(No Model.)

C. A. MARSHALL.

SEAMLESS TUBE AND THE PROCESS OF MAKING THE SAME.

No. 377,318. Patented Jan. 31, 1888.

Fig. 4.

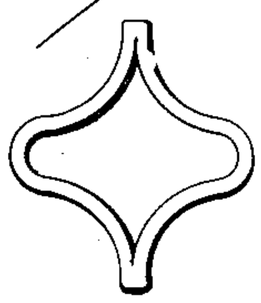


Fig. 1.

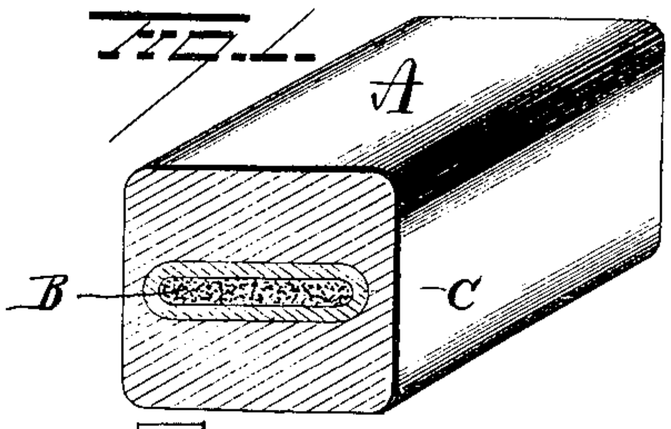


Fig. 3.

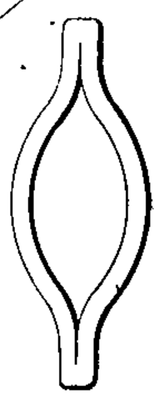


Fig. 2.

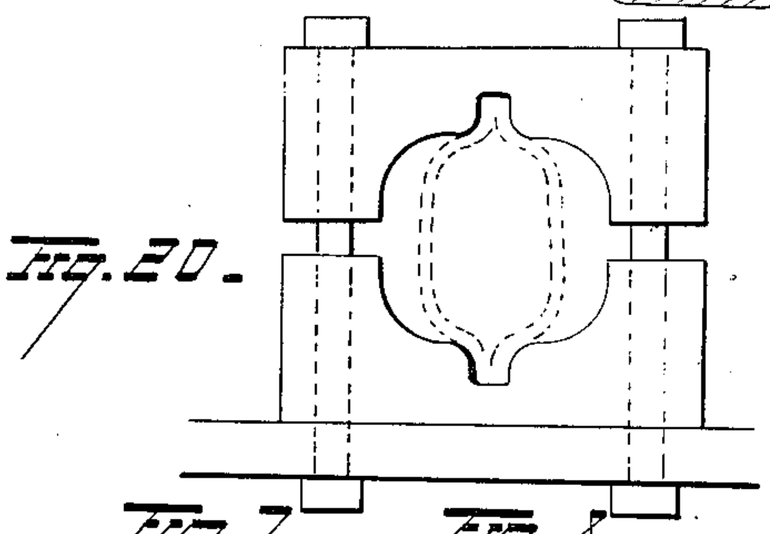


Fig. 5.

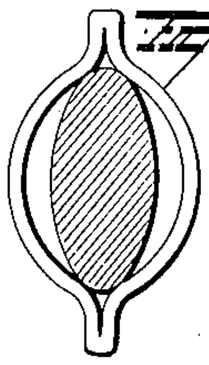


Fig. 6.

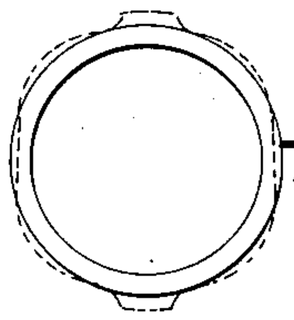


Fig. 7.

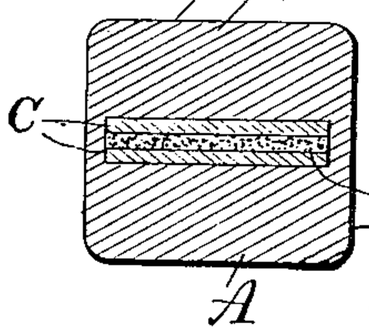


Fig. 8.

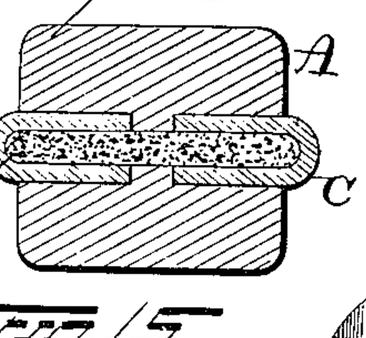


Fig. 9.

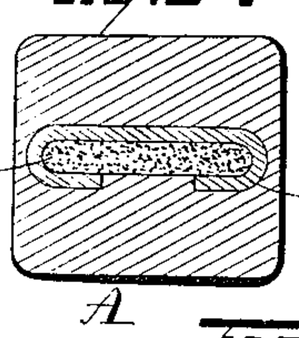


Fig. 10.

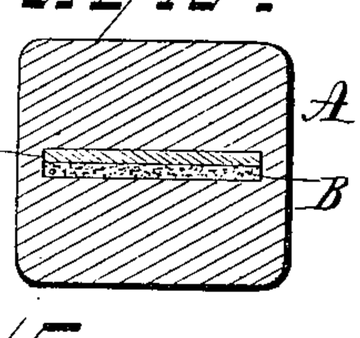


Fig. 15.

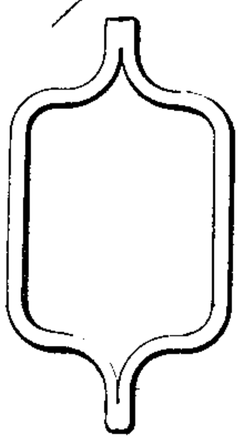


Fig. 12.

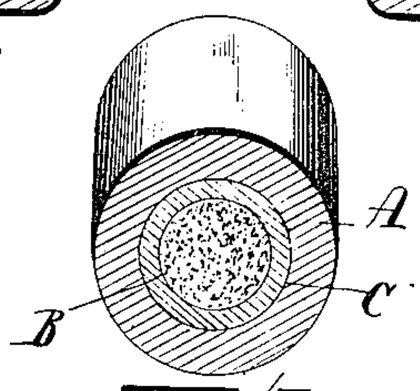


Fig. 16.

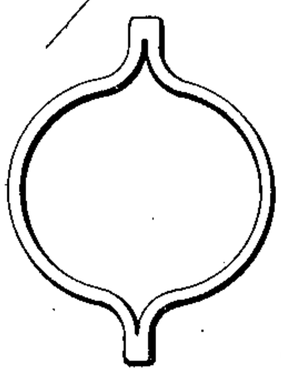


Fig. 13.

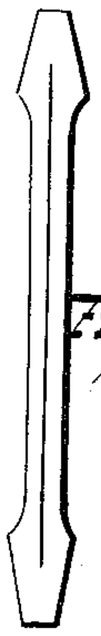


Fig. 14.

Fig. 11.

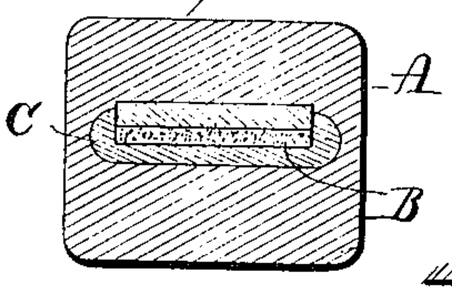


Fig. 17.

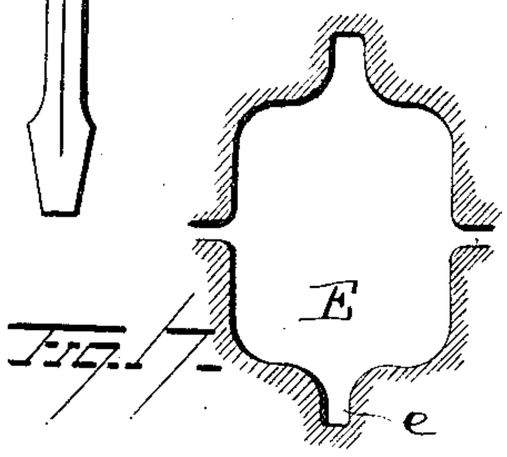


Fig. 19.

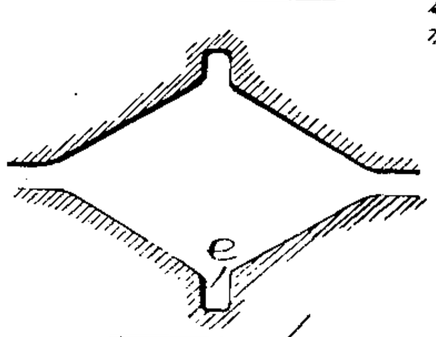
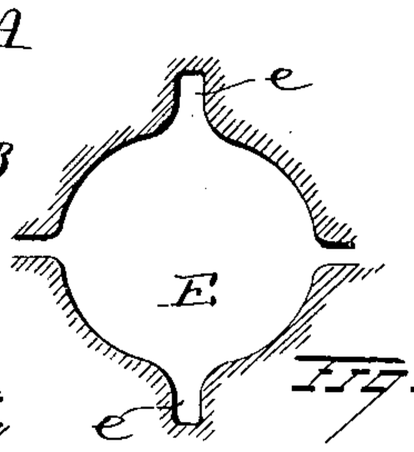


Fig. 18.



WITNESSES

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Attorney

UNITED STATES PATENT OFFICE.

CHARLES A. MARSHALL, OF JOHNSTOWN, PENNSYLVANIA.

SEAMLESS TUBE AND PROCESS OF MAKING THE SAME.

SPECIFICATION forming part of Letters Patent No. 377,318, dated January 31, 1888.

Application filed March 30, 1886. Serial No. 197,194. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. MARSHALL, of Johnstown, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Seamless Tubes and the Process of Making the Same; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in the method or process of making seamless tubes.

The object is to make a tube of iron or steel which shall have a smooth and regular internal surface, free from splits and cracks, and possessing in a high degree the qualities of lightness, strength, and durability.

With these ends in view my invention consists in first casting an ingot of iron or steel around a core of yielding refractory material; secondly, reducing the cast ingot to a flattened tube-blank, and, finally, opening the tube-blank into a tube.

My invention further consists in certain more particular steps of procedure, as will be hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 represents an ingot of iron or steel cast around a core of refractory material. Fig. 2 represents the same reduced to a flattened tube-blank. Fig. 3 represents the blank partially opened at one end. Fig. 4 represents a cross-section of the partially-completed tube as it appears when ready to be drawn over the shaping ball or mandrel. Fig. 5 is a cross-section taken through the partially-completed tube and oblong point of a mandrel; and Fig. 6 represents a cross-section of the finished cylindrical tube, the dotted lines showing the exterior contour of the original blank. Figs. 7, 8, 9, 10, 11, 12 represent modified forms of ingot-cores. Figs. 13 and 14 represent modified forms of blanks. Figs. 15 and 16 represent modified forms into which the blank may be partially opened. Figs. 17, 18, and 19 represent different forms of rolls for partially opening the blank, and Fig. 20 represents a set of guides.

The process will be described with reference to the manufacture of cylindrical tubes of uniform thickness, although the same steps of procedure would, with but slight modifications, if any, be applicable to the manufacture of tubes of various shapes in cross-section, the only important difference between the manufacture of round and other shaped tubes being the construction of the shaping-rolls and mandrel.

A represents the ingot metal, B the core of refractory material, and C the core-casing or ingot-lining of previously-worked metal, which will be referred to as "superior" metal.

The method of casting the ingot around its core is fully set forth and claimed in application for Letters Patent filed by me on December 15, 1885, Serial No. 185,719, and the method of making the ingot and tube-blank is fully set forth in an application filed by me of even date herewith, and entitled an "improvement in tube-blanks and in the process of making the same." Briefly stated, they are as follows: A core, B, of yielding refractory material—for example, powdered or finely-divided graphite having dry fire-clay mixed therewith, or, in case the core is required to be self-coherent, damp fire-clay mixed sparingly therewith, and the mixture baked to expel moisture—is either alone or partially or wholly incased by superior metal supported in a mold and the ingot metal cast around it. The core is preferably oblong in cross-section, and the ingot when cast rectangular in cross-section with beveled or rounded corners and thinner at points opposite the extremities of the longer transverse axis of the core than at intermediate points.

The ingot thus constituted is reduced by external pressure to a flattened blank, D, with finished edges. The edges may either be finished by slight edge pressure alone or by trimming, or by heavier edge pressure, either alone or in connection with a subsequent trimming. The preferred form of blank is that shown in Fig. 2, in which the metal at the longitudinal edges is somewhat thicker than the wall of the completed tube is required to be, and the walls of the blank are provided with external bulges or ribs, *d*, extending longitudinally along the blank at corresponding intervals between the edges. The excess of metal at the edges is to supply the reduction which would naturally take place in opening up the blank, and the excess at intervals between the

edges is to furnish the drawing-rolls work and bite in drawing the blank over the ball or mandrel.

The number and disposition of the ridges on the exterior of the blank will be determined by the size of the tube and the relative diameters of the drawing-rolls and tube. For example, if the tube is large with respect to the rolls, then at the parting of the rolls the metal must be actually thinner than the finish, unless the whole tube is to be materially elongated by the finish rolling or drawing operation, when at the said points the metal must still be relatively thinner than at other parts. The said ridges of metal may be readily reduced in the drawing process, and at the same time afford an excellent hold for the rolls. The blank is then opened for a short distance at one end, preferably in an oval form, as shown in Fig. 3, care being exercised not to warp the edges. The partially-opened end of the blank is then inserted between a pair of rolls, preferably recessed, substantially as shown in Figs. 17, 18, and 19, the bottoms of the recesses E being provided with grooves *e*, adapted to receive the edges of the blank. The passage of the blank between said rolls opens it into a form such, for example, as shown in Figs. 15 and 16. These forms or any form naturally lying between them, or such general form having any desired ratio of vertical to transverse axis in cross-section within very wide limits, may be readily formed by varying the spread of rolls, number of passes, and shape of recess E. This operation requires no guides for small tube-blanks; but wider ones must be held in their own planes in the middle at a moderate distance from the rolls, or otherwise both walls of the blank may buckle toward the same side instead of to opposite sides, as desired.

The opening process here described may be aided by passing the opened blank as it leaves the rolls over a bulb or mandrel, preferably of tapered oval form, which shall wedge open the blank with more perfect uniformity than is attained by the action of the rolls alone and need not affect the thickness of walls of tube.

The small grooves *e* may be used without the shaping-grooves E, and, if the exact shape to be given the blank is unimportant, without guides, or guides may take the place of shaping-grooves. The gist of this step is the progressive opening of the blank by passing it between rolls, which crowd its edges toward each other, one end of the blank having been first partially opened. The partially-opened blank may now be inspected for defects, particularly for cracks along the edges, which are liable to occur if the metal is of an inferior or red-short quality; also, any refractory material, which is preferably made the least in amount consistent with immunity from welding, as already explained, which might interfere with the finishing of the tube, can now be easily removed by a brush by washing the interior of the tube or in any convenient way, and it is then ready to be finished by one or more passes over a ball or mandrel through a pair of drawing or "pipe" rolls. In this operation an ordinary ogival-pointed "tube-ball," such as used in making lap-welded tube, may be used with guides on the entering side of the rolls to keep the edges of the blank in the plane of rotation of the rolls. A front view of such a guide is shown in Fig. 20, the blank being represented in dotted lines. The guides are represented as bolted to a horizontal "rest," which is secured to the frame of the rolls. These guides may well consist of rolls having small grooves at the bottoms of larger grooves, as described in connection with the previous step, in opening the closed blank, and they may be driven so as to perform the final or shaping pass of the opening process, thus combining in part the two operations of opening and finishing.

In the manufacture of tubes of the boiler-tube size, however, the guides are preferably dispensed with and a bulb is used, consisting of a cylindrical rear portion extending a short distance only in front of the line joining the axes of the rolls and a tapered oval front or point, F. (See cross-section, Fig. 5.) This bulb or mandrel is fixed upon the squared end of a rod which abuts against and is held from turning by a support in front of the roll at a distance therefrom greater than the length of the tube to be made and of such length as to hold the bulb or mandrel in its proper position within the drawing-groove.

The first contact of the heated partially-opened blank and the bulb or mandrel is represented in Fig. 5. It is plain that the oval form of point thus develops considerable resistance to the twisting of the blank and causes it to enter with its edges always in the plane of rotation of the rolls.

With a blank having the proper relative thickness of metal at its edges and sides a circular tube may be thus formed from the partially-opened blank by a single operation. If a higher finish is required, the tube may be further drawn, either hot or cold.

The several devices herein referred to for manipulating the metal at several steps form no part of my present invention, a portion of the same being well known in the art and the remainder being reserved as the subject-matter of a separate application. The completed tube is the subject of an application filed by me April 13, 1885, Serial No. 162,080, and hence forms no part of my present application; and the several devices herein referred to for manipulating the metal at the several steps are (a portion of them) well known in the art, and such as are new are reserved as the subject-matter of a separate application. They are here introduced to show one form of device adapted to satisfactorily accomplish the purposes for which they are employed, and may be modified or replaced by others, as experience may determine.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In the process of making seamless tubes, the following steps, viz: casting an ingot around a core of refractory material, reducing the ingot with its core therein to a flattened blank, and opening the blank into a tube.

2. In the process of making seamless tubes, the following steps, viz: casting an ingot around a core of refractory material partially or entirely incased by superior metal, reducing the ingot to a flattened blank, and opening the blank into a tube.

3. In the process of making seamless tubes, the following steps, viz: casting an ingot around a transversely-oblong core of refractory material partially or entirely incased in superior metal, reducing the ingot to a flattened blank, and opening the blank into a tube.

4. In the process of making seamless tubes, the following steps, viz: casting an ingot having a longitudinal tubular cavity, reducing the cast ingot to a flattened blank having the metal unequally disposed in cross-section, and opening the blank by external edge pressure.

5. In the process of making seamless tubes, the following steps, viz: casting an ingot around a core of refractory material, reducing the cast ingot to a flattened blank by flat and edge rolling, opening one end of the blank, and completing the opening of the blank by edge pressure between rolls.

6. In the process of making seamless tubes, the following steps, viz: reducing a hollow ingot containing refractory material to a flattened blank by edge and flat rolling, opening the blank by first opening one end, subsequently passing the blank edgewise through pressure-rolls, and finishing the tube by drawing the opened blank over a bulb or mandrel.

7. In the process of making seamless tubes, the following steps, viz: reducing a hollow ingot containing refractory material to a flattened blank by edge and flat rolling, finishing the edges of the blank to the proper thickness, opening the blank by first starting open one end and subsequently passing the blank between edge-pressure rolls, and finishing by drawing the opened blank over a bulb or mandrel.

8. In the process of making seamless tubes, the following steps, viz: casting an ingot of substantially rectangular form in cross-section and having a transversely-oblong powdered or friable core of refractory material, reducing the ingot to a flattened blank by flat and edge rolling, and opening the blank into a tube by means of a bulb or mandrel working internally therein.

9. In the process of making seamless tubes, the following steps, viz: the opening of a flattened blank by first starting one end open and subsequently passing it between a pair of edge-pressure rolls, and then completing the tube by passing it over a bulb or mandrel.

10. In the process of making seamless tubes, the following steps, viz: forming a core of refractory material partially or completely incased in superior metal, casting an ingot around the core, reducing the ingot thus constituted to a flattened blank, welding the ingot metal to the superior metal either in casting or reducing, or partly in both, opening the blank by edge pressure, and completing the tube by drawing the opened blank over a flat-pointed mandrel.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CHAS. A. MARSHALL.

Witnesses:
J. J. MALONEY,
A. MONTGOMERY.