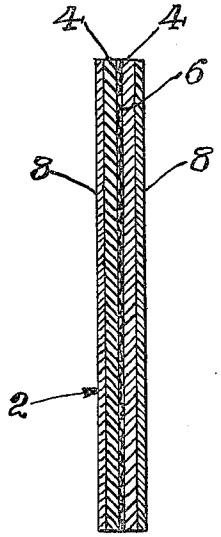
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METHOD OF CASTING CLAD

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Fig. 1.



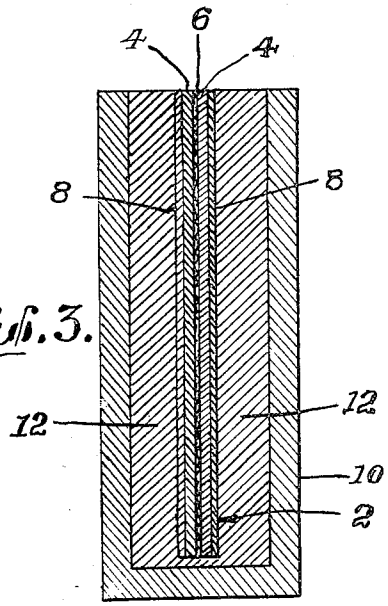


Fig. 3.

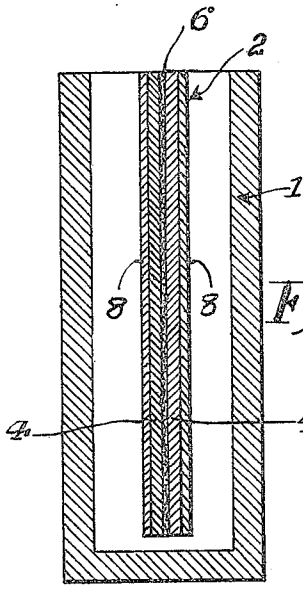


Fig. 2.

INVENTOR.
James L. Ma
BY
Mason, Mason & Albright
ATTORNEYS

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Fig. 4.

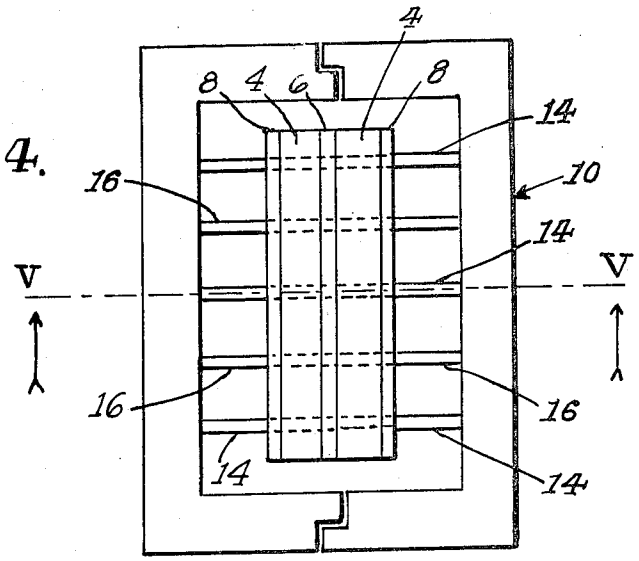
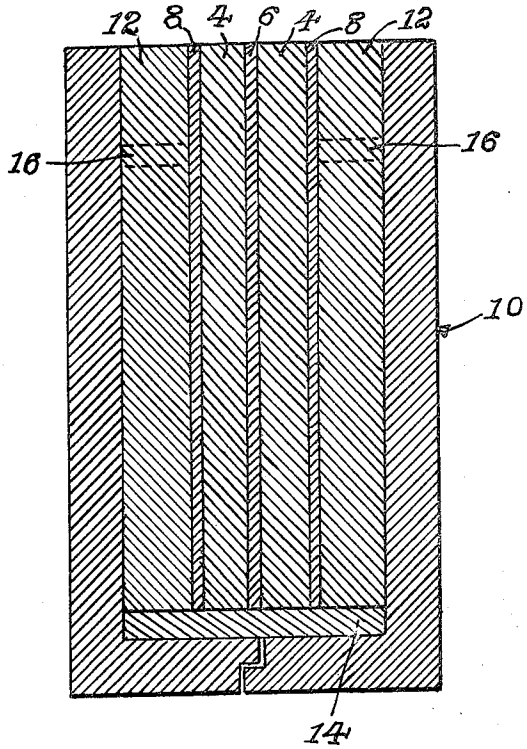


Fig. 5.



INVENTOR.
James L Ma.
BY
Mason, Mason & Albright
ATTORNEYS.

United States Patent Office

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METHOD OF CASTING CLAD

James L. Ma, West Chester, Pa., assignor to Lukens Steel Company, Coatesville, Pa., a corporation of Pennsylvania

Filed Jan. 7, 1965, Ser. No. 424,463
5 Claims. (Cl. 29—528)

This invention relates to a method of casting clad. Such clad usually comprises a low carbon steel layer or alloys thereof and a stainless steel layer bonded thereto by casting and rolling operations. The method accordingly is directed to the production of laminated steel sheets, strips, bars or slabs. In addition to a carbon steel backing plate assemblies include metal inserts composed of stainless steel, nickel, Monel metal, Inconel metal, titanium, zirconium, alloys of the foregoing and other metals generally used in the steel clad industry.

An object of the invention is to reduce the labor involved in the cladding of metals by reducing the number of steps incident to the production of clad metal.

A further object is to provide a method which includes the casting of a base metal, such as low carbon steel or its alloys, in a mold about a pair of inserts which are separated from each other by a parting composition as hereinafter more particularly described.

This application is a continuation-in-part of my application Serial No. 129,110, filed August 3, 1961, which is a continuation-in-part of application Serial No. 736,814, filed May 21, 1958, Patent No. 2,995,816 of August 15, 1961.

Referring to the drawings:

FIGURE 1 shows a vertical section through the insert assembly ready for insertion into a mold;

FIGURE 2 shows a vertical section through the mold and the insert located therein;

FIGURE 3 is a vertical section similar to FIGURE 2 after the molten metal forming the backing material has been poured.

FIGURE 4 is a top plan view of a mold illustrating the inserts supporting elements; and

FIGURE 5 is a vertical section taken substantially along the lines V—V of FIGURE 4.

A typical apparatus for carrying out the steps of the process is that shown in the several figures of the drawings wherein the insert or pack **2** is prepared by placing, after cleaning, a pair of cladding sheets, strips, bars or slabs **4** in juxtaposed position with a layer of parting material between the same.

According to the invention, the assembly **2** may be quickly dipped into a bath of molten metal, such as molten steel to provide the layer indicated by reference numeral **8**. After cooling, the assembly is conditioned by sand or grit blasting, following which the assembly is placed in a mold **10**. Molten base metal such as low carbon alloy steel is poured into the mold after the insert assembly has been placed in the mold and held in the position shown in FIGURE 2 by suitable supports as disclosed, for instance, by Patents Nos. 1,868,749 and 1,967,754 to Ingersoll. Other suitable means of support may be substituted for the supports shown in these patents.

As noted above, the molten base metal forming the

backing layers, is poured into the mold to fill the same as indicated in FIGURE 3.

The molten metal and inserts are cast together to form two cast clad metal plates, the parting compound **6** permitting separation of the cast clad metal plates from each other. Should some of the backing material require removal, such as material which lies below the insert as shown in FIGURE 3, such material can be removed by conventional methods.

After the cast clad plates have been removed from the mold, they are separated to form two cast clad metal plates, each having a base layer **12** and an insert **4** bonded thereto. Each of them is subsequently rolled by the use of heat and pressure into clad plates at a ratio of 15 to 1 or thinner. Alternately, the entire cast clad assembly may be rolled before separation.

During the casting and rolling operations, the composite metal plates are subjected to high heat and heavy pressure, in which heats of 2100° F. and higher are used while the rolling pressure is such as to reduce the compound metal bodies thinner than the conventional 10 to 1 ratio or about 15 to 1 or even below the 15 to 1 ratio of reduction.

The present invention is also directed to a parting composition that is an important factor in the process which composition prevents sticking or welding of the cladding inserts during the casting and rolling of the cast clad ingot.

Prior to placing the inserts with their faces in juxtaposed postion, one or both of the juxtaposed faces are coated with a primary coating of a parting composition, and is later coated with a covering or final coating of the parting composition, both being defined hereinafter. Both the primary and final coatings include a binding agent of especial significance. This binding agent consists of about 1% to 5% by weight, preferably 1% to 2% by weight, of nitrocellulose dissolved in ethyl acetate. In the examples the preferred binding agent is used.

The significant difference of this binder as distinguished from other known binders is that it contains a much higher viscosity nitrocellulose. Because of its very high viscosity, the binder can absorb more refractory oxides, thus giving greater protection to the surfaces of the inserts during the casting and rolling operations. The parting composition contains a high viscosity binder with a ratio of refractory oxide to binders of about 0.5–4:1, preferably 1–3:1 of chromium oxide in the prime coat or manganese oxide in the covering coat based on the weight of the binder disclosed above. The ratios and percentages herein are based on weight. The refractory oxides should be sized to pass a 200 mesh screen.

It is of particular importance to provide a binder that can absorb more refractory oxides, since the inserts are subjected to the high pouring temperature of the carbon steel, and the cast clad insert is subsequently rolled into clad plates at the high ratio of 15 to 1 or thinner.

Heretofore, in the use of separating compounds containing refractory oxides, the maximum 4-ply clad sandwich assemblies were reduced only 10 to 1, and the maximum amount of refractory oxide could not exceed about 1–1½ times the weight of the binder without causing precipitation or becoming lumpy. The amount of oxide used in the improved binder can be as high as three to four times the weight of the binder.

The following parting compositions have been used to achieve the improved results during casting and rolling

operations wherein cladding inserts are cast with a molten base metal in molds, and after removal therefrom, are reduced by rolling to as high as a 15 to 1 ratio or thinner:

	Prime Coat		Covering Coat	
		Parts		*Parts*
I.	Chromic oxide (<200 mesh).	15	Manganese dioxide (<200 mesh).	30
	High viscosity binder	13.1	High viscosity binder	10.4
	Total	28.1	Total	40.4
II.	Chromic oxide (<200 mesh).	15	Manganese dioxide (<200 mesh).	30
	High viscosity binder	12	High viscosity binder	10.5
	Total	27	Total	40.5
III.	Chromic oxide (<200 mesh).	32.7	Manganese dioxide (<200 mesh).	56.8
	High viscosity binder	22	High viscosity binder	22
	Total	54.7	Total	78.8
IV.	Chromic oxide (<200 mesh).	22	Manganese dioxide (<200 mesh).	60
	High viscosity binder	22	High viscosity binder	22
	Total	44	Total	82
V.	Chromic oxide (<200 mesh).	35	Manganese dioxide (>200 mesh).	40
	High viscosity binder	9	High viscosity binder	11
	Total	44	Total	55

The parting composition noted under III is the preferred composition, both as primary and secondary or covering coat.

The high viscosity binder consists of a high viscosity nitrocellulose having a viscosity of about 100–200 seconds, preferably about 125 seconds, at 77° F. as measured by the falling ball method. The grade specification of nitrocellulose is normally given in terms of the viscosity of the nitrocellulose when dissolved in a standard solvent mixture. This test consists of falling a standard five-sixteenth of an inch steel ball through a ten inch column of nitrocellulose solution in a standard glass cylinder of one inch diameter. The results are expressed as time of all in seconds. In the previously used binders dissolved in ethyl acetate, the rate of fall, i.e. the viscosity number, rarely exceeds one second.

A particularly effective parting compound for high temperature applications of casting and rolling clad consists of using chromic oxide mixed with a high viscosity binder, followed by a covering coat of manganese oxide mixed with a high viscosity binding agent. It appears that the manganese dioxide acts as an oxidizer for metallic chromium which can be formed from the chromic oxide under the reducing atmosphere generally existing in the insert assembly. Other refractory oxides are less preferred.

The parting composition disclosed herein finds particular application in the casting and rolling of clad metal assemblies. It will be appreciated that other uses for the composition will occur to one skilled in the art.

The above description and drawings disclose one embodiment of the invention, and specific language has been employed in describing the figures. It will, nevertheless, be understood that no limitations of the scope of the invention are thereby contemplated, and that various alterations and modifications may be made as would occur to one skilled in the art to which the invention relates.

I claim:

1. A parting composition comprising a refractory oxide and a high viscosity binder wherein the ratio of refractory oxide to binder is about 1–3:1 by weight, said high viscosity binder solution being 1–5 percent by weight nitrocellulose dissolved in ethyl acetate wherein the nitrocellulose employed has a viscosity of about 100–200 seconds as measured by the falling ball method in a standard solution of 25% ethyl alcohol, 55% toluene, and 20% ethyl acetate.

2. The composition of claim 1 wherein the binder is 1–2 percent nitrocellulose dissolved in ethyl acetate.

3. The composition of claim 1 wherein the refractory oxide is selected from the group consisting of chromic oxide and manganese dioxide.

4. The method of casting clad metal which comprises placing a prime coat and a covering coat of a parting composition on the opposing surfaces of a pair of inserts, comprising a high viscosity binder and a refractory oxide, said high viscosity binder being a 1–5% solution by weight nitrocellulose dissolved in ethyl acetate wherein said nitrocellulose employed has a viscosity of about 100–200 seconds as measured by the falling ball method in a standard solution of 25% ethyl alcohol, 55% toluene and 20% ethyl acetate, said prime coat having chromic oxide and said covering coat having manganese dioxide, assembling said inserts into a pack, quick dipping said pack in a bath of molten steel to cover and seal the pack, placing said pack in a mold and casting the clad by pouring molten metal into the mold around said pack, removing the cast clad from the mold and subjecting same to a rolling step with heat and pressure.

5. The process of claim 4 wherein the cast clad is rolled thinner than a ratio of 10 to 1.

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WHITMORE A. WILZ, *Primary Examiner*,

J. C. HOLMAN, *Examiner*.