Dec. 8, 1953 W. T. BROWN 2,662,053

HERMETIC SEAL FOR COKE OVEN DOORS

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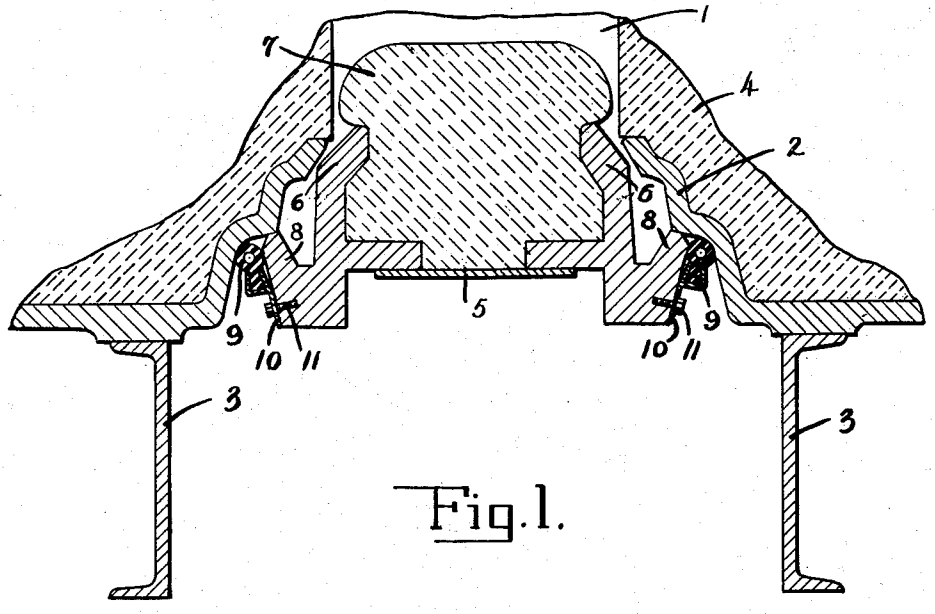


Fig. 1.

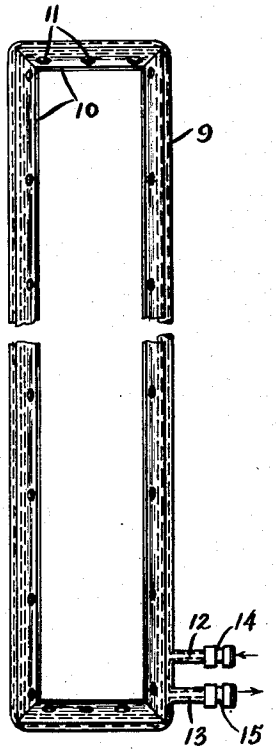


Fig. 2.

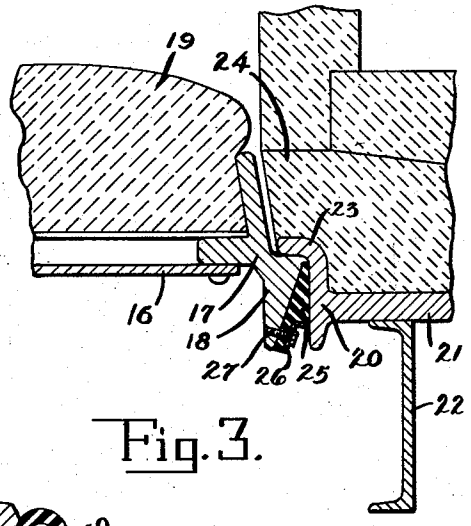


Fig. 3.

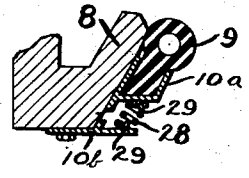


Fig. 4.

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HERMETIC SEAL FOR COKE OVEN DOORS

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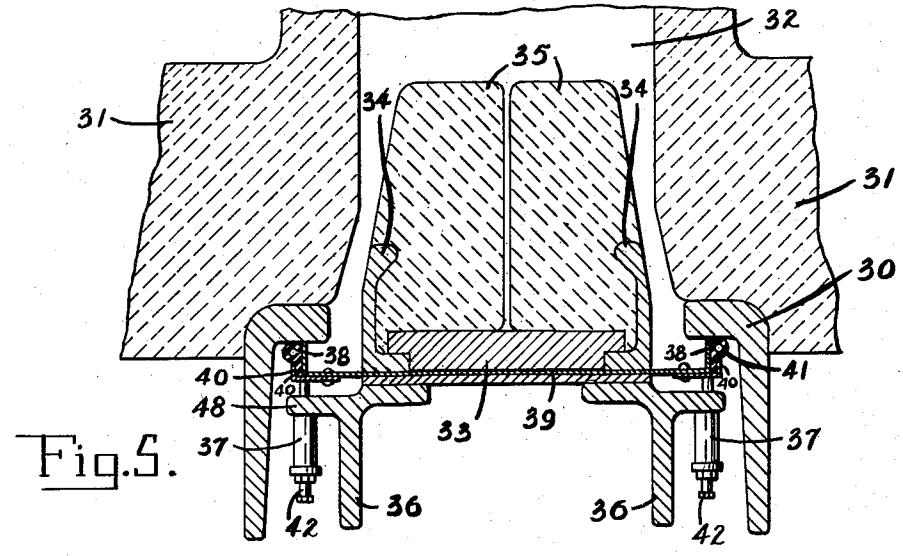


Fig. 5.

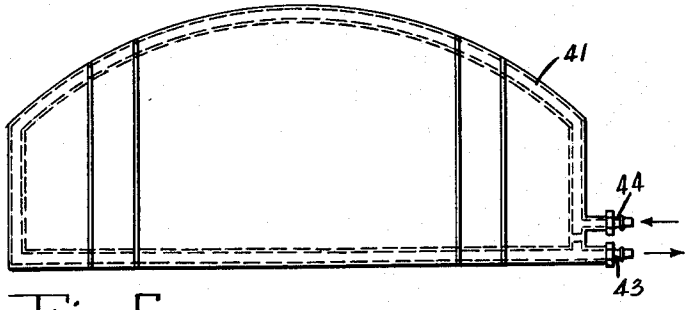


Fig. 6.

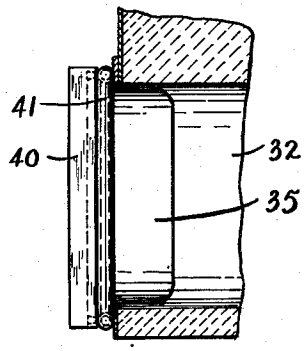


Fig. 7.

Fig. 8.

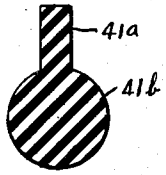


Fig. 9.

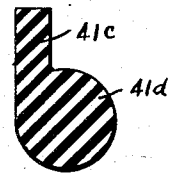


Fig. 10.



Fig. 11.



Fig. 12.



Fig. 13.

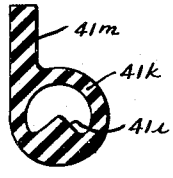


Fig. 14.

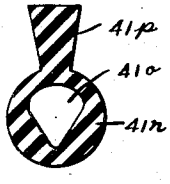


Fig. 15.



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HERMETIC SEAL FOR COKE OVEN DOORS

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Application September 26, 1950, Serial No. 186,739

9 Claims. (Cl. 202—243)

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The present invention relates to an attachment for hermetically sealing coke oven doors, but which is also useful for closures on other apparatus for distilling, carbonizing or gasifying coal, oil, pitch, asphalt, asphaltites or shale.

For over a century, numerous types of seals have been devised in an effort to provide a satisfactory means for hermetically sealing doors of coke ovens and, more recently, by-product coke ovens, but up to the present time, a completely satisfactory seal has not been attained.

By-product coke oven doors must be closed tightly so that no air will enter the oven chambers and damage the quality of coke and gas and so that coke oven gases will not leak out. More specifically, by providing a hermetic seal about the peripheral edge portion of the door, air is prevented from entering the oven chamber which would otherwise cause some of the coke or gases to burn, thereby diluting the coke oven gases with nitrogen and lowering the heating value. When coke is burned, the ash content of the remaining coke is increased and when the gases are burned inside the coke oven, the tops are overheated and considerable carbon is formed on the walls and tops of the oven resulting in a reduction of the yield and quality of the by-products. By-product coke ovens must be hermetically sealed to prevent gases from escaping around the doors because they are generally ignited by the hot brickwork and burn, causing warping of the coke oven doors, door jambs and steel binding holding the brickwork in place.

Formerly, doors on by-product coke ovens were flat and were held against the ends of the coke oven brickwork. The end heating flues were kept away from the doors and the coal charge was dropped into the center part of the oven to prevent black or partially coked ends near the doors. An early improvement was to bring the end flues nearer the oven doors in order to coke the whole coal charge, but this resulted in excessive heating of the doors. The doors were then improved by lining them with fire-brick and extending them into the oven to the end heating flues. This was followed by many improvements in design of the doors and door jambs.

A common means employed in many existing coke ovens in order to close the oven chamber air-tight and minimize excessive heating and warping of the door is to press the door on with bars and wedge it against the face of the coking chamber and lute the peripheral joint around the door with clay or a clay and coke braize mixture. Heating insulation is generally effected by

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lining the door with fire-brick. Such luting with clay does not hermetically seal the door satisfactorily and prevent leakage of air into the coke oven or leakage of the coke oven gases to the outside. Such luting by clay also has the outstanding disadvantage of requiring considerable time for mixing and handling of the luting material and involves considerable cost for applying such material. Furthermore, the coke is oftentimes contaminated with the high ash luting material.

One of the most recent improvements in coke oven doors is the development of a self-sealing door wherein the door is seated against a heavy one-piece cast iron jamb with a machined face to receive the sealing edge of the door. The door is either of steel or cast iron frame lined with fire-brick or pre-cast insulating material. A spring steel sealing diaphragm is held in place against the door jamb by self-adjusting, spring-loaded plungers placed around the periphery of the sealing diaphragm. While such self-sealing coke oven doors constitute a great improvement over the old design of luted doors and save considerable time and eliminate the operating cost for mixing and handling of the luting clay, nevertheless, such self-sealing doors are not entirely satisfactory since they do not hermetically seal by-product coke oven doors at all times. The door jambs and the steel knife edges become warped after operation of the coke oven and despite the adjusting means provided, it is almost impossible to adjust the spring plungers and to hold the knife edges in place so that they make proper contact with the machined edges of the cast iron door jambs.

An object of the present invention is to provide a novel means for hermetically sealing by-product coke oven doors which is devoid of the disadvantages of the above-mentioned commonly used sealing means for such doors, and which is effective to provide a hermetic seal even when such doors or door jambs are warped or cracked, also, which is adaptable to coke oven doors of various existing designs or new designs.

A more specific object of the present invention is to provide an attachment for hermetically sealing coke oven doors which may be readily attached to old designs of doors for by-product coke ovens to take the place of the seals provided by luting with clay or similar luting material, and thereby eliminate the time and cost of mixing and handling luting material and of applying it about the periphery of the doors to hermetically seal the oven and thus eliminate

the tendency of contamination of the coke by high ash luting material.

Another object of the present invention is to provide an adapter or attachment which may be readily attached to present designs of self-sealing doors for by-product coke ovens to provide an effective hermetic seal when the knife edges are worn or the door or door jamb is cracked or warped so as to insure maintenance of the hermetic seal over a relatively long period of time despite high operating temperatures.

A still further object of the present invention is to provide an attachment for new designs of by-product coke oven doors, which attachment per se will constitute the sole means for hermetically sealing the door to prevent leakage of air or coke oven gases.

A still further object of the present invention is to provide a novel high temperature resistant sealing attachment for coke oven doors incorporating means for improving the heat resisting and elastic characteristics of the rubber far beyond that which is inherent in the rubber itself so as to increase its resistance to permanent deformation under pressure and heat and make it useful as an effective and reliable hermetic sealing means on coke oven doors which are subject to excessively high temperatures.

A more specific object of the present invention is to provide an attachment for hermetically sealing coke oven doors and the like, which attachment is in the form of a high temperature rubber, such as silicone, in the form of a hose or tubing and through which cooling fluid is adapted to flow so as to maintain the rubber as well as the parts contacted thereby at relatively low temperatures so as to impart to the rubber amazingly improved heat stability, elastic characteristics and lower compression set values, thereby insuring a hermetic seal of the door despite high temperature operation of the oven and warping of the doors and door jambs.

A still further object of the present invention is to provide a high temperature resistant rubber attachment in the form of hose or tubing which conducts a cooling fluid and which is disposed in contact with the coke oven door and door jamb so as to cool them and prevent warping and separation of a metal-to-metal contact in a self-sealing type of door and thereby considerably prolong the life of the hermetic seal and the efficiency of the coke oven.

Other objects and advantages of the present invention will be apparent from a study of the following description, taken with the accompanying drawings wherein:

Fig. 1 is a transverse cross-sectional view of a coke oven door having secured thereto a hermetic sealing attachment involving the principles of the present invention;

Fig. 2 is a plan view of the hermetic sealing attachment applied to the door shown in Fig. 1, but shown removed from the door;

Fig. 3 is an enlarged fragmentary transverse cross-sectional view of a modified form of door and sealing attachment for sealing the door against the door jamb;

Fig. 4 is an enlarged fragmentary cross-sectional view of still another modified form of hermetic sealing attachment for application on a coke oven door such as shown in Fig. 1;

Fig. 5 is a plan view of a coke oven door of the self-sealing type and including a sealing attachment embodying the principles of the present invention for insuring the hermetic seal of the door at all times despite warping of the door or jambs, etc.;

Fig. 6 is a plan view of the attachment shown in Fig. 5 applied to a door of a sole-flue broad type of coke oven;

Fig. 7 is a side elevational view of the sealing attachment shown in Fig. 6 as applied to a broad sole-flue coke oven door, and

Figs. 8 to 15, inclusive, are enlarged cross-sectional views of various modifications of high temperature sealing attachments for coke oven doors embodying the present invention.

In the operation of by-product coke ovens and other carbonizing or gasification apparatus, the temperature at the doors or closures reaches as much as 800° F., particularly if the doors or closures are not hermetically sealed.

After considerable experimentation with various high temperature resistant rubbers, such as silicone, for example, that sold under the trademark "Silastic" by the Dow-Corning Co., I find that even the best of these are unable to withstand the high temperatures encountered in coke oven doors, that is, temperatures in the range of about 300° F. to 800° F. While some improvement is obtained in the use of high temperature rubbers, the high temperatures encountered in coke ovens cause permanent set or deformation as a consequence of pressure and heat and loss of elasticity, thus making the sealing means ineffective to maintain a hermetic seal about the doors.

In accordance with the present invention, the high temperature rubber is shaped in the form of a hose or tubing and cooling fluid is circulated therethrough so as to maintain the temperature below 300° F. Furthermore, because of the physical contact of the tubing with the door and door jamb, such door and jamb are kept at reduced temperatures so as to prevent warping and loss of metal-to-metal contact between the door and jamb or between the door diaphragm and jamb such as is present in a self-sealing door of the spring plunger actuated type.

One of the outstanding high temperature rubbers found to be especially suitable for the purposes of the present invention is silicone, high temperature rubber, since it combines the stability of silicones and the elastic properties of ordinary rubber and will withstand continuous exposure to at least 300° F. for a long period of time, whereas organic rubbers withstand only temperatures less than 200° F. Furthermore, silicone rubber will not soften or adhere to metal surfaces when hot, like organic rubbers and will not become hard and brittle and will retain its resiliency after long exposure to temperatures up to 300° F. However, long exposure to higher temperatures than 300° F. will cause a gradual breakdown, due to oxidation which causes a white powder (silicon oxide) to appear on the surface of the rubber.

Silicone, high temperature rubber has a high thermal stability because it is a silicone polymer and not a synthetic or natural rubber and does not acquire this thermal stability from special compounding. The molecular structure of silicone rubber is built on a very strong silicon to oxygen linkage and continued exposure at 300° F. will not break down this silicon to oxygen bond. However, long exposure to temperatures exceeding 500° F. will cause a gradual breakdown by oxidation, causing a white powder (silicon oxide) to appear on the surface. Silicone rubber will not only stand high temperatures, but will

also stand low temperatures down to —40° F. before becoming brittle.

Comparative tests with silicone rubber and organic rubber (GR–M specially compounded for heat and oil resistance) show that the organic rubber becomes hard and brittle after only 24 hours exposure to 300° F., whereas the silicone rubber is soft and flexible after 90 days at 300° F. Compression set tests (which measure the resistance to permanent deformation under heat and pressure) show that the organic rubber has good resistance to deformation at 158° F. (as specified by A. S. T. M. methods), but above the 200° F. compression set values increase rapidly, whereas silicone rubber has low compression set values up to 400° F.

Silicone, high temperature rubber is made from silicone polymers, which are semi-inorganic materials. Silicones are made from silicon tetrachloride by replacing two or more of the chlorine atoms with methyl groups. The polydimethyl siloxanes are made in various viscosities, the longer the chain, the higher the viscosity.

The molecular structure of high temperature, silicone rubber is built on a silicon-to-oxygen linkage which has about 1½ times the bond strength of the carbon-to-carbon linkage found in organic structures. Greater bond strength combined with freedom from unsaturation accounts for the inherent stability and resistance to heat.

Theoretically, similar polymers or high temperature rubbers can be made from other inorganic elements in group 4 of the periodic table, which includes: carbon, silicon, titanium, germanium, zirconium, tin, cerium, hafnium, lead and thorium. Polymers have been made from titanium, but were found less stable than the silicone polymers. The present invention contemplates the use of any high temperature rubber made from any semi-inorganic polymers.

Referring more particularly to Fig. 1 which shows a coke oven door assembly, numeral 1 denotes an opening forming part of the oven chamber. A door frame or jamb 2 of cast iron or wrought iron surrounds the opening, and has integrally secured thereto vertical beams or buckstays 3. Jamb 2 is corrugated to provide a succession of shoulders and is lined interiorly with brickwork of suitable silica fire-brick 4 or the like. A door 5 also of cast iron or wrought iron or other suitable metal is provided with an inner fire-brick lining 7 which is held in place by inwardly turned flanges 6 of the door frame. The door frame also has a flange 8 which provides a metal-to-metal contact with a shouldered portion of the door frame. However, this contact is insufficient to provide a suitable hermetic seal for the door, therefore must be supplemented by a hermetic sealing means 9 which embodies the principles of the present invention.

Sealing means 9 is in the form of a hose or tubing made of high temperature resisting rubber, such as silicone, and having an opening therethrough through which a suitable cooling fluid, such as water, mineral or vegetable oil or the like, may be circulated. The hose or tubing as shown more clearly in Fig. 2 is in the shape of a rectangle which extends about the door perimeter to prevent escape of coke oven gases to the outside or entry of outside air into the coke oven. It will be noted that this hose or tubing is substituted for the conventionally used luting clay which is generally applied in the V-shaped space between the door peripheral flange 8 and the confronting portion of the door jamb. In accordance with the present invention, such luting is eliminated, and instead a readily detachable hose or tubing is employed. In cross-section, the hose or tubing has a somewhat wedge-shaped wing or projection which is enclosed within a piece of angularly shaped strip material 10 which is detachably secured to the perimeter of flange 8 of the coke oven door by means of screws 11 or other suitable fastening means. The high temperature silicone rubber tubing may be extruded or molded and may be used in plain or laminated condition, for example, laminated with fibre glass, fibre glass cloths, asbestos, asbestos cloth, aluminum foil or other heat resisting, laminating or filling material.

Inlet and outlet extensions 12 and 13, respectively, are provided on the high temperature tubing 9 to permit the flow of cooling fluid through the tube, such as water, oil or other suitable liquid, which inlet and outlet extensions are preferably provided with quick connective and disconnective shut-off couplings 14 and 15, respectively, of well known type in which to connect the coupling a plug is pushed into the socket in order to open the line to flow of fluid, and to disconnect the coupling a slight pull on the sleeve releases the plug and shuts off the supply end of the line. A well-known type of such coupling is that known as the "Hansen push-tite" coupling manufactured and sold by the Hansen Manufacturing Company, of Cleveland, Ohio. The specific construction of the coupling per se forms no part of the present invention. Of course, other types of couplings may be used instead. Cooling fluid, such as water, from any suitable source (not shown) is circulated through tubing 9 in the direction indicated by the arrows at a rate to keep the temperature of tubing 9 below 300° F. Tubing 9 may be made of other high temperature rubber or rubber-like material other than silicone such as other semi-organic polymers made from elements in group 4 of the periodic table of inorganic elements, as described above, such as titanium polymers made into high temperature rubbers.

An outstandingly important feature of the fluid-cooled tubing 9 is that yieldable contact is provided with the door frame or jamb 2, thus presenting a cooled surface and thereby reducing the temperature of the door frame sufficiently to prevent warping or cracking. Furthermore, even if the door jamb were warped or cracked, the resiliency of tubing 9 would nevertheless insure a hermetic seal since it would compensate for such warping or cracking.

Fig. 3 shows a modified form of coke oven door assembly in which the door 16 is provided with a metallic framework 17 extending about its periphery and having integrally connected with said framework a rib or flange 18. The door is internally lined with firebrick 19 which is exposed to the coke oven chamber. A door jamb 20 has secured to its flash portion 21 a vertical beam or backstay 22. Door jamb 20 has an inwardly extending flange portion or offset 23 to provide a seat for the inner side of the door flange 18. The interior of the door jamb 20 is lined with firebrick 24 which may be built up so as to form a hollow heating wall (not shown). Instead of providing luting material, such as clay, in the triangular space between flange 18 and the flanged portion of door jamb 20, a strip 25 of high temperature rubber, such as silicone, is provided which is detachably secured to rib 18 by means of metallic strips 26 and fastening screws 27. The

strip 26 is shown as being of solid high temperature rubber which would be useful in coke ovens where excessively high temperatures of the door are not obtained, although it should be understood that if so desired, a channel may be formed centrally and throughout the length of the strip so as to circulate cooling fluid therethrough. Therefore, it will be seen that the strip 26 of high temperature rubber, such as silicone, is used in the place of luting clay.

Fig. 4 shows a modification of the coke oven door assembly which is identical in all respects to that shown in Fig. 1, hence the same reference numerals are employed to denote the same parts, with the exception that there is additionally provided a plurality of coil springs 28 which are guided by stems 29 so as to yieldingly urge strip portion 10*a* and the enclosed rubber tubing 9 against the door jamb and thereby form, in effect, a plurality of spring actuated plungers for forcibly holding tubing 9 against the door jamb to insure maintenance of the hermetic seal. Strip portion 10*b* forms part of a composite strip which is detachably secured to the periphery of the door.

Fig. 5 shows a coke oven door assembly of the self-sealing type. A flanged door frame or jamb 30 is internally lined with fire-brick 31. An opening 32 which communicates with the interior of the coke oven is closed by means of a door 33 having marginal flange portions 34 which extend inwardly so as to hold a fire-brick lining 35 in place. Flanged members 36 are integrally secured to the flanges 34 and have mounted thereon spring actuated plungers 37 which push against inwardly bent flanges or knife edges 38 of a diaphragm 39 so as to provide metal-to-metal sealing contact with the door frame 30. Fastened to the extremities of the inwardly extending flanges 38 are metallic strips 40 which surround a radially extending wing portion of the high temperature rubber tubing 41. Tubing 41 is held in contact with the shoulder-forming surface of the door frame or jamb 30. Strips 40 are connected to diaphragm 39 by any suitable detachable fastening means, such as screws or the like. Tension adjusting means 42 are provided at the outer portions of the spring actuated plungers 37 so as to adjust the tension of the springs and thereby selectively obtain any amount of spring pressure against the extremities of the diaphragm 39 so as to tightly press tubing 41 as well as the flanges 33 against the door jamb and provide not only metal-to-metal but rubber-to-metal sealing contact and thereby insure a hermetic seal at all times. If, due to excessive heating of the door, the door jamb should become warped or cracked and the metallic contact between flange 33 and the jamb 30 is not continuously maintained throughout the entire perimetrical portion of the door, the rubber tubing 41 nevertheless does provide continuous contact so as to maintain the hermetic seal even under these circumstances. Cooling fluid may be circulated through tubing 41 so as to maintain its temperature below 300° F. and so that by its contact with the door jamb, the door jamb will be maintained at sufficiently low temperatures to minimize warping and prevent cracking thereof.

Figs. 6 and 7 show a broad sole-flue type coke oven door in which tubing 41 is extended about the periphery of the coke oven door and show quick connecting and disconnecting couplings, such as 43 and 44, for providing a detachable connection to a source of cooling fluid in order to maintain the temperature of the tubing and door jamb at safe value.

Figs. 8 to 15, inclusive, show various modifications in the cross-section of the high temperature rubber sealing means. Fig. 8 shows a form wherein the wing portion 41*a*, which is fastened within the metallic strip, extends radially of the cylindrical portion 41*b*. Fig. 9 shows a form in which the wing portion 41*c* extends in offset relation to portion 41*d*. Fig. 10 shows a modification of sealing means wherein the wing portion 41*e* is adapted to be secured in the metallic strip, whereas a triangular or wedge-shaped portion 41*f* is adapted to form a sealing contact with the door jamb as shown in Fig. 3. Fig. 11 shows a cross-section 41*g* of rectangular outline. Fig. 12 shows a hollow tubular portion 41*h* having integrally extending therefrom a radially extending wing 41*j*. Fig. 13 shows a hollow tubular portion 41*k* having an enlarged inwardly projecting triangularly shaped part 41*i* so that even upon collapsing of the hose to the extent that part 41*i* contacts the inner surface of the tube, a passage will nevertheless be maintained so as not to interrupt the flow of cooling fluid. An offset portion 41*m* is fastened to the detachable strip. Fig. 14 shows a still further modification of the high temperature rubber tubing 41*n* which has a small pear-shaped instead of triangular opening 41*o* so as to minimize the tendency of closure of the fluid passageway upon collapsing of the tube and wherein a wedge-shaped wing 41*p* is provided for attachment to a strip such as 9 shown in Fig. 1. Fig. 15 shows a further modification in which tubing 41*r* has integral therewith a wedge-shaped wing 41*s*.

Likewise, other modifications of the high temperature rubber sealing tube or strip may be devised for providing a hermetic seal with the door frame or jamb and which is of a shape so as to minimize the tendency of stoppage of circulation of cooling fluid therethrough by collapsing the tubing.

Thus it will be seen that I have provided an efficient sealing means which may be substituted for luting material such as clay in old types of coke oven doors, thereby eliminating the time and costs required for handling and applying clay, or which may be used as a supplement to the metal-to-metal contact provided in self-sealing doors employing sealing diaphragms, or which may be relied upon exclusively as the sole sealing means in new types of doors; furthermore, I have provided a sealing means in the form of tubing of high temperature rubber, such as silicone, for maintaining the tubing at temperatures of less than 300° F. and thereby obtain substantially the elastic qualities of organic rubbers at low temperatures and low compression set values which are a measure of the resistance to permanent deformation under pressure and heat, and at the same time will provide a cooling surface which when yieldingly urged against the door frame or jamb will minimize warping and cracking thereof and thus provide a hermetic seal for long periods of time which will not fail despite high temperature operation of the coke oven.

While the hermetic sealing means for sealing has been described above as being useful for sealing coke oven doors, it is also useful for sealing closures in gas retorts, gas producers, water gas generators, shale retorts and other apparatus used to carbonize or gasify coal, oil, pitch, asphalt, asphaltities or shale and the like.

While I have illustrated and described certain

specific embodiments of my invention, it will be understood that these are by way of illustration only, and that various changes and modifications may be made within the contemplation of my invention and within the scope of the following claims.

I claim:

1. The combination with a coke oven structure having an opening therein, a door frame surrounding said opening, a door for closing said opening by metal-to-metal contact with said door frame, and hermetic sealing means surrounding said door and engageable with a portion of the door frame adjoining said metal-to-metal contacting portions, said hermetic sealing means comprising a tubing of high temperature rubber with a conduit therethrough for the passage of cooling fluid to improve the heat stability and elasticity of said rubber.

2. Apparatus recited in claim 1 wherein said door frame has a shoulder portion and wherein said door has a marginal flange portion which is adapted to seat against said shoulder portion, and wherein a detachable mounting means is provided to yieldingly seat said sealing means against a portion of said door frame closely adjacent to but exteriorly of the contacting portions of the door and door frame.

3. Apparatus recited in claim 1 together with a metallic strip having detachable securing means for detachably mounting said sealing means in place, said sealing means being in the form of tubing having a radially extending wing, in cross-section, which is partially surrounded by and fastened to said metallic strip.

4. In a coke oven of the type having a horizontal open ended coking chamber, a metallic door frame at the end of the coking chamber and a door having an outer peripheral flange adapted to provide metallic contact with an exterior flanged portion of said door frame, the improvement which comprises a tubing of high temperature silicone rubber extending about the periphery of said door peripheral flange and detachable fastening means for securing said tubing to said flange and for maintaining it in contact with a peripheral portion of the door frame in juxtaposition to and exteriorly of the metal-to-metal contacting portions of the door flange and door frame, and a source of cooling liquid for circulation through the opening in said tubing for cooling the entire periphery of the door and door frame and for limiting the temperature of the silicone tubing to about 300° F. to improve the heat stability and elasticity of said rubber.

5. Apparatus recited in claim 4 wherein said fastening means for the tubing comprises an angular-shaped strip extending about the entire periphery of the door peripheral flange and includes a plurality of fastening means for detachably mounting said fastening means so as to maintain said tubing in contacting relationship with the door frame.

6. The combination with a coke oven structure having an opening therein and a door of the self-sealing type for closing said opening, said door including a metallic sealing diaphragm whose periphery is adapted to provide yieldable metal-to-metal contact with the door frame, a strip of high temperature silicone rubber tubing secured immediately adjacent said periphery and in contacting relationship with the door frame exteriorly of the diaphragm and having a conduit for passing cooling liquid for insuring maintenance of a hermetic seal even when metal-to-metal contact between the sealing diaphragm and the door frame does not exist throughout the entire periphery of the diaphragm.

7. In combination with a coke oven having a door frame interiorly lined with fire-brick and having a door with peripherally extending flanges in metallic contact with the periphery of the door frame and being internally lined with fire-brick, the improvement which comprises a tubing of high temperature resisting rubber through which a cooling liquid is adapted to pass, and spring actuated means for yieldably urging said tubing in hermetic sealing relationship with said periphery of the door frame externally of said metallic contacting parts.

8. Apparatus recited in claim 7 wherein said tubing is made of a high temperature resistant, rubber-like silicone.

9. Apparatus recited in claim 7 wherein said tubing has a radially extending flange and wherein detachable fastening means are provided to secure said tubing flange to the periphery of the door and wherein quick-acting, shut-off couplings are provided at the ends of said tubing to provide inlets and outlets which may be quickly connected to or disconnected from a source of cooling fluid.

WALTER T. BROWN.

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Number	Country	Date
500,074	Germany	June 16, 1930
450,631	Great Britain	July 22, 1936
576,206	Great Britain	Mar. 22, 1946

OTHER REFERENCES

"Silicone Rubber," General Electric, 1949, 23 pages.