No. 715,584. Patented Dec. 9, 1902.

W. KENT.

WELDED CAST METAL PROCESS.

(Application filed Apr. 15, 1901.)

(No Model.)

Fig. I

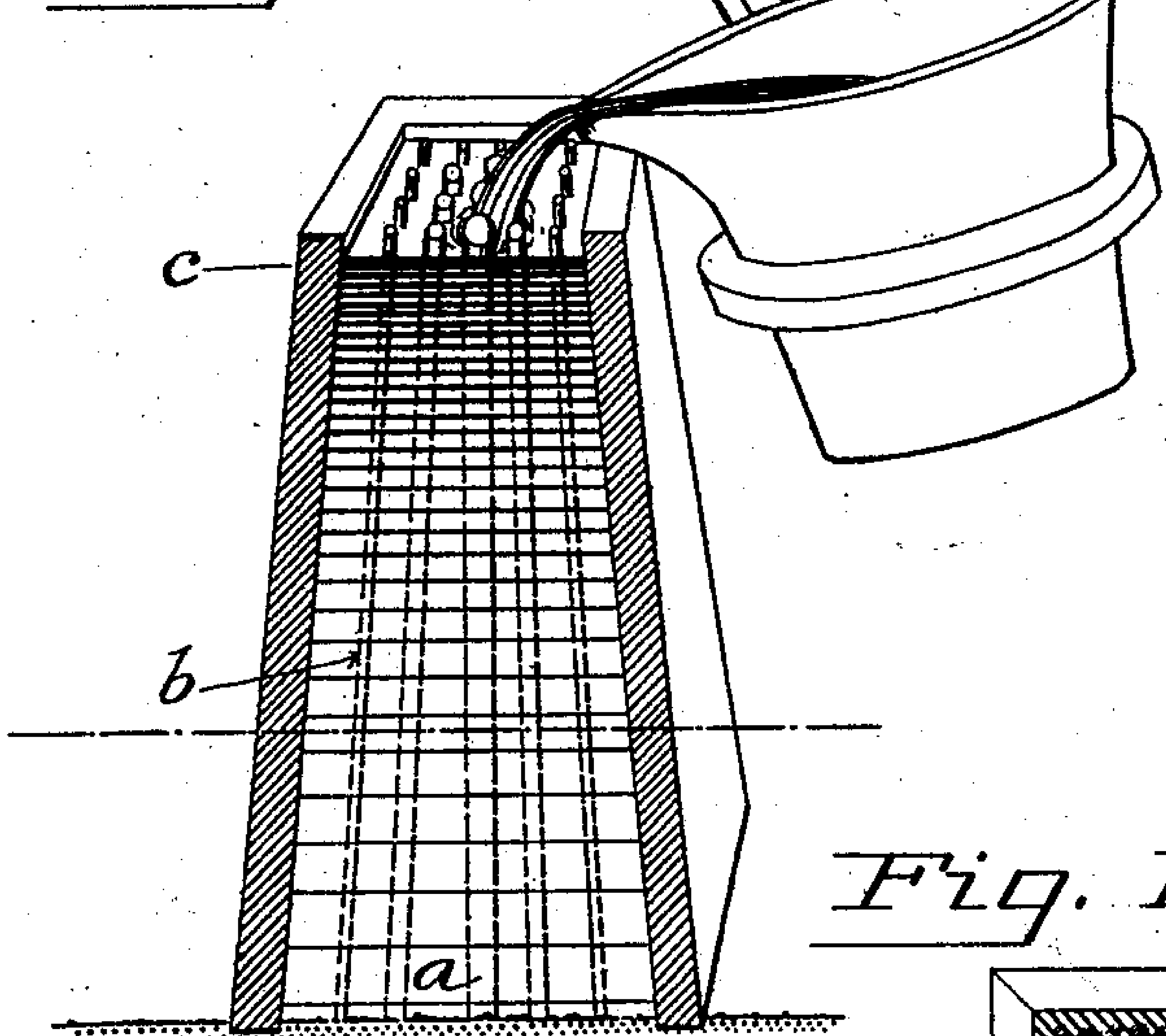


Fig. II

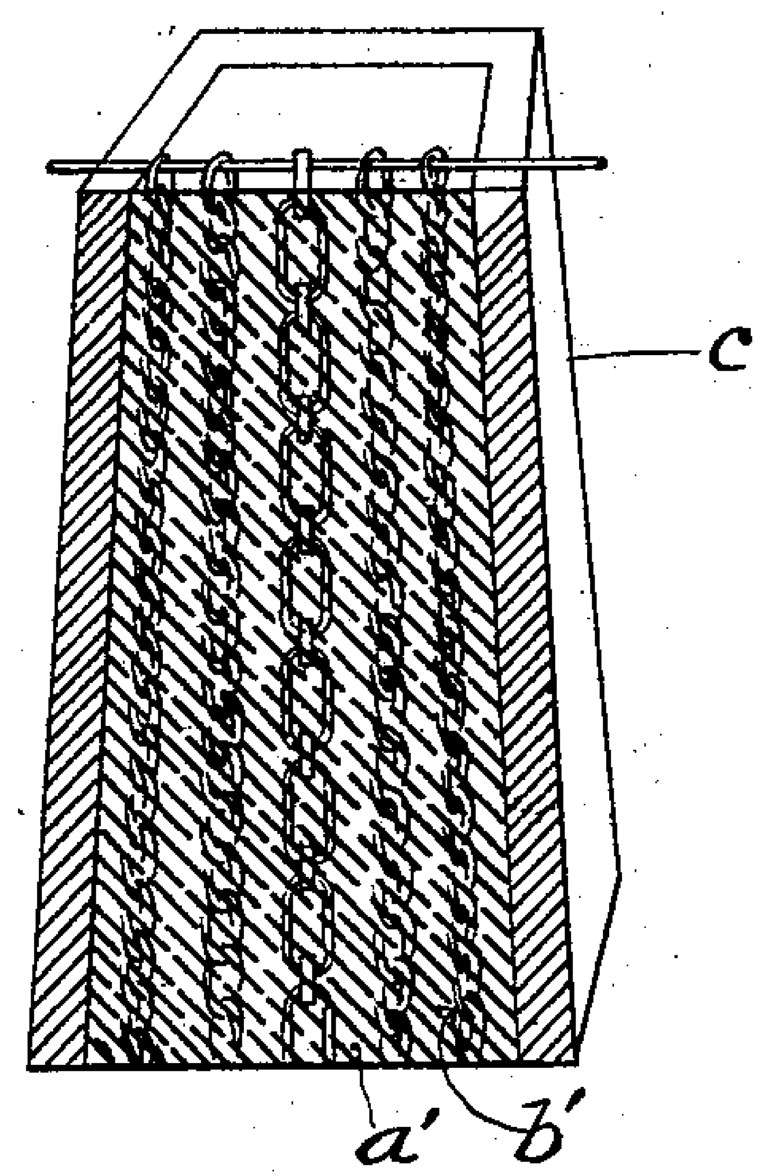


Fig. III

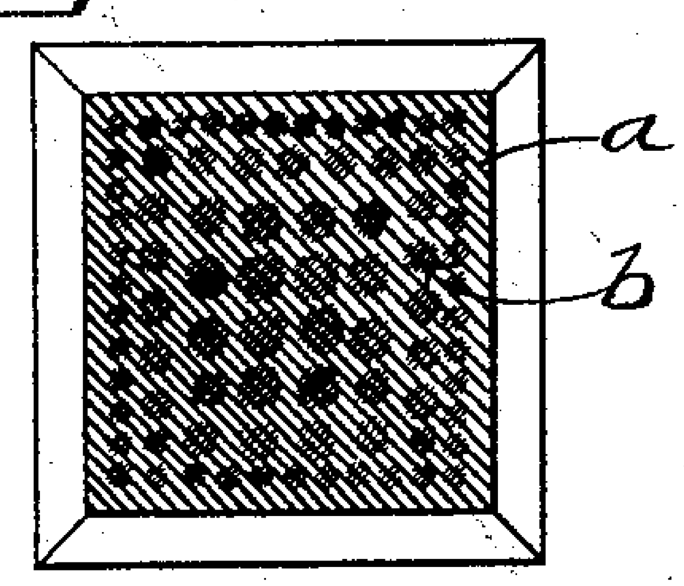


Fig. IV

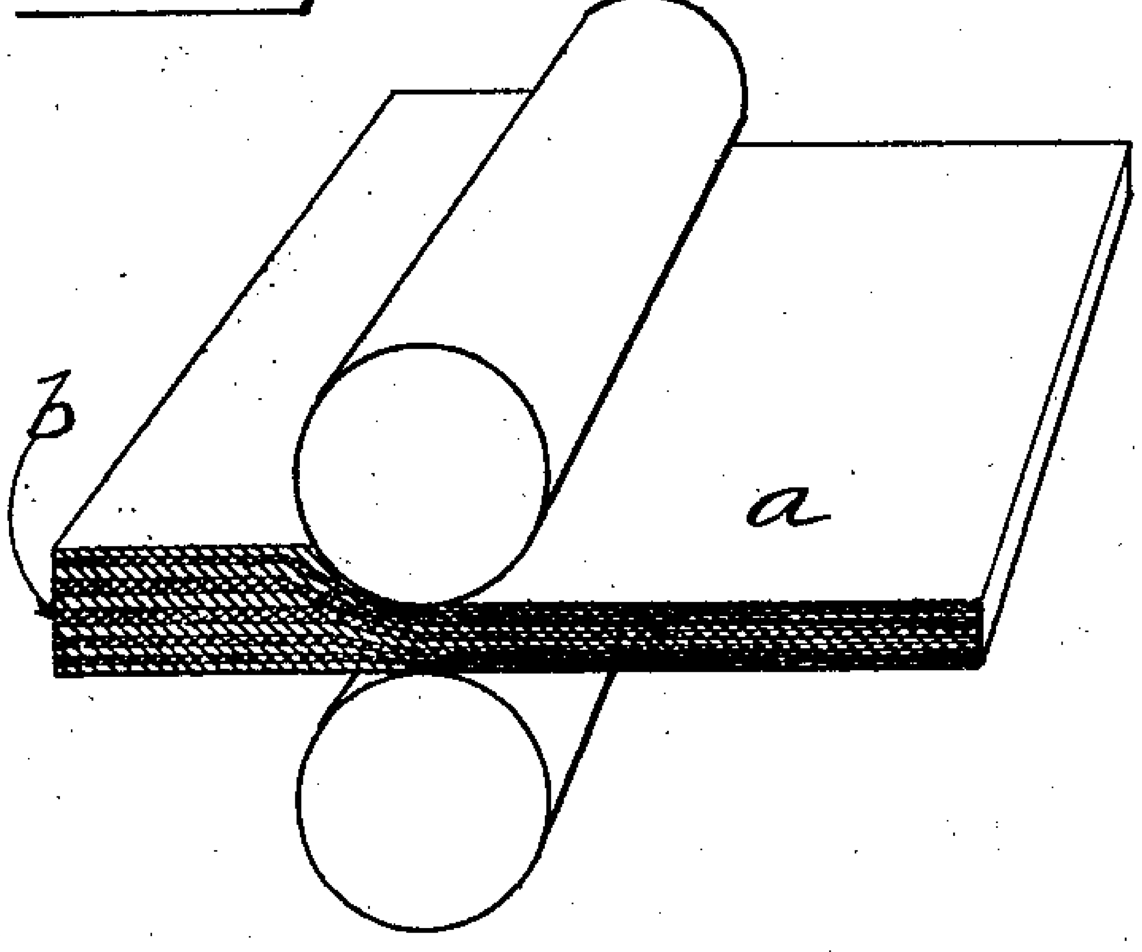
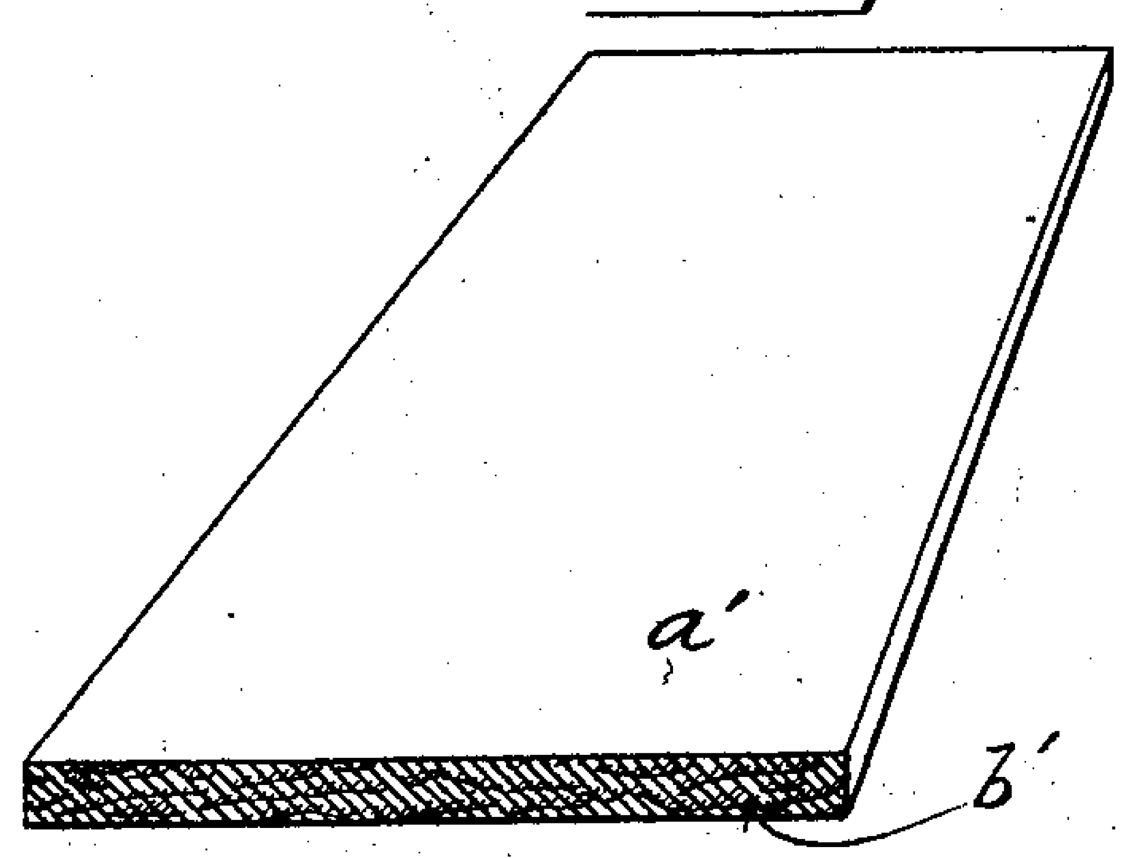


Fig. V



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UNITED STATES PATENT OFFICE.

WILLIAM KENT, OF COVINGTON, KENTUCKY.

WELDED CAST-METAL PROCESS.

SPECIFICATION forming part of Letters Patent No. 715,584, dated December 9, 1902.

Application filed April 15, 1901. Serial No. 55,810. (No specimens.)

To all whom it may concern:

Be it known that I, WILLIAM KENT, a citizen of the United States, residing at Covington, in the State of Kentucky, have invented a certain new and useful Welded Cast-Metal Process, of which the following is a specification.

My invention relates to the iron-working art, and has for its object, primarily, to strengthen cast iron or steel by intimately mixing with it a quantity of wrought iron or steel. It also consists in a composite material composed of high-carbon iron or steel and low-carbon iron or steel welded together in the act of casting and more intimately mixed by rolling.

In the use of iron there are often cases where the rigidity and hardness of cast-iron or steel is needed without the tensile strength of wrought iron or steel, and yet because the cast metal is brittle it cannot be used for fear of breaking under accidental jars and sudden strains. On the other hand, to use enough of the wrought metal to obtain the desired rigidity involves too great expense and requires too great a bulk of metal. The essential difference between the hard cast or high-carbon metal and the soft wrought or low-carbon metal is not so much chemical as structural. The former is crystalline, having no fiber. The latter is laminated in structure with a long fiber or "grain" in the mass. The best puddled iron, even when it has more carbon than certain cast-steels, is yet tougher and more malleable than the latter. It is therefore plain that the toughness is due to the internal structure, the fibrous weaving that is attained by the mechanical operation of puddling and rolling. The object of my invention then is to produce this kind of structure in a composite metal by interspersing filaments of wrought iron or steel in a mass of cast iron or steel in the act of casting and weave them in the mass by rolling rather than by mechanically mixing by stirring in the puddle while the metal is liquid.

Certain irons, like "Bessemer cast," for example, while they may be rolled when hot become brittle when cold. I prefer to use this class of cast metal, and I give it tensile strength and overcome its brittleness by incorporating in its mass various fibers of wrought metal welded in with it.

In the accompanying drawings, Figure I illustrates an arrangement of bars in the mold. Fig. II shows the use of chains for the purpose. Fig. III is a section of the ingot. Fig. IV indicates the effect of rolling; and Fig. V is a view of an armor-plate with a section showing irregular portions of wrought metal, as from the use of chains in casting.

The cold wrought iron or steel is arranged in an ingot-mold *c*, so that the size of the pieces *b* varies inversely with the distance of the piece from zone of greatest heat—that is, the center of the mold. Then I pour in the molten high-carbon iron or steel *a* at a sufficient temperature to fuse the wrought metal, when the heat imparted to it brings it to the welding state and the two become thoroughly welded together. The oxid in the fusing and in the subsequent rolling is displaced and allows full welding while itself adding strength to the composite metal by toughening the grain. The ingot may then be rolled into the desired form, and the metal will have in a large measure the qualities of both cast and wrought metal, these qualities being improved by rolling and working, which more intimately incorporates the two metals and further intermixes the oxid slag.

By properly proportioning the amount of wrought metal *b* and properly locating it so that the largest pieces get the greatest or longest exposure to the heat of the molten metal *a* a thorough welding takes place. I may use wires or bars of new iron, or old chains, or loose scraps or cuttings, or a specially-designed structure to evenly distribute the metal.

After the casting step, by which the wrought metal is distributed in the mass of cast metal in various small masses, so arranged as to facilitate the welding and the subsequent distortion and compression due to rolling, (placing more wrought metal in the interior for this purpose,) the masses of wrought metal and the oxids must be interwoven in the mass to get the desired internal structure. The ingot is then heated in the "pickling" or cementation furnace, softening without oxidation to fit it for compressing, and is then rolled and worked up thoroughly, during which step of the process these small masses of wrought metal and oxid are entirely broken down, displaced, and interwoven throughout the mass of cast metal, this distribution being facilitated by the fact that the cast metal is harder and the wrought metal crushes easily. The result is that the cast metal itself is given a striated or fibrous structure rather than the crystalline, and there are intermixed and woven all through it the filaments of wrought metal irregularly distributed in somewhat the manner attained by puddling, above referred to. It is this internal weaving of the fibers which gives the desired quality and which is the object of this process.

Probably the properties and the function of my composite metal may best be illustrated by referring to its adaption to use in armor-plate.

In the former making of armor-plate malleable metal was used, and in that case the penetration of the projectile did not destroy the plate or do any more injury than results from the penetration of wooden sides. It was afterward sought to prevent penetration by hardening the metal; but in this case even the slightest penetration of the projectile causes the entire disruption of the plate, because of its brittleness. The first attempt to overcome this difficulty was made by Warden in 1862, when he cast a plate about a central framework of wrought-iron. In case of fracture this had an action similar to the action of hair in plasterers' mortar—that is, it did not serve to prevent a fracture in any degree, (the two metals not being welded together,) but merely served to prevent the pieces from entirely dropping apart after they were fractured. Now my invention is designed, first, to use for the main bulk of the metal a cheaper grade of iron or steel; second, to form a hard resisting outer surface to prevent as much as possible any penetration of the projectile, and, third, to provide the metal with a laminated fibrous structure, giving it tensile strength, so that it will withstand a very heavy blow without producing a fracture—that is, a plate will have the advantage of hardness and rigidity, due to high carbon or cast iron or steel, and yet avoid their objectionable brittleness, so that less weight or thickness need be used to obtain the same resistance to breaking. The plate will hold together even when entirely penetrated, and at the same time the resistance to penetration that was obtained in the cast-steel plate is preserved.

The process when applied to the manufacture of shafting, rails, and structural iron, particularly for columns, is even more valuable, for there are many places where cast columns may not be used because of the danger that a sudden jar will rupture them, while, on the other hand, malleable columns may not be used because they have not sufficient rigidity.

Of course this composite metal may be used in directly casting articles in their final form—as, for example, large shafts and columns; but the filaments of wrought metal must be distributed throughout the whole mass, and the process is distinguished from those in which the wrought metal is merely embedded in the cast metal.

Having thus described my invention and its use, I desire to secure by Letters Patent of the United States the following, and I claim—

1. The process of making composite crystalline and fibrous metal by arranging in an ingot-mold a series of filaments or pieces of wrought-iron, then pouring in and around the same molten "cast" or high-carbon iron heated to a temperature just sufficient to weld the two metals together, and afterward rolling and working the ingot to further incorporate and distribute the wrought metal through the cast metal, and break down the form of the wrought pieces whereby the mass retains the hardness of cast-iron while possessing a woven fibrous internal structure of thoroughly incorporated laminæ of oxid and soft iron.

2. The process of making composite crystalline and fibrous metal by first placing in a mold various masses of wrought-iron arranged in sizes varying with the distance from the side walls of the mold, then pouring in and around the same molten "cast" or high-carbon iron at a temperature just sufficient to weld the two metals where in contact, and afterward rolling and working the whole mass to break up the form of the wrought pieces and thoroughly interweave and distribute the wrought metal, giving the mass a partly fibrous and partly crystalline internal structure.

3. The armor-plate composed of compound cast and wrought iron or steel, the wrought metal being in the form of irregular filaments varying in size approximately with their distance from the outside surface, welded and woven in the mass of cast metal, both metals being crushed and distorted out of their original cast position and form by subsequent rolling, so that the cast metal is rendered fibrous rather than crystalline, as set forth.

In testimony whereof I have hereunto signed my name in the presence of the two subscribing witnesses.

WILLIAM KENT.

Witnesses:
BERTHA O. ROSS,
CHAS. H. URBAN.