

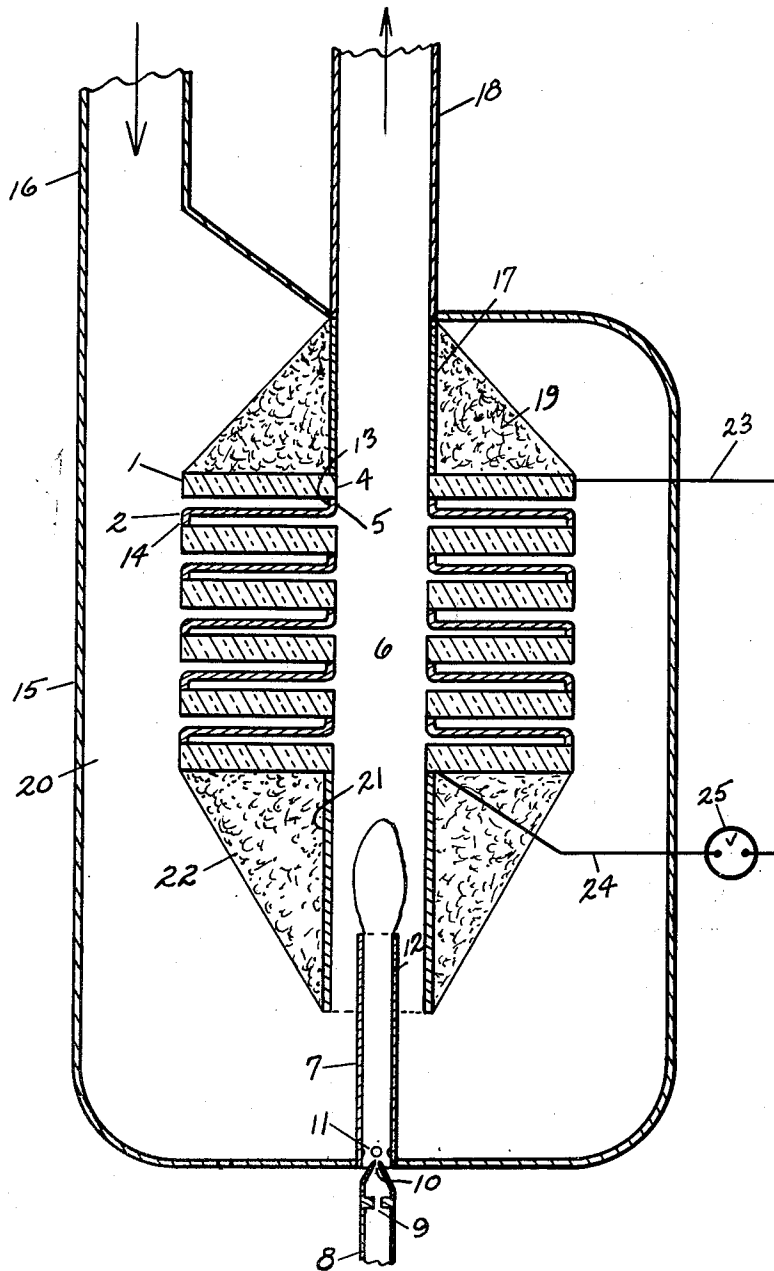
April 13, 1954

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2,675,417

PYROELECTRIC DEVICE

Filed Aug. 14, 1952



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UNITED STATES PATENT OFFICE

2,675,417

PYROELECTRIC DEVICE

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Application August 14, 1952, Serial No. 304,260

4 Claims. (Cl. 136—4)

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This invention is a pyroelectric device which in a preferred form comprises a stack of annular discs of pyroelectric material with the hot junctions at the center or bore of the stack and the cold junctions at the outside or periphery. This construction is particularly adapted to direct firing with fluid fuel where the combustion air can be utilized to cool the cold junctions and the bore of the stack serves as a flue for the hot gases which heat the hot junctions. The series connection between the hot and cold junctions of adjacent pyroelectric discs can be made by interleaved annular metal discs having contact making flanges at the inner and outer parts thereof respectively offset in opposite directions.

In the drawing, the single figure is a sectional elevation of a direct fired pyroelectric device.

In the drawing, 1 and 2 indicate alternate pyroelectric and conducting annular discs or plates arranged in a stack to provide a pyroelectric device. The discs 1 and 2 are of substantially the same outside diameter and are stacked with central openings 4 and 5 in register so as to provide a flue 6 for the products of combustion from a Bunsen burner 7 arranged at the bottom of the flue. The Bunsen burner is diagrammatically illustrated as comprising a gas inlet line 8 discharging through a flow restricting orifice 9 to a nozzle 10. The nozzle 10 is located adjacent combustion air inlet openings 11 at the lower part of a mixing tube 12. The flame appears at the upper end of the tube. Obviously, other burners may be used. With this arrangement, the inner peripheral edges of the center openings 4 in the annular pyroelectric discs 1 become the hot junctions of the discs and the laterally spaced outer peripheral edges become the cold junctions. The interleaved metal discs 2 are arranged with offset flanges 13 and 14 at the inner and outer parts thereof, which extend in opposite directions and serve to connect the hot junction of one of the discs in the stack to the cold junction of the disc next lower in the stack.

With this arrangement the combustion air for the burner 7 can be utilized to maintain the required temperature differential between the hot and cold junctions of the pyroelectric discs. This is accomplished by surrounding the stack with a duct or casing 15 having an air inlet 16 at the top. At the center of the casing is a collar 17 which connects the upper end of the flue 6 to a stack 18. Heat insulation 19 arranged around the collar prevents preheating of the incoming air by the outgoing flue gases. The incoming

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air flows down through an annular space 20 surrounding the outer periphery of the stack to the bottom of the casing where the burner 7 is located. At the lower end of the flue 6 there is a depending tube 21 which serves as a combustion chamber for the burner. The tube 21 is surrounded by heat insulation 22 which prevents cooling of the combustion chamber. By this arrangement, the combustion air coming in through the inlet 16 is used to cool the cold junctions of the pyroelectric discs 1 and the heat imparted to the combustion air increases the temperature of the burner flame and thereby maintains the desired temperature differential between the hot and cold junctions of the discs.

The voltage output can be taken off between hot and cold junctions at the top and bottom of the stack. The voltage takeoff is illustrated as a lead 23 connected to the cold junction of the uppermost disc and a lead 24 connected to the hot junction of the lowermost disc, the voltage output appearing across a voltmeter 25.

The pyroelectric discs 1 may be made of reduced titanium dioxide ceramic. Such discs are made by subjecting fired titanium dioxide ceramic (a dielectric) to a reducing atmosphere (e. g. hydrogen) at an elevated temperature for a sufficient time to reduce the titanium dioxide to a mixture of TiO_2 , Ti_2O_3 , TiO . Upon reduction the discs become semi-conductors. The reduced discs also exhibit pyroelectric effects of substantial magnitude. For example, a voltage of $\frac{1}{4}$ of a volt can readily be obtained for a temperature differential between the hot and cold junctions of from 300 to 400 degrees centigrade. The 300 to 400 degrees centigrade temperature differential is well within the operating range of the reduced titanium dioxide discs.

Reduced titanium dioxide ceramic discs have been heretofore made for use as resistors and their manufacture is well understood. The reduced titanium dioxide ceramic is characterized by a dark blue to black color as distinguished from the white of the unreduced titanium dioxide ceramic. As is usual in the ceramic art, fluxes and binders are used to make the green ceramic easier to work and to improve the density and other physical properties of the ceramic. These fluxes and binders like other inert ingredients or impurities do not change the nature of the pyroelectric action of the reduced titanium dioxide ceramic discs.

What I claim as new is:

1. A pyroelectric device comprising a stack of annular discs of reduced titanium dioxide ce-

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ramic, the central openings in the discs providing a flue, a fluid fuel burner discharging its products of combustion into one end of the flue to provide hot junctions at the inner peripheries of the discs, a combustion air intake casing for the burner surrounding the discs and drawing air over the outer peripheries of the discs to provide cold junctions, and an electrical take-off including electrical connectors interleaved between the discs connecting the inner peripheries of the discs in series with the outer peripheries of adjacent discs in the stack.

2. A pyroelectric device comprising a stack of annular discs of pyroelectric material, the central openings in the discs providing a flue, means for circulating a heating medium through the flue to provide hot junctions at the inner peripheries of the discs, means for circulating a coolant over the outer peripheries of the discs to provide cold junctions, and an electrical take-off including electrical connectors interleaved between the discs connecting the inner peripheries of the discs in series with the outer peripheries of adjacent discs in the stack.

3. A pyroelectric device comprising a stack of plates of reduced titanium dioxide ceramic, a burner discharging its products of combustion over one edge of the stack to provide hot junctions at the corresponding edges of the discs, a combustion air intake duct for the burner drawing air over a laterally spaced edge of the

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stack to provide cold junctions at the corresponding laterally spaced edges of the discs, and an electrical take-off including electrical connectors interleaved between the discs connecting the hot and cold junctions of discs in series.

4. A pyroelectric device comprising a stack of plates of pyroelectric material, means for circulating a heating medium over one edge of the stack to provide hot junctions at the corresponding edges of the plates, means for circulating a coolant over a laterally spaced edge of the stack to provide cold junctions at the corresponding laterally spaced edges of the plates, and an electrical take-off including metal plates between adjacent plates in the stack each having laterally spaced flanges respectively offset in opposite directions and respectively making contact with the hot and cold junctions of the plates to connect the hot and cold junctions in series.

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