Sept. 30, 1969 R. B. McCREADY ETAL 3,469,832

APPARATUS FOR MAKING STEEL BY THE BASIC OXYGEN PROCESS

Filed July 25, 1966 2 Sheets-Sheet 1

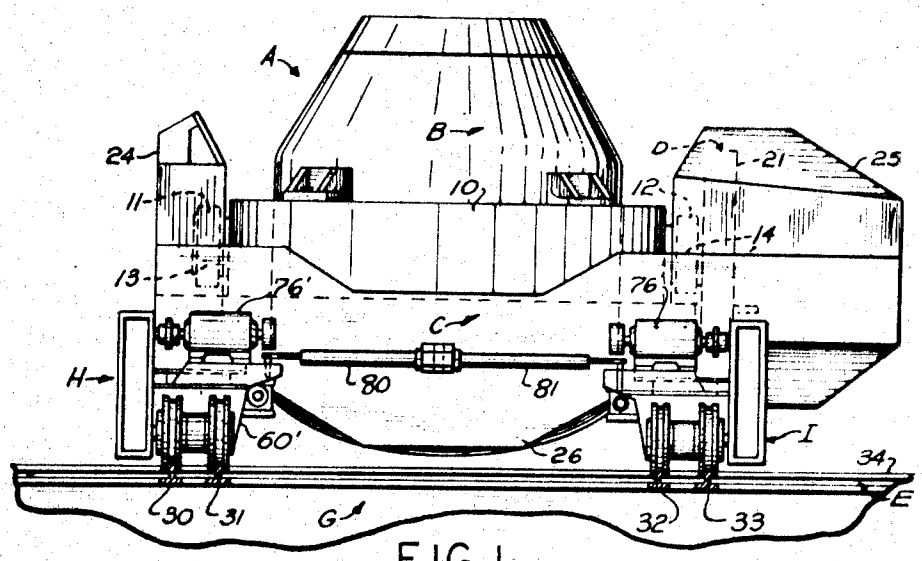

FIG. 1

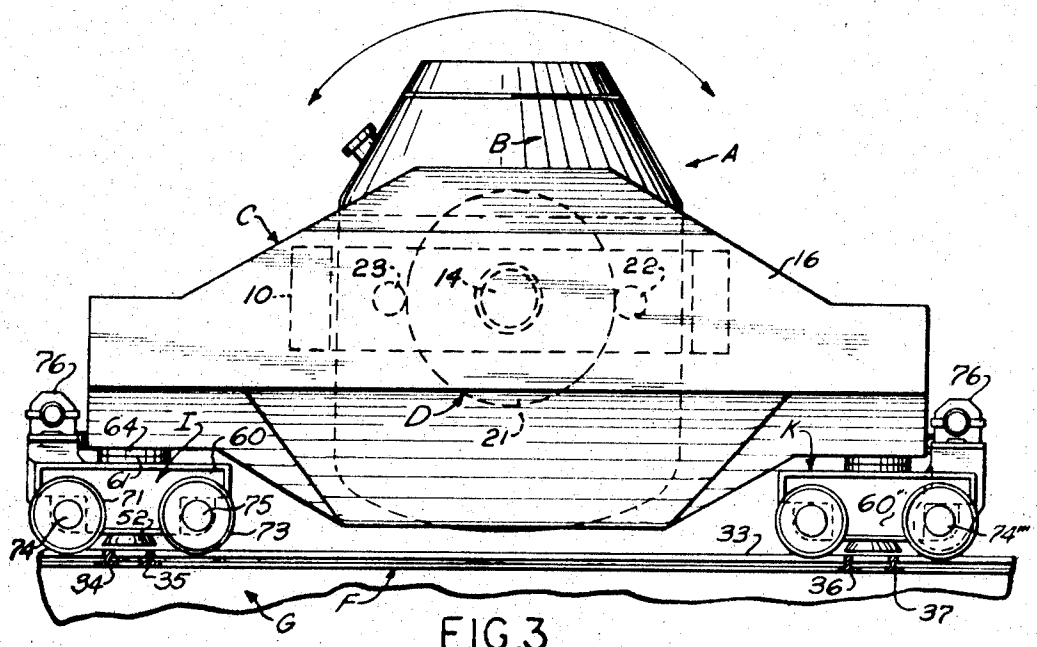

FIG. 3

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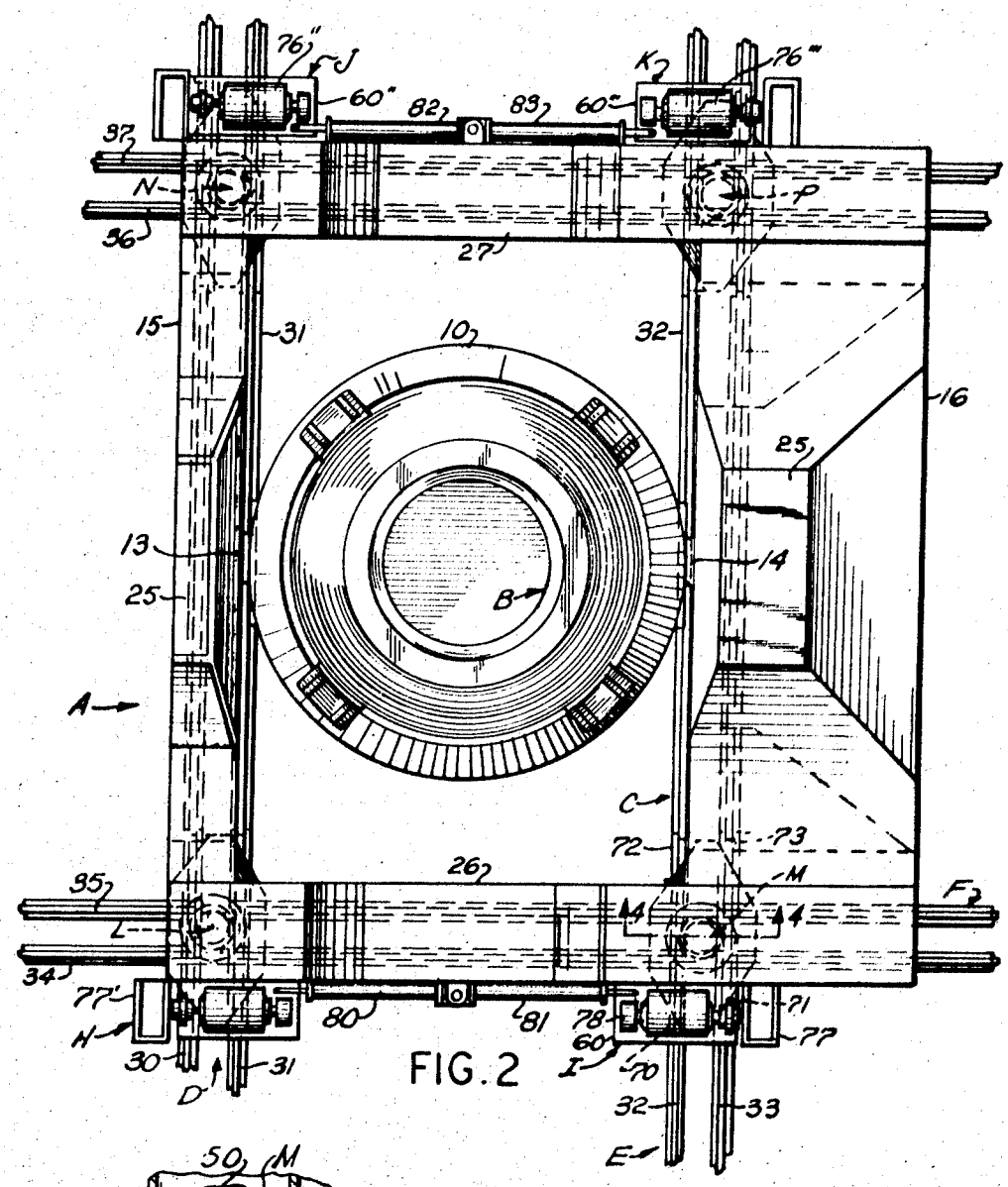

FIG. 2

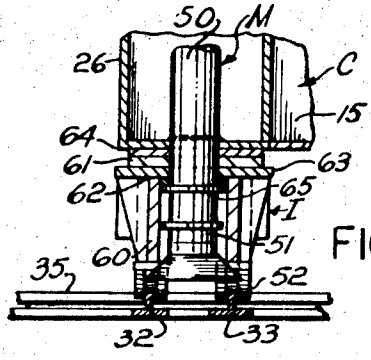

FIG. 4

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APPARATUS FOR MAKING STEEL BY THE BASIC OXYGEN PROCESS

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Continuation-in-part of application Ser. No. 514,321, Dec. 16, 1965. This application July 25, 1966, Ser. No. 567,721

Int. Cl. C21c *5/50*; F27d *3/12*

U.S. Cl. 266—39 3 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for making steel by the basic oxygen process wherein the furnace includes a plurality of wheeled trucks for facilitating movement to and from normal operating or blowing position for such operation as charging, pouring, servicing, etc.

The present invention relates to steel-making and more particularly to apparatus used in the making of steel, especially by the basic oxygen process.

This application is a continuation-in-part of our copending application Ser. No. 514,321, filed Dec. 16, 1965, entitled Method and Apparatus for Making Steel, now Patent No. 3,312,544, the disclosure of which including the specification, drawings, etc., are incorporated herein by reference.

Present day steel-making installations using the basic oxygen process usually comprise a plurality of furnaces or furnace vessels pivotally supported about horizontal axes. The furnace vessels are usually stationary, that is, not movable from one location to another in the installation. The furnaces or furnace vessels require relining and/or other servicing periodically, usually about every two weeks. The present practice is to reline and perform other services and/or operations upon the vessels while they are in their stationary operating or blowing positions. It takes three or more days to reline a furnace and during relining the furnace is out of production. When the steel being produced is being supplied to a processing installation that requires a predetermined constant or substantially constant supply of metal, an additional furnace or additional furnaces must be provided over the number which would be required to supply the demand for steel if the furnaces could be operated continuously. The necessity of providing an additional furnace or furnaces increase the overall operating cost of the installation.

It has heretofore been proposed to remove the furnaces to a service area for relining, etc., and replace the same by another furnace during the relining operation thus utilizing the auxiliary equipment, such as, the charging apparatus, etc., to the best possible advantage and thereby reducing the overall cost of producing steel for an installation of any given capacity. Prior attempts in this respect have, however, either been limited to furnaces of small capacity and/or have met with limited success.

The principal object of the present invention is the provision of a new and improved steel-making furnace, particularly one designed for use in practicing the basic oxygen process wherein the furnace is supported on or formed as a part of a transport car so that it is readily movable from its normal operating or blowing position for other operations including, charging, preheating, pouring, servicing, etc., as desired.

A more particular object of the invention is the provision of a portable basic oxygen furnace of the character mentioned so constructed and arranged that it can be moved along a track system comprising two intersecting tracks and readily transferred from one to the other of the intersecting tracks.

Another of the objects of the invention is the provision of a novel and improved movable furnace of the character referred to having a truck or trucks adapted to engage intersecting tracks and which comprise means for transferring the furnace from one track to the other which does not require any turning radius, thus making the furnace maneuverable in close quarters.

Another object of the invention is the provision of a new and improved furnace of the character referred to comprising a plurality of trucks and means for transferring the furnace from one to the other of two intersecting tracks which means comprises a plurality of hydraulically operated jacks or rams for lifting the trucks of the furnace clear of one track in combination with means for rotating the trucks to a position above the other track and subsequently lowering the furnace to engage the trucks with the second track.

The invention resides in certain constructions and combinations and arrangements of parts of a steel-making apparatus or installation, and further objects and advantages of the invention will be apparent to those skilled in the art to which it relates from the following description of the preferred embodiment described with reference to the accompanying drawings forming a part of this specification in which similar reference characters designate corresponding parts, and in which:

FIG. 1 is a front elevational view of a steel-making furnace embodying the present invention;

FIG. 2 is a plan view of the furnace shown in FIG. 1;

FIG. 3 is a side elevational view of the furnace shown in FIG. 1, looking from the right; and

FIG. 4 is an enlarged fragmentary sectional view approximately on the line 4—4 of FIG. 2.

Referring to the drawings the reference character A designates generally a movable furnace comprising a furnace proper or furnace vessel B of conventional construction carried on a trunnion ring **10** pivotally supported for oscillation about a generally horizontal axis in bearings **11** and **12** into which suitable cylindrical bosses **13** and **14** formed integral with the trunnion ring **10** at opposite sides thereof project. The bearings **11** and **12** are carried by side members **15** and **16**, respectively, of a built-up furnace frame, generally rectangular in plan. The frame, designated generally by the reference character C, is formed for the most part by metal plates welded together.

The furnace vessel B is oscillatable in the bearings **11** and **12** for charging, pouring, etc. by a suitable drive designated generally as D. The drive D is not shown in detail as it may be of any suitable construction and the source of power may be an electric motor, a fluid motor or an internal combustion engine, etc. Suffice it to say that the drive D, including a bull gear **21** keyed to the boss **14** on the right-hand side of the trunnion ring **10**, as viewed in FIGS. 1 and 2, and driven by pinions **22** and **23**. The left-hand bearing **11** is enclosed in a protective housing **24** and the right-hand bearing **12** and the drive D in a housing **25**. Both housings form part of the frame C, but are constructed to provide ready access to the operating mechanism enclosed therein.

The front and rear frame members **26** and **27**, as viewed in FIGS. 1 and 2, are depressed intermediate their ends, as shown in the figures referred to, to provide additional clearance for the furnace vessel B when tilted but this is not essential.

In the installation shown, it is assumed that the furnace A has been moved from its normal operating or blowing position and is supported on the track E at its intersection with the cross track F and in position to be transferred to the track F. The track E, shown, comprises double or

paired spaced rails 30, 31 and 32, 33 and the track F, which is of the same gauge as the track E, comprises the paired rails 34, 35 and 36, 37. The foundation or support for the tracks E and F is designated G and may be of any desired character. The track E, as previously suggested, may extend to the blowing position, etc., and the track F may extend to a service area. The furnace A includes four trucks H, I, J and K connected to the frame C adjacent to the corners thereof for movably supporting it on one or the other of the tracks E or F. The trucks are connected to the frame C for rotation about generally vertical axes. To transfer the furnace from one track to the other the frame C is raised so as to lift the wheels of the trucks H, I, J and K clear of the rails of the track upon which it is supported, the trucks rotated until the wheels thereof overlie the rails of the other track and the frame C lowered to position the furnace upon the second track. The furnace A is raised and lowered by hydraulic actuated jack means L, M, N and P, located concentric with the axis of rotation of the trucks H, I, J and K, respectively.

The trucks H to K and the jack means associated therewith are alike and only the truck I and the jack means M, associated with it, will be described in detail. The duplicate parts of the other trucks and jack means when designated by reference characters will be done so by using the same reference characters with prime, double prime and triple prime marks employed therewith when applied to trucks H, J and K, and their associated jack means, respectively.

The jack means M, associated with the truck I, comprises a fluid pressure actuated motor comprising a vertically extending cylinder 50 fixedly secured in the frame C and having a reciprocable piston rod or ram 51 projecting from its lower end. The lower end of the piston or ram 51 is provided with a circular foot member 52 adapted to engage the rails of the track upon which the wheels of the truck I rest. In the normal operation of the furnace the foot member 50 when lowered engages both tracks at their intersection. The foot member, however, may be of any desired construction and may be adapted to engage between the rails of the tracks or to span the rails as desired.

The fluid pressure acuated motor is preferably of the double acting-type so that the piston or ram 51 can be moved by fluid pressure, preferably hydraulic, in a downwardly direction to raise the frame C and the truck I when the direction of movement of the furnace is to be changed, and in the opposite direction to maintain the foot member 52 clear of the rails when the furnace is being moved along one of the tracks.

Fluid pressure may be supplied for operating the piston or ram 51 in any convenient manner. It is preferably supplied by a self-contained power unit carried by the furnace and operated by an internal combustion engine. If operated by an electric driven motor, power can be supplied by a trolley distribution system of the third rail type.

The truck I comprises a frame 60 connected to the frame C for rotation about the cylinder member or cylinder 50 of the jack means M. Suitable annular bronze ring-like members 61 and 62 are interposed between opposite sides of a plate 63 of the truck frame 60 and the adjacent plate-like member 64 of the frame C, and a ring member 65 welded to the cylinder 50. The truck I, as shown, comprises two pairs of wheels 70, 71 and 72, 73, supported on suitable axles 74, 75, respectively, connected to the frame. The wheels 70, 71 are keyed to the axle 74 and are adapted to be driven by a motor 76 supported on the frame 60 and operatively connected to the axle 74 by a suitable train of gears, enclosed in a housing 77 forming part of the frame 60. The motor provides means for moving the furnace along the track upon which it is supported, and suitable brake mechanism 78 is associated with the motor shaft so that the furnace can be held in any position to which it is moved along one or the other of the tracks.

Attention is called to the fact that the ram 51 and its foot member 52 are centrally located with respect to the wheels of the truck I and the construction is such that they do not interfere with the operation of the wheels.

In the embodiment of the invention shown, the tracks E and F cross one another at right angles, therefore the trucks H to K are pivoted through 90° in transferring the furnace from one track to the other. In the embodiment shown this is accomplished by double-acting fluid-pressure reciprocating-type motors 80, 81, 82 and 83, located at the front and rear of the furnace, as viewed in FIGS. 1 and 2, and having their pistons operatively connected with the trucks H to K, respectively. The cylinders of the motors are pivotally connected to the front and rear members 26, 27 of the frame C. As will be obvious from FIG. 2, the two front trucks and the two rear trucks are rotated in opposite directions with respect to one another in transferring the furnace from one track to the other. The motors 80 to 83 may be supplied with fluid pressure in a conventional manner, preferably from a power source such as the one previously discussed located on the furnace frame C and movable with the furnace.

From the foregoing description of the preferred embodiment of the invention it will be apparent that the objects heretofore enumerated and others have been accomplished and that there has been provided a novel and improved furnace, preferably self-propelled, especially adapted for use in the making of steel by the basic oxygen process.

While the preferred embodiment has been described in considerable detail, the invention is not limited to the particular construction shown and suggested and it is the intention to hereby cover all adaptations, modifications and uses thereof which come within the practice of those skilled in the art to which the invention relates and the scope of the appended claims.

Having thus described our invention, what we claim is:

1. A steel-making furnace of the basic oxygen type comprising a frame, a steel-making vessel pivotally supported by said frame, a plurality of trucks each individually connected to said frame for independent movement about different independent generally vertical axes, downwardly extensible jack means operably connected to said frame for raising and lowering said frame and said trucks, and means for rotating said trucks while said frame and trucks are supported by said jack means.

2. A steel-making furnace installation of the basic oxygen type comprising a trackway including first and second tracks intersecting one another, a movable furnace operable on said trackway and comprising a generally horizontal frame, a steel-making vessel pivotally supported by said frame, a plurality of trucks each individually connected to said frame for independent movement about different independent generally vertical axes, vertically extensible hydraulic jack means for raising and lowering said frame and said trucks at the intersection of said first and second tracks, means for rotating said trucks while said frame and said trucks are supported by said jack means at the intersection of said first and second tracks to move the wheels of said trucks from above one of said tracks to above the other of said tracks whereby said furnace may be transferred from one of said tracks to the other.

3. A steel-making furnace installation of the basic oxygen type comprising a trackway including first and second tracks intersecting one another, a movable furnace operable on said trackway and comprising a generally horizontal frame, a steel-making vessel pivotally supported by said frame, a plurality of trucks each individually connected to said frame for independent movement about different independent generally vertical axes, downwardly extensible hydraulic jack means operably connected to said frame for raising and lowering said

frame and said trucks, means for rotating said trucks while said frame and said trucks are supported by said jack means at the intersection of said first and second tracks to move the wheels of said trucks from above one of said tracks to above the other of said tracks whereby said furnace may be transferred from one of said tracks to the other.

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