

June 16, 1931.

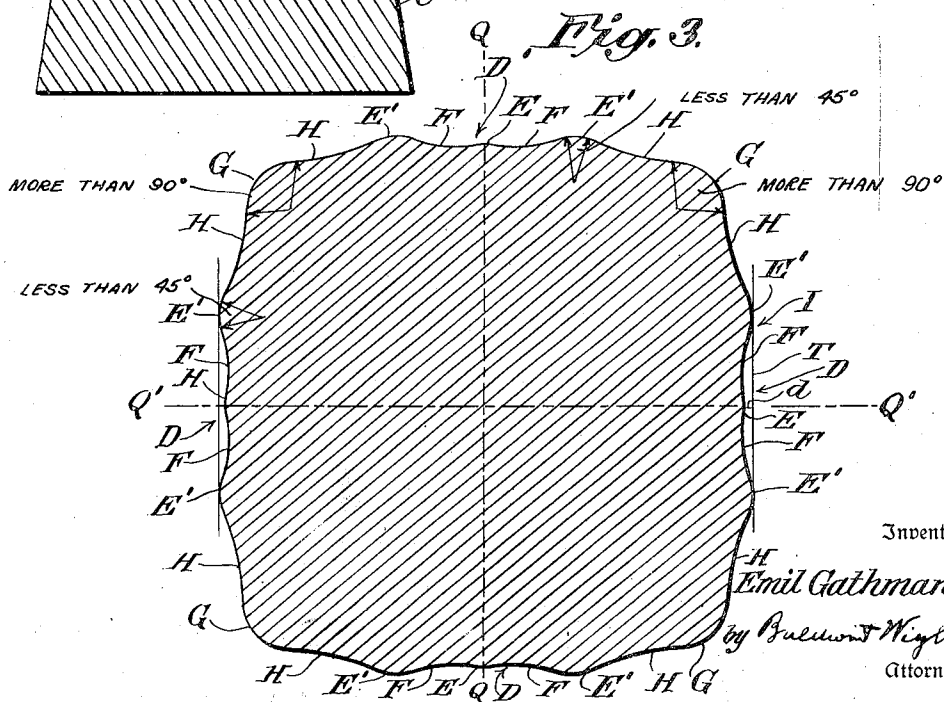
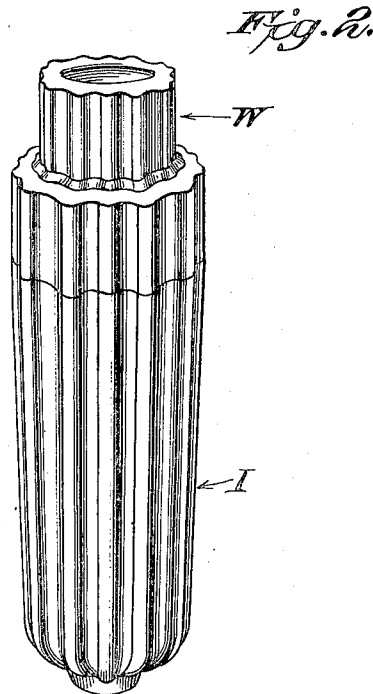
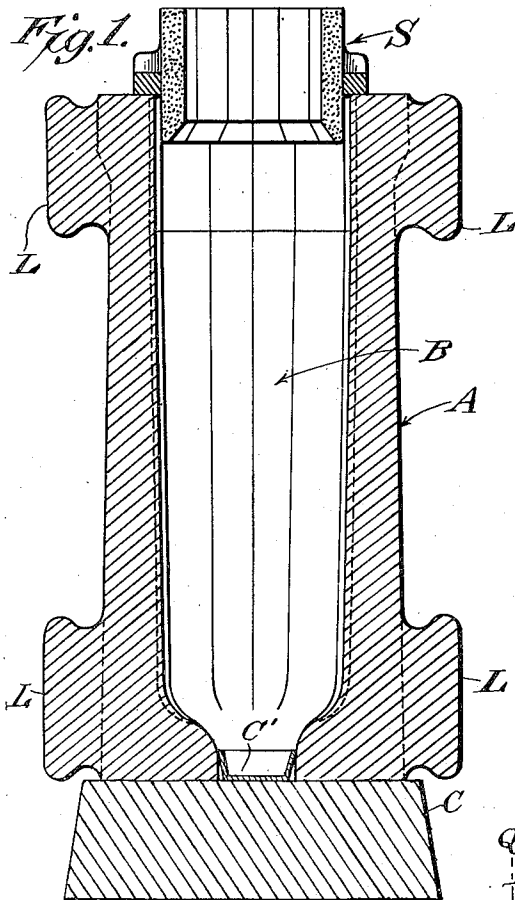
E. GATHMANN

1,810,041

METALLIC INGOT

Filed Nov. 7, 1930

2 Sheets-Sheet 1



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Attorneys.

June 16, 1931.

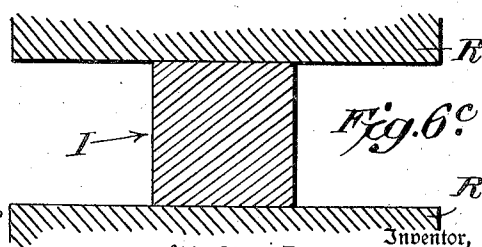
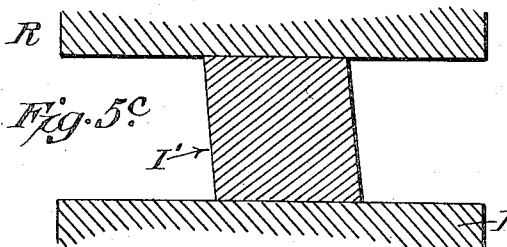
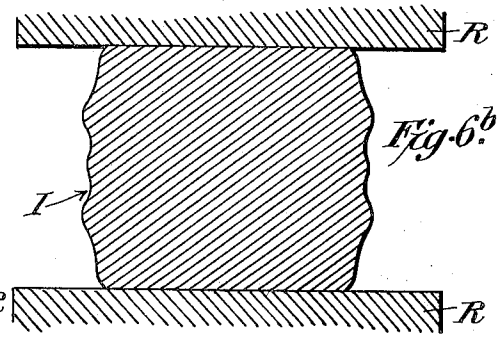
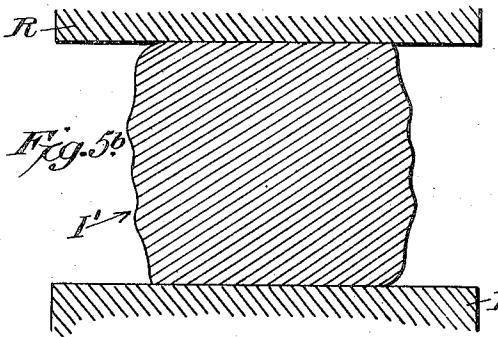
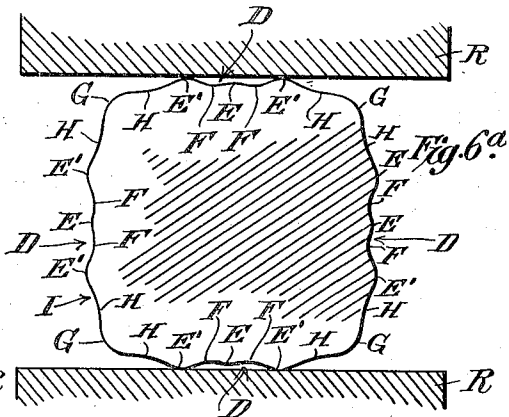
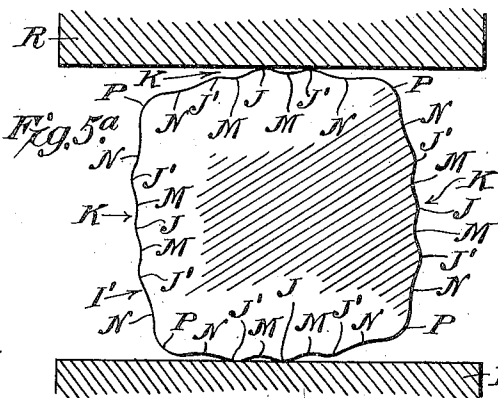
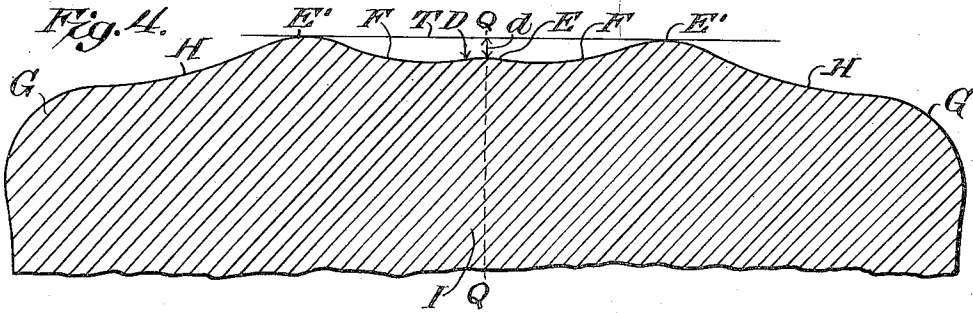
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METALLIC INGOT

Filed Nov. 7, 1930

2. Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

EMIL GATHMANN, OF BALTIMORE, MARYLAND

METALLIC INGOT

Application filed November 7, 1930. Serial No. 494,103.

This invention relates to metal ingots and more particularly to improvements in the contours of ingots of substantially rectangular cross section by virtue of which "diamond shaping" of the ingots during the rolling process is avoided, and the rolling of such ingots to true rectangular billets or blooms is made possible.

It is now well known to those skilled in the art that the metal of ingots of generally rectangular cross section may be more effectively worked during initial roll passes if the mid-portions of their sides are provided with projecting salients which are adapted to be swedged outwardly, and to a large extent parallel with the axes of the rolls, rather than flowed longitudinally as happens in ingots of rectangular cross section the sides of which are not provided with such projecting salients. An ingot having a contour including such outwardly projecting salients is shown, described and claimed in my U. S. Patent 1,767,174 of June 24, 1930. In general the ingot described in this patent is of a contour including a series of smoothly curved connected inwardly-arched portions and a plurality of outwardly-arched portions, the arcs defining each of said portions being described by a radius of substantially greater length than the chord of the arc. The ingot contour includes at least two oppositely-disposed primary sides each of which includes two inwardly-arched surface portions and three outwardly-arched surface portions or salients. The three outwardly-arched salients disclosed in the patent referred to are aligned, that is, a line drawn tangent to each of the salients of any particular primary side is parallel to a center line of the ingot. Ingots of this kind, when properly made, have been found to be capable of being more efficiently worked than other ingots of substantially rectangular cross section and the products made from such ingots are consequently more free from cracks and other flaws developed during the rolling process. A practical difficulty with ingots of the kind described in the patent referred to resides in the fact that in constructing the core box for making the ingot mold, the outwardly-arched surface portions or salients of the primary sides have not always been accurately aligned, and in cases where one outwardly-arched salient or surface portion disposed near or at the center of the primary side is made to extend beyond the other outwardly-arched salients, the ingot, when placed in position for entrance between the rolls, will cant or tip to one side or the other which will result in distortion or "diamond-shaping" of the ingot. When the ingot has been thus distorted or "diamond-shaped" it is impossible to restore the ingot to the desired rectangular shape during the rolling process.

In accordance with the present invention I so arrange the salients comprising the ingot contour that the chances for this undesirable misshaping of the ingot are rendered practically negligible.

A typical embodiment of the invention is illustrated in the accompanying drawings in which:

Figure 1 is a central vertical sectional view of an ingot mold constructed for the production of ingots in accordance with the invention;

Figure 2 is a perspective view of an ingot having a contour in accordance with the invention;

Figure 3 is a view in horizontal cross section and on an enlarged scale of the ingot shown in Figure 2;

Figure 4 is a fragmentary horizontal cross sectional view on a still further enlarged scale of the ingot shown in Figure 2;

Figures 5-a-b-c are diagrammatic views illustrating successive stages of the rolling of an improperly designed ingot and Figures 6-a-b-c are diagrammatic views similar to 5-a-b-c, but illustrating the corresponding successive stages of the rolling of an ingot made in accordance with the present invention.

Figure 1 illustrates a mold A having a mold chamber B of generally rectangular cross section. The mold is constructed of suitable heat absorbing material such as cast iron and is shown as being positioned on a stool C and provided with a cup C' of the type shown in my U. S. Patent No. 1,170,629

of February 8, 1916. The mold top consists of a shrink-head casing S made of heat absorbing material such as fire-brick or the like. The usual lugs L of a well-known kind are shown as being cast integrally with the mold at the upper and lower extremities thereof, these lugs serving to facilitate the handling of the mold when setting up a "jag" of molds and when removing the ingots therefrom.

Inasmuch as the object of the present invention is to so improve contours of various kinds of ingots of generally rectangular cross section as will result in the production of more perfectly shaped billets or blooms, the specific contour of the mold A will not be described, since it is believed that the following detailed description of the ingot contour, to which the mold contour necessarily corresponds, will be adequate for a complete understanding of the contour of the mold chamber.

Figures 2 and 3 illustrate an ingot I having a contour in accordance with the present invention and including a shrink-head portion W. The specific contour of the ingot may be more clearly seen in the enlarged fragmentary view (Fig. 4). The surface of the ingot illustrated includes four relatively narrow primary sides generally designated D, each of which includes three outwardly-extending surface portions or salients E', E, E' and two inwardly-extending salients F, F'. In the case of the primary sides D shown at the top and bottom of Figure 3, the outwardly-extending salients E are located at the mid-points of the sides D and the ingot center line Q, Q passes through said outwardly-extending salients, whereas the other outwardly-extending salients, namely, the salients E', E' are disposed on opposite sides of the center line Q, Q. Similarly, the outwardly-extending salients E, E of the primary sides D, D, shown at the right and left of Figure 3 are disposed centrally of the ingot and the center line Q', Q' passes through the center of the salients E, E, whereas the adjacent salients E', E' are disposed on opposite sides of the ingot center line Q', Q'. The primary sides D are connected to adjacent corners G by means of inwardly-curved secondary corner portions H and the arc defining each of the arched corners G preferably subtends an angle of more than 90°, while the arc defining each of the concavo-convex portions of the primary sides D subtends an angle of less than 45°.

In accordance with the invention the several salients or surface portions constituting the primary sides D are so proportioned that the centrally disposed outwardly-extending salients E extend outwardly to a slightly lesser degree than the outwardly-extending salients E', E'. This difference is indicated at d in Figures 3 and 4, being the distance from the apex of the salients E to a line tan-

gent to both of the associated salients E', E'. The amount of difference between the outward extent of the salient E and of the salients E', E' will vary according to the size of the ingot produced. In the case of an ingot having a maximum cross-sectional dimension of thirty inches, the difference d is preferably about one-sixteenth of an inch.

The practical advantages resulting from the employment of a contour of the kind shown in Figs. 2, 3 and 4 will be apparent from a comparison of Figures 5—a—b—c, with Figures 6—a—b—c. In Figure 5—a an ingot I' is shown as entering between a pair of rolls R, R. This ingot is of the same general contour as that shown in my Patent No. 1,767,174 referred to above. As stated before the outwardly-extending salients in each primary side of the ingot disclosed in this patent are supposed to be in alignment. However, since any inaccurate work in the making of the core box for producing an ingot mold will necessarily result in corresponding inaccuracies in the contour of the mold which is not machined but is used as cast, it sometimes happens that the centrally disposed outwardly-extending salient of a primary side wall of the mold and of the ingot will extend beyond the two other outwardly-extending salients of the primary side. In the ingot shown in Figure 5a each primary side generally designated K includes a centrally disposed outwardly-arched salient J, two other outwardly-arched salients J' respectively located on opposite sides of the salient J, and two inwardly-arched salients M intervening between the salients J' and the respective salients J. The primary sides K are connected to outwardly-arched corners P by means of inwardly-curved secondary corner portions N. The two salients J' of the primary walls K of the upper and lower sides of the ingot project outwardly to a greater extent than the associated salients J, J. For this reason, the ingot upon entering the rolls will assume a canted or tipped position as shown in Figure 5a. Figure 5b illustrates the shape of the ingot during the initial roll pass. It will be noted that the initial canting of the ingot has resulted in the distortion thereof from a generally rectangular cross section to a cross section of diamond shape. Figure 5c indicates the shape of the ingot after the latter has been passed through the rolls a number of times. It will be noted that the distortion produced during the initial roll pass has been maintained and that the ingot when reduced to the size shown in Figure 5c is of a diamond shape rather than of the desired rectangular shape.

Figure 6a illustrates the ingot I having a contour in accordance with the present invention positioned in readiness for the initial roll pass. It will be noted that the salients E of the primary sides D at the top and

bottom of Figure 6a are out of contact with the rolls and that the ingot is supported solely by the outwardly extending salients E' E' resting upon the lower roll Q. Thus, the outwardly-arched surface portions E' E' of each side D are the only portions of the ingot disposed to contact with the rolls when the ingot is initially introduced between the latter. By reason of this manner of supporting the ingot no appreciable tipping can take place and the ingot will be rolled into a rectangular section as shown in Figure 6c. If, because of inaccurate construction of the ingot mold, the centrally disposed outwardly-extending salient E of any primary side D of the ingot shown in Figure 6a should extend outwardly further than intended, this will not be harmful since a moderate discrepancy in this respect will not cause the salient E in question to extend beyond the associated salients E', E'. In other words, the difference d between the outward extent of the centrally disposed salient E and the outward extending of the salients E', E' provides a margin of safety which, in practice, is sufficient to prevent the occurrence of canting of the ingot and subsequent diamond-shaping thereof.

For the purposes of illustration the invention has been described as being embodied in an ingot having a contour in general similar to the contour described in my Patent No. 1,767,174, but it is to be understood that the invention may be also embodied in other kinds of ingots having sides including more than two outwardly-extending surface portions or salients.

I claim as my invention:

1. A metallic ingot having two oppositely disposed sides each of which includes more than two connected outwardly-arched portions, only two of which are initially roll-contacting.

2. A metallic ingot having two oppositely disposed sides each of which includes a plurality of connected and alternately arranged inwardly-arched portions and more than two outwardly-arched portions, two of the outwardly-arched portions of each of said sides extending outwardly beyond the other portions of said sides and being thus disposed for initial contact with rolls to the exclusion of the remaining portions of said sides.

3. A metallic ingot having two oppositely disposed relatively narrow sides each of which includes a plurality of connected and alternately arranged inwardly-arched portions and more than two outwardly-arched portions, two of the outwardly-arched portions of each of said sides being located on opposite sides of the center line passing through said narrow sides, and extending outwardly beyond the other portions of said side.

4. A metallic ingot having two oppositely

disposed sides each of which includes a centrally disposed outwardly-arched portion and two other outwardly-arched portions respectively located on opposite sides of said centrally disposed portion and connected thereto by intervening portions, said centrally disposed outwardly-arched portion extending outwardly to a lesser degree than said other outwardly-arched portions.

5. A metallic ingot having two oppositely disposed sides each of which includes a centrally disposed outwardly-arched portion and two other outwardly-arched portions respectively located on opposite sides of a center line passing through said centrally disposed portion, and connected thereto by intervening portions, said other outwardly-arched portions extending outwardly from said ingot to a greater degree than said centrally disposed portion, a tangent to both of said other outwardly-arched portions being perpendicular to the ingot center line passing through said centrally disposed portion.

In testimony whereof, I have hereunto subscribed my name.

EMIL GATHMANN.