Feb. 9, 1937. H. J. NICHOLLS 2,070,307

METHOD AND APPARATUS FOR TREATING MATERIAL WITH OZONE AND ULTRA VIOLET RAYS

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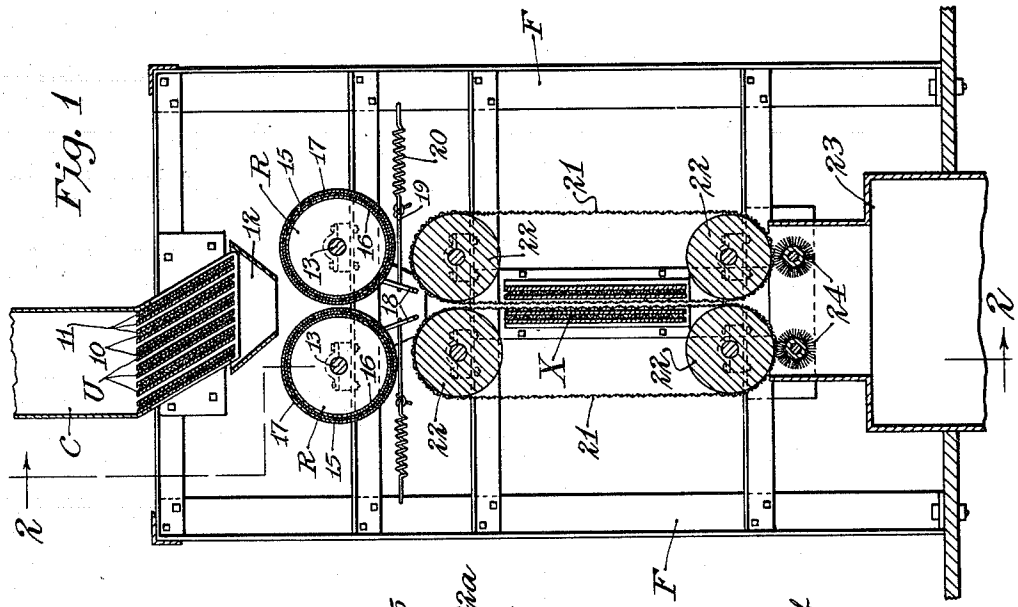
Fig. 1



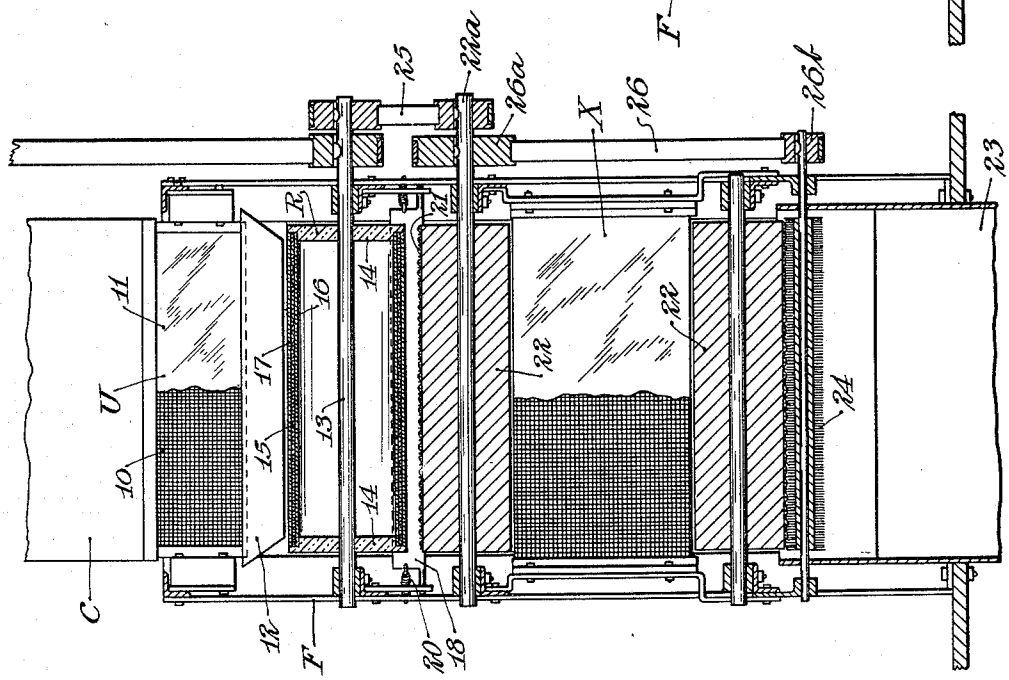


Fig. 2

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Fig. 3

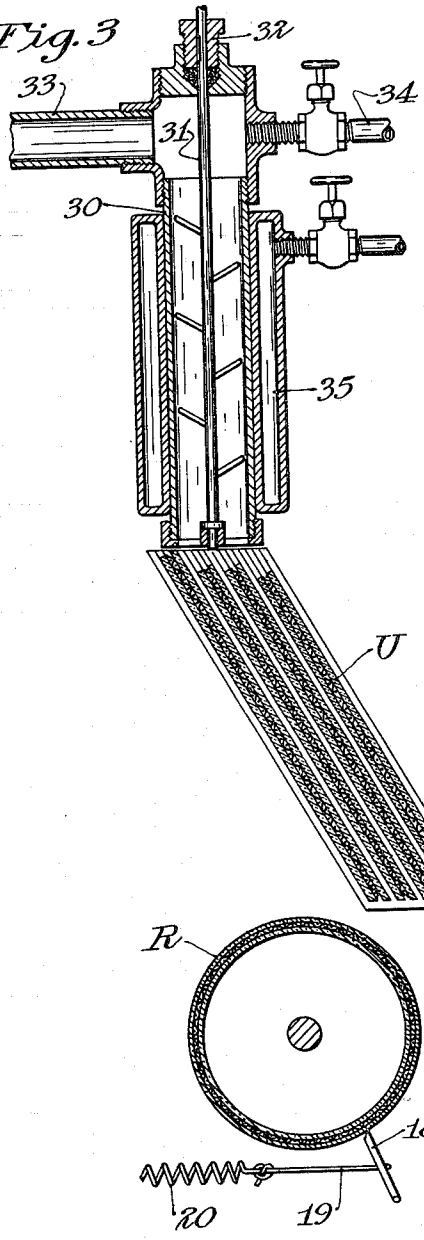


Fig. 4

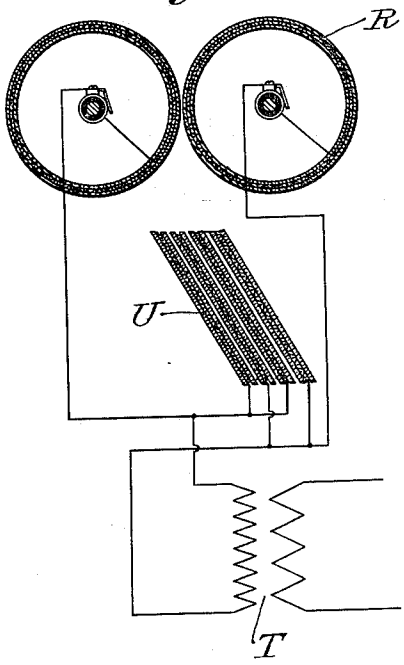
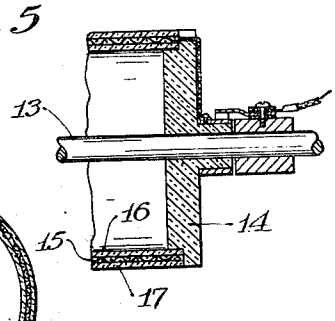


Fig. 5



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UNITED STATES PATENT OFFICE

2,070,307

METHOD AND APPARATUS FOR TREATING MATERIAL WITH OZONE AND ULTRA VIOLET RAYS

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Application December 21, 1931, Serial No. 582,279

6 Claims. (Cl. 204—31)

This invention relates to a new method and improved apparatus for treating materials, such as solids, powders and dielectric liquids with ozone and ultra violet rays.

The use and efficiency of ozone for oxidizing, preventing organic proliferation, bleaching and purifying material is well known in the art.

Medical science recognizes today that ultra violet rays are also efficient for killing bacteria, purifying, oxidizing and bleaching.

It is an object of my present invention to provide a simple and highly efficient method for simultaneously treating materials of many different classes with ozone and ultra violet rays.

More specifically it is an object to provide a method wherein material in dry, disintegrated or pulverized, or liquid state may be continuously supplied and treated to best advantage with ozone and ultra violet rays applied simultaneously throughout the several steps of the process.

Another object is to provide apparatus which will physically direct and handle material of the class described in such manner that the material will be caused to travel through the apparatus being subjected throughout the substantial length of its travel to ultra violet rays and ozone and spread out in a thin film during said travel to most efficiently apply the ozone and ultra violet rays.

These and other objects and advantages of the invention will be more fully set forth in the following description made in connection with the accompanying drawings, in which like reference characters refer to similar parts throughout the several views, and in which:—

Fig. 1 is a vertical section through an embodiment of my apparatus well adapted for treating powdered, flaked or otherwise disintegrated solid materials such as soap fats, tobacco, tooth powder, cereals and the like, although capable of being used for liquids;

Fig. 2 is a vertical section taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary diagrammatic view in vertical section illustrating an apparatus especially designed for use in treating liquids;

Fig. 4 is a diagrammatic view schematically showing the electrical circuit through the corona type condenser;

It is a known fact that ozone may be produced or generated by an electrostatic field and also by ultra violet rays. Commercially, an electrostatic field has been utilized for producing ozone. While the theory of this method is not fully understood, it is generally conceded that ionization by collision takes place with consequent disassociation of the oxygen in the air, which on recombination furnishes aggregates of ions consisting of oxygen molecules with an attached extra oxygen atom. In commercial ozone generators the production is roughly proportionate to the electrostatic intensity above a certain critical value and with alternating currents it is roughly proportionate to the frequency employed.

The essential principle in such commercial generation of ozone is the juxtaposition of two or more discharging surfaces which form a condenser with an air gap which may or may not be furnished with a dielectric element. When the electrostatic flux density in the air exceeds a certain value a pale violet light appears near the adjacent conductive surfaces. If the air between said surfaces is adequately dry and the potential and frequency are proper, the discharge of electricity will be substantially silent and there will be practically no discharge of sparks or disruptive discharge and the light generated contains a high proportion of ultra violet rays. Relatively large amounts of ozone are produced by this action. This silent discharge is called electrostatic corona and the amount of corona between conductors at a given voltage is affected by the shapes of the surfaces of the electrodes, by dielectric pressure and by humidity.

My method broadly consists in subjecting material to the effects of ozone and ultra violet rays produced by electrostatic corona. The materials, of course, are limited to those having dielectric characteristics and the materials are introduced between the electrodes or conductors or other media producing the electrostatic corona.

My method further includes passage of the material to be treated through a succession of electrostatic coronae and the physical direction of the material in such manner that it is formed into a thin stream during its subjection to the ozone and ultra violet rays.

A suitable form of apparatus for carrying out my method, particularly for operation upon disintegrated or pulverized or flaked solid material is illustrated in Figs. 1 and 2 of the drawings. As shown, this apparatus includes a suitable upright frame or support F having mounted in the top thereof a downwardly directed chute C which may communicate with a hopper or may receive from a conveyor or elevator. As shown, the lower end of chute C is inclined and an ozone generator of the electrostatic corona type is mounted therein comprising a series of parallel units U inclined in accordance with the inclina-

tion of the lower end of chute C and preferably secured in the chute from the ends thereof and having their upper and lower edges free and disconnected. Each of the units comprises a metallic electrode or grid which is preferably in the form of a rectangular plate or screen 10 clamped between a pair of dielectric rectangular plates 11 which may be in the form of sheets of quartz, glass, mica or the like. I have found that grids 10 constructed from aluminum screen or netting of fine mesh are entirely satisfactory for the purposes desired. The upper edge of each unit is preferably covered with dielectric cement or wax and the several strips of this dielectric material are preferably of V-shape or triangular cross section to more efficiently assist in guiding the material between the several units. The grids of the several units are alternately connected with the respective terminals of the output of a suitable transformer T or other source of electrical current, preferably alternating current, where the voltage and frequency is adequate.

A narrow hopper or chute 12 receives the material which passes between the units U at the lower end of chute C and delivers this material longitudinally of and between a pair of cooperating rollers R which are disposed side by side in slightly spaced relation. Rollers R are fixed to horizontal shafts 13 which are clearly shown in Fig. 2 and comprise a pair of end disks 14 constructed of dielectric material and between which a cylindrical unit, generally similar in characteristics to units U, is mounted. The cylindrical unit comprises a metallic grid 15 which may be in the form of a cylindrical screen or plate interposed between concentric dielectric cylinders 16 and 17 respectively, which cylinders may be constructed of material such as quartz, glass or mica. The grids 15 of rollers R are electrically connected to the terminals of the transformer through suitable wires and brushes, as clearly shown in Fig. 5. Hinged scrapers 18 are mounted longitudinally below rollers R, the plates of said scrapers being constructed of dielectric material as well as the rods 19 which connect said scrapers with elastic means, such as the coil springs 20 for urging the free edges of the scrapers against the rollers. It will also be seen that the elongated scrapers 18 cooperate to guide material centrally and downwardly.

A pair of cooperating vertically mounted endless aprons 21 are mounted in frame 15 directly below scrapers 18, the inner runs of said aprons extending parallel and being spaced a slight distance apart. Aprons 21 are trained about suitable rollers 22 which are driven by suitable means, preferably at the same rate of speed as rollers R. The aprons 21 may be constructed of any suitable, preferably porous, dielectric material, such as muslin or other cloth. The adjacent inner runs of the two aprons 21 extend parallel to and pass between a pair of units X similar in construction to the units U previously described but of considerably greater height in order that the material conveyed by aprons 21 may be treated during a relatively large travel through the apparatus.

A hopper or container 23 is mounted below the delivery end of cooperating aprons 21 and a pair of rotary brushes 24 are mounted in the upper portion of said hopper extending longitudinally below the adjacent lower rollers 22 respectively, said brushes engaging the lower portions of the aprons 21.

In Fig. 2 suitable means for driving the several rotary parts is illustrated. It will be noted that the shafts 13 upon which rollers R are fixed are driven from above by a belt and pulley and that the outer ends of shafts 13 and the outer ends of shafts 22a for the upper rollers are connected for driving by means of short belts 25 trained about suitable pulleys. The rotary brushes 24 are driven at relatively high speed by belts 26 which are trained about pulleys 26a affixed to shafts 22a and relatively small pulleys 26b affixed to the shafts of rotary brushes 24.

In operation the material, preferably in dry, disintegrated or pulverized state, is continuously fed to chute C in small amounts, traveling by gravity between the units U, which set up an electrostatic corona. The purple glow produces ultra violet rays and the electrostatic action effects the generation of ozone simultaneously, the material spread out in thin streams being subjected to the ozone and ultra violet rays simultaneously. The material is then dropped between the rollers R which flatten the material into the form of a thin ribbon. An electrostatic corona is produced between the substantially tangent portions of rollers R and the material is simultaneously treated with ozone and ultra violet rays as it passes between the rollers. Any material adhering to the rollers is removed by scrapers 18 and the material, substantially in the form of a thin sheet or ribbon, drops between the upper portions of the cooperating aprons 21 and is conveyed downwardly by said aprons, which move at the same speed passing between the spaced units X which are preferably of proportionally greater height than indicated in the drawings. Here the material spread out in a very thin film or sheet is subjected throughout its travel from the upper ends of units X to the lower ends thereof to ozone and ultra violet rays. The aprons deliver to hopper 23 and small amounts of the material which might adhere to the aprons are removed by the rotary brushes 24.

It will be noticed that the apparatus is so constructed that material may be fed by a conveyor or elevator to the chute C and will be guided into thin sheets or streams as it passes through the relatively short units U and will then be directed and formed into a thin sheet by the rollers R being treated with ozone and ultra violet rays as it passes between the rollers and directed between the vertical cooperating aprons 21 where it is very efficiently treated throughout its substantial travel.

The apparatus shown in Figs. 1 and 2 is especially well adapted for the treatment of soap fats, soap flakes or powders, tobacco, tooth powder, cereals, flour, hops and all powdered or granular materials which are not good conductors of electricity.

In Fig. 3 an apparatus is illustrated which is especially adapted for treating liquids and liquid mixtures. A relatively large vertical pipe or conduit 30 is provided having axially and rotatably mounted therein an agitator 31 which may extend through a packing gland 32 at the upper end of pipe 30 and a supply pipe 33 communicates radially with the upper end of pipe 30 and an ozone supply pipe 34 which is connected with a suitable source of ozone under pressure communicates also with the upper end of pipe 30 above the agitator. The ozone with small amounts of air delivered to the pipe 30 is preferably delivered by suitable means and the medial portion of pipe 30 is provided with a jacket 35 into which steam or, if desired, a refrigerant,

may be introduced in accordance with the particular requisites of the material treated. With a refrigerant introduced into jacket 35 the ozone and air passing through the pipe is de-hydrated which is of advantage in the subsequent electrostatic corona taking place between the units U. In the treatment of certain liquids, such as oils, soap fats, etc., it is desirable to melt the material and liquefy the same before passing the material through the units. In this instance steam is introduced into jacket 35.

Units U receive from the lower end of pipe 30 and the liquid passes between the units being there treated simultaneously by the ozone generated and the ultra violet rays. The treated material drops between the rollers R, which rollers are similar in construction and function to the rollers shown in Figs. 1 and 2.

The apparatus shown in Fig. 3 is especially applicable for the treatment of cod liver oil and pastes which will melt at relatively high temperatures. Butter and all liquids which are sufficiently viscous to pass between the units U and which are substantially dielectric in characteristics, may be successfully treated.

From the foregoing description it will be seen that I have provided a new and highly efficient method for treating a large number of different materials for the purpose of purifying, disinfecting, bleaching, vitaminizing and deodorizing the same.

It will further be seen that I have provided simple and efficient apparatus adapted to be constructed at relatively low cost for carrying out my said method.

It is to be understood that various changes may be made in the form, details and arrangement of parts of the apparatus and that the sequence of steps may be varied in my method, all within the scope of this invention.

While my method and apparatus are especially adapted for materials which are substantially dielectric in characteristics reasonable success has been attained with liquids such as emulsions, milk and liquid mixtures, provided the liquid is caused to dribble between the insulated units in a thin film.

What is claimed is:—

1. In apparatus of the class described, a pair of condenser units each having a unitary grid element of substantial area and a dielectric member covering said element, said units being spaced apart with said dielectric members opposed and disposed at an angle to the horizontal whereby gravity will cause material to travel therebetween and means for introducing material between said units and at the upper ends thereof.

2. The structure set forth in claim 1, and means for causing the material to travel through the passage defined by said units.

3. In apparatus of the class described, a pair of cooperating cylinders having parallel axes and mounted with their peripheral walls in closely spaced relation, each of said cylinders comprising a cylindrical grid element and a thin cylindrical covering of dielectric material, one of said cylinders being electrically connected with one terminal of a source of electricity and the other of said cylinders being electrically connected with the remaining terminal of said source of electricity, and means for driving said cylinders in opposite directions to feed material therebetween.

4. In apparatus of the class described, a pair of closely spaced condenser units each comprising a grid of substantial area and having a covering of dielectric material, the coverings of said two units being opposed to form a downwardly extending passage whereby gravity will cause material to travel downwardly through said passage between said dielectric coverings and means for continuously introducing material between said units and at the upper ends thereof.

5. In apparatus of the class described, a pair of spaced condenser grid units each having a grid of substantial area, said units being opposed to form a downwardly extending passage whereby gravity will assist in causing material to travel downwardly through said passage, means for introducing material at the upper end of said passage and means for producing a high electrical potential between said grids to produce electrostatic corona.

6. The method of treating materials, which consists in setting up an electrostatic corona action in a narrow, downwardly extending passage which is defined by a pair of grid electrodes of substantial area between which such corona action is produced, causing material with the assistance of gravity to pass downwardly through said passage and through said electrostatic corona in a continued stream whereby the particles of said material will be thoroughly permeated with ozone and the light rays produced by said corona action.

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