ABSTRACT: This disclosure relates to an ignition means for a cooking apparatus or the like which has a plurality of pilot burner means associated with respective main burner means of a cooking apparatus, the ignition means comprising piezoelectric crystal means which has its stresses altered in a repetitive manner by a pneumatically operated actuator that cycles itself automatically to provide repetitive impacts on the crystal means to produce an ignition spark output that is distributed in series to all of the pilot burner means in sequence to assure that all of the pilot burner means are ignited once the ignition means is rendered operative.
This invention relates to a pneumatically operated ignition means for the burner means of a cooking apparatus or the like as well as to an improved pneumatically operated actuator therefore 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 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 reignited by the housewife or the like utilizing matches and the like.

However, according to the teachings of the invention set forth in the copending patent application, Ser. No. 671,861, filed Sept. 29, 1967, and assigned to the same assignee to whom this application is assigned, pneumatically operated ignition means are provided for such pilot burner means wherein the housewife or the like can initiate the actuation of the igniter means by pressing a remote control from the pilot burner means while igniting the pilot burner means in a simple and effective manner.

In particular, the aforementioned copending patent application provides piezoelectric crystal means that will have the stresses therein repetitively altered in an automatic manner once the ignition means is rendered operative to produce an electrical spark ignition output that is automatically distributed to each of the pilot burner means in a sequence one or more times to assure that all the pilot burners of the cooking apparatus will be lit.

However, according to the teachings of this invention an improved system of the above type is provided wherein the pneumatically operated actuator will automatically and repetitively impose hammerlike impacts on the crystal means to alter the stresses therein instead of providing the cycling squeezing action as disclosed in the aforementioned copending patent application.

In particular, one embodiment of this invention includes a pneumatically operated actuator having a movable wall provided with a passage means therethrough which is adapted to be opened and closed by the impacting member of the actuator, the movable wall when moving to its predetermined actuated stroke position, causing the impacting member to open the passage means in the movable wall while at the same time causing the impacting member to impact against the piezoelectric crystal means to alter the stresses therein.

Accordingly, it is an object of this invention to provide an improved igniter 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 the invention for actuating a piezoelectric crystal means for a cooking apparatus or the like, the actuator being in its predetermined deactuated stroke position.

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

FIG. 4 is a perspective 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 impacting against the piezoelectric crystal means after the actuator has been actuated to its predetermined actuated stroke position.

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 embodiments 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 a plurality of main top burner means generally indicated by the reference numerals 11, 12, 13, and 14. While the ignition system of this invention is hereinafter described as being particularly adaptable for use at the top burner means 11--14 of the cooking apparatus 10, it is to be understood that the features of this invention can also provide ignition means for just the bake and broil burners of the oven of the cooking apparatus 10 or in combination with the top burner means 11--14 as desired.

However, since the ignition means of this invention will apply to any type of burner means, such ignition system is only hereinafter described for the top burners 11--14.

As illustrated in FIG. 2, a pilot burner means is associated with each main top burner means whereby such pilot burner means for the respective main burners 11--14 are generally indicated by the reference numerals 15, 16, 17 and 18.

As previously set forth, the ignition means of this invention is adapted to be actuated by the housewife or the like to automatically ignite all the pilot burner means of the apparatus 10 in a simple and effective manner.

In particular, the ignition means of this invention is generally indicated by the reference numeral 20 in FIG. 2 and is adapted to be rendered operable by the housewife or the like pushing in on a "on-off" member or button 21 which is adapted to actuate a timer operated valve means 22 carried by the apparatus 10 and being adapted to interconnect a conduit 23 with a conduit 24 for a predetermined time period after the lapse of which the timer means 22 will disconnect the conduit 23 from the conduit 24.

The conduit 23 is interconnected to a pneumatic source 25, such as the inlet of a vacuum pump or the like. The other conduit 24 is interconnected to a chamber 26 of a vacuum operated actuator 27 of this invention suitably mounted to the frame means 28 of the apparatus 10 and comprising a pair of cup shaped housing members 29 and 30 suitably snap fitted together at their respective open ends 31 and 32 to sealingly trap and secure an outer peripheral edge means 33 of a flexible diaphragm or movable wall 34 therebetween whereby the flexible diaphragm 34 cooperates with the cup shaped housing member 29 to define the chamber 26 therebetween.

The actuator 27 is carried by a suitable support frame 35 adapted to be secured to the frame means 28 of the cooking apparatus 10 in any suitable manner, the support means 35 carrying a piezoelectric crystal stack 36 between a bottom wall support portion 37 of the support frame 35 and the actuator 27 as illustrated in FIG. 2. The crystal stack 36 includes a piezoelectric crystal means 37 longitudinally disposed between longitudinally aligned pressure pad means 38 and 39, the crystal means 37 having a lead wire 40 electrically interconnected thereto in such a manner that an impact is imposed downwardly on the pressure pad 38 of the crystal stack 36 in a manner hereinafter described, the impact alters the stresses in the crystal means 37 to create a potential differential between the lead wire 40 and the support frame 35 for a purpose now to be described.

The lead wire 40 is electrically interconnected to a distributor arm 41 of a distributor 42 while the support frame 35 is, in effect, interconnected to ground potential as generally indicated by the reference numeral 43 in FIG. 2 because the
support frame 35 is interconnected to the frame means 28 of the cooking apparatus 10 which is grounded by being interconnected to the gas supply lines and to other conventional grounding means.

While the movement of the distributor arm 41 of the distributor 42 can be independently operated, the ignition means 20 of this invention is so constructed and arranged that the movement of the distributor arm 41 is synchronized with the actuation and deactuation of the pneumatically operated actuator 27 of this invention by suitable interconnecting means 44 as will be apparent hereinafter.

The distributor arm 41 is adapted to be indexed in sequence in a clockwise direction so as to serially electrically interconnect with a plurality of electrical terminal means 45, 46, 47 and 48 carried on an insulating distributor plate means 49 of the distributor 42.

The terminal means 45, 46, 47 and 48 of the distributor 42 are respectively interconnected to electrodes 50, 51, 52 and 53 carried by the frame means 28 of the cooking apparatus while being electrically insulated therefrom, each electrode 50, 51, 52 and 53 being spaced from and disposed adjacent their respective pilot burner means 15, 16, 17 and 18.

The pilot burner means 15, 16, 17 and 18 in the manner described above is directly mounted to the frame means 28 of the cooking apparatus 10, and, thus, are grounded as generally indicated by the reference numerals 54 and 55 in FIG. 2 so as to be at the same potential as the support frame 35 to thereby provide ground electrodes cooperating with the electrodes 50, 51, 52 and 53 to develop spark gaps 56, 57, 58 and 59 disposed adjacent the fuel outlet means 60, 61, 62 and 63 of their respective pilot burner means 15, 16, 17 and 18.

The pneumatically operated actuator 27 of this invention has a substantially frustoconical member 64 secured to the inner periphery 65 of the flexible diaphragm 34 so as to move in unison therewith, the inner periphery 65 of the flexible diaphragm 34 being located within the lower surface 66 extending beyond the lower surface 67 of the frustoconical member 64 so as to provide a valve seat leading to a passage means 68 that passes through the frustoconical member 64 to be fluidly interconnected to the chamber 26 of the actuator 27. A compression spring 69 is disposed in the chamber 26 of the actuator 27 and has one end 70 bearing against the end wall 71 of the cup shaped housing member 29 while the other end 72 thereof bears against the frustoconical member 64 to tend to urge the flexible diaphragm 34 downwardly to the predetermined deactuated stroke position of FIG. 2.

A movable impacting or hammer member 73 is carried by the actuator 27 and has a lower flat platelike portion 74 adapted to span the opening 68 in the frustoconical member 64 and seat against the surface 66 of the inner periphery 65 of the diaphragm 34 to close the passage 68 in the manner illustrated in FIG. 2 while at the same time bearing against the pressure pad 38 of the crystal stack 36. The impact member 75 includes a stem portion 75 having an upper end 76 interrupted by a bore 77 that telescopically receives an extension 78 projecting downwardly from the inside surface 79 of the end wall 71 of the housing member 29. The stem portion 75 of the impact member 73 passes loosely through the passage 68 of the frustoconical member 64 and has its upper end surface 76 extending beyond the adjacent upper end surface 80 of the frustoconical member 64 when the members 64 and 73 are disposed in the deactuated stroke position of FIG. 2 for a purpose hereinafter described.

A second compression spring 81 is carried by the actuator 27 and has one end 82 bearing against the frustoconical member 64 and the other end 83 bearing against the plate portion 74 of the impact member 73 to tend to normally move the impact member 73 away from the diaphragm 34 in a direction toward the crystal means 36.

The operation of the ignition means 20 of this invention for the apparatus 10 will now be described.

When the housewife or the like notices that one of the main burner means 11, 12, 13 or 14 does not ignite when she turns on the respective selector knob (not shown) to its on position, or when she actually notices that one or more of the pilot burner means 15, 16, 17 and 18 is not burning, she can merely push inwardly on the pushbutton means 21 to initiate the automatic operation of the ignition system 20 to fully ignite any unlit pilot burner means 15—18.

In particular, when the timer operated valve means 22 is initially turned to its on position by the pushbutton 21, the timer operated valve means 22 will operate for a predetermined length of time during which the valve means 22 will continuously interconnect the vacuum source conduit 23 to the conduit 24 and, thus, to the pneumatically operated actuator 27 of this invention to cause the same to cycle in a repetitive manner between its predetermined actuated stroke position and its predetermined deactuated stroke position in a manner now to be described.

Initially the actuator 27 is disposed in its deactuated stroke position of FIG. 2 so that when the vacuum source means 21 is first interconnected to the chamber 26 thereof, the chamber 26 is progressively evacuated by the vacuum source 25 as the passage means 68 is fully sealed closed from the atmosphere by the platelike member 74 of the impact member 73 sealing against the inner periphery 65 of the flexible diaphragm 34. As the pressure differential across the diaphragm 34 progressively increases to a magnitude greater than the force of the compression spring 69, the movable diaphragm 34 moves upwardly from the position illustrated in FIG. 2 toward the position illustrated in FIG. 3 and because the chamber 26 is fully in fluid communication with the passage means 68 by the loose telescoping relation between the stem 75 of the impact member 73 and the end 80 of the frustoconical member 64, the resulting pressure differential across the disc member 74 of the impact member 73 causes the impact member 73 to move in unison with the flexible diaphragm 34 in an upward direction while maintaining the passage means 68 sealed closed from the atmosphere. However, as the diaphragm 34 and impact member 73 are moving upwardly, the end surface 76 of the impact member 73 eventually engages against the inside surface 79 of the end wall 71 of the cup shaped housing member 29 in the manner illustrated in FIG. 3 whereby further upward movement of the impact member 73 is prevented by the end wall 79. At this time, it can readily be seen in FIG. 3 that the end surface 80 of the frustoconical member 64 still remains spaced from the end wall 79 so that the increasing pressure differential across the diaphragm 34 can continue to move the diaphragm 34 and frustoconical member 64 upwardly in the manner illustrated in FIG. 4 to pull the inner periphery 65 of the diaphragm 34 away from sealing relation with the disc 74 of the impact member 73 as fully illustrated in FIG. 4.

At the initial break of the seal between the diaphragm portion 65 and the disc portion 74 of the impact member 73 as illustrated in FIG. 4, the passage means 68 between the impact member 73 and frustoconical member 64 immediately returns to atmospheric condition so that the stored up force of the compression spring 81 immediately drives the impact member 73 vertically downwardly from the position illustrated in FIG. 4 to the position illustrated in FIG. 5 to impact against the pressure pad 38 of the crystal stack 36 with a hammerlike blow to thereby alter the stresses in the crystal means 37 so that a potential differential is created between the particular electrode 50, 51, 52 or 53 from which the output of the crystal means 37 is being directed by the distributor arm 41 and the respective pilot burner means 15, 16, 17 or 18 so that sparking will be created across the respective spark gap 56, 57, 58 or 59 thereof to light the respective pilot burner means if the same should be unlit.

When the actuator 27 is disposed in the position illustrated in FIG. 5, the atmosphere is now interconnected to the chamber 26 of the actuator 27 through the open passage means 68 in such a manner that the vacuum source 25 is ineffective to maintain the evacuation of the chamber 26 whereby the chamber 26 returns to atmospheric condition and the
compression spring 69 causes the flexible diaphragm 34 to move downwardly from the position illustrated in FIG. 5 back to the predetermined deactuated stroke position of FIG. 2 to again place the inner periphery 65 of the diaphragm 34 in sealing engagement against the plate portion 74 of the impact member 73 to seal off the passage means 68.

During the return of the flexible diaphragm 34 from its actuated stroke position to its deactuated stroke position as illustrated in FIG. 2, the interconnection means 44 between the actuator 27 and the distributor arm 41 of the distributor 42 will be operated to advance the distributor arm 41 one station in a clockwise direction so that upon the next actuation of the actuator 27, the sparking produced by the impacted crystal means 36 will take place at another pilot burner means.

Thus, it can be seen that when the actuator 27 finally returns to the position illustrated in FIG. 2, the flexible diaphragm 34 is again drawn upwardly by the resulting pressure differential across the same to cause another impact stroke on the crystal means 36 in the manner previously described.

Accordingly, the timer operated valve means 22 operates for a predetermined length of time so that each pilot burner means 15, 16, 17 and 18 will have sparks created at their respective spark gaps 56, 57, 58 and 59 in a sequential manner one or more times for each cycle of operation of the ignition means 20 so that the automatic ignition means 20 of this invention will almost assure that all pilot burner means of the cooking apparatus 10 will be fully ignited once the ignition means 20 is operated by the housewife or the like pushing in on the pushbutton means 21.

Therefore, it can be seen that by utilizing a single crystal means 37, in the manner previously described, the single crystal means 37 is adapted to effectively ignite all pilot burner means of the cooking apparatus 10 so that a relatively inexpensive ignition means can be provided for the apparatus 10.

Further, it can be seen that the improved pneumatically operated actuator 27 of this invention will automatically recycle itself between its actuated and deactuated positions as long as the vacuum source 25 is interconnected thereto, the actuator 27 upon each movement thereof to its predetermined actuated stroke position causing the impact member 73 to impact against the crystal stack 36 to alter the stresses therein.

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

I claim:

1. In combination, a pneumatically operated actuator, a pneumatic 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 and having movable means to alter the stresses in said ignition means by impacting said ignition means each time said actuator is actuated to a predetermined actuated stroke position thereof, said actuator having means for automatically causing said pneumatic source to actuate the same to said predetermined actuated stroke position and thereafter deactuating the same to a predetermined deactuated stroke position thereof in a continuous cycling manner whereby a repetitive impacting of said ignition means takes place by said movable means as long as said source is interconnected to said actuator, said actuator having a chamber therein defined in part by a 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 movable means of said actuator comprising a valve means for controlling said second passage means.

2. A combination as set forth in claim 1 wherein said second passage means is provided in said movable wall.

3. A combination as set forth in claim 2 wherein said movable wall has a flexible diaphragm provided with an inner periphery that defines part of said second passage means.

4. A combination as set forth in claim 3 wherein said movable means is adapted to seat against said inner periphery of said diaphragm to close said second passage means.

5. A combination as set forth in claim 4 wherein a first spring is carried by said actuator and tends to normally move said movable wall to its deactuated stroke position.

6. A combination as set forth in claim 5 wherein a second spring is carried by said actuator and tends to normally move said movable means away from said movable wall and toward said ignition means.

7. A combination as set forth in claim 1 wherein said pneumatic source is 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 movable means is closing said second passage means whereby said movable wall causes said movable means to open said second passage to interconnect the atmosphere to said chamber and impact against said ignition means when said movable wall reaches said predetermined actuated stroke position thereof.

8. A combination as set forth in claim 7 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 second passage means whereby said movable wall causes said movable means to close said second passage means and disconnect said chamber from said atmosphere when said movable wall reaches said predetermined deactuated stroke position thereof.