

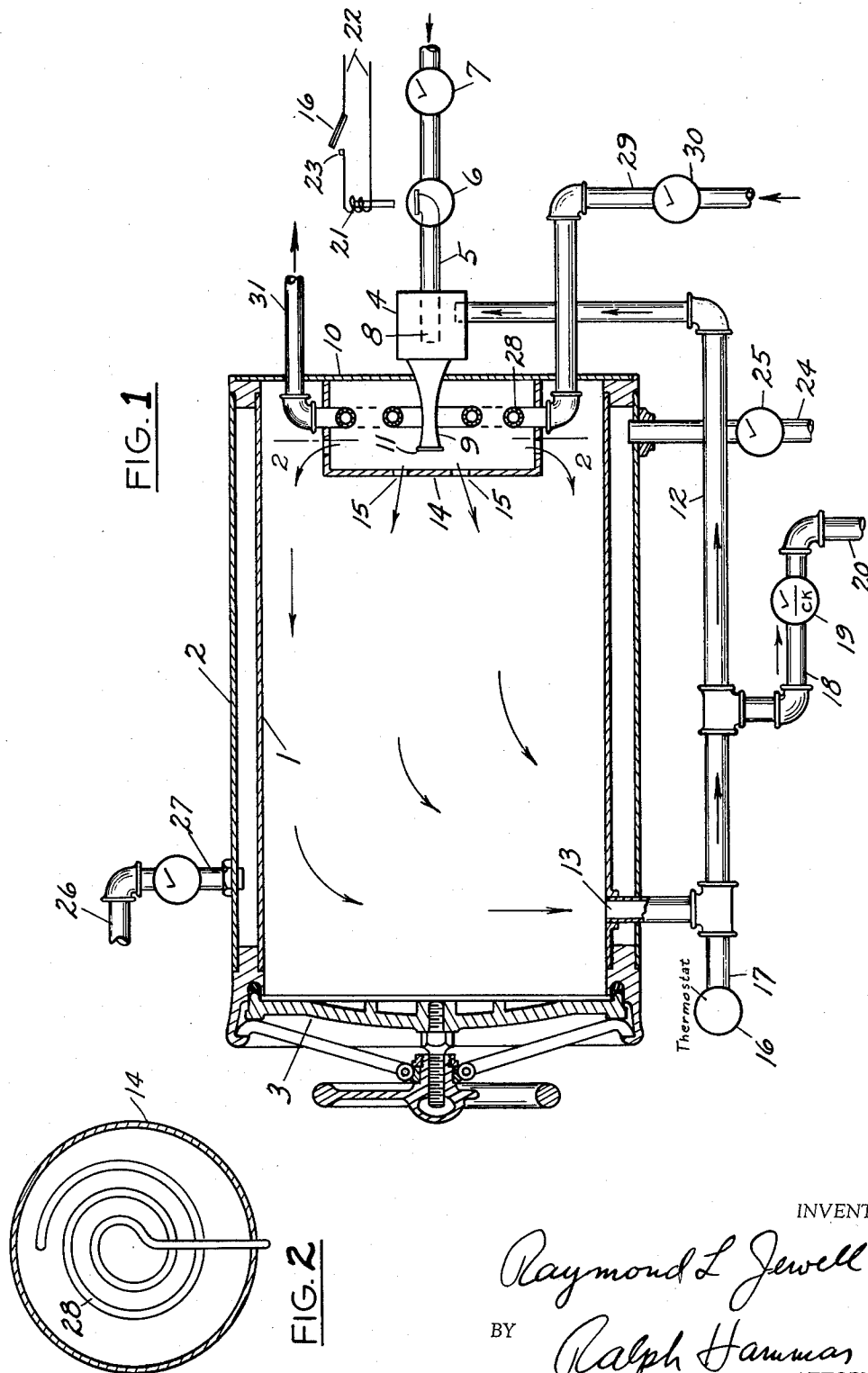
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LOW-TEMPERATURE AUTOCLAVES

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LOW-TEMPERATURE AUTOCLAVES

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This invention is intended to produce a low-temperature, moist-heat autoclave which will maintain within the autoclave chamber a uniform controlled temperature below 212 degrees F. without creating a vacuum. Such autoclaves are useful in treating heat-coagulable media such as bacteriological slants and in pasteurization of heat-sensitive solutions such as alkaloids, anaesthetics, proteins, vaccines, and serums. Such autoclaves are also substitutes for the laboratory inspissator and are useful in laboratory work requiring constant temperature and humidity. In a preferred form, the chamber is provided with a condenser and high pressure steam jets are used to circulate the air and steam vapor so as to prevent stratification. The condenser creates a sufficient demand for steam so a thermostatic control calls for steam injection a sufficiently large part of the time to maintain the circulation necessary for uniform temperature. Intermittent injection of high pressure steam produces better circulation and more uniform temperature due to the greater turbulence.

In the accompanying drawing, Fig. 1 is a sectional side elevation of an autoclave and Fig. 2 is an end view of the condenser in partial section on line 2—2 of Fig. 1.

In the drawing, 1 indicates the chamber surrounded by a jacket 2 and having its front end closed by a door 3. The parts so far described are typical of a high-temperature steam sterilizer and in fact may be used as such.

At the back of the sterilizer is an aspirator 4 connected to a high-pressure steam line 5 controlled by a solenoid valve 6 and a manual valve 7. The high-pressure steam line 5 has a discharge nozzle 8 directed into the throat of a venturi nozzle 9 extending through the back wall 10 of the sterilizer chamber and having its inner or discharge end 11 directed toward the front end of the sterilizer chamber. A line 12 leading from a drain 13 at the lower front end of the sterilizer is connected to the aspirator behind the steam jet discharge nozzle 8 so that the jet of steam discharged through the nozzle 8 into the venturi tube 9 induces a flow of air and steam from the lower front part of the sterilizer chamber through the line 12 and into the aspirator. This produces a flow of steam and air from the back toward the front of the sterilizing chamber as indicated by the arrows. In some cases, the load within the chamber may sufficiently distribute the flow of air and steam so that uniform temperatures will be obtained without stratification. In other cases, it may be necessary to arrange a baffle 14 in front of the steam jet with suitable openings 15 so directing the discharge from the front end 11 of the venturi nozzle 9 so as to produce the desired circulatory flow within the sterilizing chamber. The high-pressure steam jet discharged through the venturi nozzle 9 produces a suction which draws the mixture of air and steam vapor from the lower front part of the chamber through the drain opening 13 and back to the aspirator 4 through the line 12. This produces the desired circulation which is necessary to maintain uniform temperature throughout the sterilizing chamber without stratification. The temperature within the sterilizing chamber

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is controlled by a thermostat 16 arranged in a fitting 17 leading from the line 12 adjacent the drain 13. A drain line 18 leading from the lower part of the line 12 through a check valve 19 conducts condensate to a suitable drain 20. The check valve serves as a restriction limiting back-flow of air from the drain when the aspirator produces a suction in line 12.

The manner in which the thermostat 16 controls the temperature within the chamber 1 is diagrammatically indicated in conjunction with the solenoid valve 6. The valve 6 is normally closed and its solenoid 21 is connected in series with the thermostat 16 to the power supply 22. When the thermostat 16 cools below the temperature for which it is set, it closes a contact 23 completing a circuit to the solenoid 21 which opens the valve 6 and causes the injection of a high-pressure steam jet into the aspirator 4. As the temperature of the thermostat 16 rises to the set value, it opens the contact 23 interrupting the circuit to the solenoid 21 and permitting the closure of the valve 6 to cut off the steam jet. The thermostat 16 will ordinarily be adjustable throughout a range of from 150 degrees F. to 212 degrees F. and in the lower part of the range, e. g. 150–174 degrees will hold the temperature within the chamber to plus or minus 5 degrees and in the upper part of the range 174–212 degrees F. will hold the temperature within plus or minus 2 degrees F.

The thermostatic control arrangement above described provides for the injection of high-pressure steam to the aspirator 4 whenever the thermostat 16 calls for heat and shutting off the flow of steam whenever the thermostat 16 is satisfied. This inherently results in intermittent steam injection, but unless some arrangement is provided for dissipating heat from the chamber 1, the intermittent steam injection will take place at intervals spaced too far apart to maintain uniform temperature throughout the chamber. In order to cut down the intervals between steam injection, a condenser is associated with the chamber 1 cooling the vapor within the chamber so that more frequent steam injection will be required. The condenser may be the jacket 2 in which case a water inlet line 24 is connected to the back part of the jacket through a valve 25 and a water outlet line 26 is connected to the front part of the jacket through a line 27. The condenser may be in the form of a coil 28 (Fig. 2) having an inlet line 29 controlled by a valve 30 and an outlet line 31. Both condensers may be used together to supplement each other. Other condensing arrangements are possible, it merely being necessary that heat be taken away from the chamber 1 at such a rate that the intermittent steam injection to the aspirator 4 will occur at such frequent intervals that stratification within the chamber is prevented. Ordinarily, uniform temperature throughout the chamber will be obtained if the steam injection takes place as little as 25% of the time. There, of course, may be variations due to the size and type of load within the chamber.

The low-temperature autoclave serves as a laboratory inspissator, which is useful in the processing of heat-coagulable bacteriological slants, in the pasteurization of sterilization of various heat-sensitive solutions such as alkaloids, anaesthetics, proteins, vaccines, and serums, and as a constant temperature constant humidity chamber for certain types of laboratory work. The moist heat atmosphere provides a rapid heat transfer to the material being treated. Since the pressure within the chamber is always above atmospheric pressure and the circulation necessary to prevent heat stratification is through the return line 12, there is no danger of contamination by leakage of outside air into the chamber. The high-pressure steam (15–30 pounds) injected to the aspirator 4 is likewise sterile. Better circulation throughout the chamber 1 is obtained by the intermittent shots of high-velocity steam than would be

obtained with the same amount of steam steadily admitted under lower velocity.

The autoclave produces a mixture of air and steam having a pressure equal to or slightly in excess of atmospheric pressure and a temperature controllable to be substantially below the steam temperature corresponding to the chamber pressure. The condensate drain line, which discharges to atmosphere, prevents the creation of a vacuum in the chamber which would lower the boiling point of liquids or gels being treated.

It will be noted that for any selected temperature, the frequency of the intermittent steam injection will be directly related to the condensing water rate after the chamber has come up to temperature. If the intermittent steam injection were at a fixed frequency, the condensing water would control the temperature. Also, for a fixed condensing water rate, changes in the frequency and duration of the steam injection pulses will also control the temperature. The thermostatic control illustrated is, however, the simplest and most direct control of the chamber temperature. With the thermostatic control, the only adjustment necessary is an occasional change in the condensing water rate, increasing the water rate if the intermittent steam injection drops to such a low frequency that stratification would take place within the chamber and decreasing the water rate if steam is being wasted by too much steam injection. The water rate need not be precisely adjusted. Satisfactory results are obtained if steam is injected 25% of the time. While the temperature will be maintained if steam is injected 100% of the time, this will be wasteful both of steam and water.

What is claimed as new is:

1. An autoclave comprising a chamber, a super atmospheric steam line discharging into the chamber, means for circulating the steam within the chamber to prevent stratification, a valve controlling the admission of steam, a thermostat responsive to the chamber temperature and adapted to be set for a temperature substantially less than the super atmospheric steam temperature controlling the valve to open the valve when the thermostat calls for heat and to shut the valve when the thermostat is satisfied, and a condenser in heat exchange relation to the chamber adapted to cool the chamber while the thermostat controls the steam admission.

2. An autoclave for producing a mixture of air and steam having a pressure substantially atmospheric and temperature lower than the steam temperature corresponding to the autoclave pressure comprising a chamber, a drain from the chamber to atmosphere, a super-atmospheric pressure steam line discharging into the chamber, means for circulating the steam within the chamber to prevent stratification, and a condenser in heat exchange relation to the chamber adapted to cool the chamber while the chamber is being heated by steam to prevent the rise of temperature within the chamber to the temperature of steam at atmospheric pressure by heating from the steam discharge.

3. An autoclave for producing a mixture of air and steam having a pressure substantially atmospheric and temperature lower than the steam temperature corresponding to the autoclave pressure comprising a chamber, a steam jet aspirator discharging into the chamber, a super-atmospheric pressure steam line discharging into the aspirator, a return line from the chamber to the aspirator, a drain from the chamber to atmosphere, a condenser cooling the chamber to create a demand for steam, a thermostat responsive to the chamber temperature, a valve in the steam line controlled by the thermostat shutting off the flow of steam to the aspirator as the thermostat is satisfied and opening the valve when the thermostat calls for heat.

4. An autoclave for producing a mixture of air and steam having a pressure substantially atmospheric and temperature lower than the steam temperature corresponding to the autoclave pressure comprising a chamber, a drain from the chamber to atmosphere, a steam jet aspirator discharging into the chamber, a super-atmospheric pressure steam line discharging into the aspirator, a baffle directing the aspirator discharge so as to produce uniform circulation throughout the chamber, a suction passage leading from the chamber to the aspirator, a condenser cooling the chamber to create a demand for steam, a thermostat responsive to the chamber temperature, and an on-off valve in the steam line controlled by the thermostat.

5. An autoclave comprising a chamber, means for intermittently discharging jets of super atmospheric pressure steam into the chamber to maintain a circulation of the atmosphere within the chamber to prevent stratification, and a condenser in heat exchange relation to the chamber adapted to cool the chamber while the chamber is being heated by steam to prevent the rise of temperature within the chamber to the temperature of steam at atmospheric pressure by heating from the steam discharge.

6. An autoclave producing a mixture of air and steam having a pressure substantially atmospheric and temperature lower than the steam temperature corresponding to the autoclave pressure comprising a chamber, a drain from the chamber to atmosphere, a steam jet aspirator discharging into the chamber, a super-atmospheric pressure steam line discharging to the aspirator, a suction line leading to the aspirator from a point within the chamber remote from the aspirator discharge, an intermittently operated on-off valve in the steam line, and a condenser cooling the chamber during the period of intermittent operation of the valve.

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