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GAS SEAL STRUCTURE FOR HIGH TOP PRESSURE OPERATION

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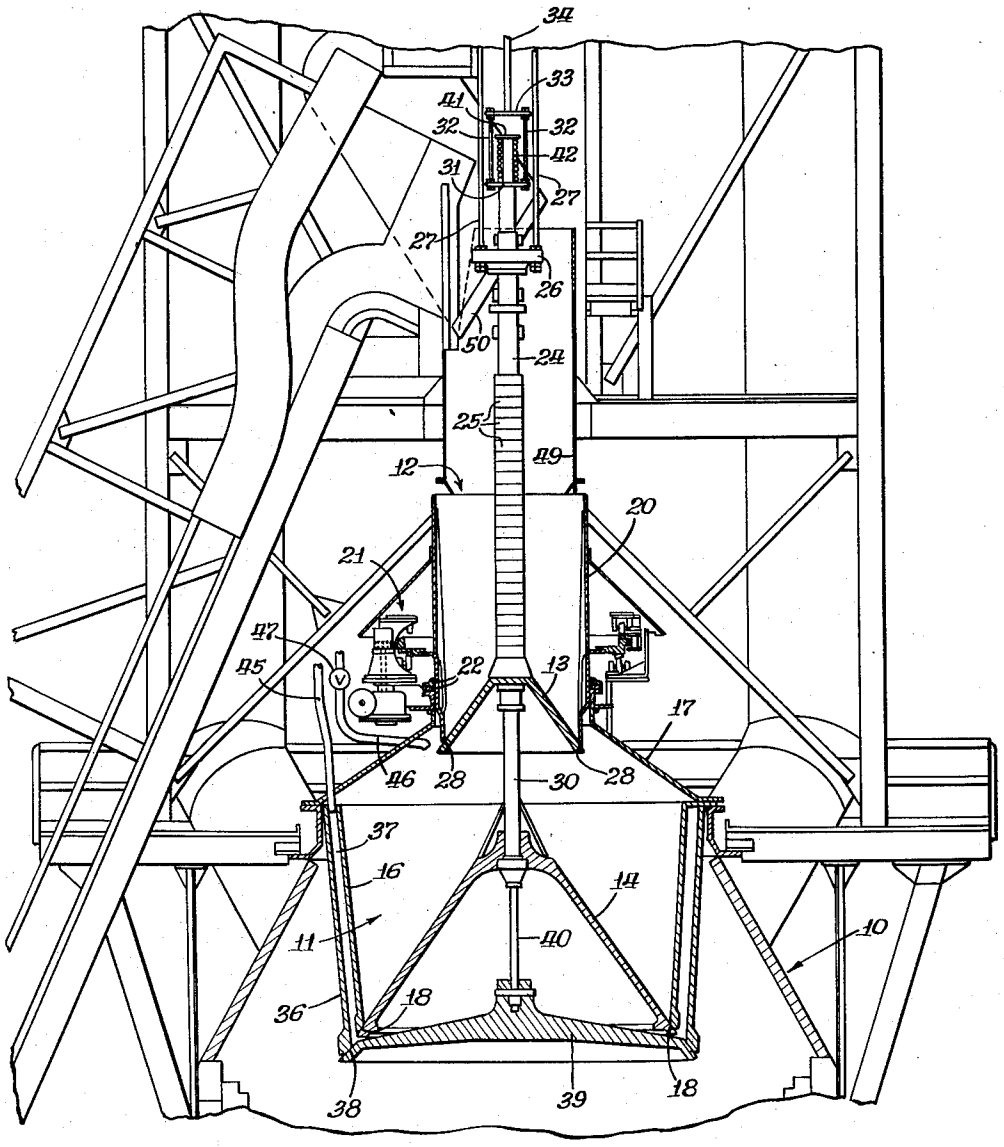

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GAS SEAL STRUCTURE FOR HIGH TOP PRESSURE OPERATION

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The present invention relates to an apparatus for use in blast furnaces or the like for high top pressure operation.

Many of the blast furnaces today are operated under conditions such that the pressure within the furnace is relatively high, as for example, from 10 to 20 pounds per square inch. In the usual furnace which has a charging distributor at the top thereof, with a material charging lock between the distributor and the interior of the furnace proper, considerable difficulty is encountered when it is sought to operate such a furnace at a relatively high pressure. While in theory the "bells" at the top and bottom of the charging lock provide a fluid-tight seal when they are in the closed position, in actual practice the seal is not perfect. Even though the seal may have been perfect at the time the furnace was constructed, with a period of use leaks develop. If a leak occurs, the gas pressure in the furnace results in the gas from the interior of the furnace passing between the bell and its seat. Since there is a high concentration of abrasive dust entrained in the gas in the interior of the furnace, the flow of the gas with that abrasive dust through a leak between the bell and its seat causes a scouring action on the two which further increase the size of the leak. Thus, in no time at all repairs are required.

The initial suggestions for solving this problem primarily were concerned with pressurizing the lock with a clean gas, so that, to the extent a perfect seal was not obtained between the bells and their seats, there would be no fluid movement between the two, or if there were a fluid movement it would be of the clean, nonabrasive gas moving from the lock to the interior of the furnace. This solution was only partially satisfactory. As long as the lock was closed and pressurized, the desired results were obtained. However, of necessity during a portion of the period of the operation of the furnace, the top bell in the lock would be open to permit the charging materials to move from the distributor into the lock. Obviously, at such times it was impossible to pressurize the lock with clean gas because of its being open to atmosphere at the top. As a result, during these periods the previously described scouring action still would occur.

Subsequently, it was proposed to use two locks at the top of the furnace, with both locks being pressurized. Thus, at all times there was at least one closed, pressurized, lock between the interior of the furnace and atmosphere. This proposal has proven to be eminently satisfactory where it has been employed. It has been used to a substantial extent in new construction. However, in the older furnaces already constructed, the extent of the modifications required in the furnace to utilize this proposal has been so substantial that many of the furnaces have not been modified to incorporate the structure. It requires the addition of a second lock at the top of the furnace, as well as operating apparatus for a third bell. The existing skip bridge must be lengthened as a result of the increase in the elevation of the distributor.

The present invention is directed to an improvement in which only one material lock is used between atmosphere and the interior of the furnace, yet which obtains a pressure seal between atmosphere and the interior of the furnace when the bell at the bottom of the distributor (i.e. top of the lock) is open. This pressure seal of clean gas prevents the scouring of the surfaces of the bell at the

bottom of the lock and its seat when material is being introduced into the lock by the lowering of the distributor bell.

One of the important features of my invention is that it may be installed on existing furnaces, since there is no necessity for increased head room above the furnaces, nor is there any requirement for lifting mechanism in addition to that already existing for moving the bells at the top and bottom of the single lock already present. Furthermore, the cost of installing my invention on an existing furnace is relatively nominal, since there is little added structure and that which is added can be installed without undue difficulty.

The increased cost of incorporating my invention in a new furnace is so small that the use of the invention is particularly attractive to a steel company having a new furnace installed. A further advantage is that the structure is positive in operation, and there is substantially nothing to get out of order and cause it to fail to operate properly.

Further objects and advantages will become apparent from the following description taken in conjunction with the drawing, which illustrates an elevational section of the top of a blast furnace incorporating my invention.

As those skilled in the art are aware, the top of a blast furnace generally **10** will have a lock generally **11** through which the materials are introduced into the furnace. At the top of a lock is a rotating distributor generally **12**. A bell **13** forms the bottom of the distributor **12** and serves to close the opening in the top of lock **11**. A second bell **14** serves to close the opening in the bottom of the lock **11**.

Lock **11** includes a generally annular wall **16** with a truncated, conical top **17**. At its bottom, wall **16** forms a seat **18** which defines the opening in the bottom of lock **11**. The angle of seat **18** is machined to conform to the angle of the exterior of bell **14**, so as to obtain a fluid-tight seal between the two.

Distributor **12** includes a generally cylindrical body **20** which is rotatably mounted in the distributor-rotating mechanism generally **21**. The distributor-rotating mechanism **21** includes packing rings **22** to provide a fluid seal between the exterior of the rotating distributor **12** and the top wall **20** of lock **11**. The details of a distributor-rotating mechanism, such as that illustrated at **21**, are shown in Patent No 2,954,884, the disclosure of which is incorporated herein by reference.

Bell **13** is attached to the bottom of an outer tube **24** about which are a plurality of wear rings **25**. A lifting plate **26** supports the top of the outer tube **24** (usually with a thrust bearing, not shown, between the two) and a pair of lift rods **27** are secured to plate **26**. As those skilled in the art are aware, lift rods **27** are connected to a lifting lever (not shown) to move rods **27** up and down. Thus, bell **13** is raised or lowered with respect to its seat **28** on the bottom of distributor **12**.

An inner tube **30** extends through the interior of tube **24**. The bottom end of tube **30** is attached to bell **14**. The lift plate **31** is secured to the upper end of tube **30**. A pair of elongated bolts **32** connect lift plate **31** with a flange **33** on the bottom of a lift rod **34**. Rod **34** is connected to a mechanism similar to that that operates the small bell **13** to raise and lower the large bell **14** with respect to its seat **18**.

A generally annular wall **36** surrounds wall **16** of lock **11** and defines a space **37** therebetween. The bottom of wall **36** is machined to form a seat **38**. A space **37** between the two walls **16** and **36** is closed except for the opening at the bottom thereof, between seats **18** and **38**. A bell **39** has its periphery machined to form a fluid-tight seal with seat **38**. Bell **39** is attached to a lift rod **40** which passes through the hollow interior of tube **30**. A

flange 41 is secured to the upper end of rod 40. A compression spring 42 is positioned between flange 41 and lift plate 31, which forms a flange on the top of tube 30.

A pipe 45 is connected to a source of clean gas under pressure, and the end of pipe 45 opens into the space 37. Preferably, the gas employed is gas which has been withdrawn from the top interior of furnace 10 and then washed to remove the entrained dust therefrom. A pipe 46 opens into the interior of lock 11, and also leads to the source of clean gas under pressure. In some embodiments, a valve 47 will be employed in pipe 36 to shut off communication between the interior of lock 11 and the source of gas when bell 13 is open, as hereinafter described.

When the furnace is in operation, the interior of the lock 11, as well as the space 37, are pressurized with clean gas. Preferably, the pressure is a few pounds greater than the gas pressure in the interior of furnace 10. Thus, to the extent that there is a leak either at seat 18 or at seat 38, the only fluid flow therethrough will be clean gas traveling toward the interior of furnace 10, rather than dirty gas passing by the seats from the interior of furnace 10 toward atmosphere.

The material to be charged into furnace 10 is emptied into a chute 49 from a lifting skip 50. After a predetermined amount of material has been deposited in distributor 12 from chute 49 and skip 50, bell 13 will be lowered to allow that material to fall from the distributor 12 into the interior of lock 11. Preferably, valve 47 is operatively connected to close at the time that rods 27 are lowered to open the bottom of the distributor. However, the space 37 remains pressurized so that there is no tendency of dirty gas from the interior of furnace 10 to pass through either of the seals defined by seats 18 or 38. To the extent that there is a leak past either of these seats, the only fluid that will pass therethrough will be the clean gas from the interior of space 37.

After bell 13 is again raised to the position illustrated in the drawing, valve 47 is closed and rod 34 is lowered. The initial downward movement of rod 34 will result in a corresponding downward movement of bell 14. However, initially bell 39 will remain against seat 38 and spring 42 will expand somewhat. Immediately upon the expansion of spring 42, bell 39 also will commence moving downwardly along with bell 14. Thus, the charge that was deposited in the interior of lock 11 will fall into furnace 10. Thereafter, rod 34 is raised as the two bells approach their seats. Bell 39 will first seat against seat 38. Spring 42 will be compressed until bell 14 contacts its seat 18, at which time the upward movement of rod 34 is stopped.

The foregoing description of a specific embodiment is for the purpose of complying with 35 U.S.C. 112, and should not be construed as imposing unnecessary limitations on the appended claims inasmuch as modifications and variations thereof will be apparent to those skilled in the art.

I claim:

1. In a blast furnace or the like, the improvement comprising: a materials lock having a generally cylindrical top opening and a generally cylindrical bottom opening and defining an enclosure except for said openings; means to close said top opening and movable with respect to said lock, whereby material may be deposited in said enclosure through said top opening and the top opening thereafter closed; an annular seat member surrounding said bottom opening and spaced from said lock; a first bell of a size to fit against the bottom of said lock about said bottom opening; a second bell below said first bell and a size to seat against said seat member; means interconnecting the lock seat member above the bottoms thereof to enclose the space therebetween except at the bottoms thereof; means communicating with said space to supply clean gas under pressure thereto; a lifting tube connected at its bottom end to the first bell and extending upwardly out of said lock; means attached to the upper end of said tube to raise and lower said first bell with respect to said lock; a rod extending through said tube and attached at its bottom end to said second bell; flange means attached to said rod; flange means on the top of said tube; and a compression spring about said rod with the top of the spring against said flange means on the rod and the bottom bearing on the flange means on the tube.

2. In a blast furnace or the like, the improvement comprising: a materials lock having a generally cylindrical top opening and a generally cylindrical bottom opening and defining an enclosure except for said openings; a rotating distributor extending into said top opening; sealing means between the distributor and the lock; a distributor bell at the bottom of said distributor; means connected to said bell to raise and lower said bell with respect to said distributor; an annular seat member surrounding said bottom opening and spaced from said lock; a first bell of a size to fit against the bottom of said lock about said bottom opening; a second bell below said first bell and of a size to seat against said seat member; means interconnecting the lock and seat member above the bottoms thereof to enclose the space therebetween except at the bottoms thereof; means communicating with said space to supply clean gas under pressure thereto; means connected to one of the last two bells to raise and lower said one bell; and means including a compression spring interconnecting said last two bells to cause the other of the last two bells to generally move with said one bell while permitting a limited amount of movement of said one bell with respect to the other bell.

3. A pressure seal construction for a blast furnace charging apparatus comprising: a fixed materials lock at the top of said furnace; said lock having an opening at the top and bottom thereof, respectively, and adapted to receive materials to be charged into the furnace, the wall of said lock being defined by an upwardly outwardly flaring wall extending up from the bottom opening and intersecting and integrally joined to an upper wall portion converging toward the top lock opening, said flaring wall defining a seat portion about the lower periphery thereof; means adapted to selectively seal and open the top lock opening; an annular wall member coaxial with and in spaced relation about the upwaardly outwardly flaring wall of the lock, said annular wall and said flaring lock wall in combination defining an annular space therebetween, said annular wall defining a seat portion about the lower periphery thereof; a first bell adapted to seat upon the seat portion of said flaring wall to define a seal at the bottom opening of the lock; a second bell positioned below and in spaced relation to said first bell and adapted to seat upon the seat portion of said annular wall to define a seal therewith; means effective to operate said first and second bells in unison with said bells being resiliently interconnected whereby the second bell will seat upon its seat portion first upon closing with relation to said first bell and will move away from its seat portion last upon opening with relation to said first bell; means connecting the annular space to a source of gas under pressure; and, means connecting the interior of the lock to a source of gas pressure, whereby the interior of the lock and the annular space may be pressurized.

4. A pressure seal construction for a blast furnace charging apparatus comprising: a fixed cylindrical materials lock at the top of said furnace, said lock being open at either end thereof and adapted to receive materials to be charged into the furnace, the cylindrical lock wall defining a seat portion about the lower periphery thereof; means adapted to selectively seal and open the top lock opening; an annular wall member coaxial with and in uniformly spaced relation to the cylindrical lock wall, said annular wall and lock wall in combination defining an annular space therebetween, said annular wall defining a seat portion about the lower periphery thereof; a first bell adapted to seat upon the seat portion of said lock wall to define a materials seal at the bottom opening of

said lock; a second bell below and in spaced relation to said first bell and adapted to seat upon the seat portion of said annular wall to define a seal at the lower periphery thereof; means effective to operate said first and second bells in unison with said bells being resiliently interconnected whereby the second bell will seat upon its seat portion first upon closing with relation to said first bell and will move away from its seat portion last upon opening with relation to said first bell; and means connecting the annular space to a source of clean gas under a pressure higher than that within the upper portion of the blast furnace whereby, in use, the higher pressure clean gas continually sweeps the lower periphery of the second bell and seat portion of the annular wall to inhibit upward passage of abrasive laden gas from the blast furnace into the seating areas.

5. A pressure seal construction for a blast furnace charging apparatus comprising: a fixed cylindrical lock at the top of said furnace, said lock being open at either end thereof and adapted to receive materials to be charged into the furnace, the cylindrical lock wall defining a seat portion about the lower periphery thereof; means adapted to selectively seal and open the top lock opening; an annular wall member coaxial with and in uniformly spaced relation to the cylindrical lock wall, said annular wall and lock wall in combination defining an annular space therebetween, said annular wall defining a seat portion about the lower periphery thereof; a first bell adapted to seat upon the seat portion of said lock wall to define a materials seal at the bottom opening of said lock; a second bell below and in spaced relation to said first bell and adapted to seat upon the seat portion of said annular wall to define a seal at the lower periphery thereof; means effective to operate said first and second bells in unison with said bells being resiliently interconnected whereby the second bell will seat upon its seat portion first upon closing with relation to said first bell and will move away from its seat portion last upon opening with relation to said first bell; means connecting the annular space to a source of clean gas under pressure higher than that within the upper portion of the blast furnace; and means connecting the interior of the lock to a source of gas under pressure higher than that existing at the top of the stack of the blast furnace, whereby the interior of the lock is pressurized and the annular space is pressurized with the escape of the higher pressure gas being confined to the lower peripheral seat areas upon opening of the bells to effect continual sweeping of said areas and prevent upward passage of abrasive laden gases.

6. A pressure seal construction for a blast furnace charging apparatus comprising: a lock at the top of said furnace, said lock being open at either end thereof, the wall of said lock being defined by an upwardly outwardly flaring wall extending up from the bottom opening of the lock and intersecting an upper wall portion converging toward and defining the top lock opening, said flaring wall defining a seat portion about the lower periphery thereof; means adapted to selectively seal and open the top lock opening; an annular wall member coaxial with and in uniformly spaced relation about the upwardly outwardly flaring wall of the lock, said annular wall and said flaring wall in combination defining an annular space therebetween, said annular wall further defining a seat portion about the lower periphery thereof; a first bell adapted to seat upon the seat portion of said flaring wall to define a seal at the bottom opening of the lock; a second bell positioned below and in spaced relation to said first bell and adapted to seat upon the seat portion of said annular wall to define a seal at the lower periphery thereof; means effective to operate said first and second bells in unison with said bells being resiliently interconnected whereby the second bell will seat upon its seat portion first upon closing with relation to said first bell and will move away from its seat portion last upon opening with relation to said first bell; and means connecting the annular space to a source of gas under pressure whereby the annular space is pressurized with the escape of the pressure being confined to the lower periphery between the second bell and the seat portion of said annular wall when said second bell is in spaced relation to the seat portion of said annular wall to effect continual sweep of the seating surfaces and prevent upward passage of abrasive laden gases therepast.

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