Aug. 9, 1966 C. F. FUNK 3,264,696

METHOD OF CLADDING METAL SURFACES

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Fig. 1.

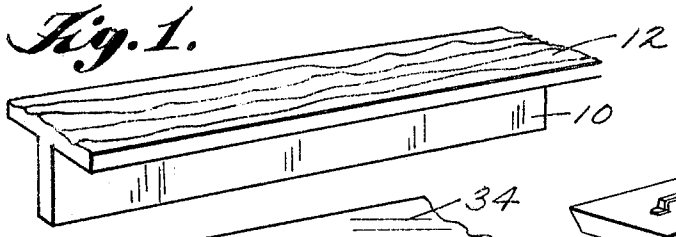


Fig. 3.





Fig. 8

Fig. 6.

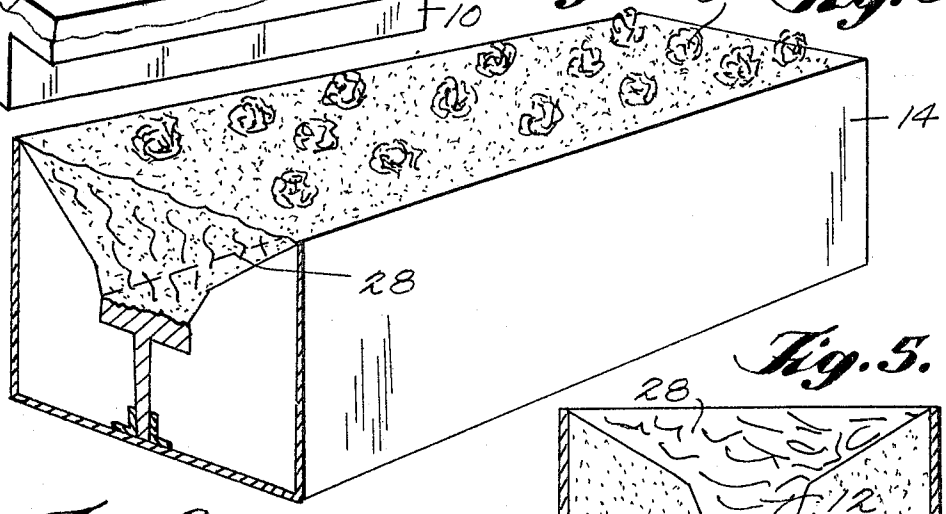


Fig. 5.

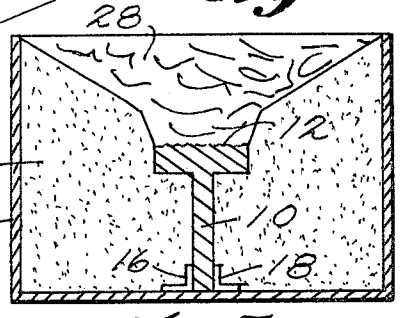


Fig. 2.

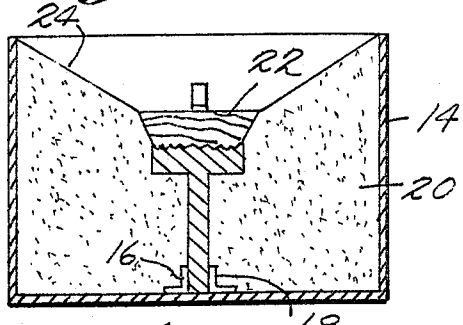


Fig. 7.

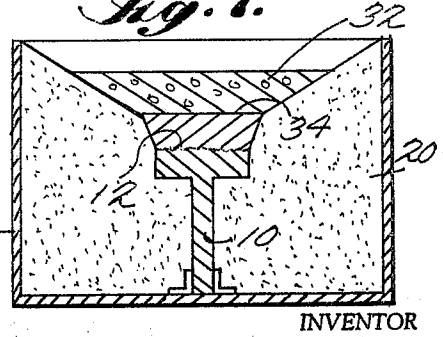
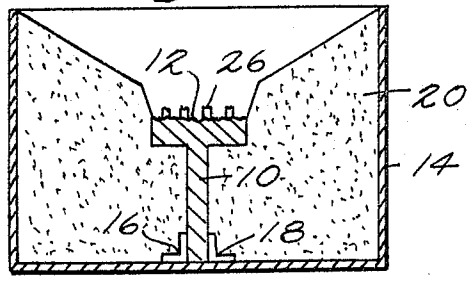


Fig. 4.



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Fig. 9.

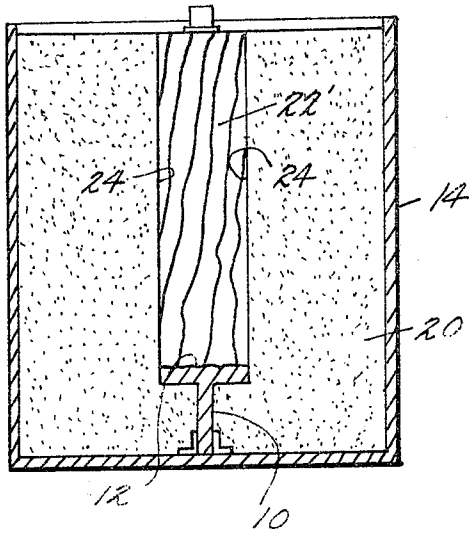


Fig. 10.

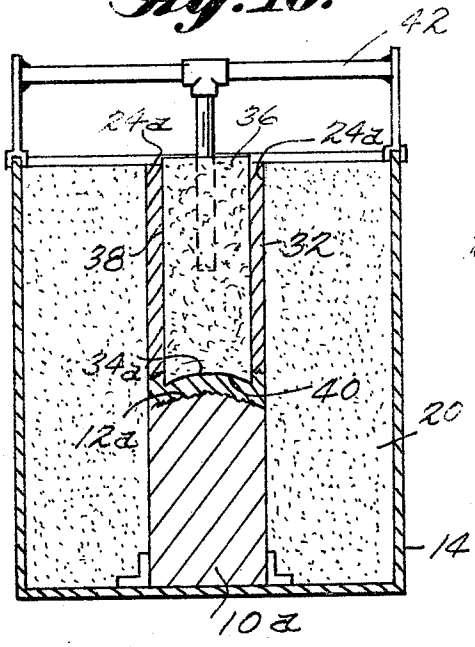
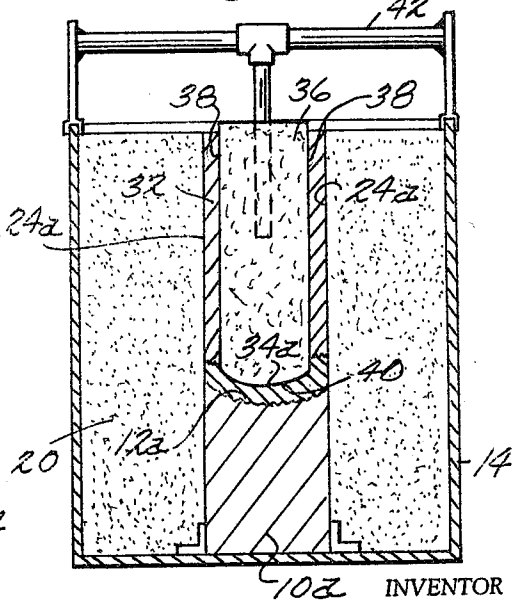


Fig. 11.



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3,264,696

METHOD OF CLADDING METAL SURFACES

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2 Claims. (Cl. 22—203)

The present invention has reference to a new and improved method of cladding the defective surface of worn parts wherein a thermit composition is reacted directly on the surface to be clad.

The thermit process for cladding metals is commonly carried out in a crucible wherein iron oxide and aluminum are reacted to form free iron in an exothermic reaction, when ignited, such as by magnesium. Necessarily, this exothermic reaction in a crucible is hazardous, in view of the excessively high temperature produced and the dangers incumbent in transferring the reduced molten metal to the surface being repaired. The pouring is a hazardous operation for molders, and is otherwise undesirable from the standpoint of the loss in temperature occurring by reason of the crucible being moved from a place of reaction to a subsequent position where the crucible is tapped and the metal is poured on the surface.

Accordingly, an important object of the present invention is to obviate the reaction of the thermit in a crucible, the present invention contemplating a method of repairing a defective surface of the like wherein the thermit composition, generally in granular form, is initially placed directly on the defective surface to be clad. By virtue of this arrangement, the use of thermit becomes quite safe in that the metal is not poured in a molten state onto the metal surface.

Still further, this invention contemplates a new and improved method of repairing a worn metal surface of a type receptive to fusion with the reduced metal product of an exothermic thermit reaction, the thermit reaction and subsequent deposit of metal taking place in situ directly on the repaired surface.

While the cladding of metal with thermit is, in itself, known in the art, as evidenced by, e.g., the patent to Young, No. 2,309,288, issued in 1943, the instant invention contemplates the elimination of any preliminary reaction of the thermit in a crucible remote from the surface to be repaired. Accordingly, the instant method of repairing defective surfaces enjoys the significant advantage of being relatively safe and free of hazards. Moreover, the instant invention readily lends itself to the repair of the rapidly worn surfaces without the requirement for skilled molders.

According to this invention, worn surface of a bar or other structure is first cleaned by conventional techniques, such as sand blasting, a chemical cleaning agent or the like. The structure is then placed in a sand mold form and the worn surface is placed upwardly in an exposed position. A core is temporarily positioned on the worn surface which configuration conforms to the desired finished configuration of the metal which is to be clad onto the worn surface, the sand being packed, as necessary, to conform to the configuration of the core. Preferably, spaced apart anchor studs are welded to the worn surface of the metal, these studs extending upwardly into the region formed by the core. These studs serve to fuse with the reduced free metal, plus whatever alloying composition is added to the thermit composition. While the use of studs welded to the worn surface is considered desirable, the same is not absolutely necessary, and successful results have been obtained without the use of studs.

The metal surface is then preheated; next, the thermit in the form of powder or granular composition is poured onto the mold from above the worn surface. The amount

of thermit required, of course, corresponds to the desired thickness of the cladding which is desired, and empirical methods have been found to be satisfactory. For example, a thickness ratio of 5:1 of thermit to the desired thickness of clad metal is a satisfactory relationship.

The thermit igniting mixture is then spread across the top surface of the unreacted thermit. In an exemplary arrangement, spaced apart piles of magnesium powder are positioned at regular intervals across the upper surface. Next, the magnesium powder is ignited, such as by fanning a blow torch flame across this surface, thereby initiating the thermit reaction. The thermit reaction, well known in the art, causes a reduction of iron oxide to free iron, which is deposited onto the worn surface, this thickness corresponding to the configuration of the core which was originally placed adjacent the worn surface. The released iron (or alloyed iron) at this very high temperature fuses with the studs, if the same were used, and the clad metal is ultimately fused with the worn surface. The slag, which has risen to the top of the mold form, is conveniently removed by any suitable means such as a chipping hammer or the like. A structure is thereby clad in a notably superior manner and is capable of being reused until the surface is again worn and the cladding is repeated to thereby prolong the useful life of the structure.

This invention also has application to cladding convex and concave surfaces; the method being modified to the extent risers and a core insert for the clad surface are provided.

The clad surface, particularly where the same is flat, is very smooth, minimum surface variation being provided by leveling the thermit composition prior to reacting the same.

The method according to this invention is particularly adapted for repairing the defective surfaces of parts which become rapidly worn due to environmental abuse. Typical of such structures are grizzly bars, which are used to convey and scalp large rocks, iron ore, coal and the like in conveyor equipment. This invention, however, is characterized by a high degree of flexibility, being adaptable for parts of both large and small sizes. A minimum of lost time for the equipment being repaired is occasioned by the fact any mold form is remarkably simple to construct, especially where flat surfaces are to be clad. Moreover, the method is relatively safe to carry out, even with unskilled workmen, as well as being relatively inexpensive.

These and still further objects, advantages, and novel features of the present invention will become apparent in the specification and claims, taken in connection with the accompanying drawings.

In the drawings:

FIGURE 1 is a perspective view of a bar having a defective surface which is to be repaired according to the present invention;

FIGURE 2 shows, in an elevational section view, the bar positioned in a mold form together with the removable core positioned on the worn surface of the bar;

FIGURE 3 is a perspective view of the removable core in FIGURE 2;

FIGURE 4 is a view similar to FIGURE 2 showing studs welded to the worn surface;

FIGURE 5 is a view of the subsequent step of placing the thermit powder onto the worn surface for subsequent reaction by the magnesium igniter;

FIGURE 6 is a perspective view, showing the ignition composition spaced on the top surface of the thermit prior to ignition;

FIGURE 7 is a view of the arrangement after the thermit reaction;

FIGURE 8 is a perspective view of the repaired metal bar;

FIGURE 9 is an elevational section view similar to FIGURE 2 but showing a modified mold form and removable core; and

FIGURES 10 and 11 are elevational sectional views of an arrangement for cladding convex and concave worn surfaces, respectively.

Referring now to the drawings, there is shown in FIGURE 1 a grizzly bar **10** of a T-shaped configuration, its upper surface **12** having become worn in the handling of iron ore or the like. While the method is shown and described as being carried out on the worn surface of the grizzly bar, it will become apparent that this invention is capable of application to any worn surface, to which clad metal is formed thereon to prolong the useful life of the worn part. The surface may be small or large, and as will become apparent, the surface can be made very uniform within close limits.

The worn surface **12** of this bar **10** is first cleaned, such as by sand blasting, chemical cleaning, in order to present an uncontaminated surface for receiving the reacted thermit. The bar **10** is then placed in a long metal box **14**, the surface **12** facing upwardly, the box **14** constituting the mold container for the bar **10**. Suitable angles **16** and **18** are positioned along the bottom surface of the box **14** in opposed parallel relationship. Conveniently, the angles **16** and **18** are tack welded to the bottom end of the bar **10**. Molding sand **20** with its usual binder is packed into the metal box **14** so as to surround the bar **10**, except at its upper surface. In this regard, a pre-formed core **22** made of wood or the like is positioned on the worn surface **12** of the bar **10**.

The core **22** conforms in cross-sectional configuration to the dimensions of the clad metal to be formed, i.e., the configuration of the bar **10** after the same has been clad. The sand **20** is tamped firmly about the bar **10** and the core **22**, leaving a top recess of an inwardly inclined angular configuration **24**. Alternatively, the surface **24** of the top of the sand mold may be in the form of vertical walls (FIGURE 9) so that there is provided a generally rectangular recess along the length of the bar. In the latter modification, however, the core **22'** is much thicker and no longer conforms to the cladding thickness, but rather the mold thickness. The core **22** is then withdrawn, care being taken not to disturb the balance of the bar **10**. Next, the mold sand is firmly packed in the usual fashion and the mold is pre-heated with a conventional torch, heating the molding sand to about 200° F., to fix the binder therein.

Spaced apart studs **26** may be welded to the ends of the surface **12**; the studs **26** will constitute an anchor for the clad metal as the same is fused on the surface **12** of the bar **10**. Any dust or loose sand is then blown away from the worn surface **12** by an air hose or the like.

The surface is then preheated in the usual manner, to drive out moisture, and the like. Now, thermit **28**, of well-known composition, in the form of a homogeneous powder, is poured into the recess **24** and stacked to the desired height, the amount of thermit poured in the recess corresponding to the desired thickness of clad metal to be added to the worn surface **12**. In order to ensure a relatively level finish on the clad metal, with a minimum of surface irregularity, the thermit is smoothed or leveled so as to be a uniform height across its top. A flash powder or igniter **30** is disposed on the top surface of the thermit **28** and preferably takes the form of magnesium powder in small, regularly spaced apart piles. This powder is then ignited from a high heat, preferably a blow torch, causing reduced metal, or alloyed metal, to be released from its oxide and aluminum mixture in the exothermic chemical reaction. The freed metal, e.g., iron, or an alloyed metal, which was initially a part of the thermit, is deposited directly on the worn surface **12**, and is fused therewith and with the studs **26** that were previously welded to the surface **12**.

As is well-known in the art, the thermit composition may yield a nickel product, stainless steel or other alloyed steels. See, e.g., the patent to Deppeler, No. 2,337,314, issued in 1943. Accordingly, the instant method may be carried out with known thermit composition, which metal surface is receptive to fusion with the free metal product of the exothermic reaction. This method works particularly well with a thermit composition exhibiting a highly fluid slag, which slag separates and rises quickly from the reduced metal. The slag **32** rises to the top of the clad metal surface **34**. The entire mold is then disassembled after the same sets, and the slag **32** is removed with conventional techniques, such as a chipping hammer.

The top surface **34** of the repaired bar **10** is characterized by a smooth surface finish having a minimum of surface variation due to the fact the thermit was previously leveled in the mold. The bar **10** is then ready for use and its useful life has been prolonged, the bar **10** then being capable of being repaired again, if necessary.

Referring now to FIGURES 10 and 11, there are shown arrangements for cladding convex and concave surfaces, respectively, of defective metal parts. The part **10***a* in FIGURE 10 has a worn or otherwise defective convex surface **12***a*, the part being positioned in the mold box **14** in a manner similar to that shown in FIGURE 2. In this embodiment of the invention, a removable core (not shown) with a concave bottom surface was positioned against the convex surface **12** and the sand packed to the top of the box **14**. In this arrangement, the core takes the general configuration of that shown in FIGURE 9 except for the concave bottom surface as described. With the sand so packed, a core insert **36** is positioned between the walls **24***a* and the mold recess above the surface **12***a*, being spaced apart from these walls **24***a* to form risers **38**. The concave bottom surface **40** of the insert **36** in this mode of carrying out the instant invention is left in place during the thermit reaction, being positioned a distance from the surface **12***a* corresponding to the thickness of the clad metal to be formed. The insert **36** is of sand construction, suitably treated to withstand the high temperatures and is supported above the mold box **14** by any suitable means such as supporting bars **42**, joined thereto.

The thermit composition **28** in this instance is then deposited into the riser spacers **38** filling this area and area adjacent the surface **12***a*. The piles of magnesium igniter are then spaced along the upper surfaces of the thermit composition **28**, and these two rows of igniter are then started with a blow torch, initiating the thermit reaction. The dimensional relationship of the riser depth **38** is selected so that the slag **32** formed in the thermit reaction is wholly within the riser area, the free metal falling to the surface **12***a* where the same is fused thereto, the clad surface **34***a* taking the shape of the insert bottom surface **40**. After the metal has set, the mold is dismantled, the slag chipped off, and the side extremities of the clad surfaces are machined to complete the configuration of the clad surface.

In FIGURE 11, the same process is carried out except that the surface **12***a* is concave and the corresponding bottom surface **40** of the insert **36** is convex. Otherwise, the process is the same as that described with reference to FIGURE 10.

In the arrangements shown in FIGURES 10 and 11, the insert **36** and the arrangement of the risers **38** renders the construction and operation somewhat more complex than the flat surface in 1–8; nevertheless, the use of a crucible and the hazards attendant therewith, is advantageously eliminated.

From the foregoing description of the various embodiments of this invention, it is evident that the objects of this invention, together with many practical advantages are successfully achieved. While preferred embodiments of my invention have been described, numerous further

modifications may be made without departing from the scope of this invention.

Therefore, it is to be understood that all matters herein set forth or shown in the accompanying drawings are to be interpreted in an illustrative and not in a limiting sense.

What is claimed is:

1. A method of forming a built up surface layer of metal on a surface of a metal article, said surface being receptive to fusion, which comprises the steps of placing said article with said surface facing upwardly and in a generally horizontal position, forming a mold having upwardly-extending sides around an area of said surface, laying sufficient thermit composition to form said built up layer on said surface within said sides, placing igniter material in contact with said thermit composition, igniting said igniter material, whereby the burning igniter material causes the ignition of said thermit composition and a layer of molten metal is formed which fuses to said surface.

2. A method of forming a built up layer of metal on a surface of a metal article, said surface being receptive to fusion, which comprises the steps of placing said article with said surface facing upwardly, forming a mold having upwardly-extending sides around an area of said surface defining a cavity over said surface, inserting in said cavity mandrel having a lower surface poised above said surface of said metal article, said mandrel being smaller than cavity and defining risers within said

upwardly extending walls, placing sufficient thermit material in the space between said surfaces and within said risers to form said built up layer, placing igniter material on said thermit composition, igniting said igniter material whereby the burning igniter causes the ignition of said thermit composition and a layer of molten metal is formed which fuses to said surface of said article.

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