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CORROSION RESISTANT JACKETED METAL BODY

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FIG. 1.

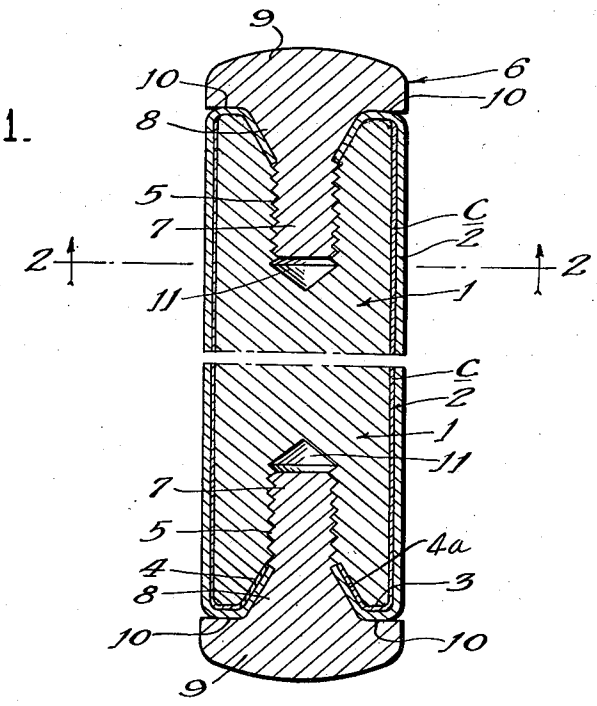
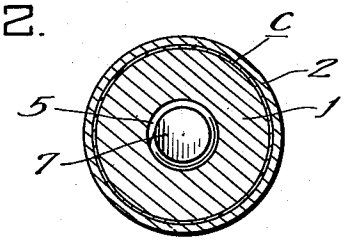


FIG. 2.



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CORROSION RESISTANT JACKETED METAL BODY

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This invention relates to new and useful improvements in metal-jacketed metallic bodies, and more particularly to metallic bodies of a highly corrodible or reactive nature that are encased within relatively inert or non-corrodible metal jackets and effectively sealed from contact with external reactive gases and liquids.

In various uses of corrodible metal bodies, such as rods, cylinders or other shapes, it is desirable that the bodies be provided with jackets or coverings of relatively inert or non-corrodible metals to prevent oxidation of the metal bodies upon exposure to gases or liquids that are reactive therewith. For example, corrodible bodies of uranium are contained in a tubular conduit or passage in which they are subjected to bombardment by neutrons for the purpose of producing various products, including radioactive uranium fission products, uranium isotopes and other products. The conduits or passages in which the bodies or slugs are placed are, generally, only slightly larger in diameter than the bodies and, in order to maintain the surface temperature of the bodies within a desired range during neutronic bombardment thereof, there is passed through the conduit or passage a stream of a suitable coolant such as, for example, air or water. Both air and water are highly reactive with uranium, particularly at elevated temperatures, and hence it is desirable that a suitable jacket or covering of relatively inert or non-corrodible metal be provided upon the uranium body to prevent corrosion thereof.

The provision of protective jackets or coverings upon such corrodible metal bodies presents certain problems of a substantially more complex and difficult nature than merely the separation of the body from contact with reactive coolant and other fluids. Thus, for example, in the typical use herein described wherein uranium bodies are placed in a tubular conduit or passage of restricted area, any inleakage of the coolant fluid through the jacket or covering into contact with the uranium body will react therewith to generate voluminous reaction products between the body and the enclosing jacket, and the reaction products, because of their greater volume than the uranium, tend to expand and distort the jacket outwardly thereby increasing the diameter of the jacketed body to an extent that it becomes wedged or jammed within the conduit or passage and cannot be removed therefrom. When a uranium body becomes wedged or jammed in this manner, an extremely dangerous condition exists, and it is very desirable that the possibility of its occurrence be prevented.

It is preferable, therefore, that the jacket or covering upon the uranium body be proof against the inleakage of coolants and other fluids that are reactive with the uranium. Furthermore, if leakage does occur, it is desirable that provision be made to effect automatic restoration of the seal and it is also desirable that, if the seal should fail expansion within the jacket be longitudinal rather than lateral so that jamming of the jacketed body within the conduit or passage may be prevented.

With the foregoing in mind, an object of the invention is to provide a novel leakproof protective covering for a body comprising a jacket open at its ends and closure plugs therefor.

Another object of the invention is to provide a novel metal-jacketed metallic body of the stated character wherein the construction and arrangement of the jacket portion is such that if leakage occurs due to a defective

seal, coolant leaking into the jacket through the seal will contact an exposed portion of the uranium on an end thereof so that such swelling as may occur will take place in an endwise direction.

These and other objects of the invention, and the various features and details of the construction and arrangement thereof, are hereinafter set forth and described with reference to the accompanying drawing, in which:

Fig. 1 is a sectional view taken along the longitudinal axis of a metal-jacketed metallic body of the present invention; and

Fig. 2 is a sectional view taken on line 2—2, Fig. 1.

Referring now more particularly to the drawings, there is a cylindrical, corrodible metallic body member 1, for example, of a fissionable material, such as metallic uranium, which is encased within a sleeve or jacket 2 of relatively corrosion resistant metal, such as aluminum, stainless steel, or the like.

The jacket 2 is of generally sleeve-shaped cylindrical configuration open at both ends and having an internal diameter such as to snugly receive the metal body 1. In order to provide for the efficient thermal conduction of heat outwardly from metal body 1 to the jacket 2 and thereby insure effective cooling of the jacketed body 1 by means of a coolant passing thereover, the jacket 2 may be securely bonded to the body 1 by means of a suitable bonding material applied, for example, to the body in the form of a coating C by dipping the body in a molten bath of the selected bonding material. Any suitable metal alloy having low neutron-capture cross section, good thermal conduction and a melting point below that of the jacket 2, such as aluminum-silicon, zinc-aluminum and zinc-tin alloys, may be employed for this purpose.

As previously stated, the present invention is directed particularly to the provision of a fluid-tight seal about the highly reactive metal body 1. To this end, therefore, prior to coating the body 1 with the selected bonding material C, the ends of the body are machined to provide identical squared ends 3 and are axially countersunk and tapped to provide conical counterseats 4 and concentric taps 5 at each end of the body 1 adapted to receive and secure cap bolts or headed studs 6.

The body 1 may be heated, dipped in the alloy coating bath of the selected bonding material, and, while the coating material is in a molten condition, slipped endwise into the jacket 2 which is formed initially to have an axial length somewhat greater than that of the encompassed body 1 in order to provide projecting jacket edge portions at each end. The edge portions may be turned or spun inwardly over the squared ends 3 and the conical counterseats 4. The body may be dipped for coating before or after being drilled and tapped; if the body is dipped after drilling and tapping, a portion of the coating material is between the edge portions and the seats 4 as shown at 4*a*. Thereafter the coating solidifies and creates an effective thermally conductive bond between the metal body 1 and jacket 2.

The open ends of the jacket 2 are provided with leakproof closures or seals in the form of corrosion-resistant headed studs 6 which may be formed of the same metal as the jacket to eliminate galvanic action therebetween and consequent failure of the jacket caused by inleakage therethrough to the body 1.

More specifically, each of the studs 6 includes a shank having an inner threaded portion 7 mating with the tapped holes 5 in the body 1, and having an intermediate conically bevelled portion 8 conforming to the conical counterseats 4. Outward of the conical bevel 8, each stud 6 is provided with a cylindrical head 9 having a squared under-shoulder 10. With this construction, tightening of the stud 6 in the tapped hole 5 effectively secures the bevelled stud portion 8 and squared shoulder

10 against the open portion of the jacket 2 conforming to the conical seat 4 and squared end 3 of the body 1. In this connection, it is to be noted that, by reason of the angular disposition of the stud bevel 8 and conforming bevelled seat 4 relative to the line of force of the stud 6, when the stud is screwed tightly in the body 1, there is provided a high unit compression on the jacket 2 in and between said stud and body members that establishes a fluid-tight seal between the stud and jacket and precludes the inleakage of reactive coolant or other fluids into contact with the metal body 1. If desired, the stud may be brazed or welded in place by a circumferential braze or weld (not shown). In such a case entry of the brazing flux into the interior of the jacketed body is prevented due to the tight seal which is established adjacent the bevelled seat 4.

In order to protect the exterior of the jacket 2 at its ends where blows resulting from handling are most apt to cause fracture with consequent inleakage, the cylindrical stud heads 9 are preferably of the same radius as the cylindrical jacket 2 so as to form a buffer coextensive with the jacket and adapted to shield the jacket ends when the studs are tightened thereon.

While the aforesaid construction and arrangement of end closure studs 6 for the jacket 2 provides an effectively sheathed metal body 1 protected from contact with reactive coolants or other fluids, the construction also embodies features that afford certain advantages and safety factors in the event of the inleakage of such fluids through the end seals provided between the studs 5 and jacket 2.

Thus, should fluid leak inwardly through either or both of said seals, the fluid will react with and corrode the uranium or the selected bonding material C in the region or area inwardly of and between the inturned edge of the jacket 2 and the conical counter-seat 4. This corrosive action is accompanied by the generation of reaction products which, being more voluminous than the uranium metal, establish substantial pressure which urges the adjacent abutting edge of jacket 2 into tighter surface contact with the bevelled plug 8 of the sealing stud 6 and re-establishes the seal therebetween so as to minimize or prevent further inleakage of the reactive coolant or other fluid therebetween.

It will be noted that the shanks 7 of the studs 6 are of substantially less length than the tapped holes 5 thereby providing an insulating gap 11 between the end of each shank 7 and the bottom of each hole 5. Inasmuch as the slug or body 1 of uranium, in undergoing fission in a neutronic reactor, is heated to a considerably greater degree at its center than at its outer periphery and since normally a continuous series of the bodies 1 are placed in the conduit in end-to-end relationship, the flow of coolant through the conduit only provides for the effective cooling of the outer periphery of the bodies. The dead-air gap 11 underlying each sealing stud 6 effectively insulates the stud from the extremely hot center of the body.

From the foregoing, it will be observed that the present invention provides a novel metal covering for a metallic body comprising an open-ended jacket that is effectively sealed at its ends by end closures. In addition, the construction and arrangement of jacket and end closures is such that any reactive fluid leaking inwardly of the seal will cause the generation of reaction products which are operable to effect a reclosure of the seal and preclude further fluid inleakage and outward swelling of the jacket in a radial direction so that the possibility of the jacket becoming wedged or jammed in the surrounding conduit is substantially eliminated.

While a single embodiment of the invention has been illustrated and described herein, it is not intended that the invention be limited to such disclosures, and changes and modifications may be made and incorporated as desired without departure from the invention as defined by the scope of the following claims.

What is claimed is:

1. A metal jacketed metallic body comprising a body member having an inner cylindrical recessed wall flared at its outer end to provide a conical section, an open-ended metal jacket snugly surrounding said body with the open edge of said jacket conforming to said conical section of said recessed wall in said body member, and closure means in said recess securing said jacket adjacent its open edge to the recessed body wall and providing a fluid tight seal.

2. A metal jacketed metallic body comprising a body member having an inner cylindrical recessed wall flared at its outer end to provide a conical section, an open-ended metal jacket snugly surrounding said body with the open edge of said jacket conforming to said conical section of said recessed wall in said body member, and closure means securing said jacket adjacent its open edge to the recessed body wall including a fluid tight sealing portion for the jacket opening and a buffer portion for the end of the jacket.

3. A metal jacketed metallic body comprising a body member having a beveled counterseat axially arranged therein, an open-ended metal jacket snugly surrounding said body with the open edge of said jacket conforming to said beveled counter seat, a beveled plug conforming to said seat and overlying the jacket at its open end, and means securing said plug to said jacket and providing a fluid tight seal between said plug and jacket.

4. A metal jacketed metallic body comprising a body member having a beveled counter-seat axially arranged therein, an open-ended metal jacket snugly surrounding said body with the open edge of said jacket conforming to said beveled counterseat, a preferentially corrodible bonding material between said body and jacket, a beveled plug conforming to said seat and overlying the jacket at its open end, and means securing said plug to said jacket and providing a fluid tight seal between said plug and jacket.

5. A metal jacketed metallic body comprising an elongated body member having a squared end, a conical seat centrally disposed in said squared end, an open-ended metal jacket snugly surrounding said body with the open end overlying and conforming to said squared end and said conical counter-seat, and a plug removably secured to said body, said plug having a beveled portion and a squared portion overlying the conical seat and squared end of said body with the open end of said jacket secured therebetween.

6. A metal jacketed metallic body comprising an elongated body member having a squared end, a conical seat centrally disposed in said squared end, an open-ended metal jacket snugly surrounding said body with the open end overlying and conforming to said squared end and said conical seat, and a plug removably secured to said body, said plug having a beveled portion and a squared portion overlying the conical seat and squared end of said body with said open jacket end secured therebetween, and a buffer portion coextensive with and overlying the end of said jacketed member.

7. A metal jacketed metallic body comprising an elongated body member having a squared end, a conical seat centrally disposed in said squared end, an open-ended metal jacket snugly surrounding said body with the open end overlying and conforming to said squared end and said conical seat, and a plug member removably secured to said body, the inner end of said plug member being spaced from said body to provide an air gap therebetween and having a beveled portion and a squared portion overlying the conical seat and squared end of said body with said open jacket end secured therebetween.

8. A metal jacketed metallic body comprising an elongated body member having a squared end, a conical seat centrally disposed in said squared end, an open-ended metal jacket snugly surrounding said body with the open

end overlying and conforming to said squared end and said conical seat, and a plug member removably secured to said body, the inner end of said plug member being spaced from said body to provide an air gap therebetween, said plug member having a beveled portion and a squared portion overlying the conical seat and squared end of said body with said open jacket end secured therebetween and having an outer buffer portion coextensive with and overlying the end of said jacketed member.

9. A metal jacketed metallic body comprising an elongated cylindrical body having squared ends, a conical seat concentrically disposed in each of said squared ends, an axially disposed tapped hole extending inwardly from each of said seats, a metal sleeve open at both ends snugly surrounding said body, each of said open sleeve ends being turned inwardly to conform to the underlying squared body end and conical seat, each of said tapped holes removably securing a jacket closure member having a beveled plug portion intermediate its length conforming to said conical seat and a head having a squared under surface conforming to the underlying squared body end.

10. A metal jacketed metallic body comprising an elongated cylindrical body having squared ends, a conical seat concentrically disposed in each of said squared ends, an axially disposed tapped hole extending inwardly from each of said seats, a metal sleeve open at both ends snugly surrounding said body, each of said open sleeve ends being turned inwardly to conform to the underlying squared body end and conical seat, each of said tapped holes removably securing a jacket closure member having a threaded shank of lesser length than said tapped hole and providing an axially disposed insulating gap between the end of each stud shank and the bottom of each tapped hole, each of said closure members having a beveled plug portion intermediate its length conforming to said conical seat and a head having a squared under surface conforming to the underlying squared body end whereby each of said closure members secures an open jacket end to the underlying squared body end and conical seat.

11. A metal jacketed metallic body comprising an elongated cylindrical body having squared ends, a conical seat concentrically disposed in each of said squared ends, an axially disposed tapped hole extending inwardly from each of said seats, a metal sleeve open at both ends snugly surrounding said body, each of said open sleeve ends being turned inwardly to conform to the underlying squared body end and conical seat, each of said tapped holes removably securing a jacket closure member having a threaded shank of lesser length than said tapped hole and providing an axially disposed insulating gap between the end of each stud shank and the bottom of each tapped hole, each of said closure members having a beveled plug portion intermediate its length conforming to said conical seat and a head having a squared under surface conforming to the underlying squared body end whereby each of said closure members secures an open jacket end to the underlying squared body end and conical seat, each of said heads overlying the end of and being coextensive with the periphery of the cylindrical jacket and adapted to shield said jacketed ends of said metallic body.

12. A metal jacketed metallic body comprising an elongated cylindrical body having squared ends, a conical seat concentrically disposed in each of said squared ends, an axially disposed tapped hole extending inwardly from each of said seats, a metal sleeve open at both ends snugly surrounding said body, each of said open sleeve ends being turned inwardly to conform to the underlying squared body end and conical seat, a preferentially corrodible bonding material between said body and said jacket, each of said tapped holes removably securing a jacket closure member having a threaded shank of lesser length than said tapped hole and providing an axially disposed insulating gap between the end of each stud shank and the bottom of each tapped hole, each of said closure members having a beveled plug portion intermediate its length conforming to said conical seat and a head having a squared under surface conforming to the underlying squared body end whereby each of said closure members secures an open jacket end to the underlying squared body end and conical seat, each of said heads overlying the end of and being coextensive with the periphery of the cylindrical jacket and adapted to shield said jacketed ends of said metallic body.

13. A metal jacketed metallic body comprising a body member having a recessed wall therein, an open-ended metal jacket snugly surrounding said body with the open edge of said jacket conforming to the recessed wall in said body member, and closure means in said recess securing said jacket adjacent its open edge to the recessed body wall and providing a fluid tight seal, and a gas space under said closure means.

14. A jacketed uranium body comprising an elongated uranium body member having a squared end, a conical seat centrally disposed in said squared end, an open-ended jacket of inert non-corrodible metal snugly surrounding said body with the open end overlying and conforming to said squared end and said conical seat, and a plug member removably secured to said body, the inner end of said plug member being spaced from said body to provide an air gap therebetween and having a beveled portion and a squared portion overlying the conical seat and squared end of said body with said open jacket end secured therebetween.

15. A jacketed uranium body comprising an elongated uranium body member having a squared end, a conical seat centrally disposed in said squared end, an open-ended jacket of inert non-corrodible metal snugly surrounding said body with the open end overlying and conforming to said squared end and said conical seat, and a plug member removably secured to said body and consisting of the same metal as said jacket, the inner end of said plug member being spaced from said body to provide an air gap therebetween and having a beveled portion and a squared portion overlying the conical seat and squared end of said body with said open jacket end secured therebetween.

16. A jacketed uranium slug comprising a uranium slug having a squared end, a conical seat centrally disposed in said squared end, an open-ended jacket of aluminum snugly surrounding said slug with the open end overlying and conforming to said squared end and said conical seat, and an aluminum plug member removably secured to said slug, the inner end of said plug member being spaced from said slug to provide an air gap therebetween and having a beveled portion and a squared portion overlying the conical seat and squared end of said slug with said open jacket end secured therebetween.

17. A jacketed uranium slug comprising a uranium slug having a squared end, a conical seat centrally disposed in said squared end, an open-ended jacket of stainless steel snugly surrounding said slug with the open end overlying and conforming to said squared end and said conical seat, and a stainless steel plug member removably secured to said slug, the inner end of said slug member being spaced from said slug to provide an air gap therebetween and having a beveled portion and a squared portion overlying the conical seat and squared end of said slug with said open jacket end secured therebetween.

References Cited in the file of this patent

UNITED STATES PATENTS

477,497	Bowman	June 21, 1892
689,590	Johnson et al.	Dec. 24, 1901
1,322,662	Watson	Nov. 25, 1919
2,161,905	Watson	June 13, 1939