Sept. 2, 1941. C. A. OLCOTT 2,254,387

MEANS FOR CONDITIONING SUGAR BEARING MATERIALS

Filed March 11, 1939 2 Sheets-Sheet 1

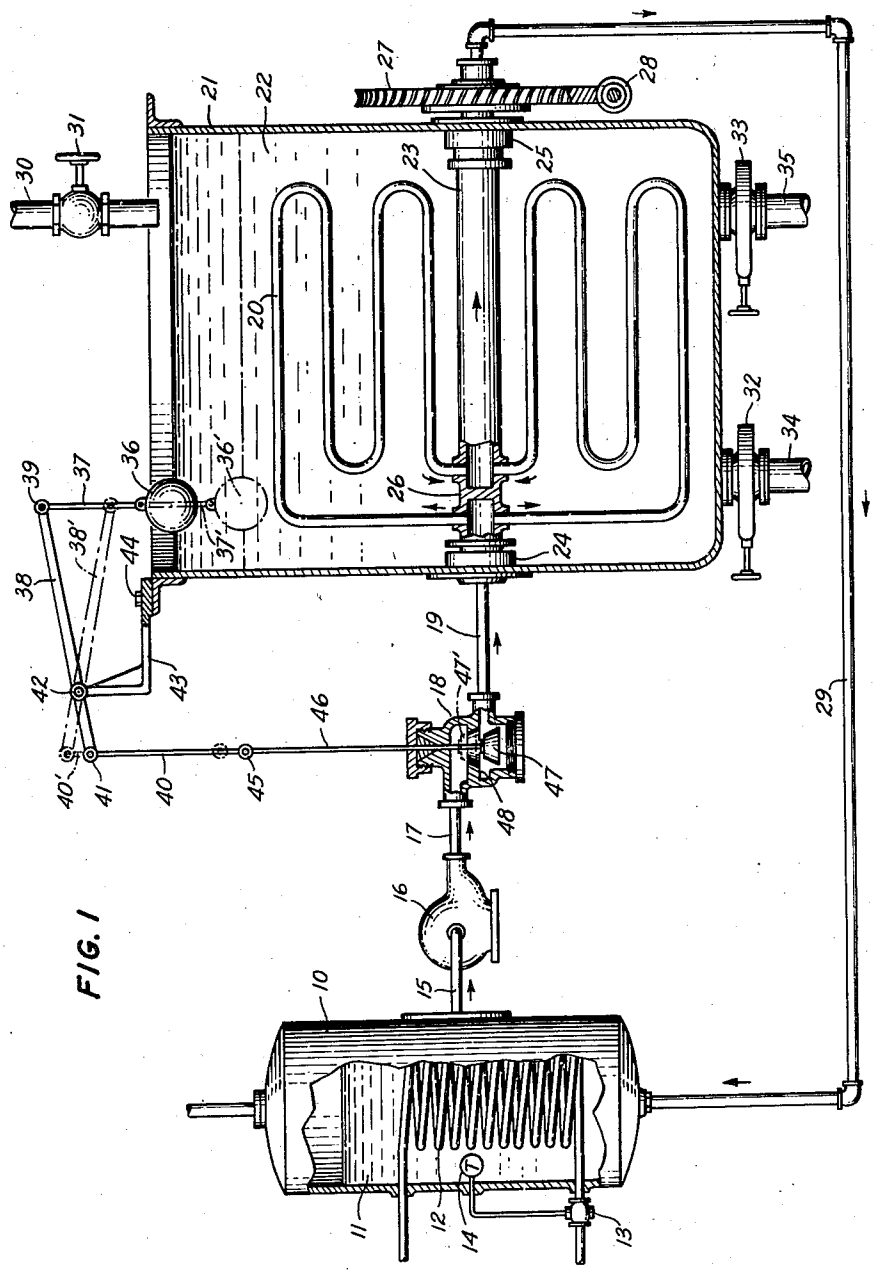


FIG. 1

INVENTOR
C. A. OLCOTT
BY
ATTORNEY

Sept. 2, 1941. C. A. OLCOTT 2,254,387

MEANS FOR CONDITIONING SUGAR BEARING MATERIALS

Filed March 11, 1939 2 Sheets-Sheet 2

FIG. 3

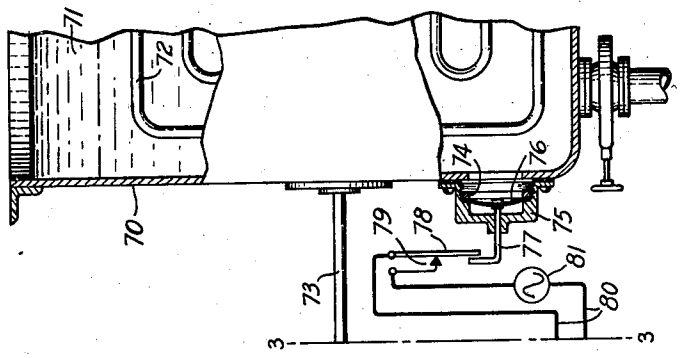


FIG. 2

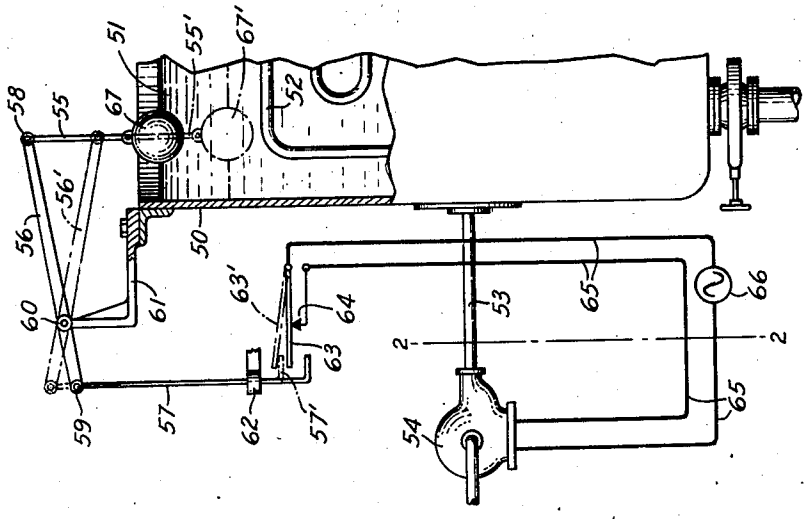
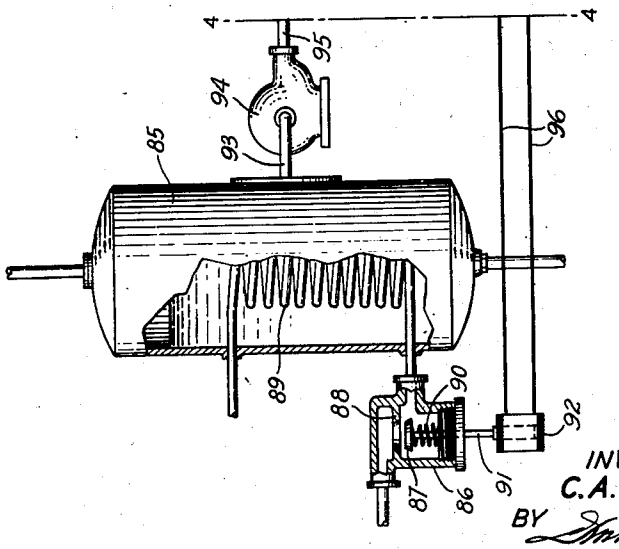


FIG. 4



INVENTOR
C. A. OLCOTT
BY
ATTORNEY

Patented Sept. 2, 1941

2,254,387

UNITED STATES PATENT OFFICE

2,254,387

MEANS FOR CONDITIONING SUGAR BEARING MATERIALS

Charles A. Olcott, West Milford, N. J.

Application March 11, 1939, Serial No. 261,185

3 Claims. (Cl. 127—19)

This invention relates to the processing of sugar bearing materials and more particularly to methods and means of conditioning such materials to extract sugar therefrom.

An object of this invention is to obtain the maximum yield of sugar from sugar bearing material.

Another object of this invention is to improve the purity of sugar obtained from sugar bearing material.

Another object of this invention is in the extraction of sugar from sugar bearing material to prevent caramelization or destruction of sugar.

A more particular object of this invention is to attain the optimum temperature range requisite for efficient processing of sugar in a sugar bearing material without destruction or damaging of the sugar due to local overheating.

In the extraction of sugar from sugar magma or like materials, the process of cooling the magma to cause crystallization of a large proportion of the sugar content is followed by heating of the magma, with the sugar crystals dispersed throughout it, to increase its fluidity so that it will be well adapted for the next step, viz., centrifugal separation of the crystals. The characteristics of the magma and of the sugar crystals are such that the temperature of the mass must be maintained within a narrow temperature range throughout the heating process. Too low a temperature and the magma becomes so viscous that centrifuging is practically impossible; too high a temperature and the sugar crystals begin to re-dissolve in the mother liquor, i. e., the magma, or caramelization of the sugar may even occur, in either of which events the yield of sugar of commercial quality may be substantially reduced.

The usual "hot mingler" for effecting the heating step described comprises a tank through which the sugar-bearing magma is passed and in which are rotating coils that carry hot water or other heating fluid. In one type of hot mingler used commercially the temperature of the heating fluid is only slightly above the temperature to which it is desired that the magma shall be heated, and not high enough to cause substantial re-dissolution of the sugar crystals or other deleterious effect. In a second commercial type of hot mingler, the temperature of the heating fluid is far in excess of any temperature to which the magma itself could safely be raised. Rotation of the coils, however, tends to produce an even distribution of the heat delivered by them, and their speed of movement through the magma is calculated to avoid overheating of any individual portion of the mass.

In the commercial use of minglers of the second type described above a heretofore unexplained impairment in efficiency has been endured for many years, that is, a substantially smaller percentage of crystalline sugar is found in the mass leaving the mingler than would be expected from analysis of the mass entering the mingler and from other considerations familiar to those working in this art.

I have found that the comparatively low yield obtaining when minglers of the second type are employed is due to local overheating of the magma and a consequent tendency for the sugar crystals to re-dissolve, and that the local overheating occurs even though the mass of magma is within the permissible temperature range and the relation of the temperature of the coil portions to their velocities through the mass is such as practically to insure no local overheating on that score. More particularly, I have found that the impairment of efficiency is due largely to local overheating of the magma during those constantly recurring "abnormal" periods when the level of the magma in the mingler is low enough to expose the rotating coils. When portions of the rotating coils break through the surface of the magma I have observed that they carry some of the magma with them, and it appears that the time the magma thus adheres to the hot coil portions before it re-enters the mass and is swept off is long enough to overheat the magma and to cause substantial loss due to re-dissolution of the sugar crystals.

Those familiar with the operation of sugar refineries are fully cognizant of the fact that the so-called abnormal condition just described actually obtains a great part of the time. It is brought about in part by the fact that the supply of sugar bearing material to the refinery is highly variable, depending as it does on agricultural, market, and shipping conditions and other factors over which the refiner has no control, so that of the huge banks of minglers many are put into or out of operation during the day. Furthermore, there are many interruptions in the refinery processes which produce a highly variable rate of flow of magma to the minglers and sustained periods of operation of at least some of the minglers at substantially less than normal

capacity. In brief, the operating conditions are such that the total mingler-hours during which the magma level is unavoidably so low as to expose the coils is great enough that the loss of yield due to overheating as described by applicant is quite substantial.

The long unexplained impairment in efficiency as hereinbefore described having been traced to its source by applicant, it is proposed in accordance with the present invention to remedy the difficulty by providing means for reducing the temperature of the coils of the hot mingler during those intervals when the magma level is so low that the coils break through the surface. The reduction in the temperature of the coils is preferably effected by means automatically responsive whenever the level of the magma drops to the point where the sugar bearing material adhering to the coils in their rotation when they rise above the surface thereof is in danger of caramelization or substantial injury, and so operating that the supply of heat to the coils is stopped or materially retarded. Consequently, if the material falls below this point, the fluid medium in the coils is sufficient to maintain the material within the predetermined range since the volume of material in the tank is markedly reduced and no danger of overheating or harmfully injuring the sugar bearing material is present. In the practise of this invention, therefore, three desired results are attained: the material is maintained within the optimum range; no caramelization or destruction occurs; and heat energy is conserved.

A more comprehensive understanding of means for carrying this invention into practice is obtained by reference to the accompanying drawings in which:

Fig. 1 is a front elevation partly in section of apparatus employed for the temperature conditioning of sugar bearing material in accordance with this invention;

Fig. 2 shows a modification of a portion of the apparatus represented in Fig. 1;

Fig. 3 illustrates a different system of producing the temperature conditioning of the sugar bearing material from that shown in Fig. 1; and

Fig. 4 shows an embodiment for controlling the temperature conditioning apparatus.

In Fig. 1, a tank 10 is normally filled with water 11 or other fluid medium. The water is heated by a plurality of coils 12 through which steam passes. The steam is admitted through a valve 13 controlled by a thermostat 14. From the tank 10, the hot water passes through a pipe 15, through a pump 16, to a pipe 17. From the pipe 17, the hot water is transmitted through a valve 18 to a pipe 19 and thence through a plurality of rotating stirring coils 20 located in a tank 21 in which magma or other sugar bearing material 22 is contained.

The rotating stirring coils may be constructed in accordance with the system described in the copending application of applicant, Serial No. 160,178, filed on August 20, 1937. The rotating stirring coils are fixedly attached to a hollow shaft 23 supported by two bearings 24 and 25. A baffle or wall 26 serves to direct the flow of hot water from the pipe 19 to the outer coils initially as noted in the above stated application of applicant. The shaft 23 is rotated by a worm wheel 27 and a worm gear 28 driven by some suitable source of power (not shown).

After the hot water flows through the rotating coils 20, it passes from the hollow shaft 23 through a conduit or pipe 29 to the tank 10. The system for effecting a limited temperature change in sugar bearing materials shown and described in the copending application of applicant, Serial No. 236,659, filed October 24, 1938 may also be advantageously employed in the system shown in Fig. 1.

The magma or sugar bearing material 22 is supplied to the tank 21 for temperature conditioning through a conduit or pipe 30, and the control of this supply is regulated by means of a valve 31. The magma is withdrawn after the conditioning through either of two valves 32 and 33 connected respectively to pipes 34 and 35 for processing in centrifugal machines (not shown). During the processing of sugar bearing materials to obtain sugar therefrom, the magma, massecuite, or other sugar bearing material 22 is withdrawn from the tank 21 and replenished at intervals from the source of supply of the material through the pipe 30 and valve 31. As a result of this practice, the level of the magma in the tank 21 changes. Frequently the level is a substantial distance below the highest horizontal position which the stirring coils 20 attain in their rotation. When this condition prevails, the magma adheres to the hot coils when, in their rotation, they rise above the surface of the magma. Caramelization or other destruction of the sugar occurs. The possible danger to the magma is aggravated by the consequentially higher temperature of the hot water in the coils due to the smaller volume of magma to be heated. To prevent the destruction of the sugar, the valve 18 controls the volume of hot fluid medium entering the coils 20 in accordance with the height or volume of the magma in the tank 21. This control is effected in the embodiment shown in Fig. 1 by a ball float 36 adapted to float on the surface of the magma 22 in the tank 21. Fixedly attached to ball float 36 is a rod 37 joined at one end of a lever 38 to pivot at a pintle 39. The other end of the lever 38 is attached to a rod 40 by means of a pintle 41. The lever 38 turns about a pintle 42 supported by a bracket 43 fixedly attached to tank 21 by means of a bolt 44. The rod 40 is connected by means of a pintle 45 to one end of a rod 46, the other end of which is fixedly attached to a valve head 47 of the valve 18. When the valve head 47 is lowered out of engagement with an associated valve seat 48, water flows from the pipe 17 to the pipe 19 and thence through the rotating coils 20. When the valve head 47 is raised to close the valve head against the valve seat 48, the flow of hot water from the source 10 to the rotating coil stops. The valve is controlled in accordance with the relative height of the float ball 36 by means of the rod 37, lever 42, and rods 40 and 46. When the float ball is above a predetermined height, the valve 18 is completely open; i. e. the position of the valve head 47 is such that any further lowering does not change the rate of flow of water through the valve 18. When, however, the height of the magma is decreased below that predetermined distance, the float ball 36 is lowered in the tank, the valve head 47 is raised to engage its associated valve seat 48 and the flow of hot water through the valve 18 is gradually decreased until it is substantially stopped when the valve head engages the valve seat. The valve head 47 and

valve seat 48 may be constructed so that the change in the flow through the coil may be gradual or sudden as desired for a particular range in height or volume of the magma in the tank. For example, to obtain a gradual change in the flow of the water over a range in height of the magma, the valve head and valve seat are deep and tapered from a very narrow cross section at the top to a large cross section at the bottom. As a result, the area through which the water passes is gradually decreased within the critical range in height for which the apparatus is adjusted. On the other hand, if a sudden stoppage of the flow of water is desired when the height of magma in the tank decreases below a predetermined minimum, the valve head and valve seat are relatively thin, and the cross sectional dimensions of the top and bottom of the valve head are more nearly the same, so that when the top of the head of the valve is in a plane with the bottom of the seat, the valve head engages the seat in a relatively short distance corresponding to a small change in the height of the magma. With this latter construction, the valve head does not interfere with the flow of water through the valve 18 until the height of the magma 22 almost approximates that at which the valve is completely closed.

The pintle 42 is located on the lever 38 so that when the surface of the magma falls below that at which caramelization or destruction of the sugar occurs, the flow of water through the coils 20 is stopped or materially retarded, either gradually or relatively suddenly, depending upon the construction of the valve. Preferably, this height is substantially the highest level to which the outside coil attains in its rotation about the shaft 23. The dotted configuration of the float ball 36', rod 37', lever 38', rod 40', and valve head 47' represent the positions of float ball 36, rod 37, lever 38, rod 40, and valve head 47 respectively, when the volume of the magma is lowered to a level corresponding to the approximate highest horizontal height that the rotating coils 20 attain in their rotation about the shaft 23. It is observed that in this position the valve head 47' is engaged against the valve seat 48 to stop the flow of hot water supplied to the stirring coils 20. Accordingly, when the level of the magma is considerably above the highest horizontal height that the rotating coils 20 attain, hot water flows through the coils 20 whereas, when the level falls below this height, the flow of water through the coils is stopped. As a result, no danger of destruction of sugar due to the adhering of the magma to the coils when the coils pass above the level of the magma is produced.

In Fig. 2, the flow of hot water through the stirring coils is regulated by controlling the pump which normally circulates the hot water through the stirring coils. A tank 50 contains magma, massecuite, or other sugar bearing material 51. Stirring coils 52 rotate in a manner similar to the coils 20 shown in Fig. 1. Hot water flows from a pipe 53 supplied from a source (not shown) through a pump 54. The pump 54 circulates the hot water or other fluid medium, and the circulating system may be similar to that shown in Fig. 1. A float ball 67 adapted to float on the surface of the magma 51 is fixedly attached to a rod 55 which is pivoted to a lever 56 by means of a pintle 58. The lever 56 is connected to a rod 57 by means of a pintle 59. The lever 56 turns about a pintle 60 held by means of a bracket 61 which is fixedly attached to the tank 50. A support 62 serves to guide the rod 57 in a vertical position. One end of the rod 57 forms a right angle to control by the vertical movement thereof a switch arm 63. Normally, the switch arm 63 engages a contact 64. The switch arm 63 and contact 64 are connected to a pair of leads 65. Connected in series with one of the pair of leads 65 is a source of current 66. The pair of leads 65 terminate at the poles of a motor (not shown) which drives the pump 54. The horizontal portion of rod 57 is so disposed in relation to the switch arm 63 that when the height of the magma falls below a predetermined level, the horizontal portion of the rod 57 disengages the switch arm 63 from its associated contact 64 to stop the pump 54 from circulating water through the system. The dotted configuration of the float ball 67', rod 55', lever 56', rod 57', and switch arms 63' indicates the position of float ball 67, rod 55, lever 56, rod 57, and switch arm 63 respectively, when the height of the magma is below the predetermined level. Accordingly, when the level of the magma 51 falls below the predetermined level, the switch arm 63 is disengaged from its associated contact 64 to stop the pump 54. As a result, the circulation of hot water through the rotating coils is materially retarded.

In Fig. 3 a system is shown for the control of the flow of the hot water through the rotating coils prior to processing in centrifugal machines, in accordance with the pressure in the bottom of the tank in which the sugar bearing material is contained. A tank 70 contains the magma 71. Stirring coils 72 through which fluid medium flows after passage through a pipe 73 rotate in the manner of the coils 20 shown in Fig. 1. Located near the bottom of the tank 70 is a pressure diaphragm 74 encased in a housing 75. The diaphragm is in contact with the magma in the tank. Immediately adjacent to the diaphragm 74 is a flexing member 76 also encased in the housing 75. A right angle rod 77 is fixedly attached to the flexing member 76 and passes through the housing 75. The vertical portion of the rod 77 controls a switch arm 78 to engage or disengage a contact 79. The engagement of the switch arm 78 with the contact 79 serves to provide a source of current through a pair of leads 80 from a source of current 81 to control any part of the apparatus. For example, the leads 80 may be connected to the terminals of the motor of a pump such as the pump 54 in Fig. 2 to stop substantially or retard materially the circulation of hot water through the coils. In order to demonstrate this control and illustrate the substitution of the portion of the apparatus shown in Fig. 3 for a portion of that appearing in Fig. 2, the broken vertical line 2—2 in Fig. 2 represents the division of the system into two parts, the right hand portion of which may be replaced by the apparatus shown in Fig. 3. The dotted vertical line 3—3 in Fig. 3 is situated at the point at which the apparatus shown therein is substituted for the portion of the system illustrated in Fig. 2 to the right of the vertical line 2—2. In the substitution, the leads 80 of Fig. 3 are connected to the leads 65 connected to the pump 54 shown in Fig. 2.

The diaphragm 74 and flexing member 76 are adjusted so that the rod 77 disengages the switch arm 78 from the contact 79 when the pressure of

the magma at the bottom of the tank falls below a predetermined minimum. This action in turn results in the withdrawing of the source of current 81 from the pump 54. The pump ceases to operate and the circulation of hot water through the stirring coils 72 is substantially retarded. The diaphragm 74 and flexing member 76 are adjusted so that when the volume of the magma decreases to substantially the level at which the magma adheres to the coils 72 when these coils pass in their rotation above the surface of the magma to affect the sugar detrimentally. Usually this level is the highest horizontal position attained by the coils in their rotation. In operation, when heated magma 71 is withdrawn below the critical level, the diaphragm 74 and flexing member 76 effect the stopping of the pump 54 from sending any substantial flow of water through the coils 72. When cold magma is added to the tank 70 to increase the height or volume in the tank above the critical level or volume, the diaphragm 74 and flexing member 76 return to their normal positions, the switch arm 78 engages the contact 79 to connect the source 81 to the pump 54. The resulting operation of the pump 54 effects the resumption of the flow of hot water through the coils 72.

In Fig. 4, a different means of controlling the temperature of the stirring coils in the tank when the volume decreases below a predetermined amount is shown. A tank 85 which supplies the heated fluid medium, such as hot water, to the stirring coils is heated by means of steam circulated through coils 89 contained in the tank, similar to the coils 12 in the tank 10 shown in Fig. 1. The steam is supplied to the coils 89 through a valve 86. The valve comprises a valve head 87 which engages a valve seat 88 to stop the flow of steam to the coils 89. The valve head 87 is biased to engage the seat 88 by a helical spring 90 which encircles a piston 91 fixedly attached to the valve head 87. The valve head 87 is held out of engagement with the seat 88 by the energizing of a solenoid 92, through the center of which the piston 91 passes.

The heated fluid medium from the tank 85 passes through a pipe 93 and a pump 94 to a conduit or pipe 95, to supply stirring coils located in a tank containing magma or other sugar bearing material in accordance with a system similar to that shown in Fig. 1. A pair of leads 96 furnishes a path for energizing the solenoid 92. The dotted vertical line 4—4 represents the place at which portions of the apparatus shown in Figs. 2 and 3 to the right of the dotted vertical lines 2—2 and 3—3 respectively are employed with that shown in Fig. 4. In the event that the actuating apparatus is that shown to the right of the dotted line 2—2 in Fig. 2, the leads 96 are connected to the leads 65 to supply normally current to the solenoid valve 92 from the source 66. Accordingly, when the volume of magma 51 in the tank 50 is above the critical amount, the float ball 67 is positioned so that the switch arm 63 engages the contact 64. Solenoid 92, under these conditions, is energized, the valve head 87 is disengaged from the valve seat 88, and steam flows through the coils 89. When the volume of the magma decreases below the critical amount, however, the float ball 67 falls to disengage the switch arm 63 from its associated contact 64. The source 66 is, as a result, withdrawn to deenergize solenoid 92. The spring 90 effects the engagement of the valve head 87 with the valve seat 88 to stop the flow of steam through the coils 89. Since the fluid medium in the tank 85 is no longer supplied with heat from the coils 89, its temperature drops. The fluid medium flowing through the stirring coils 52 is markedly cooler than that usually supplied. The magma adhering to the coils is not heated to a harmfully high temperature. When cold magma is poured into a tank 50 to increase the volume above the predetermined amount, the switch arm 63 engages the contact 64 to energize solenoid 92. The valve head 87 is disengaged from the valve seat 88 to permit the passage of steam to the coils 89.

In the event that the actuating apparatus is that shown to the right of the dotted line 3—3 shown in Fig. 3, the leads 80 are connected to the leads 96, to supply current from the source 81 to energize solenoid 92 as long as switch arm 78 engages contact 79. If the height of the magma falls below the predetermined value, the diaphragm actuates the disengagement of the switch arm 78 from contact 79. Solenoid 92 is deenergized to stop the passage of steam to the coils 89. As heretofore described, the action cools the stirring coils such as the coils 72 so that the sugar bearing material adhering to the coils is not harmfully affected. When the magma is replenished to increase the height above the predetermined value, the diaphragm returns to its former position. The switch arm 78 engages the contact 79 to energize solenoid 92. The energizing of solenoid 92 results in the passage through the valve 86 of steam to the coils 89.

The control of the supply of the fluid medium to the rotating coils may be accomplished in a manner other than that specifically described in detail. For example, the valve 18 shown in Fig. 1 mechanically operated by the float ball 36 may regulate the amount of steam supplied to the coils in a way similar to the control effected by the valve 86 of Fig. 4. Again, the pressure switch comprising the diaphragm 74, flexing member 76, rod 77, switch arm 78 and contact 79 of Fig. 3 can operate a solenoid valve similar to the valve 86 controlled by solenoid 92 of Fig. 4 located in the path of the supply of the hot water to the stirring coils. The location of the valve may be just anterior to the entrance of the hot water into the stirring coils, positioned, for example, as shown by the valve 18 of Fig. 1. Instead of utilizing the pressure switch of Fig. 3 to operate the solenoid of this valve, the float switch of Fig. 2 comprising float ball 67, rod 55, lever 56, rod 57, switch arm 63 and contact 64 may be employed for this purpose. Then, too, several means of controlling the temperature of the stirring coils may be employed simultaneously. To illustrate, the passage of fluid medium to the stirring coils may be stopped as shown in Fig. 1 and the steam prevented from entering the coils in the tank 85 as shown in Fig. 4. Further, other instrumentalities may be employed to effect the control of the supply or temperature of fluid medium flowing through the stirring coil in a tank for conditioning magma. For example, the fluid medium could be heated by an electric current and the source removed in a manner similar to that described, when the height of the magma in the tank passes through a predetermined level.

While preferred embodiments of this invention have been illustrated and described, various modifications may be made therein without departing from the scope of the appended claims.

What is claimed is:

1. A hot mingler for the temperature conditioning of sugar magma or the like comprising a tank for containing the magma, a heating surface within said tank normally covered by said magma, heat supply means normally maintaining said heating surface at a temperature substantially in excess of the highest temperature to which said magma could be heated without deleteriously affecting it, means for establishing relative movement between said heating surface and said magma whereby heat from said heating surface is distributed throughout said magma, the said relative movement being such that said heating surface breaks through the surface of said magma when the level thereof is lower than normal, and means controlled by the level of said magma and operating on said heat supply means for reducing the temperature of said heating surface whenever the level of said magma is low enough that said heating surface breaks through the surface thereof, whereby excessive overheating of magma adhering to said heating surface during its movement above the mass of magma is substantially reduced.

2. A combination in accordance with claim 1 in which said heat supply means transmits hot fluid to said heating surface and in which said controlled means controls the rate of flow of said fluid to said heating surface.

3. A combination in accordance with claim 1 in which said heat supply means transmits hot fluid to said heating surface and in which said controlled means operates to reduce the temperature of said fluid as delivered to said heating surface.

CHARLES A. OLCOTT.