DEVELOPMENT OF A STEAM-OPERATED UNCAPPING KNIFE

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A steam-operated uncapping knife was designed and built using the information gained through preliminary work. Mild steel of 14 gauge sheets has been used as its base. The knife length is 12 cm long and 5 cm wide. The handle is 15 cm long and the length of the wooden handle is 11.5 cm. The knife gives continuous satisfactory uncapping.

Origin

When honey is ripe each filled cell is covered with a beeswax cap by bees. Capping, 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 required to prevent injury to the colour, flavour, or aroma of the honey. Honey removed from cappings during thedraining process is not damaged and may be added to the crop without lowering overall quality.

Previous capping knives

To extract the honey from the cells cappings must be punctured or removed. Various types of cutting or perforating devices are used in the uncapping operation. These may be operated by hand or mechanically. Some of the large, mechanical uncapping machines with high speed rotating cutters have not heat on the cutters (MRAZ, 1949). MRAZ recommend that the combs be warmed to facilitate uncapping.

HOOPER (1991) stated that capping are cut off with a sharp, fluted kitchen knife. The fluting on the blade helps to prevent the knife being held by the viscocity of the honey. DETROY (1979) described an electrically heated knife. Operating temperatures that provide a smooth cut without tearing the cell walls and which do not overheat the honey are controlled by use of an on/off adjustable temperature control. OWENS (1963) developed and patented an electrically heated toothed roller for uncapping that could be used on mechanical machines. Filled combs were drawn between two toothed rollers by a conveyor chain. The rollers were heated by rod type electric heaters. Spring pressure on the rollers caused them to perforate the cell cappings. Here again, the yield of capping wax was low.

NICHOLS (1988) described how he made a honey knife from two thin sheets of stainless steel (welded together at the edges(; between them a heating element (low voltage, high current) encased in insulating material, and a tiny thermistor is inserted in a slot on the thin edge of blade. The temperature of the resulting honey knife is maintained at 80^{o}C (±1^{o}C) and it reaches the operating temperature from cold within four seconds.

A fully mechanised uncapping machine in which electrically heated toothed rollers are used, was built by agricultural engineers of the Agricultural Research, Science & Education Administration, USDA, at Madison, WI USA (DETROY & OWENS, 1968). The machines removed the combs from the super, uncapped them and deposited them into a container for extracting. The honey industry was not interested in this machine because of the low yield of capping wax.

It soon become evident that an acceptable mechanical uncapper would have to include some sort of device that would remove a portion of the cell rather than puncturing it. CUMMING (1950) stated that a large knife, a bread knife will do very well, heated in a jug of hot water, wiped dry on a clean cloth, then slice off the thin layer of wax cappings over a large tray or basin. EDWARDS (1947) found that the best form of knife for removing the sheet of cell cappings from honeycomb before placing it in the extractor is than known as the „Bhingham“. It is like a very long flat trowel, with sharp square soulders near the handle and a tapering point. These knives must be furnished with a keen edge and must stand in boiling water between alternate uses. Any tin stout enough to stand the fire, and deep enough to allow immersion of the entire blade will serve this purpose.

ECKERT (1961) stated that automatic machines have been invented which will cut off the cappings either with whirling knives or with metal parts attached to rollers between which the combs are moved mechanically. The Wilcox machine, the Crawford uncapping machine made by J R Jack of California and the Sue Bee atomatic uncapping machines are examples of this latter type of uncapping equipment. Bee Research Association (1974) found that knives used to uncap the honey were heated in pans of hot water. In North America and Canada, 20 circlar saw blades on a single shaft were used to build a wobble saw type uncapper which was fast that the saw ground up the cappings. Beekeepers in the USA made various improvements. The Bogenschuty brothers were first to mass produce a power uncapper in the late 1940s. Individual frames were carried by endless belts between revolving ctters that moved at high speed (1700 rpm), at which speed the metal fingers would bly out and cut off all the cappings. People experimented with

various types and sizes of knives in an attempt to grind the cappings less finely but none of the efforts were very successful.

New capping knife

An uncapping knife was designed and built using the information gained through preliminary work. Mild steel of 14 gauge sheets is used as a base. The knife length is 24 cm long an 5 cm wide.The handle is 15 cm long and the length of the wooden handle is 11.5 cm.

Mild steel sheet is used because of its machinability and heat transfer characteristics. The knife body is designed to provide space for circlation and passing of steam. Two pipes are mounted on the knife body, one is the inlet of steam and the other the outlet. A cutting edge is provided to facilitate uncapping combs 2/3 mm deep (see illustration and figure 1). The final design of the knife is such that all surfaces on which cappings could accumulate are eliminated. This was necessary because accumulated-cappings honey is darker or if cappings are scorched, this would lower the quality of the honey.

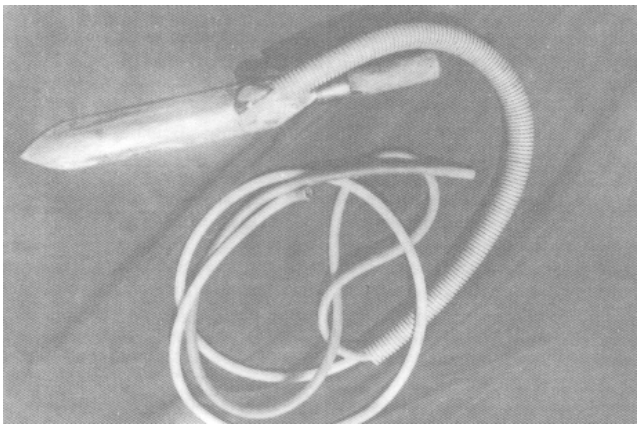

Fig. 1 – Steam operated uncapping knife

The knife was operated using steam obtained from a domestic pressure cooker of 8 litre capacity (figure 2). A temperature recording instrument Weather-tronics, Model 5117 – humidity and temperature indicator was used to measure the performance of the knife. Temperature recordings were made with the idle knife and with the knife in continuous use. The seam-operated uncapping knife was tested three times between 0800 and 1200 hours. It is best for honey extraction.

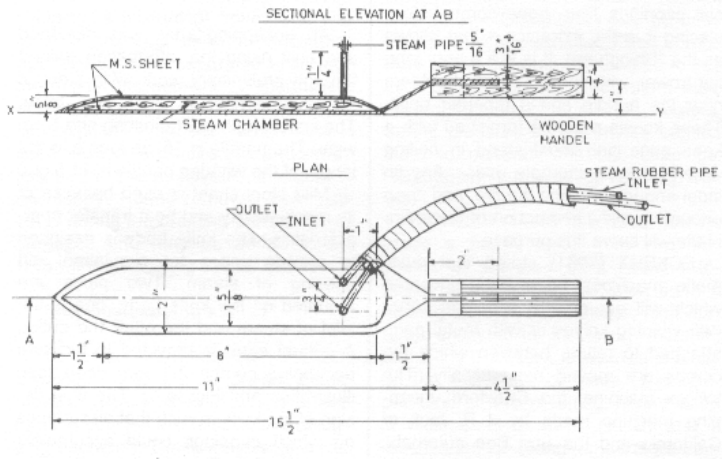

Fig. 2 – (Up) – Longitudinal section (x-y) at level A-B; (Down) – Plan of the steam operatid uncapping knife

About 1.5 litres of water was heated in the pressure cooker. The pressure cooker was tested heated on an LBG stove or an electric heater. One end of the rubber pipe was attached to the steam outlet of the pressure cooker and the other to the inlet pipe of the uncapping knife. Other pipes were attached to the

outlet of the knife to allow the steam out. After seven minutes steam started circulating in the knife and after 12 min. the knife became hot and the uncapping operation started.

At the starting point of the operation, the temperature of the knife was 40°C. About 30 frames were uncapped with the help of uncapping knives in three test runs.

Preliminary work involving several types of uncapping devices was performed to determine the most desirable design. Several modes of knife type blades made of stainless steel were found to be unsatisfactory becase of yielding uneven uncapping. Hot air jet and flame uncappers could not uncap combs where honey was in contact with the capping wax either on the inside or outside of the cells. The preliminary work indicated that a steam operated uncapper should meet the following criteria:

- The distance that heat must be transferred between the heater or the cutting edge should be the minimum possible.
- The knife should be uniformly hot throughout its length.

With the knife idle the temperature was between 40-42°C, and with the knife in continuous use, the temperature varies between 38-40°C (table 1). Temperature changes across the knife were rapid as the combs were drawn across the knife in the uncapping operation. Knife temperatures in the operating range sown were not objectionable. No scorching or caramelisation of honey during uncapping was detected.

Table 1

Increase in temperature in °C observed for steam-operated uncapping knife following initiation of steam passage through the knife

S No	Time (minutes)	Temperature (°C)
1	5	24.3
2	6	28.6
3	7	33.0
4	8	35.4
5	9	36.2
6	10	37.1
7	11	38.9
8	12	40.2
9	13	40.2
10	14	40.1

The knife uncapped combs at the rate of one frame per two minutes. Sufficient heat was available for this uncapping rate, and the cut across the face of the comb was clean when the combs were filled and sealed.

The steam-operated uncapping knife described can be compared with the simple blade type knife which is traditionally used. The simple blade type knife will scorch the was and there is uneven uncapping of combs. It is convenient to operate. The steam-operated uncapping knife developed can be used comfortably by the beekeeper.

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