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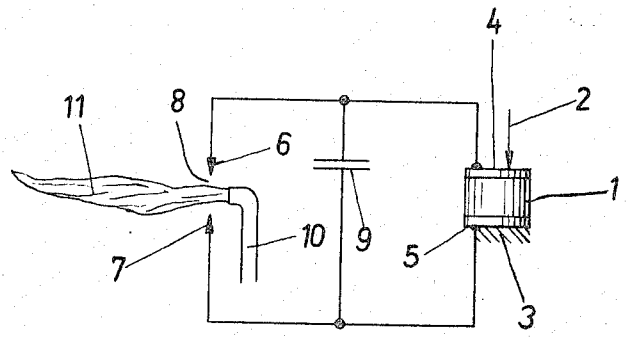

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ARRANGEMENT FOR IGNITING COMBUSTIBLE FLUID

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ABSTRACT OF THE DISCLOSURE

The invention relates to an arrangement for igniting combustible fluid. Piezo-electric means are provided for generating a piezo-electric current in response to a change in its existent stress condition. Capacitor means is connected in parallel with the piezo-electric means and is charged by the current generated by the latter, and is arranged to discharge in response to the change in the existing stress condition of the piezo-electric means reaching a predetermined limit. Electrode means is connected in circuit with the capacitor means and defines a spark gap for discharge of the capacitor means. Means is provided for heating a combustible fluid to the vicinity of the spark gap so as to be ignited upon discharge of the capacitor means across the same.

The present invention relates to an arrangement for igniting combustible fluids. More particularly, the invention relates to an arrangement for igniting such fluids by means of an electrical discharge. Still more specifically, the invention relates to an arrangement of the above-mentioned type in which the electrical current for the igniting spark is generated by piezo-electric means.

Piezo-electric ignition arrangements are already known in which the piezo-electric crystal is subjected to a change in an existing stress condition, thereby causing a flow of static- or piezo-electricity across the two poles of the crystal. This electricity is then discharged via a spark gap and serves to ignite a combustible fluid fed to the vicinity of the spark gap.

However, known piezo-electric ignition arrangements have been suffering so far from the drawback that they are not capable of igniting difficult-to-ignite fluids. The reason for this is that, as the stress-condition of the piezo-electric body is varied, for example by application of pressure to the body, the total electrical energy the piezo-electric body is capable of yielding is not produced suddenly and at once, but in a series of steps because, as the voltage for which the spark gap is designed is reached, the piezo-electric body will discharge across the spark gap. As a result, the spark discharge in known arrangements of this type is not strong enough to ignite fluids which are not readily combustible, such as butane or propane.

It is therefore a general object of the present invention to provide an ignition arrangement which will overcome the above-mentioned drawbacks.

A more specific object of the invention is to provide an arrangement for igniting combustible fluids in which the spark discharge will be strengthened so that it will ignite not-readily-combustible fluids.

Still a more specific object of the invention is to provide a piezo-electric ignition arrangement in which a capacitor means is connected in parallel with the piezo-electric body and is charged by the current created upon compression of the piezo-electric body, so that the capacitor means will discharge in response to the charge reaching a predetermined limit.

In accordance with the above objects of my invention I provide, in carrying out one of these objects and in an arrangement for igniting combustible fluids, piezo-electric means which is adapted to generate a piezo-electric current in response to a change in its existing stress condition; capacitor means which is connected in parallel to the piezo-electric means and is to be charged by said current, and which is to discharge in response to the change in the existing stress condition of the piezo-electric means reaching a pre-determined limit; electrode means connected in circuit with the capacitor means and defining a spark gap for discharge of the capacitor means thereacross; and means for feeding a combustible fluid to the vicinity of the spark gap so that the fluid is ignited upon discharge of the capacitor across the spark gap.

The invention is based on the realization, as has been briefly mentioned before, that piezo-electric bodies generally generate sufficient energy to ignite even fluids which are not readily ignitable. However, this energy is discharged not all at once, but in stages which correspond to the ignition potential of the spark gap with which the piezo-electric body is connected. As soon as this potential is reached at the poles of the piezo-electric body, the spark is discharged across the gap, and it therefore can have only as much energy as is available at the piezo-electric body at this moment. Generally speaking, the first discharge occurs long before maximum compression of the piezo-electric body is reached; in other words, if discharge at this time can be avoided, then the continued compression of the piezo-electric body will produce additional current, thereby increasing the strength of the spark.

A solution to this problem has been found in that a capacitor means is connected in parallel with the piezo-electric body, and that the capacitance of the means is greater than the characteristic capacitance of the piezo-electric body itself. Thus, the inventive construction results in a combined capacitance which serves to maintain the voltage at the piezo-electric body smaller at the identical compression of the body than would be the case without the connection in parallel of the capacitor. It will be clear that the spark discharge occurs only when the lower voltage resulting from the parallel connection of the two capacitances has reached discharge value. Since the ionization which occurs results in effect in a short-circuit, the total charge present both in the capacitor and in the piezo-electric body feeds the spark, so that the latter has a considerably higher ignition energy than heretofore known and is therefore able to ignite even difficult-to-ignite fluids, particularly gasses.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of the specific embodiments when read in connection with the accompanying drawing in which the single figure is a schematic representation of the inventive arrangement.

Reference numeral 1 indicates the piezo-electric body having a given capacitance and which is compressed by a force acting in the direction of the arrow against a support or the like indicated by reference numeral 3. The body 1 is provided with a pair of electrodes 4 and 5 at its respective poles, and these electrodes are connected by conductors 7 and 8 to the discharge electrodes 6' and 7' of the spark gap 8. A capacitor 9, which has a capacitance greater than the body 1, is connected in parallel with the electrodes 4 and 5 of the piezo-electric body 1. A conduit 10 serves to feed a difficult-to-ignite fluid, such as a mixture of butane and propane gas, to the vicinity

of the spark gap 8 so that, when this mixture of gasses is ignited, the flame 11 will result.

If, now, the force 2 compresses the piezo-electric body 1, a piezo-electric current is generated across the electrodes 4 and 5. This current is distributed to the piezo-electric body 1 and the capacitor 9 at the ratio of the capacitances of these two members. Therefore, the voltage rises more slowly than if the capacitor 9 were not present. Premature discharge is thus avoided, and when the discharge voltage of the spark gap is finally reached the ignition energy available for the spark passing across the electrodes 6' and 7' is greater than in other arrangements of this type and is sufficient to ignite fluids which are difficult to ignite.

In an actual test two piezo-electric bodies of 20 pf. each were connected in parallel. The conductor capacitance was 10 pf. Capacitors of 50 each were connected into this arrangement, resulting in a total capacitance of 150 pf. With this arrangement an appreciably increased ignition energy was observed. An optimum was achieved with a total capacitance of 250 pf. It has therefore been found that a ratio of the added capacitance to the capacitance of the piezo-electric body in excess of two is particularly advantageous.

Of course, the capacitive impedance must not necessarily be a commercially available capacitor but can also be provided thru a capacitor in form of a metal part in or at the ignition device, or thru use of air as the dielectric or as the insulating part in or at the ignition device. It is also possible to achieve the same result by increasing the capacitance of the conductor or cable, by differential arrangement of several such members, and finally thru pure earth or space capacitances.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of ignition arrangements differing from the type described above.

While the invention has been illustrated and described as embodied in ignition arrangements, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an arrangement for igniting combustible fluids,
piezo-electric means having a predetermined capacitance and being adapted to generate a piezo-electric current in response to a change in its existing stress-condition;
capacitor means having a capacitance greater than said predetermined capacitance and being connected in parallel with said piezo-electric means to be charged by said current, and to discharge in response to said change in the existing stress-condition of said piezo-electric means reaching a predetermined limit;
electrode means connected in circuit with said capacitor means and defining a spark gap for discharge of said capacitor means thereacross;
and means for feeding a combustible fluid to the vicinity of said spark gap so that said fluid is ignited upon discharge of said capacitor means across said spark gap.

2. In an arrangement for igniting combustible fluids,
piezo-electric means having a predetermined capacitance and an existing stress condition and being adapted to generate a piezo-electric current in response to a change in its existing stress-condition;
capacitor means having a capacitance greater than said predetermined capacitance and being connected in parallel with said piezo-electric means to be charged by said current, and to discharge in response to reaching a predetermined condition of charge;
electrode means connected in circuit with said capacitor means and defining a spark gap for discharge of said capacitor means thereacross upon reaching said predetermined condition of charge;
and means for feeding a combustible fluid to the vicinity of said spark gap so that said fluid is ignited upon discharge of said capacitor means across said spark gap.

3. In an arrangement for igniting combustible fluids,
piezo-electric means having a predetermined capacitance and being adapted to generate a piezo-electric current in response to a change in its existing stress-condition;
means for changing said existing stress-condition of said piezo-electric means;
capacitor means having a capacitance greater than said predetermined capacitance and being connected in parallel with said piezo-electric means to be charged by said current, and to discharge in response to said change in the existing stress-condition of said piezo-electric means reaching a predetermined limit;
electrode means connected in circuit with said capacitor means and defining a spark gap for discharge of said capacitor means thereacross;
and means for feeding a combustible fluid to the vicinity of said spark gap so that said fluid is ignited upon discharge of said capacitor means across said spark gap.

4. In an arrangement for igniting combustible fluids,
a piezo-electric element having a predetermined capacitance and being adapted to generate a piezo-electric current in response to mechanical compression;
a capacitor having a capacitance greater than said predetermined capacitance and being connected in parallel with said piezo-electric element to be charged upon generation of said current, and to discharge upon reaching a predetermined condition of charge;
a pair of electrodes connected in circuit with said capacitor and defining a spark gap between themselves for discharge of said capacitor thereacross;
and means for feeding a combustible fluid to the vicinity of said spark gap so that said fluid is ignited upon discharge of said capacitor across said spark gap.

5. In an ignition arrangement, particularly for butane, propane and similar hard-to-ignite gases,
a piezo-electric element having a predetermined capacitance and being adapted to generate a piezo-electric current in response to mechanical deformation;
a capacitor having a capacitance greater than said predetermined capacitance and being connected in parallel with said element for charging thereby upon generation of current in response to said mechanical deformation, and for discharging upon reaching a predetermined condition of charge;
a pair of electrodes connected in circuit with said capacitor and defining a spark gap between themselves for discharge of said capacitor thereacross;
and means for feeding a combustible fluid to the vicinity of said spark gap for ignition upon discharge of said capacitor thereacross.

6. A method of igniting a combustible fluid, including the steps of
mechanically changing the existing stress-condition of a piezo-electric means so as to generate piezo-electric charge in the latter;
storing said charge in a capacitor means connected in parallel with said piezo-electric means;
and providing a spark gap for discharge of said charge

thereacross so that, in response to said capacitor means reaching a predetermined condition of charge, said charge will discharge across said spark gap and ignite a combustible fluid present in the vicinity of said spark gap.

7. A method of igniting a combustible fluid, including the steps of

mechanically changing the existing stress-condition of a piezo-electric means so as to generate piezo-electric current in the latter;

storing said current in a capacitor means connected in parallel with said piezo-electric means;

providing a spark gap for discharge of said capacitor means thereacross;

and feeding a combustible fluid to the vicinity of said spark gap so that, when said capacitor means discharges across said spark gap in response to reaching a predetermined condition of charge, the resulting spark will ignite said combustible fluid.

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