

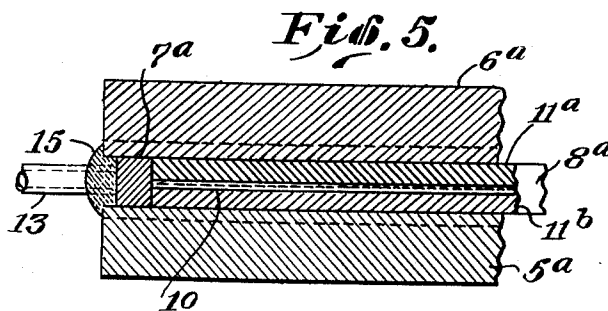
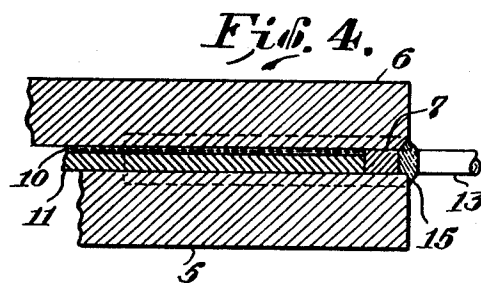
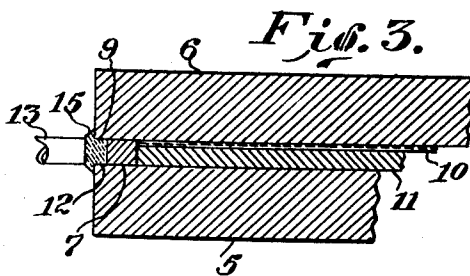
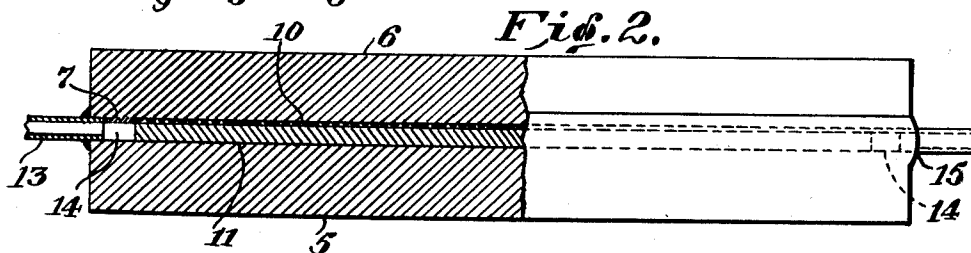
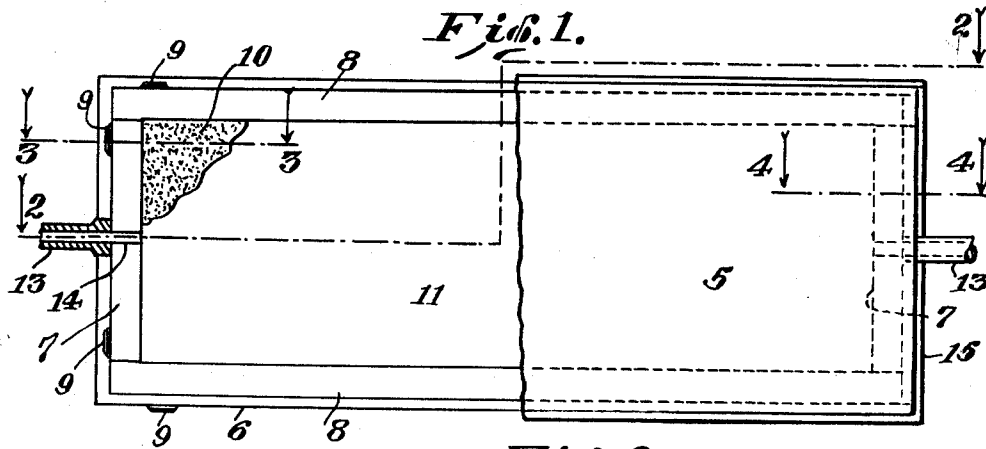
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2,932,885

METHOD AND PACK FOR MAKING ZIRCONIUM-CLAD STEEL PLATE

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METHOD AND PACK FOR MAKING ZIRCONIUM-CLAD STEEL PLATE

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2 Claims. (Cl. 29—470.9)

This invention relates to the art of making zirconium clad steel plates and is concerned with the methods and packs used in the production of such plates.

The principal object of my invention is to provide a composite metal member which will have the strength and advantages of steel and yet by reason of a zirconium surface will have the advantages peculiar to that metal.

A further object of this invention is to obtain a metallic member which has the advantages of zirconium but which can be made at a much lower cost than a solid plate of zirconium of the required strength.

Another object of this invention is to produce a composite bonded structure of the character described which can be bent 180° in either compression or tension without rupturing the bond between the different metallic layers.

A still further object of this invention is to produce zirconium clad steel plate in which the shear strength of the bond is extremely high.

Other objects will appear hereinafter throughout the specification.

This application is a continuation-in-part of my application Serial Number 353,464, filed May 7, 1953, now abandoned.

In the drawing:

Figure 1 is a bottom plan view of a preferred form of pack used in the manufacture of my zirconium clad steel plate, with parts broken away to expose the interior of the pack.

Figure 2 is a longitudinal section taken on the line 2—2 of Figure 1.

Figure 3 is a fragmentary view in section taken on the line 3—3 of Figure 1.

Figure 4 is a fragmentary sectional view taken on the line 4—4 of Figure 1, and

Figure 5 is a fragmentary sectional view showing a modified pack in which two zirconium sheets are used.

Referring now to the form of Figures 1 to 4, inclusive, the pack comprises an elongated rectangular steel plate 5 and a similarly shaped top plate 6 both preferably being made of carbon steel. Shorter steel spacer bars 7 and 8 of relatively narrow width are tack welded along the edges and on the lower side of the upper plate 6 as indicated at 9 in Figures 1 and 3. As clearly shown in Figure 1, the bars 8 extend along the side edges of the plate 6, and the bars 7 extend across the ends of the plate 6, with their ends abutting the inner side edges of the bars 8. The bars 7 and 8, together with the plate 6, thus form a shallow recess into which the zirconium plate 11 fits when the plate 6 is placed over the bottom plate 5.

Before the plates are assembled, the steel plates are cleaned on one side by blasting, pickling or grinding, and the zirconium sheet is similarly cleaned, it being made certain that all grease has been removed. After being thoroughly cleaned, the zirconium sheet is coated on one side surface with a strippable lacquer or "stop-off" after

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which the sheet is electroplated in a suitable iron plating solution to obtain a deposit of approximately 0.002 to 0.003 of an inch of iron. The lacquer or "stop-off" material may be any such material suitable for the purpose, and I have found that a lacquer material known as "Liquid Envelope" is excellent for this purpose. The lacquer prevents a deposit of a plated coating on the surface of the zirconium plate which will be exposed when the article is completed.

After the zirconium sheet has been plated, the lacquer is peeled off and the sheet is fitted into the recess formed by the top plate 6 and the bars 7 and 8 so that its unplated surface will engage the adjacent surface of the plate 6 which has previously been coated with an aqueous suspension of fine graphite powder which has been thoroughly dried. This coating 10 constitutes a parting material or compound which prevents the zirconium plate from adhering to the steel plate 6. It has been found that such a coating is highly satisfactory, however, it will be understood that any suitable coating could be used.

The plates are now assembled with the plate 5 on the bottom, the plate 6 on top, and the zirconium plate 11 and the parting material 10 between the top and bottom plates. In this arrangement, the iron plated surface of the zirconium sheet will be facing downwardly against the bottom plate 5 and the unplated surface will engage the parting material.

As shown in Figures 1 and 2, the bottom plate 5 and the bars 7 and 8 are then tack welded together, as indicated at 12.

A groove 14 is formed transversely of each of the bars 7 approximately midway between its ends as clearly shown in Figures 1 and 2. These grooves are formed in the lower faces of these bars and constitute a means through which an inert gas, such as argon, may be supplied to and conveyed from the recess formed by the bars 7 and 8 and the plate 6 by the pipes 13, one of which is secured to each end of the pack.

The pack assembly is now welded all around to form a seal at 15. While this weld is being made it is preferred that a slight flow of argon be maintained through the recess in order to prevent contamination of the cleaned surfaces of the plates.

The pack is then purged of air and heated in a suitable furnace which has been preheated to the desired temperature. The temperature will depend on different factors, such as the degree of reduction in the thickness of the pack when the final rolling or other operation is completed. Another factor is the type of hot working to be used. Experience has shown that best results are obtained where the temperature is between approximately 1000° F. and 1550° F.

In Figure 5 is shown a pack having two zirconium sheets 11a and 11b with their iron plates surfaces in contact, and arranged between the lower and upper steel plates 5a and 6a, respectively. In this form, the bars 7a and 8a which correspond in function to the bars 7 and 8 described above, must be increased in thickness to take care of the additional zirconium sheet. Also, the parting material is placed between the zirconium plates so that two zirconium plates will be produced after the pack is reduced to the desired thickness. Otherwise, the method steps are the same as in the first form described. Obviously, the production of two zirconium-clad plates by one operation will yield savings in time and cost.

The steel plates are approximately two and one-half inches greater in length and width than the zirconium sheet to allow for the spacer bars and to provide welding grooves around the pack. These plates and the sheet are preferably elongated in shape and usually about ten

feet by five feet in size, although it is to be understood that this size is in no way critical. The thickness of the steel plates may be about five-eighths of an inch, and that of the zirconium sheet about one-eighth of an inch but these dimensions are not critical and will depend upon the degree of reduction in thickness which may be desired.

It has been found that the pack should be heated about one hour per inch of thickness and during this heating time the flow of argon or other inert gas should be constantly maintained. When the pack is first put in the furnace the flow of gas should be very rapid and should remain so until a temperature of approximately 600° F. is reached. This is done to remove moisture and any gases which tend to make the zirconium sheet brittle. After this the flow may be reduced in rapidity but should be maintained throughout the heating operation.

When the heating is completed the gas is shut off and the pack is immediately rolled, pressed or forged to the desired thickness as well as to effect the bond between the plated surface of the zirconium sheet and the adjacent steel plate. The degree of reduction is not critical but it has been found that best results are obtained when the original thickness is reduced not less than twenty percent.

After the rolling or other reduction procedure and cooling, the pack is cut along the lines of the bars, separation taking place along the lines of the parting material.

In conclusion it may be stated that a nickel plating solution may be employed in place of an iron plating solution although the latter is preferred.

The above description and drawings disclose a single embodiment of the invention, and specific language has been used in describing the several 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 such as would occur to one skilled in the art to which the invention relates.

What is claimed:

1. The method of cladding steel plates with a zirconium sheet which comprises electro-plating one side surface of a zirconium sheet with metal from the class of iron and nickel to obtain a deposit of approximately 0.002 to 0.003 inch, coating one side of a steel plate with

parting material, drying said parting material, placing the unplated surface of the zirconium sheet against the dry parting material, bringing a second steel plate into engagement with the plated surface of the zirconium sheet, spacing the edges of said sheet inwardly from the edges of said plates to form a peripheral recess around the edges of said sheet, welding spacer bars between the edges of said plates to form a sealed chamber around the edges of said sheet, providing said chamber with a gas inlet and a gas outlet, flowing an inert gas through said chamber to purge it of air, heating the assembled pack to a temperature between approximately 1000° F. and 1550° F. to promote bonding of the zirconium sheet to said second plate while maintaining the flow of gas, and rolling the pack to an extent sufficient to bond the zirconium sheet to said second plate.

2. A pack for making a zirconium-clad steel plate, comprising two outer plates of steel, a sheet of zirconium between said outer plates, a parting material between one of the outer plates and said zirconium sheet, and a coating 0.002 to 0.003 inch thick of metal from the class of iron and nickel on the surface of the zirconium sheet which contacts the other outer plate, the edges of said sheet being spaced inwardly from the edges of said plates to provide a peripheral recess around the edges of said sheet, spacer bars welded to the outer edges of said plates to form a sealed chamber around the edges of said sheet, and said chamber being provided with an inlet and an outlet for the flow of gas into and out of said pack.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,932,885

April 19, 1960

Thomas T. Watson

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 55, for "plates" read -- plated --.

Signed and sealed this 20th day of September 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents