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A. E. MAIRE
VACUUM OPERATED PIEZOELECTRIC IGNITION MEANS
AND ACTUATOR THEREFOR

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2 Sheets-Sheet 1

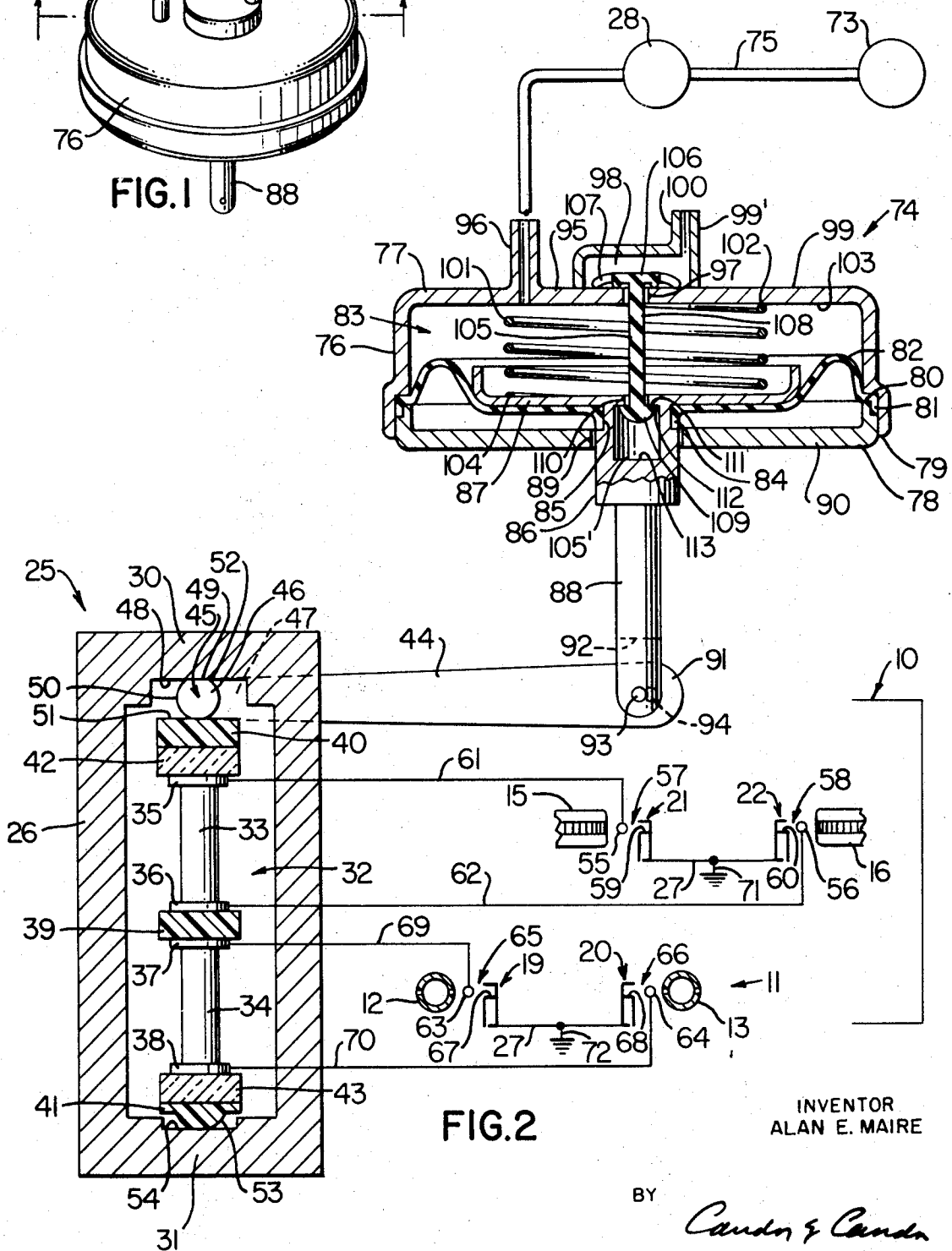
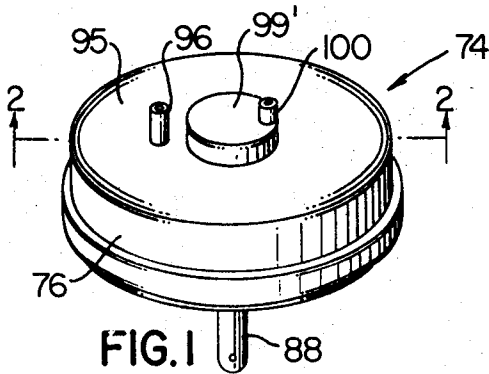


FIG. 2

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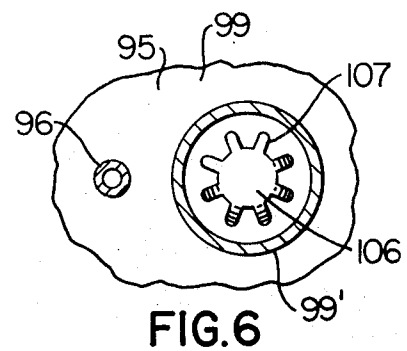
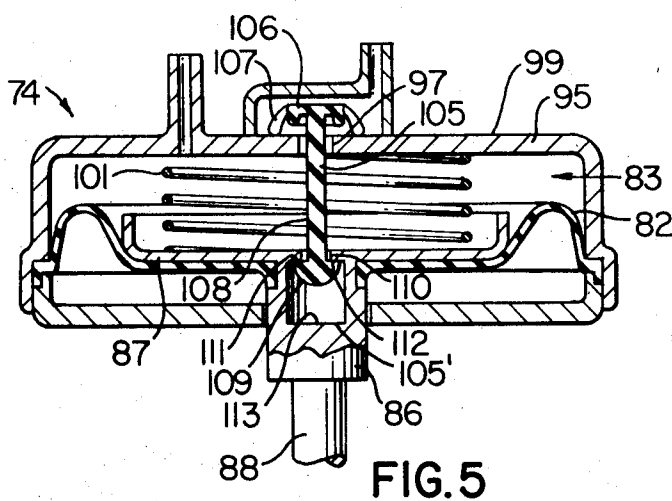
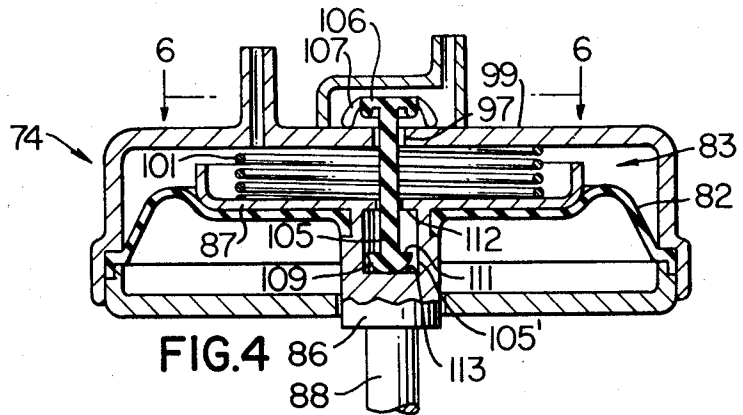
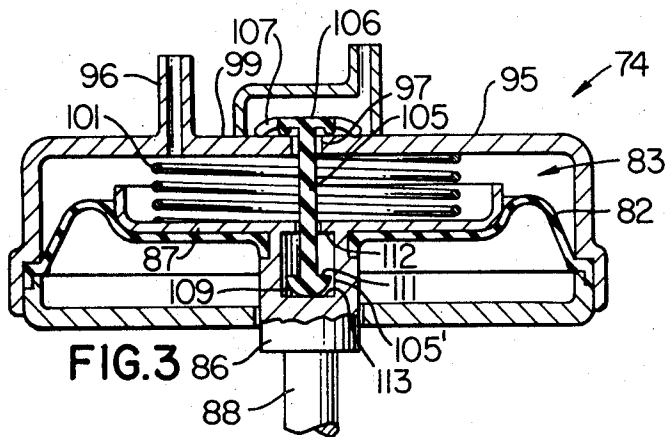
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VACUUM OPERATED PIEZOELECTRIC IGNITION MEANS AND ACTUATOR THEREFOR

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10 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a vacuum operated ignition means for the pilot burner means of a cooking apparatus or the like, the ignition means including piezoelectric crystal means that have the stresses therein altered to cause sparking at the pilot burner means when the vacuum operated actuator of the ignition means is cycled between its actuated and deactuated position. The vacuum operated actuator automatically cycles itself between its actuated and deactuated position as long as a vacuum source is being interconnected thereto by the selector means, the actuator having a movable wall that is interconnected to a single valve means by lost motion means to control the same for the automatic cycling of the actuator.

This invention relates to a pneumatically operated ignition means for burner means of a cooking apparatus or the like as well as to an improved pneumatically operated actuator therefor or the like.

It is well known that many cooking apparatus of the fuel burning variety have individual pilot burner means for each main burner thereof whether the main burner is disposed in the oven or on top of the cooking apparatus, the pilot burners being continuously burning pilot burners and when adversely put out because of air currents or the like, the same must be re-ignited by the housewife or the like utilizing matches and the like.

However, according to the teachings of the invention set forth in the co-pending patent application, Ser. No. 670,307, filed Sept. 25, 1967, and assigned to the same assignee to whom this application is assigned, ignition means are provided for such pilot burner means wherein the housewife or the like can initiate the actuation of the ignition means completely remote from the pilot burner means while igniting the pilot burner means in a simple and effective manner.

In particular, the ignition means of the aforementioned co-pending patent application includes piezoelectric crystal means that when actuated by the housewife or the like will have the stresses therein altered in such a manner that the same will cause sparking at the pilot burner means to ignite the same.

Further, according to the teachings of the invention set forth in the co-pending patent application, Ser. No. 698,006, filed Jan. 15, 1968, and assigned to the same assignee to whom this application is assigned, means are disclosed and claimed for causing the altering of the stresses in such crystal means or the like by utilizing a pneumatically operated actuator means that is adapted to automatically cycle itself between its deactuated position and its actuated position as long as the housewife or the like directs a pneumatic source to the actuator so that the cycling actuator will continuously cause the altering of stresses in the piezoelectric crystal means for the ignition sparking at the pilot burner means.

According to the teachings of this invention, however, such an automatic cycling pneumatic actuator is provided having a reduced number of operating parts adapted to operate in a simple and effective manner.

In particular, the pneumatically operated actuator

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means of this invention is so constructed and arranged in a manner hereinafter illustrated and described that the same has a movable wall which is automatically cycled between its predetermined actuated stroke position and its predetermined deactuated stroke position to alter the stresses in a piezoelectric crystal means or the like as long as a pneumatic source is interconnected thereto, the movable wall being interconnected to a valve means with a lost motion means and the valve means controlling the opening and closing of a passage means leading to the atmosphere so as to provide the automatic cycling operation of the actuator.

Accordingly, it is an object of this invention to provide an improved ignition means for a cooking apparatus or the like, the ignition means of this invention having one or more of the novel features set forth above or hereinafter shown or described.

Another object of this invention is to provide an improved pneumatically operated actuator for such an ignition means or the like.

Other objects, uses and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIG. 1 is a perspective view of the improved pneumatically operated actuator means of this invention.

FIG. 2 is an enlarged, schematic, cross-sectional view taken substantially on line 2—2 of FIG. 1 and illustrates the actuator of this invention for actuating a piezoelectric crystal means for a cooking apparatus or the like, the actuator being in its deactuated stroke position.

FIG. 3 is a fragmentary view similar to FIG. 2 and illustrates the actuator as the actuator is approaching its predetermined actuated stroke position.

FIG. 4 is a view similar to FIG. 3 and illustrates the actuator in its predetermined actuated stroke position.

FIG. 5 is a view similar to FIG. 4 and illustrates the actuator just before it reaches its predetermined deactuated stroke position.

FIG. 6 is a fragmentary cross-sectional view taken substantially on line 6—6 of FIG. 4.

While the various features of this invention are hereinafter described and illustrated as being particularly adaptable for providing ignition means for a cooking apparatus, it is to be understood that the various features of this invention can be utilized singly or in any combination thereof to provide ignition means and/or actuator means for other apparatus as desired.

Therefore, this invention is not to be limited to only the embodiment illustrated in the drawings, because the drawings are merely utilized to illustrate one of the wide variety of uses of this invention.

Referring now to FIG. 2, a cooking apparatus is generally indicated by the reference numeral 10 and has an oven chamber 11 provided with a broil burner 12 and a bake burner 13 illustrated in FIG. 2 as being in tubular form, the cooking apparatus 10 also including a plurality of top burner means with only two top burner means 15 and 16 being illustrated schematically in FIG. 2.

Individual pilot burner means are provided for the main burners of the cooking apparatus 10 and the broil pilot burner is generally indicated by the reference numeral 19, the bake pilot burner by the reference numeral 20 and the top pilot burners are generally indicated by the reference numerals 21 and 22 for their respective top burners 15 and 16. The pilot burners 19, 20, 21 and 22 are illustrated schematically in FIG. 2 and are so constructed and arranged that the same are adapted to ignite fuel issuing from their respective main burner means 12, 13, 15 and 16 as long as the respective pilot burners are burning.

However, should one or more of the pilot burners of

the cooking apparatus 10 be extinguished for any reason, spark igniting means of this invention is provided for the apparatus 10 and is generally indicated by the reference numeral 25 in FIG. 2 and will now be described.

The spark igniting means 25 comprises a support or frame member 26 suitably mounted to the frame structure 27 of the cooking apparatus 10 so that a manual actuator means 28 of the igniter means 25 will be exposed in any suitable location on the apparatus 10, the embodiment of the igniting means 25 illustrated in FIG. 2 having the manual actuator means 28 located on the conventional control panel means of the apparatus 10.

The support frame 26 has one or more piezoelectric crystal elements carried therein between the opposed ends 30 and 31 thereof with such crystal means being disposed in a recess or cutout 32 of the support frame 26. In the embodiment of the igniter means 25 illustrated in FIG. 2, two such piezoelectric crystal elements 33 and 34 are being utilized.

The crystal elements 33 and 34 are disposed in longitudinally stacked and aligned relation with the element 33 having electrical terminal means 35 and 36 at the opposed ends thereof and the crystal element 34 having electrical terminal means 37 and 38 at the opposed ends thereof. An electrical insulator 39 is disposed between the terminal means 36 and 37 of the crystal elements 33 and 34 to effectively electrically insulate the elements 33 and 34 from each other while electrically insulating means 40 and 41 respectively electrically insulate the other ends of the crystal elements 33 and 34 from the support frame 26 whereby the crystal elements 33 and 34 are not only electrically separated from each other, but are also electrically insulated from the support frame 26 and, thus, from the frame means 27 of the cooking apparatus 10. If desired, ceramic pressure pads or elements 42 and 43 can be respectively disposed between the insulators 40 and 41 and the respective terminal means 35 and 38 as illustrated.

A rocker arm 44 is pivotally carried by the support frame 26 and is adapted to rotate relative thereto about a transversely disposed axis of rotation generally indicated by the reference numeral 45, the rocker arm 44 carrying a cam member 46 at the rotatably mounted end 47 so as to be disposed between the insulator 40 and a flat surface 48 of the support frame 26 at the end 30 thereof to also rotate in unison with the rocker arm 44 about the movable axis 45. The cam member 46 has a flat surface 49 cooperating with the flat surface 48 of the support frame 26 and a true, partial circular surface 50 cooperating with an adjacent flat surface 51 of the insulator 40 whereby, when the cam member 46 is disposed in the position illustrated in FIG. 2 so as to have the flat surface 49 disposed against the flat surface 48 of the frame 26, the elements 40, 42, 33, 39, 34, 43, and 41 are disposed in stacked relation between the opposed ends 30 and 31 of the support frame 26 and will not alter the stresses in the crystal elements 33 and 34 to generate a potential differential at their respective terminal means 35, 36 and 37, 38 until the cam element 46 is rotated about the axis 45 to either axially squeeze the elements 33 and 34 between the opposed ends thereof or to relieve such squeezing action.

In particular, when the rocker arm 44 is rotated in a counterclockwise direction in a manner hereinafter described, the cam element 46 will rotate about its axis 45 in a counterclockwise direction so that a corner 52, formed by the juncture of the flat surface 49 thereof and the circular surface 50 thereof, will bear against the flat surface 48 of the support frame 26 and cause the axis 45 to move downwardly and to the right in FIG. 2 to increase the effective length of the cam member 46 between the surface 48 of the support frame 26 and the surface 51 of the insulator 40 to impose a substantially longitudinal compressive or squeezing action on the crystal elements 33 and 34 between the ends 30 and 31 of the support frame 26 so that the stresses in the crystal means 33 and 34 are

sufficiently altered to cause the same to create a potential differential at the respective pairs of terminals 35, 36 and 37, 38 to be utilized in a manner hereinafter described. When such compression or squeezing action on the crystal means 33 and 34 are subsequently relieved by the rocker arm 44 moving in a clockwise direction in FIG. 2 to again place the flat surface 49 of the cam 46 against the flat surface 48 of the frame 26, the cam member 46 will effectively decrease the effective cam length of the cam member 46 between the surfaces 48 and 51 to thereby also alter the stresses in the crystal elements 33 and 34 as the same are permitted to longitudinally expand from their previous squeezed condition to also generate a potential differential at the respective pairs of terminals 35, 36 and 37, 38.

During such rotation of the cam element 46, the stack of elements 40, 42, 33, 39, 34, 43, and 41 tends to rock as a unit to the right as the cam element 46 is rotated in a counterclockwise direction and tends to rock back to the left when the cam element 46 is rotated in a clockwise direction back to the non-squeezing position thereof whereby the insulator 41 can be provided with an arcuate end surface 53 that bears against a flat surface 54 of the support frame 26 to permit such rocking of the stack of elements between the opposed ends 30 and 31 of the support frame 26.

A first pair of electrodes 55 and 56 are mounted to the frame means 27 of the cooking apparatus 10 adjacent the respective pilot burners 21 and 22 and in spaced relation from the pilot burners 21 and 22 so as to define spark gaps 57 and 58 adjacent the fuel outlet means 59 and 60 of pilot burners 21 and 22. The electrodes 55 and 56 are electrically insulated from the frame means 27 of the apparatus 10 and are electrically interconnected to the terminal means 35 and 36 by respective leads 61 and 62.

Similarly, another pair of electrodes 63 and 64 are carried by the apparatus 10 and are disposed in spaced relation from the pilot burners 19 and 20 to define spark gaps 65 and 66 adjacent the fuel outlets 67 and 68 of the respective pilot burners 19 and 20. The electrodes 63 and 64 are also electrically insulated from the frame means 27 of the apparatus 10 and are respectively interconnected to the terminal means 37 and 38 by leads 69 and 70.

The pilot burner means 21, 22, 19, and 20 are electrically conductive and are, in effect, connected to a ground potential by being electrically interconnected to the frame means 27 of the apparatus 10 and such ground potential of the pilot burners is generally indicated by the reference numerals 71 and 72 in FIG. 2, the frame means 27 of the apparatus 10 being effectively grounded through interconnection thereof to the gas supply lines and the like and also by conventional grounding means.

In this manner, it can be seen that the pilot burner means 21 and 22 respectively provide ground electrodes cooperating with electrodes 55 and 56 to define the spark gaps 57 and 58. Similarly, the pilot burners 19 and 20 provide ground electrodes for cooperating with the electrodes 63 and 64 to define the spark gaps 65 and 66.

The operation of the ignition means 25 for the apparatus 10 will now be described.

When the housewife or the like notices that one of the main burner means 12, 13, 15, or 16 does not ignite when she turns on the respective main selector knob (not shown) of the apparatus 10 or when she actually notices that one of the pilot burner means 19, 20, 21 or 22 is not burning, she can turn on the manual actuator means 28 to effect rocking of the cam member 46 of the igniter means 25 in a manner hereinafter described whereby the stresses in each crystal element 33 and 34 will be altered in the manner previously described so that one potential will be created at the electrodes 55 and 63 and an equal and opposite potential will be created at the electrodes 56 and 64. When the differences in potential between the electrodes 55, 56, 63 and 64 and their respective grounded

electrodes 21, 22, 19 and 20 reaches a particular magnitude, electrical arcing will be created across the spark gaps 57, 58, 65 and 66 in substantially a simultaneous manner whereby such electrical sparking will ignite the fuel issuing from any unlit pilot burner means 21, 22, 19 and 20.

Continued operation of the manual actuator means 28 will effect a continuous cycling movement of the rocker arm 44 to first provide a squeezing action on the crystal elements 33 and 34 to produce the above described sparking one or more times depending upon the length of counterclockwise movement of the rocker arm 44 and then provide a relieving of the compression force on the crystal elements 33 and 34 by the subsequent clockwise movement of the rocker arm 44 that also alters the stresses in the crystal means 33 and 34 to effect sparking at the spark gaps 57, 58, 65 and 66 one or more times.

This continuous cycling movement of the rocker arm 44 in its counterclockwise and clockwise directions to cause the aforementioned sparking at the spark gaps 57, 58, 65, and 66 is produced as long as the housewife or the like causes the manual actuator means 28 to interconnect a pneumatic source 73 to a pneumatically operated actuator means 74 of this invention, the manual actuator means 28 being illustrated in FIG. 2 as a valve member disposed in a conduit means 75 leading from a pneumatic source to the actuator 74 and the source 73 being illustrated as a vacuum pump.

The pneumatically operated actuator means 74 of this invention comprises a housing means 76 formed by two cup-shaped housing members 77 and 78 snap fitted together at their respective open ends 79 and 80 to not only secure the housing members 77 and 78 together, but also to sealingly trap and secure an outer peripheral edge means 81 of a flexible diaphragm 82 therebetween, the flexible diaphragm 82 cooperating with the cup-shaped housing member 77 to define a chamber 83 therebetween.

The flexible diaphragm 82 has its inner periphery 84 snap fitted into an annular recess 85 of an actuating post means 86 that has an integral diaphragm back-up plate means 87 on one end thereof inside the chamber 83 and elongated stem part 88 at the other end thereof that projects through an opening means 89 in the end wall 90 of the cup-shaped housing member 78 to be pivotally interconnected to the right hand end 91 of the rocker arm 44. For example, the end 91 of the rocker arm 44 can be received in a slot 92 at the free end of the stem 88 and be pivotally connected thereto by a pivot pin 93 carried by the stem 88 and passing through an elongated slot 94 in the end 91 of the rocker arm 44.

The cup-shaped housing member 77 has its end wall 95 interrupted by a first passage means 96 that is disposed in fluid communication with the conduit 75 and with the chamber 83. A second passage means 97 interrupts the end wall 95 of the housing member 77 and is disposed in fluid communication with the chamber 83 of the actuator 74 as well as with a chamber 98 defined between the outside surface 99 of the end wall 95 and a chamber defining part 99' secured to the end wall 95 of the housing member 77 and being provided with a tubular extension 100 that leads to the atmosphere and which can have a porous filtering material (not shown) disposed therein to filter fluid flow through the nipple means 100 as will be apparent hereinafter.

A compression spring 101 is disposed in the chamber 83 of the actuator 74 and has one end 102 bearing against the inside surface 103 of the end wall 95 with the other end 104 bearing against the back-up plate means 87 whereby the compression spring 101 normally tends to urge the flexible diaphragm or movable wall 82 to its predetermined deactuated stroke position that is illustrated in FIG. 2 wherein the cam member 46 of the igniter means 25 has its flat surface 49 disposed flush against the flat surface 48 of the support frame 26.

A valve member means 105 is carried by the actuator

74 and comprises a one-piece resilient structure having a valve member 106 at one end thereof adapted to seat against the outside surface 99 of the end wall 95 to seal closed the second passage means 96 from the atmosphere when the valve means 105 is disposed in the position illustrated in FIG. 2, the valve member 106 having a plurality of resilient integral fingers 107 extending radially outwardly therefrom in spaced apart relation as illustrated in FIG. 6 and having a natural resiliency to extend downwardly beyond the sealing surface of the valve member 106 in the manner illustrated in FIG. 4 to bear against the end surface 99 of the end wall 95 and normally urge the valve member 106 to its open position as illustrated in FIG. 4 to fluidly interconnect the atmosphere to the chamber 83 of the actuator 74.

The valve means 105 includes a valve stem 108 projecting through the passage means 97 in the end wall 95 of the actuator 74 and terminating with an integral rivet-like head 109 at the lower end thereof which is adapted to be snap fitted through an opening 110 in the back-up plate 87 and be received within a lost motion chamber or recess 105' in the actuating post means 86, the rivet-like head 109 having a flat surface 111 adapted to engage against a shoulder means 112 of the back-up plate 87 so as to move the valve means 105 from the position illustrated in FIG. 5 to the position illustrated in FIG. 2 for a purpose hereinafter described.

Therefore, it can be seen that the pneumatically operated actuator 74 of this invention is formed from a relatively small number of parts that can be easily fabricated and assembled together to function in a unique manner now to be described.

Normally, the valve means 28 is disposed in a position to prevent the vacuum source 73 from being interconnected to the first passage means 96 of the actuator 74 so that the actuator 74 is normally disposed in the position of FIG. 2 where the chamber 83 is at atmospheric condition and the movable wall or diaphragm 82 and actuating post means 86 are in their outermost deactuated stroke position, such predetermined deactuated stroke position of the actuator 74 being coordinated with the igniter means 25 to maintain the rocker arm 44 in the position illustrated in FIG. 2 so that the cam member 46 has its flat surface 49 disposed flat against the flat end surface 48 of the support frame 26.

In addition, it can be seen in FIG. 2 that when the movable wall or diaphragm 82 is in its predetermined deactuated stroke position, the shoulder means 112 of the back-up plate 87 has pulled the flexible valve means 105 downwardly therewith in opposition to the natural force of the resilient fingers 107 to hold the valve member 106 in sealing engagement with the end wall 95 so as to fully close the passage means 97.

However, when the housewife or the like desires to initiate an igniting cycle, the housewife or the like turns on the selector or manual actuator means 28 to a position thereof which will interconnect the vacuum source 73 with the passage means 96 of the actuator 74 and as long as the selector means 28 maintains such fluid communication, the actuator 74 will cause continuous cycling action of the rocker arm 44 as previously described.

In particular, when the vacuum source 73 now being interconnected to the chamber 83 with the actuator in the position of FIG. 2, it can be seen that the valve member 106 is in its closed position to prevent the chamber 83 from being interconnected to the atmosphere so that the chamber 83 can begin to be evacuated by the vacuum pump 73. When the resulting pressure differential across the diaphragm 82 exceeds the force of the compression spring 101, the flexible diaphragm 82 is moved upwardly by such pressure differential in the manner illustrated in FIG. 3 and the valve member 106 remains closed against the surface 99 of the end wall 95 because

the resulting pressure differential across the valve member 106 exceeds the natural force of the resilient fingers 107 tending to move the valve member 106 to its open position. Because of the lost motion recess 105' in the actuating post means 86, the diaphragm 82 can move upwardly and the valve member 106 will remain in its closed position whereby the rocker arm 44 will be moved in its counterclockwise direction to cause the aforementioned sparking at the spark gaps 57, 58, 65, and 66 in the manner previously described.

However, as the movable wall 82 approaches its predetermined actuated stroke position as illustrated in FIG. 3, an end surface 113 of the actuating post means 86 that is defined by the lost motion slot 105' abuts against the rivet head 109 of the valve means 105 as illustrated in FIG. 3 to cause the valve member 105 to move upwardly therewith from the position illustrated in FIG. 3 to the position illustrated in FIG. 4 in a manner to overcome the pressure differential across the valve member 106 whereby the passage means 97 is now opened to the atmosphere as illustrated in FIG. 4. With the valve member 106 now in its open position as illustrated in FIG. 4, the vacuum pump 73 is ineffective in overcoming the flow of air now returning to the chamber 83 through the opened passage means 97, whereby the pressure differential across the diaphragm 82 progressively diminishes and the compression spring 101 can now move the movable wall or diaphragm 82 downwardly from the position illustrated in FIG. 4 to the position illustrated in FIG. 5.

Because of the lost motion recess 105', it can be seen that the diaphragm 82 when moving downwardly from the position illustrated in FIG. 4 to the position illustrated in FIG. 5 does not carry the valve means 105 therewith and the resilient fingers 107 maintain the valve member 106 in its open position. However, when the lost motion recess 105' is taken up in the manner illustrated in FIG. 5, the shoulder means 112 of the back-up plate 87 engages against the flat surface 111 of the rivet head 109 of the valve means 105 as illustrated in FIG. 5 so as to cause the valve means 105 to move downwardly therewith from the position illustrated in FIG. 5 to the deactuated stroke position of FIG. 2 where the valve member 106 is again pulled into sealing relation against the surface 99 of the end wall 95 to again seal closed the passage 97 so that the atmosphere is no longer interconnected to the chamber 83. At this time, the vacuum source 73 will now begin to evacuate the chamber 83 in the manner previously described whereby the diaphragm 82 will again move upwardly in the manner previously described to its predetermined actuated stroke position as illustrated in FIG. 4 where again the diaphragm 82 will then begin to move downwardly in the manner previously described.

During the previously described deactuation of the actuator 74, it can be seen that the rocker arm 44 is now being moved in a clockwise direction back to the position illustrated in FIG. 2 to relieve the previous squeezed condition of the crystal means 33 and 34 to further cause sparking at the spark gaps 57, 58, 65 and 66 in the manner previously described.

Therefore, it can be seen that as long as the vacuum source 73 is being interconnected to the passage means 96 of the actuator 74, the actuator 74 will automatically cycle between its actuated position and deactuated position to cause rocking of the rocker arm 44 in a cycling manner so as to continuously create sparking at the spark gaps 57, 58, 65, and 66 to insure full ignition of the pilot burner means 19-22.

While the selector means or manual actuator 28 has been previously described as being a valve means that must be held in a certain position by the housewife to maintain continuous interconnection of the vacuum source 73 with the actuator 74, it is to be understood that the selector means 28 could be a timer arrangement so that

when the housewife or the like initiates an ignition cycle by manually actuating the actuator 28, the actuator 28 will maintain full communication of the vacuum source 73 with the actuator 74 for a predetermined time period after the lapse of which the selector means 28 will automatically disconnect the vacuum source 73 from the actuator 74 until the selector means is again actuated by the housewife or the like.

While the actuator 74 of this invention has been previously described and illustrated as actuating a particular piezoelectric crystal means 25 disclosed and claimed in the first aforementioned co-pending patent application, it is to be understood that such actuating means 74 could be utilized to operate other types of piezoelectric crystal means for ignition purposes as well as operate other devices unrelated to ignition purposes as desired.

Therefore, not only does this invention provide improved pneumatically operated ignition means for a cooking apparatus or the like, but also this invention provides an improved pneumatically operated actuator means.

What is claimed is:

1. In combination, a vacuum operated actuator, a vacuum source, interconnection means for interconnecting said source to said actuator, and a piezoelectric crystal ignition means for burner means or the like, said actuator being operatively interconnected to said ignition means to alter the stresses therein at least during one of the actuation and deactuation strokes thereof, said actuator having means for automatically causing said vacuum source to actuate the same to a predetermined actuated stroke position and thereafter deactuating the same to a predetermined deactuated stroke position thereof in a continuous cycling manner as long as said source is interconnected to said actuator, said last-named means comprising a movable wall of said actuator operatively interconnected to and carrying valve means to move said valve means between the operating positions thereof, said actuator having a chamber therein defined in part by said movable wall of said actuator, said actuator having first passage means leading to said chamber and being interconnected to said source by said interconnection means, said actuator having second passage means leading to said chamber and being interconnected to the atmosphere, said valve means controlling said second passage means.

2. A combination as set forth in claim 1 wherein said interconnection means interconnecting said source to said actuator comprises a passage defining means having a selector valve means for selectively opening and closing said passage defining means.

3. A combination as set forth in claim 1 wherein said ignition means is of the squeeze-type whereby the stresses thereof are altered on both the actuation and deactuation strokes of said actuator.

4. A combination as set forth in claim 3 wherein said ignition means has a movable lever for causing the squeeze action thereof, said lever being interconnected to said actuator.

5. A combination as set forth in claim 1 wherein said movable wall of said actuator comprises a flexible diaphragm.

6. A combination as set forth in claim 5 wherein said valve means is interconnected to said movable wall by lost-motion means.

7. A combination as set forth in claim 6 wherein said valve means comprises a valve member for opening and closing said second passage means and having a valve stem interconnected to said movable wall by said lost-motion means.

8. A combination as set forth in claim 7 wherein said valve member has resilient fingers bearing against said actuator and normally tending to move said valve member to its open position.

9. In combination, a pneumatically operated actuator, a pneumatic source, interconnection means for interconnecting said source to said actuator, and a piezoelectric

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crystal ignition means for burner means or the like, said actuator being operatively interconnected to said ignition means to alter the stresses therein at least during one of the actuation and deactuation strokes thereof, said actuator having means for automatically causing said pneumatic source to actuate the same to a predetermined actuated stroke position and thereafter deactuating the same to a predetermined deactuated stroke position thereof in a continuous cycling manner as long as said source is interconnected to said actuator, said last-named means comprising a movable wall of said actuator operatively carrying valve means to move said valve means between the operating positions thereof, said actuator having a chamber therein defined in part by said movable wall of said actuator, said actuator having first passage means leading to said chamber and being interconnected to said source by said interconnection means, said actuator having second passage means leading to said chamber and being interconnected to the atmosphere, said valve means controlling said second passage means, said valve means being interconnected to said movable wall by lost-motion means, said pneumatic source being a vacuum source for imposing a vacuum in said chamber through said first passage means to move said movable wall toward its predetermined actuated stroke position when said valve means is closing said second passage means whereby said movable wall causes said valve means to open said second passage means and interconnect said chamber to said at-

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mosphere when said movable wall reaches said predetermined actuated stroke position thereof.

10. A combination as set forth in claim 9 wherein said movable wall moves toward its predetermined deactuated stroke position when said vacuum source is interconnected to said chamber and said atmosphere is also interconnected to said chamber by said opened valve means whereby said movable wall causes said valve means to close said second passage and disconnect said chamber from said atmosphere when said movable wall reaches said predetermined deactuated stroke position thereof.

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