March 18, 1947. E. G. PARVIN 2,417,780

REELING CONTROL MECHANISM

Filed Oct. 28, 1944

Fig. 1.

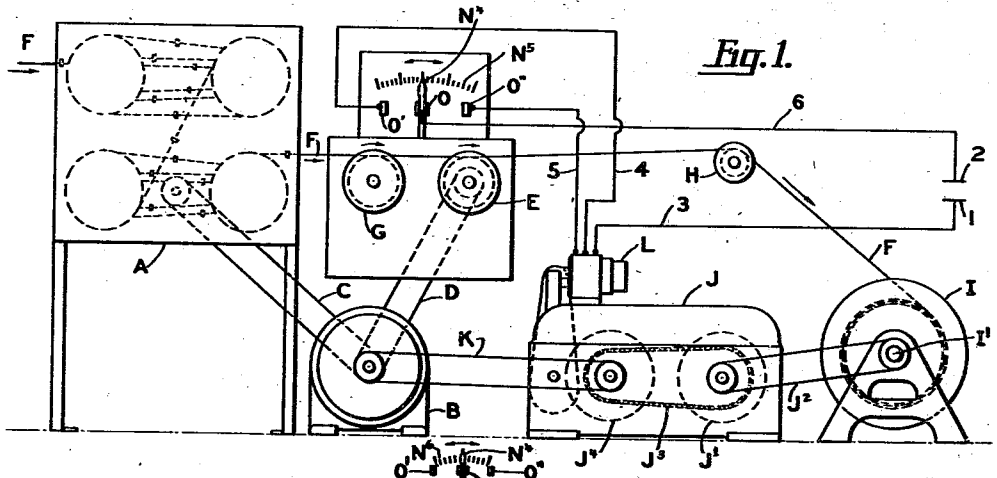


Fig. 2.

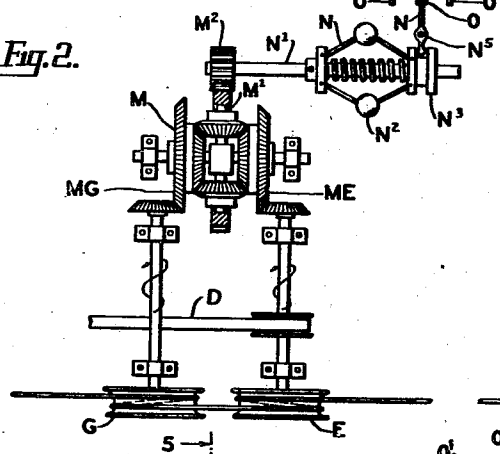


Fig. 3.

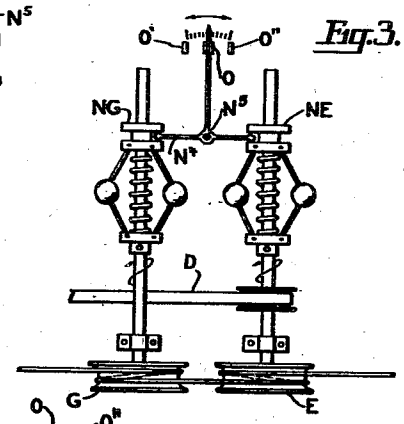


Fig. 4.

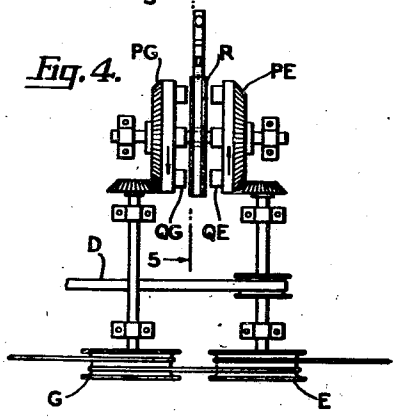


Fig. 5.

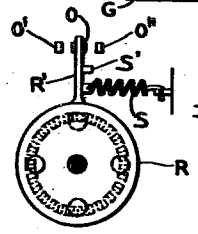
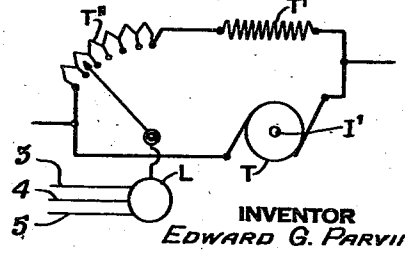


Fig. 6.



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REELING CONTROL MECHANISM

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4 Claims. (Cl. 205—16)

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The general object of the present invention is to provide improved reeling control mechanism. More specifically, the object of the invention is to provide means for controlling the relative speeds of rotation of the draw-off roll or capstan by which wire is drawn away from a wire drawing mechanism proper and the reel or spool on which the finished wire is wound. In drawing wire, the practice now is and long has been to reduce the diameter of the wire in successive steps by moving the wire through a series of dies having die apertures of successively diminishing diameter.

The wire drawing machinery proper has become standardized in a general way and form which the art finds satisfactory, but the means heretofore developed for moving the wire away from the wire drawing machinery and spooling or reeling it, are not similarly satisfactory, and it is generally recognized that it would be practically possible to speed up the operation of the standard wire drawing unit and thereby increase the wire output or capacity of the unit, if it included more satisfactory means for handling the wire after it passes through the last diameter reducing dies of the wire drawing unit.

In the practical operation of wire drawing machinery, it is necessary to reduce the speed of the rotation of the reel or spool on which the finished wire is wound as the outside diameter of the annular body of wire wound on the reel or spool increases. Furthermore, it is generally recognized that a small amount of slippage of the wire on the draw-off capstan is essential, since when the tension of the wire passing to the reel from the draw-off capstan is high enough to prevent such slippage, frequent breakage of the wire invariably occurs. If the slippage is unduly great, the output of the wire drawing machinery is undesirably reduced.

At the present time, the most usual practice is to employ means responsive to the tension of the wire passing from the draw-off capstan to the reel, to maintain said tension approximately constant. However, this practice is not entirely satisfactory as there seems to be no uniform relation between the wire slippage on the draw-off capstan and the tension of the wire. Heretofore, some use has also been made of means to decrease the rotative speed of the reel on which the wire is wound, in direct response to the increase in the diameter of the annular body of wire wound on said reel, but the last mentioned mechanism does not give proper control of the wire slippage on the draw-off roll or capstan.

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The present invention is characterized by provisions directly responsive to the ratio or proportion of the speed of rotation of the draw-off capstan to the linear speed of the wire in contact with the roll, through which the ratio of those speeds is controlled and the slippage thereby regulated. In the preferred form of the present invention, the linear speed of the wire passing over and away from the draw-off capstan is regulated by means automatically responsive to the differential of the rotative speed of the draw-off capstan and the rotative speed of an idler roll or capstan rotated by the finished wire which passes over the idler capstan without slippage as it moves toward or away from the draw-off capstan. The means responding to the differential of the measuring and draw-off roll speeds, and the means cooperating therewith to control the speed of the winding reel may take various forms, some of which are shown in the accompany drawings.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawings:

Fig. 1 is a diagrammatic representation of wire drawing and reeling machinery including a preferred embodiment of the present invention;

Fig. 2 is a somewhat diagrammatic elevation of a portion of the apparatus shown in Fig. 1;

Fig. 3 is an elevation illustrating a modification;

Fig. 4 is an elevation illustrating a second modification;

Fig. 5 is a section on the line 5—5 of Fig. 4; and

Fig. 6 is a diagrammatic illustration of a modified reel driving mechanism.

In the drawings and referring first to the apparatus shown in Figs. 1 and 2, A represents a wire drawing unit which may be of conventional type, including wire moving rolls and a suitable plurality of dies progressively varying in their orifice diameters. In the manufacture of copper wires of finished diameters of the order of $\frac{3}{16}$ to .002 of an inch, it is usual practice to include 14 dies in each wire drawing unit. As diagrammatically shown in Fig. 1, a main driving motor B operates the unit A through a belt C and ro-

tates the draw-off capstan E through a belt D. The wire F drawn from unit A passes from the latter to, and is looped about, the barrel of the draw-off capstan E. As shown in Fig. 2, said barrel is in the form of a grooved pulley or short roll.

As shown, the wire passing from the drawing unit A to the draw-off capstan E is looped about an idler capstan G barrel portion which as shown in Fig. 2, as identical in form and size with the barrel portion of the capstan E. The wire looped about the free running idler capstan G does not slip on the latter. In consequence, the rotative speed of the capstan G is an accurate measure of the linear speed of the wire passing over the draw-off capstan E.

From the draw-off capstan E, the wire passes to the reel or spool I on which the wire is wound for transportation, sale and/or use. As shown, the reel I is rotated by the motor B through a variable speed drive unit J which may take various forms. As diagrammatically shown in Fig. 1, the unit J is of the well known "Reeves" type, one form of which is shown, for example, in Patent 2,108,410, granted February 15, 1938. As diagrammatically shown in Fig. 1, the variable speed unit J comprises a driving pulley J' of variable diameter connected by a belt J^3 to the spindle I' which rotates the reel I removably mounted on said spindle. The pulley J' is driven through a belt J^3 by the variable diameter pulley J^4. The latter is rotated at a normally constant speed by the motor B through a belt K. The pulleys J' and J^4 each comprise a pair of coaxial conical pulley elements which are adjustable toward and away from one another to increase and decrease the effective diameter of the corresponding pulley by increasing or decreasing the diameters of the opposing pulley surfaces engaged by the belt J^3.

The variable speed drive unit J in the form shown, comprises a reversible control motor L. When rotating in one direction the motor L increases the effective diameter of the pulley J' and simultaneously decreases the effective diameter of the pulley J^4, and when rotated in the opposite direction the motor L increases the diameter of the pulley J^4 and simultaneously decreases the diameter of the pulley J'.

In the operation of the apparatus shown in Figs. 1 and 2, the control motor L is set into operation in one direction or the other, accordingly as an increase or decrease in the tension of the portion of the wire F between the reel I and draw-off capstan E, is needed to prevent the slippage of the wire on the capstan E from exceeding a predetermined maximum, or from becoming less than a predetermined minimum. The controlling means for the motor L shown in Figs. 1 and 2, includes a differential gear device M. The latter comprises coaxial gear elements ME and MG geared to the capstans E and G, respectively, and rotated in opposite directions at speeds respectively proportional to the rotative speeds of said capstans. The gear elements ME and MG are connected by bevelled gearing to an interposed spur gear M'. In normal condition, the latter continuously rotates in one direction at a speed which increases and decreases as the excess of the speed of the capstan E over the speed of the capstan G increases and diminishes.

The gear M' is geared to a smaller spur gear M^2 carried by the driving shaft of a speed indicator N of the centrifugal weight type, comprising a shaft N', centrifugal weights N^2, and a collar N^3. As the speed of rotation of the gear M^2 increases and diminishes, the weights move the collar N^2 axially along the shaft N' to the left and right respectively. The movements of the collar N^3 axially of the shaft N' oscillates an indicating lever or pointer N^4 pivoted at N^5. The pointer N^4 coacts with a scale N^6 to indicate the slippage of the wire on the capstan E. The scale N^6 may be graduated, conveniently, in units showing the wire slippage on capstan E as a percentage of the speed of the actual draw-off speed of the wire.

In the simple arrangement diagrammatically shown, by way of example, the motor L is energized from supply conductors 1 and 2 through terminals 3, 4 and 5. The terminal 3 is permanently connected to the supply conductor 1, and the motor L operates in one direction or the other accordingly as one or the other of its terminals 4 and 5 is connected to the supply conductor 2.

The connection of the terminals 4 and 5 to the supply conductor 2 is shown as directly controlled by a movable contact O, carried by the lever or pointer element N^4, and cooperating stationary contacts O' and O''. The contact O is connected by a conductor 6 to the supply conductor 2. The motor terminals 4 and 5 are connected to the stationary contacts O' and O'' respectively. The contacts O' and O'' are located at opposite sides of the contact O and are out of engagement with the contact O when the latter is in an intermediate position which it occupies when slippage of the wire on the capstan E is within the acceptable range of slippage. When the slippage of the wire on the capstan E becomes unduly small, the resultant reduction in the speed of the indicator shaft N' causes the collar N^3 to move to the right, as seen in Fig. 2, and thus brings the movable contact O into engagement with the stationary contact O'. When thus energized, the motor L adjusts the variable speed drive J to reduce the speed of the reel I.

The reduction in the speed of the reel I reduces the tension of the portion of the wire between the reel and the capstan E, and thereby increases the percentage of wire slippage on that capstan.

Conversely, when the slippage of the wire on the capstan E exceeds the desired percentage, the resultant increase in the speed of the indicator shaft N', operates through the weights N^2 to move the collar N^3 to the left and thus bring the movable contact O into engagement with the stationary contact O''. The engagement of the contacts O and O'' energizes the motor L for operation in the direction to increase the speed of the reel I and thereby increases the tension of the wire passing from the capstan E to the reel. Such increase in wire tension results in a decrease in the slippage in the wire on the capstan E. In general, the slippage of the wire should be a small percentage of the speed with which the wire is pulled away from the unit A. The maximum and minimum limits of the slippage permitted are determined by the spacing of the contacts O' and O'', and may be varied by adjustment of that spacing.

When the control motor L is a 3 phase motor, as it may well be in many cases, its operation may be controlled through the contacts O, O and O'' and an associated relay actuated, reversing switch arrangement of well known type.

In the modification shown in Fig. 3, each of the spindles of the capstans E and G carries a

centrifugal weight, speed responsive element including a sliding collar. The sliding collar NE on the spindle of the capstan E, and the sliding collar NG on the spindle of the capstan G are connected to opposite ends or arms of the lever N^4. The latter is pivoted at N^5, and has a third arm carrying a movable contact O. The latter is associated with stationary contacts O' and O'' as in Fig. 2, and may control the operation of the control motor L as in the construction first described.

In the modification shown in Fig. 4, coaxial gear elements PE and PG which are rotated as are the elements ME and MG of Fig. 2, carry on their adjacent faces magnet elements QE and QG, respectively. Interposed between the two magnets is a copper disc R, pivoted to turn about the common axis of the gears PE and PG, and tending to rotate in the same direction as the magnet QE rotates as a result of the fact that the rotative speed of the element PE exceeds that of the element PG. The movement of each of the magnets QE and QG, relative to the disc R, creates eddy currents in the disc and subjects the latter to opposite torques. The torque due to the movement of the rapidly moving magnet QE exceeds that due to the less rapidly moving magnet QG. The disc R has an arm R' connected to a spring S which tends to hold the arm I against a stationary stop S', except when the wire slippage exceeds a predetermined minimum and the excess of the speed of the magnet QE over that of the magnet QG is correspondingly increased. The arm R' carries a contact O which engages a stationary contact O'' when the arm engages the stop S'. On a predetermined increase in the slippage, the arm R' moves out of engagement with the stop S' and the contact O engages the stationary contact O'. The contacts O, O' and O'' of Fig. 4 may control the motor L and thereby regulate the speed of the wire as it is regulated with the arrangement shown by Figs. 1 and 2.

In lieu of operating the reel by the main driving motor through a variable speed drive mechanism as shown in Figs. 1 and 2, the reel may be driven by an individual variable speed motor. Thus, as shown diagrammatically in Fig. 6, the armature of a simple D. C. motor is mounted on and rotates the reel shaft I'. The speed of the motor I is controlled by the adjustment of a field rheostat T'' in series with field winding T', of the motor T. The rheostat T'' is automatically adjusted by the control motor L which may be controlled and operated as in the arrangement shown in Figs. 1 and 2.

As those skilled in the art will understand, the control of the speed of the reel by and in accordance with variations in slippage of the wire passing over the draw-off capstan has important and practical advantages. Those advantages include a direct and accurate control of the slippage by simple and reliable mechanism; the wire tension and slippage are independent of the increase in diameter of the coil of wire on the reel as the amount of wire on the reel increases. The close control of the extent of slippage effected minimizes wire breakage. The use of the invention thus makes possible a substantial increase in the maximum practical speed of operation of a wire drawing unit and a corresponding increase in the capacity of the unit. While the present invention was devised primarily for use in wire drawing machinery and is of especial utility when so used, those skilled in the art will understand that the principles of the present invention may be utilized in reeling strand material drawn under tension from sources of such material other than wire drawing machinery.

While in accordance with the provisions of the statutes, I have illustrated and described the best forms of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the forms of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. Wire drawing apparatus comprising in combination, a wire drawing mechanism, a variable speed wire reeling mechanism, a draw-off capstan moving wire from said drawing mechanism to said reeling mechanism, a differential speed mechanism comprising a rotatable element rotated by said capstan with an angular velocity proportional to that of the capstan, a rotatable element engaged by the wire moving from said drawing mechanism to said reeling mechanism and thereby rotated with an angular velocity proportional to the linear velocity of the wire and a member movable relative to each of said elements to deflect from a normal position, and means through which each element subjects said member to a yielding force increasing with the speed of rotation of said element and tending to deflect said member in a direction opposite to that in which the other element tends to deflect said member for maintenance of said member in said normal position when the angular velocities of said elements are in a predetermined ratio and through which said member is deflected from said normal position in one direction or in the opposite direction as the ratio of said angular velocities respectively increases above or decreases below said predetermined ratio, and mechanism controlled by said member for regulating the speed of operation of the reeling mechanism and adjusted by the deflection of said member in a direction tending to maintain said angular velocities in said predetermined ratio.

2. Wire drawing apparatus as specified in claim 1, in which the said differential speed mechanism includes a centrifugal speed governor operatively connected to each of said rotating elements for rotation with a speed proportional to the differential of the rotative speeds of the two elements and in which said governor is arranged to deflect said member from said normal direction in one direction or the other as its rotative speed respectively increases above or falls below the speed corresponding to said predetermined ratio.

3. Wire drawing apparatus as specified in claim 1, in which said differential speed mechanism elements are arranged to rotate in opposite directions about a common axis and in which said member is arranged to turn about the same axis and in which each element subjects said member to an electromagnetic force tending to rotate said member in the direction in which the element rotates and in which said apparatus includes means subjecting said member to a bias force opposing turning movement of said member in the direction which the element rotated by the capstan tends to rotate it with a force increasing with the extent of turning movement of said member in the last mentioned direction.

4. Wire drawing apparatus as specified in claim 1, in which each of the said differential speed mechanisms includes a separate centrifugal governor associated with and rotated by each of said elements, and in which each of said governors is in mechanical engagement with said member and subjects the latter to a yielding force proportional to the speed of rotation of said governor and tending to deflect said member in a direction opposite to that in which the other governor tends to deflect said member.

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