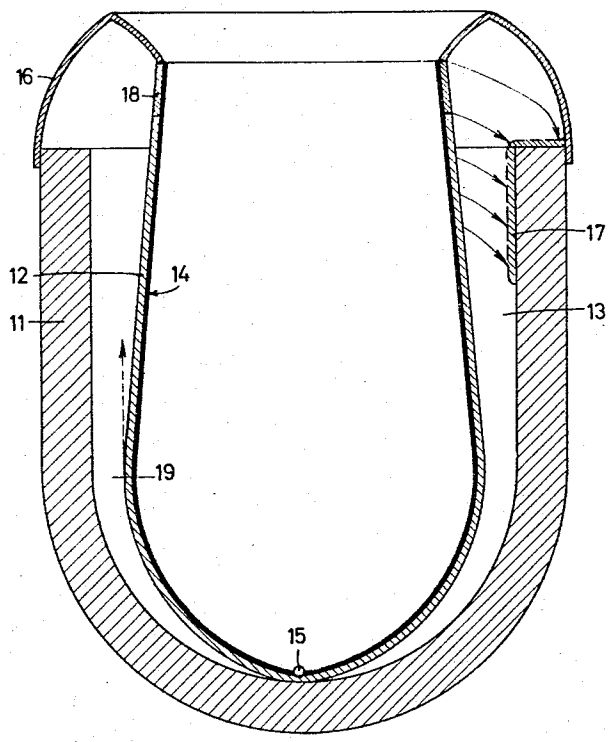
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METHOD OF SEAMLESS EXPLOSIVE PLATING OR CLADDING OF THICK-WALLED VESSELS

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METHOD OF SEAMLESS EXPLOSIVE PLATING OR CLADDING OF THICK-WALLED VESSELS

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Our invention relates to a method of plating or cladding thick-walled boilers or other vessels by an explosion process.

In known methods of this type, a metal sheet coated with an explosive foil is exploded against a base sheet. For this purpose, the plating or cladding sheet is placed against the base sheet, and the foil is ignited from the place of engagement of the sheets. This method is limited to planar sheets, which only subsequently can be fabricated into boilers or other vessels by crimping, bending and welding.

It is an object of our invention to provide a method of making a seamless explosion plating of prefabricated boilers or other vessels as a single entity without welding operation.

To this end, and in accordance with our invention, we insert into the base structure of the vessel a prefabricated vessel-shaped insert of the plating or cladding material which is so shaped and inserted that there remains, between the respective bottoms of base vessel and insert, a gap that widens from the bottom center in the directions away from that center point.

According to another, preferred feature of the invention, the gap is given a shape that widens from the center point of the vessel bottom continuously in the upward direction, that is, toward the rim of the vessel structure.

After joining the vessel-shaped insert with the base vessel, the insert is bonded to the base vessel by the force of an explosion produced in the interior of the insert. Preferably the insert is lined with an explosive foil, and the foil is ignited from the center point at the vessel bottom.

According to another, alternative feature of our invention, the vessel-shaped insert of plating or cladding metal is so shaped and inserted that the gap between the insert and the base vessel has a widening shape only from the center point of the vessel bottom toward the circumference of the bottom, but has a substantially constant width up to the vessel rim; that is, the peripheral surface of the insert extends from the circumference of the bottom in parallel or approximately parallel relation to the inner surface of the base vessel, both being preferably cylindrical.

It is particularly advantageous to provide for centering of the vessel-shaped insert by means of spacers at the rim of the base vessel in such a manner that the spacers are pressed or flung out near the termination of the explosive plating operation.

The invention will be further described with reference to an embodiment illustrated by way of example on the accompanying drawing in which a vessel assembly is illustrated in cross section during an intermediate stage of the process.

As illustrated, a prefabricated base vessel **11** is provided with an insert vessel **12** of the plating or cladding material which touches the base vessel at the center of the bottom and forms with the base vessel an intermediate gap space **13** gradually widening from the bottom center upwardly toward the rim of the base vessel. The base vessel **11** may consist of cast iron or structural steel, and the insert vessel **14** of stainless steel, copper or other metal less subject to corrosion when exposed to water or wet steam, such as when the workpiece is to form part of a steam boiler, for example. An explosive foil **14** lines the inner wall of the plating vessel. When the parts are assembled as shown, the foil is ignited at the center point **15** of the vessel bottom. Prior to, and during ignition, the plating vessel **12** is kept in proper position by spacers **16** which center the plating vessel at the rim of the base vessel. The spacers may be so designed as to form a seal, also as shown. The position of the ultimately resulting plating or cladding is partially shown at **17**.

As mentioned, the gap may be sealed at the vessel rim. This permits evacuating the interspace in such a manner that the seal is pressed out or flung away near the end of the plating operation without affecting the cladding. Suitable for this purpose is the use of a sealing spacer which, as illustrated, has a cross section similar to an upwardly pointed angle or roof. If evacuation is desired, the pressure within the interspace is reduced by connecting it to a pump prior to initiating the explosion.

The explosion foil may be ignited in air. However, the process may also be performed by filling the interior of the plating vessel with such fluid materials as water, sand or other liquid or pulverulent materials, igniting the foil in each case from the center of the vessel bottom.

The method of the invention is also suitable for plating or cladding the rim portion or any flange of the base vessel. This requires giving the inserted plating vessel such a design that its top portion protrudes beyond the height of the base vessel and is explosively thrown outwardly onto and about the rim or flange of the base vessel. This is also involved in the illustrated example. The plating at the upper rim or flange may be formed as a hard cladding by making the upper end of the plating vessel **14** from the outset of hard plating material **18** or coating it with such material.

In lieu of an explosive foil, other explosion means may be employed, for example shaped explosive charges at the vessel bottom or electrical discharges, to effect the desired explosive throw of the plating vessel from below progressively in the upward direction against the inner surface of the base vessel.

As mentioned, the widening of the gap between the base vessel and plating vessel may also be limited to the vicinity of the ignition locality, for example to the vessel bottom. In this case, the plating vessel, when using a base vessel as shown on the drawing, would be straight cylindrical rather than conical above its bottom portion. This facilitates the manufacture of the plating vessel.

Vessels as shown on the drawing have been made, for example, from the following materials. The base vessel **11** consisted of boiler steel, the plating vessel **12** of corrosion-resistant alloy steel with 18% chromium and 8% nickel. The top portion **18** of the plating vessel was made of Inconel (about 74% Ni, 15 Cr, remainder Fe). An explosive foil **14** of hexogen (trimethylene trinitramine) was used.

We claim:

1. The method of seamless explosion-plating prefabricated vessels, which comprises prefabricating a vessel-shaped insert of plating material and inserting it into the vessel, leaving between the respective bottoms of vessel and insert a gap widening in the direction away from the bottom center, lining the insert with an explosion foil, and igniting the foil from the center point at the vessel bottom.

2. The explosion-plating method according to claim **1**, which comprises sealing the gap at the vessel rim so as to have the seal blown out near the end of the explosion-plating operation.

3. The explosion-plating method according to claim **1**, which comprises igniting the explosion foil in air.

4. The explosion-plating method according to claim 1, which comprises filling the insert with flowable material prior to igniting the explosion foil.

5. The explosion-plating method according to claim 4, which comprises providing the protruding portion of the vessel-shaped insert with hard-plating material.

6. The explosion-plating method according to claim 1, which comprises giving the vessel-shaped insert of plating material a greater axial height than the vessel so that the insert protrudes over the vessel rim, and explosion-plating the insert outwardly onto and about the vessel rim.

7. The explosion-plating method according to claim 1, which comprises centering the insert by spacer means at the rim of the vessel.

8. The explosion-plating method of claim 1, which comprises sealing the gap at the vessel rim, and evacuating the gap before igniting the foil.

9. The method of seamless explosion-plating prefabricated vessels, which comprises prefabricating a vessel-shaped insert of plating material and inserting it into the vessel, leaving between the respective bottoms of vessel and insert a gap widening from the bottom center up to the rim of the vessel, lining the insert with an explosion foil and igniting the foil from the center point at the vessel bottom.

10. The method of seamless explosion-plating prefabricated vessels, which comprises prefabricating a vessel-shaped insert of plating material and inserting it into the vessel, leaving between the respective bottoms of vessel and insert a gap widening from the center to the circumference of the vessel and thence extending with a substantially constant width up to the vessel rim, lining the insert with an explosion foil and igniting the foil from the center point at the vessel bottom.

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