Dec. 25, 1962 W. H. SCHULTZ 3,069,760

CERAMIC COATED TUYERES OR THE LIKE

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FIG. 1

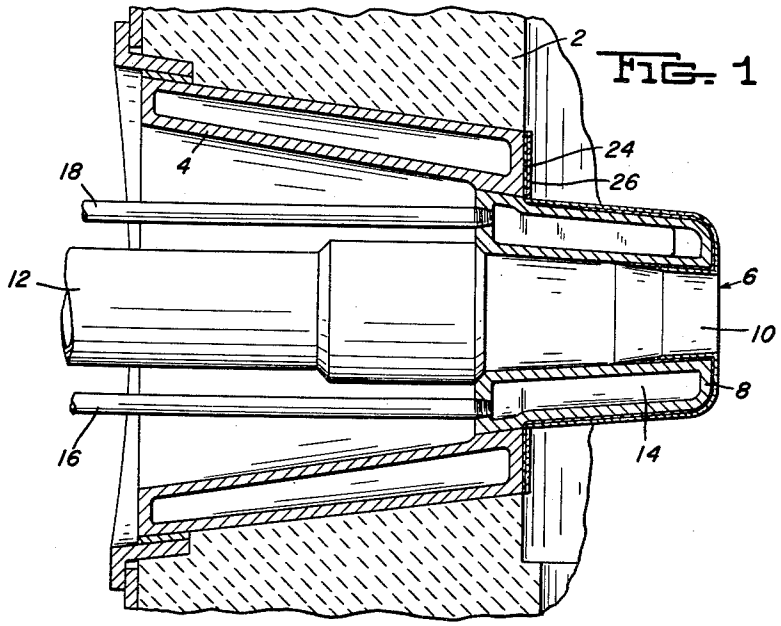

FIG. 2

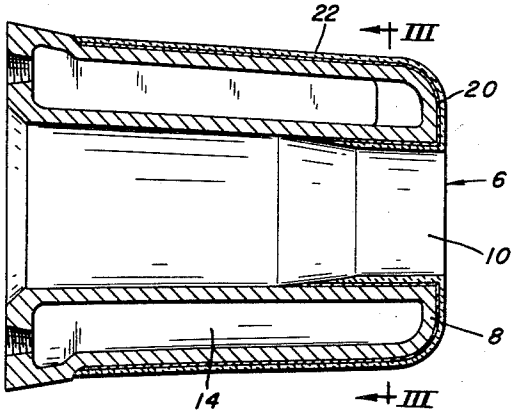

FIG. 3

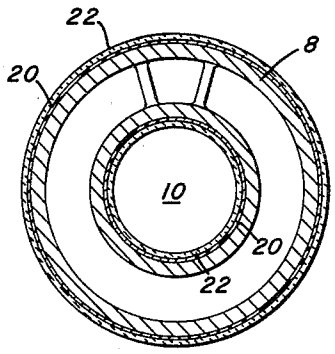

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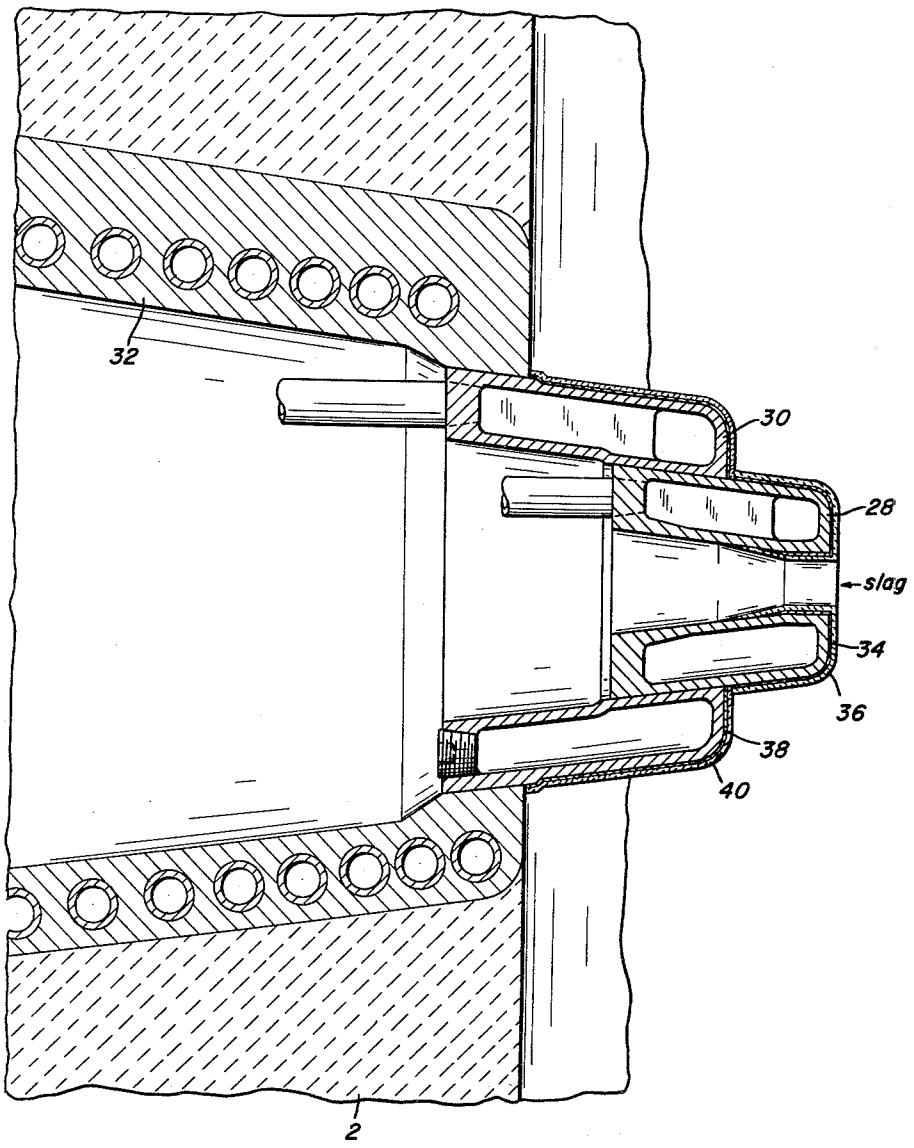
FIG. 4



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CERAMIC COATED TUYERES OR THE LIKE

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Filed June 11, 1958, Ser. No. 741,316
1 Claim. (Cl. 29—195)

This invention relates to a ceramic coated tuyere and is particularly directed to tuyeres or similar members which are inserted into a blast furnace. Such members include tuyere coolers, monkeys and monkey coolers. These members are normally made of copper and are subjected to extremely severe operating conditions because of the high temperatures in the furnace, abrasion from the moving furnace burden, and splashes of molten pig iron from the burden falling into the furnace bosh. Because of these conditions, the tuyere and other members have a relatively short life.

It is therefore an object of my invention to provide a blast furnace tuyere or the like which has a longer than normal life.

This and other objects will be more apparent when referring to the following specification and attached drawings, in which:

FIGURE 1 is a longitudinal section of a tuyere and tuyere cooler as placed in a blast furnace wall;

FIGURE 2 is an enlarged sectional view of the tuyere of FIGURE 1;

FIGURE 3 is a sectional view taken on the line III—III of FIGURE 2; and

FIGURE 4 is a sectional view showing the monkey and monkey cooler in the furnace wall.

Referring more particularly to the drawings, the reference numeral 2 indicates the wall at the bottom of a blast furnace. A tuyere cooler 4 which supports a tuyere 6 is supported in the wall 2. The tuyere 6 is of usual construction having a body 8 with an air passage 10 therethrough for the admission of a blast of air to the furnace, this passage being connected at its inlet end with the source of air supply by means of a pipe 12. Surrounding the air passage 10 is a chamber 14 to which a cooling fluid is supplied by means of an inlet pipe 16. The fluid after passing through the chamber 14 is discharged through a pipe 18. The tuyere and tuyere cooler are preferably made of copper but may be made of a copper alloy. The term "copper" as used in the claim is meant to include pure copper or an alloy which is predominantly copper, the materials being those most commonly used in tuyeres. The surface of the tuyere exposed to the burden of the furnace is coated with a metallic layer 20 with a ceramic coating 22 being applied over the metal coating. I have found that a metal coating 20 having a coefficient of expansion between that of the body of the tuyere and that of the ceramic coating 22 must be provided between the body of the tuyere and the ceramic coating to obtain the object of the invention. Metals suitable for the coating 20 include austenitic steels such as AISI types 301, 302, 302B, 303, 304, 308, 309, 310, 316, 321 and 347, chromium steels such as AISI types 403, 405, 406, 410, 414, 420, 430, 431, 440A, 440B, 440C, 442, 443, 446, 501 and 502, and pure nickel. The ceramic coating 22 may be of alumina, beryllium oxide, calcium oxide, cerium oxide, chromic oxide, chromite, magnesia, silica, strontium oxide, zirconia, and zirconia oxide silicate. In applying the coating, the surface of the tuyere to be coated is first roughened, as by grit blasting or knurling, to improve the adherence of the metal coating. The application of the coating 20 is preferably done by

blowing the metal in powdered form through a flame which applies the metal in a semi-molten form to the tuyere, which is preferably rotated as the powder is applied. The fused ceramic coating is applied over the metal coating in a similar manner after the metal has solidified. A similar metal coating 24 may be applied over that portion of the tuyere cooler 4 exposed to the furnace burden with a similar ceramic coating 26 applied over the coating 24.

FIGURE 4 shows a cinder notch monkey 28 supported by a cinder notch monkey cooler 30, which in turn is supported by cinder notch cooler 32. The monkey 28 and monkey cooler 30 are made of the same material as the tuyere. A metal coating 34 and ceramic coating 36 are applied over that portion of the surface of the monkey 28 which is exposed to the furnace burden. A metal coating 38 and ceramic coating 40 are applied over that portion of the surface of the monkey cooler 30 which is exposed to the furnace burden. The coatings 34 and 38 are applied in the same manner and are of the same material as coating 20 and coatings 36 and 40 are applied in the same manner and are made of the same material as coating 22.

A combination of coatings found to be quite successful is a coating of a metal containing 60 to 62% nickel, 12 to 15% chromium and the remainder iron, manganese and carbon with the ceramic coating being fused alumina (Al_2O_3). The metal coating should be between 0.0005 and 0.02 inch thick and is preferably between 0.002 and 0.007 inch. The ceramic coating should be between 0.001 and 0.04 inch thick and is preferably between 0.005 and 0.015 inch.

While several embodiments of my invention are shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claim.

I claim:

A structure adapted to be inserted into a furnace or the like comprising a copper body, a metal coating bonded to and surrounding at least a portion of said body, said metal coating having a thickness between 0.0005 and 0.02 inch and a ceramic coating directly bonded to said metal coating, said ceramic coating having a thickness between 0.001 and 0.04 inch, said metal having a coefficient of expansion intermediate the coefficient of expansion of said copper and said ceramic and being of the class consisting of austenitic steels, chromium steels and nickel, said ceramic being of the class consisting of alumina, beryllium oxide, calcium oxide, cerium oxide, chromic oxide, chromite, magnesia, silica, strontium oxide, zirconia, and zirconia oxide silicate.

References Cited in the file of this patent

UNITED STATES PATENTS

185,339	Mackey	Dec. 12, 1876
639,537	Dickey	Dec. 19, 1899
1,161,944	Maddy	Nov. 30, 1915
2,295,945	Fralish	Sept. 15, 1942
2,310,002	Van Geel	Feb. 2, 1943
2,340,362	Atlee	Feb. 1, 1944
2,377,321	Brown	June 5, 1945
2,470,753	Alban	May 24, 1949
2,495,835	Comstock	Jan. 31, 1950
2,515,337	Clark	July 18, 1950
2,696,662	Les Sech	Dec. 14, 1954
2,775,531	Montgomery	Dec. 25, 1956
2,975,078	Rayfield	Mar. 14, 1961