directions and has a very small clearance between the gear and the body of the pump. The chocolate, that fills the cavity between two successive gear teeth, must follow the rotation of the gear. When the gear teeth mesh together, the space between the teeth is closed and the entrapped chocolate is pushed out. As the gears revolve and the teeth disengage, the space on the low pressure side of the pump is created, trapping new quantities of chocolate.

12.5.2 Sliding vane pump

In a sliding vane pump the eccentric (off-centre) rotor incorporates sets of sliding vanes, which mechanically displace the fluid (Figure 12.4). Internal clearances although small, are required in this type of pump and therefore they cannot be truly classified as positive displacement pumps since slippage will occur. By design this system of displacement creates a pulsation in the discharge flow from the pump. However these pumps can handle solids entrained in the chocolate.

These pumps are less suitable for applications that involve very high throughputs, high viscosity, or large pressure drops, for example pumping over long distances.

12.5.3 Lobe and rotary piston pumps

Lobe pumps are similar to external gear pumps in operation in that fluid flows around the interior of the pump body (Figure 12.5). However in this case the lobes are prevented from making contact with each other by timing gears located in the external gearbox.

Rotary lobe pumps can handle large inclusions with minimal damage and a gentle pumping action minimises product degradation. They are usually made from stainless steel and therefore can be cleaned with water. When the rotors have a covering of chocolate then the air gaps around them become "sealed". This improves the efficiency of the pump to self-prime.

A lobe pump should not normally be used to move white chocolate, since severe caramelisation of the chocolate can occur in the area of the lobe lock nut

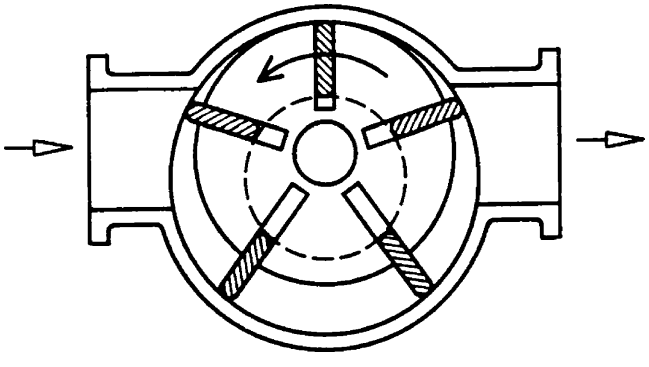

Figure 12.4 Mode of operation of a vane pump.

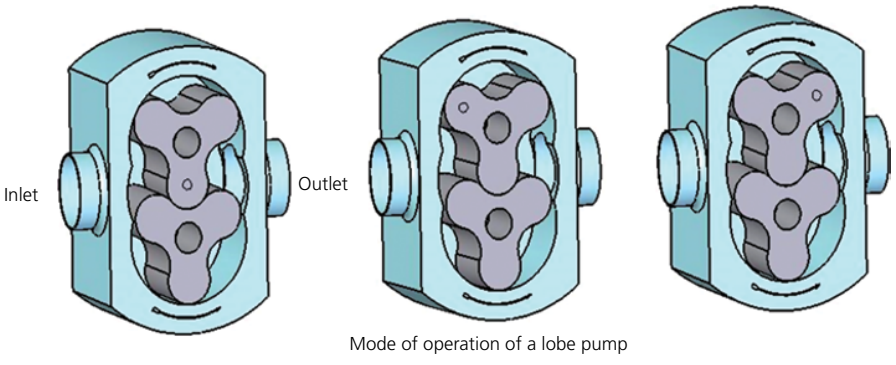

Figure 12.5 Mode of operation of a lobe pump.

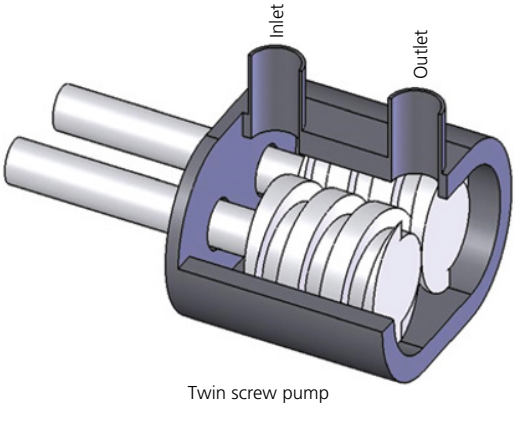

Figure 12.6 Illustration of twin screw pump.

housing. (The front plate of the pump is recessed to fit around the locknut, and it is in this recess where chocolate can become heat-damaged.)

12.5.4 Screw pump

Screw pumps have been used for many years in the conveyance of bulk chocolate. They normally have two or three rotors. A twin-screw system is illustrated in Figure 12.6. As the twin screw systems is driven by a set of gears, situated in the gearbox, there is no contact between the two pumping screws. These pumps can operate equally well when driven in reverse and at low speed offer a gentle pumping action, together with a uniform flow with little pulsation or turbulence. They are available either manufactured from cast iron or stainless steel. Some designs can cope with inclusions in the product of up to 5 mm (0.2 in).

The three rotor design comprises of a central rotor, which is connected to the drive motor and two idling satellite rotors which are driven by this central rotor. The rotors are encased in a closely fitting steel housing. The rotors are free to mesh together (there are no external timing gears). This therefore consists of a