E. GATHMANN.

METHOD OF CASTING INGOTS.

APPLICATION FILED AUG. 30, 1910.

983,357.

Patented Feb. 7, 1911.

2 SHEETS—SHEET 1.

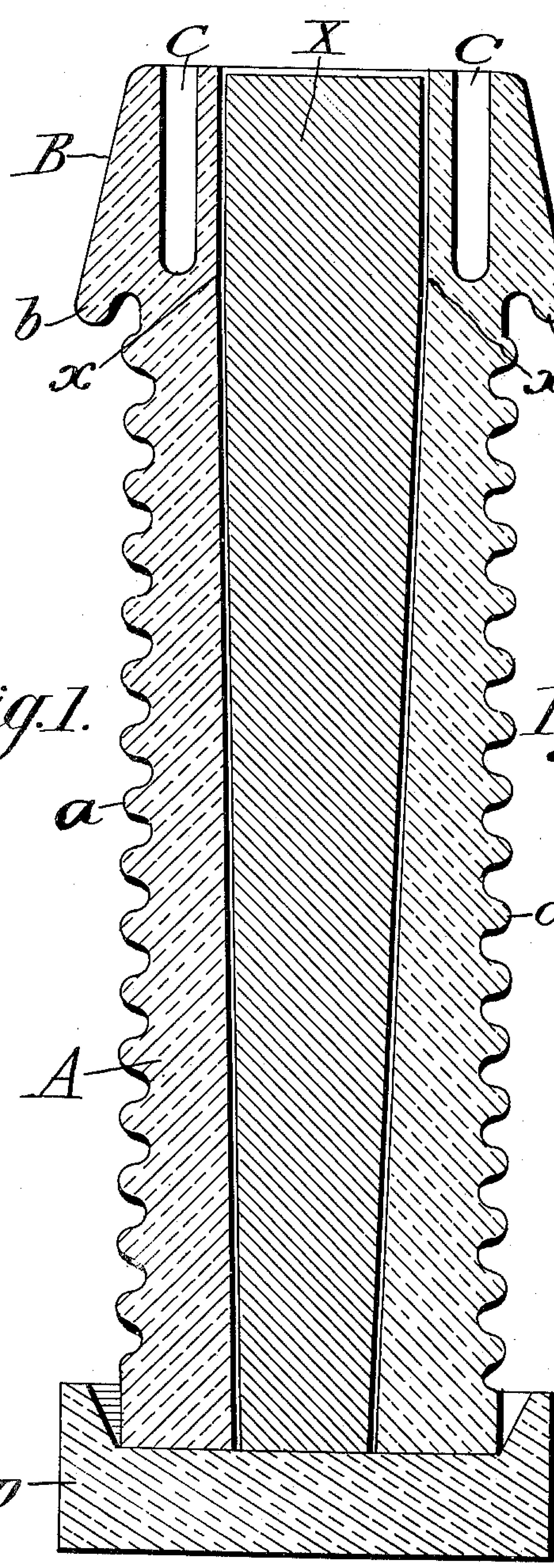

Fig.1.

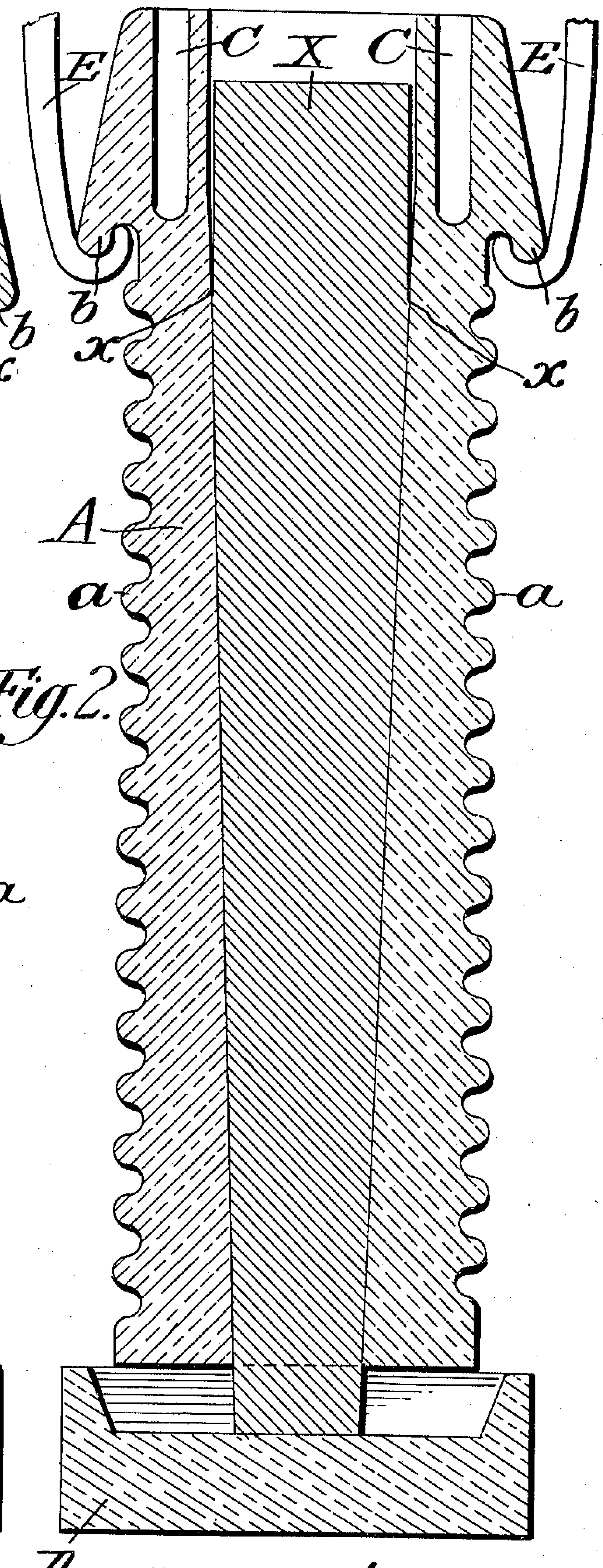

Fig.2.

Witnesses.

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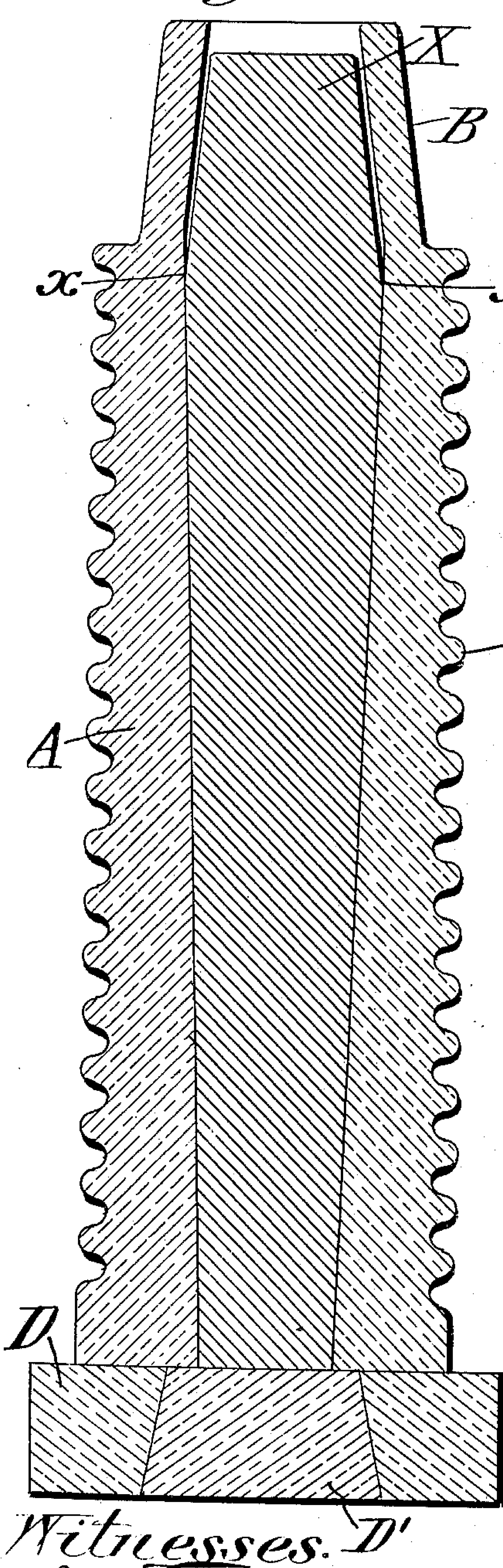
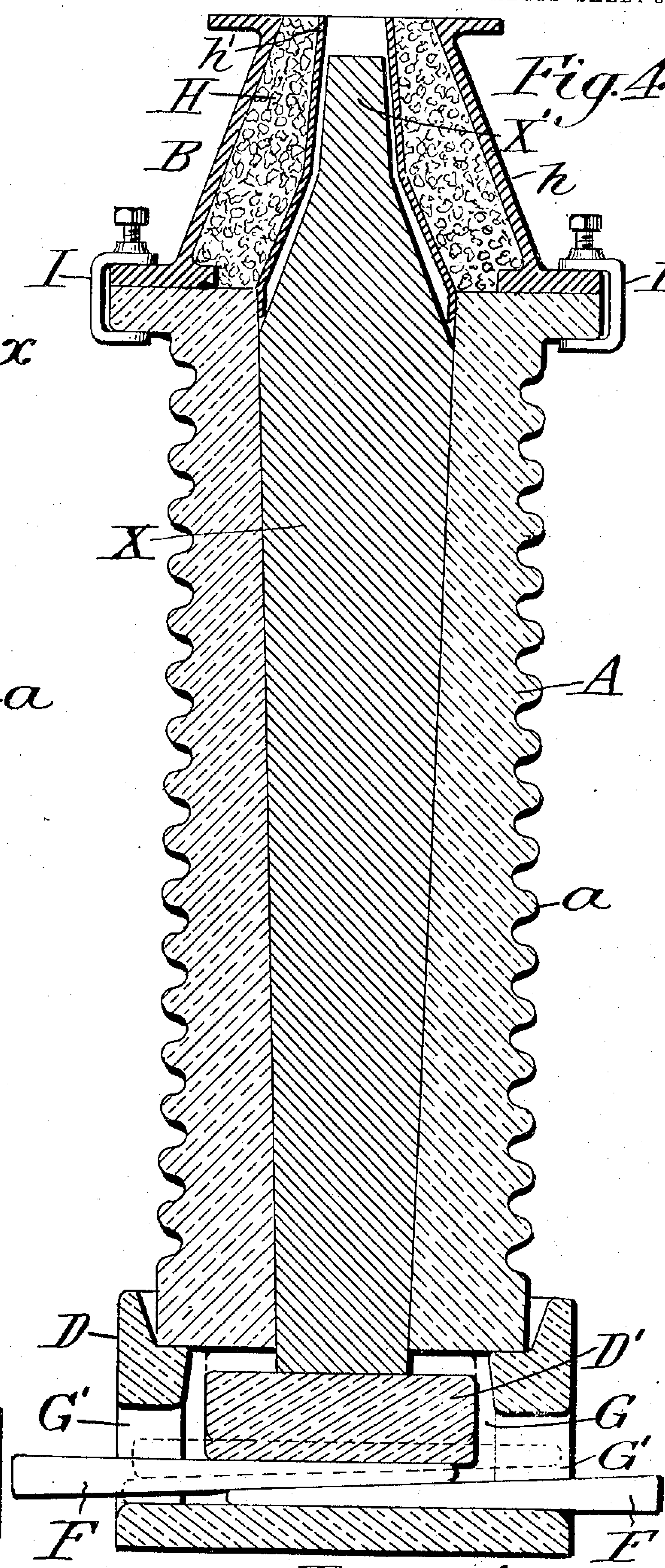
2 SHEETS—SHEET 2.

Fig. 3.





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UNITED STATES PATENT OFFICE.

EMIL GATHMANN, OF NEW YORK, N. Y.

METHOD OF CASTING INGOTS.

983,357. Specification of Letters Patent. Patented Feb. 7, 1911.

Application filed August 30, 1910. Serial No. 579,690.

To all whom it may concern:

Be it known that I, EMIL GATHMANN, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Methods of Casting Ingots, of which the following is a specification.

My invention relates particularly to the casting of steel ingots, but it may be used in connection with casting other articles.

In my U. S. Patents No. 921,972 of May 18, 1909 and No. 940,386 of November 16, 1909, I have shown molds for casting steel ingots in which provision is made for accelerating heat radiation and thus favoring the cooling of the molten mass to a greater extent at the bottom and lower part of the mold than the upper part thereof, which upper part is constructed to conserve the heat of the adjacent molten mass within the mold. By these improvements the formation of pipes and blow-holes in the ingot was greatly reduced.

According to my present invention I have devised a new way of conserving the heat in the upper part of the ingot and of accelerating the absorption or radiation of heat in the lower part thereof. This I accomplish by allowing the molten ingot to partially solidify in the mold and to shrink away from the side walls thereof, and then causing the lower part of the partially solidified ingot to move into contact with the walls of the mold while the upper part thereof remains out of contact therewith to thereby promote the cooling of the lower part of the ingot and to retard the cooling of the upper part thereof. In this way a close contact is insured of the lower inner walls of the mold with the ingot walls and an air space is produced between the upper inner walls of the mold and the upper part of the hot ingot. This insulating air space assists materially in conserving the heat in the ingot at its upper portion. To accomplish these results I preferably give to the mold chamber a tapering formation from the bottom or base thereof upward and outward to the base of the neck of the mold and in the neck of the mold I give to the mold chamber a taper upward and inward relatively to the taper of the lower portion of the mold, and I provide means whereby the ingot, when partially solidified, may be lowered relatively to the mold.

There are several ways in which my invention may be carried out, some of which are shown in the accompanying drawings, in which,

Figure 1 shows a vertical central section through an ingot mold embodying my improvements with an ingot therein in the condition it will appear after it has partially solidified. Fig. 2 is a similar view with the ingot lowered or the mold raised to cause the lower portion of the partially solidified ingot to come into contact with the inner walls of the mold chamber. Fig. 3 shows a vertical central section through an ingot mold of modified construction with a partially solidified ingot therein. Fig. 4 is a similar view of a further modification.

The mold shown in Fig. 1 is preferably made of cast iron with its neck and body portion formed integrally.

The body A of the mold rests on a stool D, and the lower part of the mold is constructed to favor heat radiation, while the upper part or neck B is reduced in thickness to conserve the heat of the ingot. Preferably, as shown in my former patents, the lower portion of the mold is provided with ribs *a* which, as shown in Fig. 1, extend horizontally around the outside of the mold, but they may be otherwise arranged. The walls of the neck B are made thinner than the walls of the body of the mold. This may be done by forming recesses or an annular recess C in the neck and the neck is provided with lugs *b* by means of which lifting devices E may be readily applied.

The heavier walls of the body of the mold prevent any material outward expansion and enlargement of the mold chamber as they remain comparatively cool and thus insure relatively close contact with the hot ingot walls, whereas the thinner walls of the neck B are heated through and expand more readily, thus enlarging the upper part of the ingot chamber and providing a relatively large clearance or air space about the upper part of the hot ingot walls. The material of which the inner mold walls, throughout their entire length, are constructed is a metal, such as cast iron which absorbs heat rapidly and expands considerably upon rise of temperature whereby a differential of expansion is obtained between the upper and lower walls of the mold.

In Fig. 1 the mold chamber at the neck of the mold is shown as having substantially straight parallel vertical walls, while the walls of the lower portion of the mold below the line *x* taper downwardly and inwardly to the bottom of the mold. As shown in Fig. 3 the walls of the neck portion of the mold taper upwardly and inwardly from the base of the neck. By this construction, after the metal is teemed or poured into the mold in some cases approximately 85% of the ingot X during its shrinkage remains in close contact with the walls of the mold, while the upper part of the molten ingot as it shrinks draws away from the walls of the mold, as indicated in Fig. 3, and thus an air space is formed which materially assists in preventing the radiation of heat, as before specified.

In Fig. 1, I have illustrated how a partially solidified ingot has drawn away from the walls of the mold chamber both in the body portion of the mold and in the top thereof. This occurs under some conditions, while in some cases the lower portion of the ingot remains in close contact with the walls of the mold, but in each case the upper part of the ingot shrinks away from the walls of the ingot.

For some classes of work it is preferable to give a decided taper to the mold chamber in the neck of the mold and the ratio of taper in such cases is best made greater in the upper part of the mold than in the lower part thereof, so that the interval or air space between the ingot and the walls of the mold will increase considerably during the cooling of the ingot. As approximately 85% of the ingot is brought into actual contact with the mold during the cooling or setting of the ingot, radiation of heat or the absorption of heat is materially promoted while the cooling of the upper part of the ingot is materially retarded by the surrounding film of air which being rarefied is a very poor conductor of heat.

In the case of ingots of large diameter or those cast of alloys in which sidewise shrinkage is excessive, in order to insure close contact of the lower side walls of the ingot with the corresponding inner side walls of the retaining mold, I provide means whereby the ingot may be lowered in the mold, or the mold raised relatively to the ingot. This may be done in various ways. In Figs. 1 and 2, I have illustrated how the mold may be lifted relatively to the ingot by lifting devices E. It will be understood that after the ingot has partially solidified, as illustrated in Fig. 1, the mold is lifted to the extent indicated in Fig. 2 so as to cause the lower portion of the ingot to come into close contact with the walls of the mold chamber and thus promote the absorption of heat while, by the construction shown, the top portion of the ingot remains out of contact with the walls of the mold and thus the heat of this portion of the ingot is conserved.

In Fig. 3 the construction is somewhat similar to that shown in Fig. 1, but the stool D is provided with a removable section or plug D′ which may be lowered in order to permit the ingot to descend in the mold. In the construction shown in Fig. 3 the walls of the neck taper upwardly and inwardly as shown.

In Fig. 4 the neck portion of the mold is constructed in the form of a shell filled with firebrick, lime or other suitable insulating material. The outer casing *h* is made of metal and the inner wall *h′* is preferably made of steel. The neck is clamped to the body portion of the mold by suitable securing devices I, and when desired, the neck may be removed and the ingot withdrawn from the mold by suitable lifting mechanism applied to the lug X′ formed on the top of the ingot.

The stool D supports the mold and it is made hollow as indicated at G, G′ to form a chamber within which is arranged a block D′ which is adapted to support the ingot. This block rests on wedges F by means of which the block may be raised and lowered. While the metal is being poured or teemed into the mold, the block D′ has its upper surface in line with the bottom of the mold, but after the ingot has partially solidified the wedges may be partially withdrawn to thus lower the block D′ and allow the ingot to drop until its walls are in close contact with the walls of the mold chamber. The lowering or the shifting of the partly solidified ingot thus insures a good contact and better heat transference to the mold from the lower portion of the ingot and at the same time increases the air film at the upper side walls of the ingot.

In place of providing the mold with ribs for cooling the lower portion thereof, water-spraying or induced or forced air currents might be used to accelerate the cooling of this portion of the mold.

In my application for patent No. 569,731, filed June 30, 1910, I have shown a mold of the construction indicated in Fig. 3 of the accompanying drawings, and in that application I have made claims to the construction of molds employed in carrying out the method herein claimed.

I claim as my invention:

1. The hereindescribed method of casting ingots, which consists in pouring the molten metal into a mold, allowing it to partially solidify therein and to shrink away from the side walls thereof, and then causing the lower portion of the partially solidified ingot to move into contact with the walls of the mold while the upper part thereof remains out of contact therewith to thus promote the cooling of the lower portion of the

ingot and to retard the cooling of the upper portion thereof.

2. The hereindescribed method of casting ingots, which consists in pouring the molten metal into a mold, producing an air space between the upper inner walls of the mold and the upper part of the hot ingot and in keeping the lower portion of the ingot in close contact with the walls of the mold chamber while the solidification of the ingot is in progress and until it has solidified.

In testimony whereof, I have hereunto subscribed my name.

EMIL GATHMANN.

Witnesses:
ANNA M. HOFFMANN,
H. L. CADMUS.