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3,226,036

NOZZLE FOR GUNNING REFRACTORY MATERIAL

Filed Feb. 5, 1963

2 Sheets-Sheet 1

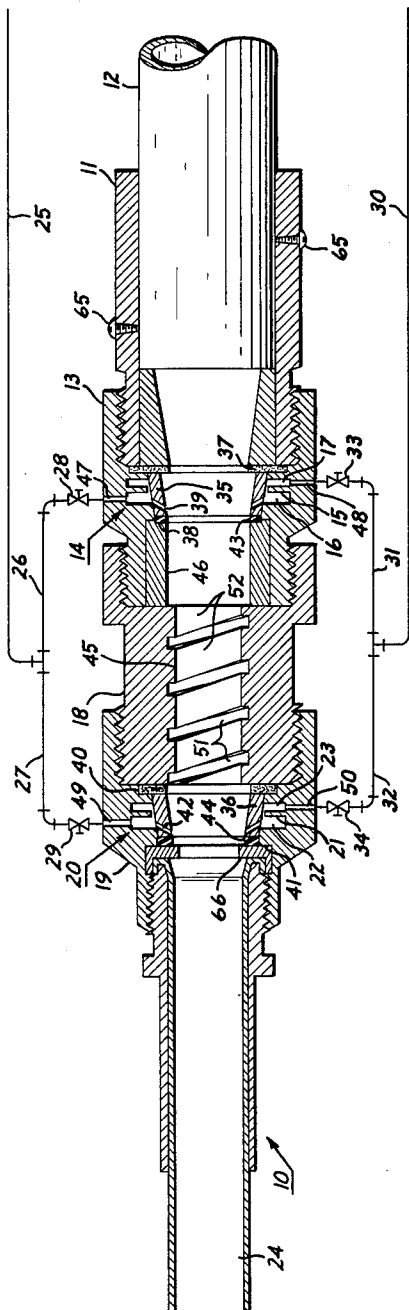


Fig. 1

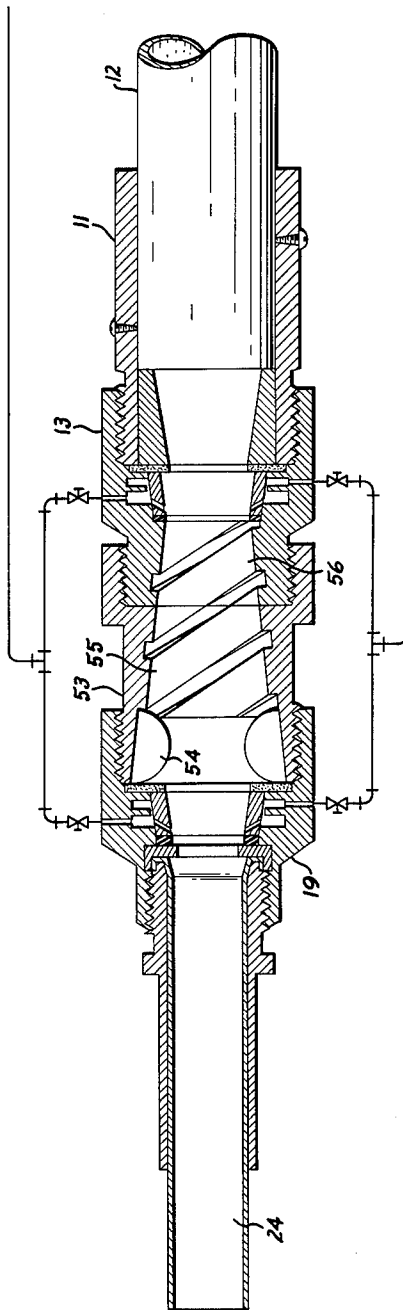


Fig. 2

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2 Sheets-Sheet 2

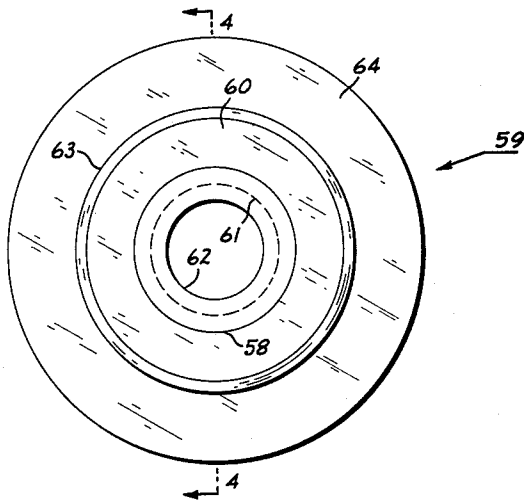


Fig. 3

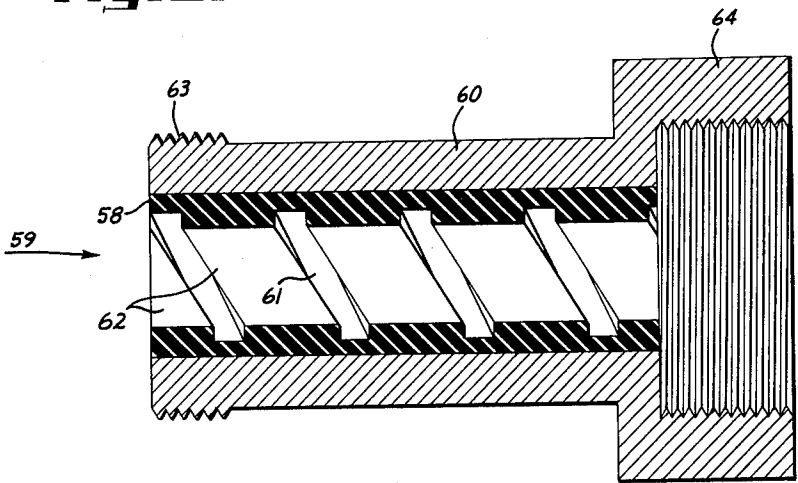


Fig. 4

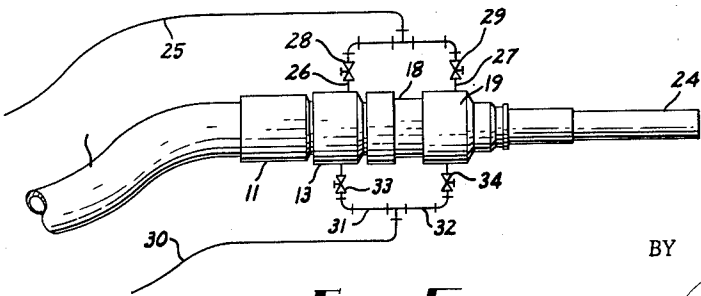


Fig. 5

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NOZZLE FOR GUNNING REFRACTORY MATERIAL

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4 Claims. (Cl. 239-400)

This invention relates to a device for use in the placing of flowing refractory materials and the repair of furnaces, boilers, cupolas and the like by means of a gunning apparatus.

It has long been known to apply granular refractory materials to furnace linings and the like, either hot or cold, by means of gun devices. One such device includes means for supplying a flow of such granular material under pressure and in a current of air to a nozzle device where the refractory material is mixed with water and air, and then the mixture flows forwardly through the nozzle and is projected therefrom onto the desired location. One of the problems involved in the use of devices for applying air-emplaced materials, such as refractory gunning and castable mixes, is the so-called "fogging." Use of the conventional prior art nozzle devices wherein the dry refractory materials are admixed with air and water just prior to ejection from a nozzle, to cause these materials to have the desirable plastic consistency whereby they will stick to the surfaces which are to be covered or coated, has resulted in this "fogging" disadvantage. Fogging results from improper or insufficient mixing of the water and air with the dry material, so that as the refractory or other similar material is ejected from the nozzle device, portions of such material are ejected in a substantially dry state, whereby there results a dust-like cloud, known as fogging; and another disadvantage is the high amount of rebound of the material from the surface being treated, with consequent loss thereof. The result, among other disadvantages, is a wastage of the material being applied; and a serious disadvantage of fogging is the prevention of visual inspection of the areas or surfaces to which the material is being applied by means of the nozzle device.

According to the present invention it has been found that by use of the device to be described herein the fogging noted above is substantially eliminated, and rebound is substantially reduced or minimized. The elimination of this fogging is attained by use of a means for conducting fluent granular refractory material in a restricted path and especially as having a fitting incorporated in a nozzle device which has also two water-and-air injection means spaced from each other, in such a manner that a turbulent or cyclonic mixing zone is provided between such injection means, to thereby admix the dry materials and the water prior to discharge thereof in a wet state from the nozzle. This turbulence zone, or cyclonic mixing zone, insures a substantially complete wetting of the material with the water or tempering liquid. It can also eliminate upstream premixing or wetting of the materials as well as the clogging problems which have hitherto occurred in the hoses employed in this operation. The use of the instant device also eliminates hazardous application of the material and wastage of the material, and insures better consistency of the refractory mix as it is applied.

The device according to the present invention is illustrated in the annexed figures as follows:

FIGURE 1 shows an axial sectional view of the nozzle and the cyclonic mixing zone or turbulence zone thereof;

FIGURE 2 is an axial sectional view of another em-

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bodiment of the turbulence or cyclonic mixing zone as included in the nozzle device;

FIGURE 3 is an end view of one embodiment of the turbulence fitting of a nozzle device, according to the present invention;

FIGURE 4 is a sectional view of the device of FIGURE 3 taken on line 4-4 of FIGURE 3;

FIGURE 5 is a perspective view of an assembled device.

In FIGURES 1 and 2 there is shown a device, indicated generally at 10, which includes a sleeve 11 adapted to receive and hold a feed conduit or tube 12 for the introduction of fluent granular refractory material to and through the nozzle. Preferably, tube 12 is more tightly affixed to sleeve 11 by means of any desired number of screws 65. A fitting or housing 13 is threadedly connected to the outlet of sleeve 11 and is provided at its inner face with an annular channel 14 which contains annular partition wall 15, serving to subdivide channel 14 into two smaller channels 16 and 17, the purposes of which will be later described. Threadedly connected to the forward end of housing 13 is turbulence fitting 18, which is of short length and is coaxial with fitting 13 and tube 12. A second housing 19 is threadedly connected to the forward end of turbulence fitting 18 and likewise contains an annular channel 20, subdivided by radially disposed partition wall 21 into two smaller channels or subchannels 22 and 23. An outlet tube 24 is suitably, e.g. threadedly, connected to the forward end of fitting 19.

As noted above, annular channels 14 and 20 are respectively subdivided into smaller channels 16, 17 and 22, 23, and into subchannels 16 and 22 water is introduced, while air is introduced into subchannels 23 and 17.

For instance, water is introduced through inlet pipe 25, the flow thereof to channel 16 being taken off through pipe 26 and passage 47; and the flow to channel 22 being effected through connecting pipe 27 and passage 49. Flow of water is further controlled by suitable valves 28 and 29, which are preferably ball valves.

Air is introduced to the device through an air pipe 30 which is connected to a suitable source of compressed air, or air under pressure, and flows through connecting pipe 31 and passage 48 to air channel 17; and through connecting pipe 32 and passage 50 to air channel 23. Flow of air is suitably controlled by valves 33 and 34 which are preferably needle valves. As air flows into channels 17 and 23, respectively, it is forced upwardly past the interior faces or ends of radially disposed partition walls 15 and 21 respectively into water channels 16 and 22 where it is admixed with the water coming in from water pipes 26 and 27, respectively.

Water rings 35 and 36 are longitudinally disposed annular walls and are disposed over the inner faces of annular channels 14 and 20, respectively. The rear face of water ring 35, which is an annulus or ring tapering in longitudinal section inwardly toward the axis of the device in the direction of flow of the material, is seated against a gasket 37 which in turn rests against the forward end of hose sleeve 11 and the ring is thereby sealed to hose ring 11. The forward end of water ring 35 seats against a gasket or sealing ring 43 which rests against shoulder 38 in the forward end of housing 13. Ring 35 is provided with a number of holes or passageways 39 which are directed inwardly and are inclined in the direction of flow of material through the device. These passageways open at their outer ends into water channel 16 and at their inner ends into the interior of the nozzle device, whereby the mixture of water and air described hereinabove issues into intimate contact with the fluent granular refractory material passing through the device. Any suitable or desired number of passages 39 are provided in water ring 35.

At the forward end of the nozzle device there is provided a secondary water ring 36 which is like water ring 35. Water ring 36 seats at its inner end against a gasket 40 which rests against the forward end of turbulence fitting 18 and is thereby sealed to said fitting. At its outer end or outlet end water ring 36 seats against a second gasket or sealing ring 44 which rests against shoulder 41 provided in housing 19 and is thereby sealed thereto. Water ring 36 is likewise tapered in longitudinal section inwardly toward the axis of the device in the direction of flow of the material; and it is provided with any desired number of openings 42 which are similar to openings or passageways 39 in water ring 35, these passages 42 opening into water channel 21 at one end and into the interior of the nozzle device at the other end and being inclined inwardly and at a suitable angle to the direction of the flow of the material to provide a flow of water and air mixture into intimate contact with the granular material flowing through the device. In the secondary water ring assembly, air is fed into annular passage 23 and passes upwardly around the inner surface or end of annular wall 21 into contact and admixture with the water in channel 22 from which it flows through apertures 42 into the interior of the device. In both the primary and secondary water rings, it is preferred that there be a plurality of apertures, such as 42, uniformly arranged around the circumference of the ring.

Turbulent or turbulence fitting 18 has a suitable interior surface provided with protuberances to effect turbulent flow or cyclonic mixing of the admixture of granular refractory material, air and water which is passing therethrough. This fitting is of short length so that the device can be conveniently held by the workmen. In one embodiment, the interior surface 45 of fitting 18 and, if desired, the interior surface 46 of housing 13, which can be of the same interior diameter as the interior of 18, are suitably rifled or provided with a helical projection, or a helical groove, which imparts cyclonic or turbulent flow to the material passing therethrough, which material is flowing at high speeds. Preferably, the projections, such as a helical projection or, alternatively, discontinuous protuberances, extend over the entire length of the interior surface of the turbulence-inducing means or conduit. Suitably, the interior surface is rifled to provide the projection; but other projecting means can be employed, if desired. This is illustrated in FIGURE 1, for instance, where the interior surface 45 of fitting 18 is shown to comprise a series of grooves 51 which result in projections 52, which disturb the flow of fluent granular material therethrough and produce turbulent or cyclonic movement in such flow. The interior surface 46 of housing 13 can likewise be grooved or rifled or, if desired, it can be a plain cylindrical surface, i.e., without projections.

It will be understood that the elements 11, 12, 13, 18, 19 and 24 are all disposed coaxially with respect to each other, to provide a continuous passageway for the fluent granular material which is ejected from the exit end of pipe 24 onto the surface to be patched or filled.

Another embodiment of the present invention is shown in FIGURE 2 wherein all the elements of the device are the same except for the turbulence chamber. Therefore, it will be understood that an alternative embodiment 53 of the turbulence fitting is placed in the line, coaxially with the other elements such as 11, 13, 19 and 24, like numbers being used for like elements in these figures. In the present embodiment turbulence fitting 53 is provided with inclined internal surfaces which diverge generally outwardly in the direction of flow of the fluent granular material which is fed therethrough when installed. In other words, the interior cross-section of turbulence-inducing conduit 53 is of constantly increasing diameter in the direction of flow of material therethrough. In this embodiment there is provided a baffle-like element 54 adjacent the outlet of fitting 53, baffle-like element 54 being an annular projection or wall extending inwardly

towards the axis of fitting 53 and suitably integral with the interior wall thereof. This provides a zone of restricted cross-section R, annular projection 54 having a generally rounded configuration, and the zone of restricted cross-section provides accelerated flow of the fluent granular material therethrough, with some change of direction of such flow, particularly adjacent the interior surfaces of the turbulence chamber as at C. The remaining areas of the internal surface 55 of turbulence fitting 53 can be a plain cylindrical surface or, if desired, this surface can also be provided with rifling or grooving to provide further projections therein with increased turbulence resulting in the flow of the fluent granular material therethrough. Preferably the interior surface 56 of housing 13 suitably diverges outwardly likewise to form a generally continuous diverging interior surface with the diverging interior surface of turbulence fitting 53.

In the turbulence fitting of the present invention, the interior surface is in some embodiments as described above grooved or rifled, or otherwise provided with projections or baffles or baffle-like elements to cause change of direction of the flow of fluent granular material passing therethrough, and effect turbulence or cyclonic flow of such material. It will be understood that the fittings can alternatively be tubular metal elements, suitably threaded for assembly into the nozzle arrangement, and there can be separately provided an interior fitting for turbulence fittings 18 and 53, for example, a removable lining preferably of hard rubber, which has a suitable interior surface configuration as described above with respect to the turbulence fitting, and which is replaceable when the protuberances or other turbulence-imparting elements have become worn or eroded away. An end view of such an arrangement is shown, for example, in FIGURE 3, and FIGURE 4 is a longitudinal cross-section of 59, the fitting of this embodiment. In the fitting shown in these figures, a metal tubular element 60 is provided at one end with an interiorly threaded annular shoulder 64 of enlarged diameter to enable attachment to an element such as housing 13 when assembled into a nozzle device according to this invention. The element 60 is provided with a tight-fitting interior lining of hard rubber 58 which is provided with helical grooves 61 and projections 62 to effect turbulence or cyclonic flow in an admixture of fluent granular refractory material, water and air, passing therethrough at high speed when the nozzle device, into which the element 59 is incorporated, is being used for placement of such refractory material. When the projections 62 become worn and less efficient after use, the separate lining 58 is removed and another lining, e.g. of the same type, is fitted into tube 60. It will be understood that the turbulence element shown in FIGURES 3 and 4 is suitable for use in an assembly such as shown in FIGURE 1, being incorporated therein instead of fitting 18. Alternatively the turbulence fitting itself can be made of hard rubber or other plastic material which is inexpensive and is replaceable in the assembled device after wear or erosion has occurred.

The nozzle assembly and its parts are preferably of generally circular transverse cross-section but tubular elements of other interior cross-sectional configuration can be employed if desired.

The device is useful for emplacement of various fluent refractory materials, for example, chrome gunning mix, magnesia gunning mix or clay or plastic gunning mixes which are all known to the art and need not be described here. The nozzle device of this invention is useful for gunning such refractory mixes in combination or as attached to a gun device as well known in this art. These products and devices are useful in lining or repairing the linings of furnaces, for example, high temperature metallurgical furnaces, soaking pits, cupolas, boilers and other furnaces. It is preferred to inject the larger proportion of the total added water by means of the secondary injection ring, in operating this device.

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It will be understood that the above specific description and drawings have been given for purposes of illustration only and that variations and modifications can be made therein without departing from the spirit and scope of the claims.

Having now described the invention, what is claimed is:

1. In a nozzle device for gunning fluent, cementitious refractory material to a furnace lining: a tubular means for conducting a rapid flow of said refractory material to said device; a primary water and air injection means; a secondary water and air injection means; a turbulence-inducing means disposed between said primary and said secondary injection means, said turbulence-inducing means comprising a tubular device having an interior cross-section tapering outwardly in the direction of flow of the material and having a continuous spiral projection on its inner surface, and an annular baffle element disposed adjacent the outlet of said tubular device and integral with the internal surface thereof to provide a zone of restricted flow at the outlet and of said tube and to induce turbulent flow therethrough; and an outlet means for said device; all of said means being coaxially arranged in series with each other.

2. A nozzle device according to claim 1 wherein said

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turbulence-inducing means comprises a tubular metal shell and a removable liner disposed within said shell.

3. A device as in claim 2 wherein said removable liner is composed of hard rubber.

5 4. A device as in claim 1 wherein said baffle element is of rounded surface configuration.

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