L. H. BRINKMAN.

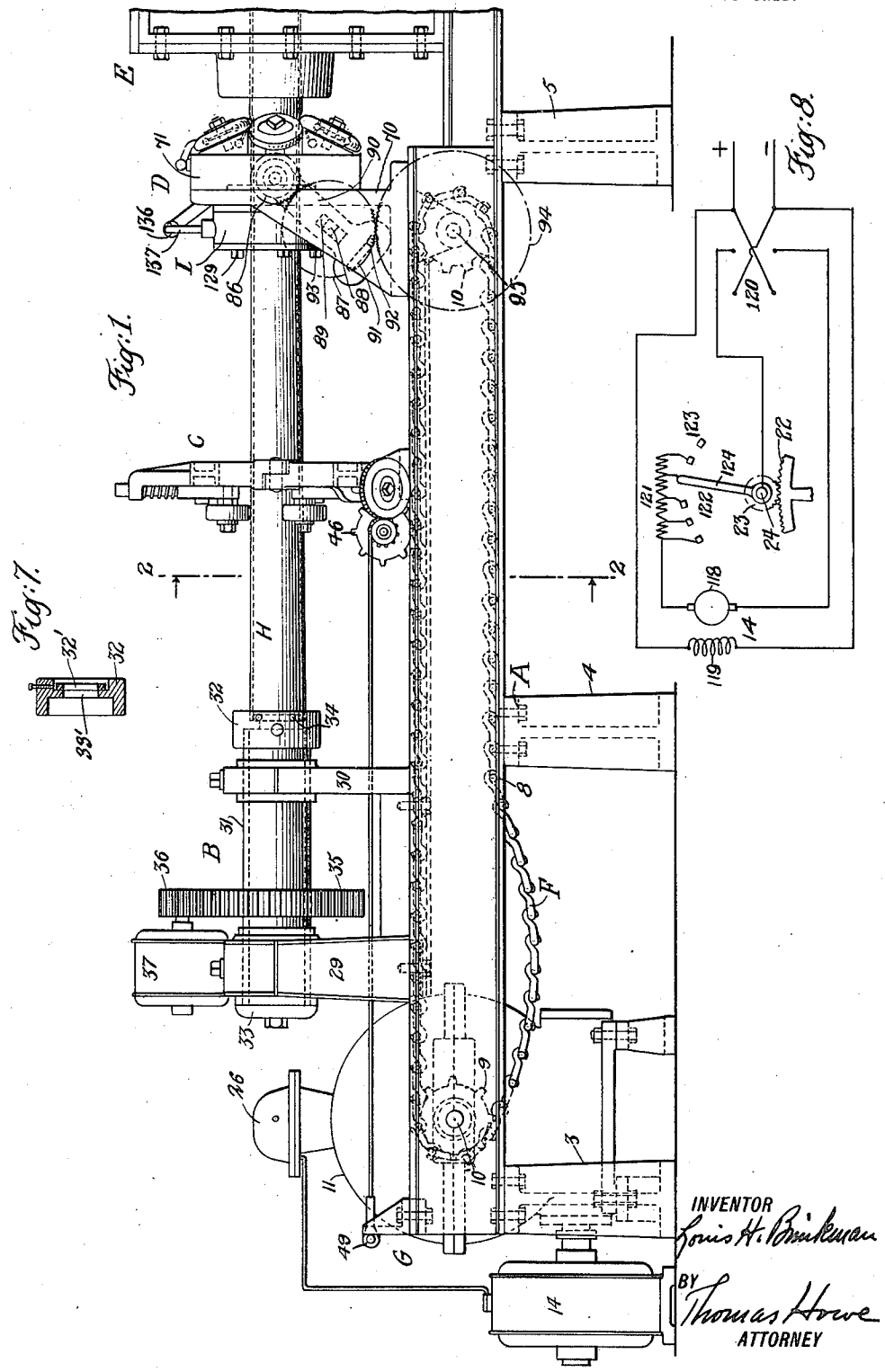
APPARATUS FOR DRAWING RODS AND TUBES OF VARYING DIAMETERS.

APPLICATION FILED AUG. 8, 1917.

1,301,220.

Patented Apr. 22, 1919.

4 SHEETS—SHEET 1.



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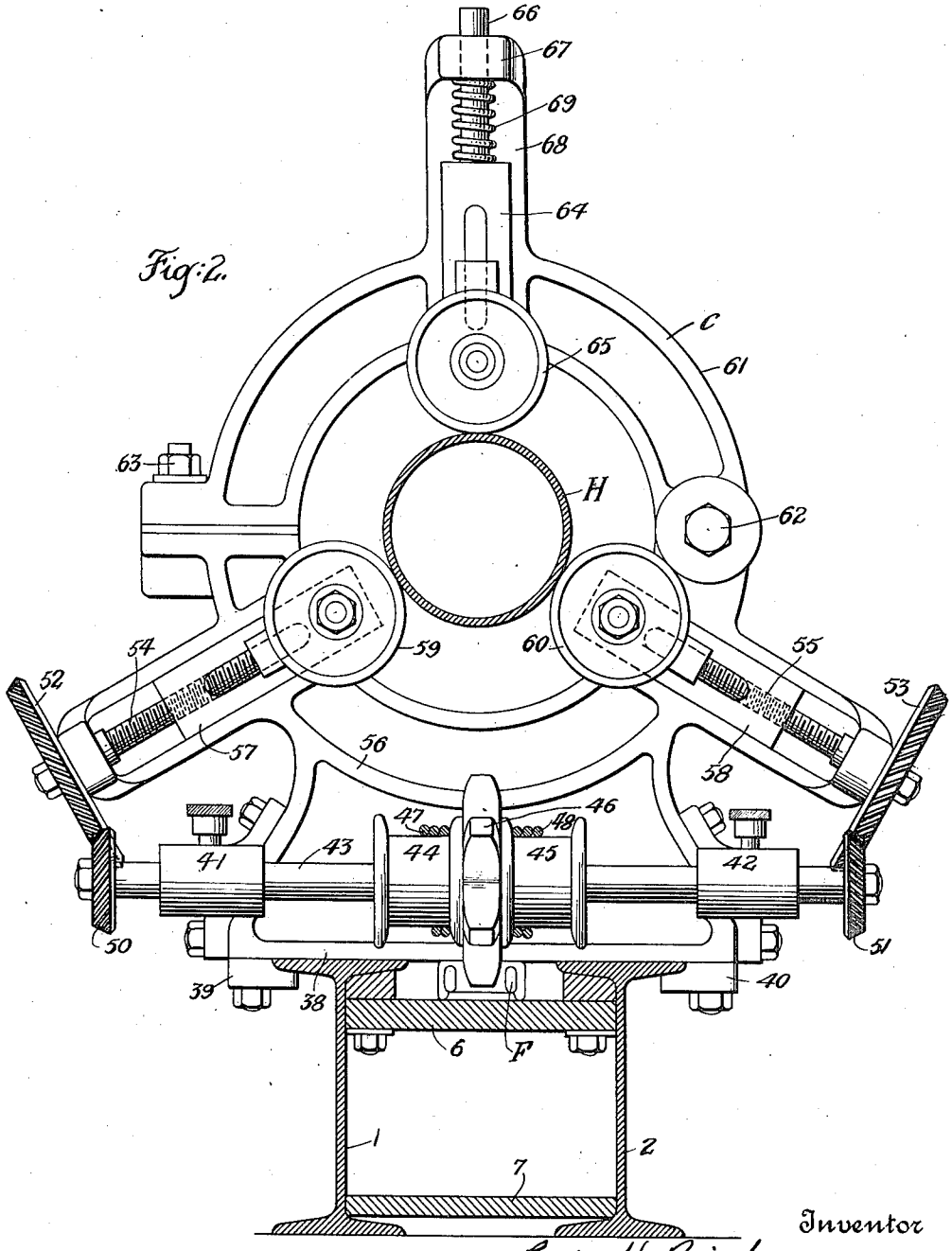
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4 SHEETS—SHEET 2.

Fig. 2.



Inventor

Louis H. Brinkman

By his Attorney

Thomas Howe

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4 SHEETS—SHEET 3.

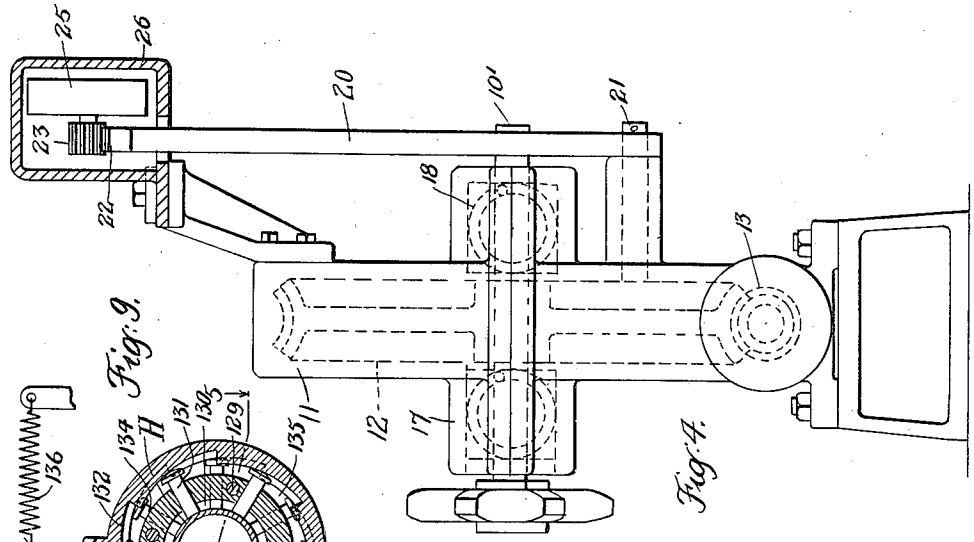


Fig. 4.

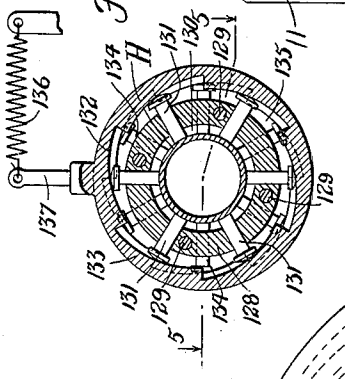


Fig. 9.

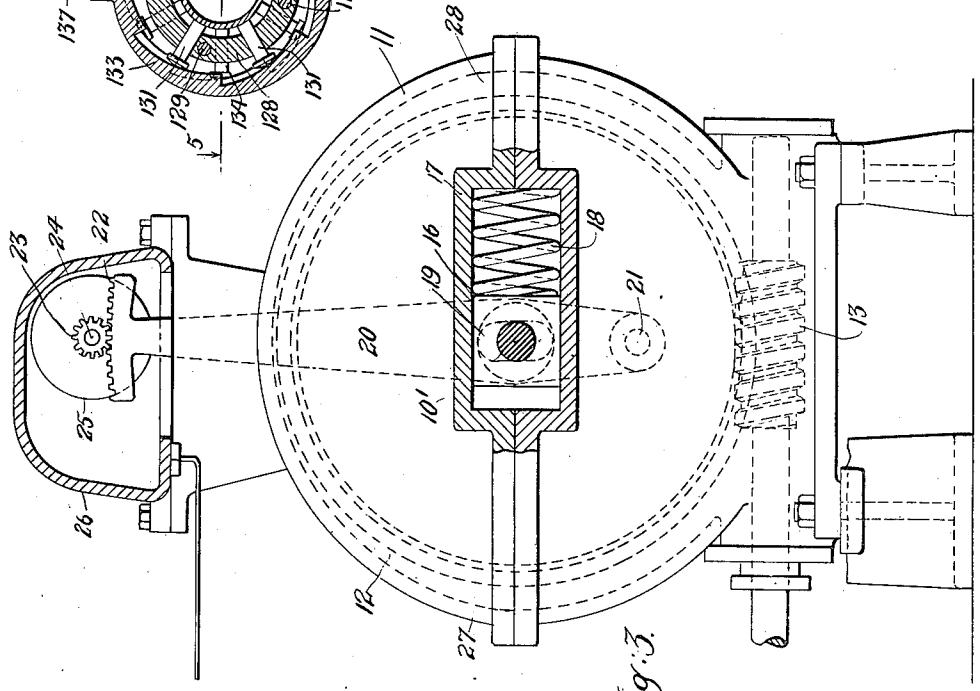


Fig. 3.

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4 SHEETS—SHEET 4.

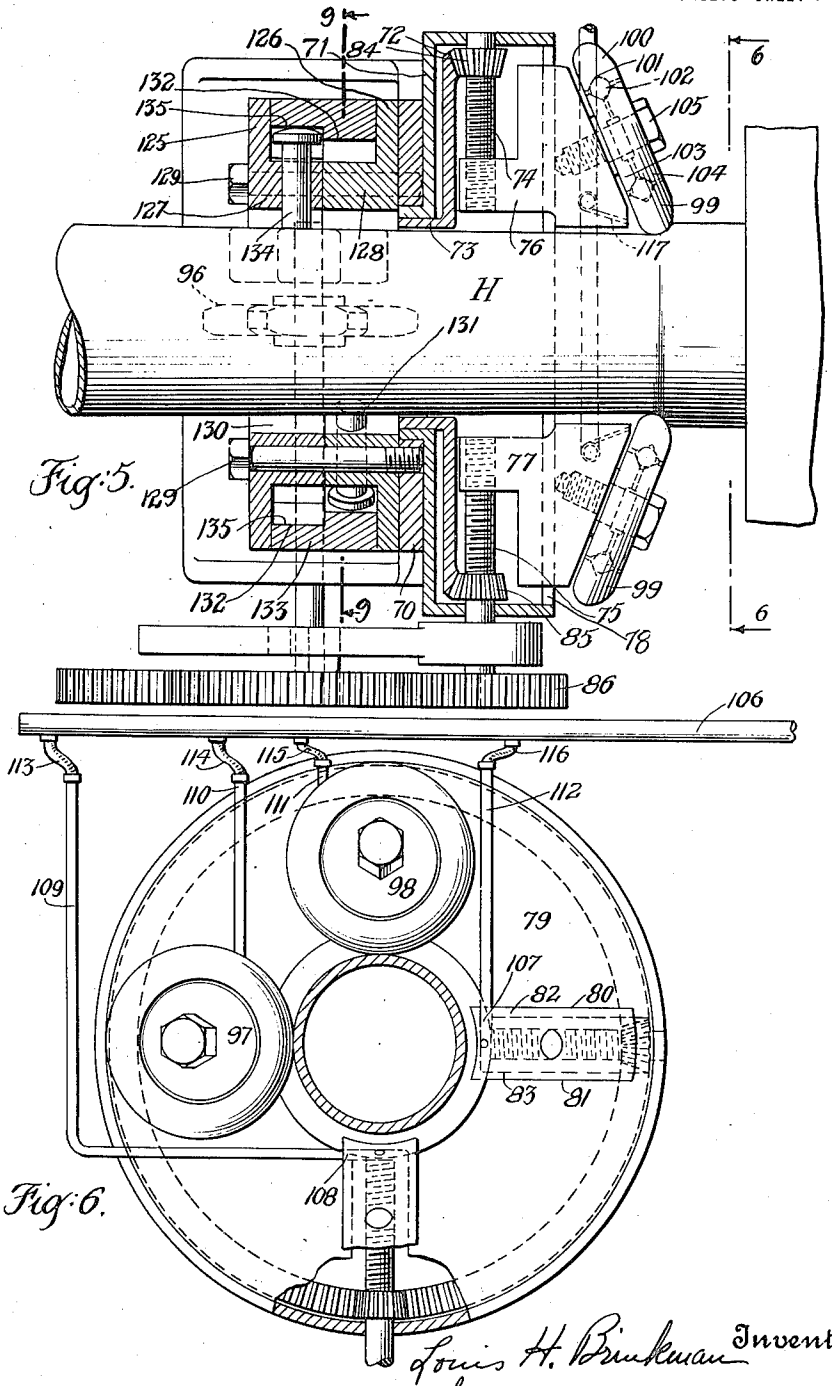


Fig. 5.

Fig. 6.

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By his Attorney

Thomas Howe

UNITED STATES PATENT OFFICE.

LOUIS H. BRINKMAN, OF GLEN RIDGE, NEW JERSEY.

APPARATUS FOR DRAWING RODS AND TUBES OF VARYING DIAMETERS.

1,301,220. Specification of Letters Patent. Patented Apr. 22, 1919.

Application filed August 8, 1917. Serial No. 185,005.

To all whom it may concern:

Be it known that I, LOUIS H. BRINKMAN, a citizen of the United States, residing at Glen Ridge, Essex county, State of New Jersey, have invented new and useful Improvements in Apparatus for Drawing Rods and Tubes of Varying Diameters, of which the following is a specification.

This invention relates to apparatus whereby a tube or rod of metal may be so drawn as to have different diameters at different portions of its length. It may be employed in the manufacture of tapered structures such as masts, flag poles, gun barrels and a multitude of other applications.

One object of the invention is to provide means for drawing a tube of varying diameters without necessitating the use of a mandrel or inside support, the tube however, accurately holding its predetermined form.

Where it is attempted to impart a taper to a tube by heating it and drawing it through a pass, without an inside support, the pass being gradually reduced in diameter as the tube is drawn longitudinally, it is found that the tube is fluted or grooved longitudinally and crushed inwardly into irregular shapes. This is because the tube in the region of the pass must be heated sufficiently to be soft enough to be acted on by the pass and, being in this condition and without any interior support, there is nothing, or practically nothing, to support the tube in its proper position against the crushing of the inwardly moving parts of the pass. I have found that the above mentioned adverse conditions may be remedied and an improved method and means of reducing the diameter of the tube provided by cooling the hot metal after it has been acted on by the pass to reduce it to the desired dimensions, this cooling being to such a degree that it maintains this desired condition of the tube and in such proximity to the hot metal being acted on by the pass, that this hot metal will be supported against distortion under the action of the inwardly moving pass members. The operation according to the present invention is very different from that of reducing the diameter of a tube by rolling it down. According to the rolling process the metal of the tube is crushed inwardly and upset, the mass of metal at any given section remaining substantially the same after the reduction in diameter as before it. According to the present invention, as the pass parts move inwardly and the tube and pass are relatively moved longitudinally, a wave or shoulder of metal is formed on the hot side of the pass so that the superfluous metal is pushed along the tube ahead of the pass. The result is that as the tube is decreased in diameter the wall of the tube is also decreased in thickness. Starting therefore with a tube of uniform diameter and thickness of wall and of a given length, the resulting tube will be not only of a diameter tapering from the large to the small end but will also have its wall thickness tapering, being thickest at the end of large diameter; and further the resulting tube will be of greater length than the original by reason of the movement of the metal longitudinally ahead of the pass above referred to. This secures a most economical distribution of the metal for many purposes. Thus masts, flag poles and many other structures require greatest strength at their butt ends, that is the ends of greatest diameter, while at the tip but little strength is required, the strength requirement tapering off between these two extremes. By applicant's invention therefore, it is possible to utilize the excess metal to lengthen the tube instead of retaining the metal at intermediate sections where it would only cause the strength to be excessive and the weight of the tube unduly large.

Another object of the invention is to coordinate the draw head of apparatus for drawing tubes or rods with the variation of the diameter of the reducing pass through which a tube or rod is drawn, so that the desired diameters may be obtained at the different sections along the tube.

Another object of the invention is to provide an improved steady rest for the rod or tube operated upon adapted to be accommodated to varying diameters of the work or stock and be properly located with regard to the draw head and reducing pass.

A further object of the invention is to provide an improved draw head.

Another object of the invention is to provide means for regulating the driving means acting upon the draw head according to the resistance of the work to the pull thereon.

Further objects of the invention relate to methods for accomplishing results as above indicated.

Other and ancillary objects will appear hereinafter.

In the accompanying drawings which illustrate the invention,

Figure 1 is a side elevation of apparatus embodying the invention,

Fig. 2 is a section, on an enlarged scale, on the line 2—2 of Fig. 1,

Fig. 3 is a view mostly in side elevation, but partly in section, on an enlarged scale, of a portion of the apparatus at the left end of Fig. 1, showing the arrangement of driving gearing and motor controller,

Fig. 4 is an end elevation of the apparatus of Fig. 3, with the controller in section.

Fig. 5 is a horizontal section, on an enlarged scale, being on a horizontal plane through the pass and on the line 5—5 of Fig. 9, through the centering rest I.

Fig. 6 is a view showing the reducing pass mostly in vertical elevation and partly in section, and with some of the parts removed for the sake of clearness, viewed from the line 6—6 of Fig. 5,

Fig. 7 is an axial section of the chuck for securing the end of the tube to the draw head,

Fig. 8 is a diagram of the electrical connections of the driving motor for the draw chain, and

Fig. 9 is a section on a reduced scale on the line 9—9 of Fig. 5.

Referring to the drawings, the apparatus comprises a draw bench A on which are slidably mounted a draw head B having a rotatable member to which the end of the tube H or rod to be drawn, is secured; also sliding on the draw bench is a steady-rest C for the tube, a pass D for reducing the rod or tube and a furnace E for heating the tube. The draw head B, the steady-rest C and the reducing pass D, are driven by a sprocket chain F by means of suitable motor and gear mechanism G. A centering rest I which receives the tube after it has emerged from the pass insures that the axes of the tube and pass shall coincide.

Referring more in detail to the drawings, the draw bench A comprises I-beams 1 and 2 supported upon pillars or legs 3, 4 and 5. Secured to the I-beams is a board or plate 6, which serves as a support for the upper side of the endless chain F, while a similar board 7 supports the lower part of the chain between the point 8 and its right hand end (see Fig. 1), the slack of the chain being allowed to fall down between the point 8 and the left hand end of the chain. The left hand end of the chain engages the sprocket 9, while the right hand end engages the sprocket 10.

The sprocket 9 is fixed upon a shaft 10′, mounted in bearings in a split gear casing 11, which incloses the worm wheel 12, which is also fixed upon the shaft 10′. The gear wheel engages with the worm 13, which is direct connected to a motor 14 regulated by a suitable controller 15, which is controlled by the pull upon the chain F. This is accomplished in the structure shown by mounting the bearing blocks as 16 of the shaft 10′ in elongated boxes as 17, formed in the gear casing. Springs as 18 interposed between the bearing blocks and the ends of the boxes oppose the pull of the chain on the sprocket wheel. The shaft 10′ extends into an elongated slot 19 in the arm 20, pivoted to the gear casing at 21. The other end of the arm 20 has a gear segment or rack 22, which engages with a spur gear 23 on the shaft 24 of the controller cylinder 25, the controller cylinder being covered by a casing 26. As the bearing blocks for the shaft 10′ move back and forth as indicated, the shaft will have a horizontal motion of translation, and clearances 27 and 28 are provided between the worm wheel and the casing so that the wheel may roll on the worm without affecting the engagement therewith as its shaft moves back and forth. The draw head B comprises two bearing supports 29 and 30 clamped to the chain and sliding upon the I-beams 1 and 2. These supports carry the bearings for the rotary spindle 31, having a chuck or coupling 32 at one end and a thrust cap 33 at the other end taking up the pull exerted upon the tube being drawn by the spindle. The chuck 32 may be simply a head secured to the spindle and having a socket into which the end of the tube to be drawn is entered and said tube is fixed by one or more set screws 34 passing through the head and engaging with the tube. To support the tube internally against the action of the set screws, a ring or boss 32′ surrounding the central opening 33′ may be provided at the bottom of the socket and, entering within the end of the tube, the latter is clamped between it and the set screws. The spindle may be rotated by means of a spur gear 35 fixed thereon, which meshes with a spur gear 36 fixed on the shaft of an electric motor 37, which is mounted upon a bracket extending from the support 29. This motor may be of any suitable type and control.

The steady-rest C comprises a support of which the lower plate 38 slides on the tops of the I-beams 1 and 2; guiding and securing pieces 39 and 40 having lips overhanging the flanges of the I-beams are secured to the plate 38. Also secured to the support are bearings 41 and 42 for a shaft 43 which has fixed to it drums 44 and 45 on either side of the sprocket wheel 46 which is also fixed to the shaft 43. Upon the drums 44 and 45 are wound the cables 47 and 48, each having an end fixed to the drum with their other ends fixed to anchors as 49, fixed to the left hand end of the I-beams (see Fig. 1). The turning of the drums to wind up the cables therefore will draw the steady-rest toward the left (see Fig. 1). At the

ends of the shaft 43 are fixed skew gears 50 and 51, which respectively mesh with the skew gears 52 and 53 fixed upon the shafts of screws 54 and 55, having their axes radially of the tube and being rotatably mounted but held against endwise movement in the support 56 of which the plate 38 is a part. Sliding in suitable guides in the support 56, are blocks 57 and 58 in engagement respectively with the screws 54 and 55, so that they are moved radially of the tube by the turning of the screws. These blocks respectively carry the rollers 59 and 60 adapted to bear against the tube H to steady the same. To the lower support 56 an upper portion 61 is pivoted at 62, so that it can be thrown to one side to permit the placing of the work in position. The portion 61 may be then turned back into holding position and secured by a screw or bolt 63. The part 61 carries a radially sliding block 64 similar to the blocks 57 and 58, which carries a rotatably mounted roller 65 and has a guiding projection 66 passing through an orifice in the lug 67 on the arm 68 extending from the portion 61. A spring 69 forces the block 64 inwardly so that the roller 65 is held against the tube H.

The sprocket wheel 46 engages with the chain F and furnishes the driving means for winding up the cables 47 and 48 and also for turning the screws 54 and 55 for moving the rollers 59 and 60 to maintain them in contact with the work H. The gearing ratio and the size of the winding drums 44 and 45 is made such as to produce the desired longitudinal movement of the steady-rest and also the radial feed of the rollers 59 and 60 so as to maintain those rollers in contact with the tube notwithstanding variations in the diameter of the tube between the rollers.

The pass D for reducing the diameter of the work, comprises a support 70 which is fixed upon the stationary frame of the draw bench. Fixed in the support 70 is a chuck frame 71 within which the beveled gear 72 has a bearing. The hub 73 of this gear has a central opening as shown, so that the work H may pass through its interior. Rotatably mounted in the frame 71, are screws as 74 and 75, which are in screw threaded engagement with blocks as 76 and 77, which slide in slots as 78 in the face plate 79 of the chuck structure, the edges as 80 and 81 of the blocks over hanging the edges as 82 and 83 of the slots so that the face plate 79 takes up the thrust of the blocks axially of the chuck. Each of the screw shafts as 74 and 75, carries a beveled gear as 84 and 85, which mesh with the gear 72, so that the turning of one of the screws involves the similar turning of all of the other screws, so that all of the blocks as 76 and 77 have a simultaneous and equal radial movement. To effect this adjustment of the blocks, the shaft of one of the screws as 75 is extended and has a spur gear 86 secured against turning thereon by reason of the end of the shaft being of square cross section and entering into a square hole in the center of the gear wheel. The gear may be secured against sliding off the end of the shaft by a set screw or in any other suitable way, so that gears of different sizes may be interchanged to produce different speeds of driving of the radial adjusting screws for the roller carrying blocks of the chuck. The gear 86 meshes with an idler gear 87 which is rotatably mounted on a pin 88 having a squared end secured in the slot 89 in the arm 90; this arm being pivoted about the axis of the screw 75 at one end and at the other end having a slot 91 in which is pressed a bolt 92 which passes through the web 93 of the support 70 and serves to lock the arm in any desired position of adjustment. The gear 87 meshes with a gear 94 which is fixed to the shaft 95 of the sprocket wheel 10, which engages with the chain F. It will appear therefore, that as the sprocket wheel 10 and gear wheel 94 are turned by the chain, the screws as 74 and 75, will be turned to move the blocks as 76 and 77 inwardly. The four blocks 76 and 77 have rotatably mounted upon them the rollers as 97, 98 and 99 adapted to bear against the work, one roller being upon each block. Each of the rollers comprises a hardened continuous steel rim 100, with an interior groove 101 forming one side of a raceway for the balls 102, the opposite raceway being formed by the plates 103 and 104, which are clamped together by means of the screw 105, which is screwed into the block 76. The central portion of the plates 103 and 104 is therefore clamped in a stationary position while a ball bearing is provided for the rim 100, which is free to rotate.

In order to supply a cooling fluid for cooling the work immediately after it has passed under the rollers, a water supply pipe 106, communicates with passages as 107 and 108 in the radially moving chuck blocks by means of pipes 109, 110, 111, 112, which are connected with pipe 106 by flexible connections 113, 114, 115 and 116, so that the radial movements of the chuck blocks are not interfered with. The pipes 109—112 inclusive may be of iron while the connections 113—116 inclusive may be rubber or other suitable flexible material.

From each of the passages as 107, 108, extends one or more channels as 117, which lead to the sides of the blocks just in the rear of the working portions of the reducing rollers, so that the water is projected with force against the hot work for the purpose of chilling it immediately after it has passed under the reducing rollers so that it will retain its shape. It may be projected against

the rolls but generally some of the fluid should be projected directly against the work to produce the desired cooling effect. Steam is liable to be formed when the water comes in contact with the hot metal, thereby holding the water out of contact with the metal and permitting it to roll off the work with but slight cooling effect. The water should therefore, be projected upon the work with considerable pressure, so that the film of steam tending to be formed upon the work, will be broken through by the force of the jet and the water brought into intimate contact with the surface of the work. It has been found in practice that a pressure of 65 pounds per square inch, gives satisfactory results.

The motor may be of any suitable or well known type and the control effected by any suitable or well known arrangement of connections. In the diagram of Fig. 8, it has been assumed that the motor 14 is a shunt motor, and governed by a resistance in the armature circuit. Thus in the diagram referred to, the armature is indicated at 118 and the shunt field at 119, the shunt field being connected across the constant potential source while a reversing switch 120 serves to connect the armature with the source through the rheostat before referred to. The controlling rheostat comprises a resistance 121, with taps therefrom connected with the stationary contacts 122, it being observed that the stationary contact 123 is not connected with any of the circuits. The arm 124, connected with the line, moves over contacts 122 and 123 as its shaft 24 is turned by the gear 23 and segment 22. It will be apparent that as the arm 124 moves to the right over the contacts 122, the resistance will be cut into the armature circuit causing slowing down of the motor and when it has been moved to the extreme right, so as to rest upon the stud 123, the circuit of the motor will be broken and it will accordingly stop; conversely, resistance will be cut out and the speed of the motor increased as the arm moves to the left over the contacts 122 and 123. The motor may be started in the first instance by an ordinary starting rheostat (not shown).

The rest I is mounted upon the support for the pass and comprises two circular members or plates 125 and 126 having the central bosses or hubs 127 and 128, these members being held together by bolts 129 and having a central hole 130 for the passage of the tube. In the hub 128 are a series of radially sliding plungers 131 extending into the passage 130 at their inner ends and adapted to have their outer ends engaged by a series of cam faces 132 on the inner side of an annular ring 133 surrounding the hubs. A similar set of plungers 134 extending through the hub 127 are engaged by a similar series of cam faces 135 on the ring 133, the series of plungers of the two hubs respectively being staggered with relation to each other. The spring 136 acts upon the arm 137 with a tendency to turn the ring 133 in such direction that the plungers will be forced inwardly by the cams so as to maintain contact with the tube notwithstanding variations in its diameter. The plungers being all forced in equally, they will tend to hold the tube in the center of the passage 130 and consequently in line with the axis of the pass, the holding forces depending upon the inclination of the cams and the force exerted to turn the ring 133.

The operation of the apparatus may now be traced as follows:

By operating the motor 14 in a suitable direction, the steady-rest C and the head B are brought into close proximity at the right hand end of the draw bench. The end of the work, that is the tube or rod to be drawn, is secured in the chuck 32 in a manner as before described and passes back through the steady-rest, the rest I and the pass D into the furnace E. The tube having been sufficiently heated, the drawing operation is started by causing the motor to draw the sprocket chain in such direction as to move the draw head to the left. (See Fig. 1.) The rolls as 97, 98 and 99 are adjusted to the outer diameter of the work at the start and a gear 86 of suitable dimension to give the desired inward movement of the reducing rollers, is fixed in place with the idler gear and its supporting arm so adjusted as to establish suitable connection between the gear 94 and gear 86. As the head is drawn to the left (see Fig. 1), the rollers of the pass D will be forced inwardly reducing the diameter of the tube, the desired taper depending upon the amount of radial movement of the reducing rollers for a given longitudinal movement of the head, this being determined by the gearing between the sprocket chain and the roller adjusting means as before referred to. It will be observed that inasmuch as the radial adjusting means for the rollers is driven from the same means which drives the draw head, the radial movement of the reducing rollers of the pass will bear a predetermined ratio to the movement of the draw head, so that in tapering a tube, the inter-dependence of the reducing rollers and the travel of the draw head insures that they will bear the proper relationship to each other. As the draw head thus pulls the tube through the pass, the tube is rotated through the instrumentality of the electric motor 37, gears 35 and 36 and spindle 31, so that the operation of the reducing rollers of the pass is extended about the whole circumference of the tube.

As the tube is drawn longitudinally and the pass members move inwardly, a wave of

metal or a shoulder is thrown up on the hot side of the pass, against which the pass members push so that the superfluous metal is pushed along ahead of the pass as the tube is drawn through it and the superfluous metal is utilized to lengthen the tube as has been hereinbefore referred to.

After a section of the tube has been operated upon by the pass, it encounters the cooling fluid as before referred to and is chilled so that it retains its shape and is not distorted by the operation of the reducing rollers upon the succeeding section of the tube or by any other distorting agencies. This renders unnecessary any mandrel or interior support for the tube during the reducing operation, so that the difficulties of mounting a mandrel and manipulating a tube of varying diameter upon it are avoided. The metal under the reducing rollers is heated to such a degree that it may be easily reduced by the action of the rollers, but after such action, the material is chilled as has been mentioned.

It is desirable that the steady-rest for supporting the tube should be half way between the draw head and the pass. To accomplish this, the steady-rest moves one-half the distance that the draw head moves and in a uniformly tapering tube, the rolls of the steady-rest in order to maintain contact with the tube, only move one-half the radial distance that the reducing rolls move. Accordingly the size of the winding drums 44 and 45 is made such that for a given movement of the chain F, the cables 47 and 48 will have a length wound up, which is equal to one-half that movement and consequently the steady-rest will be moved toward the left (see Fig. 1) at a rate of speed one-half of that of the sprocket chain. Also the gearing between the sprocket wheel 46 and the steady wheels 59 and 60, is such that for a given movement of the sprocket chain *i. e.*, for a given movement of the draw head, the reducing rollers of the pass will move radially inwardly a certain distance, while the wheels of the steady-rest will move inwardly radially one-half of the distance of the reducing rolls. Here again, the driving of the steady-rest, the reducing rolls and the draw head from the sprocket chain, is such that their movements are sure to be properly proportioned and related to each other.

The left hand limit of the draw head having been reached, the end of the tube may be released from the chuck 32, and the tube removed from the apparatus. The draw head and steady-rest may then be returned to their right hand position, a new tube secured in the apparatus, and the operation repeated as before.

It will be seen that increased pull on the sprocket chain due to insufficient heating of the stock drawn through the pass or from other causes, will cause the bearing blocks of the shaft 10′ of the driving sprocket to be drawn to the right (Fig. 1) against the pressure of springs 18, thereby turning the arm 20 on its pivot which will result in the turning of the controller of the driving motor 14, so as to slow it down. If the pull of the sprocket chain should be sufficiently increased, the controller will be turned to the off position and stop the apparatus.

While the invention has been illustrated in what is considered its best application, it may have other embodiments without departing from the scope of the claims and is not limited therefore to the structure shown in the drawings.

What I claim is—

1. In apparatus for drawing a tube or rod of varying diameters, the combination with a reducing pass, means for varying the diameter of the pass, means for drawing the stock through the pass and a common operating means for the reducing means and the said means for drawing the stock through the pass.

2. In apparatus for drawing a tube or rod of varying diameters, the combination with a reducing pass, means for varying the diameter of the pass, means for drawing the stock through the pass and a common operating means for the reducing means, and the said means for drawing the stock through the pass, and means for varying the relation of the pass diameter varying means and the means for drawing the stock through the pass.

3. In apparatus for drawing a tube or rod of varying diameters, the combination with the frame of a draw bench, of a draw head movable thereon, a pass through which the stock is drawn by said draw head, a furnace for heating said stock prior to its entrance into the pass, said pass comprising a frame, rotatable bodies for acting upon the work, means for moving said rotatable bodies radially of the work, means for moving said draw head along the draw bench frame to draw the work through said pass and gearing between the last mentioned means and the means for radially moving the rotary bodies.

4. In apparatus for drawing a tube or rod of varying diameters, the combination with a frame of a draw bench of a draw head movable thereon, a pass through which the stock is drawn by said draw head, a furnace for heating said stock prior to its entrance into the pass, said pass comprising a frame, rotatable bodies for acting upon the work, means for moving said rotatable bodies radially of the work, means for moving said draw head along the draw bench frame to draw the work through said pass, gearing between the last mentioned means,

and the means for radially moving the rotary bodies, and means for relatively rotating the pass and work.

5. In apparatus for drawing a tube or rod of varying diameters, the combination with a pass secured to a draw bench frame, said pass comprising a frame and rotary bodies for operating upon the work, radially movable therein, means for heating the work prior to its entrance into the pass, a draw head movable along the said draw bench frame and adapted to be secured to one end of the work to draw it through the said pass, said draw head carrying means for rotating the member secured to the work, whereby rotation of the work about its axis is effected, a drawing chain movable along the draw bench, means for driving said chain, means for securing said draw head to said chain and gearing driven by said chain for moving the said rotary bodies radially of the pass.

6. In apparatus for drawing a tube or rod of varying diameters, the combination with a pass of a draw head for drawing the stock through said pass, a steady-rest for the work and means for maintaining the steady-rest in predetermined desired relationship to said head and pass.

7. In apparatus for drawing a tube or rod of varying diameters, the combination with a pass of a draw head for drawing the work through said pass and a steady-rest adjustable to work of different diameters.

8. In apparatus for drawing a tube or rod of varying diameters, the combination with a pass, of a draw head for drawing the work through said pass, a steady-rest for the work and a common means for moving said head and steady-rest along the longitudinal axis of the work.

9. In apparatus for drawing a tube or rod of varying diameters, the combination with a pass of a draw head for drawing the work through said pass, a steady-rest comprising radially adjustable members, means for adjusting said radially moving steady-rest members, and a common means for moving the said draw head to draw the work through said pass and for actuating said adjusting means.

10. In apparatus for drawing a tube or rod of varying diameters, the combination with a pass of a draw head for drawing the work through said pass, said draw head being movable longitudinally of the axis of the work, a steady-rest also movable longitudinally of the axis of the work and comprising members movable radially of the work and a common means for moving said head and steady-rest longitudinally of the work and for moving the said radially movable members of said steady-rest.

11. In apparatus for drawing a tube or rod of varying diameters, the combination with a pass comprising radially moving members, of a head for drawing the work through the pass, movable longitudinally of the axis of the work, a steady-rest movable longitudinally of the axis of the work and having members movable radially of the work, and a common means for moving said draw head and steady-rest axially of the work and for moving the radially movable members of the steady-rest and pass.

12. In apparatus for drawing a tube or rod of varying diameters, the combination with a draw bench frame, of a pass secured thereon, means for heating the work prior to its entry into the pass, a draw head for drawing the work through the pass and a steady-rest between the draw head and pass, said draw head and steady-rest being movably mounted on said frame, a sprocket chain extending along said frame, and means for driving said sprocket chain, said pass comprising a frame and rotary bodies movable radially of the work and gearing connecting said bodies with said chain, said steady-rest comprising cable drums and a cable adapted to be wound thereon, said cable being secured at one end to said draw bench frame, gearing for operatively connecting said drum to said sprocket chain, radially movable members and gearing for operatively connecting the last mentioned members with said sprocket chain, said draw head comprising a rotatable spindle, means for securing the end of the work thereto, and means for securing said head to said sprocket chain.

13. In apparatus for drawing a tube of varying diameters, the combination with a pass of means for heating the metal before its entry into said pass, means for drawing the metal through said pass and means for chilling the metal immediately after it has been forced into the desired position by the working members of the pass.

14. In apparatus for drawing a tube of varying diameters, the combination with a pass of variable diameter; of means for varying the diameter of the pass, means for heating the metal prior to its entry into the pass, means for drawing the metal through the pass and means for chilling the metal immediately after it had been forced into the desired position by the working members of the pass.

15. In apparatus for drawing a tube of varying diameters, the combination with a pass having a variable diameter, of means for varying the diameter of the pass, means for heating the metal prior to its entry into the pass, means for drawing the metal through the pass, and means for applying cooling fluid to the work just after it has been forced into the desired position by the working members of the pass.

16. In apparatus for drawing a tube of

varying diameters, the combination with a pass having a variable diameter, of means for varying the diameter of the pass, means for heating the metal prior to its entry into the pass, means for drawing the metal through the pass, and means for projecting cooling water in jets under pressure upon the metal operated upon immediately after it has been acted upon by the working members of the pass.

17. In apparatus for drawing a tube of varying diameters, the combination with a pass comprising radially movable rotatable bodies adapted to operate upon the metal of the work, of means for moving the said bodies radially of the work, means for heating the metal prior to its entry into the pass, means for drawing the metal through the pass, means for relatively rotating the pass and work about the axis of the work and means for chilling the metal immediately after it has been operated on by said bodies.

In testimony whereof I have signed this specification this 1st day of August, 1917.

LOUIS H. BRINKMAN.