Dec. 27, 1932. G. E. BARNHART 1,891,904

TUBE DRAWING MACHINE

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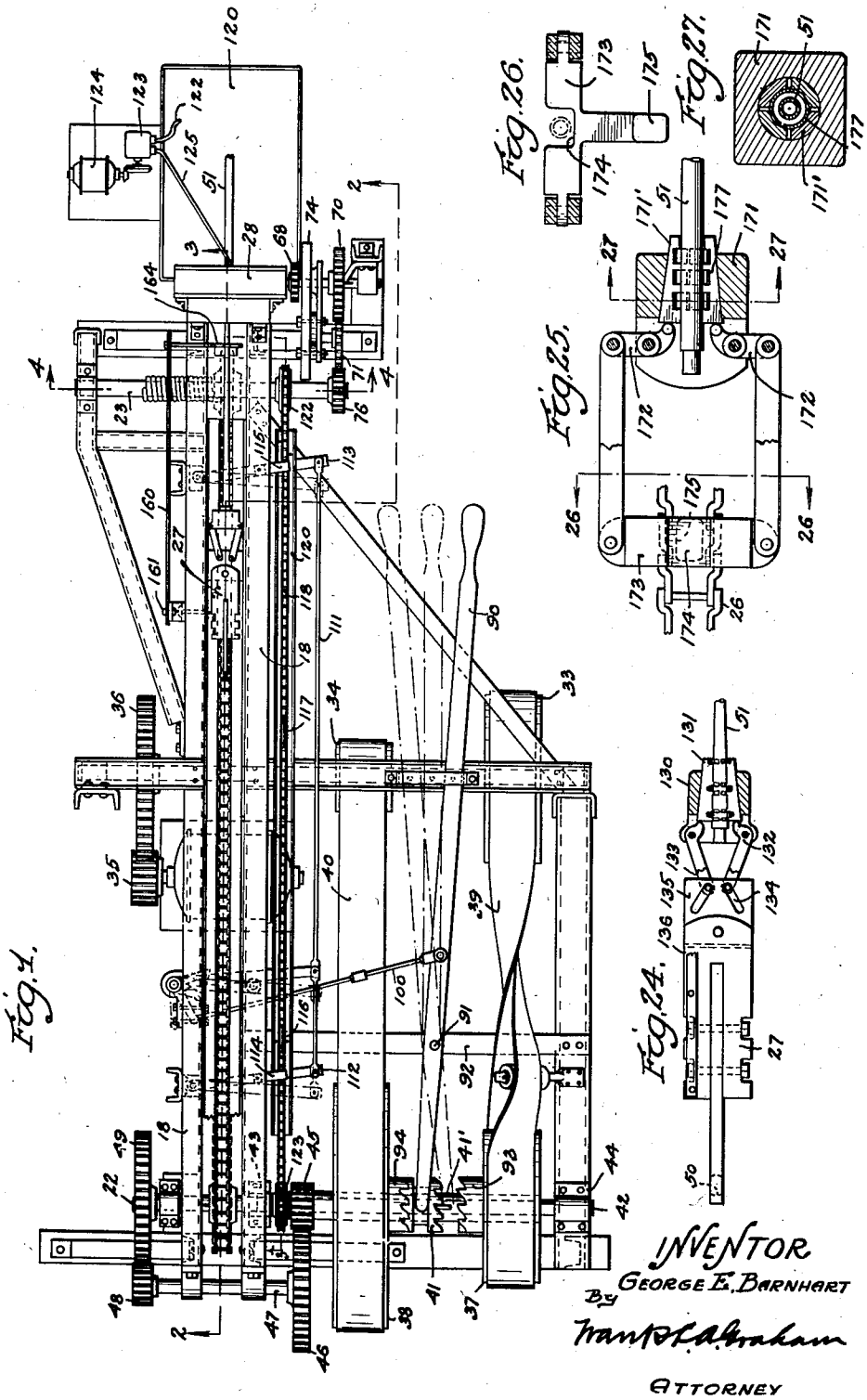


Fig. 1.

Fig. 26.

Fig. 27.

Fig. 25.

Fig. 24.

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TUBE DRAWING MACHINE

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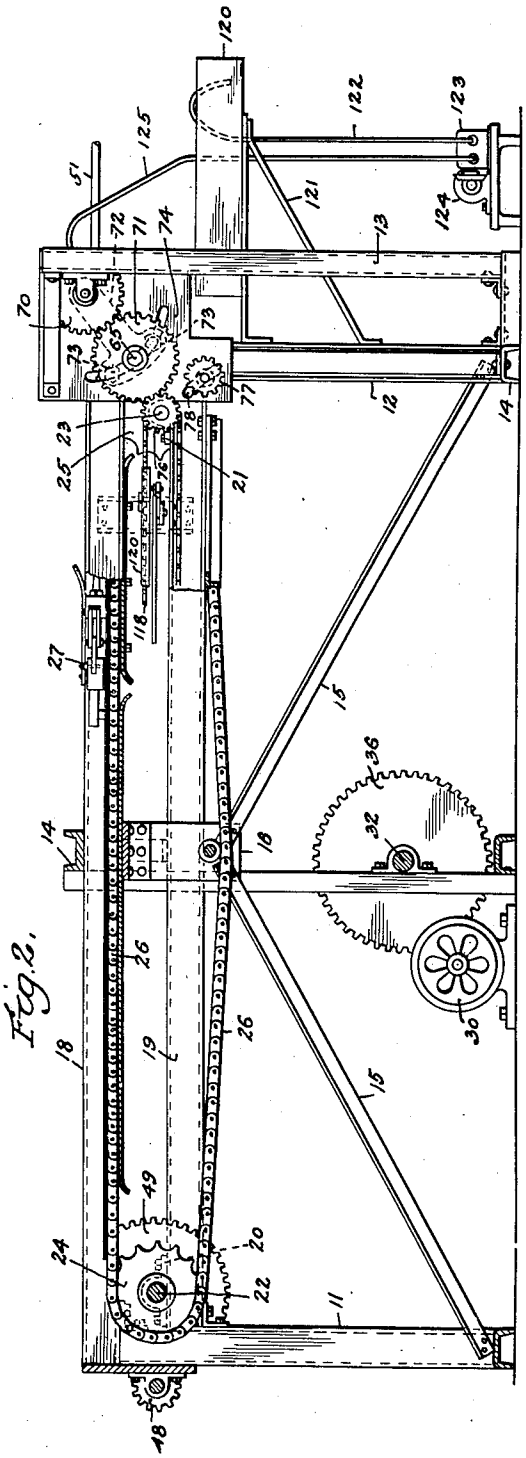


Fig. 2.

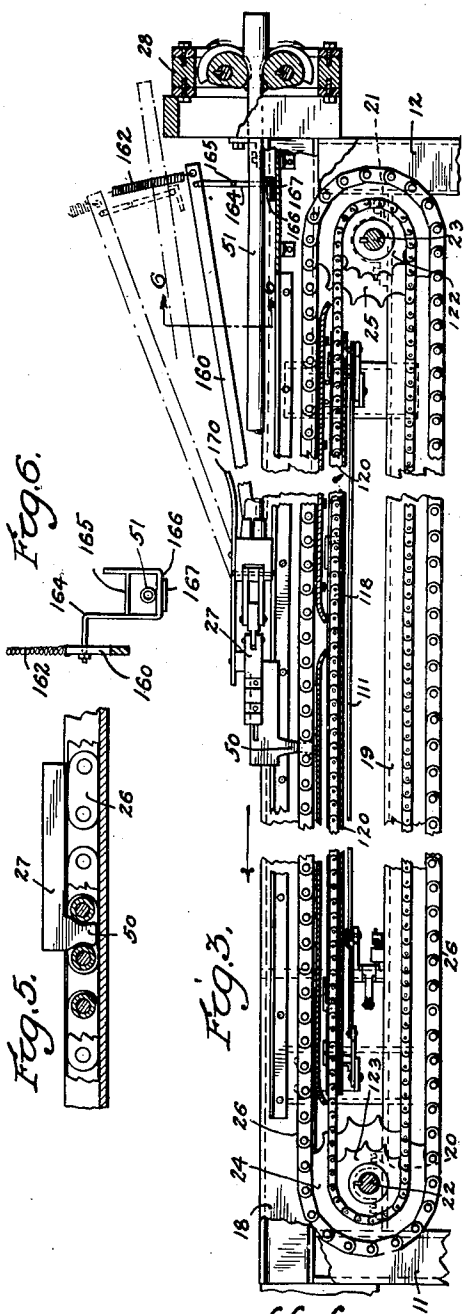


Fig. 3.

Fig. 5.

Fig. 6.

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Fig. 4.

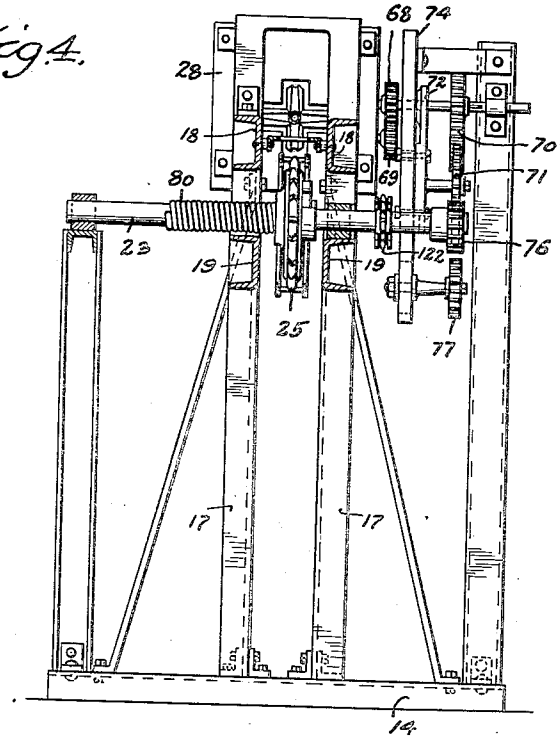


Fig. 7.

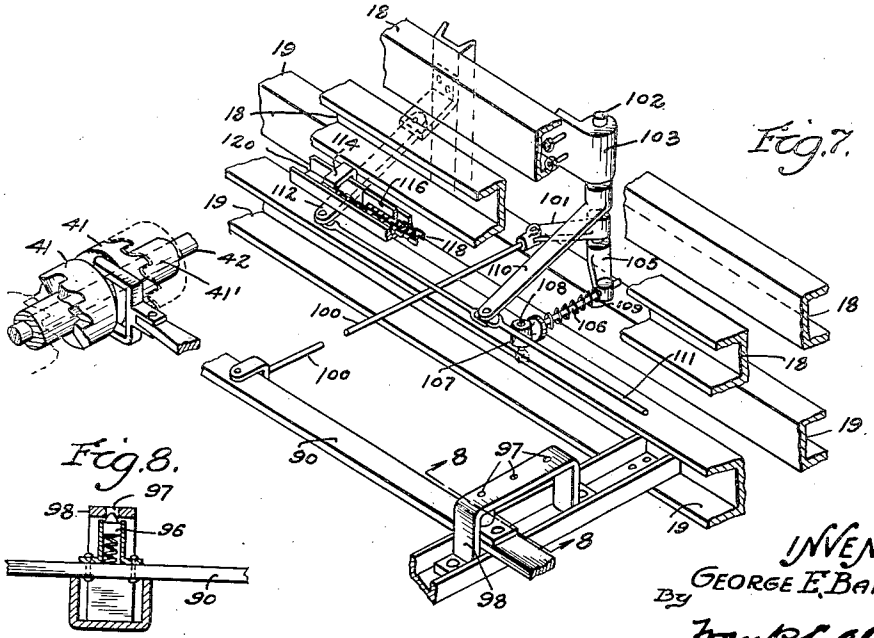


Fig. 8.

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Fig. 9.

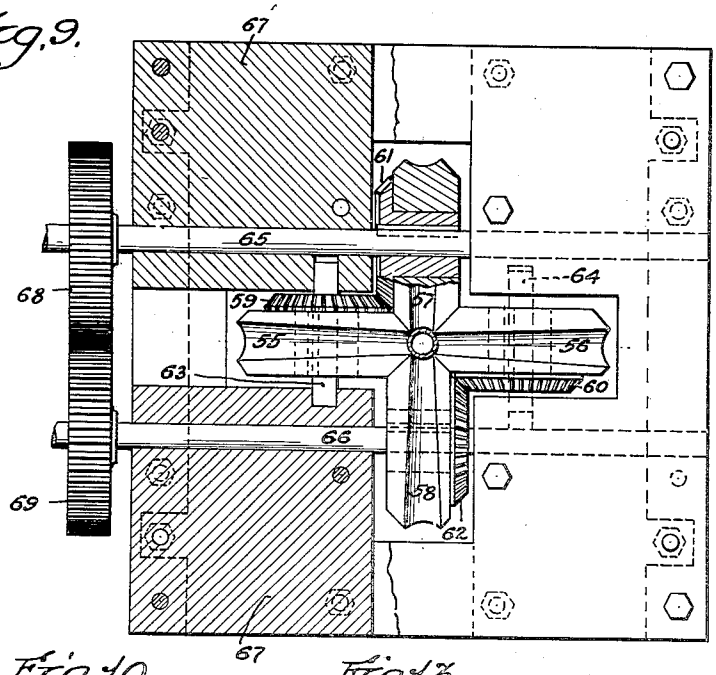


Fig. 17.

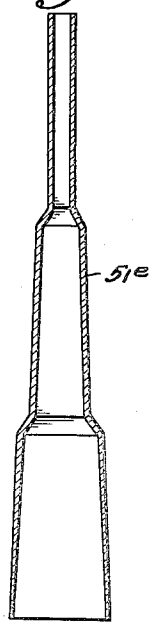


Fig. 10.

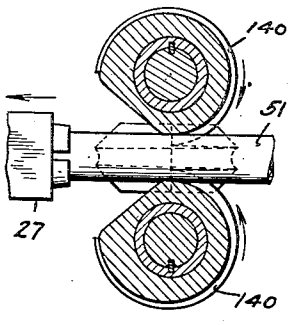


Fig. 13.

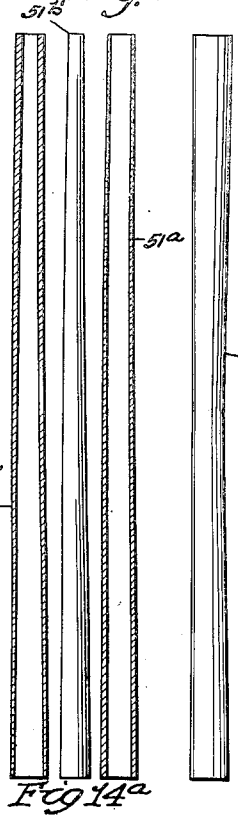


Fig. 11.

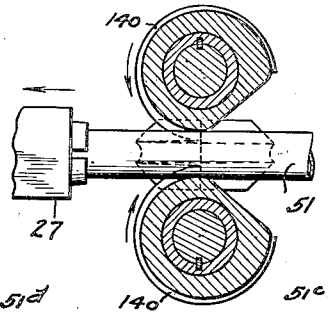


Fig. 14.

Fig. 15.

Fig. 16.

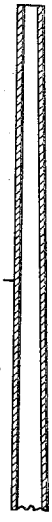


Fig. 12.

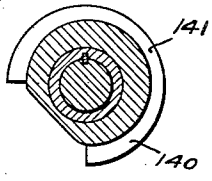


Fig. 14a

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Fig. 19.

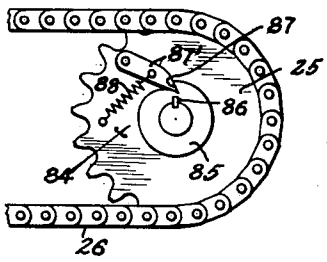


Fig. 18.

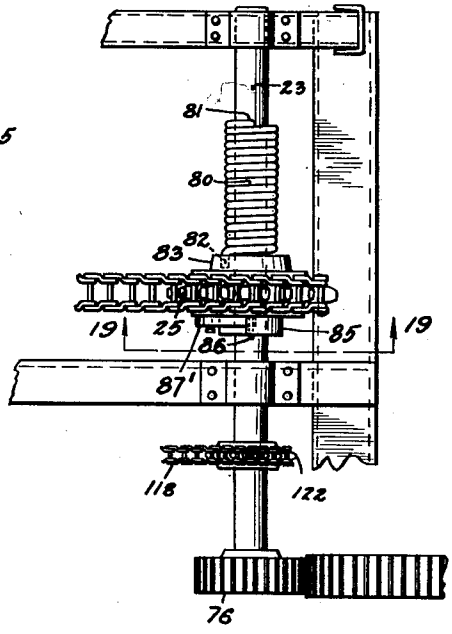


Fig. 20.

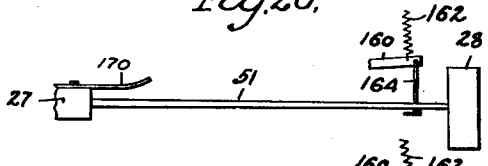


Fig. 21.

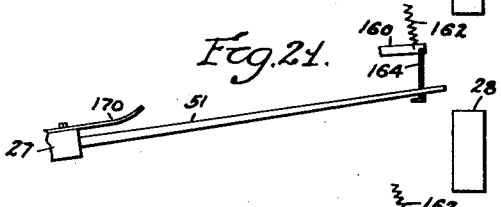


Fig. 22.

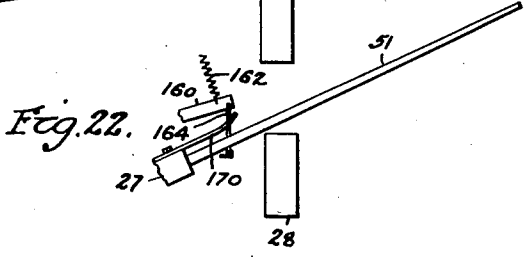
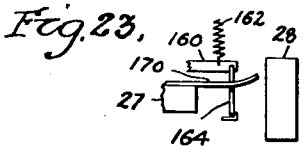


Fig. 23.



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UNITED STATES PATENT OFFICE

GEORGE E. BARNHART, OF PASADENA, CALIFORNIA

TUBE DRAWING MACHINE

Application filed September 12, 1927. Serial No. 219,161.

My invention relates to the art of producing tubular or rodlike products, being more particularly a machine for producing, by drawing or a combination of drawing and rolling, tubular or rodlike products of varying diameter, which products may be round, oval or of some other cross-sectional area.

One of the principal objects of my invention is to produce a machine of the class described by means of which tubular articles may be produced in such a manner as to form fibers in the product, which fibers are circumferentially distributed and which extend parallel to the direction of the movement of the work through the dies.

Another object of my invention is to provide a machine of the character described, having a die head comprised preferably of four die elements arranged in the same plane and geared together, and also what I have termed a "come-along" mounted in the machine in such a manner that parts of the come-along or members movable therewith are effectual in producing an automatic reversal of the direction of advance of a sprocket, chain or the like, to which said come-along may be secured, and I may also provide means whereby, upon the completion of a reverse movement a clutch is automatically thrown into a neutral position, thereby rendering a subsequent advance of the come-along (presumably then carrying a new rod or tubular unit to be drawn) conditional upon the manual manipulation of the controlling mechanism.

It is a further object of my invention to provide a machine of the class described in which dies operable to vary the cross-section of the work or to cooperate with the draw bar in such a manner that the die opening or closure shall bear a definite relation to the draw bar position, the construction of the machine being such that the dies may be manually operated and worked independently of the draw bar position, and the draw bar be automatically operated in both directions.

It is a still further object of my invention to provide resilient tension means for controlling the relative transmission of force between the draw bar and the die elements.

Referring to the drawings, which are for illustrative purposes only,

Fig. 1 is a plan view of a machine embodying a form of my invention.

Fig. 2 is a longitudinal sectional view on line 2—2 of Fig. 1.

Fig. 3 is a longitudinal sectional view, on line 3—3 of Fig. 1.

Fig. 4 is an enlarged cross-sectional view on line 4—4 of Fig. 1, a portion of the frame being broken away.

Fig. 5 is an enlarged side elevation, partly in section, of the draw bar or chain, showing the manner of engaging the same by a portion of the come-along.

Fig. 6 is an enlarged cross sectional view on line 6—6 of Fig. 3.

Fig. 7 is an enlarged fragmentary perspective view of a portion of the draw bar controlling mechanism.

Fig. 8 is an enlarged cross-sectional view on line 8—8 of Fig. 7.

Fig. 9 is an enlarged cross-sectional view of the die head.

Fig. 10 is a diagrammatic sectional view through a set of dies indicating an arrangement and relative movement of parts which are favorable to the maximum wall thickening effect in the region of minimum outside diameter with relatively little effect in elongation and moderate fiber production.

Fig. 11 is a diagrammatic view similar to Fig. 10, indicating an arrangement and relative movements which are favorable to producing maximum elongation fiber producing and wall thinning effects incidentally to tubular drawings.

Fig. 12 is a sectional view of a die element adapted to produce a constriction in an intermediate region of a drawn product, the elonging, wall thickening and fiber effects produced thereby being dependent not only upon the opening provided by the die elements, but upon the direction of rotation of the die elements relative to the direction of advance of the drawn article.

Figures 13, 14, 15, 16 and 17 are respectively diagrammatic illustrations of a few products obtainable by the means and methods hereinafter described.

Fig. 14*a* is a diagrammatic illustration of a form of mandrel used in connection with my invention.

Fig. 18 is a plan view of a portion of the machine, showing a portion of the driving mechanism connecting the draw bar with the dies.

Fig. 19 is an enlarged sectional view on line 19—19 of Fig. 18.

Figures 20 to 23 inclusive, are diagrammatic views illustrating the operation of the work lifting mechanism and re-setting mechanism therefor.

Fig. 24 is a plan view partly in section of the come-along.

Fig. 25 is a plan view partly in section of a modified form of come-along.

Fig. 26 is a sectional view on line 26—26 of Fig. 25 and

Fig. 27 is a cross-sectional view on line 27—27 of Fig. 25.

Referring to the embodiment of my invention, as illustrated in the drawings, I provide a main frame which consists of uprights 11, 12 and 13, supported on and connected to horizontal members 14 and diagonal members 15, secured at their upper ends to a plate 16. Inner uprights or posts 17 are provided directly beneath four longitudinal extending frame members or channels, the upper two of which are indicated at 18 and the lower two of which are indicated at 19, the members 19 at the opposite ends thereof being provided with bearings 20 and 21 which support shafts 22 and 23 respectively. Mounted on the shaft 22 is a sprocket wheel 24 and mounted on the shaft 23 is a sprocket wheel 25, over which extends a sprocket chain 26, the upper run of this chain being used to impart movement by means such as a come-along 27 to a tubular or other article to draw the same through a die head 28, the sprocket 24 being driven by suitable intermediate means hereinafter described subject to automatic or manual control from an electric or or other motor, for example, motion being transmitted through a driving shaft 32 shown as carrying a large pulley 33 and a small pulley 34, by means such as a reducing train comprising gears 35 and 36, driven by the motor 30, pulleys 37 and 38 may be constantly rotated in opposite directions from each other by means such as belts 39 and 40, extending over pulleys 33 and 34 respectively. The direction of rotation of the shaft 22 carrying sprocket 24 may be controlled by a clutch member 41. Instead of splining the clutch member 41 directly on shaft 22 I may, in order to effect an additional reduction of speed, key or spline this clutch for rotating with a separate shaft 41′, shown as coaxial and hollow and as supported by an inner shaft 42, having bearings at 43 and 44 rigidly securing thereon a small gear 45. The gear 45 may be in constant mesh with a large gear 46 mounted on a shaft 47, a small gear 48 on shaft 47 being employed to impart movement to a large gear 49 secured on the shaft 22 which carries the drive sprocket 24. The come-along 27 may be reciprocally secured to the chain 26 in any preferred way, as by means of a downwardly projecting finger 50 (see Fig. 5), the form of which is such as to adapt it not only to a drawing advance, but to the automatic return of a drawn article 51, said article being at all times held in coaxial relationship with a central opening between rotatable or other die elements of any preferred type secured in a suitable head or support 28.

It being an object of my present invention to provide improved means and methods of taper-drawing, I show in Fig. 9 illustrative details of one type of head having four rotatable die elements 55, 56, 57 and 58 arranged in the same plane and each mounted on and fixed to the hub of associated bevel gears 59, 60, 61 and 62 respectively, such gears being splined to shafts 63, 64, 65 and 66 respectively, mounted in bearing blocks 67. The bevel gears 59 and 61 mesh with each other and the bevel gears 60 and 62 mesh with each other so that the die elements are geared together and rotate in the same direction at the same rate of speed. The shafts 65 and 66 extend through the die head and are geared together by means of gears 68 and 69, the shaft 65 being also provided with a gear 70 meshing with a gear 71 mounted on a swinging arm 72 held in adjusted position by means of bolts 73 which extend through slots formed in a plate 74, mounted in any suitable manner on the frame of the machine. The arm mounting of the gear 71 just described is for the purpose of permitting change in speed of the shaft 65 by changing the size of the gear 71, which meshes with a gear 76 on the shaft 23.

For the purpose of changing the direction of rotation of the die elements through the gearing just above described, I mount a gear 77 in a slot 78 in the plate 74, in such a manner that the gear 77 may be swung into gear with the gear 76 and the gear 71 swung out of mesh with the gear 76 and into mesh with gear 77, thereby reversing the direction of movement of gear 71.

It will be understood that the gear 76 is driven by the shaft 23 which receives its rotation through the medium of the sprocket 25 in the following manner, reference being made particularly to Figs. 18 and 19: The sprocket 25 being loosely mounted on the shaft 23, a coiled spring 80, which will be hereinafter defined as yieldable means for transmitting rotation to the dies is mounted on such shaft 23 having one end 81 of the spring secured to the shaft and the other end 82 secured in a hub 83 on the sprocket 25. Mounted on the shaft 23 and secured thereto in any suitable manner is a clutch member

84 which consists of a plate 85 secured to the shaft by a key 86, the plate 85 having a notch 87 provided therein which is engaged by a pawl 87′ pivotally mounted on the sprocket 25, and held in resilient engagement by means of the spring 88.

The spring 80 is mounted in such a manner, relative to the shaft 23 and the sprocket wheel 25, that it will "wind up" with the positive advancement of the draw bar (that is when stock is being drawn through the die); thus there is a slight hesitation in the initial die rotation relative to the movement of the come-along, due to the tightening of the spring 80. This tightening action, besides permitting a primary alignment between the stock and the die through the mentioned hesitation, serves to effect a gradual transmission of power from the draw bar to the die, thus effecting an initial acceleration, and thereby smoother operation of the dies. The reverse motion of the dies is effected through engagement of the pawl 87′ in the notch 87, which assures a positive return and prevents distortion of the spring 80.

The controlling mechanism for the operation of the machine acts to limit the movement of the work moving means or come-along 27 is both automatic and manual, the manual operation being by means of a lever 90 pivotally mounted at 91 on a cross bar 92 of the frame. This lever 90 engages the clutch member 41, which may be thrown into engagement with either a complementary clutch member 93 on the pulley 37 or a complementary clutch member 94 on the pulley 38, and consequent driving of the hollow shaft 41′ from the respective pulleys.

As shown in Fig. 8, means are provided for elastically retaining the operating bar 90 in either forward, reverse or neutral position which consists of a spring detent 96 mounted on the bar 90, engageable with perforations 97 in a retaining member 98 mounted on the frame of the machine.

The automatic controlling mechanism consists of a lever or bar 100, the other end of which is connected to a lever 101 (see Fig. 7), fixed to a vertical shaft 102, mounted vertically in bearing 103 on the frame of the machine. The movement of this shaft 102 is governed by means of a snap-action device which consists of an arm 105 on the shaft 102, the outer end of which slidably receives the end of a rod 106 mounted at its other end in a member 107 rotatable on a bolt or shaft 108, mounted on one of the frame members 19. Interposed between the member 107 and the end of the lever on the rod, is a compression spring 109, the action of such spring being to elastically hold the arm 105 on either side of neutral position.

Secured to the shaft 102 is an arm or lever 110, the outer end of which is connected to a rod 111 which extends longitudinally of the machine, being connected at its respective ends to levers 112 and 113 pivotally mounted on the frame of the machine. These levers 112 and 113 are provided respectively with stop members 114 and 115 which extend into the path of stops 116 and 117, fixed in adjustable positions in any suitable manner to a continuous chain 118, the upper run of which is supported in a channel 120.

The chain 118 is driven through the medium of a sprocket 122 fixed to the shaft 23 and passes around a sprocket 123 loosely mounted on the shaft 42. From the construction just described, it will be understood that the chain 118 moves in unison with the chain 26 and that the engagement of the stops 116 and 117 with the stop members 114 and 115 on the respective levers 112 and 113 and movement of such levers thereby will, through the mechanism above described, operate the lever 90 to reverse the movement of the chain 26 and the come-along operated thereby.

Provision is made for lubrication and cooling of the die members and for this purpose I show a pan 120 supported on a bracket 121 on the frame of the machine, and an outlet pipe 122 leading to a pump 123 operated by a motor 124, which pump discharges oil to the die head through a pipe 125 delivering the oil upon the rod or tube 51.

The come-along as shown in Figures 1, 2, 3 and 24 consists of a head 130 which receives a plurality of wedge members 131, seated in a central opening in the head 130. The forward end of these members 131 are engaged by bell crank levers 132, pivotally mounted on the head 130, the ends 133 of such levers being provided with pins engageable in cam slots 134 formed in a cam plate 135 mounted on a carriage 136, which carriage is provided with the plate 27 having a finger 50 heretofore described.

The action of the come-along is that when the chain 26 draws the come-along forwardly as shown by the arrow in Fig. 3 the ends 133 of the levers 132 are drawn toward each other thereby exerting a pressure on the opposite ends of the levers 132 against the wedge members 131. This pressure against the wedge members causes the same to firmly grip the rod or tube 51 and continued forward movement of the come-along draws the rod or tube 51 through the dies in the die head.

It will be understood that a reverse movement of the come-along will release the pressure of the levers against the wedge members and free the rod or tube held therein.

It has been indicated above that various effects may be obtained by use of rotatable die elements of the general character described; and, instead of providing said die elements with uniform grooves, as may be done in case a mere elongation or reduction

in diameter are desired, I employ, for a tapering effect, dies of the general character illustrated in Figures 9 to 12 inclusive.

In the figures last referred to, I show each of the rotatable die elements as provided not only with a beveled gear surface, for rotating said dies proportionately to the advance of a drawn element 51, but also with peripheral grooves or channels 140, consistently varying in depth. For example, in case a uniformly tapered product, such as a tapered mast or golf club shaft, as shown in 51*c* in Fig. 16, is desired, I may provide (as by a die-production method which includes a rotating of dies, associated in a die head, during an advance of a set thereof relatively to a single tapered grinding tool not shown) cooperating channels or grooves whose bottoms are at all points accurately arcuate in cross-sectional outline or profile,—each of the mentioned grooves constituting (say) a quadrant of a circular aperture which varies in diameter, in the indicated manner, as a tubular or other article is drawn therethrough.

In case a considerable incidental elongation and fiber production are desired, with a thinning of the walls in a region of minimum diameter (as, for the production of a flagpole or the like—see 51*a*, Fig. 13) the described dies may advantageously be disposed, relatively to the direction of advance of an article 51 therethrough, substantially as indicated in Fig. 11 and in preceding figures,—an initial position of said dies being indicated in Figure 11 and a final position being indicated in Fig. 9 but, in case little or no elongation is desired, or in case I aim at not only a production of longitudinal fiber but also at a maximum wall-thickening effect, in a region of minimum diameter (as may be advantageous in the production of a golf club shaft or the like—see 51*b*, Fig. 14), the rotatable die elements may be rotated in the general direction of advance of the drawn article, substantially as indicated in Fig. 10.

In case I desire to produce an article having a minimum diameter in an intermediate region, see 51*d*—Fig. 15, I may employ the dies having grooves, such as are suggested at 141, Fig. 12, which are shallowest in an intermediate region; and such die elements may be rotated either in the direction suggested in Fig. 11 (for a maximum elongating effect) or in the relative direction suggested in Fig. 10, (for a maximum wall thickening effect); and it will be understood that the different effects referred to may be obtained by a mere reversal of the position of the head 28 in which such die elements are secured in the indicated manner, or in any equivalent manner.

Used in the indicated manner, dies disposed as illustrated in Fig. 11 may result in the production of a seamless flagpole or other structural element in which the taper may be related to wall thickness substantially as suggested at 51*a*, Fig. 13,—the walls being thickest in a region of maximum outside diameter.

Use of the similar set of dies in the alternative manner suggested in Fig. 11 (as may be effected by reversal of the die head 28 and a driving of the rotatable die elements in an opposite direction, as heretofore described, may result in the production of a very different tapered drawn article,—such as a golf club shaft 51*b* having a maximum wall thickness in a region of minimum outside diameter; and use of a set of die rolls such as are illustrated in Fig. 12 may result in the production of a structural element having an intermediate region of minimum outside diameter, the incidental elongating or wall-thickening effect being dependent upon the direction of rotation of the die elements relatively to the direction of advance of the stock, to produce a drawn article such as is shown at 51*c*, Fig. 15.

By way of further amplification, it is pointed out that my tapered products may be provided with uniform walls (as shown, for example, at 51*c* in Fig. 16); that the interior diameter of a product may be either varied or kept uniform while the outside is tapered, and that, in case a "stepped" product is preferred to a uniformly tapered product, any desired "stepped" effect may be produced, with or without use of a mandrel (such as 51*b'* which is adapted for use in drawing a tube of the type shown at 51*b*), by a suitable intermittent rotation of the die elements,—during continuous or differently interrupted advance of the drawn unit, as for the purpose of producing products having, for example, the general characteristics suggested at 51*e* in Fig. 17. In this figure only an uppermost section is shown as uniform in both its diameter and its wall thickness.

Regardless of the specific character of the products desired, it will be seen that my described methods are favorable to a simultaneous production of a desired form and a longitudinal fiber; and I may mention, in conclusion that, for the production of hollow structural elements, I may use either so-called seamless tubular stock or so-called "seam" tubular stock,— the latter being considerably less expensive; and I find that even the inexpensive stock referred to may be employed in the drawing (or in the combined drawing and rolling) of superior products, in case said stock, purchased under a low carbon specification, is suitably carbonized before the same is drawn. The resultant articles, in which the carbon content may be raised from between 10 and 15 points to between 40 points and 1 per cent may be suitably heat-treated subsequently to the described drawing operations.

It should be noted that, unless in the drawing of my very thin-walled products or prod-

ucts of unusual shape, mandrels (see Figs. 25 and 27) need not ordinarily be used within tubes during drawing operations executed in the above manner; that the cross-sectional configuration of die channels may be determinative of any desired round, rectangular, or other cross-sectional outline in drawn products,—or determinative of various polygonal outlines in different parts of the same product; and also that, a uniform cross-section must result so long as the die elements are held stationary.

Provision is made for elevating the rod or tube after the same has passed through the die head (see Figs. 1–6 and 20–23) which consists of an arm 160 pivotally attached at its rearward end to the frame of the machine at 161, the other or forward end being yieldingly held in elevated position by means of a coiled spring 162 which may be secured at its upper end to any convenient fixed member, (not shown).

Mounted on the forward end of the arm 160 is a stirrup 164 having an upper cross bar 165 and a lower cross bar 166, the lower bar 166 resting on a plate 167 on the frame of the machine, said bar engaging the underside of the rod or tube 51. The come-along has attached thereto a finger 170 which extends rearwardly from the come-along having its rear end curved upwardly in position to engage the upper side of the bar 165 on the stirrup.

The operation of the elevating mechanism just described is diagrammatically illustrated in Figs. 20 to 23:

Fig. 20 showing the come-along advanced to a position with the rod or tube just leaving the die head.

Fig. 21 shows the elevation of the tube by the stirrup acted upon by the spring.

Fig. 22 shows the come-along moved rearwardly to a position above its initial position at the beginning of the drawing action, the finger 170 having engaged the upper bar, after which the rod or tube is removed from the come-along. The weight of the come-along pulls the stirrup downwardly into the position shown in Fig. 23, where it is ready to receive the new tube or rod as shown. It will be apparent from Fig. 22 that after the tube has been advanced slightly beyond the position shown in Fig. 21, the weight of the tube and the come-along is carried by the die head 28 instead of being supported entirely by the spring 162.

In Figs. 25 to 27 inclusive, I have shown an alternative form of come-along in which the tube or rod may be removed therefrom directly forwardly. This form of come-along consists of a head 171 having a central opening forming a tapered slot to receive wedge members 171′, which are engaged at their forward large ends by one end of pivoted arms 172 mounted on the head 171. These arms are connected by links to a carriage 173 recessed as shown at 174 and having a finger 175 to engage the sprocket chain 26 constituting the draw bar. In the form shown, four wedge members 171′ are shown engaging the tube split spring members 177, being arranged in channels in the wedge members to yieldingly expand the same.

I claim as my invention:

1. In an organization of the general character described, rotatable dies, releasable engaging means for an article to be drawn through said dies, a chain for moving said releasable engaging means toward or from said dies, and means for rotating said dies from said chain, said last named means consisting of a shaft, a sprocket loosely mounted on said shaft engaged by said chain, a coiled spring on said shaft having one end secured to said shaft and the other end secured to said sprocket, a ratchet secured to said shaft, a dog on said sprocket adapted to engage said ratchet, and gearing connecting said shaft to said dies.

2. In a machine for drawing articles through dies, a die head, means for drawing an article through said die head, means for elevating the article as it emerges from the die head, said elevating means consisting of an arm swingably mounted on said machine, a spring member attached to the free end of said arm and applying a lifting force thereto, and means on said arm engaging the article in the dies.

3. In a machine for drawing articles through dies, a die head, means for drawing an article through said die head, means for elevating the article as it emerges from the die head, said elevating means consisting of an arm swingably mounted on said machine, a spring member attached to the free end of said arm, and applying a lifting force thereto, means on said arm engaging the article in the dies, said last named means consisting of a stirrup, and means on said drawing means arranged to engage said stirrup before disengagement of the article from the drawing means.

4. In a machine for drawing articles through dies, a die head, rotatable dies in said die head, releasable engaging means for drawing an article through said dies, a driven chain, means on said releasable engaging means engaging said chain, means for rotating said dies from said driving chain, and means for predetermining the movement of said driving chain, said last named means consisting of driving mechanism for said driving chain and clutch mechanism controlling the direction of travel of said driving mechanism, a second chain driven by said driving mechanism and means on said second chain for controlling said clutch mechanism, said means on said second chain consisting of a plurality of stops, and a clutch throwing

mechanism adapted to be engaged by said stops.

5. In a machine for drawing articles through dies, a die head, rotatable dies in said die head, a driving shaft, a driven shaft, a chain mounted on said shafts, releasable engaging means for drawing the articles through said dies, means on said releasable engaging means for engaging said chain, a clutch for controlling the operation of said driving shaft, a second chain driven from said driven shaft, stops on said second chain, and clutch throwing means adapted to be engaged by said stops for throwing said clutch at predetermined intervals in the operation of said machine.

6. In a machine for drawing articles through dies, a die head, rotatable dies in said die head, a driving shaft, a driven shaft, a chain mounted on said shafts, releasable engaging means for drawing the articles through said dies, means on said releasable engaging means for engaging said chain, a second chain driven from said driven shaft, stops on said second chain, and means operated by said stops to control the movement of said driving chain,—said last named means consisting of a clutch member for controlling the movement of said driving chain, arms pivotally mounted on said machine extending into the path of said stops, and means connecting said arms to said clutch member.

7. An organization of the general character described embodying: rotatable dies; a come-along adapted to releasably engage an article to be drawn through said dies; a driving mechanism; means for positively connecting said driving mechanism with said come-along; and means including a spring member connecting said driving mechanism with said dies for imparting an initial movement to said dies after said come-along has started to move.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 25th day of August, 1927.

GEORGE E. BARNHART.