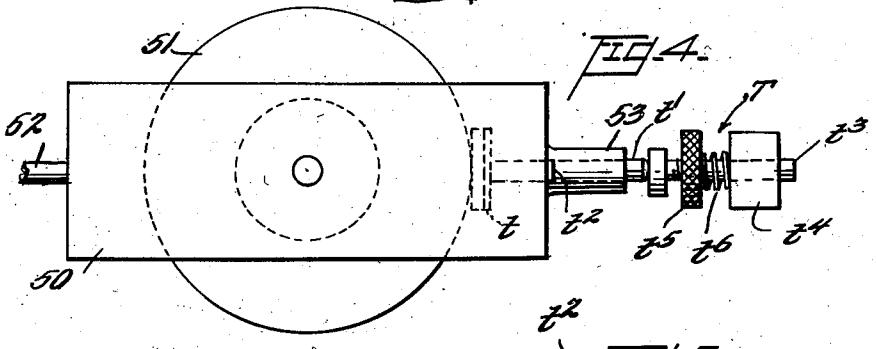


FIG. 5.

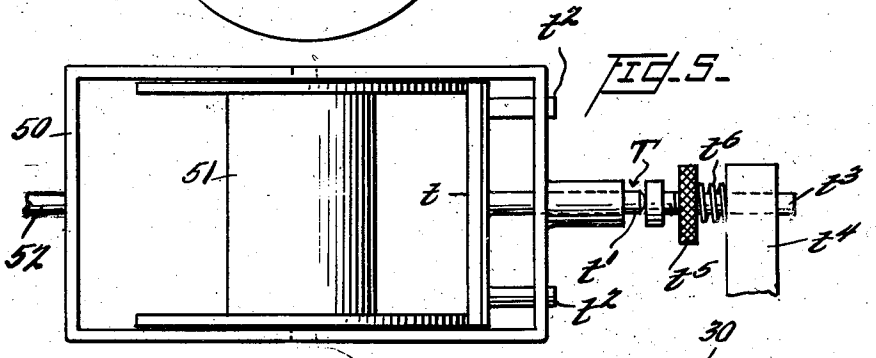
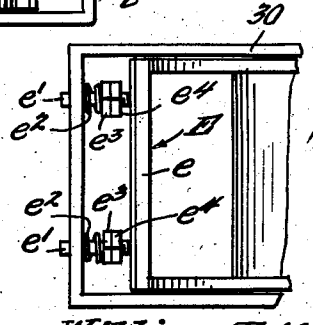


FIG. 6.



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WIRE ROPE MANUFACTURING MACHINE

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15 Claims. (Cl. 57—69)

This invention is a machine for manufacturing wire rope, and more particularly pertains to the manufacture of that type of rope or cable in which a plurality of wires are wrapped or twisted around a central wire core.

In the manufacture of wire rope, the so-called "gravity" type machine is now commonly employed. A typical construction of this type of machine provides means for feeding the wires from bobbins which are rotatively mounted in cradles, each cradle being free to oscillate within a cage or compartment which are arranged in tandem, and are mounted to rotate upon axes coinciding with their longitudinal medial lines. Each cradle is so suspended within its cage as to be free to oscillate within the cage but the weight of the cradle is so distributed that it will be normally maintained in a fixed position by the action of gravity. The accepted practice is to arrange a plurality of these cages in tandem, within a suitable supporting frame, there being one cradle-carrying cage for each bobbin of wire to be used in making the rope, so that the several wires must be drawn along the frame to the twister head. By reason of the tandem arrangement, it is obvious that some of these wires must be carried considerable distances before they reach the die. From the twister mechanism the completed product is delivered to a wind-up drum, which is rotatively mounted in fixedly supported bearings. During the rope forming operations, the wires are drawn through a die of suitable construction, and at the same time the cages are rotated about their axes, which are parallel with the axis of rotation of the twister, thereby reducing the tendency to apply breaking strains upon the wires. The cradles, however, are held by gravity from rotating with the cages, so that their bobbins are caused to remain in positions that are approximately stationary with respect to the rotative movements of the cages. Machines of this type, while commercially successful, are open to several objections. For instance, by reason of the tandem arrangement of the cages, the machine necessarily requires a space of substantial length, the required amount of space being determined by the number of cages arranged in tandem. A further serious objection arises from the necessity of carrying the strand wires long distances from their respective supply bobbins, and at high rotative speeds, thereby exposing them to danger of breakage, which frequently occurs. Any such breakage necessitates immediate stopping of the machine, which entails considerable loss of time required to replace the broken wires, and to again set up the machine, so as to continue the operation from the point of interruption. In addition to this it is difficult to employ a positive automatic stop device, because all of these wires receive rotative movement within the cages. This exposure of the wires to the danger of breakage also places a limitation upon the speed of operation of the rotating parts, and thereby constitutes a substantial drag upon production.

The main object of the present invention is to provide a machine for making wire rope which will overcome the disadvantages of the gravity type machine above pointed out, and by means of which increased production may be obtained by a machine which is entirely automatic in its operation and which requires much less space for its operation. A further object is to provide a simple and inexpensive apparatus for manufacturing wire rope of the type in which a center or core wire is axially rotated in such manner that a plurality of outer wires will be caused to twist around it. Another object is to provide a machine of the character described in which the core wire is rotated to effect the wrapping of the outer wires around the same. Another object is to provide a machine of the character mentioned which will dispense with the use of gravity cradles, and in which the outer or cover wires may be supplied from bobbins mounted in independent rotatable cages which may be placed in any desired positions, so that the bobbins may be placed closer to the twister head than is possible with the gravity type of machine, and the distance of required travel of the strand wires is reduced to a minimum. Another object is to provide means for so correlating the speeds of rotation of the cages which carry the wire feeding bobbins with the speed of rotation of a twister die, as to counteract the tendency of the outer wires to partially unwind after leaving the twister die. A further object is to provide a rotatively mounted cage for supporting wind-up mechanism, and means whereby the rotation of said cage will effect simultaneous rotation of the twister die, and the wire feeding bobbin cages at approximately the same rate of speed. A further object is to provide means for balancing the weight of the wind-up bobbin cage during rotations of the latter.

The invention will be hereinafter fully set forth and particularly pointed out in the claims.

In the accompanying drawings:

Figure 1 is a plan view illustrating a wire rope

manufacturing machine constructed in accordance with the invention.

Figure 2 is a side elevation thereof.

Figure 3 is a detail view illustrating the balanced device for guiding the finished rope to the wind-up drum.

Figures 4 and 5 are top and side views respectively of the tension devices for the cover-wire bobbins.

Figure 6 is a plan view illustrating the tension device for the core-wire bobbin.

Referring to the drawings, 10 designates an open cage for supporting the wind-up mechanism of a wire rope manufacturing machine, the same being supported by tubular end shafts 11 and 12, rotatably mounted in suitable bearings 13 and 14. Rotatively mounted in the side bars of the cradle 10, and on an axis at right angles to the axis of rotation of said cage, is a wind-up bobbin W of any desired construction, the shaft of said bobbin being provided at one end with a pinion 15, which meshes with a drive pinion 16 carried by a drive shaft 17. Said shaft extends longitudinally of the cage and is mounted in suitable bearings. Spaced from the bobbin W is a haul-off drum P, the shaft of which is rotatively mounted within the cradle 10, one end of said shaft being provided with a pinion 18 meshing with a drive pinion 19, also secured to and rotatable with the shaft 17. Interposed between the bobbin W and the haul-off drum P is a transversely disposed rotatively mounted shaft G which is actuated by a pinion 20 driven by a pinion 21 also rotatable with the shaft 17. The shaft G is provided with a double screw thread 22 to reciprocatively guide a nut 23 having an eye 24 to receive the completed wire rope, and which controls the lay of the wrap of the completed rope while the latter is being wound around the drum W. Positioned opposite to the guide nut 23 is a counterbalance nut 25 which also engages the screw threads of the shaft G, the arrangement being such that as the nut 23 moves in one direction, the balancing member 25 will move in the opposite direction and thereby prevent the overbalancing of the cradle in its pivotal mountings due to the shifting of the weight of the guide member 23 from one end of the screw to the other. The guide member 23 and the balancing member 25 are so proportioned that they may readily pass each other.

The cage 10 is rotated by means of a motor M, suitably connected to a drive pulley 26 on the shaft 11, the cage 10 being connected to the shaft 11 in such manner as to rotate therewith. Extending axially through the shaft 11, is a solid shaft 11^a, one end of which is anchored in a bracket 13^a secured to and supported by the bearing 13. On the inner end of the shaft 11^a is a fixed gear 27 which meshes with transmission gearing 28, so connected to the shaft 17 as to impart rotations to said shaft. As the cradle 10 is rotated with the shaft 11 it carries the gearing 28 in an orbit around the pinion 27 and thereby imparts rotative movement to the shaft 17. Said shaft, through the intermediate gearing already described, imparts concurrent rotations to the wind-up bobbin W, the haul-off drum P, and the screw shaft G. In practice, gear transmission units 28 of different ratios must be employed, depending upon the size of the rope being made. Therefore, the unit is removably supported by the cage 10. The weight of the unit 28 tends to unbalance the cage during rotation thereof, and to counteract this tendency a complemental counterweight unit 28^a is removably attached to the cage. Accordingly when any selected transmission unit is employed, its complemental counterweight should also be attached to the cage.

Mounted to rotate with the shaft 12 is a twister die TD, the bore of which is in axial alignment with the bore of the shaft 12. Rotatively mounted in spaced alignment with the axis of the twister die TD is a core-wire-bobbin cage 30. This cage is in the form of an open frame having axially extended shafts 31 and 32 connected to the ends thereof, said shafts being rotatively mounted in suitable bearings 33 and 34 in approximately axial alignment with the shaft 12. The shaft 31 is provided with a pinion 35 which is driven by intermediate gears 36 and 37 on a countershaft 38, the pinion 37 meshing with a drive gear 39 secured to the twister die in such manner as to rotate therewith. It will thus be observed that rotation of the twister die in either direction will impart corresponding rotative movements to the cage 30.

Mounted upon a support rod 40 is a guide member 41 for directing the various wires into the twister die TD in a manner well understood in the art. The core-wire-bobbin 42 is rotatively mounted in the side walls of the cage 30 and the wire therefrom is led through the hollow shaft 31 and the guide member 41 to the twister die as will be later more fully described.

It will be noted that the shaft 32 is extended through the bearing 34, and disposed adjacent thereto are a plurality of cover-wire-bobbin cages 50, each containing a feeder bobbin 51 rotatively mounted therein. Each of the cages 50 is provided with tubular, axially disposed end shafts 52 and 53, respectively extending through bearings 54 and 55, respectively, so that each cage is rotatively mounted on an axis parallel with the axes of the rotation of the shaft 12 and the cage 30. For purposes of illustration, six cover-wire-bobbin cages are shown, arranged in two sets on opposite sides of the shaft 32. The cages of each set receive rotative movement through the medium of transmission gearing consisting of sets of gears 56, 57 and 58. Each shaft 52 is hollow or tubular, so that the wire from the bobbin 51 may be passed axially through the shaft, and led to the twister-die TD, through the guide member 41. Obviously, the number of cages 50 and bobbins 51 may be increased to any desired number, by merely duplicating the drive gearing from the shaft 32 to the various cages.

From the foregoing description, it will be readily understood that rotative movement imparted to the wind-up mechanism cage 10 by the motor M, is directly communicated to the twister-die TD, which rotates with said cage; that rotations of the twister-die will, through the intermediate gearing, impart corresponding rotative movements to the core-wire-bobbin cage; and that rotation of the latter positively imparts corresponding rotative movements to the cover-wire-bobbin cages.

In operation, the core-wire from the bobbin 42 is passed from said bobbin through the hollow shaft 31 of its cage and then through the guide 41 and finally through the twister head. The cover-wires are also drawn from their bobbins 51 through the hollow shafts 52 of their cages, through the guide member 41, and into and through the die. In the initial set-up of the machine a suitable cable is spliced or otherwise secured to the ends of the wires which protrude from the twister die, said cable being passed several times around the haul-off drum P, so that the completed rope may be drawn through the die

when the motor M is energized. When sufficient rope has been made to reach the wind-up drum W, the cable is detached as the machine is ready for continuous operation.

Upon energization of the motor M the cage 10 and the twister head TD will be rotated and concurrently therewith the haul-off drum P, the guide screw G and the wind-up bobbin W will all be simultaneously rotated by the gearing transmission mounted in and rotatable with said cage 10. At the same time concurrent axial rotation of the cages 30 and 50 is effected, so that the core-wire as well as the outer wires receive independent axial rotative movements as they are delivered to the die. As the wires pass through the rotating twister-die the cover-wires are helically wound around the core-wire by the rotative movements of the latter. In other words, the cover-wires are disposed circumferentially around the core-wire in helical lines, and they are so crowded against the core-wire that rotation of the twister head will cause the cover-wires to wrap around the core-wire. For this reason, it is necessary that the core-wire and the cover-wires be fed from bobbins mounted in rotatively supported cages, so as to prevent crystallization and breaking of the wire. During this twisting operation, there is also a tendency for the cover-wires to each receive a local twist as distinguished from the mere wrapping of the wire around the core-wire. That is, each cover-wire as it is wrapped around the core-wire also has a tendency to be twisted upon itself. For every turn of the core-wire, each cover-wire which wraps around the core-wire accumulates approximately one turn which must be eliminated or the wire will snarl. This means that the speed of rotation of the small bobbins must not be substantially less than the speed of rotation of the core-wire. It is preferred, therefore, to rotate the core-wire cage and the cover-wire cages at approximately the same speeds, although the cover-wire cages may be rotated if desired, at a slightly greater speed. It is to be understood that the various driving transmissions are diagrammatic only and not drawn to scale, but in practice the ratios are so designed as to produce the speeds of rotation above described, so as to prevent "turn-back" of the cover-wires after the completion of the twisting operation. As the completed rope consisting of the cover-wires twisted around a core-wire, increases in length after it leaves the die TD, it travels through the shaft 12 to the haul-off drum P, and then to the wind-up mechanism as above described.

If it should be desired to rotate the die TD in the opposite direction, the motor M is reversed. However, it will first be necessary to disengage gears 16 and 19 from their respective complemental pinions 15 and 18, and to engage gears 16^a and 19^a therewith. These changes are necessary to cause the wind-up bobbin W and the haul-off drum P to rotate in the proper direction.

To prevent a too rapid unwinding of the bobbins 51, each of the cages 30 is provided with a tension device T. See Figures 4 and 5. Each tension device consists of a head t secured to a shaft t' slidingly mounted in the end shaft 53 of the cage, and provided with guide arms t^2. Bearing against the outer end of the shaft t' is the headed end of a threaded shaft t^3, slidingly mounted in a bearing t^4. Adjustably mounted on shaft t^3 is an abutment member t^5, and interposed between the latter and the bearing t^4 is a spring t^6. By this arrangement the head t is at all times yieldingly held against its bobbin, so as to prevent too rapid rotation thereof during the unwinding of the wire, and at the same time it will hold the bobbin from unwinding in the event of breakage of the wire. The core-wire bobbin is held from too-rapid unwinding by a tension device E, which comprises a head e provided with guide pins e', which slidingly extend through the adjacent end of the cage 30. Springs e^2 encircle the pins e' and bear at one end against said end wall, and at the other end against abutment nuts e^3, which are adjustably mounted on threaded portions of the pins e'. Lock nuts e^4 hold the nuts e^3 to any desired adjustment.

To stop the apparatus in the event of breakage of any of the wires, or for any other reason, the shaft 11 is provided with a brake mechanism B, operated in any suitable manner, for instance as by means of a solenoid S, which may be either manually or automatically operated in any manner well understood in the art. A brake B' is also applied to the wind-up bobbin to give the proper pull on the rope.

The advantages of the invention will be readily understood by those skilled in the art to which the invention belongs. For instance, it will be readily seen that by arranging the cover-wire-bobbin cages in the manner herein shown and described, the entire mechanism may be installed in a much shorter space than is possible with the old type tandem arrangement of feeding the wires to the die. An important advantage is that a strong wire rope is provided, in which cover-wires are helically wound around a core-wire, and that the method of feeding the wires to the twister die is such that the strands will lie inert, i. e. they will not "snake" or loop. A further advantage is that the core and cover-wires are fed from bobbins which are mounted in rotatively supported cages on axes approximately parallel with the axis of rotation of the twister bead, and that the twister die is the prime mover for effecting rotation of said cages at a speed determined by the speed of rotation of the twister die. Another advantage is that the machine is of simple and inexpensive structure, and may be readily expanded to manufacture ropes of any desired number of strands.

Having thus explained the nature of the invention and described an operative manner of constructing and using the same, although without attempting to set forth all of the forms in which it may be made, or all of the forms of its use, what is claimed is:

1. In a wire rope manufacturing machine, a rotatively supported twister die, means for rotating said die, means for supplying a plurality of wires to said die for twisting, means for drawing said wires through said twister die, means for imparting independent axial rotative movements to said wires as they are supplied to said twister die, rotative driving means directly driven by rotative movements of said twister die so that the speed of rotation of said driving means is determined by the speed of rotation of the twister die, and means connecting said driving means with said means for imparting axial rotative movements to the said wires.

2. In a wire rope manufacturing machine, a rotatively supported twister die, means for rotating said die, means for supplying a core wire to said twister die, means for independently supplying a plurality of cover wires to said twister die, means for drawing said wires through said twister die, means for imparting independent

axial rotative movements to all of said wires as they are supplied to the twister die, rotative driving means directly driven by rotative movements of said twister die so that the speed of rotation of said driving means is determined by the speed of rotation of the twister die, and means connecting said driving means with said means for imparting axial rotative movements to the said wires.

3. In a wire rope manufacturing machine, a rotatively supported twister die, means for rotating said die, a plurality of rotatively supported wire-bobbing cages, means for supplying wires from said cages to said twister die and from positions coinciding with the axes of rotation thereof, means for drawing the wires through said twister die, means for rotating each of said cages, so as to impart axial rotative movement to each wire as it is supplied to the twister die, rotative driving means directly driven by rotative movements of the twister die, so that the speed of rotation of said driving means is determined by the speed of rotation of said twister die, and means connecting said driving means with said cages.

4. In a wire rope manufacturing machine, a rotatively supported twister die, means for rotating said die, a rotatively supported core wire bobbin cage, a plurality of independent rotatively supported cover wire-bobbin cages located adjacent the first mentioned cage, means for supplying wire from said cages to the twister die and from positions coinciding with the axes of rotation thereof, means for drawing the wires through said twister die, means for rotating each of said cages, so as to impart axial rotative movement to each wire as it is supplied to the twister die, rotative driving means directly driven by rotative movements of the twister die, so that the speed of rotation of said driving means is determined by the speed of rotation of said twister die, and means connecting said driving means with said cages.

5. In a wire rope manufacturing machine, a rotatively supported twister die, means for rotating said die, a rotatively supported core-wire-bobbin cage, a plurality of independent rotatively supported cover-wire-bobbin cages located adjacent the first mentioned cage, means for supplying wire from said cages to the twister die and from positions coinciding with the axes of rotation thereof, means for drawing said wires through the twister die, means to rotate the core-wire-bobbin cage, rotative driving means directly driven by rotative movements of said twister die, so that the speed of rotation of said driving means is controlled by the speed of rotation of said twister die, and means connecting said core wire bobbin cage with said rotative driving means, and means operated by the core-wire-bobbin cage for simultaneously rotating said cover-wire-bobbin cages, whereby rotation of each cage will impart axial rotation to the wire fed thereby as it is delivered to the twister die.

6. In a wire rope manufacturing machine, a rotatively supported twister die, means for rotating said die, a plurality of wire-bobbin-cages mounted for axial rotation, means in each cage for supporting a wire bobbin mounted to rotate on an axis at right angles to the axis of rotation of its cage, whereby said wires may be delivered to the twister die, means for drawing said wires through the twister head, means for rotating said cages so as to impart axial rotative movements to the wires as they are supplied to the twister head, rotative driving means directly driven by rotative movements of the twister die so that the speed of rotation of said driving means is controlled by the speed of rotation of said twister die, and means connecting said driving means with said cages.

7. In a wire rope manufacturing machine, a rotatively supported twister die, means for rotating said die, a plurality of wire-bobbin cages mounted for axial rotation and each having a hollow shaft, a wire-bobbin rotatively mounted in each cage on an axis at right angles to the axis of rotation of its cage, and so positioned that the wire from each bobbin is supplied to the twister head through the hollow shaft of its cage, means for drawing said wires through the twister head, means for rotating said cages so as to impart axial rotative movements to the wires as they are supplied to the twister head, rotative driving means directly driven by rotative movements of the twister die so that the speed of rotation of said driving means is controlled by the speed of rotation of said twister die, and means connecting said driving means with said cages.

8. A wire rope manufacturing machine comprising wind-up mechanism, a rotatively mounted cage supporting said mechanism, means for rotating said cage, a twister die fixedly connected with said cage at one end thereof so as to be rotatable therewith, means for supplying a plurality of strand wires to said twister die, means for drawing said wires through said twister die, means for imparting rotative movements to said wires as they travel to the die, rotative driving means directly driven by rotative movements of said twister die, whereby the speed of rotation of said driving means is controlled by the speed of rotation of said die, and means connecting said driving means with said strand-wire-supply cages.

9. A wire rope manufacturing machine comprising wind-up mechanism, a rotatively mounted cage supporting said mechanism, means for rotating said cage, a twister die fixedly connected with said cage at one end thereof so as to be rotatable therewith, means for supplying a core wire to said die, means for simultaneously supplying a plurality of cover wires to said die, means for drawing said wires through said twister die, means for independently imparting rotative movements to said core wire and to said cover wires, rotative driving means directly driven by rotative movements of said die so that the speed of rotation of the driving means is controlled by the speed of rotation of said twister die, and means connecting said driving means with the respective cages.

10. A wire rope making machine comprising wind-up mechanism, a rotatively mounted cage supporting said mechanism, means for rotating said cage, a twister die connected to one end of said cage and rotatable therewith, a rotatively mounted core-wire-bobbin cage spaced from said die, means operated by rotation of said cage and die for imparting coextensive rotative movements to said core-wire-bobbin cage, a plurality of cover-wire-bobbin cages positioned adjacent to the core-wire-bobbin cage, means for drawing the core-wire and cover-wires through said twister head, and means operated by rotation of said core-wire-bobbin cage to impart coextensive simultaneously rotative movements to said cover-wire-bobbin cages.

11. A wire rope making machine comprising wind-up mechanism, a rotatively mounted cage

supporting said mechanism, means for rotating said cage, a twister die connected to one end of said cage and rotatable therewith, a rotatively mounted core-wire-bobbin cage spaced from said die, means operated by rotation of said die for imparting coextensive rotative movements to said core-wire-bobbin cage, a plurality of cover-wire-bobbin cages positioned adjacent to the core-wire-bobbin cage, means operated by rotation of said core-wire-bobbin cage to impart coextensive simultaneous rotative movements to said cover-wire-bobbin cages, and means for drawing the wires through said die, the driving connections between the twister die and the core-wire-bobbin cage and between the latter and the cover-wire-bobbin cages being so proportioned that the speed of rotation of the wind-up mechanism cage controls the speed of rotation of the twister die and wire bobbin cages.

12. A wire rope making machine comprising wind-up mechanism, a rotatively mounted cage supporting the same, a twister die connected to and rotatable with said cage on the same axis, a core-wire-bobbin cage mounted to rotate upon an axis coinciding with the axis of rotation of said twister die, means operated by rotation of said head for imparting rotative movement to said last mentioned cage, a plurality of cover-wire-bobbin cages rotatively mounted on the axes parallel to the axis of rotation of the core-wire-bobbin cage, means operated by rotation of the core-wire-bobbin cage for simultaneously imparting rotative movements to the cover-wire-bobbin cages, and means carried by and rotatable with the first-mentioned cage for drawing said wires through said die.

13. A wire rope manufacturing machine comprising wind-up mechanism, a rotatively mounted cage supporting said mechanism, means for rotating said cage, a twister die fixedly connected with said cage at one end thereof so as to be rotatable therewith, a drive pinion carried by said twister die, a core-wire-bobbin cage positioned adjacent to said twister head, means operated by said pinion for imparting rotative movements to said core-wire-bobbin cage, means for supplying cover wires to the twister die simultaneously with said core-wire, and carried by and rotatable with the first-mentioned cage for drawing said wires through said die.

14. A wire rope manufacturing machine comprising wind-up mechanism, a rotatively mounted cage supporting said mechanism, means for rotating said cage, a twister die fixedly connected with said cage at one end thereof so as to be rotatable therewith, a drive pinion on said twister die, a core-wire-bobbin cage rotatively mounted adjacent to said twister head, gearing connecting said pinion with said core-wire-bobbin cage so that rotation of the twister head imparts corresponding rotation to the core-wire-bobbin cage whereby the core-wire is rotated as it approaches the twister head, a plurality of cover-wire-bobbin cages rotatively mounted adjacent to the core-wire-bobbin cage, means operated by rotative movements of the core-wire-bobbin cage for imparting simultaneous rotative movements to the cover-wire-bobbin cages, whereby rotative movement is imparted to the cover wires as they are delivered to the twister die, and means carried by and rotatable with the first mentioned cage for drawing said wires through said die.

15. A wire rope manufacturing machine having in combination a rotatively mounted cage, a shaft rotatively mounted within said cage and rotatable on an axis parallel with the axis of the rotation of the cage in which it is mounted, a wind-up mechanism mounted in said cage and driven by said shaft, means at one end of said cage for rotating the same, a rotatable twister die fixedly connected with the other end of said cage and positioned to be rotatable therewith on the same axis, a plurality of rotatively mounted wire bobbin cages positioned to supply strand wires to said twister die, and means operated by rotation of said twister die for imparting rotative movements to said wire bobbin cages, each strand-wire-bobbin cage being rotatable on an axis parallel to the axis of rotation of the first mentioned cage.

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