

Nov. 7, 1950

E. H. SELNICK
FURNACE COMBUSTION CHAMBER CLOSURE WITH
FLUID JET GAS ESCAPE PREVENTION MEANS

2,528,671

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3 Sheets-Sheet 1

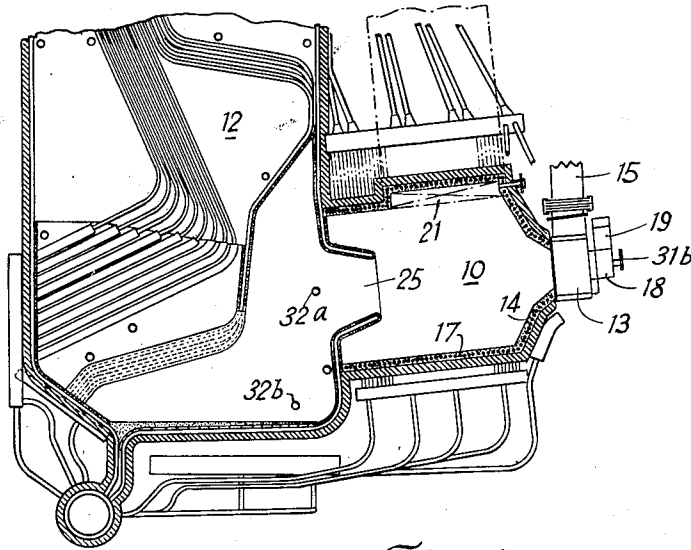


Fig. 1

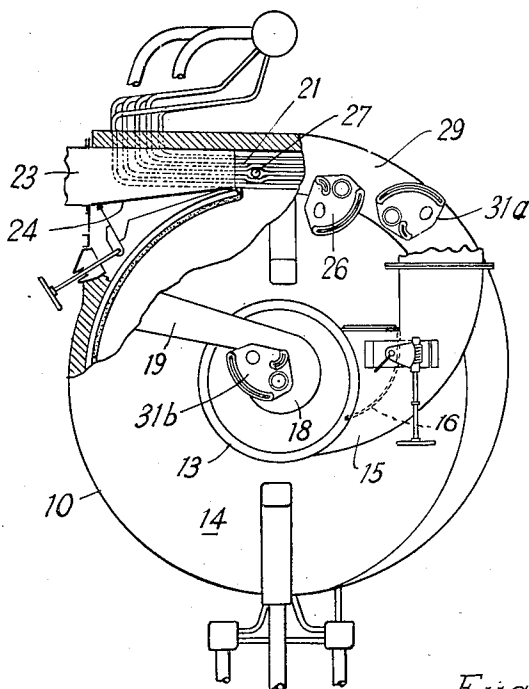


Fig. 2

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3 Sheets-Sheet 2

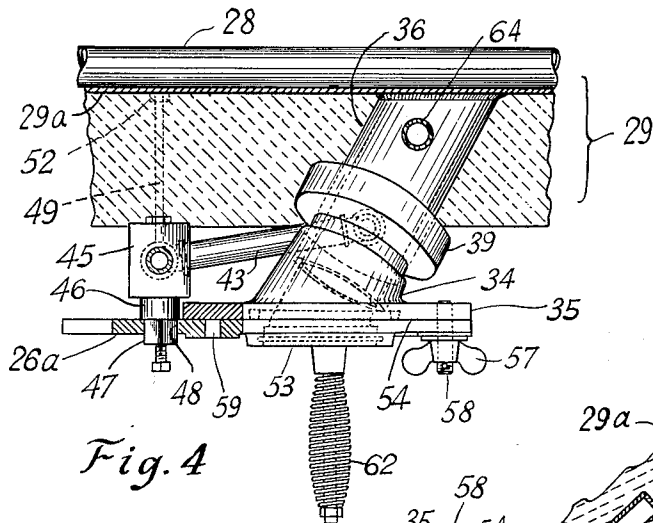


Fig. 4

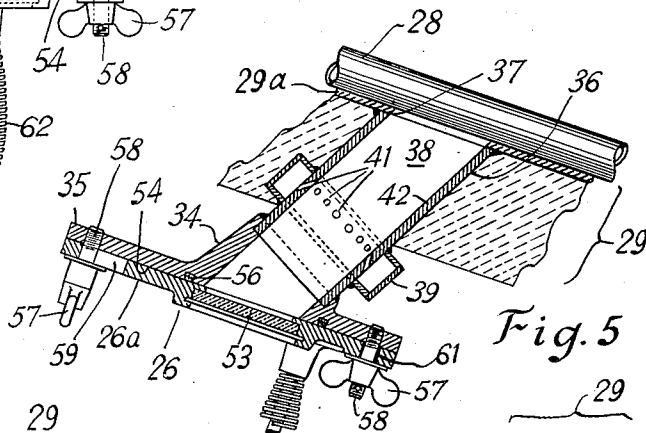


Fig. 5

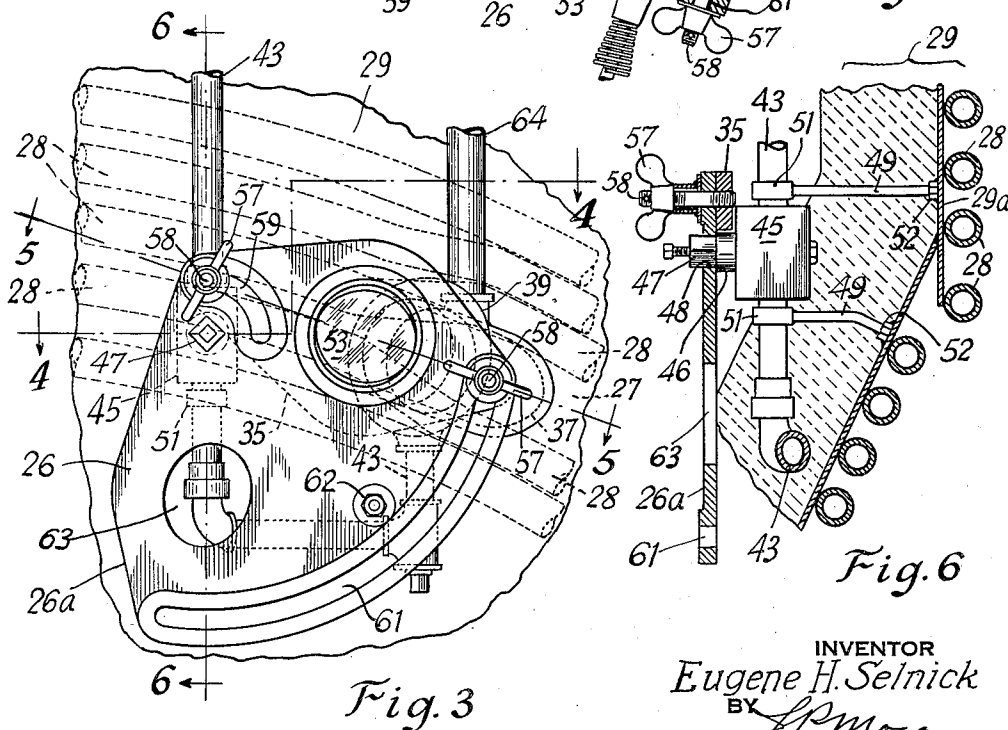


Fig. 3

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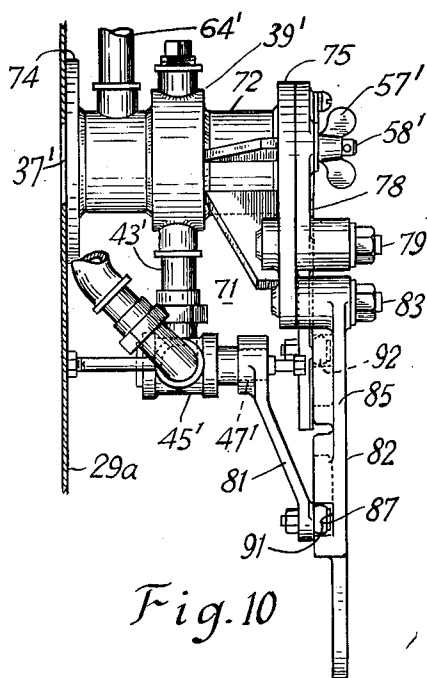
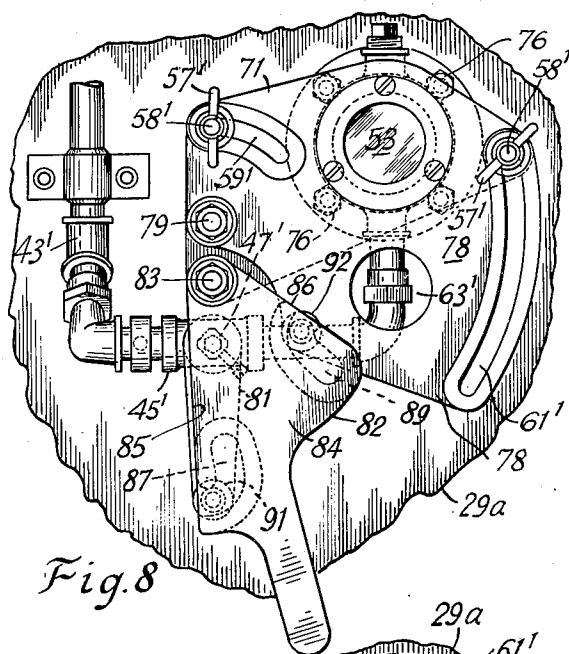
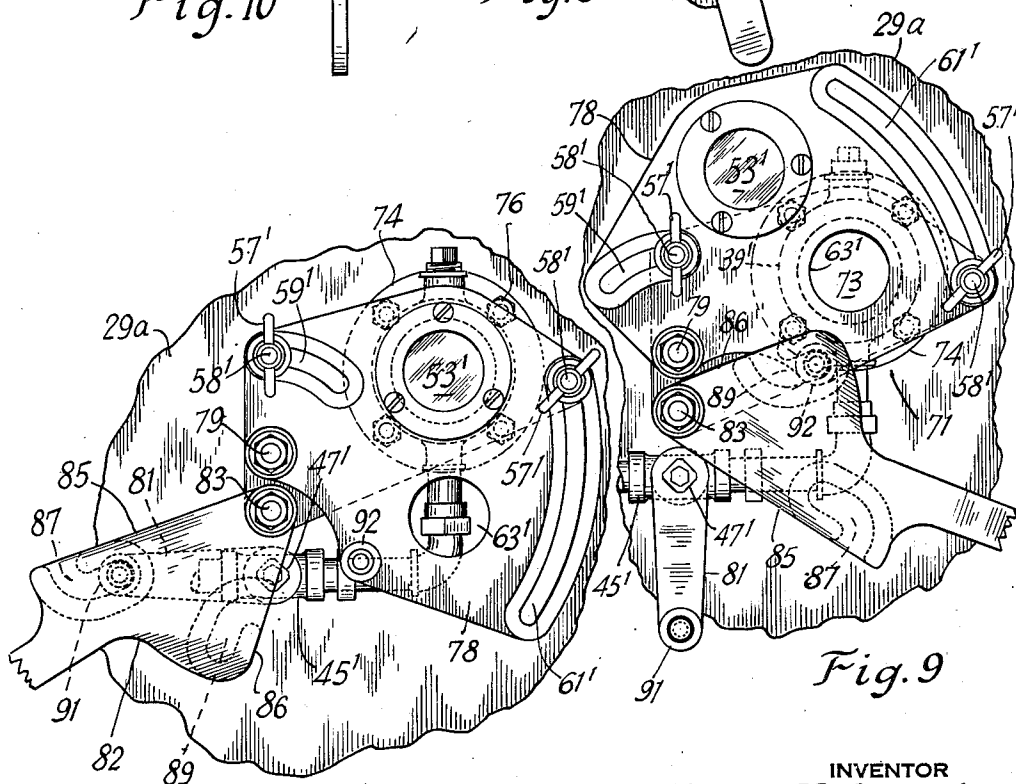
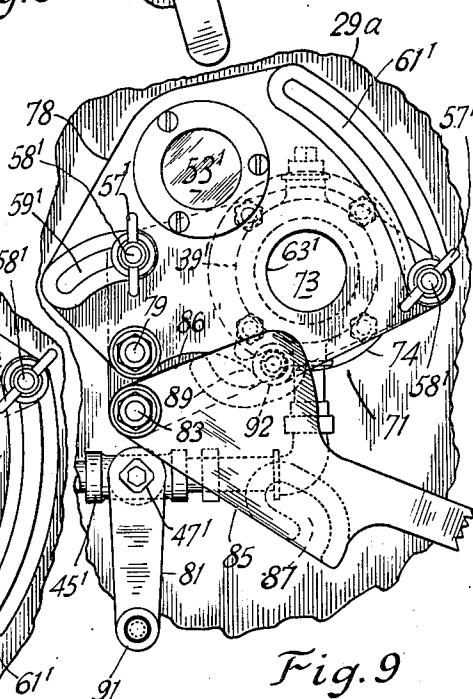
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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FURNACE COMBUSTION CHAMBER CLOSURE WITH FLUID JET GAS ESCAPE PREVENTION MEANS

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8 Claims. (Cl. 110—179)

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The present invention relates in general to the construction and operation of closure members especially adapted for use with furnaces or other similar closed chambered structures operating under high internal gaseous pressures considerably above atmospheric and requiring access at intervals without necessitating a shut-down or causing interference with their prescribed functions. Structures suitable for the practice of my invention include boilers for example having a combustion chamber together with a communicating gas flow space wherein the gases of combustion are utilized mainly for the generation and heating of vapor. In other suitable structures the high pressure gases may be produced for various other purposes such as for utilization in processes or as a hot motive gaseous fluid for gas turbines.

In such installations the enclosing walls are often fluid cooled to provide protection from high furnace temperatures and further are preferably made gas-tight throughout to avoid the troublesome and dangerous condition resulting from the ejection of high temperature gases and other products of combustion. When a wall opening is provided through which access may be had to the interior for cleaning or other purposes it is essential that the opening be fitted with closure means suitably constructed and arranged so as to maintain the continuity of the gas-tight wall construction. Further, since it is essential in many instances to gain access to the interior during normal furnace operation, it is highly desirable to arrange in some manner to adequately control or to actually prevent the discharge of hot products of combustion when the closure means is removed or shifted to expose the opening.

There is an indication in the prior art that attempts have been made to restrict the escape of combustion gases through a furnace wall opening, in some instances through the use of air or steam jets directed either across the opening in the form of a screen, or into the opening toward the interior of the furnace. However, the prior art structures are inadequate for opposing the discharge of high pressure gases and moreover do not provide among other features the required interrelation between operation of the closure means and the initiation of jet action to assure complete control of gas discharge under all conditions.

An object of my invention therefore is the provision of a closure member movable relative to a furnace wall opening and controlling the operation of fluid jet means arranged to prevent

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the ejection of gases from the furnace when the member is moved into open position.

My invention also contemplates the provision of a closure member movable relative to a furnace wall opening and controlling the operation of fluid jet means arranged to prevent the ejection of gases from the furnace, the fluid jet means being rendered operative upon movement of the member toward the open position, and being rendered inoperative upon movement of the member toward the closed position.

Another object is the provision of a closure member movable from a closed to an open position and vice versa relative to a furnace wall opening, together with fluid jet means which serves to prevent the ejection of high pressure gases from the furnace when the closure member is in the open position, the actuation of the fluid jet means being coordinated with closure member movement so as to maintain jet action except when the member is in the closed position.

An additional object is to interlock a fluid control means with closure member movement so as to initiate jet action before the closure member is moved from its closed position and to maintain jet action until the member is returned to the closed position.

A further object of my invention is to prevent the ejection of gases from a furnace wall opening by a converging series of high velocity jets of fluid directed inwardly toward the opening at an inclination to the normal course of the gases past the inner end of the opening.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of my invention.

Of the drawings:

Fig. 1 is a sectional side elevation of the lower portion of a steam generating unit embodying my invention;

Fig. 2 is a front elevation, partly broken away, of a portion of the structure shown in Fig. 1;

Fig. 3 is an enlarged front elevation of closure means installed as in Fig. 2;

Fig. 4 is a plan view, partly in section, taken along line 4—4 of Fig. 3;

Fig. 5 is a longitudinal section taken along line 5-5 of Fig. 3;

Fig. 6 is a vertical section taken along line 6-6 of Fig. 3;

Figs. 7, 8 and 9 are front elevations showing a modified form of closure means at successive stages of operation; and

Fig. 10 is a side projection of the apparatus shown in Fig. 8.

The steam generating unit illustrated in Fig. 1 is substantially the same as that disclosed in the copending application of H. J. Kerr et al., Serial No. 552,120, filed August 31, 1944, except for certain features peculiar to the present invention as will appear hereinafter, the unit including a cyclone type of primary furnace 10 from which the products of combustion flow into a secondary furnace 12. The walls of both furnaces are lined with wall cooling tubes suitably arranged and connected so as to form circuits paralleling the circulatory system of the boiler, the walls being of improved construction enabling the unit to be maintained under relatively high positive internal pressures throughout, as fully disclosed in the aforesaid prior application.

The cyclone type primary furnace 10 is of horizontally elongated substantially circular cross section and preferably fired by a primary burner 13 arranged coaxially thereof in the outer end wall 14, the burner being of a suitable type for the kind of fuel to be fired which for present purposes may be assumed to be a crushed or granular fuel, such as bituminous or semi-bituminous coal.

A stream of primary air and granular coal is delivered at a relatively high positive pressure through the involute curved primary air-coal pipe 15 which opens tangentially into a lower side portion of burner 13, the effective flow area of the pipe and thereby the velocity of the fuel-air stream being controlled by a manually operated control damper 16. The burner is constructed to impart a radial and forward motion to the entering coal-air stream and the whirling stream moves axially of the primary furnace in a helical path along and in contact with the circular wall 17.

A circular tertiary air chamber 18 is arranged at the outer end of the burner 13 and a regulable supply of preheated air is delivered thereto through a duct 19 having an involute curved connection to the chamber 18, producing a whirling stream of tertiary air which is directed axially of the burner.

An axially elongated port 21 is provided for admitting secondary air to the primary furnace 10 at a point angularly spaced approximately 180° from the point of entry of the primary air-fuel stream, the secondary air being delivered to the port through a main air duct 23 having its end section fitting into and opening to the port 21, the velocity of air admission being controlled by a series of dampers 24 arranged to maintain the entering secondary air stream at all times along the primary furnace chamber wall.

In accordance with the previous disclosure, the primary air-fuel stream enters the furnace chamber in a high velocity stream whirling in a clockwise direction with an inner core of tertiary air whirling in the same direction. The fuel-air mixture rapidly ignites and the burning stream flows longitudinally of the furnace chamber at a high angular velocity in a film or layer following a helical path along and in close con-

tact with the furnace circumferential wall. The secondary air enters at substantially the same velocity and direction and gradually merges with the burning stream of primary air and fuel, without disrupting the helical flow path of the latter or separating the primary air-fuel stream from the circumferential chamber wall by a layer of secondary air. Combustion is substantially completed in the primary furnace chamber and the resulting hot gases are discharged through the coaxially arranged rearwardly flaring outlet throat 25 which is formed with an angle of flare of approximately 15° to its axis to provide minimum pressure drop therethrough.

According to one method of operation all of the combustion air may be supplied at a high positive pressure, e. g. 40 in. H₂O, to the primary furnace chamber and a decreasing positive pressure maintained throughout the remainder of the unit.

Openings are provided in the walls of the unit, at various positions, through which operation of the furnace may be observed and, if desired, a lance or other implement inserted to dislodge slag or other accumulations, or an oil burner or other device inserted to initiate the combustion of fuel introduced through pipe 15.

A suitable closure means for one of such openings is detailed in Figs. 3-6 where an observation and lancing or lighting door 26 is shown as applied to an opening 27 formed between curved tubes 28 associated with a front wall portion 29 of the primary furnace 10 adjacent the secondary air inlet port 21. The wall portion 29 includes a metal casing 29a welded to the outer side of wall tubes 28 to provide with other wall portions of similar construction a completely sealed furnace chamber permitting operation at high positive furnace pressures. Doors of the same general type and function may be installed at various other locations such as at 31a and 31b in a wall of the primary furnace 10 and at the circled locations 32a, 32b, etc., in walls of the secondary furnace 12.

The complete door assembly 26 includes a tubular frame 34 terminating at its outer end in a transversely elongated flange or front plate 35 and at its inner end in a cylindrical body portion 36 welded or otherwise secured to the casing 29a at the perimeter of an elliptical hole 37 registering with the opening 27 between wall tubes 28. The frame 34 provides a cylindrical interior passage 38 having its axis inclined to the plane of the casing 29a at an angle of 60°, as seen in Fig. 5, with the passage pointing downstream with respect to the flow of the whirling stream of fuel and air past the inner end of the wall opening 27.

The tubular body 36 is surrounded by a manifold 39 from which holes 41 extend through the cylindrical body wall 42 for directing high velocity jets of air or other gaseous fluid into the central passage 38, the holes 41 being arranged in a circular row, preferably at equal circumferential spacings, and converging within the passage 38 at a point along its central axis. Air for example at 80 p. s. i. is supplied to the manifold 39 through a high pressure air line 43 having a straightway plug valve 45 therein, the valve plug 46 having a squared stem 47 for engagement with a correspondingly shaped opening 48 in the cover plate 26a. The valve is maintained in fixed relation to the furnace wall 29 by means of support rods 49 each secured at one end to a ring 51 engaging the air line 43 and having its

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opposite end threaded into a nut 52 welded to the casing 29a.

The door or cover plate 26a is mounted against the frame plate 35 with the squared opening 48 fitting over the squared stem 47 of valve plug 46. The cover 26a is thus movable with respect to the frame passage 38 about the axis of the valve plug 46 as a pivot whereby angular movement of the cover is accompanied by corresponding angular movement of the plug.

When the cover is fully closed, as shown in Figs. 3-6, the valve 45 is also fully closed, and the window 53 is in registry with the passage 38 to permit observation of furnace operation through the wall opening 27. In this position of the door, the cover plate 26a is clamped tightly against the seat 54 provided by the planar front surface of flange 35, wherein a ring of packing 56 may be inserted if necessary to provide a gas-tight joint. The clamping means for this purpose may suitably comprise wing nuts 57 threaded on studs 58 mounted in flange 35 adjacent opposite ends. The studs extend through arcuate cover slots 59 and 61, concentric with respect to the pivotal axis of the cover and cooperating with studs 53 to limit angular movement to the extent required to fully open and close valve 45, in this embodiment the slots being formed to different radii and limiting angular cover movement to 90°. A handle 62 is provided by which the cover may be swung in the direction desired.

In order to open the door from its fully closed to its fully opened position, the wing nuts 57 are loosened and the cover 26a is turned counterclockwise through 90° whereby the lance opening 63 is brought into registry with passage 38 and the valve 45 fully opened, the cover being again locked in place by tightening the wing nuts 58. In this position of the door, air is being supplied to manifold 39 and through jet holes 41 at full pressure from air line 43, thereby blocking the discharge of hot gases from the furnace, together with any entrained solids, so that the lancing or other operations may be carried on with safety through the uncovered frame passage 38.

In order to return the door to its fully closed position the foregoing operations are reversed, for example, the cover 26a being swung clockwise through 90° bringing the observation window 53 into registry with the frame passage 38 and simultaneously turning the valve stem 47 to shut off the supply of air to manifold 39. A pipe connection 64 is made to the tubular body 36 for continuously admitting cold air to the interior of frame 34 to prevent the door from becoming overheated as a result of furnace radiation.

Figs. 7-9 illustrate a modification whereby the air jets are placed in full pressure operation before opening movement of the door is initiated, such operation being maintained until the door is returned to its fully closed position. Certain parts of the structure similar to those already described are accordingly designated by the same numerals distinguished by primes. In this embodiment the door assembly 71 includes a tubular door frame 72 adapted for installation over a hole 37' in a furnace wall casing 29a, it being understood that the remainder of the wall structure may suitably be of the character previously described, including wall cooling tubes for example, with the hole 37' opening to the interior of the furnace between a pair of such tubes.

The frame 72 is formed with a cylindrical interior passage 73 and terminates in flanges 74

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and 75 at opposite ends, the inner end flange 74 enabling the frame to be secured to casing 29a as by bolts 76, and the outer end flange 75 providing a seat for the door or cover plate 78 which is pivoted about a hinge pin or stud 79 mounted in the frame flange 75. The cover 78 is provided with an observation window 53' and a lance opening 63' arranged at substantially equal distances from the pivotal axis to enable one or the other to be brought into registry with the frame passage 73, depending on whether the door is open or closed.

Studs 58', mounted in flange 75, are fitted with wing nuts 57' for clamping the cover 78 in place against the flange when the cover is in its fully opened and fully closed positions. The studs 58' extend through arcuate cover slots 59' and 61', concentric with respect to the hinge pin or pivot 79 and cooperating with the studs 58' to limit angular cover movement to the extent required to move the cover from the fully closed to the fully opened position, and vice versa. In this form of the invention, the angle of cover movement from one extreme position to the other is approximately 45°.

Air admitted to the manifold 39' from the high pressure air line 43' is directed into the passage 73 through a series of circumferentially spaced holes providing high velocity jets converging at a point along the central axis of the passage, substantially as illustrated and described for the first mentioned embodiment. The air is under control of plug valve 45' having a square stem 47' to which a valve lever 81 is secured. Cooling air may be continuously admitted through a separate connection 64' as previously mentioned.

An operating lever 82 is provided for controlling the operation of air valve 45' and door 78 in predetermined sequence, the lever 82 being pivoted at one end to the frame flange 75 on stud 83. The lever 82 includes a body portion 84 of generally triangular formation having side edges 85 and 86 diverging from its pivoted end. Two recesses 87 and 89 are formed in the rearward surface of the body portion 84 for engaging rollers 91 and 92 on the valve lever 81 and door 78 respectively, the recesses opening inwardly from the edges 85 and 86, respectively, and each recess having its inner end portion substantially parallel to the edge from which the recess opens.

Various positions of the operating lever 82 are shown in Figs. 7-9 together with the resulting positions of door 78 and air valve lever 81. In Fig. 7 which shows the door fully closed, with window 53' registering with passage 73, the valve lever 81 is in its closed position and the supply of high pressure air to manifold 39' is cut off, the roller 91 on the valve lever being pocketed within the inner end of recess 87 in operating lever 82.

When it is desired to open door 78, the operating lever is turned counterclockwise causing the recess 87 acting on roller 91 to turn valve lever 81 counterclockwise to its open position, as shown in Fig. 8, to supply air to the manifold and jet holes at full pressure from the high pressure line 43'. During this movement of the lever, the lever roller 91 and recess 87 are brought into different relative positions until as in Fig. 8 the roller 91 is in effect released from the recess, since any further counterclockwise movement of operating lever 82 will not affect the position of valve lever 81.

At this intermediate stage of operating lever movement the roller 92 on door 78 is at the

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entrance to recess 89. Continued counterclockwise movement of lever 82 will thus cause the recess 89 to engage the door roller 92 and effect a movement of door 78 into its fully opened position, as seen in Fig. 9, with the lance opening 63' in registry with the frame passage 73. A reversal of these operations will restore the door 78 and valve lever 31 to their fully closed positions as seen in Fig. 7.

While in the disclosure of this invention certain forms have been described with reference to their application to a boiler furnace operating at positive pressures of the order of 40 in. H₂O, nevertheless, it is to be understood that my invention may also be usefully applied to furnaces of various types operating at positive furnace pressure ranging upwardly to 90 or 100 p. s. i., wherein the problem of preventing the discharge of high temperature furnace gases becomes increasingly difficult. Furthermore, the safety features which are incorporated render the apparatus constructed in accordance with this invention especially desirable, particularly with furnace pressures of the magnitude mentioned.

I claim:

1. In combination with a wall defining a chamber normally containing a gaseous fluid under a superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer end of said wall opening, a pivot support for said door arranged for door movement about said pivot in the plane of said door, said door having a window and an access opening therein in arcuately spaced relation and adapted to register with said wall opening in predetermined positions of said door, means for discharging a high pressure fluid into said wall opening, a valve controlling a supply of high pressure fluid to said last named means, door operating means mounted for movement in opposite directions to move said door to said predetermined positions, means operatively associated with said door and said valve and movable in one direction to open said valve during movement of said door toward said access opening registering position and in the opposite direction to close said valve during movement of said door toward said window registering position, and means arranged at the sides of said opening at diametrically opposed locations spaced from said pivot support for maintaining a seal between said door and said opening in at least one of said positions.

2. In combination with a wall defining a chamber normally containing a gaseous fluid under a superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer end of said wall opening, means forming a seat for said door at the perimeter of said opening, a pivot support for said door arranged for door movement about said pivot in the plane of said door, said door having a window and an access opening therein in arcuately spaced relation and adapted to register with said wall opening in predetermined positions of said door, means for discharging a high pressure fluid into said wall opening including a circular series of inwardly converging jet holes and a valve controlling a supply of high pressure fluid to said jet holes, means for swinging said door about its pivot to and from said predetermined positions, means operatively connecting said door swinging means to said door and said valve to cause said valve

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to be opened during movement of said door toward said access opening registering position and to cause said valve to be closed during movement of said door to said window registering position, and means for clamping said door to said seat in each of said registering positions, said door clamping means being arranged at opposite sides of said opening at diametrically opposed locations angularly spaced with respect to said pivot and comprising members extending into proximity to guiding surfaces on said door throughout the extent of door swinging movement.

3. In combination with walls defining a furnace chamber normally containing combustion gases under a superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer end of said wall opening, a pivot support for said door arranged for door movement about said pivot in the plane of said door, said door having a window and an access opening therein in arcuately spaced relation and adapted to register with said wall opening in predetermined positions of said door, means for discharging high pressure air into said wall opening including a circular series of inwardly converging jet holes and a valve controlling a supply of high pressure air to said jet holes, means for swinging said door about its pivot into said predetermined positions, and means operatively connecting said door swinging means to said door and said valve to cause said valve to be opened during movement of said door toward said access opening registering position and to cause said valve to be closed during movement of said door toward said window registering position, and means for directing cooling fluid into said wall opening irrespective of the position of said door and independently of the operation of said valve.

4. In combination with walls defining a furnace chamber normally containing combustion gases under a superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer end of said wall opening, a pivot support for said door arranged for door movement about said pivot in the plane of said door, said door having a window and an access opening therein in arcuately spaced relation and adapted to register with said wall opening in predetermined positions of said door, means for discharging high pressure air into said wall opening including a circular series of inwardly converging jet holes and a valve controlling a supply of high pressure air to said jet holes, means separate from said door for swinging said door about its pivot, a support for said door swinging means arranged for movement of said means toward the door for engagement therewith to swing the door from a window registering position to an access opening registering position, and means operatively associated with said door swinging means and with said valve for automatically moving said valve to its full open position when said door swinging means is moved toward said position to engage said door for movement from a window registering position to said access opening registering position.

5. In combination with a wall defining a chamber normally confining a gaseous fluid under superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer

end of said wall opening having an access opening therein adapted to register with said wall opening in one position of said door, a pivot support for said door arranged for door swinging movement in the plane of said door, means for supplying a high pressure gaseous fluid to said wall opening including a circular series of inwardly converging jet holes at the inner side of said door discharging into said wall opening, a valve controlling a supply of gaseous fluid to said jet holes, means operatively associated with said door and with said valve for automatically opening said valve before said access opening is brought into register with said wall opening on movement of said door, and means for limiting said door movement from a closed to an access opening registering position comprising arcuate slots in said door of different radii about said pivot support together with stationarily positioned members extending into said slots.

6. In combination with a wall defining a chamber normally confining a gaseous fluid under superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer end of said wall opening having an access opening therein adapted to register with said wall opening in one position of said door, a pivot support for said door arranged for door swinging movement in the plane of said door, means for discharging a high pressure gaseous fluid into said wall opening, a valve controlling the supply of gaseous fluid to said last named means, a door operating mechanism mounted for arcuate movement and arranged to engage said door during an initial period of said arcuate movement and to swing said door to said access-opening-registering position during a subsequent period of said arcuate movement, and means operatively associated with said door operating mechanism and with said valve for moving said valve to an open position during said initial period of arcuate movement prior to engagement of said mechanism with said door.

7. In combination with a wall defining a chamber normally confining a gaseous fluid under superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer end of said wall opening having an access opening therein adapted to register with said wall opening in one position of said door, a pivot support for said door arranged for door swinging move-

ment in the plane of said door, means for supplying a high pressure gaseous fluid to said wall opening including a circular series of inwardly converging jet holes at the inner side of said door discharging into said wall opening, a valve controlling the supply of gaseous fluid to said holes, a pivoted lever constituting a combined valve and door operating means arranged to successively engage and to successively move said valve and said door during different periods of arcuate lever movement, said lever having means thereon movable into engagement with said valve to move said valve during one period of lever movement from a closed position to a fully open position, said lever having separate means thereon movable into engagement with said door to move said door during a succeeding period of lever movement from a closed position to the position in which said access opening is in register with said wall opening.

8. In combination with a wall defining a chamber normally confining a gaseous fluid under superatmospheric pressure and having a chamber wall opening therein, closure means for said wall opening comprising a door at the outer end of said wall opening, a pivot support for said door arranged for door swinging movement to open and close said wall opening, means for supplying a high pressure gaseous fluid to said wall opening, a valve controlling the supply of gaseous fluid to said last named means, a movable valve operating and door operating mechanism arranged to separately engage and move said valve and said door during different periods of mechanism movement, and means operatively associated with said operating mechanism arranged to open said valve before movement of said door to open said wall opening.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
241,433	Simmons	May 10, 1881
667,489	Brainerd	Feb. 5, 1901
740,757	Hofman	Oct. 6, 1903
805,295	Hofman	Nov. 21, 1905
1,379,873	Miller	May 31, 1921
1,448,228	Miller	Mar. 13, 1923
1,973,171	Jacobi	Sept. 11, 1934
2,112,063	Blizard	Mar. 22, 1938