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Yasunaga et al.

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[54] **METHOD FOR PARTIALLY GRINDING SURFACE FLOWS OF A HOT BLOOM AND SLAB**

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[52] **U.S. Cl.** **51/322,** 51/323
[51] **Int. Cl.** **B24b 1/00,** B24b 7/06
[58] **Field of Search** 51/322, 35, 323, 51/327

[56] **References Cited**

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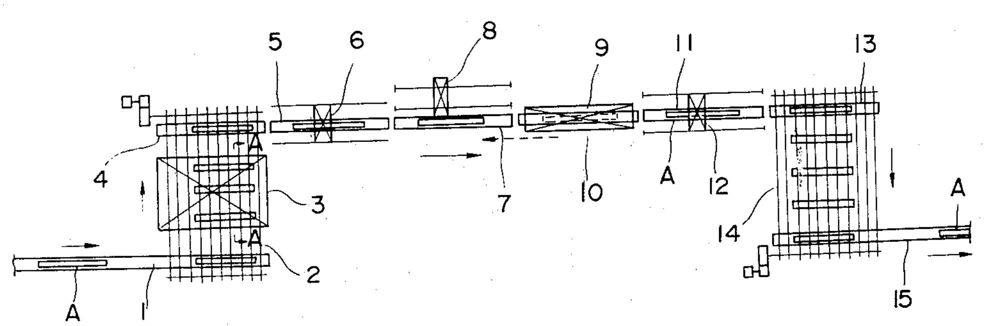
[57] **ABSTRACT**

A method for partially grinding surface flaws of hot steel slabs including bloom, wherein the hot bloom immediately after being hot-rolled is maintained in the state most suitable for detecting surface flaws therein in the rolling line from a rolling mill to a cooling zone. The surface flaws are detected and the thus detected surface flaws are removed by grinding, while the bloom is hot.

6 Claims, 8 Drawing Figures



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3 Sheets-Sheet 1

FIG. 1

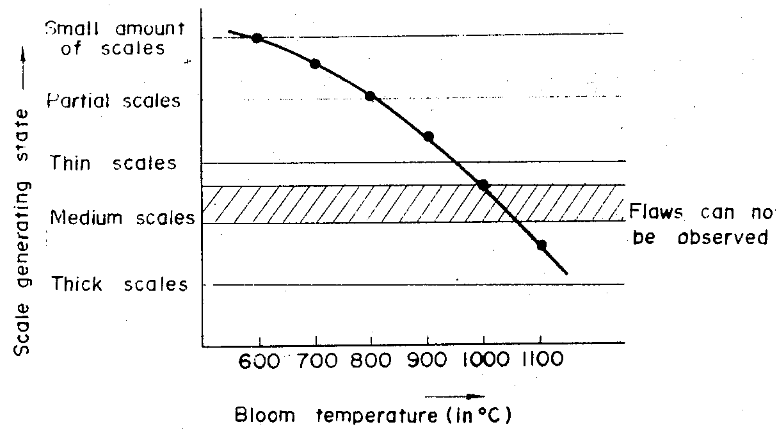

FIG. 2

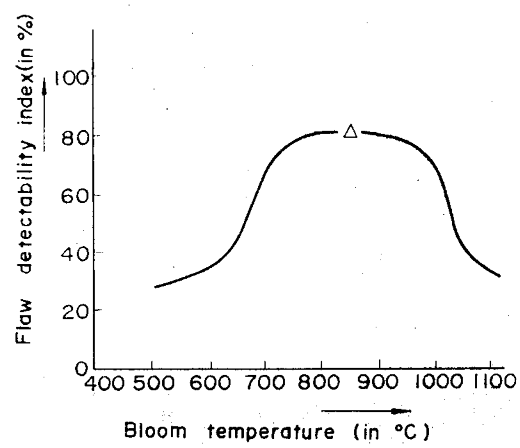

FIG. 3

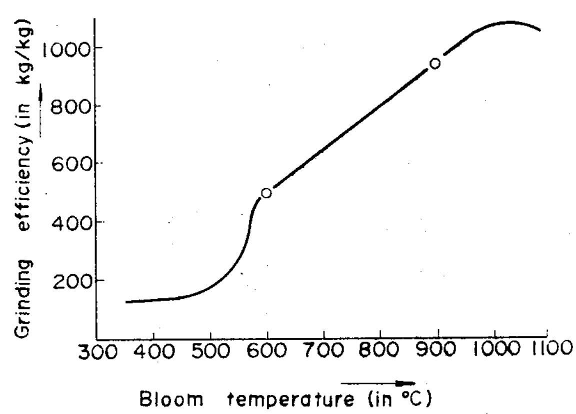

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FIG. 4

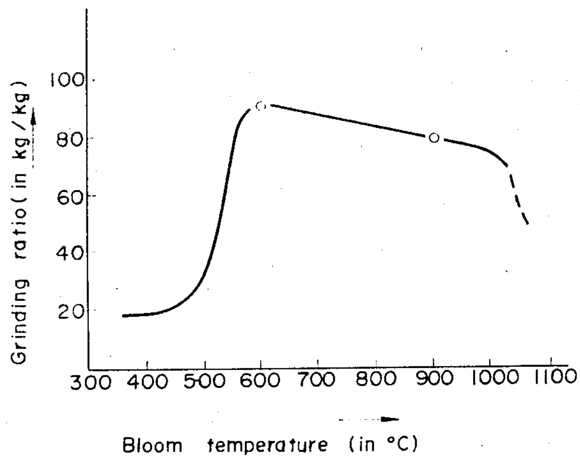

FIG. 5

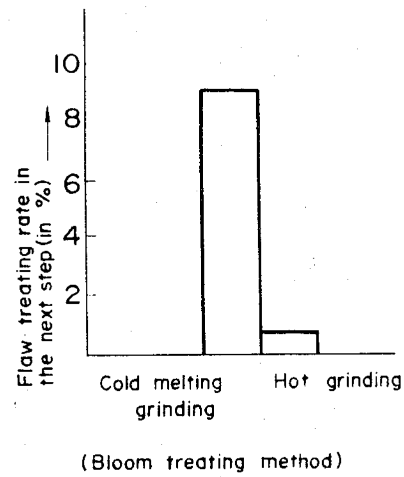

FIG. 6

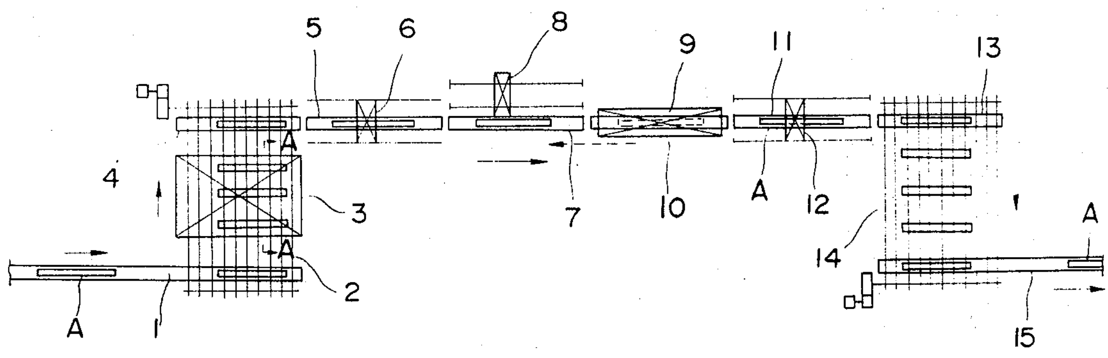

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FIG. 7

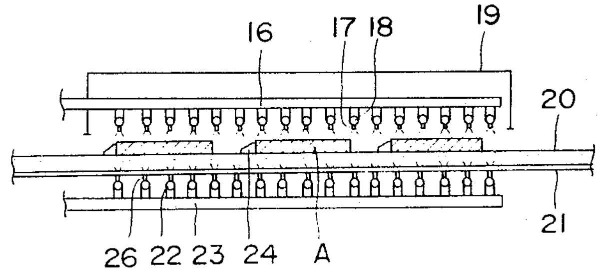
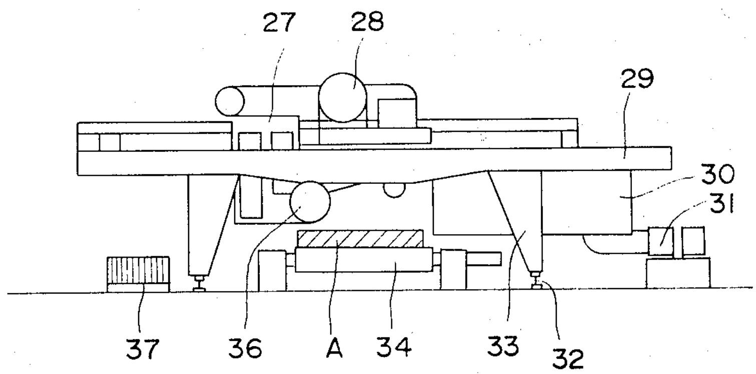


FIG. 8



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METHOD FOR PARTIALLY GRINDING SURFACE FLOWS OF A HOT BLOOM AND SLAB

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an improvement in a method for removing surface flaws in a steel bloom by grinding.

2. Description of the Prior Art

There are already known methods for removing surface flaws particularly in ordinary steels, for instance, such as a hot whole surface scarfing method, wherein defects on the surface of a bloom are removed by a gas torch, while the whole surface of the bloom is hot, and a cold partial scarfing method, wherein only the part having the flaw is partially scarfed, while the bloom is cold. The former method has such defects as the yield being reduced and the re-treatment of residual flaws being often necessitated, and the latter method is attended with the defect that the finished surface of the bloom is often worsened by causing derivative defects as a result of the treatment of the original flaws. Moreover, both methods have in common other defects in that the working environment is bad and more labor is required, since the surface flaws are to be removed by a hand operation.

Thereupon a cold partial grinding method has been then carried out by using a grinder in view of a relatively good finished surface being obtainable after the treatment according to this method, but had to be limited to the treatment of special steel pieces only, because this method was too low in the efficiency to be applied to mass production, and a heavy abrasion of grindstones was caused and many machines and workers were required.

From the necessity of increasing workability, a hot whole surface grinding method was then adopted instead of the cold partial grinding method, to reduce the abrasion of grindstones and the numbers of required machines and workers to about half as many as required in the cold partial grinding method. However, due to the yield of blooms being greatly reduced, this method was not applicable to the grinding of ordinary steels in view of the low production cost of the blooms, but was only feasible when applied to special steels, wherein the working conditions as above-mentioned have little influence on the production cost of the blooms.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an improved hot partial grinding method, wherein the defects of conventional methods may be eliminated to the effect that not only the finished surface of the bloom after the treatment of removing flaws is good, but also the treating efficiency is high enough for mass production, the working environment is favorable, and the grinding method is particularly suitable for the treatment of ordinary steels on a large scale.

Another object of the present invention is to provide a method, wherein a hot bloom discharged from a rolling mill is subjected to a partial grinding in a rolling line extending from the rolling mill to a cooling zone.

That is, in order to attain the above-mentioned objects the present invention is characterized by detecting parts having flaws in a steel bloom immediately after hot-rolled but descaled in a temperature range of from 650° to 1,000°C. and grinding only the detected parts having flaws.

Essential requirements for the grinding of ordinary steels to remove flaws therefrom are that the operation cost is low and the working efficiency is high, and the only possible method, which may meet these requirements, is a hot partial grinding method. However, the essential point in this method is how to detect the parts in the bloom having flaws, while it is hot.

As a result of research from the view point as above-mentioned the present inventors have completed the present invention by discovering the fact that the flaw detectability of a steel bloom is very high, when the steel bloom lies in a temperature range of from 650° to 1,000°C. in the course of cooling the same.

Heretofore, there has never been carried out a flaw treating method, wherein only the surface flaws of a steel bloom are removed by detecting the parts in the steel bloom having flaws after descaling (removing oxidized film formed on the surface of the steel bloom) and cooling to a fixed temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows relations between the bloom temperature and the scale generating state.

FIG. **2** shows the relationship between bloom temperature and surface flaw detectability with the naked eye.

FIG. **3** shows the relationship between bloom temperature and grinding efficiency.

FIG. **4** shows the relationship between bloom temperature and grinding ratio.

FIG. **5** shows the relationship between the bloom treating method and the flaw treating rate in the next step.

FIG. **6** shows an example of the hot grinding equipment arrangement according to the present invention.

FIG. **7** is a cross-sectional view on line A—A in FIG. **6.**

FIG. **8** is an elevation schematically showing a hot surface grinding machine of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As a result of conducting research on the detection of flaws in hot blooms, the present inventors have confirmed that, if the oxidized film or primary scale formed on the surface of a bloom at 1,100° to 1,200°C. immediately after the bloom is hot-rolled is removed, the generation of subsequent oxidized film or secondary scale is very slight. This makes the steel material easy to observe, such property being closely related with the bloom temperature. FIG. **1** shows the generation of secondary scales when a time of about 10 minutes, which is required to grind a surface flaw of a bloom, has elapsed after the primary scales formed on the surface of the bloom at various temperatures have been removed.

It is evident from this figure that in the case of a bloom of a temperature exceeding 1,000°C. the secondary scales are generated so great in number that it is impossible to observe the flaws and that therefore the bloom temperature must be below 1,000°C.

Next, the present inventors have further confirmed that the hot bloom flaw detection rate is also related to the bloom temperature. That is, as is shown in FIG. **2,** in the temperature range of from 650° to 1,000°C.

there may be observed distinct differences in the degree of luminescence between the part of the hot bloom having no flaw and the part having a surface flaw such as crack or crab. This difference in degree of luminescence is so suitable for the observation of flaws that a high flaw detection rate may be achieved even with the naked eye. The reason why the difference in degree of luminescence is produced in the above described surface flaw is as follows: If there is a flaw on the surface of a hot bloom, the heat transmission between the part of the hot bloom having the flaw and the atmosphere will differ from that between the part of the hot bloom having no flaw and the atmosphere. This necessarily causes a difference in the surface temperature between respective parts and consequently also the difference in the self-radiating degree of aluminescence of the bloom so that the presence of the flaw may be easily detected.

For example, in the case of a crack flaw, the corner part formed by the surface and crack has such a small heat supply from the interior of the bloom, but has such a large heat dissipation that this part appears dark, whereas the bottom part of the crack appears bright, because the heat dissipation in this part is small, and the part having no flaw has a medium heat dissipation. Consequently, there are produced differences in the brightness among the above three parts.

Further, in the case of a scab flaw, the scab part appears dark, because the heat supply from the interior of the bloom to the scab part is small, but the heat dissipation from the tip of the scab part is large. On the other hand, as the part having no flaw has a medium heat dissipation, there is produced a difference in the brightness between the above two parts. However, if the temperature of the bloom exceeds 1,000°C., there is produced substantially no difference in the amount of visible light (brightness) since the retained heat is very high, even though there exists a difference in the temperature between the respective areas of the flaw part. Consequently, the flaw detectability is largely diminished. Also, if the bloom temperature is below 650°C. there can be perceived substantially no difference in the brightness between the part having the flaw and the part having no flaw, because the whole surface of the bloom is darkened from the interior of the bloom. Therefore, in this case the flaw detectability is also very low just as in the case of a high bloom temperature.

Next, the grinding state at a high temperature is as shown in FIGS. 3 and 4.

As shown in FIG. 3, the grinding efficiency (the amount of bloom ground per hour) rises rapidly from a temperature of about 550°C., but then rather falls, if the temperature exceeds 1,050°C., due to the grindstone losing it resistance to heat and the teeth of the grindstone becoming clogged. Also the grinding ratio (the amount of bloom ground per the amount of the grindstone abraded) increases in the same temperature range for the above-mentioned reason.

Therefore, when a hot bloom is ground in the temperature range of 650° to 1,000°C., wherein the detection of flaws is easy and the grinding efficiency is high, there can be obtained a favorable finished surface of the bloom after the flaws have been treated and at the same time the treatment of flaws of a large quantity can be efficiently performed.

An example of the operating process of the present invention shall be concretely explained in the following.

An ingot heated in a soaking pit is rolled in a blooming mill to make a bloom, which is then cut to be a fixed length in a shearing machine after the whole surface thereof is melted and ground or without being done so. After the bloom is then weighed in a weighing machine, it is conveyed to a receiving roller table **1** of a water-cooling transfer **2**. The bloom A is transferred to the water-cooling transfer **2** from said roller table **1** and is fed into a bloom temperature adjusting water-cooling apparatus **3**.

The above-mentioned transfer and water-cooling apparatus are as shown in FIG. **7** (a cross-section view on line A—A of FIG. **6**). That is to say, the water-cooling transfer **2** consists of a fixed skid **20**, moving bar **21** and dogs **24** provided at fixed intervals on moving bar **21**. The bloom A is slid on the fixed skid **20** with the moving bar **21**, with the bloom abutted by dogs **24**, and is stopped in a fixed position in the water-cooling apparatus, wherein it is quenched to a fixed temperature. The water-cooling apparatus **3** is provided with upper and lower nozzle headers **18** and **22** on upper and lower cooling branch pipes **16** and **23** respectively. The upper and lower nozzle headers are provided with upper and lower cooling nozzles **17** and **26** respectively, and they are all covered with a cover **19**.

In the cooling apparatus, the bloom is quenched and descaled so that the flaw detectability of the bloom may be elevated and is then sent to a surface grinding roller table **5** through a water-cooling transfer outlet roller table **4**. An upper surface grinding machine **6** is arranged on roller table **5** so that the upper surface of the bloom may be partially ground.

An example of the structure of the above-mentioned grinding machine **6** is shown in FIG. **8**. A grindstone **36**, grindstone driving device **28** and operating chamber **27** are mounted so as to move on a grindstone base traversing beam **29**. Further, grinding machine **6** is so made as to run on a running rail **32** through leg bases **33** in a direction at right angles with the moving direction of the grindstone **36. 30** is a dust collecting box. **31** is a dust collecting duct. **37** is a driving current collecting device. **37** is a hone roller table.

When the treatment of the upper surface flaw of the bloom has been finished, the bloom is transferred to a side grinding roller table **7**, wherein any flaw on the side of the bloom is treated with a side grinding machine **8.** Thereafter, the bloom A is sent to a plate rotating roller table **9** and is rotated by 180° with a plate rotating machine **10.** Thereupon, the bloom is again returned to the side grinding roller table **7** and any flaw on the new side is treated with the side grinding machine **8.** The thus treated bloom is then sent to a lower surface grinding roller table **11** through the roller tables **7** and **9** and any flaw in the lower surface is partially treated with a lower surface grinding machine **12.** The bloom, in which the treatment of flaws in the upper and lower surfaces and both sides have been finished, is conveyed to an outlet transfer receiving roller **13** and is successively moved to an outlet roller table **15** through an outlet transfer **14.** Then, the bloom is sent to a cooling zone in the next step. An example is shown in the following:

Cooling conditions
Bloom temperature at an inlet of

a cooling apparatus:	1,100°C.
Bloom temperature at an outlet of a cooling apparatus:	850°C.
Amount of cooling water:	0.4 m.³/min. m.²
Cooling time:	3 minutes
Grinding conditions	
Bloom temperature:	850° to 750°C.
Hone pressing force:	600 kg.
Hone:	610 mm. in diameter and 75 mm. thick
Grinding time (for four surfaces):	10 minutes
Grinding efficiency:	800 kg. (grinding amount)/hour
Grinding ratio:	80 kg. (grinding amount)/kg. (of hone consumption)
Flaw treating rate in the next step:	1% (9% in the case of the cold partial treatment of flaws. See FIG. 5.)

In the above explanation there has been shown an example, wherein the bloom is water-cooled to any desired temperature before it is ground and the descaling of the primary scale has been carried out at the same time. However, it is also possible to descale the bloom after it is left to be cooled in an atmosphere instead of water-cooled, whereby the flaw detectability may also be improved. It is needless to say that not only water but also steam or air may be used as a quenching agent.

As above-mentioned, according to the present invention, any flaw in a bloom can be exactly detected in a simple way by utilizing the difference in the amount of self-discharged light between the part having a flaw and the other part having no flaw, which makes it possible in accordance with the present invention to partially grind any flaws at a high temperature. Therefore, by arranging a hot grinding machine within a conventional rolling line, wherein a bloom discharged from a rolling mill is conveyed to a cooling zone, the exact treatment of flaws may be carried out with high efficiency so that the mass production of blooms having flaw free surfaces may be performed within a successive streamed-line rolling operation. Thus, the present invention may

be said to be quite epochal as a method of treating flaws particularly in ordinary steels.

Summarizing the above, the present invention has great advantages in exactly removing any flaws of a bloom with a high efficiency, largely lowering the cost, economizing the required worker and assuring a favorable environment.

What is claimed is:

1. A method of detecting and grinding surface flaws in the surfaces of blooms, including slabs while the blooms are hot, comprising:

descaling an oxidized film formed on the bloom immediately after it is discharged from a hot-rolling mill;

quenching said bloom to a temperature within the range of from 650° to 1,000°C. in which range the surface flaws are most easily detected;

detecting any surface flaws on the surfaces of said bloom; and

then partially grinding only those parts of the surfaces of said bloom having the detected flaws.

2. The method claimed in claim **1**, wherein the descaling and quenching of said bloom are conducted simultaneously by spraying water onto the surfaces of said bloom immediately after it is discharged from the hot-rolling mill.

3. The method claimed in claim **1**, wherein the descaling and quenching are performed by spraying steam onto said bloom.

4. The method claimed in claim **1**, wherein the quenching is performed by leaving said bloom in air.

5. The method claim in claim **1**, wherein said surface flaws are detected by determining a difference in degree of luminescence between parts of said surfaces having flaws and parts of said surfaces having no flaws.

6. The method claimed in claim **5** wherein said difference in degree of luminescence is determined visually.

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