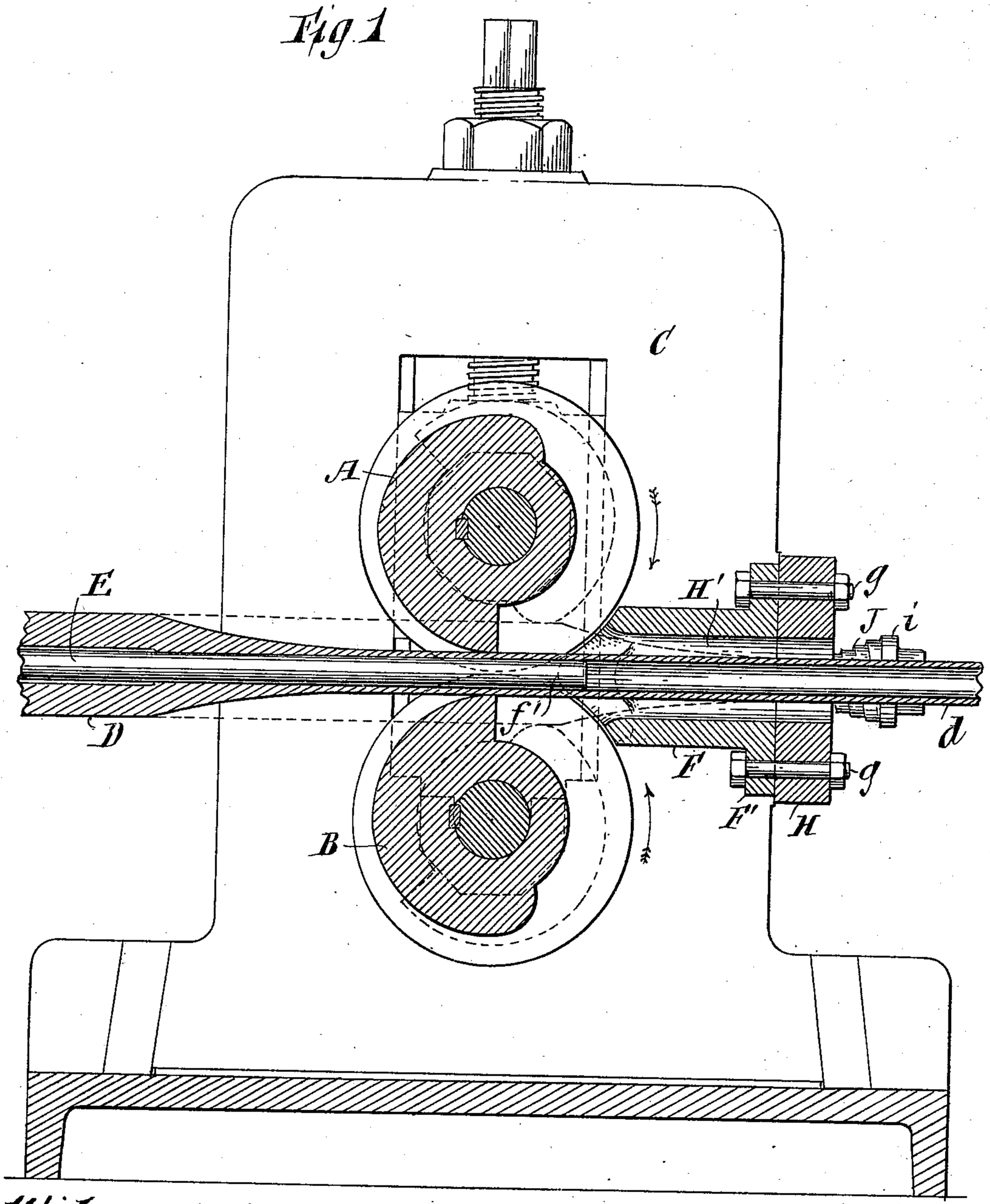
(No Model.) 2 Sheets—Sheet 1.

M. MANNESMANN.

APPARATUS FOR ROLLING SEAMLESS METALLIC TUBES.

No. 545,513. Patented Sept. 3, 1895.

Fig. 1



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(No Model.) 2 Sheets—Sheet 2.

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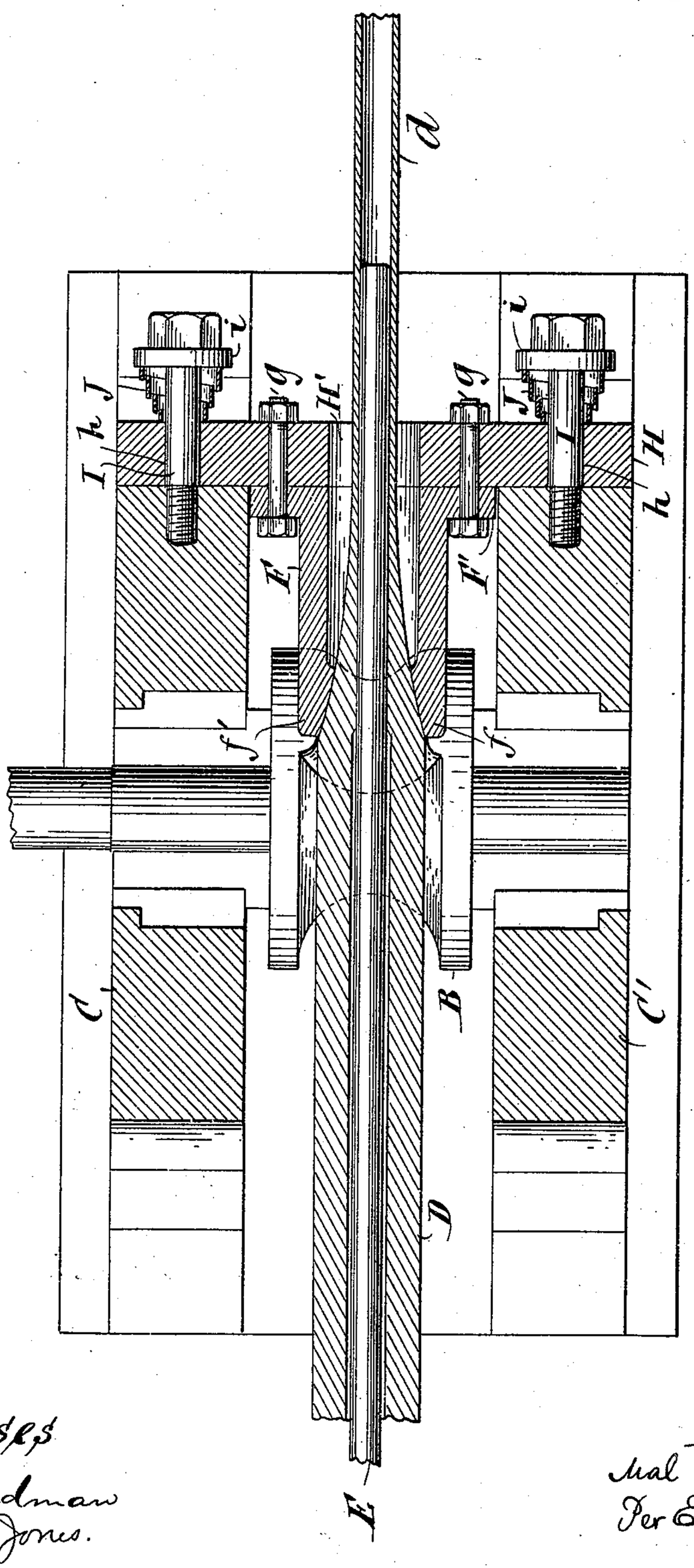
Fig. 2



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APPARATUS FOR ROLLING SEAMLESS METALLIC TUBES.

SPECIFICATION forming part of Letters Patent No. 545,513, dated September 3, 1895.

Application filed January 28, 1895. Serial No. 536,442. (No model.)

To all whom it may concern:

Be it known that I, MAX MANNESMANN, of Remscheid, Germany, have invented a certain Improvement in Work-Gages for Apparatus Employed in Rolling Seamless Metallic Tubes, of which the following is a specification.

This improvement relates to the art of progressively reducing successive sections of a relatively thick shelled hollow ingot into integrally united lengths of relatively thin shelled tubing by the employment, in combination with a suitable mandrel, of intermittently-acting rolls the cross-area of the pass through which gradually diminishes during the performance of the reducing function and afterward suddenly increases, and thus affords opportunity for imparting such feed movements as may be required for presenting the unacted upon part of the ingot in the proper position to receive the next attack of the rolls. This process of reduction, which is known as "step-by-step" rolling, may be practiced by the use of rolls which during the performance of the reducing function are forcibly moved bodily toward each other or one toward the other, and then separated from each other by a reverse movement to permit the required feeding of the ingot. It is preferred, however, to employ two rolls, each of which has what may be called a "paracentric" working face merging into a concentric finishing face, which together occupy about one hundred and eighty degrees of its perimeter, the remainder of its perimeter being formed upon a diminished radius in order to afford room and time for the feeding of the ingot during the intervals between the successive attacks of the rolls upon the previously unacted upon parts of the ingot. In any case the rolls are provided with longitudinally-tapering and laterally-flaring grooves which are approximately semielliptical in cross-section, whereby during the rolling action the roll-pass, while extensively diminishing in height, less extensively diminishes in width, and thus affords room for some lateral outward flow of the compressed metal at the opposite sides of the mandrel. It is essential that at each action the first impingement of the rolls upon the ingot shall be at short distances back of the forward extremity of its previously unacted upon portion, so that bunches or waves of metal may be formed in front of the advancing working faces of the rolls. During the rolling action the ingot is forced bodily backward; but as the vertical dimension of the roll-pass diminishes the two waves of metal referred to are pressed toward each other, their paths of motion relatively to the backwardly-moving ingot being therefore convergent. It is desirable that the rolls shall be rotated with great rapidity in order that the entire series of the reducing operations may be performed before the thicker portion of the ingot has time to cool. After each action of the rolls the ingot is turned on its longitudinal axis sixty degrees or ninety degrees, as the case may be, and requires to be fed forward to properly present it for the next action of the rolls. It will easily be seen that if fed too far forward the first impingement of the rolls will be at a distance too far back of the forward end of the previously unacted upon portion of the ingot, and there will then be danger of stalling the rolls or of breaking or dismounting them from their housings. On the other hand, if the ingot is not fed sufficiently far forward the first impingement of the rolls may take place in front of the previously unacted upon portion of the ingot, in which case the ingot will be driven rapidly backward without the formation of the waves of metal in front of the rolls, the presence of which is necessary to the successful performance by the rolls of the operation of working down the thicker end of the ingot step by step into finished integrally-connected lengths of relatively thin shelled tubing.

It is the object of the present improvement to accurately gage the forward-feeding movement of the ingot by presenting for impact, at first on the forward end and thereafter upon the partially-reduced portion of the ingot, a bifurcated stop the opposed faces of the jaws of which are slightly convex and approximately fit the forward end of the ingot, which by the preceding action of the rolls has been given a tapering shape. The jaws of the stop are chamfered upon their upper and lower sides in order that they may extend into the space between the rolls nearly to the vertical plane of the axes thereof, the position to

which the ingot is required to be fed being one in which the forward extremity of its unacted upon portion extends slightly forward of the vertical plane of the axes of the two rolls. The two jaws of the bifurcated stop may be formed of separate pieces, but will preferably be made integral with each other and with a hollow cylinder of sufficient internal diameter to allow of the free passage through it of the finished tube. Said cylinder with said bifurcated jaws, constituting what is herein designated the "work-gage," is supported upon the frame of the apparatus and is backed by a stiff spring, and thus given a narrow range of compressibility and resilience. By this expedient the ingot, after each action of the rolls upon it, may be turned and fed forward to the exact position required for its appropriate presentation for the next action of the rolls.

For the purposes of the present improvement, which relates to the combination of the work-gage with the intermittently-acting rolls, the ingot may be assumed to have its feeding movement imparted to it manually.

The accompanying drawings, representing the work-gage applied to a pair of paracentric rolls for progressively reducing a thick-shelled hollow ingot step by step into integrally-united lengths of thin-shelled tubing, are as follows:

Figure 1 is a transverse vertical section of a pair of paracentric rolls and of a hollow ingot in process of being reduced into a thin-shelled tube, showing the work-gage in vertical section in the plane of the central longitudinal axis of the tube. Fig. 2 is a horizontal section taken through the plane of the central longitudinal axis of the ingot, affording a top view of the lower roll and showing the partially-reduced forward end of the ingot in contact with the work-gage.

The apparatus represented in the drawings embraces two paracentric rolls A B, mounted in the usual manner between the housing-standards C C'.

In Fig. 1 a hollow ingot or billet D is represented in solid lines in the position to which it has been driven by the rotation of the rolls to the position in which they are represented in solid lines. The ingot and the rolls are represented in dotted lines in their relative positions at the time of the commencement of an attack of the rolls upon the ingot.

In Fig. 2 the hollow ingot is represented as being fed forward to the position which it is required to occupy in order to appropriately present for the next action of the rolls the previously unacted upon part of the ingot. In both drawings the mandrel E is represented as within the hollow ingot. In Fig. 1 the mandrel is represented as having partaken of the backward movement of the ingot. In Fig. 2 the mandrel is represented in the position which it occupies by reason of having partaken of the forward movement of the ingot.

As will be seen on reference to Fig. 2, the ingot is represented as having been brought to rest by the contact of its tapering forward portion with the work-gage, which consists of flaring jaws *f f'*, which are formed integrally with the hollow block or cylinder F. The cylinder F is provided with the circumferential flange F', which is suitably perforated to receive the bolts *g g*, by which the work-gage is secured to the yoke H. The yoke H is provided with perforations *h h* to admit the shanks of the bolts I I, which screw into the housing-standards C C', as shown. Between the head *i* of each of the bolts I and the outer face of the yoke H is a strong volute-spring J, which is placed under a condition of high tension by the screwing home of the bolts I I, as shown. By this mode of supporting the yoke H, to which the work-gage is affixed, the work-gage is given a slight range of yielding movement due to the yielding quality of the springs J J, and a corresponding range of return movement resulting from the resilient force of the springs J J.

As will be seen on reference to the drawings, the internal diameter of the work-gage and of the aperture H' in the yoke H, which is in alignment with the work-gage, is amply large to permit of the passage of the finished tube *d* through the work-gage and yoke.

What is claimed as the invention is—

1. The combination as herein set forth of the paracentric rolls, A B, the housing standards, C C', the mandrel, E, the work gage provided with the bifurcated jaws, *f f'*, the yoke, H, fastening devices for fastening said work gage to said yoke, the bolts, I I, screwed into the housing standards, C C', each of the said bolts having a spring, J, interposed between its head and the outer face of said yoke, as and for the purpose described.

2. A mandrel for supporting a hollow metallic ingot, a pair of step by step acting rolls, substantially such as described, for progressively reducing successive sections of said ingot into integrally united lengths of thin shelled tubing, in combination with a spring supported work gage bifurcated at one end and having its bifurcated end projecting partially into the space between said two rolls, as and for the purposes set forth.

3. A mandrel for supporting a hollow metallic ingot and a pair of step by step acting rolls substantially such as described for progressively reducing successive sections of said ingot into integrally united lengths of relatively thin shelled tubing, in combination with a work gage projecting partially into the space between said rolls, the said work gage affording clearance for the finished tubing but adapted to present a bearing and act as a stop for the unreduced or incompletely reduced forward end of the ingot for the purpose of arresting each of the endwise feeding movements of the ingot at a prescribed point.

4. A mandrel for supporting a hollow me-

tallic ingot and a pair of step by step acting rolls substantially such as described for progressively reducing successive sections of said ingot into integrally united lengths of relatively thin shelled tubing, in combination with a tubular work gage bifurcated at one end and having its bifurcated end projecting partially into the space between said two rolls, as and for the purpose specified.

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