

Aug. 29, 1933.

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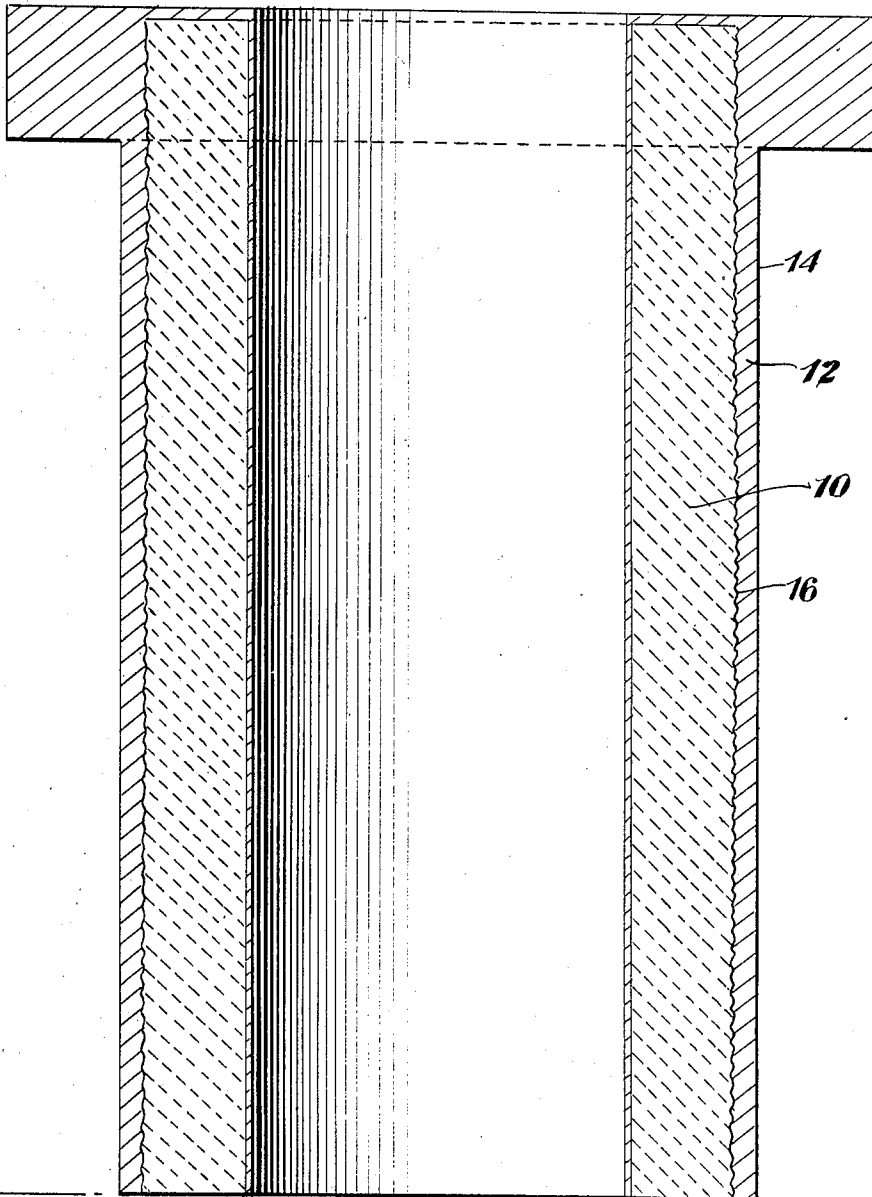
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COATING REFRACTORIES WITH METAL

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Fig. 1.



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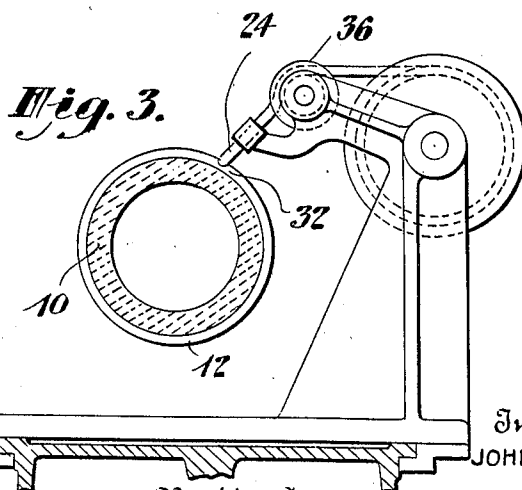
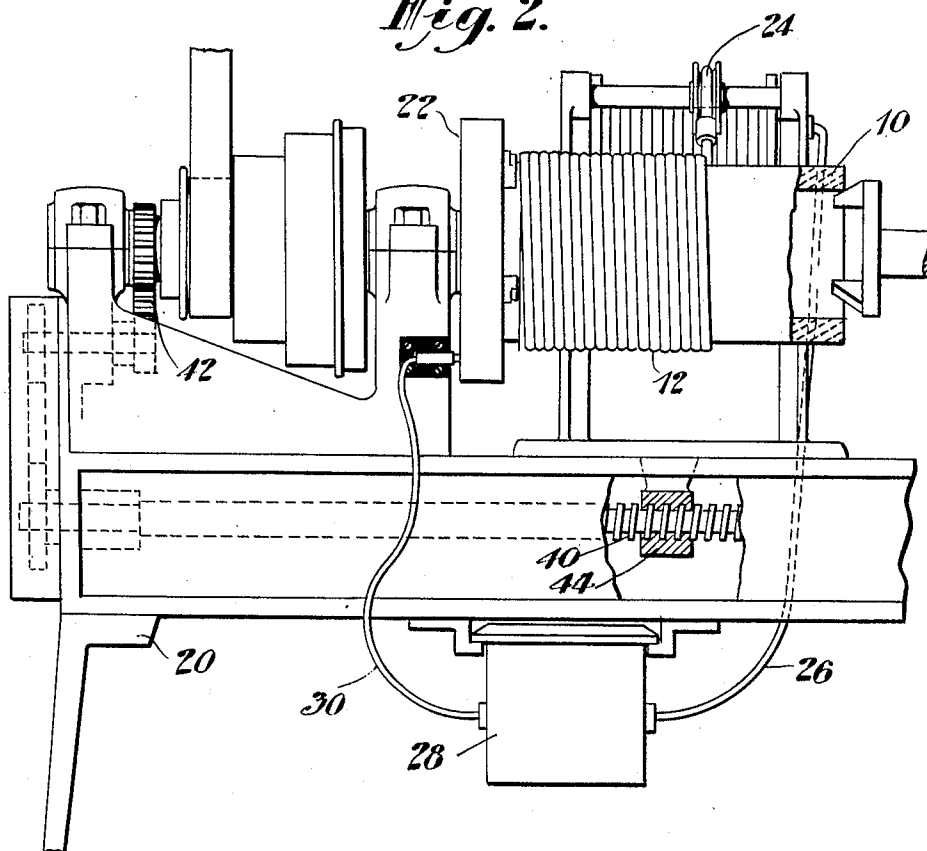
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Fig. 2.



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COATING REFRACTORIES WITH METAL

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This invention relates to a method of applying a metal to a non-metallic refractory object particularly to such objects as require a heavy backing of metallic material on the exterior thereof in order to strengthen the same.

It has previously been proposed to construct such articles by first forming the refractory core in the desired shape and casting molten metal therearound so that the same would form when cooled, a metallic backing which would be integrally united with the material of the core. This method provides a firm union at the juncture of the refractory and metal but is subject to the objection that when the refractory core is a cylindrical member such as a cylinder lining or a pipe lining, the shrinkage of the molten metal on cooling causes a contraction which the refractory structure cannot ordinarily withstand or where the same is sufficient to withstand the pressure of the contracting metal the metal itself frequently cracks. This process is therefore extremely expensive since the cost of castings which are useless, due to either breakage of the refractory or cracking of the metal must be added to the cost of the few good casts which are fortuitously obtained.

It is the object of this invention to provide an article and the method of forming the same in which the refractory portion may be first formed and baked at extremely high temperatures and the metallic backing subsequently placed thereon without injuring the refractory material.

To this end it is a feature of this invention to fuse the metal upon the preformed ceramic object over such small surface areas as to permit the metal to cool progressively so that great stresses due to the cooling of a large body of metal are avoided.

This and other objects of the invention will be further described in connection with the accompanying drawings in which:

Figure 1 is a longitudinal section through a cylindrical object, such as is suitable for use as a cylinder lining for a pump or internal combustion engine, which has been constructed in accordance with this invention;

Figure 2 represents a side elevation of a mechanism for fusing a metal to the exterior of a refractory cylinder, parts being shown in section;

Figure 3 is a section taken along the line 3—3 of Figure 2.

Referring to Figure 1, reference numeral 10 indicates a cylinder of non-metallic refractory material which has been coated with an external covering of metal as indicated at 12 in accord-

ance with the process hereinafter described. Referring to Figure 2, reference numeral 20 indicates the supporting structure of a lathe 22 which is adapted to receive elements such as cylinder 10 in its rotating portion and adapted to receive a metallic wire 24 in place of the usual cutting instrument of conventional lathes. The wire 24 is connected by a lead wire 26 to a source of welding current 28 the other lead wire 30 of which is grounded through the rotating portion 22 of the lathe to form a continuous circuit save at the point 32 (see Figure 3) where an arc is formed between the surface of the refractory 10 and the end of wire 24.

In operation the parts being in the position shown, a current is passed through the circuit formed by the wire 24 and the leads 26 and 30 causing an arc across the gap 32. The heat causes the end of the wire 24 to melt and fuse to the surface of the refractory 10 and weld to that portion 12 of the metallic covering which has already been formed. As the process continues the member 10 is gradually and continuously rotated and simultaneously wire is fed to the arc by feeding member 36 to maintain the gap 32 constant and supply the metal melted off at this point.

As the refractory core 10 is rotated in the lathe the feeding member 36 is shifted longitudinally of the member 10 at a rate which depends upon the rate of rotation of the lathe shaft. This longitudinal movement is obtained from a screw shaft 40 which is driven through gearing 42 from the main shaft of the lathe; its rotating motion being transmitted into longitudinal movement of the supporting structure of the wire feeding mechanism by means of an internally threaded member 44 integrally attached to said supporting structure.

The external surface of the metallic portion 12, is, upon completion of the process, rough and irregular conforming more or less to the contour of the wire 24. This roughness, if desired, may be ground off to form a smooth external surface as shown at 14 in Figure 1. As may likewise be seen from this figure, the metal from the wire 24 tends to bite into the surface of the refractory forming a rough indented surface at the juncture of the metal and ceramic material as indicated at 16.

This action of the arc in biting into the surface of the refractory causes the metal to conform to any irregularities in the external surface thereof so that there is a complete juncture between the two at every point along the surface.

A portion of the ceramic material forms a film of slag which covers the external surface of the metal thereby sufficiently protecting the same from oxidation when the process is conducted in an oxidizing atmosphere. It is preferred however to conduct the process in a non-oxidizing atmosphere since this protects the metal at all times during the process and also serves to increase the fusion power of the arc.

The most suitable non-oxidizing atmosphere for use in conjunction with the present invention is that formed by ammonia or other nitrogenous compounds. The use of a nitrogenous atmosphere for this purpose serves the additional function of producing a nitriding effect on the thermally deposited metal.

Although the invention has been described in connection with an electric current as the heating and fusing medium, it will readily be seen that other means of melting the end of wire such as an oxy-acetylene or other flame may be used without altering the process in its broader aspects.

It will be understood that in initiating the process if the conductivity of the refractory object is insufficient to permit the flow of current for forming the arc the circuit may be completed by holding a piece of metal on or against the surface from which the initial arc is formed whereupon the process will continue as described since the deposited metal provides a conducting surface through which current can flow to a point immediately adjacent the arc.

It will also be understood that the surface of the refractory object may be dusted with powdered metal or other common expedients resorted to to render the article more conductive to the electric current if desired.

Although the process has been disclosed in its application to but a single article it will be understood that it may be applied to numerous articles of different conformation from that shown.

The invention having been thus described, what is claimed is:

1. The method of applying metal to the surface of a non-metallic refractory object which consists in holding a metallic wire near said surface, forming an electric arc between metal held on said surface and said metallic wire to fuse the end of said wire and moving said wire relative to said surface to form the desired configuration thereon.

2. The method of applying metal to the surface of a non-metallic refractory object which

consists in holding an electrically conductant element on said surface and electro-thermally depositing metal on the surface from a metallic wire while moving the object relative to said wire in such a manner as to cover the surface of said object.

3. The method of applying a metal to the surface of a non-metallic refractory object which consists in initiating an electric arc of sufficient power between a metallic member and an electrically conductant element held on the object so as to fuse the metal to the object and maintaining the arc while moving said object in such a manner as to form the desired configuration thereon.

4. The method of applying a metal to the surface of a non-metallic refractory object which consists in supplying a non-oxidizing gas to the space about said object, forming an electric arc between a metallic wire and a conductor for electricity held on the object, and moving the wire relatively to said surface to form a backing of metallic material thereon.

5. The method of applying a metal to the surface of a non-metallic refractory object which consists in supplying a nitrogenous gas to the space about said object forming an electric arc between a metallic wire and an electrically conductant element held on the object, the arc being of sufficient intensity to fuse the metal to the object, thereby producing a nitriding effect on the thermo-deposited metal, and moving said object relative to said wire to progressively form a covering of metal on said surface.

6. The method of applying a metal to the surface of a non-metallic refractory object which consists in forming an electric arc of sufficient power between a metallic member and metal held on the said object to fuse the metal of the metallic member to said object, and thereafter bringing said object in such relation to said metallic member as to form the desired configuration of metal thereon.

7. The method of applying a metal to the surface of a non-metallic refractory object which consists in dusting the surface of the object with a powdered metal to render the same electrically conductive, forming an electric arc between said surface and a metallic electrode to fuse the end of said electrode and deposit metal therefrom upon said surface and moving said electrode relative to said surface to progressively form a metal covering thereon.

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