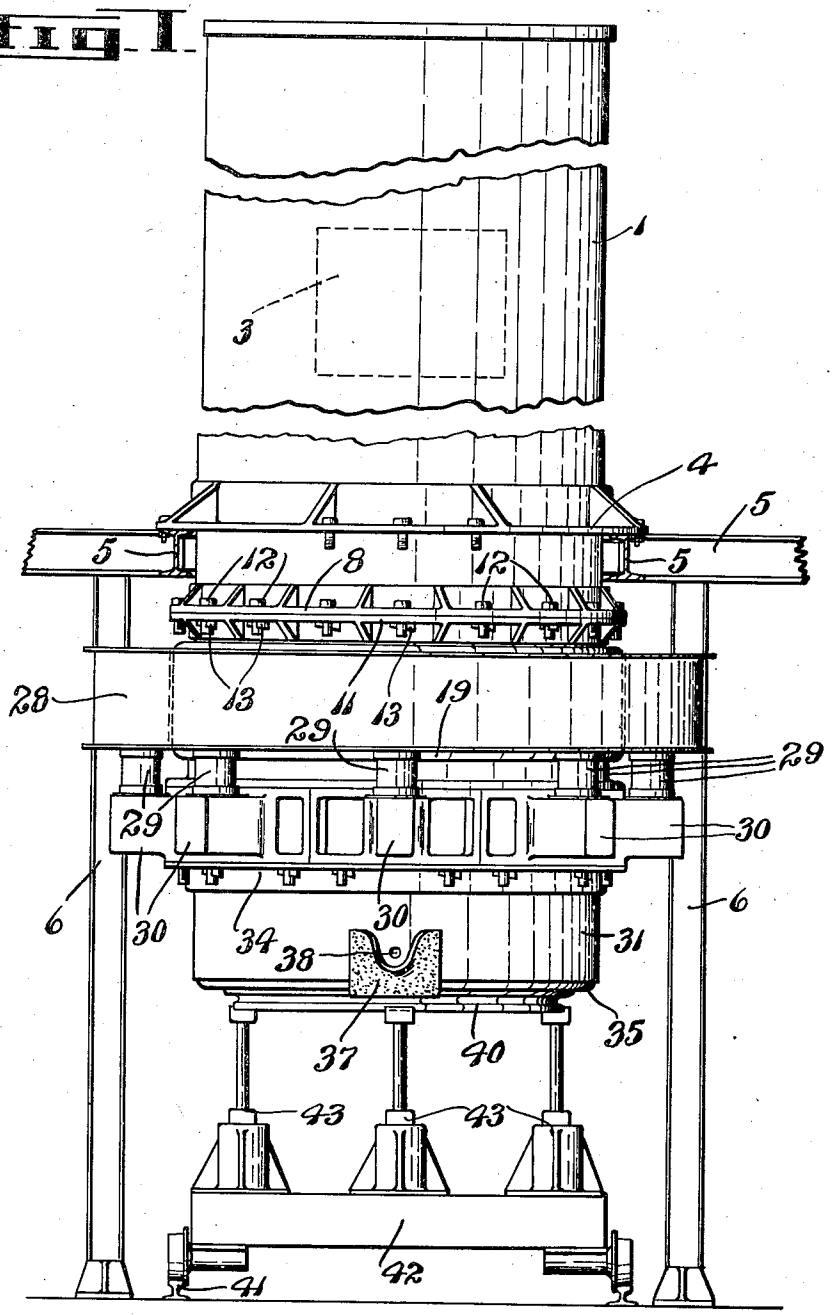
Dec. 7, 1937. L. A. GROTEWOHL 2,101,391

FOUNDRY CUPOLA

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Fig. 1.



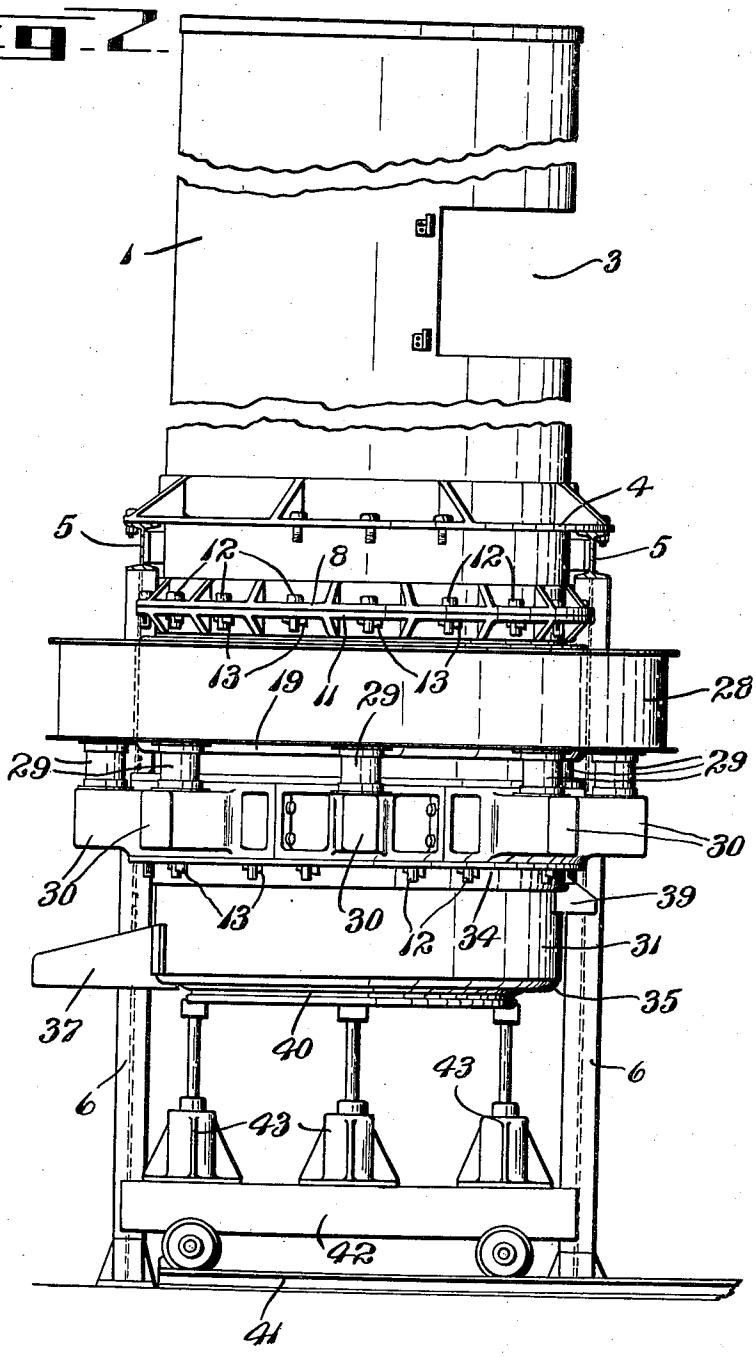
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FOUNDRY CUPOLA

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Fig. 2.



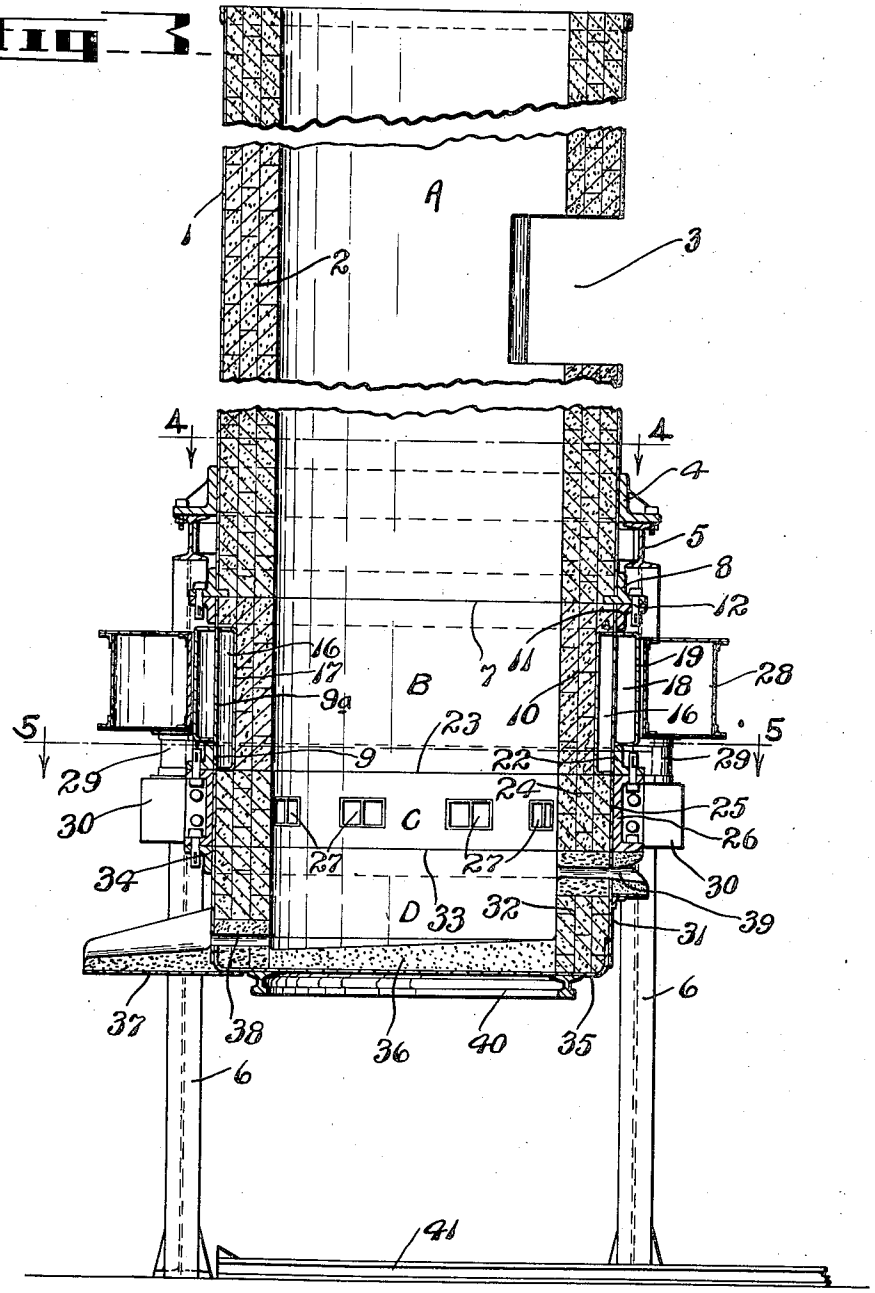
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Fig. 3.



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Fig 4

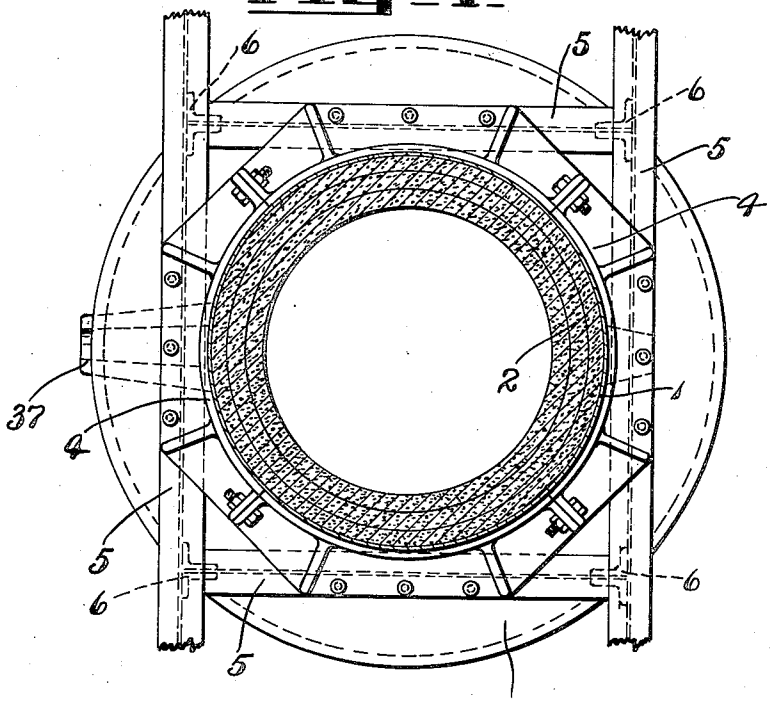
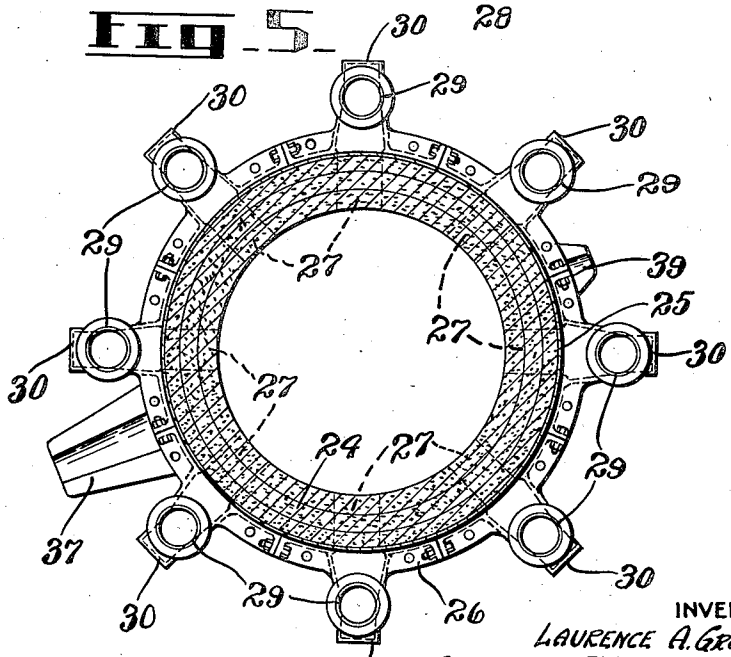


Fig 5



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Fig. 6.

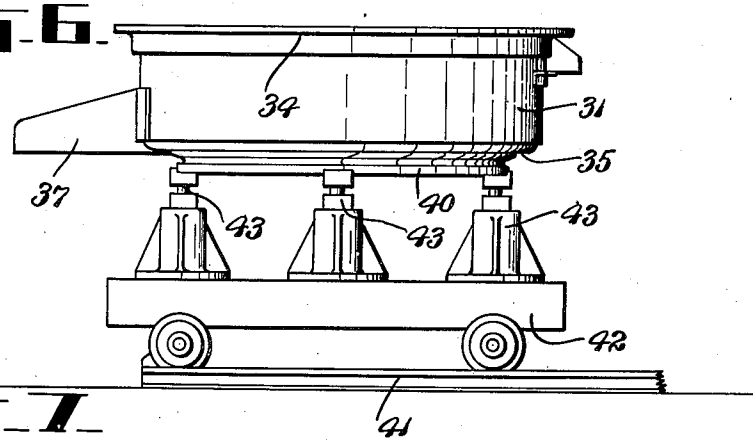


Fig. 7.

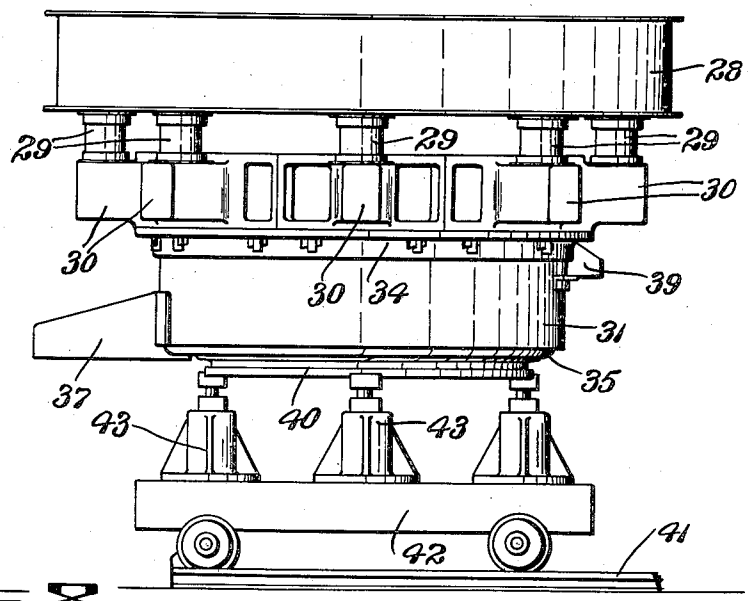
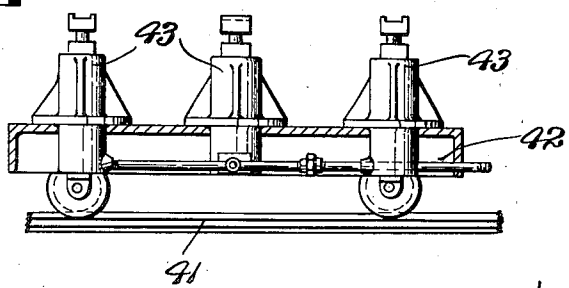


Fig. 8.



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Fig. 9.

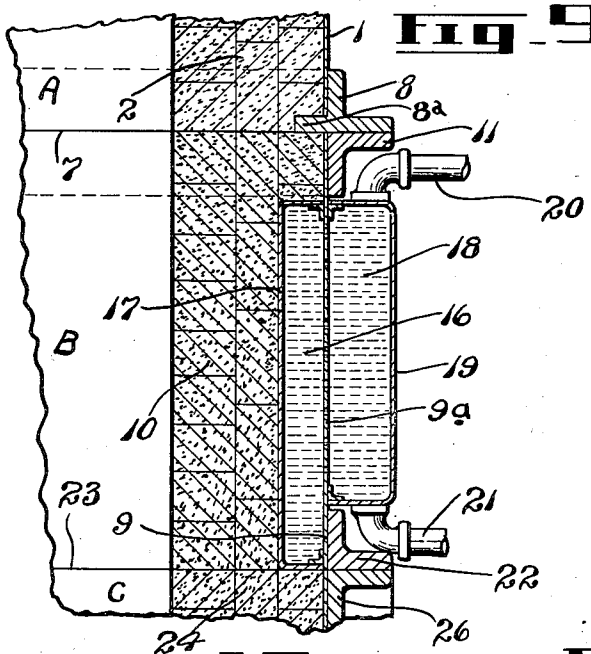


Fig. 10.

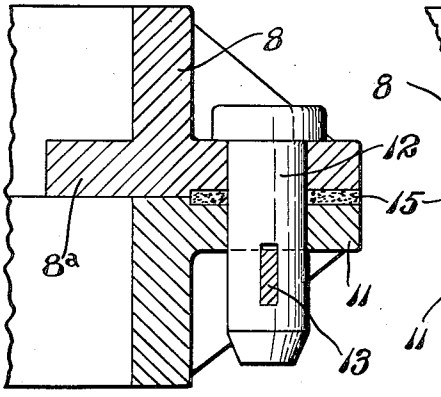
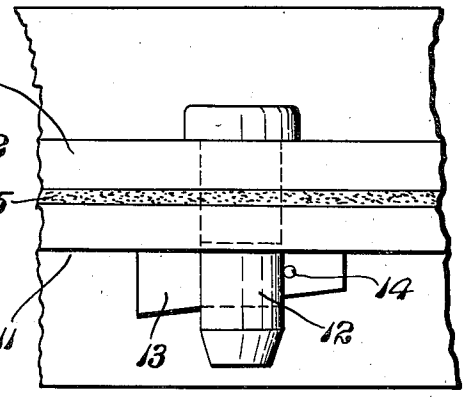


Fig. 11.



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UNITED STATES PATENT OFFICE

2,101,391

FOUNDRY CUPOLA

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Application February 3, 1936, Serial No. 62,066

4 Claims. (Cl. 266—25)

This invention relates to cupola furnaces used in foundries for the production of melted metal for casting in molds.

It is a primary object and purpose of the present invention to provide a foundry cupola which is made up of a plurality of sections located in superimposed relation, one over the other, and to detachably connect the same together in a practical, simple and effective manner whereby the lower sections, such as the well, the tuyère and the melting sections may be removed from a cupola for repair of any of the same which may be needed, and a like section or sections used for replacement of any sections which are to be repaired, thereby avoiding the necessity of having the whole cupola useless during the time that the repair of the interior lining of any part thereof is being done.

A cupola furnace, used in molding to melt and refine pig iron, or to alloy the same to produce molten iron suitable for casting, comprises essentially an outer steel shell which extends from the bottom to the top of the furnace, a stack into which material is put for charging the furnace, tuyères through which air under pressure is forced to the burning coke within the furnace whereby the iron is melted, a bottom section or well, in which the melted iron collects with a suitable outlet for the same; and the entire cupola from top to bottom is lined with fire brick or other equivalent refractory material capable of withstanding very high temperatures. The fire brick burns out under constant and severe usage and is broken and damaged in part with the dumping into the cupola, through the charging opening near the upper part thereof, of chunks of iron pigs and coke. The refractory lining usually is made of three courses of fire brick, the outer course next to the shell being of a somewhat cheaper grade, while the highest and most resistant and, therefore, most expensive grade is in the innermost course. The cupola furnaces in use are of various sizes, ranging from 18" to several feet in diameter. In operation melted iron is drawn off from time to time from the lower end portion or well of the cupola. The charges of pig iron, coke and various other ingredients which may be wanted to provide different compositions of iron are placed in the cupola at the upper end portion thereof. If the cupola never needed any repair it could be operated continuously without ever stopping.

It is apparent that when the interior lining becomes burned out or otherwise damaged by reason of service to a point where the lining needs repair, it is necessary to keep the cupola in operation without recharging with raw materials, until the materials therein are exhausted. Then before the furnace could be repaired, under previous practice, it was necessary to allow the same to cool to such a temperature that a man or men could get inside and do the repairing. The cooling could not be forced as too rapid cooling caused rapid contraction setting up strains which resulted in cracking and crumbling of the fire brick lining.

It is further evident that the fire brick lining at different places in the height of the cupola furnace is subjected to different temperatures so that in certain parts of the furnace, particularly at the melting and well portions thereof, the lining burns out and becomes destroyed earlier than at, for example, the upper portion of the cupola.

With my invention a structure has been devised whereby the cupola furnace is divided into separable horizontal sections so that it is an easy process to remove the bottom well alone, or said well with the tuyère section above it, or said well, tuyère section and the melting section above the tuyère section together. Such parts of the furnace as are removed may be taken to a repair room and if, for example, the melting section above the tuyère section is the only one needing repair, it may be replaced by a like melting section and then the whole taken back to the cupola and detachably secured again in place. There is no requirement that the sections of the furnace remaining and which do not need repair shall be cooled down. The interruption of the furnace operation is short as compared to previously long time interruption of operation while the furnace as a whole was cooling and while the lining was being repaired.

The invention for attaining the desirable results above enumerated, as well as many others not at this time stated, may be understood from the following description, taken in connection with the accompanying drawings, in which,

Fig. 1 is an elevation of a cupola furnace which embodies my invention.

Fig. 2 is an elevation at right angles to that shown in Fig. 1.

Fig. 3 is a central vertical section through the furnace.

Figs. 4 and 5 are horizontal sections substantially on the planes of lines 4—4 and 5—5, respectively, of Fig. 3, looking downwardly as indicated by the arrows.

Fig. 6 is an elevation showing the well section separated from and mounted on a truck for transporting the same.

Fig. 7 is a similar elevation of the well and tuyère and melting sections separated from the remainder of the furnace and carried in the same way by the truck.

Fig. 8 is a view of the transfer truck or car equipped with jacks for lowering and lifting the cupola sections which may be removed or used for replacement.

Fig. 9 is a fragmentary vertical section through the melting portion of the cupola illustrating the water cooling thereof.

Fig. 10 is a vertical section, and Fig. 11 is an elevation showing the detachable connecting means used for detachably securing the several sectional parts of the furnace together.

Like reference characters refer to like parts in the different figures of the drawings.

In the construction of cupola furnace illustrated, an elongated upper or charging section A, preferably of cylindrical form is provided, having an outer steel shell 1 with refractory material 2 lining the same and a charging opening 3 at one side by means of which the coke, pig iron and other ingredients are put in the cupola. A short distance above the lower end of the upper section a heavy cast steel ring 4 is secured having horizontal flanges, as best shown in Fig. 4, which rest upon I-beam frame members 5, which in turn are carried at the upper ends of vertical posts 6, the lower ends of which are anchored at the floor. This provides a permanent support for the charging section A. The lower end of the charging section is in a horizontal plane indicated at the line 7 (Fig. 3), the next section B below having a horizontal upper end to come into conjunction therewith. At the lower end and at the outer side of the steel shell 1 of said charging section A, a ring 8 of right angle cross section is secured and it may be provided with an inwardly extending flange 8a to serve as a support for the lining 2.

The next lower section B may be termed the melting section of the cupola. It has an outer steel shell enclosure 9 lined with refractory fire brick material 10, the same as the lining 2 previously described. At its upper end around its outer sides an annular ring 11 having right angle cross section, that is, two flanges located at right angles to each other, is positioned so that the horizontal legs of the two rings 8 and 11 come together when the melting section B is moving upwardly against the charging section A. Holes in conjunction with each other through said horizontal legs receive headed pins 12 which have slots therethrough below the horizontal legs of the lower angle ring 11 for the passage of drift wedges 13, which wedges have openings therethrough at 14 for cotter pins (Fig. 11). The wedges 13, also known as drift keys, serve to tightly draw the ends of the adjacent sections together and are readily removable any time when it is desired to separate the sections. The lower side of the horizontal leg of the ring 8 and the upper side of the horizontal leg of the ring 11 are recessed, as shown in Fig. 10, whereby fire clay 15 in a plastic state may be placed upon the upper side of the horizontal leg of the ring 11, and when the drift keys are driven home the fire clay is spread out and compressed, filling the recesses and providing a secure seal.

As one part of my invention the melting section is provided with a cooling means. Within the shell 9 an annular water receiving chamber 16 is made by attaching at the inner side of said shell 9 a ring 17, channel shaped in cross section (Fig. 9) so as to make a continuous chamber the width of which, preferably, is equal to the thickness of the outer course of fire clay brick used in lining the cupola. At the outer side of the shell 9 and around the water chamber 16 a continuous annular water receiving chamber 18 is made by attaching to said lining a second ring 19, channel shaped in cross section as shown in Fig. 9, with which water carrying pipes 20 and 21 are joined, one of said pipes being the inlet and the other the outlet to the annular chamber 18. The shell 9 between the chambers 16 and 18 is perforated with a large number of openings for the free passage of water from the outer chamber 18 to the inner chamber 16. It has been found that the lining 10 of the melting section B of the cupola lasts very much longer when cooled by water in accordance with the structure and use thereof which has been described.

At the lower end and outer side of the melting section B of the cupola an annular ring 22 of right angle cross section is secured, being substantially similar to the ring 8 previously described. The outwardly extending horizontal leg of the ring 22 has its lower side in substantially the same plane with the lower end surface 23 of the melting section B.

Immediately below the melting section is a relatively narrow section C, known as the tuyère section, which has the same three course fire brick lining 24 as the charging section, with an outer steel shell 25 surrounding the same, while surrounding and substantially covering the entire shell 25 is a sectional ring casting 26 which has upper and lower horizontal flanges thus making the ring of a channel form. The upper outwardly extending flange of the ring casting 26 comes against the lower side of the ring 22 and, the same connecting pins 12 with drift pins or wedges 13 are used to detachably secure the tuyère section C at the lower end of the melting section B.

Through the line 24 of the tuyère section a plurality of horizontal radial passages 27 are provided for carrying air into the cupola. A wind box 28 of continuous annular shape and, as shown, substantially rectangular in cross section, is disposed around the melting section B of the cupola immediately outside the water receiving chamber 18. From its lower side hollow supporting posts and conduits 29 extend downwardly to and may be integrally formed with or otherwise connected to radially extending hollow arms 27, whereby there are continuous conduits for air from the wind box 28 through the several post conduits 29 to the radial arms 30 and thence through the passages 27 into the cupola.

The bottom section or well D of the cupola has an outer steel shell 31 lined with fire brick lining 32 and its juncture at the lower side with the tuyère section C is in a horizontal plane as indicated at 33, the same as the junctions of the other sections are indicated at 28 and 7. An annular ring 34, like the ring 11, is secured around and at the upper end of the well D, the horizontal leg portions thereof engaging against the lower flange of the channel line ring 26 being detachably connected thereto by similar pins 12 and drift wedges 13. The bottom of the well is supplied by a sheet metal plate 35, which ordinarily is covered with a silica sand covering 26 within the cupola. The well, adjacent its lower end, has a spout 37 for guiding the molten metal when an outlet passage 28 is tapped to permit the metal to flow outward as in all cupolas. At the opposite and rear side of the cupola, a short distance above the passage 28, a blow-out 39 is provided

through which slag, dross and the like, which may be carried at the upper side of the body of molten metal within the well, may be forced out by air pressure which is entered through the tuyère passages 27. The bottom of the well is preferably reinforced by a circular or annular ring 40 of cross section similar to small railroad rails, though of course, any other form of cross section for the reinforcing member may be readily used.

On the floor of the foundry and extending under the well of the cupola furnace are spaced apart tracks 41 which lie between the opposite posts 6 supporting the cupola. A truck or transfer car 42, with wheels to run the rails 41, carries a number of jacks 43 at its upper side which, preferably, are hydraulic jacks, though the invention is in no sense limited in use to hydraulic jacks. With the jacks collapsed the truck or transfer car may be moved underneath the cupola and then the jacks extended so as to bring the upper heads of the jacks against the reinforcement 40, as shown in Fig. 2.

It is evident that with the jacks extended as shown in Fig. 2, the connecting pins 12 and the drift wedges 13 associated therewith may be removed so as to disconnect the well D from the tuyère section C. Then on lowering the jacks the well section D may be moved by moving the truck or transfer car 42 over the rails 41. It is also evident that by disconnecting the pins 12, which connect the tuyère and melting sections B and C, both the well D and tuyère section C may be lowered and removed together. Also, as shown in Fig. 7, the well D, the tuyère section C and the melting section B may all be removed together by disconnecting the melting and charging sections.

Inasmuch as the melting section B, the tuyère section C and the well D are subjected to much fiercer temperatures than the charging section A it is apparent that repair of the linings thereof is needed much more often than repair of the lining of the charging section A. Furthermore, the well section D being subjected substantially continuously to the high temperature of molten iron collected therein, and not being cooled by the water circulating construction which surrounds the melting section B, such well may need to be repaired oftener than either the section B or C. In any case whatever part of the sections below the permanent charging section A need relining repair, with my invention that part, either alone or with other parts may be disconnected, moved to a repair room where it can be permitted to cool, and any section which is left in the repair room for repair may be replaced with extra replacement sections provided for such purpose. This greatly increases the operating time a cupola furnace may have and also economizes heat losses, as the upper or charging section A does not have to be cooled down for removal of a section to be repaired or replaced with another.

The advantages described are of great value in foundry operation. The repair of the cupola lining is made much easier and safer and there is evident economy in connection therewith.

The invention is defined in the appended claims and is to be considered comprehensive of all forms of structure coming within the scope thereof.

I claim:

1. In a cupola furnace, a vertically disposed charging section, a plurality of vertical posts, means connecting the upper ends of said posts and the charging section for supporting said section by the posts, melting, tuyère and well sections of the furnace located in vertical alinement below the charging section, a second means for detachably connecting the melting section at the lower end of the charging section, a third means for detachably connecting the tuyère section at the lower end of the melting section, and a fourth means for detachably connecting the well section at the lower end of the tuyère section, said second, third and fourth means being individually operatable for the purpose described.

2. In a cupola furnace, a vertically disposed charging section, vertical posts supporting the same and extending to a floor below the lower end of the charging section, a plurality of horizontal sections located one over the other below said charging section, individually operatable means for detachably securing the said plurality of sections together, additional separate means for detachably securing the uppermost of said sections to the lower end of the charging section, and tracks extending under the furnace below the lowermost section thereof, whereby a truck may be moved underneath the cupola, as and for the purposes described.

3. A cupola furnace comprising, a plurality of vertical sections separated from each other on horizontal planes, said sections each having a metal outer shell and a fire resisting inner lining, metal members having horizontal outwardly extending flanges secured to said sections whereby said outwardly extending flanges are located at the lower end of the uppermost section, the upper end of the lowermost section and at both the upper and lower ends of intermediate sections, and means for detachably connecting together adjacent flanges at the engaging ends of said sections, whereby the sections may be readily separated and removed, one or more, from the others.

4. A construction containing the elements in combination defined in claim 3, wherein the means for detachably connecting said outwardly extending adjacent flanges comprises, headed pins passing through the flanges, said pins having each a slot therethrough, and drift wedges passing through said slots and bearing against the slots and the adjacent sides of a flange, substantially as described.

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