Sept. 7, 1926. 1,599,393

H. BLOUNT

WIRE DRAWING APPARATUS

Filed June 6, 1922 3 Sheets-Sheet 1

Fig. 1.

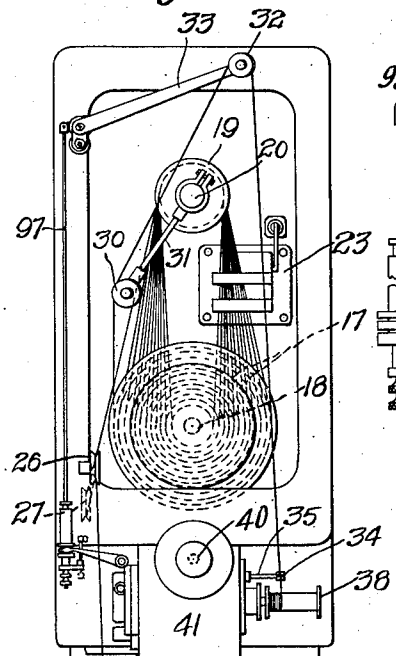


Fig. 2.

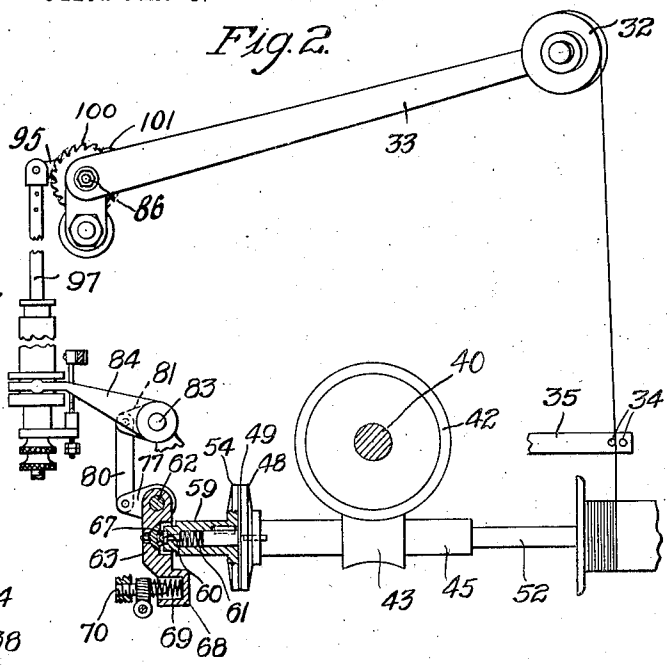


Fig. 3.

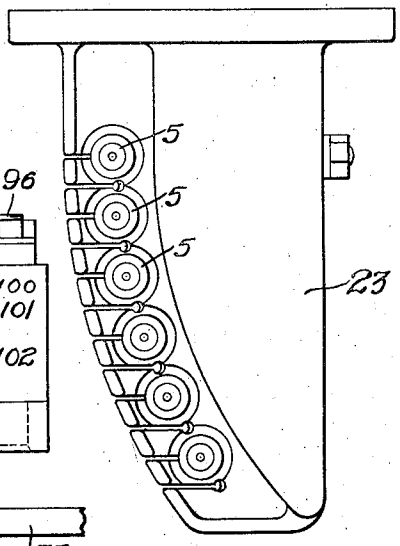


Fig. 5.

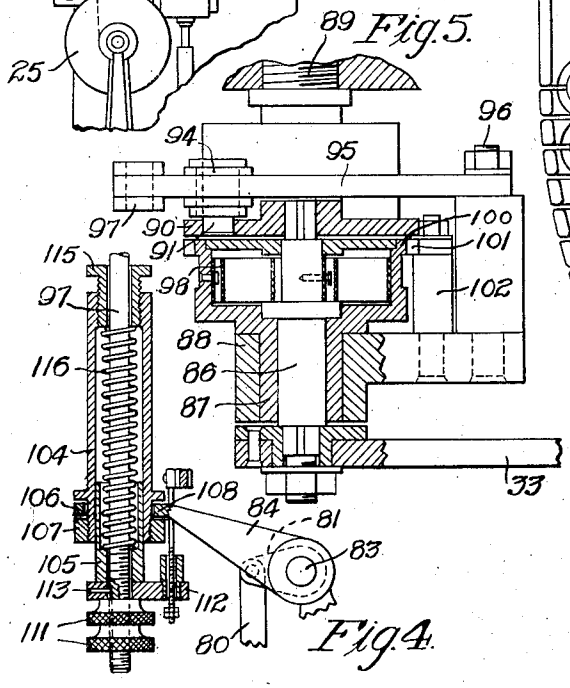


Fig. 4.

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WIRE DRAWING APPARATUS

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Fig. 6.

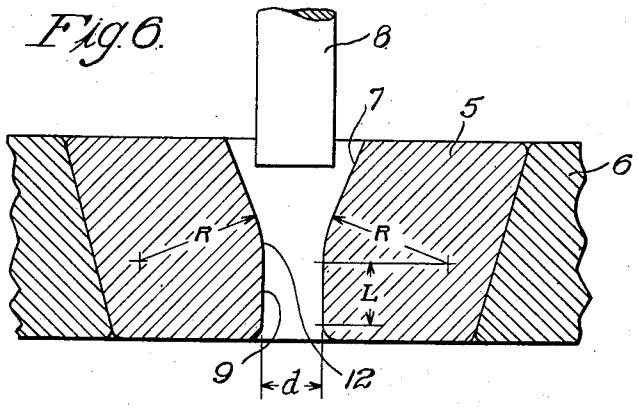


Fig. 7.

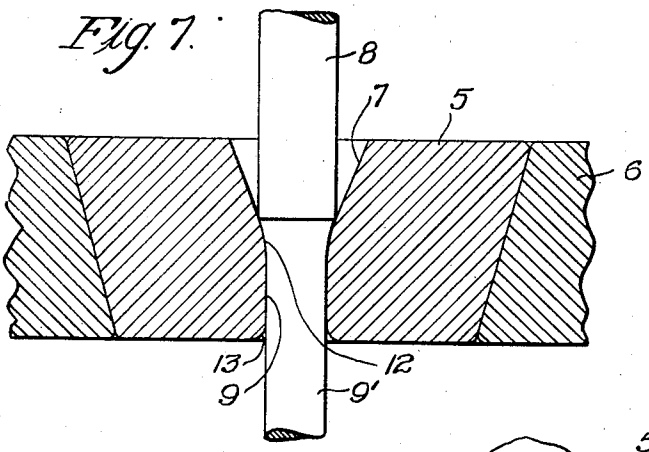


Fig. 8.

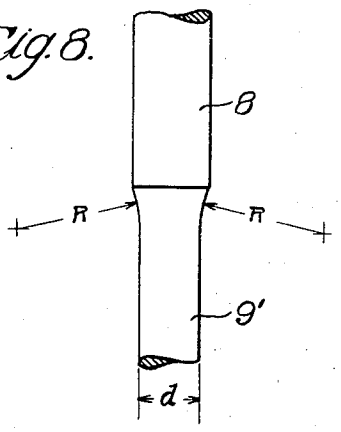
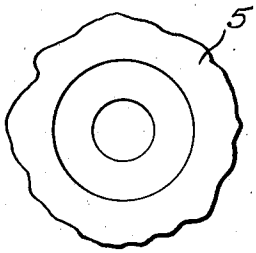


Fig. 9.



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WIRE DRAWING APPARATUS

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Fig. 10.

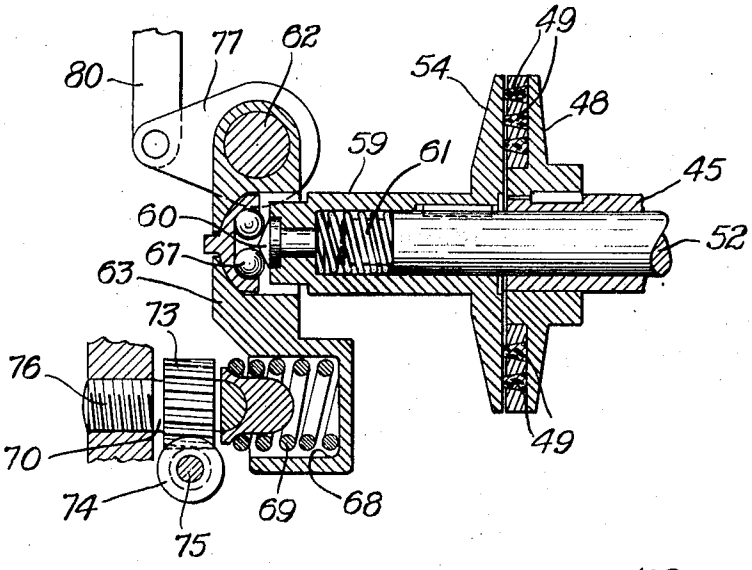
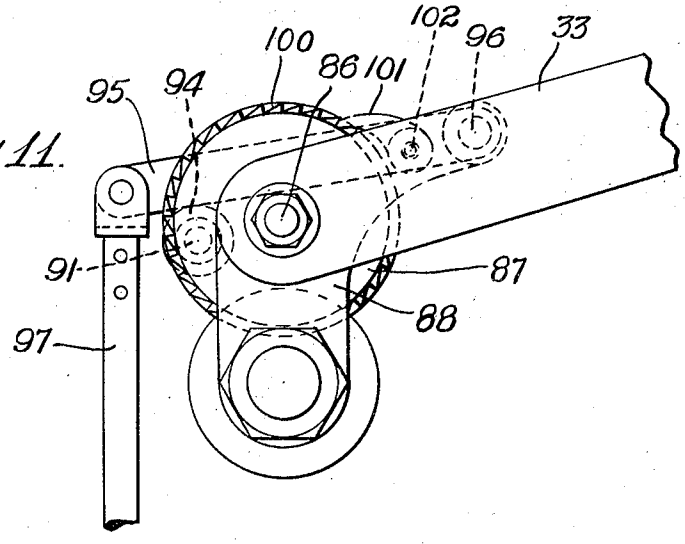


Fig. 11.



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Patented Sept. 7, 1926. 1,599,393

UNITED STATES PATENT OFFICE.

HARRY BLOUNT, OF OAK PARK, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

WIRE-DRAWING APPARATUS.

Application filed June 6, 1922. Serial No. 566,245.

This invention relates to improvements in wire drawing apparatus.

The object of the invention is to provide an apparatus for drawing wire which is very much more rapid in its operation than any machines heretofore produced.

Investigation of former wire dawing machines has disclosed that they are necessarily limited in their speed of operation, due to lack of dies designed to permit the drawing of wire therethrough at high speeds. These machines are now operating at speeds just as high as wire can be drawn commerically through the dies used therein. After a long series of tests with dies of the types heretofore used and also with various different designs of dies made up during the course of my investigations, I have discovered that the shape of the entrance to the wire reducing opening of a die relative to the diameter of the wire reducing opening fundamentally determines the amount of pull required to draw the wire through the reducing opening, and with a reduced pull a resultant increase in drawing speed can be attained without breakage of the wire. Dies heretofore constructed have been operated at a maximum speed of approximately 1600 feet per minute. In accordance with my discovery, however, when a die is so designed that it has a straight reducing portion and the entrance into it when viewed in cross section is rounded on a radius approximately equal to twice the diameter of the straight reducing portion, the amount of pull required to draw the wire through the reducing portion is materially reduced and the speed at which the wire may be drawn therethrough is very materially increased.

I have also found that the speed of reduction is further materially affected due to the length of the wire reducing opening as compared with the diameter thereof. The longer the wire reducing opening, the greater is the friction exerted on the wire drawn therethrough and as a consequence the amount of power necessary to draw the wire and the liability to breakage are both materialy affected by the length of the wire reducing opening. However, if this opening is made too short, the reducing portion is soon worn out and the die rendered unfit for the given reduction. I have found that by making the length of the reducing opening approximately equal to the diameter thereof, a die is produced having a length of life commmercially satisfactory and at the same time requires a minimum amount of pull to draw the wire therethrough. Briefly stated, the shape of the entrance into the wire reducing opening fundamentally determines the speed at which wire may be drawn through the die, and the length of the wire reducing opening is made as short as possible to reduce friction on the wire but at the same time of a length sufficient to give the die a commercial life.

Numerous tests have demonstrated that dies in which the length of the reducing portion is approximately equal to its diameter, while the contour thereof at the entrance to the wire reducing portion is rounded on a radius approximately equal to twice the diameter of the smallest portion of the wire reducing opening, are capable of drawing wire at approximately 2500 feet per minute for a length of time that is commercially satisfactory.

A long series of experiments have demonstrated that the proportions of a die made either from chilled iron or from a diamond should be as above described in order to obtain high speed reduction.

It is at present the common practice where wire is drawn down to fine sizes such as #19 to #40 B. & S. wire gauge, to store the drawn wire on what are termed take-up spools. In machines heretofore designed it has not been a serious problem to drive such take-up-spools and maintain a proper tension on the wire between the spool and the die for the reason that, as heretofore stated, former machines had had a maximum speed of operation of approximately 1600 feet per minute and as a consequence the speed of the take-up spool was not so great as to render difficult a proper storage of the wire thereon. In previous machines a satisfactory form of drive proved to be a slipping belt between the main driving mechanism and the driving means for the take-up spool. However, where wire drawing machines are equipped with my improved form of dies capable of reduction at 2500 feet per minute and it is attempted to store the drawn wire on a take-up spool driven with a slipping belt, it is found that, since the take-up spool must be driven at speeds varying from approximately 5000 to 10,000 R. P. M. in order to compensate for the varying diameter thereof as drawn wire

is stored on the spool and maintain a constant tension on the wire, the slipping belt drive causes such uneven tension on the wire between the take-up spool and the die that unsatisfactory spooling and frequent breakage of the wire result. In order to overcome these difficulties I provide my improved wire drawing apparatus with a driving mechanism for the take-up spool which includes a friction clutch between the main driving mechanism and the driving means for the take-up spool. This friction clutch consists of a pair of friction disk clutch members engaged face to face and interposed between the spindle of the take-up spool and the main driving mechanism. A system of levers is provided which is controlled by the tension of the wire between the take-up spool and the die for varying the pressure between the disk clutch members and thereby vary the speed of the spindle of the take-up spool.

The combination which includes dies, designed as I have heretofore explained, and a driving mechanism for the take-up spool including a friction clutch, the driving effect of which is controlled by the tension of the strand between the take-up spool and dies, has made possible a machine which is capable of drawing wire at speeds as high as 2500 feet per minute and the accurate storage of this wire on a take-up spool without causing a breakage thereof.

Although the tension regulating means consisting of the friction clutch referred to above is particularly well adapted for use in wire drawing machines, it is to be understood that this mechanism may be employed on various other machines for handling various different kinds of strands, without departing from the spirit and scope of the present improvement.

Referring now to the drawings which illustrate one embodiment of my invention:

Fig. 1 is a front elevation of a wire drawing machine embodying the features of the invention, part of the base member being broken away;

Fig. 2 is an enlarged skeleton view, partly in section, of the clutch controlling mechanism and the drive for the take-up spool;

Fig. 3 is an enlarged top plan view of the die block showing a series of my improved form of dies mounted therein;

Fig. 4 is an enlarged fragmentary vertical sectional view of a portion of the clutch control mechanism;

Fig. 5 is an enlarged plan detail view, partly in section showing a portion of the control mechanism for the friction drive mechanism for the take-up spool;

Fig. 6 is an enlarged vertical sectional view of a die made in accordance with my invention and used in the mechanism shown in Fig. 1;

Fig. 7 is a view like Fig. 1 showing wire in the process of being drawn through the die;

Fig. 8 is a view illustrating the form taken by the wire as it is drawn through the die;

Fig. 9 is a fragmentary top plan view of the die, and

Figs. 10 and 11 are enlarged fragmentary views of Fig. 2.

Referring now to the drawings in which like reference numerals designate similar parts throughout the several views, 10 represents a framework which supports the various elements of the wire drawing apparatus. Mounted in suitable bearings in the framework is a horizontally disposed shaft 18 upon which is mounted, so as to be driven thereby, a plurality of capstans 17—17 of different diameters, the said capstans being driven through suitable gearing by a motor (not shown) secured to the framework. Mounted above the shaft 18 are a plurality of sheaves 19 independently rotatable upon a horizontally disposed shaft 20 supported by the framework 10. For a detailed illustration and description of the sheaves 19, capstans 17, and the driving mechanism for the latter, reference is made to the co-pending application of John N. Selvig, Serial No. 541,633, filed March 7, 1922. The details of this construction have been omitted from the present application for the sake of simplicity since a full disclosure of the particular construction of the sheaves, capstans and driving mechanism is not essential to a complete understanding of the present invention. A supply of wire to be reduced in diameter is carried by a supply spool 25 suitably mounted at the front of the machine. The wire is guided from the supply spool 25 over and under pulleys 26 and 27 respectively and then over the rear sheave 19 and through the first reducing die 5 carried by the die holder 23 (Fig. 3). After leaving the first die the wire is wound once around the capstan 17 of smallest diameter, after which it is passed upward and over the next sheave 19, and through the next reducing die and around the next capstan, etc., until it is finally drawn down to the desired diameter by the last reducing die 5. From the final reducing die the drawn wire passes around the capstan 17 of largest diameter and is guided by a pulley 30 rotatably mounted on a stationary arm 31 adjustably positioned on the shaft 20 to a pulley 32 carried by a lever 33. From the pulley 32 the wire is led between two distributing fingers 34 carried by a reciprocable arm 35. This arm is reciprocated back and forth in a horizontal direction by a suitable driving mechanism (not shown) connected with the driving mechanism that actuates the shaft 18, the said arm serving

to distribute the drawn wire in even layers upon a take-up spool 38.

The mechanism for driving the take-up spool 38 at various speeds to compensate for the varying diameters thereof as wire is stored on the spool, which mechanism includes a friction clutch the driving action of which is controlled by the tension strand, will now be described. Suitable gearing (not shown) driven from the capstan shaft 18 drives a horizontal shaft 40 (Figs. 1 and 2) positioned a short distance below the shaft 18. The shaft 40 extends into a housing 41 and carries at its forward end a worm gear 42 which meshes with a worm 43 formed on a sleeve 45 rotatable in suitable bearings (not shown) carried by the housing 41. One end of the sleeve has secured thereto a disk clutch member 48 provided on its engaging face with cork or other suitable inserts 49. Extending through the sleeve 45 and rotatable independently thereof is a spindle 52 having splined thereon a disk clutch member 54. The take-up spool 38 is suitably secured to the spindle 52 so as to rotate therewith. The clutch member 54 is provided with an integral cup-shaped sleeve 59, the end wall of which is equipped with a hardened steel pin 60 provided with a cone shaped head which projects outside the end wall thereof and in line with its axis. Between the end wall of the cup-shaped portion 59 and the end of the spindle 52 upon which the clutch face 54 is movable in a longitudinal direction is a compression spring 61 which acts in a direction to separate the engaging faces of the clutch members 48 and 54. Secured to a shaft 62 positioned above the spindle 52 and having its bearings in the housing 41 is a recessed arm 63 which is positioned on the shaft 62 directly in line with the axis of the spindle 52 and is provided with a recess within which an anti-friction thrust bearing 67 is supported. The cone shaped head of pin 60 rides in the thrust bearing and is held in engagement therewith by means of a compression spring 69 mounted within a recess 68 formed in the arm 63. The compression of this spring is regulated by means of an adjustable pin 70 in engagement with the opposite end thereof. The pin 70 is equipped with a spiral gear 73 which engages a spiral pinion 74 mounted on a shaft 75 which projects outside the housing 41 and is equipped with a suitable handle (not shown) for revolving it. The supporting end 76 of the pin 70 is screw threaded into the housing 41 and as the pinion 74 is turned, it will in turn cause the gear 73 to revolve and consequently the pin 70 will be turned to either increase or decrease the compression of the spring 69 to vary the pressure between the thrust bearing 67 and the cone shaped end of the pin 60 carried by the clutch member 54. The compression of the spring 69, however, is changed only when a different size wire is to be spooled.

Secured to one end of the shaft 62 is an arm 77 pivotally connected at its end to an upwardly extending link 80 which at its upper end is pivotally connected to an arm 81 similar to the arm 77. The arm 81 is secured to a shaft 83 mounted in suitable bearings supported in the housing 41, this shaft also having secured thereto an arm 84, the purpose of which will be hereinafter explained.

The lever 33 carrying the pulley 32 is suitably secured to a pin 86 mounted to turn upon a sleeve portion of a housing 87 (Fig. 5) which is supported by a bracket 88 secured to a pin 89 carried by the frame of the machine. At the rear of the housing 87 is a disk 90 secured to the pin 86 so as to turn therewith. Rotatably mounted upon a pin 91 projecting from the rear face of the disk 90 is a roller 94, which is positioned upon the disk 90 near its periphery and below a horizontal line drawn through the axis thereof. (Fig. 1.) Resting upon the roller 94 is a link 95 pivotally connected at one end to a stud 96 carried by the bracket 88 and at its opposite end to a downwardly extending link 97. The lever 33 is held in a normal elevated position by a clock spring 98 mounted within the housing 87, one end of the spring being secured to the revolvable housing 87 and its other end to the pin 86 which supports the lever 33. Formed on the housing 87 is a ratchet 100 retained in its set position by a pawl 101 pivoted on a stud 102 carried by the bracket 88. The spring 98 acting on the lever arm 33 keeps the wire under the proper tension to insure smooth and even spooling thereof on the take-up spool 38 without causing a breakage of the wire. The tension to be used is determined by the size of the wire to be drawn. To regulate this tension the housing is turned one way or the other, which will either decrease or increase the tension of the spring 98, the pawl 101 retaining the ratchet 100 on the housing 87 in its set position.

The downwardly extending link 97 passes through a telescoping spring housing composed of two members 104 and 105. Formed on the member 104 adjacent its lower end is a circular flange 106. Screw threaded onto the member 104 below the flange 106 is a collar 107 and between the flange 106 and the collar 107 is positioned an eye 108 formed on the end of the arm 84.

The lower end of the link 97 is provided with two thumb screws 111 and between the end of the member 105 and the upper thumb screw 111 is a plate 112 loosely mounted on the link 97 and adapted to be moved vertically with respect thereto but prevented from

turning thereon by a pin 113 carried in the plate 112 and projecting into a slot formed in the link 97. Screw threaded into the upper end of the member 104 is a plug 115 through which the link 97 is free to move.

Positioned around the link 97 within the telescoping housing and resting against the plug 115 at one end and a shoulder formed on the member 105 at its other end is a compression spring 116 the tension of which can be decreased or increased by turning the thumb screws 111 one way or the other.

In the operation of the wire drawing machine the capstans 17—17 deliver the drawn wire to the take-up spool 38 at a constant speed and the speed at which the wire may be drawn through the dies is dependent upon the speed at which the wire may be taken up. To take up the wire successfully at a high speed, the tension on the wire must be maintained substantially constant. In starting and stopping the machine and during the spooling of the wire the tension on the wire will vary momentarily. During the spooling of the wire the diameter of the take-up spool increases as each layer is wound thereon and when the dies are delivering drawn wire at the rate of approximately 2500 feet per minute the take-up spool must be driven at speeds varying from approximately 5,000 to 10,000 R. P. M. in order to compensate for the varying diameters of the take-up spool and maintain a constant tension on the wire to insure uniform spooling thereof on the take-up spool. When the tension on the wire is increased above the proper tension during spooling, the free end of the lever 33 will be moved down against the action of the clock spring 98. This movement of the lever 33 moves the roller 94 in a clockwise direction and lifts the link 95, thereby causing the leverage acting against the spring 69 to be increased through the spring 116. The pressure between the thrust bearing 67 and the cone shaped head on the pin 60 will thereby be diminished and the force stored in the spring 61 now acts to diminish the pressure between the clutch members 54 and 48, resulting in the slowing up of the take-up spool 38 due to the clutch member 54 slipping on the clutch member 48.

When the tension on the wire is decreased below the proper tension the lever 33 moves upward in response to the action of the clock spring 98. This movement of the lever 33 moves the roller 94 in a direction away from the link 95, which causes the leverage acting against the spring 69 through the spring 116 to be diminished. The spring 69 now acts to press the thrust bearing 67 carried in the arm 63 against the cone shaped head on the pin 60 with greater pressure, thereby increasing the driving engagement between the clutch member 48 and clutch member 54 which results in the speeding up of the take-up spool 38 until the tension on the wire is again normal.

As the tension on the wire between the capstan 17 and the take-up spool 38 varies, the pressure between the clutch members 48 and 54 will vary in response thereto and cause a change in speed of the take-up spool accordingly. Due to the change in pressure between the members 48 and 54 in response to the tension on the wire, a substantially constant tension is maintained on the wire thereby allowing the machine to be run at high speed without breakage of the wire, and with accurate spooling of the drawn wire on the take-up spool.

My improved form of die which permits the rapid drawing of wire therethrough without breakage is shown in detail in Figs. 6 to 9 inclusive, in which 5 designates a die body which may be supported by a suitable supporting member 6 fragmentarily shown. At one end of this die there is provided a mouth or tapered opening 7 which is larger at its upper end than the diameter of a wire 8 to be reduced and is tapered inwardly toward a straight sided reducing portion 9 which has the diameter of the drawn wire 9'. The length L of the narrowed or reducing portion of the opening 9 should be approximately equal to the diameter d of this opening in order that the wire will undergo such physical changes that it will become completely set in its reduced size before emerging from the die and the die will not be subjected to too great wear. Also this length is not so great as to introduce extra friction to the drawing of the wire.

Connecting the mouth or tapered portion 7 with the narrow or reducing portion 9 is a curved portion 12 which is tangential to both the mouth and reducing portion 7 and 9, and the radius of curvature R of this curved portion is approximately equal to twice the diameter d of the straight sided reducing portion 9. This curvature has been found to offer the least resistance to the drawing of the wire. At its lower end the straight sided or reducing portion 9 is slightly beveled or rounded, as shown at 13, to prevent cutting or abrading of the wire in case it becomes necessary to back up the wire in the die for any reason.

As previously mentioned, a die constructed and having the proportions specified above permits the drawing of wire therethrough at high speeds, with a minimum amount of pull, and without causing breakage of the wire.

What is claimed is:

1. In a wire drawing apparatus including a take-up spool, and a high speed drawing means, the combination with a die designed to permit high speed drawing of

wire therethrough without breakage of the wire, of a driving mechanism for actuating the take-up spool at high speeds for storing the wire drawn through said die by said drawing means, and means to increase or decrease the speed of said take-up spool to compensate for the varying diameters thereof as the wire is stored on the spool including an element over which the wire runs to the take-up spool said element being responsive to the tension of the wire to control said means.

2. In a wire drawing apparatus including a take-up spool and a high speed drawing means, the combination with a die designed to permit high speed drawing of wire therethrough without breakage of the wire, of a driving mechanism for actuating the take-up spool at high speeds for storing the wire drawn through said die by said drawing means, said driving means including a friction clutch, and means for controlling the driving action of said clutch for varying the speed of said take-up spool, including an element over which the wire runs to the take-up spool said element being responsive to the tension of the wire to control said means.

3. In a wire drawing apparatus including a take-up spool, and a high speed drawing means, the combination with a drawing die having a straight reducing portion the entrance into which when viewed in cross section is rounded on a radius approximately equal to twice the diameter of the straight reducing portion whereby wire may be drawn through said die by said drawing means at high speed and without breakage of the wire, of a driving mechanism for actuating the take-up spool at high speeds for storing the wire drawn through said die, and means to increase or decrease the speed of said take-up spool, including an element over which the wire runs to the take-up spool said element being responsive to the tension of the wire to control said means.

4. In a wire drawing apparatus including a take-up spool, and a high speed drawing means, the combination with a drawing die having a straight reducing portion the entrance into which when viewed in cross section is rounded on a radius approximately equal to twice the diameter of the straight reducing portion whereby wire may be drawn through the die at high speed without breakage of the wire, of a driving mechanism for actuating the take-up spool at high speeds for storing the wire drawn through said die by said drawing means, and means for controlling the driving mechanism to vary the speed of said take-up spool to compensate for the varying diameters thereof as the wire is stored on the spool, including an element over which the wire runs to the take-up spool said element being responsive to the tension of the wire to control said means.

5. In a wire drawing apparatus including a take-up spool, and a high speed drawing means, the combination with a die having a reducing portion in which there is a straight portion having approximately the same length as diameter whereby wire may be drawn therethrough by said drawing means at high speed without breakage of the wire, of a driving mechanism for actuating the take-up spool at high speeds for storing the wire drawn through said die, and means to increase or decrease the speed of the take-up spool to compensate for the varying diameters thereof as the wire is stored on the spool, including an element over which the wire runs to the take-up spool said element being responsive to the tension of the wire to control said means.

6. In a wire drawing apparatus including a take-up spool, and a high speed drawing means, the combination with a die having a reducing portion in which there is a straight portion having approximately the same length as diameter whereby wire may be drawn therethrough by said drawing means at high speed without breakage of the wire, of a driving mechanism for actuating the take-up spool at high speeds for storing the wire drawn through said die, said driving means including a pair of friction disk clutch members engaged face to face and interposed between the take-up spool and driving mechanism, and means for varying the pressure between the disk clutch members to vary the speed of the take-up spool, including an element over which the wire runs to the take-up spool, said element being responsive to the tension of the wire to control said means.

7. In a wire drawing apparatus including a take-up spool, and a high speed drawing means, the combination with a drawing die having a wire reducing opening in which there is a straight portion having approximately the same length as the diameter and in which the entrance end when viewed in cross section is rounded on a radius approximately equal to twice the diameter of the straight portion, whereby wire may be drawn therethrough by said drawing means at high speed without breakage, of a driving mechanism for actuating the take-up spool at high speeds for storing the wire drawn through said die, and means to increase or decrease the speed of the take-up spool, including an element over which the wire runs to the take-up spool, said element being responsive to the tension of the wire to control said means.

8. In a wire drawing apparatus including a take-up mechanism and a high speed

drawing mechanism, and drawing means, the combination with a die designed to permit high speed drawing of the wire therethrough by said drawing means without breakage of the wire, of a driving mechanism for actuating the take-up mechanism at high speeds for storing wire drawn through said die, and means to increase or decrease the speed of said take-up mechanism, including an element over which the wire runs to the take-up spool, said element being responsive to the tension of the wire to control said means.

9. In a wire drawing apparatus including a take-up mechanism and a high speed drawing mechanism, said drawing mechanism being driven at constant speed, the combination with a die designed to permit high speed drawing of wire therethrough by said drawing means, of a driving mechanism for actuating the take-up mechanism at high speeds for storing wire drawn through said die, and means to increase or decrease the speed of said take-up mechanism, including an element over which the wire runs to the take-up mechanism, said element being responsive to the tension of the wire to control said means.

10. In a wire drawing apparatus including a take-up mechanism, a high speed drawing mechanism including a stepped capstan and positive driving means for actuating the drawing mechanism at constant speed, the combination with a die designed to permit high speed drawing of wire therethrough by said drawing means, of a driving mechanism for actuating the take-up mechanism at high speeds for storing wire drawn through said die, said driving mechanism including a friction element, and means for controlling said friction element for varying the speed of the take-up mechanism, including an element over which the wire runs to the take-up mechanism, said element being responsive to the tension of the wire to control said means.

In witness whereof, I hereunto subscribe my name this 31st day of May A. D., 1922.

HARRY BLOUNT.