

A. G. ELVIN.
FIRE BOX DOOR FOR STEAM BOILERS.
APPLICATION FILED FEB. 5, 1907.

1,066,005.

Patented July 1, 1913.

2 SHEETS—SHEET 1.

FIG. 2.

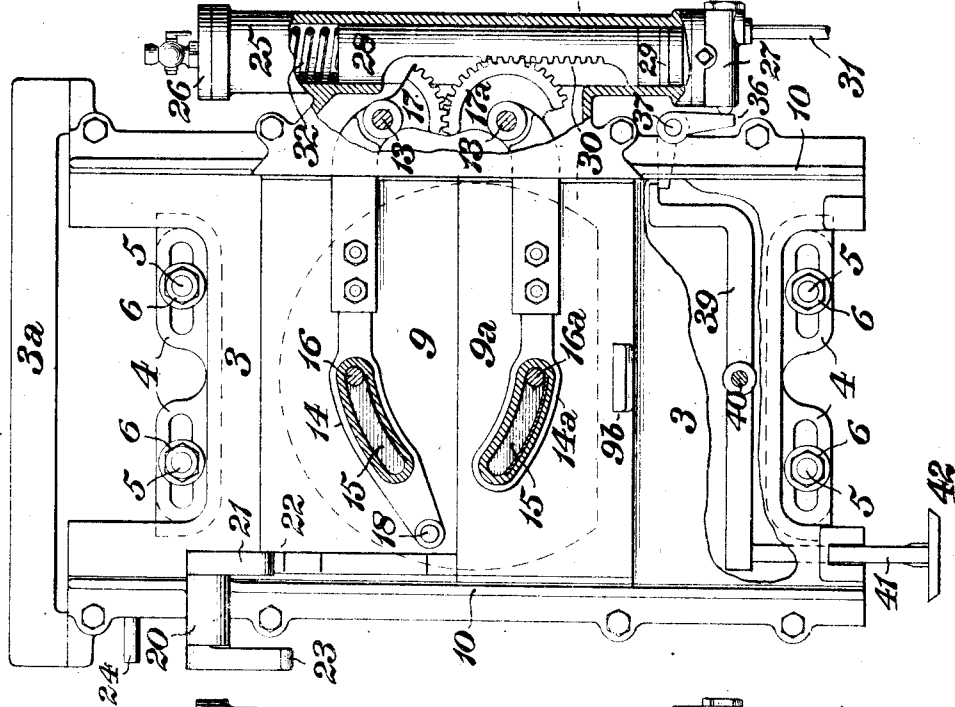
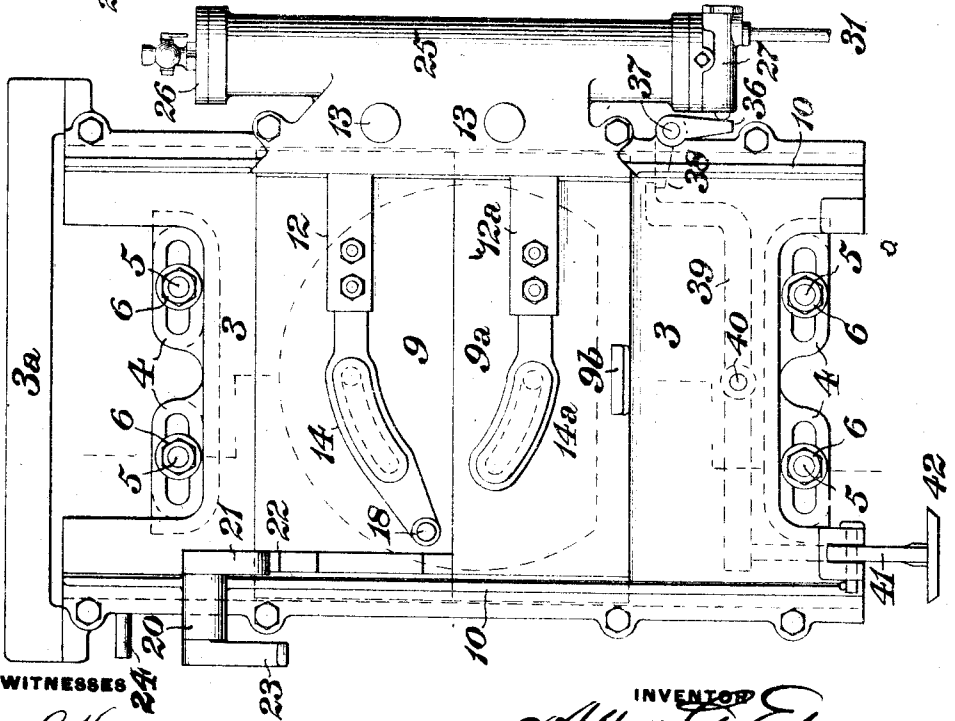


FIG. 1.



WITNESSES

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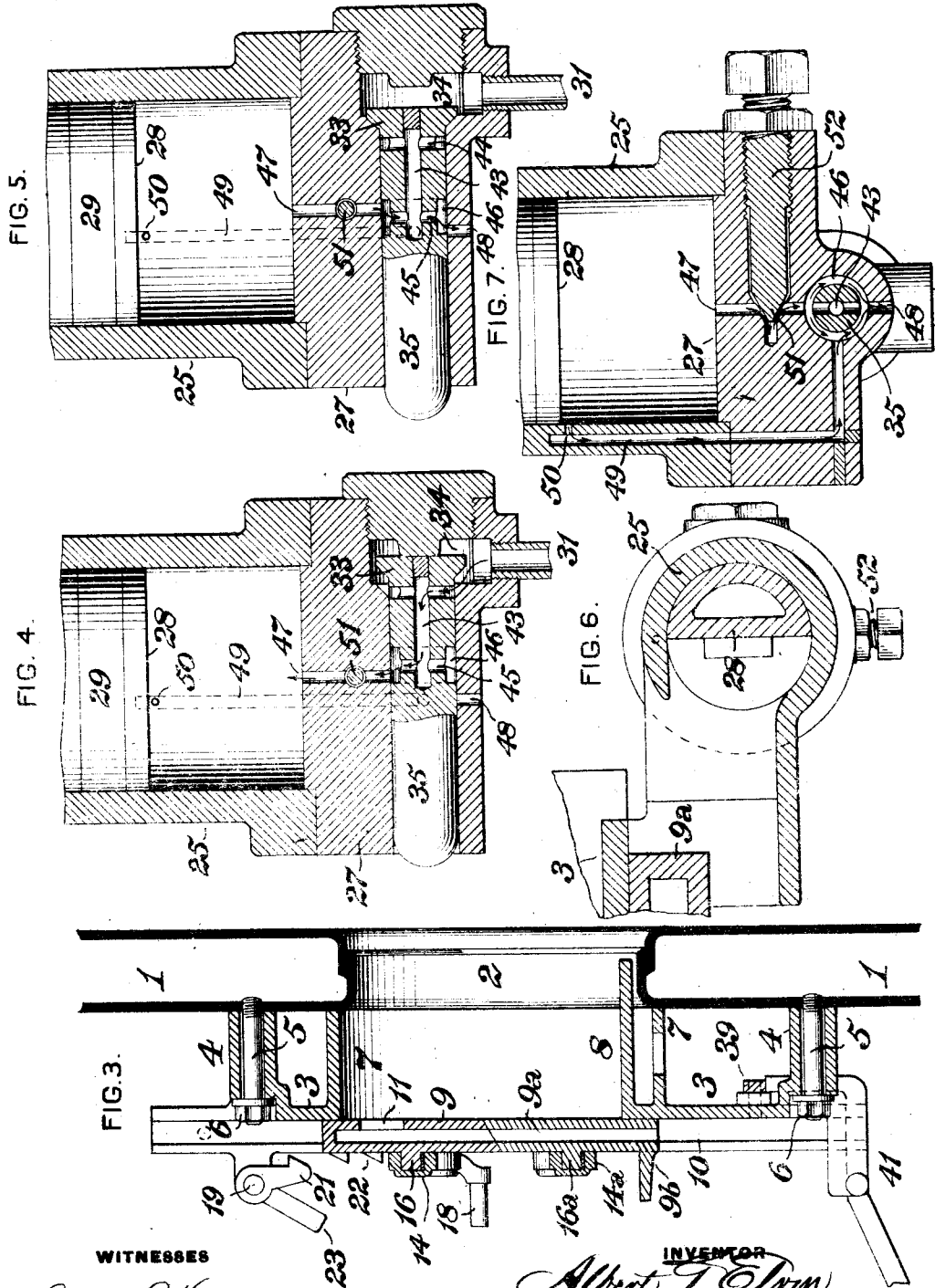
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UNITED STATES PATENT OFFICE.

ALBERT G. ELVIN, OF FRANKLIN, PENNSYLVANIA.

FIRE-BOX DOOR FOR STEAM-BOILERS.

1,066,005.

Specification of Letters Patent.

Patented July 1, 1913.

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To all whom it may concern:

Be it known that I, ALBERT G. ELVIN, of Franklin, in the county of Venango and State of Pennsylvania, have invented a certain new and useful Improvement in Fire-Box Doors for Steam-Boilers; of which improvement the following is a description.

The object of my invention is to provide a firebox door which shall be of simple, inexpensive, and durable construction and ready adaptability in connection with steam boilers of the locomotive and other standard types, and which may be operated either manually or by power as desired, and by the application of which, labor in firing and consumption of fuel may be substantially reduced, and deterioration of boiler flues and other parts incident to the use of doors of the ordinary construction be prevented.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is a front view, in elevation, of a firebox door appliance, illustrating an application of my invention; Fig. 2, a view, partly in front elevation and partly in section, of the same; Fig. 3, a vertical section through the same and through the adjoining portion of the rear water wall of a steam boiler; Fig. 4, a vertical central section, on an enlarged scale, through the lower portion of the cylinder and its lower head, showing the operating valve as unseated for the supply of fluid to the piston; Fig. 5, a similar view, showing the operating valve as seated for the exhaust of fluid from the piston; Fig. 6, a horizontal section through the cylinder and piston; and, Fig. 7, a vertical section, on an enlarged scale, through the lower portion of the cylinder and its lower head, taken at right angles to Figs. 4 and 5.

In the practice of my invention, I secure to the rear water wall, 1, of a locomotive or other steam boiler, surrounding the firing opening, 2, thereof, a door frame, 3, which is of substantially rectangular form, and is provided with lugs, 4, which abut against the water wall, 1, and are slotted horizontally to inclose studs 5, fixed in said wall, to which the door frame is firmly connected by nuts, 6, engaging threads on said studs. The longitudinal horizontal slots of the lugs enable the studs, 5, to be set in such positions in the water wall as to be clear of stay bolts therein. A central opening is formed in the door frame and an open ended

throat or casing, 7, corresponding substantially in contour with, and surrounding the firing opening, is formed around said central opening, on the inner side of the door frame, said throat abutting at its end farther from the door frame, against the water wall, and a shoveling plate, 8, projects from the door frame into the firing opening, to protect the firebox sheets from injury by blows from the fireman's shovel. An oil can tray, 3^a, is connected to the top of the door frame, and affords a convenient support for oil cans &c.

An upper door section, 9, and a lower door section, 9^a, each of which is a hollow or chambered casting of substantially rectangular form, are fitted to slide vertically in guides, 10, bolted to the sides of the door frame, the door sections fitting accurately on their abutting edges when closed, and the joint between them being preferably formed on an incline as shown in Fig. 3. The space within the lower section is open at its top and bottom, and that within the upper section is open at its bottom and closed at its top, and communicates by openings, 11, with the interior of the throat or casing, 7. The interior of the door sections thus forms an air space, through which, when they are closed, air is drawn into the firebox, and in which the air is highly heated before passing into the firebox, with the resultant advantages of protecting the door sections from becoming too hot and being thereby soon warped or burned out, and of promoting combustion and preventing the formation of smoke, by furnishing a supply of heated air to the gases evolved from the combustion of the fuel in the firebox. The upper section is made heavier than the lower, in order to assist in closing.

The door sections, 9, 9^a, are moved from and toward each other, to open and close, respectively, the outer end of the throat or casing, 7, by means of levers, 12, 12^a, pivoted by pins or bolts, 13, to one side of the door frame, and carrying arms, 14, 14^a, in which are formed curved slots, 15, engaging pins, 16, 16^a, formed or fixed centrally on the door sections, 9 and 9^a, respectively. Segment gears, 17, 17^a, are formed on the levers, 12, 12^a, on the sides of their pivots farther from the arms, 14, 14^a, and an operating handle, 18, is formed on the outer end of one of the arms, as the upper arm, 14, by the movement of which handle,

through the engagement of the curved slots, 15, with the pins, 16, 16^a, and the meshing of the teeth of the segment gears, 17, 17^a, the door sections may be simultaneously moved away from or toward each other, as desired. A tread, 9^b, is formed upon the lower door section, for the purpose of enabling the door sections to be moved by the pressure of the foot of the fireman, if desired.

In order to enable the door sections to be held at their maximum distance apart, so as to expose the entire opening of the throat, 7, as when cleaning a fire, or to partially expose said opening, as for admitting air above the grates when it is desired to check the draft through the boiler tubes, a latch shaft, 19, is journaled in a bearing, 20, on the side of the door frame opposite that to which the levers, 12, 12^a, are pivoted, said shaft carrying, on one of its ends, a latch, 21, adapted to engage one of a set of hooks or projections, 22, on the upper door section, 9, and carrying, on its opposite end, an operating handle, 23, which may be thrown back against a stop, 24, on the door frame, to hold the latch in such position that it cannot engage the hooks during ordinary firing or during such periods as it is not desired to keep the door sections at a greater or less distance apart.

The construction above described affords desirable facilities for quickly and conveniently effecting the opening and closure, either total or partial, of the throat, 7, as required in the operations of firing, cleaning fires, or checking draft, as well as for protecting the movable door sections from injury by the heat of the firebox and for affording a supply of heated air above the grate. To further facilitate the effective performance of its functions, it is, however, preferably supplemented by means for operating the door sections by fluid pressure, as air or steam, and a construction for this purpose, which has been found in practice to be advantageously operative, is herein exemplified and will now be described.

A vertical fluid pressure operating cylinder, 25, is bolted to the side of the door frame, 3, which adjoins the segment gears, 17, 17^a, of the door section levers, and is closed at its upper and lower ends by heads, 26, 27. The cylinder, 25, is cut away on its side next the segment gears, so as to allow them to project into it, and is fitted with a piston, 28, provided with suitable packing rings, 29, near its lower end. A longitudinal recess is formed in the piston, 28, above its packing rings, and is provided with a rack or plurality of teeth, 30, engaging the teeth of the segment gear, 17^a, of the lower door section. Upward movement is imparted to the piston by fluid pressure, which is preferably compressed air, admitted to its lower end through a supply

pipe, 31, and it is moved downwardly by a spring, 32, abutting on its upper end and on the upper head, 26, of the cylinder. It will be seen that the upward and downward movements of the piston, will, respectively, through the segment gears and their connections, move the door sections apart or bring them together, as the case may be.

The supply and exhaust of motive fluid to and from the piston are effected by an operating valve, 33, which is of the lift or puppet type, and is fitted to move horizontally in a chamber, 34, in the lower cylinder head, 27, which chamber, and the operating valve therein, are constantly exposed to the fluid pressure in the supply pipe, the operating valve being, consequently, normally held seated by said pressure. The operating valve is formed on or fixed to a cylindrical stem, 35, which projects outwardly through a corresponding bore in the lower cylinder head, in the direction of the door frame, and abuts against a downwardly projecting arm, 36, on a rock shaft, 37, journaled on said frame. The rock shaft, 37, carries a horizontally projecting arm, 38, which bears against one arm of a double armed lever, 39, journaled on a pin, 40, fixed in the door frame below the lower door section, and the opposite arm of said lever is connected to the inner arm of a double armed treadle lever, 41, journaled on the lower portion of the door frame. The outer arm of the treadle lever is bent downwardly to a level slightly above that of the deck or firing floor of the boiler, and carries a treadle, 42. By downward pressure of his foot upon the treadle, 42, the fireman can, through the lever system above described, unseat the operating valve, and; upon the release of such pressure, the valve will be resealed by the pressure from the supply pipe acting upon it in its chamber, 34.

A central supply passage, 43, is formed in the valve stem, 35, said passage communicating by radial ports, 44, with the valve chamber, 34, when the operating valve is unseated, and extending to radial ports, 45, leading into an annular peripheral groove or channel, 46, in the valve stem. In all positions of the operating valve and stem, the channel, 46, registers with a main supply and exhaust port, 47, leading through the lower head, 27, into the cylinder, 25, and, when the operating valve is seated, it also registers with a final exhaust port, 48, in the head, leading to the atmosphere. A preliminary exhaust passage, 49, is formed in the wall of the cylinder, said passage opening thereinto by a port, 50, located slightly below the level of the bottom of the piston, 28, when at the upper extremity of its traverse, and the lower end of the preliminary exhaust passage opens into the cylindrical

bore in which the valve stem, 35, works, at such a point in the length thereof as to register with the channel, 46, of said stem, and, through said channel, with the final exhaust port, 48, when the operating valve is seated. The area for traverse of fluid through the port, 47, is made less than that through the preliminary exhaust passage, and is varied, as desired, by a regulating valve, 51, formed on the end of an adjusting screw, 52, engaging a thread in the lower head, by the movement of which screw, the valve, 51, may be caused to close the port, 47, either entirely or to any desired degree.

In the operation of the appliance, when not fitted with a power actuating mechanism, or in the event of the derangement of such mechanism, the desired movement, either total or partial, of the door sections, is effected by the fireman by application of hand pressure to the handle, 18, or foot pressure to the tread, 9^b. The door sections are substantially balanced, and can therefore be moved more easily and conveniently than doors of the ordinary type.

When utilizing a power actuating mechanism, substantially as described, the fireman places his foot on the treadle, 42, and thereby depresses the outer end of the lever, 41, which, through the lever, 39, and rock shaft, 37, and its arms, transmits the applied pressure to the stem, 35, of the operating valve, 33, and unseats said valve. Operating fluid is thereby admitted to the cylinder, 25, below its piston, 28, through the ports, 44, passage, 43, ports, 45, peripheral channel, 46, and port, 47, the pressure of the fluid raising the piston to the limit of its upward traverse, in which, through the gearing and door sections, it moves the door sections away from one another the limit of their traverse, and fully opens or uncovers the firing throat channel, 7. Said channel remains open only so long as the pressure of the fireman's foot is maintained on the treadle, and, upon the release of this pressure, the operating valve is immediately seated by the pressure in its chamber, 34. The upper end port, 50, of the preliminary exhaust passage, 49, has previously been uncovered by the piston passing above it, and the lower end of said passage has, by the seating of the operating valve, been brought into communication with the channel, 46, and final exhaust port, 48. The port 47, is also open to the channel, 46, and final exhaust port, 48. The operating fluid is therefore exhausted from the cylinder, and the piston is forced down by the spring, 32, bringing the door sections to their normal closed position in its downward movement. The preliminary exhaust being open before the piston commences its downward stroke, the larger portion of the operating fluid below the piston will be immediately released,

thereby allowing the door sections to be quickly started in their closing movement, and as the port, 50, is closed by the piston in passing it, the remainder of the downward stroke of the piston and the resultant movement of the door sections will be made more slowly, owing to the comparatively restricted discharge opening through the port, 47, as regulated by the valve, 51. The piston will be thus, in a substantial degree, cushioned, so that while the door sections start to close quickly, they will come together easily and without shock.

The construction of the appliance is such as to involve comparatively few working parts, and these are of such character that they can be substantially made and are protected from liability to breakage and from damage by the access of dirt. The operation of the door sections, either by the power of the fireman or by fluid pressure, is quick, simple, and easy, and the automatic closure of the door sections when the fluid pressure mechanism is used, effects the substantial advantage of compelling single shovel firing, the advantage of which practice, in economizing fuel, perfecting combustion, and reducing firebox and flue repairs, has been universally recognized in railroad service. The benefit of the supply of hot air afforded by the hollow door sections is a further advantage attained in the application of the improvement.

I claim as my invention and desire to secure by Letters Patent:

1. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box and having an opening of dimensions and contour proper to surround a fire box door opening, vertically sliding upper and lower hollow or chambered door sections, the lower section having a passage for the admission of air to the chambered door sections and the upper section having an opening for the discharge of air into the furnace, said door sections being fitted to traverse on the door frame in direction to cover and uncover the opening therein, and means for simultaneously moving said door sections in opposite directions.

2. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire box, an open ended throat or channel projecting from said frame and adapted to surround a fire box door opening, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the outer end of said throat or channel, the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, and means for simul-

taneously moving said door sections in opposite directions.

3. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box, an open ended throat or channel projecting from said frame and adapted to surround a fire box door opening, a shoveling plate projecting from the frame above the bottom of the throat or channel and extending beyond the inner end thereof, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on the frame in direction to cover and uncover the outer end of the throat or channel, the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, and means for simultaneously moving said door sections in opposite directions.

4. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box, an open ended throat or channel projecting from said frame and adapted to surround a fire box door opening, lugs projecting from the frame above and below the throat or channel and provided with longitudinal slots for the reception of studs to secure the frame to the fire box, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on the frame in direction to cover and uncover the outer end of the throat or channel, the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, and means for simultaneously moving said door sections in opposite directions.

5. In a firebox door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box, and having an opening of dimensions and contour proper to surround a firebox door opening, two hollow or chambered door sections, each having passages for the admission and discharge of air, said door sections being fitted to traverse on the door frame in direction to cover and uncover the opening therein, two levers, each pivoted to the door frame on one side of a door section and having a curved slot adjoining its free end, pins fixed to the door sections and engaging the slots of the levers, intermeshing gears fixed on the levers concentrically with their pivots and means for operating one of the said gears.

6. In a firebox door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box, an open ended throat or channel projecting from said frame and adapted to surround a firebox door opening, two normally abutting

door sections fitted to traverse on said frame in direction to cover and uncover the outer end of said throat or channel, two levers, each pivoted to the door frame on one side of a door section and having a curved slot adjoining its free end, pins fixed to the door sections and engaging the slots of the levers, intermeshing gears fixed to the levers concentrically with their pivots, and means for operating one of said gears.

7. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box and having an opening of dimensions and contour proper to surround a fire box door opening, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the opening therein, the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, and a fluid pressure device connected with and actuating said mechanism.

8. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box, and having an opening of dimensions and contour proper to surround a fire box door opening, vertically sliding upper and lower hollow or chambered door sections, the lower section having a passage for the admission of air to the chambered door sections and the upper section having an opening for the discharge of air into the furnace, said door sections being fitted to traverse on the door frame in direction to cover and uncover the opening therein, mechanism for simultaneously moving said door sections in opposite directions, and a fluid pressure device connected with and actuating said mechanism.

9. In a fire box door appliance, the combination of a supporting frame for connection to a steam boiler fire-box, an open ended throat or channel projecting from said frame and adapted to surround a fire box door opening, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the outer end of said throat or channel, the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, and a fluid pressure device connected with and actuating said mechanism.

10. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box, and

having an opening of dimensions and contour proper to surround a firebox door opening, movable upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the opening therein, the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, two levers, each pivoted to the door frame on one side of a door section and having a curved slot adjoining its free end, pins fixed to the door sections and engaging the slots of the levers, intermeshing gears fixed on the levers concentrically with their pivots, a fluid pressure cylinder, and a piston working in said cylinder and carrying a rack engaging the teeth of one of the lever gears.

11. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire box and having an opening of dimensions and contour proper to surround a fire box door opening, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the opening therein, the lower section having a passage for the admission of air to the hollow door section and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, a fluid pressure cylinder, a piston working therein and actuating the door section moving mechanism, an operating valve controlling the supply and exhaust of fluid to and from said piston, and a spring bearing on said piston and acting to effect its traverse in direction opposite to that effected by the action of fluid pressure.

12. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box and having an opening of dimensions and contour proper to surround a fire box door opening, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the opening therein, and the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections, in opposite directions, a fluid pressure cylinder, a piston working therein and actuating the door section moving mechanism, an operating valve which, when unseated, admits fluid pressure to the piston, and, when seated, exhausts fluid pressure therefrom, and which is continuously subject to fluid supply pressure, a lever system for unseating the operating valve, and

a spring bearing on the piston and acting to effect its traverse in direction opposite to that effected by the action of fluid pressure.

13. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire box and having an opening of dimensions and contour proper to surround a fire box door opening, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the opening therein, and the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, a fluid pressure cylinder, a piston working therein and actuating the door section moving mechanism, an operating valve which, when unseated, admits fluid pressure to the piston, and, when seated, exhausts fluid pressure therefrom, and which is continuously subject to fluid supply pressure, a lever system, one member of which contacts with the operating valve, means, as a treadle, for unseating the operating valve through the lever system, and a spring bearing on the piston and acting, when the operating valve is unseated, to effect the traverse of the piston in direction opposite to that effected by the action of fluid pressure.

14. In a fire box door appliance, the combination of a supporting frame adapted for connection to a steam boiler fire-box and having an opening of dimensions and contour proper to surround a fire box door opening, vertically sliding upper and lower normally abutting hollow door sections fitted to traverse on said frame in direction to cover and uncover the opening therein, and the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, a fluid pressure cylinder having a direct supply and exhaust port, a piston working therein and actuating the door section moving mechanism, a preliminary exhaust port leading into the cylinder adjacent to the limit of traverse of the piston, a final exhaust port, an operating valve controlling all of said ports and continuously subjected to fluid supply pressure, and means for unseating the operating valve to admit fluid pressure to the piston and permitting it to be reseated by fluid pressure to exhaust fluid pressure from the piston.

15. In a fire box door appliance, the combination of vertically sliding upper and lower normally abutting hollow door sections, and the lower section having a pas-

sage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, a fluid pressure cylinder, a piston working therein and actuating the door section moving mechanism, an automatically seating operating valve controlling the supply and exhaust of fluid to and from the piston, and means for unseating said operating valve.

16. In a fire box door appliance, the combination of vertically sliding upper and lower normally abutting hollow door sections, and the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, a fluid pressure cylinder, a piston working therein and actuating the door section moving mechanism, an automatically seating operating valve controlling the supply and exhaust of fluid to and from the piston, an adjustable regulating valve interposed between the operating valve and the piston, and means for unseating the operating valve.

17. In a fire box door appliance, the combination of vertically sliding upper and lower normally abutting hollow door sections, and the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, a fluid pressure cylinder, a piston working therein and actuating the door section moving mechanism, an automatically seating operating valve controlling, when unseated, the supply of fluid to the piston for effecting its movement in opening the door sections, and controlling, when seated, the free ex-

haust of fluid from the piston at the beginning of its movement coincident with the closure of the door sections, and a comparatively restricted exhaust of fluid during the remainder of its movement in the same direction, and means for unseating said operating valve.

18. In a firebox door appliance, the combination of vertically movable upper and lower normally abutting hollow door sections, the lower section having a passage for the admission of air to the hollow door sections and the upper section having an opening for the discharge of air into the furnace, mechanism for simultaneously moving said door sections in opposite directions, a fluid pressure cylinder, a piston working therein and actuating the door section moving mechanism, a head closing one end of the cylinder, and provided with an operating valve chamber and a cylindrical bore for an operating valve stem, a fluid supply pipe leading into the valve chamber, a main supply and exhaust port leading from the cylindrical bore into the end of the cylinder, a preliminary exhaust port leading from said bore into the cylinder in a plane adjacent to the limit of outward traverse of the piston, a final exhaust port leading from said bore to the atmosphere, an operating valve adapted to seat in the valve chamber at the inner end of said bore, a stem fixed to said valve and fitting in and passing through said bore, and having a peripheral groove or channel adapted to register with the ports aforesaid, a longitudinal passage in said stem having radial ports at its ends leading to the periphery of the stem adjacent to the valve and to the radial groove or channel, respectively, and means for unseating the operating valve.

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Witnesses:

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