

Design and Application on Mini Type Food Slicer

Xiaowei Jiang

Institute of Machinery and Vehicle Engineering, Changchun University, Changchun 130022, China

Abstract: The research purpose is to design a mini type food slicer to slice the root vegetables. The study analyzes the development status of slicer and elaborates on the specific design method of the mini type food slicer in detail, including humanized design, shape design, color design, main structure, working principle and technical parameters. And then the structure adjustment and manufacturing requirements of the mini type food slicer is introduced, based on which the conclusion has been reached.

Keywords: Color design, food slicer, shape design

INTRODUCTION

The slicing technology has already been developed mature abroad in the late 1970s, in the mid-eighties most of the slicers can process monocrystal with large diameter up to 125 mm (5 inches), like the horizontal inside diameter slicing machine manufactured by Mayer Bbu Geyer company in Switzerland which can slice materials with the maximum diameter up to \varnothing 304.8 mm (12 inches). In the following one or two years in the mid-eighties, the slicing technology has experienced its peak of development, many of the automatic multi-function slicers have been commercialized (Xie, 1996).

As to the structure of the slicer, it can be divided into horizontal type and vertical type (Zhou, 2003), which depends on its principal shaft supported by the air bearing or rolling bearing. There're inside diameter slicer, outside diameter slicer, single-blade slicer and multi-blade slicer and the former one is more popular. In the mid-1980s, wire saw, a cutting machine which has a unique design and is totally different from the traditional slicing technology, has come to the semiconductor market quietly, which uses a steel wire to coil the four guide wheels to form hundreds of saw bands. When they operate in a high speed, the silicon carbide will be taken to the machine to produce the effect of cutting. Its advantages are to cause less kerf, small deviation, even cut surface, big quantity and less costs. Its application in the market has created a new chapter for the cutting technology in the 21st century (Huang *et al.*, 1996).

As to the function of the slicer, it has been very complete, composite and the way of slicing is diverse. The comb shape cutting machine in 1980s is not new anymore, which has been replaced by the cutting and rotating one, surface grinding one and the one with an air cushion which can prevent the blade from bending and distorting, which can repair and maintain the blade automatically (Jiang, 2011a). The chip material can roll and grind by itself while cutting, which can reduce the bending of the monocrystal. In recent years, Tokyo

Precision Corporation in Japan has developed and produced a processing system, which combines the steps of loading monocrystal into machine, slicing, transmitting slices, dismantling graphite bearing pad, chamfering, scrubbing, inspection, sorting and storage etc, to realize the full-automation for processing by connecting many equipments and devices of many kinds according to the technological working flow (Liang, 2003).

The main purpose of the research is to design a mini type food slicer to slice the root vegetables. Its body, material inlet, blade, material outlet, baffle plate and manual elevator work together and the materials are processed by the material inlet and material outlet. It's characterized by small volume, high processing efficiency, good uniformity, stability and safety.

MATERIALS AND METHODS

Humanized design: Traditional design takes product as the main target, only considering the realization of the function of product itself. Although the human factors are also involved more or less, mainly considering how to let a person to adapt to the machine, not considering the human factors and taking people as a goal of design. So it is difficult to guarantee the operation efficiency of machine best and it is not easy to judge the quality of the design. Humanized design emphasizes that humans and machines as two basic parts of mutually linking each other constitutes a whole, forming the man-machine system. The man-machine system is to put people as a part of the system design and put the human-machine-environment as a system for the overall design. People do not passively adapt to the machine any longer, but are together with the machine to complete a system target, so that it could acquire the highest comprehensive efficiency of system. Designing the mini type food slicer must take the more convenient using for people as the breakthrough point of the whole design.



Fig. 1: Appearance modelling

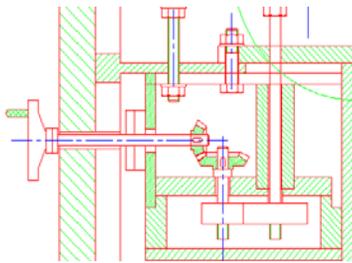


Fig. 2: Elevating system of the mini type food slicer

Shape design: In the shape design of mini type food slicer, above all, the inside quality of mini type food slicer and using safety must be ensured. Never only pursue the scale and patten beauty of shape design, so as to reduce the man-machine nature and other technique function index. The various components of slicer compose of some geometry bodies composed of dot, line, face. The shape design of mini type food slicer is combining the material techniques such as structure and function of slicer and art contents together, forming a 3D space stereoscopic shape, which has to correspond to art rule, masterly makes use of shape composing principle and masters shape appearance characteristic and forming psychology and vision error of related shape, that is important means to acquire mini type food slicer of generous beauty and novel style (Qiu, 2005), as shown in Fig. 1.

Color design: The choice of main tone of mini type food slicer is a problem of very importance; the different tone will form different art effect. In matching color of mini type food slicer, having main tone can seem to be to unify. The color is more little, the main body characteristic is more strong, the decorate characteristic is more good and the external form relation of mini type food slicer is more unify (Jiang, 2011b). Contrary, the color matches more much, causing the color more disorderly, so that it is difficult to adjust generally, the main body characteristic is unclear and the harmonious effect is broken.

The choice of tone still needs to notice whether unique beauty. It needs to hold tight people's mental request for the color of mini type food slicer, transform the tone of mini type food slicer to make it produce an unusual attraction, in the meantime, increase the

category of tone to satisfy people's fondness for different colors (Fu, 2002).

Moreover, the base, the body and other big pieces of mini type food slicer are suitable to use a low pure degree color as the main body color and use clear, elegant and clean color to unify overall situation to make the main tone definite. Using little area of high purity color to embellish to make the whole seem to be abundant, change and organic. The whole color generally uses monochrome or two sets of colors, not more than three sets of colors.

Main structure: The slicer consists of material inlet system, cutting system, material outlet system and manual elevator system. The material inlet system is very simple; because it's a household slicer which doesn't have a large quantity to slice, the manual feed is used. It not only lowers the costs, but also reduces the size of the slicer (He *et al.*, 2013):

- **Cutting system:** It consists of blade, blade rest, principal shaft and a pair of pulleys. The electric motor transmit the power to the pulley and then to the principal shaft which will rotate the blade adapter and it will drive the blade to do circle movement, so that the materials can be sliced.
- **Material outlet system:** In order to make sure all the slices of the materials come out, the size of the baffle plate shall be a bit bigger than the mouth of the material outlet, which not only can make the materials drop accurately, but also can discharge the material in time.
- **Elevating system:** The slicer's elevator system consists of hand wheel, hand wheel shaft, a pair of bevel gears, transmission shaft, a pair of transmission gears, transmission screw and clip shaft sleeve. Hand wheel and one end of the hand wheel shaft are fixed together and the other end of it is fixed and linked together with a bevel gear. The other bevel gear is fastened on the top of a transmission shaft and its bottom is fixed and connected with a transmission gear. The other transmission gear is fixed together with the bottom of the transmission screw. And the pair of the bevel gears and the pair of the transmission gears mesh, respectively, as shown in Fig. 2.

The elevating system can make the slices processed by the slicer have even thickness, neat cut surface, more accurate and convenient to adjust the thickness. When it's working, the rotation of the hand wheel will drive the hand wheel shaft turn around the horizontal axis. The transmission shaft turns around the vertical axis through the transmission of a pair of bevel gears (West and Deng, 2010). The transmission gear transmits the rotation to the transmission screw whose rotation makes it have up-and-down movement with the clip shaft sleeve, in this way; the operating clip fastened on the top of it moves upward to get one slicing thickness. Then

the whole device moves horizontally to make the blade slice the material on the clip horizontally. Because the blade is fixed on the blade rest which cannot move in the process of slicing, the slices have even thickness. The shaft group used in the structure can rotate the clip sleeve after the work piece finishes moving specified distance (slicing thickness) upward, the shaft moves horizontally through the transmission of the gear and gear sleeve. Get the clip sleeve fully fastened and don't let the work piece have the slightest movement to make sure the quality of the slices.

Working principle: Though circle movement of the blade and materials' manual feeding to realize the continuously slicing of material. The electric motor transmits power to the principal shaft through belt and the principal shaft will rotate blade rest, manually feeding the slicer and the material will be sliced.

Technical parameters:

- **Power:** 0.75 kW
- **Voltage:** 220 v
- **Slice thickness:** 0.5-5 mm
- **Principal shaft speed:** 425 r/min

RESULTS AND DISCUSSION

Structure adjustment: According to the requirement of material size, slice thickness and production efficiency; it could make the following adjustment to the mini type food slicer (Liang, 2003):

- **Cutting speed:** Through adjusting and replacing the belt pulley, changing its diameter ratio, it could realize the adjustment of cutting speed.
- **Slice thickness:** Making use of the elevating system, it could change the slice thickness and make the slices processed by slicer have even thickness, neat cut surface.

Manufacturing requirement: In order to reduce manufacturing costs and expand the applicable scope, as much as possible, the gear, the pulley and others that are used in the mini type food slicer choose the standard parts in the market. It should also equip with some spare parts of different specifications for replacing to produce material of different slice thickness daily.

Installing the guide rail of the blade should make it forward tilt a certain angle (such as 20°), so that the blade steadily touches material until cutting off, reducing vibration (Liang, 2003).

CONCLUSION

- The mini type food slicer is easy to install, repair and replace spare parts. The design is in accordance

with principles of ergonomics and it is convenient to operate and safe and reliable to use.

- The overall structure of the mini type food slicer is concise and reasonable.
- The manufacturing technical requirement and manufacturing cost of the mini type food slicer is low and the standard parts are plenty, so general small and medium-sized machinery factories are all homemade.
- Making use of the elevating system, it could adjust the slice thickness according to the need.

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REFERENCES

- Fu, L., 2002. Research on Modeling Design of Industrial Product. Jilin People Press, Changchun, pp: 129-133.
- He, W., P. Li, Z. Yuan, Y. Zhang, D. Xing, X. Xiang and H. Lu, 2013. Effect of direct sowing rates on mid-season rice feng-liang-you-xiang-1. Adv. J. Food Sci. Technol., 5(4): 422-424.
- Huang, G., Y. Qu, X. Mo and F. Zhu, 1996. Design and research of ginseng microtome. J. Jilin Agri. Uni., 18(3): 90-93.
- Jiang, X., 2011a. Discussion on the modeling design of new time's table lamp. Adv. Mat. Res., 295-297: 2581-2584.
- Jiang, X., 2011b. The modeling design and research of multi-function electric fan. Adv. Mat. Res., 287-290: 2852-2855.
- Liang, R., 2003. Design of small-sized cereal product slicer. Equip. Modern Agri., 10: 64-66.
- Qiu, S., 2005. Modeling Design Basis. Tsinghua University Press, Beijing, pp: 55-64.
- West, B. and S. Deng, 2010. Thin layer chromatography methods for rapid identity testing of *Morinda citrifolia* L. (Noni) fruit and leaf. Adv. J. Food Sci. Technol., 2(5): 298-302.
- Xie, Z., 1996. Review of slicer development abroad. Spec. Equipm. Electron. Ind., 25(3): 36-42.
- Zhou, Y., 2003. The design of vertical pineapple slicer. Mach. Design, pp: 38.