(No Model.) 3 Sheets—Sheet 1.

E. NORTON & E. ADCOCK.

APPARATUS FOR MAKING METAL TUBING.

No. 441,374. Patented Nov. 25, 1890.

Fig. 4.

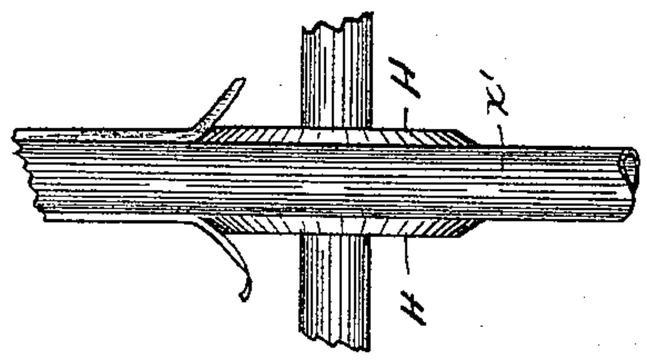

Fig. 5.

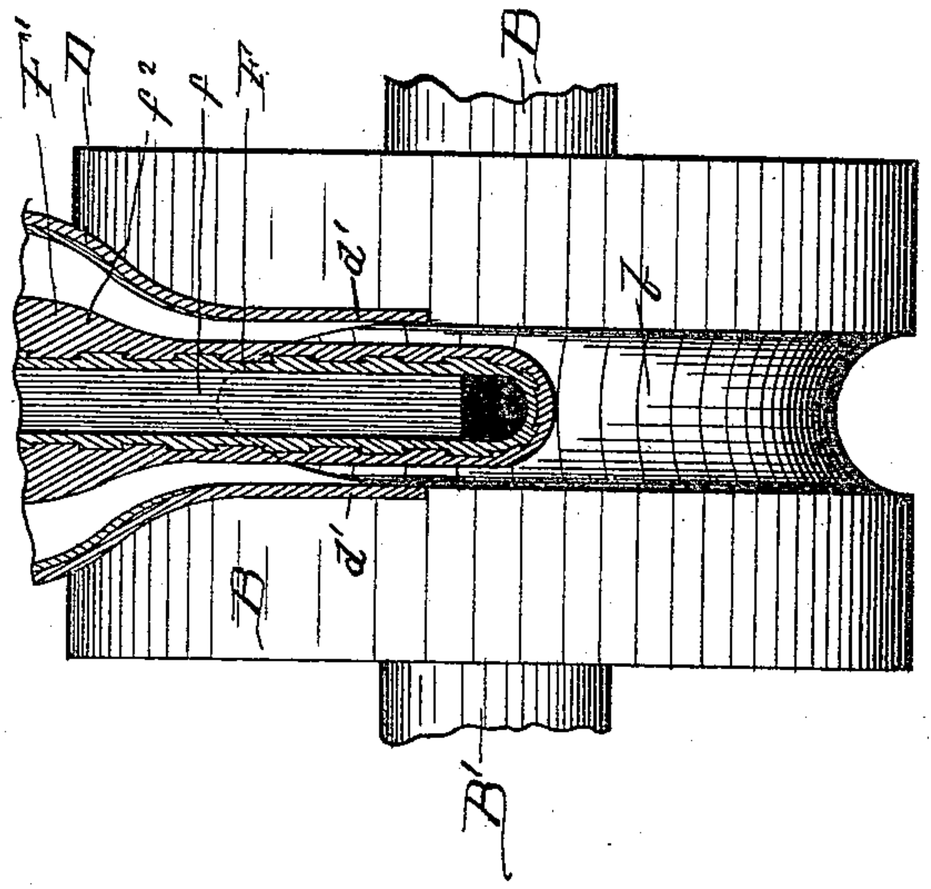

Fig. 1

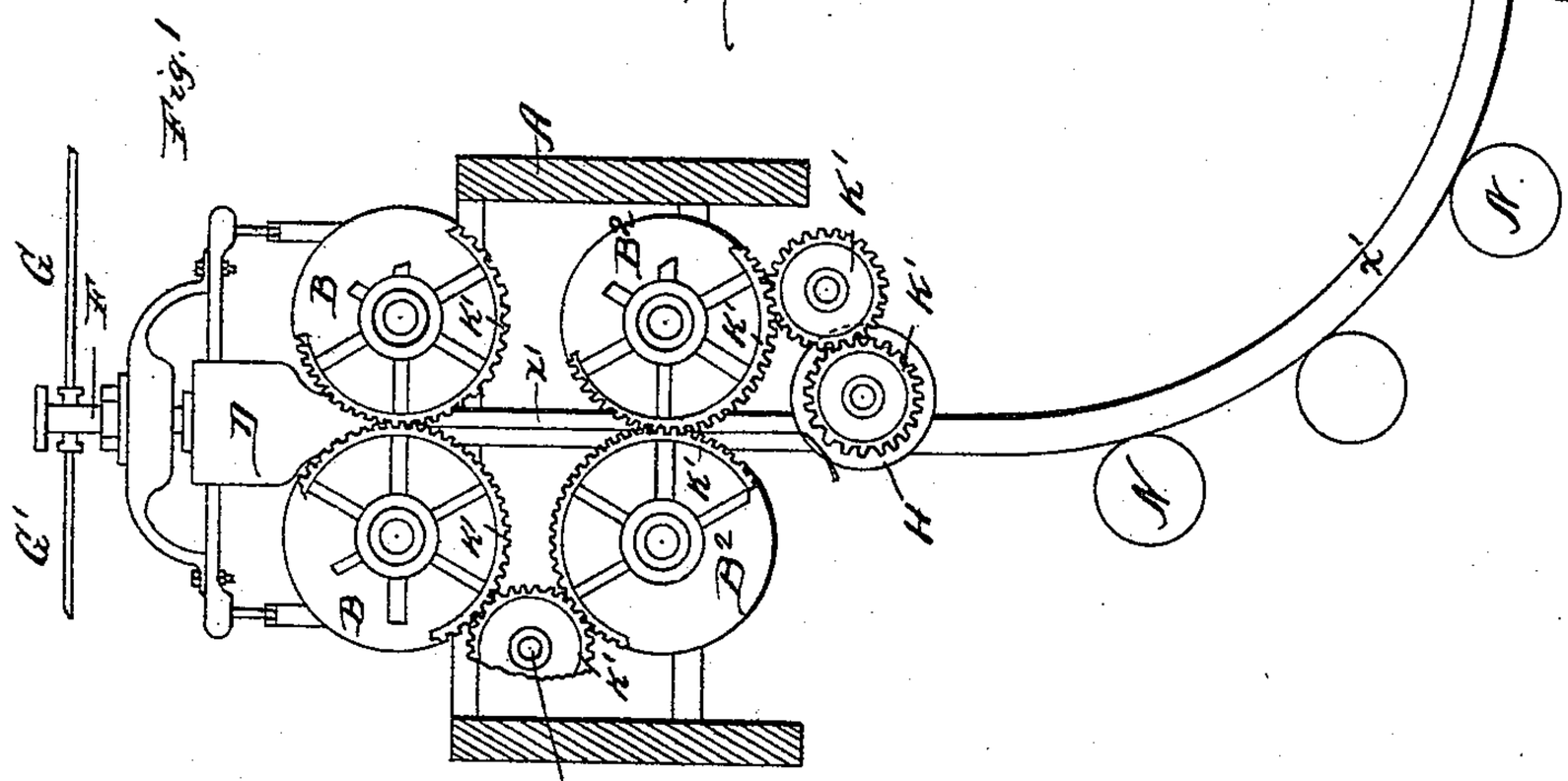

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Fig. 2.

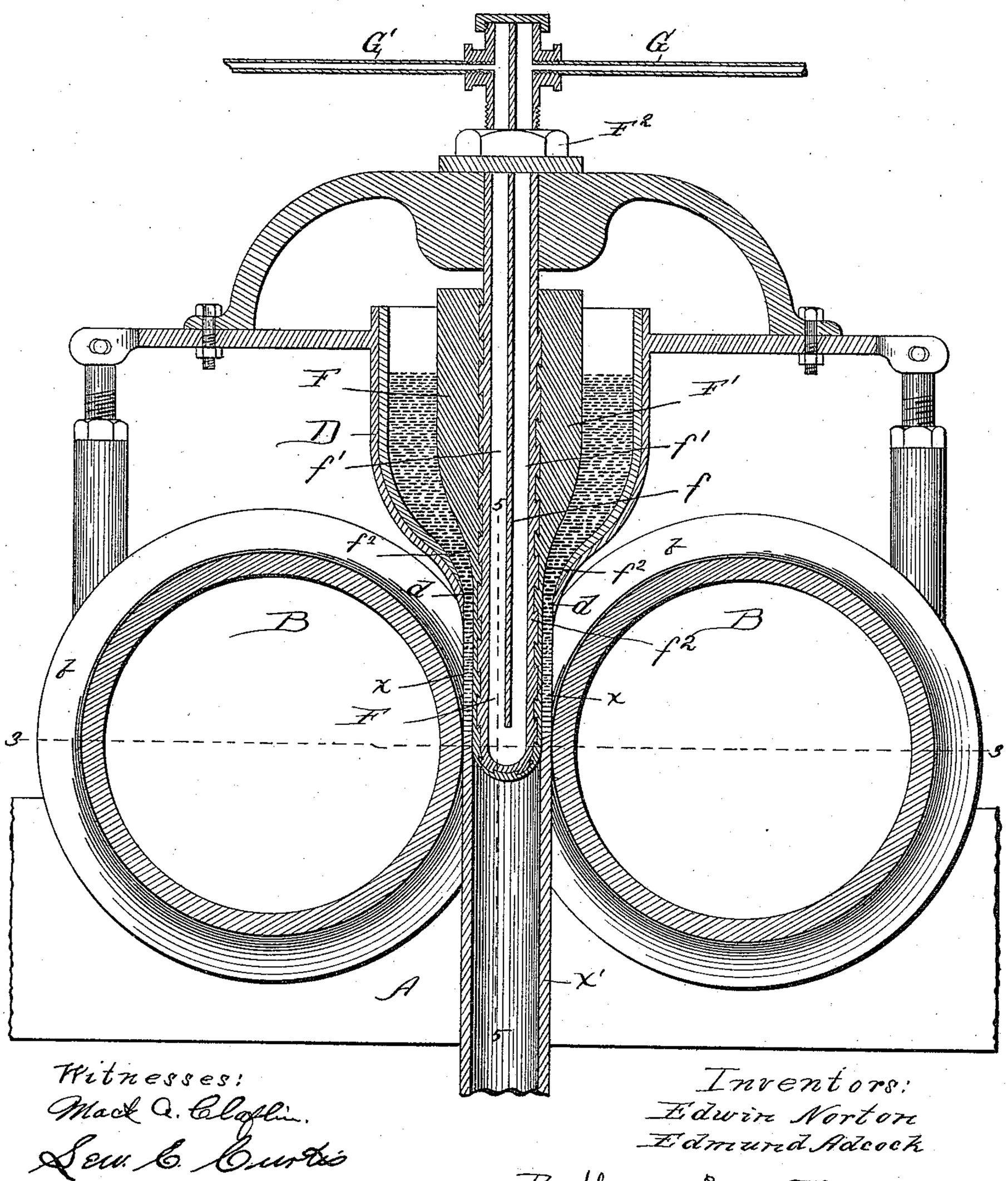

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Fig 3.

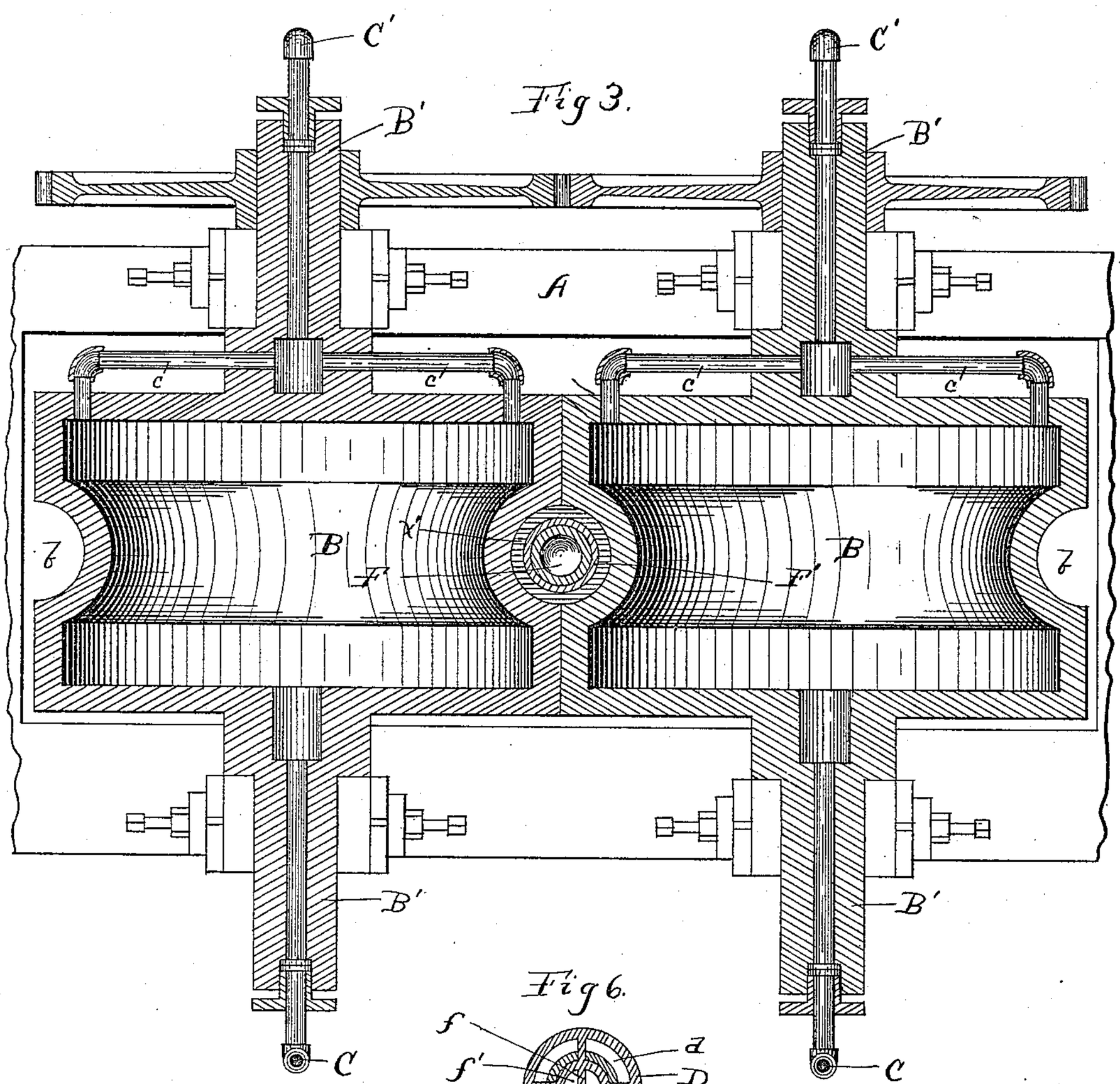
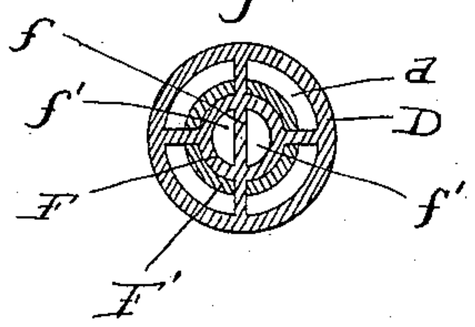


Fig 6.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR MAKING METAL TUBING.

SPECIFICATION forming part of Letters Patent No. 441,374, dated November 25, 1890.

Application filed June 6, 1889. Renewed May 14, 1890. Serial No. 351,735. (No model.)

To all whom it may concern:

Be it known that we, EDWIN NORTON, of Maywood, Cook county, Illinois, and EDMUND ADCOCK, of Chicago, Cook county, Illinois, citizens of the United States, have invented a new and useful Improvement in Apparatus for Manufacturing Metal Tubing, of which the following is a specification.

Our invention relates to apparatus for making tubes of iron or steel or other metal or alloys. Heretofore such tubes have either been cast in a tubular mold or else formed by welding, brazing, or otherwise uniting the side edges of a strip formed to the desired shape. The cast pipe so produced is liable to be defective from imperfections in the casting, may be easily broken, and can only be produced in comparatively short lengths, and cannot be economically made of small diameter. The welded or brazed pipe produced by the old method can also only be made of comparatively short lengths, cannot be made economically of large sizes, and is frequently liable to part at the weld or joint.

The object of our invention is to provide an apparatus by which seamless metal tubing may be made of a strong, homogeneous, and perfect character throughout, and whereby it may be rapidly and cheaply produced of any size or length desired.

In our invention a tubular stream of molten metal is poured continuously between and in contact with continuously-moving chilling-surfaces, preferably hollow revolving rolls filled with water, which surround the tubular stream on all sides, and set and shape the molten metal and convert it into a metal tube, while the interior of the metal tube is guided and shaped by an internal mandrel or core. The internal mandrel or core, in connection with the pouring-vessel, causes the molten metal issuing therefrom to flow in a hollow or tubular shaped stream. The chilling-rolls are furnished with peripheral grooves corresponding in cross-section to the form of the tube or pipe produced. Two or more rolls may be made to revolve together. Two rolls provided with peripheral grooves will surround the stream of molten metal on all sides and set, chill, and shape it. A greater number of rolls may, however, be made to revolve together for this purpose.

Our invention consists in the combination, with a pouring-vessel and a core or mandrel, whereby the metal may be made to flow in a tubular-shaped stream, of chilling-rolls between which the metal stream flows and by which it is converted into a metal tube.

The invention further consists in the combination, with such core, pouring-vessel, and rolls, of a cutter, which may be either stationary or rotary, and either in the nature of knives or grinders for removing thin fins or webs which may be formed upon the metal tube at the point or points where the revolving chilling-rolls meet.

It further consists in the combination, with the core, pouring-vessel, and chilling-rolls, of a second pair or set of rolls for further rolling or compressing the metal tube, while it is still at a high temperature, as it issues from the chilling-rolls.

It further consists in the novel devices and novel combinations of parts and devices herein shown and described, and more particularly pointed out in the claims.

In the accompanying drawings, which form a part of this specification, and in which similar letters of reference indicate like parts, Figure 1 is a side elevation of the apparatus; Fig. 2, a partial central vertical longitudinal section. Fig. 3 is a horizontal section on line 3 3 of Fig. 2. Fig. 4 is a detail view of the shearing wheels or cutters, and Fig. 5 is a partial vertical section on line 5 5 of Fig. 2. Fig. 6 shows a modified form of the annular orifice of the pouring nozzle or vessel.

In the drawings, A represents the frame of the machine, which may be of any suitable form to give the requisite strength and afford bearing for the different parts of the machine.

B B are a pair of revolving wheels or rolls, having half-grooves *b b* in their peripheries conforming to the exterior shape of the tube desired to be produced. As shown in the drawings, the annular grooves *b* are semicir-

cular in cross-section, as the machine is designed to produce a pipe or tube in the form of a hollow cylinder. The grooves *b* may, however, be made of any desired form, according to the form of the tube desired to be made. The rolls B are made hollow, and have hollow shafts B′, through which water or other cooling-fluid is admitted into the rolls B from the supply-pipe C and discharged through the exit-pipe C′. The water entering at the center of the rolls flows out through the branch pipes *c*, which connect with the interior of the rolls near their periphery, so that the water will circulate to the periphery of the rolls.

D is a pouring vessel or bowl mounted directly above and between the rolls B B, and having a discharge-orifice *d*, through which the stream of molten metal *x* flows directly down between and in contact with the walls of the groove *b* in the periphery of the rolls B. The stream of molten metal flows in a direction tangential to both rolls.

F is a core or mandrel conforming in cross-section to the bore of the tube designed to be produced. The purpose of the core or mandrel is to give the stream of molten metal as it passes from the vessel D, tubular or hollow shape. The lower end of this core or mandrel F may preferably project down to or beyond the meeting line of the rolls B B—that is to say, to the line joining the axes of the rolls. The core or mandrel F, in connection with the pouring-vessel D, thus serves to give the pouring-vessel an annular orifice *d*, so that the stream of molten metal issuing therefrom will be of a tubular shape.

To protect the core F from injury by the heat of the molten metal, we make, or prefer to make, the core hollow and provide it with a central web *f*, dividing it into two compartments or passages *f′ f′*, so that water, air, or other cooling-fluid may be forced entirely through it from the supply-pipe G and out through the discharge-pipe G′.

To prevent the hollow core F from injury from the heat of the molten metal in the bowl D, as well as to prevent the chilling of the molten metal therein by the mandrel, we surround or coat the mandrel F with a refractory envelope or casing F′. This may be made of any suitable material known to those skilled in the art, according to the particular kind of metal of which the metal tube is being manufactured. The portion f^2 of the core F adjacent to the orifice *d* in the vessel D should be made of a tapering or conical form, so that by raising or lowering the core F the size or capacity of the annular orifice *d* may be regulated or entirely closed. The threaded nut F^2 serves to raise or lower the core F. A second pair of rolls B^2 B^2 may be employed below the rolls B B, the same being of a similar construction to further chill or cool the metal tube as it issues and further roll and compress it. The rolls B B, as well as the rolls B^2 B^2, revolve in the same direction that the stream of metal flows, and preferably at an equal surface speed with the velocity of the issuing stream of molten metal, so that the molten metal will not dam up between the rolls.

A pair of cutters H H, preferably rotary cutters, though stationary ones may be used, serve to remove any fin which may be left or produced on the metal tube at the meeting point of the rolls.

The rolls B B and B^2 B^2, as well as the rotary cutters H H, are driven from the driving-shaft K through suitable connecting-gears K′. As the tube issues from the rolls B B B^2 B^2 it is curved from a vertical to a horizontal direction by a suitable guide N, consisting, preferably, of a series of rolls arranged in a curve. As the tube issues in a horizontal direction it is carried by a conveyer P, consisting, preferably, of a series of rolls, some of which may be used to straighten or further roll the tube. As the tubular stream of molten metal *x* flows or passes between the chilling-rolls B B the stream of molten metal is shaped and set and compressed against the core or mandrel F and converted into a metal tube *x′* of sound, strong, perfect, and homogeneous character having the qualities of forged or compressed metal, and a tube may be made in this way very rapidly and cheaply and of any length or size desired.

The vessel D is furnished with guides or wings *d′*, corresponding to the curvature of the rolls B B, and extending down to near the meeting line of the rolls, as indicated in Fig. 5, and which fit said rolls snugly and serve to direct the molten metal in the channel formed by the annular grooves *b b*, and thus to prevent the formation of fins or webs upon the tube *x′* at the meeting line of the rolls B B.

By our apparatus metal tubes may be made of any desired shape or cross-section, whether smooth or corrugated, round or square, and with a round or other form of bore, by simply changing the form of the grooves *b b* of the core F and pouring-orifice *d* of the vessel D, or by changing the shape of one or more of these parts, as may be necessary, to produce the particular outline of tube desired.

The curved wedge-shaped wings or extensions *d′*, which fit down between the chilling-rolls B B at each side of the annular groove *b* therein, may conveniently be made integral with the vessel D; but it is obvious that these wings or blocks *d′*, which fit between the rolls, may be attached or supported by any other suitable portion of the machine and be made separate from the vessel D.

The annular or ring-shaped orifice *d* of the vessel D may of course be circular, as shown in the drawings, or of other form, according as the tube is to be made cylindrical, square, or of other form. It should also be understood that the annular orifice *d* need not necessarily be a complete ring or annulus, but may be divided by webs or bridges, as the molten metal will reunite into a tubular stream after passing such webs or bridges, which break or divide the annular orifice into two

or more segments. This form of the annular orifice is indicated at Fig. 6.

We claim—

1. In an apparatus for making metal tubing by rolling fluid metal, the combination, with chilling-rolls, of a pouring-vessel and a mandrel or core for directing a tubular stream of metal between the rolls, substantially as specified.

2. The combination, with a pouring-vessel D, of a hollow mandrel F and chilling-rolls, substantially as specified.

3. The combination of pouring-vessel D, hollow mandrel F, having separate supply and discharge passages $f' f'$, so that the cooling-fluid may be made to circulate continuously through it, and chilling-rolls, substantially as specified.

4. The combination, with chilling-rolls having grooved peripheries, of a pouring-vessel furnished with a device for causing a tubular stream of metal to flow therefrom between said chilling-rolls, substantially as specified.

5. The combination, with a pouring-vessel having an annular orifice, of moving chilling devices between and in contact with which the metal is poured, substantially as specified.

6. The combination, with chilling-rolls having grooved peripheries, of a pouring-vessel having an annular orifice, substantially as specified.

7. The combination, with a pouring-vessel, of a core or mandrel and chilling-rolls, said mandrel extending down to the meeting line of said rolls, substantially as specified.

8. The combination, with a pouring-vessel, of a mandrel, chilling-rolls, and a second pair or set of rolls for further rolling and compressing the metal tube as it issues, substantially as specified.

9. The combination, with a pouring-vessel, of a mandrel, chilling-rolls, a curved guide, and a horizontal conveyer consisting of a series of rolls arranged horizontally, substantially as specified.

10. The combination, with a pouring-vessel, of chilling-rolls revolving together, between which the stream of metal is poured from said vessel, and a cutter for removing fins, substantially as specified.

11. The combination, with a pouring-vessel and a mandrel, of revolving chilling-rolls between which the molten metal is poured, and curved wings or blocks d', fitting between said rolls, substantially as specified.

12. The combination, with pouring-vessel D, of vertically-adjustable core or mandrel F, having a tapering portion f^2 for regulating or stopping the flow of the molten metal, and revolving chilling-rolls, substantially as specified.

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