ELECTRICALLY HEATED CAPPINGS SEPARATOR

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Introduction

Cappings, a mixture of honey and wax, removed from combs in the uncapping operation must be separated to salvage the honey and beeswax. Separation is accomplished by draining, heat, or a combination of the two. When heat is used, caution is necessary to prevent injury to the color, flavor, or aroma of the honey. Honey removed from cappings during the draining procedure is not damaged and may be added to the crop without lowering its quality.

Several options for the separation of cappings, honey, and wax are available to the beekeeper and his choice will depend on the size of his operation and the facilities available to him. Two methods commonly used are draining by gravity and using cappings melters. Draining may also be accomplished by centrifugal force or pressing. Drained cappings contain various percentages of honey, depending on the method used, and require rendering for final separation. When liquid wax is drawn off in the rendering process or in the cappings melter, a residue of foreign material called slumgum remains. This slumgum contains a high percentage of wax that can be recovered economically.

GILBERT (1) discusses a method of cappings separation where initial draining is by gravity followed by pressing with a screw press. The resulting cappings cake can be stored for rendering at a later time.

Conversion of a solar wax melter to an electric melter by adding a resistance heater with adjustable heat settings is discussed by SVOBODA (5). The conversion extends the usefulness of the melter by eliminating the need for sun heat to melt the wax. A screw press was also added to remove the wax from the slumgum residue.

An electric top-heat melter is described by JOHNSON (2) that is in essence a drainer and batch melter combination. The wax removed must be remelted for molding, and wax from the slumgum recovered separately. MARCY (3) discusses a converted spinner-type washing machine that can be used for recovering the wax from slumgum.

Construction materials used in building cappings separators and wax rendering equipment greatly affect the quality of the wax recovered. These materials are listed and classified by SECHRIST (4) as to their effect on wax. Careful selection of material by those constructing such equipment can result in production of high quality beeswax.

Cappings melters separate the cappings, honey, and wax in a one-step operation. The cappings are fed into the melter from a hopper and enter the main body of the tank underneath a heat grid located near the top of the tank. As the cappings material is warmed, the honey and wax separate and the honey settles to the bottom of the tank while the wax rises toward the heat grid above. The wax is melted as it rises toward the heat grid where it reaches melting temperature. The cappings continue to enter the tank under the heat grid and form a layer between the honey below and the melting wax above. Separation progresses continuously as the honey and wax separate from the cappings layer. Honey and molten wax are discharged from the melter as cappings are fed in so that the level of cappings material, honey, and wax in the tank are maintained at a desired level. Steam is the most common source of heat used in the cappings melters.

The steam heated cappings melter works very well and does not injure the honey if it is properly operated and watched carefully by the operator. There is a possibility, however, that the honey in the tank will be overheated, resulting in discoloration and injury to the flavor and aroma. This is especially true when uncapping is done at a very slow rate or when, for some reason, uncapping is delayed for a short period of time and the steam supply to the tank is left in operation. The greatest drawback to the use of steam for the heat supply is the lack of control. Also, a small steam generator is required unless there is another source of steam such as a boiler for supplying heat for the honey plant. Generally speaking, the only control on the steam supply is either all on or all off, with no provision made for modulation. It is not uncommon for the steam to be piped directly into the melter when a small generator is used, with no provision to control except turning the generator off and on. This leads to a natural tendency to keep the unit supplied with steam at all times even though uncapping may be interrupted for a short period of time.

The above-mentioned factors led to the design and fabrication of an electrically heated unit to supply heat to the cappings. It was built so that a commercial cappings melter tank could be used by removing the steam coil and inserting the electrically heated unit.

Materials and methods

The heating unit was made of 2-inch by 5/8-inch aluminium bars alternated with 1/16-inch by 6-inch aluminium plate strips. These bars and strips were clamped together so that the resulting heater was 22-5/8 inches wide and 5/8 inches thick with a series of 10 fins 5-3/8 inches deep. The rods used to clamp the unit together were made to extend out of each side the unit to support it on top of the tank. Five holes were drilled through the bars and strips so that rod-type electric heaters that extended across the entire width could be inserted. Figure 1 shows the unit assembled before the heaters were installed.

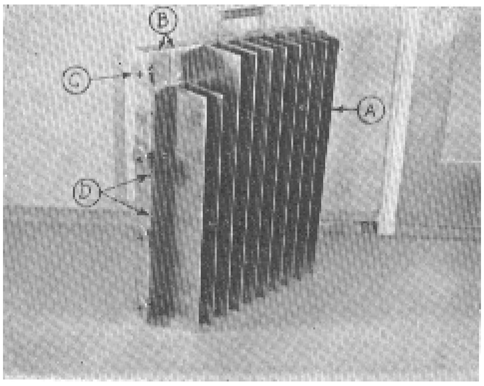

Fig. 1- Cappings melter heating unit showing (A) aluminum strips, (B) aluminium bars, (C) clamping bolts, and (D) holes for rod-type electric heaters

Rod-type electric heaters were used, five heaters of 500 watts each, making a total of 2500 watts available. The heaters were wired into the supply line in parallel and each heater could be manually switched on and off. The heaters were spaced in the unit so that more heat would be supplied to the wax bed near the cappings feed hopper and less at the discharge end of the tank.

The top of the heating unit was covered with a layer of 1/8-inch cement asbestos board and 2 inches of glass wool insulation enclosed in an aluminium metal cover. This was bolted in place over the top to aid in holding the heat, resulting in as much of the heat as possible being conducted down into the wax bed through the fins. Handles were provided so that the unit could be lifted off at regular intervals for removal of slumgum.

Complete control of the heaters is necessary so that the temperature of the aluminium plate is kept at a sufficiently high level to supply heat to the molten wax and cappings layer at the top of the separator. There is also the requirement of control of the honey temperature in the lower portion of the separator to prevent overheating, which would result in dark colored and off-flavored honey. A sensitive bulb-type thermostat was mounted on the side of the separator tank with the bulb mounted in the honey overflow chamber. The purpose of this thermostat is to cut off heaters if the temperature of the honey leaving the separator exceeds the desired set temperature. A second thermostat of the bimetallic type was mounted in the aluminium plate, which contained the heating elements and the fins for conducting the heat down into the wax bed. Both thermostats were adjustable.

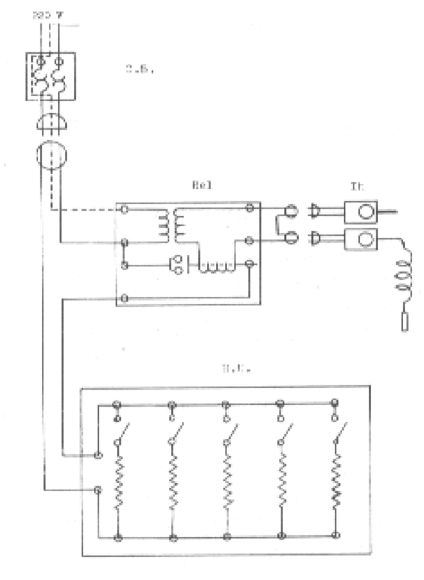

Fig. 2 – Wiring diagram for cappings melter heating unit
C.B. = circuit breaker, Rel. = relay, Th = thermostats, H.U. = heating unit

The thermostats were wired through a relay in series so that both would have to be closed, showing a temperature below the set point before the heaters would be turned on. The relay in turn closed or opened the heating circuit. A wiring diagram of the electrical circuit is shown in Figure 2.

Thermocouples were installed along one side of the separator tank so that an indication of the heat distribution within the tank could be determined. They were installed at 3 points along the length of the tank and at 5 levels at each of these 3 points, making a total of 15 measuring junctions as shown in Figure 3. Temperatures were recorded by a 16-point potentiometer. Figure 4 shows the separator tank with the electric heating unit in place. The 2 control thermostats, the individual heater switches, and the temperature recording instrument are shown.

Operation of the unit was varied so that the ability to control temperature could be determined and the capacity established. Temperature recordings were made when the cappings melter was being operated at capacity, when it was alternately in operation and idle, and when it was idle for extended periods of time.

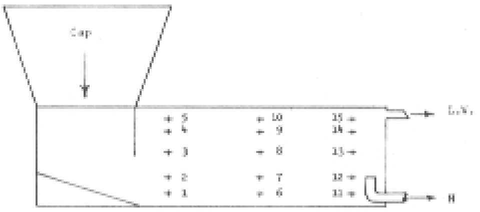

Fig. 3 – Measuring point distribution in melter tank
Cap = cappings, L.W. = liquid wax, H = honey

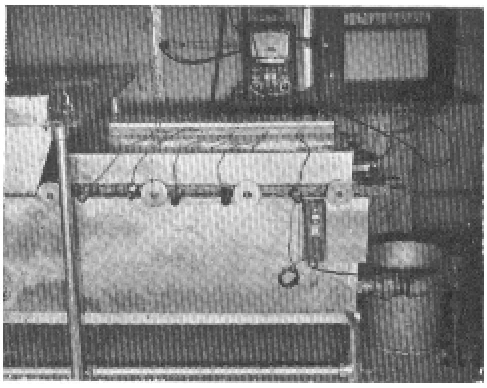

Fig. 4 – Electric heating unit with controls installed on melter tank

Results

Cappings temperatures are given in table 1. These are mean values of all measurements made at each point during the method of operation indicated. The temperature range for each point is given in parenthesis following the mean value.

Table 1

Mean temperature of cappings in electrically heated cappings melter

Measuring point location	Operation						
	Continuous (at full capacity)			Interrupted (idle for 1 hour)		Idle over night (thermostat turned back)	
	(Range)			(Range)		(Range)	
Bottom	1	119 °F	(104-140)	122 °F	(113-129)	129 °F	(119-154)
	6	118	(103-127)	120	(110-129)	188	(114-125)
	11	123	(107-132)	125	(113-128)	125	(123-128)
	Avg.	120		122		124	
Lower center	2	142	(132-151)	144	(138-152)	134	(112-145)
	7	140	(123-148)	141	(131-148)	136	(128-143)
	12	141	(124-149)	144	(135-148)	137	(135-139)
	Avg.	141		143		136	
Center	3	173	(142-187)	191	(180-198)	155	(136-166)
	8	183	(155-203)	199	(181-211)	155	(144-168)
	13	179	(153-197)	188	(175-197)	159	(153-165)
	Avg.	178		193		159	
Upper center	4	207	(149-228)	230	(201-244)	167	(122-184)
	9	219	(186-233)	239	(230-249)	175	(161-185)
	14	222	(211-236)	237	(228-246)	176	(163-184)
	Avg.	216		235		173	
Top	5	241	(226-252)	262	(256-267)	175	(138-192)
	10	239	(226-248)	258	(250-267)	181	(168-189)
	15	240	(229-251)	259	(250-267)	181	(168-190)
	Avg.	240		260		179	

Under full operation, the temperature recorded ranged from an average of 240 °F in the molten wax at the top of the separator to an average of 120 °F in the honey at the bottom of the tank. The average temperature of the honey at the overflow level was 141 °F. It was also quite obvious from the recoder charts that the temperatures for any given level in the tank were relatively uniform and the increase in temperature from the bottom of the tank to the top was gradual at the levels measured. This would indicate that the heat was being distributed well over the entire tank and that the penetration downward was uniform. The maximum deviation from the average temperature at any level was 9 ^{o}F. When uncapping was interrupted for short periods of time, such as for loading the extractor, no appreciable change in temperature at a given measuring point was recorded.

When the unit was idle for longer periods of time, a rise in temperature from that at continuous operation resulted. Periods of one hour with no cappings being fed into the separator caused a temperature increase of 2 ^{o}F at the bottom of the tank and 20 ^{o}F in the molten wax at the top. If operation was stopped for longer periods of time, the thermostats were cut back or the unit was turned off completely.

The thermostat at the honey discharge level was set at 100 ^{o}F when the day's operation ended. This temperature maintained the wax at the top of the melter in a liquid state without overheating the honey at the bottom of the tank. When the unit was idle overnight, the temperature in the molten wax dropped to an average of 179 ^{o}F and rose to an average of 124 ^{o}F in the honey at the bottom of the tank. The time required to bring the unit to operating temperature at the start of the day's operation was considerably less with the wax in this state than it was completely solidified.

The capacity of the electrically heated cappings melter was approximately 900 pounds per hour when the melter was operated on a continuous basis and light color super combs were being uncapped. At higher rates there is insufficient separation to prevent some wax particles leaving the separator with the honey. Optimum operation is obtained when the cappings are fed into the unit at a steady rate and when the slumgum is removed regularly.

Discussion

The electrically heated cappings melter described can be used successfully to separate cappings, honey, and wax in a one-step operation. It provides the operator with more control over the heat supply than with the steam heated melters. The elimination of the steam generator in the extracting room also improves personal comfort for the operator and reduces the excess atmospheric moisture that could be absorbed by the honey.

The capacity of this unit is definitely limited, but is does compare favorably with separators of the same size heated by other methods. One great advantage is the ability to control the temperature with the thermostats during periods when there are no cappings being fed into the separator. Another advantage is that a small amount of heat can be applied to the unit a night. This prevents the wax from becoming completely solidified yet does not heat the honey to a point of severe damage. Considerably less time is required to prepare the separator for use under these conditions.

The main disadvantage of the unit is the length of time required to liquefy the wax bed that has completely solidified before the unit is ready for use. Since the heat is transferred down into the wax by a series of fins, several hours may be necessary for liquefaction. This time will vary depending on the amount of slumgum present in the wax. Units that have a steam coil embedded in the solidified wax will completely liquefy the wax bed in a much shorter time. With the electrically heated unit it is necessary to have some heat added periodically during idle periods of one to 15 hours to prevent complete solidification of the wax in the separator. If the separator is to be idle for periods longer than 15 hours, all heat should be shut off because of the possibility of damaging the honey in the tank.

Another factor that was noted quite clearly was the necessity of keeping the tank relatively free of slumgum by removing it at regular intervals. A large accumulation of this material would act as an insulator to the unmolten wax beneath it and the capacity of the melter would be greatly reduced. Here again, the importance of careful attention by the operator is evident.

An immersion-type heater could also be used to heat the chamber beneath the cappings hopper with hot water. It is sometimes desirable to have heat added at this point but it is also necessary to provide a close control because the heat is added directly to the honey as well as to the wax. This additional heat should not be used unless uncapping is continuous and cappings are being fed into the separator at a steady rate.

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