MULTIPLE TUBE SPRAY DISCHARGE NOZZLE

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3 Claims

ABSTRACT OF THE DISCLOSURE

A plurality of discharge pipes in contact along their supply ends and either in contact or spread toward their discharge ends are arranged to receive from an angular supply pipe and from a connection aligned with the proximate ends of the discharge pipes an abrasive material for discharge in a laterally-extended transversely-restricted zone.

This invention is directed to a spray discharge nozzle for discharging a wet slurry of abrasive refractory material in a suitable discharge pattern from a supply pipe.

The steel industries’ increasing acceptance and use of the basic oxygen furnaces, to provide increased tonnages of steel, has necessitated the development of an entirely new concept of furnace lining repair due to the extreme wear patterns encountered in the operation of the furnaces. The wear patterns are repeatable so long as all the variables (such as the quantity of oxygen blown during any one heat together with the additives such as lime, etc., depending on the type of steel being produced) are kept constant and therefore pose no problem except that the periods during which the lining of the furnaces are available for repair are of very short duration. This one fact alone has necessitated a radical revision of the equipment and its use in applying wet slurries of abrasive refractory material to the worn, eroded and spalled areas of the lining in order to get the maximum number of heats from the lining during any one campaign or series of campaigns. It is also necessary to apply coatings of the refractory materials to the entire furnace lining in order to build it up after the worn, eroded and spalled areas have been repaired in order to replace the materials normally removed from the lining during each heat.

It is an object of this invention to provide an improved spray discharge nozzle which is capable of handling larger than usual quantities of refractory material without undue wear of the nozzle parts.

It is a further object of this invention to provide an improved spray discharge nozzle in which mixing of the refractory material with water may be accomplished if desired and in which the velocities of the wet slurries enroute therethrough may be controlled.

It is a still further object of the invention to provide an improved spray discharge nozzle that may be used on the end of any supply pipe and will accept the full volume of material passing through and will accept the incoming material in a suitable spray pattern which will first allow the worn, eroded and spalled areas to be built up and then permit the complete inside lining area to be sprayed so as to protect the lining and allow the maximum number of heats to be obtained therefrom during any one campaign or series of campaigns.

It is a still further object of this invention to provide an improved spray discharge nozzle whose spray pattern may be varied as to volume, velocity and direction to suit the conditions encountered in each and every basic oxygen furnace, whereby the wet slurry of abrasive refractory material may be distributed in even layers over the whole surface of the furnace lining to thus allow the refractory material to be evenly heated and become a monolithic mass on the heat exposed face of the lining. In this manner, time is saved by eliminating the longer waiting periods necessitated by uneven coatings which due to their greater mass take much longer to heat to react with and become a part of the parent lining and which in addition tend to spill off in the heavier coated areas, necessitating recoating with consequent loss of time.

And a still further object of the invention is to provide an improved spray discharge nozzle which can be readily cleaned after use without undue problems due to complicated designs.

The invention therefore comprises the device hereinabove described and shown in the accompanying drawings, in which:

FIG. 1 is a side view of the improved spray discharge nozzle with its discharge passages in the form of round tubes or pipes arranged at a suitable angle to a main tubular member which is attachable to the supply pipe;

FIG. 2 is a partial side view of a spray discharge nozzle such as shown in FIG. 1 but with two of the discharge tubes bent outwardly to widen the spray pattern;

FIG. 3 is an end view taken on the line 3—3 of the spray discharge nozzle of FIG. 1 and looking in the direction of the arrows;

FIG. 4 is a view similar to FIG. 3 but showing the discharge passages in the form of flattened tubes;

FIG. 5 is a top view of a modified form of spray discharge nozzle having discharge passages arranged with their longitudinal axes in parallelism with the axis of their tubular member;

FIG. 6 is a side view of the spray discharge nozzle shown in FIG. 5;

FIG. 7 is a side view of another form of spray discharge nozzle with its discharge tubes joined directly to the tubular member and arranged at an inclined angle thereto; and

FIG. 8 is a side view of still another form of spray discharge nozzle with the discharge tubes arranged with their longitudinal axes at right angles to the axis of the main tubular member which is connected by two loop sections to the supply pipe.

The improved spray discharge nozzle 10 shown in FIGS. 1 and 3 has a plurality of discharge passages in the form of three round tubes 11, 12 and 13 arranged at an inclination to the main tubular member 14 and communicating therewith by means of an elongated opening 14e in the side wall thereof, to the periphery of which an extended flattened portion 15 is affixed by means of brazing or welding. The discharge tubes 11, 12 and 13 are inserted into the outer end of the extended flattened portion 15 and are brazed or welded thereto in a fluid tight manner. The terminal end of the tubular member 14 is closed by means of a removable cap 16 to permit cleaning and which is located so as to form a space or reservoir
beyond the entrance to the flattened portion 15, whereby the wet slurry may accumulate in the tubular member 14 and thereby aid in redirecting the abrasive material therefrom into the extended flattened portion 15. The tubular member 14 at its inlet end is designed to accept the full volume and flow of the wet slurry of abrasive refractory material flowing from the supply pipe and redirect the flowing material into the extended flattened portion 15 with no loss in volume. The combined cross-sectional area of all three tubes 11, 12 and 13 may be the same as or less than or greater than the full cross-sectional area of the tubular member 14 so as to thus form a control or mixing valve and spray patterns of the wet slurry discharged from the nozzle.

The spray patterns may be further controlled by a suitable combination of straight and bent sections of pipe or tubing as shown in FIG. 2. In this modified form of spray nozzle, the center tube 12 is straight and the outside tubes 11 and 13 are bent outwardly away from the center tube in order to increase the width of the spray pattern.

The cross-sectional contour of the discharge tubes 11, 12 and 13 may be varied from circular to square, octagonal, rectangular, or some other shape (see FIG. 4) as a further means to control the flow of the wet slurry being forced therethrough as well as to control the spray pattern thereof. In this instance, the combined cross-sectional area of the discharge tubes may also be varied with reference to the cross-sectional area of the tubular member 14.

If the cross-sectional area of the discharge tubes 11, 12 and 13 is kept down to 75% of that of the tubular member 14, a greater choking effect on the flowing wet slurry will occur and tend to cause better mixing with higher velocities in the nozzle, while the reverse is true when the cross-sectional area is equal to or greater than the cross-sectional area of said tubular member. In addition, when maximum choking occurs a greater velocity is attained in the discharge passages to give greater throw power to the spray. The above design variables can be readily incorporated in the nozzle according to requirements.

The spray discharge nozzle 10 shown in FIGS. 5 and 6 is in its basic design the same as that shown in FIGS. 1, 2, 3 and 4 except that the discharge passages 11, 12 and 13 in FIGS. 5 and 6 are arranged with their longitudinal axes in parallelism with the axis of the tubular member 14. In this modification, the tubular member 14 is shorter than the tubular member 14 and the extended flattened portion 15 is integrally joined thereto on the same axis. The same variations in cross-sectional areas as in the preceding figures may be adhered to and the same results produced thereby.

The spray discharge nozzle 10 shown in FIG. 7 is similar to that shown in FIG. 1 except that here the extended flattened portion 15 and the discharge tubes 11, 12 and 13 are brazed or welded directly to the tubular member 14, so that the mixing takes place in the tubular member. Here again the same variations in cross-sectional areas and contour of the discharge tubes and the tubular member 14 may be resorted to as well as the spreading of the discharge tubes. Where square or rectangular tubes are used, an elongated hole may be cut in the side of the tubular member 14 instead of individual holes.

The spray nozzle 20 shown in FIG. 8 is also of the same basic design as the nozzles already described. However, in this further modification, there are two loop sections 21 and 22 which are connected at one end to a supply pipe 23, the means of a T 23 and at the other end to a framework carrying the main tubular member 24 which acts as a flow redirecting portion like the main tubular member 14 in the first embodiment. This tubular member 24 is formed in its outer side with an elongated slot 25a over which an extended flattened portion 27 is welded or brazed. Five discharge tubes 28, 29, 30, 31 and 32 are inserted into the outer end of the flattened portion 27 and are brazed or welded thereto in a fluid tight manner. The loop sections 21 and 22 allow the full quantity of slurry entering the T 23 to flow to the redirecting portion 25 without loss of volume or head. The cap 26 of the T 23 provides a space beyond the entrance to the loop sections 21 and 22 for the accumulation of the wet slurry of refractory material and thereby aids in redirecting the material into the loop sections as well as promoting mixing of the material therein. The tubular member has about the same cross-sectional area as the supply pipe 24 and acts much in the same way as the main tubular member 14 in the first embodiment shown in FIGS. 1 and 3.

The nozzle shown in FIG. 8 is designed for larger volumes of refractory material and there is no danger of any substantial wear occurring therein as all elements are designed to minimize this problem. In addition, good slurry mixing is accomplished not only in the T 23 but also in the tubular member 25 and the extended flattened portion 27 radiating therefrom. As the full volume of the wet refractory material leaves the supply pipe 24, it is divided into two streams, one passing into the loop section 21 and the other into the loop section 22, these loop sections having a cross-sectional area which is one-half that of the supply pipe 24 and of the tubular member 25. These two streams enter the tubular member 25 in a straight line or flash head, creating considerable turbulence and mixing both in the tubular member 25 and the flattened extended portion 27.

The combined cross-sectional area of the discharge tubes 28 to 32 may equal or be less than or greater than the cross-sectional area of the tubular member 25, as in the preceding embodiments, and the contour of the discharge tubes may also be round, square or of other shapes according to the spray pattern desired. Likewise, the contour of the loop sections 21 and 22 as well as the contour of the tubular member 25 may be square, rectangular or of some other shape.

It will be understood that the cross-sectional area of the main tubular member in all embodiments may vary according to the volume of material which it is intended to receive from the supply pipe. Likewise, the number of spray discharge tubes may not only be varied according to the volume of material to be handled by the discharge nozzle, but also according to the width of the spray pattern irrespective of volume. It may also be stated that it is desirable to make the spray discharge tubes as short as possible to minimize wear but they should in any case be long enough to give proper direction to the refractory material flowing therethrough.

The instant invention is therefore very versatile in its performance and will solve many of the problems encountered in the spraying of the basic oxygen furnaces. Where it is necessary to spray for prolonged periods of time it is possible to water cool the pipe and nozzle and this is particularly true where it is necessary to close off the flow of the wet slurry when spraying the worn and eroded areas and not have it solidify in the pipe and nozzle.

The discharge passages may be varied and so formed and dimensioned internally to make it possible to get practically any desired velocity to produce a spray pattern with any desired throughput without causing extreme losses of the wet slurry due to bouncing or spalling.

What is claimed is:

1. A spray nozzle for discharging a wet slurry of abrasive material comprising a row of discharge pipes having a supply area at one end and a discharge area at the opposite end, and disposed in a manner to be disposed in a manner to be disposed in one with another along a substantial extent of their length in proximity to said supply area, wherein said pipes extend from a laterally-extended end of a conducting and pipe-holding element having a supply area at its other end and extending in the same direction as at least the proximate end thereof, and wherein there is provided a supply pipe to which the last mentioned element is angularly connected.

2. A spray nozzle as in claim 1 wherein said discharge
5 pipes are in such contact throughout their entire length.
3. A spray nozzle as in claim 1 wherein said pipes are in such contact throughout only said extent of their length and are spread laterally fanwise at their discharge ends.

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