F. GIOLITTI.

PROCESS FOR THE TREATMENT OF STEEL.

APPLICATION FILED APR. 8, 1913.

1,144,034.

Patented June 22, 1915

2 SHEETS—SHEET 1.

Fig. 1

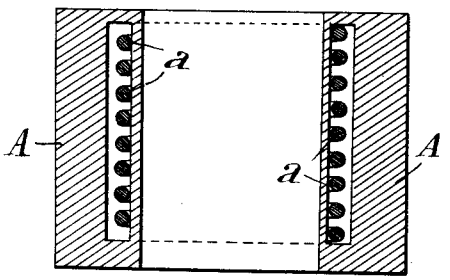


Fig. 2

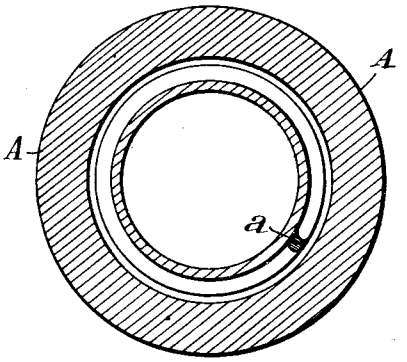
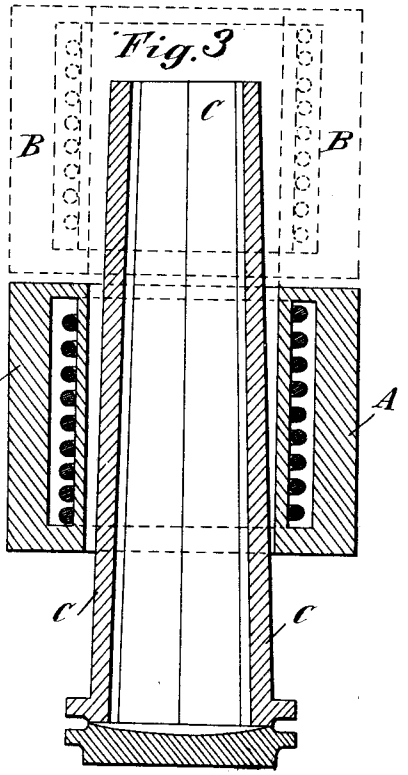


Fig. 3



WITNESSES

Charles B. Crompton

Fred Pohl

F. Giolitti.

INVENTOR

BY E. Croydon Marks

ATTORNEY

F. GIOLITTI.

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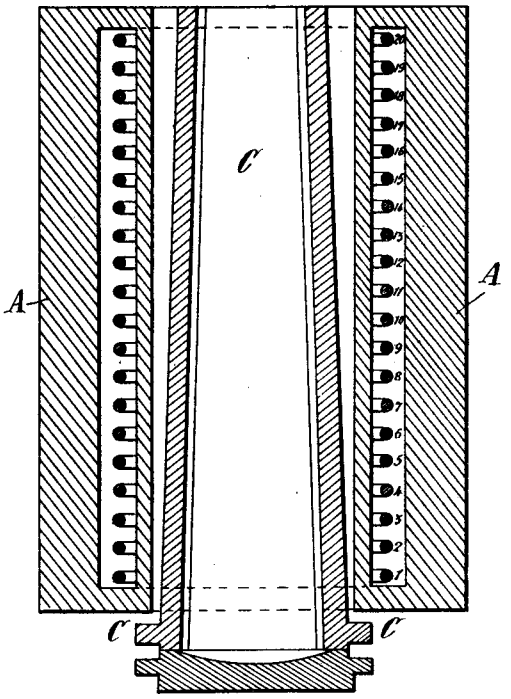
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2 SHEETS—SHEET 2.

Fig. 4



WITNESSES

Charles Bromley

Fred Pohl

F. Giolitti.

INVENTOR

BY Edwyn Davis Marks

ATTORNEY

UNITED STATES PATENT OFFICE.

FEDERICO GIOLITTI, OF TURIN, ITALY, ASSIGNOR TO SOCIETÀ ANONIMA ITALIANA GIO. ANSALDO & C., OF GENOA, ITALY.

PROCESS FOR THE TREATMENT OF STEEL.

1,144,034. Specification of Letters Patent. Patented June 22, 1915.

Application filed April 8, 1913. Serial No. 759,648.

To all whom it may concern:

Be it known that I, FEDERICO GIOLITTI, a subject of the King of Italy, residing at No. 75 Stradale Moncalieri, Turin, in Italy, have invented certain new and useful Improvements in Processes for the Treatment of Steel, of which the following is a specification.

This invention relates to the type of process and apparatus in which the ingot or casting for the purpose of preventing piping, is gradually cooled from the bottom upward, the metal in the upper portion being retained in the liquid condition during the cooling of a lower portion.

Numerous processes have been proposed for the purpose of preventing piping in steel ingots and in metal castings generally. In the case of steel ingots particularly, piping results in considerable loss for a relatively large portion of the ingot in which the piping occurs is of no value for rolling or subsequent mechanical treatment and has to be re-melted. Piping is largely due to the unequal contraction of the mass of metal in cooling, which together with unequal cooling, results in the center of the ingot shrinking. To prevent piping it has been proposed to cast the metal under pressure, or to cast in molds in which the cross section of the ingot is reduced by forcing the metal during cooling through an aperture of progressively contracting cross section. Other methods for preventing piping are based upon the principle of regulating the cooling so as to insure equal contraction of the mass of metal; the higher portion of the ingot or the gate of the casting being retained at a higher temperature than the lower portions, or retained in a fluid condition during the solidification of the lower portions so that the fused metal follows downward the solidifying metal. For this purpose it has been proposed to employ as heating means gases or mineral oils or a cap of solid fuel which is burned under the influence of a jet of air or a cap of an alumino thermic material.

The object of the invention is to provide an improved process and apparatus of the type referred to for the treatment of ingots and castings particularly of steel.

According to the invention, the ingot or casting for the purpose of preventing piping is heated by electric currents induced in the metal by means of an alternating current in a metal coil surrounding the metal to be treated.

The annular heating apparatus for carrying out the improved process comprises essentially a hollow annular casing adapted to surround a greater or smaller part (according to the size of the ingot to be produced) of the ingot mold and a coil or coils of conductor. This casing is capable of being shifted axially in relation to the mold or is arranged so that the heating zone may be raised in a vertical direction.

Figure 1 is a vertical section of a heating member. Fig. 2 is a section of the heating member taken at right angles to the section in Fig. 1. Fig. 3 is a vertical section illustrating the application of the apparatus shown in Figs. 1 and 2 to an ingot mold. Fig. 4 is a vertical section of a modified heating apparatus applied to an ingot mold.

In the drawings, A represents the casing of refractory material forming the body of the heating member, *a* represents the conductor and C represents the ingot mold.

In Fig. 3, B represents a second position of the heating member A.

When an alternating current is passed through the coils of the conductor *a* induced currents are set up in the mass of steel constituting the ingot or casting, the characteristic features of the induced current depending upon the periodicity of the alternating current in the metal coil *a* according to rules well known in the electrotechnical art (Foucault currents and the like). Of course, in all cases there is also a slight heating of the metal coil *a* due to its electric resistance.

The improved process is carried into effect as follows:—Referring to Fig. 3 when all the steel required to constitute the ingot has been poured into the mold, the heating casing A surrounding the mold occupies its lowest position, for instance the position A shown in full line in Fig. 3. As soon as the heating commences the annular heating apparatus is raised gradually until it occupies the position B indicated in dotted lines in Fig. 3, where it encircles the highest portion of the ingot mold. The intensity of the heating and the most convenient means for shifting the heating zone in relation to the mold depends greatly on the circumstances of each case, such as the shape, di-

mensions and material of the mold, the temperature of the steel at the time of pouring, the composition of the steel and the like, and must be determined by trial in each case. In cases where the heating is not too intense ordinary ingot molds of metal, such as cast iron, may be employed. Even in such cases, however, it is advisable to provide the ingot mold with a lining of refractory material. When the heating is intense the ingot mold must be made wholly or in part of refractory material.

The improved process is equally applicable to all kinds of steel castings in molds having shapes very different from the usual ingot shape and excellent results have been obtained in such cases.

Instead of shifting the heating apparatus gradually from the bottom to the top of the ingot mold, the apparatus may be constructed of such length as to envelop the entire length of the ingot mold, and be operated in successive sections, each section corresponding in length to the portion of the ingot mold which is to be heated at the time. In such a case, the section of the apparatus corresponding in length to the bottom portion of the ingot mold is operated first, and then the next sections all of the same length, situated at gradually increasing heights. The said heating is easily obtained by successively inserting into the circuit a certain number of coils in order to form a heating zone at the desired breadth.

In order that the method of carrying out the process may be better understood a specific example will now be described with reference to Fig. 4 of the annexed drawings.

If it is desired to heat the ingot mold from the bottom upward first throughout a length corresponding to the bottom section comprising for instance six turns of the heating winding, the heating is started by including the turns marked 1, 2, 3, 4, 5, 6, in the electric circuit. Then after a certain period of time turn No. 1 is cut out of circuit, and turn No. 7 is included in the circuit, and then after a further period, turn No. 2 is cut out of circuit, and turn No. 8 is included. Then turn No. 3 is cut out, and turn No. 9 is included in the circuit. On stopping for instance at this point it will be seen that the heating portion still comprises six turns (turns Nos. 4, 5, 6, 7, 8, 9) but this heating portion has been shifted toward the top with relation to the portion that was first in operation. All these operations may be effected by means of a switch of known type. If desired the heating may also be effected in the manner just described by commencing the successive inclusion of the turns from the bottom to the top, but without cutting out the lower turns in succession.

In the improved process the heating is produced mainly by the induced currents set up in the cast metal so that the heating effect is more general and more uniform than would be the case if the mold were heated by means of a gas or other furnace or if it were heated by a coil of conductor raised to incandescence by an electric current.

The improved method of heating thus results in preventing piping, more effectively than the processes heretofore employed.

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

1. Improvement in the process for preventing piping in bodies of cast metal in which the body of cast metal is gradually cooled from the bottom upward, the metal in the upper portion being retained in the liquid condition during the cooling of the portion below which consists in heating the body of metal by electric currents induced in the metal by means of an alternating current in a coil surrounding the metal.

2. The improvement in the process for preventing piping in an ingot, in which the ingot is gradually cooled from the bottom upward, the metal in the upper portion being retained in the liquid condition during the cooling of the portion below which consists in heating the body of metal by electric currents induced in the metal by means of an alternating current in a coil surrounding the metal.

In testimony whereof I affix my signature in presence of two witnesses.

FEDERICO GIOLITTI.

Witnesses:

TRUY COUSUDSTCSCEE,

JOCELYN LOUBERWON.