No. 774,087. PATENTED NOV. 1, 1904.

R. LAYBOURNE, C. W. E. MARSH & B. PRICE.

AUTOMATIC MECHANISM FOR USE IN STEP BY STEP ROLLING OF METAL TUBES.

NO MODEL. APPLICATION FILED NOV. 21, 1902. 2 SHEETS—SHEET 1.

Fig. 1.

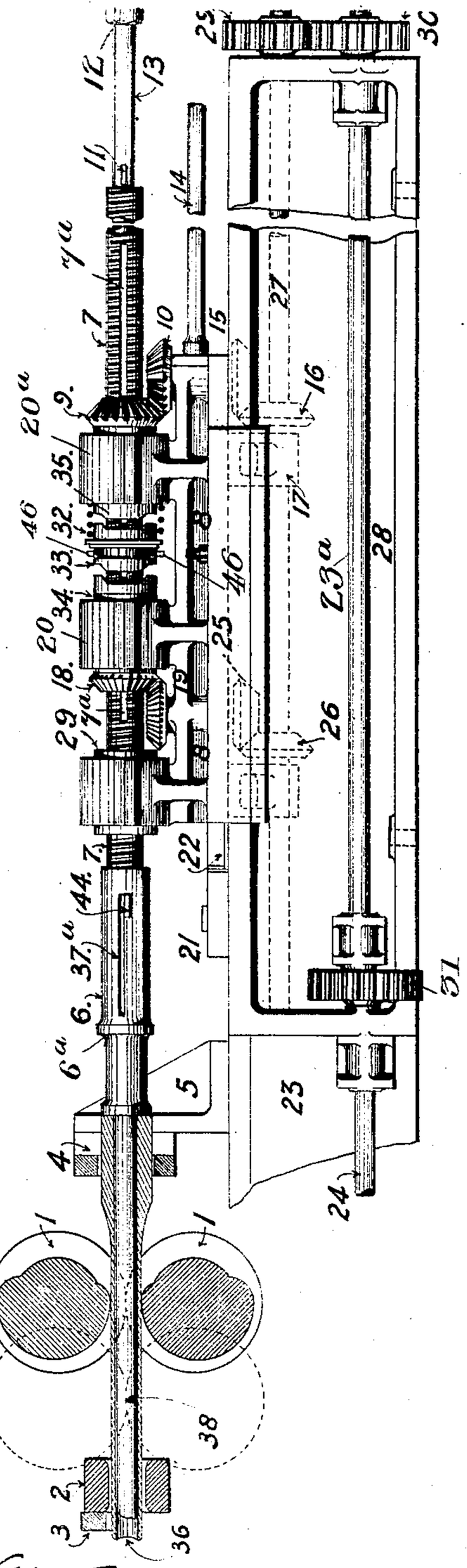
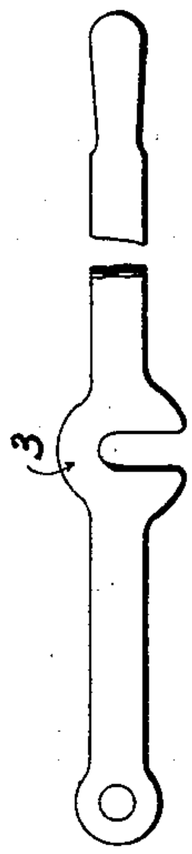


Fig. 4.



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2 SHEETS—SHEET 2.

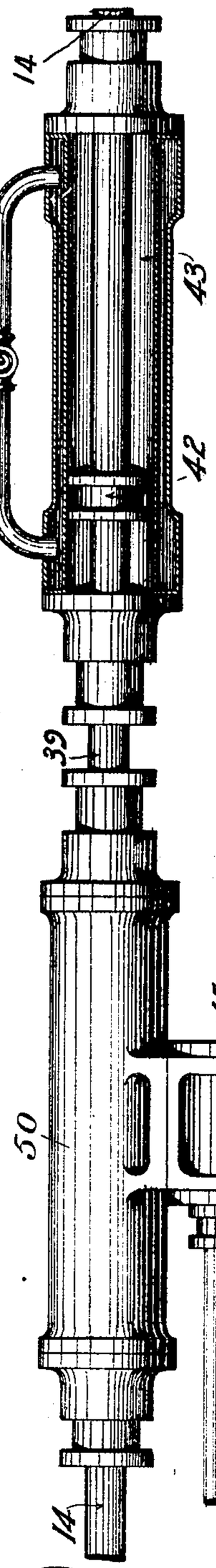

Fig. 3.

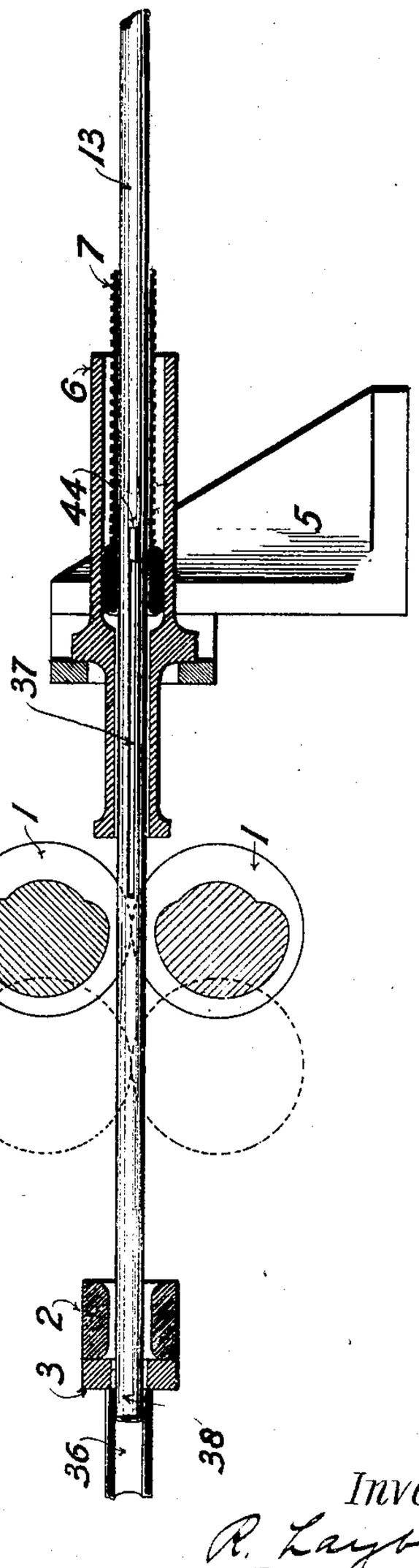

Fig. 2.

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No. 774,087. Patented November 1, 1904.

UNITED STATES PATENT OFFICE.

RICHARD LAYBOURNE, CHARLES WILLIAM EARLE MARSH, AND BENJAMIN PRICE, OF NEWPORT, ENGLAND.

AUTOMATIC MECHANISM FOR USE IN STEP-BY-STEP ROLLING OF METAL TUBES.

SPECIFICATION forming part of Letters Patent No. 774,087, dated November 1, 1904.

Application filed November 21, 1902. Serial No. 132,335. (No model.)

To all whom it may concern:

Be it known that we, RICHARD LAYBOURNE, civil engineer, CHARLES WILLIAM EARLE MARSH, civil engineer, and BENJAMIN PRICE, engineer, subjects of the King of Great Britain, residing at Newport, in the county of Monmouth, England, have invented certain new and useful Improvements in Automatic Mechanism for Use in the Step-by-Step Rolling of Metal Tubes, of which the following is a specification.

This invention has for its object improvements in or relating to automatic mechanism for use in step-by-step rolling of metal tubes, and relates more particularly to that class or type of apparatus for step-by-step rolling or swaging tubes from hollow ingots or hollow billets in which the rolls are reciprocated along the work-piece (tube)—for example, where the housings in which the rolls are journaled are adapted to be bodily reciprocated along the tube, as described in United States Patents No. 570,816, No. 608,908, and No. 681,557—such apparatus having a feed-screw and a mechanically-held and mechanically-operated mandrel adapted to intermittently advance and rotate the hollow ingot or hollow billet on said mandrel; and the present invention consists in the combination, with such feed-screw and mandrel, of a yielding clutch which is intermittently and automatically thrown out of gear by the action of the rolls when same grip the tube or work-piece and thereby prevent the rotation and advance of the feed-screw, of means to automatically force a yielding part of said clutch into gear with a constantly-rotating part of said clutch at the moment when the work-piece on the mandrel is liberated by the rolls, and consequently is free to be fed and turned, and means for advancing and turning said mandrel and work-piece a suitable distance to expose a fresh portion of the unworked part of the tube or work-piece to the action of the rolls; and, furthermore, the present invention has reference to reversing and mandrel-extracting mechanism whereby the process of rolling tubes step-by-step is considerably simplified and accelerated, all as hereinafter fully described, and the novel features of this invention finally pointed out in the claims.

According to this invention the periodic turning and advance forward of the mandrel and work-piece may be obtained by an automatic yielding or friction clutch. The feed-spindle to which the mandrel is secured is provided with a groove by means of which same can slide along a feather in one part of the said clutch part, which may be termed the "movable" clutch, being forced into gear by springs or otherwise with the other clutch part, which may be termed the "revolving" clutch part, same being continually revolved by toothed wheels mounted on a sliding saddle capable of being moved in a longitudinal direction upon a long bed attached to the main frame carrying the roll-housing. The yielding clutch may be thrown in and out of action by a lever controlled by the workman. The mandrel and work-piece are turned and advanced forward when the gaps of the rolls release the tube. As the movable clutch part is forced into the continuous rotating clutch part it has a tendency to turn and advance the feed-spindle; but this is prevented by the impingement of the rolls upon the billet or partly-rolled tube. The feed-spindle is thus retarded by the action of the rolls upon the metal and mandrel, and therefore the spindle on which the mandrel is held. As the rotating clutch part is continuously rotating the yielding clutch part is forced out of action automatically when the work-piece is held by the projecting part of the rolls. After every attack and from the moment the tube is released (by the gaps in the rolls) until it is gripped and held again by the rolls the yielding clutch part is forced into action and is rotated—say one-fourth of a revolution or to any desired extent—and as a result the feed-spindle is caused to advance and turn a suitable distance and advance and turn with it the work-piece on it. The feed-spindle unless prevented periodically by the action of the rolls pressing upon the work-piece would constantly rotate. The rolls, therefore, accord-

ing to this part of the invention, perform a very important part in regulating the feed of the work-piece between them, as during the release of the tube by the gaps the spindle is at liberty and does automatically advance and turn the tube forward. The rotation of the feed-spindle may be governed and effected by suitable gearing from the main shaft. The clutch parts may have their adjacent faces serrated in a suitable manner or they may be prepared as ordinary friction-clutches. The movable clutch part is also adapted to reverse the feed-spindle after completion of rolling. This is accomplished by forcing it with a suitable lever into another clutch part rotated in an opposite direction to the feed-clutch. The feed-spindle may be provided with a sleeve which determines the position of the work-piece upon the mandrel and is arranged to be moved automatically upon the spindle when but a short portion of the billet is left unworked. The tube is thus allowed to pass completely through the rolls, and no waste or interruption of the rolling takes place. The spindle may be hollow and the mandrel may pass through it. After completion of rolling it (the mandrel) may be pushed sufficiently far between the rolls to place a suitable yoke mounted on a cross-bar upon it and behind the tube. When this is done, the saddle carrying the feed-spindle and to which the mandrel is secured is moved back upon its bed and the mandrel is drawn out of the tube.

Referring to the accompanying drawings, Figure 1 is a side view in elevation, showing the feed and reversing gear mounted in a sliding carriage supported and suitably guided upon a bed. Fig. 2 is a sectional view showing position of head of feed-spindle in the sleeve, with the mandrel pushed forward and yoke in position to extract the mandrel from tube upon completion of rolling. Fig. 3 is a view, partly sectional, of the cylinder, with the auxiliary cylinder, for controlling movement of feed-saddle upon the bed of the machine. Fig. 4 shows form of yoke that may be used for preventing movement of tube when the mandrel is withdrawn therefrom.

Referring to Fig. 1, the tube 36 is shown partly rolled out upon the mandrel 38 by the rolls 1 1. The tube is advanced and turned periodically to expose a fresh portion of the unworked part of the tube to the action of the rolls. This has already been described in the aforesaid specifications, and therefore need not be described further herein. The shaft 24 is rotated by the shaft (not shown) operating the roll-housing in the manner shown in our former patent, No. 608,908, dated August 9, 1898, carrying the rolls 1 1. Motion is imparted to the shaft 27 within the bed 28 by means of the toothed wheels 29, 30, and 31. The miter-wheels 25, 26, 18, and 19, rotated by the shaft 27, impart movement to the movable clutch part 33 when desired. The bevel-wheel 18 has a rearwardly-extending sleeve journaled in the bearing 20, carried by the saddle, the rear end 34 being formed with slightly-recessed parts which gear in coacting parts of the clutch part 33 when the latter is forced into action. The clutch part 33 is provided with a feather sliding in the longitudinal slot 7^a, forming a feather-way in the screw-spindle 7. They therefore rotate together. The wheel 18, with the rear end 34 recessed, is bored out slightly larger than the screw-spindle 7. It would therefore by itself impart no movement to the spindle 7.

The intermittent movement of the feed-spindle 7, mandrel 38, and tube 36 is obtained as follows: The wheel 18, with its recessed portion 34, is continuously rotated, as aforesaid, by the shafts 27 and 24 and wheels 29, 30, and 31. When the rolling action takes place, the clutch part 33 is disengaged by a hand-lever (not shown) and is forced by the coil-spring 32 into gear with the clutch 34. During the attack of the rolls 1 1 upon the tube 36 it is held firmly by them, and since the mandrel 38 is secured to the screw-spindle 7, upon which the clutch part 33 is mounted, it follows that the latter must yield or give way to allow the wheel and clutch 34 to rotate. It must be understood that the recessed parts of the clutches 33 34 must not be too deep. When the tube-mandrel and feed-spindle are liberated by the gaps of the rolls, the clutch 33 automatically falls into clutch connection and rotates the spindle 7 and mandrel and tube thereon, say, about one-fourth of a turn. This takes place at each stroke of the rolls, and the tube is advanced and rotated with the mandrel and feed-spindle intermittently until they are far enough advanced to complete the rolling of the tube. The spindle 7 is preferably made hollow to admit a mandrel passing through it. The mandrel 38 may be secured to the screw-spindle 7 by cotters 44 and 11 or a set-screw or any other convenient method. The cotter 11 should be removed after the tube is rolled out. The mandrel is then free to pass through the screw-spindle until the nut 12 is in contact with the end of the said spindle. After the mandrel is withdrawn from the tube the mandrel is drawn back to its original position and the cotter 11 is reinserted, thus securing the mandrel in the feed-screw ready for the following billet to be rolled out. The mandrel 38 may also be provided with a longitudinal slot 37 to enable the mandrel (when released from the screw-spindle 7) to be pushed far enough through the spindle until the stop-nut 12 abuts the rear end of the spindle 7 at 11. In this position the finished tube is in a suitable position to place the yoke 3, pivoted in a fixed bracket 2, behind the tube 36 and over the mandrel 38. If now the saddle 8 is compelled to slide back upon the bed 28 by any suitable means,

such as the cylinder 50, connected to the said saddle by the piston-rod 14, the mandrel is withdrawn from the tube. The screw-spindle 7 is reversed and brought back to its normal position for the following billet to be rolled. This is accomplished by the miter-wheels 9, 10, 15, and 16 and clutch part 33. A sleeve on the wheel 9 is journaled in the bearing 20ª, carried on the saddle 8, and is bored out slightly larger than the screw-spindle 7, and the end 35 of said sleeve is recessed in a similar manner to the clutch part 34, but is rotated in an opposite direction. It follows that when the sliding clutch part 33 is forced by a lever (not shown) into the end 35 it will be turned, carrying the screw-spindle 7 along with it until the latter is in its proper position. The screw-spindle 7 screws through a suitable fixed nut 29, carried on the saddle or carriage 8.

For the purpose of completely rolling out the end of the tube the end of the screw-spindle 7 is furnished with and passes freely within a sleeve 6 with longitudinal slot 37ª to allow said sleeve to slide back past the cotter 44—*i. e.*, to permit the cotter 44, with spindle 7 and mandrel 38, connected thereby, to slide through said sleeve for the length of said slot 37ª. The sleeve has a collar 6ª, which abuts against the cross-bar 4, fixed on the bracket 5, secured to the main bed 23. This prevents the end of the sleeve from being carried too far toward the rolls and is proportioned in such a manner that when but a short piece of the work-piece is left unworked the sleeve is automatically held, (see Fig. 2,) and the screw-spindle carries the mandrel and tube forward until the latter is completely rolled out. By referring to Fig. 2 the position can be readily seen of the head of the screw-spindle 7 in the sleeve 6 after the tube has been completely rolled out. The cotter-slot 37ª in the sleeve 6 is slightly enlarged at one end, forming a locking-shoulder, against which the cotter 44 is seated, which allows the sleeve to be given a slight turn, as shown in Fig. 1. This prevents the sleeve from being forced back during the rolling operation. As soon, however, as the sleeve is held and the screw-spindle turned the cotter 44 is forced into the groove or slot 37ª and can then be easily pushed back over the head of the screw-spindle 7 out of the way to allow the whole of the tube to pass right through the rolls.

A stop-piece 21 is fixed on the bed 23ª, and a spring 22 is advantageously used to provide and determine the position of the carriage 8 on the bed when it is forced forward by the cylinder 50 and piston-rod 14. The cylinder is suitably secured behind the bed 23ª and is controlled by a hand-lever within reach of the workman. The shaft 27 within the bed 23ª has a feather or key way (not shown) running its entire length or thereabouts, in which a feather secured to the wheels 26 and 16 slides. It is therefore possible to rotate the wheels 16 and 26 when the carriage is moved to and fro upon the bed 28. This hand-lever is not shown on the drawings; but it is of the ordinary construction—namely, a yoke engaging the pins 46 and terminating in a hand-piece, the whole mounted on a standard secured to the bed-plate.

If the cylinder 50 is operated by steam, it is advisable to provide a dash-pot or regulating device, such as an auxiliary cylinder 42, (see Fig. 3,) filled with oil or water which passes from one side of the piston to the other through the pipe 41 as the steam-cylinder is operated. The cock 40 regulates the flow of liquid, and therefore the speed at which the carriage 8 travels upon the bed 23ª. The steam-cylinder is suitably governed by a valve in the box 45. If the carriage is controlled by a hydraulic cylinder, then of course the auxiliary cylinder is not essential.

It will be obvious that the various features of the present invention may be used separately or combined, as desired. For instance, the means for automatically feeding and turning the mandrel with the work-piece thereon may be employed without the mandrel-extracting mechanism and either with or without the means to continue the feeding, so that no part of the billet is left unworked, and in such arrangement it will be evident that it is not essential to make the feed-spindle hollow to receive the mandrel, and, if desired, the mandrel may be a short one, and the mandrel may be extracted from the tube at a separate and suitable draw-bench after same have been removed from the machine that has rolled out the tube from the billet.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent of the United States, is—

1. In apparatus for rolling or swaging metal tubes from hollow ingots step by step and having a feed-screw and mandrel adapted to intermittently advance and rotate the work-piece on said mandrel; the combination with such feed-screw and mandrel of a yielding clutch shiftably secured to and surrounding said feed-screw and adapted to be intermittently and automatically thrown out of gear with said feed-screw each time the rolls grip the work-piece and thereby prevent the rotation and advance of the feed-screw and mandrel while the work-piece is thus gripped, means for automatically forcing the yielding part of said clutch into gear with a constantly-rotating part of said clutch when the work-piece mandrel and feed-screw are liberated by the rolls, and means to constantly rotate said rotating clutch part for the purpose of advancing and turning the feed-screw mandrel and work-piece thereon for a suitable distance when the latter is released from the rolls to thereby expose a fresh part of the

work-piece to the action of the rolls substantially as and for the purposes hereinbefore described.

2. In apparatus for rolling or swaging metal tubes from hollow ingots step by step and having a feed-screw and mandrel adapted to intermittently advance and rotate the work-piece on said mandrel; the combination with such feed-screw and mandrel of a yielding clutch shiftably secured to and surrounding said feed-screw and adapted to be intermittently and automatically thrown out of gear with such feed-screw each time the rolls grip the work-piece to thus periodically prevent the rotation and advance of the feed-screw mandrel and work-piece thereon while the work-piece is thus gripped, and means for intermittently forcing the yielding part of said clutch into gear for the purpose of advancing and rotating the feed-screw work-piece and mandrel thereon when the latter are liberated by the rolls substantially as and for the purposes hereinbefore described.

3. In apparatus for rolling or swaging metal tubes from hollow ingots step by step and having a feed-screw and mandrel adapted to intermittently advance and rotate the work-piece on said mandrel; the combination with such feed-screw and mandrel of a yielding clutch shiftably secured to and surrounding said feed-screw and adapted to be intermittently and automatically thrown out of gear with such feed-screw each time the rolls grip the work-piece to thus periodically prevent the rotation and advance of the feed-screw mandrel, and work-piece thereon while the work-piece is thus gripped, means for intermittently forcing the yielding part of said clutch into gear for the purpose of advancing and rotating the feed-screw work-piece and mandrel thereon when the latter are liberated by the rolls and a sleeve to automatically allow the rear end of the work-piece to pass completely through the rolls, substantially as and for the purposes hereinbefore described.

4. In apparatus for rolling or swaging metal tubes from hollow ingots step by step and having a feed-screw and mandrel adapted to intermittently advance and rotate the work-piece on said mandrel; the combination with such feed-screw and mandrel of a yielding clutch shiftably secured to and surrounding said feed-screw and adapted to be intermittently and automatically thrown out of gear with such feed-screw each time the rolls grip the work-piece to thus periodically prevent the rotation and advance of the feed-screw mandrel and work-piece thereon while the work-piece is thus gripped, means for intermittently forcing the yielding part of said clutch into gear for the purpose of advancing and rotating the feed-screw work-piece and mandrel thereon when the latter are liberated by the rolls, a hollow feed-screw spindle through which passes a mandrel and having means to suitably secure said mandrel to said hollow spindle, means for allowing the mandrel and tube to be carried forward between the rolls after the completion of rolling, and means for extracting the mandrel from the tube without removing the mandrel from the machine, substantially as and for the purposes hereinbefore described.

5. In apparatus for rolling or swaging metal tubes from hollow ingots step by step and having a feed-screw and mandrel adapted to intermittently advance and rotate the work-piece on said mandrel; the combination with such feed-screw and mandrel of a yielding clutch shiftably secured to and surrounding said feed-screw and adapted to be intermittently and automatically thrown out of gear with such feed-screw each time the rolls grip the work-piece to thus periodically prevent the rotation and advance of the feed-screw mandrel and work-piece thereon while the work-piece is thus gripped, means for intermittently forcing the yielding part of said clutch into gear for the purpose of advancing and rotating the feed-screw work-piece and mandrel thereon when the latter are liberated by the rolls, a sleeve adapted to automatically allow the rear end of the work-piece to pass completely through the rolls, a hollow feed-screw spindle through which passes a mandrel and having means to suitably secure said mandrel to said hollow spindle, of means for allowing the mandrel and tube to be carried forward between the rolls after the completion of rolling, and means for extracting the mandrel from the tube without removing the mandrel from the machine, substantially as and for the purposes hereinbefore described.

6. In apparatus for rolling or swaging metal tubes from hollow ingots step by step and having a feed-screw and mandrel adapted to intermittently advance and rotate the work-piece on said mandrel; the combination with such feed-screw and mandrel of a yielding clutch shiftably secured to and surrounding said feed-screw and adapted to be intermittently and automatically thrown out of gear with such feed-screw each time the rolls grip the work-piece to thus periodically prevent the rotation and advance of the feed-screw mandrel and work-piece thereon while the work-piece is thus gripped, means for intermittently forcing the yielding part of said clutch into gear for the purpose of advancing and rotating the feed-screw work-piece and mandrel thereon when the latter are liberated by the rolls, and means for reversing the feed-screw spindle after completion of rolling, substantially as and for the purposes hereinbefore described.

7. In apparatus for rolling or swaging metal tubes from hollow ingots step by step and having a feed-screw and mandrel adapted to intermittently advance and rotate the work-piece on said mandrel; the combination with such

feed-screw and mandrel of a yielding clutch shiftably secured to and surrounding said feed-screw and adapted to be intermittently and automatically thrown out of gear with such feed-screw each time the rolls grip the work-piece to thus periodically prevent the rotation and advance of the feed-screw mandrel and work-piece thereon while the work-piece is thus gripped, means for intermittently forcing the yielding part of said clutch into gear for the purpose of advancing and rotating the feed-screw work-piece and mandrel thereon when the latter are liberated by the rolls, a sleeve adapted to automatically allow the rear end of the work-piece to pass completely through the rolls, and means for reversing the feed-screw spindle after completion of rolling, substantially as and for the purposes hereinbefore described.

In witness whereof we have hereunto set our hands in presence of two witnesses.

RICHD. LAYBOURNE.
CHARLES WILLIAM EARLE MARSH.
BENJAMIN PRICE.

Witnesses:
P. CHAS. CESSAC,
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