June 15, 1943. N. H. NYE 2,321,612

WIRE DRAWING APPARATUS

Filed Aug. 28, 1940 2 Sheets-Sheet 1

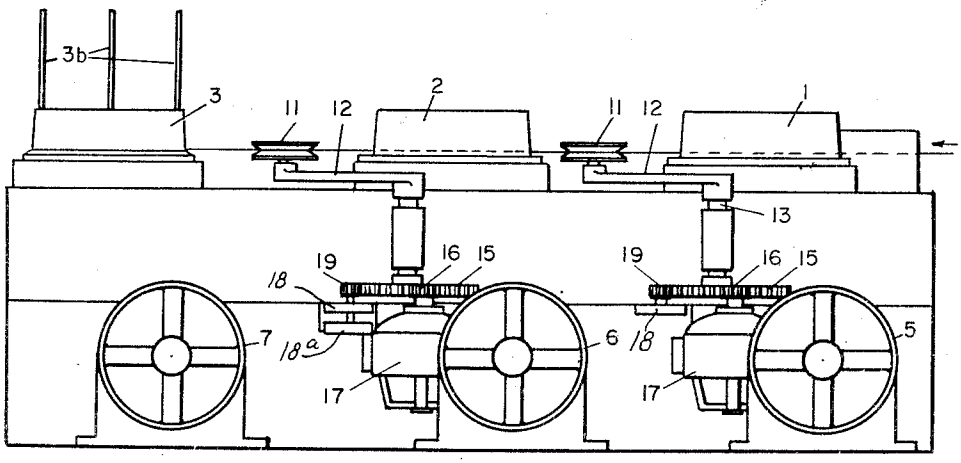


FIG. 1

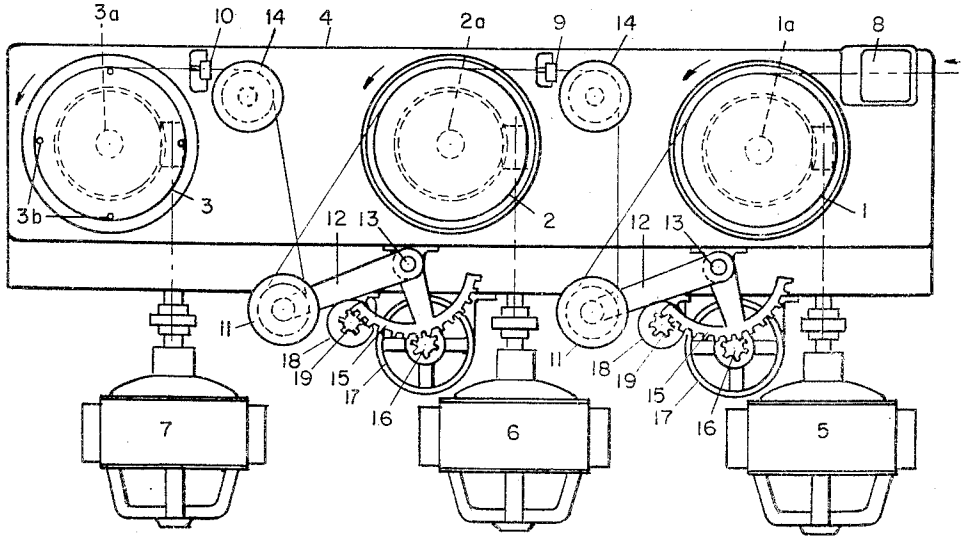


FIG. 2

INVENTOR.
NORMAN H. NYE
BY
Oberlin, Limbach & Day
ATTORNEYS.

June 15, 1943. N. H. NYE 2,321,612

WIRE DRAWING APPARATUS

Filed Aug. 28, 1940 2 Sheets-Sheet 2

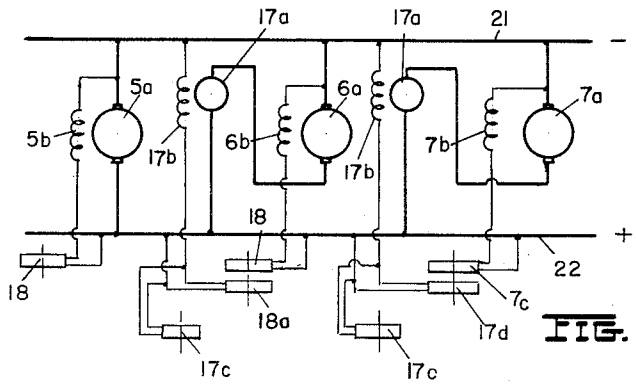


FIG. 3

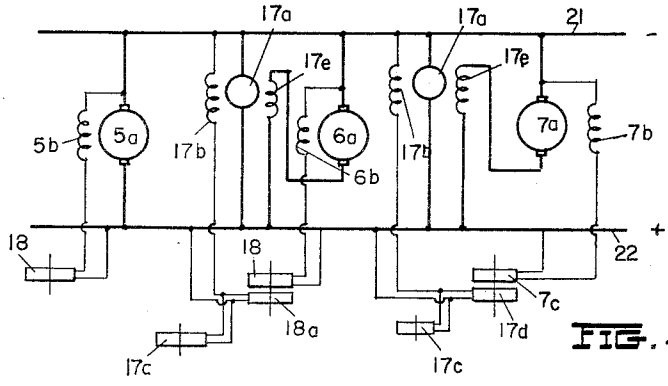


FIG. 4

INVENTOR.
NORMAN H. NYE
BY
Oberlin, Limbach & Day
ATTORNEYS

Patented June 15, 1943

2,321,612

UNITED STATES PATENT OFFICE

2,321,612

WIRE DRAWING APPARATUS

Norman H. Nye, Cuyahoga Falls, Ohio, assignor to The Vaughn Machinery Company, Cuyahoga Falls, Ohio, a corporation of Ohio

Application August 28, 1940, Serial No. 354,550

11 Claims. (Cl. 205—14)

In the continuous drawing of wire, rod and the like, where the material being drawn is passed through a series of dies or like elongating and reducing devices by being pulled by a corresponding series of drawing drums or the like interposed between such dies and beyond the last thereof in the series, the stretch of material between each such die and the succeeding drawing device is, of course, necessarily placed under tension. It has also long been recognized as desirable to maintain under tension the stretch of the material thus being operated upon which lies between each die and the preceding drawing device.

One object in maintaining such back tension on the material being drawn is to insure proper frictional engagement thereof with the preceding drum, i. e., prevent slippage of the material as it passes therearound. It has also been recognized that such back tension is desirable in order to secure more effective operation of the die or equivalent elongating and reducing device, e. g., the rolls in the case of a strip or sheet rolling mill.

Referring more specifically to the drawing of rod and wire, it has been customary to provide a device between each drum of a wire bench and the next succeeding die, which will not only take up any slack in the corresponding stretch of the wire being drawn, but also be so connected with the drawing blocks or drums as to maintain the wire under desired tension. An early form of a continuous wire drawing machine constructed to operate in this fashion is shown in United States patent to Saville No. 954,888, dated April 12, 1910, and another form will be found disclosed in Patents Nos. 1,108,971 to Clark, dated September 1, 1914 and 1,518,714 to Vaughn et al., dated December 9, 1924. The usual arrangement in such devices is to provide a movable sheave around which the wire is looped in passing from one drawing block to the next succeeding die, the movement of such sheave being operated by means of a counterweight or the like to maintain such stretch of the wire under desired tension. At the same time said movable sheave is interconnected with a driving mechanism for the respective drums so as to vary the speed thereof in accordance with the slack in the material at the point in question.

One principal object of the present improved apparatus for drawing wire and the like is to provide a back tension device of the character described which will automatically impose any desired degree of back tension on the wire in advance of the die through which it is being drawn. Another object is to provide a mechanism for accomplishing the foregoing result, which will be simple and inexpensive to construct and which, if desired, may be readily incorporated in existing types of continuous wire drawing benches or machines. Still another object is to provide such an apparatus which may be readily adjusted or adapted for the drawing of wire of various gauges while still retaining the capacity for thus imposing any desired degree of back tension on the wire.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail certain means and one mode of carrying out the invention, such disclosed means and mode illustrating, however, but one of various ways in which the principle of the invention may be used.

In said annexed drawings:

Fig. 1 is a side elevation of a wire drawing bench or machine embodying my present improvements:

Fig. 2 is a plan view thereof;

Fig. 3 is a wiring diagram of one form of electrical control which may be incorporated in the machine as illustrated in Figs. 1 and 2; and

Fig. 4 is a wiring diagram illustrating an alternative form of electrical control which may be incorporated in the same machine.

Referring to the construction of wire drawing machine illustrated in Figs. 1 and 2, such machine follows in the main the design of continuous wire drawing machine or draw bench well known in the art and currently in extensive commercial use. Accordingly, certain parts which are more or less standard are shown in diagrammatic form. As illustrated, the machine comprises a series 1, 2 and 3 of wire drawing blocks or drums, also called capstans, mounted on the upper ends of vertical spindles 1*a*, 2*a* and 3*a* which are suitably journaled in the frame 4 of the machine. The number of such blocks or drums may, of course, be greater or less, depending upon the requirements of the particular drawing operation. The terminal drum 3 of the series will ordinarily be provided with upwardly projecting arms 3*b* constituting a reel on which the finished wire is coiled preparatory to removal from the machine. The drums are rotated by a series of individual electric motors 5, 6 and 7 suitably intergeared with the correspond-

ing drum spindles, as diagrammatically shown in Fig. 2.

Mounted on the frame of the machine, one adjacent each of the drawing blocks or drums 1, 2 and 3, is a series of dies 8, 9 and 10 through which the wire passes on its way to the corresponding drum, it being understood that the wire is given a sufficient number of turns around each of the blocks so that when proper tension is maintained on the stretch of wire between the drum and the next succeeding die, slippage about the drum will be prevented. As indicated, the stretch of wire lying between each drum and the next succeeding die is to be maintained under tension. To this end, such stretch of wire is looped about a sheave 11 on the outer end of a swinging arm or lever 12 which is carried by a vertical spindle 13 mounted on one side of the frame 4 preferably adjacent the drive motor located rearwardly of the next succeeding die. From the sheave on such swinging arm the wire then passes around a stationary sheave 14 on the top of the frame 4, whence it may pass through the adjacent die in a straight line tangent to the next succeeding drum or block of the series.

Each shaft 13 which thus carries a tension arm 12 is connected as by means of a segment gear 15 and pinion 16 with a low horsepower D. C. motor 17 of non-stalling type, which tends when in operation to rotate the shaft 13, and thus the tension arm 12, in a counter-clockwise direction. Obviously, depending upon the current supplied to the motor 17 and the torque thus applied to the swing arm, the stretch of wire looped about the sheave 11 will be subjected to a variable tension.

The tension sheaves 11 and associated parts, including the motors 17, are respectively located in advance of the drive motors for the wire drawing drums to effect a control action on such drive motors in a manner to be described. To this end, each tension sheave 11 is interconnected with a rheostat 18 by an operating pinion 19 for such rheostat which meshes with the segment gear 15 associated with the corresponding tension arm 12. As best shown in Fig. 1, it will be noted that the tension sheave 11 associated with the first drawing drum and drive motor of the series, is interconnected with a single rheostat 18, and that the next succeeding tension sheave 11 is interconnected with a rheostat 18 and a second rheostat 18*a*. Although there is illustrated a construction involving only three drawing drums, it will be understood that, in the event of a greater number of drawing drums, each drawing drum except the initial and terminal drawing drums will have associated therewith two rheostats 18 and 18*a* in the manner as shown for the intermediate drawing drum 2 in Fig. 1. The manner in which the rheostats enter into the operation of the machine will be set forth in the description which follows of the wiring diagrams shown in Figs. 3 and 4.

It will also be understood, as shown in the said wiring diagrams, manual rheostats are provided for controlling the operation of the machine in addition to the rheostats 18 and 18*a* which are automatically operated by the tension sheaves associated with each motor 17.

Turning now to the wiring diagram shown in Fig. 3, it will be noted that the armatures 5*a*, 6*a* and 7*a* of the drive motors 5, 6 and 7, are connected in parallel with the leads 21 and 22 of the power line, and that in the case of the two motors viz., 6 and 7, with which tension arms are associated, the armature 17*a* of the motor 17 which is effective to exert a torque on its associated tension arm 12 tending to rotate such arm in a counter-clockwise direction, is connected in series with the next succeeding drive motor armature.

The several drive and tensioning motors 5, 6, 7 and 17 have shunt wound fields 5*b*, 6*b*, 7*b* and 17*b*. The tension arm operated rheostats 18 are connected in series with the fields of the driving motors for the drawing drums with which they are associated in all cases except the last or reeling drum 3, the rheostats 18 being connected in sreies with the fields 5*b* and 6*b* for the arrangement shown in Figs. 1 and 2. A tension arm operated rheostat 18*a* will be associated with all the wire-drawing drums except the first and last, and for the arrangement shown is connected in series with the field 17*b* of the tensioning motor 17 associated with the intermediate wire-drawing drum 2. To complete the control for the various electrically operated motors, a manually adjustable rheostat 7*c* is connected in series with the field 7*b* for the last wire drawing drum 3 in the series. Likewise, manually adjustable rheostats 17*c* are connected in series with the field 17*b* of the tensioning motors 17. The field 17*b* of the tensioning motor 17 immediately preceding the last wire-drawing drum 3 is also provided with a manually operable rheostat 17*d*. It will be understood that the particular arrangement of the manually operable rheostats 7*c* and 17*d* is employed only for the last wire drawing drum of the series, this being the drum 3 of Figs. 1 and 2. Likewise, the single tension arm operated rheostat 18 employed for the field 5*b* of the motor 5 is provided only for the first wire drawing drum of the series, this being the drum 1 of Figs. 1 and 2. It will also be understood that aside from the noted exceptions for the first and last drums of the series, the electrical hook-up for all intermediate drums will be as shown for the drive motor 6 for the intermediate drum 2 of Figs. 1 and 2.

In operating the machine with the motor armatures and fields connected as shown in Fig. 3, just described, the several manual rheostats are set or adjusted so as to distribute power to the successive driving motors 5, 6 and 7 in amount approximately that required as determined by calculation or test for continuously drawing a wire or rod of given material through the successive dies. Under theoretically perfect wire drawing conditions, it would be possible to fixedly adjust the controls of the various drive motors and tensioning motors manually and the motors would then be operative to draw wire continuously while maintaining the desired tension upon the stretches of wire intermediate the various wire drawing drums. However, under conditions of actual practice, the torque and speed of the various wire drawing motors will vary at times and thus disturb the tension which it is desired to maintain upon the stretches of wire intermediate the wire drawing drums. The arrangement diagrammatically illustrated in Fig. 3 has been designed to provide an automatic control of the speed of operation of and torque exerted by the various wire drawing drums and tension sheaves in order to maintain the desired amount of back tension on the wire in advance of each of the wire drawing dies, notwithstanding variations in actual practice of the theoretically calculated conditions.

The various rheostats shown in Fig. 3 having been adjusted for theoretically perfect conditions, the wire is led through the successive dies and around the successive drums, the interme-

diate stretches thereof being looped over the tension sheaves before the drawing operation is begun. Upon beginning the drawing operation, the current flowing through the armature 7a of the last drive motor will also flow through the armature 17a of the next preceding tension operating arm motor which is thereby energized to place under desired tension the corresponding stretch of wire looped over the sheave of the tension arm in question. Similarly, the current flowing through the armature 6a of the intermediate drive motor will also flow through the armature 17a of the tension motor 17 in advance of such intermediate drive motor and cause the tension motor 17 to place under desired tension the corresponding stretch of wire looped over the sheave preceding the intermediate wire drawing drum. By connecting each armature 17a of the tensioning motors 17 in series with the armature of the next succeeding drive motor, it will be apparent that the back tension maintained upon the stretch of wire in front of the die preceding such succeeding drive motor will be responsive to the torque exerted by the armature of such succeeding drive motor, the arrangement being such that as the torque of the succeeding drive motor increases, a correspondingly increased torque is applied to the tensioning motor 17 by which the successively intermediate stretches of the wire are maintained under tension.

By reason of the fact that the back tension imparted to the intermediate stretches of wire by the sheaves 11 will vary and will thereby exert a variable pull on the wire wrapped around the next preceding wire drawing drum, it will be apparent that variations in the tension exerted on the intermediate stretches of wire will effect a variation in the speed of operation of the next preceding drum. Obviously, variations in the speed of either the succeeding or preceding drum will cause a change in the length of the intermediate stretches of wire and thereby cause a movement of the tension operating arms 12 and associated parts. Movement of the tension arms 12, through the segment gear 15 and pinion 19, is operative to effect an adjustment of the tension arm operated rheostats 18 connected in series with the fields of the next preceding drive motors to vary the flux of such fields to cause the drive motors associated therewith to be slowed down or to be speeded up as the circumstances require. Obviously, such a speed adjustment of an intermediate drive motor, such as the drive motor 6 of Figs. 1 and 2, will vary the torque exerted by such motor. In order to compensate directly for this variation in the torque exerted by the intermediate drive motor, the tension sheave 11 in front of such intermediate drive motor is adapted to operate the rheostat 18a at the same time it operates the rheostat 18. Operation of the rheostat 18a will effect an adjustment of the field 17b of the tension motor 17 preceding the drive motor for the intermediate drum 2 to cause the torque exerted by such motor 17 to be increased or decreased correspondingly as the torque exerted by the intermediate drive motor 6 is varied under the influence of the tension sheave 11 in advance of the intermediate drive motor 6.

In machines where wire drawing drums are arranged in tandem, the maintenance of a desired tension upon the successive intermediate stretches of wire is dependent upon the operation of both the wire drawing drums between which the successive intermediate stretches appear. It will be apparent that the arrangement shown in Fig. 3 is automatically operable to maintain the proper tension irrespective of variations in the operating conditions of either drum defining such intermediate stretch which would otherwise cause an undesired variation in the tension which it is desired to maintain.

In the modified wiring arrangement diagrammatically shown in Fig. 4, the arrangement of parts and operation thereof is substantially the same as described in connection with Fig. 3. One difference lies in the fact that the armatures 17a are connected in parallel with the leads 21 and 22 of the power line instead of in series with the armatures of the drive motors as in Fig. 3. The other difference lies in the provision of an additional field 17e for the tension motor armatures 17a, the additional field 17e being connected in series with the armatures of the next succeeding drive motors. The field 17e being in series with the armatures of the next succeeding drive motors, the torque exerted by the tension motors 17 will be corresponingly increased or decreased in accordance with the torque exerted by the next succeeding drive motor to maintain the intermediate stretch of wire in advance of the die preceding such succeeding drive motor under the proper and desired amount of tension. The tension motors 17, in this manner, are operative through the connected tensioning arms 12 to bias the sheaves 11 against movement under the influence of the back tension of the wire being drawn.

The general operation of the machine where the motors are constructed and arranged as shown in Fig. 4, will be substantially as described above in connection with Fig. 3, and the same operative effect will be obtained as by the first described arrangement. In other words, each of the tension arms will be operated so as to automatically impose and maintain any desired degree of back tension on the wire in advance of the corresponding die.

From the foregoing, it will be apparent that the tensioning means is automatically operable to adjust itself in accordance with the operating conditions of each of the drums defining the stretch of wire on which the tension is maintained. That is, the tensioning means intermediate adjacent wire drawing drums is cooperatively associated with the operating mechanisms for the respective drums in such manner that the tensioning means will be responsive to the operating conditions of both of such drums and therefore operative to maintain the desired tension on the stretch of wire intermediate such drums, notwithstanding variations in the operating conditions of either of such drums.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In wire drawing mechanism, the combination of a die with an electric motor driven wire drawing drum arranged forwardly thereof for drawing wire therethrough, and a movable tensioning sheave arranged rearwardly thereof for placing a back tension on the wire being drawn, power means comprising an electric tensioning motor connected to said sheave for biasing the same against movement under the influence of the back tension of the wire being drawn, and

means responsive to the pull of said drawing drum for varying the force exerted by said electric tensioning motor in accordance with variations in the pull of said drawing drum.

2. In wire drawing mechanism, the combination of a die with an electric motor driven wire drawing drum arranged forwardly thereof for drawing wire therethrough, and a movable tensioning sheave arranged rearwardly thereof for placing a back tension on the wire being drawn, power means comprising an electric tensioning motor connected to said sheave for biasing the same against movement under the influence of the back tension of the wire being drawn, and means connecting the armature of the drive motor for said drawing drum in series with the armature of the electric tensioning motor to vary the force exerted by said tensioning motor in accordance with the pull of said drawing drum.

3. In wire drawing mechanism, the combination of a die with an electric motor driven wire drawing drum arranged forwardly thereof for drawing wire therethrough, and a movable tensioning sheave arranged rearwardly thereof for placing a back tension on the wire being drawn, power means comprising an electric tensioning motor connected to said sheave for biasing the same against movement under the influence of the back tension of the wire being drawn, and means connecting the armature of the drive motor for said drawing drum in series with the field of said tensioning motor to vary the force exerted by said tensioning motor in accordance with the pull of said drawing drum.

4. In wire drawing mechanism, the combination of a die with an electric motor driven wire drawing drum arranged forwardly thereof for drawing wire therethrough, a wire feeding drum arranged rearwardly of said die, and a movable tensioning sheave engageable with the stretch of the wire intermediate said feeding drum for placing a back tension on the wire being drawn opposed to the pull of said wire drawing drum, an electric tensioning motor having a power member tending to move in one direction and connected to said sheave for biasing the same against movement under the influence of the wire being drawn, said power member being movable in an opposite direction upon movement of said sheave against its bias by the tension of the wire being drawn, means connecting said tensioning motor with the motor for said drawing drum to vary the force exerted by said tensioning motor in accordance with variations in the pull of said drawing drum, and means connecting said sheave with said wire feeding drum for controlling the speed of operation thereof in accordance with the movement of said sheave.

5. In continuous wire drawing mechanism, the combination of a plurality of dies and associated electric motor driven drums arranged to draw wire through said dies, respectively, a movable tensioning sheave engageable with the stretch of wire between each drum and the next succeeding die for placing a back tension on the wire being drawn through such die, and power means comprising an electric motor connected to said sheave for biasing the same in a direction maintaining the back tension on the wire being drawn, and means connecting the armatures of each of said tensioning motors in series with the armature of the driving motor for the following drawing drum to vary the force exerted by such tensioning motor in accordance with the pull exerted by such drawing drum.

6. In continuous wire drawing mechanism, the combination of a plurality of dies and associated electric motor driven drums arranged to draw wire through said dies, respectively, a movable tensioning sheave engageable with the stretch of wire between each drum and the next succeeding die for placing a back tension on the wire being drawn through such die, and power means comprising an electric motor connected to said sheave for biasing the same in a direction maintaining the back tension on the wire being drawn, and means connecting the fields of each of said tensioning motors in series with the armature of the driving motor for the following drawing drum to vary the force exerted by such tensioning motor in accordance with the pull exerted by such drawing drum.

7. In continuous wire drawing mechanism, the combination of a plurality of dies and associated electric motor driven drums arranged to draw wire through said dies, respectively, a movable tensioning sheave engageable with the stretch of wire between each drum and the next succeeding die for placing a back tension on the wire being drawn through such die, and power means comprising an electric motor connected to said sheave for biasing the same in a direction maintaining the back tension on the wire being drawn, and means connecting each of said tensioning motors with the driving motor for the following drawing drum to vary the force exerted by such tensioning motor in accordance with the pull exerted by such driving motor.

8. In continuous wire drawing mechanism, the combination of a plurality of dies and associated electric motor driven drums arranged to draw wire through said dies, respectively, there being at least one drum intermediate other of said drums, a movable tensioning sheave engageable with the stretch of wire between each drum and the next succeeding die for placing a back tension on the wire being drawn through such die, power means comprising an electric motor connected to said sheave for biasing the same in a direction maintaining the back tension on the wire being drawn, and a pair of rheostats respectively operable by movement of the tensioning sheave forwardly of said intermediate drawing drum to variably control the operation of such intermediate drawing drum and the tensioning motor for the sheave positioned rearwardly of such drum.

9. In continuous wire drawing mechanism, the combination of a plurality of dies and associated electric motor driven drums arranged to draw wire through said dies, respectively, there being at least one drum intermediate other of said drums, a movable tensioning sheave engageable with the stretch of wire between each drum and the next succeeding die for placing a back tension on the wire being drawn through such die, power means connected to said sheaves for biasing the same in a direction maintaining the back tension on the wire being drawn, and means operable by movement of the sheave forwardly of said intermediate drawing drum to variably control the operation of such intermediate drawing drum and the tensioning motor for the sheave positioned rearwardly of such drum.

10. In continuous wire drawing mechanism, the combination of a plurality of dies and associated electric motor driven drums arranged to draw wire through said dies, respectively, a movable tensioning sheave engageable with the stretch of wire between each drum and the next

succeeding die for placing a back tension on the wire being drawn through such die, and power means comprising an electric motor connected to said sheave for biasing the same in a direction maintaining the back tension on the wire being drawn, means connecting the armatures of each of said tensioning motors in series with the armature of the driving motor for the following drawing drum to vary the force exerted by such tensioning motor in accordance with the pull exerted by such drawing drum, and rheostats operative by movement of said sheaves to vary the flux of the fields of the next preceding drive motor.

11. In continuous wire drawing mechanism, the combination of a plurality of dies and associated electric motor driven drums arranged to draw wire through said dies, respectively, a movable tensioning sheave engageable with the stretch of wire between each drum and the next succeeding die for placing a back tension on the wire being drawn through such die, a swingable arm carrying such sheave, an electric motor connected to said arm for biasing the same in a direction maintaining the back tension on the wire being drawn, the current flowing through the armature of a drive motor, also flowing through the armature of the next preceding tension operating arm motor to render the back tension upon each stretch of wire responsive to the torque exerted by the armature of the succeeding drive motor, and rheostat means operable by movement of the respective sheave carrying arms to vary the flux of the field of the next preceding drive motor.

NORMAN H. NYE.