United States Patent

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[54] **BURNER SHUT-OFF VALVE FOR HOT BLAST STOVE**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **137/340**
[51] **Int. Cl.** **F16k 49/00**
[50] **Field of Search** 137/340, 625.33; 251/124, 123, 196, 327

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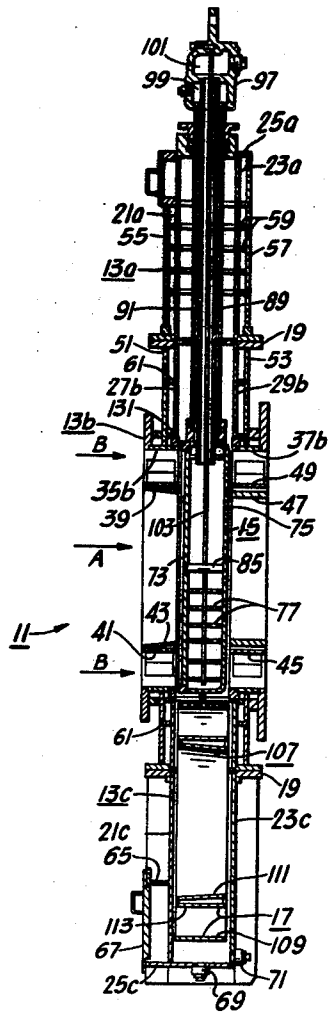
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Primary Examiner—Samuel Scott
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ABSTRACT: This burner shutoff valve includes a three-piece housing with a valve disc and guide vane movably mounted therein; the middle portion of the housing being jacketed and water cooled. The valve disc has guide pins and guide bars that cooperate with fixed guideways mounted to the housing so that scraping of the valve seat is prevented during travel of the disc. Also, the weight of the valve disc when lowered enough urges and maintains the valve disc in a seated position. The guide vane has a shape which cooperates with the valve housing to produce a venturi section in the valve through which a gaseous fluid, either air or fuel, flows toward the burner. If air flows in the venturi section, then fuel flows through the valve, but around the venturi section.



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SHEET 1 OF 2

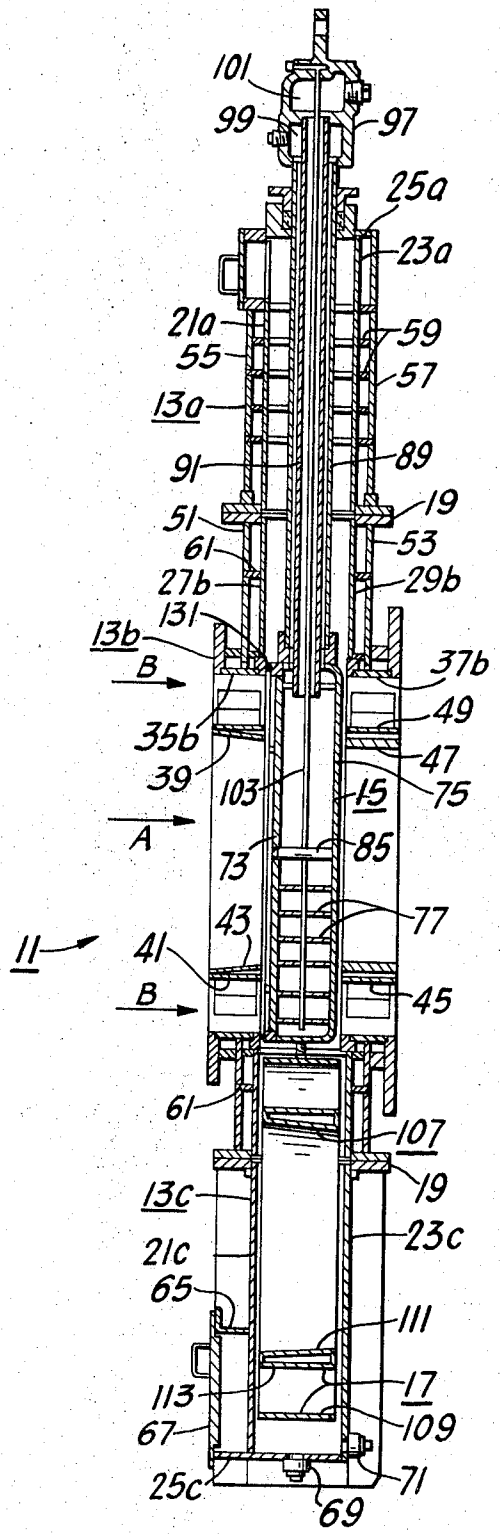


FIG. 1

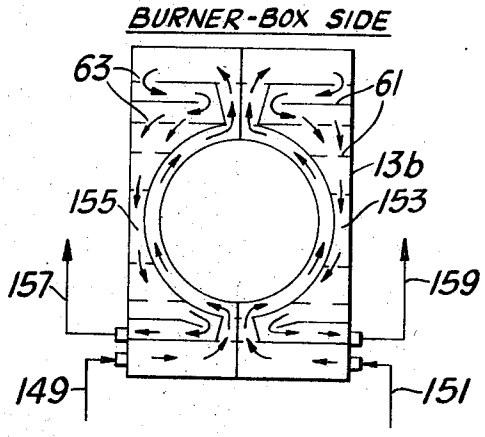


FIG. 4a

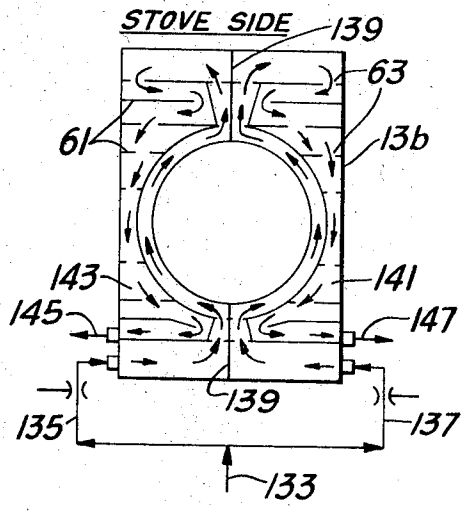


FIG. 4b

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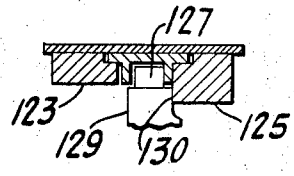


FIG. 3a

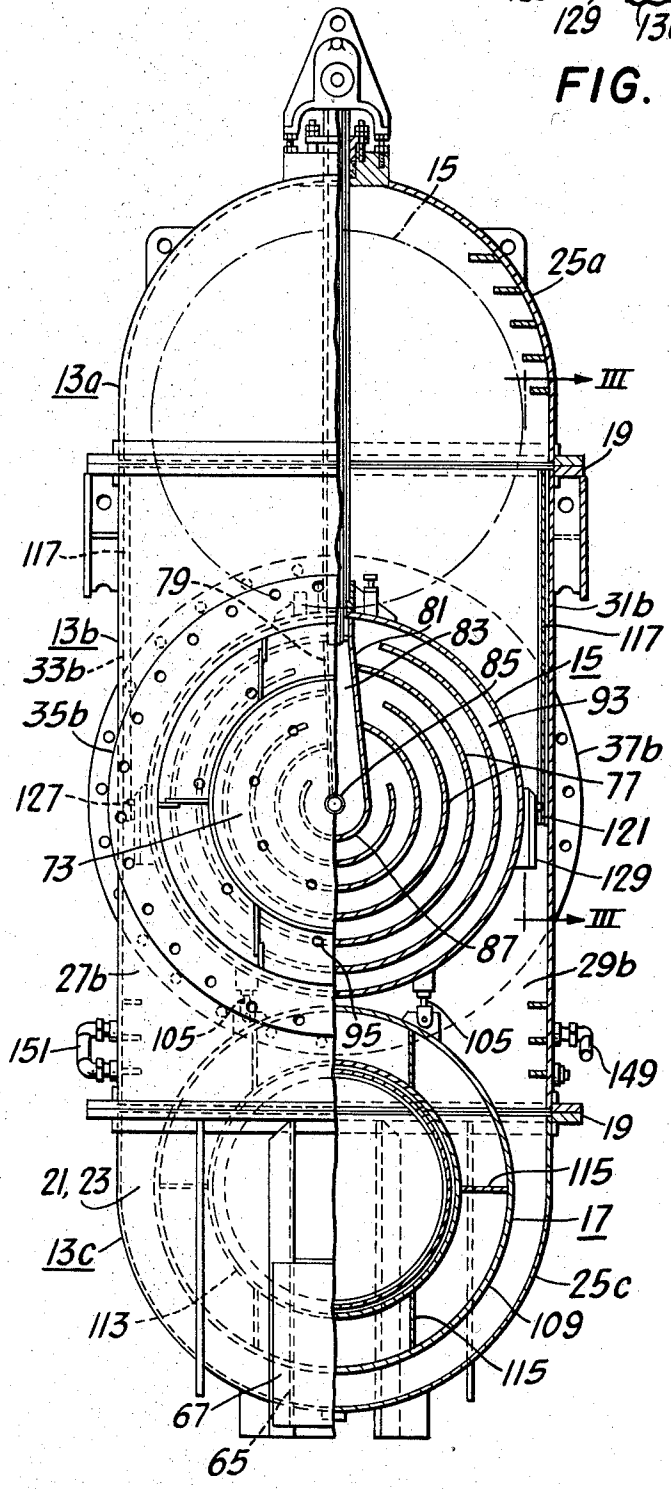


FIG. 2

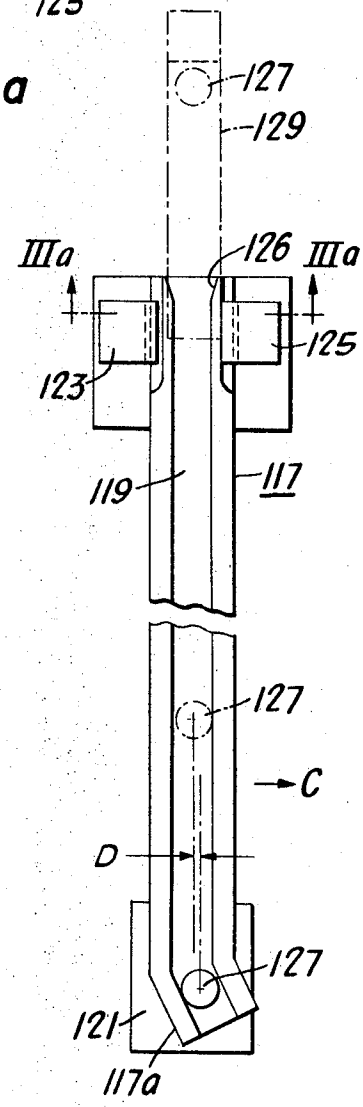


FIG. 3

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BURNER SHUT-OFF VALVE FOR HOT BLAST STOVE

BACKGROUND OF THE INVENTION

Conventional hot blast stoves are heated by burning a mixture of combustible gas and air in a combustion chamber forming a portion of the stove, and the hot gases pass through flues in the checkerbrick work which are thereby heated.

The combustible gas and air are separately conveyed to a burner nozzle at the entrance to the combustion chamber where they are ignited and then the mixed combustible gas and air burn in the combustion chamber to produce heat.

A burner shutoff valve is usually provided in the conduit that conveys the gas and air separately to the burner nozzle, and the shutoff valve is open during combustion and closed during blast air heating.

Prior art burner shutoff valves include a vertically moveable disc and a pair of coaxial cylinders that may be positioned in the valve housing, so that gaseous fluid may not flow through the valve when the disc covers the valve entrance and exit; or, so that fluid may flow in coaxial streams through the valve when the disc is raised to clear the valve entrance and exit.

The present invention is an improved version of burner shutoff valves of the prior art as it will be evident from the description herein.

SUMMARY OF THE INVENTION

The upper, middle and lower portions of a valve housing enclose a valve disc and guide vane. The middle housing portion is water cooled internally, and guideways, mounted to the middle housing portion, cooperate with guide pins and guide bars on the valve disc so that the scraping of the valve seat is prevented during the disc travel; also, the weight of the valve disc, when lowered enough, urges and maintains the valve disc in seated position. The guide vane, when axially aligned with the middle housing portion, provides a venturi section through which a gaseous fluid, such as air or fuel, flows, while gaseous fluid, such as fuel or air, flows around the venturi section.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a vertical sectional side view of a burner shutoff valve in accordance with the invention;

FIG. 2 is a vertical front elevational view, partly in section, of the valve of FIG. 1;

FIG. 3 is a view along line III–III of FIG. 2;

FIG. 3*a* is a view taken along line IIIa–IIIa of FIG. 3; and

FIGS. 4*a*, 4*b* are schematic diagrams of the flow of cooling fluid in the valve of FIG. 1.

DETAILED DESCRIPTION

FIG. 1 illustrates a burner shutoff valve 11 in accordance with the invention, which includes a valve housing 13; a valve disc 15 and a valve guide ring 17 are situated and vertically movable within the housing 13.

The valve housing 13 includes an upper housing portion 13*a*, a middle housing portion 13*b*, and a lower housing portion 13*c*. The upper 13*a* and lower 13*c* housing portions are bolted at flanges 19 to the upper and lower ends of the middle housing portion 13*b* respectively.

The upper 13*a* and lower 13*c* housing portions are comprised of spaced-apart planar members 21*a*, 23*a*, and 21*c*, 23*c*, that are substantially semicircular, and the arcuate peripheral edges of the planar members 21*a*, 23*a*, 21*c*, 23*c*, are connected to arcuate bands 25*a*, 25*c* (FIG. 2), thereby forming, with the flanges 19, the upper 13*a* and lower 13*c* portions of the valve housing 13.

The middle housing portion 13*b* is comprised of front 27*b* and rear 29*b* parallel spaced-apart panels that are generally rectangular in shape and are joined together by vertical rectangular end panels 31*b*, 33*b*.

A pair of flanged cylinders 35*b*, 37 *b* are mounted to the front 27*b* and rear 29*b* panels so as to be in coaxial alignment and thereby provide access for fluids to pass through the valve 11. It will be noticed from FIGS. 1 and 2 that the diameter of the flange on cylinder 37*b* is somewhat larger than the diameter of the flange on cylinder 35*b*. This is to match the flanges on the stove nozzle and burner box, and to prevent installation of the valve in an incorrect manner when it is being installed in service.

The front cylinder 35*b* is provided with an inner coaxial hollow ring 39 that is comprised of an outer cylindrical ring 41 and an inner frustoconical ring 43 as shown in FIG. 1. The inner frustoconical ring 43 is divergent toward the left, as viewed in FIG. 1.

The rear cylinder 37*b* is also provided with an inner coaxial hollow ring 45 that is comprised of spaced apart concentric outer 49 and inner 47 rings. The outer ring 41 is of substantially the same diameter as the outer ring 49, but the diameter of the smaller end of the frustoconical ring 43 is somewhat smaller than the diameter of the inner ring 47 for a reason that will be apparent from the description hereinafter provided.

The middle housing portion 13*b* is provided with spaced-apart parallel flat planar members 51, 53 that are disposed in spaced apart parallel relation to the front 27*b* and rear 29 *b* panels respectively. Thus, there is provided an air or water-cooling space between both the adjacent front 27*b*, 51 and the adjacent rear 29*b*, 53 members.

In like manner, the upper housing portion 13*a* is provided with spaced apart parallel flat planar members 55, 57 that are disposed in spaced-apart parallel relation to the front 21*a* and rear 23*a* planar members respectively. Within the space between the inner and outer adjacent panels 21*a*, 55 and 23*a*, 57, there are a plurality of spaced apart horizontally arranged baffles 59, that interconnect the inner and outer panels, thereby stiffening the upper housing portion 13*a*.

The middle housing portion 13*b* is provided with a plurality of internal baffles 61, disposed above and below the flanged cylinders 35*b*, 37*b* as shown in FIG. 1 and FIGS. 4 and 4*a*. The baffles 61 are of unequal length so as to provide a circuitous path for the flow of cooling water in the space between the panels. FIGS. 4*a* and 4*b* indicate the location of the baffles 61 within the middle housing portion 13*b*, as well as the path followed by the cooling water; the baffles having suitably located openings 63 to allow the cooling water to pass through them.

The lower housing portion 13*c* is provided with an access opening 65 that is suitably closed by a cover 67. The access opening 65 affords ready access to the bottom of the lower housing 13*c* for cleaning it whenever necessary. Likewise, suitable drain plugs 69, 71 are also provided at the bottom of the lower housing portion 13*c* as shown in FIG. 1.

The valve disc 15 is fabricated preferably from a circular planar member 73 (FIG. 1) and a flanged-only head 75; the flanged-only head 75 being welded peripherally to the planar member 73. Internally the disc 15 contains a plurality of spaced apart arcuate fluid guiding vanes 77 that are concentrically arranged, about as shown in FIG. 2.

A pair of spaced-apart, straight, fluid-flow directing baffles 79, 81 are disposed vertically, about where shown in FIG. 2, and they define a vertical fluid flow channel 83 within the valve disc 15. The lower end of baffles 79 terminates at a central pin 85 connecting together the circular planar members 73 and the flanged-only head 75; the lower end of baffle 81 connects to an arcuate fluid guiding vane 87 disposed in spaced relation to the central pin 85, as shown in FIG. 2.

The top of the valve disc 15 is connected to a pair of concentric tubular conduits 89, 91 (FIG. 1). Inner conduit 91 is in fluid communication with the vertical fluid channel 83, and the outer conduit 89 is in fluid communication with the outermost fluid flow channel 93 defined by the spaced apart arcuate fluid guiding vanes 77. It will be noticed that the ends of alternate fluid-guiding vanes 77 abut vertical baffles 79, while the ends of the intermediate fluid guiding vanes 77 abut vertical baffle 81. Thus, the fluid guiding vanes 77 provide a labyrinth-type of passage for the flow of cooling water in the valve disc 15.

Cooling fluid enters the valve disc through the inner conduit 91; courses the labyrinth fluid flow passages defined by the

vanes 77; and thereafter flows out of the valve disc through the annular passage between the conduit 89, 91. Weep holes may be provided in vanes 77 to eliminate air pockets.

It will be noted from FIG. 2 that the arcuate fluid-directing vanes 77 are supported and maintained in position by a plurality of strategically located pins 95. Each one of the pins 95 has a groove into which the vane 77 fits. The vanes 77 are stitch-welded only, at substantial intervals, to the flat portion of flanged-only head 75. The pins 95 are first welded to the vanes 77, and, after the planar member 73 is joined with the head 75, the pins 95, projecting through correspondingly located holes, will be welded to member 73. Thus, the two circular faces of the disc are securely supported, but the opposed flat faces can unrestrictedly respond to slight thermal movements.

The inner 91 and outer 89 conduits serve the purpose also of a valve stem to raise and lower the valve disc 15.

The upper ends of the inner 91 and outer 89 conduits communicate with a fitting 97 at the top of the valve which has fluid chambers therein. The annular space between the inner 91 and outer 89 conduits communicates with a lower chamber 99 while the inner conduit 91 communicates with an upper chamber 101 in the fitting 97. Cooling water flows into the upper chamber 101 and thence into the valve disc of the inner conduit 91. The heated cooling water returns to the lower chamber 99 and then is discharged from the valve.

A syphon tube 103 is provided within the inner conduit 91 and extends from the top portion of the fitting 97 nearly to the bottom of the valve disc 15, as shown in FIG. 1. By means of the syphon tube 103, it is possible, whenever necessary, to evacuate practically all of the cooling water from the valve disc.

Suspended from the bottom of the valve disc 15, by means of suitable clevis attachments 105, (FIG. 2) is the guide ring 17. The guide ring 17 comprises concentric inner 107 and outer 109 circular bands. As shown in FIG. 1, the guide ring 17 is disposed within the lower portion 13c of the valve housing when the valve disc 15 is in the closed position. The valve guide ring, being linked to the valve disc 15, moves upward and downward when the valve is opened and closed.

The inner circular band 107 is comprised of coaxial spaced apart inner 111 and outer 113 members, joined peripherally together. The inner member 111 is frustoconical while the outer member 113 is cylindrical in form.

The diameter of the smaller end of the frustoconical inner member 111 is substantially the same as the diameter of the larger end of the inner frustoconical ring 43. The diameter of the smaller end of the frustoconical member 111 is substantially the same as the diameter of the inner ring 47.

Thus, when the valve disc 15 is in the raised position, as suggested by the dotted outline in FIG. 2, the guide vanes 17 will be raised from the position show in FIG. 1 and will be coaxial with both the inner hollow ring 39 and the inner hollow ring 45. In such position, the guide vanes 107 then forms a central venturi section for the flow of a first fluid through the valve, while a second fluid can flow in the annular passage between the venturi section and the bands 109.

There is, of course, an annular fluid flow passage between the outer cylindrical band 109 and the cylindrical member 113; there being a plurality of vertical and horizontal vanes 115, joining member 113 to member 109, as shown in FIG. 2.

On the inner surface of each end panel 31b and 33b, there is a vertical guide bar 117 (FIG. 3) which has an elongate groove 119 in the inner surface. The guide bar 117 has an angular offset portion 117a, at the lower end, which is fixedly secured to a mounting pad 121. The pads 121 are welded, or otherwise suitably fixed, to the inner surfaces of the end panels 31b and 33b. The upper end of the vertical guide bar 117, however, is fashioned so as to be vertically movable between spaced-apart cooperative fixed guide blocks 123, 125; both blocks being fixed to the end panels 31b and 33b adjacent the top thereof.

The groove 119 at the top of the vertical bar 117 is flared, as at 126, for a purpose that will become apparent hereinafter.

Cooperating with the groove 119 in each vertical guide bar 117 is a cylindrical guide pin 127, which is securely mounted to vertically disposed guide bars 129 fixed to the valve disc 15, at opposite ends of the horizontal diameter thereof, about as shown in FIG. 2. The vertical guide bars 129 are somewhat narrower than the space between the guide blocks 123, 125.

The guide bar 129 has a face 130 that slidably engages the block 125 as long as the pin 127 is not in engagement with the wall of the groove 119, as is shown in FIG. 3. Thus, the guide bar 129 and the pin 127, by engaging the block 125 and the wall of the groove 119, maintain the valve disc away from the valve seat while the valve disc is being raised and lowered.

But, when the valve disc nears the lower end of its downward travel, the pin 127 contacts the opposite wall of the groove 119 and, thereby, urges the valve disc into engagement with the valve seat.

In a service installation, the shutoff valve 11 is located in a conduit which conducts air and gaseous fuel to the burner nozzle of a blast furnace stove. In operation, air or gas flows in a cylindrical inner conduit, in the direction of the arrow A in FIG. 1, while gaseous fuel or air flows in an annular space around the inner conduit, in the direction of arrow B in FIG. 1. If gaseous fuel flows in the inner conduit then air flows in the annular space and vice versa.

FIG. 1 illustrates the valve in a closed initial position. A resilient gasket 131, disposed in a peripheral groove in the valve disc, contacts a valve seat on the middle housing portion 13b and provides a seal against the flow of gaseous fuel and air to the burner nozzle, and, also, prevents the flow of heat from the combustion chamber of the stove into the burner box.

Cooling water in supply conduit 133 enters the middle housing portion 13b through branch conduits 135, 137 and the water courses through the stove side of the valve in the manner shown in FIG. 4b. It will be noted that a vertical baffle 139 divides the fluid flow passages into right and left separate fluid zones 141, 143. After coursing the labyrinthlike, fluid flow passages in both the right and left cooling zones 141, 143, the water emerges through conduits 145, 147, and enters the fluid flow passages in the burner box side of the valve through conduits 149, 151. The cooling water flows through similar right and left cooling zones 153, 155 in the burner side of the valve, and then emerges through conduits 157, 159.

When the valve is opened to allow the passage of fluid through it, the valve disc is in the raised position, shown in the dotted outline of FIG. 2. The guide vane 107 will be coaxial with both the coaxial hollow rings 39 and 45, whereby gaseous fluid such as air or fuel, flowing from left to right in the direction of arrow A, will be subjected to the action of the venturi section formed by the coaxial rings 43, 111, and 47. This action increases the velocity of the gaseous fluid while decreasing its pressure. The other gaseous fluid, however, flows in the axial annular passage around the venturi section and there is no perceptible change in its pressure or velocity through the valve.

When the valve disc is in the raised position, the cylindrical guide pin is located above the top of the groove in the vertical guide bar, and is in the position about where shown in FIG. 3. Now, when the valve disc is lowered, the guide pin easily reenters the groove due to its flared upper end, and the guide pin contacts the right hand side of the groove, about as shown in the intermediary position in FIG. 3. However, when the valve disc approximates to the closed position, it is moved laterally toward a seated position by the coaction of the guide pin with the opposite, left hand side of the groove, as shown in the lower portion of FIG. 3. Whereupon, the valve disc is urged in the direction of the arrow C, a distance D that is equal to the lateral movement of the valve disc, into a seated relation. Both guide pins act in the same manner so that the valve disc is readily moved laterally to its seated position, and the weight of the valve disc acting on the offset portion of the groove 119.

A feature of the invention is the guide ring that includes a portion of the venturi section which cooperates with the middle housing portion to complete a venturi section through the

valve. When the valve disc is raised the guide ring cooperates to form the venturi section.

A feature of the invention is that, by proper shaping of the venturi section, the pressure drop through the valve will be insignificant; moveover, part of the lost pressure is regained in the nozzle and in the combustion chamber.

A feature of the invention is the middle housing portion of the valve which includes internal labyrinth fluid flow channels so that circulating cooling water is more effective in removing heat from the valve structure. Such construction provides structural rigidity that resists and prevents eccentric warpage. Further, such housing structure provides equal cooling water coverage for both front and rear sides of the middle housing.

A feature of the invention is the vertical guideways on the housing portion and the guide pins and guide bars on the valve disc which cooperate, when the valve disc approaches its seated position, to urge and maintain the valve disc in its seated position. Also, such an arrangement of structure prevents scraping the sealing element on the valve seat during the full travel of valve disc.

Although the invention has been described herein with a certain degree of particularity, it is understood that the present disclosure has been made only as an example and that the scope of the invention is defined by what is hereinafter claimed.

We claim:

1. A burner shutoff valve comprising:
   a. a housing including upper, middle m, and lower interconnected portions;
      said middle portion having inlet and outlet openings for the passage of fluid through said valve, said inlet passage having therein a frustoconical axial conduit with the smaller end thereof disposed in the downstream fluid flow direction and a cylindrical conduit coaxial with said inner frustoconical conduit;
   b. a valve disc movably disposed within the housing;
   c. a valve seat on said housing with which said disc cooperates to make a seal that prevents the flow of fluid through said valve;
   d. a guide vane suspended below said valve disc and movable therewith;
      said guide vane having an outer cylindrical conduit and an inner coaxial frustoconical conduit with the smaller end thereof disposed in the downstream flow direction, the diameter of the larger end thereof being substantially equal to the diameter of the smaller end of the frustoconical conduit in said housing portion;
   e. opposed guide members vertically mounted to said middle housing portion; and
   f. means mounted to said valve disc that cooperates with said guide members to keep said valve disc in spaced-apart relation with respect to said seat during the opening and closing of said valve.

2. The invention of claim 1 wherein said valve disc is comprised of:
   a. spaced apart planar members joined together peripherally to form a hollow chamber; with
   b. guide vanes disposed arcuately within said chamber to provide a continuous arcuate fluid flow path; and
   c. means securing said guide vanes to said planar members in a way whereby said planar members can react unrestrictedly to thermal changes imposed on said valve disc without changing said fluid flow channels.

3. The invention of claim 1 wherein the outlet passage of said middle housing portion has therein cylindrical conduits that are coaxial with said frustoconical conduit in said guide vane, with the diameter of the inner conduit being substantially equal to the diameter of the smaller end of said frustoconical conduit of said guide vane, and with the diameter of the outer conduit being substantially equal to the diameter of the outer cylindrical conduit of said guide vane.

4. The invention of claim 3 wherein said guide members have lower offset portions which coact with guide pins to urge said valve disc laterally into a seating position with said housing.

5. The invention of claim 1 wherein said means on said disc includes guide blocks that cooperate with said guide members.

6. The invention of claim 5 wherein:
   a. said guide members are grooved vertical bars; and
   b. said guide blocks have pins that engage said grooved vertical bars.

7. The invention of claim 6 wherein:
   a. one end of said guide members is fixed; and
   b. the other end of said guide members if free to move vertically.

8. The invention of claim 1 wherein:
   a. said middle housing portion is comprised of front and rear hollow panels having internal baffles defining cooling fluid flow passages; and including
   b. means to conduct cooling fluid into and out of said panels.

9. The invention of claim 8 wherein the cooling fluid exiting from one panel enters the other panel and flows therein, and thereafter said cooling fluid exits said housing portion.

10. In a burner shutoff valve for a hot blast stove having entrance and exit passages in the housing thereof through which air and gaseous fuel pass in separate flow streams, the improvement comprising:
   a. a first frustoconical conduit disposed in said entrance passage with the smaller end disposed in the downstream direction of fluid flow, said conduit being a first portion of a venturi section in said valve;
   b. a cylindrical conduit in the exit passage;
   c. a guide vane adapted for positioning between said entrance and said exit passages with said guide vane comprising,
      a second frustoconical conduit that is a second portion of said venturi section and that is positionable in coaxial relation to said entrance and said exit passages, with the diameter of the larger end of said second frustoconical conduit being substantially the same as the diameter of the smaller end of said first frustoconical conduit, and with the diameter of the smaller end of said second frustoconical conduit being substantially equal to the diameter of said cylindrical conduit of said exit passage; and
   d. a cylindrical conduit surrounding each of said frustoconical conduits, said cylindrical conduits thereby forming with the walls of said housing an annular passage for the flow of gaseous fluid around the flow of gaseous fluid inside of said frustoconical and exit cylindrical conduit.