(No Model.). 2 Sheets—Sheet 1.

J. ROBERTSON.

MACHINE FOR MAKING TUBING.

No. 447,582. Patented Mar. 3, 1891.

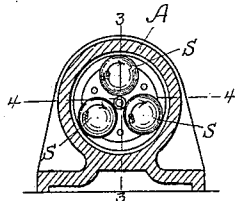


FIG. 1.

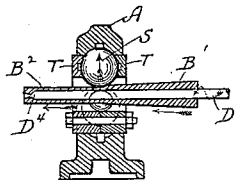


FIG. 2.

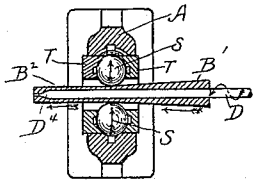


FIG. 3.

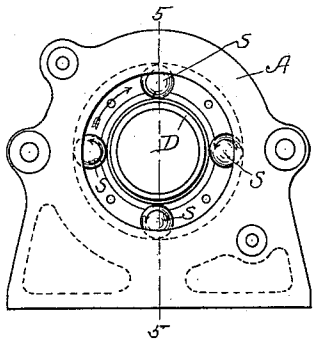


FIG. 4.

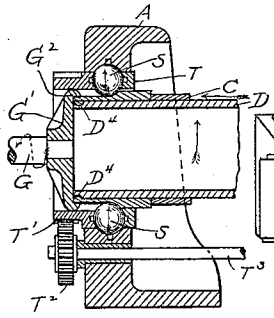


FIG. 5

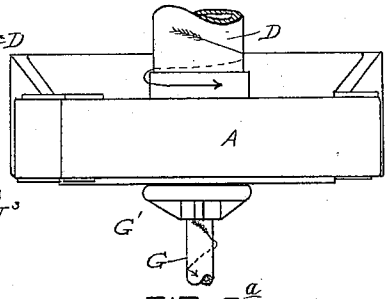


FIG. 9[a]

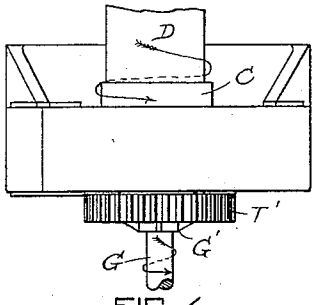


FIG. 6.

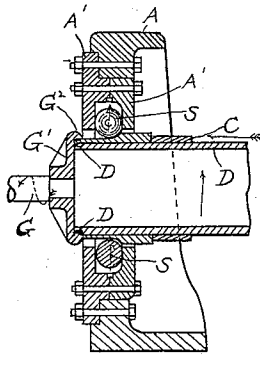


FIG. 8.

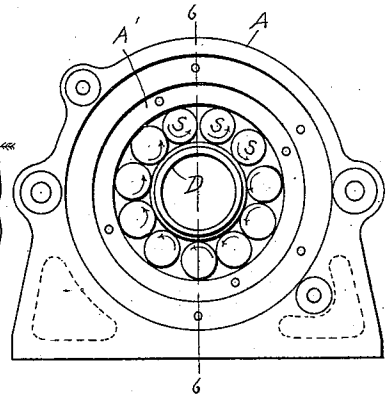


FIG. 7.

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Fig. 9.

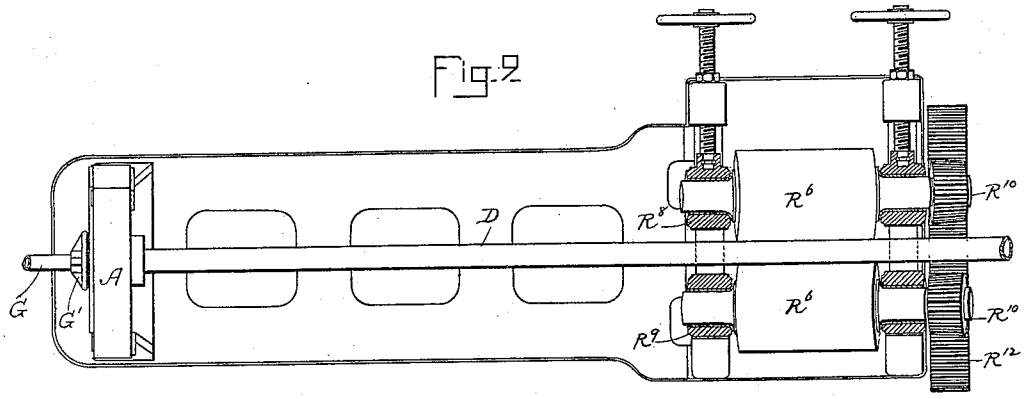
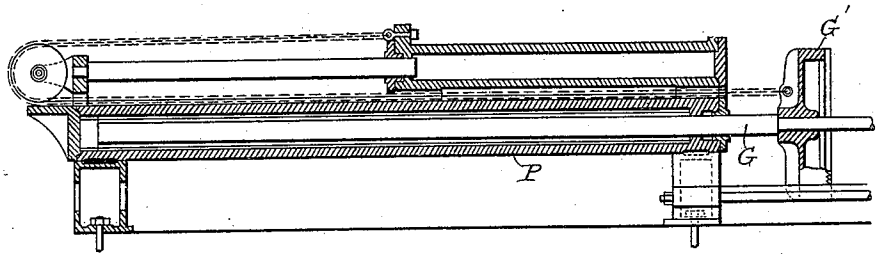


Fig. 10.



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UNITED STATES PATENT OFFICE.

JAMES ROBERTSON, OF BIRMINGHAM, ENGLAND.

MACHINE FOR MAKING TUBING.

SPECIFICATION forming part of Letters Patent No. 447,582, dated March 3, 1891.

Application filed March 7, 1890. Serial No. 343,031. (No model.) Patented in England April 4, 1888, No. 5,018; in France March 13, 1889, No. 196,678, and in Belgium March 14, 1889, No. 85,583.

To all whom it may concern:

Be it known that I, JAMES ROBERTSON, a subject of the Queen of Great Britain, residing at Birmingham, Warwickshire, England, have invented certain new and useful Improvements in Machines for Making Tubing, (for which I obtained a patent in Great Britain, No. 5,018, bearing date April 4, 1888; in Belgium, No. 85,583, dated March 14, 1889, and in France, No. 196,678, dated March 13, 1889,) of which the following is a specification.

This invention relates to means for drawing out tube-blanks or incipient tubes to thin gages, and thereby converting the same into large-sized tubes suitable for boiler-flues and other like articles.

The invention consists, chiefly, in a die of new and improved form and construction, comprising a circular series of rolls having a planetary motion about the exterior of the tube-blank, and a circular or annular holder in which said rolls are held in a circular series, so as to bear simultaneously on the exterior of the tube-blank to be drawn out. The tube-blank is by preference in a heated soft state and is placed on a mandrel about as long as or longer than the tube intended to be rolled down and finished. The roll holder or carrier in its most approved form consists of a strong stationary roll containing ring-casting, by preference of cast-iron turned out in its internal surface to form an annular channel or outside bearing for the circular series of rolls, and a circular sectional guide-frame secured within the ring-casting and made of such form as to retain the rolls in their position near to the channel in the ring, the rolls being set equally apart in a loose state and free to roll around and on the internal guide-frame. The mandrel is about the same diameter as the interior of the finished tube, and the whole arrangement, as far as the die is concerned with the mandrel placed in it, is very similar to an ordinary ball-bearing of which the mandrel is the journal.

In the accompanying drawings, forming a part of this specification, Figure 1 represents a sectional elevation of my improved roll-die as adapted for drawing out the smaller sizes of tube-blanks. Fig. 2 represents a section on line 3 3, Fig. 1. Fig. 3 represents a section on line 4 4, Fig. 1. Fig. 4 represents an end elevation of a somewhat differently-formed die embodying my invention, the same being adapted for drawing out tubes of large diameters. Fig. 5 represents a section on line 5 5, Fig. 4. Fig. 6 represents a plan view of a die of another form. Fig. 7 represents an end elevation of yet another form of die. Fig. 8 represents a section on line 6 6, Fig. 7. Figs. 9 and 9ª represent plan views of the die shown in Figs. 7 and 8, Fig. 9 also showing means for rotating and advancing the mandrel. Fig. 10 represents a longitudinal section of an apparatus for holding up the head, shown in Figs. 5, 6, 8, and 9.

The same letters of reference indicate the same parts in all of the figures.

Referring at present to Figs. 1, 2, and 3, the improved die there shown is composed of a series of rolls S, which are preferably of hard cast-iron, and a holder whereby said rolls are held in a circular series and adapted to rotate freely and to revolve about a common center, so that they will bear simultaneously on and be kept in rolling contact with the exterior of a tube-blank B', inserted in the space which they surround. The said holder, excepting when made as shown in Figs. 7, 8, and 9, is composed of a ring A, preferably made of cast-steel in one solid piece, internally grooved to form a way or channel for the outer portion of the rolls and provided with a suitable base, and an internal roll-guide composed of two rings or sections T T. The roll-guide T T is of an annular form, as shown, and has its external diameter turned to an easy-working fit for the internal diameter of the ring A. The guide T has a series of spherical cavities formed in it to receive the rolls S, said cavities being slightly larger in diameter than the rolls, so that they can rotate freely, the guide T being thus enabled to keep their rolls in their relative positions to each other. The sections composing the guide T T are bolted together by bolts placed between the rolls, as shown in Figs. 1 and 2, after the rolls are placed in the ring A. The guide T T is free to rotate in the ring A, so that the rolls which are free to rotate independently have a planet-

ary motion about the tube-blank and are always kept equally divided apart in the circle in which they roll.

D represents the mandrel with a taper-formed tube-blank B′ of metal upon it, said blank being supposed to be of steel in a hot soft state. The mandrel and tube-blank are introduced into the space surrounded by the rolls and are given simultaneously a rotary and progressive lengthwise motion. By this operation the metal of the tube-blank is first contracted at its point and is made to fit tightly over a collar and taper-pointed end D^4, formed on the mandrel in an ordinary way, as shown, the tube-blank being thus prevented from slipping forward over the mandrel D, and also from turning round on it. After this, the swift rotary and progressive movements of the mandrel and tube-blank being continued, the frictional contact of the tube-blank B′ gives rolling motion to the spherical rolls S and rotates their guide T, the rolls rolling round in the channel formed in the ring A. The soft tube-blank B′ is thus held firmly between the mandrel D and the rolls S, and its soft mass, thus put under swift rolling action, is speedily rolled down into a thin tube B^2 through its entire length. The motions of the mandrel D and of the tube-blank B′, as also of the rolls S and their guide T, are indicated by the arrows placed on said parts. There is a tendency in the tube B^2 thus rolled out of a billet to become overloose on the mandrel D, or larger in internal diameter than the external diameter of the mandrel; but this action is kept in check by the strain of the rolls against the end on traverse or progressive longitudinal movement of the mandrel, which, having the tube fixed on it at its tapered collar-point D^4, as above described, keeps the internal surface of the tube B^2 as it is being rolled out sufficiently close to the surface of the mandrel D. The necessary quick spiral or combined rotary and progressive motion may be communicated to the mandrel by any ordinary sort of gear. For the smaller sizes of tubes—such as the die shown in Figs. 1, 2, and 3 is designed for—the best mode of giving motion to the mandrel is by a pair of skew-rolls arranged to drive the mandrel by frictional contact therewith, as shown in Fig. 9, and hereinafter described.

The guide-holder T may be provided with a gear T′, meshing with a pinion or gear T^2 on a power-driven shaft T^3, whereby the guide-holder may be positively rotated, as shown in Figs. 5 and 6, said figures showing an adaptation of the invention for rolling out tubes of larger diameter than the construction above described. The gear T′ and pinion T^2 are so proportioned and the rotation of the shaft T^3 is so timed that the roll-guide T has the same number of rotations per minute that the rolling action of the rolls transmits to the rolls themselves by rolling on the surfaces of the tube-blank and on the fixed ring A.

In the last-mentioned figures I show an after-head G′, connected by a stem-rod G with a device which, while permitting the head G′ to yield or recede with the advancing motion of the mandrel, exerts a retarding pressure on the head G′, and through the latter on the end of the tube on the mandrel D. The said device may be a hydraulic ram connected with the stem-rod, as shown in Figs. 67 and 68 of my British patent, No. 5,018, of 1888, where a head G′ and stem-rod G are shown as controlled by a hydraulic ram, so as to yield to the advancing motion of a mandrel, but at a slower rate, the ram affording a frictional resistance to the yielding movement of the head G′. The head G′ is in this case adapted to rotate with the tube and mandrel, and is provided with a marginal flange G^2, which incloses the end of the tube-blank on the mandrel. The purpose for which the head G′ is employed is in this case to clamp or fix the end of the tube-blank upon the forward end of the mandrel, the latter being grooved at D^4 to engage the metal of the blank forced into said groove. The inclosure of the end of the tube-blank by the flange G^2 and the yielding pressure of the head G′ on the end of the tube-blank prevents the blank from being pushed along or turned independently on the mandrel by the action of the rolls. The hydraulic ram above referred to, with the stem-rod G, rotates with the mandrel, and the tube-blank is held up at a lesser degree of pressure exerted on it by a safety-valve than is exerted to effect the forward motion of the mandrel D.

In the construction shown in Figs. 7, 8, and 9 the rotary guide T is omitted, and the number of rolls S is such that the rolls form a continuous series, each in contact with the next. In this case the roll-holder is composed of two annular sections A′ A′, securely bolted together and to a strong containing-frame E. The sections A′ are grooved in their inner sides for the reception of the rolls S, as shown in Fig. 8. One of the sections A′ is removed in Fig. 8, to show the rolls more clearly. This form of roll-die is very suitable for rolling down a small degree of the thickness of a tube-blank at a time; but owing to the great number of rolls used and the consequent great number of acting rolling-points on the tube-blank it requires very great endwise force on the mandrel to push it in between the rolls. Hence this form is not suitable for rolling down so much at one pass as can be effected by the forms of these dies, described in connection with Figs. 1 to 6. Its action is otherwise similar to that described in connection with Figs. 4 to 6. Any suitable wheel or other gear may be employed to operate these larger sizes of dies by communicating swift spiral motion to the mandrel D.

In Figs. 5, 6, and 8 I have shown a ring C, fitted somewhat closely on the mandrel, but not rigidly secured thereto, the connection being by friction or otherwise, so that the

ring has a resisting hold on the mandrel. Said ring is in contact with the rear end of the tube-blank, and as it rotates with the mandrel it aids the latter in rotating the tube-blank.

In Fig. 9 I have shown a pair of skew-rolls R^6 R^6, arranged to rotate the mandrel and move it forward, said rolls being arranged obliquely to the mandrel in boxes R^8 R^9, the shafts of said rolls being provided with pinions R^{10}, meshing with a driving-gear R^{12}.

Fig. 10 shows the stem-rod G, supported by a hydraulic cylinder P, in which it is adapted to move endwise, its yielding movement being regulated by the means shown in Figs. 78 and 79 of my British patent, No. 5,018, of 1888.

I claim—

1. As an improvement in apparatus for making and drawing out tubes and tubular articles, the combination of a die comprising a plurality of vertically-disposed circularly-arranged rolls and a holder therefor, the periphery of said rolls constituting the forming portions of the die, a horizontally-disposed mandrel formed to pass through the space surrounded by said rolls, and mechanism for simultaneously rotating said mandrel and moving it endwise through the die, as set forth.

2. As an improvement in apparatus for making and drawing out tubes and tubular articles, the combination of a vertically-disposed fixed annular holder or casing, an annular two-part roll-guide fitted to rotate in said holder, and a vertically-disposed circularly-arranged plurality of rolls fitted to rotate independently in said guide, as set forth.

3. As an improvement in apparatus for making and drawing out tubes and tubular articles, the combination of a vertically-disposed fixed annular holder or casing, an annular two-part roll-guide fitted to rotate in said holder, and a vertically-disposed circularly-arranged plurality of rolls fitted to rotate independently in said guide, a mandrel formed to pass through the space surrounded by said rolls, and means for simultaneously rotating and advancing said mandrel, as set forth.

4. As an improvement in apparatus for making and drawing out tubes and tubular articles, the combination of a vertically-disposed fixed annular holder or casing, an annular two-part roll-guide fitted to rotate independently in said holder, a series of rolls rotatable independently in said roll-guide, and means for positively rotating said roll-guide, whereby the rolls therein are revolved about their common center, as set forth.

5. As an improvement in apparatus for making and drawing out tubes and tubular articles, the combination of a fixed annular holder or casing, an annular roll-guide fitted to rotate independently in said holder, a series of vertically-disposed circularly-arranged rolls rotatable independently in said roll-guide, and means for positively rotating said roll-guide, whereby the rolls therein are revolved about their common center, a mandrel, and means for giving simultaneous forward and rotary movements thereto, as set forth, said mandrel being passed horizontally between said rolls, as stated.

6. As an improvement in apparatus for making and drawing out tubes and tubular articles, the combination of a die comprising a plurality of loose rolls and a holder therefor, a mandrel formed to pass through the space between the rolls, mechanism for rotating and progressively moving the mandrel, and a movable guard or abutment on the mandrel adapted to bear on the end of a tube-blank in process of construction and force said guard or abutment having a frictional hold on the mandrel, whereby it is adapted first to press the blank or billet forward between the rolls and mandrel and impart rotary motion to the blank or billet from the mandrel at the commencement of the operation and afterward to yield and be forced backwardly by the elongation of the tube-blank, as set forth.

7. As an improvement in apparatus for drawing out tube-blanks, the combination of a die comprising a plurality of vertically-disposed circularly-arranged loose rolls and a holder therefor, a mandrel formed to pass horizontally through the space between the rolls, means for rotating and progressively moving the mandrel, and an after holding-up head G′, having a yielding movement and adapted to clamp the forward end of the tube-blank upon the mandrel and prevent independent movement of said blank, as set forth.

8. The herein-described method of drawing out tubes from tube-blanks, which consists in internally supporting the blank, rotating the same, and moving it longitudinally forward and applying rolling pressure to its outer surface while being revolved and moved forward, said pressure and movements compacting and drawing out the metal in tube form, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 14th day of January, A. D. 1890.

JAMES ROBERTSON.

Witnesses:

WILLIAM LINDSAY,

WM. ROBERTSON.