June 12, 1934. R. H. COWDERY 1,963,047

PRESS FOR TUBES

Original Filed Jan. 24, 1927 5 Sheets-Sheet 1

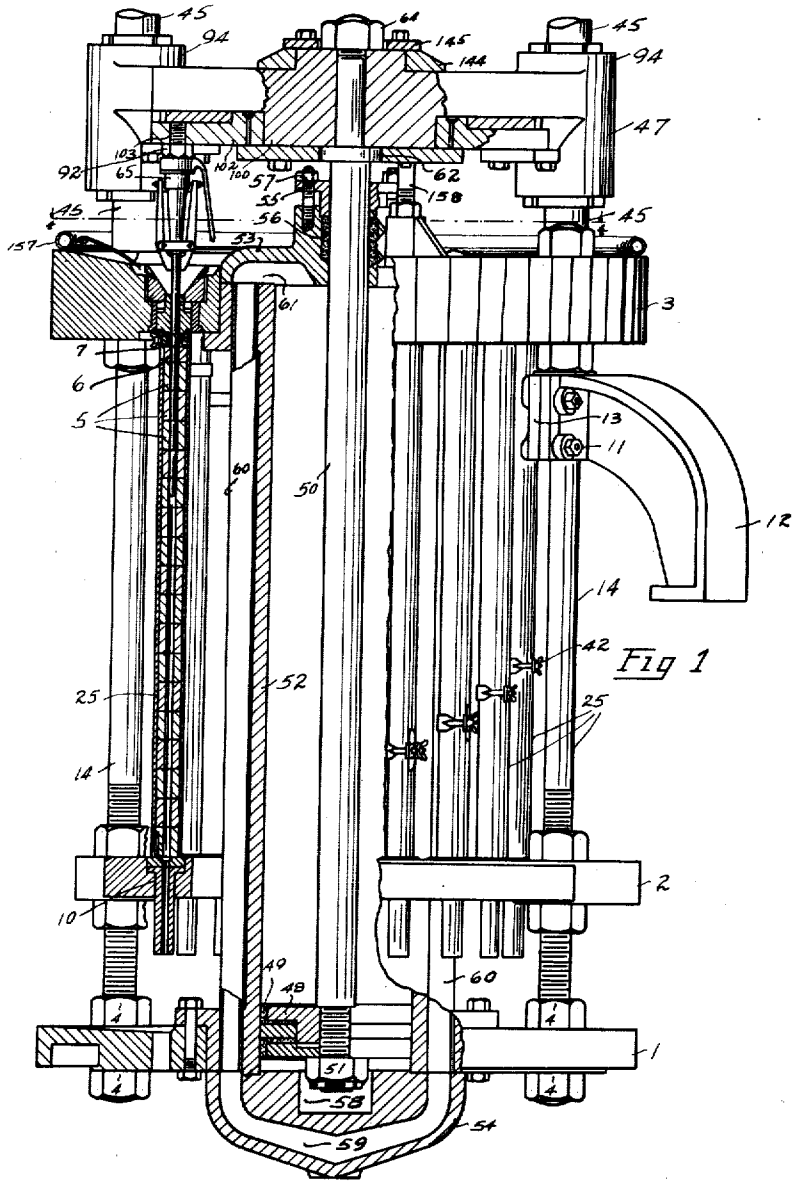


Fig 1

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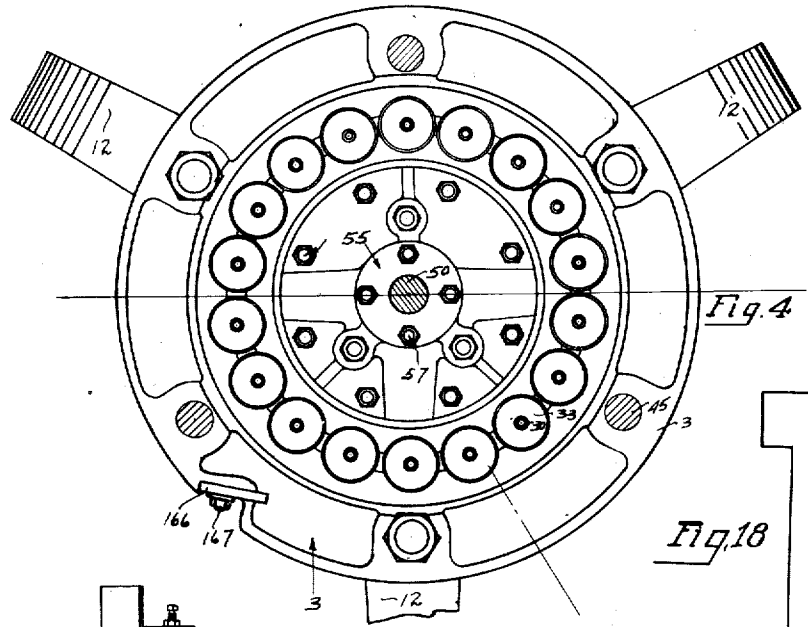
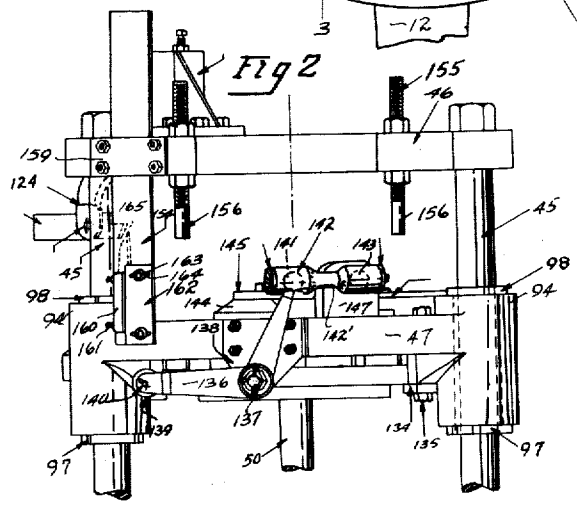


Fig. 4

Fig. 18

Fig 2



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Fig. 3

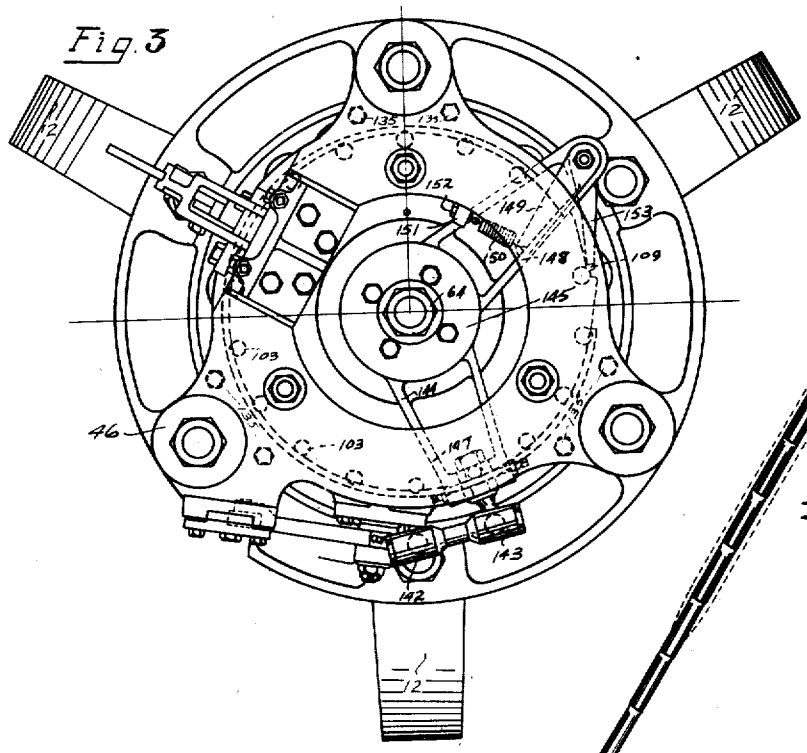


Fig. 11

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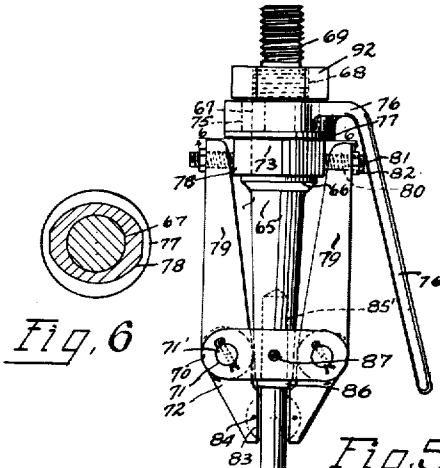


Fig. 6

Fig. 5

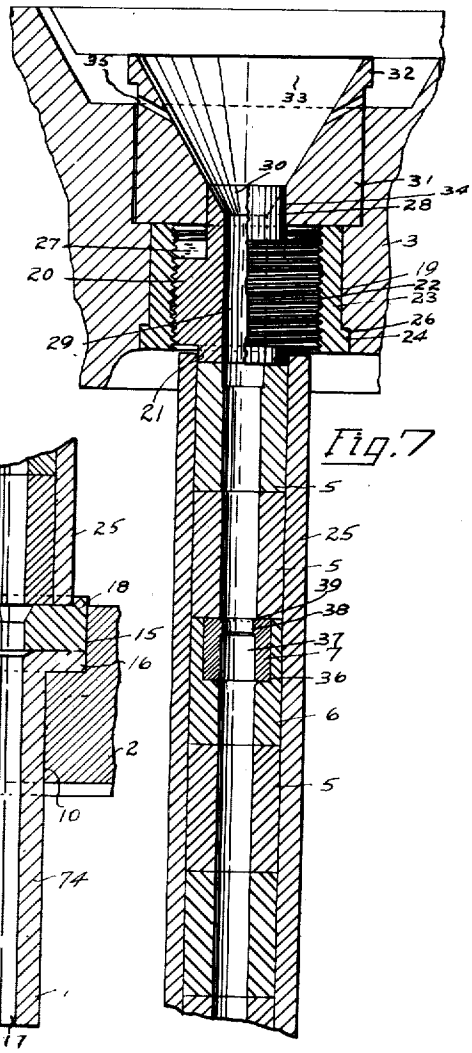


Fig. 7

Fig. 8

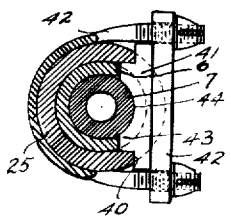


Fig. 10

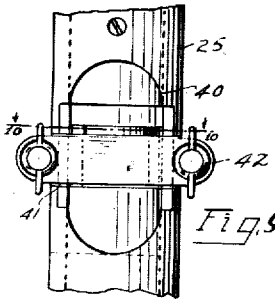


Fig. 9

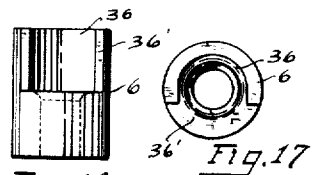


Fig. 16

Fig. 17

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Fig. 12

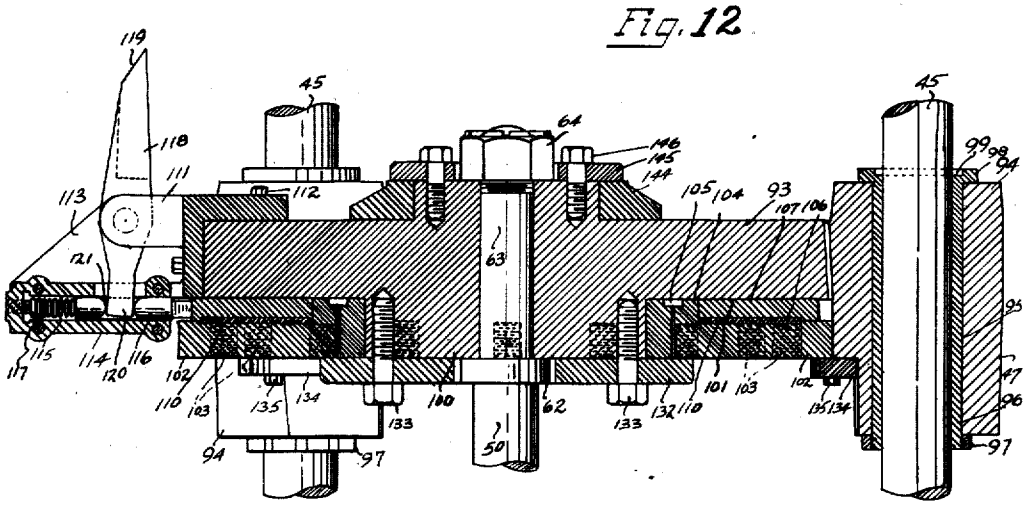


Fig. 14

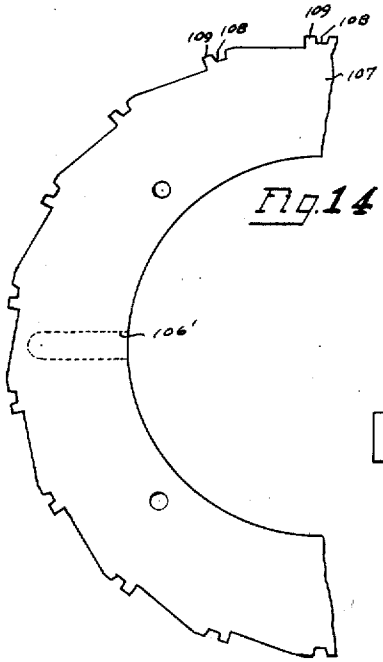


Fig. 13

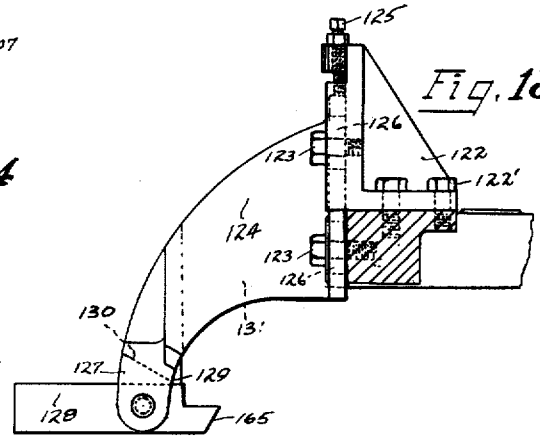
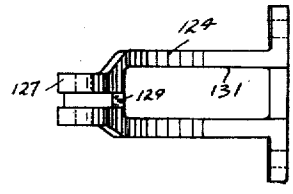


Fig. 15



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Patented June 12, 1934 1,963,047

UNITED STATES PATENT OFFICE

1,963,047

PRESS FOR TUBES

Robert H. Cowdery, Geneva, Ohio, assignor to The American Fork & Hoe Company, Cleveland, Ohio, a corporation of Ohio

Continuation of application Serial No. 163,050, January 24, 1927. This application October 24, 1928, Serial No. 314,650

20 Claims. (Cl. 205—7)

My invention relates to improvements in tube drawing presses and relates particularly to improvements in that form of presses employed for the purpose of drawing tapered tubes.

An object of my invention is to provide for the drawing of a tube of approximately cylindrical form to a different form, wherein portions at least of the tube, are reduced in diameter.

Another object of my invention is to provide for the drawing of tubes in successive operations whereby different portions of the length of the tubes are successively operated upon to effect an aggregate result of producing a tube of progressively decreased diameter toward one of its ends.

Another object of my invention is to provide for the progressive reduction in diameter of a metallic tube toward one of its ends in an efficient and expeditious manner.

Another object of my invention is to provide for the production of metallic tubes at a relatively rapid rate, from approximately cylindrical tubes, wherein the produced tubes are reduced in diameter in portions of their length.

Another object of my invention is to provide for the drawing of tubes to a form having "stepped" portions of progressively decreased diameter.

Another object of my invention is to provide certain improvements in mechanisms adaptable for the efficient carrying out of the aforesaid objects.

The aforesaid and other objects of my invention will become more apparent from the following description of an embodiment of my invention in which reference will be had to the accompanying drawings illustrating a machine which is an embodiment of my invention.

In the drawings:

Fig. 1 is a view partially in elevation and partially in section of the lower portion of a machine embodying the principles of my invention;

Fig. 2 is an elevational view of the upper portion of the machine;

Fig. 3 is a plan view of the machine;

Fig. 4 is a view taken on the line 4—4 of Fig. 1, but with portions of a traveling head, illustrated in the foregoing figures, omitted;

Fig. 5 is an elevational view of an arbor and mandrel and operating mechanism therefor, employed in the said embodiment.

Fig. 6 is a view taken on the line 6—6 of Fig. 5 looking in the direction of the arrows;

Fig. 7 is a vertical medial fragmentary sectional view of the upper portion of a supporting ring and die tube employed in the said embodiment, and showing the mechanism used to secure the die tube to the mechanism;

Fig. 8 is a vertical medial sectional view of the lower portion of the die tube of Fig. 7 with a portion of a lower supporting ring therefor, being shown;

Fig. 9 is an elevational view of a section of the die tube showing a die aperture therein;

Figure 10 is a view taken on the line 10—10 of Fig. 9, looking in the direction of the arrows;

Fig. 11 is a view of a finished tubular shaft such as may be formed by the operation of the press of the said embodiment, applied as a shaft for a golf club;

Fig. 12 is a vertical medial sectional view of the traveling head and a revolving arbor plate, and appurtenances thereto;

Fig. 13 is a view of a portion of a top ring with a ratchet stop trip attached thereto;

Fig. 14 is a plan view of a portion of revolving plate ratchet;

Fig. 15 is a bottom plan view of a ratchet stop trip hanger;

Figs. 16 and 17 are elevational and plan views, respectively, of a die bushing as used in my invention; and

Fig. 18 is an elevational view of a lower ratchet reverse bar.

Referring to the figures of drawings, in all of which like parts are designated by like reference characters, my machine comprises generally a base portion and a movable head, as best shown in Figs. 1 and 2. Suitable legs are provided for resting the machine upon the floor, the parts below the legs extending below the floor line. A plurality of threaded rods 14 are provided to hold the various parts of the frame in spaced relation. The frame generally comprises, with the rods 14, a plurality of spaced rings, a lower ring 1 adapted to support a fluid pressure cylinder 52, being secured to the rods 14 by suitable nuts 4, the rods being disposed adjacent the periphery of the ring equal distances apart. Next above the cylinder suporting ring is a ring 2 adapted to support the lower ends of tube 25, the ring being held in spaced relation to the cylinder supporting ring by nuts similar to the nuts 4 holding cylinder supporting ring. The legs 12 are connected to the rods 14 by a suitable clamp 13 and bolts 11. At the top end of the rods 14 is the bed ring 3 held in position upon the upper ends of the rods by nuts, in a manner similar to that for the rings previously described. A plurality, such as 18, of die and bushing carrying

tubes are supported between the bottom or tube supporting ring and the bed ring.

As best shown in Figs. 1 and 7 to 10, inclusive, the die and bushing tubes comprise each a supporting tube 25 having disposed therein a plurality of guide bushings 5 and a die carrying bushing 6. These bushings are preferably of equal length, and are interchangeable with each other so that the die carrying bushing 6 containing each a die 7, (see Figs. 1, 7, 10, 16 and 17) may be disposed within the different tubes at various longitudinal positions for purposes to be described.

In Fig. 1, I have shown a bushing 6 and die 7 at the top of the tube, and I preferably place the dies 7, in each succeeding arcuately disposed tube, succesively lower, and the last die, in this particular embodiment the eighteenth die, is in the lower end of the last or eighteenth tube. The bushings 5 and die carrying bushing 6 are inserted in the tubes in the order named and the lowest bushing, 5 or 6 as the case may be, is held in place Fig. 8 by a set screw 8 projected through a threaded aperture in the tube 25 into a slot 9 in the bushing; and the die and bushing 5 bushings 6 are retained within the tubes while inserting the tubes in place between the bed ring and the bottom tube ring.

The tube supporting ring 2 is provided with a plurality of annularly spaced vertical bores 10, the number depending upon the number of die tubes to be placed in the machine, in this instance eighteen. The bores are enlarged adjacent the upper portion of the ring as at 15, Fig. 8, to provide a socket to receive therein, first, an end bushing 74 which is provided with a flange 16 at its upper end adapted to engage the bottom of the enlarged portion of the bore in the ring, and has the lower end, of smaller diameter, extending through the smaller part of the bore in the ring 2. A bore 17 is provided extending through the longitudinal axis of the bushing 74. Superposed upon the bushing 74 is a bored tube guide cup 18 of generally circular form adapted to fit in the enlarged portion 15 of the bore, and to project slightly above the upper surface of the ring 2. The upper surface of the guide cup is provided with a funnel shaped depression adapted to receive therein the lower end of the tube 25 with the accompanying die and bushings and thus aligns the bushings 5 and 6 and die 7, in the tube, with the bores in the end bushing 74 and tube guide cup 18.

In placing the die tube in the machine, the die tube may be inserted through a corresponding aperture 19 in the bed ring Fig. 7, and lowered down to the tube guide cup, or it may be inserted in the aperture in the bed ring from the under side, so that the tube extends into the aperture and the bottom end of the tube may then be slid over into the tube guide cup.

The apertures 19 in the bed ring 3 are annularly disposed and align vertically with the apertures 10 in the tube supporting ring. Each aperture is provided with an internally threaded bushing 23, as best shown in Fig. 7, driven into the aperture from the lower side of the bed ring, there being a flange 24 which engages the shoulder 26 provided in the bed ring by the apertures 19 to prevent the bushing from entering the bed ring any further than the predetermined distance.

After the die tube 25 has been placed upon the guide cup 18, the upper end of the tube is aligned with the bore of the bushing 23 and a tube plug 20 is screwed into the lock bushing, by a suitable spanner wrench engaging a notch or notches 27, until a reduced lower end 21 of the plug enters into the upper end of the die tube and engages the uppermost bushing 5 or 6, the tube being of sufficient length to leave a slight space at its upper end after the bushings placed therein, have been screwed down tightly by the plug 20. The lower reduced portion 21 of the plug 20 is of circular cross-section and fits snugly within the die tube 25; and the enlarged middle portion 22 is threaded to engage the threads in the bushing 23; and the upper end is provided with a reduced portion 28 also of circular cross section. A bore 29 is provided extending longitudinally through the plug and adapted to align with the bores in the bushings and dies. The upper extremity of the bore is flared outwardly, as shown at 30.

A funnel bushing 31, sufficiently smaller than the upper portion of the bore 19 of the bed ring to fit loosely therein, is provided, and has a flange 32 adjacent its upper edge. It is provided with a bore 33 the lower part of which is cylindrical and telescoped over the upper portion 28 of the tube lock plug and the upper part of which is funnel shaped and merges into the outwardly flared upper portion 30 of the bore 29. A plurality of slanting oil holes 35, below the flange 32, lead into the aperture 33, to supply oil during the operation of the machine.

The bushings, within the die tubes, are substantially cylindrical in form with aligned bores extending longitudinally throughout their aggregate length. In each tube, as illustrated in Fig. 1, and Fig. 7, the bushings 5 disposed below the die bushing 6 have cylindrical bores of substantially the same diameter, while the bushings 5 in the remaining tubes positioned above the die bushing 6 are each of progressively smaller diameter of bore towards the die. Also in each successive tube proceeding in order, arcuately around the machine, the lower bushings are of progressively less and less relative diameters. Therefore in the last tube, not shown, wherein the die is at the lower part of the tube, the bushings above the die are all of progressively smaller bore proceeding from the top of the tube towards the die to conform to the contour of the drawn tube; and the bushings 74 below the die are provided with bores of substantially the same diameter as that of the superposed die. The die bushing 6 which holds the die, Figs. 7, 16 and 17, is substantially cylindrical, and the bore enlarged as at 36, in its upper portion, and the side wall cut away to allow insertion therein of the die 7. The die has a central bore 37, aligning with the bore in the bushing, and is provided with a constricted drawing orifice 38 in its upper extremity, the portion 39 of the orifice leading to the constriction being funnel shaped.

As best shown in Figs. 9 and 10, the die tube has an elongated aperture 40 in the side wall thereof, which allows the die 7 to be inserted in the die bushing without removing the die bushing from the die tube. The die is held in the bushing by a plate 41 held by a clamp 42 which encircles the tube. The plate 41 is of rectangular shape in elevation and has a boss 43, extending through the aperture 40 into the die tube, and has an arcuate face 44 adapted to engage the outer surface of the die.

The apertures 40 in the arcuately successive die tubes are placed progressively nearer the bottom of the tube, that in the first tube being adjacent

the top of the tube, and the one in the last tube being adjacent the lower end of the die tube.

Fastened to the bed ring 3 is a plurality of upstanding traveling head guide bolts 45 to the upper end of which is bolted a top bolt ring 46. Telescoped on the guide bolts intermediate the top bolt ring and the bed ring is a traveling head 47.

The traveling head is adapted to be reciprocated upwardly and downwardly on the guide bolts by means of a piston and rod. The piston comprises a piston body 48, having suitable packing 49, attached to a piston rod 50 by a nut 51. The piston and rod are adapted to reciprocate within a cylinder 52 having an upper and lower head 53 and 54, respectively. The rod passes through a stuffing box in the upper head which comprises a stuffing box gland 55, and suitable packing 56, held in place by studs 57. The piston is reciprocated in the cylinder by means of a flow of oil under pressure which when introduced into a chamber 58, in the lower cylinder head, by suitable connections and valves, from a hydraulic pump, said valves and pump not being shown, forces the piston upwardly until a predetermined point has been reached. Then the flow of oil is diverted from a conduit 58 into the chamber 59 which connects by suitable conduits 60 with the upper end of the cylinder at 61 above the piston and forces the piston downward. This operation may be controlled manually or automatically by any suitable valve mechanism of common construction. The piston rod is provided with a flange 62, Fig. 12, and has a reduced portion 63 above the flange which passes through a bore in the traveling head and a nut 64 on the reduced portion rigidly secures the rod to the head.

The traveling head 47 comprises a relatively large circular central portion 93 having a plurality of guides 94 disposed annularly about the central portion. The guides have each a vertical bore 95 into which is telescoped a traveling head bushing 96. The bushing is provided with threads at its lower end adapted to receive thereon a lock nut 97. The upper end is provided with an outwardly extending flange 98 having a recess 99 adjacent the bore. The central portion of the traveling head is substantially thicker adjacent its center as at 100 and circumscribing the portion 100 is an annular channel 101 in which is revolvingly supported an arbor plate 102 which comprises a metallic ring having therein a plurality of annularly disposed threaded apertures 103, Figs. 3 and 12, adapted to receive a plurality of arbors 65 therein.

Each arbor, Fig. 5, comprises a tapered spindle 65' having intermediate its ends a flange 66. The portion 67 above the flange is of reduced diameter and substantially cylindrical and the extreme upper end is reduced and threaded at 69, and adapted to be screwed into the apertures 103 in the arbor plate. The lower end of the tapered spindle is provided with two pairs of oppositely disposed ears 70, each having aligned bores 71 and adapted to hold pivotally therein a pair of jaws 72. Telescoped upon the cylindrical portion 67 is a sleeve 73 which comprises an upper hexagonal portion 75 adapted to receive thereon a wrench 76. The wrench abuts a flange 77 provided at an intermediate portion of the sleeve. The sleeve below the flanges as at 78 is substantially elliptical in cross section, as best shown in Fig. 6. The jaws 72, which are pivoted between the ears 70 by the pivot bolts 71', have a pair of upwardly extending actuating levers 79 provided at their upper ends with threaded apertures 80 through which adjusting screws 81 are projected, being locked in position by lock nuts 82.

The ends of the screws 81 contact with the elliptical surface 73 of the sleeve. Rotation of the wrench by the handle 76' causes the two levers 72 to swing outwardly by reason of the camming action of the elliptical surface 73 upon the inner ends of the screws 81. The lower ends of the jaws 72 below the pivot 71' are relatively short and are provided with a pair of semi-circular jaw faces 83 held within a groove in the inner surface of the jaw by a pin 84. The spindle 65 is provided with a bore 85' in its lower end extending upwardly along the axis of the spindle, into which is telescoped a stepped mandrel 85. The mandrel has a collar 86 to prevent telescoping it within the bore beyond a predetermined distance, and the mandrel is held within the bore by a set screw 87. The mandrel comprises generally a plurality of successively shorter cylindrical portions successively smaller in diameter, such as 88 to 91, inclusive.

The arbor is screwed by its threaded end 9 into the threaded aperture 103 of the arbor plate in the traveling head, as best shown in Figs. 1 and 12, and the nut 92 is screwed up to lock the arbor firmly upon the revolving arbor plate.

The revolving arbor plate of this embodiment is provided with 18 threaded apertures to receive therein 18 equally spaced arbors. The upper face of the plate adjacent the periphery is cut away leaving a centrally disposed upstanding flange 104, with suitable oil holes 105 therein, which bears against the lower face of the traveling head. At oppositely disposed points on the face of the revolving arbor plate are a pair of radially extending keyways 106 which extend from a point spaced from the edge of the arbor plate to the upstanding flange. Disposed upon the arbor plate, about the upwardly extending flange and flush therewith, is a revolving ratchet plate 107.

The revolving ratchet plate, as best shown in Fig. 14, is a flat ring having in its periphery a plurality of notches 108 and teeth 109. At oppositely disposed points on its lower face, a pair of keyways 106' is provided which correspond to the keyways in the arbor plate, and the keyways extend from the inner edge of the plate to a point spaced from the outer edge of the plate. Within the aligned keyways of the arbor plate and revolving ratchet plate are disposed keys 110 preventing relative movement of the arbor plate and ratchet plate.

The revolving arbor plate with the revolving ratchet plate is held in the channel 101 in the lower surface of the traveling head by means of a ring 132 disposed about the piston rod and bolted to the traveling head by bolts 133, the outer edge of the ring overlapping the inner edge of the arbor plate. The outer edge of the arbor plate is supported by a plurality of short arcuate shoes 134 bolted to the traveling heads by bolts 135, which overlap the outer edge of the arbor plate.

The arbor plate is adapted to be revolved or indexed by repeated successive operations through the exact angular distance to successively align the arbors with the arcuately successive die tubes and dies contained therein. This is accomplished for each operation by an indexing mechanism which will now be described. A bell crank lever 136, Fig. 2, is pivoted at 137, to the traveling head by a suitable bracket 138. A horizontal arm of the bell crank has a roller 139 mounted in a yoke on the end of the arm by

a pin 140. An upwardly extending crank arm has a ball 141 at the end thereof embraced in a socket 142 at one end of a connecting rod 142'. The other end of the connecting rod is attached by a ball and socket joint 143 to an arm 147 of a ratchet reverse plate 144, which is rotatable upon an upwardly extending central boss on the traveling head Fig. 12 and held thereon by a ring shaped plate 145 overlapping the plate 144 and bolted to the traveling head by bolts 146. The ratchet reverse plate comprises two arms extending radially therefrom at an angle to each other, the one, the arm 147 referred to connected to the connecting rod and the other an arm 148 provided with a ratchet pawl 153 at its end.

The ratchet pawl is mounted on the lower end of a vertical rod pivotally journaled in the end of the arm 148 and having upon its upper end an arm 149 (Fig. 3). A helical spring 150 is attached at one end to the end of the arm 149 and at the other end by an adjusting screw 152, threaded in a lug 151 integral with the arm 148. The free end 109 of the pawl 153 is held in spring pressed engagement with the periphery of the revolving ratchet plate by the spring 150 and arm 149, as described.

Attached to the traveling head by bolts 112, Fig. 12, is a bracket 111. The lower part of the bracket comprises a housing 114 strengthened and supported by a web 113 and having therein a radial bore 115, in which is disposed a ratchet stop pin 116, held spring pressed by a spring 117 into one or another of the notches 108 in the revolving ratchet plate. A generally vertical ratchet stop lever 118 is pivoted to the upper part of the bracket 111 and has a slanted operating face 119 at its upper end, and below the pivot has a lower reduced end 120 which projects into a notch 121 in the ratchet stop pin.

The ratchet stop pin provides a means of holding the revolvable arbor plate in fixed indexed positions, while a tube is being operated upon in a manner to be described, and is operated to release it by a ratchet stop trip mechanism, Figs. 2 and 13. The trip mechanism comprises a bracket 122 Figs. 2 and 13 bolted to the top bolt ring 46 by bolts 122'. Affixed to the bracket 122 and the top bolt ring by bolts 123 is a depending bracket 124 which may be raised and lowered relative to the ring 46 by loosening the bolts 123 and screwing an adjusting screw 125, threaded into the bracket 122, the bolts 123 passing through elongated slots 126. The bracket 122 has a downwardly open fork 127 in which is pivotally supported a ratchet stop trip lever 128 having an inclined face 165. The pivot is relatively near the face 165 thus leaving a relatively larger portion extending on the opposite side of the pivot adapted to act as a weight to keep the plate in a normally horizontal position. Pivotal movement of the trip lever 128 is limited by a wall 129 which extends into the fork 127 and slants upwardly as shown at 130, Fig. 13. The upper portion of the bracket is provided with an opening 131, into which the lever 118 above described may pass in operation as will be described.

In describing the operation of the mechanism thus for described, it is assumed that the traveling head 47 is at the end of its upward position of travel. Suitable stops are provided to limit the upward movement comprising the lower ends 156 of rods 155 threaded through vertical apertures in the top bolt ring 46, Fig. 2, and engaging the upper surface portions of the traveling head. Similar upwardly projecting bolts 158, one of which is shown in Fig. 1 and supported on the ring 3, limit the downward movement of the head.

A cylindrical tube to be operated upon is telescoped upon the mandrel 85 so that the upper end of the tube projects around the mandrel and between the jaws 83 of the arbor. The jaws are clamped securely upon the tube by turning the operating handle 76 of the wrench which is disposed upon the arbor and which rotates the sleeve 73. The elliptical surface 77 of the sleeve engages the ends of the screws 81, exerting a camming action upon the same, forcing the upper lever ends 79 outwardly, which being pivoted at 71, forces the short gripping arms 72 with the jaws 83 into contact with the upper end of the tube. The arbor jaws are adjustable, by means of lock nut 82 and the screw 81, to eliminate any surplus movement.

Fluid under pressure, such as oil, is introduced into the chamber 59 and travels by way of the conduit 60 into the upper portion of the cylinder at 61, contacting with the upper face of the piston 48, and forces the piston and rod with the traveling head attached thereto downward, the traveling head being guided upon the guide bolts 45. The end of the tube enters the funnel bushing 33, wherein oil flows from the oil line 157, passes through the funnel bushing 31 and through the plug 20 and is forced into and through the first die 7 disposed within the first die bushing 6. The restricted portion 38 of the die engages the tube and reduces it as it passes through the die.

During the first operation, the machine has but one tube held by one of the arbors and the first operation reduces the tube throughout the greater portion of its length, this distance being determined by suitably stopping the head upon the bolts 158.

The tube, passing through the die, and being reduced in diameter and increased in wall thickness in that portion which passes through the die, is guided by the die bushings 5 below the die and in the lower portion of the die tube to prevent any undue warping of the reduced cylindrical tube.

As the traveling head approaches the bed ring 3, the crank arm 136 is rocked clockwise, Fig. 2, and revolves the ratchet reverse plate 144 counterclockwise, Fig. 3. This is effected by the roller 139 engaging a plate 166, Figs. 4 and 18, attached to the bed ring by bolts 167, its height relative to the bed ring being adjustable by elongated slots 168 therein through which the bolts 167 are projected.

The fluid under pressure is then diverted from the chamber 59, which connects with the upper portion of the cylinder, into the chamber 58, which connects with the lower cylinder below the piston. As before stated, this may be controlled manually or automatically. The pressure of the oil upon the lower portion of the piston forces the piston and rod upwardly and head, withdrawing the work tube from the die and bushings. By the time the tube has been completely withdrawn from the die tube and is free of the bed ring and appurtenances, the roller 139 on the bell crank arm 136 contacts with the reverse bar 154 and further movement of the head will rock the bell crank and step up the ratchet reverse plate 144.

The reverse bar is secured to the top bolt head 46 by a suitable clamping bracket 159, and comprises a downwardly extending bar of substantially rectangular cross section having at its lower

end an outwardly extending flange 160 provided with a pair of adjusting screws 161. A shoe 162 is clamped to the lower part of the bar by bolts 163 extending through transverse slots 164 therein to allow the same to be adjusted upon the bar by means of the screws 161.

Just prior to the stepping up of the ratchet reverse plate 144 as described, the ratchet plate 107 which has been locked against revolving movement by the stop pin 106 in a notch 108 is released by the lever face 119 of the lever 118 contacting with the face 165 of the lever 128 which rocks the lever 118 and slides the pin 116 outward against the pressure of the spring 117, removing the pin from locking engagement with the notches 108 of the revolving ratchet plate.

The bell crank now steps up the ratchet reverse plate 144 as described. This imparts movement to the ratchet reverse arm 144, Fig. 3, by means of ball connecting rod 142' and rotates the ratchet reverse arm in a clockwise direction. The pawl 153 engages the stop 109 and rotates the revolving ratchet plate in a clockwise direction. The pawl 153 is held in contact with the periphery of the revolving ratchet plate by the spring 150 which is attached to the upper lever 149 and the lug 151. The adjustment of the shoe 162 determines the throw of the bell crank and hence the distance which the revolving ratchet plate moves. The revolving ratchet plate 107 carries with it the revolving arbor plate 102 by reason of the keys and keyways before described. The movement, as before described, is just sufficient to align the tube which is being drawn with the next succeeding die tube.

When the above described movement has been completed, the traveling head is at the upper limit of its movement. Another tube is now placed upon the next succeeding mandrel, which has moved into the place of the arbor and mandrel preceding it, and is secured thereon in the manner described for the first tube. The fluid pressure is diverted again to the chamber 59, and pressure upon the piston forces the head downwardly. The same operation is again accomplished, excepting that this time the first tube will be operated upon in the second die tube wherein the die is located in a bushing spaced from the top, and the two tubes will be reduced simultaneously, the last tube being reduced in the same manner as the first tube, and the first tube being reduced to a smaller diameter for a shorter portion of its length due to the fact that the die in the second die tube is located further from the top of the tube.

When this operation is completed, and the two tubes withdrawn in a manner similar to the preceding operating, the revolving arbor plate is again indexed as previously described and another tube attached to a third arbor and mandrel and the operation again repeated. During this operation, the first tube will be reduced by a die in the third die tube spaced still further from the top of the tube, such die and tube being shown in Fig. 7. The step by step operation is continued until the machine has thereon 18 tubes and upon the eighteenth operation, the tube first operated upon enters the die tube having a die in the lowermost portion of the tube, and reduces the lower end of the tube and forms the last step thereon formed. The tube is then removed from the mandrel and arbor and a new tube placed thereon, and the operation is continued; as each tube is completed, it is replaced by a new tube to be operated upon, one tube being completed at each reciprocation of the head or cycle of the machine.

The completed product, as best shown in Fig. 11, comprises a tube having a series of progressively reduced cylindrical portions, substantially as shown, and which portions are of progressively greater wall thickness as will be understood from the foregoing description.

As above described, I have provided a reciprocating machine for progressively reforming tubes, which comprises a pair of relatively reciprocable supports herein illustrated at 102, and 1—2—3, which are relatively reciprocable towards and from each other, and have herein provided in spirally disposed formation, on the support 1—2—3, eighteen drawing dies having die openings of successively graduated sizes and have provided for the relatively reciprocable support 102, gripping means herein illustrated as comprising the jaws 84 carried by the mandrel 65, all of which depend from the annular support 102.

The tubes, such as 85, to be reformed, may then be projected into the axially aligned bores of the bushings 5 contained within each of the tubes 25, which support the dies. The supports being relatively reciprocated, all of the tubes to be reformed will simultaneously be projected through the spirally arranged dies, such as that shown at 38, Fig. 7. These dies being held in their supports at different distances from the annular head 102, the different tubes 85 will have different lengths of their lower portions reduced in diameter.

After each reciprocation through the dies, the tubes are withdrawn by a relative recession of the supports 102, and 1—2—3, after which by the mechanism illustrated in Fig. 3, the support 102 is rotated through an arc corresponding to the space between the tubes 25, and the supports are again then reciprocated toward each other and withdrawn.

This process continues in consecutive steps, progressively, until each of the tubes is progressively reduced from its original form, which may be cylindrical, to a form corresponding to that of the tube of Fig. 11, wherein successive lengths of the tube, proceeding from the larger end, are of successively diminished diameters, resulting from successive projections of successively lesser lengths of its lower end through dies disposed successively lower in their respective tubes 25 and having successively smaller die openings.

It follows from the above that the lower end of the tube will be successively reduced in diameter eighteen times, the next adjoining section seventeen times, and so forth until the uppermost reduced section is reached, which will have been processed only a first, single time.

The operator operating the machine will, after each recessional reciprocatory movement of the rotatable tube support 102, withdraw a completely processed tube, such as illustrated in Fig. 11, and supply an entirely unprocessed tube in its place. This will be accomplished while the arbor holds the completely processed tube in a rotative position, which is unoccupied by a bushing and die holding tube 25, and whereby the tube may be easily laterally withdrawn after a releasing operation of the arbor clutch jaws effected by rotation of the camming element 73 by manual manipulation of the handle 76'.

The above process is very well adapted for the reforming of thin-walled steel tubes of a considerable hardness, such as tubes of steel having qualities of temper adapted to give best results

when the completed article is used for golf club shafts, as illustrated.

Although I have described the tube as having eighteen progressively reduced steps, it is to be understood that I may omit some of the die tubes, thus reducing the number of steps, if so desired, or that I may make tubes having a greater number of steps by increasing the number of arbors and die tubes.

The above application is a continuation of application Serial No. 163,050, filed January 24, 1927, for all subject matter common to the two applications.

Having thus described my invention in certain specific embodiments, I am aware that numerous and extensive departures may be made from the embodiment herein illustrated and described, but without departing from the spirit of my invention.

Reference may be had to my co-pending application Serial No. 447,878, filed April 28, 1930, for Method of drawing tubes, which is a division of this application.

I claim :

1. A machine for forming a progressively reduced tubular shaft from a tube, comprising a base, a carriage, a plurality of apertured drawing dies successively disposed in spiral stepped relation on the base, means to relatively reciprocate said carriage and base, means for securing a tube to the carriage with its free end presented towards one of the dies, and means for relatively rotating the carriage and base between relative reciprocatory movements thereof, to successively present the free end of the tube towards openings of successively disposed dies.

2. A machine for forming progressively reduced tubular shafts from steel tubes, comprising a pair of supports relatively reciprocable towards and from each other, a plurality of drawing dies having openings of successively graduated die opening sizes, gripping means adapted to secure a plurality of tubes by an end of each tube onto the other support with the ends of the tubes presented towards the die opening in the first said support, and means for relatively reciprocating the supports to simultaneously project the free ends of all of the said tubes through different die openings and means for varying the lateral positioning of the supports after each such recpirocating operation to advance tubes from alignment with a relatively larger die opening to alignment with a relatively smaller die opening, the different dies and tube gripping means being relatively so spaced that the dies having progressively smaller openings will be spaced progressively more distant from the most advanced position of the gripping means for the tube to be projected therethrough.

3. A machine for forming progressively reduced thin-walled shafts from substantially cylindrical or similar steel tubes, comprising a pair of relatively reciprocable supports, a plurality of drawing dies having die openings of successively graduated diametrical sizes, disposed in spiral relation between the supports and rigidly secured to one of the supports, one of the supports carrying a plurality of mandrels each presented toward a different one of the die openings, each of the mandrels adapted to receive a different tube telescoped over it, and means responsive to a relative reciprocation of the supports to rotatively advance one of the supports relative to the other, to simultaneously project differing lengths of different tubes into the different dies.

4. A machine for reforming tubes, comprising a carriage and a base, a plurality of apertured drawing dies having successively smaller die openings successively disposed in fixed spiral stepped relation on the base, means for securing a tube to the carriage with its free end presented towards one of the dies, a mandrel of progressively reduced diameter secured by its larger end to the carriage, and telescopable within the tube portion adjacent the supporting carriage, means to relatively reciprocate said carriage and base, and means for relatively rotating the carriage and base to successively present the free end of the tube towards openings of successive dies, said dies being relatively so arranged that the dies having the smaller openings are disposed successively more remote from the free end of the presented tube.

5. A machine for forming stepped thin-walled sheet metal tubes, comprising a relatively axially reciprocable base and tube supporting carriage, said carriage superposed over the base, with the free ends of the supported tubes presented thereto, a plurality of die carrying tubes supported on the base, a plurality of dies, means to secure each die in telescoped relation within a different tube, at relatively different points in their lengths, and guiding means disposed coaxially within each die tube, longitudinally of the die thereof, adapted to receive and guide the free end of a sheet metal tube into the opening of its die, and means for laterally relatively moving the base and carriage between relative reciprocatory movements thereof to successively present the free ends of the tubes toward openings of successively disposed dies.

6. In a machine for drawing progressively stepped tubes, the combination of a series of dies having die openings of different diameters, a progressively reduced mandrel telescoped into the tube to be drawn, means for consecutively pushing the mandrel and successively shorter portions of the tube length through dies the successive dies being of successively reduced diameters and spaced relatively laterally and relatively longitudinally of the mandrel, said forcing means adapted to apply a compressive strain to the tube while being acted upon by the dies and mandrel.

7. A machine for forming progressively reduced thin-walled shafts from substantially cylindrical steel tubes, comprising a pair of relatively reciprocable supports, a plurality of drawing dies disposed in spiral relation between the supports and rigidly secured to one of the supports, one of the supports carrying a plurality of mandrels each presented toward a different one of the die openings, each of the mandrels adapted to receive a different tube telescoped over it, and means responsive to a relative reciprocation of the supports to rotatively advance one of the supports relative to the other.

8. A machine for forming a progressively reduced tubular shaft from a tube, comprising a base, a plurality of apertured drawing dies successively disposed in spiral stepped relation on the base, means to relatively reciprocate said carriage and base, a work carriage, means for securing a tube to the carriage with its free end presented towards one of the dies, and means for relatively rotating the carriage and base between relative reciprocation thereof, to successively present the tube free end towards the openings of successive dies.

9. A machine for reforming tubes, comprising a pair of supports, means for securing to one of the supports a plurality of tubes to be reformed, each disposed laterally of the others in parallel

relation, a plurality of drawing dies carried by the other support in relatively lateral parallel relation and progressively differently spaced from the tube securing means, means for relatively reciprocating the supports to cause them to successively approach and recede from each other, means to accomplish a lateral movement of one of the supports following a recessional movement of the reciprocated support, said dies and said tubes being relatively so spaced that upon such lateral movement, the ends of different tubes will be successively presented to different drawing die openings for projection therein upon the following approach movement of the reciprocated support.

10. A machine for forming a generally tapering tubular shaft from a tube, comprising a base, a carriage, a plurality of apertured drawing dies successively disposed in laterally and longitudinally spaced stepped relation on the base, means to relatively reciprocate said carriage and base, means for securing a tube to the carriage with its free end presented towards one of the dies, and means for laterally relatively moving the carriage and base between relative reciprocatory movements thereof, to successively present the free end of the tube towards openings of successfully disposed dies.

11. In a machine for drawing progressively stepped tubes, a plurality of relatively laterally disposed dies, having a plurality of die pass openings of different diameters, means for supporting a plurality of tubes to be drawn, a plurality of like progressively reduced mandrels one telescopable into each tube to support the walls thereof, means for repeatedly and simultaneously forcing all of the tubes through corresponding die pass openings, and consecutive tubes successively over shorter portions of the tube lengths and through die pass openings of successively smaller diameters.

12. The machine substantially as claimed in claim 9, characterized by the successive dies having die openings of successively reduced diameters.

13. A machine for forming a progressively reduced tubular shaft from a tube comprising a base, a plurality of apertured drawing dies successively disposed in spiral stepped relation on the base, a work carriage, means to relatively reciprocate said carriage and base, means for securing a tube to the carriage with its free end presented towards one of the dies, and means for relatively rotating the carriage and base between relative reciprocations thereof to successively present the tube free end toward the openings of successive dies.

14. In a machine for drawing proprogressively stepped tubes, a plurality of relatively laterally disposed dies having die pass openings of different diameters, means for supporting a plurality of tubes to be drawn, operable means for repeatedly effecting relative reciprocatory movement between the plurality of tubes and the plurality of dies to repeatedly effect simultaneous drawing operations on all of the tubes by corresponding die pass openings, means for successively disposing each tube relative to die pass openings of successively smaller and smaller diameter, and means for effecting shorter and shorter relatively reciprocatory movement between each tube and the successive die pass opening.

15. In a machine for drawing progressively stepped tubes, a plurality of relatively laterally disposed dies having die pass openings of different diameters, means for supporting a tube to be drawn, operable means for repeatedly effecting relative reciprocatory movement between the tube and the plurality of dies to repeatedly effect a drawing operation on the tube by successive die pass openings, means for successively disposing the tube relative to die pass openings of successively smaller and smaller diameter, and means for effecting shorter and shorter relative reciprocatory movements between the tube and the successive die pass openings.

16. In a machine for drawing progressively stepped tubes, means for supporting a plurality of tubes to be drawn, a plurality of dies having die pass openings of different diameters, a support for said dies, means to relatively reciprocate the tube and die supports to effect a drawing operation on the tubes by the dies, means to move the tube and die supports relative to each other between reciprocations whereby the tubes are brought into position to be operated on by successive dies, the dies being mounted on the support spaced from the tube support, the die having the largest opening being disposed relatively adjacent the tube support, the dies being arranged in a series, each successive die in said series having an opening of smaller diameter than the preceding die in said series and being positioned more distant from the tube support than said preceding die, whereby each tube is progressively operated on by dies of successively smaller diameter and whereby progressively shorter portions of the tube are operated on by successive dies in said series, and whereby separate drawing operations may be performed simultaneously on each of a plurality of tubes.

17. In a machine for drawing progressively stepped tubes, means for supporting a plurality of tubes to be drawn, a plurality of dies having dies pass openings of different diameters, a support for said dies, means to relatively reciprocate the tube and die supports to effect a drawing operation on the tubes by the dies, means to move the tube and dies supports relative to each other between reciprocations whereby the tubes are brought into position to be operated on by successive dies, the dies being mounted on the support spaced from the tube support, the die having the largest opening being disposed relatively adjacent the tube support, the dies being arranged in a series, each successive die in said series having an opening of smaller diameter than the preceding die in said series and being positioned more distant from the tube support than said preceding die, whereby each tube is progressively operated on by dies of successively smaller diameter and whereby progressively shorter portions of the tube are operated on by successive dies in said series.

18. In a machine for drawing progressively stepped tubes, means for supporting a plurality of tubes to be drawn, a plurality of dies having die pass openings of different diameters, a support for said dies, means to relatively reciprocate the tube and die supports to effect a drawing operation on the tubes by the dies, means to rotate said tube and die supports relative to each other between reciprocations, whereby the tubes are brought into position to be operated on by successive dies, the dies being mounted on the support in spiral formation, the die having the largest opening being disposed relatively adjacent the tube support, the dies being arranged in series each successive die in said series having an

opening of smaller diameter than the preceding die in said series, and being positioned more distant from the tube support than said preceding die, whereby each tube is progressively operated on by dies of successively smaller diameter, and whereby progressively shorter portions of the tube are operated on by successive dies in said series.

19. In a machine for drawing progressively stepped tubes, a plurality of relatively laterally disposed dies having die pass openings of different diameters, means for supporting a plurality of tubes to be drawn, means for repeatedly and simultaneously effecting a drawing operation on a plurality of tubes by corresponding die pass openings, each of the tubes being successively operated on by dies of progressively smaller diameter and progressively shorter lengths of said tubes being operated on by successive dies, at least of some of said dies being disposed in a corresponding plurality of tubular guides for the tubes being drawn, each die being disposed coaxially of a guide, and annular guiding elements telescoped within each tubular guide and disposed longitudinally at either side of the die.

20. In a machine for drawing progressively stepped tubes, a plurality of relatively laterally disposed dies having die pass openings of different diameters, means for supporting a plurality of tubes to be drawn, means for repeatedly and simultaneously effecting a drawing operation on a plurality of tubes by corresponding die pass openings, each of the tubes being successively operated on by dies of progressively smaller diameter and progressively shorter lengths of said tubes being operated on by successive dies, the dies being disposed coaxially of tubular guides, each of the tubular guides being provided with a window in the tube wall thereof through which the die may be inserted into the guide or removed therefrom, the die being supported longitudinally in the tubular guide by tube guiding elements on each side longitudinally of the die, and means to normally prevent displacement of the die outwardly through the window.

ROBERT H. COWDERY.

CERTIFICATE OF CORRECTION.

Patent No. 1,963,047. **June 12, 1934.**

ROBERT H. COWDERY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 17, for "succesively" read successively; page 4, line 70, for "for" read far; page 5, line 71, strike out the word "formed" and insert the same after "The" in same line; page 6, line 135, beginning with the claim number and words "8. A machine" strike out all to and including "dies." in line 146, comprising claim 8; and for the claim numbers "9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20" read 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of September, A. D. 1934.

Leslie Frazer

(Seal) Acting Commissioner of Patents.

opening of smaller diameter than the preceding die in said series, and being positioned more distant from the tube support than said preceding die, whereby each tube is progressively operated on by dies of successively smaller diameter, and whereby progressively shorter portions of the tube are operated on by successive dies in said series.

19. In a machine for drawing progressively stepped tubes, a plurality of relatively laterally disposed dies having die pass openings of different diameters, means for supporting a plurality of tubes to be drawn, means for repeatedly and simultaneously effecting a drawing operation on a plurality of tubes by corresponding die pass openings, each of the tubes being successively operated on by dies of progressively smaller diameter and progressively shorter lengths of said tubes being operated on by successive dies, at least of some of said dies being disposed in a corresponding plurality of tubular guides for the tubes being drawn, each die being disposed coaxially of a guide, and annular guiding elements telescoped within each tubular guide and disposed longitudinally at either side of the die.

20. In a machine for drawing progressively stepped tubes, a plurality of relatively laterally disposed dies having die pass openings of different diameters, means for supporting a plurality of tubes to be drawn, means for repeatedly and simultaneously effecting a drawing operation on a plurality of tubes by corresponding die pass openings, each of the tubes being successively operated on by dies of progressively smaller diameter and progressively shorter lengths of said tubes being operated on by successive dies, the dies being disposed coaxially of tubular guides, each of the tubular guides being provided with a window in the tube wall thereof through which the die may be inserted into the guide or removed therefrom, the die being supported longitudinally in the tubular guide by tube guiding elements on each side longitudinally of the die, and means to normally prevent displacement of the die outwardly through the window.

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