(No Model.) 2 Sheets—Sheet 1.

# M. & R. MANNESMANN.

## AUTOMATIC FEED MECHANISM FOR STEP BY STEP TUBE ROLLS.

No. 556,013. Patented Mar. 10, 1896.

Fig. 1

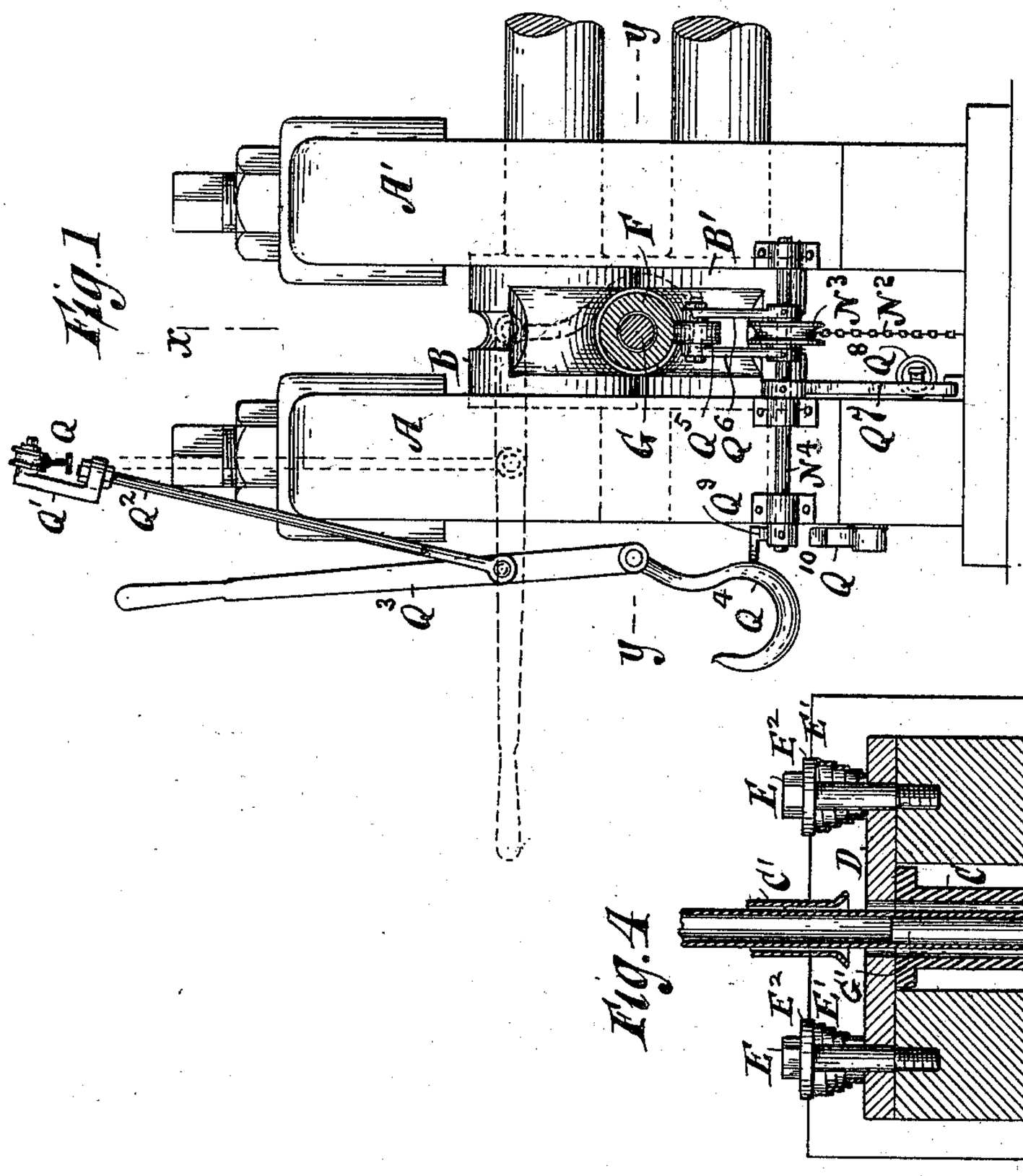
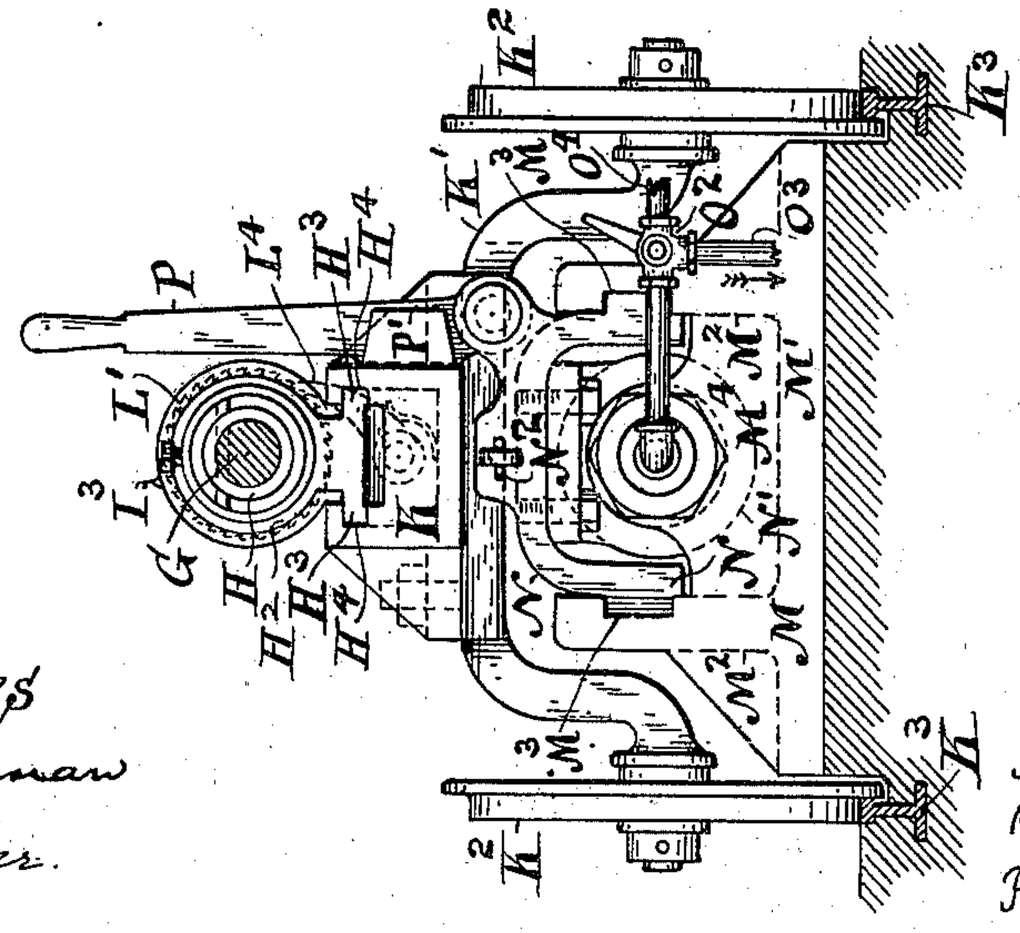



Fig. 4




Fig. 2

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(No Model.) 2 Sheets—Sheet 2.

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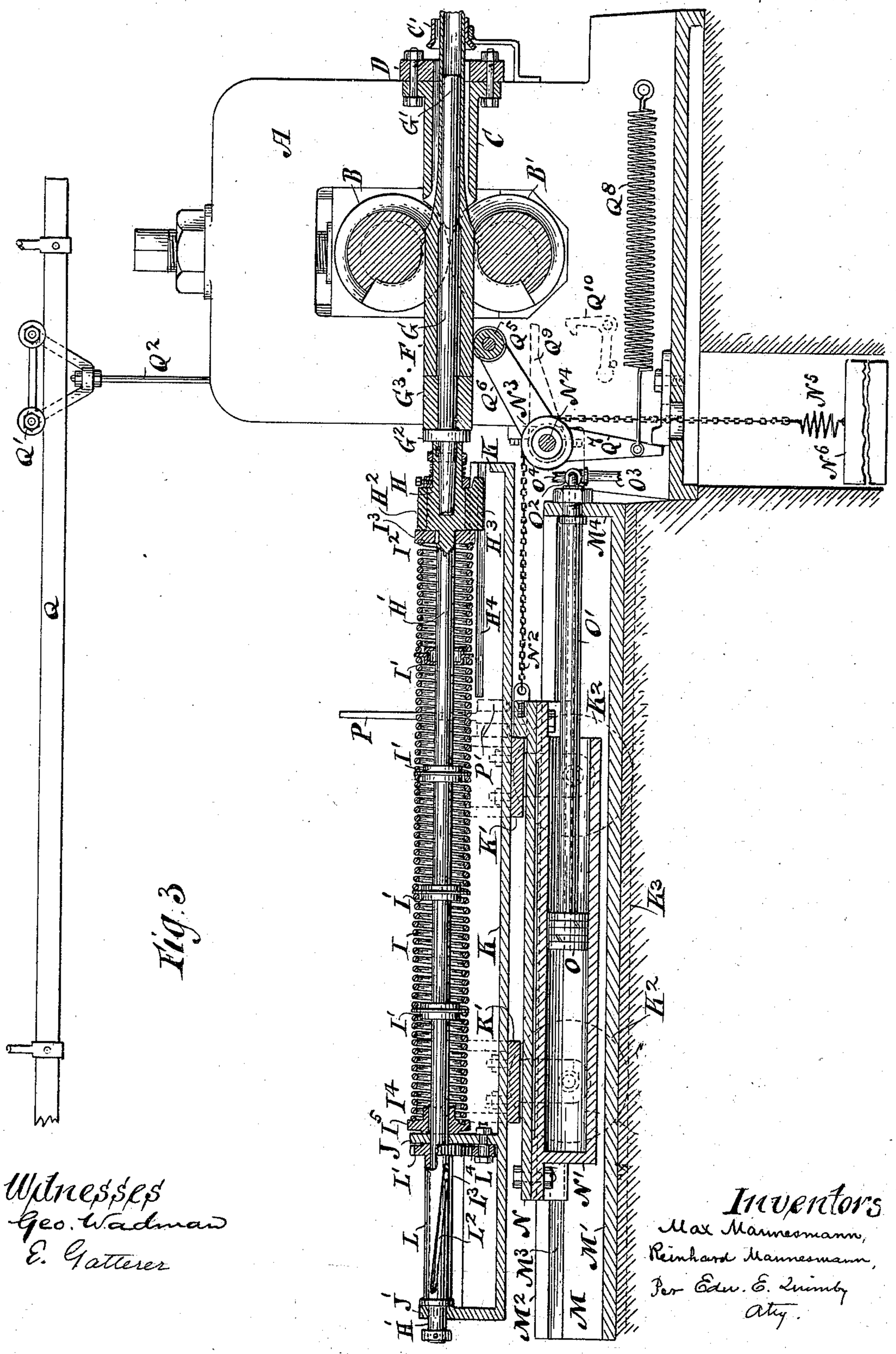


Fig. 3

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# UNITED STATES PATENT OFFICE.

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## AUTOMATIC FEED MECHANISM FOR STEP-BY-STEP TUBE-ROLLS.

SPECIFICATION forming part of Letters Patent No. 556,013, dated March 10, 1896.

Application filed August 13, 1895. Serial No. 559,134. (No model.)

*To all whom it may concern:*

Be it known that we, MAX MANNESMANN, of Remscheid, Germany, and REINHARD MANNESMANN, of the city and State of New York, have invented a certain Improvement in Automatic Feed Mechanisms for Step-by-Step Tube-Rolls, of which the following is a specification.

This improvement relates to devices for automatically feeding a mandrel and a relatively thick-shelled hollow metallic billet mounted thereon to a roll-pass, which during a part of every revolution of the rolls gradually diminishes in cross area, and thereby acts to reduce the relatively thick-shelled hollow billet step by step into integrally-united lengths of relatively thin-shelled tubing. For the successful production of this result it is preferred to employ rolls, the reducing-sections of which are paracentric. It is essential that each successive attack of the rolls upon the billet shall commence at a prescribed distance back from the forward end of the previously unacted-upon part of the billet, so that there will be a sharp initial impingement of the two rolls in the surface of the billet and a retention in front of the rolls of waves of metal which will be compressed toward each other as the main body of the billet and the mandrel are driven backward by the frictional effect of the working surfaces of the rolls upon the billet. By such compression the said waves of metal are ultimately made to form a portion of the finished tubing. As the finished tubing is formed, it is pushed forward upon the mandrel and finally pushed off the forward end of the mandrel.

The mandrel is provided with a shoulder in the rear of the billet and is hence forced backward by the backward thrust of the billet induced by the action of the rolls. A suitably-strong spring is so arranged that it is compressed by the backward movement of the mandrel. When the billet is released from the working faces of the rolls, the resilient action of the spring drives the mandrel forward. The range of the forward movement of the mandrel induced by the resilient action of the spring is intended to equal the range of backward movement induced by the frictional action of the working faces of the rolls upon the billet. During the backward movement of the mandrel a radially-projecting pin, affixed thereto by acting upon a spiral groove in a sleeve, through which a portion of the mandrel slides, turns the said sleeve and a ratchet-wheel mounted thereon ninety degrees, more or less, as may be desired. Suitably-arranged pawls prevent the ratchet-wheel and sleeve from turning backward, and hence during the forward movement of the billet the return travel of said pin through said spiral slot compels the mandrel and the billet mounted thereon to turn upon their longitudinal axis a number of degrees equal to the number of degrees to which the sleeve has been turned during the preceding movement of the mandrel.

The mandrel and its described operating devices are mounted upon a car which is subject to a prescribed strain, whereby at each revolution of the rolls it is moved toward the rolls a distance which it is intended shall equal the distance between the forward end of the previously unacted-upon part of the billet and the part of the billet which is next to be attacked by the rolls. To this end the car is locked to a hydraulic cylinder adapted to slide in fixed ways adjacent to the housings and containing a stationary hollow plunger through which liquid under pressure is forced into or withdrawn from the rear end of the cylinder. By means of an adjustable leak-valve liquid is allowed to escape from the cylinder at such a rate as will permit the cylinder and the car locked thereto to be at each revolution of the rolls pulled the required distance toward the rolls by the influence of a weight hung on a chain which is led over a suitably-placed pulley and connected with the forward end of the hydraulic cylinder.

When the rolling operations are concluded the car is unlocked from the hydraulic cylinder, and the operating-valve being suitably manipulated liquid under pressure is introduced into the cylinder, whereby the cylinder and car are forced rearwardly and the finished tube withdrawn from the rolls in a rearward direction.

A hollow work-gage is employed to act as a

stop for the forward end of the billet, so that it may not at any time feed too far forward. This work-gage is the subject of Max Mannesmann's pending application, Serial No. 536,442, filed January 28, 1895, and hence forms no part of the present invention, excepting so far as it enters as an element into combinations embracing automatic feeding devices.

In thus broadly stating the nature of the improvement it has been convenient to treat the mandrel as a single shaft extending backward upon the car and sufficiently forward therefrom to reach a short distance into the hollow work-gage, and such an organization would be entirely practicable, but inasmuch as it is desirable to employ mandrels of different sizes for making different sizes of tubing it is preferred to separably connect the forward part of the mandrel which enters the billet and supports the work with the rearward part thereof, which is permanently mounted upon the car.

The apparatus embraces a variety of appliances for handling, supporting and guiding the billet which are conventionally represented in the drawings, and which will be more conveniently described in detail.

The drawings illustrating the invention are as follows:

Figure 1 is a rear elevation of the roll-housings, showing the billet and mandrel in transverse section. Fig. 2 is a front elevation of the hydraulic cylinder, the car locked thereto, the sliding mandrel-carriage mounted upon the car, showing the rear part of the mandrel in transverse section. Fig. 3 is a longitudinal section taken through the plane indicated by the dotted line *x x* on Fig. 1 and showing the paracentric rolls in cross-section and showing also in section a hollow billet which has been partially transformed into a thin-shelled tube and showing the hydraulic cylinder and sliding mandrel-carriage in longitudinal vertical section. Fig. 4 is a horizontal section of the work-gage and adjacent parts, taken through the plane indicated by the dotted line *y y* on Fig. 1.

The apparatus represented in the drawings embraces two housings, A and A′, in which are mounted in the usual manner two grooved rolls, B B′, the working segments of which are paracentric.

The tubular work-gage C is arranged in front of the rolls upon a horizontal girder D, supported upon the shanks of the bolts E E, secured into the housings A A′.

The girder D is held with strong elastic pressure against the housings by the powerful expanding volute springs E′ E′, interposed between the outer face of the girder and the heads $E^2$ $E^2$ of the bolts E E.

The rear end of the work-gage is chamfered on the top and bottom, and thus forms two jaws, which extend nearly to the vertical plane of the axes of the rolls and present upon their opposed faces bearings approximately fitting the forward end of the partially-reduced billet F. By this construction the work-gage is made to act as a slightly-yielding stop for receiving the forward thrust of the billet when the billet is fed forward after each operation of the rolls upon it.

The billet F is supported upon a mandrel G, the forward end G′ of which terminates a short distance in front of the rolls. Near its rear end the mandrel G is provided with a shoulder $G^2$, in front of which is a waste-block $G^3$, which receives the backward thrust of the billet when the latter is acted upon by the rolls. The rear end of the mandrel G is detachably secured in the head H upon the forward end of the endwise-moving spring-bar H′, surrounded by the system I of expanding spiral springs, the members of which system are separated from each other by collars I′, which are loose on the bar H′, so that in yielding the expanding springs of the entire system act as a unit. The forward end $I^2$ of the foremost spring delivers its thrust against the collar $I^3$, which in turn transmits that thrust against the rear end of the sliding block or mandrel-carriage $H^2$. The rear end $I^4$ of the rearmost spring abuts against the collar $I^5$, which bears against the forward side of the perforated standard J, forming a part of the car-body K.

The head H is journaled in the block $H^2$, which is provided with side tongues $H^3$ $H^3$, adapting it to slide in the horizontal grooves $H^4$ $H^4$, formed in the opposite side walls of the car-body K. The bar H′ extends backward through the standard J and through the tubular hub L of the ratchet-wheel L′, and then through the rearmost standard J′ of the car-body.

The tubular hub L is provided with a spiral slot $L^2$, which engages a pin $L^3$, affixed to and projecting radially from the bar H′. During the backward movement of the bar H′ the travel of the pin $L^3$ in a right line, by its engagement with the spiral slot $L^2$, compels the rotation of the ratchet-wheel L′ through a prescribed number of degrees. During the return or feed movement of the bar H′ the ratchet-wheel is held stationary by a spring-pawl $L^4$ pivoted to the standard J, and consequently the bar H′, the mandrel G, and the billet mounted thereon are compelled to turn upon their longitudinal axes through a number of degrees equal to the number of degrees through which the ratchet-wheel has been compelled to turn during the backward movement of the bar H′. By this device or any other suitable device having the same mode of operation the rotatory feed of the billet is effected during its endwise forward feeding motion.

The car-body is mounted on inverted-U-shaped axletrees K′ K′, provided with flanged wheels $K^2$ $K^2$, traveling on parallel rails $K^3$ $K^3$, suitably aligned with relation to the housings.

Adjacent to the housings and between the two rails $K^3$ $K^3$ is erected a substantial frame M, composed of the bed-plate M′ and two lon-

gitudinal standards $M^2$ $M^2$, in the opposed side walls of which are two horizontal grooves $M^3$ $M^3$. The grooves $M^3$ $M^3$ serve as the guides for the sliding cylinder-carriage N, to which is secured the hydraulic cylinder N′. Connected to the forward end of the cylinder-carriage is a chain $N^2$, which is lead over a suitable sheave $N^3$, loosely mounted upon a rock-shaft $N^4$, supported in bearings affixed, as shown in Fig. 1, to the rear of the housings. The chain $N^2$ is led downward from the sheave $N^3$ into a well, and has its lower end connected to a strong spiral spring $N^5$, to which is attached a weight $N^6$. By this device the carriage N is constantly subjected to a strain tending to pull it toward the housings.

Within the cylinder N′ is a piston O, affixed to the rear end of the hollow piston-rod O′, which is held stationary by having its forward end fastened to the transverse standard $M^4$ of the frame M.

The forward end of the piston-rod O′ is connected to one of the valve-passages of an ordinary three-way valve $O^2$, the other two passages of which are connected respectively with a waste-pipe $O^3$ and with a pipe $O^4$, communicating with a reservoir containing a fluid under pressure.

The movement of the cylinder N′ toward the housings is governed by so regulating the three-way valve as to allow the escape from the cylinder N′ into the waste-pipe of such prescribed quantity of fluid as will permit the cylinder N′ to move toward the housings during each rotation of the rolls a distance equal to the distance between the forward end of the unacted-upon part of the billet and the place where the rolls are intended to commence their next action upon the billet.

The cylinder-carriage N has pivoted to it a locking-lever P, which, when the car has been run forward to an appropriate position, is thrown upward between the wings P′ P′, projecting laterally from the side of the car-body K. When the locking-lever P is thus seated between the wings P′ P′, the car is made to partake of the motions of the cylinder-carriage.

The thin-shelled tube as it is gradually produced by the rolling down of the billet is fed forward through the work-gage C and off the forward end of the mandrel G into the supporting-tube C′. When the billet is completely rolled down the three-way valve $O^2$ is so manipulated as to admit fluid under pressure into the hollow piston-rod O′, through which it makes its way into the cylinder N′, and by driving the cylinder backward moves the car backward and withdraws the finished tube from the rear of the housings. The finished tube is then removed from the mandrel G, and, if necessary, the waste-block $G^3$ is also removed and a new waste-block mounted in its place, and another hot billet is then slid on the mandrel.

For handling a heavy billet a suitably-arranged elevated rail Q is provided. A truck Q′, traveling on the rail Q, has suspended to it a rod $Q^2$, to the lower end of which there is pivoted a lever $Q^3$ of the first order, having pivoted upon its shorter end a hook $Q^4$, adapted to be hooked under and to sustain the billet when the lever $Q^3$ is swung into the horizontal position in which it is represented in dotted lines in Fig. 1. An operator holds the lever in a horizontal position while the car is being moved toward the housings and until the forward end of the billet is delivered between the housings and upon the supporting-roller $Q^5$, mounted upon the free ends of the arms $Q^6$ $Q^6$, which are affixed to the rock-shaft $N^4$. Another arm $Q^7$, affixed to the said rock-shaft and projecting downwardly therefrom, has its lower end connected with one end of the contracting-spring $Q^8$, the opposite end of which is secured to the side of one of the housings. The outer end of the rock-shaft $N^4$ has affixed to it another radius-arm $Q^9$, by means of which the rock-shaft $N^4$ can be conveniently so turned as to swing the supporting-roller $Q^5$ and the arms $Q^6$ $Q^6$ downward below the path of the carriage K after the forward end of the billet has been delivered between the rolls. To retain the roller $Q^5$ and the arms $Q^6$ $Q^6$ in their depressed position there is provided a weighted latch $Q^{10}$ for engaging the free end of the operating-arm $Q^9$.

For the purposes of the invention any instrumentality serving to support the mandrel-guides is to be regarded as the equivalent of the car-body K, and any means by which such instrumentality is subjected to a strain tending to move it at a prescribed rate toward the housings is to be regarded as the equivalent of the weighted chain fastened to the hydraulic-cylinder carriage to which the car-body is locked. Similarly, any means for controlling the permitted range of movement of the car toward the housings during each revolution of the rolls is to be regarded as the equivalent of the hydraulic cylinder and the device for controlling the permitted leakage therefrom during each revolution of the rolls.

A materially novel and important feature of the invention is the shoulder on the mandrel, by means of which the backward movement imparted to the billet by each action of the rolls is transmitted to the mandrel and the ensuing forward feeding movement of the mandrel is transmitted to the billet.

As will be perceived, the partial rotation of the mandrel and billet during each interval between successive actions of the rolls is effected by a motion derived from the backward movement of the mandrel, by which the ratchet-wheel, with its spirally-grooved elongated hub, is turned in one direction a prescribed number of degrees, in consequence of which, as the ratchet-wheel is prevented by its pawl from turning backward, the mandrel is compelled during its forward endwise motion to turn a like number of degrees. Thus by means of the system of springs, combined with the mandrel, the sliding hydraulic-cyl-

inder carriage to which the instrumentality supporting the mandrel is locked, and the weight constantly tending to pull the hydraulic-cylinder carriage toward the housings, the entire feeding operation is rendered automatic, and one of the features of the invention resides in the combination of automatic billet-feeding mechanism with the work-gage for arresting the forward movement of the billet by its collision at first with the forward end of the billet and thereafter with the partially-reduced portion of the billet. The work-gage, however, is not absolutely essential in all cases; but it may for abundant caution be usefully employed to arrest a forwardly-moving billet having such momentum as might otherwise carry the forward end of its unacted-upon portion too far beyond the appropriate line of impingement of the rolls.

What is claimed as the invention is—

1. In step-by-step tube-rolling apparatus substantially of the character described, the combination, as herein set forth, of paracentric rolls journaled in suitable housings, with an endwise-yielding and resilient mandrel adapted to carry a hollow billet upon its forward end portion; and provided with a shoulder at the rear of its billet-carrying portion, and guides for guiding said mandrel in a path intersecting the roll-pass.

2. The combination, as herein set forth, of paracentric rolls journaled in suitable housings, with an endwise-yielding and resilient mandrel; guides arranged in suitable alignment with said housings for guiding the said mandrel in a path intersecting the roll-pass; said mandrel being provided with a shoulder arranged at a prescribed distance back of the forward extremity thereof; means for subjecting said mandrel to a constant yielding pressure tending to move it in a forward direction through the roll-pass, and means for controlling the extent to which such forward movement is permitted during each revolution of said rolls.

3. The combination, as herein set forth, of paracentric rolls journaled in suitable housings, with an endwise-reciprocable mandrel provided with a shoulder at a prescribed distance back of its forward extremity; guides for guiding said mandrel in a path intersecting the roll-pass; springs for pressing said mandrel in a forward direction; a sliding carriage reciprocable toward and from said housings; means for connecting said guides with said carriage, and means for effecting the movement of said carriage toward said housings a prescribed distance during each revolution of said rolls.

4. The combination, as herein set forth, of paracentric rolls journaled in suitable housings, with an endwise-yielding and resilient mandrel mounted upon a car traveling on rails arranged in suitable alignment with said housings; said mandrel being provided with a shoulder arranged at a prescribed distance back of the forward end thereof; means for subjecting said car to a prescribed strain tending to move it toward said housings, and means for controlling the extent to which said car is permitted to move toward said housings during each revolution of said rolls.

5. The combination, as herein set forth, of paracentric rolls journaled in suitable housings, with an endwise-yielding and resilient mandrel mounted upon a car traveling on rails arranged in suitable alignment with said housings; an endwise-reciprocating hydraulic cylinder; guides for said cylinder parallel with said rails and approximately adjacent to said housings; means for locking said car to said cylinder; a stationary piston engaging the interior of said cylinder, and suitable pipe connections and valve mechanism for supplying said cylinder with fluid under pressure and for regulating the escape of fluid from said cylinder, as and for the purposes described.

6. Paracentric rolls mounted in suitable housings; an endwise-reciprocable mandrel; guides for guiding said mandrel in a path intersecting the roll-pass; means for automatically feeding said mandrel for the purpose of appropriately presenting a hollow billet carried thereon for the successive actions of the said rolls; in combination with a work-gage mounted upon said housings, the said work-gage provided with jaws adapted to bear upon a part of said billet and to arrest its forward feeding motion, as set forth.

7. The combination of the herein-described paracentric rolls and roll-housings with the adjustable supporting-roller, $Q^5$, tubular work-gage C and the endwise-reciprocable shouldered mandrel G, as and for the purposes set forth.

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