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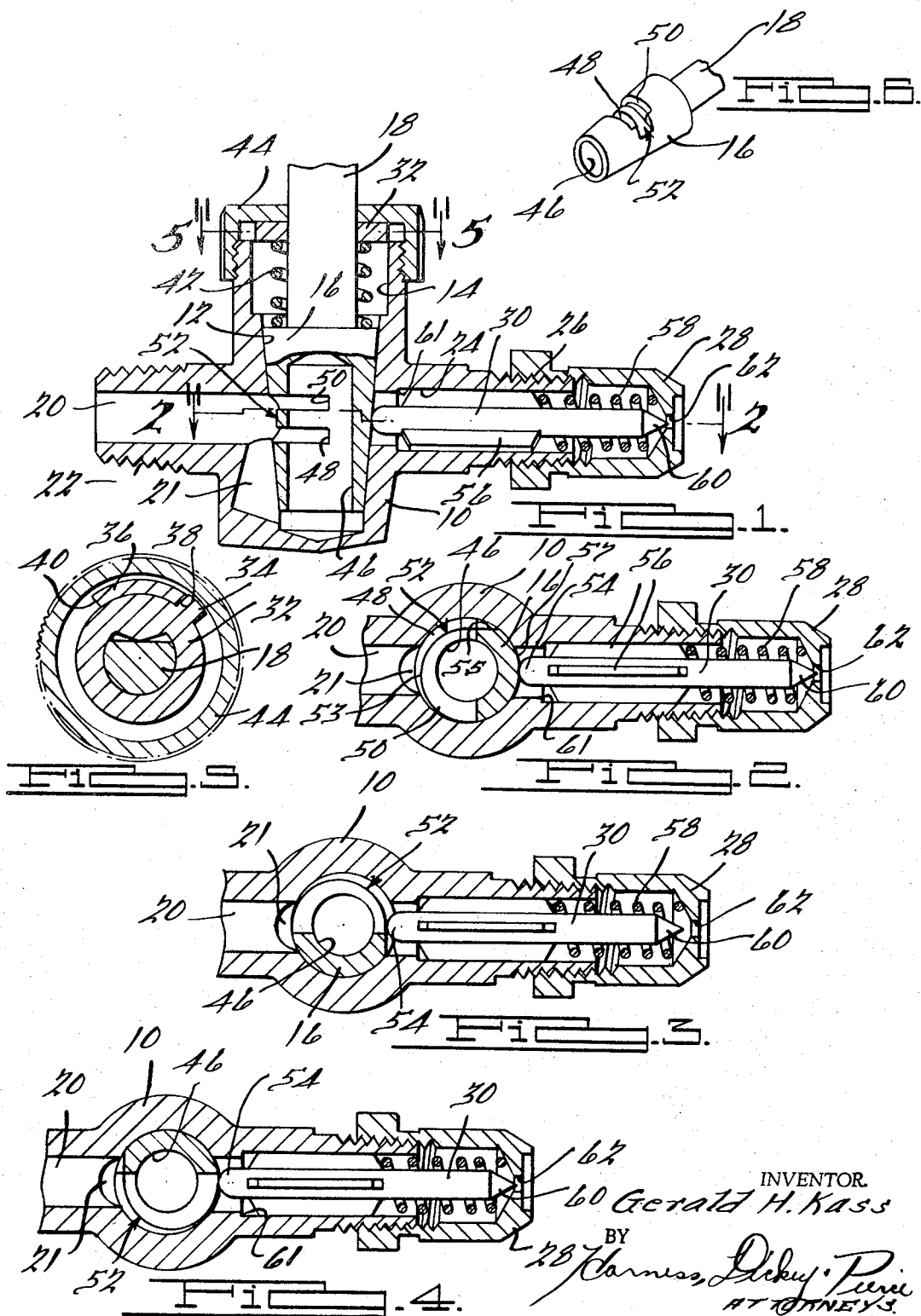
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3,402,739

VALVE FOR GAS BURNER

Filed June 15, 1964

2 Sheets-Sheet 1



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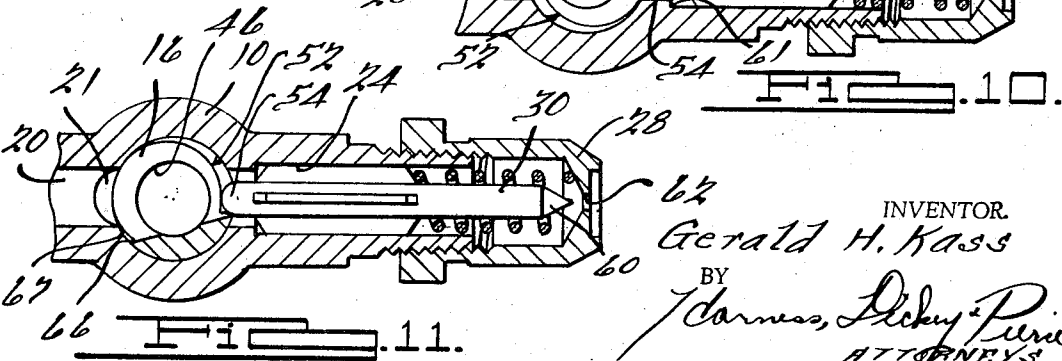
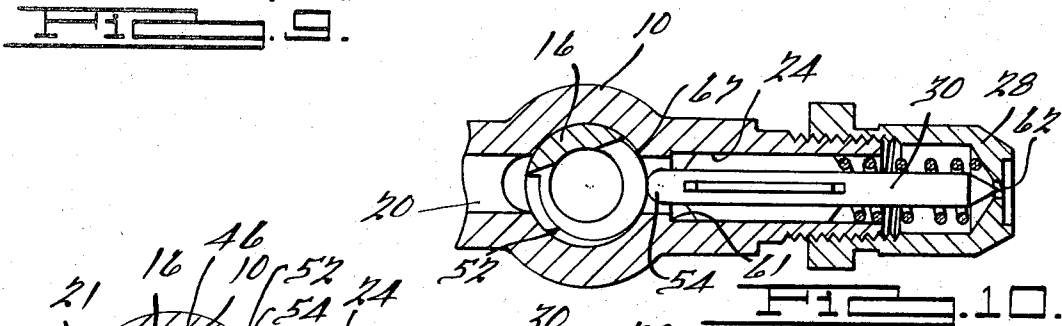
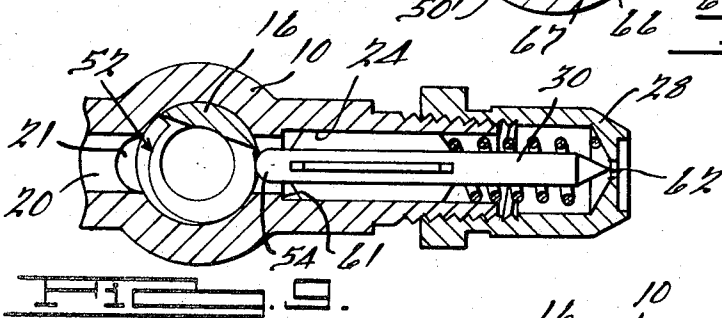
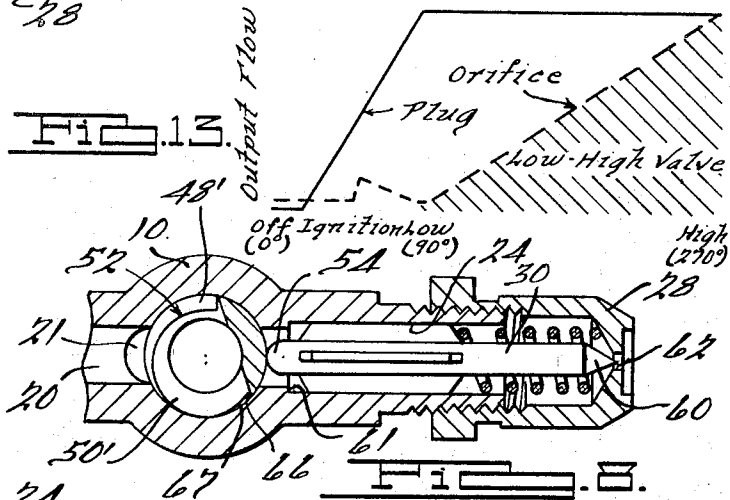
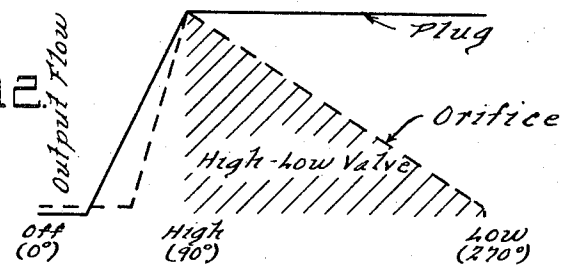
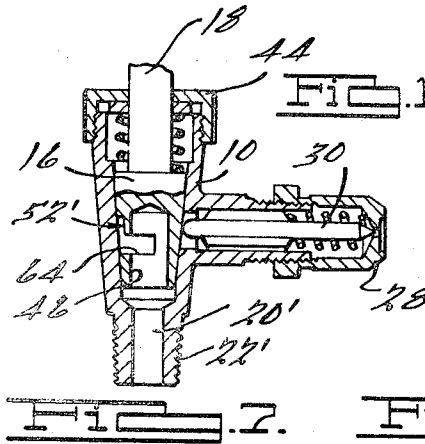
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VALVE FOR GAS BURNER

Filed June 15, 1964

2 Sheets-Sheet 2



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1

3,402,739

VALVE FOR GAS BURNER

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17 Claims. (Cl. 137-628)

This invention relates to fluid valves and more particularly to a novel valve specifically adapted for use as a gas range burner valve.

Generally speaking, conventional burner valves control the entire burner input rate by means of a fixed limiting orifice, i.e., the hood orifice. Turndown rates are obtained by rotating a plug or the like in the main valve body which throttles the gas flow through the valve by reducing the effective size of the main inlet to the valve. This reduction in gas flow in turn reduces the gas pressure upstream of the orifice and thereby lowers the input rate to the burner by lowering the gas velocity through the orifice. Insofar as controlling gas flow or input rate is concerned, this method is generally satisfactory. However, reduced gas velocities at the orifice are undesirable because they substantially reduce the primary air entrainment in the burner venturi and often seriously impair flame characteristics, especially at intermediate and low flow rates.

It is therefore a primary object of the present invention to provide a commercially practical burner valve which has improved primary air injection qualities through the full span of flow rates from "full on" to "simmer" or "low," and vice versa, by providing substantially increased gas stream velocity through the orifice at all burner input rates, whereby improved combustion and superior flame characteristics, including the substantial reduction of candlering, softening, or coalescing of the flame, may be obtained at all turndown flow rates, to as low as 500 B.t.u.'s per hour or less, while still obtaining maximum burner input rates of 12,000 B.t.u.'s per hour or greater, even on rear burners. This is accomplished by varying the orifice size rather than the gas pressure upstream of the orifice. A related object concerns the provision of such a valve as just described which may be either of the straight-through flow type or the reverse flow type, wherein the axis of the orifice is substantially perpendicular to the rotational axis of the plug or actuating handle, which does not rely at all on any form of ported plug or the like for varying the output flow during its normal operating range, and which may be either of the "high-low" type or the "low-high" type.

Another object of the present invention resides in the provision of a valve which provides extremely accurate and precise infinite control by virtue of which given output rates may be reliably duplicated at any time by repositioning the valve actuating handle at the original position. A related object concerns the provision of such a valve having a rotary valve element adapted to turn through an approximately 270° range of rotation to thereby provide very fine control of the output flow rate, and one in which backlash or play between the actuating handle and the ultimate flow controlling means is virtually nonexistent.

A further object concerns the provision of a small and compact burner valve which is simple and inexpensive to manufacture, which is practically maintenance-free, which may be completely adjusted or preset by actuation of a single adjusting means, which has no passageways external of its main housing, which may be easily installed or replaced, and which is fully compatible with and may be substituted in lieu of conventional valves existing in present gas ranges without further modification thereof.

Another object resides in the provision of a burner valve which is capable of providing a range of accurately

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controlled fuel output rates heretofore not practically possible except with double burner systems, i.e., systems having a small simmer burner, a separate outer concentric main burner, and a dual output flow valve.

A further object resides in the provision of a valve having an output flow curve in which there are no dead spots or undesirable peaks throughout its entire operating range, and which is flexible in that it may be constructed to provide any specific output curve configuration desired, including a linear curve. A related object concerns the provision of such a valve wherein output rates are not controlled at all in the normal operating range by a multiported plug, such plugs having been found by their very nature to be subject to undesirable peaks, dead spots, lubricant and foreign matter clogging, and so on.

Yet another object concerns the provision of a burner valve which can be adapted for use in connection with most known types of burners, including extremely small high performance burners.

Another object resides in the provision of a practical fluid metering valve comprising a rotary valve device and an advancing pin valve device in serial communication, wherein the rotary valve provides only an "on-off" function and 100% of the metering of the output of the valve between the maximum and minimum operating positions is performed by the advancing pin valve. A related object concerns the provision of such a valve in which the existence of backlash or play between the operating elements is virtually nonexistent. Another related object concerns the provision of such a device wherein the advancing pin valve is constructed in such a way as to obtain the advantages of needle valve performance while avoiding certain of the disadvantages thereof.

A still further object resides in the provision of a burner valve wherein, for safety purposes, means are provided for insuring that sufficient fuel will be supplied to the burner to achieve reliable and quick ignition after the valve is turned on and before it reaches its first normal operating position.

These and other objects of the present invention will become apparent from consideration of the specification taken in conjunction with the accompanying drawings in which there are illustrated several embodiments of the present invention, and wherein:

FIGURE 1 is a vertical sectional view through the center of a range burner valve embodying the principles of the present invention, the valve being of the high-low type and shown in its "off" position;

FIGURE 2 is a sectional view taken substantially along line 2-2 in FIGURE 1;

FIGURE 3 is a sectional view similar to FIGURE 2 but showing the valve in its "full on" or "high" position;

FIGURE 4 is a sectional view similar to FIGURE 2 but showing the valve in its "low" or "simmer" position;

FIGURE 5 is a transverse sectional view taken along line 5-5 in FIGURE 1;

FIGURE 6 is a perspective view of the rotary plug portion of the valve illustrated in FIGURES 1-5;

FIGURE 7 is vertical sectional view similar to FIGURE 1 but showing a modified valve body configuration and a modified rotary plug configuration;

FIGURE 8 is a sectional view similar to FIGURE 2 but showing a low-high type valve embodying the principles of the present invention, the valve being shown in its "off" position;

FIGURE 9 is a sectional view similar to FIGURE 8 but showing the valve in its "ignition" position;

FIGURE 10 is a sectional view similar to FIGURE 8 but showing the valve in its "low" or "simmer" position;

FIGURE 11 is a sectional view similar to FIGURE 8 but showing the valve in its "full on" or "high" position; and

FIGURES 12 and 13 are graphs showing approximate flow rates as a function of angular displacement of the valve actuating means for both the high-low and low-high types of valves, respectively.

Generally speaking, the present invention is directed to a fluid metering valve comprising two different valve devices communicating in series. The first valve may be any type but for gas ranges is preferably a rotary valve, such as a disc valve or a tapered plug valve, the latter type being described herein for exemplary purposes. The second valve device in the series is an advancing pin or needle valve comprising an advancing and retracting pin or needle which varies the effective cross-sectional area of the output orifice of the device, to thereby meter output flow. In the present valve, in the broad sense, the pin moves along an axis perpendicular to the axis of rotation of the plug or disc, and is actuated by a cam surface on the latter. The two said valve devices function in co-operating with one another, with the rotary valve device operating as an "on off" valve and the needle valve device performing all the output flow control for the valve between its maximum and minimum output operating positions.

Referring to the drawings there is illustrated in FIGURES 1-6 a straight-through flow type valve suitable for gas ranges. This valve is of the "high-low" type, which means that as the actuating handle is turned from the "off" position the first operating position reached is the "high" or "full on" position and the last operating position reached is the "low" or "simmer" position. As can be seen, the valve comprises generally a body 10, a tapered valve bore 12 therein communicating by means of a cylindrical bore 14 with the open top of the body, a rotary tapered valve plug 16 disposed within valve bore 12 and having an actuating stem 18 thereon to which may be affixed a suitable handle or the like (not shown), a cylindrical inlet passageway 20 communicating with valve bore 12 and having about the exterior end thereof suitable threads 22 formed in the body whereby the valve may be secured to an inlet manifold (not shown) in the usual manner, a recess 21 for communicating inlet fluid from passageway 20 into the end of valve bore 12 below plug 16 in all rotary positions of the latter, a cylindrical outlet passageway 24 extending from valve bore 12 substantially coaxial with passageway 20 and having adjustably secured about the outer end thereof, by means of suitable threads 26, a conventional hood 28, and a needle or pin 30 slidably disposed within outlet passageway 24.

Stem 18 is D-shaped in cross-sectional configuration and is provided with a conventional stop washer 32 having a tab 34 thereon defining opposed stop shoulders. The upper surface of body 10 is provided with an upstanding portion 36 (see FIGURE 5) defining upstanding stop shoulders 38 and 40 adapted to be engaged by tab 34. The circumferential extent of portion 36 thus defines the degrees of rotation through which stem 18 and hence plug 16 may be rotated. In the embodiment shown the plug may be rotated through an angle of approximately 270°. Positioned between washer 32 and the upper surface of the valve plug is a compression spring 42, and a threaded cap 44 is provided to maintain these parts in assembled relationship, spring 42 serving to maintain the plug 16 in continuous sealing engagement with valve bore 12. These features of the subject valve are not described in detail since they are well known in the art and do not form part of the present invention.

Plug 16 is provided with a hollowed-out core 46 open at the bottom end, and a pair of parallel slots 48 and 50 through a portion of the periphery thereof adapted to rotate into registry with outlet passageway 24. Slots 48 and 50 are the same in size, shape and position and their peripheral extent may be seen most clearly in FIGURES 2, 3, and 4. The surface of plug 16 disposed intermediate slots 48 and 50 is contoured in the manner shown to form a cam surface 52, on which rides a rounded follower

portion 54 on the inside end of pin 30. As viewed in FIGURE 2 cam surface 52, when considered in a clockwise direction from the point of engagement of follower 54, extends approximately 90° at a uniform radius equal to the normal outside radius of the plug in that plane. During the next 180° it progressively decreases in radius, as indicated at 53, to a minimum radius at 270 from the point of engagement of follower 54 in FIGURE 2. The surface then extends out tangentially, as indicated at 55, along a plane parallel to the axes of the inlet and outlet passageways and bore 12 until it intersects the normal plug surface, from which point it continues at constant radius to the point of engagement of follower 54, as indicated at 57. The surface is described in the clockwise direction for simplicity. Actually, follower 54 moves along the cam surface in the opposite direction. For economy of manufacture surface 53 may be circular in configuration, so that a simple fixture with an offset axis of rotation may be used. Such a surface has been found to give a satisfactory approximation of a linear output flow curve.

Pin 30 is provided with a plurality of fins 56 which serve to guide the pin for reciprocating movement along the center axis of passageway 24. Positioned between hood 28 and fins 56 is a compression spring 58 which maintains follower 54 in engagement with cam surface 52. The outer end of the pin is provided with a conical valve surface 50 adapted to move into and out of an orifice 62 in hood 28, to thereby vary the effective cross-sectional area thereof in accordance with the contour of cam surface 52.

The effective cross-sectional area of orifice 62 may be preset or adjusted at any time by simply threading hood 28 towards or away from the valve body to thereby establish the desired relative position of orifice 62 and conical valve surface 60.

Pin 30 and follower 54 may be of sufficient radius with respect to the width of slot 48 that when the valve is disassembled plug 16 may be withdrawn without the pin popping, under the influence of spring 58, into slot 48, which would hinder removal of the plug. In addition, outlet passageway 24 may be provided with a suitable shoulder 61 for preventing pin 30 from being urged all the way into valve bore 12 by spring 58 when the plug is removed from the valve body.

As can be seen in FIGURES 1, 2, 3, 4, and 12, the valve functions in the following manner. For purposes of description the "off" position of the valve will exist when there have been zero degrees of rotation of the plug. Furthermore, it will be assumed that inlet passageway 20 is placed in communication with a suitable inlet manifold having supply fluid therein. This supply fluid will be communicated in all positions of the valve to the interior of the valve plug by means of slots 48 and 50 and/or recess 21. In FIGURES 1 and 2 the valve is shown in the "off" position, wherein the passage of fluid from the inside of plug 16 to passageway 24 is blocked by the solid portion of the surface of the plug. Needle 30 is in its most advanced position, with follower 54 engaging the constant radius portion 57 of cam 52 and conical tip 60 defining a minimum effective orifice area. In this position of the valve conical tip 60 does not physically engage the periphery of orifice 62 but merely defines a minimum size opening. By thus eliminating any physical contact between these two parts there is avoided any possibility of wear or damage occurring to either the tip or the orifice. When the plug is rotated (clockwise as shown) towards its "on" or "high" position at 90°, slots 48 and 50 are brought into registry with outlet passageway 24 and follower 54 engages and then moves along the flat portion 55 of the cam surface, thereby causing the pin to retract relatively quickly to its most retracted position. Thus, at 90° both the plug valve device and needle valve device are in their maximum flow positions, as can be seen in FIGURE 3. Prior to reaching this position more than a sufficient flow of gas will be

supplied to the burner to provide reliable and quick ignition. The valve then has an 180° turndown range during which rotation of the plug and hence portion 53 of the cam surface causes needle 30 to progressively advance until it reaches its most advanced point at the "low" or "simmer" position indicated at FIGURE 4. During this turndown range the plug itself does not vary the flow rate or pressure of the gas communicated to passageway 24, and output flow is metered solely by the needle 30. Reverse rotation of the plug will simply reverse the function of the valve until it has been rotated back a full 270°, at which time the valve will be shut off. Portion 53 of the cam surface, between the 90° position and the 270° position, may be of any desired configuration to give the desired output flow curve. For the surface shown the output is approximately linear, but it may be easily varied by simply varying the cam surface, according to known principles. Stop shoulders 38 and 40 on the valve body are positioned so that forward rotation of the valve is limited at the 270° position and return rotation of the plug is limited at the zero degree position.

In FIGURE 12 there is illustrated an exemplary flow curve for the valve illustrated in FIGURES 1-6. In the curve the solid line represents the flow through the plug portion of the valve only, assuming that pin 30 and hood 28 are completely removed from the device. Thus, as can be seen, the valve is closed by the plug in the "off" position. As the plug is rotated to its 90° "high" position it is opened fully to permit at least the maximum desired output flow of gas to pass from the inlet passageway to outlet passageway 24. Further rotation of the plug does not cause any change in the flow rate through the plug portion of the valve since it remains wide open in all angular positions between 90° and 270°. The dotted line shows the flow of gas through orifice 62, as metered by the pin 30, assuming that outlet passageway 30 is placed in direct communication with the inlet manifold. As the plug is turned from its "off" position to the 90° "high" position the needle moves from a minimum flow position to its most retracted position and a maximum flow of gas is permitted to pass through orifice 62. This could be in the order of 12,000 B.t.u.'s/hr. or greater. As the plug is further rotated through the turndown range, the flow of gas through orifice 62 is progressively decreased until the pin reaches its most advanced position at 270°, at which time there is again a minimum flow through the orifice. This is the "low" or "simmer" position of the valve, and the hood may be adjusted by the manufacturer so that in this position of the plug the desired amount of gas will pass through orifice 62. For example, the hood can be set to provide an output of 500 B.t.u.'s/hr. or less in the "simmer" position. Higher or lower values at either end of the operating range may of course be used if desired. Since the plug portion of the valve and the needle portion of the valve in fact act in series, the overall output of the valve is indicated by the lowermost of either the solid or dotted line in FIGURE 12, for any given degree of rotation of the plug. The normal operating range of the valve is shown cross-hatched in FIGURE 12, and the user has an infinite choice of heat outputs in this range. Although the lines are shown as being straight, in an actual valve they would probably not be, depending on the relative configuration of the slots in the plug, the inlet and outlet passageways, valve surface 60 and the contour of the cam surface. Also, as a practical matter the leveling out point for the solid line in the curve would probably be considerably higher than that shown, but since it need only be as high as the maximum desired output through orifice 62, it is shown as leveling at that value.

In FIGURE 7 there is shown a modified version of the valve of the present invention. Generally speaking, this embodiment is the same as that shown in FIGURES 1-6, the only difference being in the slot configuration in the plug and the position of the inlet passageway. As can

be seen, this is a reverse flow type valve and the inlet passageway, indicated at 20', is positioned coaxially with the plug rather than perpendicularly thereto as in the preceding embodiment. This configuration valve is suitable for some types of ranges and like equipment. In such an arrangement a recess such as at 21 in FIGURE 1 is not required because the inlet passageway will always be in direct communication with the interior of the valve plug. The other difference is that instead of having two slots, the valve plug in this embodiment is provided with a single slot 64, which is somewhat wider than each of the slots in the preceding embodiment to provide the necessary flow. In this embodiment, the cam surface, indicated at 52', is positioned adjacent the slot as can be clearly seen in FIGURE 7. The contour of the cam surface will of course be dictated by the same criteria as in the preceding embodiment, and the operation of the valve is the same.

The reverse flow type valve body shown in FIGURE 7 may be used in connection with either the single-slot plug shown in that figure, or alternatively with the double-slot rotor shown in the preceding embodiment. Similarly, the single-slot plug shown in FIGURE 7 may be used in connection with either the reverse flow type body shown in FIGURE 7 or the straight-through flow type body shown in FIGURES 1-6. One advantage of the two-slot arrangement over the one-slot arrangement is that it provides flow passages of a greater total effective cross-sectional area, thus minimizing pressure drop, for a given degree of sealing area between the plug and valve bore. Furthermore, the narrower slots used in the two-slot embodiment substantially eliminate the risk of the pin falling into one of the slots when the plug is partially withdrawn, such as might occur if a shoulder 62 were not provided in the outlet passageway.

In FIGURES 8-11 there is shown another embodiment of the present valve which operates as a "low-high" valve, i.e., actuation of the valve handle from the "off" position causes the valve to reach its minimum operating position before its maximum operating position. This embodiment is exactly the same as the first embodiment in all respects, except for the contour of the cam surface and the circumferential extent of the two plug slots. Consequently, like reference numerals are used where applicable. The cam surface of this embodiment is different in several respects from that in the first embodiment. First, it is contoured in a reverse direction so that during the turndown range the flow of gas is increased rather than decreased. Second, the cam surface is so designed that between the "off" position and the first normal operating position, i.e., the "low" position, additional gas flow will be provided to assure that ignition will take place.

As can best be seen in FIGURE 8, the cam in this embodiment, considered in a clockwise direction, does not extend at a constant radius from the point of engagement of follower 54 for 90° as in the first embodiment, but instead contains a section 66 of rapidly decreasing radius. In the illustrative embodiment it is positioned approximately 50° from the point of engagement of the follower to provide sufficient sealing area. From section 66 the cam then gradually increases the radius up to the 90° position, as indicated at 67, at which point it is of the same radius as it is at the point of engagement of follower 54. From this position to the 270° position the cam surface gradually decreases in radius until it reaches a minimum point at 270°. It may extend slightly therepast simply to provide clearance for follower 54. This cam surface may be circular in configuration as in the first embodiment, and with portion 67 thereof being symmetrical to the corresponding portion falling between the 90° position and the 130° position. Thus, the same fixture may be used to machine the cam in this embodiment as in the preceding embodiment, the only difference being that the machine tool would be allowed to extend past the 90° position, in a counterclockwise direction, to form surface 67.

The two slots formed in the rotary plug of this embodiment are substantially the same as those in the first embodiment except that they are somewhat longer in circumferential extent, as can be clearly seen in FIGURE 8, wherein the portion of the slots seen are indicated at 48' and 50'. This is necessary to provide a flow of gas into passageway 24 in the ignition position of the plug.

As can be seen in FIGURES 8, 9, 10, 11, and 13, this embodiment of the valve functions in the following manner. When the valve is in its "off" position, as shown in FIGURE 8, communication of fluid from the center of the plug to orifice 62 is prevented by means of the solid portion of the plug wall which is in registry with passageway 24. When the plug is rotated towards its first operating position at 90° follower 54, after 40 to 50° rotation of the plug, rides down cam portion 66 and engages cam portion 67, thereby retracting needle 30 somewhat in order to provide sufficient flow through orifice 62 to insure that ignition will promptly take place. This is the ignition position and is shown in FIGURE 9. At this point the slots in the plug will have moved into at least partial registry with outlet passageway 24 so that gas will be available for ignition. Further rotation of the plug to the first operating position at 90° will result in needle 30 riding up surface 67 until it reaches a minimum flow position. During this same interval the slots in the plug will have moved into full registry with outlet passageway 24 so that no further pressure drop will occur across the rotor. This 90° position is the "low" or "simmer" position of the valve. Further rotation of the plug will cause needle 30 to progressively retract to thereby progressively increase the output flow of the valve through orifice 62 until, at 180°, the "high" or "full on" position will be reached. Reverse rotation of the plug will, of course, reverse the above-described functions of the valve until the "off" position is again reached. The stop surfaces on the valve body are positioned to limit rotation of the plug to the desired range.

An exemplary flow curve for this embodiment of the valve may be seen in FIGURE 13. This curve should be interpreted in exactly the same manner as curve 12, as explained above. If desired, this valve may operate between the same maximum and minimum B.t.u. output positions as the first embodiment. Again, the use of straight lines is merely for exemplary purposes.

As will be appreciated, in all embodiments of the subject invention the output flow of the valve is controlled by varying the effective cross-sectional area of orifice 62, rather than by varying the input pressure as is done in many conventional valves. The exact configuration and size of tip 60 and orifice 62 may be determined in accordance with well known principles, depending upon the B.t.u. output rates desired, the type of gas used, the pressure of gas supplied, and so on. Also, the valve may be constructed for rotation in either direction by merely reversing the cam surface and slots on the plug, and different angular positions may be used for the maximum and minimum positions. In addition, any well known clicking mechanism may be added to the valve to provide an audible click in any predetermined position of the valve, such as at the 90° position to indicate the beginning of the normal operating range.

A further important feature of the valve which should be noted is that in all of the embodiments tip 60 of the needle or advancing pin never engages orifice 62. It is unnecessary that it does since in the "off" position of the valve gas flow is prevented by the plug and not by the needle. This has several advantages. One, it prevents damage and wear of the tip and orifice which would arise if they were repeatedly brought into engagement with one another, which might seriously alter the flow characteristics of the valve. In addition, the possibility of distortion of the tip and orifice when closed due to thermal expansion and contraction is also eliminated. The use of only one relatively small orifice in the entire valve greatly re-

duces the chance of clogging by lubricant or foreign matter. Backlash is eliminated by the use of spring 58, as well as by the basic design of the valve. As noted above, adjustment of the valve is extremely simple. The output flow as a function of plug rotation is of course determined by the contour of the cam surface on the plug and does not change, however, the maximum or minimum points may be readily adjusted or preset by simply threading hood 20 with respect to body 10 until an effective orifice area of desired size is obtained. As a practical matter the hood is best used to preset "simmer" output, or whatever the lowest output is, since it is the most critical.

Another advantage of the subject design is that, at least in the first and last embodiments, gas for the burner pilot may be tapped directly from end of the valve body, i.e., through the portion of the valve body adjacent the end of the hollow plug. This is feasible with the present design since in all positions of the plug gas is present at this point. Also, the present valve may be adapted for use in connection with double burner systems, such as referred to above. In this case, the plug could be provided with two cam surfaces for operating two needle valves, respectively, one for the main burner and the other for the smaller simmer burner.

Several other plug designs are also possible, insofar as achieving means for accomplishing the function of the slots in the disclosed embodiments is concerned. For example, a solid plug might be used with a circumferential groove around approximately 270° of the periphery thereof in lieu of the present slots. In such an arrangement recess 21 would not be required but in lieu thereof it would be necessary to have a recess in the valve body extending approximately 90° around the periphery of the plug in registry with the groove. In such a construction, it might also be possible to use the peripheral groove defined by the cam surface itself as a gas communicating passageway. Alternatively, the disclosed slotting arrangement may be used in connection with a 90° peripheral recess in the body in lieu of the axial recess 21 disclosed.

Thus, there are disclosed in the above description and in the drawings several exemplary embodiments of the invention which fully and effectively accomplish the objects thereof. However, it will be apparent that variations in the details of construction may be indulged in without departing from the sphere of the invention herein described, or the scope of the appended claims.

What is claimed is:

1. A fluid valve comprising rotary plug valve means and needle valve means communicating in series, said plug valve means being operable upon actuation to communicate inlet fluid to said needle valve means, said needle valve means being operable to meter the output fluid flow from the valve, all of the metering accomplished by the valve between its normal maximum and minimum output positions being performed solely by said needle valve means, and cam means on said plug valve means for actuating said needle valve means in response to actuation of said plug valve means, said cam means being contoured to cause said needle valve means, as said plug valve means is progressively actuated from its "off" position, to first rapidly open to an ignition output position, then close to its minimum output operating position and then progressively open to its maximum output operating position.

2. A valve as claimed in claim 1, wherein said minimum output operating position occurs at approximately 90° rotation of said plug valve means and said maximum output operating position occurs at approximately 270° rotation of said plug valve means.

3. A valve as claimed in claim 2, wherein said ignition system occurs at approximately 50° rotation of said plug valve means.

4. A fluid valve comprising first valve means and second valve means communicating in series, said second valve means being needle valve means, said first valve

means being operable upon actuation to communicate inlet fluid to said needle valve means, said needle valve means being operable to meter the output fluid flow from the valve, all of the metering accomplished by the valve between its normal maximum and minimum output positions being performed solely by said needle valve means, and cam means operable by said first valve means for actuating said needle valve means in response to actuation of said first valve means, said cam means being contoured to cause said needle valve means, as said first valve means is progressively actuated from its "off" position, to first rapidly open to an ignition output position, then close to its minimum output operating position and then progressively open to its maximum output operating position.

5. A fluid valve comprising a body, means defining a tapered valve bore in said body, a rotary tapered valve plug disposed within said valve bore, an actuating stem connected to said plug, means defining an inlet passageway in said body communicating with said valve bore, an outlet passageway in said body communicating with said valve bore, pin means slidably disposed in said outlet passageway and having at the outer end thereof a valve surface, a hood adjustably secured to said body and having an orifice therein in axial alignment with said valve surface on said pin means, the latter being adapted to vary the effective cross-sectional area of said orifice upon reciprocation of said pin means, means in said plug including a peripheral slot for providing a substantially unrestricted flow of inlet fluid to said outlet passageway in all normal operating positions of said valve except the "off" position, and a cam surface on said plug adapted to actuate said pin means upon rotation of said plug to vary the effective cross-sectional area of said orifice, said cam surface being disposed on said plug substantially parallel to and adjacent said slot, said slot lying in a plane extending transversely to the rotational axis of said plug.

6. A fluid valve comprising a body, means defining a tapered valve bore in said body, a rotary tapered valve plug disposed within said valve bore, an actuating stem connected to said plug, means defining an inlet passageway in said body communicating with said valve bore, an outlet passageway in said body communicating with said valve bore, pin means slidably disposed in said outlet passageway and having at the outer end thereof a valve surface, a hood adjustably secured to said body and having an orifice therein in axial alignment with said valve surface on said pin means, the latter being adapted to vary the effective cross-sectional area of said orifice upon reciprocation of said pin means, a pair of slots in said plug for providing a flow of inlet fluid to said outlet passageway, and cam means positioned on said plug between said slots and adapted to actuate said pin means upon rotation of said plug to vary the effective cross-sectional area of said orifice.

7. A valve as claimed in claim 6, wherein each of said slots is of a width less than the width of said pin means adjacent the portion thereof which is actuated by said cam means.

8. A valve as claimed in claim 6, wherein said cam means consists of a cam surface the major portion of which is circular cylindrical in configuration about an axis eccentric with the rotary axis of said valve plug.

9. A valve as claimed in claim 6, wherein the axis of movement of said pin means is substantially perpendicular to the rotary axis of said valve plug.

10. A fluid valve comprising a body, means defining a tapered valve bore in said body, a rotary tapered valve plug disposed within said valve bore, an actuating stem connected to said plug, means defining an inlet passageway in said body communicating with said valve bore, an outlet passageway in said body communicating with said valve bore, pin means slidably disposed in said outlet passageway and having at the outer end thereof a valve surface, a hood adjustably secured to said body and having an orifice therein in axial alignment with said valve

surface on said pin means, the latter being adapted to vary the effective cross-sectional area of said orifice upon reciprocation of said pin means, a pair of slots in said plug for providing a substantially unrestricted flow of inlet fluid to said outlet passageway, in all normal operating positions of said valve except the "off" position, and cam means positioned on said plug between said slots and adapted to actuate said pin means upon rotation of said plug to vary the effective cross-sectional area of said orifice.

11. A fluid valve comprising a body, means defining a tapered valve bore in said body, a rotary tapered valve plug disposed within said valve bore, an actuating stem connected to said plug, means defining an inlet passageway in said body communicating with said valve bore, means defining a recess in said body adjacent said bore for communicating inlet fluid from said inlet passageway to the end of said bore, an outlet passageway in said body communicating with said valve bore, said outlet passageway being coaxial with said inlet passageway, pin means slidably disposed in said outlet passageway and having at the outer end thereof a valve surface, a hood adjustably secured to said body and having an orifice therein in axial alignment with said valve surface on said pin means, the latter being adapted to vary the effective cross-sectional area of said orifice upon reciprocation of said pin means, means in said plug for providing a substantially unrestricted flow of inlet fluid to said outlet passageway in all normal operating positions of said valve except the "off" position, and cam means on said plug adapted to actuate said pin means upon rotation of said plug to vary the effective cross-sectional area of said orifice.

12. A fluid valve comprising a body, means defining a tapered valve bore in said body, a rotary tapered valve plug disposed within said valve bore, an actuating stem connected to said plug, means defining an inlet passageway in said body communicating with said valve bore, means defining a recess in said body adjacent said bore for communicating inlet fluid from said inlet passageway to the end of said bore, an outlet passageway in said body communicating with said valve bore, pin means slidably disposed in said outlet passageway and having at the outer end thereof a valve surface, a hood adjustably secured to said body and having an orifice therein in axial alignment with said valve surface on said pin means, the latter being adapted to vary the effective cross-sectional area of said orifice upon reciprocation of said pin means, slot means in said plug for providing a substantially unrestricted flow of inlet fluid to said outlet passageway in all normal operating positions of said valve except the "off" position, means defining a cam surface on said plug, said cam surface being positioned in registry with said pin means and adapted to actuate the latter upon rotation of said plug to vary the effective cross-sectional area of said orifice.

13. A valve as claimed in claim 12, wherein the axis of movement of said pin means is substantially perpendicular to the axis of said inlet passageway.

14. A fluid valve comprising a body, means defining a tapered valve bore in said body, a rotary tapered valve plug disposed within said valve bore, an actuating stem connected to one end of said plug, means defining an axial passageway in the other end of said plug, means defining an inlet passageway in said body communicating with said valve bore, means defining a recess in said body adjacent said bore for communicating inlet fluid from said inlet passageway to the end of said bore, an outlet passageway in said body communicating with said valve bore, pin means slidably disposed in said outlet passageway and having at the outer end thereof a conical valve surface, a hood adjustably secured to said body and having an orifice therein in axial alignment with said valve surface on said pin means, the latter being adapted to vary the effective cross-sectional area of said orifice upon reciprocation of said pin means, means defining a pair of slots

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in said plug for providing a substantially unrestricted flow of inlet fluid to said outlet passageway in all normal operating positions of said valve except the "off" position, means defining a cam surface on said plug, said cam surface being positioned between said slots and in registry with said pin means and adapted to actuate the latter upon rotation of said plug to vary the effective cross-sectional area of said orifice.

15. A valve as claimed in claim 14, wherein said cam surface is contoured to cause said pin means, as said plug is progressively rotated from its "off" position, to first rapidly move away from said orifice to its maximum output operating position and then to progressively move towards said orifice to its minimum output operating position.

16. A valve as claimed in claim 14, wherein said cam surface is contoured to cause said pin means, as said plug is progressively rotated from its "off" position, to first rapidly move away from said orifice to an ignition output position, then move towards said orifice to its minimum output operating position and then progressively move away from said orifice to its maximum output operating position.

17. A fluid valve comprising a body, means defining a tapered valve bore in said body, a rotary tapered valve plug disposed within said valve bore, an actuating stem connected to said plug, means defining an inlet passageway in said body communicating with said valve bore, an outlet passageway in said body communicating with said valve bore, pin means slidably disposed in said outlet passageway and having at the outer end thereon a valve surface and at the inner end a cam following surface, the sliding axis of said pin means being disposed substantially

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perpendicularly to the rotary axis of said plug, stop means on said body for preventing movement of said pin means in a valve opening direction beyond a predetermined distance into said valve bore when said valve plug is removed therefrom, said stop means engaging said pin means between said valve surface and said follower surface, a hood adjustably secured to said body and having an orifice therein in axial alignment with said valve surface on said pin means, the latter being adapted to vary the effective cross-sectional area of said orifice upon reciprocation of said pin means, means in said plug for providing a substantially unrestricted flow of inlet fluid to said outlet passageway in all normal operating positions of said valve except the "off" position, and cam means on said plug adapted to actuate said pin means upon rotation of said plug to vary the effective cross-sectional area of said orifice.

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