Aug. 27, 1946. H. L. WETHERBEE 2,406,727

COMBINED CHIMNEY AND BLOWOFF VALVE

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FIG. 1

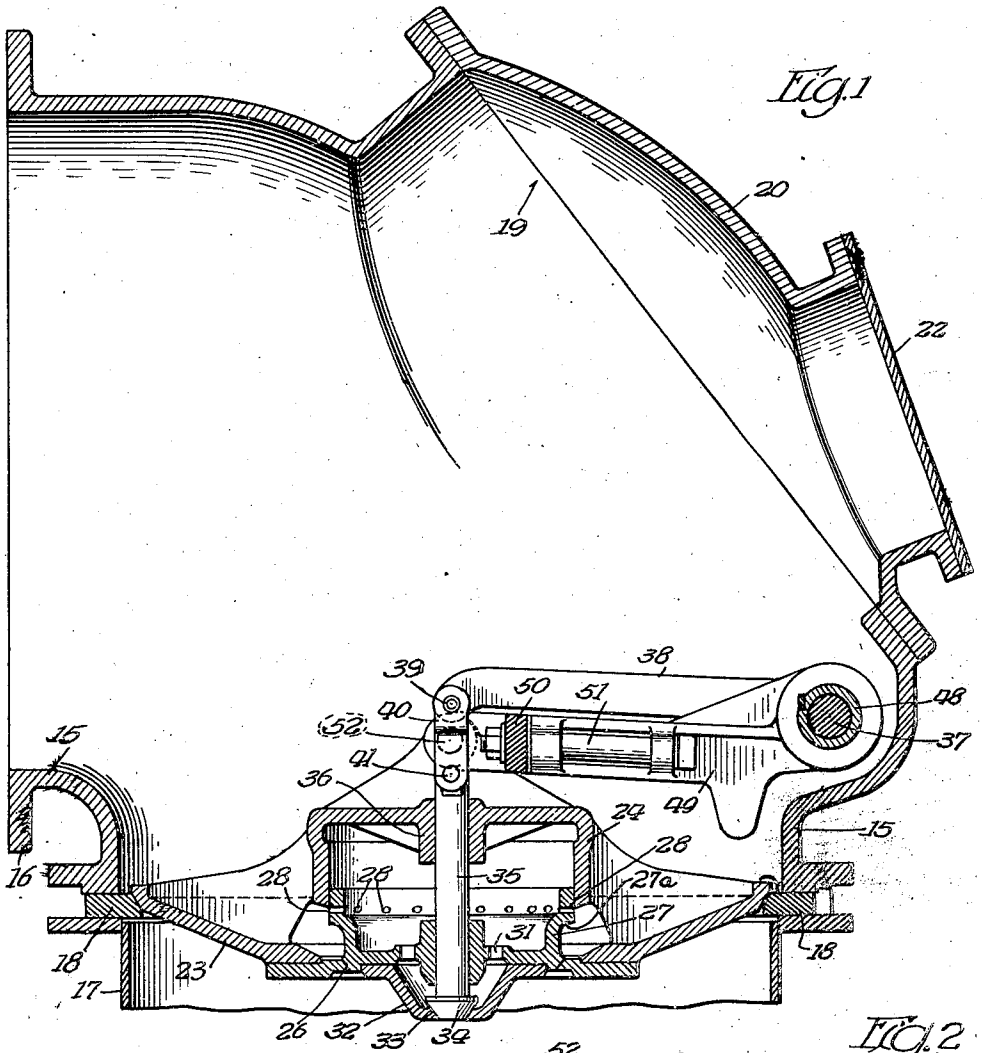
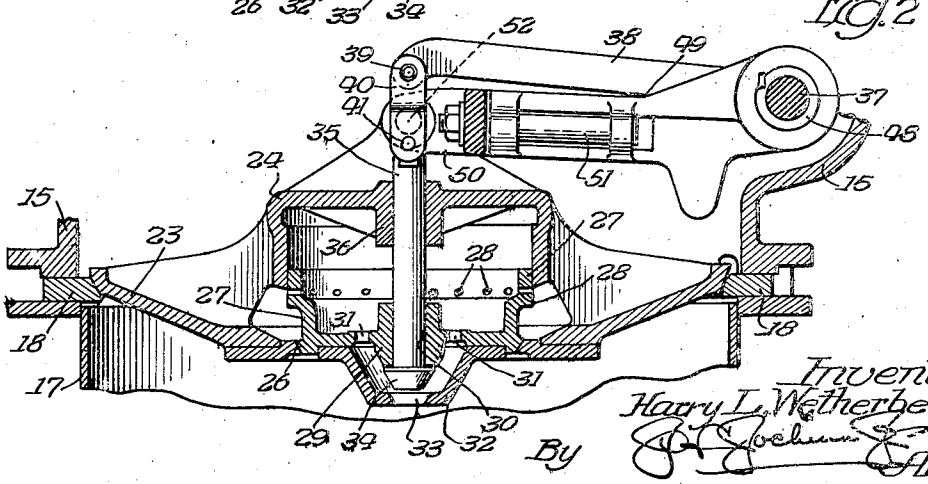


FIG. 2



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FIG. 3

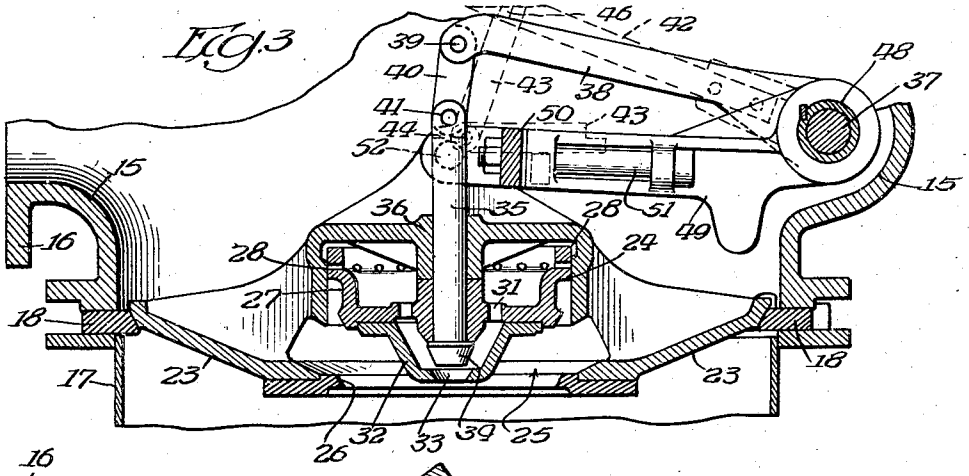
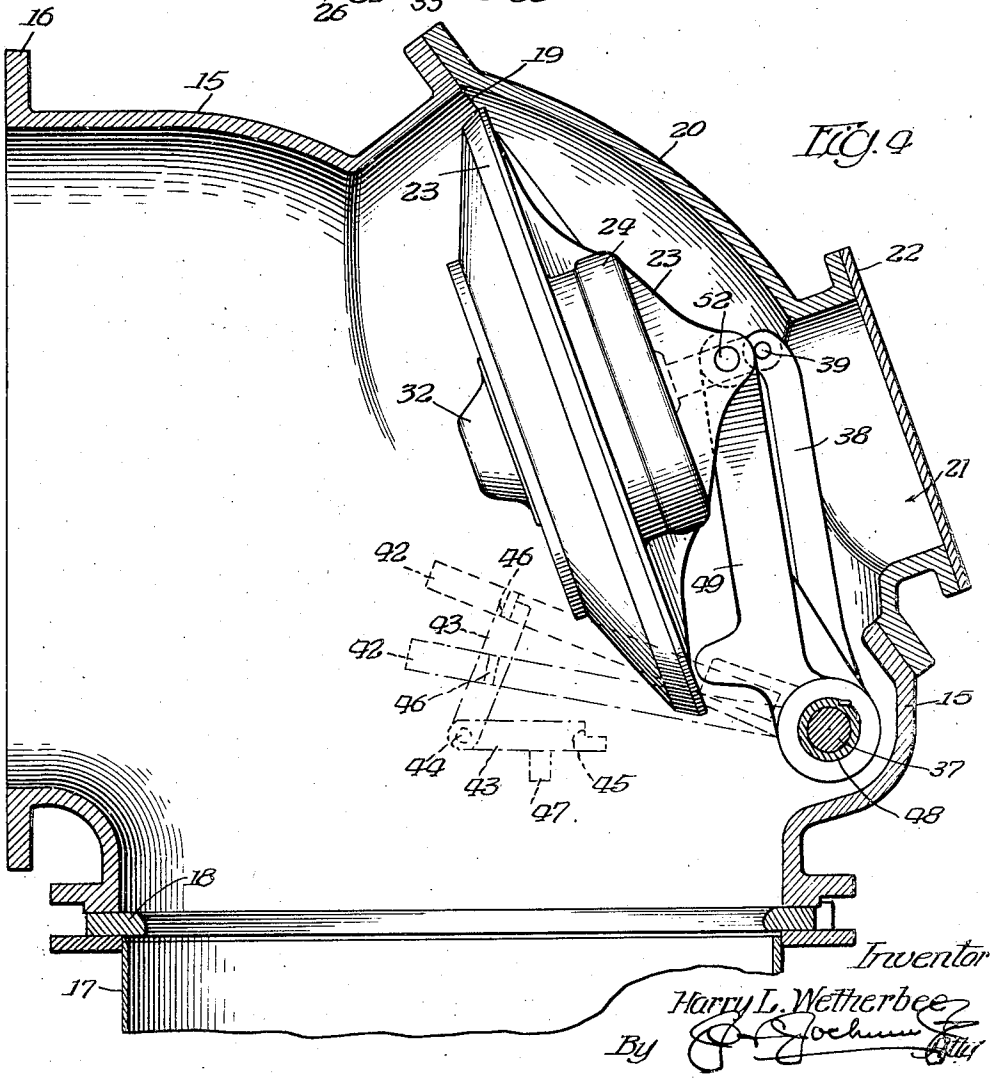


FIG. 4



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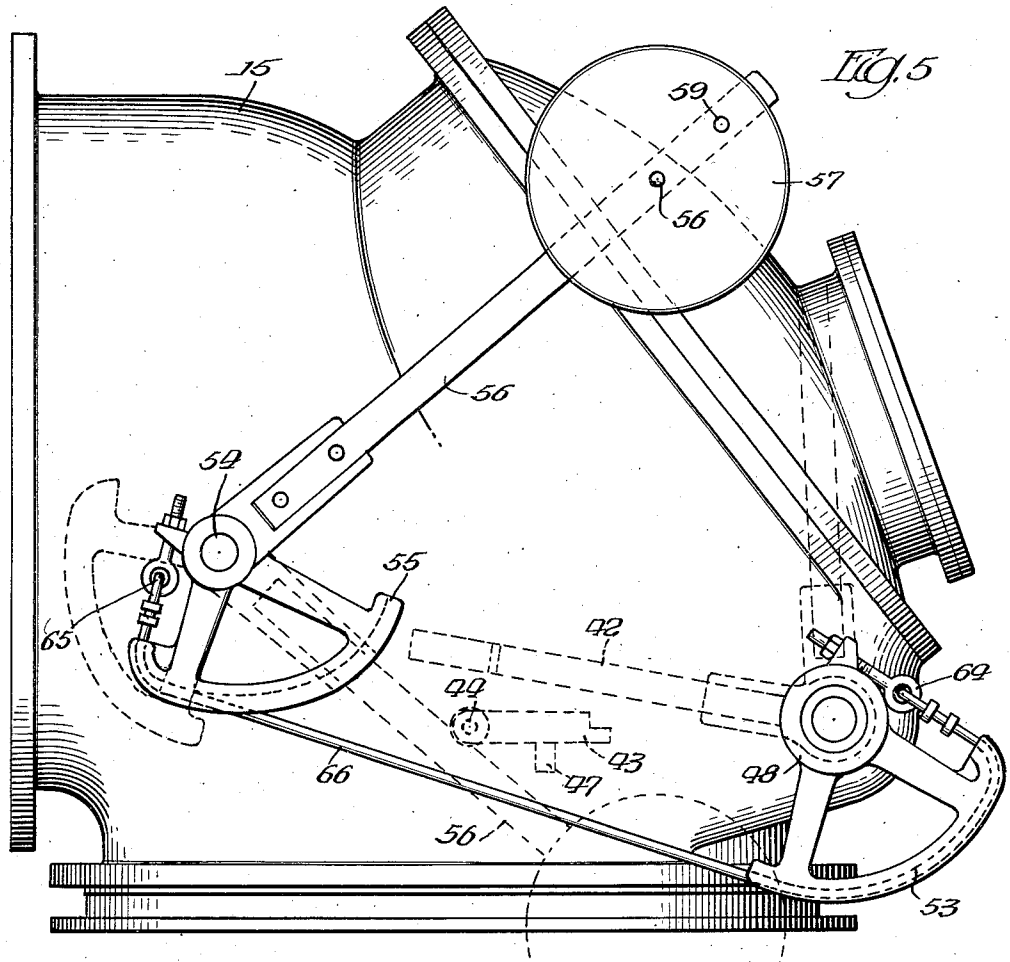


Fig. 5

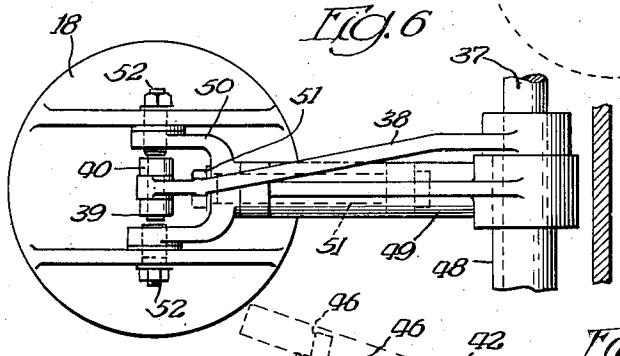


Fig. 6

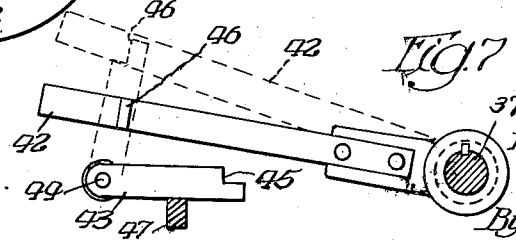


Fig. 7

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Fig. 9

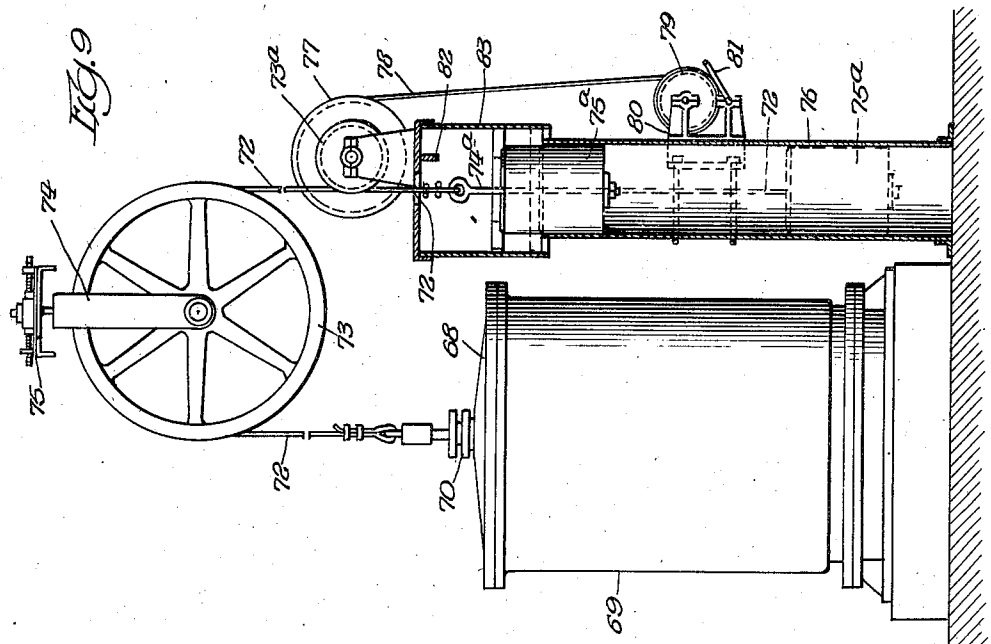
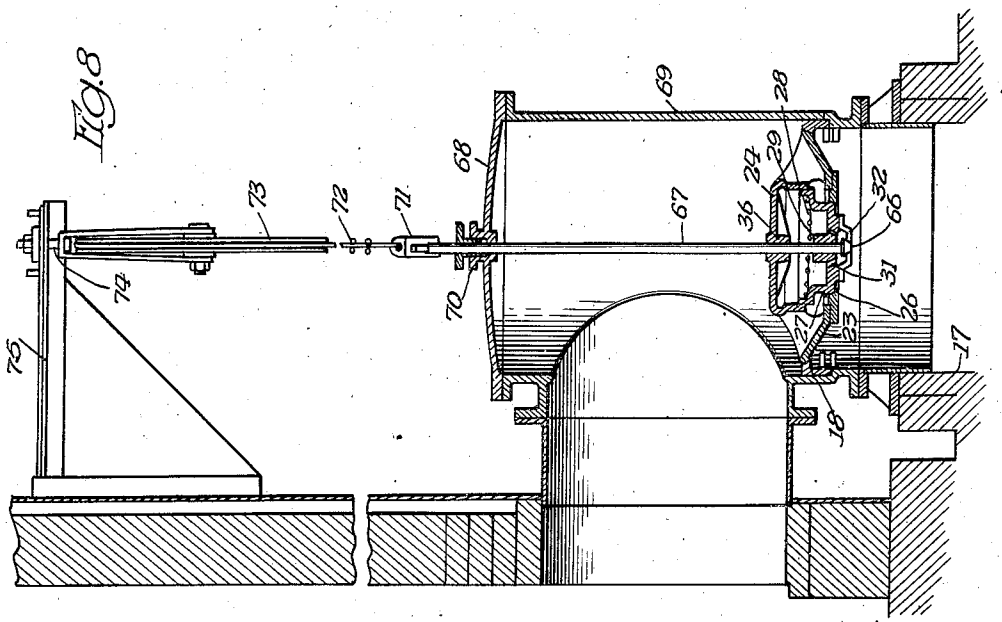


Fig. 8



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UNITED STATES PATENT OFFICE

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COMBINED CHIMNEY AND BLOWOFF VALVE

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Application August 7, 1943, Serial No. 497,728

5 Claims. (Cl. 137—144)

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This invention relates to improvements in chimney and blowoff valves for controlling the flow of gases and air in the operation of blast furnaces. In the manufacture of pig iron by means of a blast furnace, a large volume of air must be blown through the furnace to promote the combustion of coke in smelting the iron from the ore. By pre-heating the air to a temperature of from 1200° F. to 1600° F., a considerable saving in the amount of fuel required will result. Due to the resistance of the ore, coke, etc., in the furnace, commonly known as the furnace burden, a pressure of from 16 to 20 pounds, or even more, per square inch is required to force the air into the furnace, and this necessitates the employment of blowing engines.

To pre-heat the air, stoves are used, and such heating has been accomplished by burning gases, which are passed through checkers that absorb the heat. After the checkers have reached a sufficiently high temperature, the burning gas is shut off by the manipulation of proper valves, and the stove is connected to the air supply. The air thus supplied is then passed through the heated checkers and is thereby heated to the desired, or required, temperature before it is delivered to the blast furnace, the products of combustion being removed from the stove through a stack or chimney.

Between the stove and the chimney these products pass through, and are controlled by a chimney valve, and while the stove is on gas and the products of combustion are passing off through the chimney valve and through the stack or chimney, the entire system will be at atmospheric pressure.

While the stove is on air, that is, when air is being blown through the heated checkers, it is necessary to tightly close or seal the stove, such as by means of suitable valves, in order to confine the high pressure of the air delivered into the furnace.

After the air has absorbed the heat from the checkers in the stove, and to again put the stove on gas to reheat the checkers, certain valves must be opened and closed. Due to the pressure of air in the stove, large valves could not be readily moved; therefore, to render it possible to actuate the valves, the pressure inside of the stove must be reduced to, or near, atmospheric pressure, and for this purpose a blowoff valve is employed. These valves have heretofore been separate from each other, and have been expensive to install, requiring considerable space for installation.

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It is one of the objects of the present invention to overcome all of these difficulties and objections, and to provide an improved chimney valve of this character, of the mushroom type, and an improved blowoff valve, with improved mechanism for actuating the same.

A further object is to provide a combined blowoff and chimney valve, each of which is adapted to be employed individually and independently with respect to the other, or in combination with each other, and at the same time provide a structure which is of a simple construction and compact arrangement, which may be installed and maintained at an expense which is considerably less than the cost of installation and maintenance of similar valves now employed for this purpose.

A further object is to provide, as a unitary structure, a combined chimney and blowoff valve, each of which is provided with its individual operating mechanism.

A still further object is to provide an improved combined chimney and blowoff valve, comprising a plurality of valve elements arranged within each other, and in which some of the valve elements are provided with positive actuating means individual thereto. Another of the valve elements is adapted to be actuated with respect to certain of the other valve elements, automatically, by fluid pressure, whereby to permit the passage of fluid from that side of the valve proper on which the greatest fluid pressure exists, to the other side thereof, to counterbalance or equalize the pressure of fluid against the valve proper, thereby rendering it possible to shift the valve proper with respect to its seat, to open the valve.

To the attainment of these ends and the accomplishment of other new and useful objects as will appear, the invention consists in the features of novelty in substantially the construction, combination and arrangement of the several parts, hereinafter more fully described and claimed and shown in the accompanying drawings illustrating this invention, in which

Fig. 1 is a vertical sectional view of a combined chimney and blowoff valve, constructed in accordance with the principles of this invention, and showing the valve in a closed position to prevent the flow of fluid through the air conduit.

Fig. 2 is a detail sectional view of the valve, showing the main valve in a closed position and the pilot valve in an open position.

Fig. 3 is a view similar to Fig. 2, showing the parts of the valve in a different position.

Fig. 4 is a vertical sectional view of the valve

housing, showing the valve in elevation, and in a fully open position to permit flow of air through the conduit.

Fig. 5 is a side elevation taken from the outside of the valve casing, and showing part of the operating mechanism for the valve.

Fig. 6 is a detail top plan view of a portion of the valve operating mechanism.

Fig. 7 is a diagrammatic view, partly in elevation and partly in section, showing the operating mechanism for the blowoff valve.

Fig. 8 is a vertical sectional view of a modified form of the invention.

Fig. 9 is a right-hand end elevation of Fig. 8, showing parts of the operating mechanism for the valve, in section.

Referring more particularly to the drawings and to the form of the invention shown in Figs. 1 to 7, the valve mechanism consists essentially of a casing 15 which is arranged between the stove and the chimney, the casing being preferably provided with a flange 16 whereby it may be secured in position. The other end of the casing 15 is connected with the chimney or stack 17, a suitable element 18 being arranged therebetween to constitute a valve seat. In lieu of this element 18, the valve seat may, if desired, be formed as a part of the casing 15. The casing 15 is provided with an open side 19 closed by a suitable closure 20, in which latter may be provided a manhole or opening 21 which is, in turn, closed by a suitable closure 22.

The chimney valve proper consists of a main valve element 23 which may be of any desired configuration, but is preferably slightly concave, and is adapted to engage and rest upon the valve seat 18. A portion of the main valve 23 is shaped to form a cylinder 24 which is preferably open at its bottom, and preferably terminates a substantial distance above the bottom of the main valve 23, and in alinement with an opening 25 therethrough (see particularly Fig. 3), and a valve seat 26 encompasses the opening.

Reciprocable in the cylinder 24 is a piston or blowoff valve 27 which is preferably hollow and may be provided with openings 28 through the wall thereof. This piston constitutes a portion of a blowoff valve, and is itself provided with openings 31 through its bottom, and is also preferably provided with a bearing 29. Any number of these openings 31 may be provided, for a purpose to be later described. Supported by the valve member 27 is a member 32 which is also hollow and is provided with an opening 33, the wall of which latter forms a valve seat. This opening 33 is preferably in alinement with the opening 30 through the bearing element 29, and the openings 31 in the bottom of the valve member 27 are provided for the purpose of relieving the pressure within the cylinder 24, in a manner and for a purpose to be later set forth.

A pilot valve 34 is provided for controlling the opening 33, and this valve 34 is provided with a stem 35 which passes through the bearing 29, and also through a bearing 36 in the cylinder 24, and through the top of the cylinder. The pilot valve is adapted to be moved from the position shown in Fig. 1, where it closes the opening 33, to the position shown in Fig. 2, to uncover the opening 33, and the opening movement of the pilot valve may be controlled by reason of the valve 34 abutting the bearing 29, as shown in Fig. 2.

When all of the parts of the valve are in the position shown in Fig. 1, the passage between the

stack or chimney and the conduit 17 will be closed, and pressure will be exerted upon the top of the main valve to hold it in a closing position. Due to the excess of pressure on this side of the valve as compared with that which exists on the other side of the valve, it is difficult to unseat the main valve 23 so as to permit the flow of air from the stove into the conduit 17. Therefore, in order to be able to open the valve 23, this excess pressure must be relieved.

It will be noted that when the parts are in the position shown in Fig. 1, the fluid pressure on the upper side of the main valve will leak through the openings 28 into the cylinder 24 and hollow piston or blowoff valve 27 to hold this valve closed, and as the pilot valve 34 will also be closed, fluid pressure will be exerted upon the top of the valve 34 to assist in holding it in its closed position. However, as the top of the valve 34 is of a comparatively small area, the pilot valve may be more readily moved against such fluid pressure. Therefore, when it is desired to open the valve 23, the pilot valve 34 is moved from the position shown in Fig. 1 to the position shown in Fig. 2. The fluid pressure will then be relieved through the openings 31 and 33 and, at the same time, the fluid pressure will operate upon the under side as well as the surface 27*a* of the piston or blowoff valve 27 to assist in moving it from the position shown in Fig. 2 to the position shown in Fig. 3, thereby unseating the valve 27 to permit the fluid pressure to be exerted through the opening 25 in the main valve element 23. When this pressure is thus relieved, the main valve element 23, together with all of the other parts of the valve element, may be readily moved from the position shown in Fig. 1 to the open position shown in Fig. 4, to permit the air to flow from the stove into the conduit or stack 17.

Any suitable means may be provided for opening the pilot valve 34, but a simple and efficient means embodies a shaft 37 which is suitably mounted in the valve casing and is provided with an arm 38, to the forward end of which arm is pivotally connected, as at 39, a link 40. The other end of the link 40 is pivotally connected, as at 41, to the end of the pilot valve stem 35, so that by rocking the shaft 37 by means of a handle 42, which latter is arranged on the outside of the casing, and readily accessible, the pilot valve 35 may be raised or unseated. This valve 35, when raised from the position shown in Fig. 1, may be held in any open position in any suitable manner, such as by means of a latch 43 pivotally mounted, as at 44, and which is provided with a seat 45 adapted to be engaged by a shoulder 46 on the handle or lever 42, as shown more clearly in Fig. 7. When the valve is unseated by raising the shoulder 46, the latch 43 may be swung into the dotted line position shown in Fig. 7. When the pilot valve is to be closed, the latch 43 may be turned into an inoperative position to rest upon a suitable support 47.

The main valve section, together with all of the other valve elements, may be opened in any suitable manner, and for that purpose there may be provided a shaft 48 which may telescope with the shaft 37, and secured to this shaft 48 is an arm 49, upon the forward end of which a yoke-shaped member 50 is mounted in such a manner as to provide a swivel action of the yoke-shaped member with respect to the arm. This may be accomplished by means of a bolt or fastening member 51 which passes through the bottom of the yoke and into the arm 49. The link 40 be-

tween the arm 38 and the pilot valve 35 is preferably arranged within the yoke, and the arms of the yoke may be pivotally connected, as at 52, with a portion of the main valve element 23. The purpose of this swivel connection is to compensate for any unevenness or irregularities in the valve seat 18 and the valve and to insure that the valve element 23 will be properly seated when the valve is closed.

The shaft 48, which is connected to the main valve element 23 by means of the arm 49, may be rocked in any suitable manner. A simple and efficient means embodies a segmental-shaped member 53 which is secured to the shaft outside of the valve casing 15. Pivotally mounted upon a support 54, such as a stub shaft mounted upon the valve casing, is another segment 55, to which latter an arm 56 is connected, and adjustably mounted upon the arm 56 is a weight 57 which may be held in its adjusted position by means of a fastening device 58. A handle 59 may be provided for swinging the segment 55 about its pivot 54.

One end of a flexible member 60 passes over the segment 53 and is adjustably anchored by means of an adjustable fastening device 64. The other end of the flexible member 60 passes over the segment 55 and is adjustably anchored with respect to the segment by means of an adjustable fastening device 65.

With this construction, it will be manifest that, assuming the parts to be in the position shown in Fig. 5, the main valve section will be closed. When the pressure is relieved upon the main valve section so as to permit it to be opened, the segment 55 may be swung about its pivot 54 by grasping the handle 59 and moving the arm 56 from the position shown in solid line to the position shown in dotted line, in Fig. 5. This will cause the flexible member 60 to be wound upon the segment 55, and this in turn will rock the segment 53 about its pivot to open the valve.

In the operation of the closing of the main valve section, the turning moment of the valve is greater than the turning moment of the counterweight 57, thus maintaining the valve in a closed position without the benefit of air pressure in the stove. When the valve is open, that is, when it is in the position shown in Fig. 4, the closing turning moment of the valve is less than the opening turning moment of the counterweight 57, thus maintaining the valve in an open position, without the need of latches, pins, or other locking devices, and therefore the angles of the segments are correspondingly constructed, and may, if desired, be eccentric.

It is thought that the operation of this form of the invention will be clearly understood from the foregoing description, but, briefly stated, it is as follows:

When the parts are in the position shown in Fig. 1, the valve 23 is closed, and the pilot valve 34 is also closed. To open the valve 23, it is necessary to reduce the pressure on the upper side of the valve. This is accomplished by opening the pilot valve 34, that is, by moving it from the position shown in Fig. 1 to the position shown in Fig. 2, so that the fluid pressure above the valve will flow through the openings 28, and thence through the opening 33. The fluid pressure will then operate upon the bottom of the piston or blowoff valve 27, and will move it from the position shown in Figs. 1 and 2 to the position shown in Fig. 3, thereby opening the passage 25 to permit the fluid pressure to flow from the

stove into the conduit 17. This will cause a reduction of pressure upon the top of the valve 23, rendering it possible to open this valve by merely swinging the weighted arm 56 from the full line position to the dotted line position shown in Fig. 5. Before the pilot valve 34 is opened, fluid pressure will leak through the openings 28 into the cylinder 24, to assist in maintaining the blowoff valve 27 in a closed position.

When the pilot valve 34 is first opened, it may be locked in its open position by the mechanism shown in Fig. 7. Thereafter, when the fluid pressure is reduced sufficiently to permit the valve 23 to be opened by the swinging of the arm 56, the pilot valve 34 will be carried with the main valve.

In the form of the invention shown in Figs. 8 and 9, the pilot valve 66 is similar to the pilot valve 34, and the stem 67 thereof passes through the top 68 of the valve casing 69, a suitable packing 70 being provided for the valve stem. The end of the valve stem is connected, by means of a coupling 71, to a flexible member 72 which passes over a pulley 73 swiveled, as at 74, to a support 75. The other end of the flexible member 72 is wound upon a drum 73*a*, and the free end of the flexible member 72 is connected, by means of a connecting device 74*a*, with a weight 75*a* that slides in a casing 76.

Connected to the shaft of the drum 73*a* is another drum or pulley 77, over which a flexible member 78 is wound, and the other end of the flexible member 78 passes over a drum 79 journaled in a bracket 80, and the drum 79 is adapted to be rotated by means of a handle 81 having a suitable connection whereby, upon rotation of the handle, the drum will be rotated.

In this form of the invention the main valve sections operate in the same manner as in the other form of the invention, with the exception that the pilot valve 66 is first unseated by operation of the handle 81 and the turning of the drum 79 which rotates the drum 73*a*, to permit the fluid pressure to flow beneath the piston or blowoff valve 27 to unseat it. Thereafter, when the fluid pressure is equalized upon the main valve section 23 to permit it to be opened, the opening operation is accomplished by further actuating the handle 81 and rotating the drum 73*a* to cause the pilot valve 66 to raise and unseat the main valve section 23. In other words, in this form of the invention a single positive actuating means is provided for first opening the pilot valve, and then, subsequently thereto, unseating the main valve section.

A stop device 82 may be provided and arranged in a casing 83, to limit the movement of the weight 75*a* in one direction.

When desired, the blowoff and pilot valves may be employed as a unit by omitting the main valve section, and the latter, which constitutes the chimney valve, will be separate therefrom. In this instance the valve section 27 will co-operate directly with a valve seat which may be formed as a part of the air conduit. That is, instead of the main valve section or chimney valve 23 being a part of the unit movable with the blowoff valve, a stationary seat for the valve section 27 may be provided, just as though the section 23 were stationary. The chimney valve may then be located at any point, but the blowoff and pilot valves would serve the same function, that is, to reduce the pressure to permit the main valve to be opened.

While the preferred forms of the invention have been herein shown and described, it is to be un-

derstood that various changes may be made in the details of construction and in the combination and arrangement of the several parts, within the scope of the claims, without departing from the spirit of this invention.

What is claimed as new is:

1. A combined chimney and blowoff valve of the character described, embodying a main valve element for closing an air conduit, said valve element being acted upon on one side by fluid pressure to hold the same closed and having a passage therethrough, a second valve element for closing said passage, the last said element being acted upon by said fluid pressure to hold it in a closing position, a pilot valve for controlling a passage through the said second valve element, means for opening said pilot valve whereby to permit said fluid pressure to act upon the other side thereof to assist in shifting the said second valve element to open the passage in the main valve element which is controlled thereby, to reduce the fluid closing pressure upon the main valve element to permit the latter to be opened, means for thereafter opening said main valve element, and a substantially universal connection between said main valve element and the said operating means therefor.

2. A combined chimney and blowoff valve of the character described, embodying a main valve element for closing an air conduit, said valve element being acted upon on one side by fluid pressure to hold the same closed and having a passage therethrough, a second valve element for closing said passage, the last said element being acted upon by said fluid pressure to hold it in a closing position, a pilot valve for controlling a passage through the said second valve element, means for opening said pilot valve whereby to permit said fluid pressure to assist in shifting the said second valve element to open the passage in the main valve element which is controlled thereby, to reduce the fluid closing pressure upon the main valve element to permit the latter to be opened, means for temporarily locking said pilot valve in its open position, and means for thereafter opening said main valve element.

3. A combined chimney and blowoff valve of the character described, embodying a main valve element for closing an air conduit, said valve element being acted upon on one side by fluid pressure to hold the same closed and having a passage therethrough, a second valve element for closing said passage, the last said element being acted upon by said fluid pressure to hold it in a closing position, a pilot valve for controlling a passage through the said second valve element, means for opening said pilot valve whereby to permit said fluid pressure to neutralize the effect of the fluid pressure which holds the valve closed, thereby reducing the force required to open the passage in the main valve element which is controlled thereby, to reduce the fluid closing pressure upon the main valve element to permit the latter to be opened, means for thereafter opening said main valve element, the said means for opening said main valve element embodying a shaft connected with the last said element, a segment connected with the shaft, a pivotally mounted segment spaced from the first said segment, a flexible element anchored to both of the segments, and an actuating handle connected with one of said segments.

4. A combined chimney and blowoff valve of the character described, embodying a main valve element for closing an air conduit, said valve element being acted upon on one side by fluid pressure to hold the same closed and having a passage therethrough, a second valve element for closing said passage, the last said element being acted upon by said fluid pressure to hold it in a closing position, a pilot valve for controlling a passage through the said second valve element, means for opening said pilot valve whereby to permit said fluid pressure to neutralize the effect of the fluid pressure which holds the valve closed, thereby reducing the force required to open the passage in the main valve element which is controlled thereby, to reduce the fluid closing pressure upon the main valve element to permit the latter to be opened, means other than the opening means for the pilot valve for thereafter opening said main valve element, the said second valve element embodying a cylinder and piston, and means whereby the said fluid pressure is admitted between the piston and cylinder to assist in holding the said second valve element seated.

5. A combined chimney and blowoff valve of the character described, embodying a main valve element for closing an air conduit, said valve element being acted upon on one side by fluid pressure to hold the same closed and having a passage therethrough, a second valve element for closing said passage, the last said element being acted upon by said fluid pressure to hold it in a closing position, a pilot valve for controlling a passage through the said second valve element, means for opening said pilot valve to reduce the fluid closing pressure upon the main valve element and to permit said pressure to act upon the said second valve element to permit the main valve to be opened, means for thereafter opening said main valve element, the said means for actuating said main valve section embodying a shaft, an operative connection between said shaft and said main valve section, an arm connected with said shaft for actuating the latter, and a counterbalancing weight adjustably connected with said arm.

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