

UNITED STATES PATENT OFFICE.

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PROCESS FOR IMPROVING THE PROPERTIES OF INGOT-IRON AND THE LIKE.

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Specification of Letters Patent.

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No Drawing.

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To all whom it may concern:

Be it known that we, HANS GOLDSCHMIDT and HANS BIEWEND, subjects of the King of Prussia, and residents of Essen-on-the-Ruhr, in the Province of the Rhine, Germany, have invented certain new and useful Improvements in Processes for Improving the Properties of Ingot-Iron and the like, of which the following is an exact specification.

A process of manufacturing homogeneous metal castings has been previously proposed in which heat produced by an aluminothermic reaction was made to act upon certain points of a casting. More particularly this process was intended to be carried out in such a manner, that by introducing an aluminothermic mixture into the solidifying head of an ingot, the latter was to be kept liquid for a longer time so as to make the ingot capable of receiving further liquid steel. Now practice has shown that although certain parts of the ingot can be heated and kept fluid by this process it is impossible to remove a great number of disadvantages by same. So for instance frequently the case may arise that an ingot contains a shrinkage hole or cavity which is not tapering off in a regular manner but shows displacements or interruptions. If now the heat, produced according to the previously known process by an aluminothermic reaction, would be allowed to act upon the head of the ingot, only the upper part of the cavity interrupted by displacements, but not the lower part of such hole would be made accessible to the liquid metal to be further filled in. Furthermore, many places of the ingot frequently show blisters as a consequence of the inclusion of gases. These hollow spaces cannot at all or can only partly be removed by allowing the heat arising from an aluminothermic reaction to act at a certain spot and more particularly at the head of the ingot.

Now a long series of experiments has shown that by allowing the heat, produced by an aluminothermic reaction to act at certain spots of a casting a thorough improvement of the properties of the ingot cannot be obtained because only a local action by means of fusion or repeated liquefaction is obtained by this process. Further experiments have shown that the disadvantages above-mentioned can not only be avoided,

but that also a number of important advantages can be obtained by making use not of a local thermal effect only, but of a mechanical effect of the aluminothermic mixture. If namely a certain time after the casting is finished the aluminothermic mixture is introduced into the solidifying ingot, the interior of which is still fluid, in such a manner that the aluminothermic mixture comes down as far as possible to the bottom of the ingot mold, one immediately observes that the metal in the interior of the ingot is brought into a bubbling and whirling motion, which extends up to the surface. By this mechanical motion which is aided by the rapid rise of the light slag all blisters or gas bubbles inclosed or retained in the interior of the ingot are forced up to the surface. Furthermore, all the segregations which always separate out in the longitudinal axis of an ingot and likewise particles of slag, which accidentally have come into the ingots, are in the same manner brought to the surface. How perfectly the removal of gas, segregations and the like is effected may be seen from the fact that immediately after the reaction the contents of the ingot mold shrink for a considerable amount.

The new recognition is that all the factors acting unfavorably upon the properties of the ingot are eliminated by producing a whirling motion directed from the bottom to the surface within the solidifying ingot the interior of which is still fluid. This whirling motion is preferably caused by introducing an aluminothermic mixture as described above, as aluminothermic mixtures all those mixtures being understood, which are composed of one or more metal oxides and aluminum or other reducing metals, by the reaction of which heat is produced.

The bubbling and whirling motion which is the cause of improving the qualities of the cast ingot can not only be produced by the introduction of an aluminothermic mixture but also by various other means for instance with the aid of explosives the speed of explosion of which is particularly small, or by means of gases introduced under high pressure, which do not dissolve within the ingot metal, or finally by producing electric currents within the liquid metal. Now, in order to obtain the result that the whirling motion and its effects extend throughout the

ingot, it has proved necessary that for instance the box or the like containing the aluminothermic mixture, is pushed down as far as possible to the bottom of the mold.

5 After the reaction is finished and the steel rod by means of which the box has been introduced has been withdrawn, the liquid iron or steel sinks down in the ingot mold. Then the latter is again filled up
10 with liquid steel or the like metal from the ladle as quickly as possible, the steel being cast from above into the mold in such a manner that the surface equals the level of the crust which has been formed at the sur-
15 face of the mass. Hereafter the covers are laid upon the molds which then remain on their places till the ingots are perfectly solidified.

The advantages above described are ap-
20 parent for instance if low carbon steel without silicon in form of ingots is rolled to sheet metal. The practice has shown that the waste of the sheet rolled from material treated according to the above process is
25 limited to about 0.3%, whereas the waste in the manufacturing of sheet made of ordinary ingots is much higher, in some cases even fifty times and more. Moreover with the process described, besides the advan-
30 tages above-mentioned some other advantages are obtained which consist in an essential refining action on the material. It is however not possible to give numerical values for them in the same manner as
35 above.

What we claim is:

1. A process for improving the properties of metals cast in ingots which consists in producing in the fluid interior of the
10 metal body shortly before solidification a

whirling or bubbling motion directed from the bottom to the surface.

2. A process for improving the properties of metals cast in ingots which consists in producing in the fluid interior of the metal
45 body shortly before solidification a whirling or bubbling motion directed from the bottom to the surface and extending throughout the ingot body.

3. A process for improving the properties
50 of iron, steel and the like cast in ingots which consists in producing in the fluid interior of the iron and the like material a whirling or bubbling motion directed from the bottom to the surface and extending
55 throughout the ingot body.

4. A process for improving the properties of iron, steel and the like cast in ingots which consists in introducing an aluminothermic mixture into the fluid metal of the
60 ingot thereby producing a whirling or bubbling motion in the interior of the ingot mass, and extending throughout the ingot body.

5. A process for improving the properties
65 of iron, steel and the like cast in ingots which consists in introducing an aluminothermic mixture into the fluid metal down to the bottom of the latter, thereby producing a whirling or bubbling motion in the
70 interior of the mass directed from the bottom to the surface.

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