Dec. 29, 1936. K. JANDAT 2,065,895

APPARATUS FOR STERILIZING BY HEATED AIR

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Fig. 1

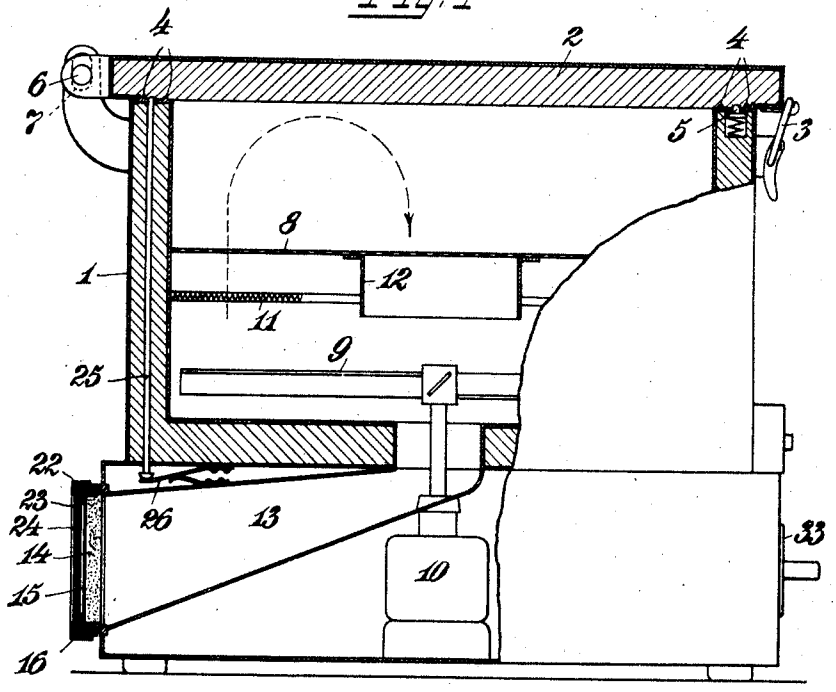
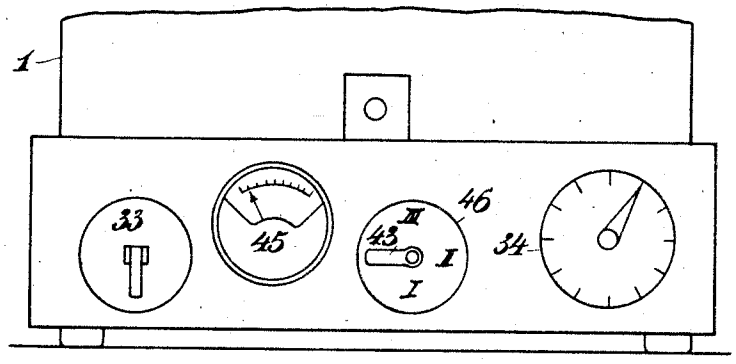


Fig. 2



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Fig. 3

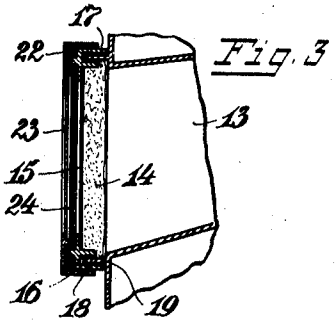


Fig. 4

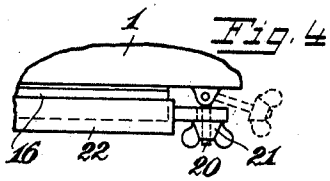


Fig. 7

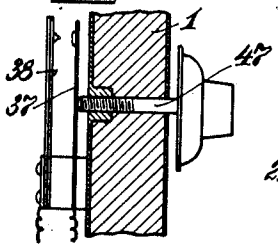


Fig. 5

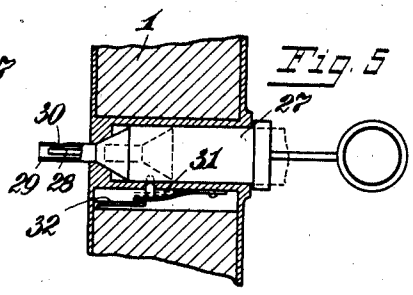
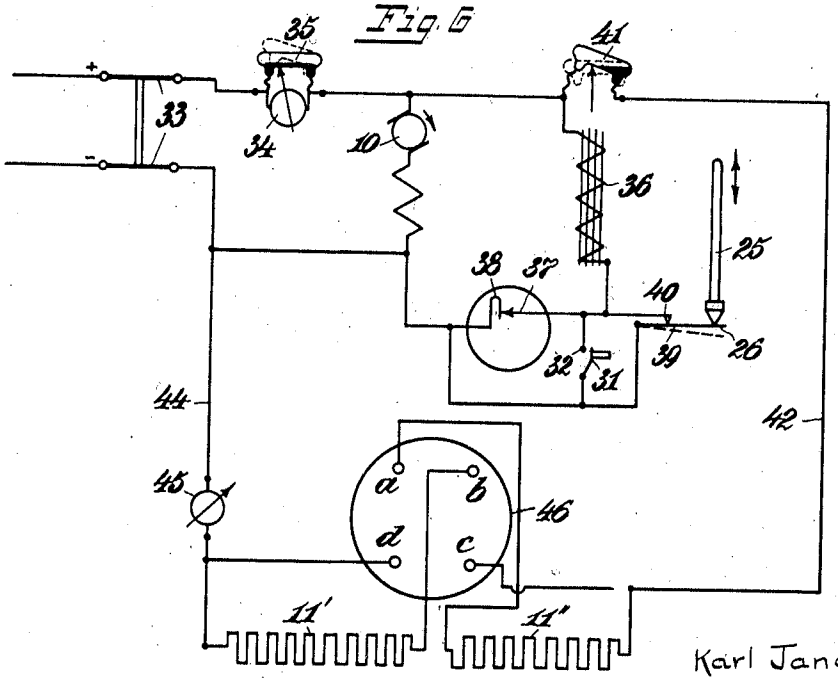


Fig. 6



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Fig. 8

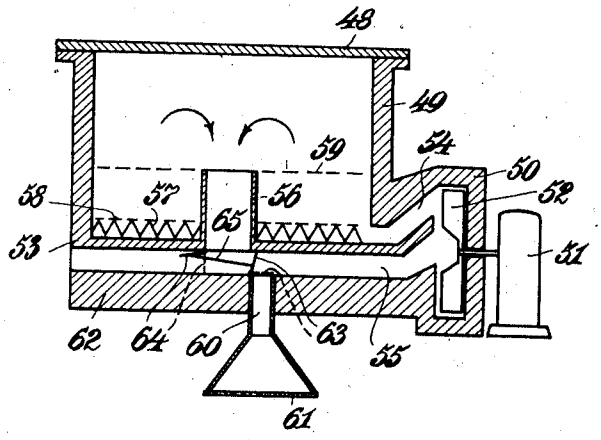
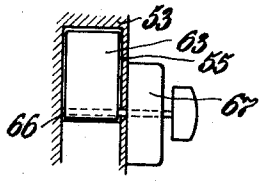


Fig. 9



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UNITED STATES PATENT OFFICE

2,065,895

APPARATUS FOR STERILIZING BY HEATED AIR

Karl Jandat, Munich, Germany

Application July 30, 1932, Serial No. 626,439½
In Germany July 11, 1928

4 Claims. (Cl. 21—18)

The invention relates to apparatus for sterilizing articles by treatment thereof with pure heated air, in some cases accompanied by treatment with a disinfectant. Apparatus of this kind is used extensively for sterilizing surgical instruments and bandages.

According to my invention a chamber enclosing a support for the article to be sterilized contains also a fan for propelling a stream of air towards the article, and electric heating resistances in the path of the said stream of air, between the fan and the support, so that air is caused to circulate by the fan when the chamber is closed, and is heated and sterilizes the article on the support. The chamber has an air inlet with an air sterilizing filter, and can be opened for the emission of air, so that when the electric heating resistances do not function a stream of cold, sterilized air can be driven through the chamber by the fan, for cooling it and the sterilized article. With the fan in operation, the heating resistances can be heavily loaded at an amperage which would destroy them if there were no artificial air current for distributing the heat. The apparatus can without difficulty be constructed for producing in the chamber, when closed, a temperature of 200° C., or more, in a very short time, and at such temperatures sterilization is very quickly accomplished. Two examples of apparatus according to the invention are shown in the accompanying drawings, in Figs. 1 to 7 and in Figs. 8 and 9 respectively.

Fig. 1 is an elevation, partly in section, and

Fig. 2 is an elevation of the base of the apparatus;

Figs. 3, 4 and 5 show details of the apparatus, Figs. 3 and 5 being sectional views.

Fig. 6 is an electric circuit diagram, and

Fig. 7 is a sectional view, showing another detail.

Fig. 8 is a vertical section of the second embodiment of the invention, and

Fig. 9 shows a detail thereof.

Referring first to the apparatus shown in Figs. 1 to 7, the chamber or casing 1 is constructed of heat-insulating material, or is lined with such material, and has a hinged lid 2 held down tightly by means of a plurality of toggle lever fastenings 3 distributed about its circumference. There are ribs 4 at the rim of the casing, which are pressed into the inside surface of the lid, or into an asbestos lining of the lid, to make an air tight joint. There are also several cavities in the rim of the casing, uniformly distributed about the circumference thereof, and each of these contains a spring loaded pin 5 tending to lift the lid. The hinge pin 6 of the lid works in a slot 7 in a bracket fixed to the casing, so that when the fastenings 3 are released the pins 5 can lift the lid uniformly from the rim of the casing, all round the same.

Inside the casing there is a horizontal sieve 8, and below this is a fan 9 driven by an electric motor 10 in a compartment at the bottom of the casing. Between the fan 9 and the sieve there are electric heating resistances 11. A short trunk 12 is fixed centrally to the under side of the sieve, above the center of the fan, and when the fan is driven, with the lid 2 closed, air circulates in the casing in the manner indicated in part by a broken line and arrows in Fig. 1, the ascent taking place past the heating resistances, outside the trunk, and the descent taking place through the trunk. This circulation of air is due to the fact that the propulsion by the fan is more powerful near the tips of the blades than at the parts near the fan spindle.

The smaller end of a funnel 13 for the admission of air is joined to the rim of a hole in the horizontal partition of the casing, and at the mouth of the funnel there is a sterilized filter 14, consisting of a layer of sterilized cotton wool and a sieve 15 held by a frame 16. The frame 16 has concentric flanges 17 and 18, which engage between them a flange 19 projecting from the rim of the funnel, so that an air tight labyrinth joint is made. The frame is held in position by fastenings 20 pivoted to the casing, with nuts 21 engaging slotted lugs on the frame. The fastenings can be swung aside, as indicated by broken lines in Fig. 4, in order to release the frame for cleaning or renewing the filter. There is fitted to the frame 16 an outer frame 22, with a sieve 23 and a porous filter 24, the latter being kept moist.

In a vertical bore in the wall of the casing 1 there is a slidable rod 25, which rests at the bottom on a spring 26. The rod depresses this spring when the lid 2 is closed and bears on the upper end of the rod, but when the lid is open the spring can lift the rod. Spring 26 constitutes the movable element of switch 39, 40 (Fig. 6) which is opened when the lid 2 is closed. If switches 31, 32 and 37, 38 are also open at this time, then relay 36 becomes deenergized and mercury switch 41 moves into the position indicated in dotted lines (Fig. 6). Current will now flow through one or both resistances 11^{1} and 11^{11}. When the lid 2 is opened the spring 26 lifts the rod 25 and closes switch 39, 40. Re-

lay 36 becomes energized and the mercury switch 41 is tipped into the position indicated in full lines. Resistances 11[1] and 11[11] will be deprived of current. The purpose of this device will be described hereinafter.

The wall of the casing has a hole for a squirt 27 (Fig. 5), which can be actuated by hand, from outside, for injecting a sterilizing liquid into the casing. The nozzle 28 of the squirt has around it a tube 29, with a hole 30 therein. Air drawn through this hole by suction due to emission of liquid from the nozzle serves to atomize the liquid.

In a cavity in the wall of the casing there are two electric contacts 31, 32 (Fig. 5), and the contact 31, which is a spring contact, has a stud fixed thereto, tending to project through a small aperture into the hole containing the squirt 27. The stud can project into this hole when the squirt is partly withdrawn, as indicated by broken lines in Fig. 5, but when the squirt is pushed in fully it depresses the stud, and the contacts 31, 32 are then closed.

Fig. 6 is a circuit diagram, and shows a main switch 33 in its closed position. Close to the main switch there is a clockwork 34 controlling a mercury switch 35. The clock can be wound up to run for a selected period, during which it holds the mercury switch in a position in which the circuit is closed. When the clock has run down the mercury switch is tilted, as indicated by broken lines in Fig. 6, and the circuit is opened. The electric motor 10 is connected across the line, and in parallel therewith is a relay 36, which can be cut into and out of circuit by any one of three switches, namely the switch 31, 32 already referred to in connection with Fig. 5, a switch 37, 38, and a switch 39, 40. The contact 39 of the last mentioned switch is on the spring 26 hereinbefore referred to in connection with the rod 25, Fig. 1. The switch 39, 40 is shown in solid lines in its closed position. A broken line indicates the open position. The switch 31, 32 is shown open, and switch 37, 38 is shown closed. The switch 37, 38 is shown separately in Fig. 7. It is a thermal switch, the contact 38 being a bimetallic contact, which bends when heated, so that the switch is closed. A screw 47, turned by a knob outside the casing, enables the distance between the contacts to be regulated.

The armature of the relay 36 controls a mercury switch 41, from which a wire 42 leads to the electric heating resistances 11[1], 11[11]. When the relay is deenergized the switch 41 occupies the position indicated by broken lines, and the circuit is closed. A controller 46 is provided enabling the resistance 11[1] to be put into circuit separately, or the two resistances to be put in in series or in parallel. For using the resistance 11[1] alone, connection is made between two contacts *b*, *c*. For connecting the resistances 11[1] and 11[11] in series connection is made between contacts *a* and *b*. By connecting contacts *a*—*d* and *b*—*c* the two resistances are connected in parallel. The connections are made by rotating a contact lever 43 to the positions I, II and III respectively (Fig. 2). In Fig. 2 the lever is shown in heat-off position.

There is an ammeter 45 in the line 44 leading from the resistances to the main switch 33.

The articles to be sterilized are placed on the sieve 8, and the lid 2 is closed, so that pressure on the rod 25 holds the switch 39, 40 open. The main switch 33 is closed and the clock 34 is wound up to run for a predetermined period. By this means the motor 10 is started, and the fan 9 is driven. The relay 36 is at this time deenergized, inasmuch as the switch 39, 40 is open due to the closing of the lid 2, the switch 31, 32 is open because no thrust has been exerted on the squirt, to push it over the stud of contact 31 and inject liquid into the casing, and the switch 37, 38 is open because the interior of the casing, in which it is located, has not yet been heated. Consequently the heating resistances 11[1] ,11[11], or the resistance 11[1] alone, can be put into operation by means of the controller 46.

The air in the chamber is highly heated by the heating resistances and set in circulating motion by the fan, sterilizing the articles on the sieve 8. If the temperature in the chamber tends to become too high for safety the thermal switch 37, 38 is automatically closed, and the relay 36 temporarily cuts out the heating resistances. When the sterilization is complete the fastenings 3 are released and the spring loaded pins 5 lift the lid 2. The switch 39, 40 is then closed, energizing relay 36 cutting out the heating resistances, and the fan propels through the chamber a stream of cold air, sterilized on entry, whereby the chamber is cooled.

In some cases it may be desired to treat the article with a liquid disinfectant, in addition to sterilizing by heat, and for this purpose the squirt 27 is used. In such cases a moderate sterilizing temperature, say about 100° C., is generally desirable, the articles treated consisting of rubber, cat-gut or other material liable to injury by heat, and the controller 46 is set accordingly. After a suitable period of heating the handle of the squirt is pushed, so that the body of the squirt is pushed over the stud on the contact 31 and the distinfecting liquid is then injected into the chamber by the plunger of the squirt, the heating resistances having been put out of operation by the closing of the switch 31, 32 and subsequent energization of relay 36. This cessation of heating enables inflammable disinfectants to be used if desired. Some vapor will be generated in the chamber, but it will escape through the funnel 13, and consequently there is no risk of explosion. The filters 14 and 24 generally effect condensation of the vapor, so that there is little or no actual discharge of disinfectant from the chamber.

In Fig. 8, illustrating another form of construction, 49 represents the chamber, and 48 the lid thereof. The chamber has on one side an enlargement 50, in which is the fan 52, driven by an electric motor 51 outside the chamber. The chamber has a horizontal partition 53 a short distance above its floor 62, and this partition has an upwardly bent part extending into the lateral enlargement, towards the fan, so that the fan propels air through a passage 54 above this part of the partition, and sucks air through a passage 55, which extends under the partition and is open at the other end.

At the centre of the chamber the partition 53 has an opening with a short tube 56 extending upwardly therefrom, and electric heating resistances 57 with a distributing sieve 58 upon them are placed on the partition around this tube. There is another horizontal sieve 59 in the chamber, level with the top of the tube 56, for supporting the articles to be sterilized.

The floor 62 has an opening 60, with the neck of a funnel shaped filter 61 fitted into the same,

for admitting air to the chamber. The opening 60 is controlled by a valve 63 on a spindle 66 (Fig. 9), and this valve can be set so that it either closes the opening 60, as indicated by a broken line in Fig. 8, or forms in the passage 55 an obstruction between the fan and the tube 56. There is also a valve 64, connected by a link 65 to the valve 63, arranged so that when the valve 63 closes the opening 60 the valve 64 forms an obstruction in the passage 55 on the other side of the tube 56, as indicated by a broken line in Fig. 8.

The spindle 66 of the valve 63 is connected to an electric switch 67 (Fig. 9) for opening and closing the circuit of the heating resistances. When the circuit is closed the valves 63 and 64 are in the positions indicated by broken lines in Fig. 8.

The articles to be sterilized are place on the sieve 59, and the lid is closed, the electric circuit containing the heating resistances being then closed by means of the switch 67. The passage 55 is consequently closed to the outer atmosphere, and the opening 60 is also closed, so that the fan causes circulation of the air in the chamber, the air being at the same time strongly heated by the electric resistances. The air propelled by the fan sweeps through the passage 54 and over the resistances, whereupon it ascends and is then sucked down through the tube 56, as indicated in Fig. 8 by arrows, and returns through the passage 55 to the fan.

When the sterilization is complete the switch 67 is turned, to break the circuit, and by this means the valves 63 and 64 are moved to the positions indicated by solid lines in Fig. 8. The fan then sucks cold air through the filter 61 and opening 60, and propels it through the sieve 59 and tube 56 to that part of the passage 55 which is open to the outer atmosphere. The chamber and its contents are thus cooled by means of air sterilized by passing through the filter 61.

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

1. Sterilizing apparatus for surgical instruments and bandages comprising in combination a sterilizing chamber having an air inlet and an outlet, means for opening and closing said outlet, an air filtering appliance for disinfecting air entering through said air inlet, a fan in said chamber, a support in said chamber for holding articles to be sterilized in the path of air propelled by said fan, electric circuit means including heating resistances located between said fan and said support and said means for closing, and means responsive to the opening of the outlet for disconnecting said resistances without affecting the operation of said fan.

2. Sterilizing apparatus according to claim 1 and comprising a funnel for delivering air from said air inlet to the suction side of said fan near the fan axis.

3. Sterilizing apparatus according to claim 1 and comprising an electric motor for operating said fan, a parallel circuit connection for said motor and said heating resistances, a time switch in said parallel connection, a switch in the circuit of said heating resistances opened in response to the opening of the air outlet whereby the heating resistances may be disconnected while the electric motor of the fan is maintained in circuit until said time switch is actuated.

4. Sterilizing apparatus according to claim 1 and in which a switch is provided in the circuit of said heating resistances, a relay for controlling said switch, and connected in series with said relay a parallel circuit comprising a manually operable switch, a thermostat and a switch actuated in response to the opening of the air outlet.

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