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THRUST CHAMBER CATALYST STRUCTURE

Filed Sept. 21, 1959

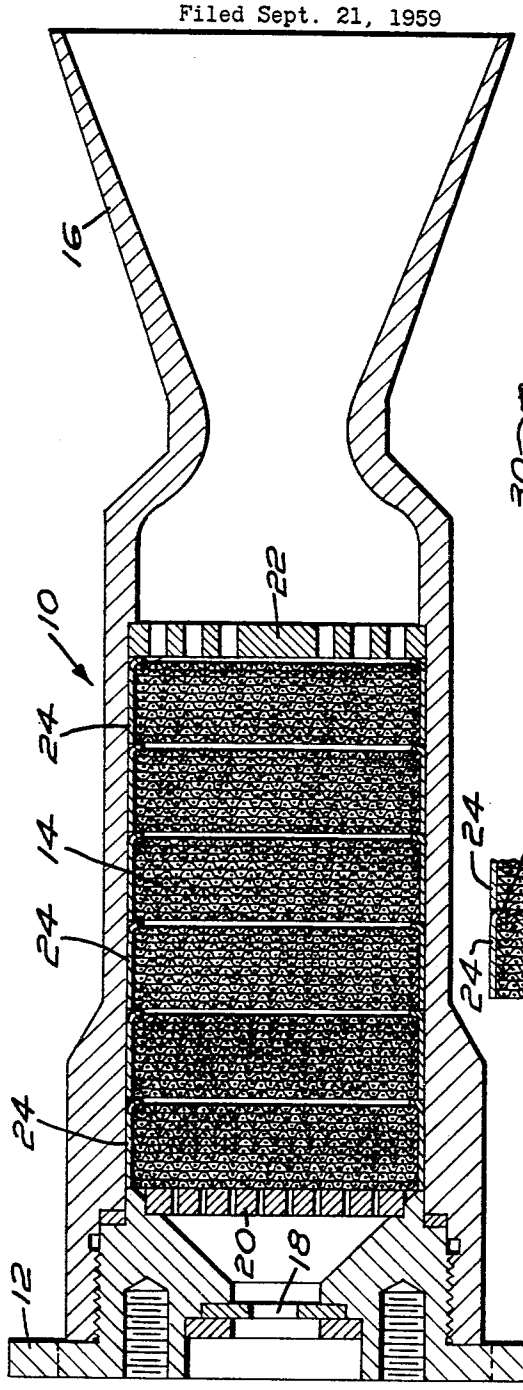


FIG. 1

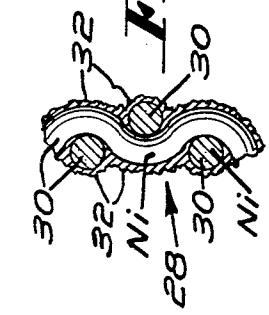


FIG. 3

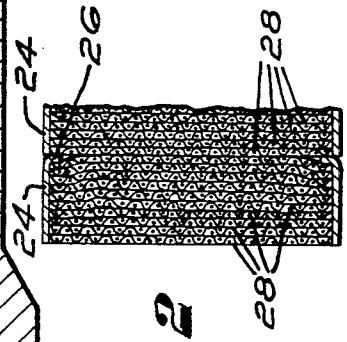


FIG. 2

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THRUST CHAMBER CATALYST STRUCTURE

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This invention relates to improvements in monopropellent thrust chambers, and more particularly to an improved catalyst bed device in a thrust chamber using 90% hydrogen peroxide as the propellent, for employment for example to provide attitude control effects in high altitude or space vehicles.

For some time it has been recognized that relatively small 90% hydrogen-peroxide thrust chambers may be effectively employed for space vehicle attitude control purposes, during high altitude or space flight where conventional aerodynamic surfaces can no longer provide effective attitude control forces. The efficiency and relative simplicity of the 90% hydrogen peroxide thrust chamber for this purpose clearly indicates its desirability; and they have already been used with marked success for this purpose.

Among other critical features of the hydrogen-peroxide type rocket, the catalyst component is of particular importance; and various catalyst configurations have been previously used with a view to obtaining acceptable operation. For example, porous porcelain stones impregnated with calcium, potassium, or sodium permanganate have been used. Also silver metal strips in various shapes and configurations have been employed; the silver sometimes being treated with samarium nitrate to increase its catalytic activity. Platinum has also been used as the catalyst metal; each catalyst metal and/or configuration having been previously designed to obtain maximum specific impulse and efficiency of the propellent use.

However, it is a primary object of the present invention to provide still further improvements in the art of catalyst bed constructions for use specifically in 90% hydrogen peroxide rocket chambers, gas generators, and the like.

A more specific object is to provide an improved catalyst bed as aforesaid which comprises a porous bed of catalyst metal parts having surface characteristics resulting in improved gas-evolution.

Another object is to provide an improved catalyst bed as aforesaid providing greatly improved "response time," due to an improved surface area-to-volume ratio.

Still another object is to provide an improved catalyst bed as aforesaid wherein the catalyst surfaces are provided by platings upon basic metal parts of such nature as to provide improved rigidity of the bed, and improved resistance to fusing and attrition such as normally occurs in connection with previously proposed silver or silver-gold alloy parts.

Still another object is to provide an improved catalyst configuration for the purposes aforesaid which is structurally simple and relatively inexpensive to fabricate by use of standard shop processes.

Other objects and advantages of the invention will appear in the specification hereinafter.

Generally stated, the invention contemplates deposition of a silver-gold alloy on nickel wire screen; the plated screen being then fabricated in the form of a stack of discs or cylindrical coils or other suitable compactions of the plated screen material, preferably in the form of individual cups stacked in multiples thereof in the thrust chamber casing.

For example, as illustrated herein FIG. 1 is a longitudinal sectional view through a thrust chamber equipped with one form of a catalyst bed construction of the present invention;

FIG. 2 is a sectional view through a detail of the catalyst bed component thereof; and

FIG. 3 is an enlarged scale schematic sectional view illustrating the form of the catalyst metal construction.

As shown in FIG.1, the invention is employed in conjunction with a rocket engine comprising generally a thrust chamber **10**, which is of conventional form and includes a mounting flange portion **12**; a catalyst bed chamber **14**; and a thrust nozzle portion **16**; it being understood that the present invention may be employed in conjunction with a thrust chamber of any other suitable design in lieu of the thrust chamber configuration shown in FIG. 1. However, as shown herein the hydrogen peroxide inlet port is indicated at **18**, and a dispersion plate is provided as indicated at **20** to distribute the hydrogen peroxide uniformly throughout the cross section of the catalyst chamber **14**. At the opposite end of the catalyst chamber a perforate "holding" or blast dispersion plate **22** is provided to retain the catalyst bed in operative position while permitting the evolving gases to exit to the thrust nozzle **16**.

As shown in FIG. 1, the thrust chamber **14** is arranged to be occupied by a stack of catalyst beds, each of which comprises a stainless steel cup designated **24** having an open bottom as indicated at **26** (FIG. 2) and supporting therein a series of wire mesh discs **28**. As shown in FIG. 3 each disc **28** comprises a wire mesh fabrication of transversely woven nickel wire strands **30—30**. It is a particular feature of the present invention that each wire mesh disc fabrication as shown herein comprises a basis metal fabrication of nickel wire strands **30** which are subsequently plated with silver-gold alloy layers as indicated at **32** (FIG. 3). It has been determined that a nickel wire screen member, as a basis for the silver-gold alloy platings thereon, provides improved rigidity and heat resistant characteristics for the overall structure, whereby the catalyst bed will be of improved overall resistance to fusing and/or attrition. At the same time, the silver-gold alloy platings thereon provide optimum catalytic action, whereby maximum gas evolution and greatly improved "response time" is provided by means of a catalyst bed structure in accord with the present invention.

It is another feature of the present invention that the silver-gold alloy plating on the basis nickel wire screen components is provided in such manner that the silver-gold alloy platings thereon are of nodular or other rugose surface form, as shown for example in FIG. 3. By virtue of this arrangement the catalyst component of the fabrication is of increased overall surface area-to-volume form; whereby an improved catalyst performance is obtained.

Thus, the efficiency of the catalytic bed according to this invention is achieved in two-fold fashion. First, by the provision of a specific alloy and secondly, by the provision of specific surface characteristics of the catalytic material.

Any suitable means may be employed of course for plating the basis metal components of the catalyst bed with the silver-gold alloy surface coatings to obtain the fabrication illustrated and described hereinabove. For example, the platings may be performed by a vapor deposition method or by an electroplating method, as may be preferred. The electro-deposition plating method may be employed for example in accordance with the following procedure. Nickel wire mesh screen stock, as obtained from any suitable commercial supplier thereof, is initially degreased by any suitable solvent such as tetrachlorethylene, and then further cleaned in an alkali bath, such as Oakite #24. The stock material is then water-

rinsed and then activated in an acid nickel-chloride solution containing 32 ozs. nickel chloride per gallon and 11 fluid ozs. hydrochloric acid per gallon. This solution is brought to a temperature 70° F., and a current density of 30 a.s.f. is applied; the electrodes being of nickel metal. The tank is preferably rubber lined. The workpieces are connected to the anode terminal, for approximately 2 minutes, and then the current is reversed to make the workpieces cathodic for approximately 6 minutes; or in the alternative the workpieces may be soaked in the solution for about 15 minutes without reversing the current flow. The workpieces are then again water-rinsed thoroughly.

The workpieces are then placed in a silver-gold alloy plating tank wherein a plating solution comprising potassium silver cyanide (double salt) 3 oz. per gallon; potassium gold cyanide (double salt) 0.024 oz. per gallon; potassium cyanide, 4 oz. per gallon; dipotassium sulphate, 4 oz. per gallon; and potassium carbonate, 2 oz. per gallon. This solution is worked at a temperature between 70°–80° F., and under a voltage between 2–4 volts with a current density between 3–15 amperes per square foot. The tank is preferably plastic or rubber lined and the anodes are of stainless steel. First, with the current on, the workpieces are immersed in the bath and initially from 4–6 amperes square foot are applied for approximately 1½ hours. This provides a deposit layer of approximately .0015 inch thick. The workpieces are then cold water rinsed, and then hot water rinsed, and are then dried by blowing clean air or oven dried air thereover for approximately ½ hour at 212° F.–220° F.

By virtue of the above described process, the deposit of silver-gold alloy on the nickel basis metal will be found to comprise approximately 1.00% to 1.25% gold, and the remainder silver. This specific alloy, on a nickel basis metal structure, will provide optimum catalyst performance for the purposes hereinabove described. Furthermore, the platings will be found to be of substantially rugose surface form, as shown for example in FIG. 3, whereby an improved catalyst surface-area versus overall volume ratio will be provided.

It will of course be appreciated that in lieu of the specific stacked wire mesh disc form of catalyst bed as shown herein, any other suitable physical configuration of silver-gold plated nickel basis metal may be employed so long as the latter is of sufficient porosity to pass the requisite flow of hydrogen peroxide gas to the thrust nozzle portion of the device. Also, it is to be understood

that the present invention is equally applicable to any other catalyst bed requirement in connection with the decomposition of hydrogen peroxide. For example, the catalyst bed of the invention may be employed in conjunction with any form of gas generator, as well as in a thrust chamber specifically, or wherever a catalyst is required to effect decomposition of hydrogen peroxide. Likewise, it will be understood that the outstanding feature of the present invention resides in the use of a basic metal selected to be of superior heat resistance and rigidity characteristics, such as are furnished by metals of the class of nickel, stainless steel alloys and the like; and that although only one form of the invention has been illustrated and described in detail hereinabove, it will be understood that various changes may be made therein without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. In a thrust chamber of the type using 90% hydrogen-peroxide monopropellent, a catalyst bed comprising a porous nickel metal mass the open surfaces of which are plated with a silver-gold alloy comprising approximately 99% silver and 1% gold, the plating being deposited thereon in rugose surface form.

2. An assembly for decomposition of hydrogen peroxide, said assembly comprising a reaction chamber having an inlet for said hydrogen peroxide and an outlet for the products of decomposition, and a catalytic bed within said chamber comprising a porous mass located between said inlet and said outlet and through which said hydrogen peroxide must pass, said mass comprising a metallic base having the surface area thereof plated with an alloy consisting of gold and silver in which the silver is present in the amount of about 99%.

3. The assembly according to claim 2 in which said mass is rendered porous by electrodepositing said alloy on said base, said base being nickel wire mesh.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 24,582	Rinker	Dec. 23, 1958
2,040,782	Van Peski	May 12, 1936
2,791,883	Moore et al.	May 14, 1957
2,865,721	Lane et al.	Dec. 23, 1958
2,972,227	Allen	Feb. 21, 1961
3,019,197	Saunders	Jan. 30, 1962
3,056,663	Maglio et al.	Oct. 2, 1962