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COOLING MEANS FOR A COMBUSTION CHAMBER AND NOZZLE IN WHICH SOLID FUEL IS BURNED

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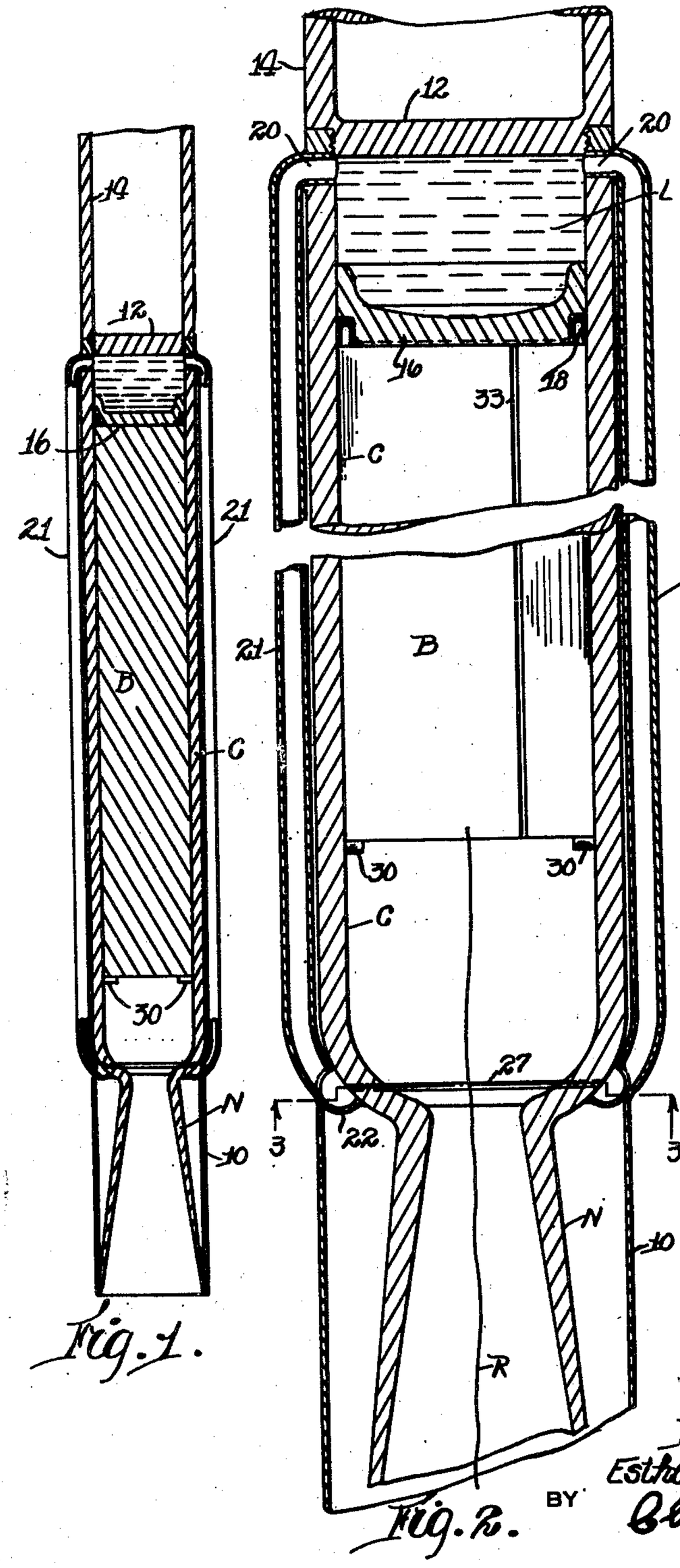

Fig. 1.

Fig. 2.

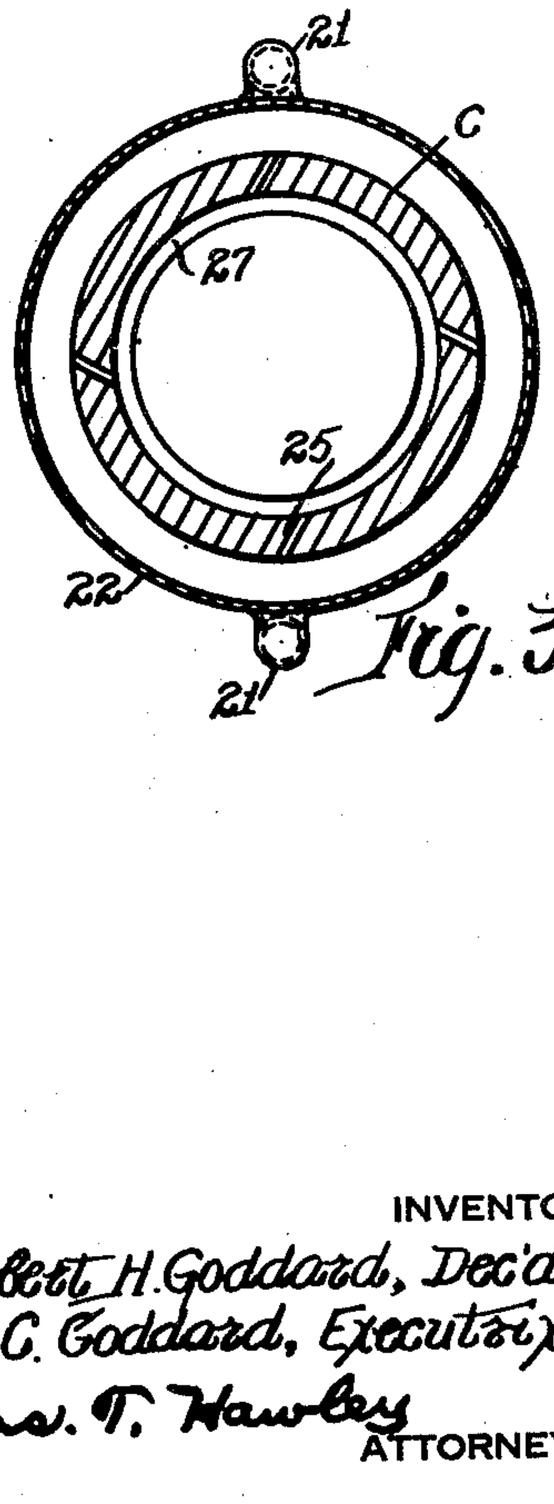

Fig. 3.

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2,544,422

COOLING MEANS FOR A COMBUSTION CHAMBER AND NOZZLE IN WHICH SOLID FUEL IS BURNED

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1 Claim. (Cl. 60—35.6)

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This invention relates to combustion chambers as used in propulsion apparatus, and relates more specifically to combustion chambers which have rearwardly-open discharge nozzles associated therewith and to which the propellant is supplied in the form of an elongated rod or bar of solid explosive material.

Such a bar of solid material commonly burns relatively slowly, and progressively from the outer end of the combustion chamber inward. The discharge nozzle and the adjacent parts of the combustion chamber are thus exposed for a considerable period to high temperature combustion gases and may easily become overheated.

To avoid such overheating, this invention contemplates the provision of improved means for cooling the discharge nozzle and the adjacent parts of the combustion chamber.

In the preferred form. sprays of water or a neutral liquid are supplied to the inner surface of the discharge nozzle and to adjacent combustion chamber surfaces, and the cooling liquid is sprayed under pressure developed in the combustion chamber itself.

The invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claim.

A preferred form of the invention is shown in the drawing, in which

Fig. 1 is a longitudinal section of a combustion chamber and nozzle embodying this invention;

Fig. 2 is an enlarged partial longitudinal sectional view of the device shown in Fig. 1; and

Fig. 3 is a transverse sectional view, taken along the line 3—3 in Fig. 2.

Referring to the drawing, a combustion chamber C is shown as provided with a discharge nozzle N enclosed in a streamlined casing 10

The chamber C has a separable inner end portion 12 firmly seated therein but threaded to permit removal for reloading. A tubular support 14 may be associated with the end portion 12 if so desired.

A bar B of solid explosive material is slidably mounted in the chamber C and at its upper end engages a piston 16 which is also slidable in the chamber C and which preferably has an annular copper packing ring 18 of U-shaped cross section.

Holes 20 in opposite side walls of the chamber C communicate through tubes 21 with an annular member 22 which has an open inner side and which is permanently secured to the lower or outer end portion of the combustion chamber C

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in any convenient manner, as by brazing or welding.

A plurality of tangential spray openings 25 are formed in the lower end of the combustion chamber C and connect the interior of the annular member 22 with an annular open groove 27, formed in the inner face of the combustion chamber wall and adjacent the entrance to the nozzle N. Use of the annular groove 27 is optional and the groove may be omitted.

In the operation of this device, the combustion chamber C is separated from the cap 12 and the bar B of explosive material is inserted through the open end of the chamber and may be located in the chamber by stop pins 30 (Fig. 2). The piston 16 is then inserted, after which the space above the piston is filled with water or any neutral liquid L. The cap 12 is reinserted and firmly seated.

When the bar B of propellant is then ignited, as by a hot wire R, the expanding combustion gases will exert pressure through the bar B and piston 16 against the water L in the inner part of the combustion chamber, and this water will be forced through the tubes 21 to the annular member 22, and then through the spray openings 25 and annular groove 27 to the inner surface of the nozzle N and to the adjacent inner end surface of the chamber C.

As the sprays of liquid enter the combustion chamber tangentially, a protecting film will be formed on the surfaces particularly exposed to the high-temperature combustion gases.

As combustion continues and the cooling liquid is gradually forced into the chamber C through the relatively small spray openings 25, the bar B and piston 16 will be moved gradually upward or inward to maintain pressure on the cooling liquid L. If the parts are correctly proportioned, the time in which the bar B is completely consumed will approximate the time in which the mass of the liquid L in the inner end of the combustion chamber will be forced through the spray opening 25.

The bar B may have a shallow longitudinal groove 33 which will permit a small portion of the combustion gases to enter the annular recess in the packing ring 18 and to expand the packing ring against the wall of the combustion chamber, thus preventing gas leakage.

Having thus described the invention and the advantages thereof, it will be understood that the invention is not to be limited to the details herein disclosed, otherwise than as set forth in the claim, but what is claimed is:

In propulsion apparatus, a cylindrical combustion chamber having a discharge nozzle and containing an elongated solid powder charge which is slidable inward in said chamber and which is of substantially less length than said chamber, a piston slidable in said chamber and engaged by the inner end of said powder charge, said chamber having a closed end member coacting with said piston to enclose a liquid-storage space, an annular casing member mounted on and external to said combustion chamber and positioned adjacent the open outer end thereof, tubular connections from said liquid-storage space to said annular casing member, and spray passages from said annular casing member to the interior of said combustion chamber.

ESTHER C. GODDARD,
Executrix of the Last Will and Testament of Robert H. Goddard, Deceased.

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