

A Novel Portable Successively-Delivering Fruit Bagging Device

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Abstract: Background: Fruit growers usually wrap developing fruits in paper bags to protect them from mechanical injury and damage from birds, and insect and disease pests. Fruit bagging provides the added benefits of improving fruit appearance and quality and preventing pesticide deposition. However, the current fruit bagging methods are often manual, or use simple mechanical or hand-held heating device. These bagging methods are labor intensive, low efficiency and out of reach on trees, and may require plastic film and external power source. **Objective and Methods:** A novel portable successively-delivering device for bagging fruits has been developed. This device uses special paper bags with rubber bands and plastic rings to overcome the disadvantages of the current manual methods. This device works based on the mechanisms of ‘over-running clutch’ and ‘self-locking between nut and bolt’ to push the special paper bags successively through a screwed pipe and then deliver them one by one. In detail, the device comprises a bag placing device, a bag pushing device, a handheld device, and special paper bags. The bag placing device comprises a supporting plate, and at least three supporting rods are arranged on the upper surface of the supporting plate, the bag pushing device comprises an overrunning clutch arranged on the supporting plate and a screw rod in threaded connection with the overrunning clutch, and sliding pipes arranged on the supporting rods in a sleeving mode and a driving mechanism for driving an outer wheel of the overrunning clutch are arranged on the top of the screw rod. An elastic ring is arranged at a bag opening of each special paper bag, circular rings are arranged on the periphery of each special paper bag, and the circular rings sleeve the supporting rods and abut against the upper portions of the sliding pipes. Grooves are formed in the top ends of the at least two supporting rods. A poking piece is upwards obliquely arranged in each supporting rod, the lower end of each poking piece is hinged to the inner wall of the corresponding supporting rod, the higher ends of the poking pieces extend out of the grooves, and when the poking pieces are in an extending state, the special paper bags on the supporting rods are located on the lower sides of the poking pieces. According to the fruit bagging device, a plurality of special paper bags slide out one by one, and thus improve the efficiency of the special paper bags. **Results and Conclusion:** This novel fruit bagging device was tested with established apple growers for its performance in Shaanxi, China. On average, an apple grower could bag 8,000 apples a day when using this device. On contrast, a grower could only bag 2,000 apples a day manually.

Therefore, the use of this new fruit bagging device could save up to \$10.8 per day in labor cost. Such device is of simplicity in mechanical structure design and high efficiency in operation, with no battery or any of other sources of power to complete the process. It is inexpensive and easy to operate. This device can bag more than 50 fruit of apple, pear and other fruit crops a time at any height. Its bagging efficiency is four times higher than the manual bagging method. The successively-delivering fruit bagging device has been awarded with Australian Innovation Patent (AU 2020103602 A4) and Chinese Invention Patent (CN 105191713 B). Growers can use this device to reduce production costs and improve productivity.

Key words : fruit bagging; portable successively-delivering; fruit bagging device; special paper bag



Fig.1 Bagged (a) apple ‘Red Fuji’ (*Malus × domestica* Borkh.) and (b) pear ‘Dangshansuli’ (*Pyrusbretschneideri* Rehd.) using the novel fruit bagging device.

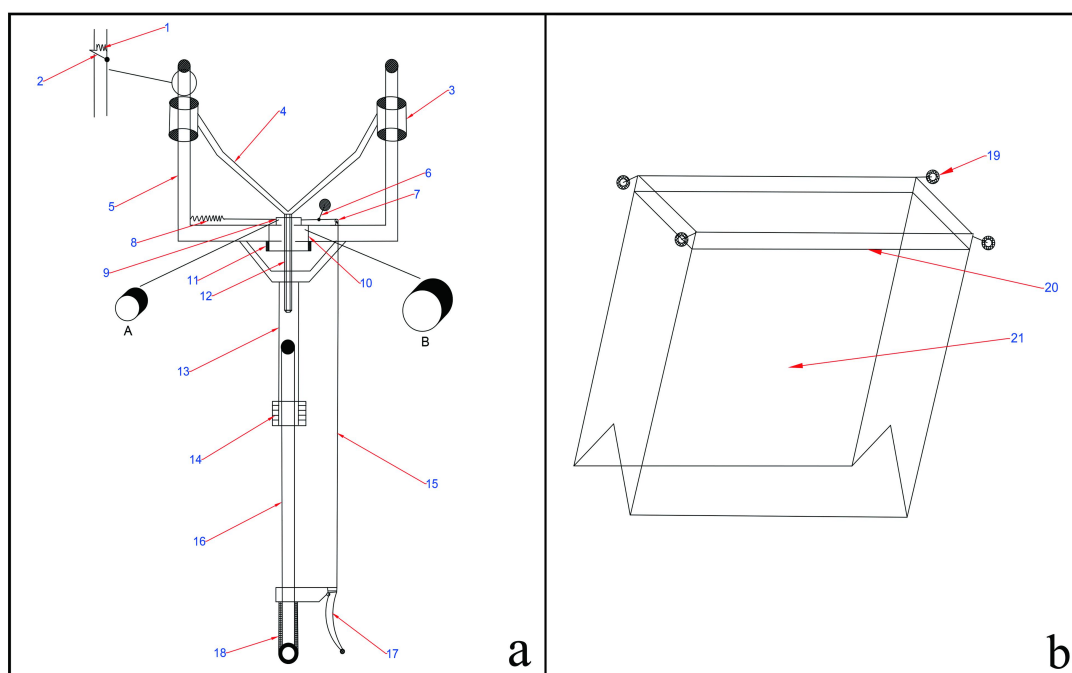


Fig. 2 2D schematic diagram of the novel portable successively-delivering fruit bagging device.

(a) the novel fruit bagging device; (b) the special paper bag.

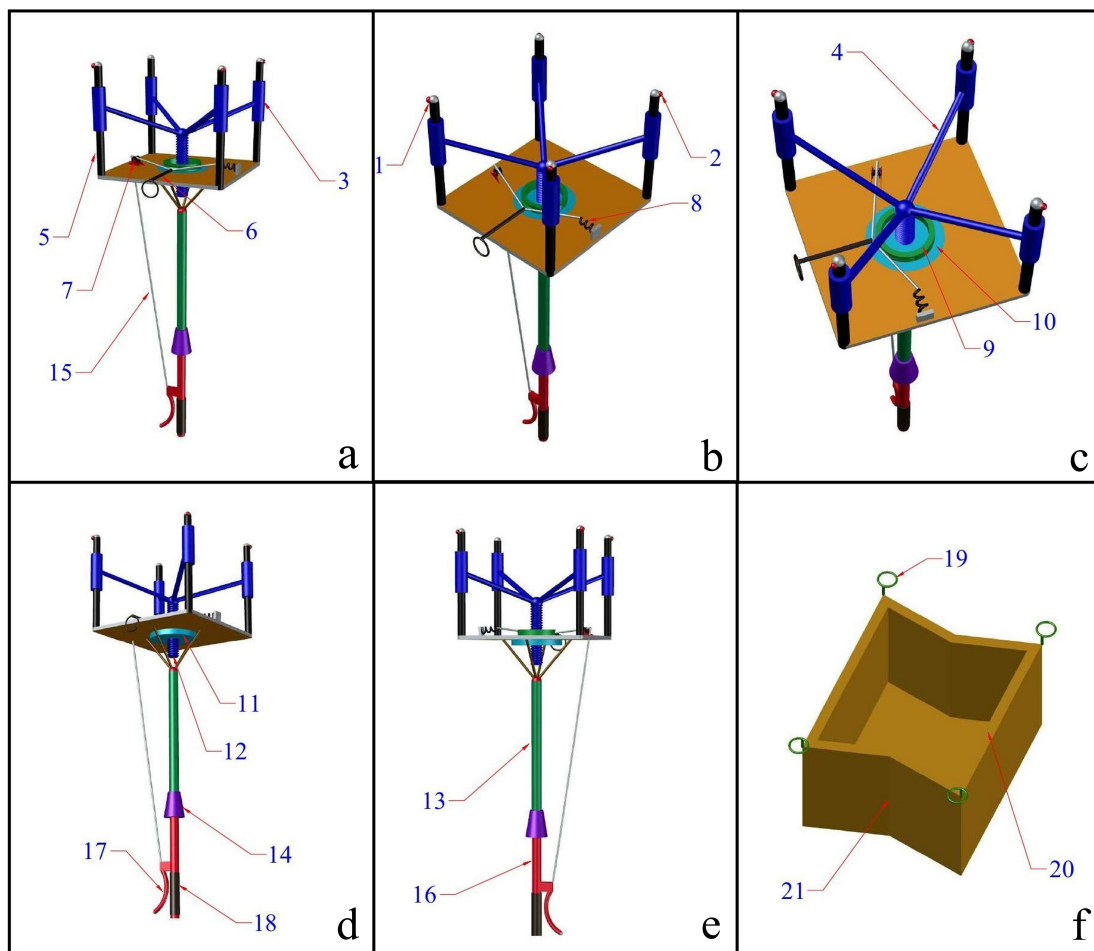


Fig. 3 3D schematic diagram of the novel portable successively-delivering fruit bagging device.

(a)-(e): different parts of the novel fruit bagging device; (f): the special paper bag.

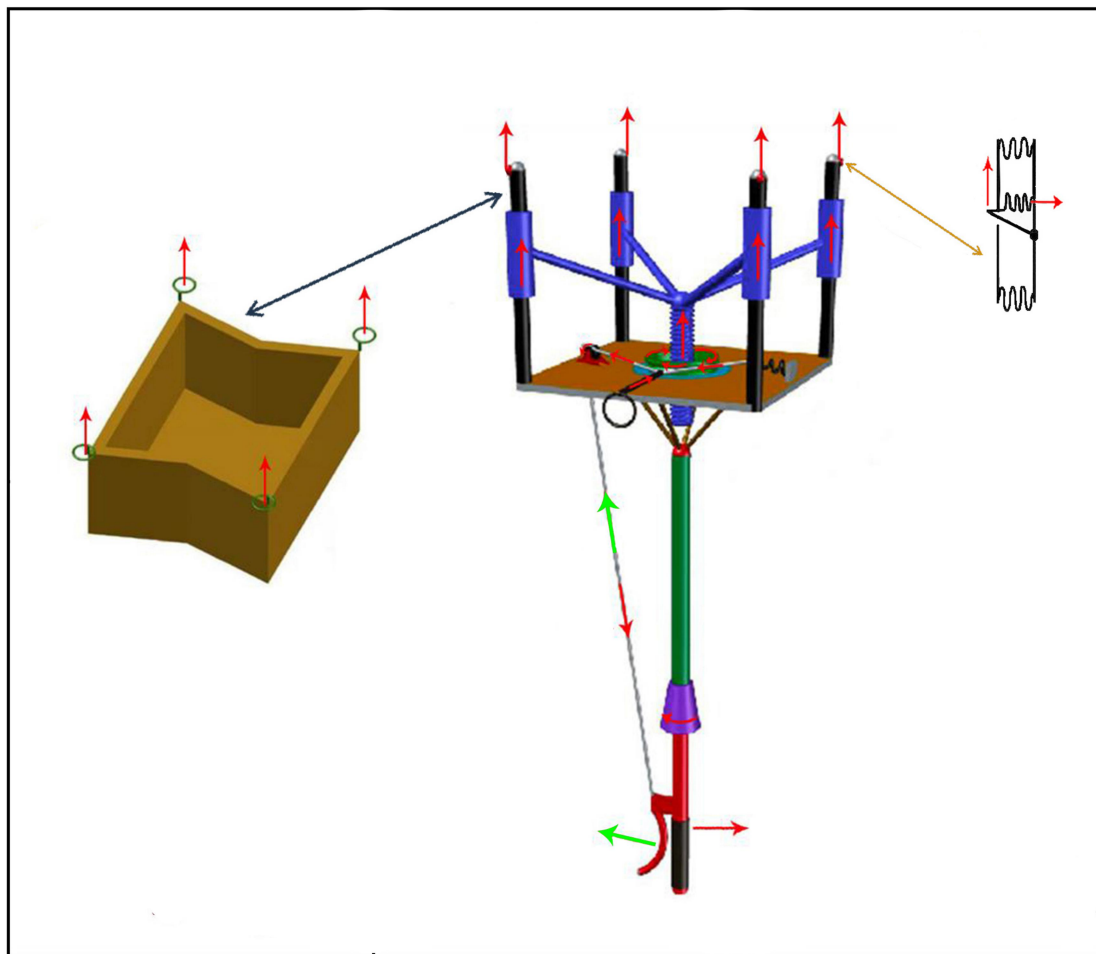


Fig. 4 Motion direction schematic diagram of driving part of the novel portable successively-delivering fruit bagging device.

Red arrows: driving direction of the driving part;

Green arrows: resetting direction of the driving part.

Table 1. Labeling of Different Parts of the Novel Fruit Bagging Device in Figs. 2 and 3

No.	Part	Function
1	Spring I	Make the rotatable plecturm (2) retained projection state
2	Rotatable plectrum of which one end is fixed	Ensure the plastic ring (19) of special paper bag slid out individually
3	Sliding pipe	Slide and release special paper bag (21)
4	Support holder	Connect sliding pipe (3) and screw with external thread (12), make the force of screw with external thread (12) transferred to four sliding pipes (3)
5	Smooth tube	Connect to plastic ring (19) of special paper bag (21)
6	Reset rope	Connect with wire rope (15), let the wire rope (15) not to act on unidirectional spiral driving wheel (10) at the same moment by pulling reset rope (6)
7	Fixed pulley	Turn vertical force into horizontal force of wire rope (15)
8	Spring II	Make wire rope (15) restored to the original state
9	Driven wheel with internal thread	Rotate and make screw with external thread (12) extended a certain distance upward
10	Unidirectional spiral driving wheel	Drive driven wheel with internal thread (9) to do a unidirectional rotation
11	Reset spiral	Rotate and make screw with external thread (12) extended a certain distance downward
12	Screw with external thread	Drive sliding pipe (3) slid upward and release plastic ring (19) of special paper bag (21)
13	Big diameter operation handle	Work together with small diameter operation handle (16) to achieve the adjustment of operational distance when bagging
14	Fixed device	Make big diameter operation handle (13) closely connected with small diameter operation handle (16), then fix the working distance of operation handles (13 and 16)
15	Wire rope	Transfer handle force to unidirectional spiral driving wheel (10)
16	Small diameter operation handle	Insert into big diameter operation handle (13) and work together with big diameter

17	Movable handle	operation handle (13) to adjust the height of reach when bagging Make grip strength switched to rope tension based on principle of leverage
18	Fixed handle with rubber sleeve	Comfortable for holding and operation
19	Plastic ring	Connect to special paper bag (21) and set on the smooth tube (5)
20	Rubber band	Embedded in special paper bag (21) and has the effect of sealing
21	Special paper bag	Bag fruit

VIDEO: [The Presentations on Structure and Function of the Novel Fruit Bagging Device.mpg](#)