

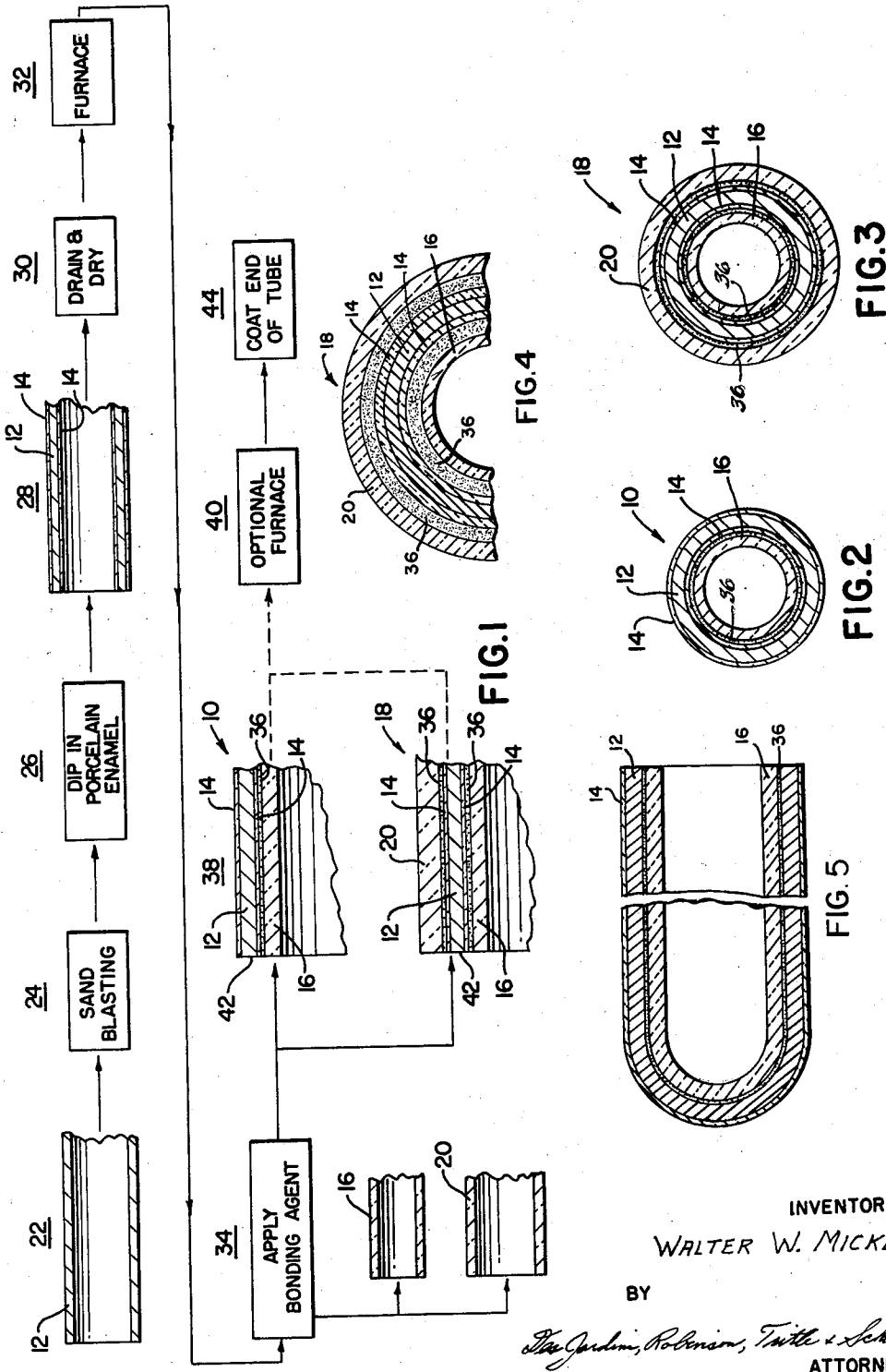
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FLUXING PIPE AND METHOD OF MAKING THE SAME OR THE LIKE

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FLUXING PIPE AND METHOD OF MAKING THE SAME OR THE LIKE

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This invention relates to an improved fluxing pipe or the like and to an improved method for making the same or the like.

It is well known in the art that when molten aluminum, zinc, lead and the like are to be purified, some means must be provided for passing a purifying agent through the molten metal in order to purify the same.

For example, one commonly known means is to insert a pipe or conduit into the lower end of a bath of molten metal so that chlorine gas and the like can be fed under slight pressure through the conduit into the bath of molten metal and bubble therethrough to remove impurities from the molten metal.

However, not only does the molten metal have a corrosive effect on the fluxing pipe or conduit, but also the chlorine gas passing therethrough has a corrosive effect on the fluxing pipe or conduit whereby the fluxing pipe is readily eaten away by the corrosive action taking place thereagainst.

The present practice is to use graphite fluxing tubes for the purification operation. However, it has been found that such graphite fluxing tubes last approximately five days in actual use and are extremely subject to breaking after the heat of the molten metal crystallizes the graphite. In fact, it has been found that such graphite fluxing tubes have an approximately 25 percent breakage before the same has been utilized through their normal lives.

An attempt was made to utilize a fluxing tube formed entirely of ceramic material. However, because the fluxing tubes are relatively long in length, such as seven to ten feet, the ceramic material is readily subject to breaking. Therefore, in the past an attempt was made to utilize a metal pipe, such as a black iron pipe or the like, coated on the inside and outside surfaces thereof with a porcelain enamel coating. However, it was found that such coated fluxing tubes only last about 200 to 300 minutes in actual use because of the high degree corrosive action taking place.

However, according to the teachings of this invention an improved fluxing pipe is provided that will last approximately four weeks in actual use and is not subject to breakage as certain of the prior known fluxing tubes.

In particular, one embodiment of the fluxing tube of this invention comprises a black iron pipe or the like having a tubular ceramic member secured to the inside peripheral surface of the metal pipe in such a manner that the metal pipe provides suitable reinforcement for the ceramic member so that the ceramic member will not be subject to breakage and the ceramic member readily protects the metal pipe from the corrosive action of the chlorine gas or other corrosive material passing there-through.

In another embodiment of this invention the fluxing pipe comprises a metal tube or the like having tubular ceramic members secured respectively to the interior and exterior surfaces thereof whereby the metal pipe provides the structural strength for the fluxing tube so that breakage will not occur and the ceramic members protect the metal pipe from the corrosive action produced by the molten metal and the corrosive gas.

One method of this invention for securing the ceramic tubular members to the metal pipe of this invention comprises the steps of sandblasting the metal pipe on both

the interior and the exterior surfaces thereof and, thereafter, dipping the metal pipe in a porcelain enamel or other ceramic solution so that a coating of ceramic material is disposed on the interior and exterior surfaces of the metal pipe.

Subsequently, the coated metal pipe is drained and dried and placed in a suitable furnace so that the dried ceramic coatings will be fused to the metal pipe.

The ceramic members are formed in tubular form and of the size to respectively be inserted or surround the coated metal pipe. Thereafter, a suitable bonding agent is applied to the coatings on the metal pipe as well as to the appropriate surfaces of the tubular ceramic members.

Subsequently, the tubular ceramic members are respectively disposed inside and around the coated metal pipe so that the bonding agent will readily bond the tubular ceramic members to the ceramic coatings on the metal pipe. If desired, this bonding step can be accelerated by heating the assembly in a conventional furnace or the like.

Thereafter, the exposed end of the metal pipe can be suitably coated with the ceramic bonding agent or the like to protect the free end of the metal pipe which will be subsequently disposed in the molten metal bath.

The thus formed fluxing tube of this invention is readily adapted for conveying a corrosive gas or the like into a bath of molten metal or the like and will not be readily eaten away by the corrosive action taking place whereby the life of the fluxing tube of this invention is substantially long when compared to the normal lives of prior known fluxing tubes utilized for the same purpose.

Therefore, it can be seen that this invention provides an improved fluxing tube and an improved method for making the same or the like.

Accordingly, it is an object of this invention to provide an improved fluxing tube.

Another object of this invention is to provide an improved fluxing tube that has a relatively long life.

Another object of this invention is to provide an improved fluxing tube that is not subject to breakage and the like.

A further object of this invention is to provide an improved fluxing tube that is readily adapted to withstand corrosive actions.

Another object of this invention is to provide an improved method for making such a fluxing tube or the like.

Other objects, uses and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIGURE 1 is a schematic flow diagram illustrating one of the methods of this invention for making a fluxing tube of this invention.

FIGURE 2 is an axial cross-sectional view of one embodiment of the fluxing tube of this invention.

FIGURE 3 is a view similar to FIGURE 2 and illustrates another embodiment of the fluxing tube of this invention.

FIG. 4 is an enlargement of a portion of FIG. 3, showing the bonding agent in better detail.

FIG. 5 is a central longitudinal section through the closed end thermocouple protection tube, the middle portion of which is broken away.

While the various features of this invention are hereinafter illustrated and described as being particularly adapted for forming a fluxing tube for purifying molten metal and the like, it is to be understood that the fluxing tubes of this invention can be utilized for other purposes as desired.

Therefore, this invention is not to be limited to only the embodiments thereof illustrated in the drawings, be-

cause the drawings are merely utilized to illustrate one of the wide variety of uses of this invention.

Referring now to FIGURE 2, an improved fluxing tube of this invention is generally indicated by the reference numeral 10 and comprises a metal conduit or pipe 12 having ceramic coatings 14 fused to the interior and exterior surfaces thereof in a manner hereinafter described.

A tubular ceramic member 16 is disposed in the metal pipe 12 and is secured to the inside ceramic coating 14 thereof in a manner hereinafter described.

The thus formed fluxing tube 10 is readily adapted to convey a corrosive gas or the like through the tubular ceramic member 16 whereby the ceramic member 16 protects the interior surface of the metal pipe 12 from the corrosive gas. Similarly, the exterior coating 14 of ceramic material protects the exterior surface of the metal pipe 12 from the corrosive action of the bath of molten metal being purified by the chlorine gas. Thus the metal pipe 12 is substantially protected from such corrosive means and still provides the structural strength for the fluxing tube 10 whereby the fluxing tube 10 is not readily subject to breakage or the like.

Further, the chlorine gas is normally pumped through the fluxing tube 10 whereby the metal pipe 12 provides the structural strength to withstand such pressures.

Another embodiment of the fluxing tube of this invention is illustrated in FIGURE 3 and is generally indicated by the reference numeral 18, the fluxing tube 18 comprising the aforementioned metal tube or conduit 12 having ceramic coatings 14 fused to the interior and exterior surfaces thereof. An inner tubular ceramic member 16 is suitably secured to the inner coating 14 of the metal pipe 12. In addition, an outer tubular ceramic member 20 is secured to the outer ceramic coating 14 of the metal pipe 12.

The outer tubular ceramic member 20 need only extend along the metal tube 12 for a distance sufficient to cover that portion thereof which is actually inserted into the bath of molten metallic material while the inner tubular ceramic member 16 extends throughout the entire length of the conduit 12 because the corrosive gas or the like completely flows through the entire length of the fluxing tubes 10 and 18.

While the fluxing tubes 10 and 18 can have any desired dimensions, one embodiment thereof that has been found to be satisfactory comprises a black iron pipe 12 having an outside diameter of approximately one inch with a wall thickness of approximately 0.140 of an inch. The ceramic coatings 14 are approximately 0.0625 inch and the inner tubular ceramic member 16 has an outside diameter of approximately 0.5950 inch. The wall thickness of the member 16 may be as desired.

When the outer tubular ceramic member 20 is utilized to form the fluxing tube structure 18, the outer tubular ceramic member 20 would have the necessary inside diameter to go over or encase the outside coating 14 on the pipe 12, which coating has an overall diameter of at least 1.1250 inch.

In the assembling of the ceramic coated tubular members a solution of a bonding agent is employed as hereinafter set forth and while the bonding agent has been illustrated, no thickness dimension for the coating solution is given, it being understood that the hereinabove set forth dimensions are approximate only and allowance would necessarily be made for the assembling of the tubular members with such bonding solution therebetween.

Of course, it should be understood that the coatings 14 and ceramic members 16 and 20 can vary in thickness as well as the metal pipe 12, as desired.

The method for making the fluxing tube 10 is substantially the same as the method of making the fluxing tube 18 except that the outer tubular ceramic member 20 is not utilized with the fluxing tube 10.

Therefore, the method for making the fluxing tubes 10

and 18 is illustrated in FIGURE 1 and will now be described, it being understood that the method for making the fluxing tube 10 is substantially the same as the method for making the fluxing tube 18.

Referring now to FIGURE 1, a suitable length of conventional black iron piping 12 is provided at station 22 and is subsequently sandblasted at station 24 so that the interior and exterior surfaces of tube 12 are substantially cleaned.

Of course, the interior and exterior surfaces of the metal tube 12 may be cleaned by means other than sandblasting, if desired.

After the tube 12 has been sandblasted at station 24, the tube 12 is dipped in a solution of porcelain enamel or other ceramic material at station 26 to suitably coat the interior and exterior surfaces of the tube 12 with the coatings 14 as illustrated at station 28.

Preferably, the coatings 14 on the metal tube 12 are provided with a satin or matte finish on the outer surfaces thereof so that the coatings 14 will have a rough texture to facilitate a subsequent bonding operation. For example, such satin finish can be provided by adding alumina instead of silica to the mill addition of the porcelain enamel solution at station 26.

After the metal tube 12 has been dipped in the porcelain enamel solution, the coated metal tube 12 is preferably disposed in the vertical position to not only drain off the excess porcelain enamel material 14 but to also permit the porcelain enamel material 14 to completely dry on the metal tube 12.

After the coatings 14 have completely dried on the metal tube 12, the assembly is placed into a suitable furnace at station 32 to cause the coatings 14 to fuse to the metal pipe 12 whereby the coatings 14 are permanently secured to the metal pipe 12 by the fusing operation.

It has been found that such fusion of the ceramic coatings 14 to the interior and exterior surfaces of the metal tube 12 is greatly enhanced when the interior and exterior surfaces of the metal tube have been originally roughened, such as by the sandblasting operation at station 24.

The thus fused and cooled metal pipe 12 and coatings 14 are transferred to station 34 where a suitable ceramic bonding agent 36 is applied to the exposed surfaces of the coatings 14 thereof. For example, the bonding agent 36 could be a zircon solution known as Number 29 cement manufactured by the Sauers Company, Pittsburgh, Pennsylvania. Alternately, alumina can be utilized as the bonding agent if desired.

The tubular ceramic members 16 and 20 of the desired lengths and sizes are also transported to station 34 whereby a coating of the bonding agent 36 is applied to the exterior surface of the ceramic member 16 and to the interior surface of the ceramic member 20.

While the ceramic members 16 and 20 can be formed of any suitable material, one embodiment thereof that has been found satisfactory for the intended use thereof comprises 80% alumina, 10% silica, and 10% suspension materials, such as feldspar, clay and the like.

After the coated metal pipe 12 and tubular ceramic members 16 and 20 have been coated with the bonding agent 36, the same are transported to the station 38 and assembled together in the manner illustrated.

In particular, when the fluxing tube 10 is being formed, only the ceramic member 16 is utilized and is inserted inside the coated metal pipe 12 whereby the bonding agent 36 on the exterior surface of the ceramic member 16 and on the interior coating 14 of the metal tube 12 suitably adhere and secure the ceramic member 16 to the coating 14 of the metal tube 12.

Similarly, when the fluxing tube 18 is being formed, the ceramic members 16 and 20 are assembled together with the coated metal tube 12 whereby the bonding agent 36 bonds the outer ceramic member 20 to the exterior coating 14 of the metal tube 12 and the bonding agent

36 bonds the inner ceramic member 16 to the interior coating 14 of the metal tube 12.

While it is not necessary to utilize any heat to cause the bonding agent 36 to bond the ceramic members 16 and 20 to the coatings 14 of the metal tube 12, the assembled members can be transported from station 38 to station 40 whereby a suitable furnace can be utilized to accelerate the bonding operation of the bond agent 36, it having been found that it requires approximately twelve hours for the bonding agent 36 to cure when the optional furnace 40 is not utilized.

After the bonding agent 36 has permanently secured the ceramic members 20 and 16 to the coated metal tube 12, the free end 42 of the fluxing tube 10 or 18, which will be subsequently disposed in the bath of molten metallic material, is covered at station 44 with a coating of zircon or alumina to prevent any corrosive action to take place at the free end 42 of the metal tube 12.

Therefore, it can be seen that the fluxing tubes 10 and 18 can be formed in a relatively simple manner by the methods of this invention to provide fluxing tubes which have a relatively long life and are substantially non-breakable because the metal tubes 12 thereof provide a suitable reinforcement to the ceramic members 16 and 20 so that the ceramic members 16 and 20 will not break even though the same are in relatively long lengths.

Further, this invention provides improved fluxing tubes which are readily adapted to convey corrosive gas and the like to a bath of molten metallic material whereby the fluxing tubes are not readily adapted to be eaten away by the corrosive action of the corrosive gas or the molten metallic material.

Another embodiment of the present invention relates to the provision of a ceramic coated thermocouple protection tube which is adapted to have mounted within it a thermocouple for the purpose of protecting the thermocouple when used in recording the temperature of molten aluminum, zinc, lead, etc. Such thermocouple protection tube is constructed in accordance with the methods heretofore disclosed and would comprise a suitable supporting cast iron pipe having one end thereof closed, and having its outer surface provided with a suitable ceramic coating and having a suitable tubular ceramic member such as 16 of the embodiments of the invention shown in FIGURES 2 and 3, also provided with a closed end which is adapted to be inserted within the cast iron pipe and bonded directly to the inner surface of the cast iron pipe by a suitable bonding agent such as the zircon solution heretofore mentioned.

Such thermocouple protection tubes are particularly adapted for continuous immersion in molten solutions of aluminum, zinc, lead and other such materials. They are of extremely rugged construction, and resist thermo shock and abrasion from loading and unloading the smelters. The thermocouple protection tubes may be of varying lengths but usually will be found in a range from 6" to 72" in length. By means of this construction, the life of a thermocouple tube may be extended three to four times that of the ordinary thermocouple tube.

In view of the foregoing description, taken in conjunction with the accompanying drawings, it is believed that a clear understanding of the construction, operation and

advantages of the device will be quite apparent to those skilled in this art.

It is to be understood, however, that even though there is herein shown and described preferred embodiments of the invention, the same are susceptible to certain changes fully comprehended by the spirit of the invention.

What is claimed is:

1. An elongate hollow tubular structure, comprising a hollow metal tube having an exterior surface and an interior surface, a coating of ceramic material on and fused to each of said surfaces, a tubular ceramic member concentric with said metal tube and having a surface in opposing relationship with one of said coatings, and a layer of a bonding agent between said surface of said tubular ceramic member and said one of said coatings of ceramic material, said bonding agent securing said ceramic member to said one of said coatings whereby said metal tube, said ceramic coatings, and said ceramic member form a unitary heat and corrosion resistant structure.

2. The invention according to claim 1, wherein the said bonding agent includes the metal aluminum.

3. The invention according to claim 1, wherein the said bonding agent includes the mineral zircon.

4. The invention according to claim 1, with a second tubular ceramic member concentric with said metal tube and having a surface in opposing relationship with the other one of said coatings, and a layer of bonding agent between the said surface of said second tubular ceramic member and the said other one of said coatings.

5. The method of forming a hollow, tubular, unitary heat and corrosion heat resistant structure, which comprises selecting a metal tube, subjecting the interior and exterior surfaces of the tube to an operation to clean and roughen the same, then applying a fluid ceramic material over each of said surfaces, then drying said ceramic material, then effecting fusion of the said ceramic material to the said tube surfaces, to form a ceramic coating thereon, then applying a bonding agent to the ceramic coating on at least one of said surfaces, then placing said ceramic tube and a tubular ceramic member in concentric relationship with one surface of said tubular ceramic member in contact with said bonding agent to thereby form a unitary hollow, heat and corrosion resistant structure.

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