

March 25, 1969

ISAO KANDA
PIEZOELECTRIC IGNITION DEVICE

3,434,790

Filed Aug. 8, 1967

Sheet 1 of 4

FIG-1

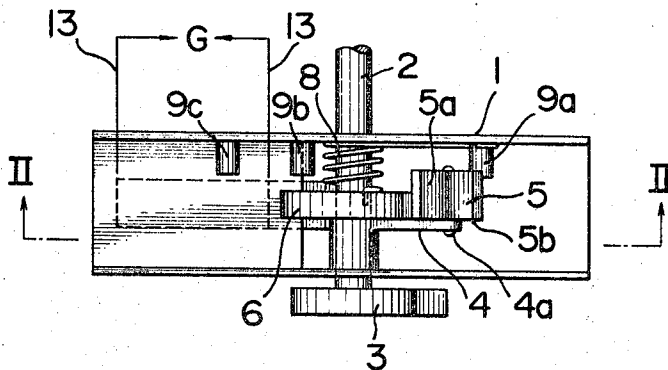
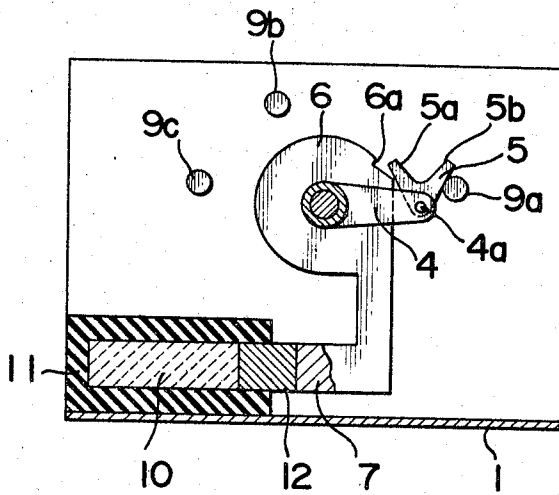


FIG-2



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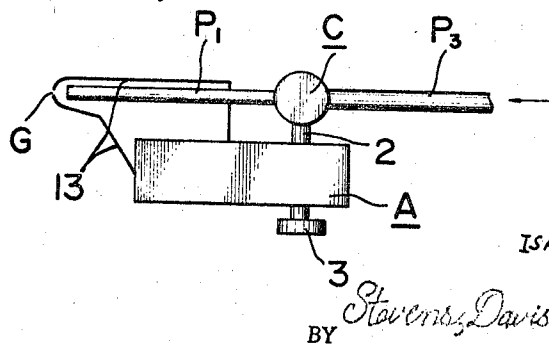
BY *Stevens, Davis, Miller & Mosher*

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PIEZOELECTRIC IGNITION DEVICE

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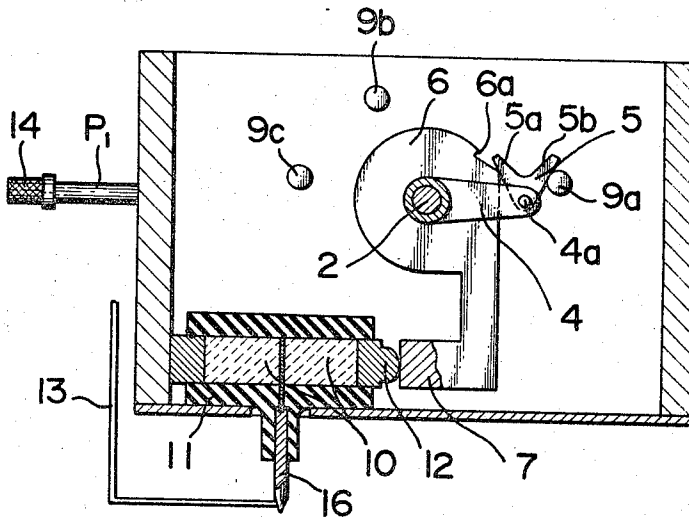
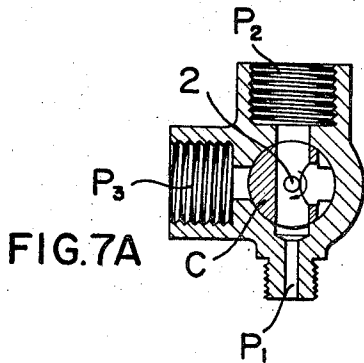
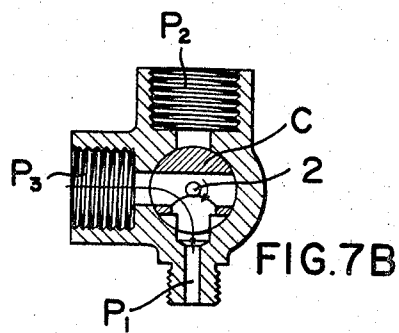
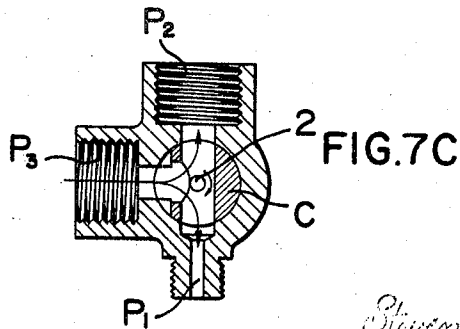
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FIG-6



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3,434,790

PIEZOELECTRIC IGNITION DEVICE

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Int. Cl. F23q 3/00; 13/00

U.S. Cl. 431—255

3 Claims

ABSTRACT OF THE DISCLOSURE

A piezoelectric ignition device comprising a main shaft extending through a casing and provided outside the casing with a knob, a V-shaped pawl having two legs and rotatable around a pin provided at the free end of a lever turning around with the main shaft and adapted to be engaged with and disengaged from a notch formed on the periphery of a rotary disc with the aid of first, second and third stops arranged along the path of the pawl, and a hammer shaped impact member formed integral with the rotary disc and capable of striking against a piezoelectric voltage source by the action of a spring to be stressed when the main shaft is rotated in one direction to produce a spark discharge across a gap formed between two electrodes connected to the piezoelectric voltage source, and the device being particularly adapted for use in igniting a gas burner.

The present invention relates to a piezoelectric ignition device which makes use of a spark discharge to be produced across electrodes connected to a piezoelectric voltage source including one or more piezoelectric elements when said voltage source is struck by a hammer shaped impact member.

An object of the invention is to provide an improved piezoelectric ignition device which is capable of producing the spark discharge by rotating a single operating shaft in one direction only and which is particularly adapted for use in igniting a gas burner.

Another object of the invention is to provide an improved piezoelectric ignition device for a gas burner with a gas control valve which may be controlled to adjust the burning condition of the gas, after the spark discharge has been produced, and subsequently the gas burner has been ignited, by rotating a single operating shaft.

Yet another object of the invention is to provide an improved piezoelectric ignition device for a pilot gas burner and a main gas burner with a gas control valve which is common to both of these gas burners and may be controlled so that at first the pilot gas burner is ignited, then the main gas burner is ignited, and subsequently the burning condition of the main gas burner is adjusted by rotating a single operating shaft.

A still further object of the invention is to provide an improved piezoelectric ignition device that is composed of a minimum of component parts, and may be constructed on a relatively economical basis.

A feature of the invention is the provision of an improved piezoelectric ignition device which incorporates a V-shaped pawl rotatable around a pin fixed to the free end of a lever turning around with a main shaft with a knob and adapted to be engaged with a rotary disc having a hammer shaped impact member formed integral with the disc so as to generate spark discharge ignition of the device and gas control means by rotating the main shaft with the knob, if applied to a gas burner.

Other objects, features and advantages of the invention will become apparent in consideration of the following

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description and the accompanying drawings, in which:
FIG. 1 is a plan view showing an embodiment of the device according to the invention;

FIG. 2 is a section on line II—II of FIG. 1, viewed in the direction of the arrows, parts being broken away;

FIGS. 3A—3F show successive operating positions of the V-shaped pawl and the hammer shaped impact member of the device shown in FIGS. 1 and 2 with respect to the first, second and third stops when the main shaft is rotated in one direction with the knob;

FIG. 4 is a diagrammatic illustration of another embodiment of the device according to the invention;

FIG. 5 is a plan view showing a further embodiment of the device according to the invention, parts being broken away;

FIG. 6 is a section on line VI—VI of FIG. 5 viewed in the direction of the arrows, parts being broken away; and

FIGS. 7A to 7C show successive operating positions of the gas control valve of the device shown in FIG. 5 with respect to the pilot pipe, main pipe and gas supply pipe, parts being shown in section on line VII—VII of FIG. 5 and viewed in the direction of the arrows.

Referring to FIGS. 1 and 2 showing an embodiment of the piezoelectric ignition device according to the invention, 1 designates a box shaped casing and 2 is a main shaft extending through the casing 1 and rotatably journaled therein. To one end of the main shaft 2 outside the casing 1 is secured a knob 3. To that part of the main shaft 2 which is positioned within the casing 1 is fixed a lever 4 which is provided at its free end with a pin 4a. A V-shaped pawl 5 having two legs 5a and 5b rotates at its base end around the pin 4a on the lever 4. A rotary disc 6 is rotatably mounted on the main shaft 2 and formed integral at its outer periphery with a hammer shaped impact member 7. The rotary disc 6 is provided at its periphery with a notch 6a to be engaged with and disengaged from the leg 5a of the pawl 5. Around that part of the main shaft 2 which is located between the casing 1 and the rotary disc 6 is mounted a coil spring 8 to be tensioned when the main shaft 2 is rotated in one direction.

Along the path of the pawl 5 are projected from the casing 1 a first stop 9a, a second stop 9b and a third stop 9c arranged so that the stops 9a and 9c with the aid of the disc 6 serve to lock the pawl 5 and hence the lever 4 and that the stop 9b serves to turn the pawl 5 and rotate the disc 6 together with the impact member 7 by means of the action of the spring 8 in the reverse direction. The second and third stops 9b and 9c may be constructed as stay rods bridging across the opposed inside walls of the casing 1, while the first stop 9a is made shorter in length than the second and third stops 9b and 9c for the purpose of permitting the impact member 7 to pass over it.

To the base of the casing 1 is secured through an insulating sleeve 11 a piezoelectric voltage source including one or more piezoelectric elements 10 adapted to receive at its end surface strong impact when the impact member 7 strikes it through a pressure piece 12 and produce a spark discharge across a gap G formed between two electrodes 13, 13 connected to both end surfaces of the piezoelectric element 10, respectively. The piezoelectric voltage source shown indicates the use of one piezoelectric element.

The operation of the device shown in FIGS. 1 and 2 is as follows:

When the main shaft 2 is rotated in a counterclockwise direction by means of the knob 3 from a position shown in FIG. 3A, the lever 4 turning around with the main shaft 2 causes the leg 5a of the pawl 5 to be brought

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into engagement with the notch 6a thus rotating the disc 6 together with the impact member 7 against the action of the spring 8 through about 45° to a position shown in FIG. 3B.

When the main shaft 2 with the knob 3 is further rotated through about 45° in the counter clockwise direction, the leg 5b of the pawl 5 becomes engaged with the stop 9b as shown in FIG. 3C. This causes the pawl 5 to turn around the pin 4a in a clockwise direction during a still further rotation of the main shaft 2 with the knob 3 thus disengaging the leg 5a from the notch 6a as shown in FIG. 3D. At this moment, the disc 6 is rapidly rotated in the clockwise direction by the action of the tensioned coil spring 8 to a position shown in FIG. 3E, thereby rotating the impact member 7 and giving the sudden impact thereof through the pressure piece 12 against the piezoelectric element 10. Thus, a high electric potential is produced across both end surfaces of the piezoelectric element 10 and a spark discharge occurs across the gap G formed between the two electrodes 13. This spark discharge may be used for igniting gas supplied around the gap G.

When the main shaft 2 with the knob 3 is further rotated in the counter clockwise direction the pawl 5 is locked between the stop 9c and the rotary disc 6 as shown in FIG. 3F so as to prevent any further rotation of the lever 4 and hence the main shaft 2 with the knob 3 in the counter clockwise direction.

Any desired valve for controlling gas to be supplied to a gas burner may be connected to the free end of the main shaft 2 and such a valve may be rotated by means of the main shaft 2 with the knob 3. Thus it is possible to control the burning condition of the gas burner during the rotation of the main shaft 2 and the lever 4 from the position shown in FIG. 3E to the position shown in FIG. 3F.

When the main shaft 2 with the knob 3 is now rotated in the clockwise direction from the position shown in FIG. 3F, the pawl 5 is turned by the stop 9b and then is locked between the stop 9a and the rotary disc 6 as shown in FIG. 3A so as to prevent any further rotation of the lever 4 and hence the main shaft 2 with the knob 3 in the clockwise direction. The lever 4 and the main shaft 2 are now ready for the next operation.

As explained hereinbefore the use of the V-shaped pawl 5 rotatable around the pin 4a at the free end of the lever 4 turning around with the main shaft 2 with the knob 3 and adapted to be engaged with and disengaged from the notch 6a of the rotary disc 6 provided with the hammer shaped impact member 7 formed integral therewith ensures free rotation of the main shaft 2 with the knob 3 in either direction after the impact member 7 has given its sudden impact upon the piezoelectric voltage source including one or more piezoelectric elements 10 and produced the spark discharge across the gap G and further provides the important advantage that a positive ignition and control of the burning condition of a gas burner having a control valve to be connected to the main shaft 2 can be attained in a simple and easy manner by rotating the main shaft 2 by means of knob 3.

Referring now to FIG. 4 there is diagrammatically shown another embodiment of the device according to the invention comprising the piezoelectric ignition device A shown in FIGS. 1 and 2 and a gas burner including a gas supply pipe P₁ and a valve C connected to the main shaft 2 of the device shown in FIGS. 1 and 2 and communicated through a pipe P₃ with a gas supply source (not shown). The end of the pipe P₁ terminates near the gap G formed between the electrodes 13, 13 of the device shown in FIGS. 1 and 2.

In the present embodiment the main shaft 2 of the valve C is rotated by means of the knob 3 so that the valve C is opened a little just before the leg 5b becomes engaged with the second stop 9b and the leg 5a is disengaged from the notch 6a and hence the impact member 7 strikes the piezoelectric voltage source including one

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or more piezoelectric elements 10 through the pressure piece 12 to produce the spark discharge across the gap G and subsequently to ignite said burner and that then the valve C becomes gradually opened during the rotation of the main shaft 2 from the position shown in FIG. 3E to the position shown in FIG. 3F.

Thus, the present embodiment provides an easy and simple way of producing the arc discharge across the gap G and igniting the gas burner and also controlling the burning condition of the gas burner by rotating the main shaft 2 with the knob 3.

FIGS. 5 and 6 show another modified device according to the invention comprising the piezoelectric device A shown in FIGS. 1 and 2, a pilot gas burner including a pilot gas supply pipe P₁, and a valve C connected to the main shaft 2 of the device shown in FIGS. 1 and 2 and communicated through the pipe P₃ with a gas supply source (not shown), and a main gas burner including a main gas supply pipe P₂ communicated through said valve C and said pipe P₃ with the same gas supply source and a burner outlet B having a plurality of nozzles 15 and being positioned so as to be ignited with the aid of the burning gas from said pilot gas burner and connected to the end of the pipe P₂. The pilot gas burner outlet is positioned near the gap G formed between the grounded pilot gas burner and the electrode 13 connected to a high tension terminal of the piezoelectric voltage source, said terminal being connected to a contact plate 16 inserted between two piezoelectric elements 10, 10 of the piezoelectric voltage source of the device A. A metal gauze outlet 14 may be connected to the end of the pipe P₁, if necessary.

In the present embodiment a three way valve may be used as an example of the valve C.

The operation of the present embodiment of the device according to the invention is as follows:

When the main shaft 2 with the knob 3 are rotated in the counter clockwise direction in FIG. 3 it causes the valve C to rotate in the clockwise direction as shown in FIG. 7. During the preliminary rotation of the main shaft 2 the pilot pipe P₁ is communicated through the valve C with the gas supply pipe P₃ as shown in FIG. 7B. Then, the pawl 5 becomes engaged with the second stop 9b to release the disc 6 and hence the impact member 7 which strikes the piezoelectric elements 10 through the pressure piece 12 and produces the spark discharge across the gap G. Thus the gas preliminary blown out of the metal gauze outlet 14 is ignited.

Further rotation of the main shaft 2 with the knob 3 in the same direction causes the main pipe P₂ also to communicate through the valve C with the gas supply pipe P₃ as shown in FIG. 7C. Thus, the main gas burner outlet B is supplied gas through the main pipe P₂ and the gas blown out of the latter is ignited in a positive manner with the aid of the burning gas from the pilot burner.

The amount of gas to be supplied to the main pipe P₂ can be controlled by means of the valve C during the rotation of the main shaft 2 from the position shown in FIG. 3E to the position shown in FIG. 3F. Such control of the amount of gas to be supplied to the main pipe P₂ can be effected by rotating the main shaft without having any counter action of the coil spring 8 since the lever 4 turning around with the main shaft 2 is not subjected to the action of the coil spring 8.

As can be seen from the above description the present embodiment makes it possible to not only effect ignition of the pilot burner and the main burner, but also control the burning condition of the main burner by rotating the main shaft 2 with the knob 3. Moreover, since the spark gap G can be located at a position far away from the main burner outlet B wear of the spark gap G due to heat radiated from the main burner outlet B can be reduced.

It will be obvious that the invention is not restricted to the embodiments described above and that those skilled

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in the art may apply many variations within the scope of the invention.

What I claim is:

1. A piezoelectric ignition device comprising a casing, a main shaft extending through the casing and rotatably journaled therein, said main shaft being provided at its one end with a knob and adapted at the other end to be connected to a gas control means, a lever turning around with the main shaft within the casing and provided at its free end with a pin, a V-shaped pawl having two legs and rotatable around the pin, a rotary disc rotatably mounted on the main shaft, formed integral at its outer periphery with a hammer shaped impact member and provided at its periphery with a notch to be engaged with and disengaged from said leg of the pawl, a coil spring mounted around that part of the main shaft which is located between the casing and the rotary disc and adapted to be tensioned when the main shaft is rotated in one direction with said leg of the pawl remains engaged with said notch of the rotary disc, a piezoelectric voltage source including at least one piezoelectric element secured to the casing and adapted to receive impact when said impact member strikes against it, a spark gap formed between electrodes connected across said piezoelectric voltage source, and first, second and third stops projected from the casing and arranged along the path of the pawl so that the first and third stops with the aid of the rotary disc serve to lock the pawl and hence the main shaft with the knob at the starting and final positions, respectively, and that the second stop serves to turn the pawl and rotate the disc together with the impact member by means of the action of the spring thus giving impact upon the piezoelectric voltage source and producing the spark discharge across the gap.

2. A piezoelectric ignition device as claimed in claim 1 and further comprising a gas burner having a valve connected to the main shaft of the device and communicated with a gas supply source, said gas burner outlet being positioned near the gap formed between the electrodes connected across the piezoelectric voltage source, and the main shaft of said valve being rotated by means of the knob so that the valve is opened a little just before one of the legs of the pawl becomes engaged with the second stop and the other leg is disengaged from the notch and hence the impact member strikes the piezoelectric

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voltage source to produce the spark discharge across the gap and subsequently to ignite said burner and that then the valve becomes gradually opened during the rotation of the main shaft from a position where the pawl is in engagement with the second stop to a position where the pawl is locked between the third stop and the rotary disc.

3. A piezoelectric ignition device as claimed in claim 1 and further comprising a valve connected to the main shaft of the device and communicated with a gas supply source, and a main gas burner and a pilot gas burner, said both burners being communicated through said valve with said gas supply source, said main gas burner outlet being positioned so as to be ignited with the aid of the burning gas from the pilot burner, said pilot gas burner outlet being positioned near the gap formed between said grounded pilot burner outlet and the electrode connected to a high tension terminal of the piezoelectric voltage source of the device, and the main shaft of said valve being rotated by means of the knob so that at first the pilot burner is communicated through the valve with the gas supply source and then the impact member strikes the piezoelectric voltage source to produce the spark discharge across the gap and ignite the gas blown out of the pilot gas burner, that then the main gas burner is communicated through the valve with the gas supply source and the gas blown out of the latter is ignited with the aid of the burning gas from the pilot burner, and that the amount of gas to be supplied to the main gas burner is controlled by means of the valve during the rotation of the main shaft from a position where the pawl is in engagement with the second stop to a position where the pawl is locked between the third stop and the rotary disc.

References Cited

UNITED STATES PATENTS

3,136,355	6/1964	Weber	431—6
3,200,295	8/1965	Owens et al.	431—131
3,344,314	9/1967	Koontz	317—81
3,387,912	6/1968	Goto	431—130

VOLODYMYR Y. MAYEWSKY, *Primary Examiner*.

U.S. Cl. X.R.

310—8.7; 317—81