H. REINHARD.

MANUFACTURE OF METAL TUBES OR THE LIKE.

APPLICATION FILED OCT. 30, 1908.

989,643. Patented Apr. 18, 1911.

4 SHEETS—SHEET 1.

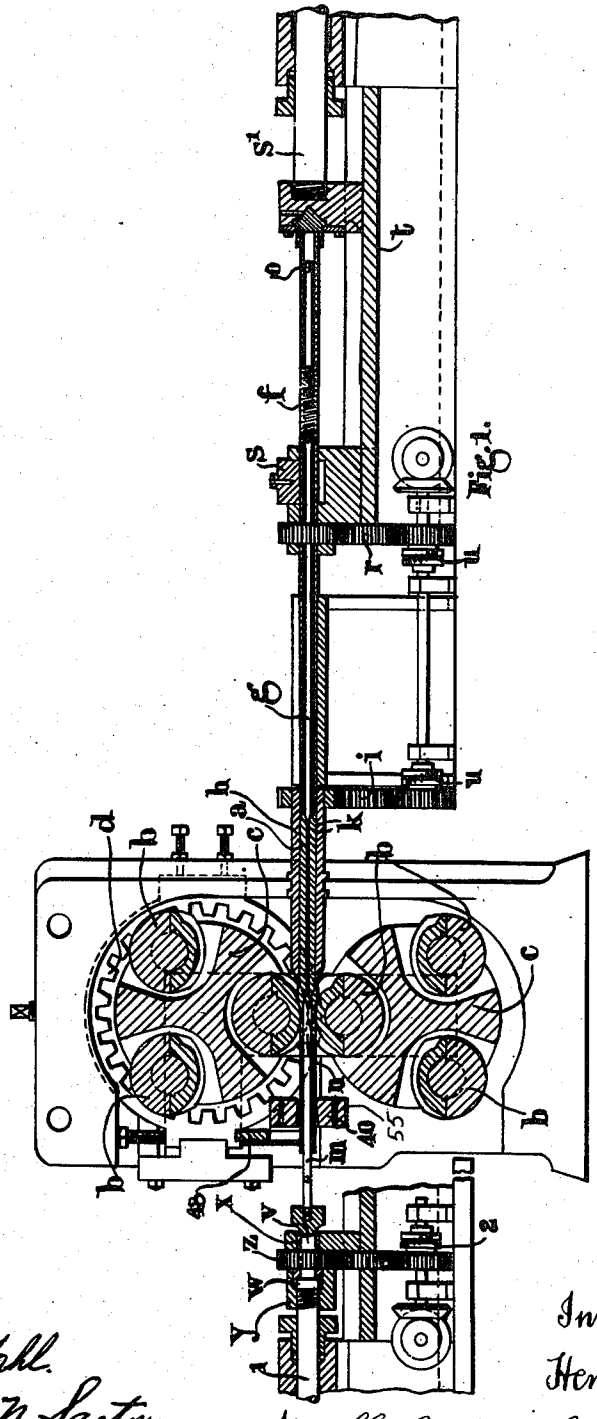

Fig. 1.

Attest.

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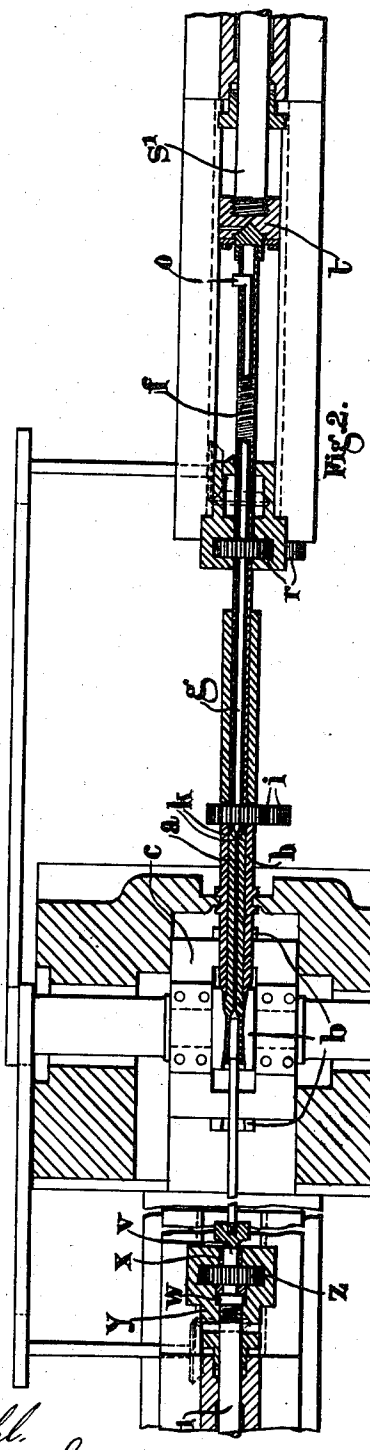

Fig. 2.

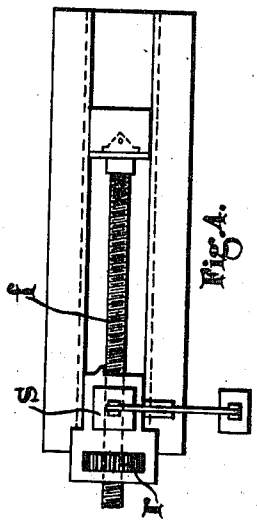

Fig. 4.

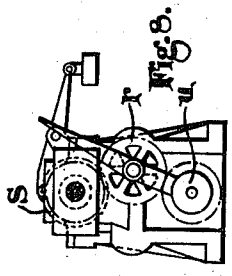

Fig. 3.

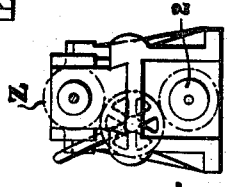

Fig. 1.

Attest.

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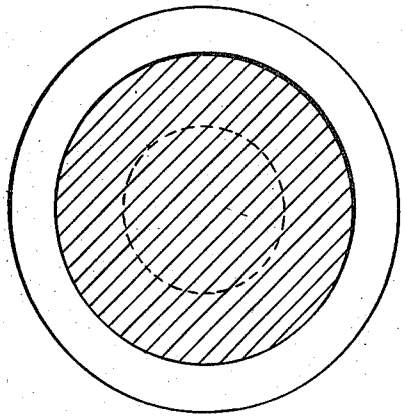

Fig. 5.

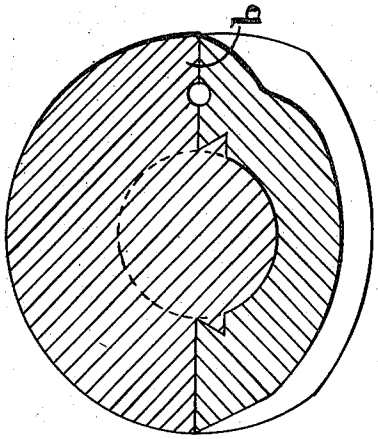

Fig. 6.

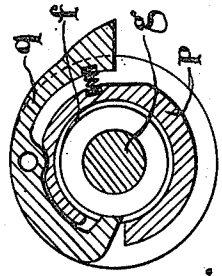

Fig. 10.

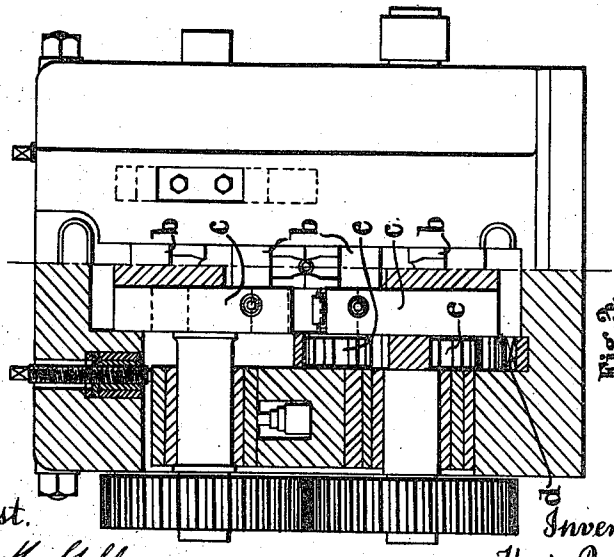

Fig. 3.

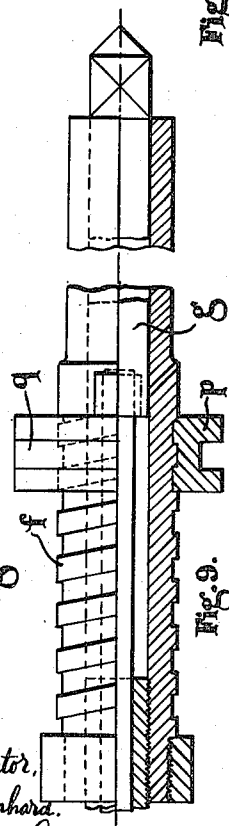

Fig. 9.

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APPLICATION FILED OCT. 30, 1908.

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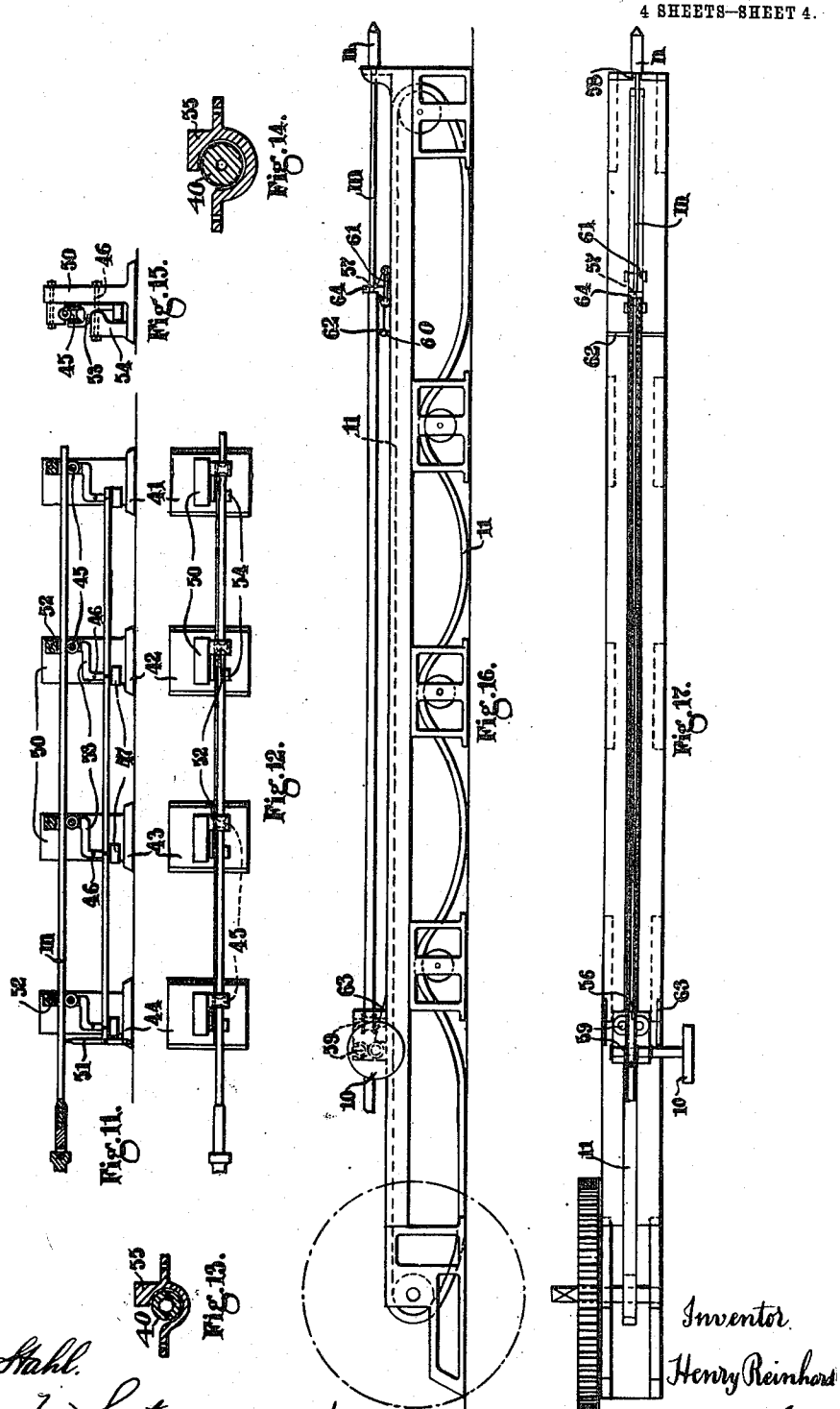
4 SHEETS—SHEET 4.



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Inventor
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Atty's.

UNITED STATES PATENT OFFICE.

HENRY REINHARD, OF ASTON, BIRMINGHAM, ENGLAND, ASSIGNOR TO TUBES LIMITED, OF ASTON, BIRMINGHAM, ENGLAND.

MANUFACTURE OF METAL TUBES OR THE LIKE.

989,643. Specification of Letters Patent. Patented Apr. 18, 1911.

Application filed October 30, 1908. Serial No. 460,359.

To all whom it may concern:

Be it known that I, HENRY REINHARD, a subject of the King of Great Britain and Ireland, and residing at Catharine Street, Aston, Birmingham, in the county of Warwick, England, have invented certain new and useful Improvements in and Relating to the Manufacture of Metal Tubes or the Like, of which the following is a specification.

This invention relates to the method of and apparatus for the piercing of metal billets in the manufacture of metal tubes or the like described in Letters Patent of the United States No. 908,329.

The object of this invention is to obtain an improved piercing mill.

The invention consists in a process and apparatus for piercing, having hydraulic, screw and hydraulic, screw, or other suitable means for feeding, and if desired, rotating the metal over a mandrel; rolls such as pilger rods for acting circumferentially on the metal; and auxiliary means acting so as to assist the end of the piercing, to position the bloom on the mandrel or to withdraw the mandrel from the bloom.

The invention also consists in the improved arrangements hereinafter described.

Referring now to the accompanying drawings, Figure 1 shows in part sectional elevation a mill according to one form of my invention. Fig. 2 is a plan view partly in section of Fig. 1. Fig. 3 is an elevation partly in section of Fig. 1. Fig. 4 shows in plan view corresponding to Fig. 2 a modified feeding arrangement. Figs. 5 and 6 are views on an enlarged scale of a concentrically grooved or breaking down roll and a pilger roll respectively. Figs. 7 and 8 show end views of the feed arrangements at the left and right ends of Fig. 1 respectively. Figs. 9 and 10 show in detail a releasing nut for allowing the metal to be worked to the end. Figs. 11 and 12 show in part sectional elevation and plan respectively the mandrel and tube standards and guides when tubes are made in one operation in the piercing mill. Figs. 13, 14, are details of the guide blocks; Fig. 15 an end view of the mandrel guide. Figs. 16 and 17 show in elevation and plan respectively a bench for use in conjunction with the mill.

In carrying the invention into effect in the form illustrated the billet, *a*, is acted on circumferentially by rolls, *b*, which may be either pilger rolls as shown in Fig. 6 or concentrically grooved rolls as shown in Fig. 5, carried in rotating housings, *c*. In the case of pilger rolls means must be provided to insure that the attack of the billet occurs at the right part of the groove. The drawings illustrate as one manner of obtaining this stationary internally toothed rings, *d*, with which are geared pinions *e*, on the roll axles. It is a property of concentrically grooved rolls that obviously they can attack the metal at any part of their circumference with equal effect and therefore no such means are required in their case. During the time the billet is not being acted on by the rolls it is fed forward by a hollow screwed spindle, *f*, which has inside it a small ram, *g*, which centers the billet at the back end and assists to rotate and feed the metal, in conjunction with the hollow spindle, through a suitable guide, *h*. If desired this guide, *h*, may be rotated through gearing *i*, in order to prevent the bloom seizing in the guide. On the front end of the spindle projections, *k*, are formed which also help to rotate the billet. As soon as the inner ram, *g*, is fed right up to the mandrel, *m*, the ram is released from the hollow spindle and the ram being relatively pushed back—on any further advance of the spindle—this hollow spindle is enabled to push the billet right over the mandrel head or plug, *n*. By this means feeding to the extreme end of the billet is assisted.

In the form shown more particularly in Fig. 2 the ram, *g*, has at one end a bayonet catch, *o*, which is released by the feed causing the hollow spindle, *f*, to travel forward after *g* comes in contact with *n*. This arrangement may be replaced by a spring nut device as shown in Figs. 9 and 10, wherein the nut *p*, on the screwed spindle, *f*, and the ram, *g*, normally rotate together being connected by the spring lever *q*, until at a suitable time the end of this lever is pressed, when the outer spindle, *f*, rotates and travels forward without the ram, *g*. The rotation of the screwed spindle, *g*, is effected as in the Letters Patent referred to above namely through gearing, *r*, and the feeding forward by the segmental nut, *s*, as shown more particularly in Fig. 8. If desired a screw nut feed such as this may be assisted by a suitable mechanical means such as a hydraulic

ram, s' attached for example to a sliding guide, t, to which the back end of the hollow screwed spindle, f, is attached in any suitable way to allow of its rotating. It will be obvious that when the segmental nut is not in position or if a plain rotating spindle be used feeding forward can take place by means of the ram alone. The intermittent feed from continuous power may be obtained through a spring coupling, u, as in the patent referred to above; and further as therein shown the feed can be controlled by raising or lowering the segmental nut, s.

With reference to the back of the mill, in the form illustrated the mandrel head or plug, n, is fastened to a mandrel bar, v, the back end of which is held in a socket, w, by any suitable means in a small hollow shaft, x, on which shaft is keyed a gear wheel, z, (Figs. 1 and 7) driven for example as in the billet feeding arrangements referred to above. The shaft x, is carried in a sliding bracket, y, to which is connected a mechanical means such as a hydraulic ram, 1, for removing the whole arrangement forward. Thus the mandrel bar, v, and plug, n, can be rotated in the same direction as the billet and so assist the turning when the billet is near the end of its travel in order to assist the end of piercing. Means for assisting the end of the piercing process—so far as feeding is concerned—have been referred to above. A spring coupling 2, is also introduced as described in the feeding arrangements. If desired a mandrel guide, the type of which may vary according to the length of mandrel in use may be used.

In the form shown in Figs. 11 to 15 a mandrel guide and carrier more particularly applicable to a long mandrel is illustrated. Such is especially useful when piercing and finished or partially finished rolling is performed in one mill at one heat. It is a property of piercing mills as herein described that with pilger rolls sufficient reduction of metal can be obtained to give a finished tube in one operation either from a solid bloom or a bloom previously pierced with a very small hole for the purpose of centering. With concentric rolls the reduction practically possible is only sufficient to give finished tubes in one operation when thick walled tubes are required.

Referring now to Figs. 11 to 15 the mandrel rod, m, of any convenient length is supported centrally to the billet about to be pierced, by means of a series of guides. The guides of which there may be any convenient number, are arranged at about equal distances along the mandrel rod. The front guide consists of a throat piece 40 (Fig. 1) which fits around the mandrel rod, and is carried in a holder 55. The piece 40 may be split in half as shown in Fig. 13, so that when pushed out of the holder 55, the two halves will fall to the ground or may be in one piece as shown in Fig. 14. The smallest internal diameter of the piece is slightly larger than the outside diameter of the tube, so that when the tube—in the case of the divided form—opens the piece 40 it will take its place in the holder 55, and be supported centrally, thus also supporting the mandrel rod and head centrally. The remaining guides 41, 42, 43, and 44 in the form shown are not similar to the first guide although such could be used arranged to allow the removal of tube and mandrel, but consist of a bottom and top portion. In the form shown the top part is fixed and the bottom movable; but this is not essential, as the necessary support could be obtained if the upper guide, neither guide or both guides were movable. The top portion is simply a guide 52, having a semi-circular hole cut in it of a slightly larger diameter than the outside diameter of the tube. This portion 52, is fixed firmly to a standard 50. The bottom portion consists of a fork 53, pivoted at 46 to standards 50 and 54, containing a roller 45, grooved similarly to the groove in the top portion 52. A weight 47, is attached to the lower end of the fork 53, which is arranged to keep this fork vertical. As the process goes on the tube will be rolled over the mandrel head, n, and so pushed along the mandrel rod m, until it comes to one of these guides, when it will rest on the bottom roller and just fit in the top groove. These top guides also help to keep the mandrel rod from bending the billet being expanded against the mandrel head. When the operation is over, the end of the tube is still firmly held on the mandrel head. The tube and mandrel are therefore drawn for example by means of the ram, 1, right through the throat piece 40, the extracting stop 48, is then dropped, fitting around the mandrel head, the rear end of the tube being ahead of it. The ram 1, is then pushed forward, and as the tube is held by the stop 48, the mandrel head is pushed clear from the end of the tube. Thus the tube or pierced or pilgered billet is positioned on the mandrel as is useful for example when the same is to be treated in a draw bench as described later with reference to Figs. 16 and 17. The ram is then again withdrawn, and the bottom portions of the guides 41, 42, 43 and 44 are all swung forward on their pivots 46, thus lowering the rollers 45, by means of the lever 51, or any other suitable arrangement. The mandrel and tube can now be lifted off the rollers and removed on the side opposite to that on which the top portions 52, of the guides are fixed. The tube can then be slipped off the mandrel rod or taken to a draw bench as hereinafter described—the rod is then replaced, and the lever 51, being released, the weights 47, swing the rollers

45, to their normal position. The ram is then pushed forward thus bringing the mandrel head, *n*, to its working position, and the halves of the divided throat-piece 40 are slipped in the holder 55, thus placing the mandrel centrally. Any other suitable form of roller or throat piece guides may be used without departing from this invention. Also sizing rolls may be provided if desired for example as shown in Figs. 16 and 17 referred to below.

If desired after the piercing or piercing and rolling operation is complete the hollow billet may be held and the hydraulic ram may withdraw the mandrel and plug right through the hollow metal, thus withdrawing the mandrel from the pierced or pilgered bloom. Further, if desired the relative stripping of tube and mandrel may take place in a bench as shown by way of example in Figs. 16 and 17, in which sizing or finishing rolls also are used. In this form, after the mandrel head, *n*, has been pushed out of the end of the tube and the mandrel rod and tube lifted from the guides 41, 42, 43 and 44, as described above the mandrel rod and tube on it are removed to the bench. On this bench are arranged sizing rolls 59, which may take any suitable form, the front pair being driven. In the form illustrated two horizontal and two vertically mounted rolls are used, one pair preferably the latter being driven from pulley 10 at a suitable speed corresponding to that of the bench chain.

The head, *n*, of the mandrel rod, *m*, is passed through the hole 57 in the plate 64 of the carrier 61, and is securely attached to the end of the bench in a slotted member 58, or by any other suitable means. The sizing rolls are arranged at such a distance from this end 58, that when the mandrel rod *m*, is attached thereto, the other head 56 (Fig. 17) mounted on the mandrel rod rests in the sizing rolls 59. This head, or plug, 56, is of such a length that both pairs of rolls may roll the tube over it simultaneously. It may either be swelled all along its length, or only where the rolls act. The catch 60 on the carrier is then pressed into the chain 11, of the bench, and the plate 64 on the carrier slides along the mandrel rod till it comes into contact with the tube, which is then pushed right through the rolls and so rolled over the plug 56. Just before the plate 64 comes into contact with the first pair of rolls, the pin 62 on the carrier catch 60 is arranged to press upon the inclined stops 63 and is so raised, thus raising catch 60 and stopping the carrier. The feed is now taken up by the driven rolls in this case the front pair of rolls, which carry the remainder of the tube right over the mandrel head 56.

Any other suitable form of automatic catch for the release of bench carrier 61 may be used in place of the one described if desired, and further other arrangements of the bench and accessories may be used without departing from the invention.

Any combination of any of the above described arrangements may be used either in a mill provided with pilger rolls or in a mill with concentrically grooved rolls. Further if desired any other suitable mechanical means may be used to replace the hydraulic or other means described herein, or any other suitable driving arrangement used for rotating the spindle or mandrel.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:—

1. The method of piercing a mass of metal in order to form a longitudinally apertured article and to enable high speed working to be obtained which consists in feeding a blank in one direction toward and against a mandrel sufficiently to cause a piercing action to take place; then subjecting it to reducing pressure operating longitudinally upon the outer portion of the part of the blank subjected to the piercing action, the point of application of the pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the pressure and at the time the same is taking place; and feeding the mandrel forward after the completion of the piercing so that the head clears the tube in order that the latter may be readily stripped; as set forth.

2. The method of piercing a solid mass of metal in order to form a longitudinally apertured article and to enable high speed working to be obtained which consists in feeding a blank in one direction toward and against a mandrel sufficiently to cause a piercing action to take place; then subjecting it to reducing pressure operating longitudinally upon the outer portion of the part of the blank subjected to the piercing action, the point of application of the pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the pressure and at the time the same is taking place; and rotating the mandrel between the forging actions toward the end of the piercing for the purpose of turning the metal and assisting the end of the piercing process; as set forth.

3. The method of piercing a solid mass of metal in order to form a longitudinally apertured article which consists in feeding the blank in one direction toward and against a mandrel sufficiently to cause a piercing action to take place, said mandrel having a piercing head and a body portion adjacent

thereto, and then subjecting the blank to reducing pressure operating longitudinally upon the blank and adjacent to the body portion of the mandrel, the point of application of the pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the pressure and at the time the same is taking place, the length of the mandrel body being equal, at least, to the elongation of the apertured article due to the pressure; and feeding the mandrel forward after the completion of the piercing so that the head clears the tube in order that the latter may be readily stripped; as set forth.

4. The method of piercing a solid mass of metal in order to form a longitudinally apertured article which consists in feeding the blank in one direction toward and against a mandrel sufficiently to cause a piercing action to take place, said mandrel having a piercing head and a body portion adjacent thereto, and then subjecting the blank to reducing pressure operating longitudinally upon the blank and adjacent to the body portion of the mandrel, the point of application of the pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the pressure and at the time the same is taking place, the length of the mandrel body being equal, at least, to the elongation of the apertured article due to the pressure; and rotating the mandrel between the forging actions toward the end of the piercing for the purpose of turning the metal and assisting the end of the piercing process; as set forth.

5. The method of piercing a solid mass of metal in order to form a longitudinally apertured article which consists in feeding the blank in one direction toward and against a mandrel sufficient to cause a piercing action to take place, and then subjecting it to a rolling action operating longitudinally upon the blank, the point of application of the rolling pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the rolling action and at the time the same is taking place; and then feeding the mandrel forward after the completion of the piercing so that the head clears the tube in order that the latter may be readily stripped; as set forth.

6. The method of piercing a solid mass of metal in order to form a longitudinally apertured article which consists in feeding the blank in one direction toward and against a mandrel sufficient to cause a piercing to take place, and then subjecting it to a rolling action operating longitudinally upon the blank, the point of application of the rolling pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the rolling action and at the time the same is taking place; and rotating the mandrel between the forging actions toward the end of the piercing for the purpose of turning the metal and assisting the end of the piercing process; as set forth.

7. The method of piercing a solid mass of metal in order to form a longitudinally apertured article which consists in feeding the blank in one direction toward and against a mandrel sufficient to cause a piercing action to take place, said mandrel having a piercing head and a body portion adjacent thereto and then subjecting it to a rolling action operating longitudinally upon the blank and adjacent to the body portion of the mandrel, the point of application of the rolling pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the rolling action and at the time the same is taking place, the length of the mandrel body being equal at least to the elongation of the tube due to the rolling action; and feeding the mandrel forward after the completion of the piercing so that the head clears the tube in order that the latter may be readily stripped; as set forth.

8. The method of piercing a solid mass of metal in order to form a longitudinally apertured article which consists in feeding the blank in one direction toward and against a mandrel sufficient to cause a piercing action to take place, said mandrel having a piercing head and a body portion adjacent thereto and then subjecting it to a rolling action operating longitudinally upon the blank and adjacent to the body portion of the mandrel, the point of application of the rolling pressure progressively traveling relative to the mandrel in the direction of feed of the blank and at a rate of speed relative to the mandrel equal to the rate of elongation of the blank due to the rolling action and at the time the same is taking place, the length of the mandrel body being equal at least to the elongation of the tube due to the rolling action; and rotating the mandrel between the forging actions toward the end of the piercing for the purpose of turning the metal and assisting the end of the piercing process; as set forth.

9. Means for piercing a mass of metal for forming a tube or the like comprising rotatable housings, rolls mounted in said housings, a piercing mandrel disposed in front

of said rolls, power means disposed behind said rolls for the purpose of forcing the metal on to the mandrel, said means including a hydraulic ram together with a screwed rod connected therewith and a nut for feeding said rod forward in addition to the hydraulic feed; as set forth.

10. Means for piercing a mass of metal for forming a tube or the like comprising rotatable housings, rolls mounted in said housings, a piercing mandrel disposed in front of said rolls, and power means disposed behind said rolls for the purpose of forcing the metal on to the mandrel, said means including a hollow rod and an inner rod adapted for relative motion with relation to the outer rod for the purpose of allowing the metal blank to be worked to the end, together with power means disposed in front of said rolls for the purpose of operating the mandrel by forcing the mandrel head through the tube; as set forth.

11. Means for piercing a metal bloom for forming a tube or the like comprising rotatable housings, rolls mounted in said housings arranged to operate on the bloom longitudinally, a mandrel disposed in front of said rolls, a bloom guide situated behind said rolls, gearing for rotating said guide and power means for feeding the bloom through the guide; as set forth.

12. Means for piercing a metal bloom for forming a tube or the like comprising rotatable housings, rolls mounted in said housings arranged to operate on the bloom longitudinally, a mandrel disposed in front of said rolls, a bloom guide situated behind said rolls, together with power means for feeding the bloom through the guide and power means disposed in front of said rolls for feeding the mandrel through the tube; as set forth.

13. In means for the piercing of metal blooms for the formation of a tube or the like in combination a hydraulic ram and a screwed spindle directly connected to said ram as by a sliding bracket, together with a segmental nut for the screwed rod so that both hydraulic and screw feeds may be employed in combination or the hydraulic ram may quickly move the screwed rod on the release of the segmental nut; as set forth.

14. Means for piercing a metal bloom comprising a piercing mandrel, power feeding means situate behind the bloom for feeding the bloom to the mandrel, rolling means situate near the mandrel for rolling the bloom over the mandrel and power means situate behind the mandrel for feeding the same at least in part through the pierced bloom; as set forth.

In testimony whereof, I affix my signature in presence of two witnesses.

HENRY REINHARD.

Witnesses:

CHARLES EDWARD COPE,

HENRY HERBERT OLIVER.