2 Sheets--Sheet 1.

W. F. BROOKS.

Manufacture of Metal Tubing.

No. 146,868. Patented Jan. 27, 1874.

Fig. 1.

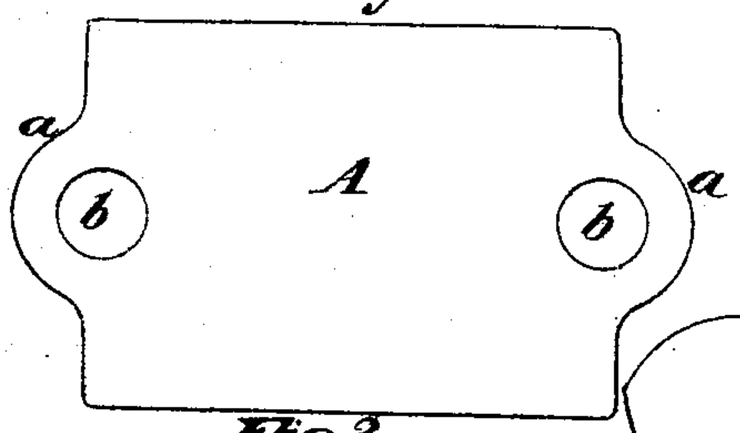


Fig. 2.

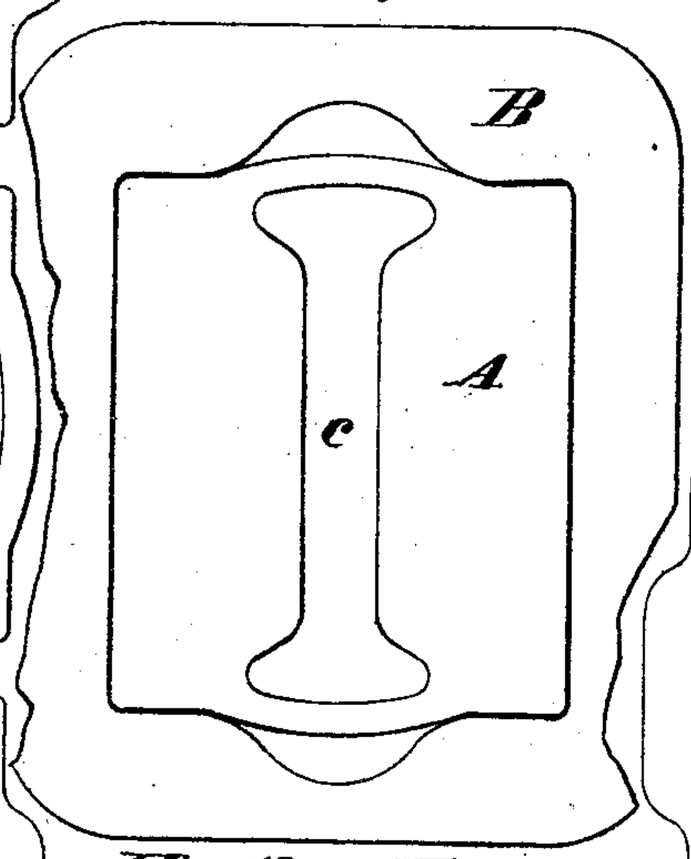


Fig. 3.

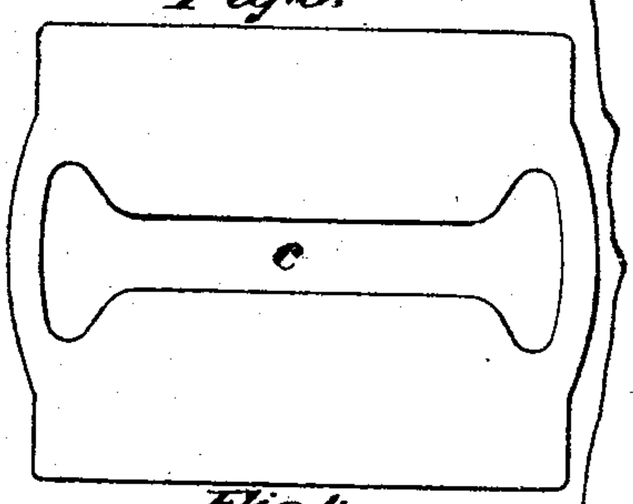


Fig. 4.

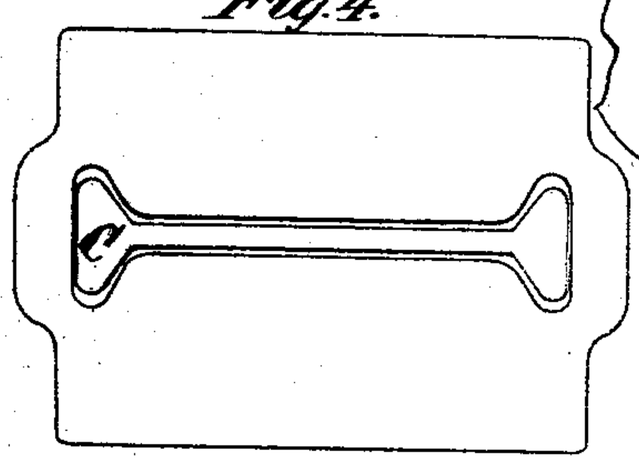


Fig. 5.

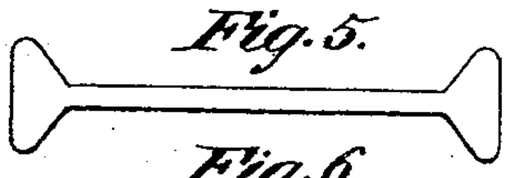


Fig. 6.

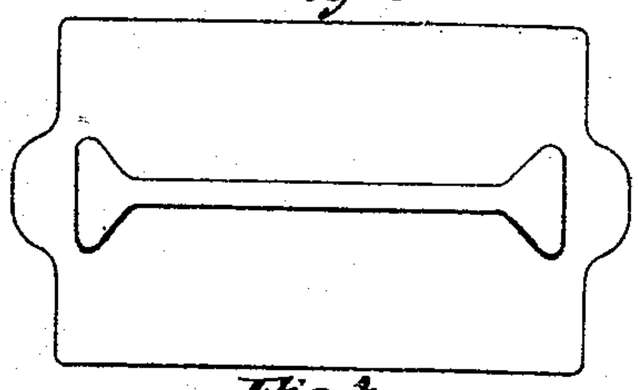


Fig. 7.

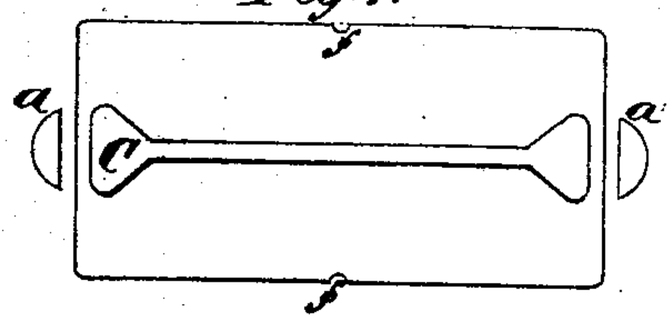


Fig. 8.

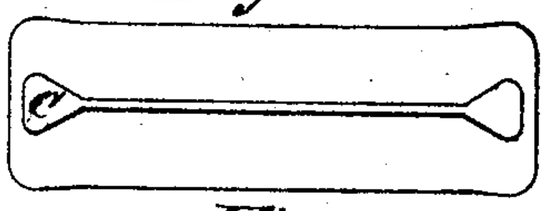


Fig. 9.

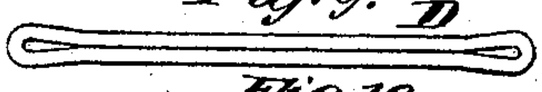


Fig. 10.

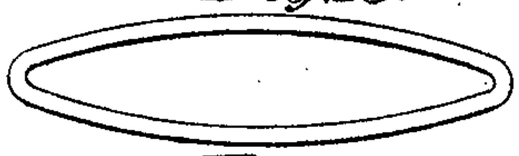


Fig. 11.

Fig. 12.

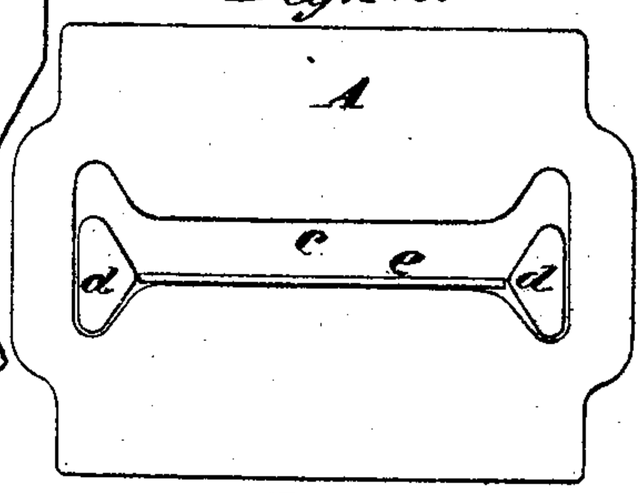


Fig. 13.

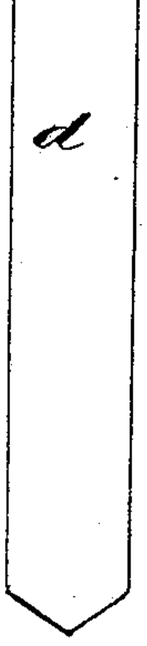


Fig. 14.

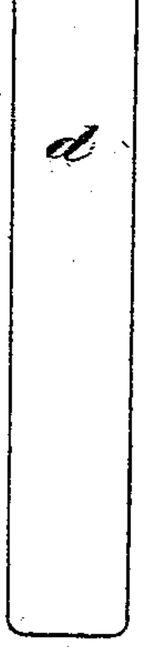


Fig. 15.

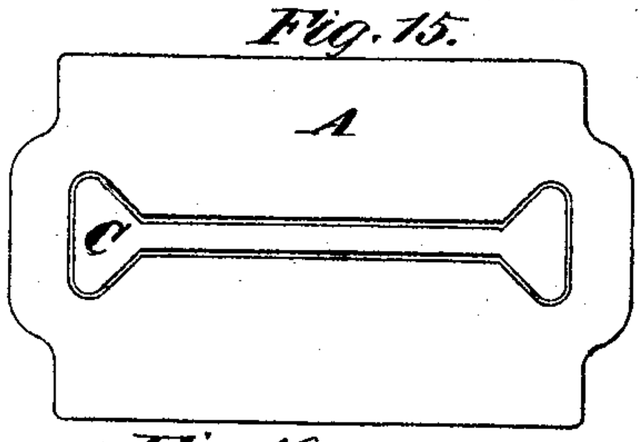


Fig. 16.

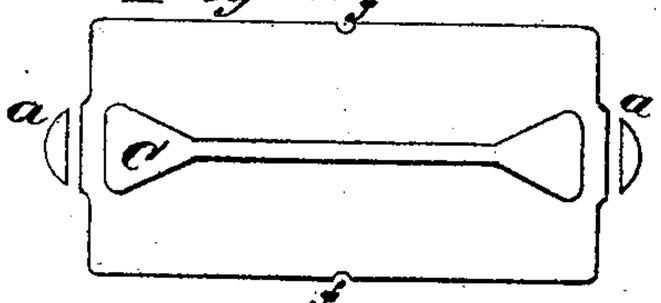


Fig. 17.

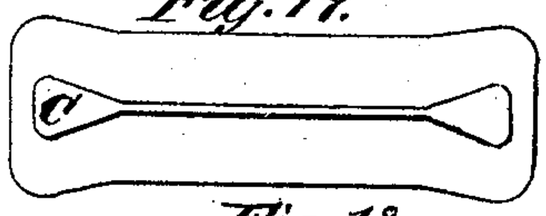


Fig. 18.

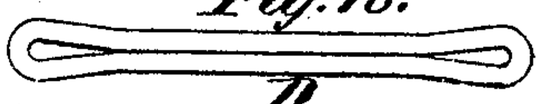


Fig. 19.

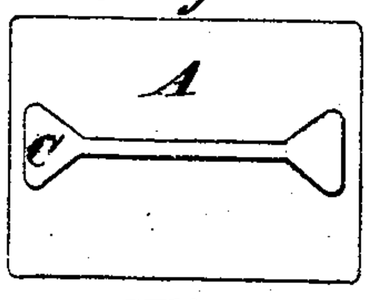
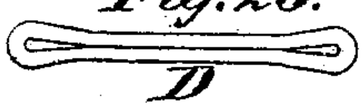


Fig. 20.



Witnesses
John Becker
Fred Haynes

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by his Attorneys
Brown & Allen

2 Sheets--Sheet 2.

W. F. BROOKS.

Manufacture of Metal Tubing.

No. 146,868. Patented Jan. 27, 1874.

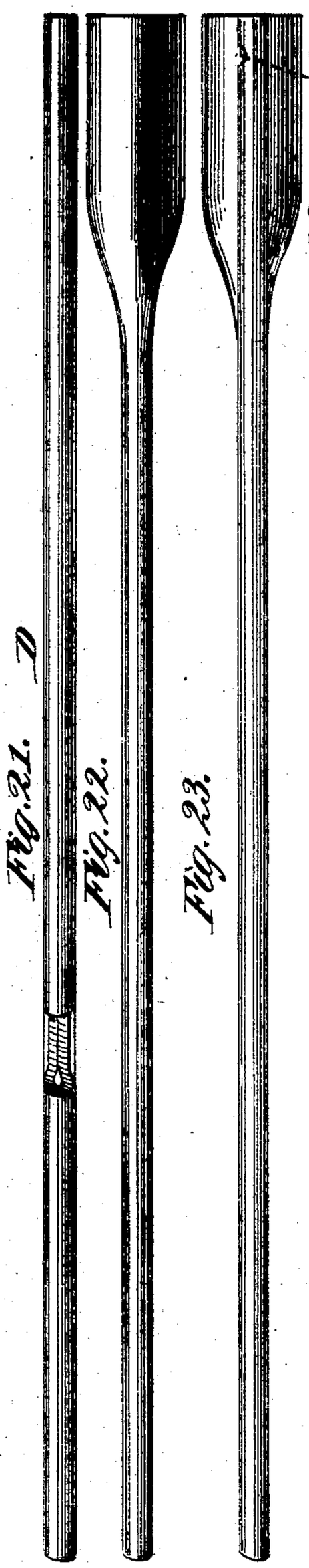

Fig. 21.

Fig. 22.

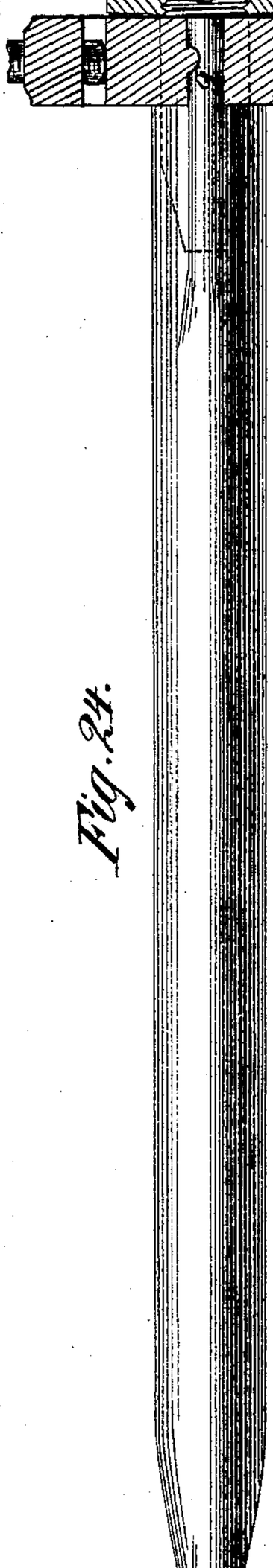

Fig. 23.

Fig. 24.

Fig. 25.

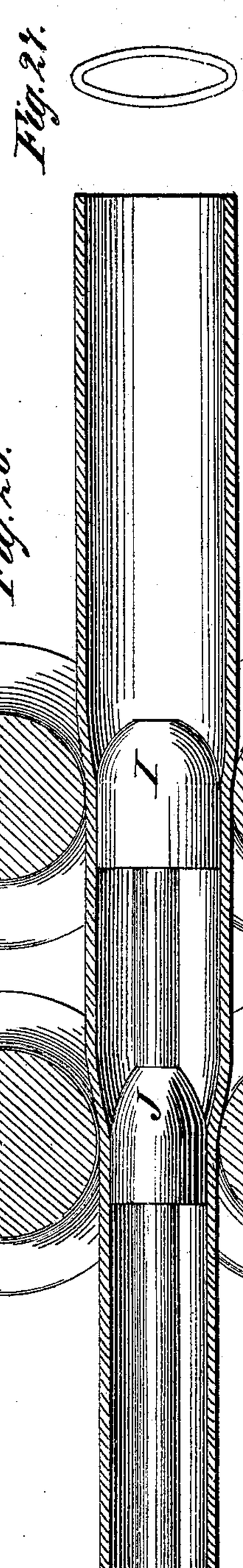

Fig. 26.

Fig. 27.

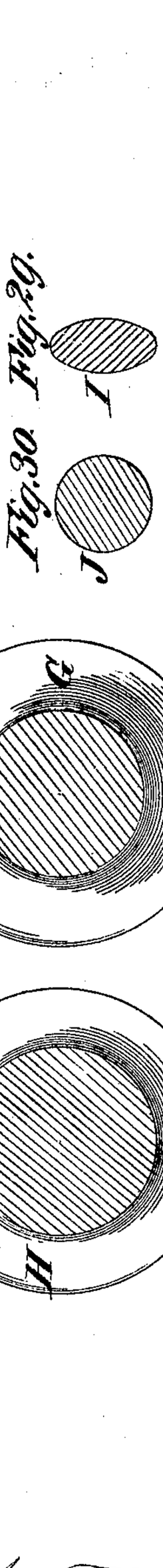

Fig. 29.

Fig. 30.

Fig. 28.

Witnesses
John Becker
Fred Haynes

Wm. F. Brooks
by his Attorneys
Brown + Allen

UNITED STATES PATENT OFFICE.

WILLIAM F. BROOKS, OF NEW YORK, N. Y., ASSIGNOR TO ELISHA P. WILBUR, OF BETHLEHEM, PENNSYLVANIA.

IMPROVEMENT IN THE MANUFACTURE OF METAL TUBING.

Specification forming part of Letters Patent No. **146,868**, dated January 27, 1874; application filed June 25, 1873.

To all whom it may concern:

Be it known that I, WILLIAM FORMAN BROOKS, of the city, county, and State of New York, have invented certain Improvements in the Manufacture of Metal Tubing, of which the following is a specification:

This invention relates to a process of manufacturing metal tubing, including tubes of "homogeneous" iron and steel, in which a seamless tube is produced from a block having a passage formed through it, and which is afterward shaped and drawn, or reduced by external and internal pressure, produced, in part, by the action of rolls. The invention may be briefly and generally described as consisting, first, in a metal block or casting, formed with bosses on opposite sides to provide for the passage of holes in said sides, arranged preferably or primarily to project partly within the bosses and partly within the body of the block, and which opposite holes are connected by an opening made between the holes. These bosses and holes provide for the subsequent opening of the block without risk of bursting or breakage by leaving loops on opposite sides of the block as the latter is rolled into a slab, and the bosses serve to determine the thickness and uniformity of the tube, they being, in the course of the process, sawed, more or less, off, according to the thickness of the tube. A flanged core or core rods with plate in between them are inserted within the block to give shape to the open or looped slab as it is rolled from the block, and to provide for a proper pro rata reduction of the metal in all directions. The opening of the tube is afterward effected by fluid, vapor, or gas, under pressure, introduced within it, and the tube subsequently passes through rolls operating in connection with a suitably-shaped mandrel. Seamless metal tubes may thus be made perfectly sound and solid without risk of bursting, and the same block be used to make tubes of different thicknesses, with the greatest uniformity as regards a given thickness.

Having thus specified the object and nature of the invention, its description will be proceeded with in reference to the accompanying drawings.

Figure 1 represents an end view of a block of homogeneous metal, formed by casting, rolling, hammering, or by any or all of these methods combined, with bosses at opposite sides, and provided, by drilling or otherwise, with holes arranged to project into the bosses and within the body of the block throughout the depth of the latter, in illustration of the first or an early stage of the invention; Fig. 2, a similar view of said block within a receiver used to hold it while being opened between the opposite side holes and pressed to form, as represented; Fig. 3, a like view of the same when removed from the receiver; Fig. 4, a view, showing such block with a flanged metallic core inserted in its opening; Fig. 5, a view of the flanged metallic core detached; Fig. 6, an end view of the block with said core therein after the former has been closed on the core by rolling; Fig. 7, a like view, showing a further reduction and preparation of the block to a point when the bosses are sawed off. Fig. 8 is a view of the block and core in it after the bosses have been removed and the block has passed rolls, which give to its top and bottom surfaces a contour or outline corresponding with that of the slab to be produced. Fig. 9 represents a cross-section or end view of the slab; Fig. 10, a view showing the same as opened a few inches, more or less, at its one end; Fig. 11, a view of the same swaged to form, as represented, preparatory to further opening it. Fig. 12 represents a modification of Fig. 4, the same showing either a casting or block of metal with opening through it, as described, and with two core-rods and a connecting-plate between them inserted therein in place of the flanged core previously referred to. Figs. 13 and 14 show longitudinal views of said core-rods detached. Fig. 15 represents a block or casting of metal with a metallic core, which is inserted in the mold previous to pouring the metal round it to form the block. Fig. 16 is a similar view to Fig. 7, but with a diminished reduction of the bosses, leaving one-half more margin between the core and the exterior of the block on the sides having the bosses; Fig. 17, a view of such block and core in it after the reduction has been made of the bosses, and after the block,

as in Fig. 8, has been rolled to give to its top and bottom surfaces an outline corresponding with that of the slab to be produced; Fig. 18, an end view of the slab produced from said block. Fig. 19 represents an end view of the block and core, shown in Fig. 16, after edge rolling to one-third the width, and correspondingly reducing the margin between the core and the boss sides of the block; Fig. 20, a cross-section or end view of the slab produced from the block shown in Fig. 19. Fig. 21 represents a partly broken side view of the slab shown in Fig. 19; Fig. 22, a side view of such slab opened a few inches from the end, as shown in Fig. 10; Fig. 23, a like view of the same when swaged to form, as shown in Fig. 11, and with a recess in its flange for a purpose hereinafter explained; Fig. 24, a further like view of the same, attached at its swaged end to a hydraulic pump or connection thereof, also closed by a clamp at its opposite end, and as partially spread between such two points by the fluid injected by the pump. Fig. 25 illustrates an end view of a nipple forming part of the hydraulic-pump connection which enters the swaged end of the slab. Fig. 26 is a longitudinal sectional view, representing the tube in its preliminary oval, and subsequently rounded, form as passing over a mandrel having two bulbs, and between two pairs of disk-rolls. Fig. 27 is an end view of the oval-shaped tube as it enters the rolls; Fig. 28, a similar view of the tube as it leaves the rolls; Fig. 29, a cross-section of the one bulb of the mandrel between the first pair of rolls, used to prevent the metal from buckling; and Fig. 30, a similar view of the other bulb between the second pair of rolls, used to give form to the interior of the tube.

The process of manufacture applicable to tubes of homogeneous iron and steel is as follows: First, a billet is produced from an ingot which is cast of larger sectional area than the billet required, so that there will be sufficient metal to consolidate the latter by hammering or rolling, or both, in bringing it to the desired form. The length and size generally of the ingot will vary with the dimensions of the billet to be produced. In preparing the ingot it is desirable that it should be heated gradually, and ultimately to such a degree that when hammered or rolled to a billet the latter will be solid, and as free as possible from all defects. The billet is then sawed transversely into sections, each of the length required to produce a given length of tubing, which may be ultimately divided to make one or more tubes of a specified length, and the same section, by edge-rolling, be used to make tubes of different sizes.

Each of these sections constitutes a block, A, (Fig. 1,) with oppositely-arranged bosses *a a* on two of its sides. Said block, when cold, is pierced by drilling with two holes, *b b*, arranged to project partly within the bosses and partly within the body of the block, throughout the depth of the latter. Said block is then placed in a receiver or jig, and the metal between the holes *b b* is split or opened throughout the length of the block, thus forming a connecting opening between the holes, and dividing the block between the latter. Said block is next put in a receiver, B, (Fig. 2,) constructed to confine the block within a given space, when a former or plunger is forced through the split which connects the holes on opposite sides of the block to give the latter a form substantially as represented in Figs. 2 and 3, widening the split between the side holes into an enlarged opening, C, and altering the configuration of the side holes, as shown in Figs. 2 and 3, so that the combined apertures form an opening somewhat of the shape of the letter **I**. Such perforated block is now put on a spud, the shape of which, in its transverse section, corresponds with the opening in the block, but smaller, so that when the block on the spud is passed between rolls it will be passed off the spud, and the opening through the block be partially closed and the bosses *a a* changed in shape, as represented in Fig. 4. The block is then reheated and a flanged metal core, C, placed within the opening in the block. Said core, at its flanged ends, should not be wider than one-third, or thereabout, of the thickness of the block at the places of their insertion, and the core should be coated with graphite to prevent welding and be entered cold within the block to insure a smooth interior surface. If preferred, the core, instead of being made in one piece, may be composed of independent core-bars *d d*, Figs. 12, 13, and 14, with a plate, *e*, arranged between them. Furthermore, the block, instead of being produced as described with reference to Figs. 1, 2, and 3, may be cast around the graphite-coated metal core C, as represented in Fig. 15, with the bosses shaped to correspond with the form shown in Fig. 4. The block, as previously described with reference to Fig. 4, being now reheated and the core inserted therein, it is passed through rolls of sufficient draft to make the block close on the core and leave the metal of the block of the same thickness on either side of the flanges of the core as the width of said flanges, as shown in Fig. 6 and in Fig. 16, when the casting shown in Fig. 15 is used. The block and core arranged within it are then both heated to a uniform degree, and the same flat-rolled, leaving guiding grooves *f f*, Fig. 7, (or Fig. 16,) in the top and bottom of the block. These grooves serve to receive a rib arranged on a table or support on which the block is placed, in order that the block may be uniformly centered and clamped on the table while the bosses are being either wholly sawed off, as in Fig. 7, or partially removed, as in Fig. 16, according to the thickness of metal required in the tube. The block with core in it is next passed between a series of grooved rolls, the faces of which have a contour or outline corresponding with the transverse top and bottom outlines of the slab to be produced. This brings the

block and core in it to the conditions represented in Fig. 8, (or 17,) till, by continued rolling, the slab D, shown in Figs. 9 (or 18) and 21, is produced. When near the finish the slab should be passed between chilled box-rolls conforming to the finished cross-section of the slab.

It may here be observed, however, that instead of reducing the block, as described, it is preferred, after the block has been closed on the core and the whole reheated, to pass the same through a stand of universal rolls grooved to receive several sized blocks previous to cutting off the bosses, which latter may be done when the block has been reduced one-half its original thickness. The blocks, with the cores in them, should then be passed between three-high rolls to nearly finish, and afterward through a pair of chilled rolls to finish.

The slab D is now cut off at one end. Said severed end is opened for a few inches in the length of the slab, as shown in Figs. 10 and 22. Such opened end of the slab is then swaged, as represented in Figs. 11 and 23, and the same fitted over a nipple of a hydraulic machine or pump and gripers screwed down to clamp the swaged open end of the slab and to enter notches *g* in the flanged portions of said end to keep the slab from being forced off the nipple when fluid is forced into the slab to open it throughout its length, or nearly so, the opposite end of the slab being closed and secured by a clamp, all as represented in Fig. 24. This opens the main body of the slab to an oval form, after which it is disengaged from the pump and clamps and the ends of the slabs opened to correspond with the remainder of it preparatory to completing the opening and shaping of the slab into a rounded tube, to do which the oval hollow slab (shown at Fig. 27) is heated and passed between two pairs of disk-rolls, G H, and over a mandrel having two bulbs, I J, the bulb I between the first pair of rolls serving to prevent the metal from buckling, and the bulb J between the second pair of rolls answering to give form to the interior of the tube, and, in conjunction with said rolls, to shape the tube, as represented at Fig. 28.

It will here be remarked, in conclusion, that the flanged or I-shaped core, as seen in Figs. 4 and 5, or the bars *d d* of the similarly-shaped but sectionally-constructed core, seen in Fig. 12, should be made of the same metal as the block or casting, or of metal that will roll pro rata with the block or casting.

The cutting or sawing of the bosses *a a* regulates the thickness of the tube. When the bosses, instead of being cut off flush with the sides of the block, as represented in Fig. 7, are sawed off outside of such faces or sides, as shown in Fig. 16, the block, previous to such cutting, should be edge-rolled, so that it will enter the groove in the rolls intended for it. The subsequent rolling will crowd the metal above and below such cut portions laterally and fill the space in the grooves of the rolls. If extra thick tubes are wanted, the opposite side holes in the blocks must be arranged nearer to each other—that is, further from the exterior of the bosses, thus leaving the metal of the bosses thicker outside of the holes.

Castings with an ordinary sand core, or blocks having the core-bars and connecting metal plate inserted within them, also castings with flanged cores, are treated the same as the split blocks.

Various-sized tubes may be made from the same block by edge-rolling previous to sawing off the bosses, or even afterward, provided the bosses are removed, so that the pro rata rolling will leave the metal at the margin—that is, the metal between the core and the exterior of the thickness required for the tubes.

In making the holes *b b*, Fig. 1, in the block, the centers of said holes should each be within their respective sides of the block to an extent equal to the thickness of the tube required, provided the bosses are to be sawed off flush with the sides of the block, as in Fig. 7. Thus, if the tube is to be one-eighth of an inch thick, the centers of the holes *b b* must be one-eighth of an inch within their respective sides of the block. If the tube is to be three-sixteenths of an inch thick, the bosses should be sawed off one-sixteenth beyond the sides of the block, and so on, according to the thickness of tube required.

The tubes, after being finally and fully opened, may be sized by well-known methods, to put them in merchantable order. When it is desired to give them a high or extra finish, they may be annealed and pickled and passed through dies over mandrels.

What is here claimed, and desired to be secured by Letters Patent, is—

1. The method of constructing or producing the block, preparatory to its final conversion into a tube, by forming bosses *a a* at its opposite ends, and holes *b b* partly entering said bosses and the body of the block, and dividing the metal between the said holes, essentially as herein shown and described.

2. The flanged or I-shaped core, constructed whole or in sections, for use within a block or body of metal of or from which the tubing is made, substantially as described.

3. The process, herein described, of manufacturing metal tubes from a block or casting having side bosses and an opening through it arranged in relation with the bosses, as specified, and fitted with a metal core, by flat and edge rolling the block, severing the bosses from the latter, spreading or opening the looped hollow slab, so produced by the internal application of gaseous or fluid pressure, and afterward further opening and shaping the tube by means of rolls and a mandrel, as herein set forth.

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