No. 877,073. PATENTED JAN. 21, 1908.

E. T. GREENFIELD.

MACHINE FOR MAKING METAL TUBING.

APPLICATION FILED NOV. 6, 1905.

2 SHEETS—SHEET 1.

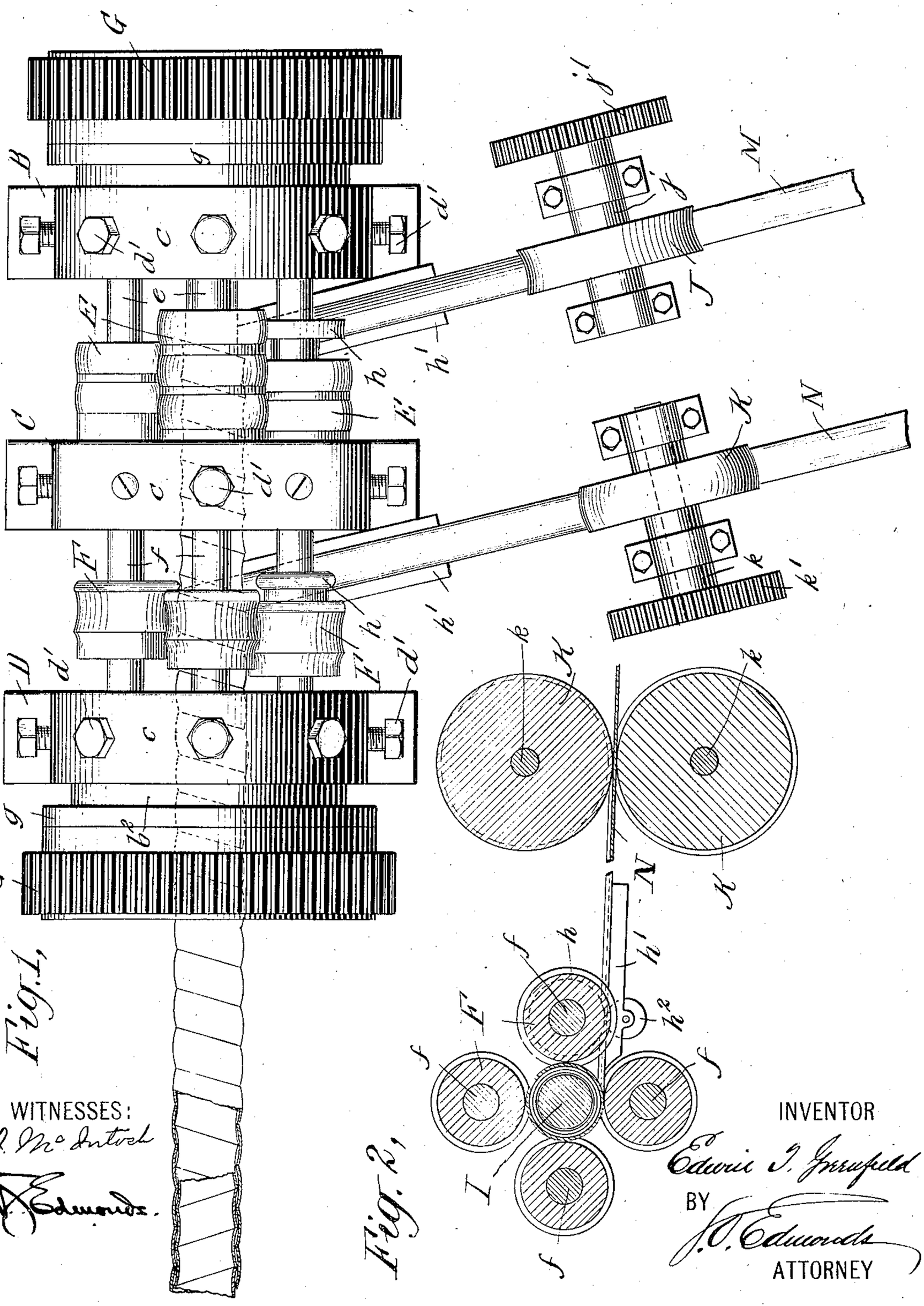

Fig. 1.

Fig. 2.

WITNESSES:
S. McDaniel
W. E. Edmunds.

INVENTOR
Edwin T. Greenfield
BY
J. O. Edmunds
ATTORNEY

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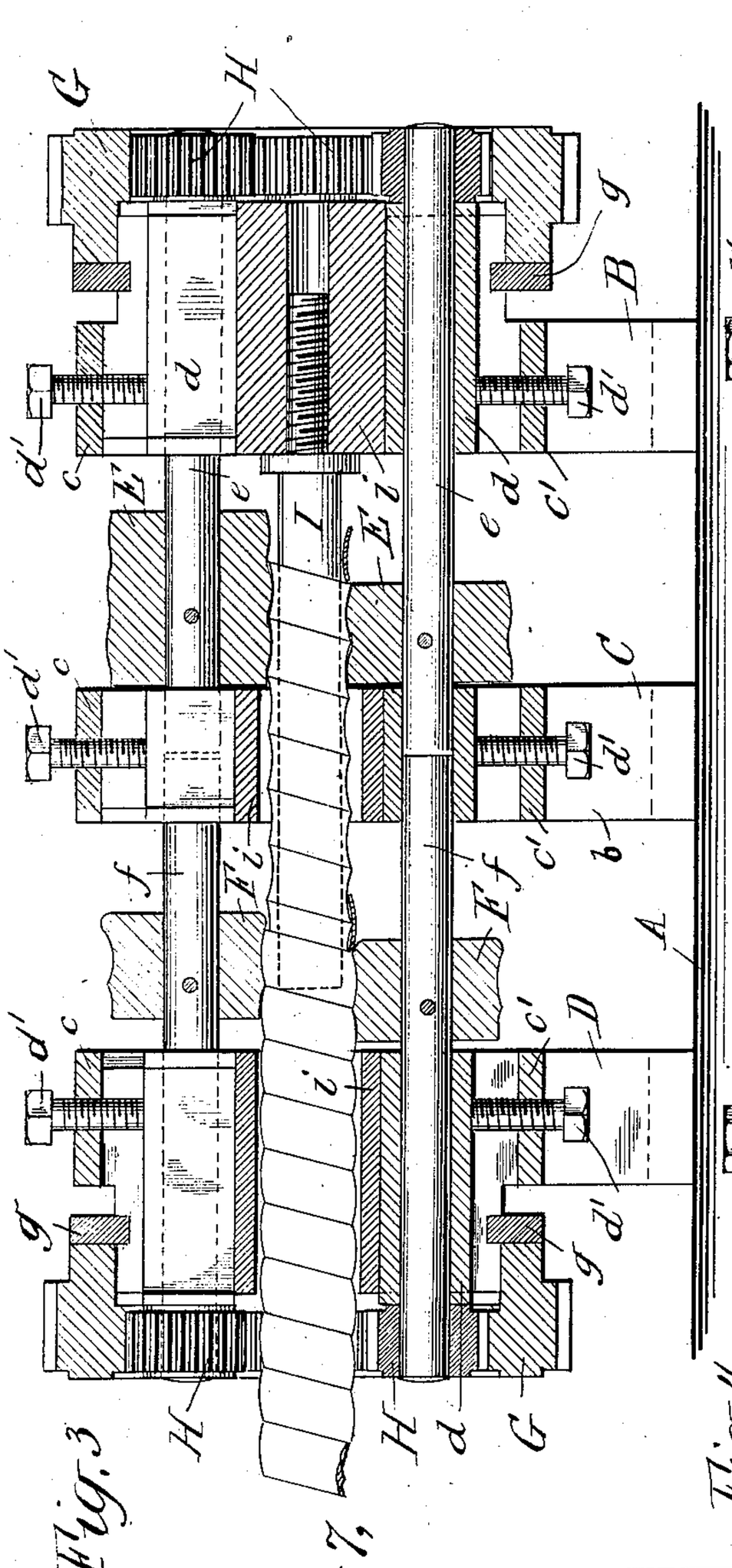

Fig. 3

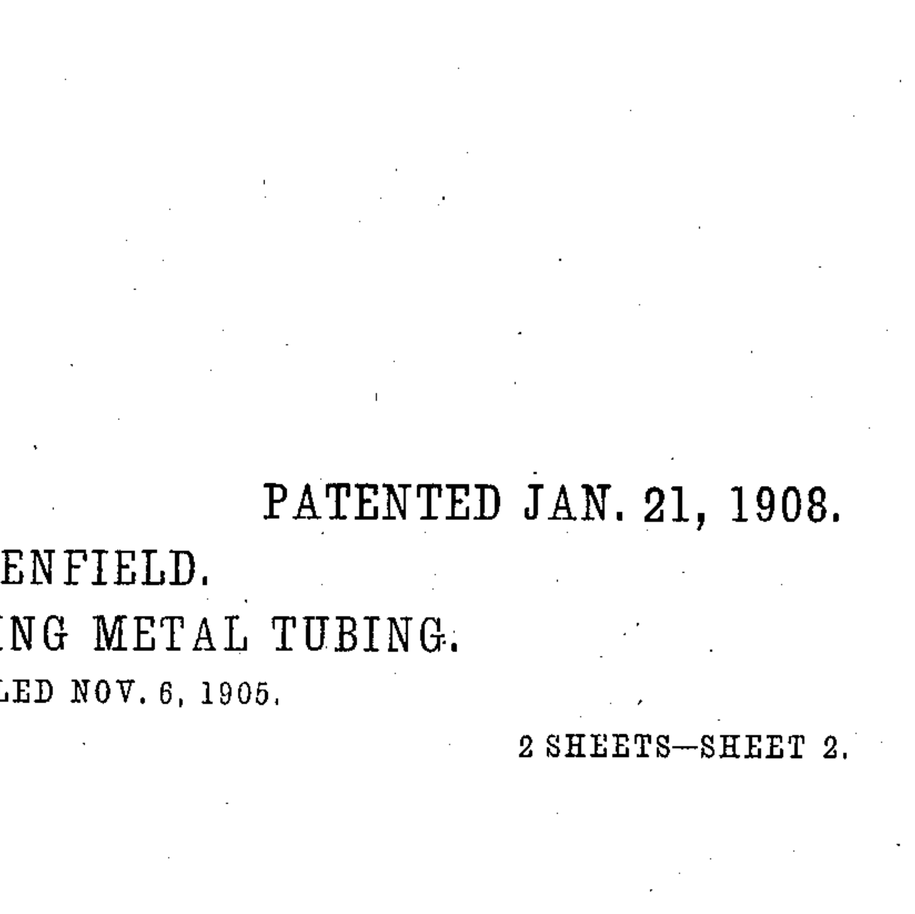

Fig. 5,

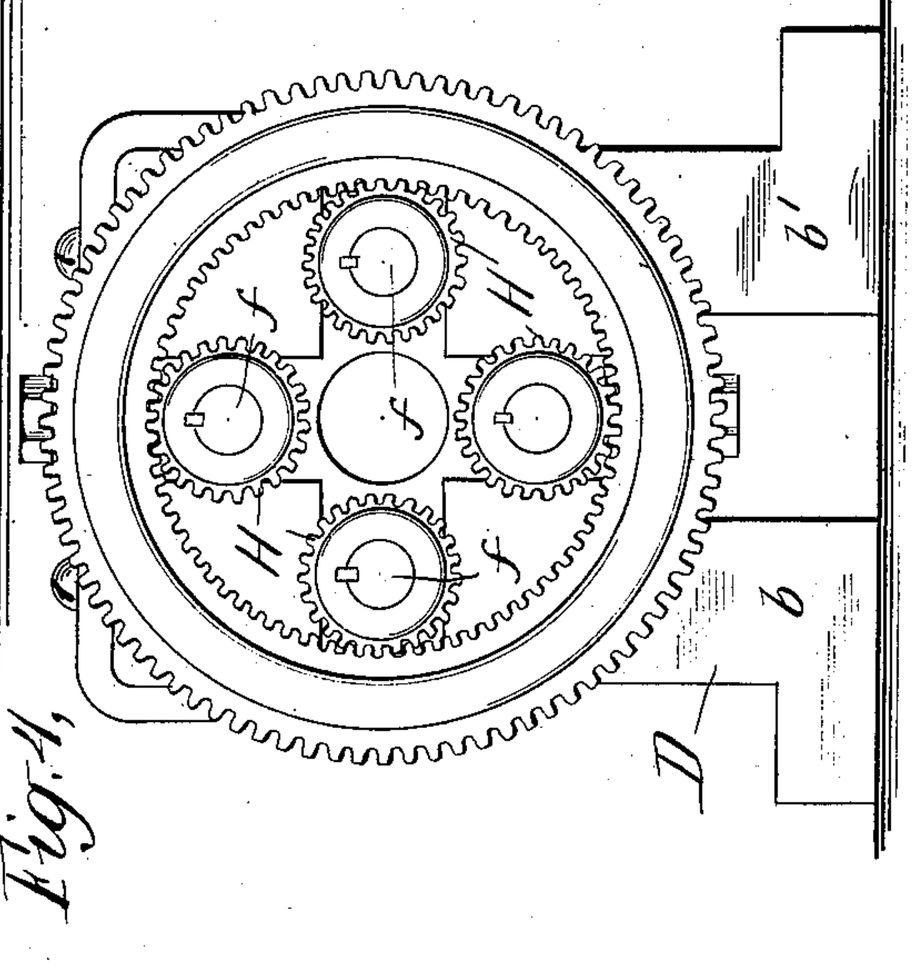

Fig. 4,

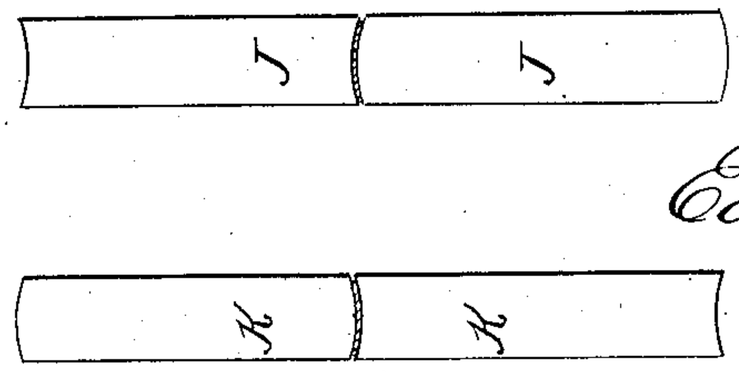

Fig. 6, Fig. 7,

WITNESSES:

J. McIntosh

J. Edmonds.

INVENTOR

Edwin T. Greenfield

BY

J. C. Edmonds

ATTORNEY

UNITED STATES PATENT OFFICE.

EDWIN T. GREENFIELD, OF KIAMESHA, NEW YORK.

MACHINE FOR MAKING METAL TUBING.

No. 877,073. Specification of Letters Patent. Patented Jan. 21, 1908.

Application filed November 6, 1905. Serial No. 286,059.

To all whom it may concern:

Be it known that I, EDWIN T. GREENFIELD, a citizen of the United States, residing at Kiamesha, in the county of Sullivan and State of New York, have invented certain new and useful Improvements in Machines for Making Metal Tubing, of which the following is a specification.

The object of my invention is to provide a machine for making flexible metallic tubing by forming a plurality of long strips of sheet-metal spirally one over another and breaking joints each with another, such tubes being of use in many different ways but particularly as conduits or armoring for electric conductors. Preferably the tubes are formed from two such sheet-metal strips, and for making such tubes, I provide a machine having a set of rotatable forming-rolls arranged to bend a strip of sheet-metal (as, for example, upon a mandrel) spirally to form a tube, and a second set of rotatable forming-rolls arranged to bend a second strip spirally about the tube formed by the first strip and so displaced laterally from the first set of forming-rolls that the strip bent thereby breaks joints with the first strip.

In the preferred form of my invention, the two strips of sheet-metal before being thus formed into a tube, are acted upon by suitable dies which give to each of the strips a transverse curvature, the strip for the inner spirally-formed layer being bent so that the convolutions formed therewith present a concave outer surface and the strip for the outer layer being bent so that the convolutions formed from it present a convex outer surface. The parts of the machine by which the spiral bending is effected are preferably so arranged that adjacent edges of successive convolutions of the two layers of spirally-formed strips are substantially in contact so that the tube formed is of double the thickness of one of the strips at all points throughout its length and there are therefore no weak points where the tube may be more readily punctured.

The preferred embodiment of my invention is illustrated in the accompanying drawings in which

Figure 1 is a top view of the machine, Fig. 2 is a view of the die and forming-rolls in diagram, Fig. 3 is a vertical section and Fig. 4 an end view of the machine, Fig. 5 is a section showing the bearings for the two sets of forming-rolls, and Figs. 6 and 7 are views of the die-rollers.

Referring to the drawings, A indicates a base or bed-plate on which three standards B, C and D are erected parallel with each other and a set of rotatable forming-rolls E and F are mounted in bearings between the middle one of the standards and each of the outer ones. Each of these standards comprise two base-blocks b and b' (Figs. 3 and 5) mounted in line with each other and a hand c fastened at each end to one of the blocks b and b'. Secured to the under side of the band c above the base-blocks b and b' are two blocks b^2 and b^3. The adjacent sides of the blocks b, b', b^2 and b^3 are parallel with each other and on each of these parallel sides is a tongue b^4 running lengthwise thereof, thus forming four guideways extending radially from a common center and spaced apart equally. Mounted to slide back and forth in each of these guideways is a suitably grooved bearing d and screws d' extend through threaded openings in the band c and a plate c' uniting the base-blocks b and b' by which the bearings d may be moved toward the center. Four shafts e, each carrying a forming-roll of the first set E are mounted for rotation in the bearings d of standards B and C and shafts f each carrying a forming-roll of the second set F are similarly mounted in the bearings in standards C and D. The blocks b, b', b^2 and b^3 of the standards B and D are extended on the non-adjacent sides and are machined to form cylindrical surfaces each having a peripheral groove therein and each of these surfaces forms a bearing for a gear G to the side of which is secured a ring g extending into the peripheral groove to position the gear. On the interior and exterior of each gear G beyond the end of the bearing are formed gear-teeth, the exterior teeth meshing with those of a power-driven gear and the interior teeth meshing with four pinions H (Fig. 4), each mounted on the end of one of the shafts e and f carrying the forming-rolls. Mounted centrally in each of the standards B, C and D is a sleeve i and in the sleeve in standard B is secured a mandrel I which extends forward through the sleeve in standard C.

The forming-rolls E of the first set are each provided with one or more annular convex surfaces (Figs. 1 and 3) approximating in width the width of the strip from which

the tube is to be formed. These forming-rolls are so constructed and positioned on the shafts *e* that the convex surfaces on each roll are offset laterally by a definite amount from those on the next succeeding roll around the mandrel I. The shaft *e* near which the strip of metal is introduced may, and preferably does, carry a roller *h* and below this roller may be mounted a guide-plate *h'* in which a roller h^2 is pivoted directly under the roller *h*. The forming-rolls F of the second set are provided with one or more annular concave surfaces approximating in width that of the metal strips and are so positioned that the concave surfaces on each roll are slightly offset laterally from those on the next succeeding roll. The shaft *f* near which the strip is introduced may be provided with a guide-roller *h* and a plate *h'* carrying a guide-roller h^2 may be mounted directly below it.

Secured on the base A, as shown in Fig. 1, opposite the first set of forming-rolls E are bearings for two shafts *j* each carrying a die-roller J and a gear *j'* by which the die-roller is driven from any suitable source of power. These die-rollers rotate one directly above the other and the periphery of the upper roller is somewhat concave and that of the lower one correspondingly convex (Figs. 1 and 7), so that a strip of metal passing between them is given a transverse curvature after which the strip passes to the first set of forming-rolls where it is bent spirally into a tube, the transverse curvature effected by these rollers being such that the several convolutions of the tubes formed from the strip present a concave exterior. Mounted on base A opposite the second set of forming-rolls F are bearings for two shafts *k* each carrying a die-roller K and a gear *k'* by which the die-roller is driven. These rollers also rotate one directly above the other and the upper one has a convex and the lower one a concave periphery (Figs. 1, 2 and 6) so that a sheet-metal strip in passing between them is given a transverse curvature such that the convolutions of the tube formed therefrom present a convex exterior.

In operating the machine, the gears *j'*, *k'* and G, G are driven from a suitable source of power thus driving the forming-rollers and the die-rollers respectively. The end of a long strip M of sheet-metal (preferably steel) is introduced between the die-rollers J, J and as the strip passes between them it is bent to conform to the shape of the peripheries of the rollers. The strip then passes between the guide-rollers *h* and h^2, under the mandrel I and up between the mandrel and the forming-roll E at the back of the machine. The annular convex surface of this roll E engages the concave face presented by the strip and presses the strip upon the mandrel to make it conform to the shape thereof. This is also true of the other forming-rolls E, which are engaged successively by the strip and as the convex surfaces on the several rolls are laterally displaced, a spiral formation is effected, the adjacent edges of successive convolutions being substantially in contact. The tube thus formed moves along the mandrel of itself so that the operation proceeds continuously. A second strip N of sheet-metal passes between the die-rollers K, K, where it is bent to conform to the surface of the rollers, then between guide-rollers, *h* and h^2, under the tube formed by the first strip and the mandrel inclosed thereby and up between the tube and the forming-roll F of the second set at the back of the machine. The annular concave surface on this roll engages the convex face of the strip as do those of the other rolls F to bend the strip upon the tube formed by the strip M, and the displacement laterally of the convex surfaces on each of the forming-rolls relative to the next succeeding roll effects a spiral formation having adjacent edges of successive convolutions substantially in contact. The second set F of forming-rolls is so displaced laterally from the first set E that the spirals of the second series break joints with those of the first and the adjacent edges of two convolutions of the convex strip lie in the depression at the middle of a convolution of the concave strip. The completed tube is moved along by the action of the machine so that the operation is a continuous one. It will be seen that the construction of the machine permits of adjusting the bearings for the several shafts carrying the forming rolls radially so that the desired spacing of the rolls relatively to the mandrel can be obtained.

As adjacent edges of successive convolutions of both the inner and outer series of spirals are substantially in contact as shown at the left of Fig. 1, the completed tube is of double the thickness of one of the strips from which it is formed at all points throughout its length and is therefore of uniform strength. Moreover, I have found that where, as in the present case, the adjacent edges of the several strips are substantially in contact, there is less danger of disrupting the tube or armor formed thereby when the same is bent on a sharp curve. Where such a curvature is given it there is little if any opening of the joints along the circumference of the curve.

What I claim is:

1. The combination of a mandrel, a set of forming-rolls disposed about the mandrel for forming a strip spirally thereon, means for rotating said rolls, a second set of forming-rolls for forming a second strip spirally about the first, said set of rolls being so displaced laterally from the first set that the strip formed thereby breaks joints with the first

strip, and means for rotating the second set of rolls, substantially as described.

2. The combination of a set of forming-rolls disposed about an axis for forming a strip spirally, means for rotating said rolls, a second set of forming-rolls for forming a second strip spirally about the first, said set of rolls being so displaced laterally from the first set that the strip formed thereby breaks joints with the first strip, and means for rotating the second set of rolls, substantially as described.

3. The combination of a set of forming-rolls having annular convex surfaces disposed about an axis for forming a strip spirally, means for rotating said rolls, a second set of forming rolls having annular concave surfaces for forming a second strip spirally about the first, said set of rolls being so displaced laterally from the first set that the strip formed thereby breaks joints with the first strip, and means for rotating the second set of rolls, substantially as described.

4. The combination of a mandrel, a set of forming-rolls having annular convex surfaces disposed about the mandrel for forming a strip spirally thereon, means for rotating said rolls, a second set of forming-rolls having annular concave surfaces for forming a second strip spirally about the first, said set of rolls being so displaced laterally from the first set that the strip formed thereby breaks joints with the first strip, and means for rotating the second set of rolls, substantially as described.

5. The combination of a die for bending a strip, a set of forming-rolls disposed about an axis for forming the strip spirally into a tube after it has been acted upon by said die, means for rotating said rolls, a second die for bending a second strip, a second set of forming-rolls for forming said strip spirally about the first and breaking joints therewith after it has been acted upon by said die, and means for rotating said rolls, substantially as described.

6. The combination of a die for bending a strip, a mandrel, a set of forming-rolls having annular convex surfaces disposed about the mandrel for forming the strip spirally thereon after it has been acted upon by said die, means for rotating said rolls, a second die for bending a second strip, a second set of forming-rolls having annular concave surfaces for forming said strip spirally about the first and breaking joints therewith after it has been acted upon by said die, and means for rotating said rolls, substantially as described.

7. The combination of a pair of die-rollers for curving a strip transversely, means for rotating said rollers, a mandrel, a set of forming-rolls having annular convex surfaces disposed about the mandrel for forming the strip spirally thereon after it has been acted upon by said die-rollers, means for rotating said forming-rolls, a second pair of die-rollers for curving a second strip transversely, means for rotating said die-rollers, a second set of forming-rolls having annular concave surfaces for forming said second strip spirally about the first, said set of rolls being so displaced laterally from the first set that the strip formed thereby breaks joints with the first strip, and means for rotating the second set of rolls, substantially as described.

8. The combination of a mandrel, a set of forming-rolls disposed about the mandrel for forming a strip spirally thereon, means for rotating said rolls, means for feeding a strip to the rolls, a second set of forming-rolls for forming a second strip spirally about the first, said set of rolls being so displaced laterally from the first set that the strip formed thereby breaks joints with the first strip, means for feeding the second strip to said rolls, and means for rotating the second set of rolls, substantially as described.

This specification signed and witnessed this 31st day of October, 1905.

EDWIN T. GREENFIELD.

Witnesses:
S. O. EDMONDS,
D. S. EDMONDS.