

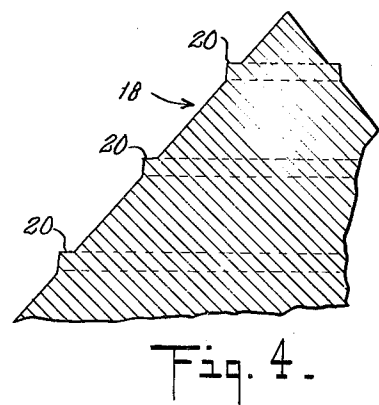
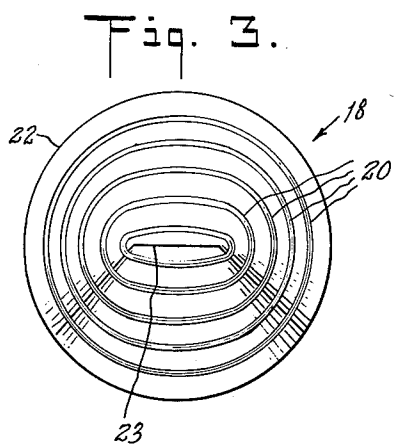
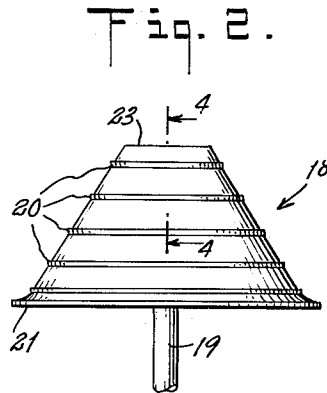
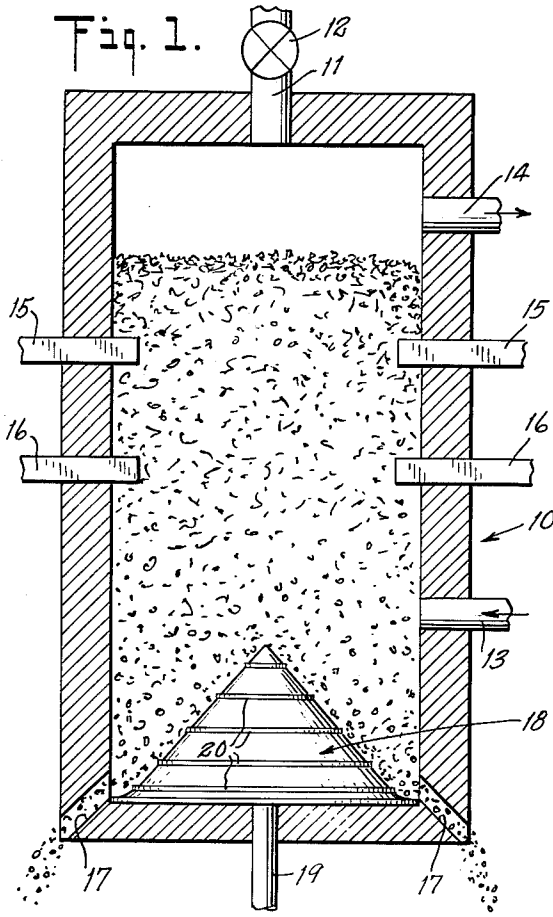
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W. FRASER

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ROTARY EXTRACTOR CONE FOR SHAFT FURNACE

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INVENTOR.
WILLIAM FRASER
BY
Paul M. Phillips
ATTORNEY

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**ROTARY EXTRACTOR CONE FOR SHAFT
 FURNACE**

William Fraser, Arvida, Quebec, Canada, assignor to
 Aluminium Laboratories Limited, Montreal, Quebec,
 Canada, a corporation of Canada

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The present invention relates to a rotary extractor cone for a shaft furnace and more particularly to such a rotary cone which will maintain the solid material within the furnace in a desired broken-up or agitated state, so that it may be discharged in suitable small particle form without forming into large clinkers which would be difficult to discharge. The invention is particularly useful in controlled atmosphere furnaces such as converters which are used in the refining of aluminum, to convert crude aluminum material to aluminum monochloride by a reaction between the aluminum content of the charge and gaseous aluminum trichloride. The invention is, however, not limited to such use and is generally applicable to any shaft furnace construction where it is desired to use a substantially conical lower end construction, which is rotated slowly so as to keep the charge from forming into large clinkers and generally to assist in the discharge of the treated material from the lower end of the furnace.

In the past, such structures have been generally conical and have been rotated about the axis of the cone, which axis is usually vertical. In such instances it is found that unless the surface of the conical member is very rough or irregularly formed in some manner, the desired agitation of the material being treated is not achieved, so that clinkering is not substantially positively prevented. Attempts have been made to overcome this difficulty by forming irregular surface portions on the substantially conical charge-engaging surface portions of these elements. In such instances the irregular portions have worn rapidly, with the result that the operation has been something less than that desired for the reasons given above, as well as involving a rapid wear of the conical extractor itself.

In order to attain a desired agitation of the furnace charge, it has been suggested that the extractor be rotated about some eccentric axis or be constructed so as to have the apex of the conical surface eccentric of the surface of rotation. In either case, while the results as to the agitation of the furnace charge have been satisfactory, the difficulty of mounting and rotating the extractor cone has been so great that these devices have again failed to attain the desired degree of utility for which they were intended. As will be appreciated, such eccentrically rotated devices have resulted in rapid wear on the bearings for the rotational equipment or have required such heavy and specially constructed bearings that the cost has been substantially prohibitive, or both.

The present invention attains the desired objects as to charge agitation and the avoidance of clinkering of the eccentrically constructed or rotated extractor devices of the prior art, while using a surface configuration for the extractor which will be in contact with the charge in the furnace such that the load on the axis of rotation or the bearings used in connection with the rotation thereof will be such that all parts of the surface are symmetrical with respect to the axis of rotation at each level in the surface, i.e. at the intersection of such surface with any plane disposed at right angles to the axis of rotation. In the present instance, the desired form of surface may be described as substantially conical, with the active furnace charge-engaging surface of such shape that the sur-

face will intersect a plane at right angles to the axis of rotation and located adjacent to the base or lower portion of the extractor member in substantially a circular line; whereas similar planes located at levels which are progressively higher than the first-named plane will intersect the active charge-engaging surface in progressively narrower oval and elliptical shapes; until at substantially the top of the extractor there will be a substantial chisel edge. In its desired form, therefore, the basic surface of the extractor cone of the invention changes in a uniform or continuous fashion from a circular cross section in its base or bottom portion to an elliptical cross section above the bottom portion, the major and minor axes of the elliptical cross sections becoming progressively smaller in progressively higher portions of the cone above the bottom portion thereof and tending toward an elliptical cross section in the top portion of the extractor cone in which the minor axis is very small in relation to the major axis. All the intersections between the charge-engaging surface of the extractor member and various planes disposed perpendicular to the axis of rotation will be symmetrical with respect to such axis, i.e., a circular line of intersection will be centered substantially on the axis of rotation and an elliptical line of intersection will have major and minor axes which intersect substantially on the axis of rotation.

In the event that the extractor member terminates at its upper end in a substantial chisel edge, the preferred form, then this edge will be in a line perpendicular to the axis of rotation, which axis will bisect such line.

The invention also contemplates the possibility of the formation of some irregularities more or less uniformly disposed over the furnace charge-engaging surface of the extractor member.

The invention will be better understood by reference to the following particular description and to the accompanying drawings showing a preferred embodiment thereof.

In the drawings:

FIG. 1 is a diagrammatic illustration principally in vertical section, but with the extractor member in elevation, showing the relationship between the extractor member of the present invention and a shaft furnace (shown diagrammatically) which could, for example, be a converter for the purification of aluminum as aforesaid;

FIG. 2 is an elevational view of the extractor member of FIG. 1 taken at right angles to the view shown in FIG. 1;

FIG. 3 is a plan view of the extractor member of FIG. 2; and

FIG. 4 is a fragmentary view in vertical section and on an enlarged scale of the upper portion of the extractor member, the view being taken on the line 4-4 of FIG. 2.

While as aforesaid the extractor device of the present invention is usable in conjunction with a considerable number of different types of shaft furnaces, it has been shown diagrammatically in FIG. 1 in conjunction with a furnace or converter, as it is called, used in the purification of aluminum, this furnace or converter being generally indicated at 10 and being substantially closed except as particularly hereinafter noted. Solid materials may be introduced into the furnace preferably through the top portion thereof through a passageway 11 which may be controlled by a device 12, here shown as a star valve, but which is intended to represent any means by which solid material may be introduced into the furnace without permitting substantial ingress or egress of gases to or from the furnace. The solid material in the case being described is an alloy of relatively impure aluminum, including such impurities as iron, manganese, etc., from

which it is desired to strip the aluminum to prepare relatively pure aluminum. The solid material input is in particulate form, with the particles usually of substantial size, but in a substantially free-flowing condition, so that the solid furnace charge may be supplied continuously or intermittently as desired to the furnace through the passage 11. Gaseous aluminum trichloride is normally supplied to the furnace adjacent to the lower end thereof through one or more passages, one of which is shown at 13. Gases, principally $AlCl_3$ and $AlCl$, pass out of the furnace through one or more passages, one of which is shown at 14 adjacent to the upper end thereof for further treatment, which in the aluminum industry comprises the recovery of metallic aluminum from the aluminum monochloride gas and the recirculation of at least a part of the aluminum trichloride. The furnace may be heated in any suitable way, but in this instance reliance is put upon electric heating, with the electric current being introduced through electrodes projecting into the furnace, some of which are shown at 15 and 16. In the normal operation of aluminum converters, this electric current is alternating current. The invention is, however, not limited to aluminum converters, to direct heating as shown, or to the heating of the furnace by electric current.

The charge in the furnace gradually works downwardly and is desired to be discharged progressively and sometimes substantially continuously through a plurality of passages, two of which are shown at 17 adjacent to the lower end of the furnace. Serving as substantially the entire bottom of the furnace (although this is not critically essential) and terminating at the passages 17 is a rotary, substantially conical device generally indicated at 18, this device embodying the present invention. This conical device or extractor member, as it is called herein, is mounted upon a shaft 19 extending through the bottom of the furnace and suitably mounted in bearings (not shown) and arranged to be driven by any suitable source of power (not shown), so as to rotate the extractor member 18 about the substantially vertical axis of the shaft 19. It will be understood that the rotation is quite slow, the actual speed of rotation being a matter of selection for any given installation and purpose. The rotation is depended upon, in the present case, to agitate the charge to the extent that clinkering will be effectively eliminated or minimized to negligible proportions and portions of the spent charge will be progressively moved downwardly to and through the openings 17.

For convenience in the present drawings there are shown a series of ridges 20 about the extractor member 18 which may be used if desired or may be wholly omitted. In the drawings these ridges serve to assist the reader in understanding the shape of the extractor member 18, in that the lowermost end of the extractor, shown at 21 may be considered to lie in a plane which is horizontal in the device shown and which, in any event, is perpendicular to the axis of the shaft 19, this axis being the axis of symmetry of the extractor member 18. The intersection of this plane at the level of the lower end 21 of the extractor member with the charge-engaging surface of the member 18, i.e. the upper surface thereof in the form shown, is substantially circular as shown at 22 in FIG. 3. The shapes of intersections between the charge-engaging surface of the member 18 and progressively higher planes, all perpendicular to the axis of symmetry of the extractor member will vary progressively from oval to narrower and narrower ovals or ellipses and finally will terminate, in a preferred form of the invention, in a substantially chisel edge 23, which is a substantially horizontal line perpendicular to the axis of symmetry, i.e. the axis of rotation of the extractor member, and which line 23 is bisected by said axis.

It will be understood that the invention does not require the extension of the charge-engaging surface to an actual straight line chisel edge, as it is adequate in

most practical installations that the surface approach such an edge even though the upper end portion of the extractor member be somewhat rounded and even though the actual configuration of the upper end portion as seen in a view corresponding to FIG. 2 might show the upper edge 23 or upper termination in a somewhat curved line, usually highest at the center at the axis of rotation and relatively lower toward the outside in each direction. In any event it is a feature of the invention that substantially the entire charge-engaging surface of the extractor member shall be substantially symmetrical with respect to the axis of rotation of the extractor member, so as to minimize eccentric loading of the bearings for the shaft 19 and thus to minimize wear of the parts.

It is found that the use of a device of this kind will result in adequate stirring up or agitation of the charge in a furnace of this general type, so as substantially to prevent clinkering and will keep the charge in a flowable condition, so that the spent solid materials may be suitably discharged from the furnace as shown in FIG. 1 through passages 17 or their equivalent.

The present invention is also generic generally to smooth and irregular surfaces for the charge-engaging surfaces of the extractor member, so long as the surfaces are made generally symmetrical to the axis of rotation, so as to minimize the eccentric loading on the bearings for the shaft 19 and hence minimize the power requirements for rotation of the extractor member. Thus it is unnecessary that the surface shall be provided with actual ridges as shown at 20 in FIG. 4 or in fact that any irregularities be present. On the other hand, it is contemplated that any desired irregularities within general limitations herein given shall be considered as within the purview of this invention.

While there has been shown and described but one physical embodiment of the invention, this description has attempted to point out all the essential features and some non-essential features. Other equivalents of the structure herein shown will occur to those skilled in the art from the foregoing disclosure. I do not wish to be limited, therefore, except by the scope of the appended claims, which are to be construed validly as broadly as the state of the art permits.

What is claimed is:

1. A substantially conical rotary extractor member for the bottom of a shaft furnace, wherein said extractor member is adapted to be rotated during at least a part of the furnace operation about a substantially vertical axis centrally of said shaft furnace,

said extractor having a furnace charge-engaging surface adapted to engage and support the contents of said furnace and of such shape that the intersection thereof with a horizontal plane located at a level substantially at the lower end of said surface is substantially circular, and the corresponding intersections with horizontal planes at progressively higher levels than the first-named plane will vary uniformly toward progressively narrower and smaller oval and elliptical shapes at least toward a substantially straight line adjacent to the top of said surface,

and wherein each said intersection between said surface and a horizontal plane at any level of said extractor is substantially symmetrical with respect to said axis.

2. A rotary extractor member in accordance with claim 1,

in which said upper surface terminates at its uppermost portion in a chisel edge which is bisected by said axis.

3. A rotary extractor member for the bottom of a shaft furnace which is adapted to be rotated about a substantially vertical axis in the central portion of said furnace during the operation of said furnace, said extractor having a substantially conical furnace charge-engag-

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ing surface to engage and support the contents of said furnace, said surface having a shape in which the outline of a horizontal cross-section is generally elliptical and in which said cross-section outline changes uniformly from an ellipse near the top in which the minor ellipse axis is very small in relation to the major ellipse axis to an ellipse at progressively lower horizontal cross-sections having progressively larger elliptical major axes and having progressively larger minor elliptical axes in relation to said major axes until said major and minor axes are substantially equal in the lowermost horizontal cross-section thereof.

4. In a substantially smooth sided shaft furnace of the type employing a rotary extractor member which is adapted to be rotated about a substantially vertical axis in the central portion of the furnace during the operation thereof, an improved extractor having an substantially conical furnace charge engaging surface to engage and support the contents of said furnace, said surface having a shape in which the outline of a horizontal cross-section is generally elliptical, said elliptical cross-section outline changing uniformly from near the top to the bottom such that the minor ellipse axis is very small in relation to the major ellipse axis at the top and at progressively lower horizontal cross-sections the elliptical outline has progressively larger elliptical major axes and progres-

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sively larger minor elliptical axes in relation to said major axes until said major and minor axes are substantially equal in the lowermost horizontal cross-section thereof, and each horizontal cross-section outline being substantially symmetrical with respect to said vertical axis.

5. A rotary extractor member in accordance with claim 1 in which the charge-engaging surface of said extractor member is provided with a plurality of annular ridges at different, displaced levels, each of said annular ridges including side walls extending from said surface at a given level thereof generally parallel to said axis and having substantially the same cross section throughout as said charge-engaging surface at the given level.

References Cited by the Examiner

UNITED STATES PATENTS

1,722,496	7/29	W. B. Chapman	-----	110—36 XR
2,059,661	11/36	C. M. Shott	-----	110—36
2,937,082	5/60	Johnston et al.		

FOREIGN PATENTS

880,001	3/43	France.
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MORRIS O. WOLK, *Primary Examiner.*

JAMES H. TAYMAN, JR., *Examiner.*