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METHOD OF FORGING CHROMIUM MANGANESE AUSTENITIC STEELS

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This invention relates to a method of rolling alloy steels and more particularly to the rolling of austenitic chromium alloys wherein manganese has been substituted for nickel.

In view of the critical shortage of nickel and the high cost thereof, considerable effort has been made in recent years to substitute manganese for nickel in the austenitic steels, particularly the high chromium steels. One of the most commonly used grades of austenitic chromium steels is the so-called "18–8" grade of stainless grade containing about 18% chromium and 8% nickel. A satisfactory substitute therefore is the SAE 301 (modified) grade, sometimes called the 16–1–17 grade. The specification for this steel is carbon .15% maximum, manganese 14–18% minimum, chromium 14% minimum, phosphorus .05% maximum, sulphur .040% maximum, copper .90% maximum, nickel .99% maximum, nitrogen .25% maximum and silicon 1% maximum. The chromium may range from 14 to 18.50%. While the steel itself is satisfactory, considerable difficulty has been experienced in rolling the same, particularly in rolling the ingots to slabs and the like, resulting in a low ingot to bloom yield.

It is accordingly an object of the present invention to provide a method of satisfactorily blooming ingots of chromium manganese austenitic steels.

The foregoing and further objects will become apparent from the following specification.

I have discovered that the high crop losses causing a low ingot to bloom or slab yield are caused by ferrite segregation and resultant stringers when the steel is heated to the conventional 2300 to 2350° F. temperatures used in rolling austenitic chromium steel ingots. Generally speaking, this becomes a serious problem when the ferrite segregation exceeds about 3%, and the steel has to be scrapped if it reaches 5%. The amount of ferrite segregation ordinarily exceeds about 3% if the nickel content is reduced to below about 4%. I have further discovered that this difficulty can be overcome by properly controlling the soaking pit temperatures within the critical limits hereinafter set forth.

In rolling ingots formed of SAE 301 (modified) steel, the ingots after being teemed into molds and then stripped therefrom are placed in the soaking pits and soaked for about 2 hours with the dampers closed and no heat added to the pit. Thereafter the temperature of the pits is increased about 100° per hour until a temperature within the range of 2025 to 2075° F. is reached. The temperature is then maintained within this range and preferably at about 2050° F. for about 24 hours. At this temperature, the ingot achieves substantially uniform physical properties throughout with substantially no ferrite segregation. After soaking for this length of time at the foregoing temperature, the temperature of the ingot is raised as rapidly and uniformly as possible to a uniform temperature of between about 2125 and 2175° F. and preferably about 2150° F. to increase its rollability. The rate of temperature increase should be about 25° per

15 minutes. Thereafter the ingots are rolled to blooms of the desired size as soon as possible without any intermediate holding or cooling beyond those incident to conventional rolling. Repeated rollings have shown that less than 2% ferrite segregation results from such heating practice.

The following Table I shows the improvement in crop losses by practicing my invention:

Table I

OLD PRACTICE

Heat No.	Heat Wt., lbs.	No. of Ingots	Sheared Wt., lbs.	Sheared Yield, percent	Blooms out for Conditioning
1	170,225	9	117,568	69.1	None.
2	102,000	6	71,800	70.4	1 ingot.
3	168,800	9	117,580	69.7	None.
4	134,356	5	91,460	68.0	2 ingots.
5	157,800	7	109,880	69.6	Do.

NEW PRACTICE

6	170,300	9	131,455	77.2	None.
7	171,225	9	127,765	74.5	Do.
8	174,900	10	127,895	73.2	Do.
9	164,050	7	120,010	73.1	Do.
10	152,300	8	114,225	75.0	Do.
11	147,375	7	109,495	74.3	Do.
12	170,200	9	126,390	74.3	Do.

In a modified form of the invention, the steel is made with the carbon content at about the maximum allowed by the specification, i. e. between about .10 and .15% and with the chromium content at the minimum end of its range, i. e. between about 14 and 16%. With the composition so modified the ingot heating practice can be modified by soaking for only about 12 hours in the range of 2025 to 2075° F. preferably at about 2050° F. The resulting rolling practice is substantially the same as that set forth in Table I with the maximum ferrite segregation being less than 2%.

While I have shown and described several specific embodiments of my invention, it will be understood that these embodiments are merely for the purpose of illustration and description and that various other forms may be devised within the scope of my invention, as defined in the appended claims.

I claim:

1. A method of blooming ingots of austenitic chromium manganese steel alloys containing less than 4% nickel characterized by less than 2% ferrite segregation in the rolled product, comprising soaking ingots formed of such steel at a temperature between about 2025 and 2075° F. for at least 12 hours, then rapidly and uniformly raising the temperature thereof to between about 2125 and 2175° F. and thereafter rolling the ingot so heated to blooms of the desired size without intermediate holding and cooling.

2. A method of blooming ingots formed of austenitic chromium manganese steel containing

Carbon	.15% max.
Phosphorus	.05%.
Sulphur	.04%.
Manganese	14 to 18%.
Silicon	1% max.
Copper	.9% max.
Nickel	.99% max.
Chromium	14 to 18.50%.
Nitrogen	.15% max.

characterized by less than 2% ferrite segregation in the rolled product, comprising soaking said ingots at a temperature between about 2025 and 2075° F. for at least 12 hours, then rapidly and uniformly raising the tempera-

ture thereof to between about 2125 and 2175° F. and immediately thereafter rolling the ingots so heated to blooms of the desired size without intermediate holding or cooling beyond that incident to normal rolling practice.

3. A method of blooming ingots formed of austenitic chromium manganese steel containing

Carbon	.15% max.
Phosphorus	.05%.
Sulphur	.04%.
Manganese	14 to 18%.
Silicon	1% max.
Copper	.9% max.
Nickel	.99% max.
Chromium	14 to 18.50%.
Nitrogen	.15% max.

characterized by less than 2% ferrite segregation in the rolled product, comprising soaking said ingots at a temperature between about 2025 and 2075° F. for at least 24 hours, rapidly and uniformly raising the temperature thereof to between about 2125 and 2175° F. and immediately thereafter rolling the ingots so heated to blooms of the desired size without intermediate holding or cooling beyond that incident to normal rolling practice.

4. A method of blooming ingots formed of austenitic chromium manganese steel containing

Carbon	.10 to .15%.
Phosphorus	.05%.
Sulphur	.04%.
Manganese	14 to 18%.
Silicon	1% max.
Copper	.9% max.
Nickel	.99% max.
Chromium	14 to 16%.
Nitrogen	.15% max.

characterized by less than 2% ferrite segregation in the rolled product, comprising soaking said ingots at a temperature between about 2025 and 2075° F. for at least 12 hours, rapidly and uniformly raising the temperature thereof to between about 2125 and 2175° F. at a rate of about 25° per 15 minutes and immediately thereafter rolling the ingots so heated to blooms of the desired size without intermediate holding or cooling beyond that incident to normal rolling practice.

5. A method of blooming ingots formed of austenitic chromium manganese steel containing

Carbon	.15% max.
Phosphorus	.05%.
Sulphur	.04%.
Manganese	14 to 18%.
Silicon	1% max.
Copper	.9% max.
Nickel	.99% max.
Chromium	14 to 18.50%.
Nitrogen	.15% max.

characterized by less than 2% ferrite segregation in the rolled product, comprising soaking said ingots at a temperature between about 2025 and 2075° F. for at least 24 hours, rapidly and uniformly raising the temperature thereof to between about 2125 and 2175° F. at a rate of about 25° per 15 minutes and immediately thereafter rolling the ingots so heated to blooms of the desired size without intermediate holding or cooling beyond that incident to normal rolling practice.

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