March 8, 1949. C. W. WEESNER ET AL 2,464,163

MANUFACTURE OF STAINLESS CLAD STEEL

Filed Feb. 1, 1945 2 Sheets-Sheet 1

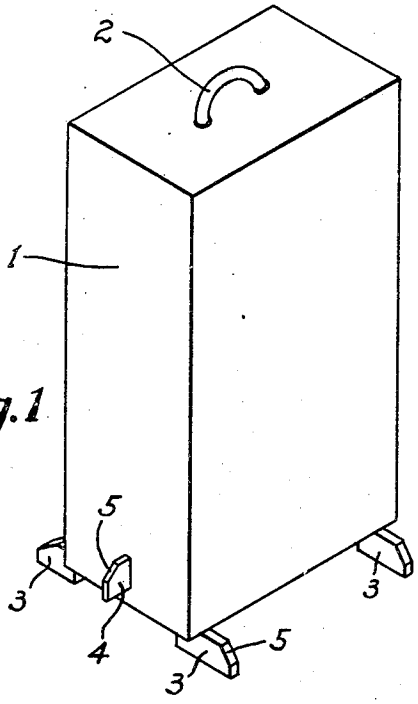


Fig. 1

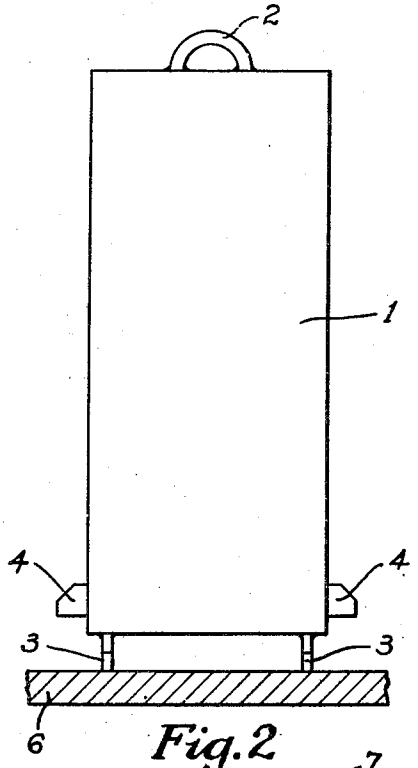


Fig. 2

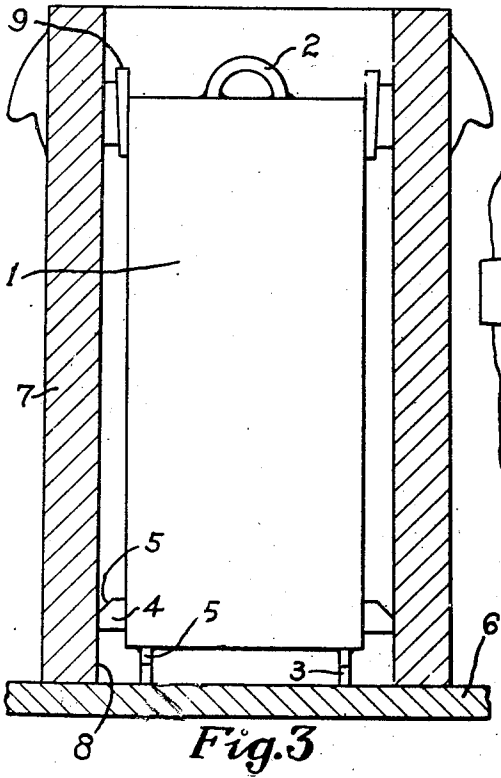


Fig. 3

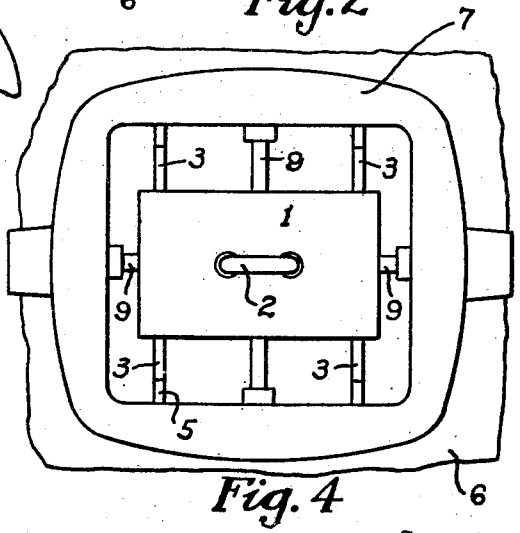


Fig. 4

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MANUFACTURE OF STAINLESS CLAD STEEL

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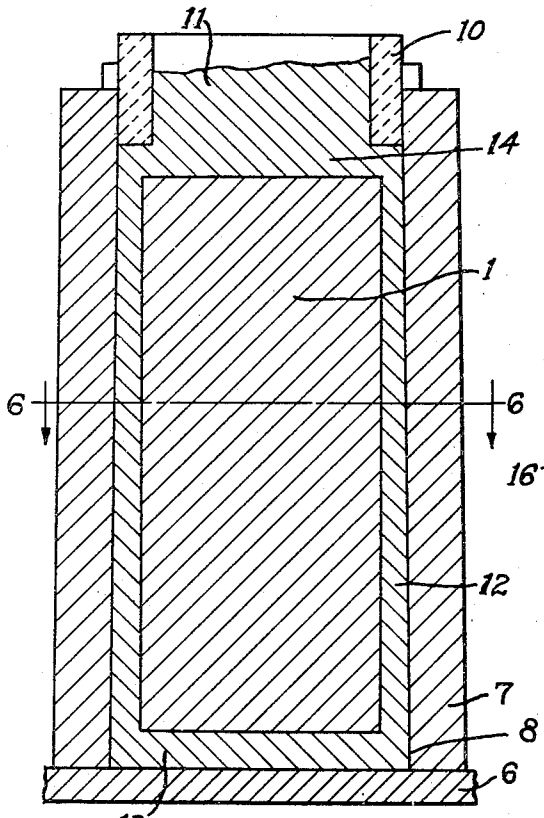


Fig. 5

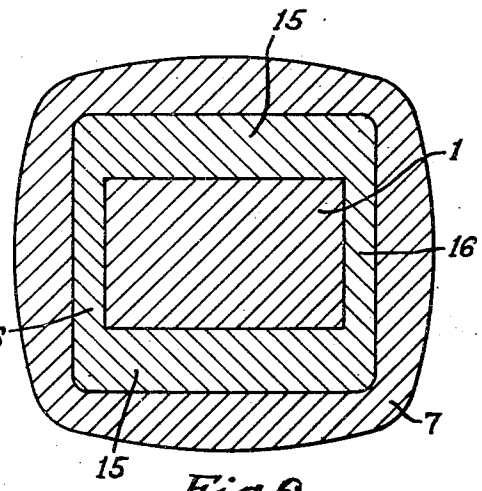


Fig. 6

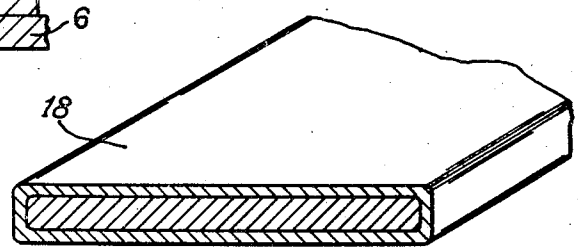


Fig. 8

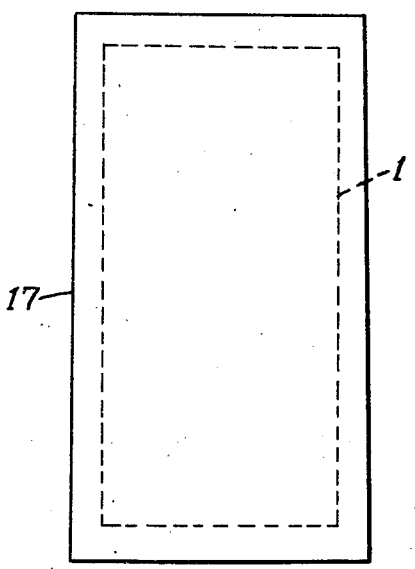


Fig. 7

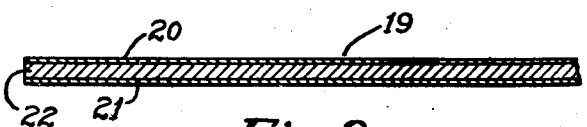


Fig. 9

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MANUFACTURE OF STAINLESS CLAD STEEL

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Application February 1, 1945, Serial No. 575,668

10 Claims. (Cl. 29—189)

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The invention relates to the manufacture of stainless clad steel and more particularly to various steps which should be carried out in order to overcome difficulties heretofore encountered in the manufacture of stainless clad steel, especially that in which a mild steel core is provided with a thin layer of stainless steel on each surface thereof.

There has been a demand existing for years for stainless clad steel and the prior art abounds with proposals of various procedures for the production of stainless clad steel, usually ply-metal having a stainless steel layer on one surface of a mild steel backing layer. The disclosure of these prior art proposals have a common similarity in that they each point out that tremendous difficulties are involved and that the prior proposals of others have been shown by experience to be incapable of commercially satisfactory results. The primary difficulty has been the inability to obtain a uniform or satisfactory bond or weld between the layers of adjacent plies, whether the procedure is one of welding, or of casting and rolling, or of cementation.

We recognize that satisfactory stainless clad steel has been made in accordance with many of the prior art proposals, in spite of the difficulties recognized in the art and which still exist. However, the production of stainless clad steel by whatever prior art procedure followed, has been complicated, expensive and wasteful.

Our approach to the problem has been characterized by a complete disregard of the prevailing beliefs, the conflicting theories and numerous cautions of those skilled in the art. We have solved the problem by rigid adherence to the dictates of fundamentals and simplicity. The failure of the art to recognize such dictates has rendered the solution of the problem obscure and inobvious.

This approach to the problem has led to the discovery that at many stages in the procedure for making stainless clad steel, the means or step utilized should be exactly what the prior art states should not be utilized.

We adopt a casting and rolling procedure as fundamental and simple because these steps may be carried out without substantial modification of existing equipment or of training of the operator.

The preponderance of all prior art proposals for making stainless clad steel by casting and rolling has indicated that paired plates of stainless steel, with separating material between,

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should be held in an ingot mold as a core around which mild steel is poured. Such ingot is rolled and the resulting product is finally split open to obtain portions thereof in the form of a mild steel backing with stainless steel layers on one or both surfaces thereof, the stainless steel having originated from the mold inserts.

We adopt exactly the reverse procedure by using a relatively large but simple, mild steel insert in an ingot mold and we cast stainless steel around the same and roll the ingot thus formed with some modifications, substantially as if it were stainless steel.

Other prior art suggestions include pouring mild steel inside of a stainless steel shell and then rolling. As indicated, our procedure is exactly to the contrary in that the ingot is formed by pouring stainless steel around a mild steel core.

Other prior art proposals include casting stainless steel around a relatively small carbon steel insert composed of one or two bars or billets so that the ingot thus formed has a layer of stainless steel on each side of the thin bar or billet substantially thicker than the thickness of the mild steel insert. On the contrary, we form an ingot having a mild steel insert two to three or more times as thick as the thickness of the layer of stainless steel cast upon any surface thereof.

It is a principal object of the present invention to provide a stainless clad steel product in which a thick mild steel core has a thin layer of stainless steel on each surface thereof.

It is a further object of the present invention to provide a stainless clad steel product which has a mild steel core and a layer of stainless steel on each surface thereof with the core thickness always two to three or more times as thick as the thickness of either stainless steel layer when finished and throughout the various stages of its manufacture.

Furthermore, it is an object of the present invention to provide a stainless clad steel product having a uniformly satisfactory bond or weld between the layers of adjacent plies.

Likewise, it is an object of the present invention to provide a new and simplified process for making stainless clad steel.

Furthermore, it is an object of the present invention to provide a new and satisfactory process of making stainless clad steel characterized by steps and procedures shown in actual operation to be successful contrary to the teachings of the art.

Also, it is an object of the present invention to

provide a simple procedure for making stainless clad steel which may be carried out without substantial modification of existing equipment or without substantial change in the training of either skilled or unskilled operators.

Finally, it is an object of the present invention to provide a method of making stainless clad steel which avoids the complications, expense, disadvantages and waste of the prior art.

These and other objects and advantages apparent to those skilled in the art from the foregoing description and claims may be obtained, the stated results achieved, and the described difficulties overcome by the methods, steps, products, treatments, and discoveries which comprise the present invention, the nature of which is set forth in the following general statement, a preferred embodiment of which—illustrative of the best mode in which applicants have contemplated applying the principles—is set forth in the following description and shown in the drawings, and which are particularly and distinctly pointed out and set forth in the appended claims forming part hereof.

The nature of the improvements of the present invention may be stated in general terms as preferably including in the manufacture of stainless clad steel the steps of providing a mild steel insert comprising a mild steel ingot or bloom; cleaning the surfaces of said insert by pickling, grinding or sand-blasting; securing mold-centering and support means to said insert; applying a coating of tar to all surfaces of said insert; baking the tar coating in the insert and heating the insert to a temperature of 200° to 300° F. and higher; placing said insert on a pouring table supported by said supporting means; telescoping a mold over said insert and centering the mold with respect to the insert by said centering means; pouring stainless steel preferably through a basket into the mold and around the insert, at as hot a temperature as possible consistent with producing the least damage to the mold, so that the sides, bottom and top of the insert are completely surrounded with cast stainless steel; soaking the composite ingot and hot rolling the same to slab shape; and cutting the rolled section into slabs and reheating, further hot rolling, and cold rolling the material with intervening annealing to form stainless clad strips or sheets as thin as .008 inch thick.

By way of example, the improved method is illustrated somewhat diagrammatically in the accompanying drawings forming part hereof, wherein;

Figure 1 is a perspective view of a mild steel ingot or bloom insert used in accordance with the present invention;

Fig. 2 is a side elevation of the insert shown in Fig. 1 placed on a pouring table;

Fig. 3 is a view similar to Fig. 2 showing an ingot mold centered around the insert;

Fig. 4 is a top plan view of the elements shown in Fig. 3;

Fig. 5 is a vertical section through the mold illustrated in Fig. 3 after the stainless steel has been cast;

Fig. 6 is a section taken as on the line 6—6, Fig. 5; Fig. 7 is a side view of a composite ingot after stripping and end cropping;

Fig. 8 is a perspective view in section of the material at a stage in hot rolling the ingot of Fig. 7; and

Fig. 9 is a section through the finished stainless clad steel.

Similar numerals refer to similar parts throughout the various figures of the drawings.

The invention will be described with particular reference to stainless clad steel having a mild steel core and a thin layer of 18—8 stainless steel on each surface thereof. It is to be understood that the invention is equally applicable to other relatively inexpensive steels suitable for use as the base, body or core of the ply-metal and that all such materials are included in the reference to "mild steel" herein and in the claims. Likewise, it is to be understood that the invention is applicable to other stainless steels than 18—8 stainless steel, such as straight chrome stainless steel and other chrome-nickel alloy steels; and all such metals are understood to be included in the term "stainless steel" as used herein. Likewise, whenever the terms, strips, sheets, strip-sheets or plates are used herein and in the appended claims, it is understood that any such term includes all such terms. Likewise, for convenience, certain sizes of inserts and ingots are referred to but it is understood that the invention is not limited to the specified sizes.

In accordance with the present invention, a low carbon or a mild steel ingot is cast, end-cropped and cleaned by one or more of the usual operations of pickling, grinding, chipping and sand-blasting to have an approximate size, for example, of 12" x 20" x 60". In the alternative, a mild steel bloom of approximately the same size is rolled from a larger ingot. Such an ingot or bloom may be conveniently referred to as the mild steel insert and is indicated at 1. A ring, or an eye, or a hook, indicated at 2, is preferably welded to the upper end of the insert 1; and feet 3 are welded to the bottom of the insert 1. Lugs 4 are also welded to the lower ends of the sides of the insert 1; and the feet 3 and lugs 4 each project outward of the insert 1 and preferably have tapered top edges 5.

A coating of tar is applied to the cleaned mild steel insert and the same is baked thereon and functions to keep the insert clean and to prevent rusting thereof.

The insert 1 with its protective baked tar coating is delivered to a pouring table 6 as warm as possible, say at a temperature of 200° F. to 300° F. and warmer at the time when molten stainless steel is about ready to be poured. An ingot mold approximately 70" high having a bottom opening approximately 21½" x 24" and a top opening of 20⅝" x 23½", indicated generally at 7, is lowered over the insert 1, as shown in Fig. 3. The feet 3 with the ingot mold and insert sizes stated, may be 3" high and they preferably project outwardly of the bottom of the insert 1 a distance of approximately 4¾". The lugs 4 project outwardly of the bottom end of the insert 1 approximately 2".

This arrangement maintains the bottom of the insert 1 spaced above the pouring table 6. The downwardly tapered surfaces 5 of the feet 3 and lugs 4 guide the bottom opening 8 of the ingot mold 7 as it lowered over the insert 1 to center the mold 7 with respect to the insert 1.

The mold 7, as indicated, has the least amount of taper possible; the taper being only sufficient to permit the composite ingot cast in the mold to be removed therefrom.

Key pieces 9 are then placed between the top of the insert 1 and the ingot mold 7 so that the top of the insert 1 is exactly centered with respect to the top of the ingot mold 7. It is es-

sential that the insert be centered exactly within the mold because the relationship of the insert 1 to the stainless steel poured around the same within the mold prevails throughout subsequent rolling. If a certain desired ratio of thickness of the stainless steel layers and core in the final product is to be obtained, it must be approximately established initially when the stainless steel is poured around the insert 1.

Stainless steel 12 is then poured into the mold 7 and around the insert 1 preferably by a basket-pouring operation, the stainless steel being as hot as possible consistent with producing the least damage to the mold.

The poured composite ingot is illustrated in Figs. 5, 6 and 7. A usual hot top is indicated at 10 in Fig. 5 and the pipe end 11 of the ingot of Fig. 5 has been removed in Fig. 7. When poured, the insert 1 is entirely surrounded with stainless steel 12, approximately 3" thick at the bottom as indicated at 13, from 3 to 5 or more inches thick at the top as indicated at 14, an average of approximately 4½" thick on each wide side as indicated at 15, and an average of approximately 1¾" thick on each narrow side as indicated at 16.

After the mold 7 has been stripped from the composite ingot, generally indicated at 17 in Fig. 7, the composite ingot is transferred to a soaking pit and there heated to the approximate optimum rolling temperature for stainless steel without too much soaking. The normal heating and soaking time for stainless steel is 8 to 10 hours including a 2-hour soaking period. However, in accordance with the present invention, the temperature should be approximately 2370° F. with a heating period of from 5 to 6 hours and with a soaking period of approximately ½ hour so that when rolled the composite ingot is on the stiff or cold range or side with relation to stainless steel.

In the normal practice of rolling stainless steel, a longer soaking period makes the steel softer and therefore easier to roll. However, the use of a long soaking period for the composite ingot 17 at a high temperature would make the mild steel insert so extremely soft, and also the stainless steel 12 surrounding the same so soft, that upon rolling the mild steel insert metal might be squeezed out of the stainless steel casing.

The composite ingot 17 having been heated and soaked as indicated is taken to a blooming mill and rolled by light passes into slab shape such as indicated at 18 in Fig. 8. In normal practice, the bloom is turned or twisted between certain passes. In rolling the composite ingot 17, the bloom cannot be twisted or turned for making a so-called edge pass when the metal is thinner than about 7" crosswise because the soft mild steel interior may permit the stainless steel casing to belly out and tear loose from the mild steel core.

The metal is then cut into slabs and the slabs are reheated. In reheating, care must be taken not to heat or soak the slabs too long. Since the stainless casing is being hot rolled on the cold side, light passes again must be taken. After reheating the slabs, they are hot rolled down to the desired reduction. In slab size and smaller, the metal section is so small that the soft mild steel core does not squeeze out at the ends, even though the material in the slabs is only encased with stainless steel on the four sides and not at the ends.

Upon completing the hot rolling operations, the material may be cold rolled with intervening annealing and pickling down to as thin as .008" gauge. In carrying out the annealing operations, the temperature used is approximately 1950° F. followed by air cooling or cooling with air blasts so as to avoid hardening the soft mild steel interior or core.

A section through the finished cold rolled ply-metal stainless clad steel product is indicated at 19 in Fig. 9 and the product has approximately a 20% by weight stainless steel coating 20 on one side, a 20% by weight stainless steel coating 21 on the other side, and a 60% by weight mild steel core 22 between the stainless steel coating layers 20 and 21. This is the approximate ratio established in the ingot 17 when originally poured and the reduction of the insert 1 and the stainless steel casing 12 from the composite ingot 17 to the finished sheet 19 progresses practically uniformly throughout the hot and cold rolling operations.

Thus, in the example given, the insert 1 is from two to three times as thick as the stainless steel 15 on each side of each wide side of the insert. The core 22 of the finished product 19 likewise is approximately three times as thick as the stainless steel layers 20 and 21 on each side thereof. It is to be understood however that the invention is not limited to the production of a product having the 20%–60%–20% relation indicated in the example because other relations in accordance with the invention may be established such as a 25%–50%–25%, or a 10%–80%–10% relation for a stainless clad steel product.

The resulting product has been discovered to have a uniformly satisfactory weld or bond between the stainless steel surface layers and the mild steel core. Thus, cooking utensils, such as deep, substantially cylindrical side walled pans, have been deep drawn from the cold rolled product without rupture of the metal or the bond between the stainless clad surfaces and the mild steel core. These pans, drawn from a .033" gauge material had some thinning of the metal in the bottom and in the lower region of the side walls and some thickening in the flange at the top of the side walls as would be expected. The actual resulting ratio by weight of the metal in the finished pan was a 21.9% layer of stainless steel on the outside, a 19.3% layer of stainless steel on the inside, and an intervening 58.8% layer of mild steel.

The stainless clad steel product is not limited in use to stock for deep drawn articles. The material has many uses where stainless steel has heretofore been required. Thus, the use of the new product results in a saving of critical materials.

A number of the steps utilized and the controls exercised in carrying out the improved method contribute to the attainment of the new results.

A mild steel ingot or a bloom rolled from a mild steel ingot, has a skin of very low carbon content, approaching pure iron. It is known that it is easier to weld stainless steel to pure iron or low carbon steel than to high carbon steel. In fact, some prior art proposals of forming ply metal products include the step of electrodepositing pure iron upon either a stainless steel insert or an ordinary steel insert in order to obtain a proper weld therebetween.

By using a mild or low carbon steel ingot or bloom as an insert in accordance with the pres-

ent invention, the desired condition of having practically pure iron on the surface of the insert is obtained without the necessity of providing a pure iron layer by electrodeposition or other means; and a satisfactory weld or bond between the mild steel insert and the stainless steel on the surfaces thereof is obtained.

The use of the tar coating step for preparing the insert not only keeps the insert clean and prevents rusting but it aids in producing a satisfactory bond or weld between the mild steel insert and stainless steel surfaces of the resultant product. The tar coating step is very cheap as compared with the complicated proposals of the prior art for preparing inserts around which other metal is cast.

It was not expected that the tar coating would benefit the weld or bond between the insert and stainless steel poured therearound. Normally, tar is used to dress the surfaces of ingot molds and to assist in the ready separation of the mold and ingot. It was believed that the use of tar to keep the insert clean might cause some difficulty in connection with the bond or weld but we unexpectedly discovered that it acted in the opposite manner and actually aided in obtaining a satisfactory bond or weld.

As indicated, the ultimate desired ratio of thickness of the stainless steel layers and core in the final product is established by exactly locating and centering the insert with respect to the ingot mold in preparing for pouring stainless steel around the insert.

The relatively soft condition of the mild steel core with respect to the stainless steel therearound has two important advantages when hot rolling the composite ingot. First, it contributes to obtaining a satisfactory bond or weld, and second, it aids in obtaining uniform rolling reduction of the stainless steel.

The insert metal in being soft and confined within the harder stainless steel casing under hot rolling conditions, is under great pressure. This enables the mild steel insert metal to be properly worked throughout and to be pressed at high temperature into intimate contact with the surrounding stainless steel thereby obtaining a satisfactory bond or weld. Moreover, the internal pressure of the soft insert metal is uniformly transmitted to the surrounding stainless steel so as to maintain uniform reducing pressure on both sides of each stainless steel portion 15 during hot rolling thereof.

These conditions are established and maintained by treating the composite ingot substantially as if it were a stainless steel ingot rolled on the stiff or cold range after rapid heating and soaking thereof.

Another factor of importance in obtaining the results is the relation between the thickness of the mild steel core and the stainless steel on any surface thereof. When the mild steel core is from two to three or more times as thick as the stainless steel on any surface thereof, the cast stainless steel is relatively thin and may be satisfactorily worked under roll reducing pressure.

The volume and softness of the mild steel core not only seem to enable a satisfactory bond or weld to be formed under the pressure and heat conditions present, but they also seem to enable a uniform reduction of the stainless steel to be obtained. On the other hand, if the stainless steel is thicker and the mild steel insert thinner, it may be difficult to obtain a uniform and satisfactory bond between the insert and stainless

steel and to obtain uniform reduction of the stainless steel; because the thickness and stiffness of the stainless steel layers and the reduced volume of mild steel may prevent any effective utilization of the internal pressure of a soft mild steel insert.

Likewise, it is important that stainless steel be cast around a mild steel insert as distinguished from casting mild steel around a stainless steel insert. Thus, in accordance with the present invention, when stainless steel is cast around a mild steel insert, the composite ingot is treated essentially as a stainless steel ingot rolled on the stiff side. Under these conditions, the stainless steel though stiff is relatively thin and is in direct contact with the work rolls for proper and adequate working during rolling.

On the other hand, if mild steel is cast around a stainless steel insert, the mild steel may be so soft if heated to the proper temperature for obtaining reduction of the stainless steel insert, that proper working conditions of heating and pressure may not be able to be maintained for rolling the mild steel.

Likewise, it is important that stainless steel be cast around a mild steel insert rather than casting mild steel within a stainless liner. Thus, if mild steel is cast within a stainless steel liner, the mild steel cannot be confined at the ends of the composite ingot; and the mild steel will squeeze out if the composite ingot is heated to a sufficient temperature to obtain rolling reduction of the stainless steel.

Also, the squeezing out prevents the attainment of sufficient pressure at high temperature for forming a satisfactory bond or weld.

Thus, the present invention proceeds, contrary to the directions of the prior art; because the prior art indicates that stainless clad metal should be made by casting mild steel around a stainless steel insert and that when stainless steel is cast around a mild steel insert, a very small mild steel insert and relatively thick stainless steel should be used.

Accordingly, the present invention provides a new method of making stainless clad steel which overcomes difficulties heretofore encountered in the prior art; which proceeds, contrary to the prevailing beliefs and numerous cautions of the prior art; which involves fundamentally simple casting and rolling procedures that may be carried out without substantial modification of existing equipment or of training of the operator; which provides a uniformly satisfactory bond or weld between the base and clad metals; and which produces a uniform and satisfactory stainless clad steel product.

The embodiment of the present invention illustrated and described herein is by way of example and the scope of the present invention is not limited to the exact details set forth.

Finally, in the foregoing description, certain terms have been used for brevity, clearness and understanding; but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such words are utilized for descriptive purposes herein and not for the purpose of limitation, and are intended to be broadly construed.

Having now described the features, principles and discoveries of the invention, the operation and use of the preferred method thereof, and the advantageous, new and useful results attained thereby; the new and useful methods, steps, com-

binations and sub-combinations, and reasonable mechanical equivalents thereof obvious to those skilled in the art, are set forth in the appended claims.

We claim:

1. In a method of making stainless clad steel, the steps of providing a mild steel insert, applying a coating of tar to the insert surfaces, casting stainless steel to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, and then hot and cold rolling the ingot metal to form stainless clad steel strip metal, the hot rolling being done on the cold side of the temperature range for hot rolling stainless steel.

2. In a method of making stainless clad steel, the steps of providing a mild steel insert, applying a coating of tar to the insert surfaces, centering the insert in an ingot mold, casting stainless steel in said mold to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, and then hot and cold rolling the ingot metal to form stainless clad steep strip metal, the hot rolling being done on the cold side of the temperature range for hot rolling stainless steel.

3. In a method of making stainless clad steel, the steps of providing a mild steel insert, cleaning the surfaces of the insert, applying a coating of tar to the cleaned insert surfaces, casting stainless steel to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, and then hot and cold rolling the ingot metal to form stainless clad steel strip metal, the hot rolling being done on the cold side of the temperature range for hot rolling stainless steel.

4. In a method of making stainless clad steel, the steps of providing a mild steel insert, cleaning the surfaces of the insert, securing mold-centering and support means to said insert, applying a coating of tar to the insert surfaces, placing said insert on a pouring table supported by said supporting means, telescoping a mold over said insert and centering the mold with respect to the insert by said centering means, casting stainless steel in said mold to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, and then hot and cold rolling the ingot metal to form stainless clad steel strip metal, the hot rolling being done on the cold side of the temperature range for hot rolling stainless steel.

5. In a method of making stainless clad steel, the steps of providing a mild steel insert, applying a coating of tar to the insert surfaces, baking the tar coating on the insert and heating the insert to a temperature of 200° to 300° F. and higher casting stainless steel to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, and then hot and cold rolling the ingot metal to form stainless clad steel strip metal, the hot rolling being done on the cold side of the temperature range for hot rolling stainless steel.

6. In a method of making stainless clad steel, the steps of providing a mild steel insert, casting stainless steel to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, rapidly heating the composite ingot to and soaking it at a temperature of approximately 2370° F. for from 5 to 6 hours including a short soaking period of approximately ½ hour, and then hot rolling the composite ingot to uniformly bond the mild and stainless steels and to uniformly reduce the mild and stainless steels.

7. In a method of making stainless clad steel, the steps of providing a mild steel insert, casting stainless steel to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, rapidly heating the composite ingot to and soaking it at a temperature of approximately 2370° F. for from 5 to 6 hours, hot rolling the composite ingot to slab section, subjecting the ingot to edge passes during said hot rolling until the section thickness is about 7", cutting the rolled slab section into slabs, reheating the slabs, and further hot rolling the same to form hot rolled stainless clad strip metal.

8. In a method of making stainless clad steel, the steps of providing a mild steel insert, cleaning the surfaces of the insert, securing mold-centering and support means to said insert, applying a coating of tar to the insert surfaces, baking the tar coating on the insert and heating the insert to a temperature of 200° to 300° F. and higher, placing said insert on a pouring table supported by said supporting means, telescoping a mold over said insert and centering the mold with respect to the insert by said centering means, casting stainless steel in said mold to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, rapidly heating the composite ingot to and soaking it at a temperature of approximately 2370° F., and then hot rolling the composite ingot to uniformly bond the mild and stainless steels and to uniformly reduce the mild and stainless steels.

9. In a method of making stainless clad steel, the steps of providing a mild steel insert, cleaning the surfaces of the insert, securing mold-centering and support means to said insert, applying a coating of tar to the insert surfaces, baking the tar coating on the insert and reheating the insert to a temperature of 200° to 300° F. and higher, placing said insert on a pouring table supported by said supporting means, telescoping a mold over said insert and centering the mold with respect to the insert by said centering means, casting stainless steel in said mold to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, rapidly heating the composite ingot to and soaking it at a temperature of approximately 2370° F. for from 5 to 6 hours, hot rolling the composite ingot to slab section, subjecting the ingot to edge passes during said hot rolling until the section thickness is about 7", cutting the rolled slab section into slabs, reheating the slabs, and further hot rolling the same to form hot rolled stainless clad strip metal.

10. In a method of making stainless clad steel, the steps of providing a mild steel insert, cleaning the surfaces of the insert, securing mold-centering and support means to said insert, apply-

ing a coating of tar to the insert surfaces, baking the tar coating on the insert and reheating the insert to a temperature of 200° to 300° F. and higher, placing said insert on a pouring table supported by said supporting means, telescoping a mold over said insert and centering the mold with respect to the insert by said centering means, casting stainless steel in said mold to completely surround said insert and form a composite ingot in which the insert is 2 to 3 or more times as thick as the stainless steel on any surface thereof, rapidly heating the composite ingot to and soaking it at a temperature of approximately 2370° F. for from 5 to 6 hours, hot rolling the composite ingot to slab section, subjecting the ingot to edge passes during said hot rolling until the section thickness is about 7", cutting the rolled slab section into slabs, reheating the slabs, further hot rolling the same to form hot rolled stainless clad strip metal, and cold rolling the hot rolled strip metal to the desired gauge to form a cold rolled stainless clad strip having a ratio of thickness of the stainless steel

layers and core approximately that established in the ingot when originally poured.

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