

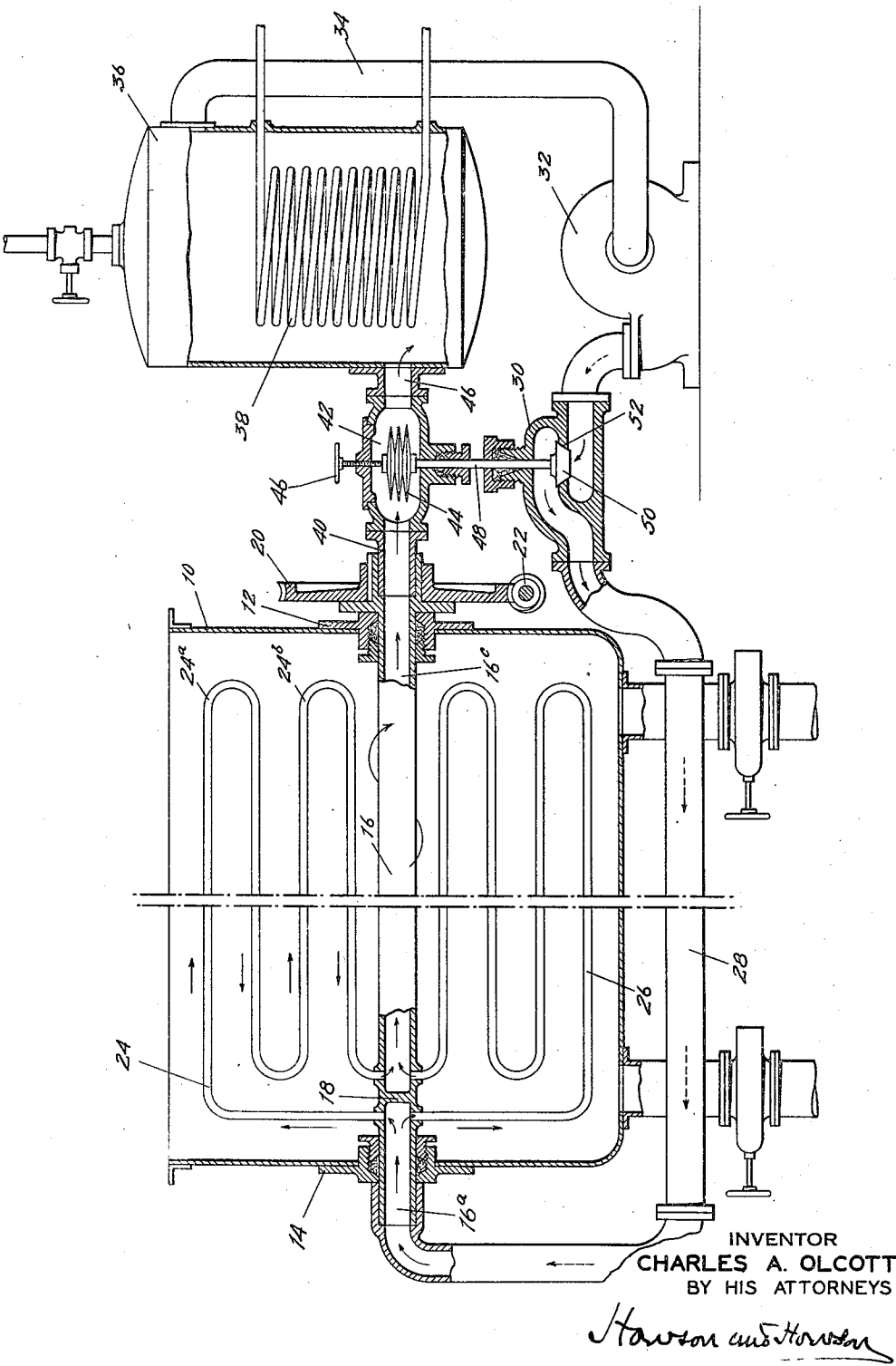
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PROCESS AND APPARATUS FOR THE TREATMENT OF SUGAR-BEARING MATERIALS

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PROCESS AND APPARATUS FOR THE TREATMENT OF SUGAR-BEARING MATERIALS

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This invention relates to an apparatus and process for the treatment of sugar bearing materials such as massecuite and magma and is applicable, in its principles, to both the crystallizing and the mixing steps in the manufacture of sugar. More particularly, this invention relates to a process and apparatus involving the use of rotating coils in a crystallizer or mixer for heating or cooling sugar bearing material such as massecuite or magma, and including the control of temperature modifying effects on the material by the coils.

In prior apparatus revolving coils have been used to advantage in heating massecuite and magma preparatory to centrifuging. Improvements in centrifugals have required this reheating to be done very rapidly in order to keep the centrifugals continually supplied with hot material. In the prior forms of revolving heating coils no attention has been paid to the maintenance of a temperature differential between slowly moving parts and rapidly moving parts. As a consequence the efficiency of the apparatus has been limited and the heat transfer has not been as efficient nor as even as possible, throughout the massecuite.

It is an object of my invention to provide an improved process and apparatus for obtaining a more even temperature distribution and heat transfer within the parts of a mixer or sugar crystallizer.

Another object of my invention is to provide improved means for control of the temperature of the heat transferring medium and to provide control of the amount of heat transfer in order to prevent deleterious effects of excessive heat upon the massecuite or other sugar bearing material.

Another object of my invention is to provide an improved apparatus, and process of operation of apparatus, having rotating coils with a temperature modifying fluid circulating within them for use either in a mixer or crystallizer wherein the hottest coils are moved at the most rapid rate through the mixture being treated and the cooler coils will move more slowly, thus maintaining a substantially equal heat-transfer contact between the temperature modifying means and the massecuite. In line with this object it is a further object of my invention to cause the motion of the various parts of the temperature modifying means through the massecuite to be substantially in proportion to the difference in temperature between the various parts and the massecuite.

A further object of my invention is to provide automatic control means for accomplishing the foregoing objects of my invention.

Other objects and advantages of my invention will become apparent as it is described in connection with the accompanying drawing.

In the drawing the single figure shows diagrammatically apparatus embodying the principles of my invention. This apparatus is adapted for carrying out my new process of treating sugar bearing materials.

Referring to the drawing, the sugar bearing material is deposited in a receptacle 10 in the vertical ends of which are bearings 12 and 14 in which rotates a hollow pipe or shaft 16 having a wall or baffle 18 within it near one end, dividing the pipe into a short passage 16^a and a long passage 16^c. This hollow shaft may be rotated by worm wheel 20 and worm gear 22 from any suitable source of power. Supported upon the hollow shaft are coils of pipe 24 and 26, one end of the pipe coil being connected with the short passage 16^a while the other end of the coil is connected with the longer passage 16^c. Coils 24 and 26 contain one or more convolutions, such as 24^a and 24^b. The particular design and object to be accomplished by the coils 24 and 26 will be hereinafter more particularly described.

The passage 16^a is connected by a conduit 28 to a valve 30 and pump 32, the pump deriving its supply through a pipe 34 from a tank 36 having therein a steam heating coil 38. By operation of the pump 32 water or other fluid medium within the tank may be circulated through the system and upon leaving the coils 24 and 26 it will pass out of the passage 16^c through a pipe connection 40 into a chamber 42 containing a metal gas-filled thermostatic bellows 44 which is adjustable by a hand wheel 46 extending through the top wall of the chamber 42 and engaging with the top of the bellows 44. The bottom of the bellows is connected with a valve stem rod 48 extending through the bottom wall of the chamber 42 and through the top wall of the valve 30 and has a head or disc 50 thereon adapted to engage with a valve seat 52 within the valve 30. Thus expansion and contraction of the bellows 44 will cause opening and closing of the valve 30. As the water passes through the chamber 42 it is returned to the tank 36 by a connection 46.

The invention finds particular field of use in mixers for the massecuite before the massecuite is delivered to the centrifugals. When so used heating water will be circulated through the coils

24 and 26 and cause reheating of the massecuite to a proper temperature. The massecuite may be heated to any temperature below the saturation point of the particular mixture within the mixer without material loss through redissolving of the sugar grains. A usual temperature range is between 110° and 120° F. but the reheating may go as high as 140° F. safely under favorable conditions.

It will be observed that the coils are produced by winding sections of pipe back and forth on themselves with the outer ends connected to the hot water entrance passage at 16° and the inner end connected to the exit passage 16°. As the heating water passes through the coils its heat is transferred to the massecuite. It is obvious in the arrangement shown that if a very large amount of hot water were rapidly circulated the whole coil would be at approximately the same temperature. If the coil were rotated at a speed sufficient to give most efficient heating to the massecuite treated by the outer coils then the slower moving inner coils would cause overheating of the inner body of massecuite. In this connection it should be remembered that massecuite is extremely viscous and a very poor heat conducting medium, and the heat of the inner hot body could not be readily and quickly transferred to the remainder of the mass to avoid adverse effects on the inner body. To avoid this difficulty the valve 30 is set to require a drop in temperature adequate to prevent overheating by the inner slow-moving portions of the coils.

With the coils 24 and 26 designed as described the heating water, in passing through their convolutions, will be hottest in the parts or convolutions which are farthest from the axis of rotation so that the hottest coils will move most rapidly through the massecuite. The design also includes provision for the water to approach the center or axis of the coil as the temperature drops and thus the portion of the coil which is moving most slowly is of lowest temperature. This has a three-fold advantage. First: The relation of speed and temperature of the hottest coil can be determined so that maximum heat transfer is accomplished without danger of caramelization, burning or overheating of the sugar grains. Second: It is known that the resistance to motion of a hot body from the viscous mass is proportional to the temperature and also that the coils furthest from the axis would normally exert the most resistance to movement due to well known principles of leverage. Therefore, the high temperature of these coils is of value, both in reducing this resistance and the power required for rotation of the coils. Third: The temperature of the slower moving inner coils will be lower so that the body of massecuite through which they move will not be greatly heated while the portion of the massecuite through which the hotter outer coils move is only slightly heated. Thus the tendency is to produce even heat transfer throughout the massecuite.

Although in the diagrammatic showing of the invention in the drawing only two sets of coils are illustrated additional sets may be provided as conditions require and any means for supporting them from the central pipe or axis may be provided. Or coils similar to those in the patent to W. A. Rolston No. 1,934,006 may be employed.

The water at the entrance of the coil may be of a temperature of 212° F., or in other words, its maximum temperature at normal pressure, or it may be slightly lower. An advantage of having

the entrance water at the maximum temperature or boiling point is that in such case the necessity for providing means to control the entrance temperature is eliminated. The temperature of the water leaving the coils will depend upon the temperature of the massecuite and the speed of rotation of the coil and velocity of water moving through the coil since the amount of heat transfer is dependent upon the temperature difference between the heating coils and the massecuite and the time of contact. As the massecuite becomes heated the exit temperature of the water will naturally increase. I make use of this fact to control the amount of heat transfer and for this purpose the thermostatic control of the valve 30 by the bellows 44 has been provided in position where it is responsive to the temperature of the exit water. It will be apparent that as the temperature rises the bellows will move the valve disc 50 toward its seat and restrict the amount of water passing through the coil, thus restricting the amount of heat transfer. The thermostatic control also acts as a safety device in case the coil stops rotating, or any other condition occurs which would cause overheating of the massecuite. In such case the exit water will at once rise in temperature and the valve will automatically move toward closed position and reduce the supply of heat, thus protecting the massecuite.

From the foregoing it will be seen that I have provided a means for automatically controlling, by means of the temperature of the exit water, the volume of water passing through the apparatus and thereby controlling the amount of heat transfer. And, by the design and temperature regulation within the coils, I have provided for even and efficient heat transfer. My means for automatic control has the advantage that it operates in proportion to the difference of temperature between the entrance and exit water.

From the foregoing it will be understood that the operation of my apparatus and process contemplates a substantial drop in the temperature of the heating water as it passes through the coils. This is a distinguishing characteristic between my invention and prior attempts at reheating massecuite in which no provision for either a substantial drop in temperature or control of such drop or even heat transfer within the massecuite by reason of such drop was made.

While the invention is particularly applicable to a mixer it is also adaptable for use in a crystallizer, in which case the heating coil 38 might be a cooling or refrigerating coil and the cooling water could be circulated in the manner indicated or in the reverse direction, provided the proper arrangement was made for directing the water through the pump in the proper manner. Such arrangements need not be described for they will be apparent to those skilled in the art.

Many modifications within the scope of my invention will occur to those skilled in the art. Therefore I do not limit myself to the specific form of the invention illustrated and described.

I claim:

1. Apparatus for stirring and producing temperature modifying effects in treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle having a temperature controlling fluid flowing through it, said stirring device having the portions which move most rapidly carrying the fluid when at high temperature and the portions which move slower carrying the fluid when

its temperature is reduced, means for controlling the heat transfer between the material and said fluid by regulating the flow of the fluid through said stirring device, said means being responsive to temperature variation of the fluid which has been in heat exchanging relation to the material being stirred.

2. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle having a temperature controlling fluid flowing through it, said stirring device having the portions which move most rapidly carrying the fluid when at high temperature and the portions which move slower carrying the fluid when its temperature is reduced, means for controlling the heat transfer to the material by regulating the flow of the fluid through said stirring device, said means comprising a thermostatic device responsive to temperature variation of the fluid at the exit, said controlling means acting to stop the fluid flow through the stirring device when the heat transfer reaches a predetermined minimum.

3. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle and having a temperature controlling fluid flowing through it, said stirring device having the portions thereof more closely connected to the fluid entrance in position for rapid movement and having the portions thereof more closely connected to the exit in position for less rapid movement, said stirrer being constructed and arranged so that the temperature differences between the various parts thereof are substantially in proportion to their different rates of linear motion, means to deliver fluid to said stirrer at substantially constant entrance temperature, and means operating automatically in response to the temperature of fluid which has been in heat transferring relation to the material being stirred to regulate the flow of fluid through the stirrer to maintain the temperature at the exit at an approximately constant temperature below the entrance temperature.

4. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle and having a temperature controlling fluid flowing through it, said stirring device having the portions thereof which are more nearly connected to the fluid entrance in position for rapid movement and having the portions thereof which are more nearly connected to the exit in position for less rapid movement, said stirrer being constructed and arranged so that the temperature differences between the various parts thereof are substantially in proportion to their different rates of linear motion, and means to regulate the flow of fluid through the stirrer to maintain said proportion, said regulating means being responsive to the temperature variations of the fluid at the exit.

5. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle and having a temperature controlling fluid flowing through it, said stirring device having the portions which move most rapidly carrying the fluid when at high temperature and the portions which move slower carrying the fluid when its temperature is reduced, means for constantly delivering entrance fluid to said stirrer approximately at its maximum atmospheric temperature, and means for automatically controlling

the fluid flow in the stirrer to maintain the exit fluid at a constant temperature substantially below the entrance temperature, whereby the amount of heat transfer by the stirrer to the material is regulated.

6. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle and having a temperature controlling fluid flowing through it, said stirring device having the portions which move most rapidly carrying the fluid when at high temperature and the portions which move slower carrying the fluid when its temperature is reduced, means for delivering entrance fluid at a constant temperature, means responsive to the temperature of the fluid at the exit to control the amount of heat transferred to said sugar bearing material by controlling the temperature drop and volume of heating fluid passing through the stirrer.

7. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle and having a temperature controlling fluid flowing through it, said stirring device having the portions which move most rapidly carrying the fluid when at high temperature and the portions which move slower carrying the fluid when its temperature is reduced, means to restrict the amount of heat transferred to said sugar bearing material by control of the relation of volume and temperature drop of the heating fluid passing through the stirrer.

8. The method of heating sugar bearing materials which comprises subjecting different portions of the material to the action of heating means at different temperatures, maintaining short heat-transferring contact between the high temperature means and longer heat-transferring contact between the lower temperature heating means, and maintaining the temperature differential between the high and low temperature heating means substantially constant.

9. The method of heating sugar bearing materials which comprises subjecting different portions of the material to the action of heating means at different temperatures, maintaining short heat-transferring contact between the high temperature means and longer heat-transferring contact between the lower temperature heating means, and varying the rate of heat transfer through said heating means in response to changes in the temperature difference between said high and low temperature heating means.

10. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle and having a temperature controlling fluid flowing through it and means for limiting the rate of flow of fluid through said stirring device, said means being constructed and arranged to operate in response to the temperature of fluid which has been in heat exchanging relation with said stirred material.

11. Apparatus for heat treatment of sugar bearing materials comprising a receptacle for the material, a stirring device moving within said receptacle and having a temperature controlling fluid flowing through it, means for maintaining a predetermined temperature differential between the inflowing and outflowing fluid of the stirring device, said means operating in response to the temperature of the fluid leaving the stirring device.