(No Model.) 3 Sheets—Sheet 1.

R. & M. MANNESMANN.

MECHANISM FOR MAKING SEAMLESS TUBES.

No. 389,585. Patented Sept. 18, 1888.

Fig. 1.

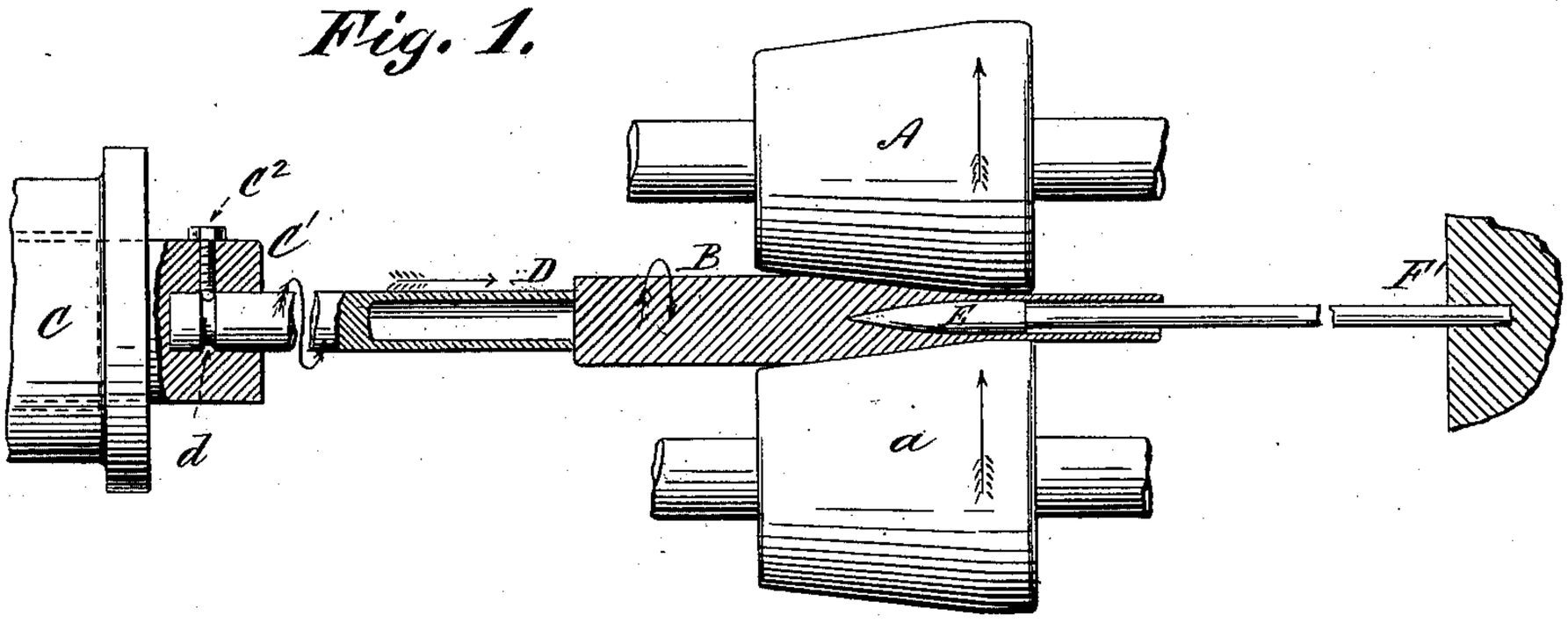


Fig. 2.

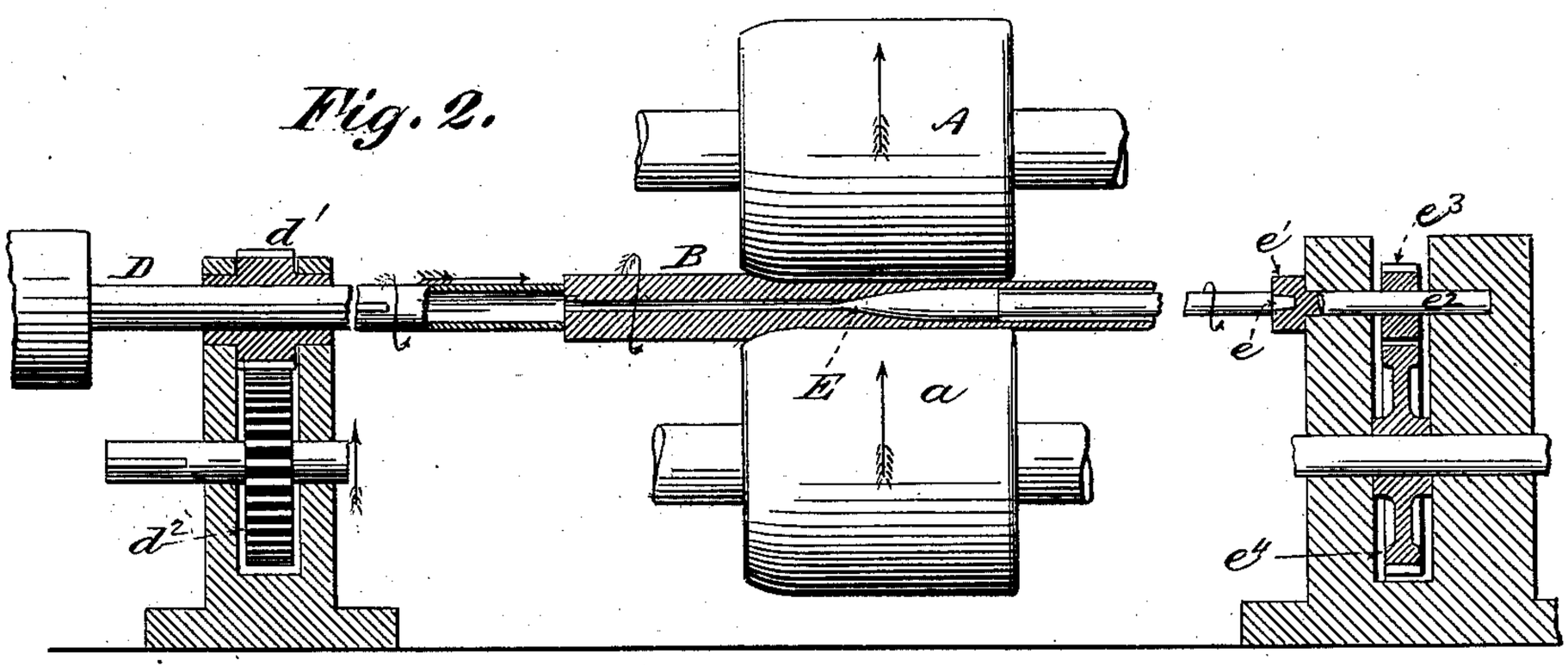
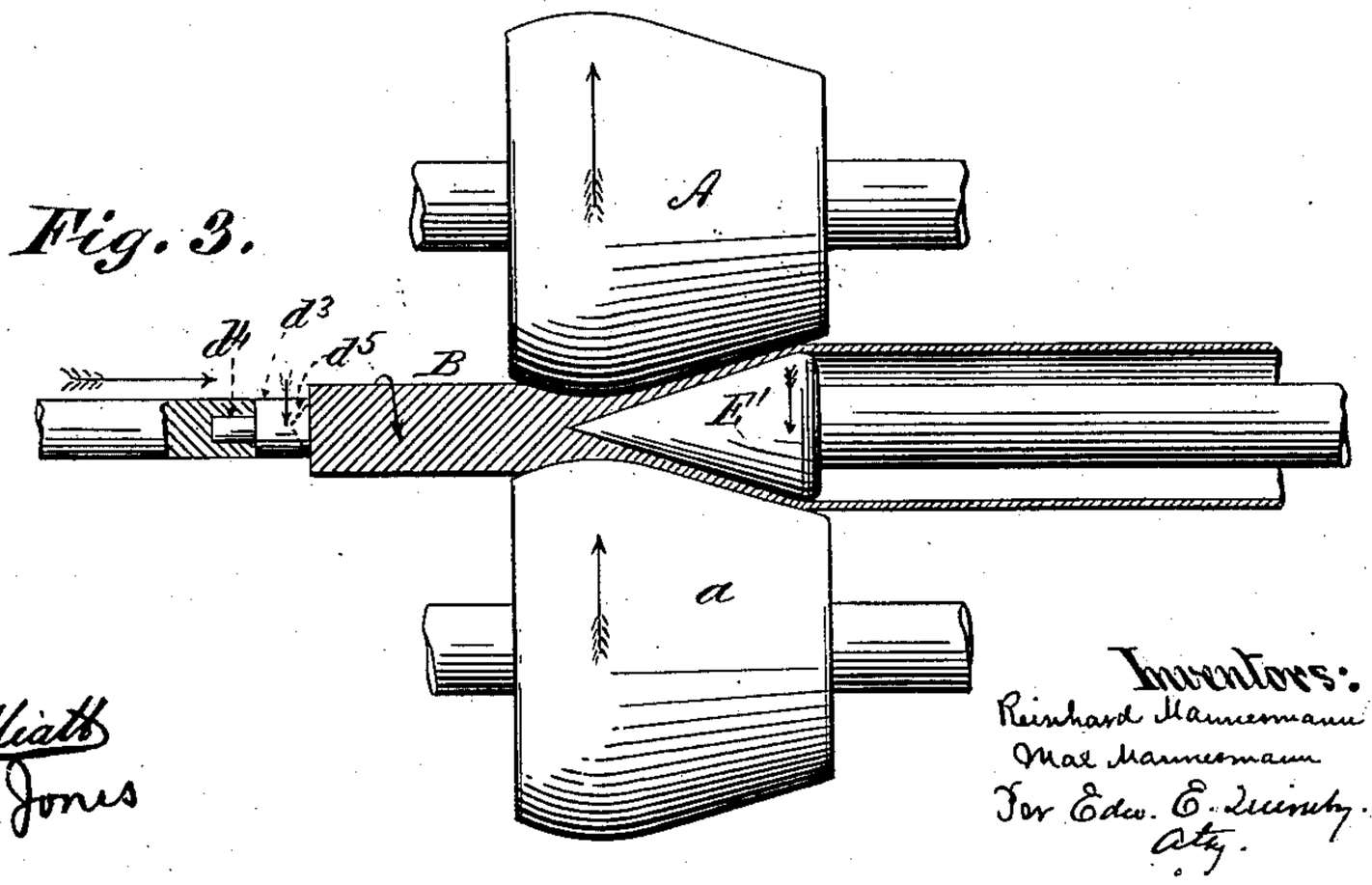


Fig. 3.



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(No Model.) 3 Sheets—Sheet 2.

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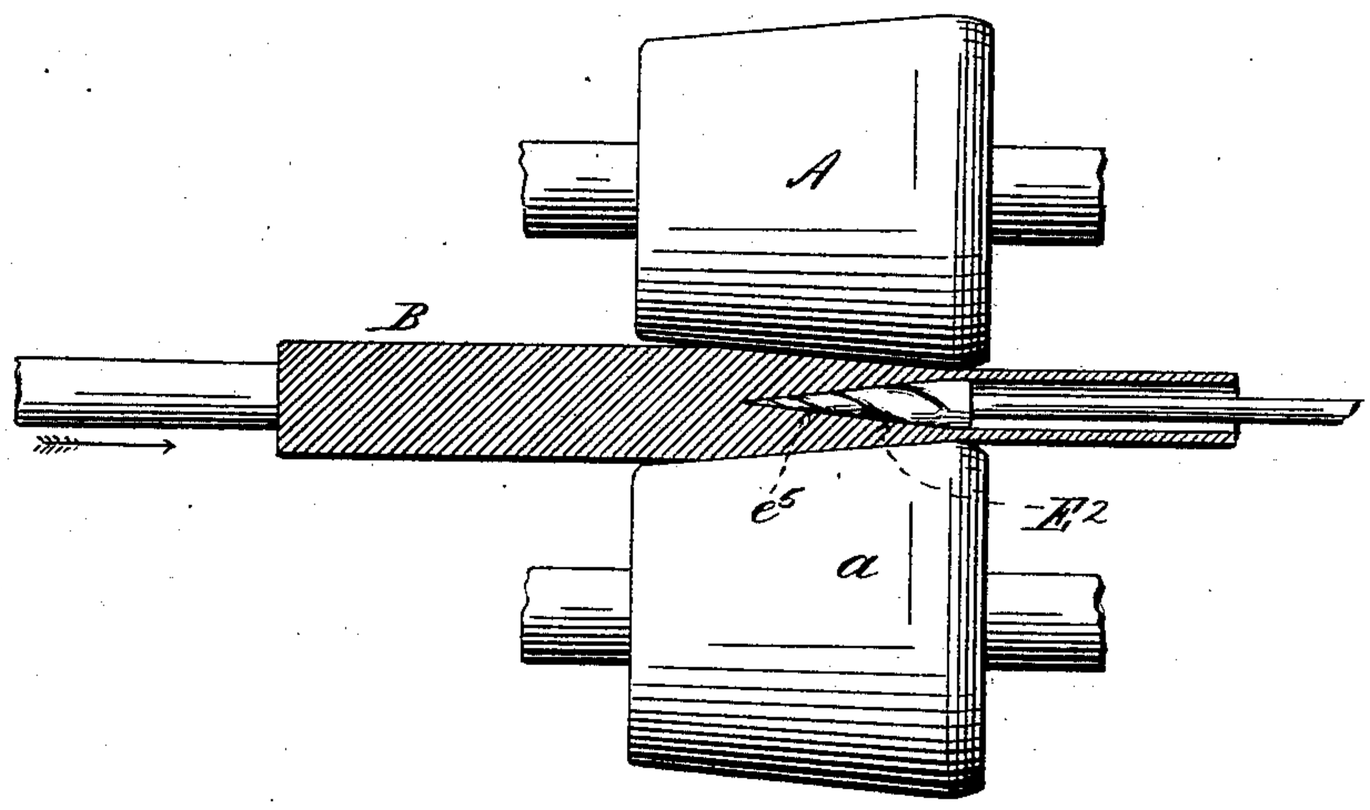
Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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MECHANISM FOR MAKING SEAMLESS TUBES.

No. 389,585. Patented Sept. 18, 1888.

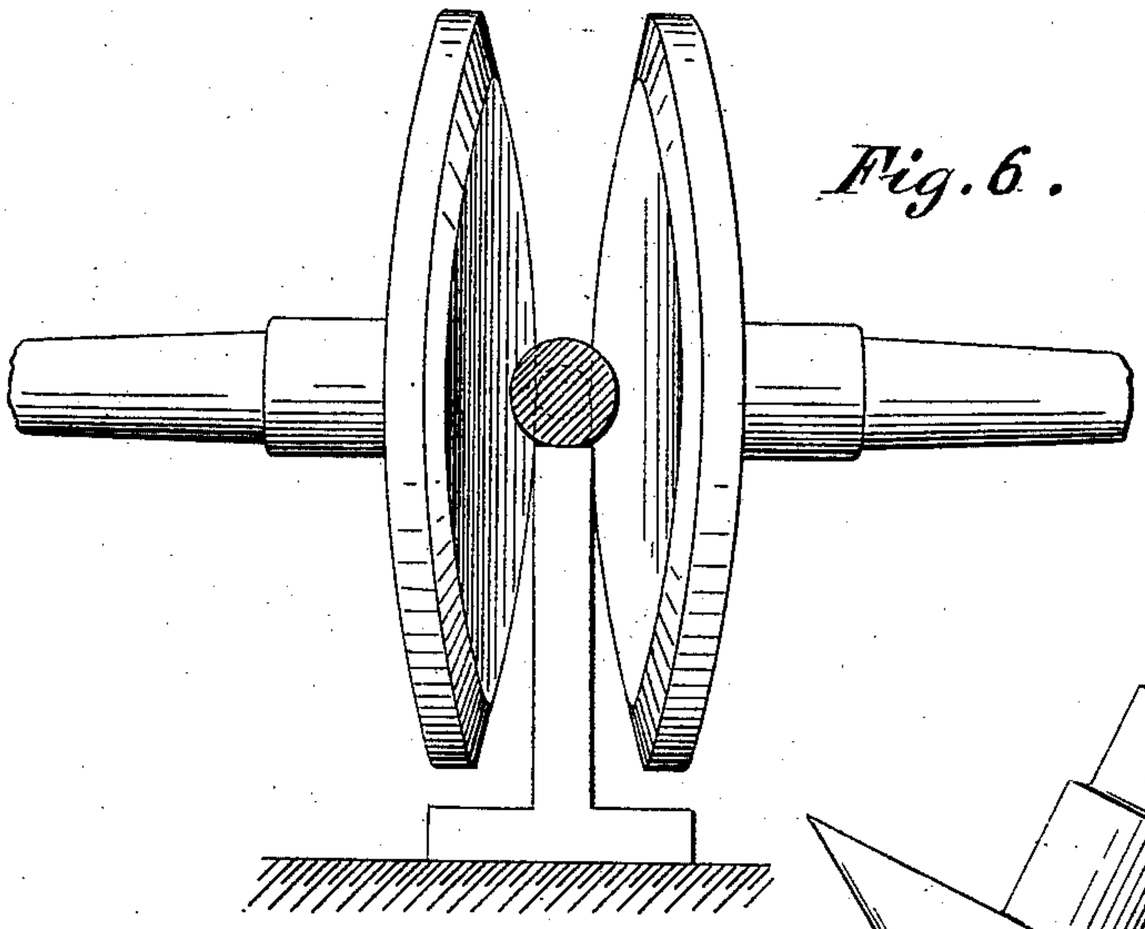

Fig. 6.

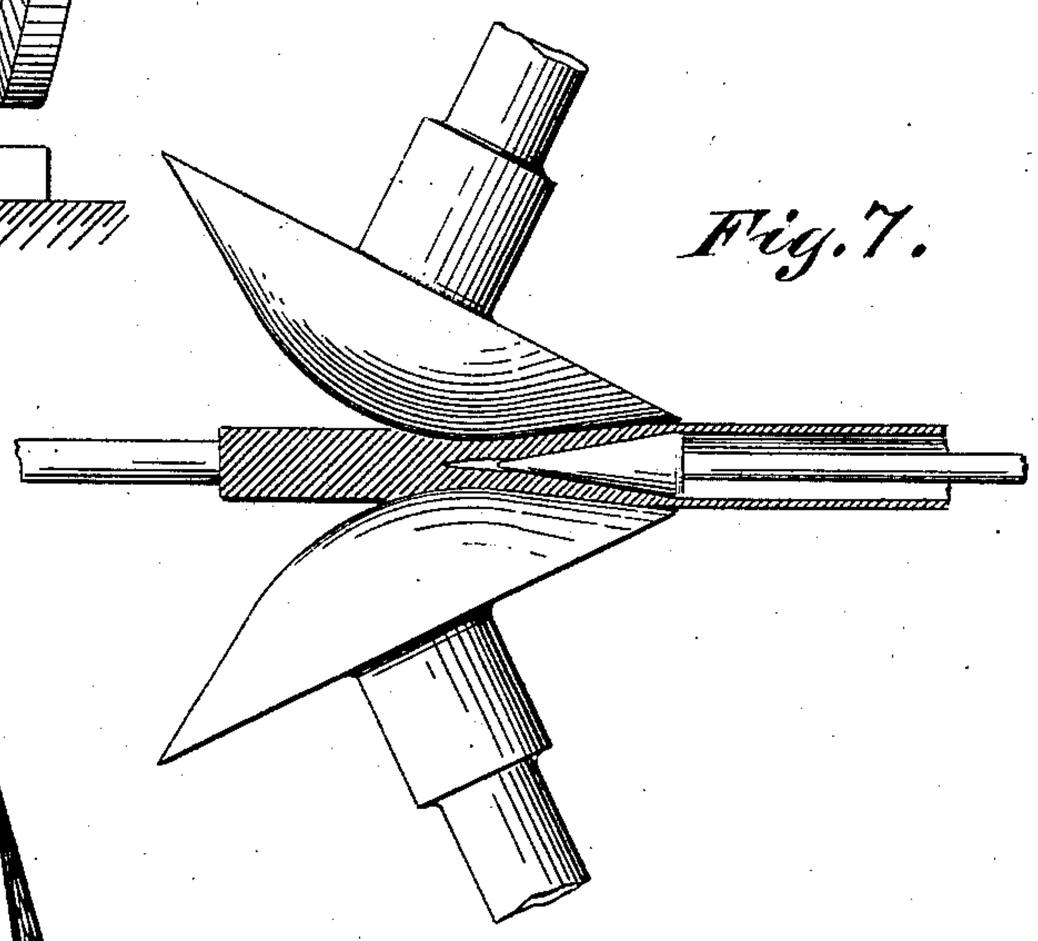

Fig. 7.

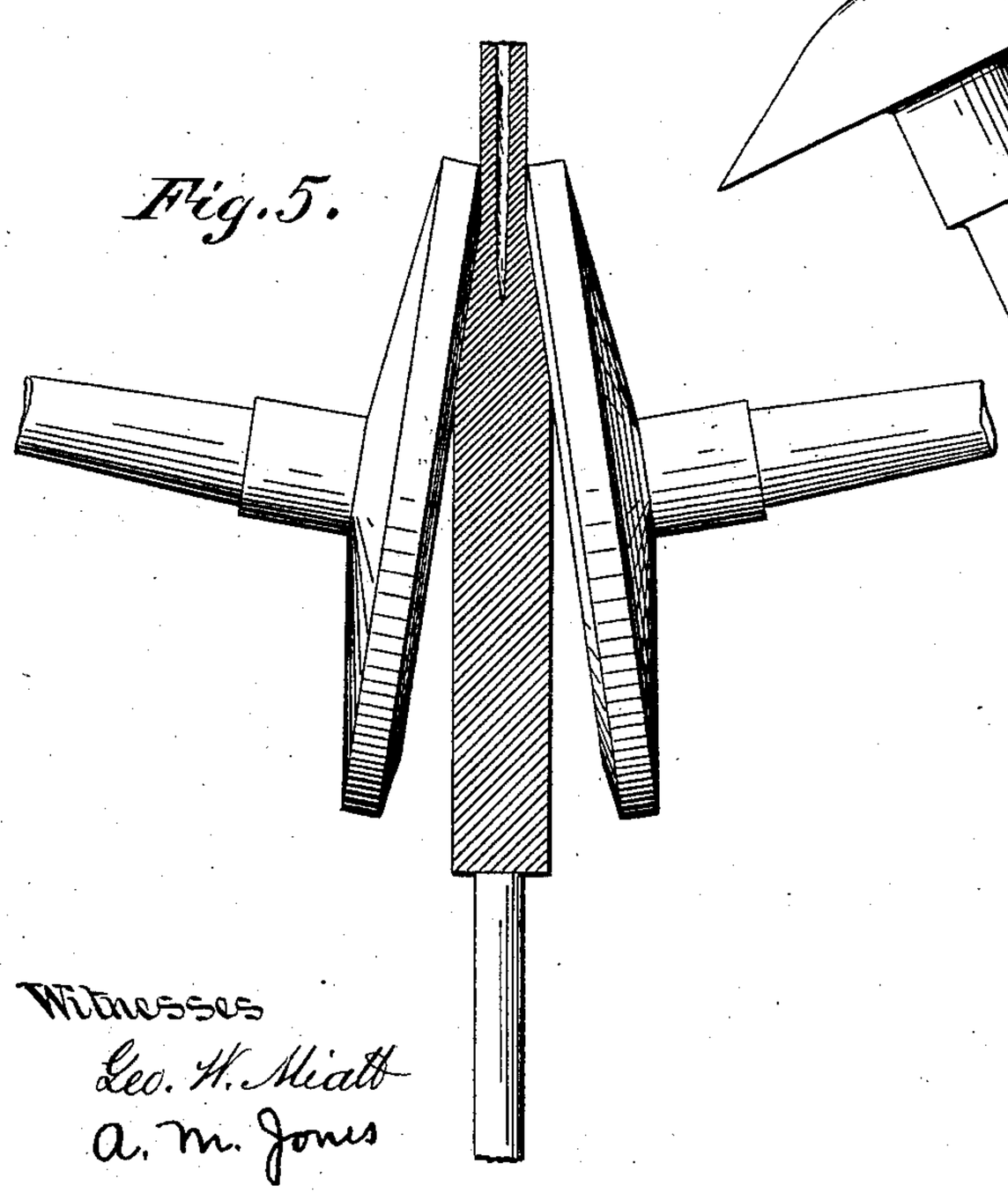

Fig. 5.

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UNITED STATES PATENT OFFICE.

REINHARD MANNESMANN AND MAX MANNESMANN, OF REMSCHEID, PRUSSIA, GERMANY.

MECHANISM FOR MAKING SEAMLESS TUBES.

SPECIFICATION forming part of Letters Patent No. 389,585, dated September 18, 1888.

Application filed September 8, 1887. Serial No. 249,063. (No model.) Patented in Italy January 26, 1886, No. 7,925; in Luxemburg June 20, 1886, No. 701; in Belgium August 14, 1886, No. 54,857; in Spain August 21, 1886, No. 9,537, and in Austria-Hungary September 18, 1886.

To all whom it may concern:

Be it known that we, REINHARD MANNESMANN and MAX MANNESMANN, of Remscheid, Prussia, Germany, have invented certain Improvements in the Art of Manufacturing Seamless Tubing, of which the following is a specification.

This invention relates to certain modifications in the apparatus for transforming solid metallic ingots into tubes, and for enlarging tubes or hollow metallic ingots, shown and described respectively in the four several Letters Patent of the United States issued April 26, 1887, to Reinhard Mannesmann, and in the six several Letters Patent of the United States issued April 26, 1887, to Max Mannesmann. In each of the forms of apparatus shown and described in the said patents the exterior of the ingot or blank is impinged upon by reducing-rolls, which act diagonally, and thereby exert a stretching or pulling effect upon the blank, which causes it to move progressively through the space between the opposed working-faces of the rolls.

The present invention consists in substituting for the stretching or pulling action of the rolls, or for a portion thereof, the action of an independent instrumentality which forcibly moves the blank along its path between the rolls at a prescribed speed. By this means the rolls may be either wholly or partly relieved from the work of imparting endwise movement to the blank. The axes of the rolls may be arranged in the same plane as the axis of the blank, or in a plane parallel thereto, in which case the operation which they perform is for present convenience called "cross-rolling," and they will be entirely relieved from the work of pulling the blank forward, or the axes of the rolls may be inclined from the axis of the blank relatively in opposite directions to a greater or less extent, in which case the endwise movement of the blank will be acquired partly from the pulling action of the rolls and partly from the action of the instrumentality especially employed to make the blank move endwise, which instrumentality is, for convenience herein, designated the "deliverer."

An incidental feature of the invention consists in the provision for employment in special cases of means for positively rotating the deliverer upon its longitudinal axis in the direction in which the blank is made to rotate by the rolls.

As diagonal rolling-machines are well known, it is deemed sufficient to herein show only those operative parts of the apparatus which in their construction and mode of operation are comprehended in the present invention.

The accompanying drawings are as follows: Figure 1 is an elevation of a pair of conical rolls, the axes of which are parallel with each other and with the axial line of a horizontal mandrel projecting into the narrower end of the space between the rolls; also showing in central vertical section a solid metallic ingot or blank in process of transformation into a tube, a deliverer bearing against the rear end of the ingot or blank, and a conventional representation of a hydraulic press for operating the deliverer. Fig. 2 is an elevation of a similarly-arranged pair of rolls and horizontal mandrel employed for enlarging the internal diameter of a hollow metallic ingot or blank while slightly reducing its external diameter; also showing a deliverer and means for imparting rotation thereto; also, means for imparting rotation to the mandrel. Fig. 3 is an elevation of a similarly-arranged pair of rolls, mandrel, and a deliverer for operating upon a solid blank, and transforming the same into a tube of larger diameter than the diameter of the original blank. Fig. 4 is an elevation of a similarly-arranged pair of rolls and deliverer and a horizontal mandrel, the conical head of which is provided with spiral grooves for the purpose of engaging the interior of the blank and promoting the forward movement of the metal thereof. Fig. 5 is a top view of a pair of diagonal rolls combined with a deliverer, showing in central longitudinal section a solid ingot or blank in process of transformation into a tube by the rupturing of the metal along the line of the geometrical axis of the blank and the movement of the metal outward therefrom in a spiral path. Fig. 6 is an elevation of the diagonal

rolls illustrated in Fig. 5, showing them arranged with their axes lying in the same horizontal plane, whereby they are adapted to perform the operation of cross-rolling, and also showing the blank in transverse section. Fig. 7 is a top view of a pair of hemispheroidal rolls arranged with their axes in the same horizontal plane and combined with a deliverer and an enlarging-mandrel, showing in central longitudinal section a solid blank in process of being transformed into a tube of larger diameter than the diameter of the original blank.

In the drawings, the various pairs of rolls are each represented as having their axes in the same plane, so that their action upon the blank is in a direction at right angles to the axis of the blank, and they hence exert no stretching or pulling effect upon the blank, the endwise movement being imparted to the blank by the deliverer bearing against the rear end of the blank, assisted in the apparatus represented in Fig. 4 by the spirally-grooved mandrel.

It is not deemed necessary to show diagonally-placed rolls, first, because such rolls are fully shown and described in the prior patents referred to, and, second, because it is obvious that the only effect of arranging rolls in relatively-opposite diagonal positions is to enable them to exert a stretching or pulling action upon the blank, and thus diminish the amount of work required to be performed by the deliverer in moving the blank forward.

The rolls may be of any desired shape, according to the particular purpose for which they are intended. Thus, when it is desired that they shall produce a hollowing effect in the blank by causing it to be ruptured along the line of its longitudinal axis, they are so shaped that their lines of impingement upon the blank converge gradually and impart to the blank a comparatively large number of revolutions while they are effecting the prescribed reduction in the external diameter of the blank. Pairs of rolls A *a*, for producing the internal rupturing effect, are illustrated in Fig. 5. Force for moving the blank B between the working-faces of the rolls is supplied by any convenient means—as, for illustration, by a hydraulic press, C, the piston C′ of which is arranged in alignment with the deliverer D, and with the path along which the blank travels. The deliverer D is, when necessary, made hollow, as shown in Figs. 1 and 2, in order to permit the entrance into it during the latter portion of its forward excursion of the mandrel E. The mandrel stem may be loosely stepped in the standard F′, or in some other stationary part of the machine, as illustrated in Figs. 1 and 2; and, similarly, the deliverer D may be loosely inserted in the end of the piston C′ and be retained therein by means of the key-bolt C^2, the inner end of which extends into the groove *d*, formed circumferentially around the inclosed portion of the shank of the deliverer.

The form of apparatus illustrated in Fig. 2 is adapted for operating upon a hollow ingot for the purpose of enlarging its internal diameter, and reducing, to a moderate extent, its external diameter. In this case, as will be seen, the rolls A *a* are tapered at their rear ends, so that their lines of impingement upon the blank at first converge slightly and are thereafter parallel with each other. As the blank is already hollow, there is in this case no necessity for the more extended convergence of their working-faces which is employed when the rolls are required to effect the rupturing of the blank along its geometrical axis. The point of the mandrel E in this case enters the hole in the hollow ingot, as shown. The directions of rotation of the rolls, blank, mandrel, and deliverer are indicated by the arrows in the drawings. The mandrel E is, when desired, rotated positively. This may be effected by the stepping of the squared end *e* of the mandrel-stem in a rectangular recess formed in the revolving head *e′*. The latter is affixed to the end of a counter-shaft, e^2, to which is keyed the pinion e^3, which is engaged and driven by the spur-wheel e^4. Similarly, the deliverer D, the rear end of which is loosely stepped in the outer end of the piston C′, as already described, is in some cases rotated positively by being feathered in the hub of the pinion *d′*, which is engaged and driven by the spur-wheel d^2.

In Fig. 3 there are shown, for the purpose of illustration, rolls A *a*, which are tapering at both ends and are combined with a conical mandrel, E′, the base of which is of greater diameter than the diameter of the blank B.

The rolls shown in Fig. 3 are especially adapted for acting on blanks composed of copper, brass, or other comparatively soft and ductile metal. It will be seen that their lines of impingement upon the blank B are at first convergent and then divergent. The deliverer D and the mandrel E′ may in this case be left free to rotate in obedience to the friction upon them of the rotating blank upon which they bear, or may be positively rotated in the manner described, or in any other convenient manner. Instead of loosely keying the end of the shank of the deliverer D in the piston of the hydraulic press, it may be rigidly affixed thereto, and its forward end may, if desired, be provided with the removable anvil d^3, the stem d^4 of which, as will be seen, is loosely stepped in a cavity formed in the forward end of the shank of the deliverer, as shown in Fig. 3.

The presence in the apparatus illustrated in Fig. 3 of the enlarging mandrel E′ prevents the anvil from moving through the space between the rolls; hence the anvil d^3 is in this case made solid, or at most is provided upon its face with a small cavity, d^5. It will of course be seen that by increasing the length of the rolls A *a* and by tapering them at their forward ends as well as at their rear ends the

pointed end of the enlarging-mandrel E might be projected into the space between the tapering rear ends of the rolls, and the apparatus might thus be adapted for first developing in the blank a tendency to rupture along the line of its geometrical axis preparatory to the penetration of the mandrel into the blank and the subsequent enlargement of the blank to an external diameter greater than its original diameter.

In the apparatus shown in Fig. 4 the rolls A *a*, as will be seen, are arranged on either side of the axial line of a mandrel, E^2, the conical head of which is provided with spiral grooves e^5. In this case the mandrel is either held stationary or is rotated positively by the means illustrated in Fig. 2, or by any other convenient means, at a different speed from, or in a direction opposite to, the direction of the rotation of the deliverer D and the blank B. It results from this arrangement that the metal in the interior of the blank engaged by the spiral grooves e^5 is forced forward. The function of the deliverer D is the same as in the other cases; but in this instance the forward movement of the metal is assisted by the screwing action of the spirally-grooved mandrel upon the metal compressed between the mandrel and the rolls.

In apparatus of the character herein referred to it is usual to mount the shafts of the rolls in movable bearings, so that the rolls may be adjusted to different angles of inclination for the purpose of varying the extent of their diagonal action upon the blank; but while it has been deemed expedient to herein point out that the various operations referred to are, by means of the employment of the deliverer, capable of being performed with rolls which act crosswise upon the blank, it is also to be understood that the deliverer is a valuable adjunct to rolls which are so arranged as to act in diagonal directions upon the blank. And it is to be further remarked that the deliverer is so effective in its operation that it may be successfully employed to force a blank along its path between the converging working-faces of reducing rolls so arranged as to operate with a diagonal action in a rearward direction.

In all cases the deliverer is simply an instrumentality for forcing the blank to travel toward the narrowest part of the space between the rolls, the path of motion of the deliverer being in all cases in alignment with the path of the blank.

When it is not desired either to smooth the interior surface or enlarge the interior diameter of the tubular product, the mandrel of course is dispensed with, in which case the rolls are simply combined with the deliverer, as illustrated in Figs. 5 and 6.

We are aware that in apparatus heretofore known the attempt has been made to force a conically-pointed endwise-driven mandrel to pierce a solid blank placed between the working-faces of cylindrical rolls, and supported at the end opposite the mandrel by a non-rotating stationary anvil.

We do not consider such apparatus practical; but it might be greatly improved by employing in it that feature of our present improvement which consists in supporting the end of the ingot opposite that which is pierced by the mandrel by an anvil, which is either free to rotate or is rotated by positive means in the direction in which the ingot is rotated by the rolls.

What is claimed as the invention is—

1. In apparatus for transforming solid metallic ingots or blanks into tubes, or for enlarging the diameters of tubes or hollow metallic ingots or blanks, the combination, as herein set forth, of a mandrel with reducing-rolls arranged on different sides of the axial line of the mandrel, a deliverer or anvil for bearing against the rear end of the ingot or blank which is being acted upon, and means for moving the deliverer or anvil forward or backward in a path which is in alignment with the path of the ingot or blank, whereby, during the forward movement of the deliverer or anvil, the ingot or blank against which the deliverer or anvil bears is forced toward the narrowest part of the space between the opposed working-faces of the rolls and against the end and over the surface of the mandrel.

2. In tube-rolling apparatus substantially of the character described, the combination, as herein set forth, of a mandrel with rolls arranged on different sides of the axial line of the mandrel, a deliverer or anvil for bearing against the rear end of the ingot or blank which is being operated upon, and means for positively rotating the said deliverer or anvil in the direction in which the blank is caused to rotate by the action upon it of the rolls.

3. In tube-rolling apparatus substantially of the character described, the combination, as herein set forth, of rolls for imparting rotation to the ingot or blank which is being operated upon, a deliverer or anvil for bearing against the rear end of the ingot or blank, and a spirally-grooved mandrel, as and for the purposes described.

4. In tube-rolling apparatus substantially of the character described, rolls for rotating the ingot or blank which is being operated upon, reducing it in diameter and imparting to it a tubular form, in combination with a deliverer bearing upon the ingot or blank, and means for moving the deliverer in a path which is in alignment with the path of the ingot or blank between the working-faces of the rolls, substantially as and for the purposes herein set forth.

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