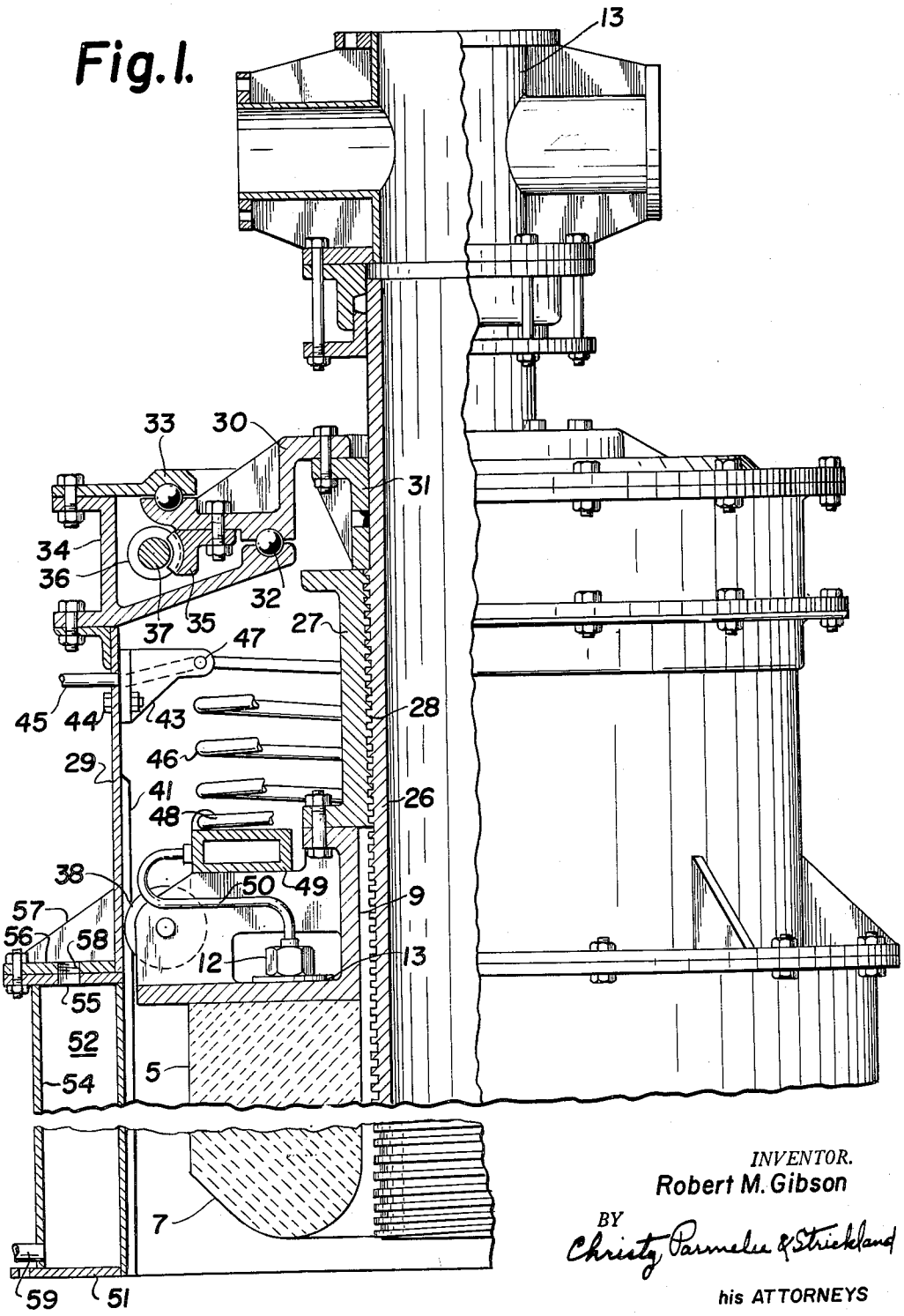
May 23, 1961 R. M. GIBSON 2,985,441

BLOWING TUBE FOR MOLTEN METAL

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Fig. 1.



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Fig.2.

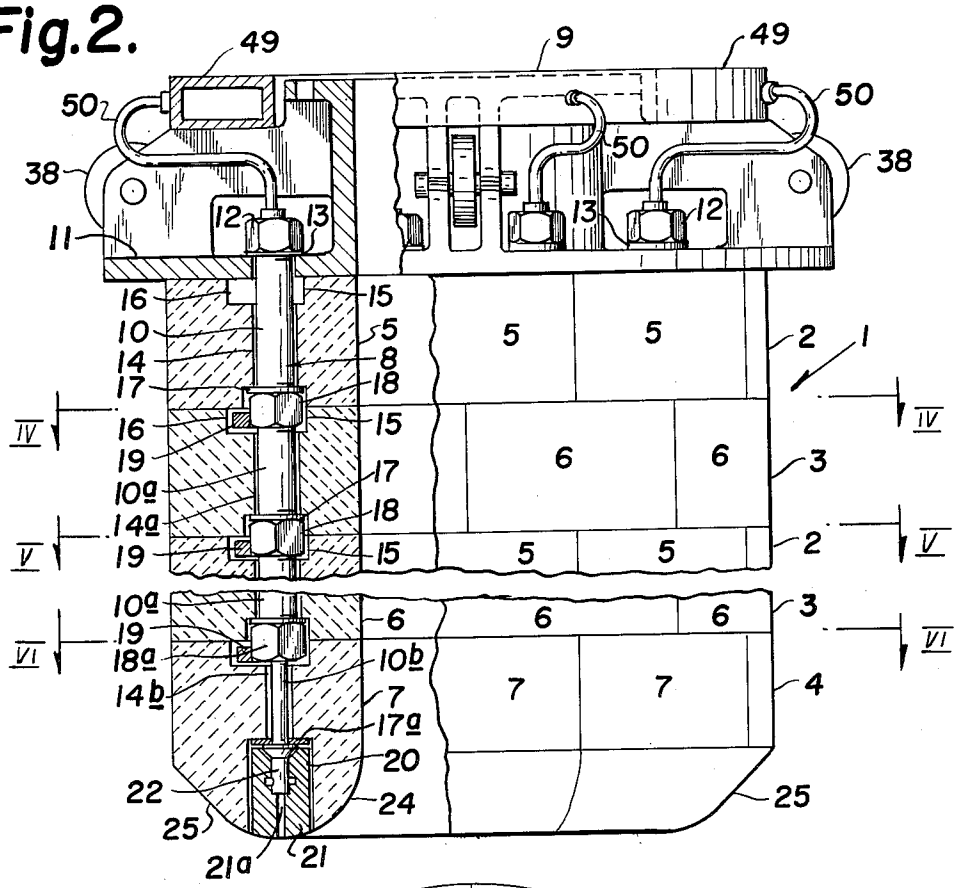
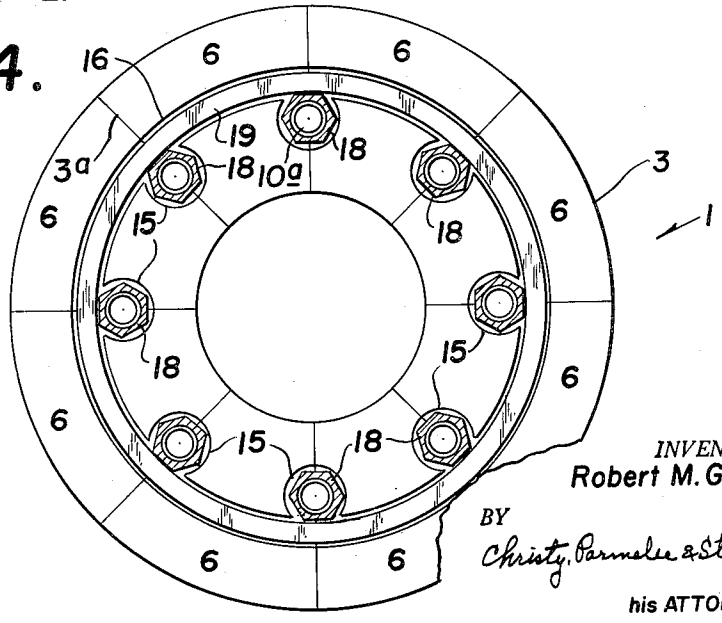


Fig.4.



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Fig. 3.

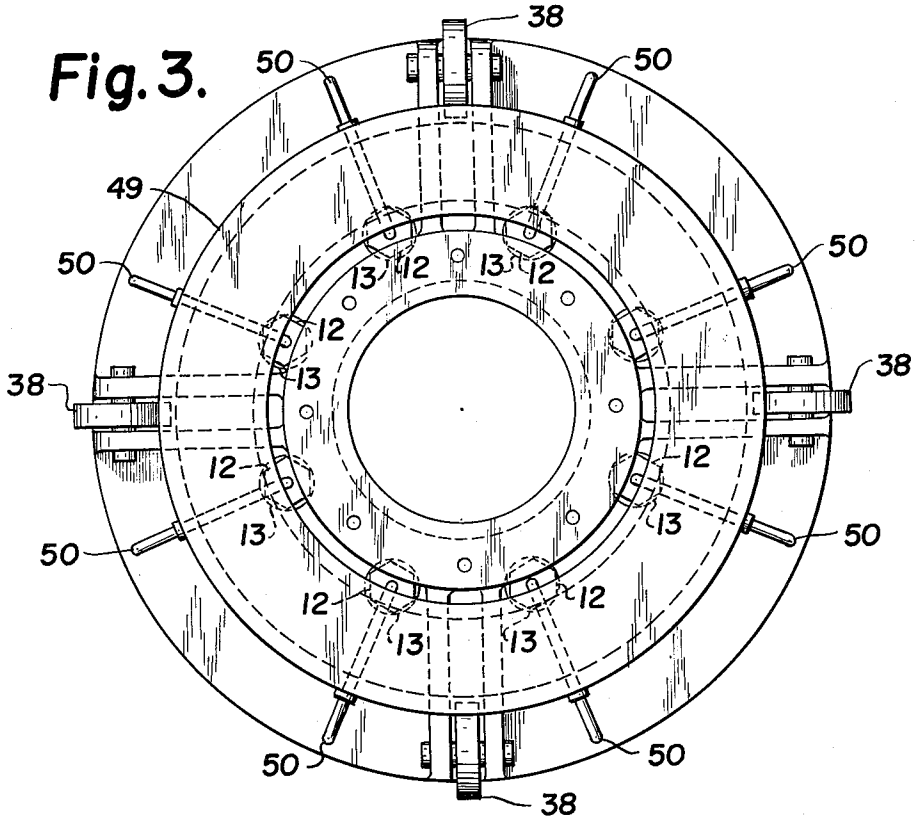


Fig. 5.

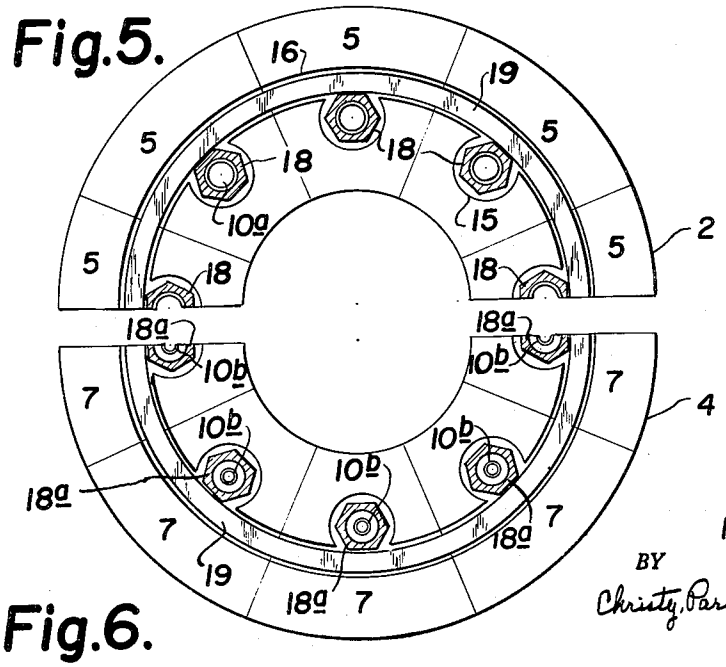


Fig. 6.

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BLOWING TUBE FOR MOLTEN METAL

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7 Claims. (Cl. 266—34)

My invention relates generally to metallurgical apparatus, for refining metal in molten state, such as apparatus for practicing the Bessemer process. More specifically, my invention relates to improvements in the blowing tube employed with such apparatus.

In Letters Patent of the United States, Number 2,472,416 granted to me June 7, 1949, and in Letters Patent 2,546,337, granted to me March 27, 1951, I have illustrated and described certain improvements in apparatus for producing steel by the Bessemer process, and reference is made to these patents for a complete understanding of the construction and operation of the metallurgical apparatus described therein.

My present invention consists in certain new and useful improvements in the blowing tube for molten metal as described and claimed in my Patent 2,472,416, to the end that the practice of the Bessemer process shall be facilitated and more readily adapted to present day large scale production, all with substantial continuity of operation with reduction in labor, time and operational expenditures.

The invention will be understood upon reference to the accompanying drawings, in which:

Fig. 1 is a fragmentary view showing partly in side elevation and partly in vertical section my improved blowing tube and its adjustable support;

Fig. 2 is a partial axial sectional view and part elevation of the blowing tube of the invention;

Fig. 3 is a top plan view of the blowing tube;

Fig. 4 is a cross-sectional view of the blowing tube, taken on lines IV—IV of Fig. 3;

Fig. 5 is a cross-sectional view of the blowing tube, taken on lines V—V of Fig. 3, and

Fig. 6 is a cross-sectional view taken on lines VI—VI of Fig. 3.

Referring to Figs. 1 to 6, the blowing tube 1 is formed of a vertical column of hollow refractory rings 2, 3 and 4, each formed of a plurality of segmental blocks 5, 6 and 7 of refractory material. The individual blocks are so formed that the hollow rings are cylindrical internally and externally, with the exception of the blocks 7 that form the lower-most ring 4 of the column and these lower-most blocks are formed with arcuate flaring bottom faces, whereby the assembly of the super-posed rings forms a refractory tube having a cylindrical bore whose lower end is outwardly flared as shown in Fig. 2. The refractory assembly of blocks is integrated by means of a plurality of supporting tubes 8 of steel or other suitable material, anchored at their upper ends to a head 9 of cast iron or steel.

Preferably there are eight of these supporting tubes and they are arranged in spaced relation circumferentially of the blow tube 1. To facilitate assembly of the refractory rings thereon, the supporting tubes 8 are comprised of pipe nipples connected by couplings. The upper end of each supporting tube is comprised of a nipple 10 extending through the horizontal web 11 of

head 9 and extends part way through a coupling 12. A washer 13 mounted beneath the coupling 12 provides a bearing support upon the said horizontal web 11. The blow tube 1 is formed of alternate rings of block segments 5 and 6, except the lower-most ring which is formed of block segments 7. Each of the block segments form one-eighth of a circle and the segments 5 and 6 each have a central cylindrical opening 14 terminating at its opposite ends in enlarged concentric openings 15 extending through the adjacent upper and lower faces of the segment. Each said segment opening 15 merges into an annular recess 16. In assembling the upper ring 2 the individual segment openings 14 are engaged over the nipple 10 into abutting relation with the under face of the horizontal web 11 of the head 9. A washer 17 is moved over the end of the nipple 10 and the coupling 18 threaded upon the lower end of the nipple to engage the washer and retain the associated segment 5 in position. After the segments 5 of ring 2 are thus assembled, a steel ring 19 encircles all of the couplings and serves to reinforce the tube laterally.

The segments 6 of the refractory rings 3 are also one-eighth of a circle as shown in Fig. 4. These fit between the tubes 8 so that the joints formed between the segments of these rings are in staggered relation to the joints between segments in the adjacent rings. Each segment 6, therefore, has a semi-circular recess 14*a* in each side wall 3*a* for reception of nipple 10*a* and one-half the concentric enlarged openings 15*a* for reception of coupling 18. Each segment 6 is, however, provided with the annular recess 15, in the upper face thereof. In assembling the segments 6, the nipple 10*a* is first threaded into the coupling 18, and, thereafter, the segments 6 are disposed between the nipples, the washers 17 slid over the end of the nipple and the assembly of nipple, segments and washers are held in place by the couplings 18. Again, a reinforcing ring 19 is slid over the couplings 18 and a refractory ring of block segments 5 is assembled as previously described. This assembly of alternate rings is continued until the bottom-most ring of the tube which is formed of the block segments 7. These ring segments, like the ring segments 5, have a central opening 14*b* for reception of a nipple 10*b* of preferably smaller size than the previous nipples 10*a*. Central opening 14*b* terminates at the upper face of the segment in an enlarged opening as in segments 5 and 6 and at the lower end of the central opening 14*b* is an enlarged concentric opening which extends to the bottom face of the block segments. The lower-most coupling 18*a* varies from the other couplings 18 in that one-half of the central opening of the coupling is of smaller diameter to receive the smaller sized nipple. 10*b*. The block segments 7 are engaged over the nipple 10*b*, a washer 17*a* is mounted on the nipple and a nozzle member 21 is threaded upon the nipple 10*b* to retain the block segment 7 in place. The nozzle 21 is preferably formed of refractory material having a metal insert 22 in the upper end of the portion for threading upon the nipple and provided with a central discharge opening communicating with the discharge opening 21*a* in the nozzle 21. As shown in Fig. 2 the block segments 7 have an inner arcuate face 24 and an outer flaring face 25.

In service, the blowing tube 1 is secured as by bolts 26, Fig. 1, to a sleeve-nut 27 that engages an externally threaded hollow spindle 28 which is rotatably borne by an upper housing 29. More particularly, a collar portion 30 is rigidly united to a knee-ring 31 welded or otherwise locked upon the hollow spindle 28, and this collar portion rides two races 32 and 33 of anti-friction bearings provided in head 34 that forms the upper end of

housing 29. A worm gear 35 is carried by the collar portion 30, and a worm-pinion 36, mounted on a shaft 37, meshes with the gear 35. Suitable means (not shown) are provided for rotating shaft 37 selectively in either direction of rotation, whereby the collar portion 30 and the threaded spindle 28 may be rotated in either direction within the sleeve-nut 27. Means are provided for preventing the sleeve-nut from rotating, and such means comprise rollers 38 which are trunnioned between paired webs 39 on the cast metal head of the blowing tube, and at their edges extend between vertical metal strips 41 that are welded in parallel pairs upon the inner surface of the housing 29, the strips in each pair being spaced apart a sufficient interval to provide a vertical way for the rollers 38. The upper end of the rotary hollow spindle 28 is hermetically united to a header 42 whence the blast of air and the reagent materials are delivered, and the bore of this spindle 28 forms with the bore of the blow tube 1 a continuous passageway to the surface of the molten metal into which the tube is injected. The structure and mode of operation as described in this paragraph forms no part of this invention and are more fully described in my Patent 2,472,416 hereinbefore referred to.

Mounted upon the inner face of housing 39, above the head 9 of the blow tube 1, is a hollow bracket 43 held in place by any suitable means, such as bolts 44. An inlet connection 45 for steam and oxygen extends through housing 39 into the hollow interior of bracket 43. Encircling the nut 27, connected to the head 9 of blow tube 1, is a flexible helically coiled tube 46. The upper end of tube 46 is connected by means of a suitable swivel coupling 47, to the interior of hollow bracket 43. The lower end of tube 46 is connected by means of a suitable swivel coupling 48 to a hollow circular header 49 mounted upon blowing tube head 9. Each blowing tube support tube 8 has the coupling 12 at the top thereof connected to said circular header 45 by the inlet tube 50. By this means oxygen and/or steam may be injected into the metal being treated, by the blow tube 1, either with or without air moving through the central opening in the blow tube.

As discussed in my prior Patent 2,472,416, the blowing tube is progressively ejected from the casing 29 into the molten metal within the ladle for the two fold purpose of burning out the silicon of the molten metal and ejection of accumulating slag from the ladle. During this operation the blow tube is heated from contact with the molten metal and such heat passes upwardly into the portions of the blow tube remaining within the casing 29.

In my improved form of blow tube, the lower end of casing 29 is provided with a water cooled jacket. As shown in Fig. 1 of the present drawings, the lower end of casing 29 is provided with an annular flange 51 projecting outwardly therefrom to provide a bottom closure wall for a cooling jacket 52 and a bolting flange 53 for attachment to a connecting casing as described in my hereinbefore mentioned patent. Such cooling jacket is defined by wall plate 54 disposed in spaced relation to casing plate 29 and extending upwardly from flange 51 to adjacent the horizontal web of the blow tube top plate in fully retracted position. The top of jacket 52 is defined by a pair of annular plate members 55, 56 disposed in overlapping relation and reinforced by a plurality of braces 57 spaced circumferentially about casing 29 and secured thereto and to member 56. Suitable connecting means such as 58 in plate members 55, 56 and 59 in wall plate 54 provide for circulation of cooling water through the water jacket 52 and dissipation of heat from the blow tube within casing 29.

The optical system arranged above the blow tube and the displacement of metal from within the submerging blow tube by inblown air through the central passageway of the blow tube, as described in my Patent 2,472,416 provided many advantages therein both as to speed and control of the reaction. In my improved blow tube, oxygen or steam, or both, may be blown, under pressure,

through the tubes 8 and about the circumference of the lower end of the central opening of the blow tube 1 into the molten metal.

Preferably the blast air from the blow tube central opening is employed to retain all the advantages resulting therefrom and also because it is the cheapest form of oxygen. The nitrogen in the blast air adds well known desirable qualities to the steel and the substantial volume thereof dissipates heat, which is greatly to be desired. The mixture of steam and oxygen emitted from the tubes 8 provides its own endothermic reaction with the metal serving to further reduce the blowing time and the desired oxidation of the carbon by the heat.

The jointed construction of the hollow tubes 8 provides a convenient and rapid means for replacing the lower refractory blocks. The form of the refractory blocks makes ready removal and replacement possible with a minimum of labor. The steel rings imbedded within the recesses of the refractory blocks resist internal pressure within the blow tube. The water jacket provides adequate dissipation of the rising heat in the refractory blocks of the blow tube and materially extends the life of all but the lowermost rings of blocks.

The invention is defined in the appended claims, and it will be understood that within the terms of such claims many variations and modifications of the structure described are permissible without departing from the spirit of the invention.

I claim:

1. A blowing tube for metallurgical use comprising an elongated refractory hollow tube of superposed abutting rings of block segments with the joints between segments of one ring staggered with relation to the joints between segments of each adjacent ring, a plurality of circumferentially spaced metal tubular members enclosed by said block segment and disposed between the inner and outer circumference of said refractory rings, each said tubular members having its upper end extending through the upper end of said blow tube and its lower end terminating within the lower end of said blow tube, the lower ring of the blow tube being provided with a plurality of circumferentially spaced openings extending inwardly from the bottom face thereof into communication with said embedded tubular members, a refractory nozzle member within each said lower ring circumferentially spaced openings, and means connected with said blow tube central and circumferentially spaced openings for introduction of air through the central opening and oxygen supplying gaseous mediums to the circumferentially spaced openings.

2. The blow tube as defined in claim 1, wherein each said metal tubular member comprises a pipe nipple disposed within each said refractory ring, the abutting faces of each said rings having inwardly recessed opening therein concentric with said aligned pipe nipples and a pipe coupling disposed in each said recessed opening connecting the ends of the adjacent aligned pipe nipples, said couplings providing adjustable vertical support for the respective refractory ring upon said hollow tubular members.

3. A blowing tube of the character described, comprising an elongated hollow refractory member of superposed rings of abutting block segments, a plurality of circumferentially arranged segmental hollow tubular members extending longitudinally of said refractory member and embedding within said rings thereof, each said hollow tubular member comprising an end segment projecting from the exposed face of the upper ring of the blow tube and terminating short of the opposite face of said end ring, a segment disposed within each of the intermediate rings of said blow tube and terminating in spaced relation to each of the opposite faces of said abutting rings, a hollow tubular segment disposed within the lower end ring of said blow tube and terminating short of the opposite faces thereof, each said rings having

enlarged recessed openings in their abutting faces concentric with and larger in diameter than said tubular member segments, coupling members connecting the adjacent ends of said tubular member segments and disposed within adjacent recesses of the abutting faces of said rings, each said coupling members adjustably supporting a block segment of the ring disposed above the coupling.

4. The blowing tube as defined in claim 3, wherein a metal head member, having a transverse web, is disposed upon the upper end of the blowing tube in abutting engagement with the exposed face of the adjacent refractory ring of the tube, said head member web being provided with openings therethrough concentric with the central and the circumferentially spaced tubular openings in said adjacent ring, said projecting member segments extending through registering web opening, and coupling members connecting said projecting segments to the head member.

5. The blowing ring as defined in claim 3, wherein the bottom-most refractory ring has an opening therein extending inwardly from the outer face thereof concentric with and larger than the tubular member segment therein, and a nozzle member within said concentric opening

connected to said tubular member segment supporting the enclosing refractory ring from said segment.

6. The blowing tube as defined in claim 4 wherein, said blow tube head member is connected with a source of air from movement under pressure through the central opening of said blow tube, and means on said head member for selectively supplying steam and oxygen to each said blow tube hollow tubular member couplings upon said head member.

7. The blowing ring as defined in claim 5 wherein the upper face of each said refractory rings has an annular recess therein enclosing said couplings and a metal ring member disposed in said recess and encircling said couplings resisting lateral pressure from air within the blowing tube central opening.

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