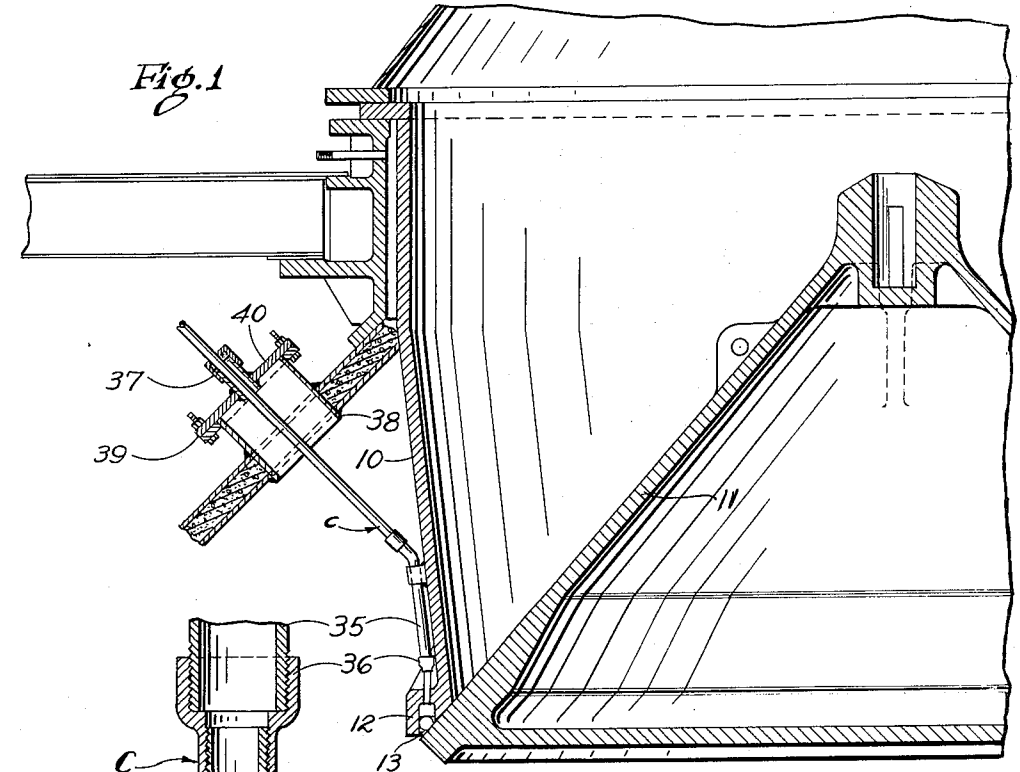
June 3, 1952 A. LATHAM, JR 2,599,334

SEAL FOR BLAST FURNACE HOPPERS AND BELLS

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Fig. 1



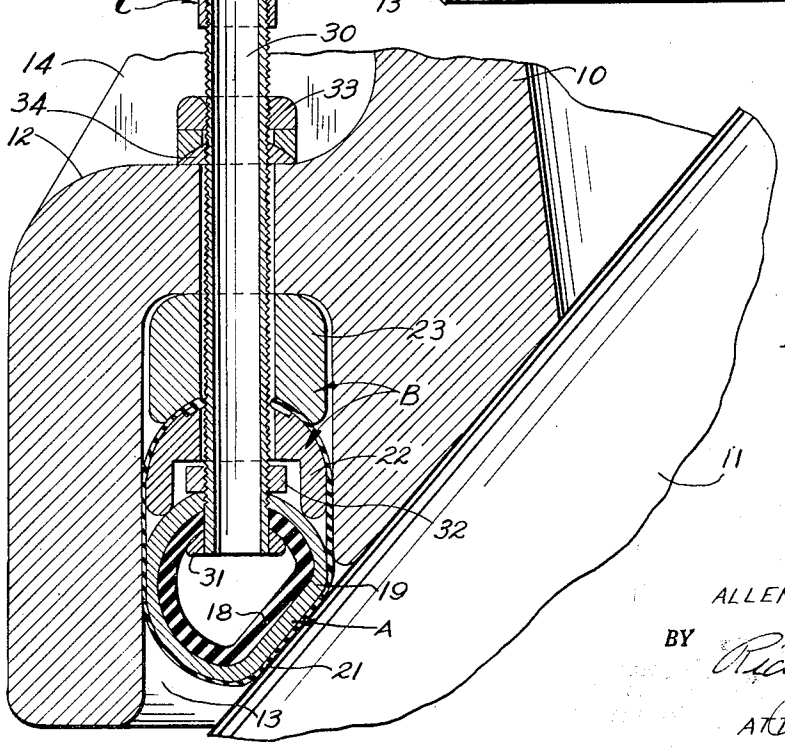


Fig. 2

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SEAL FOR BLAST FURNACE HOPPERS AND BELLS

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Fig. 4

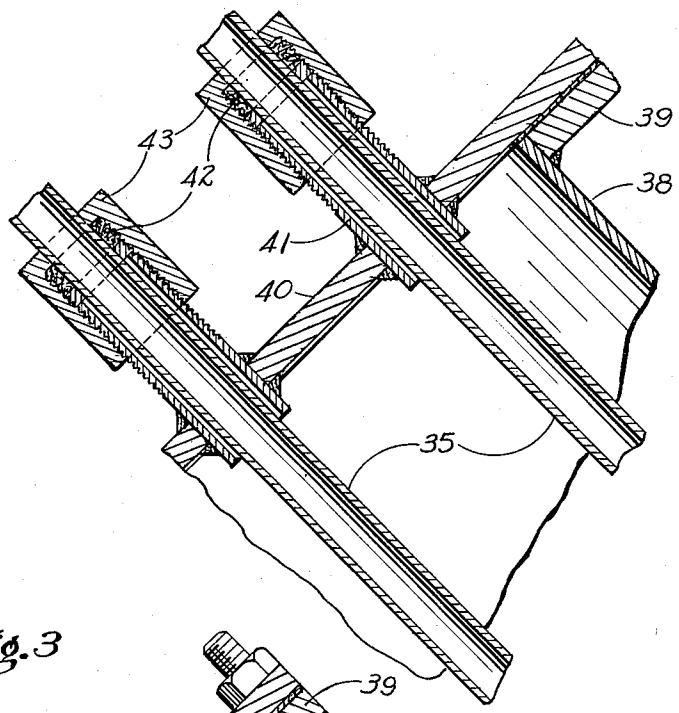
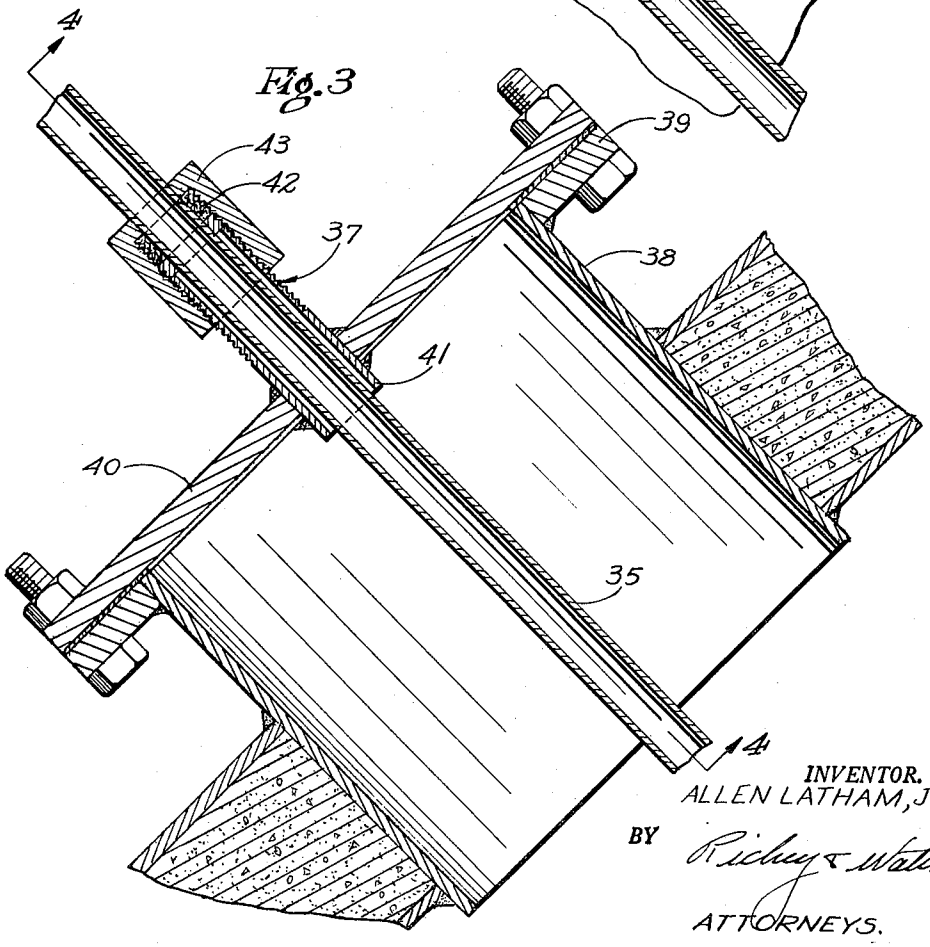


Fig. 3



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SEAL FOR BLAST FURNACE HOPPERS AND BELLS

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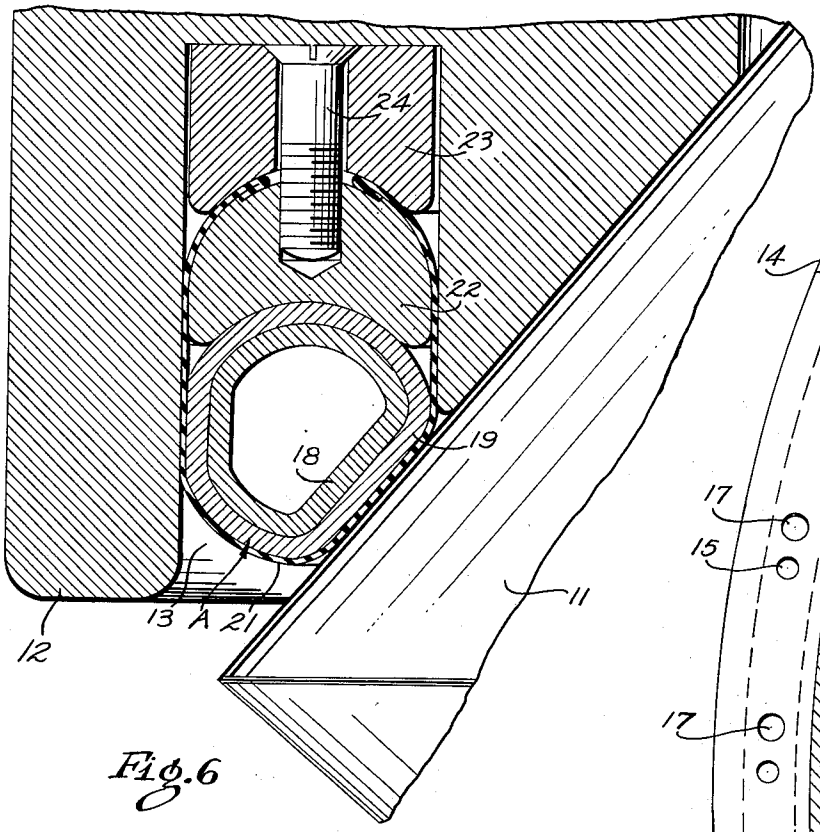


Fig. 6

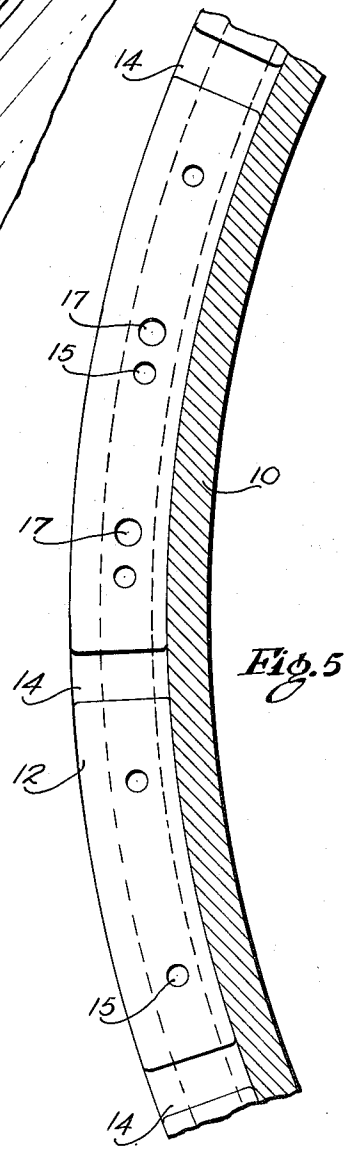


Fig. 5

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2,599,334

UNITED STATES PATENT OFFICE

2,599,334

SEAL FOR BLAST FURNACE HOPPERS AND BELLS

Allen Latham, Jr., Jamaica Plain, Mass., assignor, by mesne assignments, to Republic Steel Corporation, Cleveland, Ohio, a corporation of New Jersey

Application July 26, 1947, Serial No. 763,821

10 Claims. (Cl. 214—36)

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The present invention relates generally to seals for bells and hoppers of blast furnaces, and is more particularly concerned with novel tubular and resilient sealing means for this purpose.

In the operation of an ordinary blast furnace, there is leakage of top gases around the engaging surfaces of the big bell and hopper, which represents a substantial economical loss and a hazard to personnel. This problem recently has assumed added importance, due to the development of techniques for operating furnaces at substantially higher pressures than heretofore; that is, at pressures in excess of about five pounds per square inch. The advantages to be gained by employing high pressures in this way are numerous and very important, but can not be realized unless perfect or substantially perfect bell and hopper sealing can be accomplished. In a high pressure blast furnace system, not only does the top gas leak between the bell and the hopper, but it does so at such a high rate and carries with it such a large amount of flue dust, compared to the normal pressure operation, that the engaging surfaces of the bell and the hopper may be rapidly worn away and any sealing effect originally obtained is destroyed after a short period of operation.

I have accomplished satisfactory bell and hopper sealing in accordance with this invention, through the use of a flexible, heat resistant material which is located in a blast furnace between opposing surfaces of the big bell and hopper so that the sealing is automatically accomplished when the bell is moved into a predetermined position adjacent to the hopper. Preferably, the present sealing means includes a tubular annulus of flexible material which may be filled with a fluid to serve as a cooling medium, thus to prevent rapid deterioration or destruction of the parts thereof by the heat of the furnace. This annulus is mounted in such a way as to be protected against damaging contact with said charging materials flowing into the top of the furnace and is inflated with cooling fluid to assure a gas-tight fit between the bell and hopper under practically any pressure conditions obtaining within the furnace.

This invention will be better understood by those skilled in the art upon referring to the following detailed description and the drawings accompanying and forming a part of this specification, in which:

Figure 1 is a fragmentary, cross-sectional view of a blast furnace bell and hopper assembly

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equipped with one form of sealing means of this invention;

Figure 2 is a fragmentary, cross-sectional view on an enlarged scale of the lower flanged edge portion of the hopper of Figure 1 showing one form of means of this invention assembled in the hopper;

Figure 3 is an enlarged, fragmentary view of a stuffing sealing box shown in Figure 1 for pipes communicating with the sealing means;

Figure 4 is a fragmentary view taken on line 4—4 of Figure 3;

Figure 5 is a fragmentary plan view of the flange portion of the hopper of Figure 1; and

Figure 6 is a fragmentary, cross-sectional view similar to that of Figure 2 but taken at another place on the flanged edge portion of the hopper.

The illustrated means of this invention generally comprises hollow, flexible and resilient means A disposed at the lower edge of a blast furnace hopper 10 for engagement with the lower surface of charging bell 11 to seal the bell and hopper assembly, means B for retaining the said resilient means in position relative to the hopper, and means C for delivering cooling fluid to the resilient means and for removing the said fluid therefrom continuously.

Hopper 10 is provided with a flanged lower edge portion 12 having an annular recess 13 to receive resilient means and elements of the retaining means therefor. This flanged portion, as shown in Fig. 5, is provided with a plurality of spaced apart, integrally formed ribs 14 and with a plurality of apertures 15 communicating with recess 13 at regular intervals around the flange. Two additional apertures 17 are provided in the flange to receive an element of the means for delivering fluid to and removing fluid from resilient sealing means A.

The resilient means of this form of my invention comprises an annular elastomeric hose 18 enclosed in heat resistant hose 19, and a jacket 21 disposed as an annulus in recess 13. The jacket may preferably be of Teflon, that is polytetrafluoroethylene or other synthetic heat resistant resin having similar elastic properties, while hoses 18 and 19 may suitably be of rubber and asbestos, respectively. Hoses 18 and 19 are each provided with two openings spaced apart a short distance to receive fittings for delivering a cooling fluid into the inner hose 18 and removing fluid therefrom. A plug or block (not shown) is disposed in hose 18 between the two fittings to force the fluid to flow around the length of the hose, thereby to maintain resilient means A at a temperature

sufficiently low that the seal will not be damaged by furnace heat. In order that the portions of the hose adjacent to the plug may be cooled sufficiently, the plug may be of porous material or apertured to permit slight but sufficient cooling fluid flow therethrough.

Retaining means B comprises a pair of annular blocks 22 and 23 made up of a plurality of segments and grooved in their engaging faces to receive and securely grip the upper portion of jacket 21. Preferably the breaks between the segments of block 22 and those of block 23 are staggered. These blocks are joined together by a plurality of short flush head screws 24, the upper block 23 having openings sufficiently large to receive these screws without contact, and the lower block 22 having threaded openings in which screws 24 may be secured. These blocks are retained in recess 13 by means of bolts or solid rods (not shown) which extend through openings 15 in the flange of the hopper, holes in block 23 and are threaded into block 22. Sealing means (not shown) such as asbestos packing may be provided for use with said bolts to prevent gas leakage from recess 13.

Cooling fluid for the resilient means, suitably water, is delivered to the inner rubber hose and removed therefrom by means of two hollow, externally threaded tubes 30 extending through the openings in hoses 18 and 19 and having lower flanged end portions 31 disposed within tube 18. These tubes 30 assist the solid rods in holding the blocks and resilient means in recess 13. Nuts 32 screwed onto connections 30 engage hoses 18 and in cooperation with flanges 31 securely grip the hoses and produce fluid-tight connections. The connections are secured in fluid-tight engagement with the hopper by means of nuts 33 and washers 34 having convex surfaces to assure sealing engagement of the washers with nuts 33 and the outer surface of flange 12 around the connections. Two pipes 35 communicating with a source of cooling fluid (not shown) outside the furnace are connected to tubes 30 at the upper end thereof by means of couplings 36 thus defining a system through which cooling water may flow from the reservoir through resilient sealing means and back to the reservoir. A pump (not shown) may be provided to cause this flow and govern the rate thereof, and valves (not shown) may also be provided. Pipes 35 extend upwardly a short distance along the outside surface of hopper 10 and are then bent away from the hopper and extend through stuffing boxes 37 positioned in the dome wall of the furnace. Each of these stuffing boxes comprises an open-ended cylinder 38 having an apertured flange 39, a cover plate 40 bolted to flange 39, closing the outer end of the cylinder, and a tube or sleeve 41 welded to plate 40 and extending through an opening in said plate to receive one of the pipes. Packing 42, preferably of asbestos, is provided to prevent the escape of gases around the pipes, and is retained in place by a fitting 43 threaded on sleeve 41 which is provided with an aperture through which the pipe 35 may extend.

In the use of this assembly, before the furnace is brought to temperature, water flow is begun through one of the pipes 35 into hose 18 and thence through the other pipe and back to the water reservoir. Cooling of the water may be effected in any convenient manner, and the water temperature is preferably regulated according to the rate of flow of water through the system, so that hoses 18 and 19 and jacket 21 will not be damaged or destroyed by the heat of the furnace. The pressure of the water within hose 18 is established and maintained by means of the pump and/or valves aforementioned at about 10 pounds per square inch above the gas pressure in the furnace to insure gas-tight sealing engagement of jacket 21 and bell 11 when slips or rolls occur, as well as during normal furnace operation.

The illustrated apparatus is assembled by securing the pipes in position and making the necessary connections between them to the water supply. Hose 18, encased in hose 19, with the apertures of both in register is secured to the two tubes 30, as illustrated, with flanges 31 in hose 18, and nuts 32 drawn up on the connections in tight engagement with the hoses. Blocks 22 and 23 are assembled and screws 24 holding them together are drawn up with the ends of jacket 21 clamped between the opposing surfaces of the blocks, the hoses being carried within the jacket. The blocks are then assembled in recess 13, the tubes 30 extending through apertures 17 and bolted in tight engagement with the hopper. Nuts 33 on tubes 30 are drawn up so that washers 34 seal apertures 17 against leakage of gas around the connections. Coupling 36 is attached to the upper end of each tube 30 and pipe 35.

Having thus described the invention so that others skilled in the art may be able to understand and practice the same, I state that what I desire to secure by Letters Patent is defined in what is claimed.

What is claimed is:

1. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having a flexible hollow annulus secured to its lower edge to be engaged by the bell for sealing the bell and hopper against the flow of gases therebetween, and means including tubes communicating with the annulus for causing cooling fluid to flow through said annulus.

2. In a blast furnace top assembly including a charging bell, a charging hopper having resilient means secured to its lower edge to be engaged by the bell for sealing the bell and hopper against the flow of gases therebetween, said resilient means comprising a flexible hollow annulus and a heat resistant flexible shell enclosing said annulus.

3. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having resilient means secured to its lower edge to be engaged by the bell for sealing the bell and hopper against the flow of gases therebetween, and means for cooling said resilient means, said resilient means comprising an annular rubber tube, an annular asbestos tube enclosing said rubber tube, and an annular jacket enclosing the rubber and asbestos tubes, said cooling means comprising a source of cooling fluid and pipes communicating with said source and the rubber tube to enable flow of said fluid from the source to and through said rubber tube.

4. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having a recess in its lower end portion, tubular resilient means in the recess for engaging the bell and sealing the bell and hopper against the flow of gases therebetween, and means carried by the hopper and adjustable relative thereto for positioning and retaining said resilient means in said recess.

5. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having a recess in its lower end portion, re-

silient means in the recess for engaging the bell and sealing the bell and hopper against the flow of gases therebetween, and means for positioning and retaining said resilient means in said recess, said positioning and retaining means including a plurality of tubes spaced apart around said hopper and secured thereto and extending through apertures therein and engaging said resilient means.

6. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having a recess in its lower end portion, resilient means in said recess for engaging the bell and sealing the bell and hopper against the flow of gases therebetween, and a plurality of apertures in said portion communicating with said recess, and means for positioning and retaining said resilient means in said recess, said positioning and retaining means including a plurality of flanged externally threaded tubes spaced apart around said hopper and extending through said apertures and engaging said resilient means, means including nuts engaged with the tubes to prevent relative movement of the tubes and hopper, and packing means between said nuts and hopper for preventing gas flow through the apertures around the tubes.

7. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having a recess in its lower end portion, resilient means in the recess for engaging the bell and sealing the bell and hopper against the flow of gases therebetween, and a plurality of apertures in said portion communicating with said recess, and means for positioning and retaining said resilient means in said recess, said positioning and retaining means including a plurality of flanged externally threaded tubes spaced apart around said hopper and extending through said apertures and engaging said resilient means, means including a plurality of blocks in said recess and bearing against said tubes and resilient means to prevent relative movement of the tubes and resilient means beyond a predetermined limit, and packing means bearing against the tubes for sealing the apertures against gas flow therethrough.

8. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having a recess in its lower end portion, and a plurality of apertures in said portion communicating with said recess, resilient means in said recess for engaging the bell and sealing the bell and hopper against the flow of gases therebetween, and means for positioning and retaining said resilient means in said recess, said resilient means comprising a flexible annulus and a flexible heat resistant shell enclosing said annulus, and said positioning and retaining means including a plurality of spaced apart externally threaded tubes extending through said apertures and having flanged end portions disposed in and bearing against said flexible annulus.

9. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having resilient means secured to its lower edge to be engaged by the bell for sealing the bell and hopper against the flow of gases therebetween, and means for cooling said resilient means and maintaining a fluid pressure therein substantially in excess of normal gas pressure within the furnace, said resilient means comprising an annular rubber tube, an annular asbestos tube enclosing said rubber tube, and an annular jacket enclosing the rubber and asbestos tubes, said cooling and fluid pressure maintaining means comprising a source of cooling fluid and pipes communicating with said source and the rubber tube to enable flow of said fluid from the source to and through said rubber tube.

10. In a blast furnace top assembly including a charging bell, the combination of a charging hopper having a recess in its lower end portion and a plurality of apertures in said portion communicating with said recess, resilient means in said recess for engaging the bell and sealing the bell and hopper against the flow of gases therebetween, means for cooling said resilient means and maintaining a fluid pressure therein about 10 pounds per square inch greater than the gas pressure within the furnace, and means for positioning and retaining said resilient means in said recess, said resilient means comprising an annular rubber tube, an annular asbestos tube enclosing the rubber tube, and an annular jacket of heat resistant material enclosing the rubber and asbestos tubes, said positioning and retaining means comprising a plurality of spaced apart externally threaded hollow rods extending through said apertures and having flanged end portions disposed in and bearing against said rubber tube, a plurality of blocks in said recess screwed onto said rods and gripping between them the edges of said jacket, nuts screwed onto the rods to limit relative movement of the rods and hopper and packing means for preventing gas flow through the apertures, and said cooling means and fluid pressure maintaining means comprising a source of cooling liquid, pipes communicating with said source, and couplings joining the pipes to the rods to enable cooling liquid flow from the source to and through the rubber tube.

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