Nov. 27, 1934. F. SINGER 1,982,544

METHOD AND APPARATUS FOR ELONGATING METAL ARTICLES

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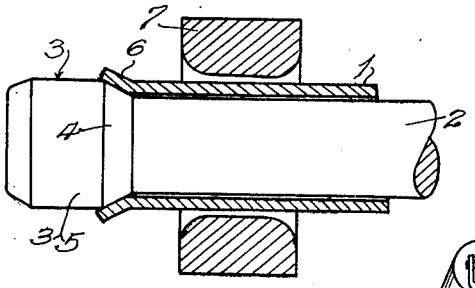


Fig. 1.

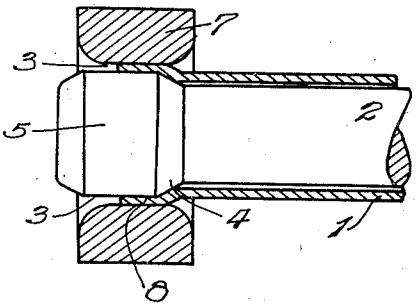


Fig. 2.

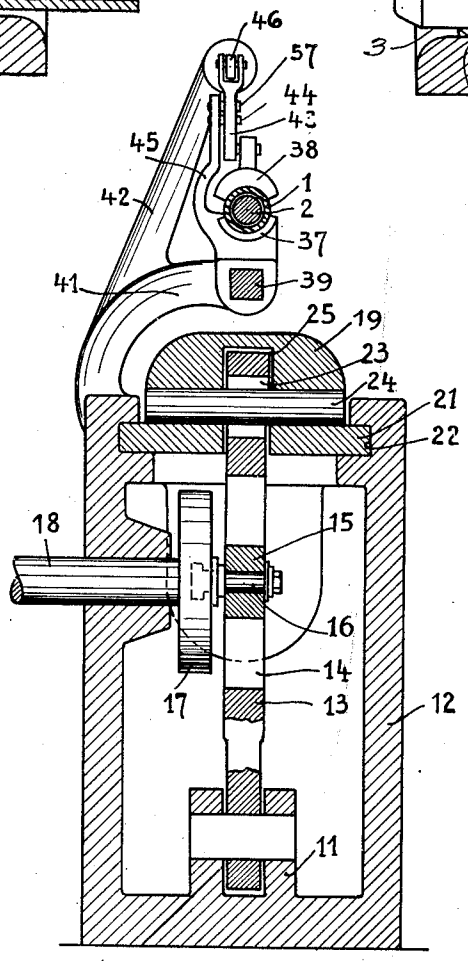
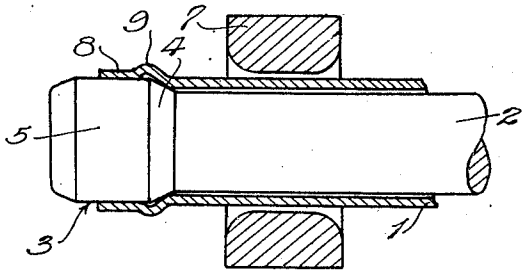


Fig. 5.

Fig. 3.



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METHOD AND APPARATUS FOR ELONGATING METAL ARTICLES

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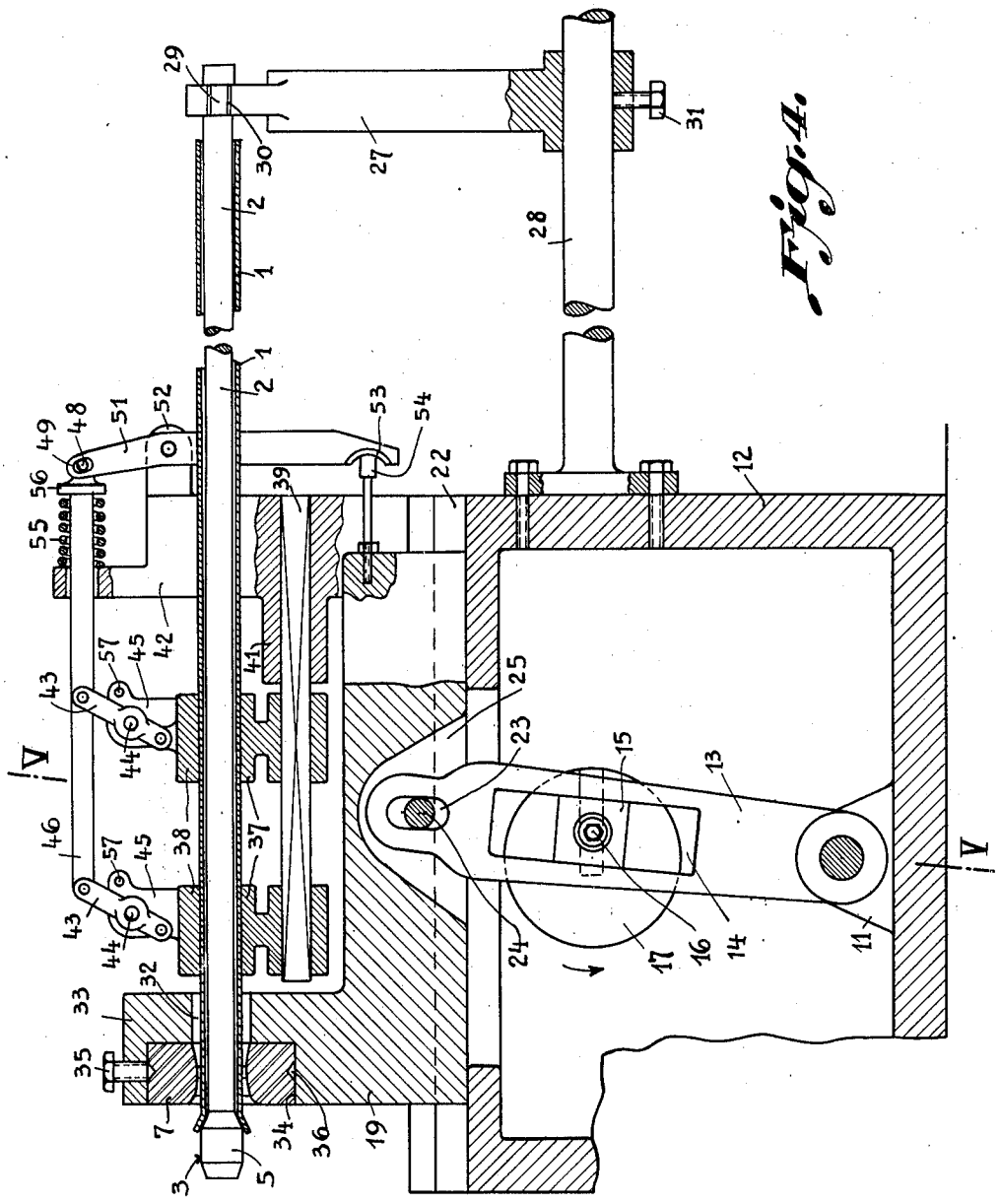


Fig. 4.

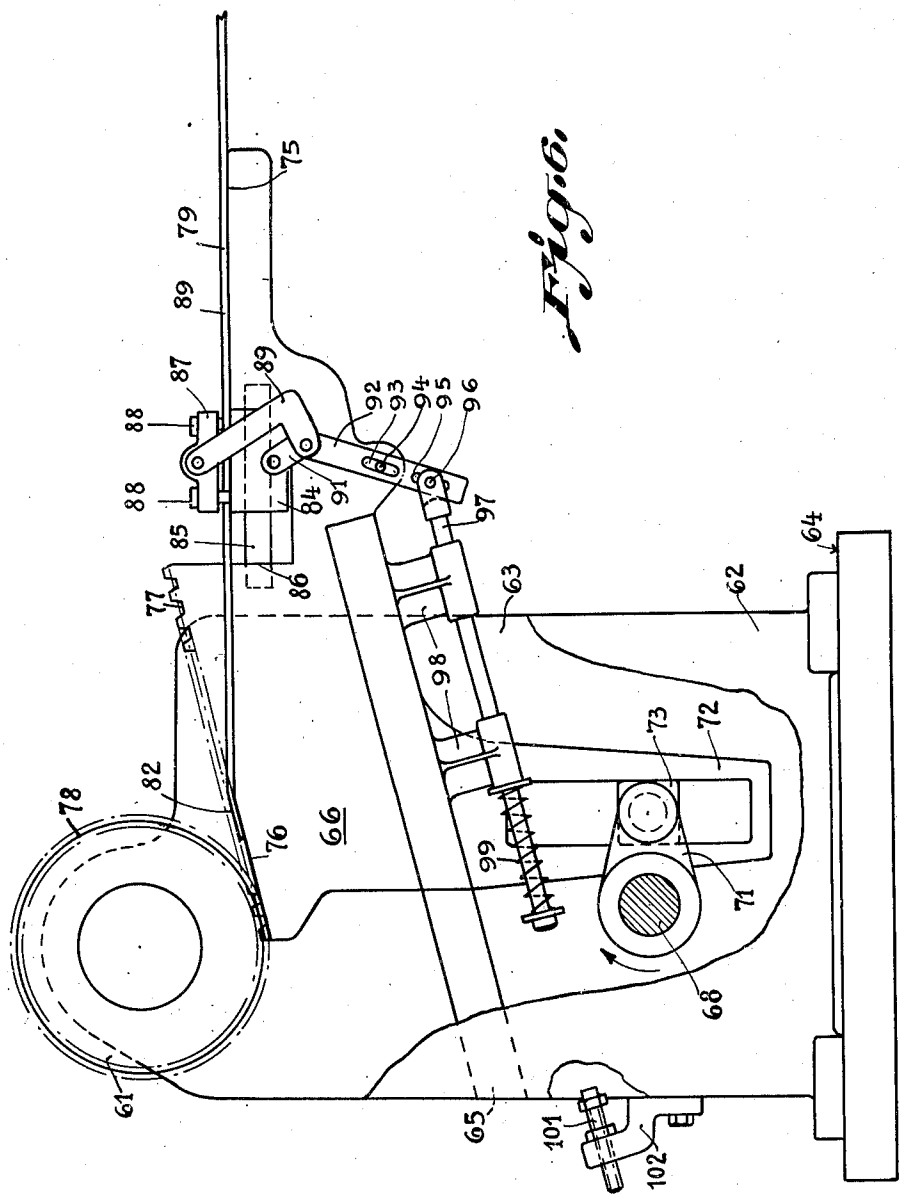
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METHOD AND APPARATUS FOR ELONGATING METAL ARTICLES

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Fig. 6.



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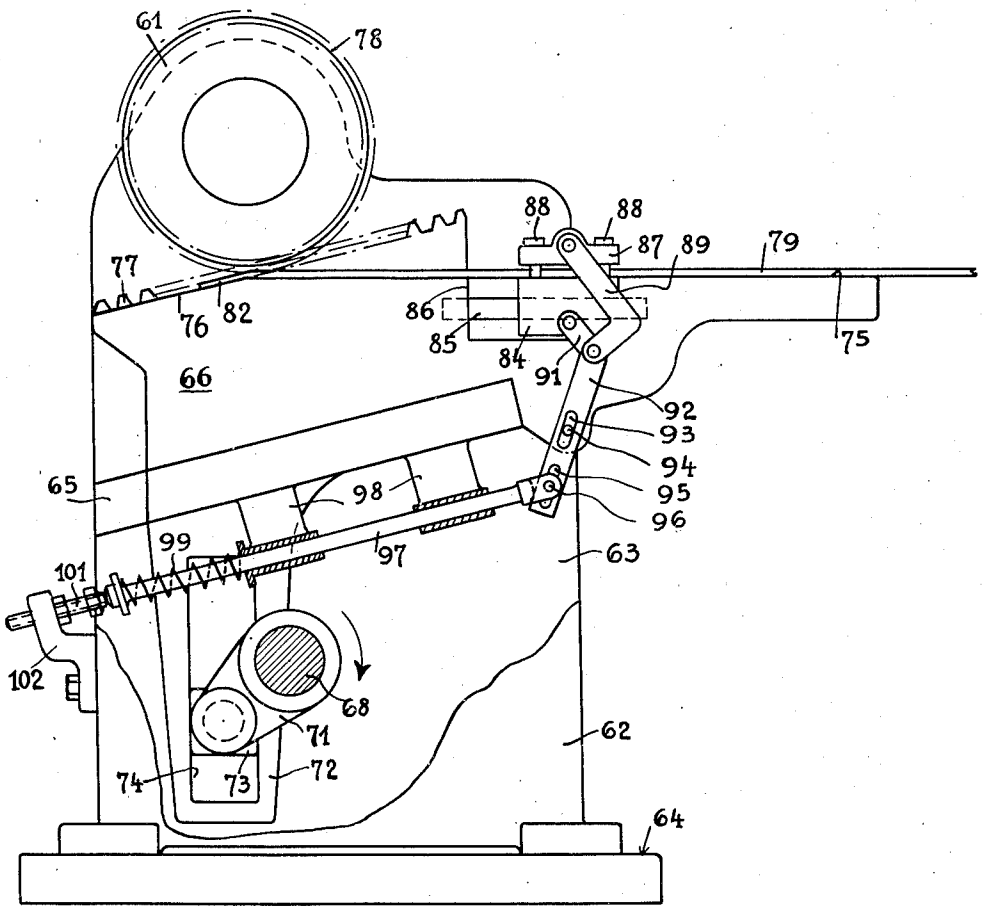
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Fig. 7.



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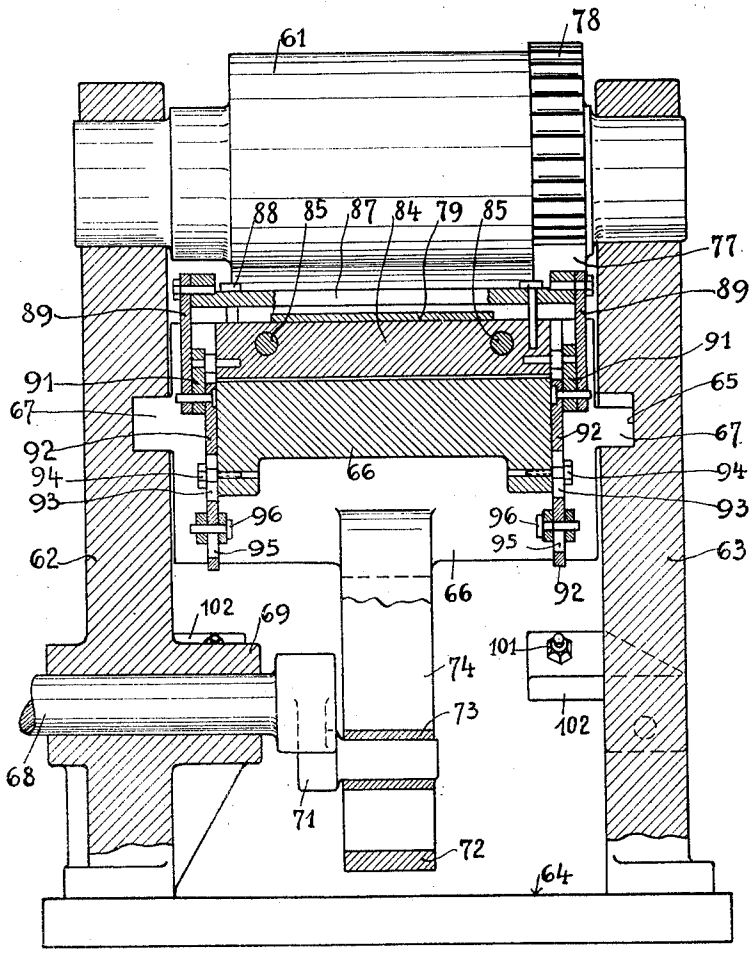
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Fig. 8.



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UNITED STATES PATENT OFFICE

1,982,544

METHOD AND APPARATUS FOR ELONGATING METAL ARTICLES

Fritz Singer, Nuremberg, Germany, assignor to Tubus A. G., Zurich, Switzerland

Application October 13, 1932, Serial No. 637,611
In Germany August 22, 1931

14 Claims. (Cl. 205—8)

The invention relates to a method and apparatus for elongating solid and tubular metal articles.

It is among the objects of this invention to provide a method, and apparatus for applying it, for rapidly elongating solid or tubular metal articles by a simple operation; which is capable of producing in one operation a greater reduction in thickness of the metal of the article than heretofore possible; which does not subject the entire article to strains of deformation at one time; which results in the grain structure of the elongated metal being fine and uniform; and which is applicable to articles in a cold state as well as while hot.

The invention is illustrated in the accompanying drawings, of which Figs. 1, 2 and 3 are enlarged longitudinal sectional views illustrating the steps of elongating a tubular article according to the method of this invention; Fig. 4 is a vertical longitudinal sectional view, partly in elevation, of the preferred embodiment of apparatus employed to elongate tubes by this method and shown after the first step of the operation; Fig. 5 a vertical transverse section of the apparatus taken on the line V—V of Fig. 4; Fig. 6 a side view of apparatus, with the near wall broken away, for elongating solid metal articles and shown after the second step; Fig. 7 a vertical longitudinal sectional view, partly in elevation, of the apparatus and article during the third step; and Fig. 8 an end view of the apparatus, partly in vertical section.

In accordance with the invention, an end portion of an article to be elongated is lengthened by stretching it in a direction away from the unstretched portion of the article. Following this, the next succeeding portion of the article is similarly stretched. This operation is repeated until all, or as much as is desired, of the article is elongated.

Referring to the illustrations of Figs. 1, 2 and 3, wherein a tube is shown in the process of elongation, a tube 1 is slidably supported on a rod 2 which is provided at its forward end with a cylindrical mandrel 3 having a diameter greater than the inside diameter of the tube. A tapered or conical end 4 of the mandrel joins its cylindrical surface 5 and the cylindrical surface of the rod.

In the first step of the elongating operation (Fig. 1) the tube is advanced along its supporting rod until a short length portion of the forward end of the tube has been forced upon the tapered end 4 of the mandrel to deflect the metal of that portion away from the axis of the tube, thereby forming a bell 6 on the end of the tube extending outward beyond the cylindrical surface 5 of the mandrel. If desired, the tube may be held stationary and the mandrel forced into the end of it to obtain the same result.

In the second step (Fig. 2), a drawing ring 7, which previously had surrounded the tube and rod, is advanced axially of the tube and, in passing over the mandrel, it encounters the enlarged portion of the tube extending beyond the cylindrical surface thereof. As the clearance space between the interior of the ring and the cylindrical surface of the mandrel must always be less than the thickness of the tube wall if the tube is to be elongated, it follows that the enlarged portion of the tube engaged by the ring is forced or drawn forward by the ring in a direction away from the remainder of the tube and squeezed between the ring and mandrel. This results in the wall of the squeezed portion being reduced in thickness and stretched forward, the reduced or stretched portion 8 thereby being elongated.

At the conclusion of the elongation of this portion 8 of the tube, the drawing ring is retracted to its original position and the tube is moved forward again to enlarge the next succeeding portion 9 on the end of the mandrel (Fig. 3), the reduction and stretching by the drawing ring then being repeated. These steps are repeated without interruption until the desired portion or all of the tube has been elongated. Of course, it is not necessary that the drawing ring be movable, for it may be stationary and the other members be reciprocated through it.

In carrying out the above-described method of elongating tubes, the outer diameter of an elongated tube may be greater than it was before elongation, or it may be the same, depending on the wishes of the operator. If the outer diameter is to remain the same, the drawing ring must fit snugly around the unstretched portion of the tube so that when it is passed over the mandrel it will press the belled-out portion of the tube radially inward until its outer diameter is no greater than that of the remainder of the tube. However, it is apparent that, as usual, the mandrel must be larger than the interior of the unstretched portion of the tube in order to enable the enlarged portion of the tube to be pressed between it and the drawing ring for reducing that portion and drawing it out. If the outer diameter of the tube is to be increased, the interior of the drawing ring will be larger than the tube to prevent the ring from pressing the enlarged

portion of the tube back to its original outer diameter.

The steps in elongating solid articles, such as plates, bands, bars and the like, which are very similar to the steps in elongating a tubular article, will be set forth in describing the elongating apparatus.

Referring to the tube elongating apparatus shown in Figs. 4 and 5, in a bearing 11 of a frame 12 there is pivoted the lower end of an upright swinging lever 13 provided with a centrally located lonigtudinal slot 14 in which a block 15 is slidably disposed. A crank pin 16 is journaled in the slide block and connected at one end to a flywheel 17 off center thereof, the flywheel being mounted on the end of a main drive shaft 18 journaled in one wall of frame 12.

As the flywheel rotates it causes the crank pin to describe a circle and thereby swing the lever 13 on its lower pivot, the slide block reciprocating in slot 14. A carriage 19, having side flanges 21 slidably mounted in guide-grooves 22 in the upper portion of the frame, is reciprocated longitudinally of the guide-grooves by means of the free end of lever 13 that is provided with a short longitudinal slot 23 through which projects a pin 24 extending across a vertical recess 25 in the bottom of the carriage.

The tube-suporting rod 2 is supported at its rear end by a rod carrier 27 rotatively and slidably mounted on a guiding rod 28 projecting rearward from the back of the frame to which it is connected. To permit the end of the supporting rod to be cleared in order to receive a tube 1, it is provided with a reduced flattened portion 29 with which registers a recess 30 in one side of the upper end of the rod carrier. The rod carrier may thus be swung away from the rod to clear its end, or be locked in upright rod-carrying position by set screw 31 engaging the guiding rod. The forward end of the tube-supporting rod projects through an opening 32 in the front upright portion 33 of the carriage which is also provided with a recess 34 in which drawing ring 7 is secured by a set screw 35 engaging it in an annular groove 36.

To deflect or enlarge successive portions of the tube on the tapered end of mandrel 3, the tube is periodically advanced on the supporting rod by means of a mechanism comprising lower clamping jaws 37 and upper jaws 38. The forward portion of the tube-enclosed rod 2 is supported by the lower jaws which are slidably mounted on a square rod 39 disposed axially of the tube and connected at its rear end to a lateral projection 41 of an upright arm 42 rising from the rear of the frame.

The upper jaws 38 are pivotally carried above the lower jaws by levers 43 pivoted on horizontal pins 44 connected to lever carriers 45 which extend upward from the lower jaws at one side thereof. The levers are spaced apart and turned on their pivots by a push rod 46 pivotally connected to their upper ends and slidable longitudinally in an opening through the uppermost portion of arm 42.

The rear end of the push rod is provided with a pin 48 projecting through a vertical slot 49 in the upper end of a push lever 51. The latter is pivoted to a rear extension 52 of arm 42, and the front face of its lower end is provided with an arcuate recess 53 engageable by a headed abutting screw 54 projecting horizontally from the rear of the carriage 19. A coil spring 55 encircles the push rod 46 between arm 42 and an integral enlarged portion 56 at the rear end of the rod, the spring serving to constantly urge the rod rearward and its movement being limited by lever-engaging stops 57 on the lever carriers, and by the lateral projection 41 of arm 42 against which rear lower jaw 37 strikes.

The operation of the apparatus is as follows: Tube 1 is slipped on supporting rod 2 by swinging the rod carrier 27 out of engagement therewith to clear its rear end. The rod carrier is again connected to the supporting rod to prevent it from moving longitudinally during the elongating process, and is held in position by set screw 31. The tube is then moved forward until it engages the tapered end of the mandrel, whereupon drive shaft 18 is rotated which sets the apparatus in motion.

During the back stroke of the reciprocating carriage abutting screw 54 engages the lower end of push lever 51 and pushes it back. The upper end of the lever is thereby swung forward, pushing the push rod 46 forward against the compression of the coil spring and causing upper jaws 38 to clamp down on the tube. As the carriage slides further back, the push rod continues to move forward, and, therefore, pushes all of the clamping jaws and the tube gripped by them forward with it, whereby the front end of the tube is forced upon the tapered end of the mandrel and belled out to form the conical portion 6 (Fig. 4).

At this time the carriage begins its forward stroke. The abutting screw 54 moves away from the lower end of the push lever, thereby enabling the coil spring to move the push rod back to its normal position. When the upper ends of levers 43 are pulled back by the push rod, jaws 38 are lifted off the tube and all of the clamping jaws are then moved back on square rod 39 to their initial positions. During this forward stroke of the carriage the drawing ring 7 is forced over the enlarged portion of the tube which is thereby pressed against the cylindrical surface of the mandrel and elongated as described in referring to Figs. 1, 2 and 3.

These same working steps are repeated in uninterrupted sequence until the entire tube has been elongated. Before the unstretched end of the tube has passed the clamping jaws, a new tube is slipped on rod 2 which enables the rear end of the first tube to be advanced and elongated after it has passed the clamping jaws.

An apparatus especially suited to elongating solid articles is shown in Figs. 6 to 8. As in lengthening a tube, the article to be elongated may be periodically moved forward on its support or the support may be moved backward under the article, and the elongating tool may be moved across the article or the article be moved across the tool. Also, the elongating tool may be of any suitable form, such as a drawing block or a rotatably mounted roll.

The preferred type of tool for elongating solid articles is a roll 61 journaled in the top of vertical side walls 62 and 63 of a frame 64. Below the roll the inner faces of the walls are provided with parallel guide-grooves 65 inclined upward toward the rear of the frame. A carriage 66 is slidably supported between the walls of the frame by laterally projecting inclined guide-ribs 67 disposed in the guide-grooves 65. The carriage is reciprocated in the guide-grooves by means of a main drive shaft 68 journaled in a bearing 69 in the lower portion of wall 62, the shaft having at its free end a crank 71 which is connected to

a depending leg 72 of the carriage by means of a slide block 73 disposed in a vertical slot 74 in the leg.

The carriage is provided with a substantially horizontal work-supporting surface 75 whose forward end meets at an oblique angle an elongating surface 76 lying in the plane of movement of the carriage. Connected to one side of the elongating surface is a rack 77 which registers with a toothed wheel 78 splined on the shaft of roll 61. Thus, when the carriage is reciprocated, the roll is rotated by the rack.

While the carriage is at rest in its forward and lower position, a solid article about to be elongated, such as a sheet 79, is fed onto the work-supporting surface 75 in any suitable manner until its forward end 81 extends a short distance beyond the front of that surface and above the elongating surface. Drive shaft 68 and crank 71 are then set in motion which causes the carriage to be moved up the inclined guide-grooves, the horizontal end portion 81 of the sheet being bent downward and against the elongating surface by the roll which is revolved counter-clockwise by rack 77. As the clearance space between the elongating surface and the roll is less than the thickness of the sheet, the end portion of the sheet is rolled out on the elongating surface like dough on a board. In being reduced in thickness, this portion is lengthened in the direction of the forward end of the sheet, forming elongated portion 82 (Fig. 6). By this time the carriage has completed its back stroke and starts to return to the front of the frame again, preparatory to repeating the cycle of movement (Fig. 7).

Before the carriage again moves up the grooves, it is necessary to advance the sheet 79 longitudinally over the supporting surface 75 to project the next succeeding portion of the sheet above the elongating surface 76 in order that that portion may be elongated in the same manner as portion 81. This is accomplished by means of a mechanism comprising a clamping block 84 slidably mounted on guide-rods 85 mounted parallel to and longitudinally of the supporting surface in a recess 86 formed in the upper portion of the carriage.

A clamping jaw 87 is vertically movable on diagonally arranged vertical guide-screws 88 screwed into the clamping block. The heads of these screws are far enough removed from the clamping block to provide sufficient clearance between it and the jaw to allow the sheet to be freely movable between them. A bell crank 89 is pivoted at its upper end to each side of jaw 87, and is pivoted at its lower end to the lower end of a short lever 91 which in turn is pivoted at its upper end to the side of block 84.

At the junction of each bell crank 89 and short lever 91, there is also pivoted the upper end of a long lever 92 provided with a central longitudinal slot 93 engaging a pin 94 projecting laterally from the rear of the carriage. The lower end of this long lever is also provided with a longitudinal slot 95 through which extends a pin 96 projecting across the forked upper end of a push-rod 97. Each push-rod is slidably mounted parallel to the guide-ribs 67 in brackets 98 depending from the sides of the carriage.

A coil spring 99 encircles the push-rod between its enlarged lower end and the lower bracket to urge the rod toward the front of the carriage, and, thereby, through levers 92 and 91 and bell crank 89, retain clamping jaw 87 in its upper position against the heads of guide-screws 88 (Figs. 6 and 7). The front or lower end of each push-rod is adapted to strike against a longitudinally adjustable abutting screw 101 mounted in a bracket 102 connected to the front of each frame wall.

After a portion of the sheet 79 has been elongated, and during the forward return stroke of the carriage, the front ends of the push-rods engage the abutting screws (Fig. 7), whereby the former are forced back against the compression of the coil springs as the carriage continues to move forward. This movement swings long levers 92 on pivot pins 94 and draws the clamping jaw down onto the sheet disposed between it and the clamping block.

The continued forward movement of the carriage causes the push-rods to swing the upper ends of the long levers further forward, thereby sliding the clamping block and its connected jaw forward on the guide rods 85. This movement carries the gripped sheet 79 a step forward to bring the next portion thereof into the path of the elongating roll.

As soon as the carriage starts its backward elongating stroke the push-rods are released and forced forward by the coil springs, and the clamping jaw is raised and drawn backward with the clamping block on the guide-rods ready for a new grip on the sheet. These operations are repeated until the desired portion of sheet has been lengthened.

As the elongating according to this method is performed in a direction away from the unlengthened portion of the article and not, as with known processes, in the opposite direction, such rates of elongating can be obtained even in a cold state as up to now have not been accomplished with other processes.

Furthermore, greater reductions in thickness of the metal can be obtained, and the grain structure is fine and uniform. For instance, by this method a tube of stainless steel of the 18% chromium—8% nickel variety and of 2 mm. wall thickness may be reduced to a tube of 0.5 mm. wall thickness by a single elongating operation, and a plate of brass containing 63 percent copper has been reduced in a single operation from 4 mm. to 0.5–0.4 mm.

The method is especially advantageous in elongating tubes, because, during the stretching, only the belled portion of the tube is subjected to strains of deforation, whereas, with the ordinary drawing processes, the drawn parts of the tube over their total length are subject to tensile strains.

According to the provisions of the patent statutes, I have explained the principle and mode of operation of my invention, and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. The method of elongating a metal article by reducing its wall thickness, comprising deflecting a relatively short portion of the wall of the article itself away from the axis thereof, then reducing and drawing out metal of said portion to lengthen it, and repeating the operation with each succeeding portion of the article, said reducing and drawing out being performed by forcing a drawing tool over said portions being lengthened

in a direction away from the unlengthened portion of the article.

2. The method of elongating metal tubes, comprising enlarging an end portion of a tube, then stretching said enlarged portion over a mandrel axially of the tube to lengthen it, and repeating the operation on successive portions of the tube.

3. The method of elongating metal tubes, comprising enlarging an end portion of a tube by means of a mandrel having a tapered end, then reducing and drawing the metal of the outer portion of said enlarged end over the mandrel axially of the tube to lengthen it, enlarging successive portions of the tube on the tapered end of the mandrel, and repeating the reducing and drawing operation on each successive enlarged portion.

4. The method of elongating metal tubes, comprising forcing a tube upon the tapered end of a mandrel to form a short belled portion, then forcing a drawing ring over the larger portion of the bell to reduce and draw the metal thereof over the mandrel axially of the tube in a direction away from the unbelled portion, periodically forcing succeeding portions of the tube upon the tapered end of the mandrel, and repeating the reducing and drawing operation with each belled portion so formed.

5. The method of elongating metal articles, comprising deflecting a relatively short portion of an article away from the axis thereof and reducing and drawing out metal of said portion to lengthen it, and repeating the operation with each succeeding portion of the article, said reducing and drawing out being performed by forcing said portions being lengthened across a drawing tool in the direction of the unlengthened portion of the article.

6. Apparatus for elongating a metal article comprising a support for said article disposed thereon, means for deflecting an end portion of the wall of the article itself away from the axis thereof and for reducing and drawing out metal of the end portion thus deflected in a direction away from the remainder of the article to lengthen it, and means for periodically advancing the article to permit the lengthening operation to be repeated on each successive foremost unstretched portion thus advanced.

7. Apparatus for elongating metal tubes comprising a support for a tube disposed thereon, means for enlarging an end portion of the tube, means for stretching said enlarged portion in a direction away from the unenlarged portion of the tube, and means for periodically effecting relative movement between said enlarging means and the tube to enlarge succeeding portions of the tube for like stretching.

8. Apparatus for elongating metal tubes comprising a support for a tube disposed thereon, means for enlarging an end portion of the tube, reciprocating means for reducing and drawing out metal of said enlarged portion in a direction away from the unenlarged portion of the tube, and means for periodically advancing said tube on said support to permit succeeding portions of the tube to be enlarged and lengthened.

9. Apparatus for elongating metal tubes comprising a support for a tube disposed thereon, a mandrel mounted on said support and having a tapered end adjacent an end of said tube, reciprocating advancing means for forcing the end portion of the tube onto the mandrel to enlarge it, and a reciprocating drawing ring surrounding said tube and being adapted to reduce and draw out metal of said enlarged end portion over said mandrel, said reciprocating advancing means being adapted to force a succeeding portion of the tube onto the mandrel at each forward stroke, whereupon said succeeding portion is likewise drawn out by said reciprocating drawing ring.

10. Apparatus for elongating solid metal articles comprising a support having a supporting surface for an article disposed thereon and an elongating surface inclined to the supporting surface, means for reducing and drawing out an end portion of the article against said elongating surface in a direction away from the remainder of the article, and means for periodically effecting relative movement between said support and said article to expose succeeding portions of the article to said reducing and drawing out means for successive lengthening.

11. The method of elongating a metal article by reducing its wall thickness, comprising deflecting a short portion of the wall of the article itself so that the deflected portion is at a greater distance from the axis of the article than before, then reducing and drawing out metal of the portion thus deflected in a direction away from the remainder of the article to lengthen it, and repeating the operation with each succeeding portion of the article.

12. The method of elongating a metal article by reducing its wall thickness, comprising deflecting a short portion of the wall of the article itself so that the deflected portion is at a greater distance from the axis of the article than before, then reducing and drawing out metal of the portion thus deflected in a direction away from the remainder of the article to lengthen it, advancing the article in short steps, and repeating the lengthening operation in the same direction at each step.

13. Apparatus for elongating metal tubes comprising a support for a tube disposed thereon, means for enlarging an end portion of the tube, reciprocating means for reducing and drawing out metal of said enlarged portion in a direction away from the unenlarged portion of the tube, and means for periodically advancing said tube on said support to permit succeeding portions of the tube to be enlarged and lengthened, said advancing means being driven and controlled by said reciprocating means.

14. A method of elongating a solid plate-like article by reducing its thickness, comprising deflecting a short portion of the article so that the deflected portion lies in a plane intersecting the central plane of the undeflected portion of the article, then reducing and drawing out metal of the portion thus deflected in a direction away from the remainder of the article to lengthen it, and repeating the operation with each succeeding portion of the article.

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