July 13, 1965 P. CANNON 3,194,628

GENERATOR OF CLEANSING MEDIUM FOR WASHING MACHINE

Filed June 27, 1961

Fig. 1.

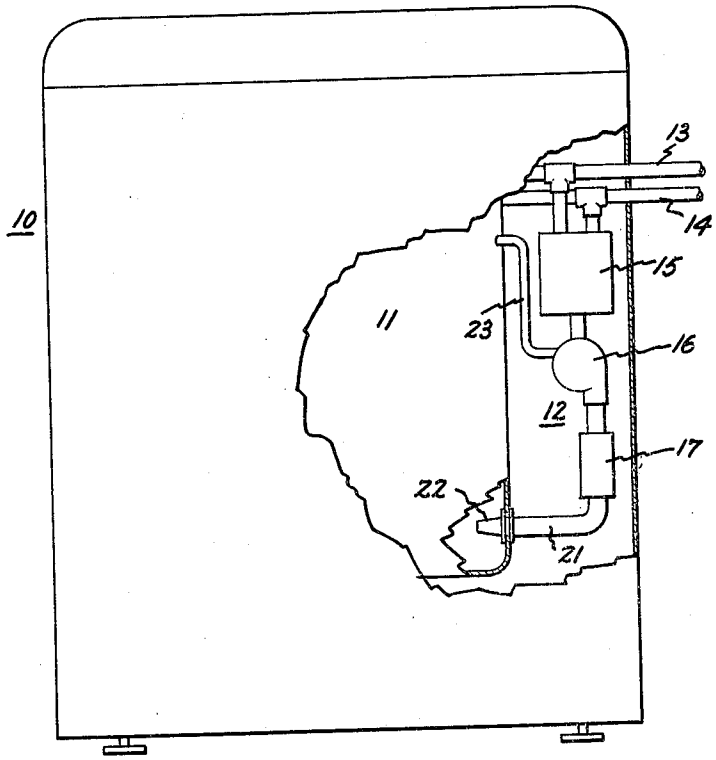
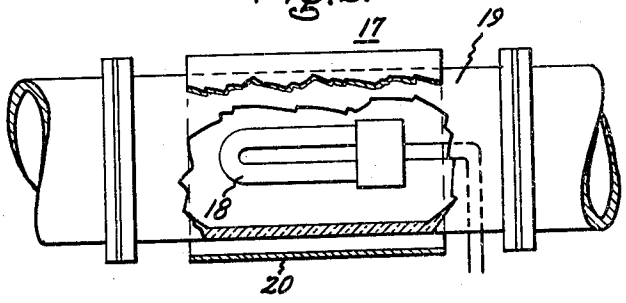


Fig. 2.



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United States Patent Office 3,194,628 Patented July 13, 1965

3,194,628
GENERATOR OF CLEANSING MEDIUM FOR WASHING MACHINE

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Filed June 27, 1961, Ser. No. 119,961
8 Claims. (Cl. 8—137)

This invention relates to washing means generally and more particularly to article washing devices employing water and/or other liquids. More specifically, this invention relates to cloth articles or clothes washing machines or facilities both commercial and domestic and to a H_2O_2 and O_3 generator in conjunction therewith.

One difficulty in clothes washing machines, especially of the domestic type, relates to the necessity of employing soap and/or detergents or other cleansing mediums which are not only uneconomical in the first instance, but which also depend to a considerable degree on the water condition, type of cloth, and washing cycle. Further disadvantages relate to the necessity not only of hot water, but also of proper soap or detergent dispensing means and methods, whether automatic, by certain dispensers attached to the machine, or by hand. In either instance, continual choice, replenishment, purchase, and storage are necessary. In conjunction with these more notable disadvantages, after ordinary washing conditions, clothes are not as white or clean as desirable because of the nature of the cleansing composition used. Substantial amounts of the double decomposition products of the components of the detergent and wash water, are produced and adsorbed by the cloth fiber (e.g. calcium phosphate on cotton). A further difficulty in the use of soap or a detergent relates to the presence of body liquids on certain areas of clothes such as cuffs and collars. These fatty materials are slightly colored, thus lend an undesirable appearance to the clothes and are difficult to remove. These factors further necessitate the addition of various bleaches, for example, chlorine, to the wash water, or exposure to sunlight or ultraviolet light in drying of the clothes. The same problems prevail with respect to choice, purchase, storage and replenishment, etc.

It has been known that certain bleaching compositions, such as H_2O_2, hydrogen peroxide, provide excellent bleaching results, and H_2O_2 has found widespread use as such in the textile industry, not only for bleaching purposes, but also to remove such substances as starches, fats, waxes, husks, and other residues in cloth weaving or manufacture. In a wash cycle as well as in bleaching processes, H_2O_2 acts as both an oxidizer and a reducer. Fats, oils, waxes, soaps and vegetable juices may also be decolorized by the oxidizing action of hydrogen peroxide, although more commonly, colored matters are removed by adsorption, as by pulverized diatomaceous earth or activated carbon. In the same operation wash cycle, the use of H_2O_2 is preferred over chlorine since chlorine is injurious to such fibers as the common staple cotton and to many vat dyes and other yarn dyes. Chlorine also causes yellowing of cotton fibers which not only may be removed by H_2O_2, but also does not occur in using H_2O_2. A more complete disclosure of the uses, properties, and manufacture of H_2O_2 in general is provided in "Hydrogen Peroxide," Schumb, Satterfield and Wentworth, ACS Monograph Series No. 128, 1955, Reinhold Publishing Corp.

Closely related to the cleansing and bleaching properties of H_2O_2, are the similar effects derived from the use of ozone, O_3. Ozone has found widespread usage in both the sterilization and bleaching fields, and has been effectively employed as a sterilization agent for drinking water and also for sewage. The uses and preparation

of O_3 are more fully described in "Ozone Chemistry and Technology Advances in Chemistry," Series, No. 21, ACS, March 1959.

It can thus be understood that the use of H_2O_2 and O_3 is a desired combination when applied, for example, to a home or domestic-type clothes washing machine. Where employed previously, these materials have been added singly from a general container, or by compounds which decompose to provide these materials, and are added directly to the wash water in the machine. Salient disadvantages in the use of these materials are their originally uneconomical nature and their tendency towards quick decomposition upon storage over periods of time. Furthermore, because of the decomposition and loss factors, prior ozone addition for domestic washing machines have been uneconomical and results limited.

Accordingly, it is an object of this invention to provide an improved washing machine.

It is another object of this invention to provide an improved washing cycle.

It is another object of this invention to provide a novel method of adding H_2O_2 and O_3 to a washing machine cycle.

It is a further object of this invention to provide a novel method of adding O_3 to the wash water in a washing machine.

It is an additional object of this invention to provide a method of automatically adding H_2O_2 and O_3 to the wash water of a washing machine.

It is still another object of this invention to provide, in combination with a washing machine, a method and apparatus for producing hydrogen peroxide, oxygen, and ozone for their admission to the wash cycle of a washing machine.

It is a still further object of this invention to provide novel means, in cooperation with a clothes washing machine, to generate H_2O_2.

Briefly described, this invention in one form contemplates the combination with a washing machine, of an improved cleansing medium generator which provides H_2O_2 from the dissociation of water entrained air by exposure to UV light and electron bombardment, with predetermined reflector, photoemitter, and construction materials.

This invention will be better understood when taken in connection with the following description and the drawings in which:

FIG. 1 is a schematic illustration of one embodiment of this invention; and

FIG. 2 is a schematic representation of a silent discharge device and photoemitter of this invention.

Referring now to FIG. 1, washing machine 10 includes a general compartment 11 which contains the usual agitator or other mechanical energy input cleaning device, and an apparatus 12 which is employed to provide additional of H_2O_2 and lesser amounts of ozone into the washing machine. In this respect reference is made to copending application S.N. 119,944 (now issued as U.S. Patent 3,130,570)—Rentzepis filed concurrently herewith and assigned to the same assignee as the present invention. In the Rentzepis patent, a washing machine and washing cycle are disclosed which utilize the addition of hydrogen peroxide and ozone. Air with water vapor added is dissociated by an electrical discharge device such as a glow discharge device to produce such excited species as hydrogen peroxide, ozone and oxygen which are thereafter introduced into a tank of cool water.

Returning to FIG. 1, conduits 13 and 14 are those generally connected to a suitable source of water supply, such as for example, the domestic water hot and cold water supply of ordinary household washing machine. Conduit 13 is the cold water inlet to the machine. Con-

duits 13 and 14 are connected to a well known proportioning device 15 to provide water of a desired temperature, although as will be hereinafter understood, a hot water supply for washing purposes is not necessary. From proportioning device 15, water is introduced into a pump 16. Pump 16 pumps a mixture of water and air and is, therefore, an aspirating type pump, or may also be of any general type of aspirating air device whereby the volume of air being admitted may be in the range of about 20 to 50 percent of water. This turbulent agitated mass of air and water is thereafter pumped or passed, through or by an electrical discharge device 17.

Referring now to FIG. 2, there is illustrated a more clear and detailed electrical discharge device or generator 17. Generator 17 may take the form of a UV lamp, arc discharge device, or electrolysis device. In a preferred embodiment of this invention, electrical discharge device 17 includes a UV lamp 18 of about 200-watt capacity which will dissociate wet air into such excited species as hydrogen peroxide, ozone and oxygen atoms. It has been discovered that hydrogen peroxide, ozone and oxygen atoms may be more satisfactorily produced by dissociation of air where the air is entrained in water at the time of dissociation so that solution in the cold water commences simultaneously with the formation of these products. By this means, these products are maintained in their original form for a longer period of time to enable them to produce better results in the washing machine cycle. One of the problems of utilizing UV lamps for the generation of O_3 and/or H_2O_2 is their rather low efficiency for a desirable low wattage input and short operative time. One preferred method of greatly increasing the efficiency of these lamps for the present purposes, and without increasing the power input, is through the use of proper shielding reflectors and photoemissive surfaces. In FIG. 2, conduit section 19 is made of a suitable transparent inert material, for example, Pyrex glass, fused quartz or other material relatively transparent to UV light. Closely adjacent conduit section is a reflector or shield 20, which may be in one or more parts and/or in various shapes. Reflector 20 is suitably formed and positioned about conduit section 19 so that light waves emanating from UV lamp 18, and through transparent section 19, may be focused and reflected back through section 19 into the water air mixture flowing therethrough. Such an arrangement increases the production of H_2O_2 by a factor or about 100 times. Not every good reflecting material is useful for this purpose. The material so chosen must have a relatively low work function so that photoemitted electrons may be employed to enhance production of the excited species. Accordingly, it is preferred to have materials such as cesium and antimony or alloys or coatings of these materials since it is possible to achieve about 1,000 times the efficiency of photoemission when these materials are employed as as compared to materials such as aluminum.

The dissociation of air into excited atoms may lead to combinations in accordance with the following reactions:

$$\text{Air} \rightarrow O_2 + H_2O$$
$$H_2O \text{ gas} \rightarrow H + OH$$
$$H + H \rightarrow H_2$$
$$O_2 \rightarrow 2O$$
$$O_2 + O \rightarrow O_3$$
$$H + O_2 + H_2 \rightarrow H_2O_2 + H$$
$$OH + OH + M \rightarrow H_2O_2 + M$$
$$O_3 + H_2O \rightarrow H_2O_2 + O_2$$

"M" is a body, i.e., a wall or other energy adsorbing means. Decomposition of both ozone and hydrogen peroxide provides a release of oxygen into the washing system as an oxidizing agent. In order to have a practical and economical operation which is programmed with usual washing cycles, it is desired to have about 30–50 p.p.m. of H_2O_2 and O_3 present in the wash water of a

washing machine while at the same time ascertaining that the amount of O_3 escaping from the water is maintained at prescribed minimal limits. The characteristics of the water and the injection method are important to the overall desired operation.

The condition of the water employed must be such that it contains minimal or no impurities which would react with the products of dissociation to form deleterious compounds, which prevent substantial dissolving of the products in the water or to decompose the products. For example, the water should be free of certain metallic ions, and the conduit materials should be of those metals which are inert with respect to H_2O_2. It is, therefore, desirable to have generator 17 and conduit 21 and following exposed materials, of aluminum or a non-metal such as glass. Metals and their ions to be avoided or minimized are, by way of example, Cu, Cr, Fe, Ag, Mn, Mb, W, Os and Pb.

Water in generator 17 should be relatively cool in order that ozone will easily dissolve therein. For example, the following table indicates solubility of ozone in water at different temperatures:

Solubility—cm.³/100 cm.³ H_2O	T., ° C.	T., ° F.
39.4	0	32
30	12	53.6
15	26	78.8
4.2	40	104
0	60	140

As the temperature of the water increases, the proportion of the amount of ozone injected into the water to the amount dissolved becomes so great that both cost and toxicity requirements are prohibitive.

Accordingly, it is desirable to limit the water temperature to below about 120° F. and preferably in the 50° F. to 75° F. range. These temperature ranges are also appropriate for generator 17 operation.

Introduction of water from conduit sections 19 and 21 into the wash cycle may be critical. For example, introduction should take place from below the surface of water in the machine to provide proper transit time, so to speak, of H_2O_2, O_3, and O_2 in the machine so that more time is provided for dissolving action. However, dissolving action is also dependent on the manner or method of introduction. A mere relatively large size pipe 21 opening into the washing chamber 11 will only introduce large bubbles of O_3 and O_2 into the water which will quickly pass therethrough with limited dissolving or cleaning action. A preferred embodiment of this invention includes a small opening spraying apparatus to inject the products into the water. Various spray nozzles are known in the art both for water and also for various fuels. A preferred injector is a nozzle 22 which in conjunction with pump 16 provides a low pressure cone-like dispersion in a manner similar to that as provided by fuel nozzles. By this means, substantially all injected products are not only dissolved but are immediately available throughout the wash water for cleansing purposes.

By employing the combination of producing H_2O_2, O_3 and O_2 by the method described, there is provided in the water a greater amount of H_2O_2, O_3, and O_2, each of which is readily dissolved in water and contributes to cleaning and bleaching action. The formation of hydrogen peroxide from dissolved O_3 is enhanced by the cool water employed. It is, therefore, understood that introduction of ozone, particularly, directly into hot wash water has been eliminated and that a practical, and far more important, economical process of introducing a sufficient amount of H_2O_2 and O_3 into the water has been provided. In conjunction therewith, a sufficient and greater amount of H_2O_2 has also been provided because of the improved formation arrangement.

It may not be desirable to introduce cool water from generator 17 into the hot wash water of the wash cycle.

directly or quickly because of more rapid dissipation or decomposition of H_2O_2 and O_3 in hot water. However, because of the teachings of this invention, the wash water need not be as hot as is required for the dissolving of soaps, detergents, etc., in present washing practice. The wash water may be on the order of less than about 120° F. with a substantial portion being supplied through generator **17**. The proportioning valve **15** may be electrically operated and connected to the well known electrical cycle timers to energize or operate device **17** as needed or desired. It is preferable that most of the needed wash water pass through this system which may also be operative during a rinse cycle. Several preferred methods may be employed to minimize dissipation.

As with ozone introduction, water from generator **17** may be sprayed into a storage tank prior to injection into the washing apparatus **11** as in the aforementioned copending application. Losses are further minimized by connecting a conduit **23** from washing apparatus **11** to pump device **16** so that air employed for aspiration is taken from the surface of water in apparatus **11**.

It is obvious that several cycles may be readily conceived to incorporate the full advantages of this invention. More particularly, the water issuing from device **17** may be added directly to the wash cycle of a washing machine or the rinse cycle of the washing machine or any other water circulating system or cycle that such a machine may have. In addition, the water may be injected into a tank as mentioned in the copending application and stored or otherwise made available for introduction into the washing machine at particular instances during the wash cycle thereof. It is obvious that the entire cleansing medium generator may be disconnected from the washing machine to be employed separately albeit in connection with the washing machine but actually at a different location.

By this means, it is understood that bleaching and cleaning species may be produced directly in combination with a washing machine, and may be controlled automatically, dependent upon the cycles of the washing machine and cleansing action to be desired. Ozone and hydrogen peroxide have essentially good cleansing properties and amounts thereof as produced will be controlled in the same manner as the cycle of the washing machine. With the use of a 200-watt UV lamp and an air water flow of about 150 cc./sec., a maximum of H_2O_2 is provided. O_3 is produced in a quantity sufficient to provide good cleaning action in combination with H_2O_2 good oxidizing action, and ample sterilizing effect, all of which without any toxicity effects from leakage from the wash water.

While a specific method and apparatus in accordance with this invention has been shown and described, it is not desired that the invention be limited to the particular description nor the particular configurations illustrated and it is intended by the appended claims to cover all modifications within the spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination with a washing machine having a container to contain water, an electrical discharge device for generating H_2O_2 and O_3 including an ultraviolet lamp, means for entraining a substantial volume of air in water and passing the resulting water air mixture through said device for H_2O_2 and O_3 generation, a photoemissive surface and shielding reflector combination located adjacent said lamp and adapted to reflect light rays and electrons from said lamp into the water-air mixture, and means for introducing the water containing newly generated H_2O_2 and O_3 into said washing machine container.

2. The generating device as recited in claim **1** wherein the photoemissive surface and shielding reflector combination is composed of a material inert with respect to hydrogen peroxide.

3. The generating device as recited in claim **1** wherein the photoemissive surface and shielding reflector combination is composed of a material taken from the class consisting of cesium and antimony and alloys thereof.

4. The invention as recited in claim **1** wherein said introduction means includes a nozzle to provide a fine spray formation from below the surface of said water in said container into the said water.

5. A method of generating a cleansing medium for a washing machine which comprises in combination, passing water containing air ranging in concentration from between about 20 to about 50 percent of the volume of water through an electrical discharge device having an ultraviolet lamp therein for the production of H_2O_2 and O_3, utilizing a photoemissive reflector with said lamp to increase production of H_2O_2 and O_3, passing water containing newly generated H_2O_2 and O_3 into a washing machine having clothes therein for the desired period of time, removing air from above the water level in said machine, and entraining the air so removed in the water to be passed through said electrical discharge device.

6. The method of generating a cleansing medium for a washing machine substantially as recited in claim **5** wherein the temperature of the water flowing through the electrical discharge device is maintained below about 120° F.

7. An improved washing apparatus comprising in combination, a washing machine having conduits for connection to a domestic hot and cold water to provide a water supply therein, a proportioning device connected to said conduits to proportion the volume of water from said conduits to provide water at a desired temperature, an aspirator pumping device in flow communication with said proportioning device to entrain air in water received therefrom, an ultraviolet lamp discharge device in flow communication with said pump to generate hydrogen peroxide and ozone in the water-air mixture received from said pump, a photoemissive surface adjacent said lamp to increase the production of hydrogen peroxide and ozone, means to spray the water containing newly generated hydrogen peroxide and ozone into said washing machine, and means placing in communication the air space above the water in said washing machine with said aspirating device to remove air to be entrained thereby.

8. In combination with a washing machine having a container for containing water and clothes to be washed, an electrical discharge device for generating H_2O_2 and O_3 including an ultraviolet lamp, means for entraining a substantial volume of air in water and passing the resulting water-air mixture through said device for H_2O_2 and O_3 generation, a photoemissive surface and shielding reflector combination surrounding said lamp being adapted to reflect light rays and electrons from said lamp into the water-air mixture, means for introducing the water containing newly generated H_2O_2 and O_3 into said container and means placing said air entraining means in communication with the air space in said container above the water therein.

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