March 25, 1947. J. H. NEIDER 2,418,045

APPARATUS FOR CLEANING OPEN HEARTH CHECKER WORK AND THE LIKE

Filed Sept. 28, 1943 2 Sheets-Sheet 1

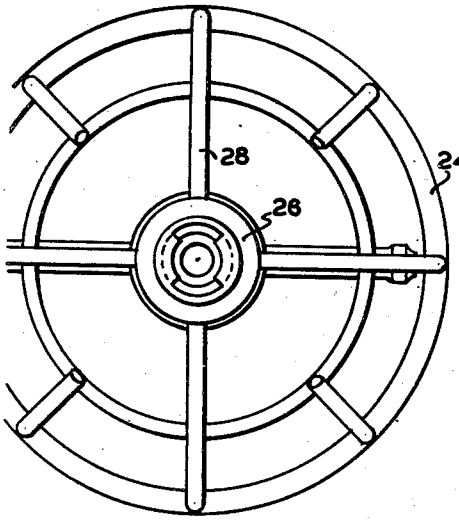


Fig 2.

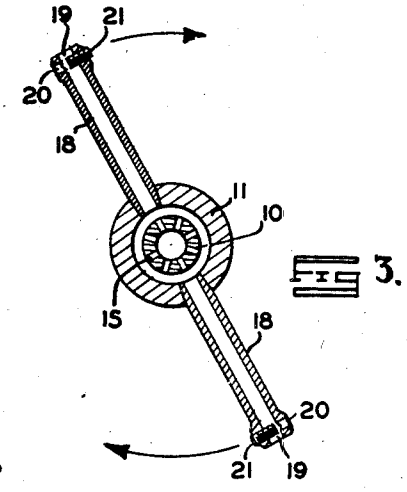


Fig 3.

Fig 1.

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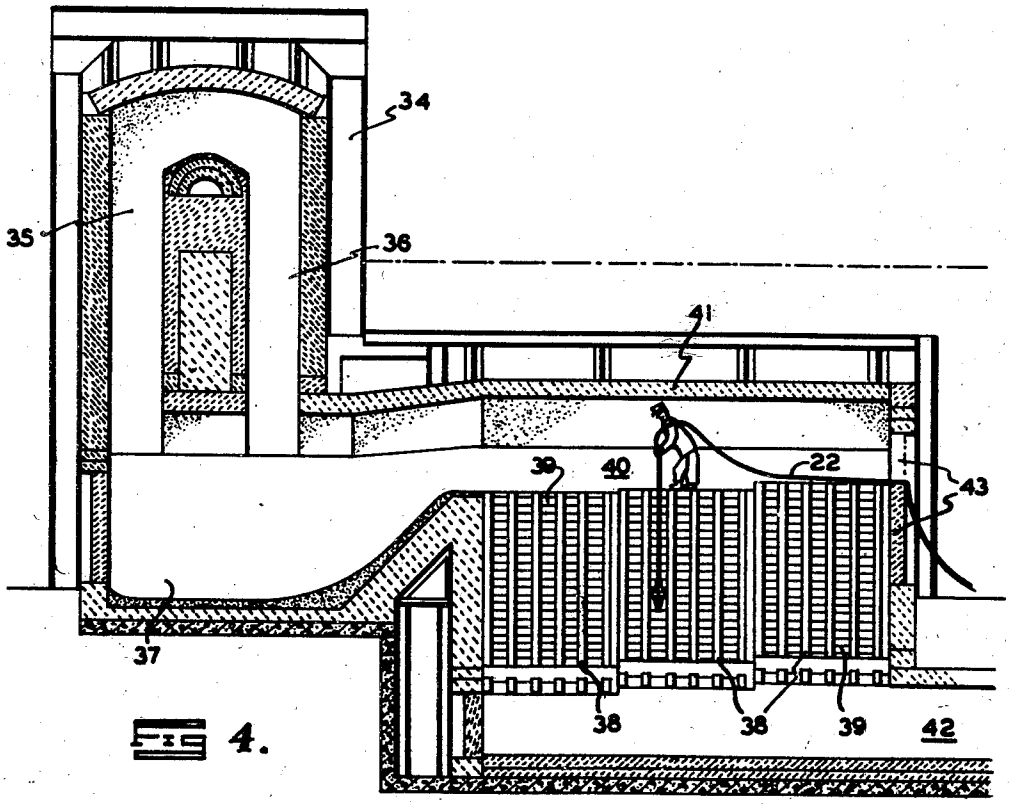


Fig 4.

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APPARATUS FOR CLEANING OPEN HEARTH CHECKER WORK AND THE LIKE

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2 Claims. (Cl. 134—167)

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This invention relates to apparatus for cleaning open hearth checker work and the like and more particularly to improved devices for utilizing the particle displacing properties of a stream or pencil of air or other fluid for accomplishing such general objects.

In the operation of various heat exchanging devices, for example—metallurgical open hearth furnaces, blast furnaces, and glass melting furnaces—it is common to utilize refractory checker work structures in the recuperators and stoves for the purpose of absorbing and storing heat from the waste gaseous products of combustion or from a gas flame and upon the refractory mass attaining a predetermined desired temperature the source of heat input is shut off and the gas or air to be supplied to the furnace is passed over and through the checker work to effect a quick and high degree of preheating of such gas or air.

It will be at once apparent that the efficiency of the above outlined apparatus is dependent almost entirely on the rate of surface absorption and emission of heat, it being assumed that the brick or other material of the checker work possesses suitable heat conductivity and retention properties. Consequently, it is common practice particularly in the steel industry to devote a great deal of attention to the keeping of the exposed surfaces of heat storing checker work in a clean and bright condition. Fly ash and slag when in a loose pulverent state as well as other particles of non-combustible debris when deposited upon the exposed surfaces of the checker work have a pronounced insulating effect which materially deters from the efficiency of the apparatus. From time to time and always when the checker work is sufficiently cooled to permit cleaning operations the air and gas passages through the work are cleaned with brushes, scalpels, and air jets and because of the complexity of the checker work this operation has heretofore been expensive and time-consuming and not at all satisfactory in its final result by reason of the inability to reach all the heat exchanging surface of the checker work.

The present invention provides improved apparatus suited for the operation outlined above and which very materially diminishes the time required for accomplishing the same while effecting definitely better final results. This is accomplished, primarily, by employing a rapidly moving stream or pencil of air or other fluid the scanning action of which is sufficiently rapid to reach all portions of the exposed surfaces of the checker work in a practicable period of time.

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While this principle may be embodied in various types of apparatus I preferably utilize a statically and dynamically balanced gyrator for effecting space distribution of the rapidly moving streams or pencils of air.

An object of the invention is the provision of an improved apparatus operative to carry out in a practical manner the methods and principles outlined above.

The above and other objects and advantages of the invention will become apparent upon consideration of the following detailed specification and the accompanying drawing wherein there is illustrated a preferred embodiment of the apparatus of the invention and also a representative manner of use of such apparatus.

In the drawing:

Figure 1 is an elevation, partly in section, of a tool constructed in accordance with the principles of the present invention and capable of carrying out the improved methods thereof;

Figure 2 is a plan view of the apparatus of Figure 1;

Figure 3 is a horizontal section through a portion of the apparatus of Figure 1, the view being taken along the line III—III of Figure 1; and

Figure 4 is a vertical section through an end portion of an open hearth furnace, the view illustrating one manner in which the apparatus of Figure 1 may be employed.

Referring to the drawing, reference numeral 10 indicates a hollow shaft on which is rotatably mounted a tubular member 11. Either integral with the principal body portion of the shaft 10 or pressed thereon is a pair of vertically spaced collars 12 and 13 of suitable bearing material and it will be observed that when the parts are assembled, as illustrated in Figure 1, the lower collar 12 is brought into engagement with the interior shoulder of the tubular member 11 to prevent axial movement of the member 11 in an upward direction with respect to the shaft 10. A cap 14 having an inwardly directed flange at its upper end to overlie the upper end surface of the collar 13 is rigidly secured, by threads or other suitable means, to the upper end of the tubular member 11 to prevent downward movement of the member 11 with respect to the shaft 10. The bearings 12 and 13 in addition to serving as thrust bearings also serve as radial bearings to maintain the concentricity of the members 10 and 11.

At a point substantially intermediate its ends the shaft 10 is provided with a plurality of circumferentially spaced apertures 15 which pro-

vides communication between the space inside the shaft and the space inside the tubular member 11. On either axial side of the apertures 15 are three axially spaced bearing and sealing rings 16 which may either be made integral with the shaft 10 or pressed thereon as will be understood. Again, rings 16 are preferably of suitable bearing material and are of an outside diameter to fit accurately within the uniform bore through the principal part of the member 11. A plurality of circumferentially spaced fluid escape apertures 17 are provided in the wall of the tubular member 11 intermediate the rings 16. Thus any air or other fluid under pressure which escapes past the rings 16 which are closest to the apertures 15 will be dissipated equally through the ports 17. The rings 16 may serve both as bearings and as air or fluid sealing means.

Extending outwardly of the tubular member 11 in diametrically opposed directions and horizontally opposite the apertures 15 in shaft 10 are the two nozzles 18 each having a fluid discharge port 19 at its outer end. It will be apparent that fluid under pressure coming into the shaft 10 will pass out through ports 15 and thence into the nozzles 18. For reasons to be more fully explained hereinafter it is highly desirable that the nozzles 18 rotate about the principal axis of the shaft 10 and to provide for this mode of operation I provide a fluid outlet 20 in the side wall of each of the nozzles 18 adjacent its outer end. Diametrically opposite the outlets 20 are tapped bores to receive screws 21 the settings of which determine the volumes of fluid passing out through the openings 20 and consequently the speed of rotation of the tubular member 11 and the attached nozzles 18.

Shaft 10 is supported by a flexible or rigid conduit 22 which is connected to the upper end of the shaft 10 by means of any suitable coupling indicated by reference numeral 23. As will be pointed out more fully below a flexible conduit for the support of the apparatus is more advantageous in some uses while in others a rigid conduit is required.

I provide a guard about the parts 10, 11 and 18 consisting of a basket-like assembly having two longitudinally spaced rings 24 and 25 in its center portion and end members 26 and 27. Welded or otherwise suitably secured to the members 26 and 24 are the circumferentially spaced struts 28 and similar struts 29 interconnect the rings 25 and 27. A number of circumferentially spaced studs 30 provide rigid interconnection between the spaced rings 24 and 25 without obstructing materially the radially outward streams of fluid issuing from the nozzles 18. Upper and lower nuts 31 and 32, respectively, screw threaded onto portions of the shaft 10, are provided to secure the guard assembly rigidly to the shaft 10.

It should be observed that the shape of the guard assembly consisting of the parts 24 through 32 is such that the entry, passage through, and withdrawal of the assembly with respect to passageways through checker work is materially facilitated. At the same time the outwardly extending nozzles 18 which revolve at high speed during operation of the apparatus are adequately protected from injury which may result due to contact with the side walls of the passages.

Referring to Figure 4 which illustrates one manner in which the apparatus described above may be advantageously employed in cleaning a checker work in an open hearth furnace, the furnace proper is indicated by reference numeral

34 and, in accordance with usual practice, the furnace is provided at each end with a pair of waste gas and air stacks 35 and 36 which are in communication at the top ends with the space above the hearth, not shown, and at their bottom ends with a slag pit 37. The checker work is shown at 38 and in the furnace illustrated this checker work is provided with a multiplicity of vertical flues or passages 39 through which the waste gaseous products from the furnace flow downwardly when heat is being stored in the checker work. For this purpose the upper ends of the passages 39 open into a space 40 provided under the arched roof 41 of the enclosure housing the checker work while the bottom ends of the passages 39 are in communication with a flue 42 leading to a stack, not shown, and to an air inlet, also not shown. It will be understood that upon the checker work 38 attaining a predetermined temperature the flow of air and gases through the furnace is reversed whereupon instead of the waste gaseous products of combustion flowing downwardly through the passages 39 air for combustion is forced into the flue 42 thence upwardly through the passages 39 and into the furnace. Heretofore the cleaning of the passages 39 has presented considerable difficulty but I have found that by suspending the apparatus described above in the passages 39 and by moving the apparatus up and down therein the passages are very quickly and efficiently cleaned. In carrying out this operation a flexible fluid supplying conduit 22 is employed and this conduit serves the additional function of suspending the tool in the passages 39, all as indicated in Figure 4. In carrying out this operation the operator may enter the passage 40 upon removal of a portion of the bulkhead 43.

Checker work varies widely in construction and in many instances the gas and/or air passages therethrough extend horizontally rather than vertically as shown and in such instances it may be more advantageous to employ a rigid length of pipe to support and to supply fluid pressure to the assembly shown in Figure 1. However, the shape of the guard for the assembly enables the assembly to be simply slid through the passages regardless of whether the assembly is attached to a flexible, rigid, or semi-rigid conduit.

In operation, I have found the apparatus described above to be highly efficient in operation. First, the fluid streams or pencils issuing from the nozzles 18 in fairly close proximity to the surfaces to be cleaned appear to be highly effective in loosening and removing scale, slag, and other debris from such surfaces. This loosened material falls to the bottom of the checker work from where it is removed by shovels, vacuum lines, or other suitable means. The fluid employed is preferably air under pressure although in some instances improved results are attained by introducing into the fluid supply conduit a quantity of water. The action of the apparatus then is to emit from the nozzles 18 slugs of water or alternate blasts of air and water. Secondly, inasmuch as the side walls of the passages through checker work are usually constructed to provide alternate bricks and voids in both circumferential and longitudinal directions the streams or pencils of fluid appear to have a more effective impingement action on the inner surfaces of the bricks than would otherwise be the case if, for example, the walls were more or less solid. This results from moving the pencils

rapidly about the surfaces of the passages which produces a quite violent "hammer" effect operative to loosen slag, carbon and other adhered debris from the bricks. Thirdly, the action of the apparatus, when employed in its normal and intended manner, is such that every increment of surface in the interior of the passages is traversed by the pencil or pencils thus insuring that a complete cleaning operation is effected.

It should now be apparent that I have provided an improved apparatus for cleaning heat storing checker work which accomplishes the objects initially set out. The apparatus is simple in design and economical to construct and when used in the manner outlined herein is operative to effect substantially improved results in the cleaning of the passages through the checker work and, moreover, enables a cleaning operation to be completed in but a fraction of the time normally and heretofore considered necessary for this task.

The above specifically described embodiment of the invention should be considered as illustrative only as obviously many changes may be made therein without departing from the spirit or scope of the invention. Reference should therefore be had to the appended claims in determining the scope of the invention.

What I claim is:

1. Apparatus for cleaning checkerwork in open hearth furnaces and the like comprising in combination a member having a fluid passage therein and means at one end thereof for connection to a fluid supplying conduit whereby said member may be supported in a depending position, an outwardly directed fluid ejecting nozzle rotatably carried by said member and having communication with said fluid passage, means to rotate said nozzle, and a guard carried by said member and positioned about said nozzle; said guard comprising a pair of longitudinally spaced collars secured to said member above and below the plane of rotation of said nozzle, spaced rings positioned above and below but adjacent to the plane of rotation of said nozzle and being of a diameter

greater than the sweep of said nozzle, circumferentially spaced struts interconnecting said rings, and inwardly tapering struts interconnecting said rings and collars.

2. Apparatus for cleaning checker work in open hearth furnaces and the like having passages therethrough comprising in combination a tubular support adapted to be connected at one end to a fluid supplying conduit, a plurality of circumferentially spaced openings in the side wall of said support, a collar rotatably mounted on said support and encircling said openings, an outwardly directed nozzle carried by said collar and in communication with said openings whereby fluid under pressure emanating from said tubular support is ejected radially outward by said nozzle, means to rotate said collar; and a guard carried by said support comprising a ring positioned adjacent to but outwardly of the circular path taken by the discharge end of said nozzle, and inwardly tapering struts carrying said ring at their outer ends and secured to said support at their inner ends.

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