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[54] **APPARATUS FOR REMOVING LININGS AND OR/SLAG FROM FURNACES AND THE LIKE**

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[58] Field of Search 173/43

[56] **References Cited**

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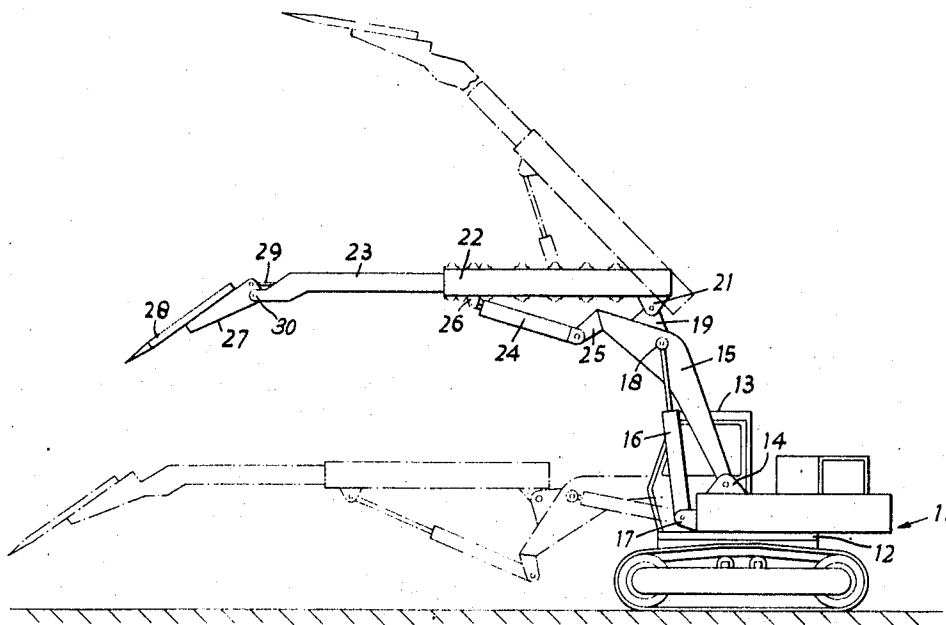
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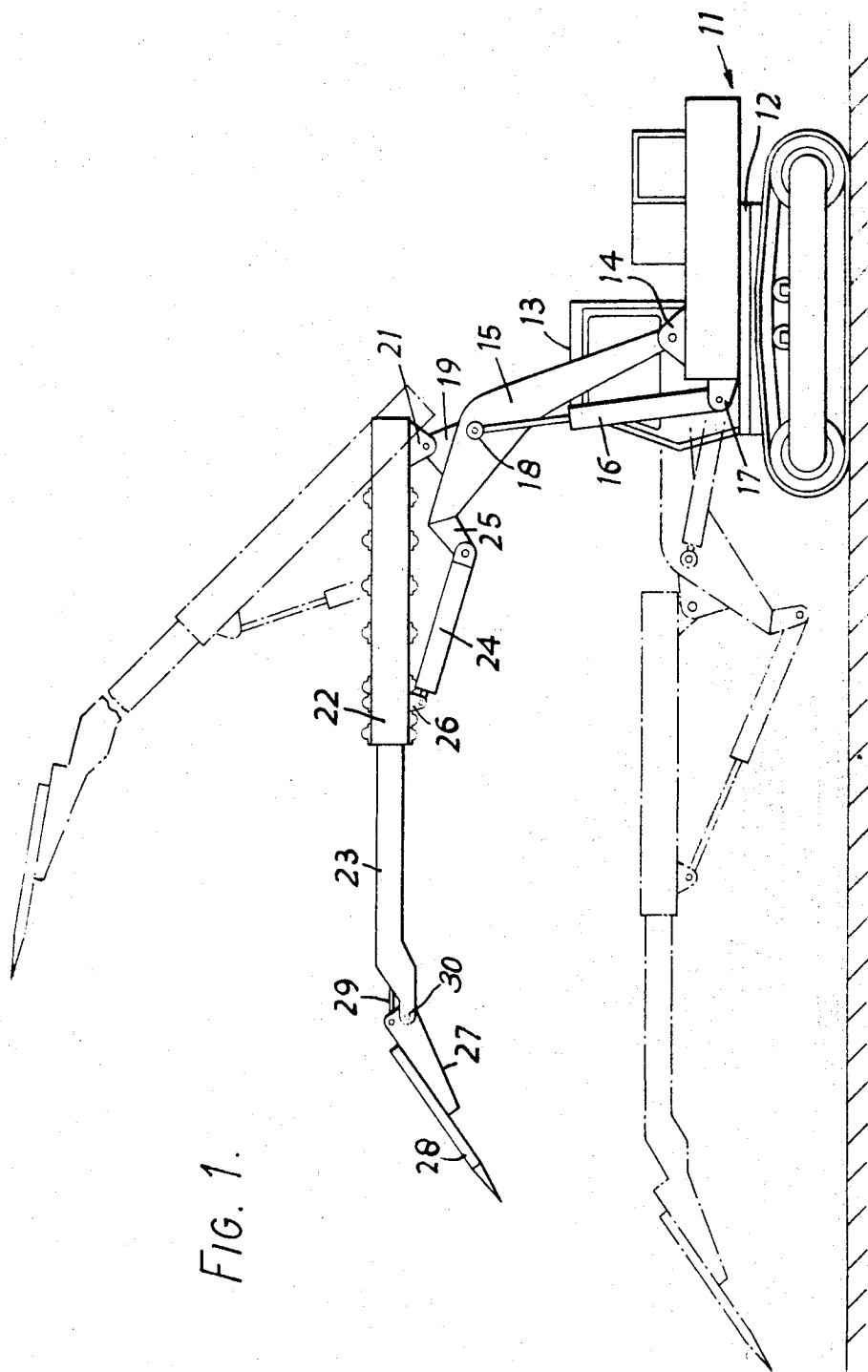
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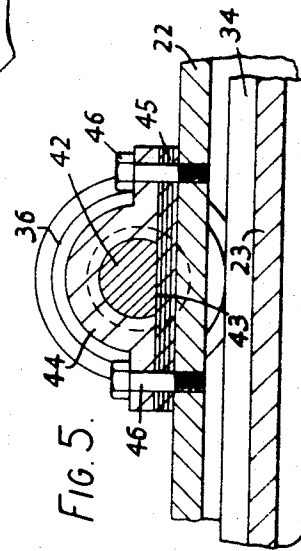
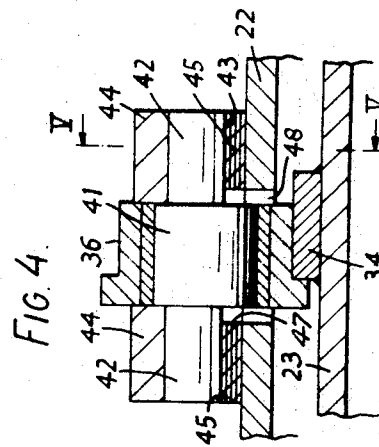
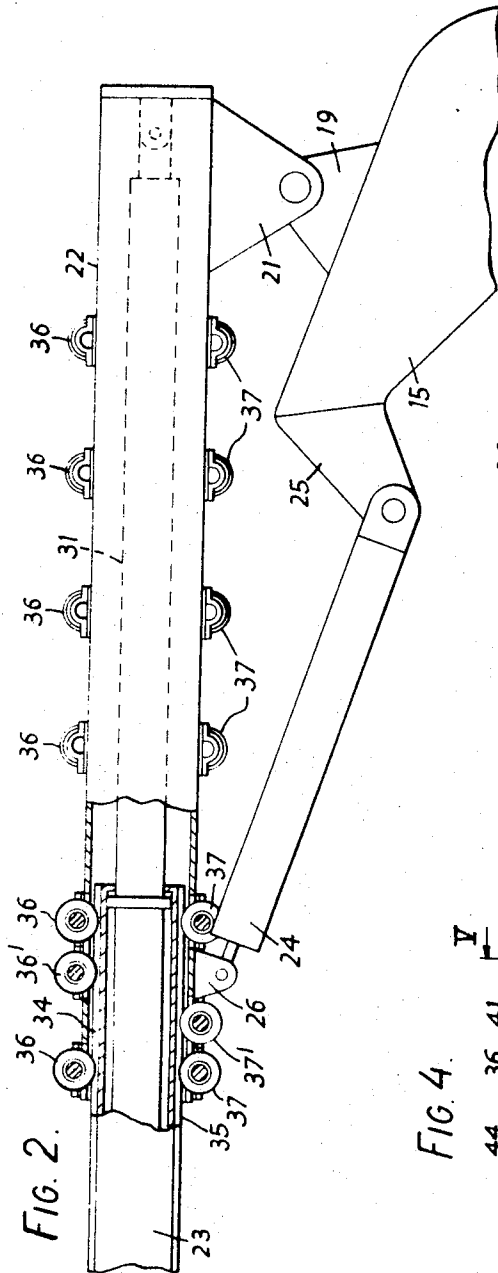
[57] ABSTRACT

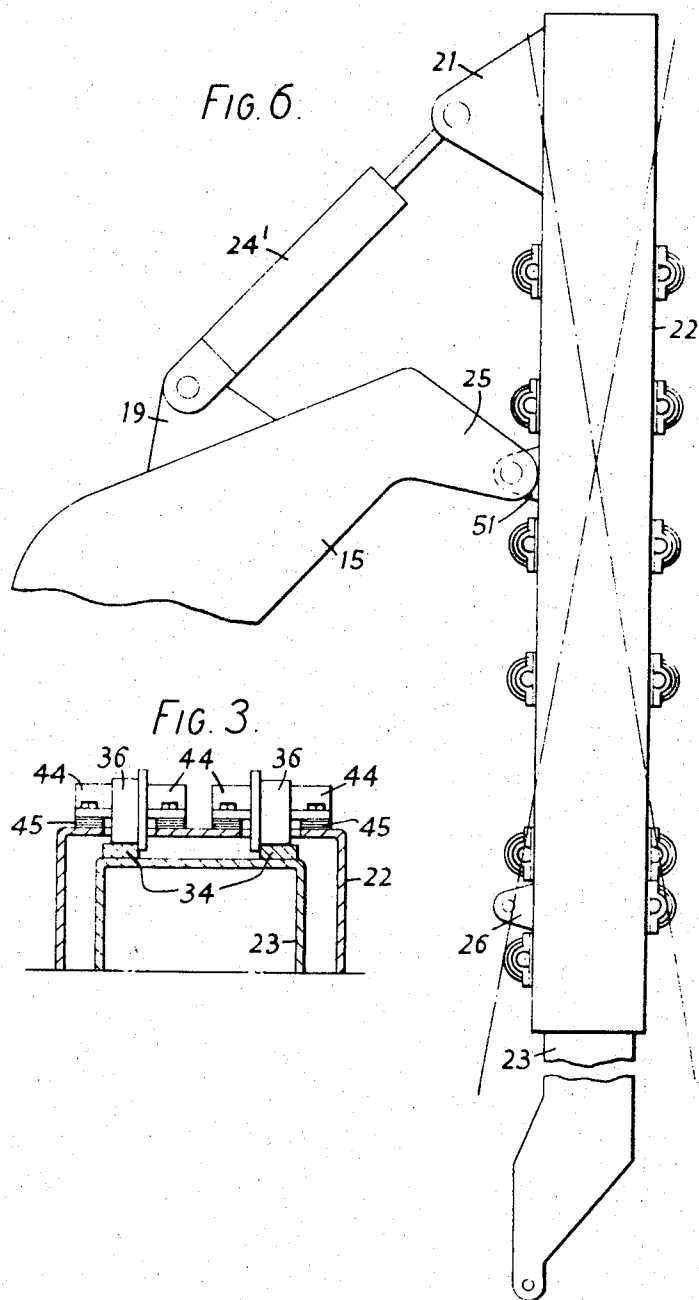
Apparatus for delining a furnace of the kind including a platform for positioning within the furnace, which platform carries a turntable on which a boom is mounted for pivotal movement in a vertical plane. A telescopic jib is pivotally connected by one of its ends to the swinging end of the boom for pivotal movement in said vertical plane. At the other end of the jib is pivotally mounted for adjustment in said vertical plane a cradle for supporting a power tool. The relative pivotal movements of the boom, jib and cradle and extension and contraction of the telescopic jib are effected by power-operated means.

6 Claims, 6 Drawing Figures









APPARATUS FOR REMOVING LININGS AND OR/SLAG FROM FURNACES AND THE LIKE

This invention relates to apparatus for removing linings and/or slag from furnaces, especially metallurgical furnaces, and from vessels, ladles and the like used in conjunction with furnaces. Such apparatus will hereafter be referred to for convenience as "furnace delining apparatus".

In British Pat. Specification No. 1,067,221 there is described and claimed a furnace delining apparatus which comprises a platform for positioning within the furnace, a turntable rotatably mounted on the platform about a vertical axis, a boom mounted on said turntable and pivotally movable in a vertical plane, and a power-actuated drilling tool mounted at an outer end portion of the boom.

In this patent specification an embodiment is described and illustrated in which the turntable is mounted on a tracked self-propelled chassis, while the platform is adapted to provide within the furnace to be delined a ground support for the tracks of this self-propelled chassis. The specification also mentions an alternative arrangement in which the tracked self-propelled chassis is dispensed with and the turntable is mounted directly on the platform.

The present invention is concerned with improvements in and modifications of those parts of the above-mentioned furnace delining apparatus whereby the power-actuated drilling tool is adjustably supported on the turntable.

The invention provides a furnace delining apparatus comprising a turntable mounted for rotation about a vertical axis on a fixed or mobile platform, a boom mounted at or near one end thereof on the turntable for pivotal movement in a vertical plane, a telescopic jib connected by one of its ends to the other end of the boom for pivotal movement in the said vertical plane between an upper position in which it is substantially aligned with the boom and a lower position in which it is inclined downwardly with respect thereto, means at the other end of the telescopic jib for mounting a power-actuated tool for pivotal movement with respect to the telescopic jib in the said vertical plane and power-operated means for raising and lowering the boom with respect to the turntable, the telescopic jib with respect to the boom and the power-actuated tool with respect to the telescopic jib and for effecting extension and retraction of the telescopic jib.

An important advantage of this arrangement is that it enables the telescopic jib to be raised and lowered through a considerable vertical distance while being maintained horizontal.

The invention also includes an alternative arrangement in which the telescopic jib, instead of being connected by one of its ends to the other end of the boom for pivotal movement between an upper position in which it is substantially aligned with the boom and a lower position in which it is inclined downwardly with respect thereto, is supported, at the said one end or at a point nearer to the said one end than to the said other end with its said other end lowermost, for pivotal movement in the said plane between inclined positions on two opposite sides of a vertical position.

This alternative arrangement is particularly useful when the apparatus is to be used for cleaning electric arc furnaces and "Kling" vessels.

The invention also includes an improved telescopic jib or telescopic boom which may be used as the telescopic jib in the improved furnace delining apparatus just referred to or as the boom in apparatus according to British Pats. Nos. 1,067,221 and 1,174,337. This improved telescopic jib or boom comprises a non-reciprocable jib or boom part of rectangular cross-section, a reciprocable jib or boom part, also of rectangular cross-section, which is mounted for telescoping movement within the non-reciprocable jib or boom part and guide means including upper parallel longitudinal guide rails fixed to the top surface of the reciprocable part, lower parallel longitudinal guide rails fixed to the bottom surface of the reciprocable part and upper and lower sets of pairs of flanged rollers arranged at intervals along the top and bottom respectively of the non-reciprocable part for rolling engagement with the upper and lower guide rails, the two sets of rollers being rotatably supported in bearings which are secured on the top and bottom respectively of the non-reciprocable part in such a manner that their positions can be adjusted individually to take up wear on the guide rails or on the rollers.

The possibility of adjusting the rollers independently of one another makes it possible to obtain truer telescopic movement than is otherwise obtainable and also to compensate for uneven wear on the guide rails.

In this telescopic jib or boom the flanges on the rollers are located on opposite sides respectively of the rollers of each pair so as to withstand side thrusts on the reciprocable part.

The bearings of each of the rollers are preferably secured to the respective top or bottom walls of the non-reciprocable part of the telescopic jib or boom by means of bearing caps which are bolted to the top and bottom walls of the box-section, non-reciprocable part with the interposition of one or more shims which can be removed and/or replaced by shims of different thickness in order to adjust the positions of the rollers as required to take up wear as mentioned above.

The platform which is a feature of the furnace delining apparatus according to British Pat. No. 1,067,221 is not an essential feature of the present invention.

Preferably those two pairs of rollers of the upper set which are nearest to the end of the non-reciprocable part remote from its pivoted end are arranged closer together than the other pairs of rollers of the upper set, while, in the case of the lower set, the second and third pairs of rollers from the said end are likewise arranged closer together than the other pairs of rollers of the lower set. This arrangement imparts to the telescopic jib or boom increased strength, and more accurate guiding of the reciprocable part thereof, at and near its fully extended condition, than is obtainable when all pairs of rollers of each set are uniformly spaced.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a side elevation of one preferred embodiment of the delining apparatus according to this invention,

FIG. 2 is a partly-sectioned, fragmentary, side elevation of a telescopic jib and certain associated parts,

FIG. 3 is a transverse section through the upper half of the telescopic jib, illustrating the arrangement of a pair of upper guide rollers, their adjustable mounting

on one part of the telescopic jib and corresponding guide rails on the other part thereof,

FIG. 4 is a fragmentary transverse section on an enlarged scale illustrating further details of one of the guide rollers,

FIG. 5 is a fragmentary section taken on the line V—V in FIG. 4, and

FIG. 6 is a fragmentary side elevation showing a telescopic jib pivotally suspended in a vertical position on the outer end of a boom.

Referring to FIG. 1 of the drawings, a self-propelled tracked chassis (which is indicated generally by the reference 11 (and in this embodiment is the chassis of a HYMAC Tracked Trenching Machine 580C) has a turntable 12 which is rotatable in known manner by a drive taken from the engine of the Vehicle via reduction gearing (not shown). Mounted well forward on one side of the turntable 12 is a cab 13 for the driver of the vehicle who will also operated the apparatus described below. Pivotally mounted on brackets 14 located alongside the cab 13 and fixed to the turntable 12 is the lower end of a boom 15. Two hydraulic elevating rams 16, only one of which is visible in FIG. 1, have the lower ends of their cylinders pivotally connected to brackets 17 fixedly supported by the turntable 12 at positions below and in front of the brackets 14, while the upper ends of their piston rods are pivotally connected to the boom 15 by pivots 18. The two rams 16 are located one on each side of the boom 15. The upper rear edge of the boom 15 is angled so that, when the boom is raised as shown in full lines in FIG. 1, the part thereof adjoining the upper end will be less steeply inclined than the part thereof adjoining the lower end. On the part of the boom adjoining its upper end are fixed brackets 19 to which is pivotally connected a downwardly projecting part 21 on the rear end of the non-reciprocable part 22 of a telescopic jib 22, 23. A hydraulic ram 24, connected between depending lugs 25 on the upper front end of the boom 15 and depending lugs 26 on the underside of the non-reciprocable part 22 of the jib, serves for elevating and lowering the jib 22, 23 relatively to the boom 15. On the front outer end of the telescoping part 23 of the jib is pivotally supported a cradle 27 on which is removably mounted a pneumatic impact hammer 28. The cylinder (not shown) of a further hydraulic ram for raising and lowering the cradle 27 is mounted within the reciprocable part 23 of the jib and has its piston rod 29 connected to the cradle 27 at a point above the pivotal connection 30 between the latter and the jib part 23.

The telescoping part 23 of the telescopic jib 22, 23 is slidably guided by means to be described later within the non-reciprocable part 22 by means of a double-acting ram housed within the jib and having its cylinder 31 (FIG. 2) and piston rod connected respectively to the jib parts 22 and 23.

The pivotal movements of the boom 15 with respect to the turntable 12, of the jib 22, 23 with respect to the boom 15 and of the cradle 27 with respect to the jib 22, 23 are all in common vertical plane. As shown in FIG. 1, the pivotal connections between the turntable 12, boom 15 and jib 22, 23 enable the jib to be raised and lowered through a considerable distance between a lower horizontal position (shown in chain-dotted lines) and a horizontal raised position (shown in full lines). Also, when required, the jib can be telescopically extended and retracted and/or pivoted upwardly from the

horizontal, e.g. to the raised position shown in broken lines in FIG. 1. In addition, the angular disposition of the cradle 27 and tool 28 with respect to the jib can be varied as required.

Referring now to FIGS. 2 to 4, the jib parts 22, 23 are both of rectangular cross-section, the inner telescoping part 23 having pairs of parallel longitudinally extending rails 34 and 35 welded respectively to its top and bottom surfaces. The outer non-reciprocable part 22 of the jib is provided with seven pairs of upper guide rollers 36, 36' for rolling engagement with the rails 34 as shown in FIG. 2 and seven pairs of lower guide rollers 37, 37' for similar rolling engagement with the rails 35. The flanges of the rollers, which are located on their inner sides (as shown in FIG. 3) are arranged to take side thrusts. As shown in FIG. 2, the six pairs of upper guide rollers indicated by the reference 36 are well spaced apart, while the seventh pair 36' of upper guide rollers is located close to that pair of upper rollers 36 which is located second from the front. The six pairs of lower guide rollers indicated by the reference 37 are likewise well spaced apart, while the seventh pair 37' is located close behind the front pair of rollers 37. This arrangement provides effective support for the telescoping part 23 of the jib when it is in the fully extended position illustrated in FIG. 2, since, in this position, two closely adjoining pairs of rollers, i.e., the pair 36' and the pair 36 immediately behind it, are available to take upwardly acting forces, and two closely adjoining pairs of rollers, i.e., the pair 37' and the pair 37 immediately in front of it, are available to take downwardly acting forces.

The manner in which the rollers 36 are mounted on the top of the jib part 22 is illustrated in FIGS. 3 to 5. The rollers 36' are all similarly mounted on the top of this jib part and the rollers 37, 37' are all similarly mounted on the bottom thereof. Each roller 36 is rotatably mounted on a cylindrical part 41 of a shaft which has reduced diameter projecting end parts 42, the bottom parts of which are cut away to form flats 43. Engaged over the end parts 42 with their bottom surfaces flush with the respective flats 43 are cap members 44. A number of shims 45 are clamped between each of the flats 43 and the bottom surface of the corresponding cap member 44 on the one hand and the top surface of the jib part 22 on the other hand by means of bolts 46 the screw-threaded shanks of which are engaged in tapped bores in the jib part 22. Apertures 47, 48 are provided in the shims 45 and in the jib part 22 to allow the lower parts of the roller 36 to project through them into engagement with the corresponding rail 34. If the roller 36 or the part of the corresponding rail 34 on which it rolls should become worn, the resulting play can be eliminated either by removing a shim 45 or by replacing one or more of the shims 45 by others of different thickness or thicknesses.

Referring to FIG. 6, it will be seen that only comparatively slight modifications of the jib 22, 23 are necessary to enable it to be suspended on the boom 15, with its tool-carrying end lowermost, for pivotal movement in two opposite directions from the vertical and in the same plane as that in which the boom 15 is pivotally movable. First, additional brackets 51 are provided on what in FIG. 2 was the underside of the jib part 22 and said jib part is pivotally connected to the lugs 25 on the boom 15 by means of these brackets. Next a hydraulic ram 24' is connected between the brackets 19 on the

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boom and the part 21 on the jib part 22. In this case, extension of the telescopic jib has the effect of lowering the tool which is supported, as described with reference to FIG. 1, on a cradle 27 (not shown in FIG. 6) pivoted on the free end of the jib part 23.

What is claimed is:

1. A delining apparatus, such as for delining furnaces, comprising:

a platform;

a turntable rotatably mounted on said platform;

a boom mounted on said turntable for pivotal movement with respect thereto in a vertical plane, said boom being provided on its swingable end with a downwardly projecting pivot support and at a position set back from said swingable end an upwardly projecting pivot support;

power-operated means for pivotally adjusting said boom with respect to said turntable;

a telescopic jib comprising a socket part and a reciprocable part arranged for telescopic extension from and retraction into said socket part, said socket part having pivot supports on its underside near its front end and rear end respectively,

said jib being mounted on said boom by a pivot connecting said rear pivot support on the underside of said socket part to the upwardly projecting pivot support on said boom,

hydraulic jack means connected between the front pivot support on the underside of said socket part and said downwardly projecting pivot support on said boom for pivotally adjusting said jib with respect to said boom; and

power-tool-supporting means mounted on said reciprocable part for pivotal movement in said vertical plane and power-operated means for pivotally adjusting said power-tool-supporting means with respect to said jib.

2. A delining apparatus, such as for delining furnaces, comprising:

a platform;

a turntable rotatably mounted on said platform;

a boom mounted on said turntable for pivotal movement with respect thereto in a vertical plane;

a telescopic jib pivotally suspended on said boom at a position near the swingable end of said boom to extend substantially vertically downwardly therefrom;

said telescopic jib comprising a socket part and a reciprocable part arranged for telescopic extension downwardly from and retraction upwardly into said socket part, said socket part having, on the side thereof facing said boom, a pivot support located near its upper end and a further pivot support located intermediate its upper and lower ends but nearer its upper end than its lower end;

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said boom having its swingable end a first pivot support and at a position set back from said swingable end an upwardly projecting second pivot support; a pivot connecting said intermediate pivot support on said socket part to said first pivot support on said boom;

hydraulic jack means connected between said pivot support near the upper end of said socket part and said second pivot support on said boom for pivotally adjusting said jib with respect to said boom;

power-tool-supporting means mounted on said reciprocable part of said jib for pivotal movement in said vertical plane; and

power-operated means for pivotally adjusting said boom with respect to said turntable and said power-tool-supporting means with respect to said jib.

3. A telescopic jib adapted for use in a furnace delining apparatus, comprising:

a socket part of rectangular cross-section;

a reciprocable jib part of rectangular cross-section mounted for telescoping movement within said socket part; and

guide means including

upper parallel longitudinal guide rails fixed to the top surface of said reciprocable part,

lower parallel longitudinal guide rails fixed to the bottom surface of said reciprocable part,

upper and lower sets of pairs of flanged rollers arranged at intervals along the top and bottom respectively of said socket part in rolling engagement with said upper and lower guide rails, the flanges of the rollers abutting inside surfaces of the upper and lower guide rails,

said sets of rollers being rotatably supported in bearings secured to the top and bottom respectively of said socket part by adjustable means whereby their positions can be adjusted individually to take up wear on said guide rails and rollers.

4. A jib according to claim 3, wherein those two rollers of said lower set which are nearest to the end of the socket part remote from its pivoted end are arranged closer together than the other pairs of rollers of said lower set and those pairs of rollers of said upper set which are second and third from the said end are arranged closer together than the other pairs of rollers of said upper set.

5. A jib according to claim 3, wherein said adjustable means includes platelike shim means clampingly held between said bearing and the respective top or bottom wall of said socket part.

6. A jib according to claim 5, wherein said shim means includes a plurality of stacked platelike shim members.

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